Xerox Real-Time Batch Monitor (RBM)

Xerox 530 and Sigma 2/3 Computers

System Management
Reference Manual

XEROX

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REVISION

This publication is a revision of the Xerox Real-Time Batch Monitor (RBM) System Management Reference Manual for Xerox 530 and Sigma 2/3 Computers, Publication Number 90 30 36B (dated March 1974). This revision incorporates changes that reflect version G00 of the RBM system.

RELATED PUBLICATIONS

Manual Content Codes: BP — batch processing, LN — language, OPS — operations, RP — remote processing, RT — real-time, SM — system management, TS — time-sharing, UT — utilities.

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COMMAND SYNTAX NOTATION

Notation conventions used in command specifications and examples throughout this manual are listed below.

Notation	Description
lowercase letters	Lowercase letters identify an element that must be replaced with a user-selected value. CRndd could be entered as CRA03.
CAPITAL LETTERS	Capital letters must be entered as shown for input, and will be printed as shown in output. DPndd means "enter DP followed by the values for ndd".
[ ]	An element inside brackets is optional. Several elements placed one under the other inside a pair of brackets means that the user may select any one or none of those elements. [KEYM] means the term "KEYM" may be entered.
{ }	Elements placed one under the other inside a pair of braces identify a required choice. $\begin{Bmatrix} A \\ id \end{Bmatrix}$ means that either the letter A or the value of id must be entered.
. . .	The horizontal ellipsis indicates that a previous bracketed element may be repeated, or that elements have been omitted. name[, name]. . . means that one or more name values may be entered, with a comma inserted between each name value.

$\vdots$	The vertical ellipsis indicates that commands or instructions have been omitted.
	
	    MASK2 DATA,2 X'1EF'
	        $\vdots$ means that there are one or more statements omitted between the two DATA directives.
	    BYTE DATA,3 BA(L(59))

Numbers and special characters	Numbers that appear on the line (i.e., not subscripts), special symbols, and punctuation marks other than dotted lines, brackets, braces, and underlines appear as shown in output messages and must be entered as shown when input. (value) means that the proper value must be entered enclosed in parentheses; e.g., (234).
Subscripts	Subscripts indicate a first, second, etc., representation of a parameter that has a different value for each occurrence. $sysid_1$, $sysid_2$, $sysid_3$ means that three successive values for sysid should be entered, separated by commas.

1. INTRODUCTION

SCOPE AND PURPOSE OF THIS MANUAL

The information in this manual falls into three general areas, as follows:

- Hardware and software configuration planning.

- System generation and initialization.

- System maintenance.

The intended readership of this manual falls, correspondingly, into three major categories.

- Installation management, responsible for planning the functional capabilities of the desired RBM system and for selecting a hardware configuration to best satisfy the installation's requirements.

- System programming staff, responsible for designing the installation-specific system generation and initialization procedures required to achieve an operational system, and for formulating any post-generation maintenance that may be necessary.

- Senior operations personnel, responsible for performing the system generation, initialization, and maintenance procedures.

ORGANIZATION OF THE MANUAL

The present chapter, in addition to providing an introduction to the manual, presents an overview of the Xerox Availability Features of the RBM system. These features are designed to complement the salient reliability and maintainability characteristics of the hardware. (See the Xerox Availability Features/Reference Manual, 90 30 54, for detailed usage descriptions of the Availability Features.)

The succeeding chapters are organized as follows:

- Chapter 2 presents guidelines for the selection of a desirable hardware configuration in terms of performance requirements, application suitability, data-bandwidth considerations, etc. For example, guidelines are given for selection of the size of main storage, and the size and type of secondary storage, appropriate to the user's specific needs.

- Chapter 3 presents both guidelines for software configuration planning (supplementing the information in Chapter 2 in this regard) and detailed information on designing a specific system generation procedure for the desired system.

- Chapter 4 presents the operational aspect of system generation (SYSGEN), i.e., directions for performing the SYSGEN process.

- Chapter 5 presents system initialization information; that is, it gives directions for adding desired processors, libraries, resident foreground programs, etc., to the newly generated monitor so as to achieve a fully operational RBM system.

- Chapter 6 gives system maintenance information and procedures: how to temporarily or permanently replace RBM modules with newer or modified versions; how to patch RBM, subsystems, and processors; how to prepare a modified SYSGEN input tape; etc.

AVAILABILITY FEATURES

The Availability Features provided with RBM are designed to streamline maintenance activities and reduce maintenance down-time. These features are error logging, SYSERR analysis, device isolation, and on-line device verification. The Availability Features can be used by on-site customer personnel as well as (in the case of the Model 530) by remotely-located Xerox maintenance experts, via the Xerox Remote Assistance interface. These features enable the user to interact more effectively with the system to increase "up-time" availability.

User sites at which remote assistance is not available still benefit by the use of the information gathered by automatic error logging during system operation. The other features are of course also usable whenever customer personnel or a Xerox system specialist is on-site (assuming provision for these features during system generation).

Note that Xerox Remote Assistance is applicable only to Model 530 systems. All of the availability features otherwise apply without restriction to all RBM users.

See the Xerox Availability Features/Reference Manual, 90 30 54, for full descriptions.

REMOTE ASSISTANCE

The Xerox 530 Remote Assistance feature, in conjunction with the use of error logging and SYSERR analysis, permits operator-attended sites to be examined by a system specialist without his having to make a trip to the site. He can monitor the transactions at the operator's console from his remote console. He can examine a SYSERR analysis printout and selectively interrogate the error log. He can detect a pattern of error buildup for an I/O device, as seen in the error log, facilitating proper maintenance scheduling and increased availability. He can even "look over the shoulder" of a Xerox Customer Engineer or of a site operator during device isolation and exercise, all while RBM is processing normal production tasks.

This remote-assistance capability allows for assignment of the proper level of aid to a problem at the earliest possible moment and permits customer self-help in increasing system availability.

ERROR LOGGING

RBM provides hardware error detection and the automatic logging of such errors to a special file. This error-log file then serves as a history of errors that may be analyzed and listed by an on-line program (in chronological or sorted order) for use by customer or Xerox maintenance personnel.

Query of the error log reveals the quantity and type of errors, frequency of occurrence, and the distribution of device status reported at time of error. Analysis of error-frequency changes and other factors leads to scheduling of maintenance prior to actual failure, and lessens the time required for analysis and correction of unpredicted failures.

Sites that use this feature provide Xerox with an error-log database to be examined during scheduled or unscheduled maintenance. Whether the system specialist is using Remote Assistance or is actually at the site, he takes advantage of the error log summary, sorted listing, and chronological listing to maintain the system and increase its availability. The user's operations personnel can also benefit by the error-log summary by using it to monitor their system's performance over a period of time.

SYSERR ANALYSIS

RBM provides the capability to obtain a formatted representation of the internal state of system tables and contents of memory. The displayed data is segregated and labeled as to significance. This provides the local or remote Xerox system specialist (or the user) with a simplified means of seeing and understanding abnormal system states without having to decipher a raw hexadecimal dump. It is especially useful in reducing the time required to isolate problems that can be detected by their effect upon system-table data.

The format of output is optimized for display on line printers, but may be displayed on other devices. In fact, the Remote Assistance system specialist expects to analyze such displays at his console, as one of his most valuable remote problem-solving tools.

DEVICE ISOLATION

Noncritical devices that are known to be faulty or considered to be marginal can be isolated from the system by operator control. While the device is being exercised, repaired, or replaced, RBM continues to operate any programs that do not mandatorily and specifically require that particular device. Thus, in many cases the system is now still available when formerly it would have been "down". The on-line device exerciser tests (described below) may be run only on devices that have been so isolated (i.e., made unavailable to normal access).

RBM allows device-address substitution between devices of the same model number (except for disk devices). This permits, for example, switching (by means of an operator key-in) from one magnetic tape drive to another of the same type.

ON-LINE DEVICE EXERCISERS

Prior to exercise, a device is isolated from normal system use, via the local or remote-assistance console. Then the device exercisers (to the exclusion of any other programs) operate the device, verifying its functional capability and recording any errors in the error log. Upon completion of such a device test, a device status message is printed at the operator's console to indicate whether or not the device is capable of operating within normal service requirements. If so, the device becomes eligible for return to the system. A device that fails to pass these tests should be scheduled for maintenance.

The exercisers are not designed to diagnose the device at the component level. Rather, they exercise the device's functional capabilities in the user environment (without interfering with the operation of RBM with respect to its other functions). Recoverable errors are seen by examination of the error log, while irrecoverable errors cause the exerciser to report that the device did not pass the testing.

One appropriate use of the on-line device exercisers is to check the assumed operational reliability of a device that has just undergone maintenance or repair, prior to returning it to normal service.

2. HARDWARE CONFIGURATION GUIDELINES

INTRODUCTION

This chapter is intended as an aid to the system manager in selecting the proper hardware for his RBM system. A reasonable selection of hardware can be made only on the basis of a thorough understanding of the particular application's requirements. Requirements that must be evaluated include the number of discrete interrupt levels required, the amount of secondary storage required for programs and data, memory requirements to satisfy resident foreground needs and concurrent batch (if desired), and peripheral equipment requirements for the data media desired. Figure 1 illustrates the lowest-cost minimum RBM configuration. Figure 2 illustrates a more typical RBM configuration.

HARDWARE INTERRUPT REQUIREMENTS

The maximum number of foreground tasks that are expected to operate concurrently determines the number of hardware-interrupt levels required, in addition to those needed by RBM itself. The association of an interrupt level with a task establishes the priority of the task. The task's worst-case response time (to an external stimulus) is dependent upon the maximum RBM inhibit time and the possible activity of higher priority tasks. Tasks that are prioritized above

the I/O interrupt task must contend only with the RBM maximum inhibit of 100 μsec and possible interference among themselves.

The standard Xerox 530 is equipped with two interrupt levels, Integral 5 and Integral 6, that are higher in priority than the I/O interrupt task. (Sigma 2/3 can have a larger number of these.) Tasks associated with an interrupt priority higher than I/O cannot utilize any RBM services that involve I/O; thus these higher interrupt levels are typically associated with high priority tasks that utilize the Direct I/O interface with SIUs and defer RBM services to related, lower-priority tasks.

Tasks that operate at a priority lower than the I/O interrupt level can utilize all RBM services including I/O. Any number of these tasks may operate concurrently up to the number of available lower-priority hardware interrupts minus one. (The RBM Control Task requires the lowest-priority hardware interrupt level actually utilized in the system.) For tasks below the I/O level, the I/O interrupt can cause an interference of up to approximately 500 microseconds, however since I/O interrupts can stack up, the interference can be extended in order to service all pending interrupts.

The same hardware interrupt can be used "serially" by different tasks, but only one can be connected to a given interrupt at any one time. Table 1 gives a comparison of the Sigma 3 and 530 interrupt structures.
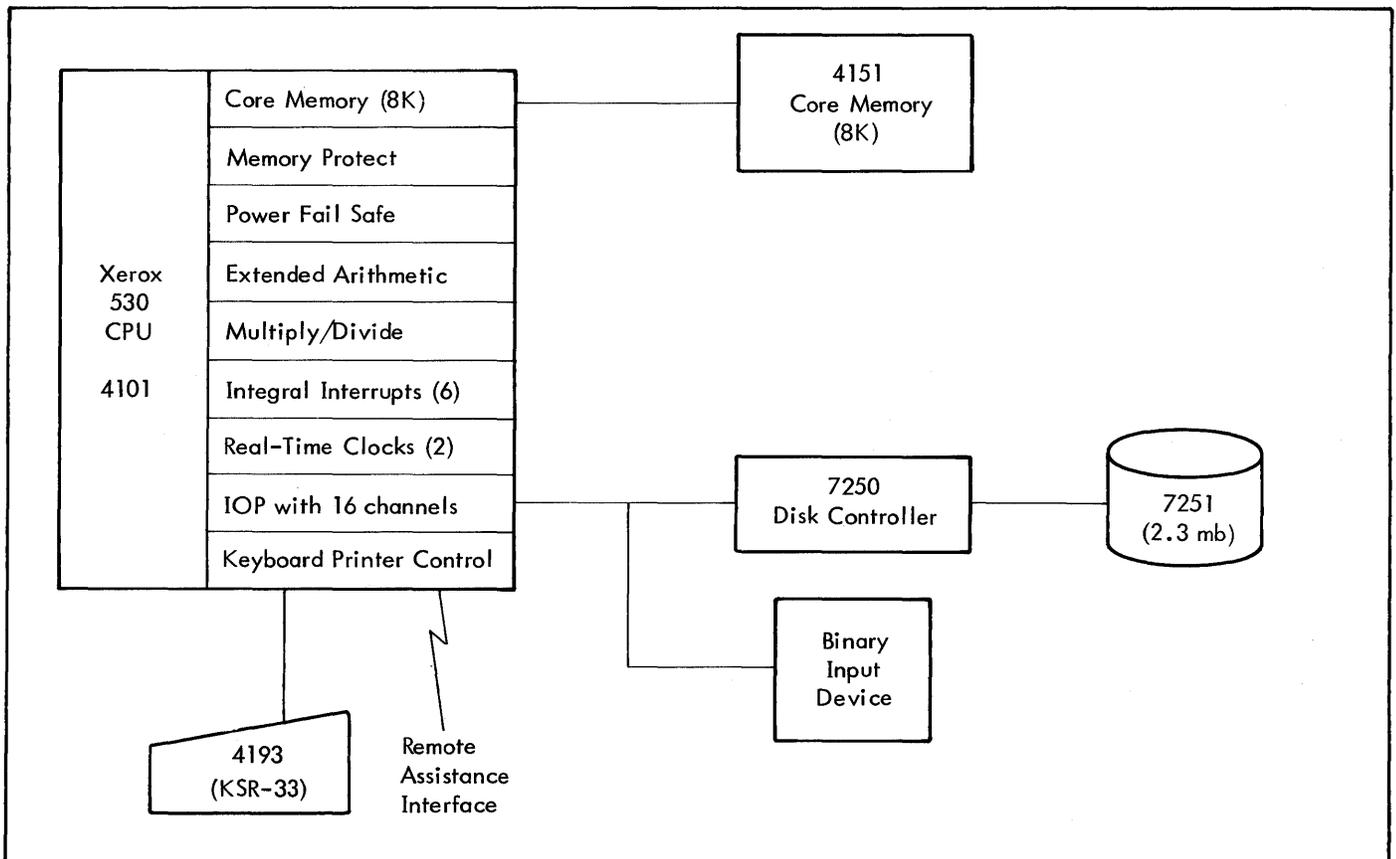
Figure 1. RBM Lowest-Cost, Minimum Configuration
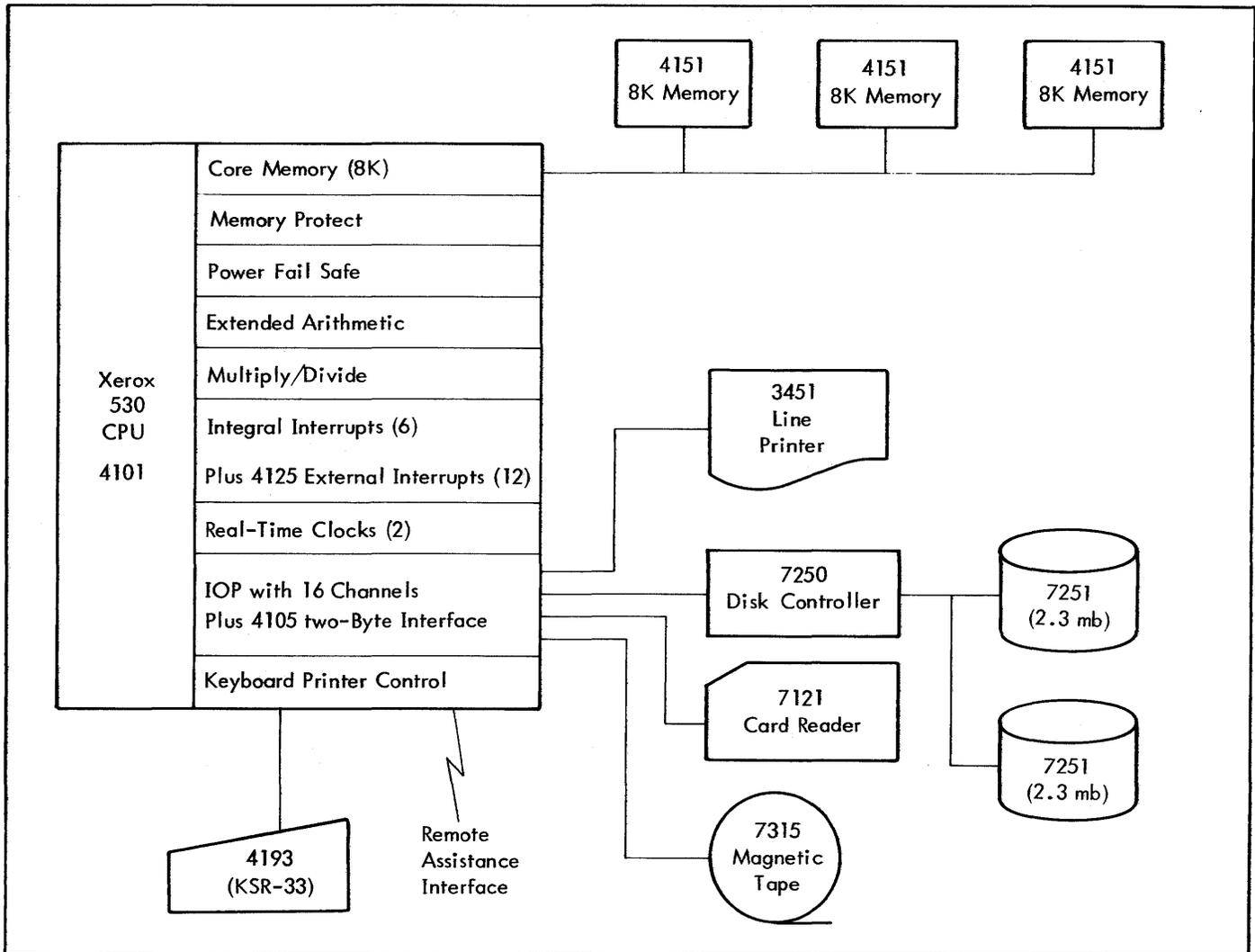
Figure 2. RBM Typical Configuration

Table 1. Model 530/Sigma 3 Interrupt-Structure Comparison

Computer	Maximum No. of External Interrupts	Clocks[1]	Priority Levels > I/O	Priority Levels < I/O[2]
530	30, standard and optional combined.	2 standard	2 standard	4 standard, 24 optional
Sigma 3	100, all optional	4 optional	100 optional	100 optional

Notes: 1. Clock 1, set at a frequency of 500 Hz, is typically dedicated to provide RBM services relating to I/O timeouts, job accounting, and background-execution-time limit. There is a SYSGEN override (CLK1FREQ,0); therefore, an installation may choose to forego these facilities in favor of real-time usage of Clock 1. This should not be necessary however, since a Clock 1 receiver is provided.

2. RBM requires that the lowest-priority hardware interrupt level be dedicated to the RBM Control Task.

MAIN STORAGE (MEMORY) REQUIREMENTS

MEMORY SPACE REQUIREMENTS FOR RBM

The minimum RBM system, which would include keyboard/printer, paper tape, and RAD I/O routines only, and provide a minimum number of RAD device-files and operational labels, requires about 5000_{10} cells for the monitor and all of its tables. This minimum memory space requirement would increase as handlers are added for additional peripherals, as optional software routines are chosen (see Chapter 3) during SYSGEN, and as additional device-files, operational labels, or Public Library DEFs are allocated during SYSGEN. The residence-space requirements for RBM will vary from 5000 to 8000 cells, depending upon the user's configuration. If background processing is desired, the user must allow an additional minimum of 6000 cells for background space in order to accommodate the RBM Job Control Processor, the standard RBM subsystems, and Extended Symbol.

MEMORY SPACE REQUIREMENTS FOR THE RBM PROCESSORS

The memory space required for concurrent background processing is a function of the longest overlay path of the set of processors in question, plus the maximum work-space and blocking-buffer requirement of that set. The standard RBM language processors (Basic and ANS FORTRAN, and Extended Symbol) require resident work space for symbol-description tables during compilation or assembly. Thus, the number of source statements that can be processed in a single compilation or assembly is directly proportional to the amount of background memory available over and above the longest-overlay-path requirement.

All of the RBM processors are designed to utilize memory efficiently and will take advantage of any excess space that may be available. The performance of SORT, for example, can be substantially enhanced by addition of memory.

Table 2 shows the various combinations of processors that are operable in the context of several sample RBM/memory configurations.

MEMORY SPACE REQUIREMENTS FOR USER-FOREGROUND PROGRAMS

The amount of memory required for user-foreground programs is the total size requirements for all concurrently resident foreground programs and their blocking buffers, plus the size of the nonresident foreground area if any.

The overhead for foreground tasks is 19 words per interruptible task, for the task control block and the task's PSD, plus temp space as follows:

Monitor Services Requirements	Amount of Temp Required
None	0
M:IOEX only	16
All services	83

A restricted number of RBM services are available with a temp stack size of less than 83 words. (See "Monitor Service Routines" in the RBM/RT, BP Reference Manual, 90 10 37.) Additional temp space is required if the tasks are written in ANS FORTRAN IV and perform I/O.

Table 2. Processor Availability in Sample Configuration

	Total Memory in System		
RBM Configuration	16K	24K	32K
6K RBM, 1K resident foreground, no non-resident foreground, no PUBLIB.	9K BKGND All Processors except ANS FORTRAN and COBOL	17K BKGND All Processors	25K BKGND All Processors
6K RBM, 4K resident foreground, no non-resident foreground, no PUBLIB.	6K BKGND JCP RADEDIT UTILITY XSYMBOL OLOAD	14K BKGND All Processors except COBOL	22K BKGND All Processors
8K RBM, 6K resident foreground, 2K non-resident foreground, 2K PUBLIB.	(not applicable)	6K BKGND JCP RADEDIT UTILITY XSYMBOL OLOAD	14K BKGND All Processors except COBOL

The following table provides an indication of the additional temp-space requirements of ANS FORTRAN IV foreground programs that perform I/O:

Sequential I/O		Direct Access I/O					
		320x or 323x		720x or 725x		7232 or 724x	
Binary	Formatted	Binary	Formatted	Binary	Formatted	Binary	Formatted
76-112 words	131-167 words	170 words	225 words	222 words	277 words	554 words	609 words

Blocking buffers are required for each operational label (or FORTRAN device number) that is associated with a blocked disk file. The blocking buffer sizes are as follows:

320x or 323x	720x or 725x	7232 or 724x
128 words	180 words	512 words

If nonresident foreground tasks are desired, a separate non-resident foreground partition — contiguous with background at its upper boundary — must be defined at SYSGEN. The nonresident foreground area may be as small as K:BLOCK + 17 words as allowance for background TCB.

Note that a large nonresident foreground program will automatically cause a checkpoint of background if it extends into the background area. Thus it is not necessary to define a nonresident partition that will accommodate the largest possible nonresident forground program, but rather only one large enough to contain the largest nonresident program that must coexist with background programs.

SECONDARY STORAGE REQUIREMENTS

The optimal type of secondary storage for an RBM system is dependent upon the requirements of the installation. The storage capacity required may dictate the use of disk packs, or perhaps where access time is very important and the majority of transfers are small, a 320x RAD would be appropriate. (Note that for small average-transfer sizes on the order of 500-1000 bytes, access time is more critical than transfer rate.)

Although RBM does not require magnetic tape, it provides optimum backup capability for RAD and disk packs as well as providing on-line, bulk-data I/O. Table 3 gives a comparison of the access time, capacity, and other pertinent characteristics of the various secondary storage devices supported by RBM.

The amount of secondary storage required for an RBM system is a function of the secondary storage requirements of RBM itself, plus user requirements for program and data storage, plus background temporary file space.

RBM SECONDARY STORAGE REQUIREMENTS

If a user wants to have all the system processors and a complete system library stored on the disk and wants to allocate enough Background Temp area to assemble an average 5000-line source program, approximately .56 megabytes of disk storage would be needed for the system. (The smallest Xerox RAD unit, Model 7202, has a .75-megabyte storage capacity.)

USER SECONDARY STORAGE REQUIREMENTS

Figure 3 illustrates the hierarchy of RBM file management. It is important to note that since a file may not span physical devices boundaries, the capacity of secondary storage devices at an installation may limit the maximum file size. This is especially important to consider for RPG and COBOL ISAM data bases, since the entire data base must be contained within one file.

The SORT processor also requires disk space for sorting; the amount of disk space required is approximately 2.2 times the input file size. This intermediate disk storage may be divided into two files, each on a separate device, to provice for faster sorts and also to accommodate larger input files.

It is also important to note in this regard that blocked files (packed random, blocked sequential, or compressed) require use of a blocking buffer. Extensive usage of blocked files on 724x disk packs may involve an additional core requirement due to the large sector size (1024 bytes) and the consequently large blocking buffer size. RBM does have a provision for defining a blocking buffer size of less than 1024 bytes for 724x disk pack systems. This, however, is wasteful of disk space, the feature being provided merely as a conversion aid for installations upgrading to a 724x configuration.

REMOVABLE DISK PACKS AND CARTRIDGES

AREA DEFINITION AND PACK/CARTRIDGE INITIALIZATION

Each disk can be divided into from 1 to 16 areas. Removable disk packs are initialized by the RAD Editor. The RAD Editor writes a Volume Table of Contents (VTOC) onto the pack/cartridge, which contains the serial number of the disk pack/cartridge and the area descriptors of the areas contained on that disk pack/cartridge. The pack/cartridge may be mounted on any available spindle through use of the M (Mount) key-in. (Packs/cartridges to be permanently mounted on a given spindle are initialized at SYSGEN during Disk Allocation; see Chapter 3.)

PACK/CARTRIDGE MOUNTING

The Mount key-in specifies the areas to be mounted or directs that all areas on that disk pack/cartridge to be mounted. In either event, the core-resident Master Dictionary will be updated to indicate the areas mounted.

Table 3. Comparison of Secondary Storage Devices

| Device | Capacity[1] | Average Access Time | Maximum Transfer Rate | IOP Bandwidth[2] Requirements | | | Blocking Buffer Size |
| | | | | 530 | Sigma 3 | | |
					IIOP	EIOP	
3203	1.3 mb	8.5 ms	755.2 kb	100%[8]	NA	NA	128 words
3204	2.6 mb	8.5 ms	755.2 kb	100%[8]	NA	NA	128 words
3231[9]	2.4 mb	50 ms	312 kb	36%	NA	NA	128 words
3232[4,9]	4.9 mb	50 ms	312 kb	36%	NA	NA	128 words
3325	23mb ⁐800bpi[5]	8.8 ms	36 kb	6%	NA	NA	NA
3335	46mb ⁐1600bpi[5]	8.8 ms	72 kb	11%	NA	NA	NA
7202	.75 mb	16.9 ms	187.5 kb	45%	35%	35%	180 words
7203	1.5 mb	16.9 ms	187.5 kb	45%	35%	35%	180 words
7204	3.0 mb	16.9 ms	187.5 kb	45%	35%	35%	180 words
7232	6.3 mb	16.9 ms	384 kb	NA	78%	72%–60%	512 words
7246[3,9]	24.5 mb	87.5 ms	312 kb	77%–52%	59%	59%–49%	512 words
7251[4]	2.3 mb	50.5 ms	312 kb	78%–57%	NA	NA	180 words
7315/16	23mb ⁐800bpi[5]	5 ms	60 kb	18%	13%	13%	NA
7362	16mb ⁐556bpi[5]	10 ms	20 kb	8%	7%	7%	NA
7372	23mb ⁐800bpi[5,6]	5 ms	60 kb[7]	NA	12%	12%	NA

Notes:

1. RBM requires approximately .36–.56 megabytes for system storage, including standard processors.

2. RBM does not manage bandwidth control, thus the installation must be properly configured to avoid data overruns. When two figures are shown, the second figure indicates bandwidth requirements when the two-byte interface is included; this figure is not shown if not applicable.

3. RBM treats each 7242 as two 7246 disk packs. All disk packs except the system-residence pack may be declared to be removable.

4. Each 7252 is treated as two 7251 devices. Each 3232 is treated as two 3232 devices.

5. Assuming 2400-foot reels and no interrecord gaps. Reduce this figure by the percentage of the tape required for interrecord gaps. This value is a function of record size since gap is fixed (0.75 inches for 7362/72; 0.5 to 0.75 inches (average 0.6 inches) for 7315/16; 0.6 inches for 3325/35).

6. Model 7372 transfers six bits of information per byte.

7. Model 7372: reduce transfer rate by 25 percent for packed binary mode.

8. Requires dedicated IOP2.

9. Any device controller which is capable of performing seek overlap cannot share a channel with any other device controller.

The following rules apply:

- A physical device (e.g., a RAD) may contain 1 to 40 areas. An area is totally contained on one physical device.

- An area may contain one or more files. A file is totally contained within one area.
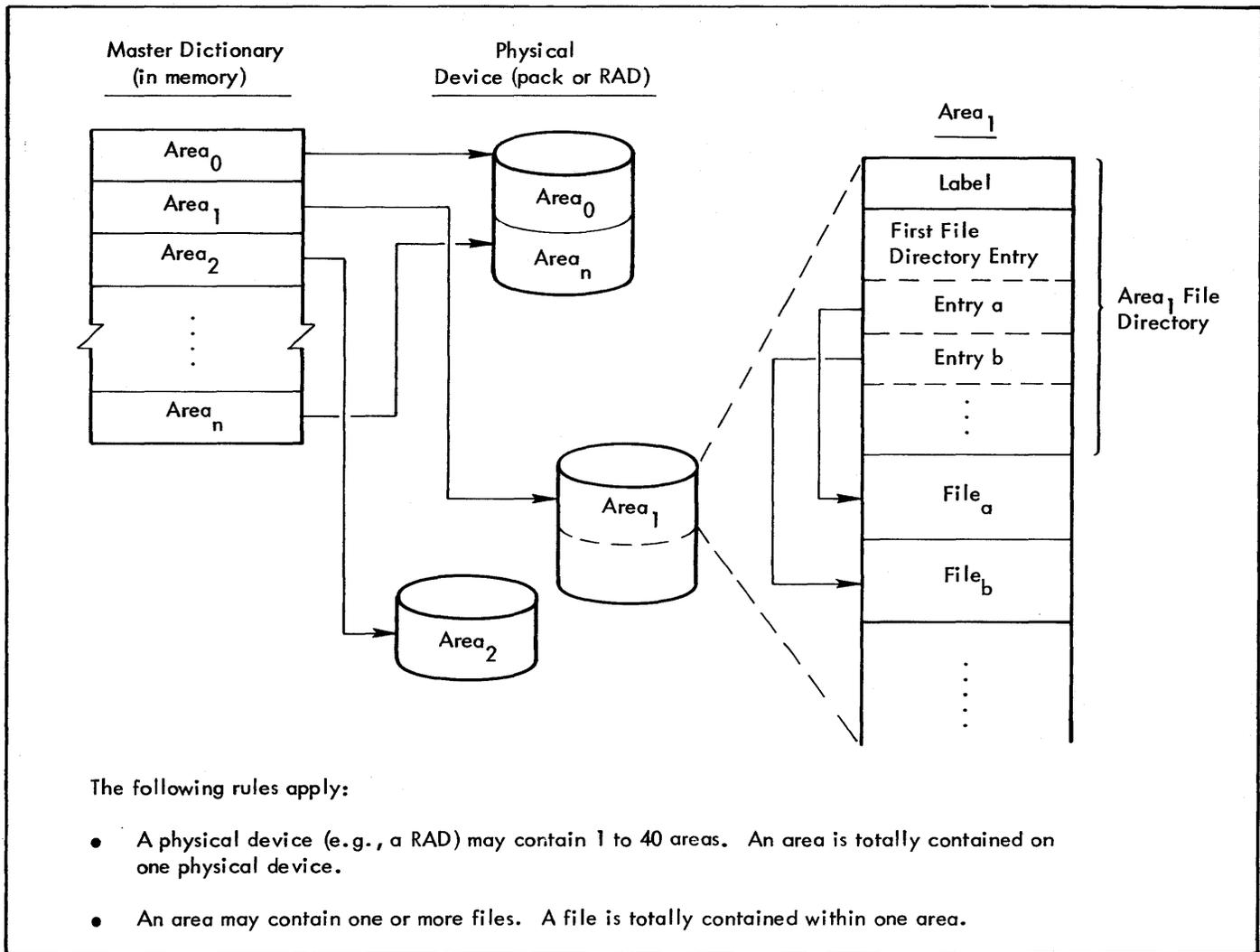
Figure 3. RBM Disk File Management

sufficient spare entries must be available in the Master Dictionary to accommodate the newly mounted areas, and the areas to be mounted must be uniquely named among those areas already mounted. RBM performs the necessary checks to ensure proper mounting.

Special precaution must be taken for 7252 and 3233 Cartridge Disk units. Since the fixed disk as well as the removable disk is stopped when replacing the cartridge, all file activity must be quiesced for both the fixed and removable portions of the device (which are independently addressable). If RBM's SP area resides on the fixed disk, the computer must be placed in a completely idle state (no active background or foreground, no key-ins pending). Failure to do so will result in a SYSERR with code SP when an attempt is made by RBM to access an overlay. Foreground tasks that access files on the fixed portion of a drive may also require the computer to be in the idle state to avoid the 'nonoperational' condition. Obviously a critical real-time environment cannot tolerate the computer being in 'idle', therefore, proper allocation of areas and spindles is essential (e.g., two 7251 devices may be required rather than a single 7252).

PERIPHERAL EQUIPMENT REQUIREMENTS AND OPTIONS

KEYBOARD/PRINTER – REQUIRED

RBM requires that the minimum configuration include a keyboard/printer for operator control.

If an installation is configured with two or more keyboard/printers, it is strongly suggested that DFN 1, which must reference a keyboard/printer, point at the same printer used for background operations. Foreground tasks that reference a keyboard/printer should not reference the keyboard/printer associated with DFN 1.

CHARACTER-ORIENTED COMMUNICATIONS (COC) – OPTIONAL

- One buffered input/output channel dedicated to a 7630 Controller, with eight lines.

- External DIO interface feature (Model 4170 for Xerox 530, Model 8170 for Sigma 3).

- Two external interrupts dedicated to the COC controller.

The COC software support (Catalog No. 705719) requires approximately 1K words of resident memory space.

PLOTTER SYMBIONT – OPTIONAL

- One interrupt level reserved for symbiont usage.

- Model 7530 or 7531 graph plotter.

The plotter software support requires approximately 1K words of resident memory space. Approximately .06 megabyte of secondary storage is required for each eight minutes of output backlog desired.

XEROX SATELLITE PROCESSOR – OPTIONAL

- One interrupt level is required for basic scheduling and local operations.

- One interrupt level is required for remote communication.

- Model 7605 synchronous controller – full or half duplex – with proper code set (IBM EBCDIC but with ACKO replacing ACK).

- 2000-19,200 bps modem (higher or lower speeds require approved field request).

Satellite processor core requirements are a function of line and peripheral speeds. Refer to the printed description 706491-11 for complete information. A rough rule of thumb would be to allow 8.4K for full remote operation of four streams at 9600 bps and 5K if only local/local operation is desired (see Chapter 3, Table 10 for spooling requirements).

BASIC SPOOLING SYSTEM – OPTIONAL

- One interrupt level is required for each active copy of BSS.

The basic spooling system requires approximately 1K, plus buffer space, for each active copy of BSS (see Chapter 3, Table 10 for spooling requirements).

ADDITIONAL PERIPHERAL OPTIONS

Consult Chapter 3 for details about other optional peripheral devices supported by RBM, and their memory space requirements for device handlers.

MISCELLANEOUS HARDWARE OPTIONS

SIGMA 3 EXTENDED ARITHMETIC – MODEL 8119

This feature provides hardware multiply and divide and multiple-precision mode instructions. This option is required for RPG and COBOL.

XEROX 530 HARDWARE FLOATING-POINT – MODEL 4118

This feature, in conjunction with the ANS FORTRAN library routines that utilize the floating-point instructions, will provide a substantial performance improvement for FORTRAN programs. Performance improvement relative to software floating-point for a compute-bound test program has been measured at a 2.2 : 1 ratio. (The program used for the test is an actual program in commercial use for data reduction and analysis.)

3. SOFTWARE CONFIGURATION GUIDELINES

INTRODUCTION

This chapter is intended as an aid to the system manager in defining the system generation parameters that are required to create an RBM system optimized for its specific application environment. The two primary aspects of "tailorable" system resources are main memory and secondary (disk) storage.

MAIN MEMORY ALLOCATION

Main memory is allocated in the following manner (and as illustrated in Figure 4):

1. The first 256 words in lower memory (the zero table) are reserved for constants and pointers.

2. The region from 256 to 399 (decimal) is reserved for internal and external interrupt levels; any space not required for interrupt levels will be used by the Monitor for table space.

3. The remainder of memory is allocated as follows:

   a. Resident RBM, to be loaded beginning at location 400 (decimal) and to include only those optional routines selected by SYSGEN.

   b. Public Library (if allocated).

   c. Resident foreground (if allocated).

   d. Nonresident foreground (if allocated).

   e. Background. At least 256 words must be allocated whether or not batch is required; minimum useful amount allocated should be the length of the Job Control Processor (6000 words decimal) (see Figure 5).

4. No foreground space need be allocated for a batch-only system.

The user should decide which of the areas described under item 3, above, are more apt to need additional space in future and make allocations accordingly. A given area could then be expanded downward in a future SYSGEN, into unused area space below it, and only the programs in the reallocated area would have to be reloaded, not the entire system. (In Figure 4, for example, the resident foreground might expand into the unused Public Library area.)

RESIDENT RBM MODULES

RBM consists of both resident and nonresident modules. Resident modules consist of functions that are frequently used or which must quickly react to internal or external events. Nonresident modules consist of functions that are infrequently used or for which immediate response is not necessary. Resident modules consume memory space as the price for rapid response to internal/external events. Nonresident modules consume response time as the price for memory space availability.

Since the user has the option to select whether certain modules are to be resident or nonresident, this chapter is intended to provide the information necessary to make tradeoff decisions between memory space and response time when either resource is critical to system performance.

NONOPTIONAL RESIDENT MODULES

The following RBM functions are unconditionally included as resident in memory. All sizes are approximate unless otherwise specified.

Function	Size (decimal) Min.	Max.
Constants, pointers, transfer vectors, interrupts, etc.	275	400
Fixed tables and nonresident-overlay area.	575	575
Variable tables (including TVECT).	(See "Resident I/O Tables and Routines")	
Integer Multiply/Divide Simulation.	0	175
I/O Interrupt Task.	300	300
PCP Interrupt Task and RBM Control Task.	150	150
Machine Fault Task	50	200
Sigma 2 = 50 Sigma 3 = 100 Model 530 = 200		
Service Routines	2500	2600
Total Nonoptional (v represents variable tables)	3850+v	4440+v

OPTIONAL RESIDENT MODULES

The following RBM functions are included as resident in memory if selected as an optional feature during SYSGEN.

Selection Keyword	Function	Size
PROTECT	Protection Task	75
POWER	Power On-Off Tasks	250
ERRORSUM	I/O Error and Use Count	25+4*I/O channels
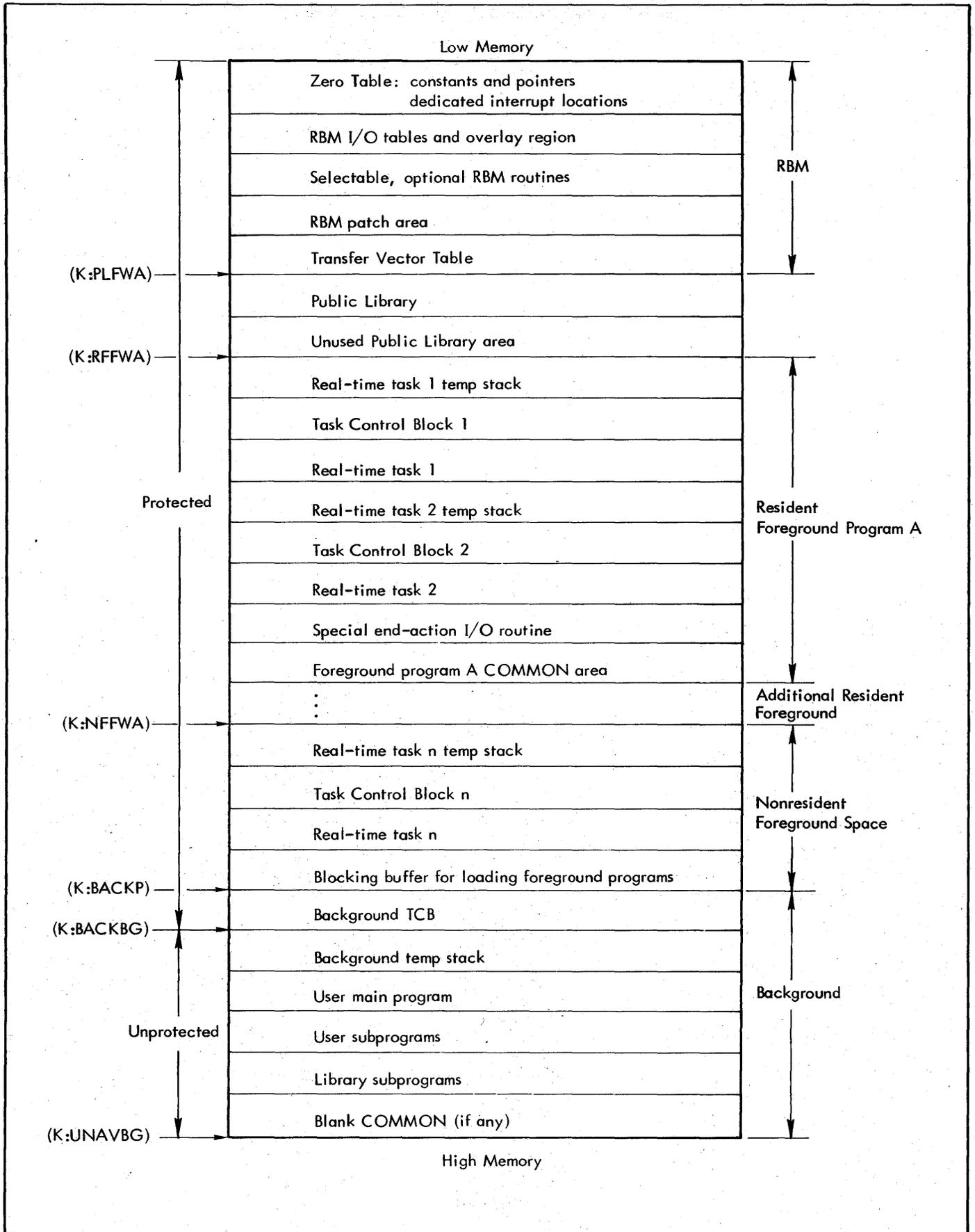
Figure 4. RBM Memory Allocation Example

Low Memory ↕ Protected	Background TCB, without PSD	(K:BACKP)
	Floating accumulator (5 locations)	(K:BACKBG), (K:BASE)
	FORTRAN I/O format information	
	Allocated temporary space	TEMPBASE+6 . . .
Unprotected	Unallocated (as yet) temporary space for Public Library and monitor service routine use.	K:DYN . . .
	User program and subprograms (including any library routines not in the Public Library)	TEMPLIM
	Unused space	
	Disk I/O blocking buffers (From 1 to 16 buffers; size of buffer determined at SYSGEN)	(K:BACKBUF)
High Memory	Blank COMMON (if any)	(K:UNAVBG)

(Unavailable memory, if any)

Figure 5. Background Memory Usage Example

Selection Keyword	Function	Size
IOEX	General I/O Driver.	200
JOBACCT	Background Job Accounting (includes CLOCK1).	100
DEBUG	Foreground/background program debugging.	625
HEXDUMP	Hexadecimal patches. Memory dumps. RAD dumps. I/O table dumps.	40 or 115[†]
COC	Character-oriented communications handler (includes RCOC).	1000-1100
DISMISS	Task dismissal on "wait" I/O.	130
ERRORLOG [,entries]	Error logging on disk file (includes ERRORSUM) entries defaults to K:BLOCK/S.	240 + 4 * I/O channels + s * entries
ANALYSIS	Saves system status and memory snapshot on disk or magnetic tape in event of critical system error.	325 + 2 * devices + 3 * I/O channels
R:IDxx	Includes RBM module xx as a resident rather than nonresident module.	(See Table 5)
RSVPTABL [,entries]	Specifies other than default Reserve Peripheral function. Entries specifies maximum number of concurrent Reserve requests (active +queued). If entries is specified as zero, the Reserve Peripheral function is not included in the system (default is 5 entries).	3 * entries

For ERRORLOG:

K:BLOCK	S
180	15
128, 256 or 512	16

RESIDENT I/O TABLES AND ROUTINES

The size of the resident area allocated for I/O tables and device specific routines depends on the specific peripheral devices selected. The basic size (in words) of the I/O table is

    8 x number of I/O channels
    15 x number of device types
    + 22 x number of disk File Control Table entries
    (disk DFNs)
    + 2 x number of operational labels

[†]115 if only RAD and no disk in system.

Add to this amount the values given in Table 4 if the corresponding device type is included in the system (SYSGEN parameter DEVICE FILE INFO).

Since SYSGEN attempts to store whatever optional tables it can into unused interrupt locations, the size of the unused interrupt region can generally be subtracted from this accumulated sum. The size of the unused area can be determined by subtracting the value specified for the SYSGEN parameter MAX. INT. LOC from 399. However, this figure will be somewhat larger than the true size since not all of these unused interrupt locations can be used for tables.

FILE CONTROL TABLE ALLOCATION

The File Control Table (FCT) is indexed by device-file number and contains information about all device-files in the system. The total size of the File Control Table is determined and allocated at SYSGEN time. The device-file numbers (DFNs) are assigned on the basis of the order in which devices are defined. For example, since the first device defined must always be a keyboard/printer, DFN 1 will always specify a keyboard/printer. Devices other than disk have permanent device-file number assignments made at SYSGEN time. SYSGEN allows room for up to 50 permanent device-files (not including disk files).

A separate device-file number (i.e., FCT entry) is required for each open disk file. Hence, the total number of entries necessary in the File Control Table for all disk files is the maximum number of simultaneously open files. At SYSGEN time, the user must specify this maximum number of disk files for his foreground programs. To this value, SYSGEN will add the number of foreground device-files required for operation of RBM. This number is 2, plus 1 if the checkpoint area is included, plus 1 if job accounting is included, plus 1 if a 7242/46 disk pack is included, plus 1 if error logging is included. For the background, nine device-files will be allocated (a sufficient number for the system processors), plus the number of background DFNs requested by the user.

OPERATIONAL LABEL ASSIGNMENTS

During SYSGEN the user specifies the selected standard operational labels for background and foreground, and assigns each to a device-file number (other than a disk file number) or to zero. These assignments will be maintained as default assignments for the selected operational label. (Assignment to zero is essentially a 'null' assignment, but does produce an entry in the appropriate table for the specified operational label.)

After all inputs are made by the user, SYSGEN allocates two to six additional reserve entries in the Foreground Operational Label Table for disk file labels, and nine additional reserve entries in the Background Operational Label Table.

A total of 100 operational labels can be allocated and assigned at SYSGEN time, including those automatically allocated by SYSGEN.

Table 4. I/O Table and Routine Increments by Device Type

Device		Increment Size (Decimal)	
Type	Model Number	First Input	Additional Inputs
Line Printer (LP)	3451 3466 3461 7440 3463 7441 3464 7445 3465 7446	25	16
	7450	40	15
Keyboard/Printer (KP)	4191 4193	38	23
	7012 8091	32	16
Paper Tape (PT)	7020 7060	43	16
Card Reader (CR)	7120 7121 7122 7140	41	12
Card Punch (CP)	7160	164	135
	7165	41	12
Magnetic Tape (MT)	3325 7323 3335 7332 7315 7333 7316 7362 7322 7372	155	13
Graph Plotter (PL)	7530 7531	26	12
Special device for M:IOEX use	'XX'	7	7
RAD Disk (RD)	3203 3204 3231 3232 3233	161	40
	7202 7203 7204 7232	11	11
	7251 7252	111	20
	7242 7246	361	11

NONRESIDENT RBM MODULES

Table 5 lists the RBM functions normally included as nonresident overlays. Each overlay is identified by a two-character identifier composed of a combination of the numerals 0-9 and the letters A-F. An IDNT source statement at the beginning of each overlay defines the unique identifier for that overlay.

Note that while all of the modules listed in Table 5 are normally loaded automatically as nonresident overlays (if the corresponding function is required), certain of them may be made resident at the user's option. Those modules for which a size is given in Table 5 can be loaded as resident modules by specifying (in SYSGEN phase 1) the corresponding overlay ident in the OPTIONAL FEATURES parameter R:IDxx, where xx is the ident of the desired module. (See "Input Parameters" in Chapter 4.)

OPTIONAL FOREGROUND FACILITIES

SYMBIONT PLOTTING SYSTEM

The symbiont plotting system performs a circular buffering of plotter commands in a RAD or disk file (PLSYMB). A set of background subroutines in the FORTRAN subroutine library is provided to build the file. The background subroutines trigger a foreground task that reads the file and drives the plotter. The trigger is accomplished via a

public library subroutine. A set of unsolicited operator key-ins permit the operator to supervise the plotting operation.

The SYSGEN considerations for inclusion of the symbiont plotting system are

- Allocation of an interrupt level for symbiont use.

- Five public library DEFs.

- Disk allocation:

  o UP area requirement of 16 sectors at 256 bytes/sector, seven sectors at 360 bytes/sector, or five sectors at 1024 bytes/sector.

  o SD area requirement of one sector (LIBSYM file).

  o UD area requirement of 240 sectors at 256 bytes/sector, 160 sectors at 360 bytes/sector or 60 sectors at 1024 bytes/sector for an 8-minute backlog of plotter output.

- One DFN for the plotter device.

- Two foreground disk-file DFNs.

- Two foreground operational labels (PL and OC).

- Three reserved foreground operational label entries (for YP, ZC, and ZP).

Table 5. Nonresident RBM Modules

Group	Function		Ident	Size[t]
Monitor Service Routines	M:ASSIGN I	(Non-RAD files)	A1	
	M:DEFINE		A2	
	M:OPEN		A3	
	M:CLOSE		A4	490
	M:LOAD		A5	
	M:DOW		A6	100
	M:WAIT		A7	
	M:CTRL I		A8	512
	M:RSVP		A9	
	M:DATIME		AA	
	M:COC		AB	400
	M:ASSIGN II	(RAD files)	B1	400
Control Task Subtasks	S:CKPT		01	
	S:REST		02	
	S:LOAD		03	512
	S:ABORT		04	
	S:TERM		05	
	S:ELOG		06	
	S:KEY		07	
	S:KEY2		72	
	S:KEY3		73	
	S:KEY4		74	

[t]A size is indicated for the optionally resident functions only.

Table 5. Nonresident RBM Modules (cont.)

Group	Function	Ident	Size[t]
Control Task Subtasks (cont.)	S:KEY5 S:KEY6 S:PMD S:PMD1 S:CCI, S:ATTN S:PARPWR	75 76 0E 11 0F FF	
Job Control Processor	Process control commands	10	
Debug	Debug	20-2F	
Device-Dependent I/O Editing and Error Recovery	KP and PT pre-I/O and post-I/O editing (Models 4191, 4193, 7012, 7020, 7060, 8091, and 8092).	30	
	MT error recovery (Models 7315/16, 7322/23, 7332/33, 7362/72).	31	
	CP error recovery (Moedl 7160).	32	
	CP error recovery (Model 7165).	33	
	CR error recovery (Models 7120, 7121 7122, and 7140).	35	
	CR and 7tk MT post-I/O BCD conversion (Models 7120, 7121, 7122, 7140, 7362, and 7372).	36	250
	CP and 7tk MT pre-I/O and post-I/O BCD conversion (Models 7165, 7362, and 7372).	37	160
	CP pre-I/O and post-I/O BCD conversion (Model 7160).	38	250
	LP pre-I/O editing (Models 3451, 7440, 7441 and 7445).	3A	175
	LP pre-I/O editing (Models 3461/62/63/64/65/66 and 7446).	3B	140
	LP pre-I/O editing (Model 7450).	3C	200
	LP error recovery (All Models).	3D	
	LD pre-I/O and error recovery	3E	310
	MT error recovery (Models 3325/35)	3F	467
HEXDUMP	Memory/RAD dump	40	
	Hexadecimal patching	41	
	I/O table dump	42	
Miscellaneous	I/O message writer	12	
	RBM bootstrap	AC	

[t]A size is indicated for the optionally resident functions only.

- Public Library — 150 words.

- Resident foreground — 800 words[t] or 1150 words[tt].

- Background (in addition to user program) — 1625 words[t] or 1950 words[tt].

CHARACTER-ORIENTED COMMUNICATIONS PROGRAM (RCOC)

The RCOC program is a foreground task connected to the input and output interrupts of the Character-Oriented Communications controller (Model 7611). As a handler, the RCOC task will edit and translate input and output characters, echo characters if required, form input messages, and transmit output messages. The RCOC task functions in response to control operations initiated through the RBM service routine M:COC.

With a nominal buffer size of 64 words less line status tables (five words per communications line), and with keyboard-display code suppressed, the size of RCOC is approximately 1000 words (decimal). The keyboard/display feature will add 100 words to give an approximate total foreground memory requirement of 1100 words.

---

[t]UD = 360 bytes/sector.

[tt]UD = 1024 bytes/sector.

The RCOC program is normally assembled by the user in order to exercise various installation options, e.g., number of lines.

SYSTEM INTERFACE UNIT HANDLERS

Real-time programs can control or communicate with a large variety of special devices theough Xerox System Interface Units (SIUs). (SIUs and their usage are described in the publication "Xerox System Interface Units", 64-28-01.) Standard SIU-handler software is available, under separate catalog numbers, for operating the SIUs under RBM. Table 6 lists the handlers, their memory space requirements, and their catalog numbers.

The SIU handlers, supplied in relocatable object form, may be loaded with the user's foreground program. But if more than one program is to utilize a given handler, it is preferable to place that handler in the Public Library (PUBLIB), thereby eliminating the need for a separate copy per program.

BACKGROUND PROCESSOR MEMORY REQUIREMENTS

The standard RBM processors and subsystems listed in Table 7 operate in the background memory area. The sizes given in Table 7 represent the minimum amount of memory required to load the processors, to execute them, and to assemble them from source code.

Table 6. Standard SIU Handlers

Description	Model Number	Size (Decimal)	Catalog Number
ANALOG OUT	7910	210	706115
ANALOG IN	7915	380	705853
ANALOG AND DIGITAL ADAPTER	7923	200	705898
IOP TO DIO ADAPTER	7929	260	706171
DIGITAL I/O ADAPTER	7930/7931	225	705856
FREQUENCY CONTROL UNIT	7969	40	706123

Table 7. Background Processor and Subsystem Requirements

Processor	Size In K Words (K=1024$_{10}$)		
	Load	Execute	Assemble
RBM Job Control Processor	6	6	18
Overlay Loaders	6	6	18
RAD Editor	6	6	18
Utility	6	6	10
Extended Symbol	6	6	9
Basic FORTRAN IV	8	8	12
ANS FORTRAN IV	8.5	10.5	18
Sort	6	6	12
RPG	8	8	12
ANS COBOL	8	16	N/A

DISK STORAGE ALLOCATION GUIDELINES

During SYSGEN, each RAD or disk pack that will be mounted during SYSLOAD may be divided into from 1 to 16 areas. Each area is labeled with an area mnemonic from the following list:

    SP   SD   SL   BT   CP   FP
    BP   UP   UL   UD   Xn   αα

where n is an integer, and αα is any remaining combination of alphanumeric characters except SK, the first character of which must be alphabetic (excluding X).

Areas are allocated by tracks so that the actual size of an area is dependent on the type of disk device. The disk types are summarized in Table 8.

DISK ALLOCATION SUMMARY

Table 9 summarizes the disk allocation requirements by area (in tracks) and by file (in sectors) for major RBM software.

SYSGEN DISK-ALLOCATION PARAMETERS

Disk area allocations — performed at the point identified as "DISK ALLOCATION" during SYSGEN — can be achieved by explicit area specifications, by default allocations, or by a combination of the two. Basically, disk allocation is performed by specifying a disk device and, optionally, following it by a set of area specifications for that device. This procedure is followed for all disk devices to be accessed via M:READ/M:WRITE. (Disk devices accessed exclusively via M:IOEX need not be specified.) The allocation process is terminated by an END statement.

Normally, only nonremovable disk devices are specified with area allocations; that is, only

1.   RAD units.

2.   "Nonremovable" disk pack/cartridge units upon which a system pack/cartridge (i.e., an invariable set of areas) is to be permanently mounted.

(See "Removable Disk Packs and Cartridges" in Chapter 3.)

Table 8. Disk Data Organization

Type[t]	Model	Track size (bytes)	Tracks	Sectors Per Track	Bytes Per Sector	Capacity (mb)
A	7202 7203 7204 7251 7252[tt]	5760	128 256 512 400 2x400	16	360	.75 1.5 3.0 2.3 2x2.3
B	7232	12288	512	12	1024	6.3
C	7242[tt] 7246	6144	4000	6	1024	2x24.5 24.5
D	3203 3204	10240	128 256	40	256	1.3 2.6
E	3231 3232 3233	6144	400 800 2x800	24	256	2.4 4.9 2x4.9

[t]The disk type designation is utilized in Table 9.

[tt]Models 3233, 7242, and 7252 are packaged as two separate logical devices. A logical device is the limiting factor in allocation of an area.

Table 9. System-Disk Storage Summary

Processor	Area	File Name	File Size	Record Size	Format	Sectors			Tracks			
						256	360	1024	A	B	C/E	D
RBM and Standard Processors	SP	RBM	84,000 bytes	Sector size	Random	256	190	64				
		TVECT	700 bytes	Sector size	Random	3	3	1	13	8	11	7
		BOOT	120 bytes	Sector size	Random	1	1	1				
		OLOAD	17,300 bytes	Sector size	Random	68	51	17				
		RADEDIT	22,500 bytes	Sector size	Random	88	63	22	14.5	8	15	9
		UTILITY	15,000 bytes	Sector size	Random	60	41	15				
		X SYMBOL	30,000 bytes	Sector size	Random	144	82	34				
		FORTRAN (Basic)	18,500 bytes	Sector size	Random	72	51	18	3.2	1.5	3	2
		BLOAD	20,500 bytes	Sector size	Random	63	38	20	2.4	1.7	3.4	1.6
	SD	RBMGO	300 records	120	Blocked	140	100	35				
		RBMOV	46,080 bytes	Sector size	Random	180	128	45				
		RBMS2	38 records	108	Blocked	16	9	4				
		RBMPMD[†]	1105–1537 records	2	Packed	12	7	3	17	8	16	10
		RBMSYM	470 bytes	Sector size	Random	2	2	1				
		RBMAL[††]	75 records	24	Packed	8	5	2				
		RBMID[†††]	36 or 102 records	10	Packed	8	5	2				
		ERRFILE[††††]	100 records	30 or 32[††††]	Packed	13	9	3				
	SL	EBCDIC	1800 bytes	Sector size	Random	8	5	2				
		MODIR	720 bytes	Sector size	Random	3	3	1				
		BDFRF	720 bytes	Sector size	Random	3	2	1	6.7	3.4	6.5	4
		EDFRF	360 bytes	Sector size	Random	2	1	1				
		MODULE	34,560 bytes	120	Packed	135	96	35				
Sigma 3 ANS FORTRAN IV	SP	FORTRAN	41,760 bytes	Sector size	Random	164	116	41	7.3	3.5	6.9	4.1
	SL	EBCDIC	4680 bytes	Sector size	Random	20	13	5				
		MODIR	2160 bytes	Sector size	Random	8	6	2	12	5.5	11	4.5
		MDFRF	3240 bytes	Sector size	Random	12	9	3				
		MODULE	59,040 bytes	120	Packed	232	164	58				
SORT	SP	SORT	16,920 bytes	Sector size	Random	64	47	16	3	1.4	2.7	1.5
RPG	SP	RPG	23,040 bytes	Sector size	Random	90	64	26	4	1.8	3.4	2.3
	SL	MODIR	1440 bytes	Sector size	Random	6	4	2				
		EBCDIC	1440 bytes	Sector size	Random	6	4	2	6.3	3.2	6.4	10.1
		MDFRF	1080 bytes	Sector size	Random	5	3	2				
		MODULE	32,040 bytes	120	Packed	128	89	32				
COBOL	SP	COBOL	50,000 bytes	Sector size	Random	196	138	49	8.6	4.1	8.1	4.9
	SL or UL	MODIR	1440 bytes	Sector size	Random	6	4	2	.25	.17	.34	.15
		EBCDIC	1440 bytes	Sector size	Random	6	4	2	.25	.17	.34	.15
		MDFRF	1440 bytes	Sector size	Random	6	4	2	.25	.17	.34	.15
		MODULE	41,040 bytes	120	Packed	161	114	42	7.1	3.5	7	4
	SD	COBDIHG	12,240 bytes	60	Packed	48	34	12	2.1	1	2	.9
XSP[†††††]	UP	XSP	40,000	Sector size	Random	157	112	39	7	3.25	6.5	6.5
BSS[†††††]	UP	BSS	3,000	Sector size	Random	12	9	3	.75	.25	.5	.3
Plotter Symbiont	UP	PUBLIB	720 bytes	Sector size	Random	3	2	2	.63	.5	1	.3
		PLOT	2880 bytes	Sector size	Random	12	8	4				
	SD	LIBSYM	360 bytes	Sector size	Random	2	1	1	.06	.09	.17	.05
	UD	PLSYMB	57,600 bytes	Sector size	Random	225	160	60	10	5	10	5.6
RCOC	SP, UP, or FP	RCOC	2520 bytes	Sector size	Random	10	7	3	.45	.25	.5	.25
RBM Maintenance/ Utility Processors	SP, UP, or BP	ANALYZE	43,200 bytes	Sector size	Random	160	120	40				
		COMPRESS	2160 bytes	Sector size	Random	9	6	3	8.6	4.1	8.2	4.6
		EXPAND	1800 bytes	Sector size	Random	8	5	3				
		REPLACE	2160 bytes	Sector size	Random	9	6	3				
	SP, UP, or FP	INDUMP	3600 bytes	Sector size	Random	12	10	5	.65	.42	.85	.3

[†]Contains the area of background memory that is overlayed by PMD when PMD is active.

[††]Not allocated if the JOBACCT option is not selected during SYSGEN.

[†††]Not allocated if the DEBUG option is not selected during SYSGEN.

[††††]Not allocated if the ERRORLOG option is not selected during SYSGEN: 30 if K:BLOCK = 180; 32 if K:BLOCK = an even power of 2.

[†††††]Consult Table 10 for Spooling File requirements.

Table 10. Spooling Volume Requirements

| Device Type | Model Number | Rated Speed (Rec/Min) | Comp. Char. Per 10 Minutes Operation | Sectors Required Per 10 Minutes Operation | | | | Feet of Tape (XSP Tape Spooling) Per 10 Minutes Operation | |
				Model 7204	Model 7242	Model 7250	Model 32xx	800 BPI Density	1600 BPI Density
Readers	7121	200	80K	225	79	225	310	18	14
	7122	400	160K	450	160	450	625	37	28
	7140	1500	600K	1700	580	1700	2350	140	105
Printers	7450	225	106K	295	100	295	415	24	19
	3451	350	175K	490	170	490	680	40	31
	7440	800	400K	1100	390	1100	1550	92	71
	7445	1000	500K	1400	490	1400	1950	115	89
Punches	7165	100	40K	110	390	110	155	9	7
	7160	200	80K	225	79	225	310	18	14

Assumptions:
1. 50% overall data compression.
2. 80-byte records.
3. 100-byte print records.
4. 400-byte block size on tape media.
5. 23 feet of tape required per 100K bytes at 800 BPI density, and 17.7 feet at 1600 BPI.
6. Blocks per 100K bytes for Models 7204, 7242, 7250, and 32xx are 280, 98, 280, and 390, respectively.

MASTER DICTIONARY FORMATION

During disk allocation, the permanent entries in the Master Dictionary are filled in. (That is, the disk-resident copy of the Master Dictionary is constructed.) The total size of the dictionary is determined beforehand by the "NO EXTRA DICT. ENTRIES" parameter value. This value reserves a user chosen number of entries (from 0 to 40) that is additional to the five entries automatically reserved — nominally for the "basic" system areas SP, SD, SL, BT, and CP. The total number of entries so determined must provide for both the permanent entries defined at SYSGEN and any possible temporary areas defined dynamically via the MOUNT key-in.

The only restrictions on area definitions are

1. The two-character area mnemonics must begin with an alphabetic letter other than X (and cannot be SK).

2. The size of the Master Dictionary may not be exceeded.

3. The available space on the disk device may not be exceeded.

4. The resident RBM portion of the RBM files in the SP area may not cross a cylinder boundary.

Prior to disk allocation, default definitions for the areas SP, SD, SL, BT, and CP are entered into the dictionary. If any of the latter three areas (SL, BT, or CP) are not desired, they should be removed at the beginning of disk allocation, by specifying their size as zero (discussed further below), in order to provide room for other areas to be allocated. (This applies to both the explicit and default allocation methods described below.)

EXPLICIT AREA ALLOCATION

Explicit area allocation implies the specification of a complete set of area definitions (each consisting of a mnemonic

and a track extent) for each device to be allocated. A sample set of device/area specifications is as follows:

(a) 7204/B0

(b) SP = 40

   SD = 20

   SL = 20

   CP = 0

   FP = 50

   UD = 100, NO

   BT = ALL

(c) END

Specification (a) defines a Model 7204 RAD unit with device number B0 (on the integral IOP, or IOP1, by default). Specification (b) and those that follow define the areas desired on that device and the number of tracks to be assigned to each. The specification "CP = 0" effectively deletes the automatic CP entry from the Master Dictionary. Specification "UD = 100, NO" allocates 100 tracks for the UD area with no write protection. Specification "BT = ALL" allocates the entire remaining space (ALL) on the RAD following the FP area (i.e., 262 tracks) to the BT area. (Write protection parameters and defaults are described below.)

If the RAD unit on B0 were either the last or only device to be allocated, parameter (c) would be used to end the allocation process.

Note that all desired areas other than the system areas SP, SD, SL, BT, and CP must be explicitly allocated. Optionally, any or all of these system areas may also be allocated explicitly, as shown in the above example.

Rule for Use of the Area Parameters. Areas are allocated in the order specified, and area specifications pertain to the immediately preceding device definition.

The occurrence of an area specification of the form "area= ALL" causes all of the tracks remaining unallocated at that point (on the device in question) to be allocated to the defined area. This specification effectively terminates allocation on that device; any following area or SK specifications for that device will cause an alarm message only.

Rule For Placement of System Bootstrap. Each disk device allocated during SYSGEN will automatically receive a system bootstrap (pointing to the device containing the SP area) unless the first area allocated on the device is preceded by an SK = nn (skip nn tracks) specification. If an initial SK is not specified, the bootstrap is written into sector 0 of track 0 and the first allocated area will begin at sector 1 (sector 2 for removable areas on cartridge/ disk). All other areas allocated on the device, with the possible exception of the BT area, will always start on a track boundary. If default allocation is accepted for

CP and BT, BT will begin at the next available sector following the CP area. The CP area is not forced to end on a track boundary unless it is explicitly allocated.

Note that an SK specification is ineffectual as a final parameter, i.e., if not followed by an area definition.

DEFAULT AREA ALLOCATION

The basic system areas SP, SD, SL, CP, and BT may all be allocated by default, and in that order on the default device. Alternatively the SP area may be specified explicitly and the remaining four areas be allocated by default. Also, by accepting default allocations and then selectively adding explicit specifications, the user can relocate default areas, change the default contents, and/or delete the SL, CP, or BP areas as desired, in addition to adding nondefault areas to the default device.

Default allocations are selected by the user in either of two ways:

1. By specifying a system-default-allocation device, by means of an "S" parameter in the device definition, e.g.,

   7204/B0, S (for IIOP or IOP1, by default)

   or

   7204/B0, S, E (for the EIOP or IOP2)

2. By specifying an SP area for a given device. In this case, any of the other basic system areas that were not already explicitly specified will receive default allocations on the device containing SP.

The "S" parameter takes precedence over the SP area specification; that is, default allocations may occur on some device other than that which is to contain the SP area.

The order and extent of the areas allocated by default are given in Table 11. (The rules for IOP specifications and defaults are given in Chapter 4.)

The device chosen to receive the system defaults via the S parameter will automatically receive a system bootstrap in sector 0/track 0, and presumably will be the "system device" unless the SP area is moved to another device by a subsequent, explicit SP area specification. Any of the default area definitions can be superseded by subsequent explicit specifications, allowing the default extents to be modified, the order of the default areas to be rearranged, and/or default areas to be deleted in case of SL, CP, or BT (by setting their size to zero). Also, any of the default areas may be moved to another disk by

Table 11. Default Area Allocations

Area	Default Allocation	Number of Tracks			
		A	B	C/E	D
SP	Only large enough to contain RBM, TVECT, BOOT, and all standard processors (see Table 9).	35	19	37	23
SD	Only large enough to contain nominally large RBMGO and RBMOV files, and other small files RBMS2, RBMID, etc.).	17	8	16	10
SL	Only large enough to contain the Basic FORTRAN IV libraries: Standard precision, extended precision and common, or main libraries.	7	4	7	5
CP	Only large enough to contain all of background.[t]	$\dfrac{\text{bkg. (words)}}{2880}$	$\dfrac{\text{bkg. (words)}}{6144}$	$\dfrac{\text{bkg. (words)}}{3072}$	$\dfrac{\text{bkg. (words)}}{5120}$
BT	Remaining disk space up to and including the last available track.	"ALL"	"ALL"	"ALL"	"ALL"

[t]If the ANALYSIS, CP option is selected, the default size of CP will be large enough to contain all of memory.

explicit specifications following a subsequent device definition. (See "Rule For Placement of System Bootstrap", above, concerning SK usage.)

Rule For Adding Nondefault Areas to the Default Device.
If nondefault areas are to be allocated on the device receiving the default system-area allocations, at least the default BT area definition (effectively BT=ALL, BG) must be superseded by an explicit specification — not specifying ALL — preceding the nondefault area specifications. (This is because the default "BT=ALL" allocation effectively inhibits any further nondefault area specifications for that device, including SK specifications.)

General Rule For Ordering of Areas. There is no advantage in any particular arrangement of disk areas on fixed-head devices (e.g., 720x or 7232). However, the arrangement of areas on a movable-arm device (e.g., 724x or 725x) can significantly affect performance. The general guideline to be followed in the latter case is to allocate the disk areas such that the most frequently used areas are in the central cylinders (e.g., cylinder 100 for a 724x, equivalent to track number 2000) and the least frequently used areas are in the outer or inner cylinders. Such organization increases the probability of small arm motion when disk I/O is required.

Allocation Example. The following example of combined default and explicit allocation will illustrate the various points made above.

7204/B0, S

SP = 40

BT = 20

CP = 0

FP = 30

UD = ALL, BG

7242/C0

SK = 20

SD = 25

⋮

The specifications following the 7204 device definition redefine the SP area extent, leave the SD and SL default allocations unmodified, redefine the BT area, suppress the CP area, and add the FP and UD areas. The subsequent SD area specification following the 7242 device definition effectively "moves" and reallocates the default SD area, leaving the order of areas on the system device (7204) as SP, SL, BT, FP and UD. Note that the 7242 device will

not contain a system bootstrap and the SD area will begin at sector 0 of track 20. (Track 20 is effectively track 0 of cylinder 1.)

AREA WRITE PROTECTION

Each area will have a protection code assigned to it. This protection code is checked by the RAD Editor area maintenance commands to prevent inadvertent loss of critical files. The protection codes are

Protection Code	Meaning
NO	No restriction (i.e., unprotected area). Only files with NO write protection may be added, deleted, etc., without restriction.
BG	Background files and unprotected files (i.e., NO write protection) may be added, deleted, etc., without restriction.

Protection Code	Meaning
FG	Foreground and unprotected files may be added if an SY key-in is in effect.
SY	Files with any write protection may be added if an SY key-in is in effect.

The following areas have fixed protection codes:

Area	Protection Code
SP, SL, SD	SY
FP, CP	FG
BP, BT	BG

The other areas may have an area protection code assigned during SYSGEN. If none is specified, the default is SY.

4. SYSTEM GENERATION

INTRODUCTION

System generation (SYSGEN) is a process that produces an RBM system "tailored" to the specific needs of a particular installation. The primary object of the process is to achieve the least system overhead cost consistent with functional requirements, in terms of memory and system disk space and of critical response times. The selection criteria for including or excluding optional RBM functions, for determining the size of various system tables and areas, etc., are described in Chapter 3. The functional and operational aspects of the SYSGEN process are described in the present chapter.

SYSGEN FUNCTIONAL OVERVIEW

System generation is performed by a stand-alone SYSGEN program. The process essentially involves the selection and consolidation of Xerox-supplied RBM modules, based on user input parameters, and is performed in two phases:

1. A definition phase — or phase 1, which collects user supplied parameters that

   - Describe the hardware configuration.

   - Select the optional software features and functions.

   - Determine various table sizes, memory partition boundaries, and system disk area extents.

   Based on this information, the definition phase generates a core image of resident RBM consisting of the mandatory resident modules, optional resident modules, the RBM overlay area, and various I/O and other system tables. (The tables are compacted as far as possible into otherwise unutilized low-core spaces.) The resident RBM modules are supplied in relocatable form. Phase 1 also generates several tables — memory and disk allocations, monitor symbol values, etc. — for later use by phase 2 and subsequently by the newly generated operating system itself. (Certain of these tables are completed by phase 2 processing.)

2. A system load (SYSLOAD) phase — or phase 2, which generates on disk the nonresident portion of RBM and completes the system disk image of the entire Monitor (resident and nonresident), using information supplied by phase 1. In so doing, it

   - Completes the disk allocation determined by phase 1.

   - Absolutizes and loads onto the system disk the required RBM overlays (mandatory and optionally selected nonresident modules), which are supplied in relocatable form.

   - Completes the RBM overlay loading control table.

   - Completes the resident monitor core image and loads it onto the system disk.

   - Completes the system disk (insofar as the Monitor is concerned) by adding such items as the RBM bootstrap, Transfer Vector Table, and Symbol Table files, and initializing the SP and SD area file directories.

   Note that, at the user's option, certain of the normally nonresident modules may be loaded by phase 2 as resident routines rather than as overlays — the normal case. This option is controlled by phase-1 parameters.

Throughout, both phase 1 and phase 2 test for various error conditions such as invalid parameters, loading errors, disk area overflow, excessive module size, and invalid load items.

OPERATIONAL OVERVIEW

The SYSGEN process is initiated by a hardware load from either a magnetic tape unit, paper tape reader, or card reader, depending upon which form of system-release media is employed. In any case, the SYSGEN program is self-loading. The system release tape or deck is self-sufficient in that it contains all of the materials required for generation of RBM. (The format of the system release tape/deck is described below.)

Once SYSGEN is loaded, the user is requested to supply, via the operator's console, the model number and device number of the input device through which all further user inputs — parameters, options, etc. — will be supplied, and of the output device (if any) on which input requests are to be printed and user responses logged. If the console (keyboard/printer) is chosen for these subsequent inputs and outputs, the definition-phase operational sequence is controlled from this point on by further printed messages — requests for key-ins — from the SYSGEN program.

User input need not be via the keyboard/printer; a paper tape reader or card reader may be utilized. In this case, the individual option and parameter records must be ordered in exactly the same sequence as they would be entered in response to prompts at the keyboard/printer. The end of the definition phase is signaled by the message LOAD RESIDENT MODULES, at which point the required resident RBM routines are read from the file of resident modules (see "System-Release Tape Format", below).

The beginning of the SYSLOAD phase (phase 2) is marked by the message RBM SYSLOAD followed by the request INPUT OPTION (ALL, UPD, or PA). The ALL option is used for an initial system generation, or whenever all areas

of the system disk must be reinitialized, i.e., when
subsystems, processors, libraries, user programs, etc., as
well as RBM itself must be written anew on the system disk.
The UPD option is used for an update SYSGEN where the
current disk area sizes and locations remain the same, and
only RBM itself need be replaced. In this case, if the
size of the resulting (new) RBM file on the system disk is
greater than the current one, the entire SP area, at least,
will need to be reloaded (via the procedures described in
Chapter 5).

Messages issued by phase 2 will indicate to the user the
several categories of programs that may require subsequent
reloading due to SYSGEN changes to RBM. For example,
changes in memory allocation for the public library, resi-
dent or nonresident foreground, or background will require
reloading of the affected user programs.

The PA option is used for making permanent patches to the
resident RBM modules (obviating the necessity for subse-
quent boot-time patching). After the patches are applied,
the request for an ALL or UPD option is reissued. The
message LOAD NONRESIDENT MODULES indicates the
point at which the second, nonresident module file will be
searched and read from. After the required nonresident
modules have been loaded, phase 2 outputs a map of the
symbols defined within RBM. On completion, the SYSLOAD
phase terminates by a transfer of control to the RBM boot-
strap routine, and the standard sequence of system startup
messages is encountered.

Detailed operational descriptions of both SYSGEN phases
are presented below, following a description of the system
release tape or card deck format.

SYSTEM-RELEASE TAPE FORMAT

The system is distributed on magnetic tape, paper tape, or
punched cards. The format of the released materials is
logically identical in each case; only the magnetic-tape
form, however, will contain all of the standard processors
distributed with the system (this does not affect the SYSGEN
process). We will describe a typical system release in
magnetic tape form, noting any operational differences if
the paper tape or card deck form is utilized.

The general format of the system release tape is shown
pictorially in Figure 6. It consists of a number of files,
only the first three of which are involved in the SYSGEN
process itself. These first three files contain, respectively,
the SYSGEN program (and its bootstrap), the complete set
of resident RBM modules, and the complete set of non-
resident RBM modules or "overlays" (certain of which may
optionally be made resident). These three files consist ex-
clusively of binary records.

All of the succeeding files consist of "normal" jobs for the
new RBM system to be created from the three files just de-
scribed. These jobs load the RBM subsystems and standard
processors that are supplied with the system. The first

job loads an absolute copy of the Overlay Loader subsystem
by means of the ABS loader. All of the following jobs
utilize the Overlay Loader and the RAD Editor as required.
The files representing these jobs contain a combination of
control commands and object module records. Loading of
the system processors is described further in Chapter 5.

DEFINITION-PHASE OPERATION

Operation of the SYSGEN definition phase (phase 1) in-
volves first the loading of SYSGEN and then the entering
of input parameters.

LOADING SYSGEN

Whether the initial hardware load operation is performed
from magnetic tape, punched cards, or paper tape, the
computer enters the wait state twice during the loading of
SYSGEN:

1. Following loading of the bootstrap record.

2. Following loading of the SYSGEN program itself.

The device address of the keyboard/printer to be used for
the first SYSGEN operator exchange must be set up on the
DATA switches prior to clearing the second wait state. The
step-by-step procedure is as follows:

1. Perform the standard hardware load procedure from the
   selected SYSGEN input device, e.g., a magnetic tape
   unit with the PROTECT switch in the off position and
   the PARITY ERROR (Sigma 2/3) or FAULT (Model 530)
   switch set to HALT.

2. Clear the first wait state encountered (i.e., COMPUTE
   switch to IDLE, then back to RUN).

3. Set the PARITY ERROR or FAULT switch to INTRPT,
   and set in the DATA switches the device address of the
   keyboard/printer (i.e., the operator's console) to be
   used later for the first request/response interaction
   (request: "INPUT DEVICES").

4. Clear the second wait state encountered.

At this point, the initial sequence of SYSGEN messages
will be typed on the selected keyboard/printer (step 3,
above), as follows:

```
RBM SYSGEN
INPUT DEVICES
```

The first message indicates the successful loading of SYSGEN
and initiation of phase 1. The second message is a request
for an input parameter, which is described below.

Figure 6. System Release Tape Format Example
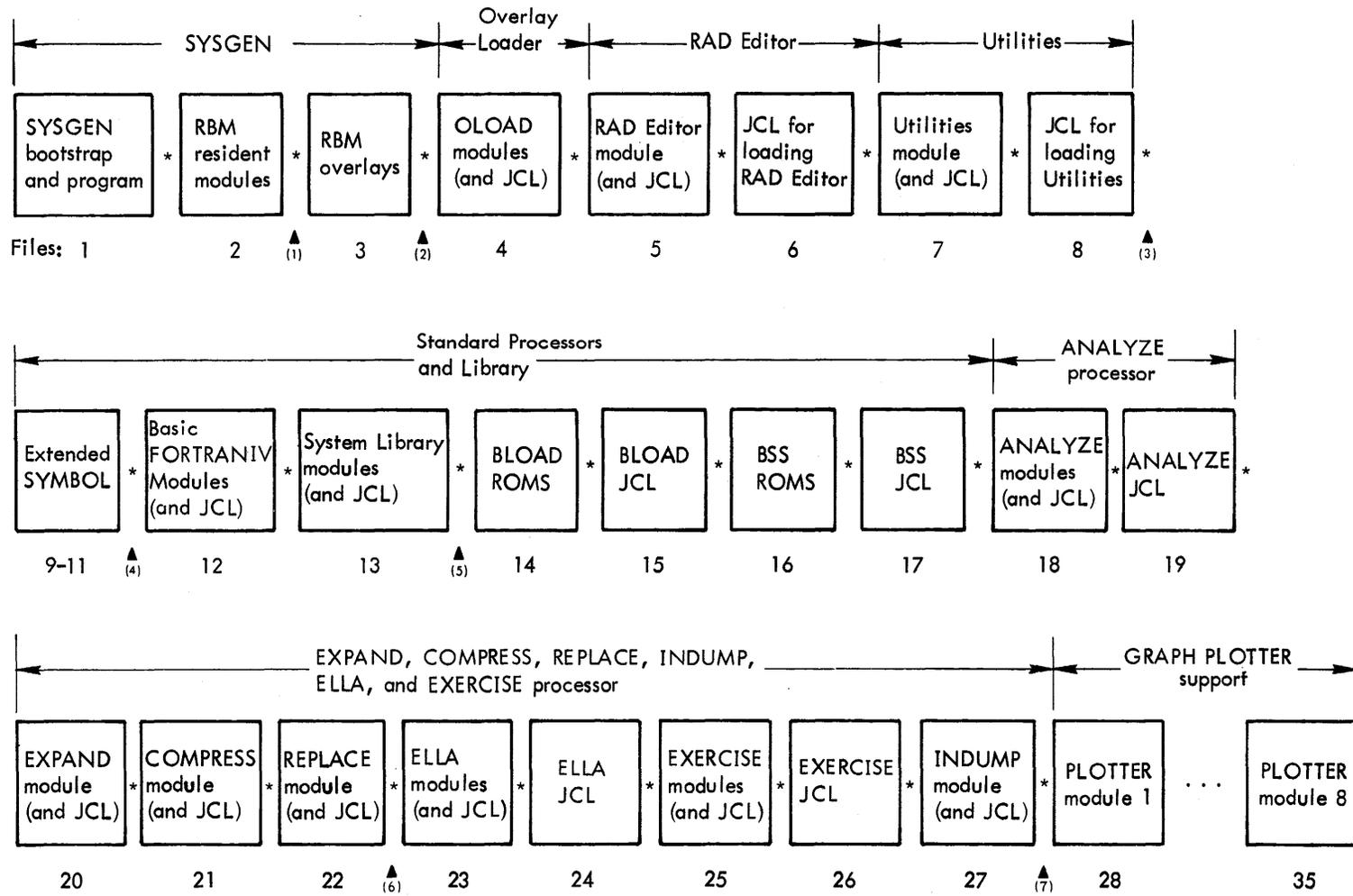
Notes: 1.   * indicates a tapemark/!EOD record (equivalent).

2.   ▲ = end of paper tape reel.

3.   The magnetic tape form of system release also contains compressed listings of files 1-8, 14-22, and 27 indicated above; consult the program description document (-11 element) for the release in question, since the exact format may vary.

INPUT PARAMETERS

Table 12 lists the parameter requests that are issued by phase 1 and defines the syntax of the parameters that are to be entered by the operator in response to these requests. All of the parameters except the first one may be input via the card reader or paper tape reader instead of the console keyboard. The first parameter (in response to "INPUT DEVICES") defines the input device to be so used, as well as an output device — for request/response logging — if desired. If the input parameters are entered via cards or paper tape, they must be ordered (one per physical record) in the exact sequence in which they are listed in Table 12.

Special Note on Card Deck Input. If the card deck form of system release is utilized (that is, if SYSGEN is loaded from the card reader) and if the parameter input is also via the card reader, do the following:

● When the message "INPUT DEVICES" is issued, place the input-parameter deck in the reader ahead of the remaining portion of system-release deck. (Only the first file will have been read at this point.)

Special Note on Paper Tape Input. When the message "INPUT DEVICES" is issued, the paper tape reel used to load SYSGEN should be removed from the reader. If the input parameters are also to be entered via paper tape, place the parameter tape in the reader at this point.

GENERAL SYNTAX OF INPUT PARAMETERS

All numerical values indicated in Table 12 may be input in either decimal or hexadecimal form with leading zeros omitted; hexadecimal values must be preceded by a plus sign (+). Comments can be added to any of the parameters by leaving at least one space following the required input. All inputs via the keyboard/printer or paper tape reader must be terminated with a NEW LINE character. Commas are used to separate fields except as specifically indicated in Table 12.

When entering input/output device specifications (i.e., in response to INPUT DEVICES, DISK ALLOCATION and DEVICE FILE INFO.), standard Xerox model numbers are used as identifiers. The model numbers of the devices supported by RBM are listed in Table 13, according to device type.

Table 12. SYSGEN Input Options and Parameters

Output Message	Input Parameters	Description
RBM SYSGEN INPUT DEVICES	I/O device model number(s) and address(es), in the form in-device$[/dn_1[$, out-device$/dn_2]]$ Examples: 7122/03, 7450/02 — CR in, LP out. 7020/40, 7012/40 — PT in, KP out. 7122/03 — CR in, no output. Special Cases:[†] 7012 — KP in and out, device address read from data switches. 7012/40 — KP in and out.	Input and output device(s) to be used during SYSGEN for reading and listing SYSGEN-input options and parameters. The only acceptable devices are Keyboard/printers — 7012, 8091, 4191, 4192, 4193, 4194. Paper tape readers — 7020, 7060, 8092. Card readers — 7120, 7121, 7122, 7140. Line printers — 3451, 3461, 3462, 3463, 3464, 3465, 3466, 7440, 7441, 7445, 7446, 7450. If DATA switch 1 is set at the time the input device parameter is entered, SYSGEN patches will be read from the input device until an !EOD is encountered. See PA option under "SYSLOAD-Phase Operations".
VERSION XX	Two alphanumeric characters (e.g., A1 or A2 or B1, etc.)	The RBM version will be stored in K:VRSION. The version number is output by RBM on LL at the start of each job and by Postmortem Dump whenever it runs.
MEMORY SIZE	Numeric size	Total size of memory to be utilized, exclusive of INDUMP residence (if any). Stored in zero table location K:UNAVBG.

[†]KP devices only, i.e., model numbers 7012, 8091, 4091, or 4193.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description
MAX. INT. LOC	Address	Maximum address for real-time external interrupts. The space unused by the interrupts will be allocated to RBM tables.
CONTROL TASK INT. LOC.	Address	Address of interrupt used by RBM Control Task. Must be the lowest-priority interrupt to be used.
NO. LINES/PAGE	Number / $(0 < n < +8000)$	Number of lines to be printed on each page during an assembly or compilation. SYSGEN will save the input value in K:PAGE, for later use in printing out a title at the top of each page. Input value n must be less than 32,768 (decimal).
NO. DEFS IN PUB. LIB	Number $(n < +100)$	Number of definitions (DEFs) in the Public Library, up to 255 (decimal). This input is needed so that the Transfer Vector Table can be correctly allocated. If zero is input, SYSGEN assumes there is no Public Library.
NO. ENTRIES IN NONRES. FGD. QUEUE	Number	Reflects the maximum queue size for non-resident foreground programs.
NO. EXTRA DICT. ENTRIES	Number $(n \leq 40)$	Specifies the number of optional entries in the Master Dictionary. Entries are already allocated for SP, SD, SL, CP, and BT. A number from 0 to 40 may be input, specifying the additional Master Dictionary entries.
DISK ALLOCATION	xxxx/dn [, [i][, S]] For example, 7242/E1, E, S	The valid model numbers (xxxx) are as follows: 3203 – 1.3 megabyte RAD 3204 – 2.6 megabyte RAD 3231 – 2.4 megabyte cartridge disk system 3232 – 4.9 megabyte cartridge disk system 3233 – 2x4.9 megabyte cartridge disk system 7202 – .75 megabyte RAD 7203 – 1.5 megabyte RAD 7204 – 3 megabyte RAD 7232 – Extended performance RAD 7242 – Disk pack, dual spindle 7246 – Disk pack, single spindle 7251 – 2.3 megabyte cartridge disk system 7252 – 2 x 2.3 megabyte cartridge disk system dn is the hardware device number for this disk being defined. Each device can only be input once, but as many as 12 devices, each with area allocations, may be input.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description
DISK ALLOCATION (cont.)		Any device controller capable of performing seek overlap may not share a channel with another controller.
		The parameter i specifies the IOP type. For Sigma 3, an I refers to an Integral IOP, and E to an External IOP. E is the default for a 320x, 7232, 7242, or 7246; otherwise I is assumed. I or E must be input for a 720x or 725x. For Model 530, an I refers to IOP1 and E to IOP2. If this parameter is not used, an intervening comma before the next parameter is necessary.
		S indicates that this device is to receive the system default allocations. If more than one disk device is specified with the S parameter, only the last S is recognized. If S is not specified, the device to which the SP area is assigned (see below) will receive the default allocations. (Either an S must be specified or the SP area must be defined.)

	$yy = zz[,wp]$
	
	For example,
	
	  SP = 30
	  SD = 20
	  D1 = 100,FG
	  D2 = 200,BG
	
	In the example given, areas SP, SD, D1, and D2 will receive the number of tracks specified. SL, CP, and BT will be default allocated (as described in Chapter 3) on this same device.
		yy is an area mnemonic, usually from the following:
		
		  SP SD SL BT CP FP
		  BP UP UL UD Xn $\alpha\alpha$
		
		where n is a decimal digit and α is any letter except X. (The combination "SK" has a special meaning and is not a valid mnemonic.)
		
		zz is the number of tracks to allocate on the last specified disk device for area yy. If $zz = 0$, area yy will be undefined, and an additional Master Dictionary entry will be available. If $zz = $ALL, the area will occupy the remainder of the RAD and no other inputs may be made for this RAD. If SK $= zz$ is entered, zz tracks will be skipped before the next area is allocated. But to be meaningful, another area must be input. If the first input is not SK $= zz$, this RAD or disk will receive a system bootstrap[tt] in sector 0 and the next area will actually begin in sector 1. If no areas are allocated on disk dn, however, no bootstrap will be written.
		
		wp is a write protection code for the set NO, SY, FG, or BG. This option is not valid for the SP, SD, SL, BT, CP, FP, or BP areas. For all other areas, the default is SY.

[tt]If the system is to be saved on magnetic tape, the first area allocated on the disk from which the system is booted (i.e., the disk containing the effective bootstrap) must not be BT or CP.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description
DISK ALLOCATION (cont.)	END	Terminates the RAD ALLOCATION parameter.
BLOCKING BUFFER SIZE	A value N, where $64 \leq N \leq 1024$, and is a power of 2 or an <u>even</u> multiple of 5.	Specifies the blocking buffer size (K:BLOCK) for all monitor blocked files in this system. If 0 is input, the largest sector size of the SYSGEN configuration is used.
OPTIONAL FEATURES (The specification of any or all of the keywords in the next column causes the corresponding feature to be included.)	ANALYSIS, CP or ANALYSIS, MT	This feature provides for saving the current system environment and memory contents on the checkpoint area or on magnetic tape, in the event of a critical system error.
	CLK1FREQ, n	Controls the frequency of the Clock1 receiver and optionally disables RBM's use of Clock1. Clock1 is used by RBM to invoke software timeouts of I/O and provides for date and time-of-day. Clock1 is strongly recommended and is automatically selected by SYSGEN. Only if an installation cannot allow for RBM's use of Clock1 should a value of zero be specified for n which will prevent RBM's use of the clock and recover the 100 cells of resident Monitor space. The value n represents the reciprocal of the frequency of the Clock1 receiver and may be any value in the range of $1 \leq n \leq 100$ which is an even divisor of 500 (Clock1 has 2 ms resolution). If n is specified as other than an even divisor of 500, the next lower even divisor will be used (e.g., if n is specified as 67, the clock receiver frequency will be set to 1/50 second). The default value of n is 10, which provides for a 1/10 second Clock1 receiver.
	COC	This feature permits input, output, and control functions on character-oriented communication lines. The communication handler, RCOC, must subsequently be loaded as a resident foreground program (available under a separate catalog number).
	DEBUG	This feature provides foreground and background program debugging aids. The DI (Debug Input) and DO (Debug Output) devices must be specified under "DEVICE FILE INFO".
	DISMISS	This feature improves background and low-priority foreground throughput by temporarily dismissing a foreground task performing "I/O with wait".
	ERRORLOG[,entries]	This feature creates and maintains a disk file of information on errors and other pertinent events

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description
OPTIONAL FEATURES (cont.)		detected by RBM, with the maximum number of entries to be buffered in memory as specified. This option also implies the ERRORSUM option. Entries default to K:BLOCK/S (S = 15 for K:BLOCK = 180; 16 for K:BLOCK = 128 or 512). In addition, SYSGEN will create the file ERRFILE, SD with a file size default of 100 records.
	ERRORSUM	This feature provides counts, for each I/O channel, of the number of accesses (initial SIOs) and the number of errors. Key-ins are included to display and reset the counts. (This option is automatically included by selection of ERRORLOG.)
	HEXDUMP	This feature includes the hexadecimal memory dump key-ins (DM, DF, and DB), the RAD dump key-in (DR), the file control table dump key-in (f), the !HEX control command, and boot-time system patching.
	IOEX	The optional monitor service routine M:IOEX provides direct control over I/O operations.
	JOBACCT	This feature includes the Clock1 feature plus background job accounting, elapsed time recording, and background time limitation.
	POWER	The power-off task preserves the volatile environment in the event of a system power failure. The power-on task restores the volatile environment when power returns to operating limit.
	PROTECT	The protection violation interrupt task prevents background programs from changing protected memory (i.e., RBM or a real-time task), executing privileged instructions (such as input/output), or executing code in protected memory (other than monitor services or "public library" routines).
	R:IDxx where xx is the hexadecimal identifier of an optionally resident RBM overlay.	Specifies that the RBM overlay identified by xx, normally nonresident (see Chapter 3), is to be loaded as a resident module. (This option may be repeated for several such overlays.)
	RSVPTABL , entries	This feature allows foreground to reserve a device. (Other tasks receive a "busy" status at an attempt to access a reserved device.) The "entries" value results in 3 words of table space reserved in core per entry. If option is zero, RSVP is not included in the system (a call to M:RSVP receives a "table full" return). If RSVPTABL is not specified the default of 5 entries will be used.
	END	Terminates the optional-features selection process; the keyword must be the last parameter entered.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description

DEVICE FILE INFO. (INC. DEBUG)	$model/dn, \begin{Bmatrix} B \\ F \\ DI \\ DO \end{Bmatrix} \left[\left[\begin{Bmatrix} I \\ E \end{Bmatrix} \right] \left[, \begin{Bmatrix} BCD \\ ASC \end{Bmatrix} \right] \right]$	Parameters of this form specify device file information
		
		where
		
		    model specifies an I/O-device model number and must be one of those previously listed under "General Syntax of Input Parameters". xx used in model requires M:IOEX option.
		
		    dn specifies the hardware device number for the unit.
		
		$\begin{Bmatrix} B \\ F \\ DI \\ DO \end{Bmatrix}$ indicates the file type: B if background, F if foreground, DI if Debug input, DO if Debug output. (DI and DO will only be accepted if DEBUG has been included as an optional feature).
		
		$\begin{Bmatrix} I \\ E \end{Bmatrix}$ specifies the IOP (for a multi-unit controller). I specifies the IIOP or IOP1, E specifies the EIOP or IOP2. I is assumed by default. This specification will be ignored if the device is not a multi-unit type.
		
		    BCD indicates that BCD (026 keypunch) conversion is to be done to/from internal EBCDIC. BCD conversion is available for the following devices:
		
		        Card readers 7120, 7121, 7122, or 7140.
		
		        Card punches 7160 or 7165.
		
		        Seven-track magnetic tapes 7362 or 7372 with BCD option.
		
		    ASC indicates that ASCII code conversion is to be invoked by default. ASCII code conversion is available only for 9-track magnetic tape 3325 and 3335 which have the 1046 ASCII translation option installed. If ASC is not specified, no code conversion (EBCDIC) is the default mode.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description
DEVICE FILE INFO. (INC. DEBUG) (cont.)		The first device file entry, DFN = 1, must be one of the following: 7012/dn, F 8091/dn, F 4191/dn, F 7193/dn, F } Model 530 only
	RD, {B/F}, nn	This parameter is used to reserve entries for RAD/disk file DFNs, either for background or foreground use. B specifies background, F, foreground. SYSGEN always allocates two to six foreground RAD/disk DFNs for use by the Monitor in addition to the number of RAD/disk foreground DFNs specified by the user. Hence, the total size of the File Control Table will be the sum of the number of nondisk DFNs assigned, plus the total number of DFNs reserved for foreground use plus two (to six), plus the number of DFNs reserved for background use plus nine, plus one if DI is specified and one if DO is specified (see example).
	LD/yy, {B/F} where: LD represents a 2-charater mnemonic. Any mnemonic other than RD and XX can be used. This mnemonic may indicate a device type the logical device is to represent; e.g., LP for Line Printer, as required by the printer symbiont. yy is a pseudo-device number and X'00' ≤ yy ≤ X'FF' Examples: LD/08, F LD/08, F } LD#1 B1/09, B F1/09, F } LD#2	Logical Device (LD) definition is used to reserve entries for LD DFN groups, either for background or foreground use. B specifies background, F foreground. The pseudo-device number, yy, is a channel number that typically is unused by any real device. A unique channel number should be used for each LD DFN group.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description	
DEVICE FILE INFO. (INC. DEBUG) (cont.)	Examples:		
		DFN	Device/File
	7012/40, F	1	Keyboard/printer for RBM use
	7450/02, B	2	Line printer, 225 lpm
	7121/03, B	3	Card reader, 200 cpm
	7165/04, B	4	Card punch, 100 cpm
	7012/40, B	5	Keyboard/printer for background
	7020/40, B	6	Paper tape reader/punch
	7322/D0, B, E	7	9-track magnetic tape
	7362/D0, B, E	8	7-track magnetic tape
	7362/E0, B, E, BCD	9	7-track magnetic tape, BCD conversion
	7121/03, B, BCD	10	Card reader, 200 cpm, BCD conversion
	7165/04, B, BCD	11	Card punch, 100 cpm, BCD conversion
	RD, B, 20	29-48	Background disk files (see note 1)
	7450/02, F	12	Line printer, 225 lpm
	7121/03, F	13	Card reader, 200 cpm
	XX/F0, F, E[†]	14	9-track magnetic tape for M:IOEX use only
	7121/03, DI	15	Debug input (see note 2)
	7450/02, DO	16	Debug output (see note 2)
	RD, F, 12	17-28	Foreground disk files (see note 1)
	LD/09, B LD/09, F	29 30	Logical Device group with the 2 associated DFN's.
	LP/0A, B LD/0A, F	31 32	Logical Device group with 2 associated DFN's. DFN 31 can be used as Line Printer symbiont output, without requiring modification to the COBOL and FORTRAN printer output library routines.
	(See note 2)	49-50	Debug input, output
	Notes: 1. RAD file DFNs are always high-order as shown above, regardless of sequence of entry, and foreground files will have the lower value DFN assignments. 2. DFNs 15 and 16, in this example, may be used as normal foreground files; DFNs 49 and 50 are automatically reserved for use by DEBUG instead.		
	END	Signifies end of device-file information.	

†XX devices are only allowed if the IOEX optional feature is specified.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description

BCKG. OP. LBL.	$\left\{\begin{array}{l}\text{oplabel = dfn}\\ \text{fdun = dfn}\\ \text{0 = n}\end{array}\right\}$ (one per entry)
	
	where
	
	    0 = n means reserve n loca-
	        tions in Operational Label
	        Table for temporary
	        assignments.
	
	    oplabel is a two character
	        operational label, the first
	        of which must be alphabetic.
	
	    dfn is a background device
	        file number defined under
	        "DEVICE FILE INFO".
	
	    fdun is a decimal number in
	        range 1-32,764 (FORTRAN
	        device unit number, ex-
	        cluding "F:").
	
	Examples:
	
	    SI = 3
	
	    102 = 4
	
	    0 = 3 (reserves three additional
	        entries in Operational
	        Label Table).
		Background operational labels or FORTRAN device-unit number and device-file number equivalents for permanent I/O assignments. (Note that no operational labels can be assigned to disk files at SYSGEN time.) The following operational labels are defined by RBM; thus, they may not be specified:
		
		<table><tr><td>Label</td><td>Use</td></tr><tr><td>GO</td><td>Normally assigned to the RBMGO file for "assemble and go" type operations.</td></tr><tr><td>LI, LS, RS</td><td>Used by OLOAD for library loading.</td></tr><tr><td>OV</td><td>Normally assigned to the RBMOV file for "assemble and go" type operations.</td></tr><tr><td>PI</td><td>Should be used by any background program with overlays to load the overlay segments from the RAD. For system processors, PI is assigned to the processor file. For background programs loaded with an XEQ command, PI is assigned to OV. Foreground programs must specifically assign an operational label to the file which overlay segments are to be read.</td></tr><tr><td>S2</td><td>XSYMBOL standard procedures.</td></tr><tr><td>X0-X6</td><td>Processor scratch files.</td></tr></table>

	END	Signifies the end of background operational label specifications.
FGD. OP. LBL.	Same as for background, except that space for two to six operational labels is automatically assigned.	Foreground operational labels or device unit number and device file number equivalents for permanent foreground I/O assignments. No foreground operational labels can be assigned to disk files at SYSGEN time.

Table 12. SYSGEN Input Options and Parameters (cont.)

Output Message	Input Parameters	Description
FGD. OP. LBL. (cont.)		The foreground operational labels listed below are normally associated with RAD/disk files. Therefore, assigning these labels to non-RAD files at SYSGEN time is not permitted.
		Label Use
		AL Used for accounting log data.
		CK Used to write/read checkpoint area.
		DP Used by RBM for M and R keyins.
		EL Used for error log data.
		ML Used by M:LOAD to load nonresident foreground programs.
		RM Used by RBM to load the RBM overlays and reserved exclusively for RBM.
	END	Signifies the end of foreground operational label specifications.
PUB. LIB. FWA[t]	Address (omit if no. DEFs in PUB. LIB. = 0)	If zero has been input for the number of DEFs in the Public Library, this typeout will not occur. Otherwise, the input should reflect the first word address (FWA) of the Public Library (which may be equal to RBM LWA). An input of zero is illegal. This value is stored in zero table location K:PLFWA.
RES. FGD. FWA[t]	Address	First word address of the resident foreground area. An input of zero indicates no resident foreground. This value is stored in zero table location K:RFFWA.
NONRES. FGD. FWA[t]	Address	First word address of nonresident foreground area. An input of zero indicates no nonresident foreground. This value is stored in zero table location K:NFFWA.
BCKG. FWA[t]	Address	First word address of background memory. This address must start on page boundary (some multiple of 100_{16}). This value is stored in zero table location K:BACKBG.

[t] These four addresses must be in increasing order. That is, the core allocation must be made in the same order as the SYSGEN input. If nonresident foreground is used, it must be at least 17 cells plus the blocking buffer size (K:BLOCK). This area is used as a buffer for the Q key-in.

Table 13. I/O Device Model Numbers

Device Type	Model Numbers	Run-time Device Name[t]
Keyboard/printer[tt]	4191, 4193, 7012, or 8091	KP
Paper tape[tt]	7020, 7060, or 8092	PT
Card reader	7120, 7121, 7122, or 7140	CR
Card punch	7160 or 7165	CP
RAD	3203, 3204, 7202, 7203, 7204, or 7232	RD
Disk Pack	7242, or 7246	RD
Cartridge disk	3231, 3232, 3233, 7251, or 7252	RD
Magnetic tape, 9-track	3325, 3335, 7315, 7316, 7322, 7323, 7332, or 7333	MT
Magnetic tape, 7-track with packed binary option	7362, or 7372 (with 7374 option)	MT
Magnetic tape, 7-track with BCD option	7373, or 7362 (with 7365 option)	MT
Line printer	3451, 3461, 3462, 3463, 3464, 3465, 3466, 7440, 7441, 7445, 7446, or 7450	LP
Graph plotter	7530 or 7531	PL

[t]This is the device mnemonic output by the read/write routines for operator communication (e.g., !!CR03 EMPTY) and is returned in the A register for a call to M:READ/M:WRITE with a zero order code.

[tt]For keyboard/printers with paper tape reader/punch, the model number input for keyboard/printer use must be as indicated, instead of the model number of the entire unit. For example, use model number 7012 for the keyboard/printer and model 7020 for the paper tape reader/punch where the model number of the complete unit is 7020.

DEFINITION PHASE OUTPUT

MESSAGES TO THE OPERATOR

The error messages listed in Table 14 may be issued by SYSGEN. Note that for input errors the corrected input must be from the keyboard/printer exclusively.

After all input parameters have been processed, phase 1 issues the message

> LOAD RESIDENT MODULES

and enters the wait state (unless magnetic tape input). When the wait state is cleared, the file of resident modules is processed from the SYSGEN-input device and control is passed to the SYSLOAD phase.

If an error condition occurs during the loading of the individual modules making up the resident RBM, the following message is output:

> XX ERR, ID:yy

where

XX   is one of the following error types

XX	Error Type
TO	Table overflow – loading of module would overflow into symbol table. Maximum size of RBM has been exceeded – decrease table allocation.
TY	Illegal load item type in module.

Table 14. SYSGEN Error Messages

Message	Meaning	Recovery
PARAMETER ERR	Input parameters is out of expected range, or maximum number of allowed inputs have been made.	Retype input with correct value.
FORMAT ERROR	Input format not valid.	Retype input with valid format.
INTERRUPT ERR	Control task interrupt is at a higher priority level than the I/O interrupt level, or the control task interrupt cannot be triggered.	Requires hardware modification, or reassignment of control task interrupt to another level.
IN/OUT ERROR	An error has occurred on the last input.	Correct the problem with the input device and retype last input.
ALLOCATION ERR	No disk was defined as the system disk.	Since this alarm is output only after the END parameter is input (i.e., after the disk allocation has been completed), the user must reallocate all areas assigned to the system disk. The default allocations will be restored for the second iteration. The computer will enter a wait state so that the error can be isolated and corrected unlike other SYSGEN errors. The corrected inputs must be made on the original input device.
TOO MANY AREAS	Not enough entries were defined in the Master Dictionary.	Fewer entries must be input or more Master Dictionary entries must be made available. In any event, disk allocation must be restarted.
CAN'T BOOT RBM	RBM resides on a 724x disk and crosses a cylinder boundary.	The SP area must be reallocated during a second disk allocation.
ILL. OP. LBL.	The user has attempted to permanently assign one of the reserved operational labels.	Retype input with different operational label.

XX	Error Type
CS	Checksum error.
SQ	Sequence error.
IB	Invalid binary format.
IN	Input device error.

yy   is the ident of the current module.

After the message is output, the loader enters the wait state. For error types CS, SQ, and IN, clearing the wait causes the loader to proceed with the record as read. For error types TO, TY, and IB, clearing the wait has no effect — SYSGEN must be restarted.

SYSLOAD-PHASE OPERATIONS

Initiation of the SYSLOAD phase (phase 2) of SYSGEN is automatic; it is indicated by the following sequence of messages:

```
RBM SYSLOAD
INPUT OPTION
```

The second message requests that the operator indicate at this point whether a complete, "new" SYSGEN or an update SYSGEN is to be performed, or whether patching of the newly-generated resident monitor image (now in memory) is required prior to a choice of either of the former options. The specific meanings of the operations (to be entered via the keyboard/printer) are as follows:

ALL   specifies that a complete system load is to occur and nothing on the disk is to be saved. (Described further below.)

UPD   specifies that an updated version of RBM,
only,   has been made to replace the existing ver-
       sion. Portions of the disk may have to be re-
       loaded, depending on the new RBM memory
       allocation. (Described further below.)

PA   specifies that one or more patch records are
       subsequently to be read from the SYSGEN input
       device; the record is of the form

$$\left\{ \begin{array}{l} addr, patch_1, patch_2 ..., patch_n \\ !EOD \quad (terminates\ PA\ input) \end{array} \right\}$$

where

    addr   is the location where $patch_1$ is to
            be applied. $patch_2$ through $patch_n$ (if
            any) are applied to successive locations
            $addr + 1$ through $addr + (n-1)$. $Patch_i$ is
            the value to be applied, and may be
            one of the following forms:

$$\left\{ \begin{array}{l} +value \\ symbol \\ symbol \pm value \end{array} \right\}$$

            where

                value   is a hexadecimal value.

                symbol   is the external-definition
                         symbol for an RBM-module
                         value.

If a patch record is in error, the message

       PA ERR, ID:00

is output on the keyboard/printer followed by a
wait condition. Clearing the wait causes the next
patch record to be read.

After an !EOD is read, the request "INPUT OP-
TION" is reissued.

Note: Patches to SYSGEN itself can be accom-
       modated via absolute patches in the format
       just described. If patches are to be applied
       to SYSGEN, set data switch 1 prior to ini-
       tiating the response to the "INPUT DEVICES"
       message. Patches must be absolute and
       since SYSGEN relocates itself on systems
       with 24K or more of memory, special care
       must be taken to bias all location references
       by $+2000_{16}$ from the listing references.
       SYSGEN patches are read from the SYSGEN
       input device and are terminated by an
       !EOD command.

ALL OPTION

The ALL option specifies that a complete loading of the
system disk is to occur. A complete load is necessary for
the initial generation and subsequently whenever any of
the system disk areas has to change size.

In this case, phase 2 first searches the Master Dictionary
left by phase 1 to determine if any disk areas have not
been completely defined.

A check is then made to determine if the checkpoint area
allocation is large enough to contain the entire background.
If it is not, the following message is output:

```
┌─────────────────────────────────────────────┐
│            CP AREA TOO SMALL                 │
└─────────────────────────────────────────────┘
```

The CP area will be undefined. This error is fatal (to
background) only if an attempt is made during subsequent
system operation to checkpoint the background. It can be
corrected only by a complete re-SYSGEN, using at least
the default size for the checkpoint area. If ANALYSIS, CP
was specified (during phase 1), it will be modified to not
write out the memory image.

If ANALYSIS, CP was specified (during phase 1), a check
is made to determine whether the CP area allocation is
large enough to contain all of memory. If it is not, the
following message is used.

```
┌─────────────────────────────────────────────┐
│     CP AREA TOO SMALL TO CONTAIN ENTIRE      │
│     ANALYSIS DUMP                            │
└─────────────────────────────────────────────┘
```

In the event of a call to the SYSERR routine, not all of
memory will be written to the CP area in this case. This may
in turn prevent a complete analysis of the SYSERR condition.

After the Master Directory has been completed, phase 2
will write into the first sector of each area the area mne-
monic and the bounds of the area, and will clear the second
sector of each area.

At this point, phase 2 issues the following message:

```
┌─────────────────────────────────────────────┐
│          LOAD NONRESIDENT MODULES            │
└─────────────────────────────────────────────┘
```

and enters the wait state (unless magnetic tape input). If
module input is via paper tape, the operator should now
mount the next reel. After the wait state is cleared, the
required nonresident modules (i.e., RBM overlays) are read
from the SYSGEN input device and written into the RBM file
in the SP area defined in phase 1. If phase 2 encounters a
track on the system disk upon which it cannot write, an
appropriate message is issued giving the track number.

Phase 2 only loads the modules specified by the options se-
lected during phase 1. The final module must be followed
by an !EOD. The ident from the Extended Symbol direc-
tive, IDNT, used to identify each module loaded and placed
by phase 1 in the OV:LOAD table, is used as the overlay
identification.

If an error condition occurs during the loading of the individual modules making up the RBM overlays, the following message is output:

```
xx ERR, ID:yy
RETRY?
```

where

xx   is one of the following error types:

xx	Error Type
TY	Item type; no external references or definitions are allowed.
BI	Binary module is incomplete.
OG	Origin error; an attempt has been made to re-origin a portion of the routine to a region already on the disk.
LG	Length; the specified overlay is longer than the overlay region (512 words).

yy   is the ident of the current module.

The response to the RETRY query can be either N (no) or Y (yes). If the response is N, phase 2 skips to the next module. If Y is input, the current module is left as is and an attempt is made to continue with the next record. For some of the above errors, however, continuing in this manner may be undesirable.

After loading of the RBM overlays, phase 2 determines if all required modules are present. If some modules are missing, the following alarm is typed:

```
MISSING IDENTS:  xx xx xx xx . . .
RETRY?
```

where xx is the ident of the missing module.

If Y is input to the RETRY query, SYSLOAD again reads the input device to load the missing modules. The operator must, in this case, rewind or reload the module-input device. This sequence is repeated until all required modules are loaded or until an N is input.

After the overlays have been loaded, SYSLOAD will output

RBM LWA = +xxxx

where xxxx is the lowest address that may be used for the public library FWA, resident foreground FWA, or non-resident foreground FWA. If any of the memory partitioning parameters are invalid, a message so indicating is issued at this point. The SYSGEN must be completely redone in this case.

RBM SYMBOL MAP

If the memory partitioning parameters were valid, a map of all defined symbols is printed on the SYSGEN output device. The format of the map is

RBM SYMBOLS

[U] symbol   address   symbol   address
       :   :   :   :
       :   :   :   :
(in alphabetic order)   (in numeric order)

where

symbol   is an external-definition symbol (EBCDIC).

address   is the hexadecimal memory address defined by the symbol, or the address at which it is referenced if it is not defined.

If a symbol appearing on the map is undefined, which may be caused by an unsatisfied reference in a user-written module or by the absence of a standard module, the letter U appears before the symbol. After the symbol map is output, DATA switch 1 is tested to determine whether any patches are required (see SYSLOAD PA option). Following patch input, if any, entries are made in the System Processor area file directory for RBM, the Transfer Vector Table, and the RBM bootstrap. Each of these items is assigned a separate file in the System area (see Table 9, in Chapter 3).

After the nonresident portion of the RBM is written in the RBM file, the resident portion is written, and then the Transfer Vector Table is written into the TVECT file. The Transfer Vector Table contains transfer vectors for monitor service routines and Public Library routines.

The final program output to the System Processor area is a copy of the RBM bootstrap, written into the BOOT file and on sector zero of the system disk, from where it can be hardware-loaded into core. Also, a copy of the bootstrap may be output to the foreground BO device, which enables the user to start RBM on any sector of the RAD or to boot from a disk pack. If the user chooses to start RBM at any sector other than sector zero, he can reboot RBM only by loading the bootstrap punched on the BO device.

The next output to the RAD will be the System Data area file directory, which contains the files itemized in Table 9.

If the installation does not wish to retain the standard SD area file allocations as defined in Table 9, reallocation via the RAD Editor may be performed as described in Chapter 6. Note that the RBM Symbol Table (file RBMSYM) contains the definitions (DEFs) for the monitor service routines. These DEFs are needed by the Overlay Loader at load time to satisfy any reference to the monitor service routines.

When the system load phase completes its writing of the SD area, it transfers control to the RBM bootstrap, which goes through its normal loading procedure (as described in Chapter 11 of the RBM/RT, BP Reference Manual, 90 10 37).

UPD (UPDATE) OPTION

The UPD option specifies that a new version of RBM has been made but none of the areas on the system disk need increase in size. This option can also be used when changes are made in any of the following phase 1 input parameters:

- Public Library (PL) FWA
- Resident Foreground FWA
- Nonresident Foreground FWA
- Background FWA

UPD may not be used if any of the disk areas must change in either size or location. Note that a change in the background FWA to increase the total size of background might require a change in size of the checkpoint area, which could necessitate a complete new SYSGEN. In this case, a CP AREA TOO SMALL alarm would be output for the user's information.

Phase 2 reads the bootstrap to determine where the old version of the RBM is located on the disk, reads the Monitor Constant Table, and compares the old load addresses against the new load addresses to determine which files on the disk must be reloaded.

The size of the new Master Dictionary must be at least as large as the old Master Dictionary. If it is not, an error message will be output and phase 2 will continue. As the comparison checks are made, a subset of the following messages will be issued on the keyboard/printer:

    RELOAD

    PUB. LIB.

    RES. FGD.

    NONRES. FGD.

    BCKG.

    MSR/PL USERS AND PL

    NOTHING

If any of the following modules are relocated on the disk, the contents of other affected areas must be reloaded:

Relocated Module	Required Reloading
Public Library required reloading because its load address has changed.	All programs that reference the Public Library must also be reloaded. None of the Public Library, and no system processors would have to be reloaded.
Resident or nonresident foreground was relocated.	The appropriate routines must be reloaded in these areas.
Background was relocated.	All system processor and background user programs must be reloaded. (See Chapter 5.)

Relocated Module	Required Reloading
TVECT Table load address has changed.[t]	All programs referencing Monitor service routines (MSR) or the Public Library (PL) through the TVECT Table via an external reference must be relocated.

After these checks are made, phase 2 outputs the message

```
LOAD NONRESIDENT MODULES
```

and enters the wait state. When the wait is cleared, phase 2 proceeds to load the overlays as described earlier for the ALL option, but with the following additional considerations.

After the overlays are loaded, check is made to see if the new version of RBM exceeds the disk space allocated to the old version. If so, all programs in the System Processor area must be reloaded. (Reloading of the System Processor area is necessary because RBM is the first file in the area.) If a reload is necessary, the following message is output:

```
RELOAD
SP AREA
```

After the necessary RELOAD alarms are output for the user's information, the Master Dictionary is read from the disk version of RBM and stored into its allocated area in the new version of RBM in memory. The new version of RBM will then be written onto the RBM file, followed by an updated bootstrap in the BOOT file and on the foreground BO device (if one was assigned). Finally, the Transfer Vector Table and the RBM Symbol Table will be updated and then rewritten on the disk.

SYSTEM LOAD PHASE ERROR MESSAGES

In addition to the RELOAD messages listed previously and those concerned with loading the overlays, the messages given in Table 15 can be generated and are unique to phase 2.

---

[t] The TVECT load address will change any time the first word address of the area adjacent to RBM in core has changed.

Table 15. System-Load Phase Error Messages

Message	Meaning	Recovery Procedure
CP AREA TOO SMALL	The size of background has changed and/or disk area allocated for the CP area is too small for all of background memory.	If background checkpoint is required, the entire SYSGEN must be redone with either a larger CP area allocation or the default allocation for CP. (If ANALYSIS, CP was specified during phase 1, SYSERR will not be able to write to the CP area.)
CP AREA TOO SMALL TO CONTAIN ENTIRE ANALYSIS DUMP	The ANALYSIS, CP option was selected and the CP area allocation was not sufficient to contain all of memory.	If complete analysis dump is required, re-run entire SYSGEN with a larger (or default) CP area allocation.
INVALID PARAMETER	An invalid response has been made to the INPUT OPTION request.	Retype either ALL, UPD, or PA.
UPROTECT RAD	One of the write-protect switches has been set on the disk for an area that phase 2 is attempting to modify.	Reset the write protect switches for the appropriate area.
EOT ON SP AREA	An end-of-tape status has been returned while writing on the SP area. Not enough room has been allocated for the SP area.	A new SYSGEN will have to be performed with an increase in the SP area.
EOT ON SD AREA	Same as for SP, except the SD area has overflowed.	Same as for SP.
RDdn FAULT	A nonexistent address has been given for a seek operation.	Check disk allocation parameters in phase 1 for allocation of more tracks than exist on this disk. Repeat Phase 1 and/or Phase 2.
MASTER DICT. O'FLOW	Version of RBM on disk has a larger Master Dictionary than new version.	Last areas of old dictionary were lost. A complete new SYSGEN may be necessary.
UPDATE UNSUCCESSFUL	The previous Master Dictionary could not be located, or the location/size of one or more areas has changed.	The new SP area must be at the same disk address as the previous SP area, otherwise, the ALL option must be used.

5. LOADING RBM SYSTEM PROCESSORS

SYSTEM STARTUP AND PROCESSOR LOADING

Upon completion of the SYSGEN process, as indicated by the messages

!!AFTER WAIT, SET PROTECT

!!SET FAULT (!!SET PARITY for Sigma 2/3)

!!KEYIN AN 'S' TO BEGIN

it will be necessary to place the system processors in the SP area. This process is initiated by the operator activating the control panel 'INTERRUPT' switch. In response to this, the message !!KEY-IN is issued at the operator's console (OC device). The operator responds by typing KP.

The following message is issued at this point:

!!KEYIN: DT M, D, Y, HRMN

The operator interrupts and keys in the current data and time. Following the DT key-in (e.g., DT 11,4,73,2004), RBM will output

!!JCP

and turn on the Keyboard/printer input light (or prompt with "/" in the case of KP Models 419x). The operator then types three control commands:

!JOB   (Note: This job-stream operation verifies a working system.)

!ASSIGN CC=device file number or oplabel of input device.

!CC

Loading begins from the CC device, which must be positioned to the portion of the transmittal (system-release) tape containing the control commands and object modules for loading the standard RBM processors. This portion of the release materials is shown in the printed description (-11). This position is automatically attained at the conclusion of the SYSGEN process, or can be achieved by skipping three files on the system release tape.

The loading of all processors and symbionts is described in the printed description (-11) for the current release version of RBM.

The system release tape contains (besides the SYSGEN, RBM and RBM overlays binary files) the JCL and binary for:

Overlay Loader
RAD Editor

Utility
XSYMBOL
Standard Procedures
Basic FORTRAN IV Compiler and Library
BLOAD
BSS (Basic Spooling System)
ANALYZE
EXPAND
COMPRESS
REPLACE
ELLA
EXERCISE
INDUMP
PLOT (Plotter Symbiont System)
R:COC SI

Other processors are available by catalog number:

ANS FORTRAN IV
RPG
SORT
COBOL
XSP

SAVING THE NEW SYSTEM

It is desirable to save the newly completed RBM system at this point. If a magnetic tape unit is available, enter the following commands:

!JOB

!ASSIGN BO=oplabel or device file number of magnetic tape unit

!RADEDIT

!#SAVE

!#END

!FIN

ADDITIONAL RBM PROCESSORS

RBM MAINTENANCE/UTILITY PROCESSORS

The following additional processors are available on the transmittal tape and are described in Appendix A of the RBM/RT, BP Reference Manual, 90 10 37, (excepting ANALYZE, described in the RBM/Availability Features Reference Manual, 90 30 54 and REPLACE, described in Chapter 6 of this manual).

Name	Purpose
ANALYZE	If ANALYSIS is included as a SYSGEN optional feature, a snapshot of core is written on either the CP area or on magnetic tape in the event of a system failure. ANALYZE produces formatted displays of all major RBM tables and a display of all available hardware status at the time of the failure.
EXPAND	A processor for expanding the blocked, compressed file created by COMPRESS to files composed of either 80-byte source records or 110-byte line printer listing records.
COMPRESS	A processor for creating blocked compressed EBCDIC files on tape, used in preparing the source and listing files on the transmittal tape.
REPLACE	A processor for replacing monitor overlays, useful in system maintenance.
BSS	Basic symbiont system.
INDUMP	A stand-alone DUMP program to be used in conjunction with RBM.
PLOT	A symbiont subsystem for the 7530 or 7531 graph plotter.
ELLA	Error log listing program.
χ RCOC	Character Oriented Communications Handler.
EXERCISE	Peripheral exerciser.

OTHER RBM PROCESSORS

The following additional processors (foreground program in the case of RCOC) are available by separate catalog number:

Name	Purpose	Catalog No.
ANS FORTRAN IV	Compiler and Library	706277
RPG	Report Generator	706401
SORT	Record Sorting	706257
XSP	Xerox Satellite Processor	706491
COBOL	Compiler and Library	706500

The instructions for loading these programs are described in the printed description (-11 element) corresponding to the applicable catalog number.

LOADING RBM MAINTENANCE/UTILITY PROCESSORS

The actions required to initiate loading of the RBM maintenance/utility processors EXPAND, COMPRESS, REPLACE, and INDUMP are

1. Position the transmittal tape to the desired processor (e.g., !FSKIP CC, 15 to position at EXPAND, where CC is assigned to transmittal tape).

2. Assign the background CC operational label to the operational label or DFN of the magnetic tape.

Loading proceeds from CC, which must contain the control commands and object modules shown in the printed description (-11) for the current release version of RBM.

6. SYSTEM MAINTENANCE

INTRODUCTION

This chapter describes the system hardware/software requirements and the procedures for making source-level corrections or changes to RBM and the RBM subsystems (Overlay Loader, RAD Editor, and Utility). Hardware requirements and maintenance procedures for other system processors are given in the program description (-11 element of the catalog number) for the individual processor.

HARDWARE/SOFTWARE REQUIREMENTS

HARDWARE REQUIREMENTS

The minimum hardware resources required to maintain RBM are

1. 18K of background memory.

2. 1.5 megabytes of disk storage.

3. One magnetic tape unit.

4. One card reader.

SOFTWARE REQUIREMENTS

The following RBM software is required:

1. The RBM subsystems (Overlay Loader, RAD Editor, and Utility).
2. Extended SYMBOL processor.
3. EXPAND processor.
4. REPLACE processor.

SYSGEN CONSIDERATIONS

The following guidelines are directed toward construction of an RBM system using the minimum hardware resources described above. The primary objectives are

1. To provide as much background memory space as possible.

2. To provide as much background temporary file space as possible.

The SYSGEN parameters that follow may be used as a model for constructing a Xerox Model 530 RBM system to meet the above objectives.

Output Message	Parameter Value
VERSION	xx
MEMORY SIZE	+6000
MAX. INT. LOC.	+10C
CONTROL TASK INT. LOC.	+10C
NO. LINES/PAGE	37
NO. DEFS IN PUB. LIB.	0
NO. ENTRIES IN NONRES. FGD. QUEUE	0
NO. EXTRA DICT. ENTRIES	0
DISK ALLOCATION	7203/F0,I,S
	SL = 0
	CP = 0
	END
BLOCKING BUFFER SIZE	180
OPTIONAL FEATURES:	END
DEVICE FILE INFO.	4191/01,F
	3451/02,B
	7120/03,B
	7316/80,B,I
	4191/01,B
	END
BCKG. OP. LBL.	CC = 3
	DO = 2
	LL = 2
	LO = 2
	MT = 4
	OC = 5
	SI = 3
	END
FGD. OP. LBL.	END
RES. FGD. FWA	0
NONRES. FGD. FWA	0
BCKG. FWA	+1400

MAINTENANCE PROCEDURES

RBM MODULE UPDATE PROCEDURE

The following procedure is used to modify an RBM module or subsystem:

1. Load the subsystems, Extended SYMBOL, REPLACE, and the EXPAND processor as described in Chapter 5 (as necessary.

2. Create a procedure file in the system processor (SP) area to contain the procedures used to assemble RBM modules/subsystems. This can be accomplished with the following JCL:

```
!JOB
!PAUSE KEYIN SY,S
!RADEDIT
!#ADD SP,S24RBM,ALL,108,B,SY
!END
!ASSIGN CI=MT    (Transmittal tape)
!DEFINE EO,.100,80,C
!TEMP S
!EXPAND S,RSP
!TEMP T
!REWIND EO
!UNLOAD CI
!ASSIGN SI=EO
!ASSIGN X1=EO
!ASSIGN S2=S24RBM,SP
!XSYMBOL PP
!TEMP  R
!RADEDIT
!#TRUNC SP,S24RBM
!#END
```

3. Expand the source file of the system module of interest to a temporary file. For example, the following JCL will expand the source of RBM overlay A1:

```
!JOB
!ASSIGN  CI=MT   (Transmittal tape)
!DEFINE EO,1000,80,C
!TEMP    S
!EXPAND S,A1
!REWIND  EO
!UNLOAD  CI
```

4. Perform an XSYMBOL update using plus (+) cards with XSYMBOL as follows:

```
!ASSIGN SI = EO
!ASSIGN S2 = S24 RBM,SP
!XSYMBOL CR,LO,GO,UI,LU
```

The assembled binary output is now on the RBMGO file.

5. For a nonresident module, the REPLACE processor may be used to replace the module with the binary output. For example, continuing the previous example:

```
!OLOAD   0,F
!$ROOT      0, + overlay bias, GO, 1
!$END
!REPLACE IDA1
!FIN
```

For a resident module replacement, refer to the section on generation of SYSGEN input tape, below.

RBM OVERLAY REPLACEMENT

REPLACE, loaded as a processor file in either the SP or UP areas, will replace a monitor overlay on the system disk as if it had been done by SYSLOAD.

REPLACE may be called as follows:

  !REPLACE IDxx

where xx is any RBM overlay identifier (e.g., 41 is the Hex Patching overlay).

REPLACE replaces the xx overlay using the load module in the OV file. REPLACE also extends the size of the overlay to the next sector boundary in order to allow for addition of patch code at the end of the overlay. The length value thus calculated is inserted into the OVLOAD table both in memory and in the RBM image on the disk.

REPLACE OPERATIONS

Once REPLACE has been established in either the SP or UP area, the following JCL sequence may be used to update and replace an overlay:


```
!FIN
!REPLACE IDxx
!$END
!$ROOT 0,+overlay bias,GO,1
!OLOAD 0,F
!XSYMBOL CR,LO,GO
!ASSIGN SI = overlay source
!ASSIGN S2 = S24RBM,SP
!JOB
```
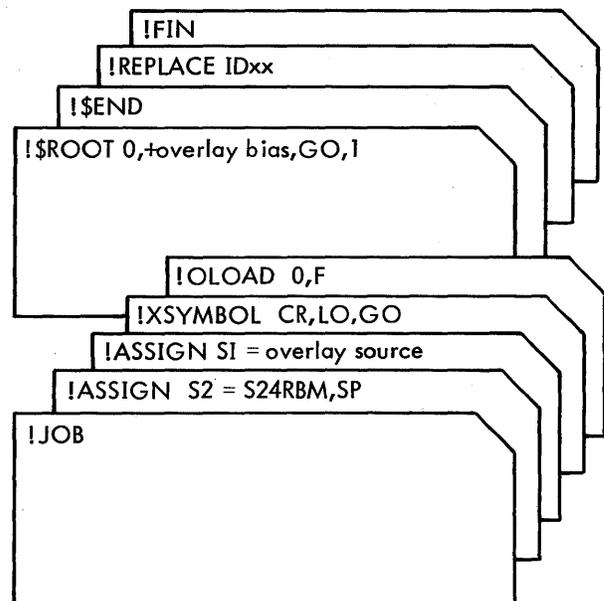
Overlay xx would now exist on the system disk as if SYSGEN had placed it there.

During the REPLACE run, the operator will be requested to set the PROTECT switch to OFF and then to ON to allow REPLACE to alter protected memory.

REPLACE DIAGNOSTICS

The diagnostic messages output by REPLACE and their meanings are itemized in Table 16.

REPLACE OPERATOR MESSAGES

The REPLACE processor may output the messages in Table 17 during execution.

GENERATION OF SYSGEN INPUT TAPE

The procedures described here are directed to analysts and/or customers who wish to generate a SYSGEN-input magnetic tape containing updated resident and/or nonresident RBM modules replacing modules on the system release tape.

Step 1 — Expand all source modules that require updating.

Step 2 — Assemble each module in order.

Table 16. REPLACE Diagnostics

Message	Meaning[†]
OVERLAY NOT PRESENT IN OVLOAD	xx was not found as an overlay identifier.
NEW OVERLAY TOO LARGE	After extending xx to its maximum size, the new overlay exceeds the available space or is larger than the overlay area (512 words).
OVERLAYS BIAS SHOULD BE +xxxx	The bias used when the load module read from OV was found is not the bias used by the system (this check is not made for JCP). xxxx will give the proper bias.
NO ID FOUND ON REPLACE CALL	The !REPLACE IDxx call is not in correct format; thus, the ID field cannot be located.
ERROR CODE xx ON HEADER READ	Error code xx has been received while attempting to read record 0 from OV.
ERROR CODE xx ON OVERLAY READ	Error code xx has been received while attempting to read the rest of the load module, beginning at record 1 from OV.
ERROR CODE xx ON OVERLAY WRITE	Error code xx has been received while attempting to write the overlay to the SP area.
ERROR CODE xx ON RBM WRITE	Error code xx has been received while attempting to write RBM.
ERROR CODE xx ON RBM READ	Error code xx has been received while attempting to read RBM.
[†]See Tables 9 and 10 of the RBM RT and BP Reference Manual for an explanation of error codes xx.	

Table 17. REPLACE Operator Messages

Message	Action
!!AFTER WAIT SET PROTECT SWITCH TO 'OFF', INT. AND KEY-IN 'S' !!BEGIN WAIT	Operator must follow the instructions or the message will reappear.
!!AFTER WAIT SET PROTECT SWITCH TO 'ON', INT. AND KEY-IN 'S' !!BEGIN WAIT	Operator must follow the instructions or the message will reappear.
Note: If the PROTECT switch on the console is set to the OFF position prior to running the job, neither of the above messages will be output.	

Step 3 — Assign BI to the output GO file.

Assign UI to the original Release Tape and rewind UI.

Assign UO to a new SYSGEN tape. Call UTILITY OMEDIT as follows:

!UTILITY OMEDIT
!*MO SY,n (writes a Double EOF after last file on UO)

where n = the number of files from the Release Tape to be written to the output tape; n is defaulted to the correct number to cover a complete SYSGEN including the RBM processors.

!REWIND UI
!REWIND UO

The updated files on the GO file will replace identically named modules from the original Release tape.

HEXADECIMAL PATCHING PROCEDURE FOR RBM MODULES

Both the resident and overlay portions of RBM can be patched either temporarily or permanently through use of RBM hex patching (if the HEXDUMP feature is included at SYSGEN). Whether the patch is temporary or permanent is determined by the manner in which the hex patching function is activated.

A temporary patch means that the copy of RBM located on the disk is not altered. This is achieved by activating hex patching via a !HEX control command or an H operator key-in.

A permanent patch means that the disk copy of RBM is altered; and, therefore, the changes will remain in effect for all future boots of the system from the disk. Permanent changes are effected through activating hex patching by setting DATA switch 1 before RBM is booted from the disk. By using the two methods in conjunction, patches can be checked out on a temporary basis and when verified, can then be made permanent.

When the patching function is activated by either one of the two methods described above, it will read records from the background CC operational label and write records on the background DO operational label. The records read in are either bias or patch records.

Bias records have the form

$$+ \left\{ \begin{array}{l} bbbb \\ ID \left\{ \begin{array}{l} PA \\ xx \end{array} \right\} \end{array} \right\} \quad [*Comments]$$

where

bbbb   is a hexadecimal address.

PA   represents the bias of the RBM patch area (defined by SYSGEN)

xx   is an RBM overlay identifier (for example, 41 is the Hex Patching overlay.

Patch records have the form

$$aaaa \; cccc_1 [,cccc_2 \ldots ,cccc_n] \quad [*Comments1]$$

where

aaaa   is the hex location where the corrections will go. (If a bias record has been encountered, aaaa will be added to the value so established to determine the location of the patches.)

cccc_i   is the hex patch to be inserted at the location aaaa + bias + i.

The hex patch $cccc_i$ may also be of the form $Rcccc_i$ which means the value to be stored is $cccc_i$ + bias, or it may be of the form $Pcccc_i$ which means the value to be stored is $cccc_i$ + bias of the RBM patch area.

An !EOD terminates patch input.

Figure 7 shows sample patch input. Note that the first and last cells of the RBM patch area may not be used for corrections, since the first contains the length of the Patch Area and the last contains the number of temporary RBM overlay patches. Each temporary overlay patch takes three patch area words (taken from the top of the patch area down).
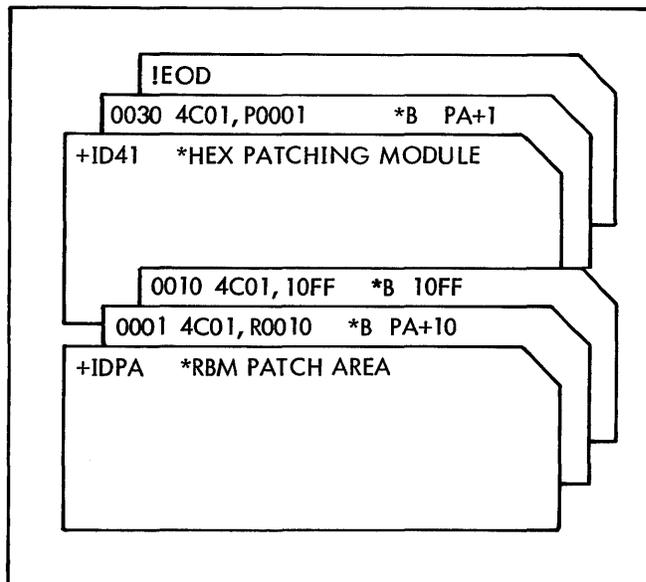

Figure 7. Hex Patching Input Example

HEXADECIMAL PATCHING PROCEDURE FOR PROCESSORS

The following describes a procedure for inserting hexadecimal patches into subsystems and processors by means of the Overlay Loader. Three methods are presented, the method to be used is determined by the SYSGEN input medium.

METHOD FOR MAGNETIC TAPE

1. Position the SYSGEN tape so that the next record to be read is the first binary record of the desired processor. For example, the following control commands will position the SYSGEN tape to the RAD Editor binary records:

        !JOB
        !PAUSE KEYIN SY, S
        !FSKIP AI, 4
        !RSKIP AI, 3

2. Load the processor from the AI device, patching the segment of interest after it is loaded. For example, to patch segment 3 of the RAD Editor, the following commands would be required:

        !REL
        !OLOAD   12
        !$MS
        !$ROOT   +60,, GO, 1
        !$SEG   1, 0, GO, 1
        !$SEG   2, 1, GO, 1
        !$SEG   3, 1, GO, 1
        !$MD   SEG3+13, +6203, +67FD
        !$MD   SEG3+3AD, +4801
        !$SEG   4, 1, GO, 1
              .
              .
              .
        !$END

METHOD FOR PUNCHED CARDS

1. Locate the !JOBC LOAD ... and !$END control cards that delimit the desired binary deck.

2. Place the following cards in the reader preceding the !JOBC card:

        !JOB
        !PAUSE KEYIN SY, S

3. Insert the !$MD cards following the !$SEG card for the segment being patched.

4. Run the job through the !$END command.

METHOD FOR PAPER TAPE

1. Locate the tape reel containing the desired processor. Consult the printed description (705368-11) for the organization of the tape reels for the release in question.

2. Mount the tape reel and input the following:

        !JOB
        !PAUSE KEYIN SY, S
        !ASSIGN CC = xx

   where xx is the oplbl or DFN of the paper tape reader.

3. While the message

        !!MESSAGE LOADING ...

   is being output, interrupt and key in KP.

4. When the interrupted message is completed, control will be given to the OC device, from which the following control command should be entered:

        !ASSIGN CC = xx

   where xx is the oplbl or DFN to read the appropriate Overlay Loader control commands.

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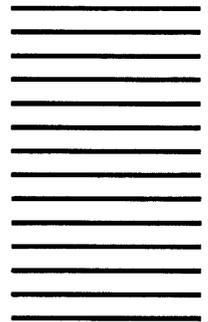
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