Type III   Class A Program

IBM

IBM System/360 DOS Power II
Application Description Manual

This is a general introduction to POWER II (Priority
Output Writers, Execution Processors, and Input
Readers), an automatic SPOOLing processor and
priority scheduler for normal batch processing under
DOS. POWER II operates under DOS, providing
significant improvement in system throughput, and
many additional functions.

CONTENTS

INTRODUCTION

The POWER II (Priority Output Writers, Execution Processors, and Input Readers) system is an automatic SYSIN/SYSPCH/SYSLST SPOOLing processor and priority scheduler for normal batch processing under the Disk Operating System. Using a variable number of IBM 2311 Disk Storage Drives or IBM 2314 Direct Access Storage Facility disk packs for intermediate storage, this assembler-written program can concurrently operate up to 26 local peripheral devices and maintain unique input/print/punch streams for one or two DOS partitions.

POWER does not require IBM or user program changes, and does not require changes to DOS Job Control Language. The POWER system operates in a foreground partition with a minimum 18K. The POWER system is generated from macros to create a system tailored to the user's needs.

MINIMUM MACHINE REQUIREMENTS

- IBM System/360 Model F30 (64K), and whatever unit record, tape, and direct access storage devices are required to support DOS.

- Disk space for the POWER II data files depends on the user's operational considerations. All POWER II files must be on like units, for example, all on IBM 2311s or all on IBM 2314s. Multiple disk extents and multiple disk volumes are supported to a maximum of five extents. Typically, one IBM 2311 or one IBM 2314 is required.

PROGRAMMING REQUIREMENTS

The POWER II system requires the DOS supervisor to have been generated with MPS=YES or BJF, TP=BTAM or QTAM, and CCHAIN=YES.

Because the POWER II system is generated by the DOS Assembler, the DOS Assembler is required.

SUMMARY OF POWER II CAPABILITIES

- The central installation operator controls POWER II system activity. He may display job status, release jobs from hold status, alter job priorities, delete jobs from queues, terminate jobs in process and start or stop given readers or writers.

- User requirements are defined by the POWER II system generation.

- "Warm" start support is provided.

- Tape intermediate storage may be used for output queues.

SIGNIFICANT DIFFERENCES FROM PREVIOUS VERSIONS OF POWER

- Printer output may conform to special printer carriage control tape.

- Up to five disk volumes are supported for POWER II intermediate storage.

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- TRACKGP specification may be from one track to a full cylinder.

- Improved buffer management separates program and data buffer use.

- UCS automatic loading is performed, using standard DOS job control language.

- Full priority scheduling support has been provided for up to ten classes.

- Device error recovery is provided.

- Asynchronous processing is supported.

RESTRICTIONS

- Column binary card reading is not supported.

- There is no punch stacker selection for 1442 and 2520 Card Read Punches.

- The IBM 2495 Tape Cartridge Reader is not supported.

- Tape Punch Writers are not supported.

- Multivolume tape intermediate storage is not supported.

POWER II CONCEPTS AND FACILITIES

INTRODUCTION TO SPOOLING

POWER II is a system that performs asynchronous SPOOLing of unit record equipment for the Background and Foreground 2 partitions of the Disk Operating System. To understand POWER II operation, an understanding of multiprogramming and SPOOLing is necessary.

STANDARD DOS OPERATIONS

Standard operating system functions are to perform automatic job-to-job transitions. Generally, this means reading the next job from the input device (normally a card reader). Symbolic names are given to input and output files. DOS provides the symbolic names SYSRDR and SYSIPT for input of control cards and data files, and the symbolic names SYSLST and SYSPCH for output of printed and punched card files. If the SYSRDR and SYSIPT files are assigned to the same device, the symbolic name for the combination is SYSIN. If SYSLST and SYSPCH are assigned to the same device, the symbolic name is SYSOUT. Normally, SYSRDR and SYSIPT (SYSIN) are assigned to a card reader, SYSLST to a printer, and SYSPCH to a card punch (see Figure 1).

A disadvantage of this approach is that the CPU is dependent upon the speed of the relatively slow unit record devices. Another disadvantage is that the unit record devices are used only when required and are idle much of the time.
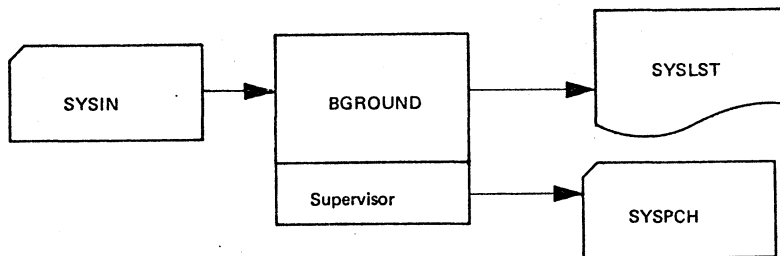

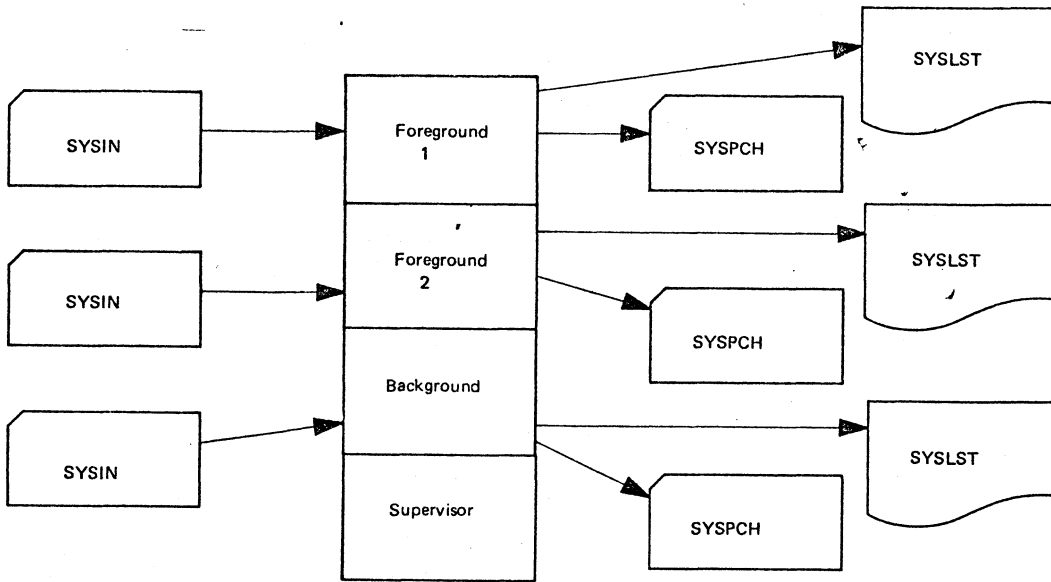Figure 1. Standard DOS background-only configuration

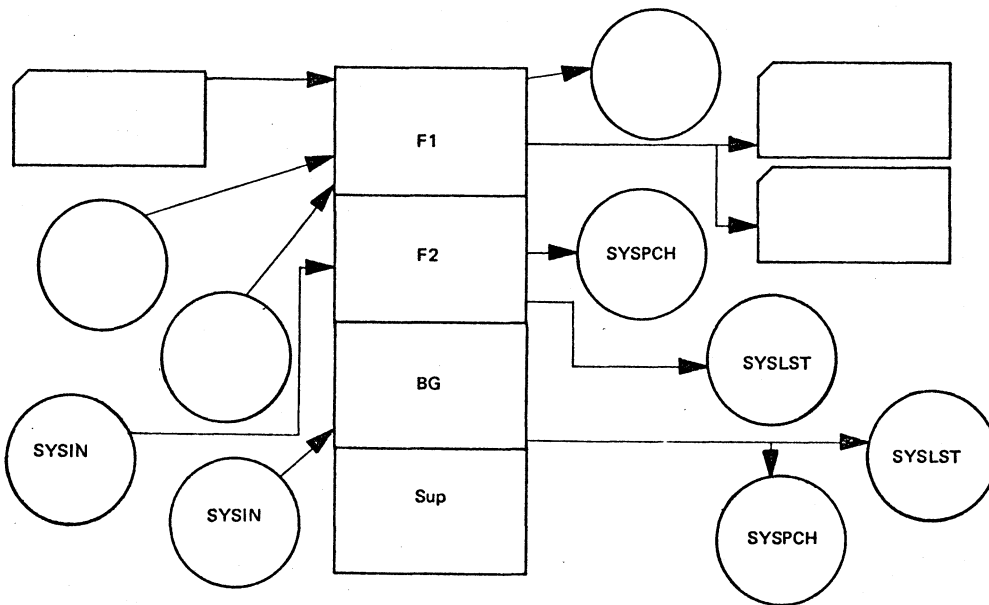Figure 2.   Standard DOS assignments with multiprogramming

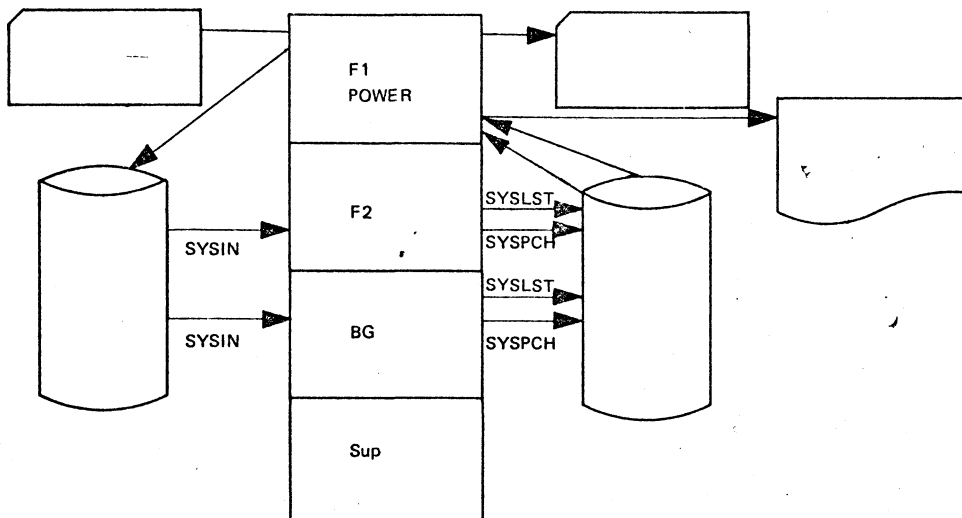Figure 3.   Tape SPOOLing F2 and BG, F1 does utility function

Figure 4. POWER II (Disk SPOOLing) for F2 and BG multiprogramming

   The advent of multiprogramming allowed for more effective CPU
utilization simply by executing concurrently two or three programs.
The main storage was divided into partitions, and a program was executed
in each partition. The CPU shared its time between the programs, that
is, when one partition was waiting for an I/O event to complete, the
CPU transferred control to a different partition. This operation
increased CPU utilization, but generally required more I/O devices
(see Figure 2). Also, the CPU was still bound to the speed of the
unit record devices for each partition.

SPOOLING (TAPE)

   SPOOLing (Simultaneous Peripheral Operations On Line) was devised
to reduce CPU dependence on unit record equipment by using magnetic
tape as intermediate storage. The SYSIN, SYSLST, and SYSPCH data files
were assigned to magnetic tape units for the background partition.
One foreground partition was dedicated to performing unit record
operations to and from magnetic tape.

   Figure 3 represents a tape SPOOLing system. The Background and
Foreground 2 partitions read card images from tape as the SYSIN job
stream. Their SYSLST and SYSPCH output are recorded on magnetic tape.
A program that is capable of performing concurrent multiple utility
functions resides in Foreground 1. The Foreground 1 utility creates
the SYSIN tapes for the Background and Foreground 2 by performing a
card-to-tape utility function. The utility also prints the SYSLST
tape on the printer, and punches the SYSPCH tape on a card punch.

   The primary advantage of this configuration is that in the Background
and Foreground 2 partitions, SYSLST, SYSPCH, and SYSIN operations are
performed at magnetic tape device speeds. The printing, punching, and
card reading utility functions are performed at their maximum speed,
without waiting for processing operations in Foreground 1. Tape
SPOOLing allows CPU utilization in these partitions to be increased,

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realizing a greater throughput for the computer system. The drawbacks of this operation are that the system could require additional tape drives and tape handling, and a job's output is delayed until the tape containing it is filled with data and is processed by the Foreground 1 utility program.

POWER (DISK SPOOLING)

POWER II is a SPOOLing system that uses disk space for intermediate storage. The SYSIN card images for the Background and (optionally) Foreground 2 are written in input queues on disk, and the SYSPCH and SYSLST images are written in output queues on disk for printing and punching when the job that created the images is completed (see Figure 4). Any programmer logical units assigned to the same unit record device as SYSIN, SYSPCH, and SYSLST assignments will be serviced in the same manner as the system logical units.

A schematic of the POWER II system elements for one partition is shown in Figure 5. An executing partition operates with three queues. The Reader Queue consists of the SYSRDR file and whatever SYSIPT files are assigned to the SYSRDR device, that is, the Reader Queue contains all the card images that are normally placed in the input job stream. Additional jobs are added to the Reader Queue by the Reader Task. The Reader Task reads cards from a card reader and places them in the Reader Queue. The operator initiates a Reader Task by means of a command that is entered at the console typewriter (SYSLOG).
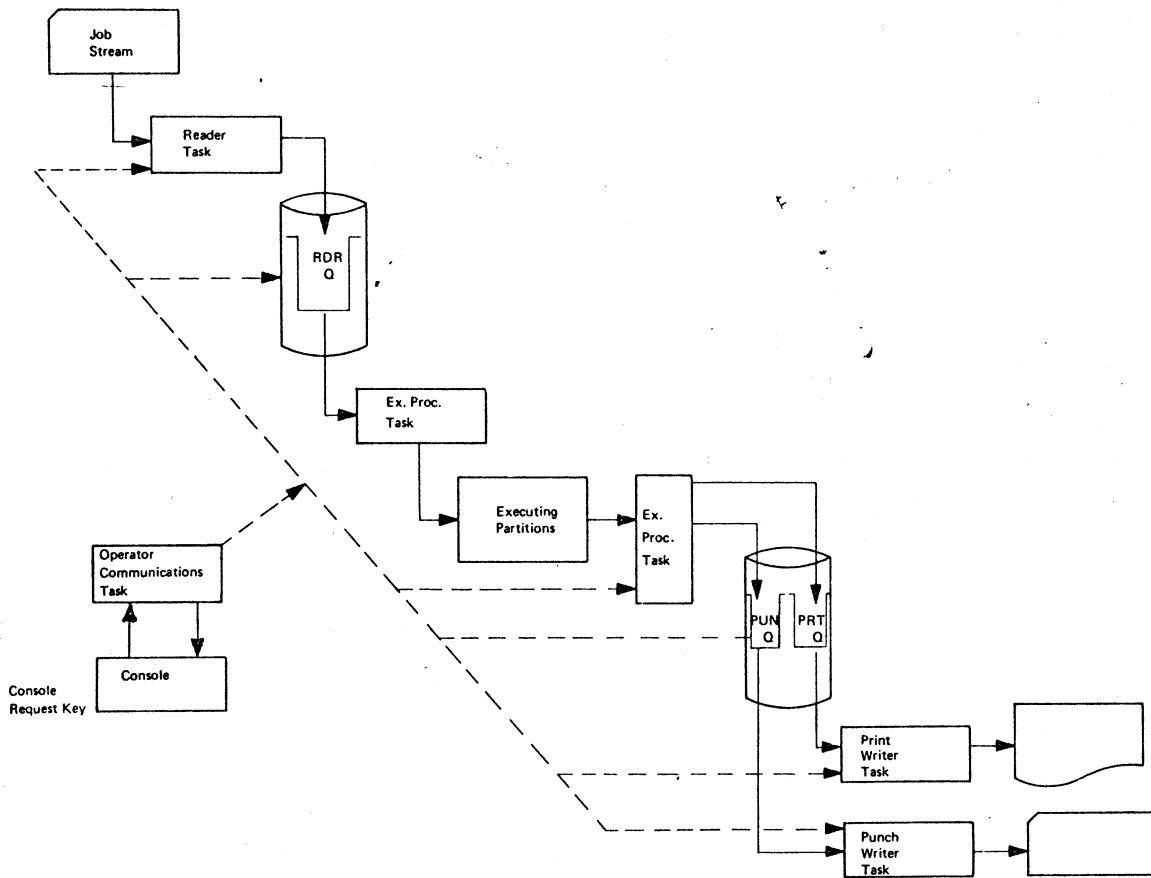
Figure 5. Schematic of POWER II system elements

The job stream contained in the Reader Queue is read into the executing partition by the Execution Processor Task. In addition to providing input card images for the executing partition, the Execution Processor also SPOOLs SYSLST and SYSPCH records to their respective queues. The Print and Punch Queues exist on disk storage, and contain information for printing and punching. Job output is placed in the Print and/or the Punch Queue only when its execution is completed. Output is printed or punched from the Print and Punch Queues by the Print Writer and Punch Writer Tasks. The operator initiates the Print Writer and Punch Writer by issuing commands to the POWER II system via the Operator Communication Task.

The POWER II program has a generation option that allows the user to generate a Writer-Only system. In this system, no input queue exists, and input occurs according to standard DOS operation. The use of the output queues in a Writer-Only system is identical to the use of the output queues in a Reader/Writer POWER II System. The only restriction on a Writer-Only POWER II system is that the Power Job Entry Control Language (see POWER II User's Guide) must be used for each job.

In summary, the POWER II system is a SPOOL system using disk space as intermediate storage, which operates with the following tasks:

- Reader Tasks that add card images to Reader Queues to be used as job streams.

- Execution Processors that feed card images to an executing partition from a Reader Queue, and intercept print output and punch output records to add to Print and Punch Queues.

- Print Writers and Punch Writers that print and punch records from the Print and Punch Queues, respectively.

- An Operator Communication Task that performs all operator communications.

The advantages of the POWER II system are:

- The execution time of any one job is decreased, because unit record operations are performed at disk device I/O speeds.

- The blocking of card and punch records into disk records further increases system throughput, because the number of disk I/O operations is less than the equivalent number of unit record operations.

- The reading, printing, and punching operations are optimized by the use of command chaining to reduce I/O interruptions.

- The asynchronous operation of unit record functions maximizes the amount of channel overlap.

- Since Reader and Writer Tasks are operator-initiated and are not necessary for partition operation, a fail-soft situation exists. For example, if the printer becomes unavailable, job stream execution can continue with the SYSLST data collected in the Print Queue. When the printer becomes available, the operator can start a Print Writer, and printing will commence for all jobs in the Print Queue with no loss of output or CPU time.

- Since Print Writer and Punch Writer Tasks are essentially disk-to-print and disk-to-punch utilities, the determining factor in print and punch outputs is the speed of the I/O devices. Device

utilization is increased since the devices do not wait on process-bound operations that occur during job execution.
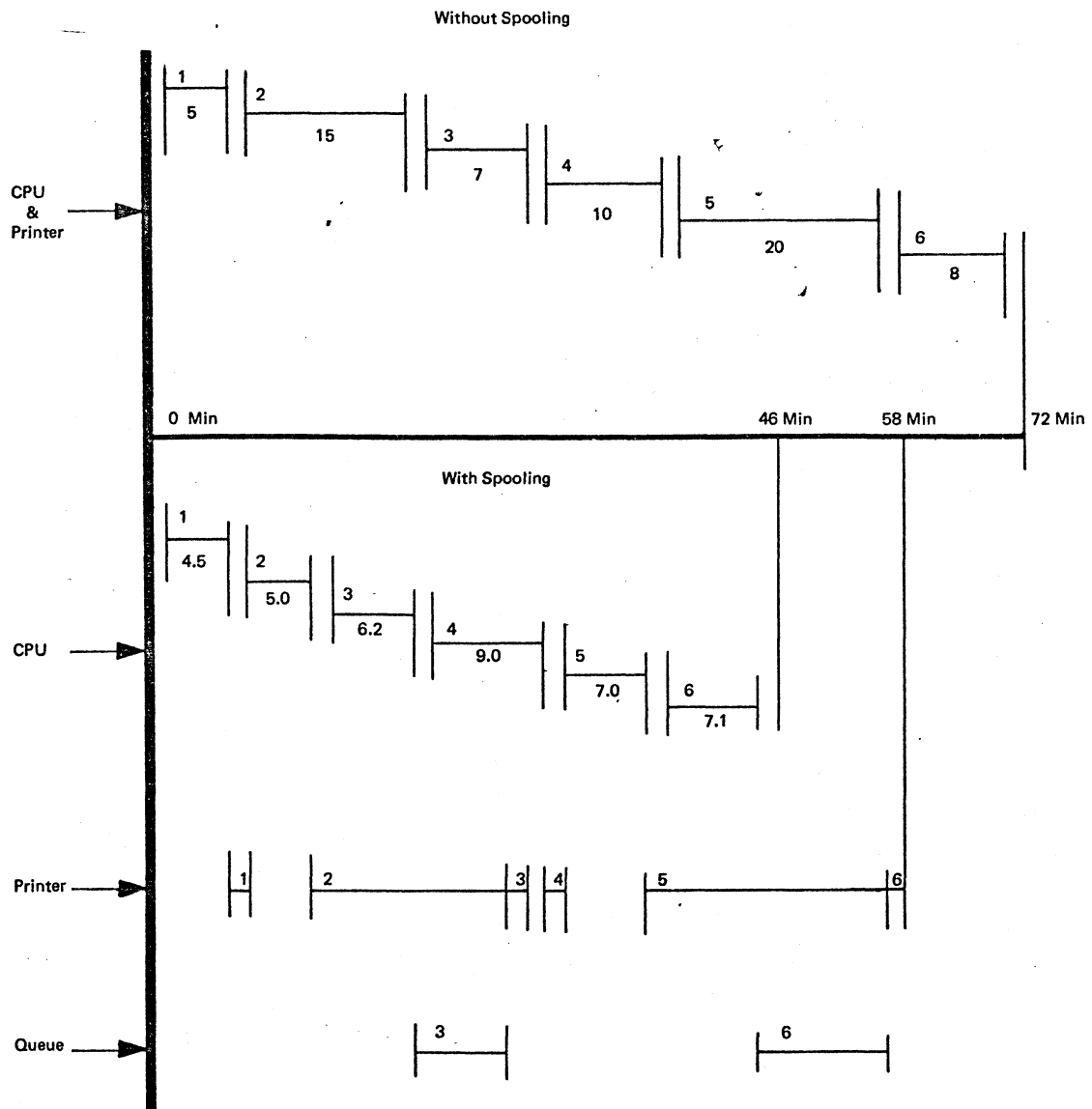
Figure 6. Job stream comparison I

Without Spooling

CPU & Printer

With Spooling

CPU

Printer

Printer Queue
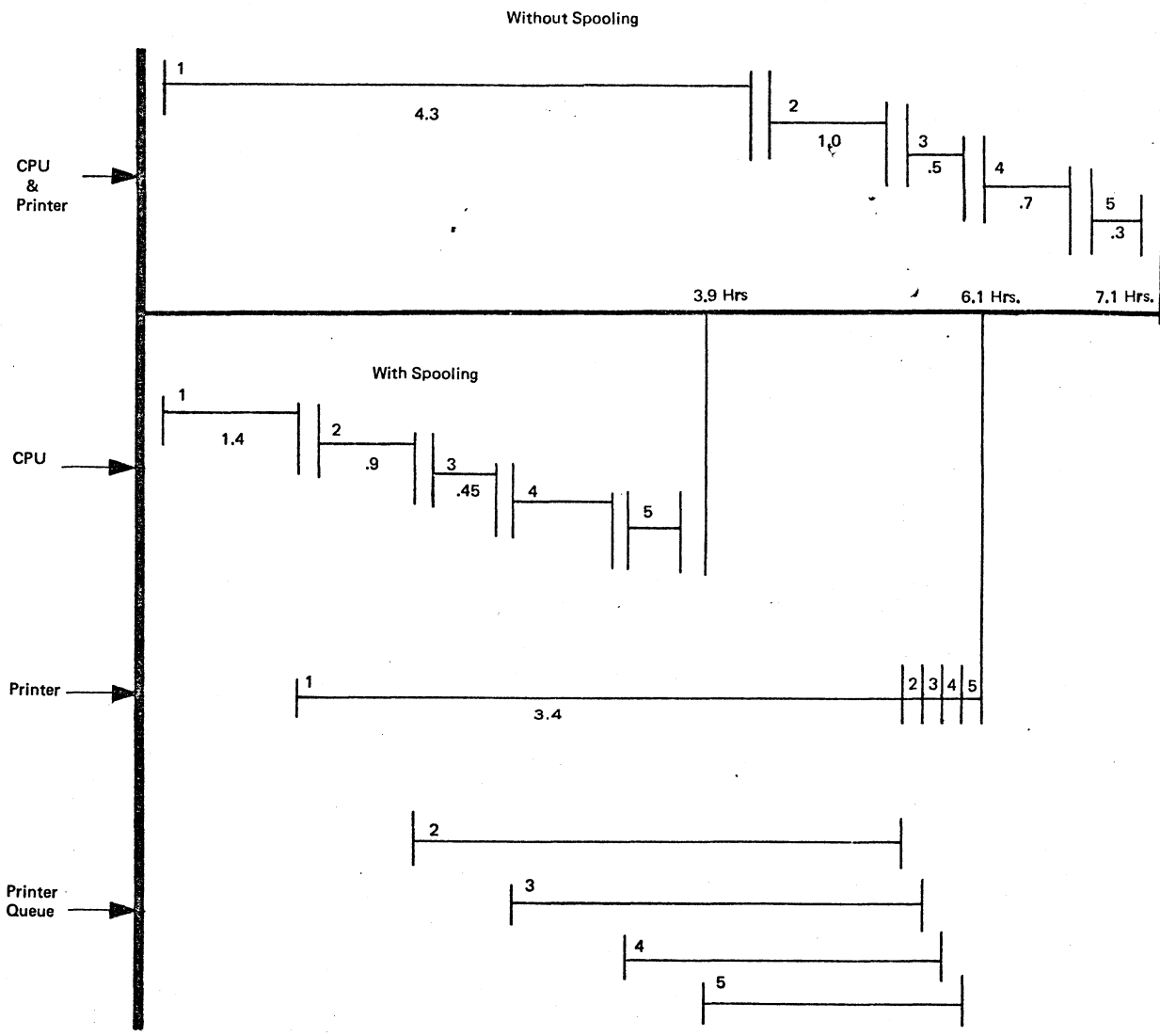
Figure 7. Job stream comparison II

The POWER II system requires less I/O equipment than tape SPOOLing or basic multiprogramming. For example, one card reader, punch, printer, and disk drive can perform all the I/O operations required for two partitions running under POWER II. Basic multiprogramming requires one card reader, one punch, and one printer per partition. A two-partition tape SPOOL system requires tape drives in addition to a card reader, punch, and printer. Two examples of these advantages are shown in Figures 6 and 7. Figure 6 represents a job stream of six jobs that required 72 minutes to run under DOS alone. The same job stream, run under the POWER II system, had the following characteristics:

- The total job stream took only 58 minutes (20% reduction in total time).

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- The CPU was free after 46 minutes, and could have been processing other jobs if they had existed in the Reader Queue (35% greater CPU availability).

Figure 7 represents a different job stream which required 7.1 hours to run under DOS. Under POWER II, this job stream had the following characteristics:

- The total time was reduced to 6.1 hours (15 % reduction in total time).

- The CPU was free after 3.9 hours and could have been processing other jobs if they were in the Reader Queue (45% greater CPU availability).

Figure 7 also illustrates the advantages of I/O overlap. Job 1 under DOS alone required 4.3 hours to execute. Under POWER II, it required 1.4 hours to execute and 3.9 hours to print. The printing began after the job finished executing. The advantage of POWER II is that while the printing was going on, the CPU was executing Jobs 2, 3, 4, and 5. In fact, all the jobs had completed their execution before the printing of Job 1 was completed. The output from Jobs 2, 3, 4, and 5 was saved in the Print Queue until the Print Writer Task printed the jobs.

In general, indications have been that throughput increases of up to 30% can be expected from the use of POWER II.

ELEMENTS OF THE POWER II SYSTEM

This section discusses each of the POWER II system elements. An overview of the POWER II system is shown in Figure 8, and the reader should refer to it as each of the POWER II elements is discussed, to see how each element fits into the overall picture. Figure 9 is an illustration of the interrelationship of the POWER II queue structure, Reader/Writer Tasks, and Execution Processor Tasks. The reader should refer to Figure 9 when reading about the first six of the following elements.

Figure 8. POWER system overview

- Reader Task
- Execution Processor Task
- Writer Task
- Operator Communications Task
- Command Processor
- Input Queue
- Output Queue
- Task Handler
- SVC Interrupt Handler
- Channel End Appendage
- DOS Supervisor
- Problem Program
- Transfer of Control
- Communication (Data)
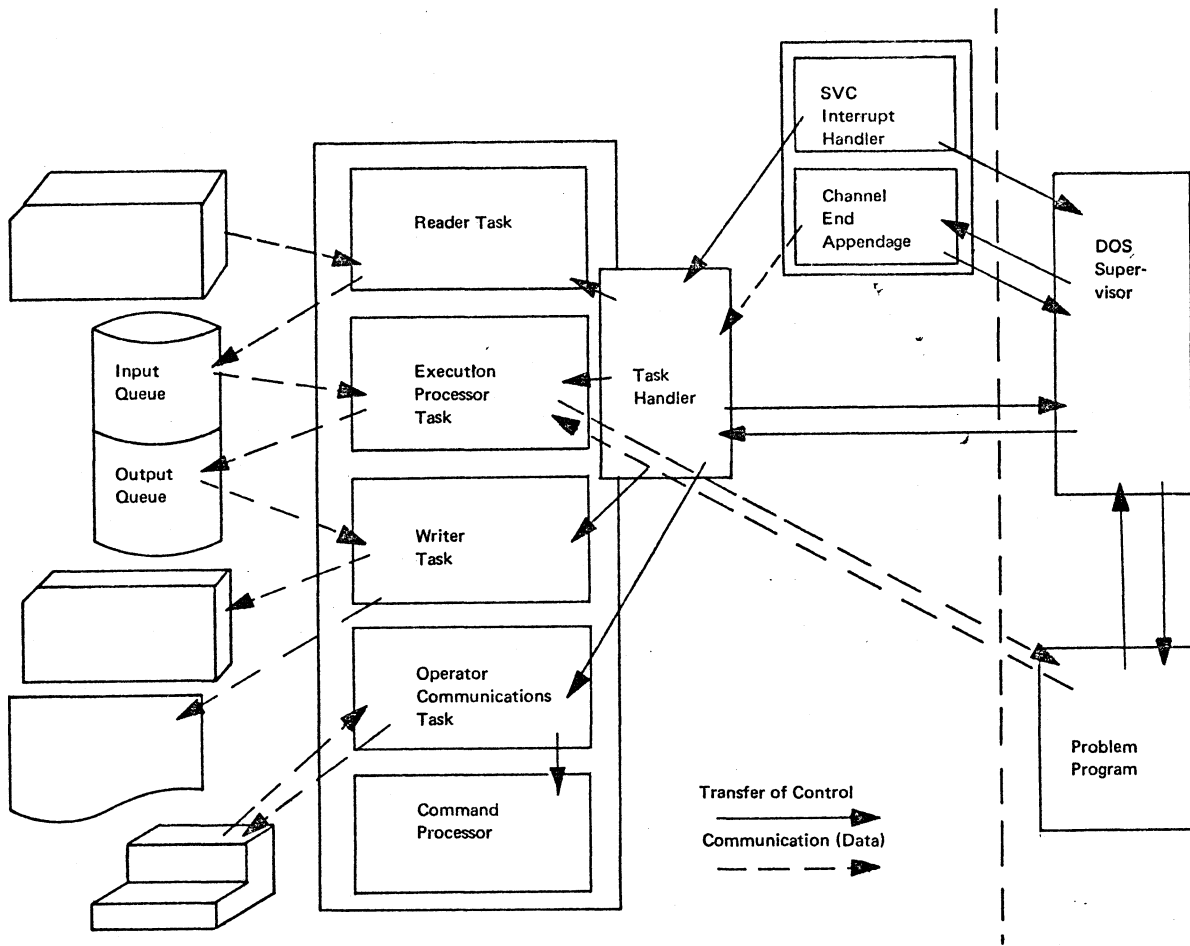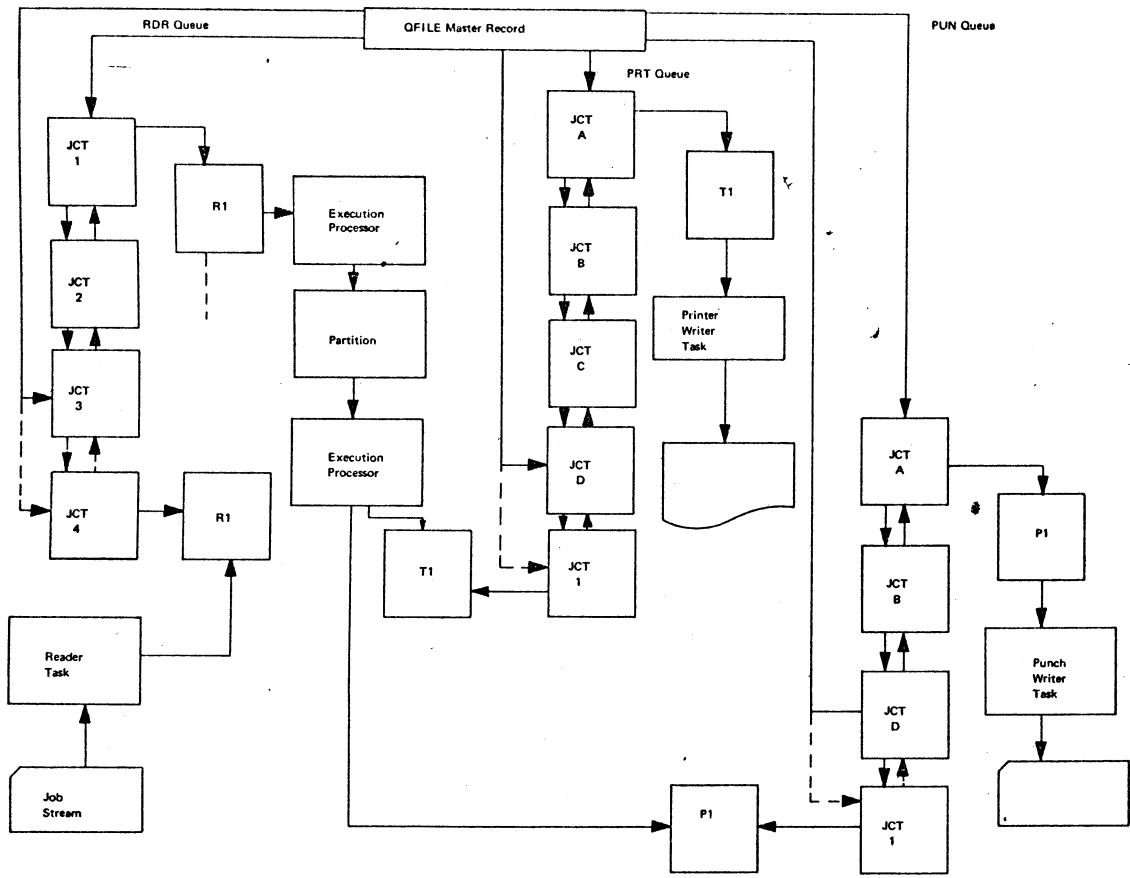
Figure 9. Interrelationship of POWER tasks and queues

JOB ENTRY

A <u>job entry</u> for the POWER II system is defined as the collection of input from the reader that is logged by the system under a single job name. There are two methods of creating a job entry: (1) DOS Job Control Language and (2) POWER II Job Entry Control Language (JECL). When DOS Job Control Language is used, the // JOB jobname and /& statements delimit a job entry. When JECL is used, the * $$ JOB jobname and * $$ EOJ statements delimit a job entry. The job name in the * $$ JOB jobname statement is used to log a job entry.

A job number is assigned to a job entry by the POWER II system when the job entry is logged, and the POWER II system places output from the job entry in the appropriate output queues under the job name and job number of the job entry.

The operator must state the job name (and, optionally, the job number) when using operator commands to control the job entry.

QUEUES

POWER II uses a two-queue structure (QFILE and DATAFIL) to handle the large amount of data involved in normal operation. The basic structure is shown in Figure 10. As each job is read into the system, a <u>Job Control Table</u> (JCT) is created for it.
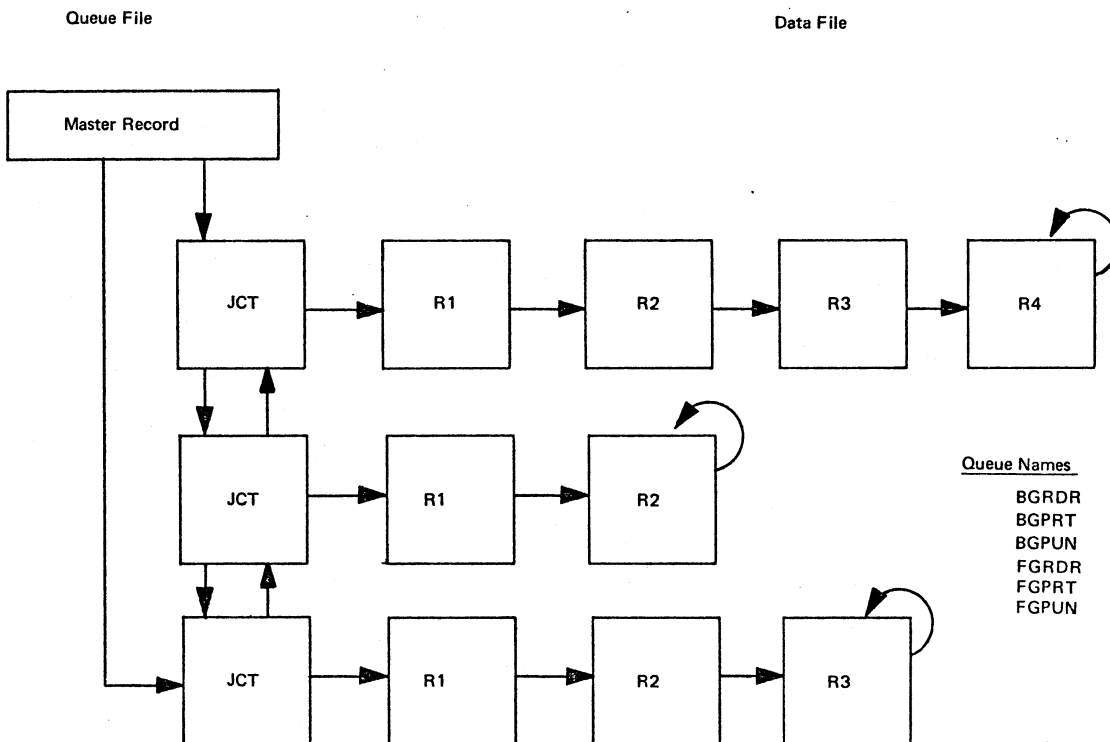
Figure 10. Basic queue structure

The <u>JCT</u> contains a summary of the control cards and status of the job, as well as pointers to other components of the queue structure. Each JCT is chained forward to the JCT representing the next job in the queue, and backward to the JCT representing the prior job. This structure or chain of JCT's is called a <u>segment</u> of the QFILE. The Reader Queue, Punch Queue, and Print Queue are all segments of the QFILE.

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Each JCT also contains a pointer to the data records for the job. The data records are chained only in the forward direction. The chain of data records is a segment of the DATAFIL. Each job contains such a chain.

READERS

A <u>Reader Task</u> is a POWER II task that creates or adds jobs to a designated Reader Queue. The task is initiated by the console operator via a Start command. The Reader Task functions are:

- read the job stream from the designated device.

- create a JCT record for each job entry designated by the job stream.

- place the created JCT into the designated Reader Queue. The Reader Queue is designated by the operator in the Start command.

PRINT WRITERS

A <u>Print Writer Task</u> is a POWER II task that prints the material contained in a designated Printer Queue. The task is initialized by the console operator via a Start command. The designated Print Queue is also specified in the command. The functions of the Print Writer Task are:

- read the JCT's representing the output of a job stream.

- print the print data chain associated with each JCT on the printer specified in the Start command.

- dequeue the processed JCT from the Print Queue.

- if the punching for that job is also completed, purge the JCT from the QFILE.

PUNCH WRITERS

A <u>Punch Writer Task</u> is a POWER II task that punches the material contained in the designated Punch Queue. The task is initialized by the console operator via a Start command. The functions of a Punch Writer are:

- read the JCT's representing data to be punched from a job stream.

- punch the punch data specified by the JCT on the punch specified in the Start command.

- dequeue the processed JCT from the Print Queue.

- if the punching for that job is also completed, purge the JCT from the QFILE.

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EXECUTION PROCESSORS

The Execution Processors Tasks are always active during the execution of the POWER II system. The Execution Processor performs the following functions:

- intercept all partition unit record I/O requests for SYSRDR and other files assigned to the same device.

- satisfy executing partition requests by reading data records from the DATAFIL, deblocking the records, and passing card images to the partition.

- intercept all unit record I/O requests for SYSLST, SYSPCH and other files defined by programmer logical units assigned to the same devices.

- block and condense these output images into records, which are written onto the DATAFIL.

- when job execution ends, remove the JCT from the Reader Queue, and place it in the Print and Punch Queues.

OPERATOR COMMUNICATIONS TASK AND COMMAND PROCESSOR

The Operator Communications Task reads all the operator commands into the POWER II system. Based on the command, the Operator Communications Task calls the proper Command Processor module. The Command Processor module analyzes the command and executes it if the format is correct. The Operator Communications Task is enabled by pressing the request key on the console typewriter (SYSLOG).

CHANNEL END APPENDAGE

All POWER II I/O uses a channel end appendage routine. The purpose of the appendage is to notify POWER II that an I/O request has been completed, and to enable the POWER II task that initiated the I/O request.

TASK HANDLER

The POWER II program provides its own multitasking of the various Reader, Writer and Execution Processor Tasks.

The multitasking operation is internal to POWER II and independent of DOS releases. When no tasks are ready to run (all waiting) the program issues a Wait against a dummy CCB that has no I/O started for it. When one of the task I/O operations completes, the Channel End Appendage posts the dummy CCB complete and returns control to DOS. DOS task selection will then return control to the POWER II partition.

SVC HANDLER

The POWER II system simulates unit record operations of an executing program by intercepting I/O requests when an SVC instruction is executed. If the SVC was a system unit record I/O request from a partition being served by POWER II, the POWER II system transfers the data and simulates the operation of the device. The SVC instruction is intercepted by POWER II because the SVC new PSW is overlaid by a POWER II PSW during POWER II partition initiation. SVC requests not used by POWER are returned to the DOS supervisor for processing.

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A Batch Partition under the control of the POWER II system will have the following files SPOOLed to disk:

- SYSRDR, SYSIN, SYSLST, and SYSPCH.

- any other data file assigned to the same unit record device as any of the above files.

INSTALLATION CONSIDERATIONS

In order to optimize the performance of the POWER II system, an installation should consider the following:

- Job stream mix: optimal performance is achieved when process-bound and I/O-bound jobs are intermixed in the job stream.

- Operator training: since POWER II's operating characteristics differ greatly from standard DOS operation, an extensive operator training program is recommended. The operator is responsible for additional commands and timing considerations.

- Foreground 1 or Foreground 2 partitions: POWER II can operate in either Foreground 1 (F1) or Foreground 2 (F2). In F1, POWER II may service F2 and the Background (BG) partitions, or just the BG partition, depending on a generation option. These limitations should be considered before installation.

- Device allocation: POWER II will generally require a card reader, a punch, a printer, and some disk space. The amount of disk space required is proportional to the maximum number of jobs to be held in the Reader Queue, the amount of input for each job, the amount of output from each job, the number of printers and punches available, the blocking factor used for the DATAFIL, and several other considerations.

FACILITIES OF THE POWER II SYSTEM

The facilities of the POWER II system can be divided into the following categories:

- POWER II System Generation Options

- Task Management

- Queue Management

- Job Entry Control Language

- Job Accounting

- Warm Start and Fail Soft Capability

The capabilities provided in each of these categories are discussed below.

POWER II SYSTEM GENERATION OPTIONS

The user generates his own version of the POWER II system by specifying various options at assembly time. The POWER II program is distributed as a set of macros that the user catalogs into his Source Statement Library. He then assembles a version of POWER II by

specifying various keyword parameter options, which tailor the POWER
II system to his own needs. The following are some of the options
available:

- Have POWER II intercept unit record I/O from the F2 partition and
  the BG partition, or the BG partition alone.

- Specify the maximum number of Reader Tasks and Writer Tasks that
  can exist at any one time.

- Specify an automatic startup procedure, for example, starting
  automatically a reader, punch writer and/or print writer when POWER
  II is initialized.

- Specify the maximum number of devices that can be under the control
  of POWER II at any one time.

- Specify the actions that a Reader Task should take at end of file.

- Specify intermediate disk storage as either IBM 2311 or IBM 2314.

- Specify the name of a user's accounting routine or the POWER II
  accounting routine to handle the accounting statistics that POWER
  II provides.

- Specify the format of a printer carriage control tape to perform
  print page formatting.

- Specify print record count and punch record count maximums that
  require operator intervention for a job to continue, if the job
  output exceeds the maximum number of print and/or punch card
  records.

- Generate a Writer-Only POWER II system.

In addition to the above options, the user designs his own data
handling system by specifying the following options:

- Data Buffer Block Size - determines the blocking of input and
  output records on disk space.

- Maximum Number of Data Buffers - determines maximum number of
  buffers POWER II will create from available main storage at
  initialization time.

- Queue Record Block Size - determines the maximum number of job
  entries that the POWER II system can manage concurrently.

- Track Group Size - specifies the number of disk tracks allocated
  to a task when it requests disk space.

- Number of Track Groups - specifies the maximum number of track
  groups that the POWER II system can manage. The product of Track
  Group size and the number of Track Groups is the maximum amount
  of disk space that the POWER II system can manage.

- Number of Data File Disks - specifies the number of disk volumes
  that can be used to hold the total amount of disk space determined
  above.

As in any system design, there are certain tradeoffs associated
with design decisions. "Design Considerations" explains the tradeoffs
that are involved in designing the POWER II system.

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TASK MANAGEMENT

POWER II allows the central installation operator to control the initialization, termination, and operation of Reader and Writer Tasks. The operator also has limited control over the operation of the Execution Processor Tasks. The following commands enable the operator to perform the task management functions:

- Start command - initiates a Reader, Print Writer, or Punch Writer Task immediately, leaving the current job in the queue. For the Print or Punch Writer Tasks, the current jobs remain in the output queue. The Reader Task stops processing the current job entry. The job entry is not entered into the system, and must be resubmitted.

- Cancel command - deactivates a Print or Punch Task immediately and the current job is deleted from the output queue. For a Reader Task, the operation is identical to the Stop command.

- Restart command - directs the specified Print Writer to stop printing the current job immediately, and restart the printing from the beginning of the current job.

- Flush command - directs the Print or Punch Writer Task to terminate printing or punching of the current job entry, and delete it from the Print or Punch Queue. The task then begins to operate on the following job in the queue.

- Go command - reactivates a Reader, Print Writer, Punch Writer, or Execution Processor Task. This command is normally issued in response to error messages, warning messages, or information messages.

- Multiple Copy command - allows the operator to specify an additional number of copies of the current job being printed by a Print Writer.

- End command - terminates the POWER II program.

- Kill command - terminates the POWER II program immediately and provides an interpreted dump of all of main storage.

A detailed explanation of the format, options, and functions of each of these commands is given in POWER II User's Guide.

QUEUE MANAGEMENT

The POWER II system provides the central installation operator with the facilities to alter the input and output queues and to control their operation. The commands that provide these queue management facilities are:

- Hold command - allows the operator to place a specified job in a specified queue in the "hold" state. When a job is in the "hold" state, it will not be acted upon by any of the POWER II tasks. An option of this command will place all the job entries of a specified queue in the "hold" state.

- Release command - allows the operator to change a specified job entry from the "hold" state to its normal state. An option of this command releases all the jobs in a particular queue.

- Display command - allows the operator to obtain on SYSLOG a printout of the status of a specified job entry in a specified queue. An

option of this command displays the status of all the jobs in a particular queue.

- Delete command - allows the operator to delete a specified job entry from a specified queue. An option of this command deletes all the job entries in a specified queue.

- Alter command - allows the operator to change the priority of a job entry in a queue.

The above commands can be used to modify all the queues and jobs that exist in the POWER II system. A more detailed explanation of the format, options, and functions of each command is given in POWER II User's Guide.

JOB ENTRY CONTROL LANGUAGE (JECL)

The POWER II system provides an optional set of control statements, which allow the user to modify normal POWER II operation. The names and facilities provided by the statements are:

- JOB Statement - designates the origin of a job entry. It allows the user to name a job, assign a priority number to it, and/or enter the job into the input queue in the "hold" state.

- PRT Statement - provides the user with the ability to modify the Printer Writer operations in the following areas:

    disposition of Print Request - tape or disk intermediate storage.
        Either do not intercept print requests
        Or place print output on disk in "hold" state.

    forms number and carriage control tape format.

    number of copies of printout.

    maximum number of records to be SPOOLed before the initial warning message is issued.

- PUN Statement - provides the user with the ability to modify the Punch Writer operations in the following areas:

    number of copies desired of the punched output.

    disposition of SPOOL Request - disk intermediate storage.
        Either do not intercept punch requests
        Or place punch output on disk in "hold" state.

    maximum number of records allowed to be SPOOLed before the initial warning message.

- EOJ Statement - designates the end of a job entry.

A job entry can be either a multiple number of DOS jobs, one DOS job, or one step of a DOS job. Proper use of the Job Entry Control Language can produce output based on DOS job steps, jobs, or multiple jobs. A more detailed explanation of the format, options, and functions of these cards is given in POWER II User's Guide.

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JOB ACCOUNTING

When all printed and punched output for a job has been processed,
the job is purged from the system. At this time, limited job accounting
information is available to the user. This data includes the job name
and number, date of execution, the number of cards read and punched
and lines printed, the number of copies of the printed and punched
output, the time required by the reader and writer tasks to process
the input and output, and the job execution time. The information is
contained in the job entry's JCT; the format of the JCT may be obtained
from the DSECT that appears in the listing of the POWER assembly.

WARM START AND FAIL SOFT CAPABILITY

The POWER II system has the capability to warm start and preserve
its state when last terminated. If the system is terminated for any
reason, the user can follow a warm start procedure and reinitiate SPOOL
processing from where it was terminated.

The fail soft capability of POWER II allows execution of any
partition to continue if a unit record device became unavailable. If
a card reader is unavailable, all the jobs that were placed in the
Reader Queue will be executed. If a printer or punch is unavailable,
the output for these devices will be saved in the Print and Punch
Queues until the device becomes available and a Print or Punch Writer
Task is initiated.

DESIGN CONSIDERATIONS

To generate a customized POWER II system, the user must make some design decisions. Some of the design considerations are the amount of main storage and disk space available, job stream characteristics, and desired response time. This section discusses some of the design criteria that an installation should consider.

1. Data Buffer Size - the data buffer size is the size of a physical intermediate storage record. It affects the number of reader card images that will be blocked into a disk record by a Reader Task, the amount of print and punch records that can be blocked into a disk record by the Execution Processor Tasks, and the number of disk operations that are required by a Reader or Writer Task. The principal advantage of the large buffer is that it reduces the number of disk operations required to process a job, and, therefore, reduces arm contention on the POWER II disk modules. The disadvantage is that large buffers require large amounts of main storage.

2. Number of Data Buffers - the number of data buffers is the maximum number of buffers of the size specified (see 1 above) that will be created by POWER II at initialization time. The operator may assign one or two buffers to a Reader or Writer Task at task startup time. A task having two buffers may overlap more I/O per task, resulting in greater throughput. The disadvantage of assigning two buffers per task is, again, the amount of main storage required.

3. Queue Block Size - A queue block contains a Job Control Table on disk storage. The minimum size of the queue block is determined by the maximum number of track groups (see 5 below) that the user wants his POWER II system to manage. The maximum size is determined by the data buffer size, because queue records are read into and created in data buffers. Within this range, however, the size is a user option. The size of the queue block determines the maximum number of jobs that the POWER II system can contain at any one time. An offsetting factor is that the larger the queue block size, the fewer the number of queue blocks per track, and, therefore, the more disk space is required to contain the job queue.

4. Track Group Size - A track group is the number of disk tracks allocated to a task when it requests disk space. The size of the track group is determined at generation time, and it must be an integral division of the number of tracks in a cylinder, that is, 1, 2, 5, or 10 for an IBM 2311, and 1, 2, 4, 5, 10 or 20 for an IBM 2314.

5. Number of Track Groups - The number of track groups is the maximum number of groups that the POWER II system can manage. The total amount of disk space that POWER II can manage is the product of the track group size and the number of track groups. The number of track groups affects the size of the Job Control Table, and the size of the JCT is the minimum size of the queue blocks.

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The tradeoffs involved in track group size and number of tracks are:

- Large track group sizes tend to use disk storage space inefficiently, particularly for job entries with small amounts of input cards and output records.

- For small track group sizes, the total amount of disk space that the system can manage is small. To compensate, increasing the number of track groups increases the minimum size of the queue block.

The above considerations explain some of the tradeoffs involved in the design of a POWER II system. It is left to the user to select the best combination for his installation.

EXAMPLES OF POWER II SYSTEM ADVANTAGES

This section illustrates the following advantages of the POWER II System:

- asynchronous processing

- fail soft operation

- queue management

EXAMPLE 1

This example consists of two jobs presented sequentially to a batch partition. The cards in the job stream are shown in Figure 11. The first job is a listing of some of the POWER II macros in the Source Statement Library. The second job is an assembly of POWER II (defaulting all options). Figure 12 summarizes the results of executing the job stream under DOS alone, and under DOS with POWER II.

The two jobs running under DOS alone consumed 35-1/2 minutes. This means that the CPU and all unit record equipment allocated to the background were tied up for the full 35-1/2 minutes. The jobs running under POWER II took a total of 31-1/2 minutes and tied up the CPU for 20-1/2 minutes and the printer 20-1/2 minutes. The card reader and punch were not used for these jobs and could have been used to read more jobs into the Reader Queue or to punch the output from other jobs.

The CPU usage was as follows:

- For the first 5 minutes, the CPU executed the print job, SPOOLing card images from the Source Statement Library to the Print Queue.

- After the print job was executed, the assembly began immediately and executed for 15-1/2 minutes. At this point, the CPU was free and could have executed more jobs if they were available.

The operations of the Print Writer Task were as follows:

- It did nothing while the print job was being executed by the CPU.

- After the print job completed execution, it printed the output for that job for 12 minutes.

- It did nothing for 3-1/2 minutes while the assembly job was completing its execution.

- It printed the assembly output for 11 minutes after the assembly job was completed.

The initial 5-minute idle time and the 3-1/2 minute idle time could have been used to print output from other jobs if the output were available in the Print Queue.

```
// JOB      PRINT
// EXEC     SSERV

   DSPLY    A.POWER,A.POWERSUP,A.POWERBUF
   DSPLY    A.POWERCOM,A.POWERRDR,A.POWERPRT
   DSPLY    A.POWERPUN

/*
/&
// JOB      ASSEMBLE
// OPTION   NODECK
// EXEC     ASSEMBLY
   POWER
   END
/*
/&
```

Figure 11.   Sample job stream - Example 1

```
DOS ALONE


JOBNAME      TOTAL TIME    EXECUTE TIME    PRINT TIME

PRINT        13 minutes    13 minutes      13 minutes
ASSEMBLE     22-1/2 min.   22-1/2 min.     22-1/2 min.
For Both
Jobs         35-1/2 min.   35-1/2 min.     35-1/2 min.

POWER II AND DOS

JOBNAME      TOTAL TIME    EXECUTE TIME    PRINT TIME

PRINT        17 minutes     5 minutes      12 minutes
ASSEMBLE     26-1/2 min.   15-1/2 min.     11 minutes
For Both
Jobs         31-1/2 min.   20-1/2 min.     23 min.


Savings Using
POWER II        4 minutes    15-1/2 min.   12-1/2 min.

PRINT has 9,481 lines, Assembly has 10,271 lines,
740 cards
```

Figure 12.   Results - Example 1

EXAMPLE 2

This example illustrates the fail soft capability of POWER II.
Assume that the only printer on a System/360 becomes unavailable.
Under normal DOS operation, the complete computer system is unavailable
for use until the printer is available.   Under the POWER II system,
the user can execute the job stream with the restriction that no Printer
Writer Task may be started.   POWER II will intercept and SPOOL to disk
the job stream output, but no printing can be done until the printer
is available.   When the printer becomes available, the operator can
start a Print Writer Task, and the task will begin printing at the
beginning of the Print Queue.

EXAMPLE 3

This example illustrates the flexibility that can be achieved by the use of the queue management commands:

Assume that a user has a POWER II system running, and that a rush job for the background partition, requiring print output only, is entered into the job stream. The operator can hold the background Reader and Print Queues and then read the priority job into the Reader Queue. The required job will begin execution immediately after the current job is completed. The print output will occur immediately upon completion of the job.

After the priority job has been completed, the operator can release the Reader and Print Queues, and normal processing will resume. If the system had a batched job stream in the foreground, and if the operator desired to minimize the execution time of the job stream in the background, he could have held the foreground queues.

The above example could be extended to include the holding and releasing of individual job entries in the job stream, that is, the operator can hold an entire queue and release job entries individually, or hold job entries individually with the entire queue released.

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