

GH20-1173-1

Systems

**IBM System/360 and
System/370 ASP Version 3
Asymmetric Multiprocessing
System
General Information Manual**

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PREFACE

This manual contains a general description, machine configuration, application programming considerations, system programming considerations, operational considerations, and extended ASP configurations. It is intended primarily for data processing management, and personnel planning the use of ASP. Previous experience with the System/360 and System/370 Operating System (OS) is assumed.

Second Edition (November 1972)

This edition, GH20-1173-1, is a major revision obsoleting GH20-1173-0. It applies to Version 3 of ASP (360A-CX-15X) and to all subsequent versions and modifications until otherwise indicated in new editions or Technical Newsletters.

Changes are continually made to the specifications herein. Therefore, before using this publication, consult the latest System/360 and System/370 SRL Newsletter (GN20-0360) for the editions that are applicable and current.

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CHAPTER 1. INTRODUCTION

ASP provides a multiprocessor or uniprocessor operating system as an extension of the IBM Operating System (OS). ASP is an evolutionary system. The first version of ASP was delivered in 1966. Since then ASP has kept pace with the highly volatile leading edge of data processing applications. The current number of ASP users is large and it is growing. This chapter will describe what ASP is and point out some of the reasons for its growing acceptance.

WHAT IS ASP?

ASP can be many things. Each user will view ASP differently depending on his data processing environment. In broad terms ASP can be thought of in the following ways.

ASP - The Programmed Operator

Computers are becoming faster and faster. In an installation that is running 700 jobs a day, jobs are starting and stopping on an average of one a minute. Since a job consists of many steps, the changes that take place are even more frequent. A system operator is hard pressed to monitor, much less control, the total system activity. Add to this the fact that many jobs require special operator intervention to load tape reels, mount disk packs, or change forms, and it becomes clear that some sort of computer assist for the operator is not only desirable but necessary. ASP provides such assistance.

ASP - The System Coupler

The emergence of online teleprocessing systems makes the availability of the computing center very apparent to its users. The effects of a component failure must be contained within the center and must not be readily apparent to the users at the terminals. A trend is to use multisystems to provide redundancy as protection against total failure. However, there needs to be a method of efficiently distributing the backlog of work among several systems when all are operational. Coupling systems with a channel-to-channel adapter (CTC) is the ASP approach to this requirement.

ASP - The System Scheduler

A centralized scheduling mechanism that takes into account the total resources of the interconnected systems is provided by ASP. The user is able to control the trade-offs between maximum resource utilization and service for priority requests. As a result, ASP achieves a good balance between responsiveness and efficiency.

ASP - The Spooling System

The speed with which a CPU can handle input and output is much greater than that of the unit record devices. ASP, operating in a connected Support Processor, can achieve high performance by placing all job input on disk before supplying it to the Main Processor. In a like manner, all output is staged to disk before printing or punching. The input and

output service functions of ASP are specialized and are written for high performance.

ASP - The CPU Controller

The workload on each CPU is managed by monitoring the amount of storage available. Only jobs that have all resources immediately available are scheduled by ASP. ASP can also adjust dispatching priorities to balance the I/O and compute activities.

Although ASP is a multiprocessing operating system, it should be pointed out that it is not necessary to have more than one CPU in order to take advantage of the benefits ASP can provide. ASP is based on a Support Processor - Main Processor concept. The ASP Supervisor executes in the Support Processor. In larger systems using a System/360 Model 50 or larger, the services of ASP and the work of the Main Processor can be provided in a single CPU.

The major goal of ASP is to improve throughput and operational efficiency for the large data processing user. This goal applies to the broad spectrum of users from the single large CPU installation to the user with an entire network of interconnected CPUs. Many features of ASP contribute to achieving this goal. Among them:

- The single job queue concept of ASP permits it to manage the total installation workload.
- Throughput is maximized since nonsetup jobs are run while those requiring setup are being handled by the operators.
- The turnaround for high priority jobs can be improved by user selection of appropriate ASP options.
- ASP supports online teleprocessing systems such as Conversational Remote Job Entry (CRJE) and Time Sharing Option (TSO).
- Via Remote Job Processing (RJP), ASP supports programmable and non-programmable remote workstations.

ASP multiprocessing offers flexibility and orderly growth. This growth is CPU-independent. A user need not add an identical CPU to the one that is currently installed. ASP is asymmetric. The CPU that meets his application requirement is the one that should be selected. The user may grow from 360 to intermixed 360-370 and then to 370 while still maintaining a consistent operational environment.

WHO ARE THE ASP USERS?

ASP is currently serving the needs of IBM data processing users the world over. These users include:

- Banking systems
- Oil companies
- Automobile manufacturers
- Aerospace firms
- Universities
- State and national governments
- Large manufacturers
- Public utilities
- Insurance companies
- Airlines
- Service bureaus

These installations presently range from a single Model 50 to a triplex System/370 Model 165 configuration.

WHO SHOULD CONSIDER ASP?

If the IBM data processing user falls into any of the categories stated below and he is not currently using ASP, consideration should be given to its implementation:

- Multiple OS system users
- Single system user with an additional CPU on order
- Purchased user requiring more computing power
- Large OS system
- High volume job shop
- User with a mix of setup and nonsetup jobs
- User with high setup requirements (tape, disk and unit record)
- User with remote job processing requirements
- User with pooled tape or shared DASD

In order to illustrate situations in which ASP would be a prime candidate for installation, the following hypothetical examples are given:

Example 1

The ABC Corporation, a large data processing user, has currently installed a System/360 Model 65J operating under the OS MVT control program.

Example 2

The XYZ Corporation, a very large data processing user, has currently installed a System/360 Model 50I and a System/360 Model 65IH. This user is planning to replace the Model 50 with a System/370 Model 155J now on order. OS MVT is also being used.

The characteristics of both of the above installations are strikingly similar:

- A significant number of the jobs require the mounting of special volumes (tape or disk), special forms, and the use of special destinations and multiple locations for output data sets.
- OS MVT is being used but the management is not certain that operators are able to run such a system with the utmost efficiency. Currently they have high wall-clock machine time usage but, even though multiprogramming is being used, there is a low CPU utilization (e.g., 30 or 40 percent).
- The execution of utility-type functions such as tape duplication, listing cards, etc., is awkward for machine operations and, hence, gets a low priority.

There are many things that both of these users would like their systems to be able to do more efficiently than at present if, in fact, they can do them at all. These include:

- Operate under a single job queue, including integrated emulation work, even in the case where multiple CPUs are installed.
- Provide extensive restart capabilities for temporary printer failure (e.g., paper jam), a permanent failure, or for a system failure.
- Have only one copy of the input and output routines regardless of the number or types of card readers and printers installed.
- In the case of two (or more) CPUs, when one system is unavailable, realize more effective backup for the entire installation.
- Be able to start SYSOUT for long jobs before the job ends.
- Allocate SYSIN/SYSOUT space and manage the buffering of data.
- Schedule the printers to minimize forms, train, and carriage tape changing.
- Unload to tape and reload to the job queue jobs that have been deferred (e.g., low priority, or output destined for remote workstations disconnected during second and third shift).
- Schedule and process jobs submitted by a conversational terminal system (e.g., CRJE or TSO).
- Run remote batch with the added capability of having jobs originate locally and have the output transmitted to a remote workstation.

ASP provides the means with which its user can efficiently realize the above capabilities. These, however, are only part of the ASP potential.

HIGHLIGHTS OF ASP

In order to provide insight into ASP and its capabilities, the following list of highlights is provided:

1. Computer-controlled execution of support functions in multiprogrammed mode on a lower-cost Support Processor or in a region of OS on a larger processor which provides:
 - a. Improved job scheduling
 - b. Automatic processing of system input and output data sets
 - c. Concurrent processing of peripheral and other user programs, such as:
 - Card-to-Card
 - Card-to-Printer
 - Card-to-Tape
 - Tape-to-Card
 - Tape dumping
 - Tape labeling
 - Tape-to-Printer
 - Tape-to-Tape
 - User-written background programs
2. Increased usability of resources on the Main Processor in terms of:
 - a. Main storage. Main storage buffering of Main Processor system input and output data sets is provided in the Support Processor.

- b. CPU time. Multiplexer channel interference and interrupt service for peripheral input/output devices are eliminated in the Main Processor.
 - c. Data channels. Selector channel data flow time for servicing input and output on Main Processor is reduced.
 - d. Input/output devices. An algorithm is provided for efficient management of direct access storage devices for system input and output data sets.
3. Preexecution fetch and setup of removable input/output volumes on the Main Processors.
 4. Support of pooled multiple operator consoles for functional organization of system operation.
 5. Concurrent input/output and background processing on the Support Processor during execution on the Main Processor.
 6. Remote job processing using multileaved mode for programmable workstations and non-interleaved mode for 2770, 2780, and 3780 BSC terminals.
 7. Internal job processing, which provides a generalized interface to the ASP system by problem programs during their execution.
 8. Automatic failsoft options, which enhance total system availability.
 9. Network job processing for workload sharing between remote ASP systems.
 10. POLYASP, a facility of ASP that allows two copies of ASP to run in the same CPU. This is a great aid during user modifications, and during transition from an earlier version of ASP.
 11. Dependent job control, which allows the submission of a string of interrelated jobs, such as month-end processing in a large commercial system. ASP will conditionally schedule successor jobs when predecessor jobs complete.
 12. Deadline scheduling, to increase the probability that a given job will complete processing by a specified time.
 13. Designation of specified long-running or never-ending jobs (e.g., Time Sharing, IMS, etc.) as ASP Hot Jobs to allow them to remain active in the event of an ASP system failure.
 14. Ability to submit jobs created using TSO to ASP for scheduling along with other batch work.
 15. OS Reader/Interpreter under control of the Support Processor, which eliminates the redundancy of job control language processing separately on each Main Processor.
 16. Main Storage Fencing, which enables jobs to have their own exclusive core areas protected from use by other jobs.

CHAPTER 2. ASP SYSTEM DESCRIPTION

This chapter describes the role of the Main Processor and the Support Processor in the total ASP system. It explains the variations possible in the Support/Main Processor configuration. Emphasis is placed on the ASP components of the Support Processor.

MAIN PROCESSOR

The Main Processor operates under OS/MVT or OS/VS2. The system input and output devices for the Main Processor are replaced by the channel-to-channel connection with the Support Processor. Direct access storage devices for systems residence and program library are attached to the Main Processor, as are any input/output devices accessed during execution by the problem programs. The operating system in the Main Processor provides an environment for the problem program similar to a standalone system. The performance of the system is directly related to the throughput capability of OS on the Main Processor with enhancements provided by use of the channel-to-channel adapter for I/O and ASP lookahead scheduling.

OS for the Main Processor is modified for the ASP system to recognize the presence of the channel-to-channel adapter for the system input, print, and punch data sets. This change, and additional minor changes to facilitate job control by the Support Processor, are the only changes to OS in the Main Processor.

SUPPORT PROCESSOR

The ASP operating system resides in the Support Processor. It is added to a private JOBLIB and is loaded and executed as a single-step job under control of OS/MVT or OS/VS2. Any real Main Processor attached to the system must operate under either OS/MVT or OS/VS2. The ASP Supervisor schedules and initiates the various support and background functions. It is multiprogrammed within itself to minimize the overhead associated with the sharing of CPU and channel time. Other OS jobs can be scheduled by ASP on the CPU containing the Support Processor to utilize excess CPU capacity. In this mode the Support Processor is considered to contain a 'Local Main' Processor (discussed later).

Structure of ASP in the Support Processor

ASP in the Support Processor can be described in two major ways:

- ASP Resident Programs (ASP Nucleus)
- ASP Non-Resident Programs (ASP Dynamic Support Programs)

First, the ASP Nucleus: a fixed portion of ASP that must remain resident during the execution of ASP. This resident portion includes the ASP Supervisor and common service programs.

Second, the ASP Non-Resident Dynamic Support Programs (DSPs): transient routines that are loaded from a direct access device when a specific function is required. ASP DSP's may be made resident, as installation options, to increase overall system performance. The extent to which this can be done depends on several factors, such as storage available,

types and number of direct access devices, and support activity. (See Chapter 8 for minimum Support Processor requirements.)

Some primary ASP DSP's and their functions include:

1. Input Service - reads the input stream on the Support Processor, recognizes control cards, and takes the appropriate action.
2. Reader/Interpreter Service - interprets OS job control language to determine system resources required by a job before being sent to a Main Processor.
3. Main Service - manages the flow of data (for example, system input, system print and punch data sets) across the CTC to and from the Main Processor.
4. Print Service - prints the data sets.
5. Punch Service - punches the data sets.
6. Purge - removes each job from the system, returning to the system all direct access storage space allocated to that job.

Additional DSP's have been implemented to support special operator functions, such as background processing utility functions. The user may program additional DSP's as required. The multiprogramming function of the ASP Supervisor can control up to 250 different DSPs. More than one copy of the same DSP may be active at the same time.

MULTIPLE MAIN PROCESSORS

If the workload at an installation exceeds the capacity of one Main Processor, the ASP Support Processor can be expanded to support additional Main Processors, balancing the total installation workload between them. In this configuration, termed a Multiple Main Processor system, the Main Processors need not be symmetric, but may be any combination of System/370 and System/360 systems able to run OS/MVT or OS/VS2. Jobs will be distributed to the available system based upon job priority, device requirements, and processor dependency. The ASP program can logically recognize up to 32 Main Processors; however, physical planning considerations usually become the limiting factor at four or five systems.

COMBINED SUPPORT/MAIN PROCESSOR (LOCAL MAIN PROCESSORS)

The ASP system also provides for the execution of application programs on the Support Processor (or a single processor) through the use of the local execution mode. This mode of processing provides all ASP functions on a single processor. The ASP system then treats the Support Processor as if it were another Main Processor and schedules jobs to it. The local execution mode may be used on a Support Processor which is also supporting Multiple Main Processors, or it may be used on a single processor to provide the ASP operational features. This mode of execution can provide support for a Main Processor operating from an established ASP job queue during periods when the Support Processor is being serviced. By careful installation planning and the use of switching devices, critical Support Processor units can be attached to the Main Processor in the event of Support Processor failure. The ASP program can then be loaded into the Main Processor, specifying the local execution mode, and processing can resume from the ASP system checkpoint.

Note: The System/360 MP65 is not supported as a local Main Processor.

NETWORK JOB PROCESSING (NJP)

Network Job Processing (NJP) provides the capability to communicate with remote ASP systems. Selected jobs at a given ASP installation may be submitted to any other ASP system in the NJP network for execution. These jobs may then be transmitted to any ASP system in the network for printing and punching. Remote ASP systems may also be used as line concentrators. Jobs to be submitted to other ASP systems may be selected either by ASP control cards or by the ASP operator at the time the jobs are submitted. Each ASP system in the network must have a 3705 (Emulator Mode), 2701, or a 2703 with the appropriate adapters to support a leased BSC line including full transparency.

SAMPLE ASP STRUCTURE

Figure 1 summarizes the basic structure of the ASP system.

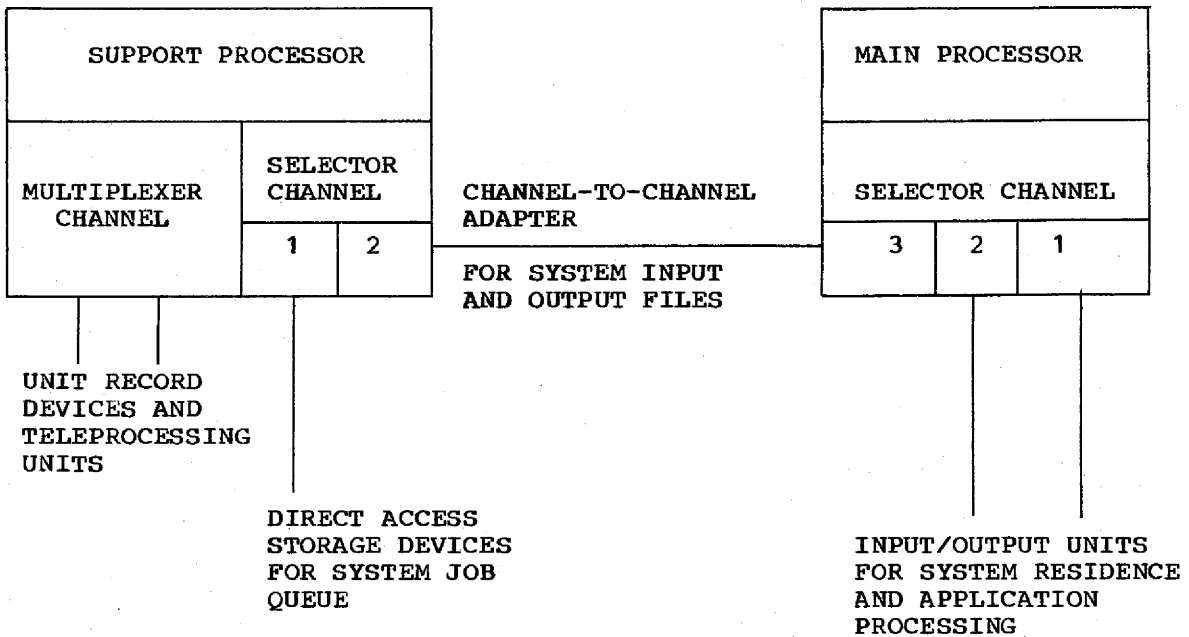
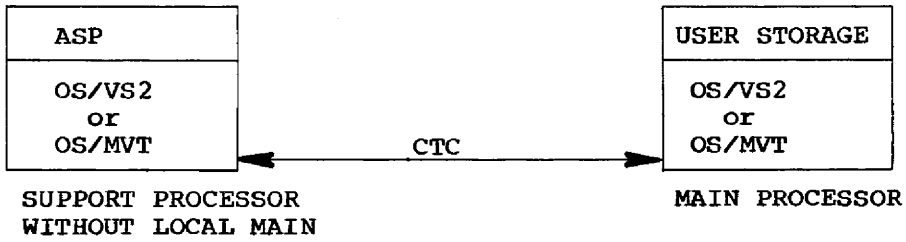


Figure 1. Basic ASP configuration

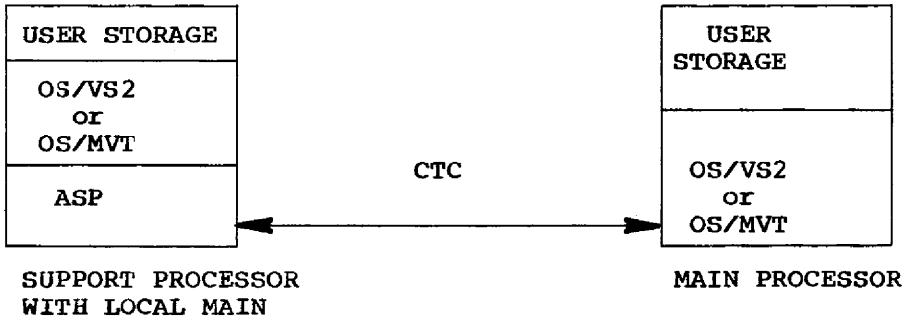
SAMPLE ASP CONFIGURATIONS

Figures 2 and 3 show some sample ASP configurations.

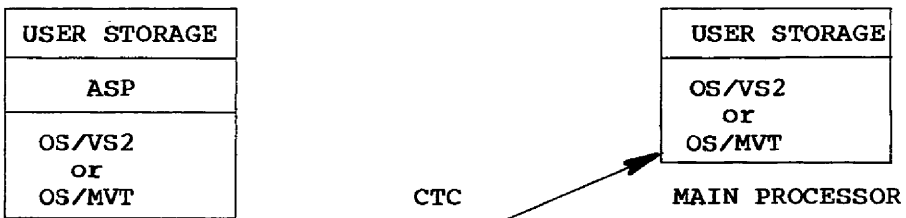
Single Main Processor



Two Main Processors (One Local)



Single Local Main Processor



Four Main Processors

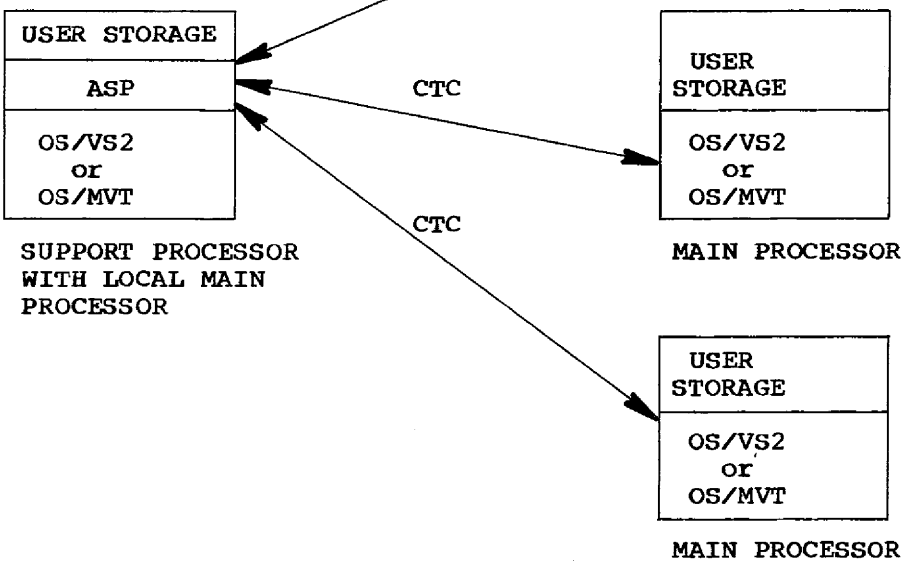


Figure 2. Sample ASP configurations

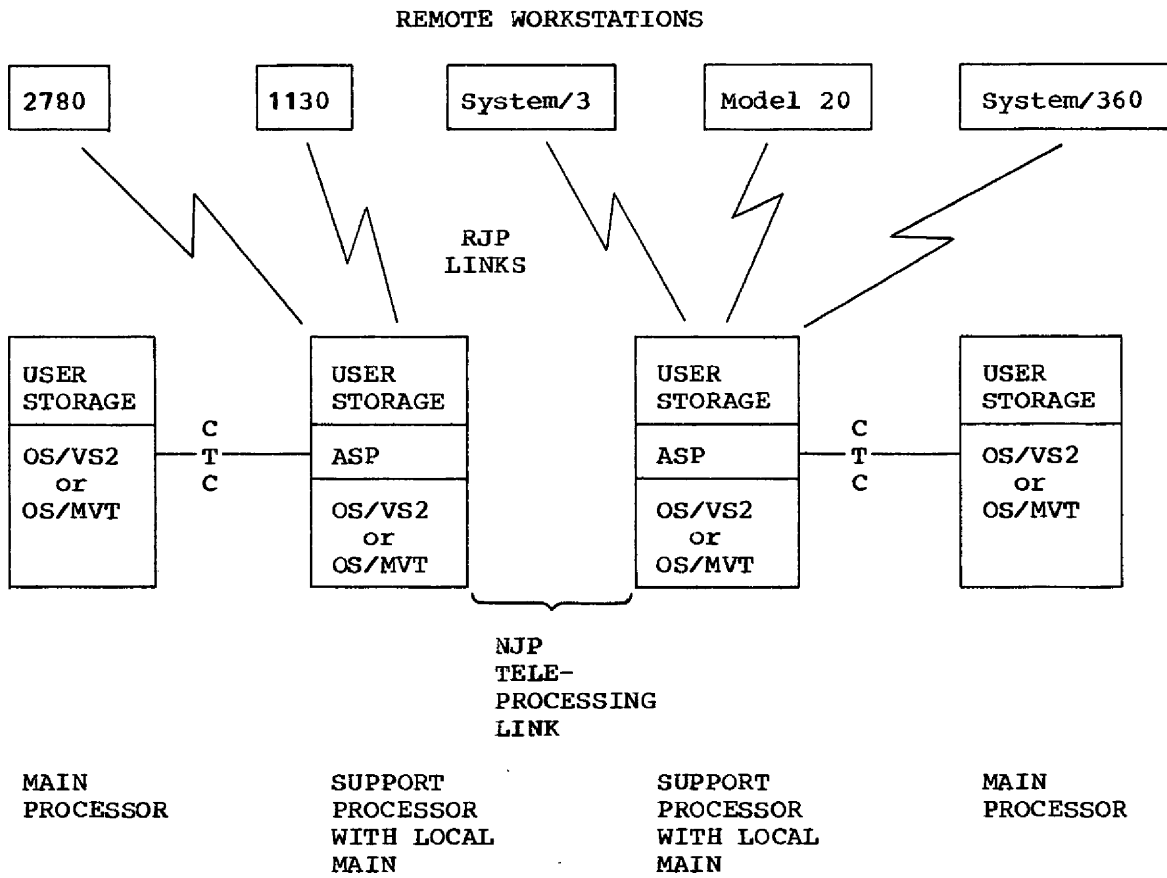


Figure 3. Sample RJP and NJP ASP configurations

CHAPTER 3. ASP OPERATIONAL ENVIRONMENT

The operational environment in the ASP system is radically different from that of the non-ASP system. The implementation of multiple system-wide operator consoles, the separation of ASP support functions, and the two-way operator communication with these support functions cause the system to appear to be composed of many separate, independently operated computer operations.

PHYSICAL PLANNING FLEXIBILITY

ASP provides great flexibility in the location of equipment in a machine room. By using additional operator consoles, ASP installations can physically separate the operational functions (card input/output, printing, and tape setup) across multiple systems to locate them in areas more convenient to the local work flow. The card read/punches and the printers may be located in the job dispatching area for proximity to the area in which programs are submitted for execution and output is returned. The mountable input/output units may be placed in an area that is convenient to the tape and disk library. In addition, an operator console can be placed at the tape and disk librarian's desk to issue library volume requests. The central processing units may then be placed in some other area that is free of the congestion typical of the peripheral units.

THE ROLE OF THE ASP OPERATOR

The ASP operator is not concerned with operating an application program or scheduling work for the Main Processor, except to monitor the work flow and, if necessary, to expedite specific jobs by changing their priorities. Rather, he operates the devices attached to the ASP system, such as the printers, card readers, and card punches; mounts and demounts the Main Processor mountable units; manages the disposition of the required special volumes; and monitors the flow of jobs through the system. In addition, he may invoke background utility tasks such as card reproduction or card-to-tape operation. These activities, however, take on the appearance of separate operations tasks that are independent of both Main Processor operation and the application program.

Since support functions can be operated independently of other ASP consoles, each function or device can be separated. Thus, the operator's attention can be focused on the specific task, with little or no concern for the operations in the other areas.

Each ASP support function (processing stage) responds to a number of operator commands that permit the operator to cancel job processing, to restart processing, or to resume processing after an operator intervention request. Some functions, such as the Print Service program (at the print stage), provide additional options. For each printer, processing can be restarted either at the beginning of the data set or job or at a checkpoint made within several pages of the current position. The restart can be accomplished on the same printer or on a newly assigned printer. In addition, a request can be made to reload the Universal Character Set buffer of a local printer.

Similarly, the Main Service program provides an option to send a special operator message to the Main Processor. Background peripheral or utility programs can be invoked from an operator console, as well as from the input JCL. When invoked from a console, the utility programs

receive all of their execution parameters from the operator through the console in a conversational manner.

The ASP console inquiry function permits the operator to determine the status of the ASP work queue, the status of a given job in the queue, the amount of space left in the ASP queue, a summary of the workload backlog, and the status of the workload for any ASP processing stage. This inquiry feature also permits the operator to determine whether the backlogs are adequate or too high and to obtain an estimate of when a given job will be processed in the current queue. With this information, and with the ability to change job priorities and to place a job in hold status and later release it for processing, the operator maintains complete operational control of the system. The operator may also inquire into the status of functional components of the ASP system, such as the amount of space available within the ASP queue and the number of buffers currently in use. He may also invoke a support function which will display the entire system status on a printer attached to the ASP system.

OPERATIONAL CONTROL FACILITIES

A summary of those facilities that directly involve the operational personnel is given below.

Operator Console Facility

Operational control is maintained at every stage of processing for the following functions:

- Deletion of a job. The operator may delete a job from the system by issuing the CANCEL message from the console.
- Restart of job processing. The operator may restart applicable job segments on the Support Processor by issuing the RESTART message at a console.
- Change of job priority. The operator may change the priority of a particular job. This option is usually used to expedite the start of job processing for a particular job.
- Holding and releasing of a job in queue. The operator may withhold a job from processing. Further, a job previously in hold status may be released to be scheduled for additional processing. Jobs may be held and released on the basis of priority. Jobs received from remote workstations may be held and released on the basis of individual terminals. Jobs in hold status from a particular terminal may be released entirely, or the operator may specify the number of jobs to be released.
- Initiation of processing of background support functions. Using the CALL facility, the operator may request the system to schedule support functions such as Card-to-Tape, Tape-to-Printer, etc., to be executed concurrently with the standard preprocessing and postprocessing facilities.
- Dynamic reconfiguration of Support Processor input/output and terminal devices (printers, card read/punches, Main Processors, etc.). These devices may either be removed from available-for-processing status or be made available by the operator, or the output may be rerouted.
- System status inquiry. The operator may query the system regarding the job queue for various functions, such as estimated Main

Processor running time and estimated number of lines of print. In addition, the operator may request the status of an individual job, as well as a printout of the entire job queue status.

Messages may be sent between ASP consoles.

System Fetch Facility

Volumes required for preexecution setup by the ASP system, prior to being mounted, are assumed to reside in an installation tape and disk library. Messages are sent to the library requesting that these volumes be removed from the library and forwarded to the tape and disk setup areas. This action is performed for each job requiring setup prior to ASP's actually requesting mounting of these volumes.

System Setup Facility

Preexecution input/output device setup and automatic nonsetup padding are included. ASP manages reference to tape devices and mountable direct access volumes that are either permanently resident or removable. Jobs referencing permanently resident volumes will be automatically routed to the Main Processor on which the volume resides. Jobs that require special data set volumes to be mounted are withheld from execution until the appropriate units are available for mounting. Instructions are then issued to the operator to mount and/or ready the required volumes. ASP then waits for all operators involved to complete their required tasks before allowing the job to execute on a Main Processor. If all devices allocated to a job are shared between Main Processors, that job will be eligible for execution on any Main Processor to which the devices are attached. When setup is complete, the job is released to an execution queue for processing.

Jobs which do not require setup devices or for which setup has already been effected are executed while the setup process is being carried out for other jobs. This exclusive ASP feature also fully supports cataloged data sets.

Preexecution setup has been extended from earlier versions to include the following:

- Setup and OS messages for direct access devices and tapes may be routed to the console located nearest each device.
- Multiple OS jobs may share direct access volumes based on specified data set dispositions. This allows multiple jobs sharing a volume to be in execution simultaneously.
- Volume verification occurs at the time a device is made ready. The operator is no longer required to initiate verification by an operator command.
- Operator commands are available to determine the status of jobs, devices, and volumes in setup control.
- JCL references to permanently resident direct access volumes require no operator action.

CHAPTER 4. ASP SYSTEM FACILITIES AND FEATURES

While a general description of the advantages and structure of ASP has been given, there are numerous technical considerations that require additional discussion. This chapter discusses those that are of particular interest to persons responsible for planning the use of ASP.

DIRECT ACCESS STORAGE DEVICE (DASD) MANAGEMENT FACILITY

The ASP system provides complete management and scheduling of direct access storage devices (2314 or 3330) for system input and output data sets by a set of special Disk Input/Output routines. These introduce an algorithm which is designed to maximize the effective data transmission rate from DASD while processing multiple sequential files. This algorithm employs a large common buffer pool and a standard means of blocking small records into a larger buffer. The effect of this technique is to group the actual data transmissions into record sizes that are best suited to the type of DASD being used. The result is a higher effective data transmission rate than would otherwise be possible.

The ASP Disk Input/Output routines provide two additional benefits:

- With all data sets using the same buffer pool, the data transmissions can be ordered in priority sequence. This permits ASP to give the Main Processor (hence, the application program) the highest priority service from DASD. In addition, reading can be given priority over writing, thus servicing an immediate need of the system (input data required for processing), while accumulating output data (to be transcribed when the demands on the direct access storage device permit) in the buffer pool.
- The ASP Input/Output routines employ a private pool of direct access storage devices rather than assigning individual data sets to specific units or areas on a unit. This provides a total resource of storage that is allocated to the data sets in the ASP queue as needed.

PRINTER AND PUNCH MANAGEMENT FACILITY

For most jobs, the system message data set and the system output data set are processed with the established conventions for forms control, print train, and printer forms. However, the programmer may request variations from the standard printing conventions in addition to specifying the printing of additional data sets or additional original copies of the output for a data set. The types of forms and print trains being used are recorded, and an attempt is made to minimize the number of forms changes or print train changes required.

Output for all jobs will be processed simultaneously on as many printers as are available to the system. The operator controls each printer separately. He may restart, cancel, load the UCS buffer or cause any specific job to be assigned to any specific printer.

Output destined for a particular type of card will also be routed to minimize the number of card stock changes in the system punches. The operator may also temporarily reroute output to a different printer or punch.

REMOTE JOB PROCESSING (RJP)

Remote Job Processing permits the input, processing, and output of jobs to and from terminals, remote from the installation. This function is achieved through the use of the IBM 3705 Communications Controller (Emulator Mode), IBM 2701 Data Adapter, or the IBM 2703 Transmission Control to interface with binary synchronous communications (BSC) terminals. RJP provides the facility for attaching BSC remote terminals as remote card readers, printers, and card punches, with job output routed optionally to any remote terminal or local output devices.

RJP Data Format

The ASP system supports three data formats for remote BSC transmission:

- Standard 2770, 2780, or 3780 Data Transmission Terminal compatibility format
- IBM 2770 or 2780 Data Transmission Terminal with the Multiple Record Transmission feature compatibility format
- A full pressed data format intended primarily for transmission to programmable remote terminals

RJP supports:

- Interface with the HASP II remote workstation packages. ASP RJP is designed to operate with the HASP workstation packages which are available for the 1130, Model 20, System/3, and System/360 as terminals.
- Password protection. An eight-character password may be assigned by the central operator to each RJP line.
- Logical terminal support. All communications are established by the remote workstations. The remote operator submits a signon card to identify his terminal.
- Remote console support. Support is provided for the remote terminal console as a full-function ASP operator console, as a console to control work originating from that terminal, or as an inquiry-only console.
- Error recovery. All error recovery procedures are attempted automatically by RJP.
- Error statistics. RJP records line error statistics and, on request, presents them to the operator.
- Interleaved unit record operation on programmable terminals. Multiple printers, punches, and card readers, up to seven of each with a total of 16 devices maximum (eight input, eight output) in addition to console operations, may be supported on a terminal. (This is limited also by the maximum hardware configurations allowed for the workstation.)

RJP Supported Terminals

The supported terminals are the 2770, 2780, 3780, 1130, System/3, Model 20, 2922 and System/360. The 2770 and 2780 are supported in a non-interleaved mode. The other workstations are supported in an interleaved mode and permit job input and output simultaneously on a half-duplex communication line. The operator may control RJP output transmission to restart or cancel a job. In addition, he may redirect the output to a local or to another remote printer and punch. Remote

RJP terminals may be connected by either leased or dial-up transmission lines. Communication lines of any speed supported by the hardware are supported also by ASP.

Jobs submitted from remote RJP terminals follow the same programming conventions as those established for jobs submitted locally. If standard job routing is used, the ASP system automatically replaces conventional printing and punching with output terminal transmission. Output from remotely submitted jobs may be returned to any terminal specified by the submitter, or may be processed locally. The standard operator console is supported as either a full- or limited-function remote operator console. Only one console is supported on each remote workstation.

NETWORK JOB PROCESSING (NJP)

Network Job Processing (NJP) permits the input, processing, and output of jobs to and from compatible ASP installations. This function is achieved through the use of the IBM 2701 Data Adapter Unit with the Synchronous Data Adapter Type II-EBCDIC and Transparency features, the IBM 2703 Transmission Control, with point-to-point leased binary synchronous communication (BSC) lines or the IBM 3705 Communications Controller (Emulator Mode) properly configured.

NJP is designed to give the ASP user increased flexibility in scheduling and operating his data processing environment. Scheduling and routing of a job in the ASP system may be initiated at an operator console or by the use of ASP control cards in the job's input stream. This nonstandard job routing, when specified by means of ASP control cards, cannot be rerouted by an operator.

Included in the NJP support is an operator-initiated inquiry capability as to the status of remote location job queues. With NJP capability, users with more than one ASP system can load-level jobs, by operator control or ASP control cards, between various physical locations in order to achieve a better CPU utilization.

Transmission of SYSIN/SYSOUT data and job-related control blocks is accomplished through the use of the Basic Telecommunications Access Method (BTAM) in full transparency mode. A partially compressed data format is used on all ASP data sets. For compatibility, the ASP buffer sizes and the DSP dictionaries must be the same on all systems in a network. Jobs are transmitted by sending all ASP single-record files as individual, separate transmissions. All other data is blocked into a transmittal buffer and is deblocked at the receiving end. Thus, all ASP control blocks must be compatible on all systems in the network.

INTERNAL JOB PROCESSING (IJP)

The Internal Job Processing (IJP) routines provide an interface to the ASP system by problem programs during execution. Some examples of IJP usage are:

- A conversational terminal system submitting job input to ASP for scheduling and processing
- A job requiring printing or punching prior to termination of execution
- A job that builds a JCL input stream and must submit it for processing
- Support of OS Time Sharing Option (TSO)

In essence, IJP can be used to provide to the using task a logical extension of the card reader and ASP control card capabilities.

There are no machine requirements peculiar to IJP other than those required by ASP and the IJP user task. In addition to enabling the submission of jobs to ASP by IJP, IJP allows ASP data sets which were created by submitted jobs to be moved to the Main Processor where the job originated.

Support is also provided for TSO STATUS/CANCEL. With these facilities, a job may be created by TSO and submitted to ASP. The user has the ability to inquire on the status of his job and cancel his job. He may specify in his control cards that certain ASP output data sets be routed back to his terminal.

JOB FLOW CONTROL

By means of control cards, the application programmer retains job flow control for preprocessing and postprocessing. These control cards permit the application programmer to specify sequentially the required processing steps and to issue special instructions to the operator (for example, he might request that special printer forms be used).

DEPENDENT JOB CONTROL (DJC)

This major facility of the ASP system allows simple or complex job string dependencies present in most commercial data processing installations to be automated. DJC allows jobs to be entered into the ASP system as members of a Dependent Job Net (a collection of related, dependent jobs). This net will then be managed throughout its execution in the ASP system. Dependencies such as success or failure of predecessor jobs may be used to cause execution, holding, or flushing of successor jobs.

Extensive inquiry capabilities are also provided for the operator to examine the status of a dependent net.

DEADLINE SCHEDULING

Deadline Scheduling is a technique for increasing the probability that a job will complete processing by a specified time. This is accomplished by manipulating the job's priority according to installation-specified algorithms during ASP initialization based upon the amount of time the job is in the system. There are two main considerations in the algorithms:

1. An initial priority change associated with a job's processing lead time.
2. Subsequent priority changes to be applied at regular intervals.

Deadline Scheduling also allows jobs that normally run on a regular basis (e.g., once each week) to be specified for completion by a particular day of the week (or month) at a particular time.

GENERALIZED MAIN PROCESSOR SCHEDULING

This facility allows the system operator to dynamically modify the ASP scheduling algorithm in use on the basis of system workload changes, shift changes, operational manpower changes, etc. Various job classes, setup criteria, and message routing criteria are specified to ASP at initialization. The operator is then free to choose the appropriate algorithm for his current workload.

POLYASP

POLYASP permits concurrent execution of the ASP system in two or more regions of the same processor. Each region contains the complete ASP system and therefore each region will run independently of the others.

POLYASP is particularly useful in system testing. For example, a production version of ASP might be running in one region while system programmers are checking out a test version of ASP in another region.

READER INTERPRETER

The OS Reader Interpreter is a part of the ASP system on the Support Processor, allowing ASP to have access to Job Control Language before, during, and after it has been interpreted. This kind of control gives ASP the capability to automatically execute decisions that were previously relegated to the user and/or OS on the Main Processor.

Note: In a mixed OS/MVT and OS/VS2 environment the OS/VS2 reader/interpreter will be used. Hierarchy LCS will not be supported in a mixed environment.

DYNAMIC TASK DISPATCHING

ASP provides a dynamic task dispatcher, which dynamically adjusts the priorities among ASP-scheduled jobs on either a local or remote Main Processor. The objective is to keep CPU-bound jobs from consistently locking out I/O-bound jobs.

Note: ASP dynamic task dispatching is not required when OS/VS2 is being used. This function is performed by the Automatic Priority Group facility of OS/VS2.

DISK READER

The disk reader provides a high-performance input capability for jobs or job streams that change relatively infrequently. Each input file of JCL becomes a partitioned data set member which the operator can selectively read in, just as if it were a card deck.

MAIN STORAGE FENCING

Main Storage Fencing enables the ASP user to structure Main Storage into pre-defined areas called "fences". Each fenced area is associated with a group of ASP job classes. When a fenced job is scheduled on an ASP Main Processor, its region size is allocated from the fenced area. A fenced job cannot obtain Main Storage outside its fenced area; likewise, unfenced jobs cannot obtain Main Storage from within a fenced area. As a result, once a fenced area is constructed, the jobs running within the fence are isolated from other jobs on that Main Processor. In effect, a fenced area is an MFT-like partition.

Fencing a long-running job solves a number of Main Storage management problems. First, storage fragmentation can be eliminated by allocating the fenced area at the top of available Main Storage. Also, if the job has multiple steps with large region sizes, the fence prevents other jobs from taking this job's region space during a step change. And finally, if the job abends and must be restarted, fencing will reserve the job's region until the restart can be accomplished.

CHAPTER 5. SYSTEM PROGRAMMING CONSIDERATIONS

In previous chapters it was shown that there are many areas in which ASP improves the performance over standalone OS processors. Total system performance is still greatly dependent on many factors over which the customer has ultimate control. These include:

- Effective coding techniques in user modifications
- Selection of ASP Initialization control card parameters (careful planning and some testing will be necessary here)
- User job mix
- Amount of storage available
- System hardware configuration
- OS tuning

The ASP system is completely reconstructed at each ASP restart. Any control card parameters that do not affect the ASP queue may be modified across an ASP restart. This gives the user great flexibility in tuning his ASP system. Through the use of Generalized Main Scheduling, the user may also dynamically modify his choice of main scheduling options without restarting the system.

USER-WRITTEN MODIFICATIONS

The ASP system is written in the OS Macro Assembler Language. Although many background utility Dynamic Support Programs (e.g., Card-to-Tape, Tape-to-Print, etc.) are provided with the ASP system, the user may create additional DSPs and add them to the system. These additional DSPs must also be written in the OS Macro Assembler Language.

The ASP system is designed for the large data processing user. This user typically has many unique processing requirements which are present in his current system. These include (but are not limited to):

- Unique accounting routines
- Specialized DSP's (e.g., plotting, paper tape)
- Special volume label processing
- Extraordinary setup criteria
- Tailored console messages
- Special control card processing

These unique requirements may be satisfied by customized modifications to the ASP system. Many currently installed ASP systems contain user-designed and user-implemented modifications. To design and install user modifications, the user must be knowledgeable in ASP internals, use of ASP Macro facilities and the OS Macro Assembler Language (the F-level or H-level assembler is used when reassembling ASP modules). Distribution and maintenance assumes the use of IEBUPDTE.

The design of the ASP system contains many features to facilitate modifications. These include:

- ASP Macro services
- Centralized tables
- Mapping DSECTs
- ASPIO facilities
- Standard interfaces to OS, such as ASPEXCP

The ASP system also has built-in protection mechanisms to isolate failures and provide good debugging facilities. These include:

- Initialization analysis routines
- ASP SPIE and STAE interfaces
- ASPABEND dump facilities
- Dump core DSP
- POLYASP (see Chapter 4)
- DSP Failsoft (see Chapter 7)

SYSTEM/360 AND SYSTEM/370 OPERATING SYSTEM CONSIDERATIONS

All ASP Main Processors operate with either OS/MVT or OS/VS2. The Support Processor and/or local Main Processor can also use OS/MVT or OS/VS2. ASP exploits some of the key features provided by MVT and therefore supports only this option.

Note: ASP itself, when operating under OS/VS2, must operate in the Virtual=Real mode.

ASP contains certain modifications to OS on each processor and is therefore OS release-dependent. For this reason, the proper planning for an ASP installation includes the selection of the proper ASP release to support the selected OS release.

Normally, ASP Console Service will be the exclusive console program used in the Support Processor. There is one case, however, when the OS Multiple Console Support (MCS) feature is necessary: when the primary console on the Support Processor is a graphic console (e.g., the 3060 on the Model 195 or the 3066 on the Model 165). In this case, both MCS and ASP Console Service must be specified during system generation. MCS is necessary to allow the Support Processor to be IPL'ed from the primary console. For a detailed discussion of system generation, refer to the ASP System Programmer's Manual.

ASP does not support the Automatic Volume Recognition feature of OS. Improper operation will result if it is specified.

INTEGRATED EMULATION

The ASP system will schedule work destined for the System/360 and System/370 integrated emulation features. The jobs will be treated as normal OS jobs with no unique action taken.

ASP VERSION 2 FEATURES NO LONGER SUPPORTED

The following OS features and devices supported in ASP Version 2 are no longer supported:

- OS PCP (Main or Support)
- OS MFT (Main or Support)
- The 709X Emulation Feature on System/360 Model 65
- ASP Queue on the 2311
- Use of the CTC as a scratch tape

The following channel-to-channel commands are not supported by Version 3. The commands and actions taken by ASP, should they be used, are:

<u>Command</u>	<u>Action</u>
Rewind	Close or ignore
Rewind Unload	Close or ignore
Erase Gap	Ignore
Backspace Record	Invalid - cancel job w/msg
Backspace File	Ignore
Forward-Space Record	Invalid - cancel job w/msg
Forward-Space File	Ignore

CONVERSION TO ASP VERSION 3

From Previous ASP Versions

The user planning a conversion from ASP Version 2.6 to ASP Version 3 can utilize POLYASP to aid in the conversion. Since the Version 3 system does not have a compatible ASP queue to Version 2.6, a Cold Start must be instituted when the final conversion takes place. POLYASP will minimize the difficulty in the transition by allowing both Release 2.6 and Version 3 to operate concurrently in the same CPU if storage is available. The POLYASP Reader feature allows jobs from the 2.6 queue to be transferred to the Version 3 ASP queue, with the transferred job either purged from the old queue or left in the old queue in hold status.

Using this facility, a job may be executed in parallel under control of Version 2.6 and Version 3 and the outputs compared to ensure compatibility before the switchover to Version 3. To accomplish this use of POLYASP, each ASP region must schedule a different Main Processor (e.g., Version 2.6 schedules local, Version 3 schedules remote). Even in a single processor system, POLYASP may be useful through a facility known as Dummy Main Processors. The use of a Dummy Main Processor allows one ASP region to schedule the local Main and the second region to schedule the Dummy Main. This use of Dummy Main allows some checkout of user modifications prior to production use of Version 3.

From OS Without ASP

It is recommended that the user install MVT or VS2 on his planned ASP configuration and gain operating experience before installing ASP. He should then obtain Version 3, add the appropriate ASP PTFs, and test against his actual workload before going into production with the system.

Note: It is highly recommended that both the existing user of ASP and the new ASP user initially generate Version 3 without user-written modifications applied. Modifications, applied to a soundly functioning system, will then be easier to implement.

CHAPTER 6. APPLICATION PROGRAMMING CONSIDERATIONS

APPLICATION PROGRAMMER RESPONSIBILITIES

The primary programming considerations of concern to the ASP application programmer are the programming conventions of the Main Processor OS. The programmer may use any user-oriented feature or component that is available at the current support level of the Operating System.

Data sets assigned to the channel-to-channel adapter must be unlabeled sequential and are limited in physical record size to the ASP I/O buffer size - 24 bytes of the Support Processor. Buffer size is assigned by the local installation and is dependent on the size of the Support Processor and the type of direct access storage device being used for the ASP queue. Use of a smaller buffer size is possible but will limit the performance of the ASP system. In general, the use of the channel-to-channel adapter should be restricted to output data sets to be postprocessed by the Support Processor, using the standard Data Management access methods to create them.

When ASP is used in a multiple Main Processor environment, the ASP system ensures proper Main Processor assignment for jobs requiring specific devices that are controlled by ASP. In addition, ASP informs the programmer on which system the job was executed. However, differences in the Main Processors, such as in processor speeds or special features, must be accounted for by the application programmer in his specification of the Main Processor on which his job is to be run.

ASP CONTROL CARDS

The ASP system introduces several ASP control cards. These control cards permit the programmer to take advantage of the benefits provided by ASP. The use of these control cards is optional, depending on the special capabilities required. The cards communicate to the system special instructions for forms control on the printer or card punch, the requirements for a specific Main Processor, and the special functions required for job processing. The features introduced by these control cards are sometimes provided in a different manner in a non-ASP environment; thus, if a non-ASP job requires these features to execute properly, some changes are necessary.

In addition to the ASP control cards, all required OS job control cards must be used. All OS job control cards remain unaltered and are used in the same manner in which they are used in a non-ASP system. For a detailed explanation of these cards and their use, refer to IBM System/360 Operating System Job Control Language, System Reference Library (GC28-6539).

ASP Version 3 control cards are formatted similar to OS comments cards (i.e., /** in columns 1-3) and may be used anywhere in the job's JCL.

CHAPTER 7. ASP RELIABILITY, AVAILABILITY, AND SERVICEABILITY (RAS)

ASP, as a programmed operator of System/360 and System/370 multiprocessing systems, is a powerful enhancement to the OS/MVT and OS/VS2 control programs and their RAS features. RAS features are designed into all IBM products, and the basic concept of ASP is to increase the RAS of the entire installation. To the ASP user, reliability is one of the most significant factors in the selection of ASP as his system program.

RAS FEATURES

The additional RAS features that ASP brings to the user include:

1. DSP Failsoft - When any DSP in the ASP system abends, an attempt is made to continue processing in a degraded mode rather than bring down the entire system.
2. ASP System Failsoft - An ASP system abend does not generally abend any program execution in the ASP complex independent of ASP. ASP may be reinitialized without the need for a re-IPL of the system.
3. ASP Hot Job Support - The capability exists within ASP to schedule long-running or never-ending jobs as ASP "Hot Jobs". Hot Jobs are those jobs that must continue their execution in the event of an ASP software failure. If ASP abnormally terminates, Hot Jobs will continue to execute independently of ASP and the master console is returned to OS. When ASP is reinitialized, ASP will recognize these jobs and resume control without further interruption or reinitialization of the jobs.
4. Console Service Error Recovery - Many RAS features are inherent in the design of ASP Console Service. Console Service will log hardware errors, including error status information, and perform appropriate error recovery procedures. Console Service provides a special console test DSP which may be used to diagnose potential hardware problems. Support is provided to switch messages destined for one console to any other console attached to the system. Support is provided to disable a console from the system for offline repair or preventive maintenance and then reenables the console for use by ASP.

ASP Console Service provides automatic rerouting of console messages to a user-defined alternate console in the event of a permanent error. Console buffer depth can be exceeded by an out-of-ready condition on that console. In that case, overflow messages will also be rerouted to the alternate.

5. Remote Job Processing (RJP) - RJP also has many RAS features. RJP handles all error conditions without operator intervention (where possible). The operator is informed only of disastrous types of errors, although all errors are accumulated in statistics tables. The design of RJP includes positive acknowledgment of all transmissions between the ASP system and its remote workstations. The ASP RJP support includes a DSP which displays the accumulated error statistics upon operator command.

6. ASP DSP's - All ASP DSP's which utilize unit record, tape, or disk devices support OS LOGREC, and all appropriate errors are logged.
7. ASPABEND - This feature formats and prints the ASP tables, registers, and status at the time of an operator-initiated or abnormal termination dump.
8. Dump Core (DC) - This dynamic facility displays selected areas of core on the operator console. It may be used to invoke the ASPABEND feature mentioned above. As a debugging aid it will, in some cases, enable a system recovery that would not otherwise be possible.
9. POLYASP (see Chapter 4) - POLYASP greatly increases system availability by allowing testing of ASP to be performed concurrently with production jobs.

PROGRAM SERVICE CLASSIFICATION

ASP is a Type I extension with Class A service. Maintenance questions regarding ASP should be directed to the local IBM Program Support Representative.

CHAPTER 8. MACHINE CONFIGURATIONS

MAIN PROCESSOR

The Main Processor may be any IBM System/370 or System/360 capable of running OS/MVT or OS/VS2. This includes the Model 65 Multiprocessing System.

The Main Processor in the ASP system is configured as required by OS and the application workload of each installation. When more than one processor is used, an ASP system differs from a single processor configuration in that the channel-to-channel connection replaces the conventional system input/output devices on the remote Mains.

The channel-to-channel adapter interconnects two channels, one each on the Support and Main Processors. The feature, required physically on only one of the channels, uses one control unit position (two on the 145) for each of the interconnected channels. On the Main Processor, the channel-to-channel adapter may be considered as a set of tape units. While it is desirable to dedicate a channel to the CTC adapter, it is not necessary. If additional control units share the CTC channel, they should be high-speed devices so as not to seriously impair system performance. (On a local Main Processor the CTC is simulated internally by ASP. A real CTC is not required.)

In multiple Main Processor systems, the Main Processors need not have the same configurations, but rather may be different models with dissimilar input/output characteristics. They may share input/output units, such as tape units connected by a 2816 Switching Unit; however, this is not required.

SUPPORT PROCESSOR

The Support Processor in an ASP system using more than one processor is required to have:

- Processing unit
- Processor storage
- Two or more selector channels
- Channel-to-channel adapter (if not on the Main Processor)
- Multiplexer channel
- 3330 or 2314 Direct Access Devices (Block Multiplex Channel required for 3330)
- Input card reader(s)
- Output card punch(s)
- Output printer(s)
- Console typewriter

The IBM System/370 processing unit that is recommended for ASP is the Model 145 or larger. The choice of a Support Processor is governed by the plans of each installation for:

- The number and types of support functions required
- The number and types of RJP and NJP communication lines to be supported
- The number and types of Main Processors and their anticipated workload
- The extent of local mode execution to be used

The Model 145 may be adequate to satisfy a basic Support Processor workload for most installations. However, when multiple high-speed teleprocessing units are attached, the potential CPU multiplexer channel interference may dictate a faster processor. (Other factors, such as the number and types of Support Processor functions, amount of multiplexer I/O activity for RJP and NJP or the installation of multiple Main Processors, may also dictate the installation of a Model 155 or larger.) If Support Processor tasks, particularly the anticipated teleprocessing workload, dictate a faster CPU, consideration should be given to using the local mode of execution on the Support Processor to absorb the excess processing unit capacity.

The minimum storage required for an ASP Support Processor is a Model HG (393,216 bytes). All storage sizes above this minimum are also supported.

The storage size that should be selected also depends upon local installation plans for the number and types of support functions (RJP, NJP, etc.).

The Support Processor should have at least two selector channels. It is recommended (though not required) that selector channel 2 (or selector channel 3 on a three-channel processor) have only the channel-to-channel adapter device attached to it (refer to Figure 1). This eliminates the interference on the connection between the Main and Support Processors, enabling the Support Processor to service the Main Processor to best advantage. The direct access storage devices should, if possible, be attached to a selector channel other than the one that services the channel-to-channel adapter.

The channel-to-channel adapter is used to interconnect two channels, one each on the Support and Main Processors. It should be assigned to the lowest priority channel on each system. The feature, required on only one of the channels, uses one control unit position on each of the interconnected channels.

The multiplexer channel is used for attaching to the Support Processor the card readers, card punches, printers; and the teleprocessing control units for operator consoles and RJP and NJP terminals.

The direct access storage space on the Support Processor is used to store the system residence file and the ASP job queue. The supported direct access storage devices are the IBM 3330 Direct Access Storage Facility or the IBM 2314 Direct Access Storage Facility. The Support Processor requires one IBM 3330 or one IBM 2314 module for the ASP system residence device. Depending upon the space allocation for OS and the ASP job library, some space may be allocated from the system residence device for the ASP job queue; however, it is not recommended because of possible contention between system use and the ASP Disk Input/Output program. Remaining 3330 or 2314 modules may be used to queue ASP jobs in the system (ASP will support up to 32 modules for that purpose). Each 3330 has the capacity to queue about 240 average jobs, whereas a 2314 module is capable of queuing about 60 average jobs. (An average job is defined as a total of 5000 cards and/or print lines of

data.) Although ASP can operate with one queue pack, additional packs are recommended for improved performance.

Support of Input Readers

The following devices may be used to enter jobs into the ASP queue:

- IBM 2501 Card Reader
- IBM 2540 Card Read Punch
- IBM 3505 Card Reader
- IBM 3525 with Card Read feature, 1533
- IBM 2400 series magnetic tape units
- IBM 2420 series magnetic tape units
- IBM 3410 series magnetic tape units
- IBM 3420 series magnetic tape units
- Any OS BPAM supported DASD
- Remote RJP workstations connected through appropriate transmission control units (see RJP configuration section)

Jobs may be input to ASP using either 9-track tape or, with the Data Conversion feature, 7-track tape, with the above-listed magnetic tape units.

Support of Output Printers and Punches

The following printers may be used as ASP output devices:

- IBM 1403 Model 2 or N1 Printer
- IBM 3211 Printer
- Remote RJP workstations connected through appropriate control units (see "ASP Requirements for RJP", below)

The following card punches may be used as ASP output devices:

- IBM 2540 Card Read Punch
- IBM 3525 Card Punch

(Feature numbers 5272 and 8338 are not supported)

The number of printers to be attached to the system depends on installation requirements. Support of other types of unit record devices is a user responsibility and must be considered on an individual basis. There are no restrictions within the ASP system that preclude other printer models; however, device peculiarities could impact specific programs in the system.

Support of Operator Consoles

The following devices are supported as auxiliary operator consoles in the ASP system:

- IBM 2740 Communication Terminal, Model 1

Required features:

4790 IBM Line Adapter
9104 Character Spacing - 10 char/inch
9435 or 9436 Line Feeding
9592 PTTT/EBCD Printing Element
9700 System Application

Restricted features (should not be installed on ASP console devices):

1313 Automatic EOB
3255 Dial Up
6114 Record Checking
7479 Station Control
8028 Transmit Control

This console must be attached to a 2701, 2702, or 2703 via a dedicated line (no other terminals on this line) as follows:

IBM 2701 Data Adapter Unit

Required features:

4636 IBM Line Adapter (one/console)
4640 IBM Terminal Adapter Type I (one/console)
9581 Speed Selection (for #4640)

Permitted Features:

3815 Expanded Capability (for additional lines)
3855 Expansion Feature (for additional lines)

IBM 2702 Transmission Control

Required features:

4612 IBM Line Adapter (one/line)
4615 IBM Terminal Control Type I
9684 Speed Selection (for #4615)
9696 Terminal Control Base

Permitted feature:

7955 31 Line Expansion

IBM 2703 Transmission Control

Required features:

4619 IBM Terminal Control Base
4688 IBM Line Set 2 (one/eight consoles)
4696 IBM Terminal Control Type I
4878 Line Speed Option
7505 Start Stop Base Type I

Permitted features:

1440 Base Expansion

IBM 3705 Communications Controller (Emulation Mode)

The 2701, 2702, 2703, and 3705 may include other features (e.g., Adapters, Speed Selections, Terminal Controls) only if they are not used with the auxiliary console portion of ASP.

- IBM 2260 Display Station, Model 1

Required feature:

4766 Alphameric Keyboard

Permitted feature:

9430 Long Cable Attachment

The 2260 must be attached via a Local Mode IBM 2848 Display Control, Model 3, as follows:

IBM 2848 Display Control, Model 3

Required features:

4787 Line Addressing
9011 Channel Adapter
Specify System Attachment

Permitted features:

3858, 3859 Expansion Unit
5340 (5341) Non-Destructive Cursor (and Adapter)
7928 Printer Adapter (required for 1053 Model 4)

Restricted features (should not be installed on ASP console devices):

4656, 4657 IBM Terminal Adapter, Type III

- IBM 1053 Printer, Model 4 (available with the 2848)

Permitted feature:

1006 Accelerated Carrier Return

- IBM 1443 Printer, Model N1
- IBM 1403 Printer, Models 2, 3, 7, or N1

Requires:

1416 Interchangeable Train Cartridge (Models 3 or N1)

- IBM 3211 Printer

Requires:

3216 Interchangeable Train Cartridge

Permitted Feature:

5554 150 Print Positions

- IBM 1052 Printer/Keyboard, Model 7 (Direct attachment or remote)

For remote systems consoles, Model 7 attaches to a 2150 as follows:

IBM 2150 Console

Required features:

Attach to 1052, Model 7 (above)

Permitted features:

5475, 5476 Operator Control Panels

- IBM 2250 Display Unit, Model 1

Required features:

1245 Alphameric Keyboard
1498, 1499 Buffer
1880 Character Generator

Permitted features:

1002 Absolute Vectors and Control
4485 Graphic Design
4785 Light Pen
5475, 5476 Operator Control Panel
5855 Programmed Function Keyboard

- IBM 3060 System Console for System/370 or System/360, Model 195

Permitted features:

5476 Operator Control Panel (second)

- IBM 3066 System Console for System/370, Model 165
- IBM System/360, Model 85 Operator Console - Feature 5450
- IBM 3210 Console Printer/Keyboard, Models 1 and 2
- IBM 3215 Console Printer/Keyboard
- IBM 3277 Display Station, Model 2

Required feature:

EBCDIC or Operator Keyboard

Permitted features:

All other features

The 3277 Model 2 must be attached via a 3272 Model 2 as follows:

IBM 3272 Control Unit, Model 2 (local attachment)

- IBM 3284 Printer, Model 2 attached to 3272, Model 2 (above)
- IBM 3286 Printer, Model 2 attached to 3272, Model 2 (above)

- IBM 7412 Printer/Keyboard, Model 1 (RPQ - similar to 2150 but uses a 3215 type printer)

Support of Additional Components

The Support Processor can be expanded to include such additional components as:

- Additional selector channels on the System/370 or the System/360. This allows additional units such as tapes and direct access storage devices to be attached to the Support Processor.
- Tape drives. This allows tape background processing (such as tape-to-printer or conversion of seven-track tape to nine-track) to be performed on the Support Processor.
- Additional operator consoles.
- User-specified devices (e.g., plotters), under control of user-written DSPs.

ASP REQUIREMENTS FOR RJP

Support Processor Requirements

The central system requires a 2701, or a 3705, equipped for binary synchronous communication in the EBCDIC mode. Optional supported features are:

- EBCDIC Transparency
- Dual Code (with EBCDIC as either code)
- Dual Communications Interface

Non-programmable Remote Workstation Configurations

2780

Any model 2780 with the EBCDIC transmission code may be used as an ASP remote workstation. The Multi-Point Line Control feature is not supported and will cause improper operation if installed.

Optional features supported by 2780 remote workstations are:

- EBCDIC transparency. This feature is required only if transmission of the full EBCDIC character set is required (such as for transmission of object decks). Normal reading, printing, and punching of the standard (nontransparent) EBCDIC characters may be done without this feature.
- Multiple Record feature (#5010). This feature is highly recommended to improve terminal performance, particularly on a switched, 2000-baud line.
- 120- or 144-character print line (#5820, 5821).
- Printer Horizontal Format Control (#5800). This feature, if present, is used by RJP to provide an embedded blank compression capability. ASP RJP's use of horizontal tabs is completely automatic and is totally transparent to the system and the problem

programmer. Depending upon the print data structure (that is, the extent of embedded blanks), the use of this feature can significantly improve terminal print performance, particularly on slower-speed communications lines. The feature may be present on a system that contains the transparency feature.

- Synchronous Clock (#7705), AutoAnswer (#1340), and Auto-Turnaround (#1350). The presence of these features is transparent to RJP.

2770

A 2770 configured with the appropriate features may be used as an RJP workstation. The minimum 2770 system requires a 2772 Control Unit with EBCDIC. No special features are required.

The following features are not required but will be supported if present:

- #1490 - Buffer Expansion (recommended for optimum performance)
- #1491 - Buffer Expansion Additional
- #3650 - EBCDIC Transparency (required if OS object decks are to be transmitted or punched)
- #4690 - Keyboard Correction
- #7705 - Synchronous Clock
- #7950 - Transmit-Receive Monitor Print

The #5010 Multi-Point Data Line Control feature is incompatible with ASP RJP support and should not be specified.

All features not specifically prohibited may be attached to the 2772 but will not be supported by ASP RJP.

Supported input/output units include:

- 2213 Model 2 Printer
- 2203 Model A1 or A2 Printer
- 2502 Model A1 or A2 Card Reader

All other input/output units may be attached to the 2772 but are not supported by ASP RJP.

3780

Any model 3780 with the EBCDIC transmission code may be used as an ASP remote workstation. The Multi-Point Data Link Control (#5010) and Identification (#9350) features are not supported and will cause improper operation if installed.

Optional features supported by ASP are:

- #3601 - EBCDIC Transparency. This feature is required only if transmission of the full EBCDIC Character Set is required (such as transmission of object decks). Normal reading and printing of the standard (non-transparent) EBCDIC Characters may be done without this feature.
- #5701 - Print Positions, Additional

- #4650 - Keylock
- #7651 - Switched Network Control (specify no Terminal Identification)

Programmable Workstation Support

ASP RJP is designed to operate with the HASP remote workstation packages. These packages are currently available for 1130, Model 20, System/360, and System/3 terminals. These packages may be obtained by ordering the HASP II system (360D-05.1.014). It is the customer's responsibility to order the HASP II system and to perform the appropriate remote generations of the needed remote terminal packages.

System/360

Any System/360 (with 8K or more of main storage) with a 2701, 2703 or 3705 (or equivalent on Models 25 and 135) equipped for EBCDIC mode, binary synchronous communications, and any 2540, 2501, 2520, or 1442 card reader may be used as an ASP RJP remote workstation. All of the following readers, punches, and printers are supported: 1442, 2501, 2520, 2540, 1403, 1443, 3211; and 1052 console. A maximum of seven readers, seven printers, and/or seven punches are used by RJP on each workstation, but only 16 functions may occur simultaneously (eight input and eight output) in addition to console operations.

Note: To obtain maximum performance with more than four simultaneously active unit record devices, the user should have at least 12K bytes of storage and appropriate communications and CPU facilities.

Communications lines (switched or nonswitched) of any speed supported by the hardware are supported. The standard operator console is supported as an ASP limited- or full-function remote operator console. Only one console is supported on each remote workstation.

System/360 Model 20

Any submodel of the Model 20 with at least 8K bytes of core storage, the EBCDIC Binary Synchronous Communications Adapter (Feature 2074), and any 2501, 2520, or 2560 card reader may be used as an ASP RJP remote workstation. The unit record devices supported in any combination allowed by the hardware are: 1403, 2203, 1442, 2520, 2560, and 2152 console. Any speed communication line supported by the hardware (switched or nonswitched) is supported. It is recommended (but not required) that a submodel 5 be used in conjunction with high-speed communications lines (19,200 bps and greater) for maximum performance. Certain other features of the Model 20 that are supported if present but are not required include:

- Full Transparency (#4100).
- 2152 Printer/Keyboard. Cannot be used on other than a submodel 5 if a high-speed communications line (19,200 bps or greater) is used.

2922

The IBM 2922 is supported as an ASP RJP workstation. The 2922 utilizes the same HASP system (360D-05.1.014) generation as is used with the Model 20. The standard reader and printer available with the 2922 are the supported input and output devices.

Any model of the 1130 with at least 8K words of storage, the Synchronous Communications Adapter (#7690), and any card reader, may be used as an ASP RJP remote workstation. All standard readers, printers, and punches available for the 1130 system are supported in any combination (including multiple readers and printers). The console printer/keyboard is supported as a limited- or full-function remote operator console. Any standard communication line (switched or nonswitched) of any speed is supported. The RPQ feature to allow the use of high-speed communication facilities is not supported.

System/3 Model 10

The System/3 with the following features is supported as an ASP RJP workstation.

Minimum System/3 requirements are:

- 5410 - Central Processing Unit (any model)
- 5424 - Multifunction Card Unit (any model)
- 5203 - Printer (any model)
- 2074 - Binary Synchronous Communications Adapter with EBCDIC code

Supported features are:

- 1442 Card Read Punch (RPQ 843175 on System/3 5410 and RPQ 841205 on 1442)
- 5471 Printer Keyboard or 5475 Keyboard
- #8639 - Universal Character Set for 5203 Printer
- #5558 or 5560 - Additional print positions for 5203 Printer
- #1315 - Text Transparency
- Any type or speed transmission line available for System/3

Recommended features are:

- 24 or 36 extra print positions on 5203 Printer (to provide for standard OS print line)
- UCS and PN train on 5203 Printer (to provide for standard OS character set)
- Text Transparency (to allow full use of the EBCDIC character set)
- 5471 Printer Keyboard (as a remote operator console)

The following features are incompatible with ASP RJP support and should not be specified:

- #9482 - Multi-Point Network Attachment
- #9061 - USASCII Transmission Code
- #7477 - Station Selection

All features not specifically prohibited may be attached to the System/3 but will not be supported by the HASP II System/3 workstation program.

MINIMUM MAIN PROCESSOR

The minimum Main Processor for an ASP configuration is a System/370 or System/360 computer that is capable of executing OS/MVT or OS/VS2. Except for the attachment of the channel-to-channel adapter to a selector channel, ASP does not impose any requirements upon the Main Processor equipment configuration over those imposed by OS.

Certain modifications to the OS nucleus are required to operate as an ASP Main Processor. They increase its size by approximately 2000 bytes. Most ASP functions required on the OS Main Processor are incorporated in the module MAINTASK, which operates as a system task on the Main Processor. MAINTASK size will vary in the 30K-60K range depending on the options selected. The OS reader and writer functions for each Main Processor are performed by MAINTASK. Since the OS reader and writer modules are no longer required on a Main Processor, a storage saving can be realized.

MINIMUM SUPPORT PROCESSOR

The configurations described below represent practical minimum configurations for the various options. Determination of the best configuration for an installation must be made by taking into account the anticipated system workload and by balancing the unit record equipment with the direct access storage device work queue and Support Processor storage. Under special circumstances, a configuration that is less than the stated minimum may be employed successfully. However, deviation from the minimum configuration should be considered only after careful study and evaluation of the system and its anticipated workload. In most cases, additional DASD queue space and additional unit record equipment will be required in order to maintain a balanced system. For ease of system maintenance and operational convenience, it is strongly recommended that at least one tape unit (nine-track or, with Data Conversion feature, seven-track) be attached to the Support Processor.

Basic Support Processor

The basic Support Processor minimum configuration represents the smallest system that executes the ASP system efficiently. This minimum Support Processor configuration can:

- Process jobs under OS MVT
- Read the input stream from a card reader
- Punch the output stream on a card punch
- Print the output stream on a printer
- Queue 60 jobs (as defined above) on the direct access storage devices
- Perform several support functions concurrently on the Support Processor

The configuration is as follows:

One 3145 Processing Unit, Model HG with:

3345 Model 1 393,216 bytes of processor storage feature

3046 Power Unit

One 1850 Channel-to-Channel Adapter feature

One 1421 Selector Channel 1
One 1422 Selector Channel 2
One 3215 Console Printer/Keyboard with:
One 7855 Adapter Feature
One 3811 Printer Control Unit
One 3211 Printer
One 3216 Interchangeable Train Cartridge
One 3525 Card Punch
One 3505 Card Reader
One 3830 Storage Control
One 3330 Disk Storage
Two 3336 Disk Packs
One 3803 Tape Control
One 3420 Magnetic Tape Unit, Model 3

Note: Any units or functions beyond the above, such as multiple printers, nonminimum buffer sizes, or use of RJP or NJP, may cause the minimum storage requirement to be exceeded.

Basic Support Processor - Local Mode Execution

A basic Support Processor intended to run in the local execution mode (combined Support Processor - Main Processor) must of necessity be somewhat larger than the Support-only Processor.

The configuration below defines an acceptable standalone system, assuming that OS MVT is being used and that other OS tasks are under the control of ASP through the use of the local mode execution option.

This standalone ASP Support-Main Processor may be expanded to meet installation requirements. This is especially true where the standalone is supporting additional (remote) Main Processors. For an additional discussion of this configuration, see the section titled "Extended ASP Configurations", below:

A basic configuration of the combined Support/Main Processor is as follows:

One 3155 Processing Unit, Model J
One 3215 Console Printer/Keyboard with:
One 7855 Adapter Feature
One 3811 Printer Control Unit
One 3211 Printer
One 3216 Interchangeable Train Cartridge
One 3525 Card Punch

One 3505 Card Reader
One 3830 Storage Control
Two 3330 Disk Storage Devices
Four 3336 Disk Packs
One 3803 Tape Control
Two 3420 Tape Units, Model 3

REPRESENTATIVE ASP CONFIGURATION

Figure 4 illustrates a representative configuration of the ASP system. Additional components may be attached to the system when dictated by the requirements of an installation.

The representative ASP configuration can:

- Read the input stream from a card reader, tape unit, and/or RJP terminals attached through a communication line.
- Punch the output stream on a card punch and/or RJP terminals.
- Write the output on any of two printers and/or four RJP terminals.
- Queue hundreds of jobs on the 3330 disk storage devices.
- Perform background processing on the Support Processor such as tape-to-printer, tape-to-tape, etc.
- Utilize the Support Processor local execution option to effectively have dual Main Processors.
- Support the use of OS MVT on the Main Processors.

This representative ASP configuration has the following components:

Support Processor - System/370, Model 165K
One 3165 Processing Unit, Model K, with:
 Four 3360s, Model 5 (2M bytes of processor storage)
One 2860 Selector Channel, Model 2 (2 channels)
One 2870 Multiplexer Channel
One 2880 Block Multiplexer Channel, Model 1 (1 channel)
One 3505 Card Reader, Model B2, with:
 One 8103 3525 Punch Adapter
One 3525 Card Punch, Model P3

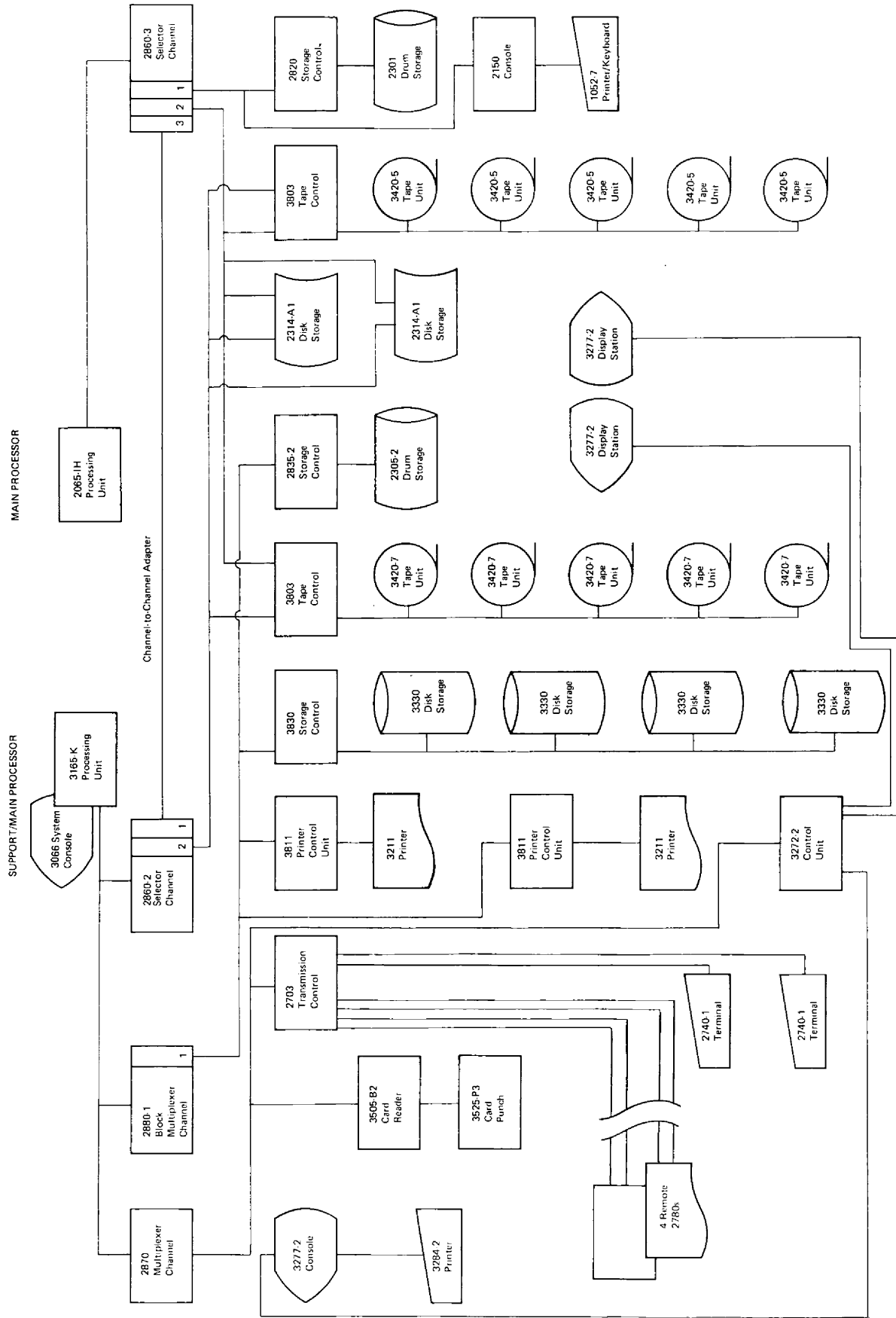


Figure 4. Representative ASP System

One 2703 Transmission Control Unit with:

- One 4878 Line Speed option
- One 4619 Terminal Control Base
- One 4696 Terminal Control Type I
- One 7505 Start Stop Base Type I
- One 4688 IBM Line Set 2
- One 7715 Synchronous Terminal Control (EBCDIC)
- One 7702 Synchronous Attachment
- One 7706 Synchronous Base Type 2A
- Two 7710 Synchronous Line Sets

Four 2780 Data Transmission Terminals, Model 3, each with:

- One 5800 Horizontal Format
- One 5820 120 Print Positions
- One 8030 EBCDIC Transparency

Three 2740 Communication Terminals, Model 1, each with:

- One 4790 IBM Line Adapter
- One 9592 PTTC/BCCD Print Element
- One 9104 10 char/inch
- One 9435 Line Feeding
- One 9700 System Application

One 3272 Model 2 Control Unit with:

- Two 3277 Display Stations, Model 2
- One 3277 Display Station, Model 2, with:
- One 3284 Printer, Model 2

Two 3811 Printer Control Units

Two 3211 Printers, each with:

- One 3216 Interchangeable Train Cartridge

One 3830 Storage Control

Four 3330 Disk Storage Modules, each with:

- Two 3336 Disk Packs

One 3803 Tape Control with:

- One 3551 Dual Density
- One 8100 Two-Channel Switch

Five 3420 Magnetic Tape Units, Model 7, each with:

One 3550 Dual Density (800-1600 bpi)

One 2835 Storage Control, Model 2

One 2305 Fixed Head Storage, Model 2

Main Processor - System/360 Model 65IH

One 2065 Processing Unit, Model IH, with:

Three 2365s, Model 2 (768K bytes of processor storage)

One 7920 1052 Adapter (first 1052)

One 2150 Console

One 1052 Printer-Keyboard, Model 7

One 2860 Selector Channel, Model 3, with:

One 1850 Channel-to-Channel Adapter

Specify 9097 Channel-to-Channel Adapter on Channel 3 (Gate 3)

Two 2314 Storage Control Units, Model A1, each with:

One 8170 Two-Channel Switch

Three 2313 Disk Storage Modules, Model A1, each with:

Four 2316 Disk Packs

One 3803 Tape Control Unit with:

One 3551 Dual Density (800-1600 bpi)

One 8100 Two-Channel Switch

Five 3420 Tape Units, Model 5, each with:

One 3550 Dual Density

EXTENDED ASP CONFIGURATIONS

The ASP system can be extended or contracted from its basic two-computer (plus remote RJP terminals) configuration into larger or smaller configurations. The Support Processor may be enlarged to provide the facility to execute problem programs under control of the ASP system.

In addition, ASP can be expanded to support a second, third, (... to 32) Main Processor. This configuration, called a Multiple Main Processor ASP system, provides workload balancing between the Main Processors.

ASP Local Main Processor Support

The ASP system is implemented as a task under OS/MVT or OS/VS2 and loads as an application program under control of the operating system. In this environment, the ASP Supervisor is loaded first, with the local execution option specified. After ASP Initialization has been completed, ASP takes control of the primary console and initiates job execution as lower-priority tasks on the Support Processor. It should

be noted that ASP treats the Support Processor logically as a Main Processor when the local execution option is used. For this reason, a two-processor system operating under the local execution option is logically a Dual Main Processor system. It is recommended, but not required, that ASP be the highest-priority task, since job performance depends upon the speed with which ASP can respond to a request.

ASP executes in supervisor state under its own storage protect key. This status permits ASP to handle input/output interrupts for the channel-to-channel adapter and provides the best possible response to the Main Processor for input/output requests. Other tasks in this environment, however, remain in problem program state under their own storage protection keys.

Care should be taken in selecting the programs to be run in the other regions of the Support Processor. Although ASP, as typically the highest-priority region, preempts control over lower-priority regions when necessary, it is still possible for lower-priority regions to interfere with ASP and, consequently, to degrade system performance. If programs that execute in lower-priority regions use the same selector channel, control units, or direct access devices as are used by ASP, such programs may degrade ASP performance. Consequently, the performance of the application jobs under its control force ASP to wait for a channel or control unit to become available or to wait for the arm on a direct access device to be repositioned. This is especially true of the ASP queue device. Performance will be seriously degraded if any other data sets are placed on the same volume as an ASP queue. The extent of degradation cannot be stated explicitly since it is dependent upon the program and the frequency of interference. However, installations that are planning such configurations should be aware of the potential problem.

Multiple Main Processors

The Multiple Main Processor ASP system provides the ability for very large installations to combine their computing systems into a highly versatile configuration. Logically, up to 32 different Main Processors may be coupled to a Support Processor to provide a common work queue for the systems. Jobs may be designated for processing on any system or may be scheduled for the first available system. Job scheduling continues to be performed on a priority basis as it is in the basic ASP system. However, with several Main Processors being scheduled, jobs that may be scheduled on any computer tend to be expedited, since they need not wait for a specific processor.

For efficient system operation of a Multiple Main Processor ASP system, it is recommended that an ASP operator console be provided for each of the Main Processors. These consoles would receive all OS write-to-operator-type messages. Individual customer requirements such as unit record usage, setup usage, and tape library facilities may dictate use of additional functional ASP consoles.

For the ASP work queue, the IBM 3330 or 2314 Direct Access Storage Facility is required. Since the ASP system is controlling the workload of multiple computers, a lack of available direct access queue space for output poses a very serious problem. Care must be taken to ensure an ample reservoir of direct access space to accommodate the system. Not all of the modules of an IBM 3330 or 2314 need be assigned. The actual number required will be a function of the type of work being done and the control the operator exercises over the incoming job stream.

The processing demands that are imposed by two Main Processors dictate that a computer of the power of a System/360 Model 50 or larger be used. For three or more Main Processors, a Model 155 or larger is recommended.

Not only is the number of channel-to-channel interrupts increased significantly, but the unit record workload can be expected to increase proportionately as well.

CTC Considerations

Any control program requires unrestricted access to its vital resources to avoid performance degradation or absolute lockout. Load module libraries or queue data sets are examples of critical resources requiring frequent accesses.

In configuring a multiple-CPU environment, particular consideration must therefore be given to the resources which are shared between CPUs. In an ASP configuration, where commonly used disk files are shared between the Support and Main Processors, a potential for this performance or lockout problems exists.

These problems may be avoided by:

- a. Insuring that the channel used to access the CTC from the Main Processor is not the same Main Processor channel used to access the shared DASD control unit on which any data sets referenced by the ASP region reside. In addition to the normal data sets, such as JOBLIB, queue packs, and CHKPNT, the data sets referred to by user DSPs must be examined.
- b. Insuring that no program which runs on a real Main Processor reserves a shared disk pack on which any data sets referenced by the ASP region reside. This can be avoided, for example, by routing any program, such as a SUPERZAP job which is modifying ASP's JOBLIB, to the local Main Processor.

While it is not necessary, both of these conditions may be satisfied by insuring that the ASP referenced data sets are not shared with any other processor.

GLOSSARY

Application Programs. Programs that are run on the Main Processor under control of OS. These include such applications as compilations, assemblies, production jobs, and so forth.

ASP Input/Output Routines. A resident section of the ASP system on the Support Processor that manages the flow of data between the Support Processor and the ASP queue devices.

ASP Supervisor. A resident section of the ASP system on the Support Processor which controls job flow.

Asymmetric Loosely Coupled Multiprocessing. Processing of data shared by two or more computing systems interconnected by an I/O channel-to-channel adapter. The CPUs may be of different types and have their own unique configurations.

Background Job. A job, usually of a utility type, run by ASP on the Support Processor in the ASP region independent of the local or real Main Processor.

Console Service. A resident section of the ASP system on the Support Processor which accepts and transmits messages. This support is not dependent on OS MCS.

Dynamic Support Program. A program, residing on the Support Processor system residence device, that is known to the ASP system by an entry in the Dynamic Support Program Dictionary. The program is executed when a job segment pointing to the Dynamic Support Program is scheduled by the Job Segment Scheduler.

Failsoft. A facility whereby ASP System or Dynamic Support Program failures do not generally halt unaffected jobs. An attempt is made to continue running in a degraded mode.

Hot Job. A job designated by the // *MAIN control card as one that should continue executing in the event of an ASP system abend.

Input Service. A set of Dynamic Support Programs that read the input data and build the system input data set and control table entries for each job.

Interleaving. The alternating of transmission input and output on a single communications facility. This facility enables a terminal to read input and to print and punch output simultaneously.

Internal Job Processing (IJP). A facility which allows jobs to be submitted to ASP directly from an application program such as CRJE or CRBE executing under control of ASP. This job will be processed like a job entering the system from a card reader.

Job. One or more job segments defined to the ASP system by control cards. (The first card of a job is the JOB card, and the job definition is terminated by another JOB card or by an end-of-file indicator.) The standard ASP job is composed of job segments to:

- Interpret the job's job control information
- Transmit the input data to the Main Processor for execution (Main Service)

- Print the output (Print Service)
- Punch the output (Punch Service)
- Purge the job from the system

Job Segment. A logical portion of a job. When the input data is read by Input Service, a Scheduler Element is created for each job segment. The Scheduler Element points to a Dynamic Support Program, which performs the required work.

Job Segment Scheduler. A section of the ASP Supervisor that initiates the processing of job segments.

Main Device Scheduler. A section of the ASP system that schedules the allocation of devices prior to scheduling problem program execution.

Main Processor. A component of an ASP system comprising a central processing unit and input/output devices. This processor is devoted to the execution of application programs.

Main Service. A Dynamic Support Program that schedules the problem program for execution and manages the flow of data (system input, print, and punch) across the channel-to-channel adapter to and from the Main Processor.

Multifunction Monitor. A section of the ASP Supervisor that passes control between the functions within the Support Processor.

Network Job Processing (NJP). A facility that permits the input, processing, and output of jobs to and from compatible remotely located ASP installations.

Nonsetup Padding. The facility to schedule jobs that require no pre-execution setup for execution on Main Processors while processing the setup jobs on the Support Processor.

Print Service. A Dynamic Support Program that prints the data sets created by the Main Processor.

Punch Service. A Dynamic Support Program that punches the data sets created by the Main Processor.

Purge. A Dynamic Support Program that deletes the control table entries and data for each job in the system as it is completed. It may contain the system accounting routine.

Resident Programs. Service programs that are common to ASP support functions. These programs reside in storage throughout ASP execution.

Remote Job Processing (RJP). A facility that permits the input, processing, and output of jobs to and from terminals remote from the ASP installation.

Support Processor. The dominant processor of the ASP system in terms of processing control. Its purpose is to control job flow and system input, printing, and punching, to service remote terminals and other ASP installations, and to perform such background services as tape-to-printer or card-to-tape.

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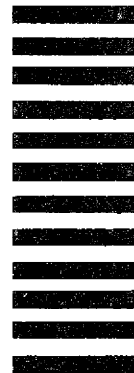
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