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# Job Networking Facilities

By J. M. Hutchinson
Washington Systems Center

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## ABSTRACT

The interconnection of several data processing systems is becoming increasingly common with MVS, VS/1, DOS and VM installations. With different processors, operating systems and subsystems in different geographical locations, these connections can also be complex. This bulletin provides an overview of the IBM products related to job networking and remote job entry, and their compatibility with one another. The operating systems covered are primarily MVS (JES2 & JES3) and VM/370, with some mention of VS/1, SVS, DOS/VSE, DOS/VS and TSS.

The first chapter introduces the concept of job networking, its use and history, and an overview of the IBM product line in this area. Job networking has emerged as an extremely powerful set of protocols for distributed batch processing systems. Some operating systems, notably DOS and VS/1, have no such facility and rely upon workstation programs for this communication. Unfortunately, a lot of capability is lost with workstation programs when compared with job networking implementations.

The next four chapters on RJE, Remote Workstations, Job Networking and Bulk Data Transfer compare products available with each of the operating systems. The chapter on RJE compares the products at a fairly high level and does not address the esoteric differences in areas such as operator commands and messages. The chapter on Workstation Programs compares the products available with DOS and VS/1 systems in more detail with special emphasis on differences between workstation programs and job networking mechanisms. The Job Networking chapter addresses the differences between the various job networking programs when communicating with each other in a network of mixed operating systems. The last of these chapters addresses Bulk Data Transfer as it has been implemented in a network of workstation programs and job networking products.

The final chapter presents installation considerations when designing and implementing a job network. Topics covered are: network configuration, availability, security, and accounting. Also included are some thoughts on installation standards, testing and performance considerations.

Included in the appendices are some reference charts for interconnecting systems for job transmission and bulk data transfer, a bibliography and a glossary of job networking terms.

# PREFACE

The ideas presented in this paper are the result of some experimentation, studying the source code and available documentation, and discussions with users, developers and many other people. As a result, some of the points in this bulletin are the result of speculation and should be taken as such, although a considerable effort has been made to verify the contents for accuracy.

CONTENTS

## LIST OF ILLUSTRATIONS

# 1.0 INTRODUCTION

Job Networking and Remote Job Entry (RJE) are mechanisms that provide a means for users to use batch computing facilities at geographically remote locations. This bulletin describes the features of IBM products supporting these capabilities and gives some insight into how these products may be combined to support the entire batch computing requirements of an enterprise.

## 1.1 DEFINITIONS

- Remote Job Entry

  A host facility to receive jobs from remote terminals and transmit sysout to remote terminals. RJE can be viewed as an extension of local unit record devices (card readers, punches, & printers) and (optionally) consoles.

- Workstation Program

  A program residing in a 'sub-host' which acts like an RJE terminal. The workstation can only transmit jobs to the host, and receive sysout from the host. The host must have the appropriate RJE facility.

- Job Networking

  A facility for transmitting jobs (JCL and in-stream data sets), sysout data sets, (job-oriented) operator commands and operator messages, and job accounting information from one computing system to another.

  This can also be described in the above terms as either "bi-directional RJE support", or as multiple workstations sending jobs and sysout anywhere in the network.

- Job Network

  A collection of peer-coupled systems connected by communication links.[1]. Any member of a Job Network can send jobs, sysout, commands and messages to any other member of the network.

- Bulk Data Transfer

  A host facility or mechanism to transfer data sets (files) to another host.

  This is usually accomplished through a set of utility programs which transform a data set into a job stream (or a sysout data set) and reconstruct it at the receiving end. Usually, the job networking or RJE mechanism is used to actually transmit and receive the data.

- For other definitions relating to job networking and RJE, please see "Appendix C: Glossary" on page 75 at the end of this publication.

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1 This may include channel-to-channel adapters in addition to teleprocessing lines.

## 1.2 A SAMPLE NETWORK

The diagram below is a useful example showing the various systems that may be tied together through the use of RJE facilities, workstation programs, and job networking products. Note the different operating systems: MVS (JES2 & JES3), SVS, VM/370, VS/1 and DOS. Also note several alternate paths available between different node pairs.

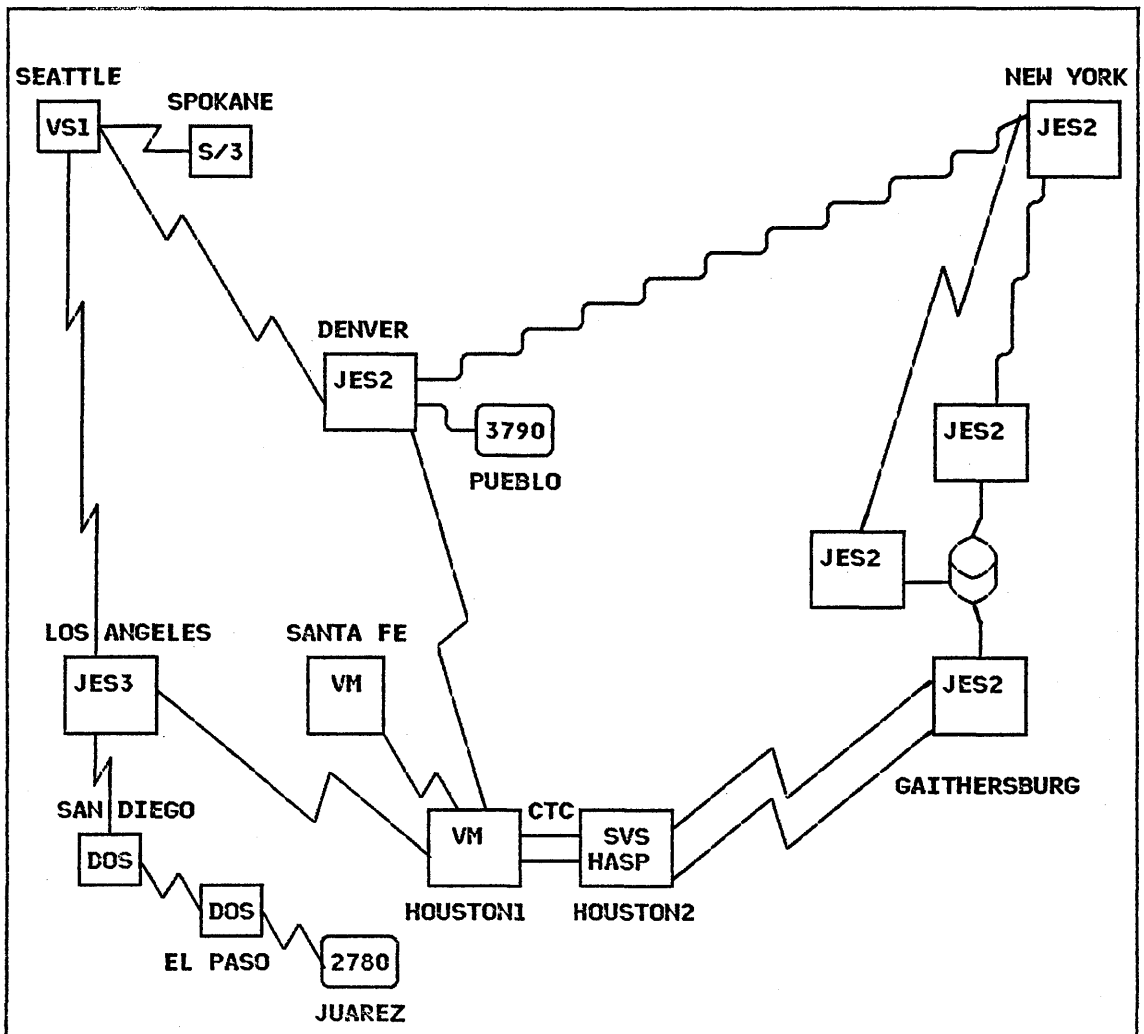


Figure 1. A Sample Network: using RJE, Workstations, and Job Networking.

## 1.3 USES OF JOB NETWORKING

Job Networking and Remote Job Entry (RJE) mechanisms can provide a means for users to use batch computing facilities at geographically remote locations. These products may be combined to provide greater access to the entire batch computing resources of an enterprise.

1. To move JOBS...

   - Job networking can be used to transmit jobs to the system containing the data sets or data bases required for job processing.

   - Job networking can be used to move jobs to systems with the available processing resources. Perhaps the processing power of a 3033-MP is available in the network. This is a simple form of manual workload leveling across nodes in a job network.

   - Job networking can be used to move jobs to systems with the special hardware features such as emulators, or array processors.

   - Job networking can be used to move jobs to specific application processing centers. In this way, a customer may be able to justify a licensed program product for an entire corporation, while it could not for an individual site.

2. To move Job SYSOUT...

   - The most obvious reason for transmitting sysout data sets is to get them to their appropriate locations, closer to the end users.

   - Job networking can be used to move sysout to available print or punch resources, such as the printing power of an IBM 3800 printing subsystem.

   - Sysout data sets may be sent to a special output device such as a plotter or a microfiche printer.

3. To Assist Migration...

   The ability to connect systems together can provide a migration aid. Systems running OS/SVS, OS/MVS, and VM/370 can all be tied together in a compatible job network. In this way, jobs can be entered into any system in the network and can be either run on the "old" system (for production jobs not yet converted), or on the "new" system (for testing or production jobs that have been converted). In a JES2 Multi-Access Spool environment, the complex can be split into two complexes connected by NJE and migrated

to a new release of JES2 in a smooth and orderly fashion.

4. Peer-group communication

   Through job networking and electronic mail, users on the network can communicate with one another by sending messages and files between related work groups. This is the most common use of the IBM Corporate Job Network which has become an extremely fast, easy-to-use, and valuable tool for communication within the company. The Corporate Job Network currently consists of more than 300 processors connected in a world-wide network.

5. Other uses

   A system running VM/370 for interactive program development may be connected to remote processors running OS. With this kind of a "mixed" or "hybrid" job network, batch work may be sent to the OS machine, while keeping the VM system available for interactive use. This configuration may also be used for remote program testing and maintenance in supporting turn-key systems at remote sites.

   In another mixed network, front-end processors for specific applications (e.g., CADAM) may be supported by larger batch processing systems. The batch systems may be used for large file storage and maintenance and large compute-bound jobs, while the smaller front-end processors can respond to a real-time or interactive workload.

   Job networking may also be used to offload or back-up the spool disk during critical situations.

   A distributed data processing network can be used to centralize and coordinate batch computing for an entire enterprise or corporation. Job Networking is an easily implemented and immediately useful vehicle for accomplishing this function.

## 1.4 HISTORICAL OVERVIEW OF JOB NETWORKING

Remote Job Entry (RJE) has been around for many years and is present in all of today's large data processing environments. The design of RJE is to extend the support for card readers, printers and punches to geographically remote locations. At first, RJE used bulk data transfer mechanisms to manually transmit the jobs and output. In 1965, the IBM 1978 was delivered as a custom RPQ box to provide 1440 I/O on a control unit connected to a synchronous transmit-receive (STR) line.

In August of 1969, HASP II Version 2 provided a new "multi-leaving" capability for BSC remote workstations supported at the host by the remote terminal access method (RTAM). Also provided for support at the remote end, were a series of workstation programs written for System/360 Model 20 and above, the 1130 Computing System, and the System/3. Although this exercise was intended to be a demo, it was picked up by ASP and VS/1 and became a "de facto" standard in RJE protocols. The workstation programs have since been upgraded for both IBM products (S/3, S/32, etc.) and other systems. The DOS/VS Remote Workstation Programming RPQ extended this type of support to the small/intermediate 370 user in 1974.

Bulk Data Transfer has its origins before RJE. In fact, early RJE implementations used tape-to-tape transmission units to accomplish remote job entry.

Job networking is relatively new compared to the above two types of batch transmission facilities. As it was defined above, job networking is an extension of RJE facilities with the following differences:

- Peer-to-peer relationship instead of master-slave.
- Network of systems instead of one-to-one connections between host and terminal.
- Bi-directional; jobs and sysout can go in either direction.

In its simplest form, a job network could consist of two processors connected by a communications link. Jobs could be read in on either processor (local or remote reader), executed locally or routed to the other for execution. The output could then be printed or punched locally, on RJE terminals connected to this processor, or sent to the other processor to be printed or punched on its local or remote devices.

In other words, job networking implies complete flexibility for input, execution, and output.

ASP Network Job Processing (NJP) was the first IBM product to provide a form of job networking. Although it is still in use today at a few installations, it is not compatible with the rest of the programs which make up the IBM job networking product line. There are a few short-comings of NJP which were recognized when contrasted to new developments in networking software:

- It uses the basic telecommunications access method (BTAM) which does not make good use of the teleprocessing line.
- It does not automatically route jobs or sysout to the appropriate location. The user is forced to explicitly direct his work along each leg of the network.

- The operator cannot re-route jobs or sysout. If a link or node is down, work in transit cannot continue until the path as originally defined is back in service.

- NJP is only supported by ASP and the protocols consisted of ASP control blocks transmitted between the CPU's. This also meant that all nodes must be at the same software level.

About the same time, some HASP users modified their HASP systems to implement forms of job networking by modifying the 360 stand-alone workstation program to run in an OS region. By running this program in each of two OS machines, jobs and sysout could be sent in either direction. See Figure 2.

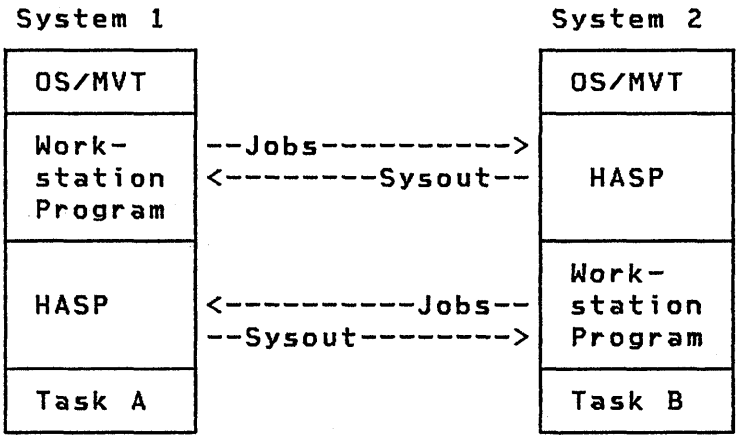


Figure 2. Rudimentary Job Networking: using two workstation programs

Further sophistications were made to support other versions of HASP and add other functions. Multi-leaving protocols were used which made much better use of the communication facility. Jobs and sysout along with commands and messages could be multiplexed on the same line in both directions. Operator commands were also implemented to display and control jobs and sysout at other nodes in the network. System independence was designed into the protocols by using the external form of the job, sysout, message or command which meant that all nodes did not have to be at the same software level. The same kind of bi-directional support was available for VM systems using Remote Spooling Communication Subsystem (RSCS) in early 1974.

In 1973 and 1974, IBM developed two job networks internally (centered in San Jose and Kingston) to communicate between development groups, plants and laboratories. These networks were eventually combined into one and called the "Subsystem Unified Network" (SUN). This internal implementation had many

of the capabilities of the HASP-to-HASP system mentioned above, plus the ability to "store-and-forward" jobs or other data from one processor to the next. The SUN system, later known as the IBM Corporate Job Network (CJN), was the model on which the compatible IBM job networking products were built. The Corporate Job Network today consists of more than 298 nodes throughout the world with support for HASP, ASP, JES2, JES3, VM/370, and TSS.

In November of 1976, IBM announced a set of these products to support job networking at the same time as the announcement for Systems Network Architecture/Advanced Communication Facility (SNA/ACF). The four products announced were:

- Network Job Entry for JES2
- VM/370 Networking[2]
- HASP Networking[2]
- ASP Networking[2]

Unfortunately, the impact of the job networking products was somewhat obscured by the ACF announcement and many people failed to appreciate the significance or value of job networking at that time.

Release 1 of ACF included products that are relevant to the job networking environment. The Multi-Systems Networking Facility (MSNF) of ACF/VTAM would enable the NJE user (when NJE Release 3 was available) to use a SNA session for a NJE connection. This would benefit the JES2 job networking user in several ways:

- Link Sharing: the same SDLC link could carry NJE transmissions along with other SNA sessions, such as TSO, IMS, etc.
- Full Duplex transmissions: for better transmission throughput.
- Link Level Forwarding: This could eliminate the store-and-forward overhead at intermediate nodes.

Since that initial series of job networking announcements, several newer products have expanded the number of systems that can participate in a compatible job network. TSS/370 Extended Support provided a job networking capability in December of 1978.

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[2] These three products are referred to collectively and individually as Network Job Interface (NJI).

In January 1979, the 4300 announcement added three products that were significant to the job networking and remote job entry environment:

- DOS/VSE/POWER and the RJE Feature
- DOS/VSE Remote Job Entry Workstation
- VM/RSCS Networking

These new products were significant to the RJE and job networking community in several respects. For the DOS user, it provided more capabilities for attaching DOS systems to other DOS systems or to OS hosts without using job networking protocols. Unfortunately, this introduced a new (and incompatible) protocol with less capability than the existing job networking protocols (e.g., no store-and-forward facility.)

For the VM/370 user, RSCS Networking replaced the VM Networking Programming RPQ with a program product and had some enhancements over the PRPQ. The most notable feature was the special message facility which extended the VM user's command and message capability to remote locations.

For the JES3 user the JES3 Networking PRPQ was announced in March of 1979, adding the other MVS subsystem to the list of systems that supported a compatible form of job networking. When this product was available in September 1979, the list of operating systems supporting job networking looked like this:

- MVS/JES2 & JES3
- VM/370
- SVS/HASP & ASP
- MVT/ASP
- TSS/370

Unfortunately, there is still no job networking support for DOS or VS/1.

## 1.5 OVERVIEW OF THE PRODUCT LINE

This page highlights the IBM product line by listing the various offerings in the area of workstation programs and job networking facilities:

- Workstation Programs[3]
  - Multi-leaving Remote Terminal Processing programs
  - Specialized workstation programs (e.g., 8100 DPPX)
  - DOS/VS and VSE Remote Workstation Programs
  - DOS/VSE Job Entry Program (JEP)
  - VS/1 Host Remote Node Entry System (HRNES)
  - VM/370 Remote Spooling Communication System (RSCS)
- Job Networking[4]
  - VM/370 Networking[5]
  - RSCS Networking
  - Network Job Entry for JES2
  - JES3 Networking
  - HASP Networking
  - ASP Networking[5]
  - TSS Enhanced Support
- Bulk Data Transfer[6]
  - Bulk Data Transfer IUP (OS)
  - File Transfer Program (DOS/VSE)
  - Wideband Communication Program IUP (OS)
  - Cross-Domain Network Data Transfer FDP (DOS, OS)

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3 Note no support for MVS.
4 Note no support for DOS & VS/1.
5 These PRPQ's are no longer available.
6 See also some of the above workstation and job networking products.

This page sorts the same list by operating system:

- DOS/VSE Facilities[7]
  - VSE/POWER/RJE Feature
  - DOS/VSE Remote Workstation Program
  - Job Entry Program & File Transfer Program
- VS/1 Facilities[7]
  - Information Distribution Workstation Support (IDWS)
  - Host Remote Node Entry System (HRNES)
- VM/370 Facilities
  - RSCS Component of VM/370
  - VM Networking (VNET)[8]
  - RSCS Networking
- MVS Facilities[9]
  - Information Distribution Workstation Support (IDWS)
  - Network Job Entry for JES2
  - JES3 Networking
- SVS Facilities[9]
  - HASP Networking
  - ASP Networking[8]
- TSS Facilities
  - TSS Enhanced Support

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7 Note the lack of any job networking facility.
8 These PRPQ's are no longer available.
9 Note the lack of any workstation program.

## 2.1 CHARACTERISTICS/DESIGN OBJECTIVES

Before comparing the RJE facilities of various host systems, it may be helpful to review the following characteristics which should be a part of every host's RJE support:

- Routing Capability

  Jobs may be routed to the host, and sysout may be returned to the submitter at the remote. The programmer can explicitly route the sysout elsewhere and the operator may re-route it to still another location.

- Simplicity for the End User

  The RJE station is an extension of the central computing facility. The user is not concerned with how the job or sysout gets to its destination. All Jobs are automatically sent to the central site and output is sent back to the submitter or to the destination specified by a simple parameter or control card. Work can be sent to the host whenever the host system is running. There is no need to schedule and run a job to do the transmission.

- Ease of Installation

  RJE is usually part of the system or job entry subsystem. Parameters are used to enable or activate the facility.

- Interconnectability

  Standard communication protocols are used which enable most RJE terminals to connect to most host systems with an RJE facility.

- Operator Commands

  Additional operator commands are provided for the central operator to control and display the line and remote devices. Also, the remote operator must be able to display, monitor, and control his jobs at the host. Both can send messages back and forth to eliminate the need for a separate voice communication link.

- Recovery

  In the event of a line or system failure, jobs must usually be resubmitted if they were not entirely transmitted to the host, but printout in progress at the remote can be restarted from a checkpoint taken by the host.

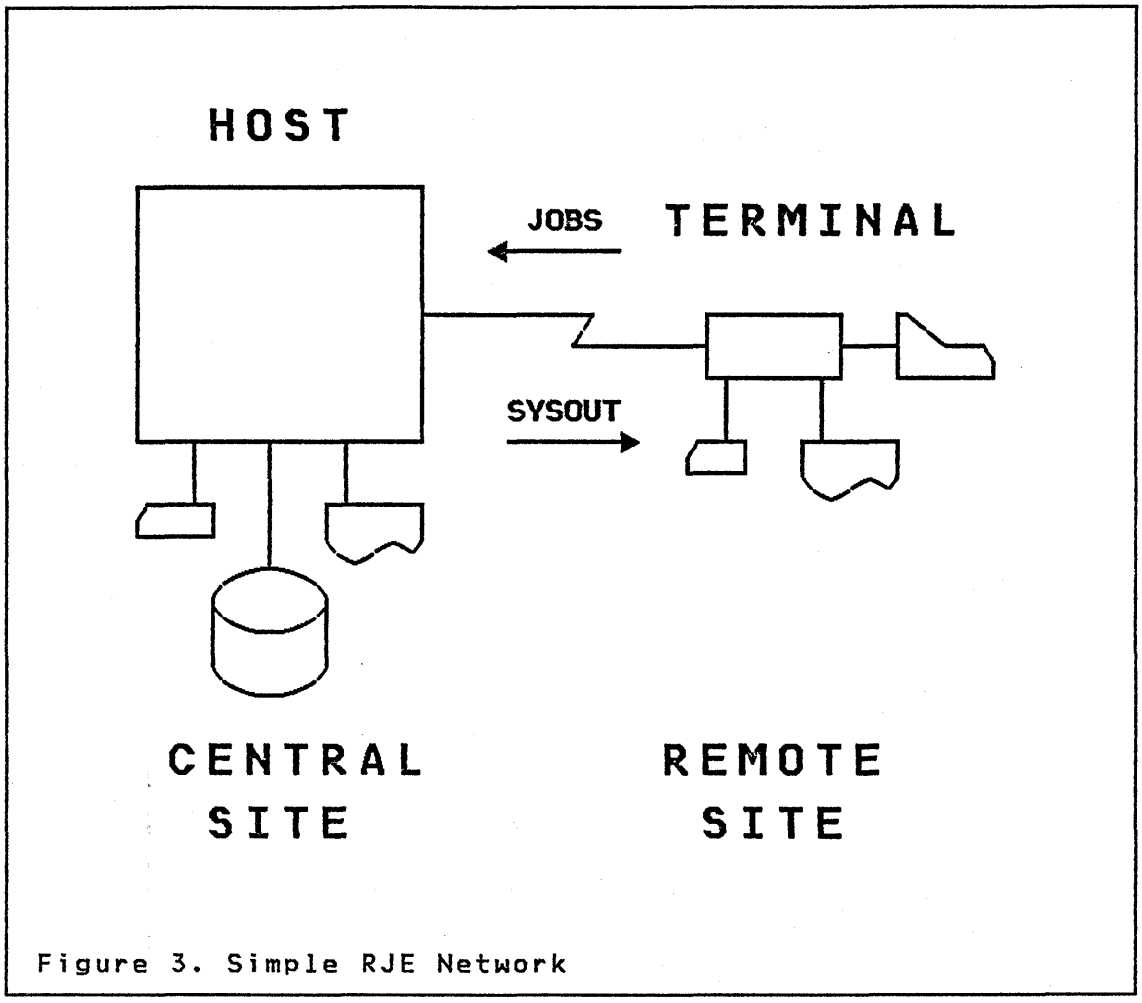


Figure 3. Simple RJE Network

Two types of line disciplines are supported for remote job entry communications:

1. Binary Synchronous Communications (BSC)
2. Synchronous Data Link Control (SDLC) for Systems Network Architecture (SNA)

The types of terminals supported as remote job entry devices by today's operating systems can be further broken down into the these four categories:

1. BSC Hardware Terminals
2. BSC Multi-Leaving Workstations
3. SNA Logical Unit Type 1 Workstations
4. SNA Logical Unit Type 4 Workstations

## 2.2 BSC HARDWARE TERMINALS

BSC Hardware Terminals include the following devices:

- 2770 Data Communication System
- 2780 Data Transmission Terminal
- 3780 Data Communications Terminal

Other BSC hardware terminals (e.g., 3741, 3770, Series/1, System/6) are supported as a "look-alike" of one of the above three terminal types.

The characteristic features of these terminals include the following features:

- The terminal can only transmit or receive (not both concurrently) one data stream at a time (a data stream is a job stream or sysout stream.) That is, if a job stream is being transmitted, a sysout stream (or operator message) cannot be received until the job stream has finished transmission.
- Most of these terminals have an interrupt capability so the terminal operator can suspend a long printout to submit a job.
- Data compression is an optional feature supported by some of the terminals to compress out multiple blanks and repetitive characters from the transmitted block of data. This is supported only for output (sysout data sets).

## 2.3 BSC MULTI-LEAVING WORKSTATIONS

BSC Multi-Leaving Workstations include the following devices:

- S/360, Model 20
- S/360, Models 22 and up
- S/370, Models 115 and up
- 1130 Computing System
- 2922 Programmable Terminal
- S/3 Card System

"Multi-leaving" has been loosely defined as "pseudo-simultaneous bi-directional fully-synchronized multi-stream transmission facility."

The characteristics of this support include the following features:

- Multiple data streams can be transmitted in both directions concurrently. This includes job streams, sysout, operator commands and messages.
- Data compression is a standard part of the protocol.
- Console support is an optional facility supported by most of the terminals.

## 2.4 SNA LOGICAL UNIT - TYPE 1 WORKSTATIONS

SNA Logical Unit - Type 1 workstations include the following devices:

- 3770 Data Communication Terminal
- 3790 Communication System
- 8100 Information System
- System/3

These (LU-Type 1) workstations can be further broken down into two categories:

- Single Logical Unit (LU) per workstation
- Multiple Logical Units (LUs) per workstation

The single LU workstations are similar in many ways to the BSC hardware terminals described above. They can only transmit or receive one stream at a time.

The multiple LU boxes are similar to the BSC multi-leaving workstations in that they can transmit and receive multiple streams in each direction at a time.

SNA terminals (LU Type 1) also have the following features:

- Diskette and tape I/O are optional devices on most of these terminals. Although they are still treated as card readers, punches or printers by the host, diskette and tape files can be more than eighty characters in logical record length (e.g., 128 characters) and multiple files can be concatenated into a single jobstream.
- Data compaction is a further sophistication of compression to further reduce the size of the transmitted block on the teleprocessing line. The object is to decrease transmission time and/or make better utilization of the line.

## 2.5 SNA LOGICAL UNIT - TYPE 4 WORKSTATIONS

At this time, SNA Logical Unit - Type 4 workstations include only the following device:

- 6670 Information Distributor

Type 4 LU sessions are used for data communications between two terminals or between an application program and a single or multiple device terminal. They are similar to type 1 sessions but were designed to support word processing applications. In addition, some type 4 implementations perform additional functions such as storing data for retrieval and manipulation by the sender.

**Remote Job Entry Support**

| Host Operating System: | MVS | | VS1 | DOS/ VSE | SVS (&MVT) | | VM/ 370 | TSS |
|---|---|---|---|---|---|---|---|---|
| Subsystem: | JES2 | JES3 | RES | POWER | HASP | ASP | RSCS | |
| Remote Type | | | | | | | | |
| BSC hardware | YES | YES | YES | YES | YES | YES | YES | YES |
| BSC Multi-leaving | YES | YES | YES | NO | YES | YES | YES | NO |
| SNA -LU Type 1 | YES | YES | YES | YES | NO | NO | NO | NO |
| -LU Type 4 (6670) | YES | YES | YES | NO | NO | NO | NO | NO |

Figure 4. RJE Reference Chart

The above chart shows the type of RJE terminals supported by the various operating systems. A short description of the support is provided below for each of these operating systems.

## 2.6 DOS FACILITIES

DOS/VS and the VSE/POWER RJE Feature of DOS/VSE support BSC hardware RJE terminals but not the multi-leaving workstations. They also support SNA LU type 1 workstations, but not LU type 4.

There is also a function of the VSE/POWER RJE feature which supports other DOS/VSE/POWER/RJE systems using a specialized Multileaving Interface (MLI) in a "peer-coupled" relationship. It allows jobs, sysout, commands and messages to be transmitted in both directions. It is an enhanced form of the multi-leaving protocol, but is incompatible with BSC RJE multi-leaving hosts or workstations. This feature can also be used to communicate with a VM/370 system running the RSCS Networking program product.

## 2.7 VS/1 FACILITIES

The Information Distribution Workstation Support (IDWS) for VS/1 supports 6670 in SNA (LU type 4) mode. This extends VS/1 Release 6 RJE facilities to include all four types of RJE terminals.

## 2.8 VM/370 FACILITIES

The Remote Spooling Communications Subsystem (RSCS) component of VM/370 supports the two types of BSC remote terminals. There is no RJE or RSCS support for SNA communications with VM/370 (even with the recently announced VM/VTAM Communications Network Application program product.)

## 2.9 MVS FACILITIES

JES2 Remote Job Entry and JES3 Remote Job Processing (RJP) support the first three of the above types of RJE terminals and, with IDWS, supports all four.

The Information Distribution Workstation Support (IDWS) for MVS provides the support for the 6670 in SNA (LU type 4) mode. It allows remote users to access MVS applications from remote 6670's and provides additional features to help the office system user. It supports a "Run Library" to translate Operator Control Language (OCL) to Job Control Language (JCL) and a "Format Library" to translate a form number to the appropriate printing characteristics in OCL for the 6670.

IDWS for MVS supports both JES2 and JES3 subsystems without any change to the job entry subsystems. JES RJE facilities are only used for the routing codes to provide destination identification on the sysout data sets. IDWS for MVS uses the internal reader to submit work to JES and the external writer to retrieve output from JES. IDWS contains the VTAM I/O code to send and receive data to and from the terminal instead of that support being part of the job entry subsystem.

## 2.10 SNA RJE WITH MSNF

ACF/VTAM with the Multi-Systems Networking Facility (MSNF) provides maximum flexibility for the user of an SNA RJE workstation. The remote user can logon directly to the appropriate host in the ACF/VTAM network. This capability can be used instead of, and is complementary to, a job networking facility in a ACF/SNA network. Figure 5 shows an example of an RJE network with two hosts. The remote user can logon to either host depending on the application desired. (There is currently a restriction that a JES2 host cannot initiate a cross-domain SNA/RJE session.)

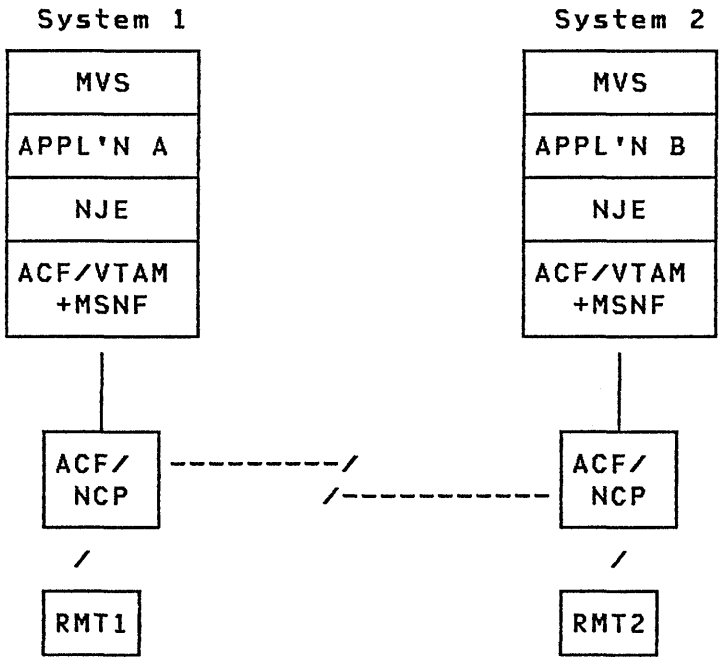


Figure 5. SNA RJE with Multi-Systems Networking: The remote users can logon to either system, and have access to either application.

## 3.1 DEFINITIONS:

A **Workstation Program** is a host or sub-host facility which acts like a remote terminal. That is, it can send jobs to a host and receive sysout from the host. The host must have the appropriate RJE support. See Figure 6.

A **Sub-Host** acts as an RJE user to another host but may also be a host to other RJE users.

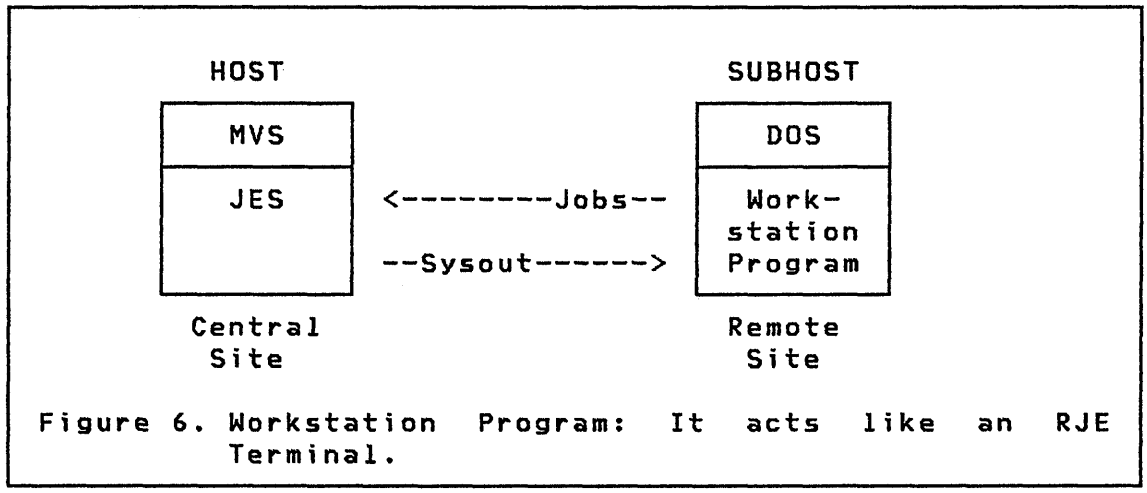


Figure 6. Workstation Program: It acts like an RJE Terminal.

## 3.2 CHARACTERISTICS/DESIGN OBJECTIVES

Before comparing the facilities of various workstation programs, review the characteristics above for RJE support and the following specific design objectives for a workstation program:

- Routing Capability

  Jobs may be submitted from the sub-host to the host and sysout returned to the sub-host just as if the sub-host was an RJE terminal. However, for jobs to be sent from the host to the subhost, they must be sent as punched output and re-spooled to the input queue through some (usually awkward) mechanism. For the sub-host to send sysout to the host it must be sent as a job stream with the eventual sysout data included as sysin data. The subhost may be a host to other RJE stations, but there is no standard mech-

anism to route output to "remotes of remotes."

- Operator facilities

  The host operator should be able to control the connection with the sub-host and display activity on that line. The sub-host operator should be able to display jobs and output that he submitted or jobs that are destined for his remote workstation. Both operators should be able to send messages to one another.

- Output

  Workstation protocols generally do not support the transmission of sysout attributes back to the sub-host in a format available to the sub-host operating system.

REMOTE WORKSTATION - REFERENCE CHART

| OPERATING SYSTEM: (SUBHOST) | MVS/ SVS | VS1 | DOS/VS | DOS/VSE | | | VM/370 | |
|---|---|---|---|---|---|---|---|---|
| SUBSYSTEM: | ANY | JES | POWER/ VS | VSE/ POWER | VSE/ POWER/ RJE | VSE/ POWER | RSCS | RSCS NETWKG |
| WORKSTATION | (NONE) | HRNES IUP-1 | RWSP PRPQ-2 | RWSP PP-3 | FEATUR PP-5 | JEP PP-4 | DMTSML | DMTSML PP-6 |
| FACILITY | | | | | | | | |
| -COMMUNICATION PROTOCOL | | BSC ML | BSC ML | BSC ML | BSC MLI | SDLC LU-1 | BSC ML | BSC ML&MLI |
| -JOB SUBMISSION HOST TO SUBHOST | | * | * | * | YES | YES-7 | N/A | N/A |
| -SEND OUTPUT SUBHOST TO HOST | | * | * | * | YES | YES-7 | * | * |
| -2ND LEVEL RJE SUPPORT** | | YES | NO | * | YES | YES | * | * |
| -3800 SUPPORT | | YES | NO | * | YES | * | NO | NO |
| -FILE TRANSFER | | * | YES | YES | NO | YES-7 | NO | NO |
| -MULTIHOST CONNECT | | * | NO | NO | NO | YES | YES | YES |

LIST OF PROGRAMS SUPPORTING THE ABOVE FACILITIES.

| # | TYPE | PROG-NUM | PROGRAM NAME |
|---|---|---|---|
| 1 | IUP | 5796-PJY | HOST REMOTE NODE ENTRY SYSTEM FOR VS/1 |
| 2 | PRPQ | 5799-WHX | DOS/VS REMOTE JOB ENTRY WORKSTATION PROGRAM |
| 3 | PP | 5746-RC9 | DOS/VSE REMOTE JOB ENTRY WORKSTATION |
| 4 | PP | 5746-XE6 | JOB ENTRY PROGRAM |
| 5 | FEAT. | 5746-XE3 | VSE/POWER + REMOTE JOB ENTRY FEATURE |
| 6 | PP | 5748-XP1 | RSCS NETWORKING |
| 7 | PP | 5748-XE6 | FILE TRANSFER PROGRAM |

* CAN BE ACCOMPLISHED WITH A NON-STANDARD (IE. CUMBERSOME) MECHANISM.

** CAN A JOB BE SUBMITTED BY A REMOTE ATTACHED TO A SUB-HOST, RUN ON A HOST, AND HAVE ITS OUTPUT AUTOMATICALLY ROUTED BACK TO THE SUBMITTING REMOTE?

Figure 7. Workstation Program Reference Chart

The above chart shows the type of remote workstation capabilities supported by the various operating systems. A short description of the support is provided below for each of these operating systems.

## 3.3 STAND-ALONE WORKSTATION PROGRAMS

- Remote Terminal Processor (RTP) programs

  The stand-alone programs to support multi-leaving workstations were included with the HASP and JES2 components until recently. With MVS release 3.8 (after the application of PTF number UZ29226 on PUT 80.01 ), they are packaged as a separate component with a function-ID of EML1102. They are still documented in the JES2 publications.

  Support is provided for the following processors as remote terminals through RTP programs:

  - S/360 Model 20
  - S/360 Model 22 & up
  - S/370 Model 115 & up
  - 1130 Computing System
  - 2922 Programmable Terminal
  - S/3 Model 10 (Card System)
  - 303x and 4300 processors are supported as S/370's (the 3203-5 printer is not supported) (the 3777-2 is supported as a S/360 Model 20-5)

- Multileaving Remote Job Entry/Work Station (MRJE/WS) programs for System/3 (program number 5704-SC1).

- Distributed Processing Programming Executive/Remote Job Entry (DPPX/RJE). This provides RJE support for the 8100 Information System using either SNA/SDLC or BSC multileaving line control.

- Other individual workstation programs also support the following as Logical Unit-Type 1 terminals: 3770, 3790, S/32, etc.

## 3.4 DOS/VS/VSE

- DOS/VS Remote Job Entry Workstation Program (PRPQ)

  This Programming RPQ (PRPQ) can read jobs from cards, tape and disk, and transmit them to the host for execution. It can also receive output from the host for printing and punching. There is a Spool Utility Program to print or punch sysout that was spooled to tape or disk when it was

received. The 3800 is not supported; that is, the attributes specified by the executing job for 3800-related features (e.g., character sets, flash, burst, etc.) are not transmitted back with the output. There are facilities to enable the operator to communicate with the local workstation and the central host with both commands and messages. A bulk data transfer mechanism is provided with a couple of utilities to convert sequential data sets to job streams and back again.

- DOS/VSE Remote Job Entry Workstation Program (PP)

  This program product is an enhanced version of the above PRPQ. The 3800 features are not explicitly supported but may be specified on the LST command.

- DOS/VSE Job Entry Program (PP)

  This program product can be thought of as an SNA version of the above BSC workstation programs. The Job Entry Program (JEP) simulates a Logical Unit Type 1 (LU-1) terminal. It can send jobs that have originated from local or remote (SNA or BSC) readers. There is a complimentary program product called the "File Transfer Program" which can be used for transmitting bulk data and for "reverse RJE" (i.e., sending jobs to the subhost and output to the host.)

- DOS/VSE POWER - RJE Feature

  This feature has several components. In addition to being the remote job entry support for DOS/VSE, It also has the facility to communicate with another DOS system running this feature. This part of the support is also referred to as "peer-coupled DOS." This is, in a sense, a form of workstation program, but the multi-leaving protocols used here are not compatible with the RJE multi-leaving protocols mentioned in the previous section. This part of the RJE feature may only communicate with other DOS/VSE POWER or VM/RSCS Networking systems using this Multi-Leaving Interface (MLI) protocol.

## 3.5 VS/1

- Host Remote Node Entry System (IUP)

  This looks like a S/360 Model 30 with a reader, printer, punch, and console to the host RJE facility. It uses the BSC multileaving line control to handle multiple streams in each direction.

Job routing to a host is accomplished by submitting the job into a specified job class which is associated with a "node queue". The job class can be changed before transmission by the operator. To use the host's procedures, the job must be sandwiched in an IEFBR14 job step.

Output routing from the host to the remote can be accomplished several different ways:

- A special form number can be specified on the output which is associated with a remote destination via the RJEFORMS macro (DEST=xxxx parameter).

- The jobname may have a specific character in a specific location. This can then be associated with a specific destination through the PITABLE.

- Data set control cards may be supplied with the job for keeping track of output returned to the subhost. This permits output to be returned to the submitter at the RJE site without any of the above specifications.

For additional details, see the HRNES documentation listed in the bibliography.

To send jobs from the host for execution at the subhost, see Appendix C.1 in 4300 Distributed Systems OS/VS1 Installation Aids (G320-6039). This gives sample procedures for accomplishing this through operator started tasks.

## 3.6 VM/370

The Remote Spooling Communications Subsystem (RSCS) component of VM/370, in addition to providing RJE support as a host VM system, also acts like a BSC multi-leaving workstation (System/360-Model 20).

The RSCS Networking program product also supports the multi-leaving interface (MLI) with a specialized line driver and protocols to communicate with a DOS/VSE system.

## 3.7 SUMMARY

Workstation programs (WSPs) are similar to the job networking concept of an "end-node", but have the following restrictions:

- They can only transmit jobs to a host, receive sysout from a host, and communicate commands and messages.

- To receive jobs for execution at a subhost, the workstation program must receive the job-stream as a sysout file and enter it into job input mechanism.

- To send sysout to the host, it must be sent as a job. IEBGENER or a similar sysin-to-sysout utility can be used for sysout records up to 80 bytes (sysin logical record length). For larger records, a bulk data transfer mechanism must be used. (See "5.0 Bulk Data Transfer Mechanisms - Comparisons" on page 51.)

- Sub-hosts (e.g., VS/1 and DOS/VS systems with workstation programs) can also have their own remotes, but the two "networks" are independent and isolated from one another. In contrast, remotes attached to NJE or NJI hosts are really part of the entire job network as we'll see in the following chapter on job networking.

- Two-level route-codes are required to get output generated at a host directed back to the submitting remote location. The first route-code will return the output to a particular subhost, the second is required to send it to the remote attached to the subhost. This is not supported by normal RJE protocols nor by most of the workstation programs. See Figure 7 on page 25.

**Job Networking** - A host facility to transmit jobs and sysout, to and from other hosts, in a network of peer-coupled systems.

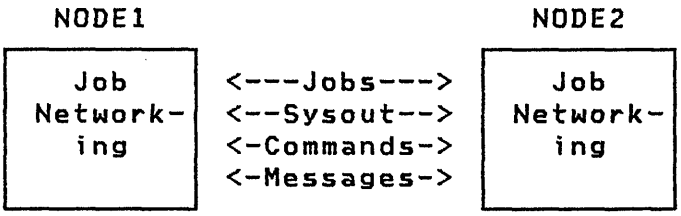


Figure 8. A Simple Job Network: Two computers connected via a T/P line.

## 4.1 CHARACTERISTICS/DESIGN OBJECTIVES

Before comparing the capabilities of various job networking products, review the following characteristics which should be a part of every job networking participant:

1. Routing Capability

   Jobs and sysout may go to any node in the network. Jobs can be explicitly routed to a remote node, either by the programmer, or by an operator, or implicitly routed by the local job entry system. Output may be routed to any node, any remote connected to a node, or any VM user in the network. It is returned to the submitting node by default, or may be explicitly routed elsewhere by the programmer or operator.

2. Simplicity for the End User

   The job network is an extension of the local computing facilities. Users need not be concerned with how the job or sysout gets to its final destination. The system controls the actual routing and transmission.

3. Ease of Installation

   There should be no complex parameters to specify; the job networking product should install as easily as the JES product.

4. Dynamic Network Configuration

   The system programmer or operator doesn't have to define and maintain a complete up-to-date picture of the network; the system automatically (re-)defines the network configuration as it receives connection information from other elements in the network.

5. Interconnectable

   Job networking systems use a defined protocol (different from RJE protocols) which make it possible to interconnect systems independent of the SCP, subsystem and release level. There is a defined set of control information in a common data format (Job Headers, Trailers, etc.) that makes up this protocol. The protocol is an extension of the RJE multileaving communications and is present on both bisynch links, channel-to-channel adapters, and SDLC links.

6. Additional Operator Commands

   To adequately support a job networking environment, new operator commands are required to do the following:

   - Control and display the status of the network and connections to other nodes.
   - Control and display jobs at remote nodes.
   - Send messages to other nodes and users in the network.
   - Send commands to other nodes.

7. Extendible

   The control blocks that constitute the protocols of job networking have room for future growth and user-supplied fields. These control blocks are designed so that they are upward-compatible. New fields or sections can be added to these data areas by newer versions. These additions should be preserved by the older versions, even if they are not used.

8. Recovery

   The members of a job network must be able to recover from a line or system failure without affecting the integrity of data in the network. The basic data elements of transmission in job network are jobs, sysout data sets, or files (VM). The technique to insure data integrity is the "store-and-forward" architecture whereby the transmitting node does not purge an element of data until the receiving node acknowledges that it has successfully stored the data.

## 4.2 LEVELS OF JOB NETWORKING SUPPORT

Full Job Networking support consists of the following facilities:

- Support for job and sysout transmission and reception (including store-and-forward support as an intermediate node.)
- Commands and messages can be sent to any network node and command responses returned.
- Dynamic path management with support for multiple links and alternate paths

Subsets of Job Networking

- "End node" support allows only one link to the network and cannot receive data destined for another node. It has no store-and-forward capability. (There are currently no implementations of this subset of job networking.)
- A non-Network Path Manager subset uses a statically defined network topology, does not support alternate paths and has a tendency to isolate sub-nets having dynamic path management.

## 4.3 EXTENSIONS OF JOB NETWORKING

The following facilities can be viewed as extensions of a job network to better understand how existing users of the system can use job networking to extend their routing capabilities.

1. RJE Terminals

   RJE terminals are extensions of the host's local devices. A "second level" of routing is required to get to a remote workstation connected to a remote node. The system sending a sysout data set does not have to verify the name of the second-level RJE user. The user-id is verified and the file is sent by the node to which the end-user is attached.

   Workstation programs are treated as RJE terminals. If they have the additional capabilities of receiving jobs or transmitting sysout, this is not compatible with most RJE facilities and usually involves some cumbersome file manipulation.

2. Interactive Users

CMS and TSO users are also second-level users of a job network. Routing output to them is usually similar to routing to an RJE site. (Currently there is no mechanism to send output directly to a TSO user.

3. Virtual Machines

Guest operating systems can be connected to the job network through one of several mechanisms:

- If the guest operating system supports job networking, then it may have a peer connection with its VM host or another node and participate fully with the rest of the network as if it had its own real CPU.

- The spooling capability of VM may be used to connect the virtual readers, printers and punches of the guest to RSCS.

- There are other ways involving workstation programs on the guest, but these are usually less practical than the above two alternatives.

4. Multiprocessing

Loosely-coupled JES2 or JES3 systems are also extensions of the job network. The entire JES2 or JES3 complex is treated as a single node. Jobs, sysout, messages and commands can be directed to a particular member of the complex just as if job networking was not involved.

## 4.4 SPECIFIC FACILITIES

The chart below shows the type of job networking facilities supported by the various operating systems.

JOB NETWORKING - REFERENCE CHART

| OPERATING SYSTEM: | MVS | | SVS/MVT | | VM/370 | | TSS |
|---|---|---|---|---|---|---|---|
| SUBSYSTEM: | JES2 | JES3 | HASP V. 4 | ASP V3.2 | RSCS | RSCS | TSS |
| JOB NETWORKING FACILITY | NJE PP-1 | JES3 NETWKG PRPQ-2 | NJI PRPQ-3 | NJI PRPQ-4 | RSCS-NETWKG PP-5 | VNET PRPQ-6 | NJI PRPQ-7 |
| BSC & CTC SUPPORT | YES | YES | YES | YES | YES | YES | YES |
| SNA SUPPORT | YES | NO | NO | NO | NO | NO | NO |
| NETWORK PATH M'GR | YES | NO | NO | NO | NO | NO | NO |
| DYNAMIC RECONFIG'N | NO | YES | YES | YES | YES | YES | YES |
| ALTERNATE PATHS | YES | NO | NO | NO | NO | NO | NO |
| PARALLEL LINKS | YES | YES | YES | NO | * | * | YES |
| MULTIPLE TRANS/RCVR | YES | YES | YES | NO | NO | NO | NO |
| MAXIMUM # OF NODES | 99 | NONE | 234 | NONE | NONE | NONE | NONE |
| GLOBAL COMMANDS | | | | | | | |
| - SEND | YES | NO | NO | SOME | NO | NO | NO |
| - RECEIVE | YES | MOST | NO | MOST | YES | YES | NO |
| JOB CARD TRANSPARNT | NO | YES | YES | YES | YES | YES | YES |
| 3800 SUPPORT | YES | YES | YES | NO | YES | YES | YES |

LIST OF PROGRAMS SUPPORTING THE ABOVE FACILITIES.

| # | TYPE | PROG-NUM | PROGRAM NAME |
|---|---|---|---|
| 1 | PP | 5740-XR8 | NETWORK JOB ENTRY FOR JES2 |
| 2 | PRPQ | 5799-AZT | JES3 NETWORKING |
| 3 | PRPQ | 5799-ATC | HASP NETWORKING |
| 4 | PRPQ | 5799-ATB | ASP NETWORKING |
| 5 | PP | 5748-XP1 | RSCS NETWORKING |
| 6 | PRPQ | 5799-ATA | VM/370 NETWORKING |
| 7 | PRPQ | 5799-AXA | TSS ENHANCED SUPPORT |

* CAN BE ACCOMPLISHED IN A NON-STANDARD OR CUMBERSOME WAY.

Figure 9. Job Networking Reference Chart

A short description of this support is given below to clarify the above chart.

- All job networking mechanisms support binary synchronous communications and channel-to-channel adapters, but only NJE for JES2 supports SNA sessions.

- NJE for JES2 has a network path manager, while the rest of the systems have the ability to dynamically reconfigure the network in the event of an outage. NJE, through its path manager, supports alternate paths, parallel links, and multiple transmitters and receivers on the same line. JES2, HASP and TSS support parallel links, but RSCS Networking does not. JES3 can support up to three parallel links if they are all the same type.

- The maximum number of nodes that can be defined to JES2 is 99 (easily modified to accept 255) and for HASP is 234, while the other systems have much higher practical limits governed by available resources.

- Only JES2 fully supports global commands. JES3 can process most of them, but can't initiate any. VNET and RSCS Networking will try to translate them to the appropriate RSCS command when encountered on the NJI line driver.

- Job cards are transparent to JES3, ASP, and VM acting as intermediate nodes, but not to JES2.

- 3800 attributes are transmitted and preserved by all current systems except RSCS Networking release 1.

The remainder of this chapter on job networking explains these facilities in more detail.

## 4.5 GENERAL COMMENTS

JES2 and JES3 are job-oriented systems (as are HASP and ASP), whereas VM is user-oriented. (TSS is both job and user-oriented.)

There is no official IBM support for MVT/HASP although several users have implemented the HASP Networking PRPQ on their OS/MVT system.

There is no support for DOS or VS/1 systems. There are two alternatives for these users to connect to a job network:

1. Run under VM and let RSCS do the networking.

2. Use workstation programs and act like an RJE site.

The advantages and disadvantages to each of these methods are explained below under the following headings:

1. Jobs & JOB Cards
2. Output
3. Routing Files to Users on other Systems
4. Message Handling
5. Operator Commands
6. Network Management and Error Recovery
7. Accounting
8. Summary

## 4.6 JOBS & JOB CARDS

- JES2 (& HASP)

  JES2 requires that each job entering the system (including those just "passing through") have a valid JOB statement conforming to the local installation standards. If not, the job is flushed without even looking to see if the job is destined to execute on this node.

  The same JOB card is used for origin, intermediate and execution node, so it must conform to local standards on each node, or the job will be flushed. Sometimes this is infeasible, so standards must be changed, or the JES2 system must be changed so as not to examine JOB cards on jobs not destined to do this.

  The NOTIFY parameter and RACF password are also treated specially by NJE. On the origin node, they are moved into the Job Header control block. On the execution node, NJE expects them to be in the Job Header. If the origin node was not an NJE node, then these parameters will not be in the header and NJE will look for them on the JOB card.

- JES3 (& ASP)

  For jobs that are to be sent to other nodes for execution, a two-card scheme is used; one for the origin node, (followed by ROUTE card) and another for execution node (which is not scanned for RACF password). Each one conforms to local standards. Again re-routing is still a problem if a different JOB card is required. While this may be more cumbersome than JES2 which only requires a single control card to

execute the job elsewhere, it provides the flexibility necessary in many environments which do not have universal JOB statement standards.

The RACF password is not scanned at the input node if this job is to be transmitted for execution. The password (if present) is left on the second job card, and not put in the header. At the execution node, JES3 expects to find the password on the JOB card. As a result, jobs sent from JES2 to JES3 cannot use passwords.

- VM/370

  VM doesn't know about jobs or JOB statements which accounts for most of the compatibility considerations below.

  Multiple jobs sent as a single file give unpredictable results when sent to JES2. They are treated by JES2 input service as a single job, but the converter recognizes the JOB statement and produces strange messages. Don't do it.

  The RACF password stays on the JOB statement (JES2 will pick it up after not finding it in the job header.)

  Don't forget to specify "NOHeader" when punching jobs to OS because the job will be failed by JES when it trys to scan the header as a JOB statement.

  VM reorders transmission queues (except priority 1) smallest files first within a given priority. The problem here is that jobs submitted in sequence can easily get out of order if passing through a VM node. Solutions to this problem are:

  1. Transmit at priority 1 (transmission priorities can only be set at the VM node)

  2. Transmit each job with descending priorities. With VM, this means ascending priority numbers.

  3. Modify VM not to do this.

  4. Don't use VM as an intermediate node

  5. Use some form of dependent job control at the execution node (e.g., JES3)

  6. Submit the jobs one at a time.

- TSS

  TSS uses "LOGON" or "DATASET" cards; it doesn't use "// JOB" statements for jobs executed locally. However, at the origin node, TSS permits a JOB statement; as the execution node, TSS ignores the JOB statement. TSS puts the RACF

password into the Job Header from the "EXECUTE" command.

## 4.7 OUTPUT

- JES2 & JES3

  3800 characteristics are supported for both transmitted and received sysout data sets.

  Multiple destinations are supported; JES2 supports up to four, and JES3 has no limit.

  The TSO OUTPUT command and SVC 99 (dynamic allocation) don't support the two-level form of the destination parameter (i.e., node.user.)

  Output received from VM node uses job name of "VNETnnnn" where 'nnnn' is the VM spool file identification.

  Spun-off data sets in JES2 are available for transmission at unallocation time. With JES3, they are not available for transmission until the end of the job.

- HASP

  3800 characteristics are supported for both transmitted and received sysout data sets.

  Local printers can be supported as alias nodes. This is useful for routing output to the node which happens to have the appropriate printer.

  Predefined Output Control Records (OCR) can be used to support canned sets of 3800 characteristics.

- VM

  3800 characteristics are supported for both sending and receiving nodes with release 2 of RSCS Networking. With release 1, output sent from VM may have the 3800 output characteristics specified on the TAG command, but 3800 output received will not use 3800 characteristics when printed by VM.

  Multiple destinations are not supported for files originating from VM.

- TSS

  3800 characteristics are supported for both sending and receiving nodes.

- General

  Separator pages are not always transmitted with the output. If there is meaningful data on the headers and trailers (which would be printed at the execution node) that would not be printed on the separator pages at the output node, then perhaps this information must be added to the (user section of the) job header or trailer control block and retrieved by the page separator routine at the output node. This is typical of an installation which puts some statistical information on the trailer page.

## 4.8 ROUTING FILES/OUTPUT TO USERS ON OTHER SYSTEMS

- RJE Users

  Sysout data sets and messages can be routed to RJE stations connected to job networking nodes; it is part of the support of all job networking products. RJE stations connected to "subhosts", however, present a different problem. To route a file to a remote user connected to a DOS or VS1 "subhost", a special technique must be used. The VS1 HRNES program provides for a few different mechanisms to achieve this. See section "3.0 Workstation Programs - Product Comparisons" on page 23

- MVS - TSO Users

  Although sysout data sets can be routed to TSO users on remote nodes (via JCL & JES control cards or operator commands), there is no mechanism available for the TSO user to retrieve them from spool on an OS system. Some user implementations use the external writer interface under MVS and specify a writer name equal to the user ID for whom the file is destined. TSO Users can't route output to another location without running a batch job, because the OUTPUT command does not support the job networking form of destination (i.e., 'node-id:user-id').

- MVS - general

  Dynamic allocation, like the TSO OUTPUT command does not support the job networking form of destination (i.e., 'node-id:user-id').

- VM/370 - CMS Users

  Sysout data sets can be routed to CMS users in the network, who can 'read' these files through their virtual readers and store them as CMS files. CMS users can route files to other users through the SPOOL and TAG commands.

VM/370 - Other Users

Only two levels of routing are permitted in a job network today: the node-id being the higher level, and the remote- or user-id being the lower level of qualification. Therefore, a file cannot be (easily) routed to a user or remote connected to a virtual machine that is not connected to the job network as a peer-coupled node. See the figures below for some examples.

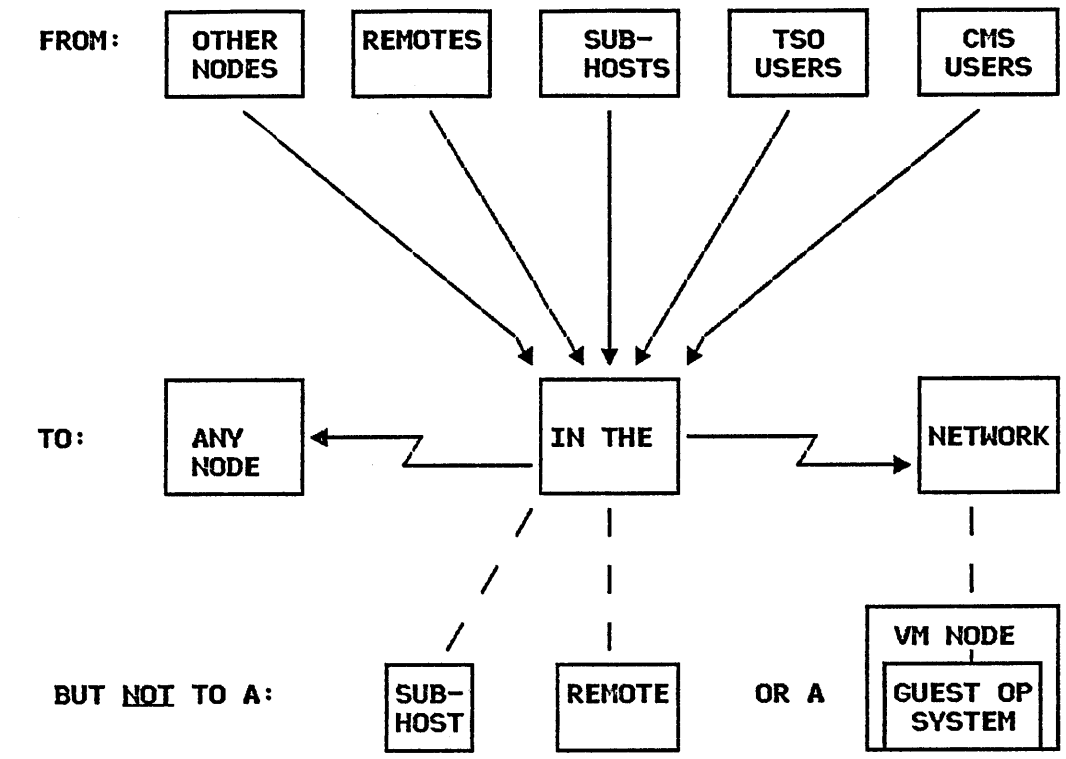


Figure 10. Job Routing

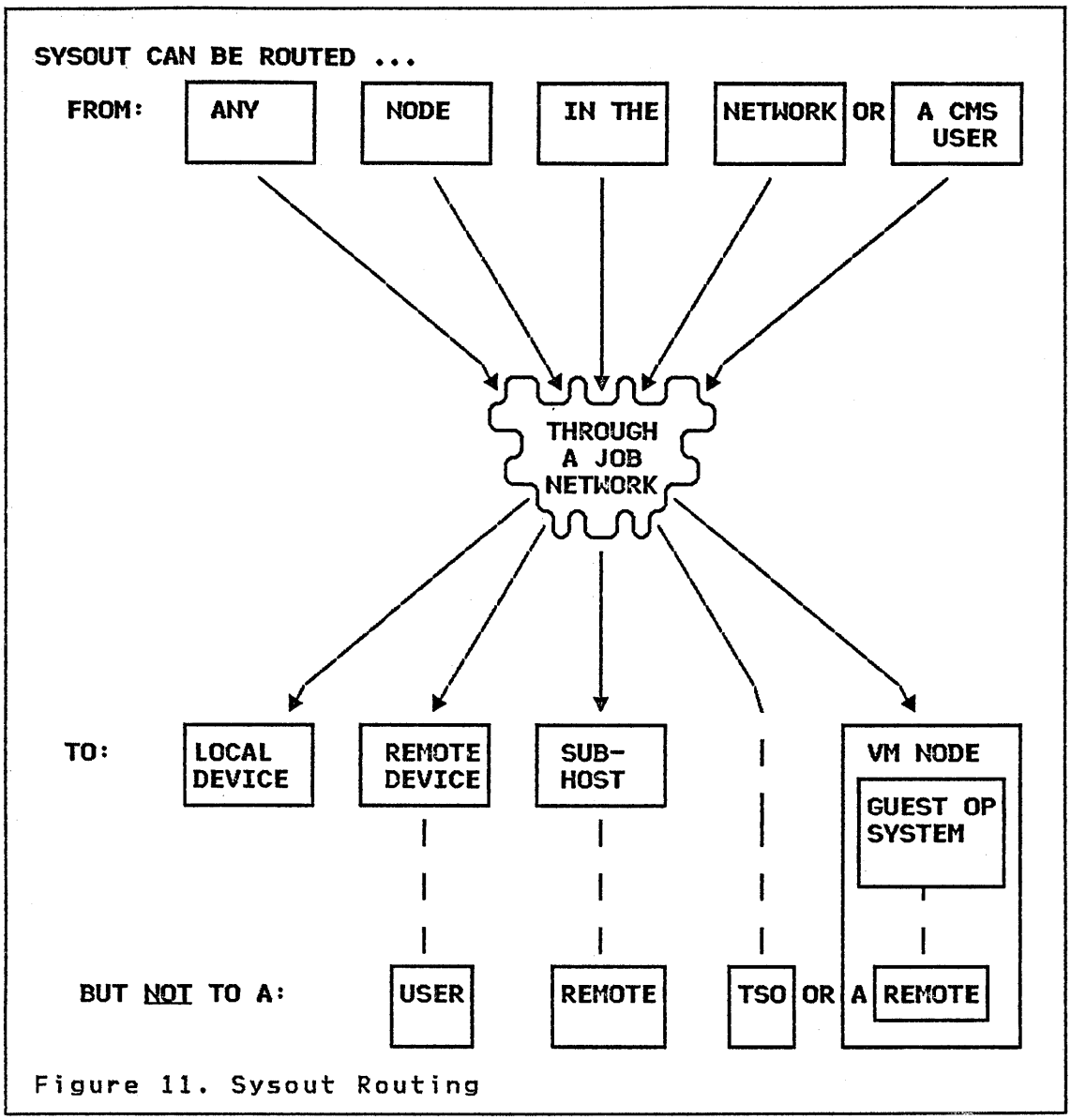


Figure 11. Sysout Routing

Referring to Figure 11, output cannot be routed to the following locations:

1. An RJE connected to a sub-host.
2. A specific user connected to a remote, sub-host or another node.
3. Any TSO user.
4. An RJE user connected to a virtual machine (i.e., guest operating system running on a VM node).

## 4.9 MESSAGE HANDLING

- JES2 & JES3 (& HASP & ASP)

  These systems use a control block called the Network Message Header (NMH) when receiving a message from another system. The NMH contains both the message being transmitted and the routing information, but there is only one field for the USERID and it contains the TO userid. This means that when the recipient gets the message, he does not know who sent it unless the sender put that information in the message text. This imposes restrictions on all messages passing through a JES2 or JES3 system, thus preventing these systems from properly acting as a store-and-forward node between two VM systems.

  TSO users have no access to the network except to submit jobs and receive notification at particular points in time; they cannot send or receive messages. The TSO user on a JES2 node receives notification at three distinct points in time:

  1. When.The job leaves his (origin) node for transmission towards its execution node.

  2. When the job finishes execution.

  3. When the sysout data set(s) reach the output node. (If there are multiple destinations, then the TSO user will get additional notifications.

  For the TSO user on a JES3 node, he will be notified at slightly different points in time:

  1. When the job is queued for transmission at the submission node.

  2. When the job arrives at the execution node.

  3. When the job completes execution.

  4. When the job is queued for output processing at the destination node.

  JES2 system operators cannot send messages to remote time sharing users. The destination field of the $DM (display message) command only supports RJE stations, not TSO or CMS/VM users. For the JES3 system operator, the send command supports two-level destinations (i.e., node.userid). Therefore, the JES3 operator can communicate directly with VM(CMS) users.

- VM/370

VM does not use the same NMH control blocks to send messages between nodes, so the above restrictions are not present. With the VM Networking PRPQ, CMS users can't send messages to other users on the network unless they are on the same node. With the RSCS Networking Program Product, however, the Special Message (SMSG) Facility allows CMS users to communicate with other nodes and users in the network. Watch out for JES2 intermediate nodes (see above.)

- TSS/370

  Users of TSS with the enhanced support have the capability of sending messages or mail (messages that are permanently kept) to one another.

## 4.10 OPERATOR COMMANDS

- JES2

  Global commands are fully supported to locate (display), hold, release, cancel, or route a job (or its output) on a remote node. These are supported whether the NJE system is the inquirer or the target system. The operator can also send commands to other nodes using the appropriate command syntax of that node. NJE has poor support for displaying the transmission queues (priority, record counts, routing information.) Therefore, it is hard to determine the status of a file awaiting transmission. If a file is destined for a distant node in a large network, the operator often can't tell the next node to which the file is to be transferred.

- JES3

  Most global commands are accepted from other nodes with the exception of the ROUTE command (which is ignored.) For the HOLD, RELEASE and CANCEL commands, the job number must be specified. JES3 however does not support global commands to be sent to other nodes by the JES3 operator. Therefore, the JES3 system operator has no "locate job" facility. Commands must be in the language of the remote node (i.e., the appropriate command must be sent as a text string.) JES3 also has the same inadequacies as JES2 in operator facilities for displaying the transmission queues.

- VM

  Global commands can not be sent to other nodes from a VM system. If encountered on the DMTNJI line driver, they will be translated to the appropriate VM/RSCS command:

- Global Display is translated into a Query File xxxx VNET/RSCS command where xxxx is the local VM spoolid which must have been specified as the job-name in the Global Display command. To find the spoolid, an RSCS-formatted command "Query SYstem Queue" must first be sent to that node.

- Global Cancel becomes a PURge spoolid command.

- Global Hold and Release are translated into CHange spoolid HOld and NOHold commands respectively.

- Global Route is translated into a TRANsfer spoolid TO locid userid command.

Since these commands are only interpreted over the NJI line driver, if they are propogated to another VM node through the VMB or VMC line drivers, then they will not be interpreted at that subsequent node.

The operator can send commands to other nodes using the appropriate command syntax of that node. There are good operator commands to display the local transmission queues along with record counts and routing information.

- HASP

Global commands are not supported either for sending to other nodes or to interpret and execute them if sent from another node. HASP has better support than JES2 for displaying queue sizes, record counts, and routing information.

- ASP

Some global commands may be issued from an ASP node, notably the commands to display, cancel, hold and release a job. (i.e., the "I Job" & "F Job C/H/R" are translated into the global format.) Other commands must be in the language of the remote node. The same subset of global commands are accepted from other nodes (all except route) and the job number must be specified.

- TSS

TSS does not support global commands in either direction, but the TSS user can display his work queues while still on his system. The operator can, however, send commands to other nodes using the appropriate command syntax of that node. There are good operator commands to display transmission queues with record counts and routing information.

## 4.11 NETWORK MANAGEMENT AND ERROR RECOVERY

- General

  Adjacent node recovery is supported by the store and forward scheme. Jobs being transmitted are re-queued for transmission at the sending node and purged from the queues at the receiving end. In this way, data integrity is maintained as a job or sysout data set is transmitted through the network.

- JES2

  NJE is unique in this area because it has a dynamic "Network Path Manager" which can communicate with other NJE path managers to dynamically adjust the network configuration as nodes sign on and off. This will only work with other JES2 NJE nodes directly attached or attached through other NJE systems. Path managers cannot communicate with other path managers through non-NJE nodes. In order to maintain an awareness of other non-NJE systems, or NJE nodes connected through non-NJE nodes, CONNECT statements must be used to statically define those parts of the network. While this facility is sensitive to real-time changes in the network, a clear path must be open from the origin to the destination before NJE will begin forwarding jobs and sysout. In large networks this may not be desirable especially when some of the nodes in that path are not up all the time. In this case, a CONNECT statement may be used to tell each NJE node of a permanent configuration. See the JES2/NJE Systems Programmers Library (GC23-0003) for a more complete description of the use of this statement.

  The network path manager automatically re-configures the network and re-routes work taking advantage of alternate paths in the event of a line failure or node failure, but operator intervention is required to restart a line after a permanent failure. Unlike most other job networking systems, JES2 has no commands to dynamically change a path or add a node to the network. JES2 must be warm started to redefine a path or a node and cold started to increase the number of nodes.

- HASP

  While HASP has no Network Path Manager (the network must be defined manually,) it does have commands to dynamically change a Path. However HASP Networking must be re-generated to add a node to the network configuration.

- JES3

JES3 has no network path manager (the network must be defined manually,) but it does have commands to dynamically change a path in the network. A warm start (with analysis) must be done to add a node to the network.

- VM

  Likewise, VM has no network path manager, but has commands to dynamically change a path in the network. It also has the facility to automatically initialize the network with an EXEC. In the case of a multileaving line failure (i.e., DMTSML or DMTNJI line drivers), VM automatically invokes an EXEC with the same name as the failing node. (Partial nodal resistance may be specified on start command to tell a JES2 node information for its path management algorithms.)

  While RSCS Networking only allows one link to any adjacent node, parallel links may be achieved by running multiple copies of RSCS.

- TSS

  TSS has no network path manager, but the network map can be completely replaced or modified by operator commands; no restart is necessary. A line may be automatically restarted after some errors and a "PROCDEF" may be used to redefine the network configuration.

## 4.12 ACCOUNTING

- General

  As jobs are shipped around the network, as sysout is processed at remote nodes and as the network continues to grow, more resources are being consumed by remote users at scattered locations. Accounting records are recorded at each node in the network, but there is no easy way to combine these records and bill the end user for all the resources consumed by a given job. In some cases, the information is not available at all. In mixed networks, some of the information required to consolidate these billing records may have to be determined empirically.

  Some potential problems with collecting all of the SMF records for a given job are:

  - When do you know you have all records for a given Job?
  - There is no consistent way to uniquely identify a job (the job number or name may even change part way through its life).

- Time stamps are not synchronized between nodes. They should be in Greenwich Mean Time (GMT) in the control blocks, but usually are recorded in SMF as local time.

- Origin and/or destination node names are not always identified.

- Some statistical information does not get back to the user such as the information an SMF exit (or JES2 modification) may put on the trailer page of the execution node.

- JES2

  The Job Trailer records are not used for passing accounting information back with the job after execution, but the following SMF records are recorded at the appropriate node:

  - Type 26 (purge) record at every node. It is possible to have multiple purge records for the same job.

  - Type 4, 5 records at the execution node.

  - Type 6 records at each output node (but not for the TSO OUTPUT command or if the output was purged prior to printing.)

  - Type 57 records at each node from which sysout was transmitted. (The jobname is not in this record.)

  There is no identification of second-level user in type 26 and 57 records. Sysout files entering a JES2 node from VM do not contain the accounting parameters.

  With the fix for APAR OZ43707, the reader start time is recoded as the time-on-reader at the origin node. (Before this fix, a new reader start time would be recorded at each node the job enters until the execution node.) Since the time is translated from GMT to local time at each subsequent node, this time will not match the same time in other records in different time zones.

- JES3

  SMF Records are created at each node. There is a new SMF record (type 57) for networking. (It contains buffer and byte counts instead of record counts which may make it difficult to correlate with other records.)

- VM

  Accounting records are recorded, for each file received on any node, and for files sent on the origin node. Files stored and forwarded have only one record cut for the receipt of the file.

- TSS

  Accounting information is available to user exits at each node.

## 4.13 SUMMARY

**GENERAL**

- Review local installation standards at each site for incompatibilities. See section "6.5 Standards" on page 65.

- Carefully plan the topology of the network (i.e., who is connected to whom), in the case of large networks (more than two nodes). See section "6.1 Network Configuration" on page 59.

- For homogeneous networks (e.g., NJE-NJE or VM-VM), there are very few problems. For hybrid (mixed) networks, note the following considerations:

**VM - OS**

- Don't put a non-VM (i.e., an OS) node between two VM nodes. See section "6.1 Network Configuration" on page 59.

- From VM, submit only one job at a time when sending them to a JES2 node. See section "4.6 Jobs & JOB Cards" on page 37.

- Bulk data transfer may be a problem with large record sizes. See section "5.0 Bulk Data Transfer Mechanisms - Comparisons" on page 51.

**NJE - NON NJE**

- NJE has a network path manager, the rest do not. In general, the network configuration must be defined manually at each node. Carefully plan and test network reconfiguration because it cannot be done automatically.

- Watch out for JOB card handling differences. See section "4.6 Jobs & JOB Cards" on page 37.

- Don't put an NJE node between two non-NJE nodes. See section "6.1 Network Configuration" on page 59.

# 5.0 BULK DATA TRANSFER MECHANISMS - COMPARISONS

Bulk data can be defined as OS data sets, DOS data sets, or VM files, either DASD or tape. Bulk data transfer is not necessarily a logical part of job networking, but can be conveniently implemented in a job networking environment. Data records must be put in the form of a jobstream or sysout data set before a job networking mechanism (or workstation program) can transfer it. Bulk data transfer programs are usually just utilities to convert sequential data sets to card images. As card images, the data can then be imbedded as sysin data within a jobstream. No transmission actually takes place in the utilities. The job networking or RJE mechanism actually does the sending and receiving.

## 5.1 CHARACTERISTICS/DESIGN OBJECTIVES

Before comparing the bulk data transfer facilities of various host systems, review the following characteristics which should be a part of every such facility:

1. Simplicity for the End User

   The user is not concerned with how data is transformed for transmission nor is he concerned with how the data gets to its destination. There should be no complex JCL or parameters for the user (or operator) to specify.

2. Ease of Installation

   It should install like a simple utility.

3. Interconnectable

   The necessary characteristics of the file should be transmitted in a common data format (control records) that is universally understood by all programs adhering to the facility for transmitting bulk data.

4. Extendible

   The protocols should allow for future enhancements to be upward compatible, and the facility should allow for user data to be transmitted with the file.

BULK DATA TRANSFER - REFERENCE CHART

| # | Bulk Data Transfer Mechanism | Operating System MVS | VS1 | SVS | DOS/VS | DOS/VSE | VM/370 | TSS 370 |
|---|---|---|---|---|---|---|---|---|
| 1 | Bulk Data Transfer | X | *3 | X | - | - | X | - |
| 2 | DOS/VS RJE WSP | X | X | X | X | - | - | - |
| 3 | DOS/VSE RJE WSP | X | X | X | - | X | X | - |
| 4 | FTP / JEP | X | X | - | - | X | - | - |
| 5 | HASP Networking * | - | - | X | - | - | - | - |
| 6 | ASP Networking | - | - | X | - | - | - | - |
| 7 | TSS Enhancements | - | - | - | - | - | - | X |
| 8 | Wideband ** | X | X | X | - | - | - | - |
| 9 | Cross-Domain Network Data Transfer ** | X | X | X | X | X | - | - |

X Supported.
- Not supported.
* The HASP Networking BDT mechanism is compatible with the Bullk Data Transfer program.
** These do not use RJE or job networking facilities.
*3 The use of BDT is awkward for there is no internal reader in VS/1.

| # | TYPE | PROG-NUM | PROGRAM NAME |
|---|---|---|---|
| 1 | IUP | 5796-PKK | Bulk Data Transfer |
| 2 | PRPQ | 5799-WHX | DOS/VS Remote Job Entry Workstation Pgm |
| 3 | PP | 5746-RC9 | DOS/VSE Remote Job Entry Workstation |
| 4 | PP | 5748-XE6 | File Transfer Program (requires JEP) |
| 5 | PRPQ | 5799-ATC | HASP Networking |
| 6 | PRPQ | 5799-ATB | ASP Networking |
| 7 | PRPQ | 5799-AXA | TSS Enhanced Support |
| 8 | IUP | 5796-PDJ | Wideband Communication Program |
| 9 | IUP | 5798-DAE | Cross-Domain Network Data Transfer |

Figure 12. Bulk Data Transfer Reference Chart

The above chart shows which bulk data transfer mechanisms are supported by the various operating systems. A short description of the support is provided below for each of these operating systems.

## 5.2 DOS FACILITIES

- DOS/VS Remote Job Entry Workstation Program (PRPQ)

  This PRPQ (the original one) contains utilities to convert sequential data sets to job streams and back again.

- DOS/VSE Remote Job Entry Workstation Program (PP)

  This is an enhanced version of the above PRPQ with basically the same utilities supported on OS, DOS, and VM systems. (This may be a useful bridge to transfer data between OS and VM systems.)

- DOS/VSE File Transfer Program

  This program product (FTP) is for use with the Job Entry Program (JEP) on SNA RJE links. It consists of a set of utilities to convert sequential data sets to job streams and back again. It will be supported on OS hosts and DOS subhosts in June of 1980.

## 5.3 OS FACILITIES

Most of the following programs can be used with any of the OS operating systems (MVS, JES2, JES3, SVS, VS/1, MVT, etc.) because they are merely problem programs which use standard OS macros and interfaces.

- IEHMOVE Utility

  This favorite old utility unloads sequential, partitioned, or direct files into eighty-character records (e.g., a card stream), but it is extremely awkward to use because it usually must go to tape as an intermediate storage media at each end. For instance to transmit a sequential file with an logical record length of 100 bytes, the following steps must be taken:

  1. Use IEHMOVE at the sending node to unload the data set to tape (the data set will not be 'unloaded' unless SYSUT2 is a tape or disk with a smaller track-size.)

  2. Use IEBGENER at the sending node to read it back to disk (this cannot be part of the following step because input from tape and disk cannot be concatenated.)

  3. Use IEBGENER at the sending node to concatenate JCL for the final two steps to the front and back of the unloaded data set that has been copied to disk.

4. Transmit the resulting job stream to the destination (i.e., the receiving) node.

5. Use IEHMOVE at the receiving node to copy the data to tape (this is required because IEHMOVE will not reload unless SYSUT1 points to a tape file or disk file with a smaller track size.)

6. Use IEHMOVE to reload the data set from tape to disk on the receiving system.

As you can see this procedure is too awkward because it involves too many steps and requires an operator to mount a tape at both ends.

- IEBISAM Utility

  This utility unloads an ISAM file to eighty-character records and is more usable than IEHMOVE because it can unload to disk.

- Access Method Services

  IDCAMS(REPRO) can be used to convert VSAM to SAM, then use IEHMOVE to move it as a sequential data set (see above). AMS(REPRO) must also be used at the receiving end to rebuild the VSAM file.

- IEBGENER

  If the data set is already in record lengths of eighty bytes, this simple utility (or IEBEDIT) can be used to copy the file from its original location to its ultimate destination.

- Bulk Data Transfer (IUP)

  This package is a set of simple utilities which is much easier to use than the above utilities because it can create a job stream containing several unloaded data sets suitable for transmission in one step. The initiation of the bulk data transfer and the job stream executing on the receiving node requires no operator intervention. An added feature of this package is that it compacts the data before transmission and reconstructs it at the receiving end. This can significantly reduce the transmission time. This package is compatible with the HASP Networking bulk data transfer utilities if compaction is not used (see below.)

- HASP Networking - Dataset Transmission facility (PRPQ)

  This networking package contains a set of utilities to convert sequential data sets to job streams for transmission by job networking. It is similar to and compatible with

above IUP if the data compaction routines are not used.

- ASP Networking - Data Transfer Utilities (PRPQ)

  This Networking PRPQ also contains a bulk data transfer facility but transmits the data as a sysout data set. As a result, it is incompatible with all the other bulk data transfer mechanisms.

- Wideband Communication Program (IUP)

  This IUP does not use job networking to transmit the data but has its own spooling and teleprocessing support. It is supported on OS/VS1 and OS/VS2 systems and uses BTAM for the transmission access method. It is mentioned here only because it performs bulk data transfer; it is totally independent of any job networking or remote workstation facility.

- Cross-Domain Network Data Transfer (FDP)

  This FDP likewise does not use job networking to transmit the data but communicates directly with another copy of Cross-Domain Network Data Transfer over an SNA connection. It is supported on DOS/VS, DOS/VSE, SVS, VS/1 and MVS using ACF/VTAM or ACF/VTAME and Multi-Systems Networking Facility. It is mentioned here only because it performs bulk data transfer; it does not use any job networking or remote workstation facility.

## 5.4 VS/1 FACILITIES

Most of the above procedures will work on a VS/1 system. However, there is no internal reader facility in VS/1, so the Bulk Data Transfer IUP is somewhat more cumbersome to use, but still is the best way to send OS data sets back and forth. See appendix C.1 in 4300 Distributed Systems OS/VS1 Installation Aids (G320-6039). This gives sample procedures for using Bulk Data Transfer through operator started tasks.

## 5.5 VM FACILITIES

Spool files are already in a form suitable for transmission. They can be punched or printed to a virtual card punch or printer that has been spooled to RSCS (or VM Networking) and tagged for the remote destination. Other CMS files can be "disk dumped" for transmission to other VM nodes/users, but there is no facility to send or receive files in this format on OS sys-

tems.

For files other than CMS or spool files, the CMS command MOVEFILE can be used to create a spool file if the record size is less than 256 bytes.

The Bulk Data Transfer IUP will also run under CMS with the appropriate file definitions (FILEDEFs).

## 5.6 TSS FACILITIES

- VAM (Virtual Access Method) Files (i.e., TSS Native files)

  TSS has some utilities to convert VAM-to-Card and Card-to-VAM (VCCV.) These are incompatible with other transfer mechanisms. (One might be able to use OS Utilities with the TSS-OS Interface.)

- Tape or BSAM Files

  Use the "copy data set" utilities to convert to VAM and then use VCCV.

## 5.7 SUMMARY

- OS Systems

  Use the Bulk Data Transfer IUP. reader.

- VM Systems

  Use the 'Disk Dump' facility for CMS files.

- OS <-> DOS

  Use the utilities accompanying the appropriate DOS workstation package.

- VM <-> DOS

  Use the File Transfer Utilities provided with the RJE Workstation program product.

- VM <-> OS

  If the data is in the form of spool files (i.e., card or print images) then it needs no transformation. If the data is not a spool file, the utilities accompanying the DOS workstation package might be useful as a bridge. (i.e.,

OS <-> DOS <-> VM.) Another alternative would be to use the Bulk Data Transfer IUP for it will work under VM with the appropriate file definitions.

## 6.1 NETWORK CONFIGURATION

### NETWORK TOPOLOGY

- Homogeneous networks

  A simple two-node network is the most trivial form of a network and there are no decisions to be made about the topology of such a network. (Connect one to the other.)

  For larger homogeneous networks, the topology depends on the amount of traffic between each node, the speed of the lines, the overhead one is willing to sustain, and the transit time required. JES2/NJE networks have path managers which can maintain an awareness in real time of the network configuration. With SDLC connections, NJE can bypass the store-and-forward overhead at the intermediate nodes. JES3 Networking incurs an additional level of overhead by having to double-spool all store-and-forward files.

- Non-homogeneous (Mixed) networks

  Again, if the network only has two nodes, there are no decisions to be made about the network topology. With larger networks, the following tips should be observed:

  1. Don't put a non-VM node between two VM nodes

     Directly link all RSCS Nodes; otherwise, the message capability is diminished (see section "4.9 Message Handling" on page 43.)

  2. Don't put JES2/NJE (or HASP) between VM, JES3 or ASP nodes

     JES2 (as does HASP) looks at each job card and may flush those with invalid job cards even though it is acting as an intermediate node.

  3. Don't put VM or NJI between two NJE nodes

     Network path manager records cannot pass between the two NJE nodes because other systems will not forward them.

  4. Don't use JES3 as an intermediate node

JES3 spools jobs twice as an intermediate node. This can be costly in terms of processor cycles and I/O resources.

A full-mesh network (i.e., every node connected to every other node) or a partial mesh may be the answer. This would entail higher teleprocessing costs, but would probably have the following benefits:

- Quicker routing
- Less store & forward overhead
- Less incompatabilities

- Remote Workstations in a job network

  Use job networking product rather than the workstation program. This is not possible with DOS or VS1 systems. Attach remote workstations (and RJE terminals) to a job networking node rather than to a subhost. This will provide the user with more routing flexibility. In addition, SNA RJE and MSNF may provide another level of flexibility. See Figure 5 on page 21.

- Guest Operating Systems in a job network

  Use a job networking connection (if possible.) This could be done with no additional hardware using virtual channel-to-channel adapters. In this way, the guest can fully participate as a node in the network as a peer, but a license is required for each system.

  If the guest operating system does not participate as a node in the job network, RSCS can still be used as the "surrogate" routing mechanism, but there are limitations. This is fine for job submission out of guest, but there is no standard way to go the other way (i.e., route jobs to a second level user.)

- Multi-access spool (JES2 only)

  The entire MAS complex is a node in the network. All members must run the same level of NJE. Some reasons for connecting JES2 systems with a job networking link instead of making them part of the same MAS complex are:

  - Different versions of JES2 can be connected with job networking whereas they cannot with shared spool. This may make a smooth migration path for a complex with many JES2 systems.
  - More Than 3 or 4 processors may be split apart for integrity or performance reasons with an NJE connection.

Particular processors may be isolated for security or availability reasons with a job networking connection.

With SNA NJE, the restriction that only one SDLC link exists between any two processors does NOT mean that you can't have multiple links between any two nodes as long as there is still only one SDLC link between any two processors. See Figure 13 below. (That restriction goes away with ACF Release 3.)

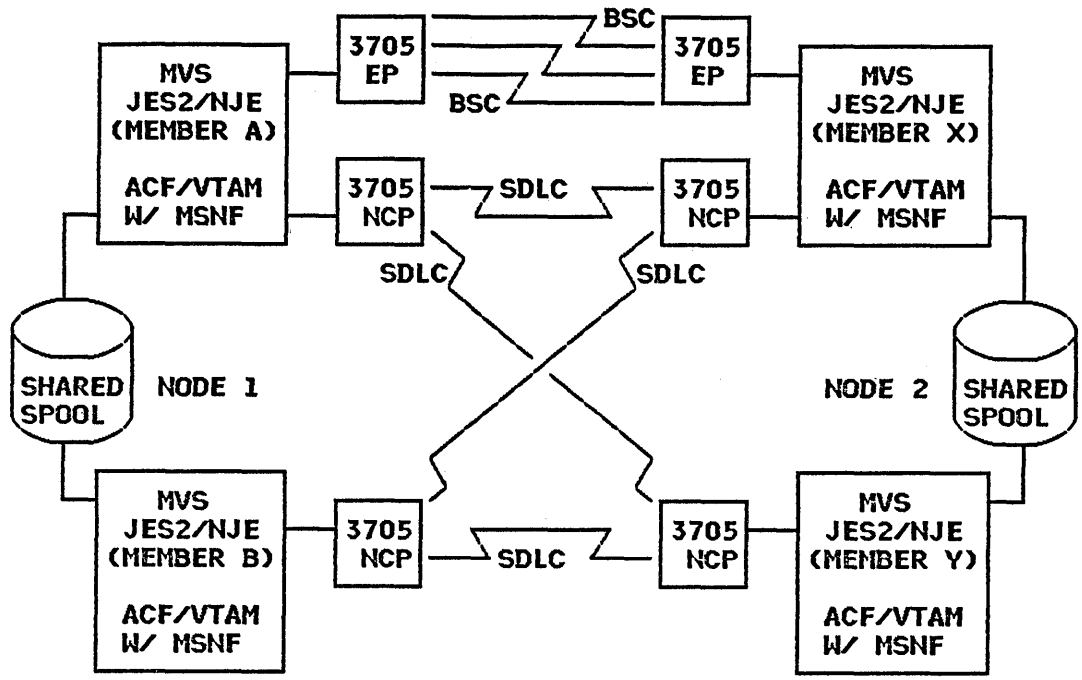


Figure 13. SNA NJE with Multi-Access Spool: Possible link configuration.

## COMMUNICATION FACILITIES

Binary Synchronous Communications (BSC) is the most common connection between processors. It is supported by all job networking products, and can use line speeds up to 230 KB. Most of the job networking products also support parallel links if they are BSC (see Figure 9 on page 35.)

Channel-to-channel adapters (CTC or CTCA) are the most common connection if the processors are in the same room (or building). It runs in S/360 mode and the same multi-leaving protocol is used as is used with BSC lines. The CTC must be dedicated to job networking and cannot be shared with other applications. The extreme high speed of the device has both good and bad aspects. On the positive

side, it can transfer large volumes of data very quickly, but on the negative side, this can significantly impact host processor cycles and possibly even impact on-line systems. The CTC in this environment should be on a block multiplexor channel, or dedicated on a selector channel to avoid serious interference with other devices. On MVS systems, it should be permanently on-line (i.e., zap the UCB) to avoid IOS loops. (Otherwise, make sure the CTC is varied online to MVS on both sides before starting it from JES.)

Synchronous Data Link Control (SDLC) is a third type of job networking connection, but is only supported by JES2/NJE. It provides several advantages over BSC links:

- Link sharing; the line can be shared with other applications.

- Full duplex; line turn-around is eliminated and greater throughput can be achieved (especially with satellite communications.)

- Link level forwarding; intermediate nodes do not have to store-and-forward the data.

A shared 3705 running ACF/NCP could be used instead of a CTC for a close connection between two NJE nodes. The advantage of this kind of a connection, is that the VTAM pacing parameters could be used to reduce the impact on processor cycles. (See the CTC discussion above.)

The transmission requirements for each facility should be estimated on the high side for several reasons: A job networking facility typically gets more use and quicker acceptance than its implementors or advocates expect. The consequences of a transmission backlog can significantly affect the transmission time. Parallel links should be considered for availability reasons instead of a single, higher speed line. Dial backup lines are typically limited to 2400 baud and should only be considered for limited, degraded backup. Full or partial mesh configurations should be considered to eliminate store-and-forward overhead if SNA/NJE is not applicable.

## 6.2 AVAILABILITY CONSIDERATIONS

To protect against line outages, parallel links or alternate paths should be designed into the network. Dial back-up connections could be used, but are typically limited to 2400 baud which is much too slow for most job networking connections.

For the case where the node is down or unreachable, there are two causes for concern: The obvious reason is that jobs and data cannot get to their destinations. The other reason is that nodes adjacent to the break may not have the spool capacity to accumulate a lot of data if the connection cannot be re-established soon. Some procedures to alleviate this situation include the following:

- Re-route the jobs and sysout to another node if they could be executed or printed at an alternate node. This would require prior planning to establish back-up execution or print nodes.

- In a pure NJE network, re-consider the use of CONNECT initialization parameters which allow jobs and sysout to be sent before there is a clear path from origin to destination.

- Route the jobs and/or sysout to a secondary NJE or dummy node which could temporarily hold the jobs and sysout until the connection was re-established. A spool offload or transfer mechanism (e.g., the HASP-JES2 Spool Transfer Program FDP) could be also used for the same purpose.

- As an extreme precaution, the job and sysout receivers could be stopped to prevent any more jobs or sysout from entering an over-loaded node from the rest of the network.

A potential problem with the current job networking products is the store-and-forward protocol which restarts all unrecoverable transmission errors at the job level. In the case of such a failure during transmission, the transmitter requeues the work for retransmission from the start, and the receiver purges the job or the entire set of a job's sysout from its queues. In the unlikely event of a failure after the last record of a job has been transmitted, but the acknowledgement has not been returned (a very small window), the transmitter requeues the work as "held", and the operator at the transmitting site must release or cancel the job after determining that the receiving node has successfully received the job. This manual intervention is necessary to prevent loss or duplication of a job (or a job's sysout.)

## 6.3 SECURITY CONSIDERATIONS

Security can be broken down into three general areas for the purposes of examining a job network:

**NETWORK ACCESS:** This applies to the controls available to prohibit unauthorized users from gaining access to the network. This mainly refers to people outside the organization, or employees who are not authorized to use the enterprise's com-

puting facilities. First, physical access should be the primary means of protection. By this, we mean access to the data processing equipment and the communication facilities. A leased line is more secure than a dial-up port. For another unauthorized job networking node to gain access to a dial-up port, he must know the node names and passwords for the line and node. A communication line may be made more secure against line tapping by using data encryption techniques.

**NODE PROTECTION:** Protecting a node means protecting it against unauthorized users outside a particular node (but within the network) from gaining access to that particular node. This primarily refers to their running jobs or issuing commands on that node. RACF should be the primary mechanism to control jobs and therefore access to data sets. SMF or subsystem exits can be used instead, or to augment the above mechanism. As an extreme precaution, some users have drained the job receivers to prohibit any jobs from entering a secure node. Commands can be controlled to some extent by various levels of authorization. Each command has an authorization level associated with it, and each node is defined as having a certain level of authorization for issuing commands on each other node. In NJE, this can be specified with initialization parameters, and can be changed by the operator. (The levels are Job, Device, System, and Network.) Private connections can also be established to partition the network into secure subnets through the use of predefined connections, secondary subsystems, or multiple copies of RSCS networking.

**DATA PROTECTION:** More attention should be paid to protecting data in a job network than in an isolated system, because more users have access to the system. Again, RACF should be the primary mechanism to control access to data in each OS system. Data encryption is an additional mechanism that should be considered to protect the data. As an extreme measure, some installations have even considered draining all job and sysout transmitters to prevent any data leaving a particular secure node.

## 6.4 ACCOUNTING CONSIDERATIONS

Three reasons for accounting are billing, performance measurement and security (audit trail). To be safe, one should assume that an unrestrained user will find the cheapest computing facility in the network or may try to access any data in the network that is not protected. Therefore, at least rudimentary accounting data should be captured at each node and reviewed for irregularities in resource consumption and access to programs and data. Job networks (especially hybrid job networks) pose special problems for accounting. More work should be done in this area, but is beyond the scope of this bulletin.

## 6.5 STANDARDS

Coordinating several different data processing installations into a common computing facility with job networking requires a great deal of standardization. Just as an outside user would face problems if he were to come into an installation with his own jobstream, so do users face the same problems when using job networking to transfer jobs and sysout data sets to different locations. (The account numbers, and job card standards would probably be different, along with many other differences in JCL standards.) The following subsections can serve as a preliminary checklist for coordinating the various computing environments into a job network.

First of all, node names should be well-defined at the beginning and not changed because users will immediately begin coding these symbolic names in their JCL, EXECs, etc.

**JOB EXECUTION ENVIRONMENTS:** Initiator classes should be standardized across the network unless they are not significant, set automatically, or they are publicized for each potential user.

OS unit names must also be standardized or the use of generic name (e.g., 3400-6) could be encouraged.

Procedure libraries, program libraries and catalog structures may have to be coordinated, or at least documented, for the new set of remote users.

**OUTPUT ENVIRONMENTS:** Sysout classes, if not standardized across the network, should at least be coordinated and well publicized; especially dummy, held, and punch classes. These special classes only take effect on the node to which the output is destined.

Special forms, as well as character sets, forms control buffers, and other contents of Imagelib must also be available at each potential output node.

## 6.6 TESTING

Simple networks and options should be tried before more complex networks and options. Try two nodes before many. Perform initial testing in the same location (same room). Try BSC before SNA connections.

With JES2/NJE, use secondary subsystems on the same processor with wrapped line(s) if stand-alone test time is not always available. With SNA/NJE, the wrapped lines are not necessary for an intra-domain SNA session can be set up between two NJE subsystems in the same MVS system.

In the VM/370 environment, use virtual channel-to-channel adapters. Even if the installation is not a VM user, it may be worthwhile to install VM for an extensive test of the job network.

TPNS is probably not appropriate because it is easier to use another job networking system instead of using a TPNS driver.

## 6.7 PERFORMANCE CONSIDERATIONS

Transmission buffer size is probably the most critical factor relating to performance. In general, the larger the buffer size, the better the performance. In job networking, the lower transmission buffer size of the two adjacent nodes is usually used. (With JES3 networking, the buffer sizes between two adjacent nodes must match exactly.) The buffer sizes are specified as follows:

- JES2/NJE

  The JES2 initialization parameter, &TPBFSIZ (rounded up to &MLBFSIZ if the latter is higher) is used as the transmission block size on BSC lines, channel-to-channel adapters, and SNA sessions. It defaults to 400 with a permissible range of 300 to 3976.

- JES3 Networking

  The NJERMT initialization statement has a parameter, BFSIZ, which establishes the transmission buffer size. It defaults to 400 with a maximum value of the spool buffer (JSAM) size. The buffer sizes between JES3 Networking and its adjacent nodes must match exactly.

- RSCS Networking

  For the NJI line driver, the BUFF parameter on the START command can be used to specify a value for the transmission buffersize. The allowable range is from 300 to 1017 bytes with a default of 400 bytes. The VMB line driver for BSC lines uses a hard coded value of 824 bytes (after compression.) The VMC line driver transmits 4K spool blocks (uncompressed.)

- HASP Networking

  The HASP generation parameter, &TPBFSIZ is used as the transmission block size on BSC lines and channel-to-channel adapters.

Particular attention should be paid to intermediate nodes for they could become bottlenecks if any of the following resources are already constrained:

- Processor cycles

  These are required not only to receive and transmit stored-and-forwarded data, but also to spool, despool and compress the data. (JES3 also adds additional overhead by double-spooling intermediate jobs.)

- Main Storage

  Each additional link requires its set of buffers for transmitting, receiving, spooling, de-spooling, etc.

- I/O

  Channel, control unit and device activity will increase on the teleprocessing and spool (DASD) devices.

- Auxiliary Storage

  Additional space is required on the spool and jobqueue for the additional jobs traipsing through the system.

## A.1 FOR JOB SUBMISSION

INTERCONNECTING SYSTEMS for JOB SUBMISSION

| | to MVS | to VS1 | to DOS/VSE | to VM/370 |
|---|---|---|---|---|
| from MVS | Job Networking * MVS: NJE or JES3 NETWKG | Non-Standard MVS: JES2 or JES3 VS1: HRNES & Oper. Manip. | MVS: JES2 or JES3 DOS: JEP + FTP | Job Networking * MVS: NJE or JES3 NETWKG VM: RSCS NETWKG |
| from VS1 | VS1: HRNES MVS: JES2 or JES3 | VS1: HRNES | VS1: RES + FTP DOS: JEP + FTP | VS1: HRNES VM: RSCS |
| from DOS | DOS: JEP or RWSP MVS: JES2 or JES3 | DOS: JEP or RWSP VS1: RES | DOS: POWER/RJE | DOS: POWER/RJE VM : RSCS NETWKG DOS: RWSP VM : RSCS |
| from VM | VM : RSCS NETWKG* MVS: NJE or JES3 NETWKG VM : RSCS MVS: JES2 or JES3 | VM: RSCS VS1: RES | VM: RSCS NETWKG DOS: POWER/RJE | Job Networking * VM: RSCS NETWKG |

ABBREVIATIONS:
FTP - File Transfer Program for JEP/DOS/VSE (5748-XE6)
HRNES - Host Remote Node Entry System for VS1 (5796-PJY)
JEP - Job Entry Program for DOS/VSE (5746-XE6)
JES3 NETWKG - JES3 Networking PRPQ (5799-AZT)
NJE - Network Job Entry for JES2 (5740-XR8)
Oper. Manip. - Operator manipulation required
POWER/RJE - RJE Feature of VSE POWER (5746-XE3)
RES - Remote Entry Services (RJE support integral to VS1)
RSCS NETWKG - VM/RSCS Networking (5748-XP1)
RWSP - DOS/VSE RJE Workstation Program (5746-RC9)

NOTES:
*MVS-VM connections use the full job networking protocols
JEP requires POWER/VSE
POWER/RJE requires POWER/VSE
All above communications are BSC except JEP and CDNDT (SNA only) and NJE (SNA or BSC)

Figure 14. Interconnecting Systems - Job Submission

## A.2 FOR FILE TRANSMISSION

INTERCONNECTING SYSTEMS for BULK DATA TRANSFER

| | to MVS | to VS1 | to DOS/VSE | to VM/370 |
|---|---|---|---|---|
| from MVS | MVS: NJE + BDT<br>or JES3 NETWKG + BDT<br>or CDNDT | Non-Standard<br>MVS:JES2/3 + BDT<br>VS1: HRNES + BDT<br>& Oper. Manip.<br>or CDNDT | MVS: JES2/3 + FTP<br>DOS: JEP + FTP<br>MVS: JES2/3 + FTU<br>DOS: RWSP<br>or CDNDT | MVS: NJE or JES3-NETWKG + BDT<br>VM : RSCS NETWKG + BDT |
| from VS1 | VS1: HRNES + BDT<br>MVS: JES2/3 + BDT<br>or CDNDT | Non-Standard<br>VS1: HRNES + BDT<br>& Oper. Manip.<br>or CDNDT | VS1: RES + FTP<br>DOS: JEP + FTP<br>or CDNDT | VS1: HRNES + BDT<br>VM: RSCS + BDT |
| from DOS | DOS: JEP + FTP<br>MVS: FTP<br>DOS: RWSP<br>MVS: FTU<br>or CDNDT | DOS: JEP + FTP<br>VS1: FTP<br>DOS: RWSP<br>VS1: FTU<br>or CDNDT | DOS: POWER/RJE<br>(SPOOL Files only<br>or CDNDT | DOS: RWSP<br>VM : RSCS + FTU |
| from VM | VM : RSCS NETWKG + BDT<br>MVS: NJE or JES3 NETWKG + BDT | VM: RSCS (SML)<br>VS1: RES<br>(SPOOL Files only | VM: RSCS + FTU<br>DOS: RWSP | VM: RSCS NETWKG + DISK DUMP |

ABBREVIATIONS.
- BDT - Bulk Data Transfer Program (5796-PKK)
- CDNDT - Cross-Domain Network Data Transfer (5798-DAE)
- FTP - File Transfer Program for JEP/DOS/VSE (5748-XE6)
- FTU - File Transfer Utilities; a component of RWSP (5746-RC9)
- HRNES - Host Remote Node Entry System for VS1 (5796-PJY)
- JEP - Job Entry Program for DOS/VSE (5746-XE6)
- JES2/3 - JES2 or JES3
- JES3 NETWKG - JES3 Networking PRPQ (5799-AZT)
- NJE - Network Job Entry for JES2 (5740-XR8)
- Oper. Manip. - Operator manipulation required
- POWER/RJE - RJE Feature of VSE POWER (5746-XE3)
- RES - Remote Entry Services (RJE support integral to VS1)
- RSCS NETWKG - VM/RSCS Networking (5748-XP1)
- RWSP - DOS/VSE RJE Workstation Program (5746-RC9)
- SML - Spool Multi-Leaving line driver of RSCS in VM

NOTES:
- BDT runs on MVS, VS1 (with operator manipulation), and VM
- CDNDT does not use job networking or RJE but is an ACF/VTAM application program running on MVS, VS1 and DOS
- FTP requires JEP on the DOS/VSE subhost
- FTU runs on MVS, VS1, and VM
- JEP requires POWER/VSE
- All above communications are BSC except JEP and CDNDT (SNA only) and NJE (SNA or BSC)

Figure 15. Interconnecting Systems - Bulk Data Transfer

## B.1 GENERAL


Job Networking (IBM Systems Journal, V17, N3, 1978) ..... G321-5071
NJI General Information ..... GH20-1941
SNA - Intro to Sessions Between Logical Units ..... GC20-1869


## B.2 MVS


**MVS/JES2**
RJE Operator's Guide ..... GC38-0225

**MVS/JES2 NJE**
General Information ..... GC23-0010
Network Job Entry (IBM Sys.Journal, V17, N3, 1978) G321-5072
Network Job Entry (Slide Presentation) ..... GV20-0752
System Programmer's Library ..... SC23-0003
Operator Commands ..... SC23-0011
Installation Reference Manual ..... SC23-0012
Program Logic Manual ..... LY24-6001
Operators Reference Summary Card ..... SX23-0004
Installation Considerations ..... GG22-9010

**MVS/JES3**
System Programmer's Library ..... GC28-0608

**MVS/JES3 NETWORKING**
General Information ..... GH20-2204
Operations Guide ..... SH20-2416
Users Guide ..... SH20-2417
Program Reference Manual ..... SH20-2415
Program Logic Manual ..... LY20-2489

**BULK DATA TRANSFER**
Availability Notice ..... G320-6060
Program Description & Operations Manual ..... SH20-2088
Systems Guide ..... LY20-2367

**MVS INFORMATION DISTRIBUTION WORKSTATION SUPPORT**
General Information ..... GC23-0031
Administration, Customization & Installation Guide
..... SC23-0032
Operation: General User Guide ..... SC23-0034
Operation: Work Station Controller & System Owner Guide
..... SC23-0033
Command Reference Summary ..... SX23-0006

## B.3 VM/370

| | |
|---|---|
| Introduction | GC20-1800 |
| RSCS Users Guide | GC20-1816 |
| Planning & Sysgen Guide | GC20-1801 |

**RSCS NETWORKING (PP)**

| | |
|---|---|
| General Information | GH24-5004 |
| Evolution of Virtual Machine Subsystem (IBM Sys.Journal, V18, N1, 1979) | G321-5089 |
| Program Reference & Operations Guide | SH24-5005 |
| Program Logic Manual | LY24-5203 |
| Operators Reference Summary Card | SX24-5119 |

**VM/370 NETWORKING (PRPQ)**

| | |
|---|---|
| NJI General Information | GH20-1941 |
| Program Reference & Operations Guide | SH20-1977 |
| Program Logic manual | LY20-2342 |
| Operators Reference summary card | SX23-0004 |

## B.4 SVS

**HASP**

| | |
|---|---|
| Systems Programmer's Guide | GC27-6992 |
| Operator's Guide | GC27-6993 |

**HASP NETWORKING**

| | |
|---|---|
| NJI General Information | GH20-1941 |
| Users Guide | SH20-1980 |
| Operations Manual | SH20-1982 |
| Systems Programmers Guide | SH20-1981 |
| Program Logic Manual | LY20-2340 |

**ASP**

| | |
|---|---|
| General Information | GH20-1173 |
| Operator's Guide | GH20-1289 |
| Systems Programmer's Guide | GH20-1292 |
| Application Programmer's Guide | GH20-1291 |

**ASP NETWORKING**

| | |
|---|---|
| NJI General Information | GH20-1941 |
| Users Guide | SH20-1978 |
| Program Reference & Operations Guide | SH20-1979 |
| Program Logic Manual | LY20-2341 |

## B.5 VS/1

RES System Programmer's Guide ..... GC28-6878
RES Workstation User's Guide ..... GC28-6879
Operator's Library: Reference ..... GC38-0110
4300 Distributed Systems OS/VS1 Installation Aids G320-6039

**HOST REMOTE NODE ENTRY SYSTEM (VS1 WORKSTATION)**
General Information ..... GB21-9862
Availability Notice ..... G320-5813
Program Description & Operations Manual ..... GH20-2047
Systems Guide ..... LY20-2351

**VS1 INFORMATION DISTRIBUTION WORKSTATION SUPPORT**
General Information ..... GC24-5193

## B.6 DOS

**DOS/VS**
System Generation ..... GC33-5377
VTAM System Programmer Guide ..... GC27-6957
POWER/VS Installation Guide & Reference ..... GC33-6048
POWER/VS Workstation User's Guide ..... GC33-6049

**DOS/VS REMOTE JOB ENTRY WORKSTATION PROGRAM**
General Information ..... GH20-1574
Program Reference Manual ..... SH20-1590
Operations Guide ..... SH20-1589
Program Logic Manual ..... SH20-1592

**DOS/VSE**
General Information ..... GB21-5128
Installation & Operations Guide ..... GH12-5329
POWER RJE User's Guide ..... SH12-5328
SIPO Extended General Information ..... GC20-1873

**DOS/VSE REMOTE JOB ENTRY WORKSTATION PROGRAM**
General Information ..... GH20-2199
Program Reference Manual ..... SH20-2205
Operations Guide ..... SH20-2206
Program Logic Manual ..... LY20-2455

**DOS JOB ENTRY PROGRAM (JEP)**
General Information ..... GH20-5129

**DOS FILE TRANSFER PROGRAM (FTP)**
General Information ..... GH20-5129

## B.7 TSS

**TSS ENHANCED SUPPORT**
Concepts & Facilities ..... GC28-2003

**ACF** Advanced Communication Facility - A group of SNA program products for users of DOS/VS and OS/VS that can provide improved data communication capability.

**ACF Networking** The use of Advanced Communication Facility to exchange data between two or more processors using MSNF.

**ASP** Attached Support Processor or Asymmetric Multiprocessing System - A system that provides supplementary job management, data management, and task management functions, such as: control of job flow, ordering of tasks and spooling. Predecessor of JES3.

**ASP Networking** The programming RPQ providing job networking support for ASP 3.2.1 systems (SVS or MVT).

**BSC** Binary Synchronous Communications - Communications between two devices using data transmission protocols in which synchronization of characters is controlled by timing signals generated at the sending and receiving stations.

**bulk data** Collections of data in a file (VM) or data set (OS or DOS). The term is used to differentiate from a transaction which is a smaller amount of data or a message. Also called "batch data".

**CADAM** Computer-graphics Augmented Design And Manufacture - An IUP supporting several on-line graphic terminals on VS/1 and MVS for design & manufacturing.

**CJN** Corporate Job Network - The IBM internal job network.

**CMS** Conversational Monitor System - The interactive time-sharing facility available under VM/370.

**cold start** The type of initialization of a system or subsystem that purges the queues upon starting.

**compaction** The reduction of data for transmission by representing adjacent "master" characters by a single byte. See the JES2 SPL.

**compression** The elimination of duplicate blanks (or other characters) by a special code which is used upon decompression for reconstituting the duplicate characters. In multi-leaving protocols, up to 63 blanks can be represented by a single byte, and up to 63 non-blank characters can be represented by a two bytes.

**connection** (in job networking) a physical link between two processors. It may consist of:

1. one or more BSC lines
2. a channel-to-channel adapter
3. an SNA session
4. (JES2 only) a shared spool

**end-node** A node in a job network which has only one connection to the network. It cannot act as an intermediate node, but can only receive jobs or sysout destined for itself.

**FDP** Field Developed Program - A type of IBM licensed program offered to users which was normally developed by IBM branch office personnel.

**GMT** Greenwich Mean Time - The standard global universal time used as a common time reference around the world.

**HASP** Houston Automatic Spooling Priority - A system that provides supplementary job management, data management, and task management functions, such as: control of job flow, ordering of tasks and spooling. Predecessor of JES2.

**HASP Networking** The programming RPQ providing job networking support for HASP/SVS systems.

**host** A processor running OS (e.g., MVS, VS1, SVS) or VM having remote terminals attached.

**hybrid network** A job network with different systems (e.g., OS, VM, TSS) or subsystems (e.g., JES2, JES3) on different nodes.

**IUP** Installed User Program - A type of licensed program offered by IBM which was developed by, or for, an IBM user.

**JES** Job Entry Subsystem - A system facility for managing jobs and sysout data sets on auxiliary storage including spooling, job queueing and scheduling. See also JES2 and JES3.

**JES2** Job Entry Subsystem/2 - A functional extension of HASP II program that receives jobs into the system and processes all sysout data produced by the job.

**JES3** Job Entry Subsystem/3 - A functional extension of ASP 3 program that receives jobs into the system, manages device allocation, setup, and processes all sysout data produced by the job.

**JES3 Networking** The programming RPQ providing job networking support for JES3 systems.

**JCL** Job Control Language - A high level programming language used to code job control statements.

**JECL** Job Entry Control Language (also called JES control statements) - A high level language used to describe job characteristics to the job entry subsystem.

**job** The basic unit of transmission in a job network.

**job control statement** A statement in a job that is used in identifying the job or describing its requirements to the operating system.

**job networking** A facility for transmitting jobs, sysout data sets, commands and messages, from one computing system to another.

**jobstream** Input to the system containing JCL and input data. May be one or more jobs. Usually in card image format.

**link** See connection.

**logical unit** See LU.

**logoff** (1) The process by which a user ends a terminal session. (2) In VTAM, a request that the terminal be disconnected from a VTAM application program.

**logon** (1) The process by which a user begins a terminal session. (2) In VTAM, a request that the terminal be connected to a VTAM application program.

**LU** Logical Unit - In SNA, a type of network addressable unit. It is the port through which an end user accesses function management in order to communicate with another end user.

**mixed network** See hybrid network.

**Multi-Access Spool (MAS)** Two to seven JES2 systems sharing the input, execution, and output queues through the use of shared DASD.

**multi-leaving** A pseudo-simultaneous bi-directional fully-synchronized multi-stream transmission between two computers using BSC facilities.

**MLI** Multi-Leaving Interface - A modified set of BSC protocols implemented by DOS/VSE and RSCS for peer-to-peer RJE.

**MSNF** Multi-Systems Networking Facility - A feature of ACF/VTAM or ACF/TCAM that supports communication among multiple host computers operating with DOS/VS and OS/VS.

**MVS** Multiple Virtual Storage - An alternate name for OS/VS2 releases 2 and 3.

**NCP** Network Control Program - A program, generated by the user from a library of IBM-supplied modules, that controls the operations of a communications controller (3705).

**NDH** Network Data set Header - A control block transmitted as part of the job networking protocol at the front of each sysout and, optionally, sysin data set which contains necessary information about the data set.

**network** The assembly of equipment through which physical connections are made between remote locations. See also "job network" and "ACF Networking."

**NJE** Network Job Entry - A facility of JES2 which provides for the transmission of selected jobs, operator commands, messages, sysout data sets, and accounting information between communicating job entry nodes that are connected in a network either by BSC lines, channel-to-channel adapters, SNA sessions, or shared (multi-access) spool.

**NJI** Network Job Interface - A collection of programming RPQ's supporting job networking on VM, HASP, and ASP systems.

**network path manager (NPM)** The component of NJE which controls nodal sign-ons and sign-offs and keeps a real time picture of the network topology. It also handles alternate path routing and parallel links.

**NJH** Network Job Header - A control block transmitted as part of the job networking protocol at the front of each job which contains necessary information about the job.

**NJT** Network Job Trailer - A control block transmitted as part of the job networking protocol at the end of each job stream which contains statistical information about the job.

**node** The high-level addressable point in a job network. A processing point in a network. It can be either a single system (e.g., VM processor), or a collection of loosely-coupled systems (e.g., JES2 or JES3 complex) sharing a common job queue.

**nodename** The one-to-eight character (EBCDIC) name assigned to a node by which a node is known to the rest of the network.

**non-switched line** A communication link between two devices or processors that does not have to be established by dialing.

**path** A collection of connections through which jobs (and sysout data sets, commands & messages) flow from an originating node to a destination node.

**PP** Program Product - An IBM licensed program offering.

**PRPQ** Programming RPQ (Request for Price Quotation) - An IBM licensed program offering.

**remote job entry (RJE)** A host facility for receiving jobs from, and sending output to, remote terminals.

**remote terminal** A terminal attached to a host (or subhost) system through a data transmission link.

**RJP** Remote Job Processing. The ASP and JES3 name for RJE.

**routing** The assignment of a communication path by which a message (or other transmission) will reach its destination.

**RTP** Remote Terminal Processing program - A stand-alone workstation program for S/360, 370, 1130, and S/3 to support the remote processor as a BSC multileaving remote terminal.

**RSCS** Remote Spooling Communications Subsystem - A virtual machine subsystem of VM/370 that transfers spool files between VM/370 users, remote stations, and remote and local batch systems via HASP-compatible telecommunications facilities.

**RSCS Networking** The program product version of RSCS providing job networking support for VM/370 systems.

**SCP** System Control Program - An IBM program offering, usually used to manage systems, control I/O devices and provide an interface for program products and user programs.

**SDLC** Synchronous Data Link Control - A protocol defined by SNA used for data transmissions over common-carrier communication facilities.

**session** (in SNA) A formally bound pairing between two network addressable units.

**SMF** System Management Facility - A standard feature of OS/VS2 that collects a variety of system and job related information.

**SNA** Systems Network Architecture - A data communications protocol for controlling a teleprocessing network through a formal definition of the functional responsibilities of communication system components.

**SPOOL** (also spool) Simultaneous Peripheral Operation On-Line - To read and write input and output streams on auxiliary storage devices, concurrently with job execution, in a format convenient for later processing or output operations. As a noun it refers to the DASD device used for storing the spooled data sets.

**store-and-forward** The protocol of completely storing a job (or sysout data set) at an intermediate node before forwarding it on to the next node in the path to its destination.

**subhost** A system that can act like a host to its RJE terminals, but can also act as an RJE terminal to another host system through a workstation program.

**SUN** San Jose Unified Network or Subsystem Unified Network - An implementation of job networking between IBM internal sites. Now called the IBM Corporate Job Network (CJN).

**switched line** A communication link in which connection between two devices or processors is established by dialing.

**SYSOUT** SYStem OUTput data which is SPOOLed by the job entry subsystem and eventually de-SPOOLed and written to a card punch, printer or other output device.

**TCAM** Telecommunications Access Method - A teleprocessing access method used to transfer data between application programs and local or remote terminals. In the RJE and job networking context, only the version of ACF/TCAM which supports the VTAM interface is relevant.

**TSO** Time Sharing Option - An option of MVS, SVS, and MVT that provides conversational time-sharing from remote terminals.

**TSS/370** Time Sharing System/370 - A controlled marketing general purpose virtual memory operating system.

**VM/370** Virtual Machine/370. A System Control Program

**VNET** (slang) Contraction of Vm NETworking, a programming RPQ that supports job networking on VM/370 systems. Predecessor to RSCS Networking.

**VTAM** (Virtual Telecommunications Access Method) A set of programs that control communication between terminals and application programs running under DOS/VS, OS/VS1, and OS/VS2.

**warm start** The initialization of a system of subsystem that does not clean work out of the queues, but resumes processing of work previously left in the system.

**workstation** A remote terminal connected to a host (or subhost) using RJE. (It may, or may not, be a processing unit.)

**workstation program** A program residing in a subhost which acts like an RJE terminal.

**WSP** See workstation program.

Reader's Comments

Title: Job Networking Facilities
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Comments:

Please mail to: John M. Hutchinson
IBM Corporation
Washington Systems Center
18100 Frederick Pike
Gaithersburg, Md. 20760

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