IBM AS/400
TCP/IP Configuration and Operation

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Take Note!

Before using this information and the product it supports, be sure to read the general information under "Special Notices" on page xv.

Third Edition (April 1994)

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Abstract

This document describes the Transmission Control Protocol/Internet Protocol for AS/400 Licensed Program.

It is intended for customers who need to configure and use the program product without having special AS/400 TCP/IP skill, and it provides additional considerations for those who want to get to know the program product in more detail. It covers the full range of the AS/400 TCP/IP protocol suite including TELNET, FTP, SMTP, LPR/LPD, Netstat, and the TCP/UDP API.

A knowledge of the basic operation of the AS/400 system is assumed.

(298 pages)

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Special Notices

This publication is intended to provide customers with additional guidance on configuration and operation of AS/400 TCP/IP. It primarily contains information about basic configuration and operation of the File Transfer Protocol (FTP), the Simple Mail Transfer Protocol (SMTP), the Network Terminal Protocol (TELNET) and the Line Printer Requester/Line Printer Daemon (LPR/LPD) of TCP/IP in the AS/400 system, additional considerations about using these protocols in larger networks, and about the TCP and UDP application program interface. The information in this publication is not intended as the specification of any programming interfaces that are provided by the File Transfer Protocol (FTP), the Simple Mail Transfer Protocol (SMTP), the Network Terminal Protocol (TELNET), and Line Printer Requester/Line Printer Daemon (LPR/LPD) of TCP/IP in the AS/400 system, or the TCP and UDP application program interface. See the PUBLICATIONS section of the IBM Programming Announcement for these products for more information about what publications are considered to be product documentation.

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Preface

The purpose of this document is to give the inexperienced AS/400 TCP/IP user a quick start with the configuration and operation of TCP/IP on AS/400.

The document is organized as follows:

- Chapter 1, "Introduction to TCP/IP"

  This chapter gives the reader a brief overview of TCP/IP. It also provides a short explanation of typical TCP/IP environments and technical terms.

- Chapter 2, "TCP/IP for the IBM AS/400 System"

  This chapter describes, step-by-step, an example configuration process for AS/400 TCP/IP. It also contains the steps required to configure the AS/400 to communicate with other non-AS/400 systems.

- Chapter 3, "Additional TCP/IP Considerations"

  This chapter contains additional considerations that are important when using TCP/IP in larger networks.

- Chapter 4, "Additional TELNET Considerations"

  This chapter contains additional considerations that are important when using AS/400 TELNET with other non-AS/400 systems. It describes how the AS/400 can act as a TELNET server and client. Keyboard and character mapping issues are also covered.

- Chapter 5, "Additional FTP Considerations"

  This chapter contains additional considerations when using FTP in larger networks.

- Chapter 6, "Additional SMTP Considerations"

  This chapter contains additional considerations when using SMTP in larger networks. It provides examples of how to configure the AS/400 to be an office gateway between the SNA and SMTP world. New useful enhancements like the automatic registration and mail router capability are described in detail.

- Chapter 7, "Additional LPR/LPD Considerations"

  This chapter contains additional considerations when using LPR and LPD for network printing.

- Chapter 8, "Network Status"

  This chapter describes the NETSTAT function in the AS/400. It teaches how to monitor and control the status of local TCP/IP links and connections.

- Chapter 9, "TCP and UDP Application Program Interface"

  This chapter gives a brief overview of the considerations and ways you can use the Application Program Interface (API) to write programs to communicate with other systems through TCP/IP.

Related Publications

The following publications are considered particularly suitable for a more detailed discussion of the topics covered in this document.

Prerequisite Publications

IBM AS/400 Communications: Transmission Control Protocol/Internet Protocol Guide, SC41-9875

Related Publications

IBM AS/400 Communications: Operating System/400 Communications Configuration Reference, SC41-0001-02

IBM AS/400 Programming: Control Language Reference, SBOF 0481

IBM AS/400 Printing III, GG24-4028

IBM AS/400 OS/400 Workstation Customization Function Programmer's Guide SC41-0056-01

IBM AS/400 National Language Support User's Guide, GC21-9877

TCP/IP Tutorial and Technical Overview, GG24-3376

IBM 8209 LAN Bridge Customer Information, SA21-9994

IBM 8209 LAN Bridge Service Information, SY31-9077

IBM TCP/IP for VM Programmer's Manual, GC09-1206

Communications Systems Bulletin: TCP/IP by Alan Reinhold, GG22-9125

Introduction to the Internet Protocols, Rutgers State University of New Jersey, 1987 (Copyright by Charles Hedrick)

Internetworking with TCP/IP, Douglas Comer, published by Prentice Hall Inc. 1988, ISBN 0-13-470154-2.

Hitchhikers Guide to the Internet, RFC 1118 by E. Krol

Introduction to Administration of an Internet Based Local Network, Rutgers, State University of New Jersey, 1988 (Copyright by Charles Hedrick).

A complete list of International Technical Support Organization publications, with a brief description of each, may be found in:

Bibliography of International Technical Support Organization Technical Bulletins, GG24-3070.

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- *System/36 to AS/400 System Migration*, GG24-3249
- *System/36 to AS/400 Application Migration*, GG24-3250
- *AS/400: System/38 Application Migration to AS/400*, GG24-3251
- *AS/400 Communication Migration*, GG24-3253
- *AS/400 Office in a DIA/SNADS Network*, GG24-3268
- *Converting S/36 Environment Application to Native*, GG24-3304
- *AS/400 Communications Problem Determination*, GG24-3305
- *SQL/400: A Guide for Implementation OS/400 V2R2*, GG24-3321
- *AS/400 - S/370 Connectivity*, GG24-3336
- *AS/400, S/38 and PS/2 as T2.1 Nodes in a Subarea Network*, GG24-3420
- *Writing SAA Applications for AS/400*, GG24-3438
- *IBM AS/400 TCP/IP Operation and Configuration*, GG24-3442
- *IBM AS/400 in Large Networks: A Case Study*, GG24-3447
- *AS/400 Communications Definitions Examples*, GG24-3449
- *AS/400 Object Distribution Facility and SNA RSCS PROFS*, GG24-3479
- *IBM AS/400 ISDN Connectivity*, GG24-3517
- *OfficeVision/400 and AS/400 Query Applications in a Multilingual Environment*, GG24-3579
- *Managing Multiple AS/400s in a Peer Network*, GG24-3614
- *OfficeVision/400 in a DIA/SNADS Network*, GG24-3625
- *PC Support/400 Implementation and Performance*, GG24-3636
- *AS/400 Audit and Security Enhancements in OS/400*, GG24-3639
- *WAF/400 5363 Optical Subsystem Configuration and Installation*, GG24-3680
- *OfficeVision/400 Printing*, GG24-3697
- *AS/400 Printing II*, GG24-3704
- *AS/400 APPN with PS/2 APPN, 3174 APPN, 5394 and Subareas*, GG24-3717
- *AS/400 CPI Communications Selected Topics*, GG24-3722
- *AS/400 Performance Management V2R2*, GG24-3723
- *Multimedia Examples with the AS/400 Using AVC*, GG24-3743

- *Getting Started with AS/400 OSI*, GG24-3758
- *AS/400 Communication Definition Examples Volume 2*, GG24-3763
- *Installation Considerations for National Language*, GG24-3790
- *Artificial Intelligence and AS/400: Neural Networks and Knowledge Based Systems*, GG24-3793
- *Facsimile Support/400 Implementation*, GG24-3797
- *Application Development on the AS/400*, GG24-3806
- *PC Support/400 Asynchronous and SDLC Configuration Examples*, GG24-3808
- *5494 & OS/2 ES: Connecting Remote User Groups*, GG24-3828
- *AS/400 Automation Using NetView and SNA MS Transport*, GG24-3841
- *DOS PCS/400 in OS/2 V2 Virtual DOS Machine*, GG24-3856
- *WAF/400 Administration and User Examples*, GG24-3866
- *OfficeVision/400 Application Enabler*, GG24-3868
- *Cooperative Processing and GUI in an AS/400 Environment*, GG24-3877
- *OfficeVision/400 Application Programming Interfaces V2R2*, GG24-3885
- *OfficeVision/400 Integration with CallPath/400 and Fax Support*, GG24-3896
- *AS/400 Performance Capacity Planning V2R2*, GG24-3908
- *AS/400 System Availability and Recovery for V2R2*, GG24-3912
- *AS/400 Network Routing Facility*, GG24-3918
- *AD/CYCLE Code/400, ADM/400 and ADS/400*, GG24-3928
- *OfficeVision/400 V2 Technical Tips and Techniques*, GG24-3937
- *CICS/400 Migration from Mainframe CICS*, GG24-4006
- *Using DOS PC Support/400 with Novell NetWare 3.11 and NetWare for SAA 1.3*, GG24-4013
- *Ultimedia Video Delivery System/400*, GG24-4020
- *AS/400 Client Series - Products and Positioning*, GG24-4027
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- *Current-OV/400 Workgroup Program*, GG24-4050
- *Using V2R3 DOS and OS/2 PC Support under OS/2 2.1*, GG24-4070-00
- *Apple Macintosh and the AS/400*, GG24-4071-00
- *OfficeVision/400 Application Enabler Version 2 Release 3*, GG24-4072
- *The IBM AS/400 as a TCP/IP Network File Server*, GG24-4092
- *ENVY/400 Hints and Tips*, GG24-4094
- *Introduction to ENVY/400*, GG24-4126
- *AS/400 Integrated Language Environment*, GG24-4148-00
- *CICS/400 V2R3 Task Book*, GG24-4182-00

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Chapter 1. Introduction to TCP/IP

TCP/IP *(Transmission Control Protocol/Internet Protocol)* refers to a specific set of protocols that allow computers to share resources and exchange information in a network. Because TCP and IP are two of the best-known protocols in this set, the term TCP/IP has become the commonly used name for the whole family. Remember this when looking at the protocols and how they fit together.

Some of the protocols provide low-level data delivery functions that are needed by many applications. Other protocols are actually high-level applications that provide services such as file transfer, mail, and remote login. FTP, SMTP, and TELNET are examples of high-level protocols. They are defined in more detail in section 1.4.2, "TCP/IP Protocols" on page 5.

1.1 History of TCP/IP

TCP/IP was developed by a group of researchers in the United States centered around ARPAnet. This US-based network was developed by the *Defense Advanced Research Projects Agency* (DARPA) in the late 1960s for research on packet switching technology. It interconnects research centers, military bases, and government locations. By 1980 most of the machines on the network were converted to new TCP/IP protocols, which became the standard for any machine to connect. Thus, most vendors now support TCP/IP.

Today, there are many networks that comprise regional networks, local networks at universities and research institutions, and military networks. The term *Internet* applies to this entire set of networks. Because these networks are interconnected, information can be sent from one to another if security restrictions permit. This *Internet* is controlled by a central authority, who is responsible for assigning network addresses to new users and sub-networks. Many smaller "private" networks around the world use TCP/IP protocols, but they are not connected to the *Internet*; for example, organizations that have machines from several vendors and need to interconnect them. TCP/IP provides a good solution for these small networks.

Much of the information published about TCP/IP domain naming and addressing conventions is relative to *Internet*. These conventions are designed to give flexibility and control to this large interconnection of networks. If a proposed network is not part of *Internet*, simpler conventions may meet the requirements of that network.

1.2 TCP/IP, SNA, and OSI

TCP/IP, SNA *(Systems Network Architecture)*, and OSI *(Open Systems Interconnection)* are similar; that is, they provide protocols that enable systems in small and large networks to exchange data and share resources.

TCP/IP has existed for many years and there are many TCP/IP networks in place; IBM* and many other vendors support it. SNA has also been around for many years and is IBM′s strategic communications network offering. OSI, by comparison, is fairly recent and does not have the same degree of market penetration as the other two. OSI is, however, seen as strategic by much of the networking community. Therefore all of these standards have a significant place in the networking community. To support this position, IBM will continue to enhance its support for SNA, as its strategic communications network offering, and its support for both TCP/IP and OSI.

1.3 TCP/IP Terminology

The objective of this section is to provide an explanation for the terms commonly used in TCP/IP networking.

Bridge Connects two or more networks and forwards packets between them. Bridges operate at the physical layer and sometimes at the data link layer. The networks can use the same or different transmission protocols; for example Ethernet – Ethernet or Ethernet – token-ring. A bridge only forwards packets to a destination that is not on the local network, this is known as filtering. The high-level protocols are the same on both sides of a bridge. An example is the IBM 8209 LAN Bridge.

Client-Server Is the model of interaction in a distributed system where a program at one site sends a request to a program at another site and waits for a response. The *requesting* program is called a *client*; the *answering* program is called a *server*.

Domain Can be a host or a set of hosts. In Internet, authority for assigning names and addresses is delegated to individual domains. Domains are organized hierarchically; each has authority for machines within that domain but does not have authority for machines in other domains.

Domain Name Is the name of a host in a network. The terms *host name* and *domain name* are often used interchangeably.

A domain name is a sequence of subnames separated by a delimiter character. For example, *rchasm01.rchland.ibm.com* is the name of a host in the lowest-level domain, which is a subdomain of *rchland.ibm.com*, which is a subdomain of *ibm.com*, which is a subdomain of *com*. For more information about domain naming conventions, see 3.6.6, "Domain Naming Conventions" on page 67.

Gateway Interconnects two or more networks in the TCP/IP environment. Gateways connect to other gateways by using a special gateway protocol (EGP, RIP, GGP). A gateway also performs the function of an IP router. Gateways can be used to interconnect networks using different network architectures, for example, TCP/IP to SNA.

Host A unique internet address and associated system name. The function of a host is to control all or part of a network and provide an access method to that network.

Internet address Is a unique 32-bit address which is assigned to each host on the TCP/IP network and is used for all communications with that host. Usually this address is written as four decimal numbers, each representing 8 bits of the address. Internet Protocol uses this address for routing.

IP Datagram Is the base unit of information passed across the Internet. and is divided into header and data areas. The header contains source and destination Internet addresses.

The datagram is encapsulated in the underlying network′s frame, which usually has a maximum length of frame limitation, depending on the hardware used. For a token-ring network, the maximum length is 1994 bytes, for Ethernet 1500 bytes, for IEEE802.3 1496 bytes and for X.25 is 1024 Bytes.

Name Server Is a server application providing the translation between domain names and the Internet address. Usually, all name servers are arranged in a tree structure corresponding to the domain naming hierarchy. At each domain, one or more machines assumes this task.

Port Identifies an interface between a higher-level protocol or application and the TCP or UDP protocol. It is specified as a 16-bit number. Some protocols, such as FTP and SMTP use the same port number in all TCP/IP implementations. Those assigned port numbers are called ′well known ports′.

Protocol Is a formal description of message formats and the rules that two or more machines must follow to exchange messages. Protocols determine the machine-to-machine interface at the lowest level (such as the order in which bits from a byte are sent) and at the highest level (such as file transfer programs).

Route Is the path that network traffic follows from its source to its destination. In the TCP/IP network, each datagram is routed separately. The route of an IP datagram may include many gateways and many physical networks.

Router Receives and forwards datagrams in a network; it could also provide the functions of a bridge. Normally, routers use functions in the Internet Protocol. The higher-level protocols are the same on both sides of a router.

Socket Defines a TCP/IP application (process) in the Internet Protocol by the following pair of numbers:

- The Internet address of the host on which it runs
- The port number through which it communicates with TCP/IP.

Subnet Is one of the smaller, more manageable networks created when subnet addressing subdivides networks. Subnets are grouped by host addresses. For example, a typical Internet address may be:

<network address> <host address>

and after subnetting:

<network address> <subnet address> <host address>

Many large organizations divide their network number into subnets. This way, each institution that wants to connect to the network has only one entry to define. Each update of the organization′s network does not affect the definition in the other network.

For more information about subnets, see Appendix C, "Theoretical Network Example" on page 239 and 3.6.5, "Subnetworks" on page 64.

Subnet mask Defines the portion of the host address used for routing to specific subnets.

Subnet value Defines which host or hosts are addressed within a subnet. This value is a subset of the subnet mask.

1.4 Overview of TCP/IP

This chapter gives a general overview of the TCP/IP architecture and protocols.

1.4.1 TCP/IP Architecture

Internet protocols are organized into four conceptual layers as shown in Figure 1.

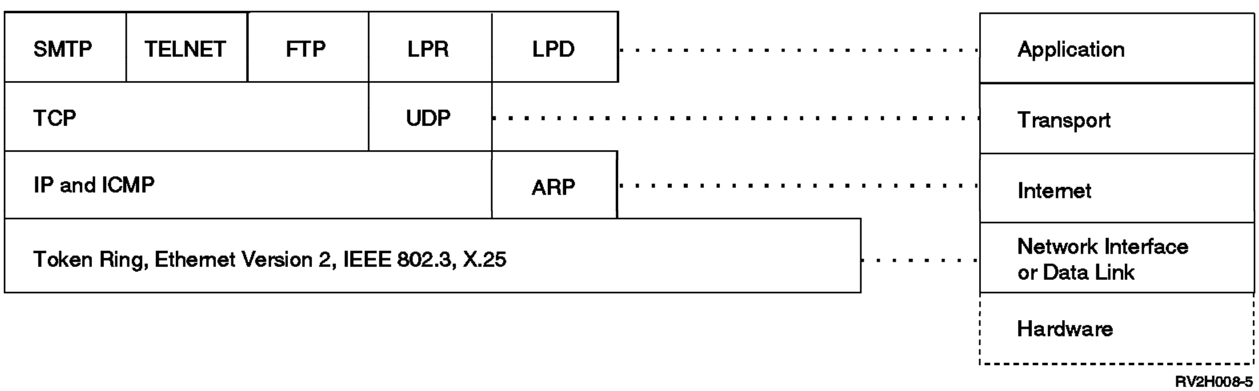

Figure 1. Model of the TCP/IP Architecture

The four layers are defined as follows:

Application

This is where a process cooperates with another process on the same or a different host. Examples of applications are the File Transfer Protocol (FTP), the Simple Mail Transfer Protocol (SMTP) and the TELNET protocol (for remote terminal connections). For more information on these protocols, see 1.4.2, "TCP/IP Protocols" on page 5. These applications will pass data in the required form to the transport level for delivery.

Transport

This layer has the primary duty of providing communication from one application program to another. Such communication is often called end-to-end data transfer. Examples of protocols that provide transport services are the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP).

Internet

The internet layer makes the entire physical network seem like a single "virtual network" and it does this by shielding the higher levels from the underlying network architecture. Examples of protocols at this level are the Internet Protocol (IP), the Address Resolution Protocol (ARP) and the Internet Control Message Protocol (ICMP). IP is the most important protocol at this level and it is a connectionless protocol that does *not* provide reliability, flow control or error recovery, and does not assume reliability from the lower layers.

Network Interface
This layer is the interface to the actual network hardware. It may not provide reliable delivery; and may be packet or stream-oriented. In fact, TCP/IP does not specify any protocol here, but can use almost any network interface available, which illustrates the flexibility of the IP layer. Examples are token-ring, Ethernet, IEEE 802.3 and X.25.

1.4.2 TCP/IP Protocols

The protocols that build up the TCP/IP family can be divided into two categories:

- Low-level functions which are required by most applications. These protocols are IP, TCP, and UDP.
- High-level functions or applications. These protocols include FTP, SMTP, LPR, LPD and TELNET.

Each layer in the TCP/IP protocol suite provides services to the layer above it and uses the services provided by the layer below it. The layer next to the hardware is not part of the TCP/IP family, but consists of hardware-specific network protocols. The relationship between each layer can be seen in Figure 1 on page 4.

The following are descriptions of some of the low-level and high-level protocols:

Internet Protocol (IP)
The IP layer delivers datagrams to the physical network interface. Its job is simply to find a route for the datagram and get it to the other end.

It includes no reliability, flow control, or error recovery. That has to be ensured by a higher layer protocol (such as TCP) or a user-written application.

Transmission Control Protocol (TCP)
TCP breaks up the data into datagrams, gives it to IP, and reassembles it at the other end when it is received from IP. TCP also resends missing datagrams and puts them back in the right order. User applications can be written using TCP application program interfaces.

User Datagram Protocol (UDP)
UDP is an application programming interface to IP. It provides only checksum. It does not provide other reliability, such as flow-control or error recovery. It serves as a “multiplexor/demultiplexor” for sending and receiving IP datagrams, using ports to direct the datagrams.

Address Resolution Protocol (ARP)
The ARP dynamically associates internet addresses to physical hardware addresses on a local network. It relies on the broadcast capabilities of the underlying media (for example, the token-ring adapter) to provide this function.

Internet Control Message Protocol (ICMP)

The ICMP is an integral part of every IP implementation. It provides for error and control messages between host systems and gateways. Gateways and hosts use ICMP to send reports of datagram problems. ICMP also includes an echo request/reply function used to test whether a destination is reachable and responding. This echo facility is commonly known as “PING”.

File Transfer Protocol (FTP)

FTP enables a user on a local host (client) to copy a file to or from a remote host (server). This is done by the user logging on to the remote server under FTP and executing FTP subcommands; for example, GET and PUT. A user ID and password on the server machine are required. FTP uses TCP as the reliable end-to-end data transmission protocol.

Network Terminal Protocol (TELNET)

TELNET allows a user to logon to any other computer in the network for which a user ID and password are known. Standard TELNET provides only line mode support, but full screen emulators are available for many environments.

Simple Mail Transfer Protocol (SMTP)

SMTP provides message and note exchanges between TCP/IP hosts. The normal user interface to SMTP is a local mail application (such as OfficeVision/400) that sends the mail through a bridge to the SMTP application, which then sends the mail to the destination.

The SMTP application is based on an *end-to-end delivery*, which means that the source and destination hosts must be in contact when the mail is sent. This is different from protocols like SNADS *(Systems Network Architecture Distribution Services)*, which uses a store-and-forward method of delivery. However, SMTP provides a retention and retry mechanism for cases when end-to-end contact is not possible initially.

Line Printer Requester (LPR)

This is the client function that allows a user to send spool files to any system that supports the LPD protocol (see LPD below) in the TCP/IP network for printing.

Line Printer Daemon (LPD)

This is the server function that accepts print requests from another system in the TCP/IP network that supports LPR.

1.4.3 Products with TCP/IP Support

The TCP/IP family of protocols is a widely used set of protocols for communication that is vendor-independent.

IBM has the following TCP/IP implementations:

- TCP/IP for IBM AS/400*
- TCP/IP on IBM RISC System 6000*
- TCP/IP on AIX RT PC*
- TCP/IP on AIX PS/2*
- TCP/IP for MVS*

- TCP/IP for VM*
- TCP/IP for OS/2*
- TCP/IP for PC/DOS

The following is a list of some of the non-IBM systems that have the TCP/IP protocols available, either from third-party vendors or from the system vendor directly:

- Digital Equipment Corporation**
- Hewlett-Packard Company**
- Sun Microsystems, Inc.**
- Apple Macintosh**

Most UNIX** systems are able to run TCP/IP.

Chapter 2. TCP/IP for the IBM AS/400 System

This chapter contains an overview of supported TCP/IP protocols on the AS/400 system.

It also contains the basic steps for setting up TCP/IP and the application protocols like TELNET, FTP, SMTP, LPR and LPD. For further details on each of these application protocols, refer to Chapter 4, "Additional TELNET Considerations" on page 71, Chapter 5, "Additional FTP Considerations" on page 109, Chapter 6, "Additional SMTP Considerations" on page 127 and Chapter 7, "Additional LPR/LPD Considerations" on page 189.

2.1 AS/400 TCP/IP Overview

With TCP/IP installed, the AS/400 system is able to participate in non-SNA networks containing non-IBM computers. This gives users the opportunity for new applications with host-to-host communications.

The TCP/IP support on the AS/400 system, hereafter called AS/400 TCP/IP, contains some of the most commonly used protocols in the TCP/IP family. Besides the low-level functions covered by TCP, IP, UDP and ICMP, the following high-level functions are included:

File Transfer Protocol (FTP)
Enables AS/400 TCP/IP to have the capability of being both a TCP/IP client and server. The client logs on to the remote server machine and can PUT and GET files interactively. All transfers are interactive, which means that the user is unable to send commands during the transfer.

Although FTP is normally used in an interactive manner, it is possible to use FTP in an unattended or batch mode. Refer to section 5.5, "FTP in Batch Mode" on page 118 for an example.

Line Printer Requester (LPR)
Allows an AS/400 user to send spool files to any system in the TCP/IP network for printing.

Line Printer Daemon (LPD)
Enables AS/400 TCP/IP to accept print requests from other systems in the network and place them in the local output (printer) queues.

Simple Mail Transfer Protocol (SMTP)
Is supported by AS/400 TCP/IP under the cover of SNADS, which means that the user can use the regular OfficeVision/400 interface to handle mail. SMTP can also be accessed by the AS/400 commands Send Distribution (SNDDST) and Receive Distribution (RCVDST).

SMTP includes a bridge program between SNADS and SMTP that automatically takes care of all traffic outside the SNADS/PROFS world.

Network Terminal Protocol (TELNET)
The TELNET protocol allows you (the TELNET client) to access the resources of another remote system (the TELNET server) as though your terminal were locally connected to the server remote system.

Standard TELNET provides only line mode support, but full-screen emulators are available for many environments.

Packet Internet Groper (PING)
Is an echo request and reply function in the Internet Control Message Protocol (ICMP) to verify the TCP connection to a remote system. This is a useful command that allows users to easily verify connections to remote hosts.

Network Status
Is an application used to display the status of the current TCP/IP network configuration. This function also allows you to end TCP/IP connections as well as to start and end TCP/IP links.

Application Program Interface (API)
Is provided for both the TCP and UDP layers. It is implemented as a library of subroutines that are called from the AS/400 Pascal high-level language.

Network File System (NFS)**
Is a method of sharing files by providing the same access to remote files in exactly the same way as it is provided by the local operating system. Ideally, a user can execute any application program using remote and local files as input or output; that is, the network file system is implemented to be transparent to the application program.

The AS/400 can only be a server in this environment, and then only if you purchase the AS/400 TCP/IP File Server Support/400 product in addition to any fees for the TCP/IP Connectivity Utilities/400. FSS/400 is not covered in this book. For more information about FSS/400 please see *The IBM AS/400 as a TCP/IP Network File Server*, GG24-4092

The structure of AS/400 TCP/IP is shown in Figure 2 on page 11. It shows where the protocols and interfaces are located in the layered model.

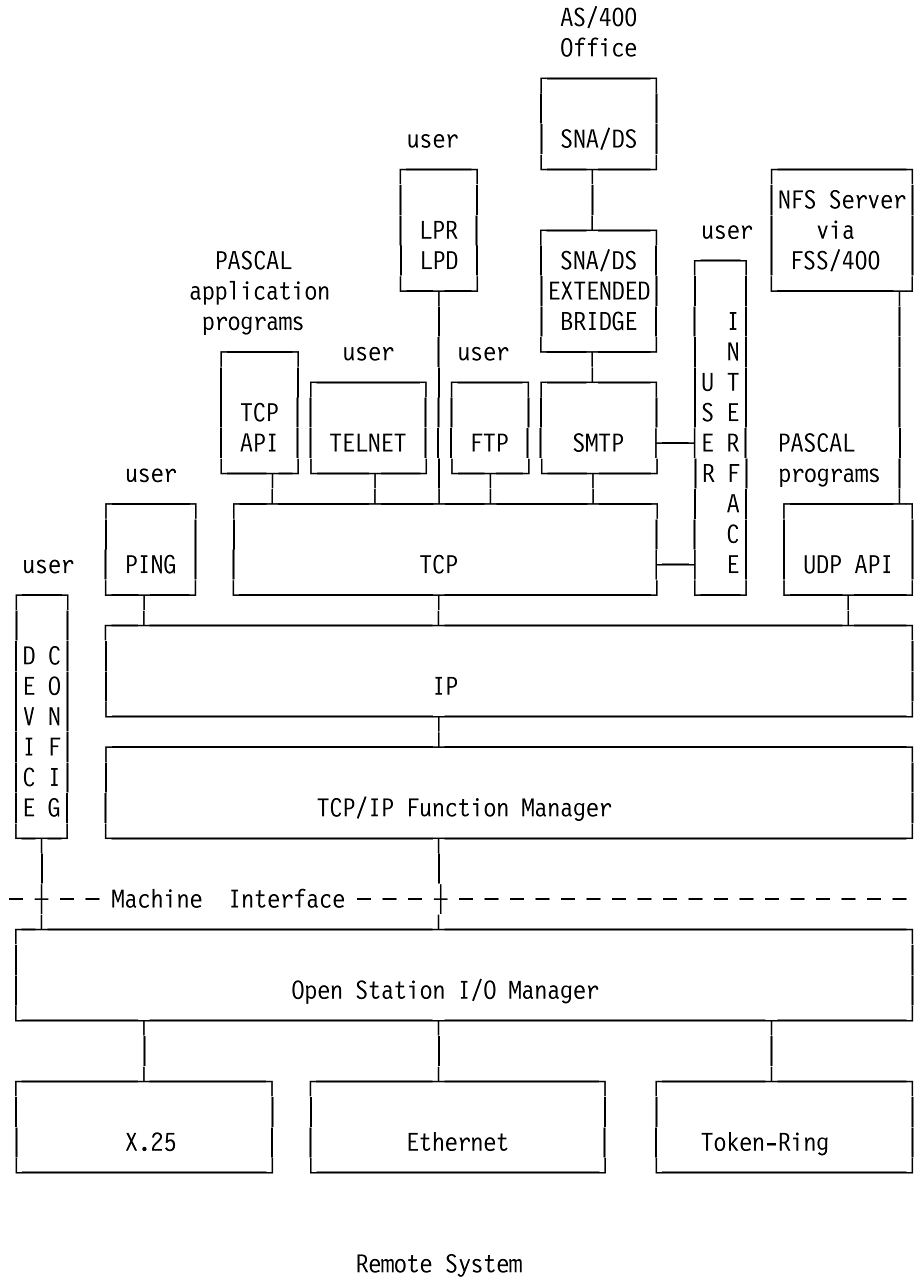

Figure 2. TCP/IP Suite for the AS/400 System

Note: AS/400 TCP/IP uses a token-ring, Ethernet or X.25 to connect to the network. This allows it to communicate directly with any other host on a token-ring, Ethernet or X.25 networks. For AS/400 TCP/IP to communicate with hosts that are not on these networks, some sort of network bridge is required.

2.2 Getting Started with AS/400 TCP/IP

This section is intended to help you configure TCP/IP on the AS/400. Once it has been configured, you can proceed to use other functions like TELNET, FTP and LPR/LPD. For SMTP, further steps need to be done. Most of these steps will be SNADS configuration because SMTP is closely coupled to SNADS. Refer to 2.5, “Using SMTP” on page 34 for a description of these steps.

In this simple scenario, we will consider two AS/400s that are connected in a token-ring. Though two AS/400s would normally communicate via the SNA protocol, we will configure them for TCP/IP for the purpose of this chapter and for simplicity reasons.

Please note that Figure 3 is just a simplified subset of our larger TCP/IP network.

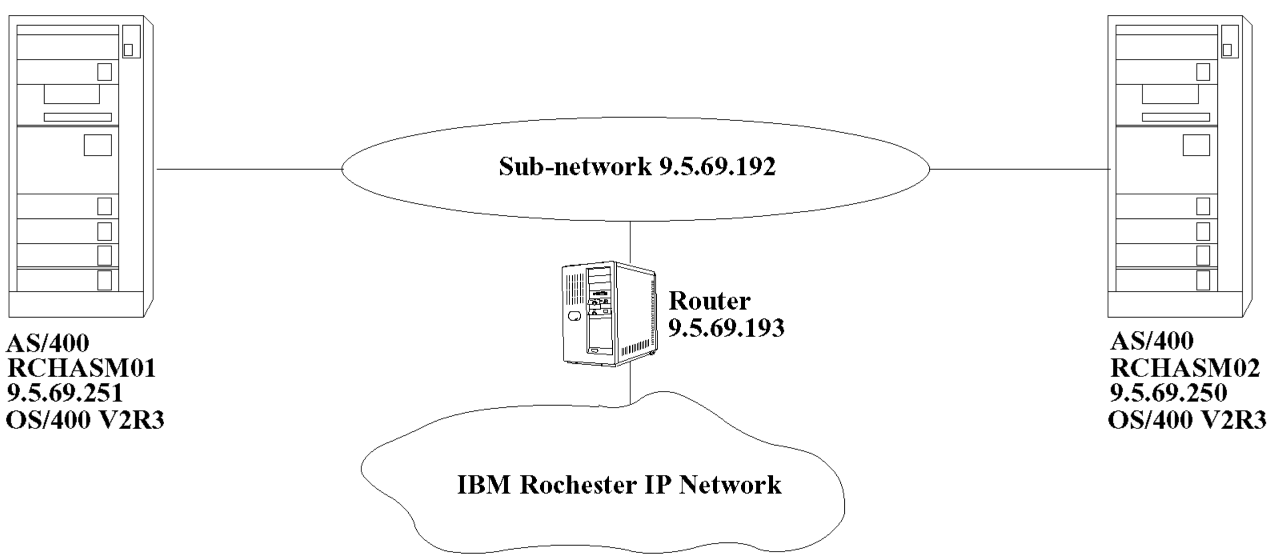

Figure 3. Simple Network—Two AS/400 Systems on a Token-Ring LAN

2.2.1 Basic Configuration

The following steps are *required* to perform the basic TCP/IP configuration in the local host system (RCHASM01). Similar configurations should be done on the remote host system (RCHASM02).

1. Create or modify the line description.
2. Configure the host table.
3. Add the TCP/IP link.
4. Add the TCP/IP route(s).

Once the above steps are completed, proceed to verify the TCP/IP connection:

5. Start the TCP/IP subsystem.

6. Verify the TCP/IP connection using PING.

Note: An AS/400 security officer should perform all of these steps to ensure sufficient authority.

2.2.1.1 Step 1—Create or Modify the Line Description

AS/400 TCP/IP requires either a token-ring or Ethernet adapter or X.25 to connect to the network. It therefore requires the appropriate line description. The AS/400 TCP/IP automatically creates the controller and device objects for you, if needed, and varies them on.

Here is an example of creating a token-ring line description. For Ethernet and X.25 examples, refer to IBM AS/400 TCP/IP Guide (SC41-9875) Appendix A for details.

1. **If the Token-Ring Line Description Does Not Exist**

   Enter the command:

   CRTLINTRN

   Press F4 to create the token-ring line description as shown in Figure 4.

```
                     Create Line Desc (Token-Ring) (CRTLINTRN)

 Type choices, press Enter.

 Line description . . . . . . . . > ITSCTRN       Name
 Resource name  . . . . . . . . . > LIN041        Name, *NWID
 Online at IPL  . . . . . . . . .   *YES          *YES, *NO
 Vary on wait . . . . . . . . . .   *NOWAIT       *NOWAIT, 15-180 (1 second)
 Maximum controllers  . . . . . .   40            1-256
 Line speed . . . . . . . . . . . > 4M            4M, 16M, *NWI
 Maximum frame size . . . . . . .   1994          265-16393, 265, 521, 1033...
 Local adapter address  . . . . . > 400000001001  400000000000-7FFFFFFFFFFF...
 Exchange identifier  . . . . . .   *SYSGEN       05600000-056FFFFF, *SYSGEN
 SSAP list:                         _
   Source service access point  .   *SYSGEN       02-FE, *SYSGEN
   SSAP maximum frame . . . . . .   _________     *MAXFRAME, 265-16393
   SSAP type  . . . . . . . . . .   _______       *CALC, *NONSNA, *SNA
               + for more values _
 Text 'description' . . . . . . . > 'Token Ring Line for TCP/IP'
______
                                                                       Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 4. Create Token-Ring Line Description

   The important parameters are *Resource name, Line speed, Local adapter address*, and *SSAP list* (Source Service Access Point).

   The *Resource name* is the name of the token-ring adapter card and can be obtained by using the WRKHDWPRD (Work with Hardware Products) command.

   For the parameter, *Local adapter address*, you can either specify a unique address or leave it as *ADPT. If *ADPT is specified, the system will use the burnt-in address of the token-ring adapter card. This address is always a unique address. When the line is varied on for the first time, the system will interrogate the card, determine its address, and insert it into the line description.

Alternatively, if you know your network well, you can select a unique address that is easy to remember. This unique address must be within the valid address range of the *Local adapter address* parameter.

The *SSAP list* (source service access point list) is a set of logical addresses associated with the adapter address. Leave the *SSAP list* value as the default of *SYSGEN so that the values for TCP/IP (X′06′ and X′AA′) are automatically specified as entries in the *SSAP list* when creating a new token-ring line description.

2. **If a Token-Ring Line Description Exists**

   The SNA and TCP/IP protocols can share the same token-ring adapter as well as the same token-ring network. But ensure that this existing line has the SSAP values X′06′ and X′AA′. If they are not found, then add them using the CHGLINTRN command.

   The controller and device descriptions (*network descriptions*) are created automatically when the QTCP subsystem is started. The QTCP subsystem automatically varies on the line, controller, and device descriptions when it starts.

2.2.1.2 Step 2—Configure the Host Table

The host table allows you to associate a *host name* to an internet address. It should contain an entry for the local host (your own system) as well as one for each of the other hosts in the network. The host names and internet addresses must be unique in the network. The host names must also be consistent throughout the network so that a host is not referred to by one name on one host, and by another name on another host. These conditions are especially important if SMTP is to be used. See section 6.13, “Central Host Maintenance” on page 184 for further host table considerations.

To define host names in the host table, follow these steps:

1. Enter the command

   ```
   CFGTCP
   ```

2. The Configure TCP/IP menu will be displayed as shown in Figure 5 on page 15. Select option 1 to Work with TCP/IP Host Table Entries.

```
                          Configure TCP/IP
                                                    System:   RCHASM01
Select one of the following:

     1. Work with TCP/IP host table entries
     2. Work with TCP/IP links
     3. Work with TCP/IP route entries
     4. Change local domain name
     5. Work with names for SMTP
     6. Work with TCP/IP remote system information

    10. Change remote name server
    11. Change TCP/IP attributes
    12. Work with TCP/IP port entries
    13. Change SMTP attributes
    14. Change TCP/IP tuning values

    25. Convert host table

Selection or command
===> 1

F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
```

Figure 5. Configure TCP/IP Menu

3. Take option 1 to add an entry. Input the local host system name and its internet address as shown in Figure 6.

```
                    Add TCP/IP Host Table Entry
                                                    System:   RCHASM01
Type choices, press Enter.

  Internet address . . . . . . .   9.5.69.251
  Host name  . . . . . . . . . .   RCHASM01



F3=Exit   F12=Cancel
```

Figure 6. Add Host Table Entry

4. Press the Enter key to add the entry to the host table and return to the Work with Host Table panel.

5. Continue to add another entry for the remote host system as shown in Figure 7 on page 16.

```
                    Add TCP/IP Host Table Entry
                                                   System:   RCHASM01
Type choices, press Enter.

  Internet address . . . . . . .   9.5.69.250
  Host name  . . . . . . . . . .   RCHASM02



F3=Exit   F12=Cancel
```

Figure 7. Add Another Entry for the Remote Host System RCHASM02

6. Repeat these steps for each remote host to which the local system wants to communicate.

   This simple naming technique is adequate in simple locally controlled networks, but may become confusing when connecting to other TCP/IP networks where other systems may use the same simple names. For this reason we need to refer to the host systems by their longer host domain name.

   In large networks that use domains or networks connected to the Internet, hosts are referred to by both their (short) host name and their full host domain name. To achieve this, add an entry for both the (short) host name and the full host domain name to the host table as shown in Figure 8.

```
                 Work with TCP/IP Host Table Entries
                                                   System:   RCHASM01
Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display

        Internet           Host
Opt     Address            Name
 _      _______________
 _      9.5.69.250         RCHASM02
 _      9.5.69.250         RCHASM02.RCHLAND.IBM.COM
 _      9.5.69.251         RCHASM01
 _      9.5.69.251         RCHASM01.RCHLAND.IBM.COM


F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Position to
```

Figure 8. Host Table with Host Names and Domain Names

   In Figure 8 there are two entries for the local host system; the (short) host name RCHASM01 and the (long) domain name RCHASM01.RCHLAND.IBM.COM. Notice that both entries are associated to the same internet address. You can define up to four names for each internet address.

   Note: The full host domain name is used when sending mail via SMTP between two AS/400 systems.

7. Press F3 to exit. You will be prompted with the screen shown in Figure 9 on page 17.

```
                          Exit TCP/IP Host Table
                                                       System:   RCHASM01
 Type choices, press Enter.

   Convert host table . . . . . . . . .   Y       Y=Yes, N=No

   Display job log  . . . . . . . . . .   Y       Y=Yes, N=No

 F12=Cancel
```

Figure 9. Exit Host Table

8. For the *Convert host table* parameter, select option Y to convert the host table to an internal format that can be used by TCP/IP.

   If you select option N, then the host table will not be converted into the internal format. However, the changes are saved, though they are not usable by TCP/IP at this point of time. You can choose to convert the host table later by using option 25 from the the *Configure TCP/IP* menu.

   For the *Display job log* parameter, option Y is applicable if you are converting the host table. Statistics and errors detected during conversion are written to a job log and detailed messages can be displayed using the function key F10.

   Selecting option N indicates that you do not wish to view the job log at this point of time.

   Notes:

   a. After converting the host table, the message `Results of host table conversion written in job log` is shown at the bottom of the display. For information on interpreting the information in this job log, see Appendix A of IBM AS/400 TCP/IP Guide (SC41-9875).

   b. After taking Y or N for the *Convert host table* parameter, the member HOSTS of the physical file QATMTCP is changed, though these changes may, or may not, have been converted to show in the internal table.

   c. If the option to convert the host table is chosen, then the changes take effect the next time a TCP/IP application accesses the host table or when the QTCP subsystem is started. Unpredictable results may be experienced for any currently active connection once the remote host definition is changed.

2.2.1.3 Step 3—Add the TCP/IP Link

In the AS/400 system, each line that connects to a TCP/IP network must be assigned an internet address.

To add a TCP/IP link,

1. Select option 2 to Work with TCP/IP links from the Configure TCP/IP menu.
2. Take option 1 to add a new link for the token-ring line ITSCTRN as shown in Figure 10 on page 18. You can also get to this screen using the command ADDTCPLNK.

```
                        Add TCP/IP Link (ADDTCPLNK)

Type choices, press Enter.

Line description . . . . . . . .   ITSCTRN       Name
Internet address . . . . . . . .   '9.5.69.251'
Automatic start  . . . . . . . .   *YES          *YES, *NO
X.25 reverse charge  . . . . . .   *NONE         *NONE, *REQUEST, *ACCEPT...
X.25 idle circuit timeout  . . .   60            1-600
X.25 maximum virtual circuits  .   32            1-32
X.25 DDN link  . . . . . . . . .   *NO           *NO, *YES
TRLAN bit sequencing . . . . . .   *MSB          *MSB, *LSB


                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 10. Add a TCP/IP Link

3. Fill in the name of the line description created in subsection 2.2.1.1, "Step 1—Create or Modify the Line Description" on page 13 and the internet address assigned to it.

4. Press the Enter key to add the link and return to the Work with TCP/IP Links panel shown in Figure 11.

```
                          Work with TCP/IP Links
                                                          System:   RCHASM01
Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display   9=Start   10=End

          Line          Internet            Link
Opt     Description     Address             Type
__      __________
__      ITSCTRN         9.5.69.251          *TRLAN


                                                                      Bottom
F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Top   F18=Bottom
```

Figure 11. Work with TCP/IP Links (Link Added)

Note: The TCP/IP link information defines the internet address of the AS/400 system to the TCP/IP network. It maps the line description to the internet address, and causes the TCP/IP subsystem to automatically create a network controller and device when first brought up. TCP/IP will then automatically vary on the line, controller and device descriptions when the QTCP subsystem starts.

2.2.1.4 Step 4—Add the TCP/IP Routes

Routing information is required to tell the local system how to route data to other systems (hosts) on a local network or on other networks connected to it. For each route, a routing entry must be added to a routing table. The TCP/IP routing table should always contain a default entry so that if there is no match on any other entry, the default entry is used. It will serve as a catch-all entry.

In this example, we are using the router (with internet address 9.5.69.193) as the default entry. Look at Figure 3 on page 12 for this router. This means that if you want to send data to a remote system that does not have a specific route defined, then the default route (which is via the router in this case) will be used.

But first, let′s configure a routing entry that will allow us to communicate with all the TCP/IP hosts in our local network:

1. Select option 3 to Work with TCP/IP Route Entries from the Configure TCP/IP menu.

2. Take option 1 to add a new route entry as shown in Figure 12. This screen can also be obtained using the ADDTCPRTE command.

```
                      Add TCP/IP Route Entry (ADDTCPRTE)

 Type choices, press Enter.

 Network  . . . . . . . . . . . .   9
 Line description . . . . . . . .   ITSCTRN       Name
 First hop  . . . . . . . . . . .   *HOME
 Maximum datagram size  . . . . .   *CALC         512-1994, *CALC
 Subnet mask  . . . . . . . . . .   *NONE
 Subnet value . . . . . . . . . .   *NONE


                                                                     Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 12. Add a TCP/IP Route Entry

3. The Rochester TCP/IP network is a class A network. Thus its network ID can be anything from 1 to 127. The network ID assigned to IBM is 9. Refer to 3.6, "TCP/IP Naming Conventions" on page 63 for more information on TCP/IP Naming conventions.

4. Enter the line description created in subsection 2.2.1.1, "Step 1—Create or Modify the Line Description" on page 13 in the parameter *Line description*, and specify *HOME for the parameter *First hop*. Leave the other fields as default.

   Specifying *HOME for *First Hop* tells TCP/IP that the remote hosts are on the same local network as this host.

   Note: You can see from the network diagram in Figure 58 on page 65 that the network we are using has been sub-divided into sub-networks. To keep things simple at this stage we have not yet implemented sub-networks. In this environment, specifying a network id of 9 with a first hop of *HOME will mean that traffic can only be routed within the sub-network to which RCHASM01 is connected - no traffic could be sent via the router that connects this sub-network to the remainder of the network. In 2.7, "Configuring AS/400 TCP/IP with Non-AS/400 Systems" on page 47 we will modify this entry to allow us to communicate with the rest of the network.

5. Press the Enter key to add the route and return to the Work with TCP/IP Route Entries panel.

```
                           Work with TCP/IP Route Entries
                                                                  System:   RCHASM01
 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display

                             Line                            Maximum
 Opt  Network          Description  First Hop          Datagram Size

  _   _______________
  _   9                ITSCTRN      *HOME                 *CALC


                                                                          Bottom
 F3=Exit          F5=Refresh   F11=Display subnet information   F12=Cancel
 F15=Print list   F17=Top      F18=Bottom
```

Figure 13. Route Entry Added

2.2.1.5 Step 5—Start the TCP/IP Subsystem

Before any TCP/IP services are available, the QTCP subsystem must be started first. You can either select option 2 to Start TCP/IP subsystem from the TCP/IP Administration menu (GO TCPADM), or enter the command

```
STRSBS QTCP/QTCP
```

Note: If changes are made to the links or the routes after the subsystem QTCP has been started, these changes take place immediately.

Allow a few minutes for the subsystem to start, then check if all the necessary jobs have started, using the command

```
WRKACTJOB SBS(QTCP)
```

There should be at least eight jobs as shown in Figure 14 on page 21. The first three jobs with prefix FTP are FTP server jobs. Under certain circumstances, there may be more than three FTP server jobs. The QTCPIP, QTCPSTART and QTCPTIMER are control jobs. The jobs with prefix LPD are the LPD server jobs. There may be additional LPD jobs.

Once these jobs are started, the TCP/IP subsystem is fully operational.

Note: If SMTP has been configured and the QSNADS subsystem started, an additional job called QTMSMTP will be started as well.

```
                         Work with Active Jobs                     RCHASM01
                                                         12/02/93  19:43:07
CPU %:    0,0     Elapsed time:   00:00:00     Active jobs:   83

Type options, press Enter.
  2=Change   3=Hold   4=End   5=Work with   6=Release   7=Display message
  8=Work with spooled files   13=Disconnect ...

Opt  Subsystem/Job  User        Type  CPU %  Function        Status
__   QTCP           QSYS        SBS     0,0                   DEQW
__     FTPSRV1      QTCP        BCH     0,0                   DEQW
__     FTPSRV2      QTCP        BCH     0,0                   DEQW
__     FTPSRV3      QTCP        BCH     0,0                   DEQW
__     LPDSRV1      QTCP        BCH     0,0                   DEQW
__     LPDSRV2      QTCP        BCH     0,0                   DEQW
__     QTCPIP       QTCP        BCH     0,0                   DEQW
__     QTCPSTART    QTCP        ASJ     0,0                   EVTW
__     QTCPTIMER    QTCP        BCH     0,0                   DEQW


                                                                     Bottom
Parameters or command
===> _________________________________________________________________________
F3=Exit      F5=Refresh   F10=Restart statistics   F11=Display elapsed data
F12=Cancel   F23=More options   F24=More keys
```

Figure 14. Work with Active Jobs for the QTCP Subsystem

2.2.1.6 Step 6 - Verify TCP/IP Connection

To verify TCP/IP operation, you can use the PING (VFYTCPCNN) function. PING is a TCP/IP protocol that sends data to a specified internet address and waits for a response. It then displays status information that indicates whether the connection is successful.

We have just configured the local system to connect to one remote system and to a router. We will now verify the connections to all of them.

1. To test the TCP/IP code, without sending anything out of the token-ring adapter, specify the special internet address 14.0.0.0:

   ```
   PING RMTSYS(*INTNETADR) INTNETADR('14.0.0.0')
   ```

   or specify the special local host name *LOOPBACK*:

   ```
   PING RMTSYS(LOOPBACK)
   ```

   This is often called the *loopback* test, and for more details, refer to 3.1.1, “Using PING in the AS/400” on page 53.

2. To test the TCP/IP code, token-ring hardware and token-ring connection, specify the internet address of the local adapter (as defined in Figure 6 on page 15):

   ```
   PING RMTSYS(*INTNETADR) INTNETADR('9.5.69.251')
   ```

   or simply

   ```
   PING RMTSYS(RCHASM01)
   ```

   This sends data out onto the token-ring, which is then received again by the local adapter as if the data is from the TCP/IP network.

   Figure 15 on page 22 shows that the PING was successful:

```
Start of terminal session.

VFYTCPCNN verifying connection to host system RCHASM01 at address 9.5.69.251.
Connection verification 1 took .431 seconds.  1 successful connection
verifications.
Connection verification 2 took .057 seconds.  2 successful connection
verifications.
Connection verification 3 took .055 seconds.  3 successful connection
verifications.
Connection verification 4 took .167 seconds.  4 successful connection
verifications.
Connection verification 5 took .062 seconds.  5 successful connection
verifications.
Press ENTER to end terminal session.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 15. Successful PING Execution

3. Proceed to test the connection to the remote system as well as to the router. You should get similar screens to that of Figure 15 if successful.

   If the PING operation is unsuccessful, you will see similar messages as in Figure 16. If this occurs, check through your configuration steps, starting from 2.2.1.1, "Step 1—Create or Modify the Line Description" on page 13. Also, check that the configuration at the remote system is correct and the remote system is not powered down. For more details about PING (VFYTCPCNN), see 3.1, "PING (VFYTCPCNN) - Verify TCP/IP Connection" on page 53.

```
Start of terminal session.

VFYTCPCNN verifying connection to host system RCHASM02 at address 9.5.69.250.
Remote host did not respond to VFYTCPCNN within 10 seconds for connection
verification 1.
Remote host did not respond to VFYTCPCNN within 10 seconds for connection
verification 2.
Remote host did not respond to VFYTCPCNN within 10 seconds for connection
verification 3.
Remote host did not respond to VFYTCPCNN within 10 seconds for connection
verification 4.
Remote host did not respond to VFYTCPCNN within 10 seconds for connection
verification 5.
Press ENTER to end terminal session.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 16. Example of an Unsuccessful PING Execution

You have just completed a simple TCP/IP configuration on the AS/400. The system is ready for applications like FTP, LPR, LPD, TELNET as well as other user-written applications.

2.3 Using TELNET

The TELNET protocol allows you (the TELNET client) to access the resources of another remote system (the TELNET server) as though your terminal were locally connected to the server remote system.

The purpose of this section is to provide you with a quick start to operating TELNET. For a detailed description of TCP/IP and TELNET see the *IBM AS/400 TCP/IP Guide (SC41-9875)*.

2.3.1 TELNET Client

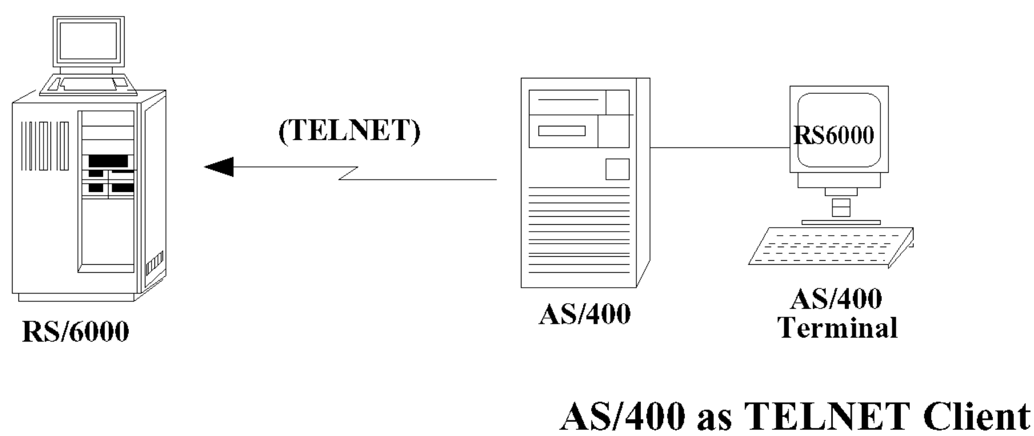

Figure 17. TELNET Client

AS/400 TELNET *client* allows an AS/400 TCP/IP user to sign on to and use applications on a remote system that has a TELNET server application. The AS/400 TELNET client support negotiates the transmission of data streams with the TELNET server application in the following modes and in the order shown:

- 5250 full-screen mode
- 3270 full-screen mode
- VT220** full-screen mode
- VT100** full-screen mode

If the AS/400 TELNET client fails to negotiate one of the above modes, VT100 full-screen mode is used as a default.

5250 and 3270 full-screen modes are IBM supplied options to TELNET support. With AS/400 as client, the 5250 full-screen support is similar to 5250 pass-through to another AS/400 and 3270 full-screen support is similar to 3270 device emulation to S/370 type system.

VT220 and VT100 full-screen modes are DEC supplied options to TELNET. However, the support is not limited to connectivity to a DEC system. It is true that these are DEC terminal types but they are also industry wide defacto standards that are used by many vendors in addition to DEC.

Before starting a TELNET client session the following conditions must be met:

- The client system must have been configured for TCP/IP, as described in section 2.2.1, "Basic Configuration" on page 12.

- The TCP/IP subsystem (QTCP) must be running.
- The TELNET server must be available and configured on the server system.
- Know the name or internet address of the server system with which you want to start a TELNET session.

TELNET is not restricted to adjacent systems only. For example, if all systems within a large TCP/IP network are appropriately configured for TELNET then any system within that network can use TELNET to any other system within the same network.

To start TELNET the STRTCPTELN or TELNET command is issued on the local AS/400 system. The STRTCPTELN or TELNET command can also be issued by selecting option 7 from the TCP/IP Administration menu (GO TCPADM) or option 25 from the TCP/IP Commands menu (GO CMDTCP).

The following example shows the STRTCPTELN command being executed from the TCP/IP Administration menu:

1. To display the TCP/IP Administration menu as shown in Figure 18, enter the command: GO TCPADM

```
TCPADM                    TCP/IP Administration
                                                         System: RCHASM01
Select one of the following:

     1. Configure TCP/IP
     2. Start TCP/IP subsystem
     3. End TCP/IP subsystem
     4. Start TCP/IP FTP session
     5. Verify TCP/IP connection
     6. Work with names for SMTP
     7. Start TCP/IP TELNET session
     8. Work with TCP/IP network status
     9. Send TCP/IP spooled file


Selection or command
===> 7

F3=Exit F4=Prompt F9=Retrieve F12=Cancel
(C) COPYRIGHT IBM CORP. 1987, 1993.
```

Figure 18. TCP/IP Administration Menu

2. Select option 7 to Start TCP/IP TELNET session.
3. Enter the name of the host you intend to establish a TELNET session with, see Figure 19 on page 25:

```
                        Start TCP/IP TELNET (STRTCPTELN)

Type choices, press Enter.

Remote system  . . . . . . . . .rchrs001



                                                                        Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display       F24=More keys
```

Figure 19. Start TCP/IP TELNET Command Prompt

4. Press the Enter key.

   Note that the remote system can also be selected by internet address. To select by internet address, press F10 from the Start TCP/IP TELNET panel (Figure 19), specify *INTNETADR for *Remote system* and enter the internet address as shown in Figure 20:

```
                        Start TCP/IP TELNET (STRTCPTELN)

 Type choices, press Enter.

 Remote system  . . . . . . . . .>*INTNETADR



 Internet address . . . . . . . .>9.5.69.198

                            Additional Parameters

 Control character key  . . . . .   &             Character value, &
 Keyboard language type . . . . .   *LCL          *LCL, AGB, AGI, BLI, CAB...
 Page Up (Roll Down) key  . . . .   *PA2          *PA2, *PA1, *PA3, *NONE...
 Page Down (Roll Up) key  . . . .   *PA1          *PA1, *PA2, *PA3, *NONE...
 Cursor Select key  . . . . . . .   *NONE         *NONE, *F1, *F2, *F3, *F4...
 Outgoing EBCDIC/ASCII table  . .   *CCSID        Name, *CCSID, *DFT
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB

                                                                      More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 20. Start TCP/IP TELNET Session Using the Internet Address

Note: For a detailed description of the Start TCP/IP TELNET command parameters refer to 4.2.1, "Start TCP/IP TELNET Command" on page 73.

Note

The fast-path commands for the above options would be:

TELNET rchrs001

TELNET '9.5.69.198'

5. Press the Enter key twice.

2.3.1.1 TELNET Logon Display

If the Start TCP/IP TELNET command executed successfully then a logon display will be sent back to the client AS/400 from the server system.

Figure 21 shows an example of a logon prompt from an RS/6000 in full-screen mode.

```
IBM AIX Version 3 for RISC System/6000
(C) Copyrights by IBM and by others 1982, 1991.
login:
```

Figure 21. Example of an AS/400 Full-Screen Mode Display

Note: To prevent your password from being displayed in VTxxx full-screen mode, press the function key associated with the *HIDE function (F6 by default).

2.3.1.2 Ending TELNET

TELNET on the AS/400 can be ended by pressing the attention key and then selecting option 99 (End TELNET session - QUIT) from the Send TELNET Control Functions menu. See Figure 22

```
                     Send TELNET Control Functions
                                                       System: RCHASM01

Select one of the following:

     1. Interrupt process - IP
     2. Query connection status - AYT
     3. Discard host output data - AO

      8.  Change VT220 (Primary) keyboard map
      9.  Change VT220 (Alternate) keyboard map

    99. End TELNET session - QUIT



 ===> 99

  F3=Exit    F12=Cancel
 Primary keyboard map active.
```

Figure 22. Send TELNET Control Functions Display

Options 1 to 9 on the Send TELNET Control Functions menu are discussed in section 4.2.4.2, “TELNET Control Functions” on page 85.

2.3.2 TELNET Server

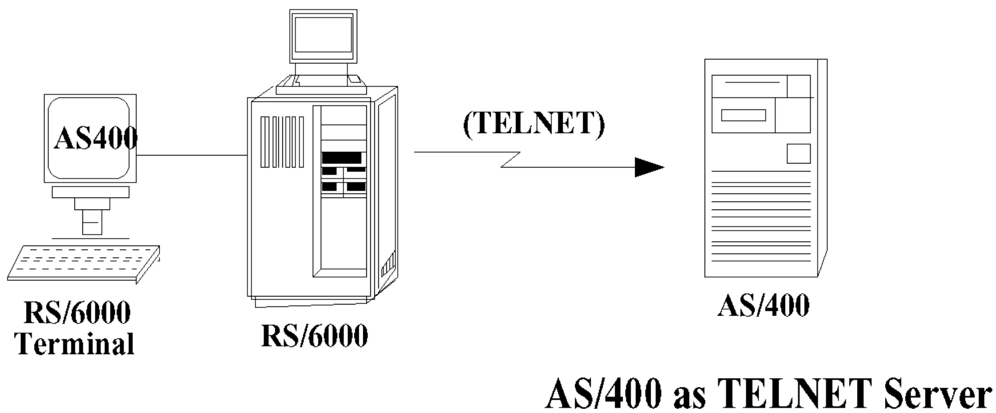

Figure 23. TELNET Server

AS/400 TELNET *server* allows a TCP/IP user on a remote TELNET client system to sign on to and run applications on the AS/400 system. The AS/400 TELNET server support negotiates the transmission of data streams with the TELNET client application in the following modes and in the order shown:

- 5250 full-screen mode
- 3270 full-screen mode
- VT220 full-screen mode
- VT100 full-screen mode
- ASCII line mode.

The DFTNVTTYPE (default network virtual type) parameter specifies the mode to be used when the TELNET server is not able to negotiate one of the above modes. The CHGTCPA command is used to set this parameter.

5250 and 3270 full-screen modes are IBM supplied options to TELNET support. 5250 full-screen support is similar to 5250 pass-through and 3270 full-screen support is similar to 3270 SNA Primary LU support (SPLS).

VT220 and VT100 full-screen modes are DEC supplied options to TELNET. However, the support is not limited to connectivity to a DEC system. It is true that these are DEC terminal types but they are also industry wide de facto standards that are used by many vendors in addition to DEC.

For ASCII line mode a customer application program is required at the AS/400 server to acquire a network virtual terminal (NVT) workstation device. If ASCII line mode is negotiated, the AS/400 will not automatically send a sign-on display to the client system. For an example of a server application program on the AS/400 please see the *IBM AS/400 TCP/IP Guide (SC41-9875)* .

Before the AS/400 TELNET server can be used, the following conditions must be met:

- The AS/400 must have been configured for TCP/IP, as described in section 2.2.1, “Basic Configuration” on page 12.
- The TCP/IP subsystem (QTCP) must be running.

- AS/400 automatic configuration of virtual controllers and devices must be allowed by changing the system value QAUTOVRT to allow for the maximum number of users that will be signed on using automatically configured virtual devices at any one time. These are for both TELNET and 5250 Display Station Passthru users.

  The automatic configuration of virtual devices introduces some security considerations involving the number of invalid signon allowed (system value QMAXSIGN) and the limitation on security officer signing on at other display devices (system value QLMTSECOFR). Refer to the *IBM AS/400 TCP/IP Guide (SC41-9875)* for more information on the TELNET considerations of the system values: QAUTOVRT, QMAXSIGN and QLMTSECOFR in the TELNET chapter.

For more information on the AS/400 TELNET server please refer to section 4.3, "AS/400 TELNET Server" on page 90.

2.3.2.1 Ending TELNET

Each TELNET client, it seems, has a different method of ending the TELNET session. As an alternative to using this local method, all TELNET clients accessing an AS/400 can use SIGNOFF ENDCNN(*YES) to end the connection. Make sure the AS/400 is at V2R3 of OS/400 or later.

For more information on the AS/400 TELNET client please refer to section 4.2, "AS/400 TELNET Client" on page 71.

2.4 Using FTP

The purpose of this section is to demonstrate the use of the basic functions of the File Transfer Protocol (FTP) on the AS/400 system. The network in Figure 3 on page 12 is used in the example. The following FTP functions are performed on the local AS/400 system (client):

1. Start FTP
2. Logon to a remote server
3. Put a file into the remote server
4. Get a file from the remote server
5. End FTP

Notes:

1. The maximum file size that can be transferred using FTP is 16 million bytes.
2. FTP can only be used for sending and receiving physical files, source files and logical files, not save files.

2.4.1.1 Step 1—Start FTP

Start the FTP function by entering the AS/400 command:

```
FTP
```

and press F4 (Prompt).

Enter the host name (defined in Figure 8 on page 16) to which you intend to transfer files:

```
                    Start TCP/IP File Transfer (FTP)

 Type choices, press Enter.

 Remote system  . . . . . . . . .   rchasm02


                                                                        Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
  F13=How to use this display       F24=More keys
```

Figure 24. Start FTP with Host Name

or the host's internet address:

```
                    Start TCP/IP File Transfer (FTP)

 Type choices, press Enter.

 Remote system  . . . . . . . . .   '9.5.69.250'


                                                                        Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
  F13=How to use this display       F24=More keys
```

Figure 25. Start FTP with Internet Address

Press the Enter key. This establishes the connection to the specified remote host (server).

Instead of prompting with F4 for the FTP display on the command line enter:

```
FTP hostname
```

or:

```
FTP 'internet address'
```

When the AS/400 TCP/IP FTP application takes control of the display screen, it clears the screen. Information appears one line at a time, above the bottom line of the screen and rolls up when new lines appear. The bottom line in the FTP application is the FTP command line.

2.4.1.2 Step 2—Logon to the Server

The FTP function at the local host (client) automatically initiates the USER subcommand when the connection to the remote host (server) is established. This subcommand identifies the local host (client) to the remote host (server) as shown in Figure 26 on page 30. It prompts for a user ID valid on the remote host, and it may request a password to complete the logon:

```
Start of terminal session.

Connecting to host system RCHASM02 at address 9.5.69.250 at port 21.
220-QTCP at RCHASM02.RCHLAND.IBM.COM.
220 Connection will close if idle more than 5 minutes.
Enter your userid to log on the remote host system.
hans
>>>USER hans
331 Enter password.
>>>PASS ********                (not displayed)
230 HANS logged on.
Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 26. FTP Start-up and Logon

When FTP is active at the display screen, FTP subcommands are the only commands that can be used. These subcommands are used to perform the different functions available under FTP. If you enter HELP at the prompt shown in Figure 26 you will see a list of all the local FTP subcommands. For more details see section 5.2, “FTP Subcommands” on page 114.

The FTP server will send return codes to the client host as a response to each subcommand. For example, a 331 response when the user ID is entered or a 230 response after a successful logon. See Appendix B, “FTP Return Codes” for a description of the FTP return codes.

2.4.1.3 Step 3—Put a File

The FTP subcommand PUT is used to copy a local file member into a file at the remote host. The AS/400 objects that are transferred with FTP PUT or GET operations are physical files (source and data), logical files and graphical data files. The PUT or GET of a logical file creates a physical file according to the view defined in the logical file. Save files cannot be transferred.

To copy a local file member into a file at the remote host, write authority is required for the library into which the file will be put. A library at the AS/400 system is a logical placeholder for other objects such as programs, files, and commands. A library can be compared to a directory on other systems.

The syntax of the PUT subcommand is as follows:

```
PUT localfile remotefile
```

For the AS/400 system, the syntax of a file name is:

```
library/file.member
```

On the AS/400 system, files may have one or more members. Each file member can consist of data records, or each may contain other records such as source programs or database definitions.

An example of the PUT command follows:

```
Enter an FTP command.
put libm01/filem01.mbrm01 libm02/filem02.mbrm01
>>>PORT 9,5,69,251,3,234
200 PORT subcommand request successful.
>>>STOR libm02/filem02.mbrm01
150 Sending file to member MBRM01 in file FILEM02 in library LIBM02.
250 File transfer completed successfully.
68400 bytes transferred in 7.125 seconds. Transfer rate 9.600 KB/sec.
Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 27. FTP PUT Display

This command (see Figure 27) copies the file member MBRM01 in file FILEM01 in library LIBM01 at the local host RCHASM01 to MBRM01 in FILEM02 in library LIBM02 at the remote host RCHASM02. If the file already exists at the remote host, the remote system may overwrite the existing file.

If you want to transfer several files to the remote host, the MPUT subcommand may be used to do this, as follows:

```
mput libm01/filem01.*
```

The subcommand MPUT sends multiple file members to the remote host. This command copies all members in the file FILEM01 in library LIBM01 to file FILEM01 in the current library of the remote host. The local file.member name is required but the library name may be omitted. If the library name is not specified, the local user's current library is used.

The remote name is optional. If it is not specified, the file and member name used is the same as specified in the local name, and the library used is the remote user's current library. The remote user's current library is set automatically to the one specified in his user profile at logon time. The PWD subcommand may be used to determine the current library. The CD subcommand is used to change it. Example:

```
Enter an FTP command.
pwd
>>>PWD
257 "QGPL" is current library.
Enter an FTP command.
cd libm02
>>>CWD libm02
250 Current library changed to LIBM02.
Enter an FTP command.


F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 28. FTP Determine and Change Server's Current Library

Note: On other systems, the current "library" may be called the current "directory."

If an existing remote file and member name is specified, the *old* member is by default replaced with the new one.

To control whether a file is replaced when doing a PUT or MPUT subcommand, use the SUNIQUE (Store Unique) subcommand. The SUNIQUE subcommand acts like a toggle switch. By default it is set off and causes the remote FTP server to replace an existing file. To prevent the replacement of the file enter SUNIQUE in the FTP command line. This sets SUNIQUE on and the FTP server will create a new file. Two server subcommands (that is, subcommands that are sent from the client, the local host, to the server, the remote host, and are run on the server) regulate whether a file sent to the remote host should replace an existing file with the same name or should create a new file. The subcommands are STOR and STOU:

- STOR causes the remote file (member) to be overwritten if it already exists. STOR is sent by default when the local host (client) executes the subcommand PUT and MPUT.
- STOU causes a new file (member) to be created on the remote host if the specified one already exists. The name of the new member will be the same as that specified, but with a sequence number appended to the end. For example, if MBR were specified as the member name, MBR1 would be created. The name of the member created will be returned to the user.

The subcommand SUNIQUE regulates whether STOR or STOU is sent by PUT and MPUT. If SUNIQUE is off (default), STOR is sent and an existing file will be replaced. If SUNIQUE is on, STOU is sent and a new file will be created. To set SUNIQUE on, enter SUNIQUE. To set it off, enter SUNIQUE again.

```
  Enter an FTP command.
  sunique
  Store unique is on.
  Enter an FTP command.
  sunique
  Store unique is off.
  Enter an FTP command.

 F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 29. FTP Setting SUNIQUE On and Off

2.4.1.4 Step 4—Get a File

The GET subcommand is used to copy a file member from a remote host into a file at the local host. To do this, read authority is required for the remote library from which the file is copied. The syntax of the GET subcommand is as follows:

```
GET remotefile localfile (REPLACE
```

An example of the GET command follows:

```
Enter an FTP command.
get libm02/filem02.mbrm02 libm01/filem01.mbrm02
>>>PORT 9,5,69,251,3,243
200 PORT subcommand request successful.
>>>RETR libm02/filem02.mbrm02
150 Retrieving member MBRM02 in file FILEM02 in library LIBM02.
250 File transfer completed successfully.
68399 bytes transferred in 5.061 seconds. Transfer rate 13.516 KB/sec.
Enter an FTP command.


F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 30. FTP GET Display

The GET command copies the file member MBRM02 in file FILEM02 in library LIBM02 at the remote host RCHASM02 to member MBRM02 in file FILEM01 in library LIBM01 at the local host RCHASM01. If this member already exists at the local host, the GET operation does not run, because REPLACE is not specified. Figure 30 shows an example of a GET display session.

The remote file name is required, but the library name may be omitted. If the library name is not specified, the remote user's current library will be used.

The local file name is optional. If it is not specified, the file and member names used are the same as specified in the remote file name, and the library used is the local user's current library. The local user's current library may be automatically set at sign-on time. The SYSCMD CHGCURLIB subcommand may be used to change it. The SYSCMD subcommand enables the user to run AS/400 commands on the local system. For example, the following changes the local user's current library to TCPLIBA:

```
SYSCMD CHGCURLIB TCPLIBA
```

If no current library has been set, an error message is displayed and the GET operation is not run.

If an existing local file and member name is specified, and REPLACE is specified, the old member is replaced with the new one. If REPLACE is not specified, an error message is displayed and the GET operation does not run.

2.4.1.5 Step 5—End FTP

The FTP session is ended with the QUIT subcommand. This closes the connection with the remote host and ends the FTP session on the AS/400 system. A message at the bottom of the display directs you to `Press ENTER to end terminal session` as shown in Figure 31.

```
Enter an FTP command.
quit
>>>QUIT
221 Goodbye.
Press ENTER to end terminal session.

F3= End of File    F9=  Retrieve       F21= Extend line
```

Figure 31. FTP QUIT Display

The CLOSE subcommand may also be used to close the connection with the remote host. This subcommand does not end the FTP session. The OPEN subcommand may then be used to establish a connection with another host. For example the following opens a connection to RCHASM01 (if RCHASM01 is configured in the host table):

```
OPEN RCHASM01
```

The USER subcommand then needs to be run. The system then prompts for a user ID, as it does at FTP start up.

For more information about FTP, please see Chapter 5, "Additional FTP Considerations" on page 109.

2.5 Using SMTP

The purpose of this section is to demonstrate the configuration process and operation of SMTP on the AS/400 system. OfficeVision/400* is the user interface to SMTP. However, mail may also be sent and received using SNADS CL commands. Because SNADS interfaces with SMTP, much of the configuration process is SNADS configuration.

It is important to remember that the usual method of communication between two AS/400s will be through SNADS. The only realistic exception to this, where SMTP will be used, is where two AS/400s are separated by an Internet Network.

The configuration process may appear confusing in this test scenario if your systems are already configured for SNADS. The problem arises because of some system addressing conflicts and some of these issues will be addressed in this section.

The steps presented in this section provide basic information only. Section 6.6, "SNADS/SMTP Interrelationship" on page 151 contains a detailed description of the relationship of SNADS and TCP/IP tables. More details about SNADS are found in the IBM AS/400 Distribution Services Network Administrator′s Guide (SC41-9588). The steps are:

1. Configure TCP/IP.
2. Configure local domain name.
3. Verify routing entry in QSNADS subsystem.
4. Create a SNADS distribution queue.
5. Update the SNADS routing table.
6. Update the system directory.
7. Enroll OfficeVision/400 users.
8. Update the SMTP alias table.
9. Send a message.
10. Receive a message.

2.5.1.1 Step 1—Configure TCP/IP

TCP/IP configuration is described in 2.2.1, "Basic Configuration" on page 12.

2.5.1.2 Step 2—Configure Local Domain Name

The local domain name is used by TCP/IP to identify the local host to other systems when FTP and SMTP are being used and is essential for SMTP.

To define a local domain name for the AS/400, take option 4 to Change Local Domain Name from the Configure TCP/IP menu. An example of the resulting display is shown in Figure 32.

```
                          Change Local Domain Name
                                                          System:   RCHASM01
 Type choices, press Enter.

   Local domain name . . . .   RCHLAND.IBM.COM
 _____________________________________________________________________________
   Local host name . . . . .   RCHASM01
 _______________


 F3=Exit   F12=Cancel
```

Figure 32. Change Local Domain Name Display

There are two parts to the local domain name - local domain name and local host name. The combination of the local domain name and the local host name becomes the full local host name by which this host is known to the network. See 3.6.6, "Domain Naming Conventions" on page 67 for a discussion on domain naming conventions and 3.2, "Local Domain Name" on page 56 for more information on the local domain name.

2.5.1.3 Step 3—Verify Routing Entry in QSNADS Subsystem

A routing entry in the QSNADS subsystem is required to start the SMTP side of the SNADS-SMTP bridge. A routing entry is an entry in a subsystem description that specifies the program to be called to control a routing step that runs in the subsystem.

Verify that an SMTP routing entry exists in the QSNADS subsystem. To display the routing entry :

1. Enter the command

   `DSPSBSD SBSD(QSNADS)`

2. Select option 7 to display routing entries.
3. Scan the list of routing entries to find the sequence number 1500. This is the default routing entry for SMTP in QSNADS subsystem description (**1** in Figure 33 on page 36).

```
                        Display Routing Entries
                                                      System:   RCHASM01
Subsystem description:   QSNADS        Status:   ACTIVE

Type options, press Enter.
  5=Display details

                                                                   Start
Opt    Seq Nbr    Program       Library       Compare Value          Pos
 _        100     QZDSTRUP      QSYS         'QSTARTUP'               1
 _        200     QZDROUTR      QSYS         'QROUTER'                1
 _        275     *RTGDTA                    '#INTER'                 1
 _        300     QZDSTSND      QSYS         'QSENDER'                1
 _        350     QS2STSND      QSYS         'QSVDSSND'               1
 _        500     *RTGDTA                    'PGMEVOKE'              29
 _        600     QOSDIATP      QSYS         'QDIATP'                 1
 _        650     QOSASYNC      QSYS         'QDIALOCAL'              1
 _        660     QOSMLFMT      QSYS         'QDIAINDUSR'             1
 _        700     QNFTPDTA      QSYS         'QNFTP'                  1
 _        800     QZDSTGAT      QSYS         'QGATEWAY'               1
 _        900     QGTPUTCL      QRJE         'RPDSLINE'               1
                                                                 More...
```

```
                                                                   Start
Opt    Seq Nbr    Program       Library       Compare Value          Pos
 _       1000     QGTISNAD      QRJE         'RPDSRCVR'               1
 _       1100     QOHMAILP      QSYS         'QDIAHSTPRT'             1
 _       1200     QOHSTSL       QSYS         'QDIANOTIFY'             1
 _       1300     QESFXRCV      QSYS         'QESTP'                  1
 _       1400     QX4SNMTA      QX400        'QX4SNMTA'               1
 _   1   1500     QTMSTRBR      QTCP         'SMTPRTGD'               1


                                                                  Bottom
F3=Exit   F9=Display all detailed descriptions   F12=Cancel
```

Figure 33. QSNADS Routing Entries

4. If the routing entry for program QTMSTRBR is not found as shown above, add it in by entering the command :

   ADDRTGE

   Press F4. Enter the parameters exactly as highlighted in Figure 34 on page 37.

```
                     Add Routing Entry (ADDRTGE)

 Type choices, press Enter.

 Subsystem description . . . . .   QSNADS        Name
   Library . . . . . . . . . . .     *LIBL        Name, *LIBL, *CURLIB
 Routing entry sequence number  .   1500          1-9999
 Comparison data:
   Compare value . . . . . . . .   SMTPRTGD

   Starting position . . . . . .   1             1-80
 Program to call . . . . . . . .   QTMSTRBR      Name, *RTGDTA
   Library . . . . . . . . . . .     QTCP         Name, *LIBL, *CURLIB
 Class . . . . . . . . . . . . .   QSNADS        Name, *SBSD
   Library . . . . . . . . . . .     QGPL         Name, *LIBL, *CURLIB
 Maximum active routing steps . .   *NOMAX        0-1000, *NOMAX
 Storage pool identifier . . . .   1             1-10


                                                                Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 34. Add a Routing Entry

Notes:

a. If the QSNADS subsystem is currently active (started), it must be stopped before the routing entry can be added. Use the ENDSBS SBSD(QSNADS) command to do this.

b. Prior to V2R3M0, the routing entry for QTMSTRBR program was not automatically added to the QSNADS subsystem description; it had to be manually added as shown in Figure 34.

2.5.1.4 Step 4—Create a SNADS Distribution Queue

A special SNADS distribution queue called QSMTPQ is required for SMTP. The steps to add the new entry are as follow:

1. To display the Configure Distribution Services menu, enter the command:

   CFGDSTSRV

2. Select option 1 for distribution queues.

3. Press F6 to add a distribution queue.

4. Enter the parameters as highlighted in Figure 35 on page 38.

   Use the Help key to get information about the parameters in the display, if needed.

```
                     Add Distribution Queue                 Page 1 of 2

Type choices, press Enter.

  Queue  . . . . . . . . . . .   QSMTPQ__________    Name
  Queue type . . . . . . . . .   *RPDS___            *SNADS, *RPDS, *SVDS, *DLS
  Remote location name . . . .   TCPIPLOC            Name
  Mode . . . . . . . . . . . .   *NETATR_            Name, *NETATR
  Remote net ID  . . . . . . .   *LOC____            Name, *LOC, *NONE
  Local location name  . . . .   *LOC____            Name, *LOC
  Normal priority:
    Send time:
      From/To  . . . . . . . .   __ : __  __ : __    00:00-23:59
      Force  . . . . . . . . .   __ : __             00:00-23:59
    Send depth . . . . . . . .   __1                 1-999, blank
  High priority:
    Send time:
      From/To  . . . . . . . .   __ : __  __ : __    00:00-23:59
      Force  . . . . . . . . .   __ : __             00:00-23:59
    Send depth . . . . . . . .   __1                 1-999, blank

                                                                More...
F3=Exit      F12=Cancel
```

Figure 35. Add a Distribution Queue

2.5.1.5 Step 5—Update the SNADS Routing Table

A system name must be associated with the QSMTPQ distribution queue QSMTPQ. A single SNADS routing table entry can be used for all SMTP mail by selecting a single "dummy" system name for this entry. In the example in Figure 36 on page 39, TCPIP is the name selected, but could be any other unique identifier.

To add a SNADS routing table entry:

1. Enter the command

   `CFGDSTSRV`

   to display the Configure Distribution Services menu.

2. Select option 2 for routing table.
3. Press F6 to add a routing table entry.
4. Enter the parameters as highlighted in Figure 36 on page 39.

QSMTPQ (the distribution queue added in the previous step) should be specified for all service levels.

```
                          Add Routing Table Entry

 Type choices, press Enter. (At least one queue name is required.)

   System name/Group  . .   TCPIP
   Description  . . . . .   For TCP/IP Routing
   Service level:
     Fast:
       Queue name . . . .   QSMTPQ           Distribution queue name
       Maximum hops . . .   *DFT             Number of hops, *DFT
     Status:
       Queue name . . . .   QSMTPQ
       Maximum hops . . .   *DFT
     Data high:
       Queue name . . . .   QSMTPQ
       Maximum hops . . .   *DFT
     Data low:
       Queue name . . . .   QSMTPQ
       Maximum hops . . .   *DFT



 F3=Exit      F12=Cancel
```

Figure 36. Add a Routing Table Entry

2.5.1.6 Step 6—Update the System Directory

An entry in the system directory is required for every user to whom you want to send mail. An entry can be for a specific user or for a group of users. For remote users, group entries generally work best. A group entry is set up by specifying *ANY in the *user ID* field instead of a specific user name. This means that any user ID with a matching address matches that entry. So, individual entries for each user at that address are not required. Refer to 6.6, "SNADS/SMTP Interrelationship" on page 151 for a description to route mail to a particular user.

For SMTP, one system directory entry should be set up for each host to whom mail is sent. *ANY should be specified for the *user ID*, and the TCP/IP host name should be specified for the *address*. If this host name is longer than 8 characters, a name of 8 characters or less should be selected to represent it. A long SMTP host name can be mapped to a SNADS name using an alias table. See 6.1, "Alias Tables" on page 127 for a more detailed discussion.

The system distribution directory allows a catch-all entry of the type *ANY *ANY. However, whenever possible, do not use this catch-all entry for a system name that is configured to use the QSMTPQ distribution queue because it may cause indefinite looping. Refer to *IBM AS/400 Distribution Services Net*, work Administrator's Guide (SC41-9588), for detailed explanation.

The "dummy" system name used in step 5 should be specified in the *system name* parameter of all the *ANY system directory entries. When this is done, only one SNADS routing table entry is required for all outgoing SMTP mail to the specific host. In Figure 37 on page 40, a "dummy" system name of TCPIP has been used. This matches the system name specified in the SNADS routing table entry defined in step 5.

To add a system directory entry:

1. Enter the command:

   ```
   WRKDIR
   ```

2. Press F6 to add a directory entry.

Figure 37 shows the Add Directory Entry display.

```
                            Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   *ANY      RCHASM02
   Description . . . . . .   Any user on RCHASM02
   System name/Group . . .   TCPIP     ________     F4 for list
   User profile  . . . . .   __________             F4 for list
   Network user ID . . . .   _______________________________________________

   Name:
     Last  . . . . . . . .   ________________________________________
     First . . . . . . . .   ____________________
     Middle  . . . . . . .   ____________________
     Preferred . . . . . .   ____________________
     Full  . . . . . . . .   __________________________________________________

   Department  . . . . . .   __________             F4 for list
   Job title . . . . . . .   ________________________________________
   Company . . . . . . . .   __________________________________________________
                                                                        More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 37. Add an Entry to the System Directory

The directory entry shown in Figure 37 will be correct if the AS/400 has not already been configured for SNADS. If it has, however, there may already be a similar group entry directing work, via a routing entry, to a different SNADS distribution queue.

There are two ways to correct this problem:

1. If the remote AS/400 SMTP user is known, an individual entry in the local directory should be made for that remote user with the entry being directed to the “dummy” system name of TCPIP.

2. The alternative is to use a substitute system name, shown in the address parameter here, for TCP/IP use.

The above problem is not applicable for most non-AS/400 systems since they do not have the SNADS conflict.

One mandatory entry is required for SNADS to be able to start the mail again after the SMTP job has ended. That entry is shown in Figure 38 on page 41.

```
                        Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   QSMTPDMY  QSMTPSYS
   Description . . . . . .   QSMTP user - do not delete
   System name/Group . . .   TCPIP     ________      F4 for list
   User profile  . . . . .   __________              F4 for list
   Network user ID . . . .   _______________________________________________

   Name:
     Last  . . . . . . . .   ________________________________________
     First . . . . . . . .   ____________________
     Middle  . . . . . . .   ____________________
     Preferred . . . . . .   ____________________
     Full  . . . . . . . .   __________________________________________________

   Department  . . . . . .   __________              F4 for list
   Job title . . . . . . .   ________________________________________
   Company . . . . . . . .   __________________________________________________
                                                                        More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 38. Add Required SMTP Entry to System Directory

2.5.1.7 Step 7—Enroll OfficeVision/400 Users

If OfficeVision/400 is used to interface to SMTP, users must be enrolled in the normal way. Information about OfficeVision/400 enrollment is found in *IBM AS/400 OfficeVision/400 Planning and Set Up (SC41-9626)*.

2.5.1.8 Step 8—Update the SMTP Alias Table

This is the last step of the configuration. It requires proper planning because it does the translation of a three-part SNADS name (user ID, address, system) into a two-part SMTP name (SMTP user ID, SMTP domain). This process is called aliasing. A more detailed explanation of the mapping between SNADS and SMTP names is given in 6.1, “Alias Tables” on page 127.

An alias is required in the AS/400 only if any of the following is true :

- The remote AS/400 user's SNADS address is different from the remote host system name.
- Users on either the local or remote host systems have abbreviated SNADS or SMTP names.
- The remote user to whom you want to send mail to has an SMTP user ID longer than 8 characters.

  If the SMTP user ID and host name are each 8 characters or less, you only need to define them in the system directory.
- The SMTP user IDs contain special characters.

  An alias entry is required in this case because an SMTP user ID will be translated to a SNADS user ID when a mail arrives at the AS/400. The SNADS user ID of the AS/400 can only permit alphabetic characters A through Z, numeric 0 to 9, extended alphabetic characters, and some other characters. (Refer to Appendix D for a list of supported characters in

SNADS). See 6.1, “Alias Tables” on page 127 if you need to define alias tables for user IDs with special characters.

Note: These special characters refer to characters that are not found in Appendix D. An example of a special character is the “!”.

- The route to a remote system needs to be specifically defined.

Refer to section 6.1, “Alias Tables” on page 127 for a more detailed discussion of the above points.

In this basic configuration, we only considered sending and receiving distributions between two AS400s. An SMTP alias table is normally not necessary for an AS/400 to AS/400 SMTP communication unless one or more of the above conditions are true. See 6.8, “Using SMTP With Non-AS/400 Systems” on page 160 if you need to exchange distributions between an AS/400 and a non-AS/400.

2.5.1.9 Step 9—Verify That Necessary SMTP Jobs Are Started

The QTCP and QSNADS subsystems must be started for SMTP to work. The essential jobs that need to be started in the QSNADS subsystem are QOTCPIPLOC and TCPIPLOC. The essential job in the QTCP subsystem is the QTMSMTP job.

Note: These are the SMTP-related jobs. There are other jobs that are necessary for the proper functioning of the QSNADS and QTCP subsystems. An example would be the three control jobs (QTCPIP, QTCPSTART, QTCPTIMER) of the QTCP subsystem. Refer to Figure 14 on page 21.

The TCPIPLOC job is the bridge-server transform job that creates the necessary objects for SMTP. The QTMSMTP job is the extended bridge job that serves the QSMTPQ distribution queue.

If these jobs have ended or are not started up yet, try ending the QSNADS and QTCP subsystems. Then re-starting them, with QSNADS first.

2.5.1.10 Step 10—Send a Message Using OfficeVision/400.

SMTP supports the distribution of notes, messages and final-form text (FFT) documents. SMTP mail can be sent with or without the OfficeVision/400 program product. Because OfficeVision/400 offers an easy-to-use interface, we use it in the following example. To send SMTP mail without OfficeVision/400, refer to 6.7, “Using SMTP Without OfficeVision/400” on page 157.

In this example we are sending a *message* from RCHASM01 to RCHASM02. To send a message, take option 3 from the main OfficeVision/400 menu.

```
                              Send Message

 Type message.
   Message to JOHN at system RCHASM02.  From Daryl of RCHASM01.
 ________________________________________________________________________________
 ____________________________________________

 Type distribution list and/or addressees, press F10 to send.
   Distribution list  . . . . .   ________ ________   F4 for list

 -----Addressees------
 User ID     Address      Description
 JOHN        RCHASM02
 ________    ________
 ________    ________
 ________    ________
                                                                        More...
 F3=Exit   F4=Prompt   F9=Attach memo slip          F10=Send   F12=Cancel
 F13=Change defaults   F21=Select assistance level   F24=More keys
```

Figure 39. Send a Message

Figure 39 shows the OfficeVision/400 Send a Message display. The displays for sending a note or a document are similar.

In the *user ID* and *address* fields, specify the SNADS user ID and address of the receiver. These must match either an individual or group entry in the system directory. Refer to 2.5.1.6, "Step 6—Update the System Directory" on page 39 for information about system directory entries and to 6.6, "SNADS/SMTP Interrelationship" on page 151 for more information on how a mail is sent. If no match is found, the mail is not sent.

2.5.1.11 Step 11—Receive a Message Using OfficeVision/400

To receive mail, select option 2 from the OfficeVision/400 menu. This displays a list of all received mail items. Select option 5 (View) to display an individual item. Figure 40 on page 44 shows a message received by way of SMTP using OfficeVision/400.

```
View Mail           |Skip                     |    |    |Adapted     |Pg 1
GPBS4324.56,QOTTMFLR                          |Typestyle 86 (12p)    |Ln 1
<2....:....3....:....4....:....5....v....6....:....7....:....8....:....9>
*
Received: from RCHASM02.RCHLAND.IBM.COM by RCHASM01.RCHLAND.IBM.COM (SMTP
Received: from RCHASM02 by RCHASM02.RCHLAND.IBM.COM (SMTP Version 2) Rele
Date: Tue, 23 Nov 93 13:58:03 .
From: JOHN?RCHASM02%RCHASM02@RCHASM02.RCHLAND.IBM.COM
To:   DARYL@RCHASM01.RCHLAND.IBM.COM
Subject: Yes I received your message


TO: DARYL    RCHASM01  Daryl on RCHASM01 via TCP/IP

FROM: JOHN    RCHASM02  John on RCHASM02

DATE: November 23, 1993
Subject: Yes I received your message

Hi Daryl,
Yes I received your message.  Please send the stocks over today.

Regards,
John


F3=Exit       F8=Reset            F13=Edit options      F17=Functions
F5=Goto       F10=Forward mail    F14=Delete mail       F19=Print
F6=Find       F11=Reply           F15=File local        F21=Nondisplay
F7=Window     F12=Cancel          F16=File remote
```

Figure 40. Receive a Message

The message in Figure 40 was received by DARYL of host RCHASM01 from JOHN of host RCHASM02. Messages can also be received without using OfficeVision/400 and this is described in 6.7, “Using SMTP Without OfficeVision/400” on page 157.

For information on how a mail is received in the AS/400, refer to 6.6, “SNADS/SMTP Interrelationship” on page 151.

2.6 Using LPR/LPD

This section describes how to use the LPR (Line Print Requester) command (or SNDTCPSPLF) on AS/400 to send spooled files to another AS/400, and how to setup the AS/400 LPD (Line Print Daemon) server to receive print output from an other AS/400 Line Print Requester.

2.6.1 Using LPR

For sending spooled files with the LPR command from the client (local) AS/400 to an LPD server (remote) AS/400 the following steps are recommended:

1. Locate the spool file to be sent
2. Start the spool file transfer with the LPR command

2.6.1.1 Step 1—Locate the Spool File to Be Sent

1. Enter the WRKSPLF command to see your spool files:

```
                          Work with All Spooled Files

 Type options, press Enter.
   1=Send   2=Change   3=Hold   4=Delete   5=Display   6=Release   7=Messages
   8=Attributes        9=Work with printing status

                                Device or                        Total     Cur
 Opt  File        User        Queue       User Data   Sts    Pages    Page  Copy
      QPJOBLOG    HANS        QEZJOBLOG   QPADEV0004  RDY       10             1
      QPJOBLOG    HANS        QEZJOBLOG   P23XYG41F   RDY        3             1
      QPCSMPRT    HANS        PFEIFFER                RDY        4             1
      QPDCLINE    HANS        PFEIFFER                RDY        1             1
      QPJOBLOG    HANS        QEZJOBLOG   P23XYG41    RDY        1             1
      QPJOBLOG    HANS        QEZJOBLOG   P23XYG41F   RDY        7             1
      QPCSMPRT    HANS        PFEIFFER                RDY        4             1
      QPCSMPRT    HANS        PFEIFFER                RDY        4             1
      QPCSMPRT    HANS        PFEIFFER                RDY        4             1
      QPCSMPRT    HANS        PFEIFFER                RDY        4             1
                                                                          Bottom
 Parameters for options 1, 2, 3 or command
 ===>
 F3=Exit   F10=View 3   F11=View 2   F12=Cancel   F22=Printers   F24=More keys
```

Figure 41. Work with Spooled Files Display

2. Press F10 to get the spool file job information:

```
                          Work with All Spooled Files

 Type options, press Enter.
   1=Send   2=Change   3=Hold   4=Delete   5=Display   6=Release   7=Messages
   8=Attributes        9=Work with printing status

                  File
 Opt  File        Nbr  Job         User        Number  Queue       Library
      QPJOBLOG       1 QPADEV0004  HANS        058135  QEZJOBLOG   QUSRSYS
      QPJOBLOG       1 P23XYG41F   HANS        058220  QEZJOBLOG   QUSRSYS
      QPCSMPRT       3 P23XYG41F   HANS        058406  PFEIFFER    PFEIFFER
      QPDCLINE       4 P23XYG41F   HANS        058406  PFEIFFER    PFEIFFER
      QPJOBLOG       1 P23XYG41    HANS        058405  QEZJOBLOG   QUSRSYS
      QPJOBLOG       5 P23XYG41F   HANS        058406  QEZJOBLOG   QUSRSYS
      QPCSMPRT       1 P23XYG41F   HANS        058480  PFEIFFER    PFEIFFER
      QPCSMPRT       2 P23XYG41F   HANS        058480  PFEIFFER    PFEIFFER
      QPCSMPRT       3 P23XYG41F   HANS        058480  PFEIFFER    PFEIFFER
      QPCSMPRT       4 P23XYG41F   HANS        058480  PFEIFFER    PFEIFFER
                                                                          Bottom
 Parameters for options 1, 2, 3 or command
 ===>
 F3=Exit   F10=View 2   F11=View 1   F12=Cancel   F22=Printers   F24=More keys
```

Figure 42. Spooled Files Job Information

3. Locate the spool file to be sent to another AS/400 and remember file, job, and user name and job number.

Note: The 1=Send option in the Work with Spooled Files display only applies to sending spooled files in an SNA network (using the command SNDNETSPLF). This option does not apply to sending spooled files in a TCP/IP network.

2.6.1.2 Step 2—Start the Spool File Transfer with the LPR Command

Enter

```
LPR
```

and press F4 (Prompt) fill in the highlighted fields of Figure 43.

Enter the host name (defined in Figure 8 on page 16) or the internet address to which the spooled file is to be transferred and (in parameter Printer queue) the qualified OUTQ (library/OUTQ) of the remote system to receive that file.

In addition enter the information from Figure 42 on page 45 for the specific spooled file to be sent.

When transferring spooled files from AS/400 to AS/400 no transformation of the data stream is necessary.

```
                    Send TCP/IP Spooled File (LPR)

 Type choices, press Enter.

 Remote system  . . . . . . . . . > rchasm01

 Printer queue  . . . . . . . . . > pfeiffer/pfeiffer

 Spooled file . . . . . . . . . . > qpcsmprt      Name
 Job name . . . . . . . . . . . . > p23xyg41f     Name, *
   User . . . . . . . . . . . . . >   hans        Name
   Number . . . . . . . . . . . . >   058480      000000-999999
 Spooled file number  . . . . . .   2             1-9999, *ONLY, *LAST
 Destination type . . . . . . . . > *as400        *AS400, *PSF2, *OTHER
 Transform SCS to ASCII . . . . . > *no           *YES, *NO
                                                                  Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 43. Spooled File Job Information in LPR Display

Instead of using the LPR prompt you may enter the CL command string:

```
LPR RMTSYS(RCHASM01) PRTQ('PFEIFFER/PFEIFFER') FILE(QPCSMPRT) +
    JOB(058480/HANS/P23XYG41F) SPLNBR(1) +
    DESTTYP(*AS400) TRANSFORM(*NO)
```

Note: If the spooled file being sent was created with the current interactive job, then an * (asterisk) could be specified for the Job name parameter.

2.6.2 Using LPD

On the AS/400 the Line Printer Daemon (LPD) is the server printer function that receives print files from remote Line Printer Requesters (LPRs) and puts them in printer OUTQs from where they can be printed using OS/400 functions. No special setup is required when receiving print files from another AS/400. Two LPD jobs waiting for remote LPR requests are started automatically when the QTCP subsystem is started. Figure 44 on page 47 shows these two LPD server jobs.

```
                          Work with Subsystem Jobs                   RCHASM02
                                                            11/24/93  12:43:08
 Subsystem  . . . . . . . . . . :   QTCP

 Type options, press Enter.
   2=Change   3=Hold   4=End   5=Work with   6=Release   7=Display message
   8=Work with spooled files   13=Disconnect


 Opt  Job         User        Type     -----Status-----  Function
      FTPSRV1     QTCP        BATCH    ACTIVE
      FTPSRV2     QTCP        BATCH    ACTIVE
      FTPSRV3     QTCP        BATCH    ACTIVE
>>>   LPDSRV1     QTCP        BATCH    ACTIVE
>>>   LPDSRV2     QTCP        BATCH    ACTIVE
      QTCPIP      QTCP        BATCH    ACTIVE
      QTCPSTART   QTCP        AUTO     ACTIVE
      QTCPTIMER   QTCP        BATCH    ACTIVE
      QTMSMTP     QGATE       BATCH    ACTIVE            PGM-QTMSTSMT
                                                                        Bottom
 Parameters or command
 ===>
 F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve   F11=Display schedule data
 F12=Cancel
```

Figure 44. LPD Jobs in Subsystem QTCP

Note: If the LPD job on the AS/400 receives the spool file data as ASCII (as would be the case from an OEM LPR) it will place the output in a spool file with data stream type USERASCII. This spool file cannot be viewed at the remote AS/400, and may only be printed on an ASCII printer attached in one of three ways:

1. Through the ASCII-Workstation Controller
2. Through the serial port on an IBM InfoWindow* display
3. Through PC Support/400

For information about LPR/LPD NLS consideration refer to Chapter 7, "Additional LPR/LPD Considerations" on page 189.

2.7 Configuring AS/400 TCP/IP with Non-AS/400 Systems

The information presented in this section pertains to the operation of AS/400 TCP/IP with non-AS/400 systems. We will reference our network diagram as shown in Figure 58 on page 65. We have seen at the beginning of this chapter how we setup TCP/IP on RCHASM01 to communicate with RCHASM02. In this section, we will show how we can configure RCHASM01 to communicate with other systems using TCP/IP.

Most of the configuration steps here are the same as those described in 2.2.1, "Basic Configuration" on page 12 except for some additional considerations which will be discussed below.

1. **Update Host Table**

   Add the new host names and their domain names into the host table. Convert the host table so that the changes will be effective. Please see Figure 45 on page 48.

```
                     Work with TCP/IP Host Table Entries
                                                         System:   RCHASM01
 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display

         Internet             Host
 Opt     Address              Name
  _      _______________
  _      9.5.65.254           RCHAS008
  _      9.5.65.254           RCHAS008.RCHLAND.IBM.COM
  _      9.5.69.198           RCHRS001
  _      9.5.69.198           RCHRS001.RCHLAND.IBM.COM
  _      9.5.69.211           UK
  _      9.5.69.211           UK.RCHLAND.IBM.COM
  _      9.5.69.212           STUTTGART
  _      9.5.69.212           STUTTGART.RCHLAND.IBM.COM
  _      9.5.69.213           SINGAPOR
  _      9.5.69.213           SINGAPOR.RCHLAND.IBM.COM
  _      9.5.69.214           MACIAN
  _      9.5.69.214           MACIAN.RCHLAND.IBM.COM
  _      9.5.69.250           RCHASM02
                                                                  More...
```

```
         Internet             Host
 Opt     Address              Name
  _      _______________
  _      9.5.69.250           RCHASM02.RCHLAND.IBM.COM
  _      9.5.69.251           RCHASM01
  _      9.5.69.251           RCHASM01.RCHLAND.IBM.COM
  _      9.5.8.134            HPUX
  _      9.5.8.134            HPUX.RCHLAND.IBM.COM
  _      9.5.8.138            SPARKY
  _      9.5.8.138            SPARKY.RCHLAND.IBM.COM
  _      9.5.8.252            MVAX
  _      9.5.8.252            MVAX.RCHLAND.IBM.COM
                                                                  Bottom
 F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Position to
```

Figure 45. Updated Host Table

2. **Update Route Entries**

   Notice that we have segregated the systems into three subnetworks. Subnetworks are normally used to divide a huge network into multiple smaller ones to allow for departmentalization, easy management, growth and flexibility. 3.6.5, "Subnetworks" on page 64 describes subnetworks in detail.

   To implement subnetworking in RCHASM01, you have to change the TCP/IP route entry to include a subnet mask and subnet value. Since the RCHASM01 belongs to the subnetwork 9.5.69.192, change the subnet mask and value as shown in Figure 46 on page 49. It is not possible to use the change option to change the subnet mask and subnet value parameters within a route entry. Therefore, to make these changes the current route entries must be deleted and re-created.

```
                    Add TCP/IP Route Entry (ADDTCPRTE)

Type choices, press Enter.

Network  . . . . . . . . . . . .   9
Line description . . . . . . . .   ITSCTRN       Name
First hop  . . . . . . . . . . .   *HOME
Maximum datagram size  . . . . .   *CALC         512-1994, *CALC
Subnet mask  . . . . . . . . . .   0.255.255.192
Subnet value . . . . . . . . . .   0.5.69.192


                                                                 Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 46. Change Subnet Mask and Value for RCHASM01

```
                       TCP/IP Route Information Entry

                           Line         Maximum
Network    First hop   Description   Datagram Size   Subnet mask    Subnet Value

*DEFAULT   9.5.69.193    ITSCTRN        *CALC           *NONE          *NONE
9           *HOME        ITSCTRN        *CALC       0.255.255.192   0.5.69.192
```

Figure 47. TCP/IP Route Entries for RCHASM01

By specifying *HOME for *First Hop*, traffic with internet address belonging to the same subnetwork (9.5.69.192) will be routed by the local system itself, without going through any intermediate systems. If the internet address belongs to another subnetwork, the default route via the router (9.5.69.193) will be used.

The same default routing method is applied to other systems, that is, internet addresses meant for another subnetwork will be routed via the routers.

3. **Update System Directory**

   We have configured RCHASM01 to exchange mail with RCHASM02 via SMTP in 2.5, "Using SMTP" on page 34. To exchange mail with users on other systems, update the system distribution directory with entries to each system as shown in Figure 48 on page 50. Recall from Figure 37 on page 40 that when you add a SNADS entry and you want this entry to use TCP/IP, you have to specify the system name to be TCPIP.

   For more information on sending mail between AS/400 and non-AS/400 systems, refer to 6.8, "Using SMTP With Non-AS/400 Systems" on page 160.

```
                         Work with Directory

Type options, press Enter.
  1=Add      2=Change   4=Remove   5=Display details   6=Print details
  7=Rename   8=Assign different ID to description   9=Add another description

Opt  User ID   Address   Description
 _   ________  ________
 _   *ANY      HPUX      Any user on HPUX (HP 705 Apollo)
 _   *ANY      MVAX      Any user on MVAX (MicroVax 3100)
 _   *ANY      RCHASM02  Any user on RCHASM02 (AS/400)
 _   *ANY      RCHAS008  Any User on RCHAS008 (AS/400)
 _   *ANY      RCHRS001  Any user on RCHRS001 (RS/6000)
 _   *ANY      SINGAPOR  Any user on SINGAPOR (PS/2)
 _   *ANY      SPARKY    Any user on SPARKY (Sun)
 _   *ANY      STUTT     Any user on STUTTGART (PS/2)
 _   *ANY      UK        Any user on UK (PS/2)
 _   QSECOFR   QSECOFR   Security Officer
 _   QSMTPDMY  QSMTPSYS  QSMTP user - do not delete

                                                                     More...
F3=Exit      F5=Refresh   F9=Work with nicknames   F10=Search directory
F12=Cancel   F13=Work with departments   F17=Position to   F24=More keys
```

Figure 48. Updated System Distribution Directory

4. **Update System Alias Table**

   If alias names are required, define them in the system alias table. For example, since the host name STUTTGART is longer than 8 characters, you have to define an alias table entry as shown in Figure 49.

```
                          Add Name for SMTP
                                                        System:   RCHASM01
Type choices, press Enter.

  User ID . . . . . . . . .  *ANY____   Character value, *ANY, F4 for list
  Address . . . . . . . . .  STUTT___   Character value, F4 for list

  SMTP user ID  . . . . . .  ________________________
  SMTP domain . . . . . . .  STUTTGART.RCHLAND.IBM.COM_________________
_______________________________________________________________________
_______________________________________________________________________
___________________________________________

  SMTP route  . . . . . . .  _____________________________________________
_______________________________________________________________________
_______________________________________________________________________
___________________________________________


F3=Exit   F4=Prompt   F12=Cancel
```

Figure 49. Add Entry for Stuttgart System to System Alias Table

5. **Enable IP Forwarding**

   IP forwarding is an important capability of the AS/400. When an AS/400 is physically residing in two or more networks at the same time, you may want to enable the AS/400 to route IP datagrams from one network to the other.

   This capability is not implemented in our network because there is no need to. Appendix C, "Theoretical Network Example" on page 239 provides another network example where IP forwarding is implemented. Refer to this Appendix if necessary.

With the above changes, RCHASM01 will be ready to communicate with other systems using applications like TELNET, FTP, LPR, LPD and SMTP.

Chapter 3. Additional TCP/IP Considerations

This chapter contains the additional considerations that are especially important when using TCP/IP in larger networks.

3.1 PING (VFYTCPCNN) - Verify TCP/IP Connection

To be able to verify the connection to a remote TCP/IP host, an echo request/reply function called PING, is used in TCP/IP implementations. PING uses the Internet Control Message Protocol (ICMP) to send data to a specified internet address and wait for a response. It then displays status information indicating whether the connection was successful or not.

On the AS/400, the PING function is performed using the TCP/IP command PING or the AS/400 command VFYTCPCNN. Both commands perform exactly the same function.

3.1.1 Using PING in the AS/400

Figure 50 shows an example of a PING screen.

```
                       Verify TCP/IP Connection (PING)

 Type choices, press Enter.

 Remote system  . . . . . . . . . > *INTNETADR



 Internet address . . . . . . . . > '9.5.69.250'

                             Additional Parameters

 Packet length (in bytes) . . . .   256           8-512
 Number of Packets  . . . . . . .   5             1-999
 Wait time (in seconds) . . . . .   10            1-120



                                                                    Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 50. PING Operation

You only need to specify the remote system name or the remote system's internet address. The additional parameters of this command allows you to specify the packet length, the number of packets to be sent and the wait time for a response. It is recommended that these be left at their default values. Be aware that if you do change them, a combination of a large packet length and a short wait time may not give the network enough time to transmit and receive the response, leading to timeouts.

PING is primarily used for a three types of connection tests:

1. **Loopback Test**

TCP/IP in general supports a special host called *Loopback*. In the AS/400, this special host has the internet address of *14.0.0.0*. Different systems have different internet addresses for loopback. The loopback internet address cannot be modified in the AS/400 but can be in some other systems like the RS/6000.

By using this special host name or internet address, datagrams will be routed from the TCP or UDP layer to the IP layer and back again to the TCP or UDP from which they came. The datagrams do not leave the local system at all.

Thus loopback allows the user to:

- Test application programs *without* being physically attached to a token-ring LAN, Ethernet LAN or X.25 link. And because there is no real network connection, these application tests will not impact the performance of the TCP/IP or SNA traffic.
- Test the TCP/IP code and ensure that the QTCP subsystem is started up correctly.

2. **Local System Test**

   When you have completed the basic TCP/IP configuration, it is a good practice to verify that the TCP/IP connection is working even before trying to use applications like TELNET, FTP or LPR/LPD. Try doing a PING to the local system′s internet address or the local host name first. This will cause a datagram to be sent out of the local host system into the network (for example a LAN) and back again. If this is successful, it helps to verify that the TCP/IP code, the LAN hardware and the LAN connection are working.

3. **Remote System Test**

   Once the loopback and local system tests are successful, proceed to verify connection to the desired remote system. You can either specify the remote system′s internet address or simply the remote system name as defined in the host table. If this is successful, you should be able to carry on with applications like TELNET, FTP and LPD/LPR, for example.

3.1.2 Common Errors with PING

When you try to PING to another host in the network, TCP/IP could give you an error message. Some of the most common error messages and their possible causes are listed below:

- **No TCP-IP service available (TCP3423)**

  Either the QTCP subsystem is not started or if it is started, some of the necessary jobs (Figure 14 on page 21) may not be started up properly. For PING to work, the three control jobs – QTCPIP, QTCPSTART and QTCPTIMER, must be started. These three jobs are also essential for other functions as described below:

Function	Essential jobs in QTCP
TELNET	the three control jobs QTCPIP, QTCPSTART and QTCPTIMER, must be started.
FTP	the three control jobs QTCPIP, QTCPSTART and QTCPTIMER, and at least one of the three FTP server jobs FTPSRVx, FTPSRVy, FTPSRVz, must be started.

LPD/LPR the three control jobs QTCPIP, QTCPSTART and QTCPTIMER, and at least one of the two LPD server jobs LPDSRVx and LPDSRVy, must be started.

SMTP the QTMSMTP job must be started together with the three control jobs. SMTP is also dependent on two jobs in the QSNADS subsystem – QOTCPIPLOC and TCPIPLOC. Check that the QSNADS subsystem and these two jobs are active.

- **Not able to establish connection with remote host system (TCP3409)**

  Check that your line configuration as well as the TCP/IP link and route definitions are correct.

- **Remote host did not respond in xx seconds (TCP3206)**

  Your configuration is probably correct but you do not get an answer back. Run the PING tests in the sequence described in 3.1.1, "Using PING in the AS/400" on page 53 so that you can determine where the possible fault could be. If necessary, ask the remote system operator to execute PING to your system.

  Check the host tables, TCP/IP route and TCP/IP link definitions in both the local and remote systems. If you are using a remote name server, ensure that it is up and running.

  Also, you can try to PING the internet address of the remote host directly. If the PING is successful, then something still might be wrong with your local host table or the remote name server.

- **Host unknown (TCP3203)**

  Check the host table. If there is an entry for the destination host and the internet address is correct, then try to do the host table conversion using option 25 from the Configure TCP/IP menu. You may have forgotten to convert the host table after adding or deleting an entry. After the conversion, check the joblog to ensure that the conversion process is successful.

3.2 Local Domain Name

The domain name is used to identify the local host to a hierarchy of systems in the network. It is required for functions like FTP and SMTP.

A domain name consists of labels that are separated by periods, for example, RCHASM02.RCHLAND.IBM.COM. It is always associated with an internet address in the host table. Most of the time, the first label of the domain name is the host name.

The AS/400 allows you to define a domain name using option 4 from the Configure TCP/IP menu as in Figure 51. Notice that the domain name comprises of two portions: local host name, which is the name of your system, and local domain name, which is the hierarchy of network your system belongs to. Refer to 3.6.6, "Domain Naming Conventions" on page 67 for a more detailed discussion of domain names.

```
                          Change Local Domain Name
                                                              System:   RCHASM02
 Type choices, press Enter.

   Local domain name . . . .   RCHLAND.IBM.COM

   Local host name . . . . .   RCHASM02


 F3=Exit   F12=Cancel
```

Figure 51. Change Local Domain Name

The combination of the local domain name and the local host name becomes the full local host domain name by which the local system is known to other hosts in the network.

It is important to check that the host name shown here is present in the local host table and that its associated internet address has an entry in the TCP/IP link information. If the host name is not in the host table or there is a mismatch between the link internet address and the one in the host table for this host, the local domain name will not be considered valid and SMTP will be ended.

Note: A remote name server may be used as a replacement for the local host table. See 3.3, "Name Server" on page 59.

3.2.1.1 FTP

When a user from an RS/6000 system logs on to an AS/400 system using FTP, a message which identifies the AS/400 system's name will be displayed on the user's screen. The host name in this message is the full local host domain name of the AS/400 system. Look at Figure 52 on page 57.

```
# ftp rchasm02

Connected to RCHASM02.RCHLAND.IBM.COM.
220-QTCP at RCHASM02.RCHLAND.IBM.COM.
220 Connection will close if idle more than 5 minutes.
Name (rchasm02:root): JOHN
331 Enter password.
Password:
230 JOHN logged on.
ftp>
```

Figure 52. FTP Messages on RS/6000 System

3.2.1.2 SMTP

When mail is sent from the AS/400 system, the mail header contains the full host domain name. For example, when a user on the RS/6000 system receives mail from an AS/400 system, the mail header would look like Figure 53.

```
Message  1:
From JOHN?RCHASM02@RCHASM02.RCHLAND.IBM.COM Sat Dec 4 17:21:15 1993
Date: Sat, 04 Dec 93 16:28:53 .
From: JOHN?RCHASM02@RCHASM02.RCHLAND.IBM.COM
To: ROOT@rchrs001.rchland.ibm.com
Subject: Note to RS/6000 from AS/400


TO: ROOT     RCHRS001  Root at RCHRS001 RS/6000

FROM: JOHN    RCHASM02  John of RCHASM02

DATE: December 4, 1993
SUBJECT: Note to RS/6000 from AS/400

Hi Beet Root,

How is the Unix world nowadays ?

Regards,
John
```

Figure 53. Mail Sent from an AS/400 System to an RS/6000 System

Also, when a mail is received by the AS/400 system, the local domain name is added to the mail to identify the receiving system. Figure 54 on page 58 shows an example of a mail received through OfficeVision/400. This mail was sent from an RS/6000 user. The highlighted part indicates the AS/400 system's full host domain name.

```
View Mail            |Skip                     |    |    |Adapted     |Pg 1
GPFV4052.62,QOTTMFLR                           |Typestyle 86 (12p)    |Ln 1
<2....:....3....:....4....:....5....v....6....:....7....:....8....:....9>
*
Received: from rchrs001.rchland.ibm.com by RCHASM02.RCHLAND.IBM.COM (SMTP
Received: by rchrs001.rchland.ibm.com (AIX 3.2/UCB 5.64/4.03)
          id AA07738; Sat, 4 Dec 1993 17:31:36 -0500
Date: Sat, 4 Dec 1993 17:31:36 -0500
From: root@rchrs001.rchland.ibm.com
Message-Id: <9312042231.AA07738@rchrs001.rchland.ibm.com>
To: JOHN@RCHASM02.RCHLAND.IBM.COM
Subject: Mail from RS/6000 to AS/400


Hi John,
The Unix world is doing fine.  Thanks for your concern.

Regards,
Root


 F3=Exit        F8=Reset             F13=Edit options      F17=Functions
 F5=Goto        F10=Forward mail     F14=Delete mail       F19=Print
 F6=Find        F11=Reply            F15=File local        F21=Nondisplay
 F7=Window      F12=Cancel           F16=File remote
```

Figure 54. Mail Sent from an RS/6000 System to an AS/400 System

If the domain portion was left blank, or if the local domain name was not defined, SMTP will not run.

3.3 Name Server

To address a host in a network, the host name is normally used instead of the internet address for simplicity reasons. The IP protocol, however, uses the internet address. The translation from host name to internet address is normally done using the host table on the local host system. However, it is possible to define a remote host to perform this translation. Such a host is known as a name server. In large networks with large host tables, it is more convenient to have name servers than to have a complete copy of the host table on every host in the network.

An AS/400 cannot be a name server, but it can use a name server.

A name server receives requests (to translate host names) from the other hosts. If the requested host name is known to the name server, the request is returned with the internet address. If the requested host name is not known to the name server, the request is forwarded upwards in the domain hierarchy to the next level of name servers until it is returned with or without the internet address. If it is returned without an internet address, the requesting host will search its own host table.

Note: In the current AS/400 implementation of search for an internet address, the remote name server, if configured, will always be searched first for whatever host name you are looking for (even your own local host) and if not found, then the local host table will be searched.

When using some other systems, the order of search for internet addresses may be the reverse. That is, the local host table is searched prior to sending a search request to the name server.

To define a name server for the AS/400, take option 10 from the Configure TCP/IP menu. The resulting display is shown in Figure 55.

```
                     Change Remote Name Server
                                                      System:   RCHASM02
 Type choices, press Enter.

   Server address . . . . . .   9.5.100.76          Internet address
   Server port  . . . . . . .   53                  0-65534
   Server protocol  . . . . .   *UDP                *UDP, *TCP
   Retries  . . . . . . . . .   3                   1-99
   Time interval  . . . . . .   10                  1-99 (seconds)



 F3=Exit   F12=Cancel
```

Figure 55. Change Remote Name Server Display

The *server address* is the internet address of the remote name server. Port 53 is the most commonly used port for the name server and the UDP protocol the most commonly used name server protocol. It may be necessary to check that these values are correct for the name server to be used.

3.4 TCP/IP Attributes

TCP/IP operations are controlled by a set of attributes. For example, these attributes determine the type of mapping tables to be used for different applications, the error checking on incoming messages, the use of the AS/400 as an IP router, and so on.

To change the TCP/IP attributes, select option 11 from the Configure TCP/IP menu. The Change TCP/IP Attributes prompt will appear as shown in Figure 56. This screen can also be accessed by using the command CHGTCPA.

Note: Once the TCP/IP attributes are changed, the QTCP subsystem must be restarted for the changes to be effective.

```
                     Change TCP/IP Attributes (CHGTCPA)

 Type choices, press Enter.

 Checksum on incoming messages  .   *NO            *SAME, *YES, *NO
 IP datagram forwarding . . . . .   *NO            *SAME, *YES, *NO
 TELNET inactivity timeout  . . .   0              0-2147483647, *SAME
 TELNET timemark timeout  . . . .   0              0-2147483647, *SAME
 TELNET default NVT type  . . . .   *VT100         *SAME, *VT100, *NVT
 SMTP - outgoing mapping table  .   *DFT           Name, *SAME, *DFT
                                                   Name, *LIBL, *CURLIB
 SMTP - incoming mapping table  .   *DFT           Name, *SAME, *DFT
                                                   Name, *LIBL, *CURLIB
 FTP - outgoing mapping table . .   *DFT           Name, *SAME, *DFT
                                                   Name, *LIBL, *CURLIB
 FTP - incoming mapping table . .   *DFT           Name, *SAME, *DFT
                                                   Name, *LIBL, *CURLIB
 VT100 - outgoing mapping table     *DFT           Name, *SAME, *DFT
                                                   Name, *LIBL, *CURLIB

                                                                  More...
```

```
 VT100 - incoming mapping table     *DFT           Name, *SAME, *DFT
                                                   Name, *LIBL, *CURLIB

                                                                   Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 56. Change TCP/IP Attributes

The parameters have the following meanings:

Checksum on incoming messages

Specifies if error checking should be performed on incoming messages. It is a small integer value that is computed from the sum of data in a packet. This checksum is appended to the packet when it is transmitted, and the receiving system recomputes the checksum and compares it to the value sent.

The default value *NO means that checksums will not be calculated. If you are experiencing transmission errors, you may want to change this to *YES. Checksum calculations will degrade TCP/IP performance and it may be redundant because most line descriptions provide similar error checking mechanism. Therefore, it is best left at *NO unless transmission errors occur.

IP packet forwarding
Specifies if your system should be a router that forwards IP packets destined for other networks. For example, the AS/400 may be physically connected to two separate Local Area Networks at the same time. If the *IP Forwarding* capability is enabled (set to *YES), then the AS/400 would be able to route IP datagrams from one LAN network to the other. The default value is *NO.

TELNET inactivity timeout
Specifies how many seconds the TELNET server will allow for a TELNET session to be inactive before timing out and closing the connection. A value of 0 means that the system will allow the connection to be inactive indefinitely.

TELNET timemark timeout
Specifies the number of seconds between TELNET server timemarks. For example, if this attribute is set to 60, the TELNET server will send a timemark to each connection every 60 seconds. Those connections that do not reply will be closed. A value of 0 means that no timemarks will be sent. The default is 600 seconds (10 minutes). This parameter does not apply to the TELNET client.

TELNET default NVT type
If the AS/400 TELNET server fails to negotiate one of the supported terminal types, it will use the default Network Virtual Terminal (NVT) type specified in this parameter.

If *VT100 is specified, then the TELNET server defaults to VT220 or VT100 mode when it fails to negotiate one of the supported terminal types with the client. The AS/400 TELNET server will operate as though the VT220 or VT100 terminal type has been negotiated.

If *NVT is specified, then the AS/400 TELNET server defaults to NVT mode when it fails to negotiate one of the supported terminal types with the client. NVT mode requires an application program written to interact with the NVT work station devices.

Mapping tables for SMTP, FTP and TELNET
The system provides default (*DFT) tables for mapping between ASCII and EBCDIC. Refer to *IBM AS/400 TCP/IP Guide (SC41-9875)* and to the respective additional considerations chapters in this book for more information about mapping tables.

3.5 TCP/IP Tuning Values

The AS/400 picks the appropriate number of control blocks, buffers and envelopes that affect performance. You can change these values as shown in Figure 57 on page 62.

Notes:

1. If you change the values inappropriately, performance could degrade.
2. Changes to the tuning values take effect the next time the QTCP subsystem starts.

To configure the tuning values, select option 14 on the Configure TCP/IP menu.

```
                      Change TCP/IP Tuning Values
                                                        System:   RCHASM02
 Type choices, press Enter.

   Activity control blocks . . . . . .   *CALC    20-2000, *CALC
   Client control blocks . . . . . . .   *CALC    10-300, *CALC
   Socket control blocks . . . . . . .   *CALC    10-256, *CALC
   Transmission control blocks . . . .   *CALC    10-256, *CALC
   Data buffers  . . . . . . . . . . .   *CALC    10-160, *CALC
   UDP control blocks  . . . . . . . .   *CALC    10-200, *CALC
   Data envelopes  . . . . . . . . . .   *CALC    40-1500, *CALC




 F3=Exit   F12=Cancel
```

Figure 57. Change TCP/IP Tuning Values

*CALC tells the AS/400 to use the default values. The range of allowed values is shown on the right.

Activity control blocks (ACB) are used for scheduling processes. Too few ACBs cause TCP/IP to fail. The default is 1000.

Client control blocks (CCB) describe processes. Too few CCBs prevent new processes from being scheduled. The default value is 150.

Socket control blocks (SCB) describe connections and ports. Too few SCBs prevent the opening of new connections and ports. The default value is 256.

Transmission control blocks (TCB) describe connections. Too few TCBs prevent new connections from being opened. The default value is 256.

Data buffers hold data during TCP/IP processing. Too few buffers prevent new connections from being opened. The default value is 160.

UDP control blocks (UCB) describe open UDP ports. Too few UCBs prevent the opening of new UDP ports. The default value is 30.

Data envelopes also hold data during TCP/IP processing. Too few envelopes prevent new connections from being opened. The default value is 750.

3.6 TCP/IP Naming Conventions

In larger networks it is important to follow certain naming conventions that exist for TCP/IP.

3.6.1 TCP/IP Ports

Commonly used protocols and applications such as FTP and SMTP have assigned port numbers. These *assigned* port numbers are called *well-known ports.* Port numbers 1 to 1000 are reserved for the well-known ports and should not be used by user application programs.

It is not necessary to configure the port information unless you are writing your own TCP/IP applications and want to restrict the use of specific ports to specific user IDs.

To configure port information select option 12 (Work with TCP/IP port entries) on the Configure TCP/IP menu. On the Work with TCP/IP Port Entries menu take option 1 to be able to add new TCP/IP Port Entries.

3.6.2 Internet Addressing

Each node in a network is known as a host and has a unique address called an internet address. This address is a 32-bit integer. An address is expressed in the form nnn.nnn.nnn.nnn, where each field is the decimal representation of one byte (8-bits) of the address.

Within your own networks, you can assign your own addresses. However, if you want to connect to the Internet (the collection of government, military and university networks) to allow you to communicate with hosts outside of your organization, then your internet addresses must be assigned by Government Systems, Inc. For their address see *IBM AS/400 TCP/IP Guide (SC41-9875)* .

3.6.3 Network Classes

There are two logical addresses in each internet address: a *network address* representing the physical network within the internet and a *local address* which specifies an individual host or gateway within the network.

IP address = <network address><host address>

The first byte of the IP address specifies how the rest of the address should be separated into its network and host part as shown in Table 1.

Table 1. Classes of Networks

Network class	Range of first byte	Network ID	Host ID	Maximum number of hosts per network class
Class A	0 to 127	First byte	Last 3 bytes	16,777,214
Class B	128 to 191	First 2 bytes	Last 2 bytes	65,534
Class C	192 to 223	First 3 bytes	Last byte	254

If the first byte of an internet address is in the range 0 to 127, then it is a **Class A** network. These are very large networks. The host IDs can range from 0.0.1 to 255.255.254 which allows for a maximum of 16,777,214 hosts. An example of a class A internet address would be 9.5.1.2. The network ID is 9 and the host ID is 5.1.2.

If the first byte of an internet address is in the range 128 to 191, then it is a **Class B** network. These are medium size networks. The host IDs can range from 0.1 to 255.254 which allows for a maximum of 65,534 hosts. An example of a class B internet address would be 150.244.1.241. The network ID is 150.244 and the host ID is 1.241.

If the first byte of an internet address is in the range 192 to 233, then it is a **Class C** network. These are relatively small networks. The host IDs can range from 1 to 254 which allows for a maximum of 254 hosts. An example of a class C internet address would be 221.6.1.244 The network ID is 221.6.1 and the host ID is 244.

Note: The above information on network classes and how the internet address is divided in the different classes is important in the next section on subnetworks.

3.6.4 Broadcast Addresses

On each network, a host ID of all 1 bits is reserved as a broadcast address. For example, the broadcast address on a class B network could be 150.244.255.255.

An internet address where the host ID part is all zeros is the address of the network itself and hence is also reserved.

3.6.5 Subnetworks

A class A, B or C network can be further divided into multiple smaller networks called *subnetworks*. These smaller networks are addressed through a subnet ID that is made up from the network ID and part of the host ID. For example, consider a class B network ID 144.22. If the high order byte of the host ID is used for a subnetwork ID, then it can be divided into 254 subnetworks ranging from 144.22.1 through 144.22.254. It is also valid to use part of a host ID byte for a subnetwork ID.

IP address = <network address><subaddress><host address>

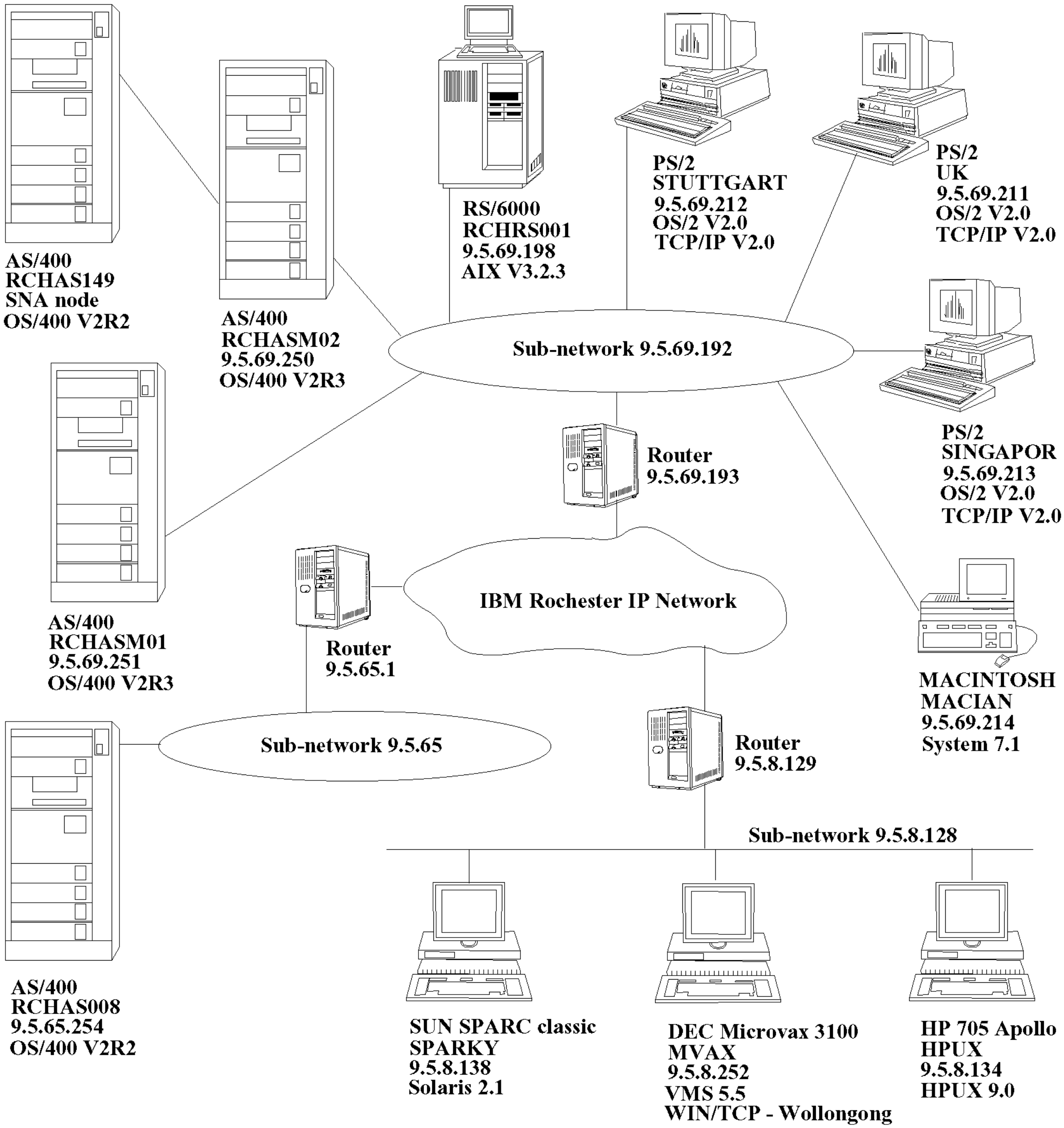

Figure 58. Rochester IP Network

The network used during our residency is an example of a network where subnetting is used (see Figure 58). The first byte of the internet address is 9 which makes it a class A network. Two subnets are shown, one has a subnet ID of 9.5.65 and the other a subnet ID of 9.5.69.192. 9.5.65 is an example of a network where 2 complete bytes of the host ID have been used for the subaddress. 9.5.69.192 is an example where 2 complete bytes and part of a 3rd byte of the host ID has been used for the subaddress. For 9.5.65 the range of host IDs available is 9.5.65.1 through 9.5.65.254. For 9.5.69.192 the range of host IDs available is 9.5.69.193 through 9.5.69.254.

A *subnet mask* is used to distinguish between a subnet ID and a host ID. Bits in the subnet mask are set to 1 if the network treats the corresponding bit in the IP address as part of the network address and to 0 if it treats the bit as part of the host address. For example, a subnet mask of:

```
Subnet mask      =  11111111  11111111  11111111  00000000
```

specifies that the first 3 bytes identify the network and the 4th byte identifies the host. A subnet mask would normally be specified in the same dotted decimal notation as an internet address. Thus, the above would be written 255.255.255.0. If an internet address of 9.5.65.254 is compared against the above subnet mask:

```
Subnet mask      =  11111111  11111111  11111111  00000000
Internet address =  00001001  00000101  01000001  11111110
  (logical and)     --------  --------  --------  --------
Subnet ID        =  00001001  00000101  01000001  00000000
```

The subnet ID is 9.5.65 and the host ID is 254. The subnet mask for subnetwork 9.5.65 is 255.255.255.0. The subnet mask for subnetwork 9.5.69.192 is 255.255.255.192. The later is an example of a subnetwork where part of a host ID byte has been used for the subaddress. In bit form the subnet mask is:

```
Subnet mask      =  11111111  11111111  11111111  11000000
```

It is also possible to have a subnet mask where the network ID part is not contiguous. For example:

```
Subnet mask      =  11111111  11111111  01100000  01000000
```

But this method is not normally used and not recommended.

On most systems the subnet mask configured includes both the network ID and the part of the host ID to be used as the subaddress. This gives subnet masks of 255.255.255.0 for network 9.5.65 and 255.255.255.192 in the case of 9.5.69.192. On the AS/400 this is not the case. On the AS/400 the subnet mask and subnet value include only the part of the host ID that is to be used as the subaddress and excludes the network ID. Since both networks 9.5.65 and 9.5.69.192 are class A, you must configure zeros for the first byte of the subnet mask and subnet value. Thus, for network 9.5.65, the subnet mask is configured on the AS/400 as 0.255.255.0 and the subnet value as 0.5.65.0; for network 9.5.69.192, the subnet mask is configured on the AS/400 as 0.255.255.192 and the subnet value as 0.5.69.192.

For AS/400 RCHASM02, the full route entry table is:

Network	Line Description	First Hop	Maximum Datagram Size	Subnet Mask	Subnet Value
*DEFAULT	ITSCTRN	9.5.69.193	*CALC	*NONE	*NONE
9	ITSCTRN	*HOME	*CALC	0.255.255.192	0.5.69.192

For AS/400 RCHAS008, the full route entry table is:

Network	Line Description	First Hop	Maximum Datagram Size	Subnet Mask	Subnet Value
*DEFAULT	ISTRN	9.5.65.1	*CALC	*NONE	*NONE
9	ISTRN	*HOME	*CALC	0.255.255.0	0.5.65.0

In both cases, the default is to route all traffic to the router associated with that subnetwork. Only if the internet address required is within the same subnetwork will the traffic be routed to the local network (*HOME).

All hosts in the same subnetwork must use the same subnet mask.

3.6.6 Domain Naming Conventions

In a network environment, all hosts have to know the addresses of the other hosts to be able to establish a connection. However, it is easier to use names than to specify the low-level hardware addresses, and so names are assigned to addresses.

When a network is small, the host names can be a sequence of characters without any further structure. The big advantage of this kind of name is that it is convenient and short. The big disadvantage is that it is not suitable for large sets of machines, for the following reasons:

- When the number of sites increases, the potential for name conflict increases.
- Authority for adding new names must rest at a single site, and the administrative workload increases as the number of sites increase.
- The name-to-address bindings change frequently, and the cost of maintaining correct copies at each site is high.

The answer to these problems is the decentralization of the naming mechanism by delegating authority for parts of the network. The name area of the network is partitioned at the top level and the top level delegates authority for the partitions where it has some authority. The top level need not be bothered by changes within the different partitions.

The syntax of hierarchically assigned names reflects the hierarchical delegation of authority used to assign them. For example the names of the form *local.site* means *site* is the top level of the hierarchy and this name has been authorized by the central authority, *local* is a host name controlled by the *site*. The authority may be further subdivided at each level. For example in our example the *site* can be divided in two groups:

- Production
- Marketing

Syntactically, adding a new level introduces another subdivision to the name. In our example, the machine can belong to the marketing group. The name will be: *local.market.site*.

Normally the hierarchical machine names are assigned according to the structure of organizations that obtain authority for parts of the namespace, not according to the structure of the physical network interconnections.

Internet follows the rules described above. The *Internet* authority that has ultimate responsibility for the namespace, has chosen to partition the top level into the following domains:

Domain Name	Meaning
COM	Commercial organizations
EDU	Educational institutions
GOV	Government institutions
MIL	Military groups
NET	Major networks support centers
ORG	Organizations other than those above
ARPA	Temporary ARPANET domain
country code	Countries other than USA

The meaning of the domain name used in this book *RCHASM02.RCHLAND.IBM.COM* is that the *Internet* authority has assigned IBM into the commercial organizations group, the IBM authority has assigned to Rochester the group name RCHLAND, and the Rochester authority has assigned RCHASM02 as the name for this IBM AS/400. If a new name for a host has to be defined in Rochester, only the Rochester authority needs be involved.

3.7 Security

The authority for the following commands is limited to QSECOFR, QPGMR, QSYSOPR, QSRV and QSRVBAS user profiles.

- Add TCP/IP Link(ADDTCPLNK)
- Add TCP/IP Port Entry(ADDTCPPORT)
- Add TCP/IP Remote System Information(ADDTCPRSI)
- Add TCP/IP Route Entry(ADDTCPRTE)
- End TCP/IP Connection(ENDTCPCNN)
- End TCP/IP Link(ENDTCPLNK)
- Change TCP/IP Attributes(CHGTCPA)
- Change TCP/IP Link(CHGTCPLNK)
- Change TCP/IP Route Entry(CHGTCPRTE)
- Configure TCP/IP(CFGTCP)
- Remove TCP/IP Link(RMVTCPLNK)
- Remove TCP/IP Port Entry(RMVTCPPORT)
- Remove TCP/IP Remote System Information(RMVTCPRSI)
- Remove TCP/IP Route Entry(RMVTCPRTE)
- Start TCP/IP(STRTCPLNK)

The remaining TCP/IP commands have public authority.

Authority is changed using the RVKOBJAUT command and the GRTOBJAUT command. To remove the authority of the QSYSOPR user profile to the CFGTCP command, the following example command may be used :

```
RVKOBJAUT OBJ(CFGTCP) OBJTYPE(*CMD) USER(QSYSOPR) AUT(*USE)
```

To give another user authority to the CFGTCP command, the GRTOBJAUT command is used as follows:

```
GRTOBJAUT OBJ(CFGTCP) OBJTYPE(*CMD) USER(RUNEB) AUT(*USE)
```

These commands are used in the same way to revoke or grant user authority to almost any object on the AS/400. To be able to view which users have authority to an object, use the EDTOBJAUT command. This command is used by a user with all rights to the object, to revoke and grant user authority to the object from a single display.

For more information related to the configure TCP/IP commands, automatic configuration, network devices and programs, see the *IBM AS/400 TCP/IP Guide (SC41-9875)*.

3.8 Token-Ring, Ethernet and X.25 Considerations

TCP/IP is supported to run over token-ring, Ethernet and X.25 lines. This provides the possibility of using TCP/IP to communicate in a large and varied network. The following are points to notice when configuring the different line types.

3.8.1 Maximum Datagram Size

The maximum datagram size that can be entered on the MAXDTGSIZE parameter of the Add TCP/IP Routing Entry (ADDTCPRTE) command or the Change TCP/IP Routing Entry (CHGTCPRTE) command depends on the type of line that is being used. Table 2 shows the differences for the applicable line types.

Table 2. Maximum Datagram Size for Line Type.

Line Type	**Maximum Datagram**
Token-ring (4M/16M)	1994
Ethernet (802.3)	1496
Ethernet (Version 2 IEEE)	1493
X.25	1024

3.8.2 X.25 TCP/IP Support

The AS/400 TCP/IP support for X.25 public or private data networks is only available over switched virtual circuits (SVC). Permanent virtual circuits (PVC) are not supported.

When using TCP/IP with X.25 data networks, it is necessary to translate the internet address of the destination host to its network address. To define this internet-to-network address relation, select option 6 to Work with TCP/IP Remote System Information from the Configure TCP/IP menu. The resulting display is as shown in Figure 59 on page 70. The term *Remote System* is used to refer to the remote DTE in the X.25 network.

```
                Work with TCP/IP Remote System Information
                                                     System:   RCHASM01
Type options, press Enter.
  1=Add   4=Remove

        Internet            Network
Opt     Address             Address
 1

  (No remote system information)

                                                                 Bottom
F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Top   F18=Bottom
```

Figure 59. Work with TCP/IP Remote System

Take option 1 to add an entry. Specify the internet address and its associated network address as shown in Figure 60.

```
                   Add TCP/IP Remote System (ADDTCPRSI)

Type choices, press Enter.

Internet address . . . . . . . . > '9.5.69.260'
Network address  . . . . . . . .   005652246167

                                                                 Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 60. Add an Entry to Translate the Internet Address to Network Address

3.9 TCP/IP Performance

The TCP/IP protocol and application codes always run in the *BASE pool on the AS/400 system. If the *BASE pool is not given enough storage, TCP/IP performance, especially SMTP performance, can be adversely affected.

Although it is possible to run in less than 4000 KB of storage, to perform well when running FTP and SMTP sessions, it is recommended that the *BASE pool is configured to use at least 4000 KB of storage. You can use the WRKSYSSTS command to view and change the pool sizes.

Optionally, the user may change the QTCP subsystem description in library QTCP to run in a user defined pool. Other performance sensitive objects may be changed also, such as the job descriptions and classes in the QTCP library. These alterations should only be performed by a system administrator who is knowledgeable on AS/400 work management concepts.

Chapter 4. Additional TELNET Considerations

This chapter contains information that must be taken into consideration when using TELNET. For a more complete discussion of TELNET use the *IBM AS/400 TCP/IP Guide (SC41-9875)* .

4.1 AS/400 TELNET Operating Modes

TELNET operates in five modes on the AS/400:

- 5250 full-screen Mode
- 3270 full-screen Mode
- VT220 full-screen Mode
- VT100 full-screen Mode
- ASCII line Mode

ASCII line mode is supported by the AS/400 TELNET server only. A user program is required to provide this support.

These operating modes are negotiated by the TELNET client and TELNET server applications. The functions available to the TELNET user during the TELNET session depends on the operating mode that is negotiated.

Each of the above modes is discussed in this section, first in the client context and then in the server context.

4.2 AS/400 TELNET Client

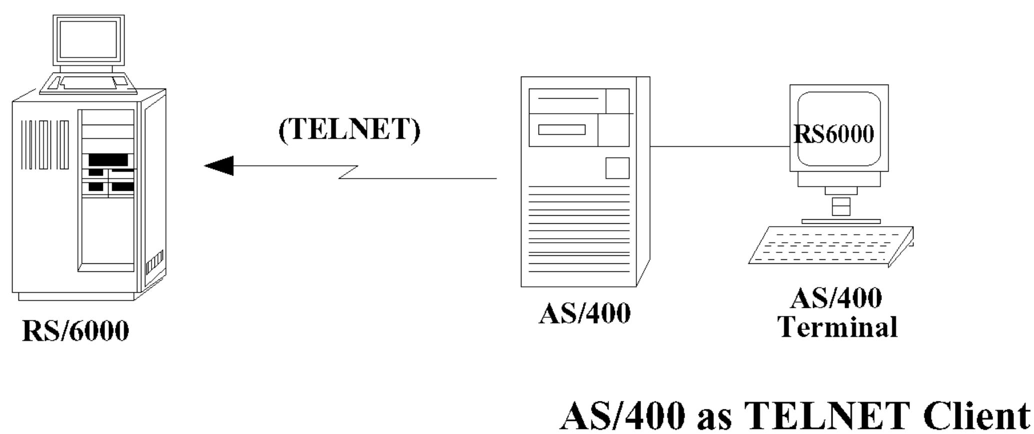

Figure 61. TELNET Client

AS/400 TELNET *Client* allows an AS/400 TCP/IP user to sign on to and run applications on a remote system that has a server TELNET application.

The AS/400 TELNET client support negotiates the transmission of data streams with the TELNET server application in the following modes and in the order shown:

- 5250 full-screen Mode (TN5250)

- 3270 full-screen Mode (TN3270)
- VT220 full-screen Mode
- VT100 full-screen Mode.

If the AS/400 TELNET client fails to negotiate one of the above modes, VT100 full-screen mode is used as a default.

The AS/400 TELNET client user has no control over this negotiation process. The attention key is used to determine which mode from the above list was negotiated - a different Send TELNET Control Function screen is presented for each.

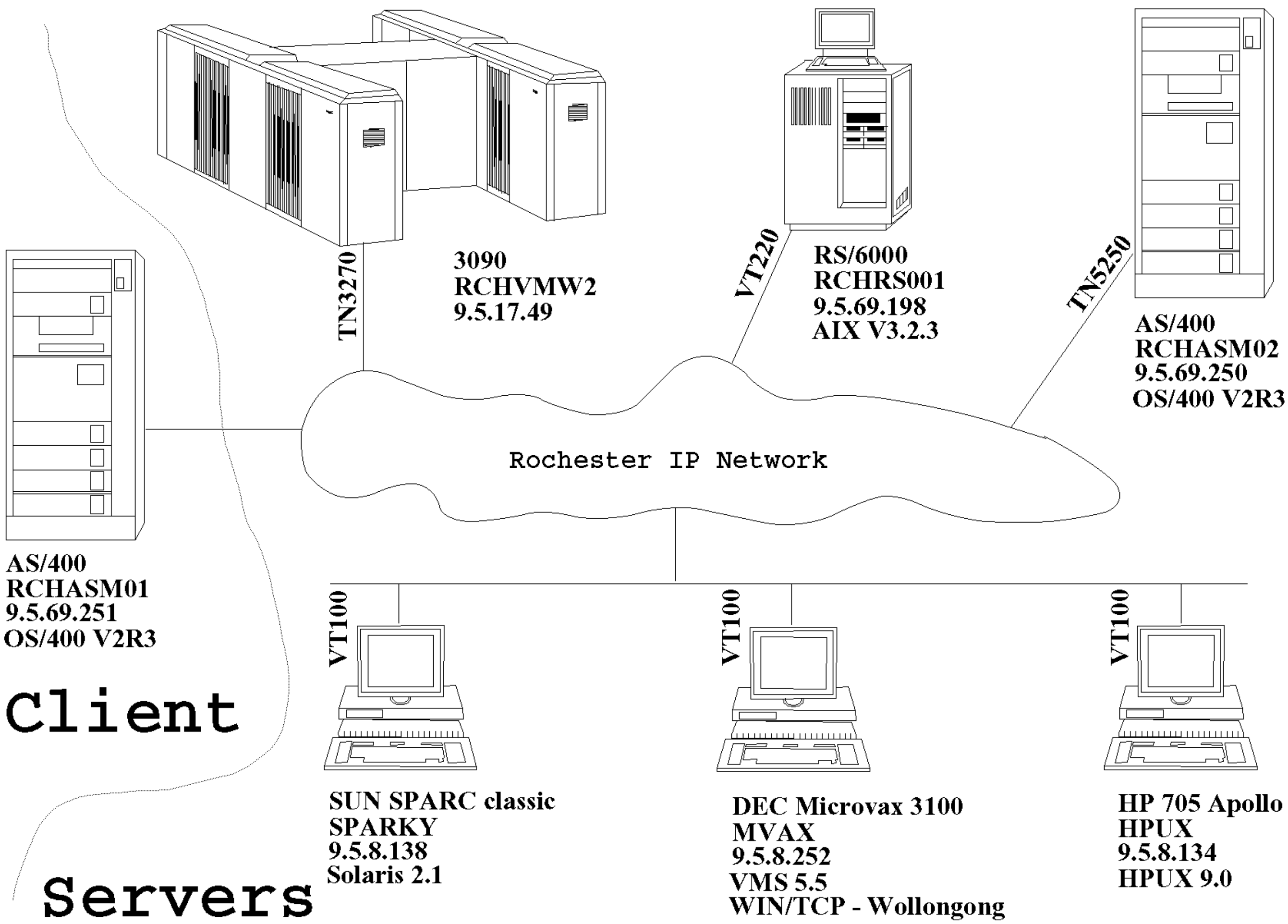

Figure 62. TELNET Client Network

A number of IBM and non-IBM TCP/IP systems were available to us during our residency. While these systems all provided TELNET server support, they did not provide the same level of support in each case. Hence when AS/400 client TELNET was used to access each of the systems, the TELNET mode negotiated in each case varied. The figure above shows the systems to which the AS/400 TELNET client was used, the mode negotiated in each case and the TCP/IP software involved.

4.2.1 Start TCP/IP TELNET Command

In all modes, TELNET is started either through a menu option (as described in section 2.3.1, “TELNET Client” on page 23 or through either the STRTCPTELN or TELNET command.

To display all the Start TCP/IP TELNET options, enter the command TELNET, press PF4 and PF10. The Start TCP/IP TELNET panel as shown in Figure 63 will be presented:

```
                         Start TCP/IP TELNET (TELNET)

 Type choices, press Enter.

 Remote system  . . . . . . . . . > rchrs001

                            Additional Parameters

 Control character key  . . . . .   &             Character value, &
 Keyboard language type . . . . .   *LCL          *LCL, AGB, AGI, BLI, CAB...
 Page Up (Roll Down) key  . . . .   *PA2          *PA2, *PA1, *PA3, *NONE...
 Page Down (Roll Up) key  . . . .   *PA1          *PA1, *PA2, *PA3, *NONE...
 Cursor Select key  . . . . . . .   *NONE         *NONE, *F1, *F2, *F3, *F4...
 Outgoing EBCDIC/ASCII table  . .   *CCSID        Name, *CCSID, *DFT
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
 Incoming ASCII/EBCDIC table  . .   *CCSID        Name, *CCSID, *DFT
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
                                                                      More...
```

```
 Outgoing 3270 mapping table  . .   *KBDTYPE      Name, *KBDTYPE
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
 Incoming 3270 mapping table  . .   *KBDTYPE      Name, *KBDTYPE
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
 Timeout wait for host  . . . . .   120           1-32767 seconds, *NOMAX
 Numeric lock keyboard  . . . . .   *NO           *NO, *YES
 Handle nulls . . . . . . . . . .   *BLANK        *BLANK, *REMOVE
 ASCII full screen draw out . . .   *DFT          Name, *DFT
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
 ASCII full screen draw in  . . .   *DFT          Name, *DFT
   Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
 ASCII full screen options  . . .   *NONE         *NONE, *ALL, *LOCALECHO...
               + for more values
 Display character attributes . .   *YES          *NO, *YES
 ASCII page scroll feature  . . .   *NO           *NO, *YES
 ASCII answerback feature . . . .   *NONE
                                                                      More...
```

```
 ASCII tab stops  . . . . . . . .   *DFT          0-133, *DFT, *NONE
               + for more values
 Coded character set identifier     *MULTINAT     *MULTINAT, *BRITISH...
 ASCII operating mode ID  . . . .   *VT220B7      *VT220B7, *VT220B8, *VT100...

                                                                       Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 63. Start TCP/IP TELNET

The options relevant to the different modes are discussed in the section following that mode. Figure 63 shows the defaults for each parameter, except for the Remote system which has been filled in.

4.2.2 5250 Full-Screen TELNET Client

5250 full-screen support (TN5250) can only be satisfactorily negotiated with a TELNET server application running on an AS/400 or a system that supports 5250 TELNET server. This support is similar to the AS/400 5250 display station pass-through between two AS/400 systems. A TELNET user at the client AS/400 will receive an AS/400 5250 sign on display from the server system and will be able to run applications on the remote system as though the display was locally attached.

TN5250 sends the datastream between the two systems as EBCDIC.

Automatic configuration of virtual controllers and devices must be enabled at the server AS/400, see section on 4.3.1, "5250 Full-Screen TELNET Server" on page 92.

4.2.2.1 Start TCP/IP TELNET Command

The TELNET command (see Figure 63 on page 73) prompts relevant to 5250 full-screen mode are as follows:

Note: Only the *remote system* name was used during our testing. The defaults were used for all other parameters. For example, to access AS/400 RCHASM02 from AS/400 RCHASM01, the command used at RCHASM01 was TELNET RCHASM02.

RMTSYS Remote system. The remote system name must be valid and the remote system must provide TELNET server support. The user can assign names to an internet address by using the Work with Host Table menu (an option on the Configure TCP/IP menu), or a remote name server can be used to map remote system names to internet addresses. If a remote name server is configured (also an option on the Configure TCP/IP menu) then this is searched before the host table. If *INTNETADR is specified, the INTNETADR parameter is prompted.

INTNETADR Internet address. Internet address of the remote system to which TELNET is started. The internet address is specified in the form nnn.nnn.nnn.nnn, where nnn is a decimal number ranging from 0 through 255. An internet address can be specified instead of the remote system name.

KBDTYPE Keyboard language type. The type of keyboard used on the display device. If the device you are starting TELNET from is remotely attached to the AS/400, this parameter is used to specify the type of keyboard being used.

INZWAIT Timeout wait for host. The amount of time in seconds that a local system waits for a connection to the remote system to be established. If a connection with the remote system does not occur within this time, the TELNET session is ended.

4.2.2.2 TELNET Control Functions

The AS/400 5250 full-screen TELNET client supports the following five functions that allow you to control terminal processing on the server system. You can select one of them from the Send TELNET Control Functions panel as shown in Figure 64.

```
                      Send TELNET Control Functions
                                                          System:   RCHASM01
 Select one of the following:

      1. Interrupt process - IP
      2. Query connection status - AYT
      3. Discard host output data - AO
      4. Clear the data path - SYNCH
      5. Attn key to remote host

     99. End TELNET session - QUIT


 Selection


 F3=Exit   F12=Cancel
```

Figure 64. TELNET Control Function Menu

To achieve this panel from an AS/400 system acting as TELNET client press the attention key (ATTN).

After the selection of any control function you will be returned to the interrupted TELNET session unless you have selected Option 99.

Option 1 - Interrupt process (IP): Allows you to interrupt, cancel or suspend a process that has started on the server. You can use IP, for example, when the process seems to be in an unending loop or an unwanted process was wrongly activated.

If the server is an AS/400 System, it maps this control function to the 5250 SYSREQ key.

Option 2 - Are you there (AYT): Provides the client some visible or audible evidence that the server system is still up and running.

If the server is an AS/400 System (5250 full-screen), AYT will cause a message to be sent to your workstation.

Option 3 - Abort Output (AO): Allows a process that is generating output to run to completion (or to reach the same stopping point it would reach if running to completion) but without sending the output to the user's terminal. This function typically clears any output already produced but not yet actually displayed on the user's terminal.

If the server is an AS/400 System (5250 full-screen), it maps this control function to the 5250 SYSREQ with option 2 (END REQUEST).

Option 4 - Clear Data Path (SYNCH): Discards all characters (except TELNET commands) between the client and server system. This control function counters the problem introduced when the network's flow control mechanisms cause other control functions (such as IP or AO) to be buffered.

Option 5 - Send AS/400 ATTN: This is an AS/400 specific option, NOT STANDARDIZED, so it is shown only when working in 5250 full-screen Mode.

Sends an attention (ATTN) key request to the remote AS/400 (TELNET Server). The function performed is application dependent.

Option 99 - End TELNET (QUIT): Allows the client to close the TCP/IP connection to the server and end the TELNET session. This control function is not passed on to the server, so you should sign off or end the application at the server system prior to ending the TELNET session. Otherwise this could leave the client user logged on to the server system because the TELNET protocol does not define an end to end session termination sequence as part of the default protocol.

If the server is an AS/400, when TELNET server receives a notification from the TCP/IP interface that the connection no longer exists, it calls a function that makes the AS/400 force the logoff of the terminal session.

4.2.2.3 System Request

If the TELNET connection is 5250 full-screen mode, the SYSREQ is sent to the server system. The display on the server system is suspended and the AS/400 System Request menu is displayed from the server system as shown in Figure 65.

```
                              System Request
                                                        System: RCHASM02
Select one of the following:

     1. Display sign on for alternative job
     2. End previous request
     3. Display current job
     4. Display messages
     5. Send a message
     6. Display system operator messages
      7. Display work station user


     10. Start system request at previous system
     11. Transfer to previous system

     13. Start system request at home system
     14. Transfer to home system
                                                                 More...
```

```
     90. Sign off
                                                                  Bottom
 Selection

 F3=Exit   F12=Cancel
```

Figure 65. System Request Menu on the Server System

Options 1 to 7 are the standard System Request menu options.

- Option 10, select this option to suspend the job at the current system and display the System Request menu at the previous system (the source or client system for the current system).
- Option 11, select this option to suspend the job at the current system and transfer back to the alternative interactive job on the previous system (the source or client system for the current system).
- Option 13, select this option to suspend the job at the current system and display the System Request menu at the home system (the first system on which you entered the pass-through command).
- Option 14, select this option to suspend the job at the current system and transfer back to the alternative interactive job on the home system (the first system on which you entered the pass-through command).
- Option 90 with End connection *YES will end the TELNET connection. End connection *NO/*YES is prompted for when option 90 is selected.

4.2.3 3270 Full-Screen TELNET Client

3270 full-screen support (TN3270) allows an AS/400 TELNET client user to sign on and run 3270 full-screen applications. 3270 full-screen support is negotiated with any TELNET server application that supports 3270 full-screen.

The TELNET user at the local (client) AS/400 receives a 3270 logon screen and is able to use full-screen applications on the 3270 host as though his display were locally attached. A 3270 TELNET server is available for both MVS and VM. Keyboard and display differences must be considered.

Either 5250 or 3270 devices attached to an AS/400 TELNET client can invoke 3270 full-screen mode. All terminal types negotiate to 3278-2 except remote attached 3277 which negotiates 3277-2 and remote attached 3279 which negotiates 3279-2.

TN3270 sends the datastream between the two systems as EBCDIC.

4.2.3.1 Start TCP/IP TELNET Command

The TELNET command (see Figure 63 on page 73) prompts relevant to 3270 full-screen mode are as follows:

Note: Only the *remote system* name was used during our testing. The defaults were used for all other parameters. For example, to access 3090 RCHVMW2 from AS/400 RCHASM01, the command used at RCHASM01 was TELNET RCHVMW2.

RMTSYS Remote system. The remote system name must be valid and the remote system must provide TELNET server support. The user can assign names to an internet address by using the Work with Host Table menu (an option on the Configure TCP/IP menu), or a remote name server can be used to map remote system names to internet addresses. If a remote name server is configured (also an option on the Configure TCP/IP menu) then this is searched before the host table. If *INTNETADR is specified, the INTNETADR parameter is prompted.

INTNETADR Internet address. Internet address of the remote system to which TELNET is started. The internet address is specified in the form nnn.nnn.nnn.nnn, where nnn is a decimal number ranging from 0 through 255. An internet address can be specified instead of the remote system name.

KBDTYPE Keyboard language type. The type of keyboard used on the display device. If the device you are starting TELNET from is remotely attached to the AS/400, this parameter is used to specify the type of keyboard being used. This parameter also determines which mapping table is used. If KBDTYPE(*TRNTBL) is specified, user-defined mapping tables are used. These mapping tables are specified on the Incoming 3270 mapping table prompt (TBL3270IN parameter) and the Outgoing 3270 mapping table prompt (TBL3270OUT parameter).

PAGEDOWN Page Down (Roll Up) key. The key to assign to the 5250 keyboard Page Down key when the 5250 display device is emulating a 3270 full-screen display device. As 3270 terminals have no Roll up key, this 5250 key can be used to emulate a 3270 key that is not available on 5250 keyboard, for example PA1, PA2, PA3.

PAGEUP Page Up (Roll Up) key. The key to assign to the 5250 keyboard Page Up key on a 5250 keyboard when the 5250 display device is emulating a 3270 full-screen display device. As 3270 terminals have no Roll down key, this 5250 key can be used to emulate a 3270 key that is not available on 5250 keyboard, for example PA1, PA2, PA3.

CSRSLT Cursor Select key. The key on the 5250 keyboard used to emulate a 3270 keyboard′s cursor select key.

TBL3270OUT Outgoing 3270 mapping table. The outgoing (user-defined) mapping table used to translate characters sent to the remote system when in 3270 full-screen mode. This parameter is valid only when *TRNTBL is specified for the Keyboard language type prompt (KBDTYPE parameter).

See *IBM AS/400 TCP/IP Guide (SC41-9875)* for details on how to create user-defined mapping tables.

TBL3270IN Incoming 3270 mapping table. The incoming (user-defined) mapping table used to translate characters sent from the remote system when in 3270 full-screen mode. This parameter is valid only when *TRNTBL is specified for the Keyboard language type prompt (KBDTYPE parameter).

See *IBM AS/400 TCP/IP Guide (SC41-9875)* for details on how to create user-defined mapping tables.

INZWAIT Timeout wait for host. The amount of time in seconds that a local system waits for a connection to the remote system to be established. If a connection with the remote system does not occur within this time, the TELNET session is ended.

NUMLCK Numeric lock keyboard. Specifies whether the numeric input fields allow only numeric data on the 5250 display device. This parameter specifies whether the numeric shift lock is set automatically on the 5250 display device which is used for numeric input fields received from the remote system.

NULLS Handle nulls. Specifies how the 3270 data stream nulls are handled before being sent to the remote system.

4.2.3.2 TELNET Control Functions

The AS/400 3270 full-screen TELNET client supports the following four functions that allow you to control terminal processing on the server system. You can select one of them from the Send TELNET Control Functions panel as shown in Figure 66.

```
                       Send TELNET Control Functions
                                                            System:   RCHASM01
Select one of the following:

     1. Interrupt process - IP
     2. Query connection status - AYT
     3. Discard host output data - AO
     4. Clear the data path - SYNCH


    99. End TELNET session - QUIT



Selection


F3=Exit   F12=Cancel
```

Figure 66. TELNET Control Function Menu

To achieve this panel from an AS/400 system acting as TELNET Client press the attention key (ATTN).

After the selection of any control function you will be returned to the interrupted TELNET session unless you have selected Option 99.

The individual functions are discussed in section 4.2.2.2, "TELNET Control Functions" on page 75.

4.2.3.3 Keyboard Mapping

As 5250 terminals and 3270 terminals are full-screen terminals that use different function keys, keyboard mapping is necessary for AS/400 client and server TELNET.

When using TELNET from an AS/400 5250 terminal, if 3270 full-screen mode is negotiated the functions of some 3270 keys are defined as parameters in the TELNET command (see 4.2.3.1, "Start TCP/IP TELNET Command" on page 77). Other keys are mapped automatically to certain keys depending on the keyboard type used. For the mapping of the automatically mapped functions and keys refer to the *IBM AS/400 3270 Device Emulation Guide (SC41-9602)*. This manual provides the detailed keyboard layouts and mapping for different terminal and keyboard types.

4.2.3.4 Character Mapping

By default, the mapping tables used are dependent on the keyboard language type. If a user-defined mapping tables are required, these can be built as shown in *IBM AS/400 TCP/IP Guide (SC41-9875)* and are selected via the TBL3270OUT and TBL3270IN prompts in the TELNET command (see 4.2.3.1, "Start TCP/IP TELNET Command" on page 77).

4.2.3.5 System Request

If the TELNET connection is 3270 full-screen mode, the SYSREQ is handled by the local (client) system and the standard AS/400 System Request menu is displayed.

4.2.4 VTxxx Full-Screen TELNET Client

TCP/IP Connectivity Utilities/400 (5738-TC1) was enhanced at V2R2 to provide a VT100 client and at V2R3 to provide a VT220 client.

There are operational differences between VTxxx and 5250 terminals that you should be aware of when using the AS/400 VTxxx TELNET client:

- 5250 is a block mode terminal. Data typed is accumulated in a buffer and only sent to the AS/400 when an AID (attention identifier) key is pressed. An AID key is a key that initiates a function, for example, Enter, Command Function key, Page Up, Page Down and Attn.

  Data is also written to a 5250 terminal in blocks.

- VTxxx is a character mode terminal. Data typed is sent to the host immediately a key is pressed.

  Data is also written to a VTxxx terminal one character at a time.

VTxxx sends the datastream between the two systems as ASCII.

A VTxxx terminal is an ASCII full-screen terminal manufactured by Digital Equipment Corporation (DEC). This does not mean, however, that the AS/400 can only connect to a DEC system. TELNET VT220 and VT100 are industry wide defacto standards that are used by many vendors in addition to DEC.

VT100 is limited to four function keys - PF1 through PF4. An example of a VT100 keyboard is shown below for reference:

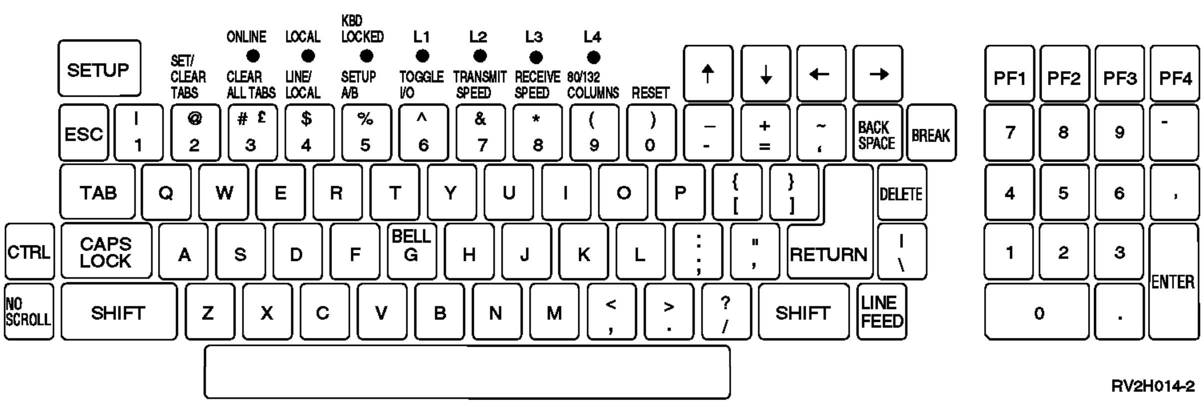

Figure 67. VT100 Keyboard

VT220 has function keys PF1 through PF4 and F6 through F20. An example of a VT220 keyboard is shown below for reference:

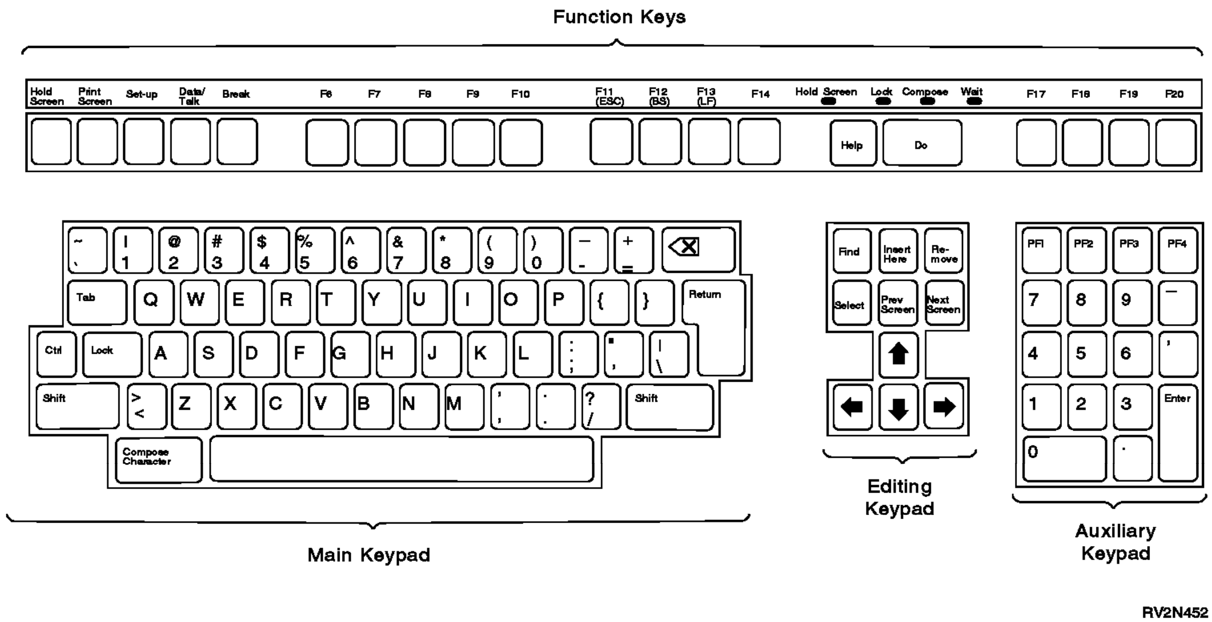

Figure 68. VT220 Keyboard

4.2.4.1 Start TCP/IP TELNET Command

The TELNET command (see Figure 63 on page 73) parameters relevant to VTxxx full-screen mode are as follows:

Note: Only the *remote system* name was used during our testing. The defaults were used for all other parameters. For example, to access RS/6000 RCHRS001 from AS/400 RCHASM01, the command used at RCHASM01 was TELNET RCHRS001.

RMTSYS Remote system. The remote system name must be valid and the remote system must provide TELNET server support. The user can assign names to an internet address by using the Work with Host Table menu (an option on the Configure TCP/IP menu), or a remote name server can be used to map remote system names to internet addresses. If a remote name server is configured (also an option on the Configure TCP/IP menu) then this is searched before the host table. If *INTNETADR is specified, the INTNETADR parameter is prompted.

INTNETADR Internet address. Internet address of the remote system to which TELNET is started. The internet address is specified in the form nnn.nnn.nnn.nnn, where nnn is a decimal number ranging from 0 through 255. An internet address can be specified instead of the remote system name.

CTLCHAR Control character key. The key that is used to represent the control (Ctrl) key on an ASCII keyboard. Since this key does exist on a 5250 keyboard, it must be emulated. When this character is used, TELNET interprets the next character as a control character to send to the remote system. For example, the characters ′&C′ indicate that ASCII control character C (′03′X) is sent (& is the default control character key). *SENDWOCR (Function key F11 by default) is used to send the control characters without a carriage return. The control key (Ctrl) is used to select functions on ASCII hosts.

TBLASCOUT Outgoing EBCDIC/ASCII table. The table object that is used to map all outgoing TELNET data when in VT220 or VT100 full-screen mode. All outgoing data is mapped from EBCDIC to ASCII. The control sequences for VT220 and VT100 are not mapped. The remote system controls whether the standard ASCII character set (as specified here) or the ASCII special characters and line drawing character set is in effect.

If a value other than *DFT or *CCSID is specified, then the user-defined mapping table object defined here overrides the mapping table defined in the CCSID parameter.

See section 4.2.4.4, "Character Mapping" on page 88 for an example of the use of this parameter for user-defined character sets.

See *IBM AS/400 TCP/IP Guide (SC41-9875)* for details on how to create user-defined mapping tables.

TBLASCIN Incoming ASCII/EBCDIC table. The table object that is used to map all incoming TELNET data when in VT220 or VT100 full-screen mode. All incoming data is mapped from ASCII to EBCDIC. VT220 and VT100 control sequences are not mapped. The remote system controls whether the standard ASCII character set (as specified here) or the ASCII special characters and line drawing character set is in effect.

If a value other than *DFT or *CCSID is specified, then the user-defined mapping table object defined here overrides the mapping table defined in the CCSID parameter.

See section 4.2.4.4, "Character Mapping" on page 88 for an example of the use of this parameter for user-defined character sets.

See *IBM AS/400 TCP/IP Guide (SC41-9875)* for details on how to create user-defined mapping tables.

INZWAIT Timeout wait for host. The amount of time in seconds that a local system waits for a connection to the remote system to be established. If a connection with the remote system does not occur within this time, the TELNET session is ended.

TBLVT1DRWO ASCII full screen draw out. The outgoing mapping table used to map outgoing TELNET data when in VT100 or VT220 full-screen mode. All outgoing data is mapped from EBCDIC to ASCII characters and the ASCII line drawing character set. The control sequences for VT220 and VT100 are not mapped. The remote system controls whether the standard ASCII character set (or national language character set) or the ASCII special characters and line drawing character set (as specified here) is in effect.

The default (*DFT) tables are built dynamically the first time TELNET is used to a remote system and are based on your national language. You can identify the table object (*TBL) using the Work with Objects command: WRKOBJ OBJ(QUSRSYS/Q*) OBJTYPE(*TBL). All of the system table objects are in QUSRSYS library. The table object is named QxxxA0MA5K where xxx is the

EBCDIC code page that you are using. The EBCDIC code page value is taken from the CCSID within message CPX8416.

TBLVT1DRWI ASCII full screen draw in. The incoming mapping table used to map incoming TELNET data when in VT100 or VT220 full-screen mode. All incoming data is mapped from ASCII to EBCDIC characters and the ASCII line drawing character set. The control sequences for VT220 and VT100 are not mapped. The remote system controls whether the standard ASCII character set (or national language character set) or the ASCII special characters and line drawing character set (as specified here) is in effect.

The default (*DFT) tables are built dynamically the first time TELNET is used to a remote system and are based on your national language. You can identify the table object (*TBL) using the Work with Objects command: WRKOBJ OBJ(QUSRSYS/Q*) OBJTYPE(*TBL). All of the system table objects are in QUSRSYS library. The table object is named object is named QA5K697xxx where xxx is the EBCDIC code page that you are using. The EBCDIC code page value is taken from the CCSID within message CPX8416.

VT1OPT ASCII full screen options. The VT220 and VT100 setup options. The possible values are:

- *NONE: None of the available VT220 or VT100 setup options are selected.
- *ALL: All of the available VT220 or VT100 setup options are selected.
- *LOCALECHO: The VT220 or VT100 local echo option is selected. This option allows you to specify whether the remote system or the local workstation displays the characters typed.
- *NEWLINE: The VT220 or VT100 new line option is selected. This option allows you to specify which characters are transmitted when you press the Enter key. When the NEWLINE option is off, the Enter key transmits a carriage return. When the NEWLINE option is on, the Enter key transmits a carriage return followed by a line feed.
- *AUTOWRAP: The VT220 or VT100 automatic wrap option is selected. This option allows you to specify where the next character appears when the cursor reaches the right margin. When the automatic wrap option is on and the cursor is in the last character position of a line, the next character received is put in the first position of the next line. When the automatic wrap option is off and the cursor is in the last character position of a line, the next character received replaces the character in the current position of the cursor.

DSPCHRATTR Display character attributes. Specifies whether character attributes are displayed. This parameter is not applicable when using a display that supports extended attributes (such as a 3477). Character attributes are displayed without data loss on these displays.

PAGESCROLL ASCII page scroll feature. Specifies whether page scrolling is used in this session. The possible values are:

- *NO: Page scrolling is not used. Data is displayed as fast as the system allows when received from the remote system.
- *YES: Page scrolling is used. Data is displayed one page at a time, and you must press the Page Down (Roll Up) key to move on to the next page of data.

ANSWERBACK ASCII answerback feature. The VT220 or VT100 answerback message. You can store an identifying message of up to 20 characters in length that is sent to the remote system when that system transmits an enquire (ENQ) character. You cannot specify any control characters here, like CR (carriage return).

TABSTOP ASCII tab stops. Specifies which columns are to contain tab stops. A maximum of 10 tab stops can be specified.

CCSID Coded character set identifier. The coded character set identifier identifies the ASCII character encoding to be initialized when in VT220 or VT100 full-screen mode. This parameter is used to tell the AS/400 the ASCII character set used by the remote system. The AS/400 does the EBCDIC/ASCII and ASCII/EBCDIC translation based on this parameter. The default (multinational) is the one most commonly used today. However, you should verify that the remote system is not using one of the older (NRC) character sets. The possible values are:

- *MULTINAT: The default, is the 8-bit DEC multinational translation table, which consists of the 7-bit compatible standard ASCII Graphics Set (US) and the 8-bit compatible DEC supplemental graphics set.
- *BRITISH
- *DUTCH
- *FINNISH
- *FRENCH
- *FRENCHCAN
- *GERMAN
- *ITALIAN
- *NORDAN
- *SPANISH
- *SWEDISH
- *SWISS

The above are NRC (national replacement character) sets. See section 4.2.4.4, "Character Mapping" on page 88 for more information and for an example of the use of this parameter.

If something other than *DFT or *CCSID is chosen for the TBLASCOUT or TBLASCIN parameter, then the mapping table specified in TBLASCOUT or TBLASCIN will be used instead of the mapping table defined in this parameter.

ASCOPRMOD ASCII operating mode ID. The mode the TELNET client session will be initialized in when VT220 full-screen mode is negotiated. The possible values are:

- *VT220B7: The default mode is VT220 7-bit, which transmits all escape sequences using standard VT220 7-bit ASCII communications and can receive and run standard 7-bit functions. An 8-bit communications environment is used with 7-bit controls. Provides the full range of VT220 capabilities. Uses standard ANSI functions. The DEC Multinational character set and the NRC character sets (depending on the character set selected) are supported in this mode.

- *VT220B8: VT220 8-bit mode transmits all escape sequences using 8-bit ASCII characters and can receive and run standard 8-bit functions. An 8-bit communications environment is used with 8-bit controls. Provides the full range of VT220 capabilities. Uses standard ANSI functions. The DEC Multinational character set and the NRC character sets (depending on the character set selected) are supported in this mode.
- *VT100: VT100 mode transmits all escape sequences using standard VT100 7-bit ASCII communications and can receive and run standard 7-bit functions. Uses standard ANSI functions. In this mode the keyboard is restricted to VT100 keys. Only ASCII, NRC or special graphics characters are generated.
- *VT52: VT52 mode transmits all escape sequences using standard VT52 7-bit ASCII communications. This mode uses DEC private functions (not ANSI). The keyboard is restricted to VT52 keys.

4.2.4.2 TELNET Control Functions

The AS/400 VTxxx full-screen TELNET client supports the following functions that allow you to control terminal processing on the server system. You can select one of them from the Send TELNET Control Functions panel as shown in Figure 69.

```
                     Send TELNET Control Functions
                                                      System:   RCHASM01
Select one of the following:

     1. Interrupt process - IP
     2. Query connection status - AYT
     3. Discard host output data - AO
     4. Clear the data path - SYNCH

      8.  Change VT220 (Primary) keyboard map
      9.  Change VT220 (Alternate) keyboard map

    99. End TELNET session - QUIT



Selection



F3=Exit   F12=Cancel
 Primary keyboard map active.  1
```

Figure 69. TELNET Control Function Menu

To achieve this panel from an AS/400 system acting as TELNET Client press the attention key (ATTN).

After the selection of any control function you will be returned to the interrupted TELNET session unless you have selected Option 99.

Functions 1 through 4 and 99 are discussed in section 4.2.2.2, "TELNET Control Functions" on page 75

Option 8 - Change VT220 (Primary) Keyboard Map: Displays the Change VT220 Primary Keyboard Map panel as shown in Figure 70.

```
                       Change VT220 Primary Keyboard Map

 Type changes, press Enter:

 5250 key                    VT220 function
   Function Key 1  . . . .   *PF1
   Function Key 2  . . . .   *PF2
   Function Key 3  . . . .   *PF3
   Function Key 4  . . . .   *PF4
   Function Key 5  . . . .   *ESC
   Function Key 6  . . . .   *HIDE
   Function Key 7  . . . .   *TAB
   Function Key 8  . . . .   *CTLA
   Function Key 9  . . . .   *CTLB
   Function Key 10 . . . .   *SHIFTDSP
   Function Key 11 . . . .   *SENDWOCR
   Function Key 12 . . . .   *CTLC
   Function Key 13 . . . .   *CSRUP
   Function Key 14 . . . .   *CSRDOWN
   Function Key 15 . . . .   *CSRRIGHT
   Function Key 16 . . . .   *CSRLEFT
                                                                          More...
  F3=Exit    F6=Save    F12=Cancel
 Primary keyboard map active.  1
```

```
                       Change VT220 Primary Keyboard Map

 Type changes, press Enter:

 5250 key                    VT220 function
   Function Key 17 . . . .   *CTLD
   Function Key 18 . . . .   *F6
   Function Key 19 . . . .   *F7
   Function Key 20 . . . .   *F8
   Function Key 21 . . . .   *F9
   Function Key 22 . . . .   *F10
   Function Key 23 . . . .   *F11
   Function Key 24 . . . .   *F12
   Rollup key  . . . . . .   *KEYPRI
   Rolldown key  . . . . .   *KEYALT

  F3=Exit    F6=Save    F12=Cancel
 Primary keyboard map active.  1
```

Figure 70. Change VT220 Keyboard Map

Option 9 - Change VT220 (Alternate) Keyboard Map: This option allows the VT220 alternate keyboard map to be change. A Change VT220 (Alternate) Keyboard Map panel is displayed which is similar to the above for the primary map.

If the VT100 mode was negotiated then options 6 and 7 would be given in place of options 8 and 9 above. Option 6 allows the VT100 primary keyboard map to be changed and option 7 allows the alternate VT100 alternate keyboard map to be changed. The change keyboard map panels are similar to those above for VT220.

The mapping of 5250 function keys to VTxxx function can be changed (and saved) through these panels. The keyboard map currently active is shown at the bottom of the screen. **1**

The use of primary and alternate keyboard maps is discussed in section 4.2.4.3, "Keyboard Mapping."

4.2.4.3 Keyboard Mapping

As 5250 terminals and VTxxx terminals use different function keys (see Figure 67 on page 80 and Figure 68 on page 81 for examples of VT220 and VT100 keyboard layouts) , keyboard mapping is necessary.

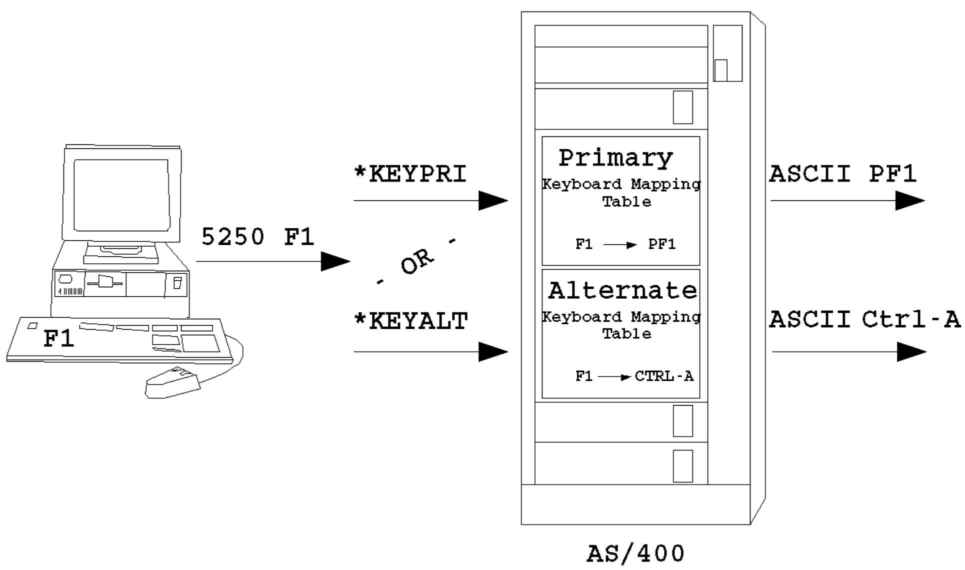

Figure 71. VTxxx TELNET Client Primary/Alternate Keyboard Mapping

The VTxxx TELNET client support allows two keyboards maps to be defined. The two keyboard maps are switched between the *KEYPRI and *KEYALT keys (Rollup key and Rolldown key by default). Having two keyboard maps allows the user to ′tailor′ each map to different application requirements. In the example above the primary keyboard map translates the 5250 Function key F1 to an ASCII function PF1 while the alternate keyboard map translates the same F1 to the ASCII Ctrl-A.

Both of the keyboard maps can be displayed and changed through Send TELNET Control Functions (see Figure 69 on page 85). When a keyboard map is changed and saved, it is saved against that user′s user profile. Thus, the next time that user initiates a TELNET session that selects the same VTxxx mode, the saved keyboard map will be used.

In addition to being able to generate ASCII control characters in the above manner through 5250 function keys, it is also possible to generate them through the Control Character key (CTLCHAR). When this key is pressed (& by default), the next character keyed is interpreted as a control character. *SENDWOCR (F11 by default) is used to send the control character without a carriage return. Thus, for example, the following would result in the ASCII Ctrl-C (x′03′) being sent:

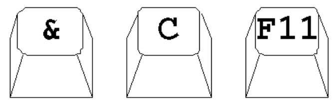

Figure 72. Sending an ASCII Control Character

4.2.4.4 Character Mapping

Mapping tables are required to map incoming ASCII data into EBCDIC and outgoing EBCDIC data into ASCII when operating in VTxxx full-screen mode. By default, the mapping tables used are the DEC multinational translation tables. Either an NLS mapping table or a user-defined mapping table can be used instead.

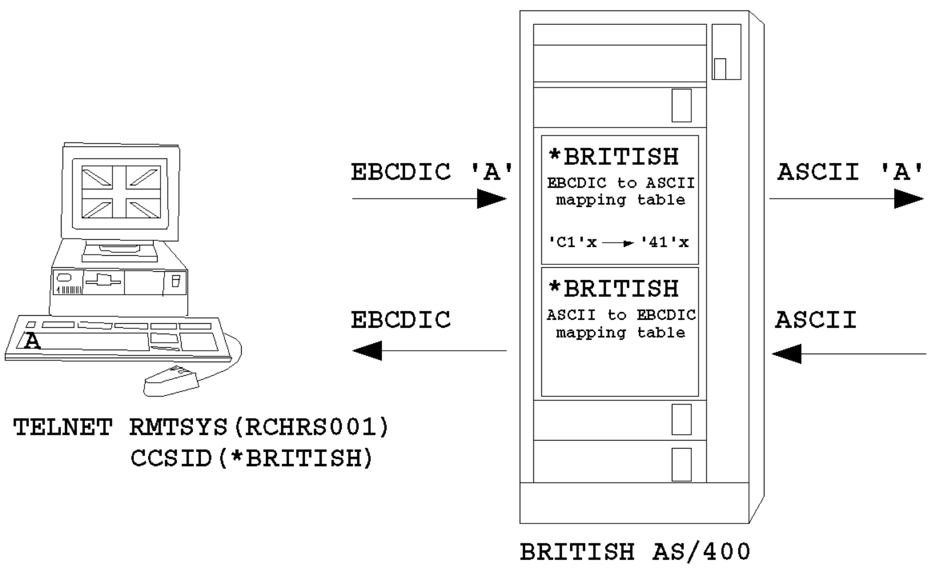

Figure 73. VTxxx TELNET Client Character Mapping - NLS

An NLS mapping table is selected through the CCSID prompt on the TELNET command (see 4.2.4.1, "Start TCP/IP TELNET Command" on page 81).

The NLS mapping tables are built dynamically the first time TELNET is used to a remote system and are based on DEC NRC (national replacement character) sets. Being 7-bit based they can only contain the unique characters from one country. The DEC multinational character set being 8-bit based has sufficient bits to allow the unique characters from a group of countries to be included.

You can identify the table objects (*TBL) using the Work with Objects command: WRKOBJ OBJ(QUSRSYS/Q*) OBJTYPE(*TBL). All of the system table objects are in QUSRSYS library.

The table objects are named Qxxxyyyzzz where xxx is the FROM code page, yyy is the TO character set and zzz is the TO code page.

For the outgoing (EBCDIC to ASCII) table:

- The FROM code page id is taken from the code page id in QCHRID of message description CPX8416 (use WRKMSGD CPX8416 to display), 037 in the example below from a US English based system.
- The TO character set and code page are derived from the CCSID parameter used with the TELNET command. See Table 3 for the ids used.

For the incoming (ASCII to EBCDIC) table:

- The FROM code page id is derived from the CCSID parameter used with the TELNET command. See Table 3 for the ids used.
- The TO character set and code page are taken from the the character set id and code page id in QCHRID of message description CPX8416 (use WRKMSGD CPX8416 to display), 697 and 037 in the example below from a US English based system.
- The FROM code page id is derived from the CCSID parameter used with the TELNET command. See Table 3 for the ids used.

```
                                                              System:   RCHASM01
 Message ID . . . . . . . . . :   CPX8416
 Message file . . . . . . . . :   QCPFMSG
   Library  . . . . . . . . . :     QSYS

 Message . . . . :
 QCHRID     697 37                QCURSYM    $ QDATFMT    MDY QDATSEP    /
   QDECFMT      QLEAPADJ   0 QCCSID     37    QTIMSEP    : QLANGID    ENU
   QCNTRYID   US QIGCCDEFNT *NONE
```

Figure 74. Example CPX8416 Message

Table 3. ASCII/EBCDIC Translation Table Naming

CCSID	Character Set		Code Page	
	Actual ID	**Table ID**	**Actual ID**	**Table ID**
MULTINAT	1290	A05	1100	A5U
BRITISH	1291	A06	1101	A5V
DUTCH	1292	A07	1102	A5W
FINNISH	1293	A08	1103	A5X
FRENCH	289	289	1104	A5Y
FRENCHCAN	1192	A8E	1020	A3M
GERMAN	265	265	1011	A3D
ITALIAN	293	293	1012	A3E
NORDAN	1297	BAB	1107	A52
SPANISH	1195	A8H	1023	A3P
SWEDISH	1296	BAA	1106	A51
SWISS	1193	A8F	1021	A3N

For example, on a British system with a QCHRID of 697 285 (character set 697 code page 285) in message CPX8416 and using TELNET with CCSID(*BRITISH) , the tables would have the following names: outgoing (EBCDIC to ASCII) Q285A06A5V, incoming (ASCII to EBCDIC) QA5V697285.

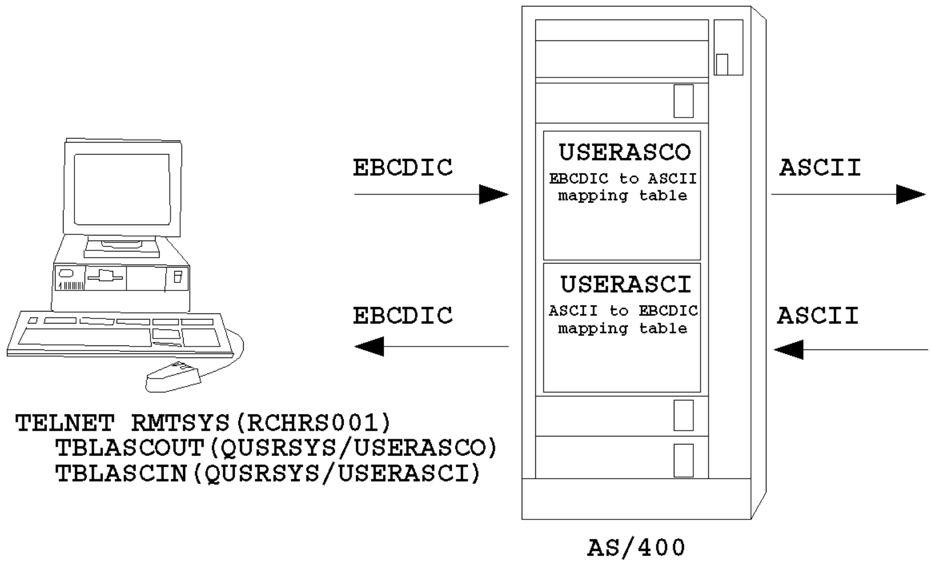

Figure 75. VTxxx TELNET Client Character Mapping (User-Defined)

Where the multinational or NLS mapping tables do not meet a user's requirements, user-defined character mapping tables can be created and used. These mapping tables are specified through the TBLASCOUT and TBLASCIN parameters (see 4.2.4.1, "Start TCP/IP TELNET Command" on page 81).

See *IBM AS/400 TCP/IP Guide (SC41-9875)* for details on how to create user-defined mapping tables.

4.2.4.5 System Request

If the TELNET connection is VTxxx full-screen mode, the SYSREQ is handled by the local (client) system and the standard AS/400 System Request Menu is displayed.

4.3 AS/400 TELNET Server

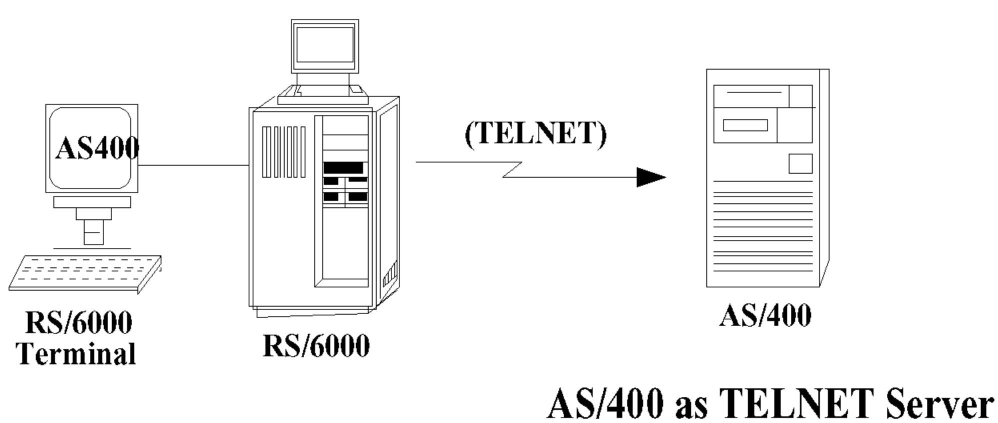

Figure 76. TELNET Server

AS/400 *Server* TELNET allows a TCP/IP user on a remote TELNET client system to sign on to and run applications on the AS/400 system.

The AS/400 TELNET server support negotiates the transmission of data streams with the TELNET server application in the following modes and in the order shown:

- 5250 full-screen Mode (TN5250)
- 3270 full-screen Mode (TN3270)
- VT220 full-screen Mode
- VT100 full-screen Mode
- ASCII line Mode

3270 DBCS is supported where a client negotiates a 3278-2-E terminal type.

Some TELNET clients are able to override this negotiation process. For example, from an RS/6000:

```
telnet> emulate vt100
Now emulating a vt100 terminal
telnet> open rchasm01
```

The DFTNVTTYPE (default network virtual terminal type) parameter specifies the mode to be used when the TELNET server is not able to negotiate one of the supported terminal types. The CHGTCPA command is used to set this parameter.

An incoming TELNET session will connect to a virtual device, the mode from the above list that was negotiated can be determined by looking at the type of virtual device created (WRKDEVD QPADEV*). The virtual device naming convention is QPADEVnnnn. For both VT220 and VT100 the virtual device type created will be V100.

For ASCII line mode a customer application program is required at the AS/400 server to acquire a network virtual terminal (NVT) workstation device. If ASCII line mode is negotiated, the AS/400 will not automatically send a sign-on display to the client system. For an example of a server application program on the AS/400 please see *IBM AS/400 TCP/IP Guide (SC41-9875)* .

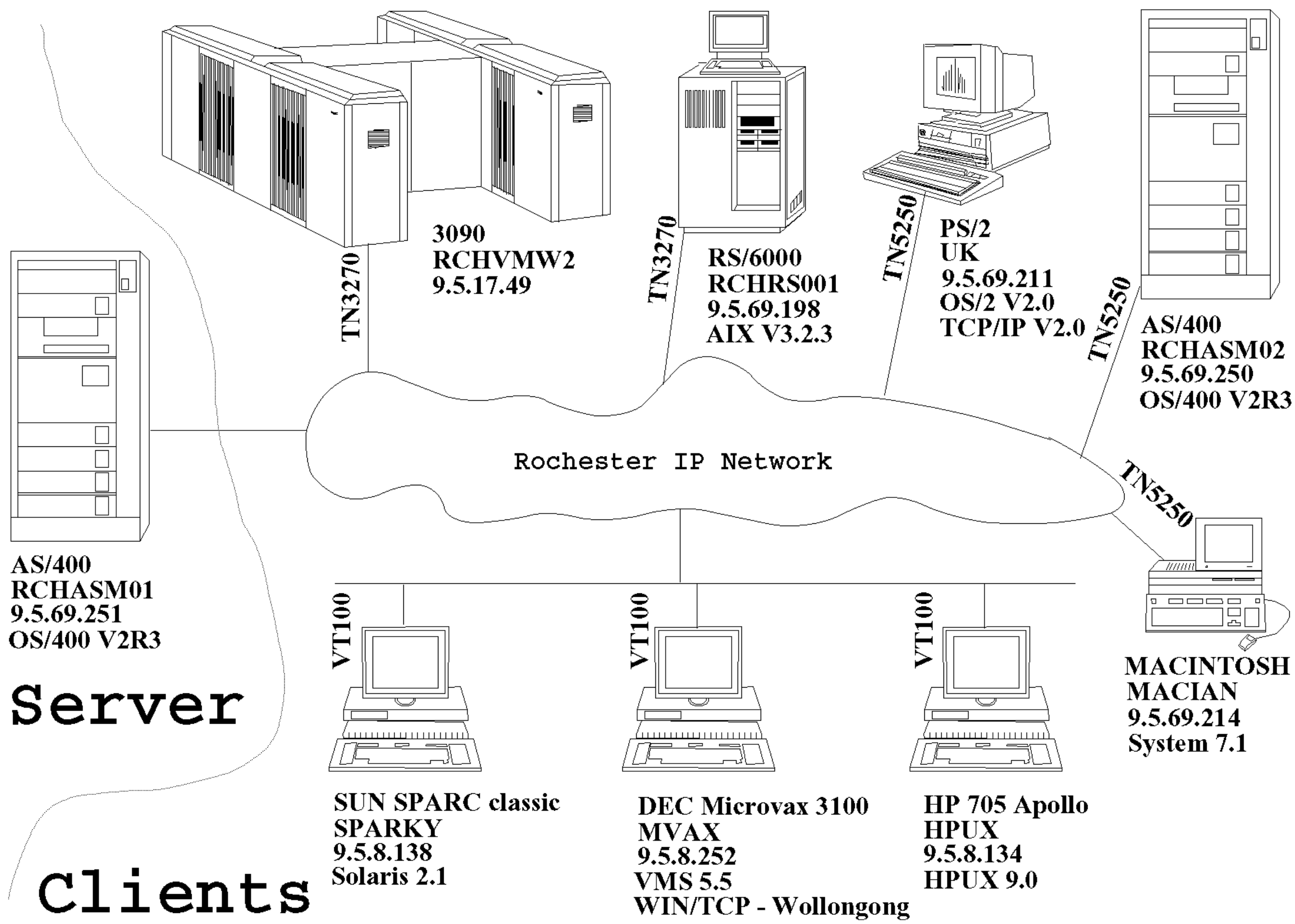

Figure 77. VTxxx TELNET Server Network

A number of IBM and non-IBM TCP/IP systems were available to us during our residency. While these systems all provided TELNET client support, they did not provide the same level of support in each case. Hence when TELNET was used from each of these systems to access the AS/400, the TELNET mode negotiated in each case varied. The figure above shows the systems from which the AS/400 TELNET server was accessed, the mode negotiated in each case and the TCP/IP software involved.

Note: The Connection Program/400 was not installed on the RS/6000. Had it been installed, the mode negotiated would have been 5250 full-screen support.

4.3.1 5250 Full-Screen TELNET Server

5250 full-screen support (TN5250) can only be satisfactorily negotiated with a TELNET client application running on an AS/400 or a system that supports 5250 TELNET client. Virtual controllers and devices are required on the server system to direct output on the client system. AS/400 TELNET server must be allowed to automatically configure virtual controllers and 5250 devices. The system value, QAUTOVRT at the TELNET server system, must be changed to allow for the maximum number of users that may be signed on using automatically configured devices at any one time.

TN5250 delivers the datastream between the two systems as EBCDIC.

The following 5250 full-screen TELNET clients, were available to us during our residency:

- AS/400
- OS/2
- Apple Macintosh

Although not available to us during our residency, the Connection Program/400 does, of course, provide a TN5250 client for the RS/6000 as well as certain Sun and HP** UNIX workstations.

TN5250 is the preferred protocol for a client system accessing AS/400 applications. In addition to the 5250 full-screen clients mentioned above, many other vendor products exist. Check the client vendor or third parties known to provide TN5250 clients (such as OpenConnect) for the availability of a TN5250 client.

When the client system requests TELNET support to automatically configure a device, the server system examines each of the virtual devices on the virtual controller named QPACTLxx. If a device is available, the client system application configures that device to match the client physical device. If the TELNET server application cannot find an available virtual device, it checks the QAUTOVRT system value. If creating another device makes the number of devices attached to QPACTLxx greater than the QAUTOVRT system value, another device is not created and the TELNET session ends. If creating another device keeps the number of devices less than or equal to the QAUTOVRT value, a device is created.

The QAUTOVRT system value controls the number of automatically configured virtual devices for both TELNET and pass-through.

The number of sign-on attempts increases if devices are automatically configured. The number of sign-on attempts in this case is equal to the number of system sign-on attempts allowed (system value QMAXSIGN) multiplied by the number of virtual devices that can be created.

4.3.1.1 OS/2 5250 Full-Screen TELNET Client

IBM TCP/IP Version 2.0 for OS/2 provides a 5250 full-screen TELNET client (TN5250). TN5250 can be started either by clicking on the TN5250 icon or from an OS/2 command line. For example:

```
[C:\]tn5250 rchasm01
```

The session is ended by selecting *Exit* from the menu bar.

Keyboard Mapping: The default keyboard map is changed by creating a file named TN5250.KEY using a text editor. For example, the following would map the PS/2 Enter key (Enter key on numeric keypad) to the AS/400 Enter key function:

```
enter enter
```

TN5250.KEY is searched for (and used if found) when TN5250 is invoked. OS/2 looks for this file first in the current directory and then in the ETC directory. There is a list of valid PS/2 keys and AS/400 functions plus a listing of the default keyboard map in the *IBM TCP/IP Version 2.0 for OS/2 Users Guide.*

Character Mapping: The PS/2 is an ASCII based device. 5250 TELNET data streams are in EBCDIC format. The PS/2 must therefore translate all incoming data from EBCDIC to ASCII and all outgoing data from ASCII to EBCDIC. A default mapping table is provided to do this. User-defined mapping tables can also be created, a sample table (5250XLT.SAM) is provided in the ETC directory. The table includes both ASCII to EBCDIC and EBCDIC to ASCII translation. The table is located in the ETC directory. A user-defined mapping table is selected using the *-tx* option when starting a session, for example:

```
[C:\]tn5250 rchasm01 -tx 5250xlt.sam
```

4.3.1.2 Apple Macintosh 5250 Full-Screen TELNET Client

Apple SNA.ps** 5250 provides 5250 connectivity for Apple Macintosh computers and is a result of the alliance between Apple an IBM. Version 1.2 (available March 1994) will add support for AppleTalk and TCP/IP - the current support is SNA/APPC only. The TCP/IP support is used in conjunction with TCP/IP Connection for Macintosh (M8113Z) and provides a TN5250 client which allows Apple Macintosh computers to connect directly (the gateway support is SNA/APPC only) to an AS/400. Token-ring and Ethernet are supported. LocalTalk/Ethernet gateways are available from third parties.

Once installed, the Mac TCP/IP support is configured through three panels in two steps:

1. The first two panels are selected through the MacTCP control panel icon. Having selected the type of network adapter to be used (token-ring or Ethernet) from the first panel, click on *more* for the second panel. The following is configured via this second panel:

   - The gateway internet address
   - Your domain name.
   - The name server internet address
   - Your internet address

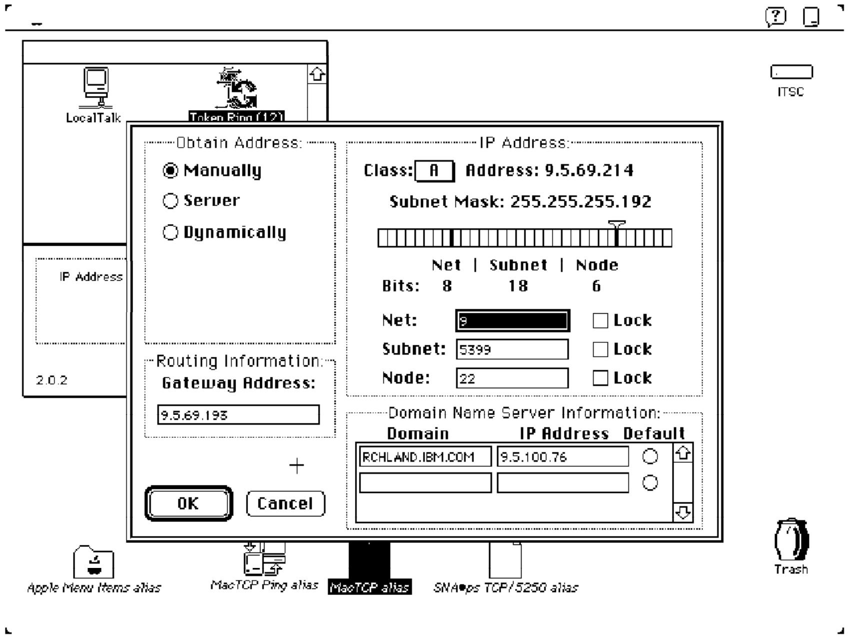

Figure 78. Apple Macintosh TCP/IP Configuration Panel

The internet address of the gateway in our network example was 9.5.69.193, this was entered in the *Gateway Address* field under Routing Information. Our domain name of RCHLAND.IBM.COM was entered in the *Domain* field under *Domain Name Server Information*. The name server internet address (9.5.100.76 in our network example) was entered in the *IP Address* field, also under *Domain Name Server Information*.

The *IP Address* section is used to enter your own internet address. Enter your network class (A in our network example). The slider will now move to show the bits allocated to the network ID (Net), 8-bits in our class A network example (see 3.6.3, "Network Classes" on page 63). The slider bar must now be moved to correctly divide the remaining section into Subnetwork ID (Subnet) and Host ID (Node). The subnet mask in our network example was 255.255.255.192. This equates to 18-bits allocated to the Subnet and 6-bits allocated to the Node as shown. See section 3.6.5, "Subnetworks" on page 64 for information on subadressing.

Now enter your local internet address through the network ID (Net) Subnetwork ID (Subnet) and Host ID (Node) fields. The information is entered in these fields in decimal. In our example the local IP address in the more normal dotted decimal format was 9.5.69.214. This information was entered as follows: 9 in the *Net* field, 5399 in the *Subnet* field and 22 in the *Node* field. The example below shows how these numbers are derived from the dotted decimal IP address once the internet address has been divided into Net, Subnet and Node:

```
      9         |         5         |       69         |     214

0 0 0 0 1 0 0 1   0 0 0 0 0 1 0 1   0 1 0 0 0 1 0 1   1 1 0 1 0 1 1 0

 Net (class A)  |        Subnet (255.255.192)              |    Node
                |                                          |
<----8-bits---->|<---------------18-bits------------------>|<-6-bits-->
                |                                          |
      9         |                 5399                     |     22
```

Note

> If you are unsure of the value to put here, enter what you think it should be and click on OK, the IP address entered will then be displayed in the more normal dotted decimal format. Selecting *more* again from this panel will allow you to go back and correct your IP address!

Once the internet address has been entered, click on OK and you will be returned to the first panel where your IP address will be shown in dotted decimal format.

Having completed the above, close the MacTCP control panel and restart the Mac.

2. The Mac host table information is configured through the third panel. Select the SNA.ps TCP/5250 option from the Apple Menu control panels option. Add host names and addresses as required. Click on ADD to add a name entered to the table.

To start a TN5250 session:

- Select TCP/IP with SNA.ps 5250 from the SNA.ps folder.
- Select *Session* then *Connection* from the menu bar.
- Select a *Connection Type* of 5250 Access/TCP.
- Select the required host name from the list of configured *Hosts*.
- Click on *tn5250* on the right side of the screen.
- Click on *Connect*.
- You should then be presented with an AS/400 signon screen.

Figure 79 on page 97 shows an AS/400 screen once the user has signed on. The figure also shows the keypad from which functions are selected using the mouse.

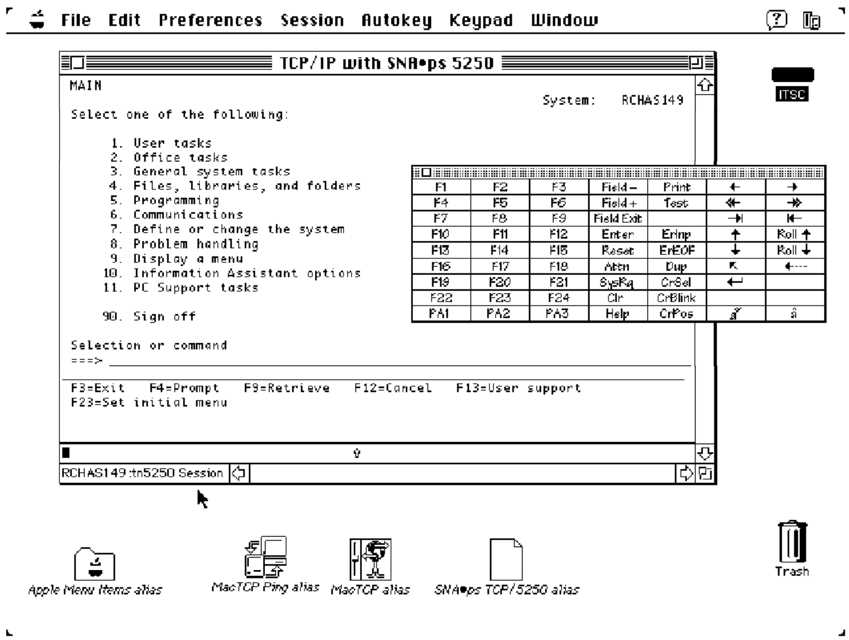

Figure 79. Apple Macintosh 5250 Signon Screen

Select *Session* then *Disconnect* from the menu bar to end the session.

Keyboard Mapping: A function key can be selected either through the mouse or through the keyboard. To select a function key using the mouse use the *Keypad* option from the menu bar. A default keypad is provided (Standard Keypad), others can be created as required that might include Autokeys for example. To display the current keyboard map, select *Preferences* then *Keyboard Map* from the menu bar. The keyboard map can also be changed from the panel presented using a ′drag and drop′ process.

Character Mapping: The Apple Macintosh is an ASCII based device. Since the TN5250 datastream is EBCDIC based, the Mac must do ASCII/EBCDIC character translation. The translation table used is changed by selecting an appropriate host language. To do this, select *Session* then *Host Language* from the menu bar. A list of the languages that are supported is presented from which a language is selected.

For more detailed information about configuring an Apple Macintosh to connect to the AS/400 through both TCP/IP and SNA, please see *Using Apple Macintosh with AS/400 (GG24-4071)*.

4.3.2 3270 Full-Screen TELNET Server

3270 full-screen support (TN3270) allows the IBM S/370 and S/390 family systems and non-AS/400 systems 3270 TELNET client users to sign on and run AS/400 5250 full-screen applications as though they were locally attached to the AS/400. Automatic configuration of controllers and devices can be allowed and has the same considerations that apply to 5250 full-screen TELNET support, see section 4.3.1, “5250 Full-Screen TELNET Server” on page 92. Keyboard mapping occurs similar to that employed with 3270 SNA Primary LU Support (SPLS).

TN3270 delivers the datastream between the two systems as EBCDIC.

4.3.2.1 Keyboard Mapping

When using TELNET from a 3270 workstation to an AS/400 server some of the 3270 full-screen TELNET client applications provide their own keyboard mapping, others don′t. For those that do not, AS/400 provides a default keyboard mapping for 3270 terminals. The user can view the default mapping using the DSPKBDMAP command after using TELNET to the AS/400:

```
                     Help for 3270 Keyboard Mapping

 3270 Key                                3270 Key
 Sequence   Function                     Sequence   Function
   PF1      5250 help text                 PF13     F13
   PF2      3270 help text                 PF14     F14
   PF3      Clear display                  PF15     F15
   PF4      Print display                  PF16     F16
   PF5      Display attributes             PF17     F17
   PF6      Test request                   PF18     F18
   PF7      Page up (Roll down)            PF19     F19
   PF8      Page down (Roll up)            PF20     F20
   PF9      Attention                      PF21     F21
   PF10     Error reset                    PF22     F22
   PF11     System request                 PF23     F23
   PF12     Record backspace               PF24     F24

                                                                More...
```

```
 3270 Key                                3270 Key
 Sequence   Function                     Sequence   Function
 PA1 PF1    F1                           PA2 PF1    F13
 PA1 PF2    F2                           PA2 PF2    F14
 PA1 PF3    F3                           PA2 PF3    F15
 PA1 PF4    F4                           PA2 PF4    F16
 PA1 PF5    F5                           PA2 PF5    F17
 PA1 PF6    F6                           PA2 PF6    F18
 PA1 PF7    F7                           PA2 PF7    F19
 PA1 PF8    F8                           PA2 PF8    F20
 PA1 PF9    F9                           PA2 PF9    F21
 PA1 PF10   F10                          PA2 PF10   F22
 PA1 PF11   F11                          PA2 PF11   F23
 PA1 PF12   F12                          PA2 PF12   F24
                                                                More...
```

```
        Function             3270 Key Sequence       5250 Key Sequence
   Erase all input fields      Not supported            Erase Input
   Field plus                  Not supported            Field+
   Field minus                 Not supported            Field-
   Erase end-of-field and      Erase EOF,-->|           Field Exit
      exit field

         To use the attention function (ATTN), do one of the following:
         - Press Test Request, then press PA1 if using a 3277 display
           attached to an SNA 3274 controller.
         - Press ATTN if using a 3278 or 3279 display attached
           to an SNA 3274 controller.
         - Press the 3270 Key Sequence set by the user if
           using a Distributed Host Command Facility device, network routing
           facility, or SNA Primary LU2 Support device.

 Press Enter to continue.
                                                                 Bottom
F3=Exit     F12=Previous
```

Figure 80. Default Keyboard Mapping

The panels above show the default settings. To change the default keyboard mapping while in a TELNET connection enter the SETKBDMAP command. The user can then redefine the keyboard mapping. As the changed keyboard mapping is only valid for this TELNET session, it is recommended you create a command or CL program that changes the keyboard mapping and can be called at the beginning of a TELNET session. Please see *IBM AS/400 TCP/IP Guide (SC41-9875)* for an example CL program. We suggest having this simple CL program executed as part of your Initial program to call in your AS/400 User Profile. In this case the program will be run and the keyboard re-mapped each time the user signs onto the AS/400.

Note: When using TELNET 3270 full-screen mode from the 3270 terminal and before the default mapping for the terminal is changed, the keys PF1 to PF12 might be emulated by the key sequence ′PA1 PFx′. So prior to creating a new keyboard map, as in the above example, instructions like ′press PF3′ or ′press PF4′ should read: ′press PA1 PF3′ and ′press PA1 PF4′. In this case, depending on the host′s TELNET client installation (VM TELNET client for example), when pressing PA1 the user might get the instruction: ′TELNET command:′ at the bottom line of the display. If this instruction is displayed, then type: PA1, press the Enter key, move the cursor to the command line and press the desired PF key. So in this case PF1 to PF12 might be emulated by:

1. Press PA1, get the TELNET instruction: ′TELNET command:′
2. Type PA1, press the Enter key.
3. Move the cursor to the command line.
4. Press the desired PF key.

4.3.3 VTxxx Full-Screen TELNET Server

TCP/IP Connectivity Utilities/400 (5738-TC1) was enhanced at V2R2 to provide a VT100 client and at V2R3 to provide a VT220 client.

VTxxx sends the datastream between the two systems as ASCII.

A VTxxx terminal is an ASCII full-screen terminal manufactured by Digital Equipment Corporation (DEC). This does not mean, however, that the AS/400 can only connect to a DEC system. TELNET VT220 and VT100 are industry wide defacto standards that are used by many vendors in addition to DEC.

Automatic configuration of controllers and devices can be allowed and has the same considerations that apply to 5250 full-screen TELNET support, see section 4.3.1, “5250 Full-Screen TELNET Server” on page 92.

4.3.3.1 Keyboard Mapping

As VTxxx terminals and 5250 terminals use different function keys (see Figure 67 on page 80 and Figure 68 on page 81 for examples of VT220 and VT100 keyboard layouts) , keyboard mapping is necessary. The user can view the default mapping using the DSPVTMAP command after using TELNET to the AS/400:

```
                           Display VT Keyboard Map

5250 Function              VT Key(s)
  5250 Attention . . . :   *CTLA      *ESCA
  5250 Help  . . . . . :   *CTLQST    *ESCH
  Page Down (Roll Up)  :   *CTLD      *CTLF      *NXTSCR
  Page Up (Roll Down)  :   *CTLB      *CTLU      *PRVSCR
  System Request . . . :   *CTLC      *ESCS
  Insert . . . . . . . :   *ESCI      *ESCDLT    *INS
  Delete . . . . . . . :   *DLT       *RMV
  Enter  . . . . . . . :   *RETURN
  Backspace  . . . . . :   *BACKSPC
  Duplicate  . . . . . :   *ESCD
  Erase Input  . . . . :   *CTLE
  Error Reset  . . . . :   *CTLR      *ESCR
  Field Exit . . . . . :   *CTLK      *CTLX      *ESCX
  Field Minus  . . . . :   *ESCM
  Home . . . . . . . . :   *CTLO
  New Line . . . . . . :   *ESCLF
                                                                         More...
```

```

5250 Function              VT Key(s)
  Print  . . . . . . . :   *CTLP      *ESCP
  Field Advance  . . . :   *TAB
  Field Backspace  . . :   *ESCTAB
  Cursor Up  . . . . . :   *CSRUP
  Cursor Down  . . . . :   *CSRDOWN
  Cursor Left  . . . . :   *CSRLEFT
  Cursor Right . . . . :   *CSRRIGHT
  Clear Screen . . . . :   *ESCC
  Test Request . . . . :   *CTLT
  Toggle Indicator
    Lights . . . . . . :   *ESCT
  Redraw Screen  . . . :   *CTLL      *ESCL
  F1 . . . . . . . . . :   *ESC1      *PF1       *F1
  F2 . . . . . . . . . :   *ESC2      *PF2       *F2
  F3 . . . . . . . . . :   *ESC3      *PF3       *F3
  F4 . . . . . . . . . :   *ESC4      *PF4       *F4
                                                                         More...
Press Enter to continue.

F1=Help   F3=Exit   F12=Cancel
```

Figure 81. Display VTxxx Keyboard Map

```
                           Display VT Keyboard Map

5250 Function              VT Key(s)
  F5 . . . . . . . . . :   *ESC5      *F5
  F6 . . . . . . . . . :   *ESC6      *F6
  F7 . . . . . . . . . :   *ESC7      *F7
  F8 . . . . . . . . . :   *ESC8      *F8
  F9 . . . . . . . . . :   *ESC9      *F9
  F10  . . . . . . . . :   *ESC0      *F10
  F11  . . . . . . . . :   *ESCMINUS  *F11
  F12  . . . . . . . . :   *ESCEQ     *F12
  F13  . . . . . . . . :   *ESCEXCL   *F13
  F14  . . . . . . . . :   *ESCAT     *F14
  F15  . . . . . . . . :   *ESCPOUND  *F15
  F16  . . . . . . . . :   *ESCDOLLAR *F16
  F17  . . . . . . . . :   *ESCPCT    *F17
  F18  . . . . . . . . :   *ESCCFX    *F18
  F19  . . . . . . . . :   *ESCAMP    *F19
  F20  . . . . . . . . :   *ESCAST    *F20
                                                                    More...
```

```
5250 Function              VT Key(s)
  F21  . . . . . . . . :   *ESCLPAR
  F22  . . . . . . . . :   *ESCRPAR
  F23  . . . . . . . . :   *ESCUS
  F24  . . . . . . . . :   *ESCPLUS
                                                                     Bottom
Press Enter to continue.

F1=Help   F3=Exit   F12=Cancel
```

Figure 82. Display VTxxx Keyboard Map (continued)

The above shows the default keyboard mapping. A user can change this mapping using the SETVTMAP command. See Figure 83 on page 103.

```
                     Set VT Keyboard Map (SETVTMAP)

Type choices, press Enter.

5250 Attention . . . . . . . . .   *CTLA         *CTLA, *CTLB, *CTLC...
              + for more values    *ESCA
5250 Help  . . . . . . . . . . .   *CTLQST       *CTLA, *CTLB, *CTLC...
              + for more values    *ESCH
Page Down (Roll Up)  . . . . . .   *CTLD         *CTLA, *CTLB, *CTLC...
                                   *CTLF
              + for more values    *NXTSCR
Page Up (Roll Down)  . . . . . .   *CTLB         *CTLA, *CTLB, *CTLC...
                                   *CTLU
              + for more values    *PRVSCR
System Request . . . . . . . . .   *ESCS         *CTLA, *CTLB, *CTLC...
              + for more values    *CTLC
Insert . . . . . . . . . . . . .   *ESCI         *CTLA, *CTLB, *CTLC...
                                   *ESCDLT
              + for more values    *INS

                                                                 More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 83. Set VTxxx Keyboard Map

The Pagedown key (Ctrl-D by default) is used to see the remainder of the displays.

SETVTMAP with no parameters resets the values back to the defaults. CHGVTMAP allows changes to be made without a reset of any values not selected back to the defaults. As the changed keyboard mapping is only valid for this TELNET session, it is recommended you create a command or CL program that changes the keyboard mapping to be called at the beginning of a TELNET session.

See the *IBM AS/400 TCP/IP Guide (SC41-9875)* for an example of this. SETVTMAP would be substituted for SETKBDMAP in the example.

4.3.3.2 Character Mapping

With VTxxx the datastream sent between systems ASCII encoded, the AS/400 TELNET server must therefore translate the incoming data to EBCDIC and the outgoing data to ASCII. VT220 and VT100 commands are not translated. The default ASCII/EBCDIC mapping tables assume the TELNET client is using the DEC multinational character set and the mapping is done from/to this based on the system code page (using the QCHRID of message CPX8416). The default ASCII/EBCDIC mapping tables can be changed through the CHGTCPA command. CHGTCPA does not allow mapping table selection through the CCSID parameter. If the remote host is using an NRC NLS character set then the table name must be entered here. To determine the table name refer to 4.2.4.4, “Character Mapping” on page 88. If the table does not exist, start an outgoing TELNET session with this CCSID value in the TELNET command, the table will then be dynamically created. The SETVTTBL command is used to override this default for the current session, see Figure 84 on page 104.

```
                         Set VT Mapping Tables (SETVTTBL)

Type choices, press Enter.

Coded character set identifier     *MULTINAT     *MULTINAT, *BRITISH...
Outgoing EBCDIC/ASCII table  . .   *CCSID        Name, *CCSID, *DFT
  Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB
Incoming ASCII/EBCDIC table  . .   *CCSID        Name, *CCSID, *DFT
  Library  . . . . . . . . . . .                 Name, *LIBL, *CURLIB

                                                                        Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 84. Selecting a Mapping Table

The SETVTTBL command is used during a TELNET session to change the ASCII/EBCDIC character mapping tables being used by the AS/400. The DEC multinational character set, a DEC NRC (national replacement character set) or user-defined character sets can be selected.

4.3.3.3 System Request

The system request processing is slightly different than that for a normal 5250 workstation. When the system request key is pressed (Ctrl-C or Esc-S by default), the System Request menu is displayed immediately for VTxxx sessions. For a normal 5250 session the menu is displayed after the Enter key is pressed.

4.3.3.4 DEC MicroVax VT100 Full-Screen TELNET Client

The VT100 TELNET client provided by the Wollongong MicroVax** TCP/IP package was tested to the AS/400 VTxxx TELNET server. Although this testing was by no means thorough, the connection appeared to work OK providing the TELNET session was initiated in the following way:

```
$ telnet
  telnet> xon
  Data flow control characters processed locally.
  telnet> promptmode
  Will show 'telnet>' prompt when connected.
  telnet> open 9.5.69.251
  Trying 9.5.69.251.....
  Connected to 9.5.69.251
  Escape character is '^]'.
```

An AS/400 signon screen was then received from RCHASM01.

Note: Without xon turned on, the AS/400 screen was corrupted.

The TELNET session from the MicroVax could either be ended by using SIGNOFF ENDCNN(*YES) or by Entering *quit* or *close* at the *Telnet* prompt. To obtain the Telnet prompt, Enter the 'escape character' (Ctrl-] by default). 'Promptmode' must be enabled to obtain the Telnet prompt.

The connection was initiated from a VT320 terminal attached to the MicroVax. The results may be different for different terminal types and the above information is provided for guidance only. During the testing a requirement for a change to the default keyboard map became apparent since the F6 function key on the VT320 terminal being used appeared to perform a local function (Interupt). SETVTMAP or CHGVTMAP would allow this function to be mapped to another key if it wasn′t possible to override this key being a local function.

4.3.3.5 Sun Sparc Classic VT100 Full-Screen TELNET Client

The VT100 TELNET client provided by the Sun UNIX TCP/IP package was tested to the AS/400 VTxxx TELNET server. Although this testing was by no means thorough, the connection appeared to work OK using the default TELNET command parameters:

```
# telnet
  telnet> open 9.5.69.251
  Trying...
  Connected to 9.5.69.251
  Escape character is ′^]′.
```

An AS/400 signon screen was then received from RCHASM01.

The TELNET session from the Sun could either be ended by using SIGNOFF ENDCNN(*YES) or by Entering *quit* or *close* at the *Telnet* prompt. To obtain the Telnet prompt, Enter the ′escape character′ (Ctrl-] by default).

The connection was initiated from a console attached to the Sun. The results may be different for different terminal types and the above information is provided for guidance only. During the testing a requirement for a change to the default keyboard map became apparent since the F11 and F12 function keys did not appear to perform the normal F11/F12 AS/400 functions (F11 resulted in a print screen function and F12 did nothing). SETVTMAP or CHGVTMAP would allow these functions to be mapped to other keys.

4.3.3.6 HP 705 Apollo VT100 Full-Screen TELNET Client

The VT100 TELNET client provided by the HP UNIX TCP/IP package was tested to the AS/400 VTxxx TELNET server. Although this testing was by no means thorough, the connection appeared to work OK using the default TELNET command parameters from an *xterm* session on the HP X Window** display:

```
# telnet
  telnet> open 9.5.69.251
  Trying.....
  Connected to 9.5.69.251
  Escape character is ′^]′.
```

An AS/400 signon screen was then received from RCHASM01.

Note: An *xterm* session is initiated by Entering the *xterm* command from an *hpterm* session.

The TELNET session from the HP could either be ended by using SIGNOFF ENDCNN(*YES) or by Entering *quit* or *close* at the *Telnet* prompt. To obtain the Telnet prompt, Enter the ′escape character′ (Ctrl-] by default).

The connection was initiated from an HP X-station attached to the HP system. The results may be different for different terminal types and the above information is provided for guidance only. During the testing a requirement for a change to the default keyboard map became apparent since HP X-station appeared to have function keys F1 to F8 only. SETVTMAP or CHGVTMAP would allow these functions to be mapped to other keys.

4.3.4 ASCII Line Mode TELNET Server

ASCII Line Mode is the standard TELNET NVT support.

The AS/400 operates in full-screen mode and has screens with multiple input fields. Therefore, it is difficult to map to a line mode device. This has to be taken into consideration when attempting to provide the TELNET server function from the AS/400.

TELNET server is automatically set up to receive TELNET connections when the TCP/IP subsystem is brought up. In 5250, 3270, VT220 or VT100 full-screen modes, the AS/400 system will automatically send the AS/400 sign-on display when a TELNET connection is made, however this is not the case if ASCII line mode is negotiated.

There are two methods of coping with this situation and enabling the AS/400 to provide a TELNET server function :

1. Write an application program on the AS/400 server to allow a user on the remote system to access the AS/400.
2. Have an emulation program running on the client system which will negotiate 5250, 3270, VT220 or VT100 full-screen mode with the AS/400 server.

For details on the necessary configuration and for details of an example NVT program, please refer to *IBM AS/400 TCP/IP Guide (SC41-9875)*.

4.4 AS/400 TELNET Restrictions

- The OfficeVision/400 standard editor cannot be used from a TELNET session when in VTxxx full-screen mode or 3270 full-screen mode. However, the OfficeVision/400 adaptive editor can be used instead. When 5250 full-screen mode is used, the use of the standard editor depends on the device being used - if the device does not support the standard editor, the adaptive editor will be used instead.
- If TELNET client is used from a remote device and that device has a low speed connection to the AS/400, then the TELNET performance from that device is likely to be bad. The reason being that the AS/400 'builds' the 5250 screen images from the incoming TELNET data streams and transmits them to the remote device as complete 5250 screen images complete with blanks. A complete screen image is also sent from the remote device to the AS/400 when the Enter key is pressed. This means that, for example, the following would result in 1920 characters being sent to the remote device instead of just 38:

```
HP-UX hpux A.09.01 A 9000/705 (ttys0)

login:
```

- The AS/400 TCP/IP Utilities/400 can only support a maximum of 80 TCP sessions. About 5 TCP sessions are generally used for the FTP Servers, and such, leaving around 75 available for customer use.

  Each TELNET session in or out of the AS/400 uses one TCP session. This basically means that a customer may only have a maximum of 75 TELNET sessions in and out of the AS/400 active at one time.

4.5 Using TELNET with 5250 Pass-through

TCP/IP Connectivity Utilities/400 (5738-TC1) was enhanced at V2R3 to allow:

- A TELNET session to be started from a TELNET session.
- A TELNET session to be started from a 5250 pass-through session.
- A 5250 pass-through session to be started from a TELNET session.

To complete the above V2R3 also allows a 5250 pass-through session to be started from a 5250 pass-through session.

The system where you first use pass-through or TELNET is called the home system. The last TELNET server system or the last pass-through system is called the end system. The systems between are called intermediate systems.

See *IBM AS/400 TCP/IP Guide (SC41-9875)* for further information on this subject.

Chapter 5. Additional FTP Considerations

This chapter contains additional considerations that are especially important when using FTP in larger networks.

5.1 Using FTP with Non-AS/400 Systems

The process of running FTP to other hosts is the same as for running it to another IBM AS/400. However, there will be differences in file naming and directory structures, and the operation of some of the FTP subcommands on those hosts. FTP uses the naming conventions of the specific host on which it is implemented. The results returned by some subcommands will differ depending on the host connected to.

When file members are transferred from IBM AS/400 to other systems, each IBM AS/400 file member will create/replace a separate file on the other system.

This section shows two examples:

- VAX/Wollongong considerations
- AIX (UNIX) considerations

Note: The restrictions and considerations noted in the following sections were discovered from tests on the particular systems. The results may be different for other software releases or implementations.

5.1.1.1 VAX/Wollongong Considerations

FTP from IBM AS/400 to VAX: Figure 85 shows the FTP logon process to the VAX.

```
 Start of terminal session.

 Connecting to host system MVAX at address 9.5.8.252 at port 21.
 220 FTP Service Ready
 Enter your userid to log on the remote host system.
 tester
 >>>USER tester
 331 User name TESTER received, please send password
 >>>PASS ********
 230 TESTER logged in, directory $DISK1:[TESTER]
 Enter an FTP command.
F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 85. VAX FTP Logon Process

This logon is very similar to the FTP logon to an IBM AS/400. It is necessary to have a valid user ID and password for the VAX.

Figure 86 on page 110 shows the results of the QUOTE HELP subcommand (entered on the AS/400) which lists the subcommands supported by the Wollongong server software.

```
Enter an FTP command.
 quote help
 >>>help
 211-The following commands are accepted:
   USER  PASS  ACCT  MAIL  MLFL  PORT  ABOR  QUIT  NOOP  HELP  TYPE  MODE
   STRU  BYTE  ALLO  XSEN  XSEM  XVRB  XTER  SYST  REIN  SITE  STAT  RETR
   STOR  APPE  DELE  RNFR  RNTO  LIST  NLST  REST  CWD   XCWD  CDUP  PWD
   XPWD  MKD   XMKD  RMD
 All file specifications must be in VMS or UNIX format.
 211 Problems to Postmaster@mvax
 Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 86. VAX FTP Server Subcommand Help Screen

Help is not available for individual subcommands. For example, QUOTE HELP APPE returns a message indicating that no information is available.

To determine the functions of some of these remote commands, it would be necessary to refer to the appropriate Wollongong reference manuals.

The PUT and GET operations are performed in the same manner as for IBM AS/400 to IBM AS/400, with small differences as noted in the following text.

Figure 87 and Figure 88 show examples of the operations PUT to the VAX and GET from the VAX.

```
 Enter an FTP command.
 put pfeiffer/text.ftpaix [tester.hans]ftpaix
 >>>PORT 9,5,69,250,4,37
 200 PORT Command OK.
 >>>STOR [tester.hans]ftpaix
 125 ASCII transfer started for $DISK1:[TESTER.
 HANS]FTPAIX.;
 226 File transfer completed ok
 51300 bytes transferred in 2.237 seconds. Transfer rate 22.928 KB/sec.
 Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 87. PUT Operation from AS/400 to VAX

```
 Enter an FTP command.
 get [tester.hans]ftpput pfeiffer/text.ftpget
 >>>PORT 9,5,69,250,4,38
 200 PORT Command OK.
 >>>RETR [tester.hans]ftpput
 125 ASCII transfer started for $DISK1:[TESTER.HANS]FTPPUT.; (43000 bytes)
 226 File transfer completed ok
 42750 bytes transferred in 3.242 seconds. Transfer rate 13.186 KB/sec.
 Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 88. GET Operation to AS/400 from VAX

The specification of files on the VAX is as follows:

```
NODE::DEVICE:[DIRECTORY]FILENAME.TYPE;VERSION
```

where DIRECTORY is expressed as a sub-directory structure such as [AAA.BBB.CCC.DDD...].

This is the full specification possible but certain parts can be omitted and defaults will be taken for them. In our example, we had $DISK2:<TCPIP.RUNEB> which uses the default node, $DISK2 for the device and TCPIP.RUNEB for the directory. The CD subcommand may be used to change this directory.

Different versions of files can exist, files with the same name but different version number. This will occur if multiple puts are done to the same file name.

Note: Because the VAX has this version number inherent in the file name, Wollongong TCP/IP does not support the STOU server subcommand. This means that if SUNIQUE is turned on at the IBM AS/400, which causes the STOU subcommand to be sent when PUT and MPUT are executed, Wollongong TCP/IP will return an error message from the VAX.

It is possible to put a logical file from the IBM AS/400 to the VAX. This will create a normal file on the VAX which will contain data according to the view of the logical file.

FTP from VAX to IBM AS/400:

When using FTP from the VAX to the IBM AS/400, the VAX user should be aware of the IBM AS/400 library/file.member structure and naming conventions. The QUOTE HELP command gives this information for users who are unfamiliar with the IBM AS/400.

Points to Note:

1. When starting FTP from the VAX, Wollongong TCP/IP prompts for NAME. This is actually the user ID for the IBM AS/400.
2. The CD subcommand is used to change the current library on the IBM AS/400. This is equivalent to the IBM AS/400 CHGCURLIB command.
3. The DIR subcommand is used to display the contents of the current library.

   Note: This command may take some time to execute if the current library contains a large number of objects.
4. Some of the error messages returned may not be very clear. For example, if you try to delete the current library, the message returned is “Unable to delete library.”
5. If a file with a name but no type is put to the IBM AS/400, a file and member of that name will be created or replaced. For example:

   ```
   PUT TEST
   ```

   will create or replace a file named TEST with a member named TEST in the current library.

5.1.1.2 AIX (UNIX) Considerations

Note: The following information is based on tests using AIX on an IBM RS/6000. AIX on other IBM systems and other UNIX implementations may have some differences.

FTP from IBM AS/400 to AIX: When starting FTP the user has to logon to the remote host.

Figure 89 shows the logon process to the RS/6000.

```
Start of terminal session.

Connecting to host system RCHRS001 at address 9.5.69.198 at port 21.
220 rchrs001.rchland.ibm.com FTP server (Version 4.7 Tue Mar 09 17:39:34 CST
    1993) ready.
Enter your userid to log on the remote host system.
root
>>>USER root
331 Password required for root.
>>>PASS ********
230 User root logged in.
Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 89. AIX FTP Logon Process

This logon is very similar to the FTP logon on an IBM AS/400. It is necessary to have a valid user ID and password for the AIX.

Figure 90 shows the results of a QUOTE HELP subcommand which lists the subcommands supported by the AIX server software.

```
Enter an FTP command.
quote help
>>>help
214- The following commands are recognized (* =>'s unimplemented).
   USER    PORT    STOR    MSAM*   RNTO    NLST    MKD     CDUP
   PASS    PASV    APPE    MRSQ*   ABOR    SITE    XMKD    XCUP
   ACCT*   TYPE    MLFL*   MRCP*   DELE    SYST    RMD     STOU
   SMNT*   STRU    MAIL*   ALLO    CWD     STAT    XRMD    SIZE
   REIN    MODE    MSND*   REST    XCWD    HELP    PWD     MDTM
   QUIT    RETR    MSOM*   RNFR    LIST    NOOP    XPWD
214 Direct comments to ftp-bugs@rchrs001.rchland.ibm.com.
Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 90. AIX FTP Server Subcommand Help Screen

Additional help information may be available for each server subcommand. For example:

`QUOTE HELP APPE`

returns information on the parameters for the APPE subcommand.

The PUT and GET operations are performed in the same manner as for IBM AS/400 to IBM AS/400, with small differences as noted in the following text.

Figure 91 and Figure 92 show examples of PUT and GET operations.

```
Enter an FTP command.
put pfeiffer/text.ftpaix /tmp/ftpaix.txt
>>>PORT 9,5,69,250,3,240
200 PORT command successful.
>>>STOR /tmp/ftpaix.txt
150 Opening data connection for /tmp/ftpaix.txt.
226 Transfer complete.
51300 bytes transferred in 1.923 seconds. Transfer rate 26.676 KB/sec.
Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 91. AIX PUT Operation

```
Enter an FTP command.
get /tmp/ftpaix.txt pfeiffer/txt.ftpaix1
>>>PORT 9,5,69,250,3,242
200 PORT command successful.
>>>RETR /tmp/ftpaix.txt
150 Opening data connection for /tmp/ftpaix.txt (51000 bytes).
226 Transfer complete.
51300 bytes transferred in 4.308 seconds. Transfer rate 11.908 KB/sec.
Enter an FTP command.

F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 92. AIX GET Operation

The specification of files on AIX is as follows:

`/DIRECTORY/FILENAME.TYPE`

where directory can be expressed as a sub-directory structure such as /AAA/BBB/CCC/DDD/...

This is the full specification possible but the directory can be omitted and the default directory will be used. In our example, we used FILE1.TYPE1 which uses the default directory established at sign-on time. The CD subcommand may be used to change this directory.

It is possible to put a logical file from the IBM AS/400 to AIX. This will create a normal file on AIX which will contain data according to the view of the logical file.

FTP from AIX to IBM AS/400:

When using FTP from AIX to the IBM AS/400, users should be aware of the IBM AS/400 library/file.member structure and naming conventions. The QUOTE HELP command gives this information for users who are unfamiliar with the IBM AS/400.

Points to Note:

1. When starting FTP from an AIX host, AIX prompts for NAME. This is actually the user ID for the remote FTP server.

2. The CD subcommand is used to change the current library on the IBM AS/400.

3. The DIR subcommand is used to display the contents of the current library in the AIX host.

   Note: This command may take some time to execute if the current library contains a large number of objects.

4. Some of the error messages returned may not be very clear. For example, if you try to delete the current library, the message just says 'Unable to delete library'.

5. The AIX operating system is case-sensitive.

5.2 FTP Subcommands

There are two groups of FTP subcommands:

- Local or client subcommands
- Remote or server subcommands

Client subcommands are interpreted by FTP on the local host while server subcommands are interpreted by FTP on the remote host. Appendix A, "FTP Local Subcommands" on page 235 shows a list of the IBM AS/400 client (local) subcommands.

5.2.1 HELP

The HELP client subcommand displays all of the subcommands available at the local host (client). Enter:

```
HELP
```

to get the list of local subcommands on the AS/400.

```
  Enter an FTP command.
  help
  User-FTP recognizes these commands.
  ?        ACCT     APPEND   ASCII    BINARY   CD
  CLOSE    DELETE   DIR      EBCDIC   GET      HELP
  LOCSTAT  LS       MDELETE  MGET     MODE     MPUT
  NOOP     OPEN     PASS     PUT      PWD      QUIT
  QUOTE    RENAME   SENDPORT SENDSITE SITE     STATUS
  STRUCT   SUNIQUE  SYSCMD   SYSTEM   TYPE     USER
  Enter an entire command name. Specify a local file in the format:
  library/file.member or file.member. Default local library for subcommands
  GET, MGET, PUT, or MPUT is the current library. If you have no current
  library, use the CHGCURLIB command. For information about a particular
  command, enter HELP <command>.
  Enter an FTP command.
F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 93. Local Host (Client) Help Display

5.2.2 SYSCMD

The SYSCMD client subcommand executes IBM AS/400 Control Language commands from within the FTP terminal session. Using this subcommand, the user can execute any IBM AS/400 command or application on the AS/400 FTP client. For example:

```
SYSCMD DSPLIB TCPLIBA
```

will execute the IBM AS/400 Display Library function and return to FTP. Also,

```
SYSCMD CALL QCMD
```

will display the local IBM AS/400 command entry screen, from which further IBM AS/400 commands may be used. To invoke the IBM AS/400 command prompter, a question mark can be put in front of the command as follows:

```
SYSCMD ?CRTLIB
```

In many cases, entering a local subcommand will cause FTP to send one or more remote subcommands to the remote host. For example, when a PUT is executed, FTP sends a PORT and a STOR server command to the remote host.

5.2.3 QUOTE

The QUOTE client subcommand allows the user to send server subcommands directly to the remote host. The remote subcommand is specified as a parameter on the QUOTE subcommand and the local FTP passes it directly to the remote host. For example:

```
QUOTE HELP
```

will send the HELP subcommand to the remote host, which will return a display of all subcommands it supports. The information displayed will vary depending on the type of remote host. The IBM AS/400 remote help screen is shown in Figure 94.

```
  Enter an FTP command.
  quote help
  >>>help
  214-Server-FTP commands follow:
  214-ABOR, ADDM, ADDV, APPE, CRTL, CRTP, CRTS, CWD
  214-DELE, DLTF, DLTL, HELP, LIST, MODE, NLST, NOOP
  214-PASS, PASV, PORT, PWD, QUIT, RCMD, RETR, RNFR
  214-RNTO, SITE, STAT, STOR, STOU, STRU, SYST, TIME
  214-TYPE
  214-The data representation type may be ASCII, EBCDIC, or IMAGE.
  214-Data structure must be file.  Mode can be stream (S) or block (B).
  214-If this connection is not used more than 300 seconds, the session will
      end.
  214-File identifiers have three components: File, library, and member.
  214-Library and file components are separated by the / delimiter.
  214-File and member components are separated by the . delimiter.
  214-Example:  Library/file.member.
  214 For information about a specific command, enter HELP <command>.
  Enter an FTP command.
F3=End of File     F9=Retrieve     F21=Extend line
```

Figure 94. IBM AS/400 Remote Host (Server) Help Display

The remote subcommands are required by the FTP architecture to be four characters in length. Many of them, like PORT, STOR and STAT, perform purely FTP functions. However, there are a number of others which perform other functions, like creating and deleting files. In the case of the IBM AS/400, these include CRTL(Create Library), CRTP(Create Physical File) and ADDM(Add Physical File Member). For example:

```
QUOTE CRTL TCPLIBB
```

will create a library TCPLIBB on a remote IBM AS/400. Figure 94 on page 115 shows the complete list available. Details on individual subcommands are found by executing the QUOTE subcommand and specifying HELP and the name of command. For example:

```
QUOTE HELP LIST
```

will display information about the LIST subcommand.

5.2.4 TIME

After the FTP control connection is established between FTP client and FTP server, the FTP server controls time-out for this connection. Use the TIME server subcommand to set the remote server time-out value. The time-out value is the amount of time the FTP server waits before closing the FTP connection. Time-out values can range from 1-9,999,999 seconds.

To set the time-out value of the FTP server to 1000 seconds, type the following:

```
QUOTE TIME 1000
```

5.2.5 RCMD

The RCMD server subcommand allows a local client to execute AS/400 CL commands on the remote FTP server system. The length of the RCMD command string is limited to 94 characters.

If the CL command called through the RCMD ran successfully, a message will be displayed that states the command was successful. If a CL command run error occurred, a message will be displayed that states an error occurred.

```
QUOTE RCMD SBMJOB JOB(FTPS) JOBD(QTCP/QTCPFTPS) RTGDTA(*JOBD) RQSDTA(*JOBD)
```

As in the normal IBM AS/400 environment, the F9 key may be used during the FTP session to copy previously executed subcommands. The roll keys may also be used.

5.3 National Language Support Considerations for FTP

Be aware of the following when using the File Transfer Protocol(FTP) in a multiple language environment.

- If you establish an FTP connection between two AS/400 systems that have different primary languages, the data is displayed or stored in the EBCDIC code page of the system it came from.

  For example, assume you establish an FTP connection between an AS/400 system that has German as the primary language and an AS/400 system that has French as the primary language, If you PUT a file, in EBCDIC mode, from the German client system to the French server system, the file will be stored on the French system in the EBCDIC code page of the German client system. This might cause data processing problems when the file from the German client system is used by the French server system.

- When using FTP in ASCII mode between to EBCDIC systems, the data on the system sending the file is translated from its stored EBCDIC code page to ASCII, and then from ASCII to the EBCDIC code page of the receiving system. Usually this will not present a problem because the 7-bit ASCII code page used by the two systems are the same unless the EBCDIC characters on the sending system are not defined in the ASCII code page. Also, some characters in the ASCII code page may be mapped differently between the two different EBCDIC code pages. This might occur if some of the ASCII characters are *variant* (the character occupies a different hexadecimal code point in an EBCDIC code page). The variant character may be interpreted differently on the receiving system if the EBCDIC code page is different from that of the system sending the file.
- When using FTP in binary mode the data is not translated.

5.4 Mapping Tables

5.4.1 Specifying ASCII Mapping Tables in TCP/IP Attributes

For server FTP the incoming (ASCII to EBCDIC) and outgoing (EBCDIC to ASCII) mapping tables to be used can be specified in the TCP/IP attributes:

1. Enter the command CHGTCPA (Change TCP Attributes),
2. Press PF4.

The Change TCP/IP Attributes display is presented:

```
                     Change TCP/IP Attributes (CHGTCPA)

 Type choices, press Enter.

     :
     :
 FTP - outgoing mapping table . .   q273337850    Name, *SAME, *DFT
                                      qusrsys     Name, *LIBL, *CURLIB
 FTP - incoming mapping table . .   q850337273    Name, *SAME, *DFT
                                      qusrsys     Name, *LIBL, *CURLIB
     :

 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 95. Specify ASCII Mapping Tables in TCP/IP Attributes

If in the mapping table prompts *DFT is not changed, the default mapping tables provided by IBM will be used.

In the example the default mapping is changed to EBCDIC German (code page 273) and ASCII PC Multilingual (code page 850).

5.4.2 Specifying ASCII Mapping Tables in FTP Command

For client FTP, the ASCII mapping tables are specified in the FTP command.

1. Enter the command FTP
2. Press PF4

The Start TCP/IP FTP display is presented. Press PF10, the prompts for outgoing and incoming ASCII/EBCDIC tables are displayed.

```
                    Start TCP/IP File Transfer (FTP)

Type choices, press Enter.

Remote system  . . . . . . . . . > SUN3


                         Additional Parameters

Outgoing ASCII/EBCDIC table  . .   *DFT          Name, *DFT
                                                 Name, *LIBL, *CURLIB
Incoming ASCII/EBCDIC table  . .   *DFT          Name, *DFT
                                                 Name, *LIBL, *CURLIB

                                                                   Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 96. Specify ASCII Mapping Tables in TCP/IP Attributes

Specify the mapping tables to be used in client FTP. When *DFT is not changed, the mapping tables defined in the TCP/IP attributes will be used.

5.5 FTP in Batch Mode

FTP is designed as an interactive TCP/IP application. But with the AS/400 the user may run FTP in batch mode too. This is important for large file transfers or for file transfers in unattended mode.

To run FTP as a batch job, the following steps are required:

1. Create a CL program (or a REXX procedure) that starts FTP.
2. Provide a source physical file member with all those FTP commands that in interactive mode would be entered at the display station.
3. Submit a batch job that schedules and runs the CL program.
4. Check the results.

The following example shows how to retrieve files from several remote hosts to a central AS/400 in batch mode:

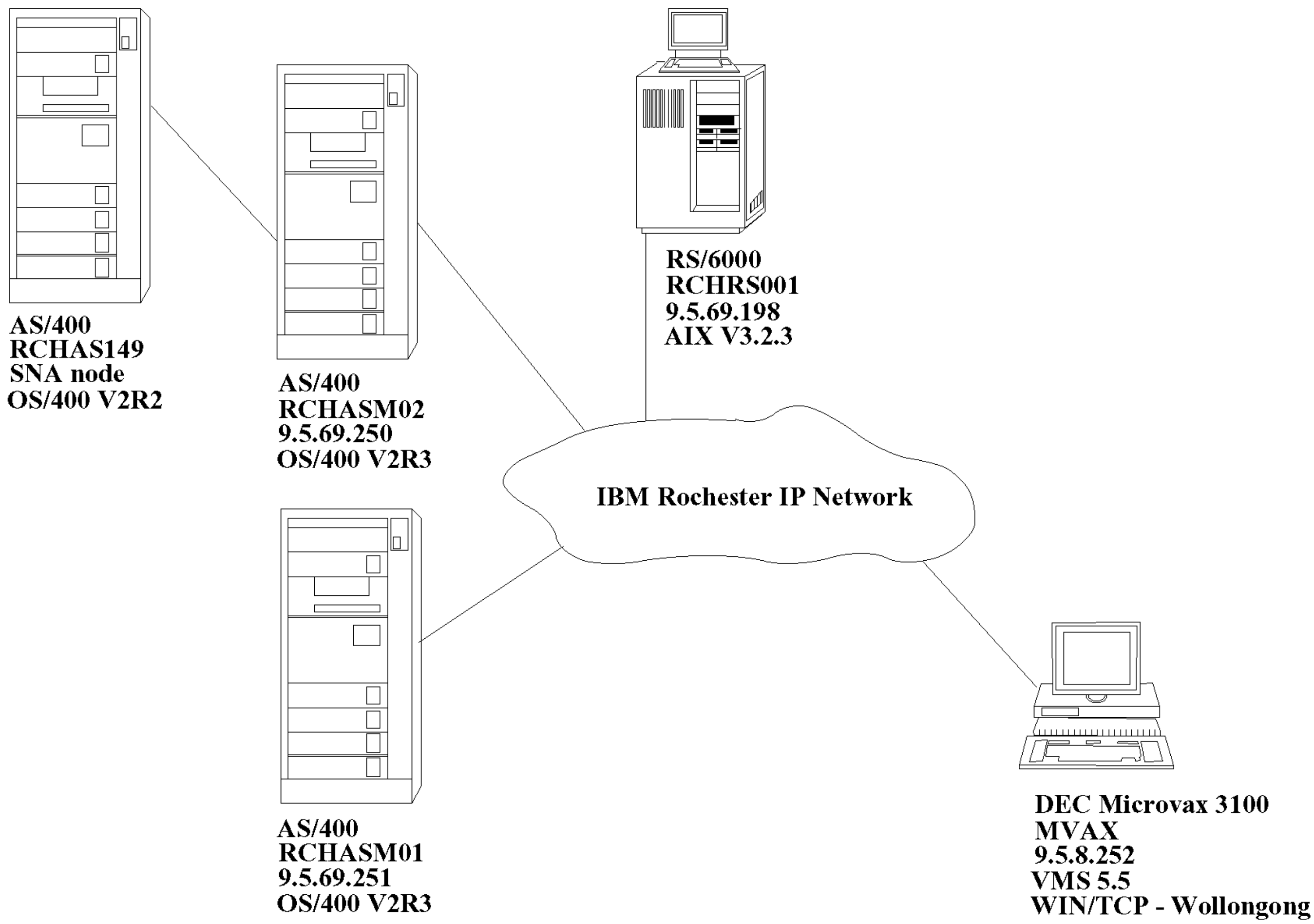

Figure 97. Network Example for Batch FTP

User HANS on AS/400 RCHASM01 wants to

1. Retrieve files from hosts RCHRS001 (RS/6000) and MVAX (VAX).
2. After retrieving the file from RCHRS001 the file should be transferred to RCHASM02 (another AS/400) using FTP.
3. From there the file is to be sent through SNA to AS/400 RCHAS149.

5.5.1.1 Create a CL program to start FTP

1. As the FTP command is an interactive command it must be changed for use in batch environment:

```
CHGCMD CMD(QSYS/FTP) ALLOW(*ALL)
```

2. FTP uses the display station for command INPUT and message OUTPUT. In batch mode, command input is provided by a source physical file member (here: FTPCMDS) and messages should be logged in an output file (here FTPLOG) that may be checked visually or by a program for error messages. In the CL program use the OVRDBF command to overwrite these files with the ones to be used in batch:

```
OVRDBF FILE(INPUT) TOFILE(PFEIFFER/QCLSRC) MBR(FTPCMDS)
OVRDBF FILE(OUTPUT) TOFILE(PFEIFFER/QCLSRC) MBR(FTPLOG)
```

3. Call FTP in the CL program. The FTP command expects a host name or internet address as a parameter before processing the input file with the FTP

client subcommands. Use LOOPBACK as a ′dummy′ host name for FTP, so total control of the FTP connections are placed in the FTP input file (FTPCMDS):

```
FTP RMTSYS(LOOPBACK)
```

FTP processes the input file and writes messages to the output file (FTPLOG).

4. After the FTP application ends, delete the overrides:

```
DLTOVR     FILE(INPUT OUTPUT)
```

So the CL program for batch FTP will look like the following example on system RCHASM01:

```
 Columns . . . :    1  71           Browse                       PFEIFFER/QCLSRC
 SEU==>                                                                 FTPBATCH
 FMT **  ...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7
        *************** Beginning of data *************************************
0001.00 PGM
0002.00              CHGCMD     CMD(QSYS/FTP) ALLOW(*ALL)
0003.00              OVRDBF     FILE(INPUT) TOFILE(PFEIFFER/QCLSRC) +
0004.00                           MBR(FTPCMDS)
0005.00              OVRDBF     FILE(OUTPUT) TOFILE(PFEIFFER/QCLSRC) +
0006.00                           MBR(FTPLOG)
0007.00              FTP        RMTSYS(LOOPBACK) /* (FTP CL Program) */  A
0008.00              DLTOVR     FILE(INPUT OUTPUT)
0009.00 ENDPGM
        ****************** End of data ****************************************


 F3=Exit   F5=Refresh   F9=Retrieve   F10=Cursor   F12=Cancel
 F16=Repeat find       F24=More keys
                                        (C) COPYRIGHT IBM CORP. 1981, 1993.
```

Figure 98. CL Program FTPBATCH for Batch FTP

5.5.1.2 Create the FTP Input File (FTPCMDS)

This file has to contain all FTP client subcommands that would normally be entered in interactive mode through the display station. Subcommands such as user-id and password, puts and gets, and close. User HANS creates the following file member FTPCMDS:

```
 Columns . . . :    1  71           Browse                          PFEIFFER/QCLSRC
 SEU==>                                                                     FTPCMDS
 FMT **  ...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7
        *************** Beginning of data *************************************
0001.00 hans hans  01
0002.00 close  02
0003.00 open rchrs001  03
0004.00 user root mozart  04
0005.00 ascii  05
0006.00 syscmd dltf file(hans/rs6)  06
0007.00 get /tmp/ftpput.txt hans/rs6.rs6  07
0008.00 close  08
0009.00 open mvax  09
0010.00 user tester test  10
0011.00 get [tester.hans]ftpput hans/vax.vax (replace  11
0012.00 close  12
0013.00 open rchasm02  13
0014.00 user hans hans  14
0015.00 ebcdic  15
0016.00 put hans/rs6.rs6 pfeiffer/rs6.rs6  16
0017.00 quote rcmd sndnetf file(pfeiffer/rs6) tousrid((pfeiffer rchas149))  17
0018.00 close  18
0019.00 quit  19
        ****************** End of data ****************************************
 F3=Exit   F5=Refresh   F9=Retrieve   F10=Cursor   F12=Cancel
 F16=Repeat find        F24=More keys
```

Figure 99. FTP Client Subcommands (File Member FTPCMDS)

Note: Explanation for FTP client subcommands in file FTPCMDS:

01 user-id and password for ′dummy′ connection within client AS/400 RCHASM01

02 close dummy connection in AS/400 RCHASM01

03 open control connection to RS/6000 RCHRS001

04 user user-id password (enter subcommand ′user′!)

05 transfer ASCII data (will be translated on AS/400 to/from EBCDIC)

06 CL command to be run on client AS/400: delete file. Instead parameter ′(replace′ could be used with the next statement.

07 retrieve file from RS/6000

08 close control connection to RS/6000 RCHRS001

09 open connection to VAX MVAX

10 user user-id password (here: wrong password to produce an error message)

11 retrieve file from VAX replacing existing AS/400 file

12 close control connection to VAX MVAX

13 open control connection to remote AS/400 RCHASM02

14 user user-id password (enter subcommand 'user'!)

15 transfer EBCDIC data (as it is from AS/400 to AS/400)

16 send AS/400 file to AS/400 RCHASM02 through TCP/IP

17 send this file from server AS/400 RCHASM01 to remote AS/400 RCHAS149 through SNA network

18 close control connection to AS/400 RCHASM02

19 end FTP application

5.5.1.3 Create CL Program for Submitting the FTPBATCH Job

In order to schedule the file transfers and run them unattended create a CL program that submits the FTPBATCH job. In the example the file transfers are supposed to run the next Friday, 17:00 hour, in unattended mode. So user HANS creates the following CL program:

```
 Columns . . . :    1  71           Browse                      PFEIFFER/QCLSRC
 SEU==>                                                               FTPSUBMIT
 FMT **  ...+... 1 ...+... 2 ...+... 3 ...+... 4 ...+... 5 ...+... 6 ...+... 7
        *************** Beginning of data ************************************
0001.00 PGM
0002.00              SBMJOB     CMD(CALL PGM(PFEIFFER/FTPBATCH)) +
0003.00                           JOB(FTPFRIDAY) OUTQ(PFEIFFER/PFEIFFER) +
0004.00                           SCDDATE(*FRI) SCDTIME(170000) /* FTP for +
0005.00                           Friday, 5:00 in the afternoon */
0006.00 ENDPGM
        ****************** End of data ****************************************

 F3=Exit   F5=Refresh   F9=Retrieve   F10=Cursor   F12=Cancel
 F16=Repeat find        F24=More keys
                                        (C) COPYRIGHT IBM CORP. 1981, 1993.
```

Figure 100. CP Program for Submitting Batch FTP Job.

5.5.1.4 Check the FTP Output File for Errors

While running at the scheduled time FTP creates the data in file member FTPLOG shown in Figure 101 on page 123.

Note: Bold reference numbers (**nn**) in the following pages refer to original statements found in Figure 98 on page 120 and in Figure 99 on page 121.

```
A
     Connecting to host system LOOPBACK at address 14.0.0.0 at port 21.
     220-QTCP at RCHASM01.RCHLAND.
     220 Connection will close if idle more than 5 minutes.
     Enter your userid to log on the remote host system.
01
     >>>USER hans
     331 Enter password.
     >>>PASS ********
     230 HANS logged on.
     Enter an FTP command.
02
     >>>QUIT
     221 QUIT subcommand received.
     Enter an FTP command.
03
     Connecting to host system rchrs001 at address 9.5.69.198 at port 21.
     220 rchrs001.rchland.ibm.com FTP server (Version 4.7 Tue Mar 09 17:39:34 CST
        1993) ready.
     Enter an FTP command.
04
     >>>USER root
     331 Password required for root.
     >>>PASS ********
     230 User root logged in.
     Enter an FTP command.
05
     >>>TYPE A
     200 Type set to A; form set to N.
     Enter an FTP command.
06
     Enter an FTP command.
07
     >>>PORT 9,5,69,250,3,244
     200 PORT command successful.
     >>>RETR /tmp/ftpput.txt
     150 Opening data connection for /tmp/ftpput.txt (42500 bytes).
     226 Transfer complete.
     42750 bytes transferred in 3.580 seconds. Transfer rate 11.942 KB/sec.
     Enter an FTP command.
08
     >>>QUIT
     221 Goodbye.
     Enter an FTP command.
```

Figure 101 (Part 1 of 2). FTP Output (FTPLOG) After Running FTPBATCH Program

```
09
    Connecting to host system mvax at address 9.5.8.252 at port 21.
    220 FTP Service Ready
    Enter an FTP command.
10
    >>>USER tester
    331 User name TESTER received, please send password
    >>>PASS ********
    530 User authorization failure
    Enter an FTP command.
11
    You must first issue the USER command.
    Enter an FTP command.
12
    >>>QUIT
    221 Goodbye.
    Enter an FTP command.
13
    Connecting to host system rchasm02 at address 9.5.69.250 at port 21.
    220-QTCP at RCHASM02.RCHLAND.IBM.COM.
    220 Connection will close if idle more than 5 minutes.
    Enter an FTP command.
14
    >>>USER hans
    331 Enter password.
    >>>PASS ********
    230 HANS logged on.
    Enter an FTP command.
15
    >>>TYPE E
    200 Representation type is EBCDIC nonprint.
    Enter an FTP command.
16
    >>>PORT 9,5,69,250,3,247
    200 PORT subcommand request successful.
    >>>STOR pfeiffer/rs6.rs6
    150 Sending file to member RS6 in file RS6 in library PFEIFFER.
    250 File transfer completed successfully.
    42500 bytes transferred in 2.989 seconds. Transfer rate 14.219 KB/sec.
    Enter an FTP command.
17
    >>>rcmd sndnetf file(pfeiffer/rs6) tousrid((pfeiffer rchas149))
    250 Command sndnetf file(pfeiffer/rs6) tousrid((pfeiffer rchas149))
       successful.
    Enter an FTP command.
18
    >>>QUIT
    221 QUIT subcommand received.
    Enter an FTP command.

19 (This ends the FTP application)
```

Figure 101 (Part 2 of 2). FTP Output (FTPLOG) After Running FTPBATCH Program

This output should be checked for errors that might have occurred during FTP processing either visually or by a program testing for error return codes. Three digit FTP error return codes start with 4 or 5. For a list of FTP return codes refer to Appendix B, “FTP Return Codes” on page 237. The *IBM AS/400 TCP/IP Guide (SC41-9875)* contains an example program for checking FTP return codes in the FTP output file.

In addition a sample REXX procedure and a sample physical file member for batch FTP are shipped as part of the TCP/IP product. The *IBM AS/400 TCP/IP Guide (SC41-9875)* explains how to use this program.

Chapter 6. Additional SMTP Considerations

This chapter contains the V2R3 enhancements for SMTP and describes how they can be implemented. It also contains additional considerations that are important when using SMTP in a larger network.

The V2R3 SMTP enhancements include :

- Automatic Registration of incoming users
- Alternate routing using a Mail Router
- Remote Name Server retries
- SMTP User ID Delimiter Support

In order to achieve these functions in V2R2, the following PTFs must be loaded into your system :

- SF13195
- SF11822
- SF11302
- SF12424

Caution: End the QTCP subsystem before applying or removing these PTFs.

6.1 Alias Tables

An AS/400 user is enrolled in the system directory (SNADS) before being able to participate in any communication functions like SMTP or OfficeVision/400. A SNADS name is comprised of three parts: user ID, address and system name. The user ID and address are each limited to eight characters each. There are certain special characters, like the ! mark, that are not supported in the SNADS names but may be needed in the SMTP name. Refer to Appendix E, “Supported SNADS Characters” on page 277 for a list of supported characters. If required, these special characters can be added in the alias table.

An SMTP name is comprised of two parts: user ID and domain. SMTP allows the user ID to be 24 characters and the domain to be up to 255 characters. The combination of the SMTP user ID and domain must not exceed 255 characters, however.

For example, suppose an AS/400 user wants to send message to a remote user, KRIS, whose SMTP user ID is KRISPETERSON. This remote user resides in a system whose full host domain name is SINGAPOR.RCHLAND.IBM.COM. Normally, it would not be possible to send the message to KRISPETERSON because this name exceeds 8 characters. Therefore, there is a need for a mapping table to translate the short SNADS name to the longer SMTP name. The alias table provides this function also. Figure 102 on page 128 shows the mapping process.

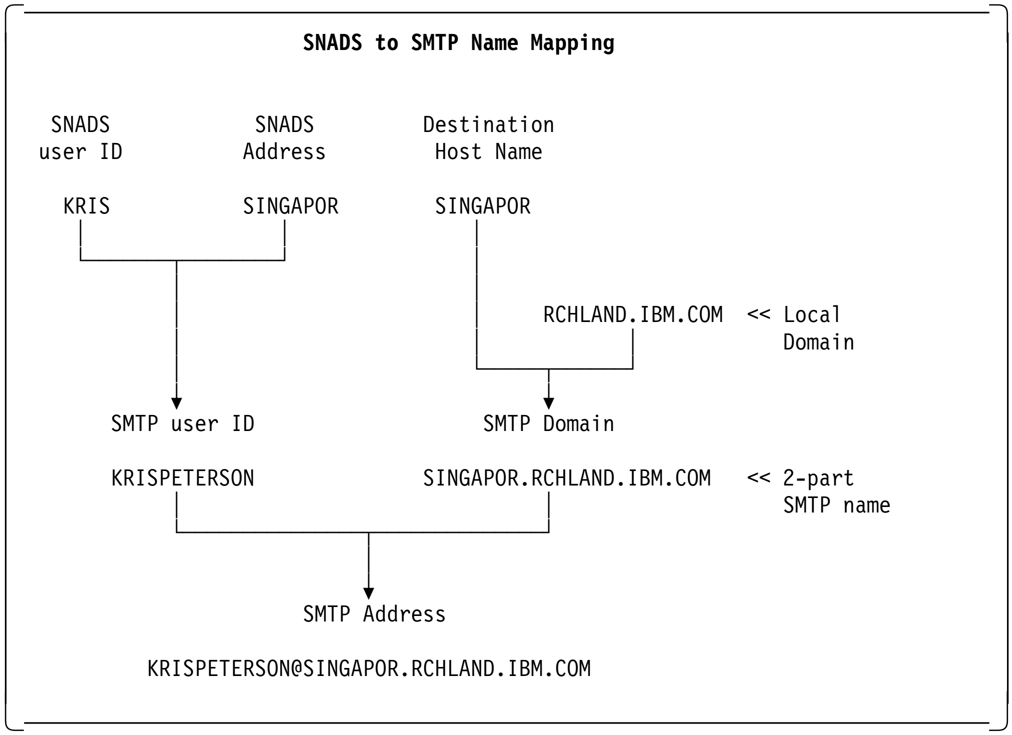

Figure 102. SNADS to SMTP Name Mapping

6.1.1 Types of Alias Tables

With V2R3, SMTP supports two types of alias tables :

1. Personal alias table

   Every SMTP user can create their own personal alias table. They can specify entries of SMTP users with whom they want to send or receive SMTP mail. This function is similar to a personal list of nicknames. The personal alias table for a user can only be accessed by that user, the security officer or the system administrator.

2. System alias table

   This table contains the SMTP user IDs, domains as well as SMTP routes at the system level. You can specify generic entries (*ANY) for each remote host system. Thus, once this table has been properly setup with all these remote host systems, it will not be necessary to setup the personal alias tables for each user.

   The system alias table is recommended because it makes maintenance easier, takes up less storage and offers better performance compared to accessing individual personal alias tables. Only the security officer or the system administrator can update the system alias table.

When sending or receiving a mail, SMTP will always search the personal alias table first, and if there are no matches, then the system alias table will be searched.

6.1.2 How to Set Up an Alias Table

This redbook will only describe the steps to create a system alias table. For information on creating personal alias tables, refer to IBM AS/400 TCP/IP Guide (SC41-9875).

To add an entry to the SMTP alias table for a remote or local SMTP user, follow these steps :

1. Either select option 6 to Work with Names for SMTP from the TCP/IP Administration menu (shown by typing GO TCPADM) or enter the command

   WRKNAMSMTP

2. You will be shown the screen to Specify Alias Table (Figure 103). Select option 1 for system alias table.

```
                         Specify Alias Table
                                                     System:   RCHASM02
Type choices, press Enter.

  Alias table type  . . . . . . . . . .  1         1=System
                                                   2=Personal



F3=Exit   F12=Cancel
```

Figure 103. Specify Alias Table Display

3. You will be shown the following screen. Notice that there are already some entries defined. To add a new entry, take option 1.

```
                        Work with Names for SMTP
                                                     System:   RCHASM02
Alias table type . . . . . . . . :   System


Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display   6=Print

Opt     User ID      Address      SMTP Name
 1      *ANY         RCHASM01
 _      *ANY         RCHAS149     @RCHAS149.RCHLAND.IBM.COM
 _      QSM2         QSMRMTAD     QGATE@RCHASM02.RCHLAND.IBM.COM


                                                                 Bottom
F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Position to
```

Figure 104. System Alias Table

```
                         Add Name for SMTP
                                                      System:   RCHASM02
 Type choices, press Enter.

   User ID . . . . . . . . .   *ANY       Character value, *ANY, F4 for list
   Address . . . . . . . . .   RCHASM01   Character value, F4 for list

   SMTP user ID  . . . . . .   ________________________
   SMTP domain . . . . . . .   RCHASM01.RCHLAND.IBM.COM________________________
________________________________________________________________________________
________________________________________________________________________________
_______________________________________________

   SMTP route  . . . . . . .   ________________________________________________
________________________________________________________________________________
________________________________________________________________________________
_______________________________________________

 F3=Exit   F4=Prompt   F12=Cancel
```

Figure 105. Add a Generic Entry to System Alias Table

4. For generic entries (*ANY), you do not need to fill in the SMTP user ID field. You only need to specify the SMTP domain.

```
                         Add Name for SMTP
                                                      System:   RCHASM02
 Type choices, press Enter.

   User ID . . . . . . . . .   KRIS       Character value, *ANY, F4 for list
   Address . . . . . . . . .   SINGAPOR   Character value, F4 for list

   SMTP user ID  . . . . . .   KRISPETERSON____________
   SMTP domain . . . . . . .   SINGAPOR.RCHLAND.IBM.COM______________________
________________________________________________________________________________
________________________________________________________________________________
_______________________________________________

   SMTP route  . . . . . . .   ________________________________________________
________________________________________________________________________________
________________________________________________________________________________
_______________________________________________

 F3=Exit   F4=Prompt   F12=Cancel
```

Figure 106. Add a Specific Name to System Alias Table

5. Alternatively, you can add a specific user. Enter the SNADS user ID and address as well as the long SMTP user ID and domain.

6.1.3 When to Use an Alias Table

2.5.1.8, "Step 8—Update the SMTP Alias Table" on page 41 has briefly mentioned the four conditions under which you will need the alias tables in SMTP. This section will discuss those conditions.

1. **In an AS/400 to AS/400 mail exchange (through SMTP), if the user on the remote AS/400 has a SNADS address that is different from the host system name, then an alias table is required.**

Refer to 6.3.3, “When to Use a Delimiter” on page 140 for an example to illustrate this.

2. **If users on either the local or remote host systems have abbreviated SNADS or SMTP names.**

   For example, you may want to send mail to a remote AS/400 user whose SMTP name is JOHN and SNADS name is “JOHNNY RMTAS400”. Thus there has to be an entry in the alias table to map the long SNADS name to the short SMTP name as shown in Figure 107.

```
                          Add Name for SMTP
                                                    System:   LCLAS400
Type choices, press Enter.

  User ID . . . . . . . . .   JOHNNY     Character value, *ANY, F4 for list
  Address . . . . . . . . .   RMTAS400   Character value, F4 for list

  SMTP user ID  . . . . . .   JOHN
  SMTP domain . . . . . . .   RMTAS400



  SMTP route  . . . . . . .

F3=Exit   F4=Prompt   F12=Cancel
```

Figure 107. Add an Entry for JOHNNY RMTAS400 in the System Alias Table

3. **If an SMTP user ID or host name has more than eight characters (each) and/or special characters.**

   If the remote non-AS/400 user ID has more than eight characters or special characters, each remote user must be defined in the alias table.

   The *user ID* should contain a SNADS user ID.

   The *address* should contain a SNADS address.

   The *SMTP user ID* should contain the long user ID of the user at the remote host.

   The *SMTP domain* should contain the long domain name of the remote host or the host name as defined in the local host table, so that TCP/IP can determine where to send it.

   With this type of entry, mail addressed to the specified SNADS user ID and address will be sent to the specified SMTP user ID at the specified domain.

4. **If an SMTP Route needs to be defined.**

   SMTP routing, also known as SMTP relay, is a method that is used to send SMTP mail to a user on a host which is not defined in the host table, or to send SMTP mail by a specific route. See Figure 108 on page 132 for an example of an SMTP route definition.

```
                              Add Name for SMTP
                                                             System:   RCHASM02
 Type choices, press Enter.

   User ID . . . . . . . . .   KRIS       Character value, *ANY, F4 for list
   Address . . . . . . . . .   SINGAPOR   Character value, F4 for list

   SMTP user ID  . . . . . .
   SMTP domain . . . . . . .   @EMVAX2,@EPSAX:KRISPETERSON@SINGAPOR.RCHLAND.IBM


   SMTP route  . . . . . . .

 F3=Exit   F4=Prompt   F12=Cancel
```

Figure 108. SMTP Alias Table Entry with SMTP Route

When specifying an SMTP route, you do not need to fill in the *SMTP user ID*. The SMTP domain is used to specify the route as shown in the above example.

The route defines a list of intermediate hosts through which the mail will travel, combined with the SMTP user ID and domain name of the remote user. The first host in the route (first hop) has to be defined in the local host table (EMVAX2 in this example). Then there can be a number of intermediate hosts (EPSAX). Each intermediate host must be configured to communicate with the next host in the route.

When specifying the route, each host name must begin with an @ and be separated from the other host names by a "," , the host names must be separated from the SMTP user ID by a ":" and the SMTP domain name must be separated from the SMTP user ID by an "@." See Figure 109.

```
SMTP route              @EMVAX2,@EPSAX:KRISPETERSON@SINGAPOR.RCHLAND.IBM

Host and domain names
start with              @       @               @

Host name of the first
hop as specified in
the local host table     EMVAX2

separates host names           ,

Intermediate host                EPSAX

separates host names
from SMTP user ID                     :

AS/400 SMTP user ID                    KRISPETERSON

Destination domain name                            SINGAPOR.RCHLAND.IBM
```

Figure 109. SMTP Route Example

Notes:

1. Generic entries are not allowed when specifying SMTP routes. For example, you cannot specify:

   ```
   @EMVAX2,@EPSAX:*ANY?SINGAPOR@SINGAPOR.RCHLAND.IBM.COM
   ```

   in the SMTP route field.

2. *SMTP route* may be used instead of *SMTP user ID* and *SMTP domain*. However, changes to the TCP/IP standards (RFC 1123) suggest that the use of explicit SMTP source routing within the Internet environment should be discouraged. Unless the target host is not defined or the target host cannot be reached directly, simple use of 'USER@DOMAIN' should be used.

The following table (Table 4) summarizes the criteria for filling in parameters of an alias table entry.

Table 4. Alias Table Parameter Combinations

Alias table parameters	**SMTP user ID on AS/400 (≤ 8 char)**	**SMTP user ID on non-AS/400 (no special char and ≤ 8 char)**	**Abbreviated SNADS or SMTP address**	**SNADS address differs from host name (SMTP between 2 AS/400s)**	**SMTP user ID on non-AS/400 (with special char or >8 char)**	**If a Specific Route is Required**
User ID	Optional Entry	Optional Entry	Required	Required	Required	Required
Address	Optional Entry	Optional Entry	Required	Required	Required	Required
SMTP user ID	Optional Entry	Optional Entry	Required	Required	Required	Not Required
SMTP Domain	Optional Entry	Optional Entry	Required	Required	Required	Not Required
SMTP Route	Not Required	Not Required	Not Required	Not Required	Not Required	Required

6.2 Automatic Registration of Incoming Users

When mail is received in the AS/400, the SMTP user ID and domain of the sender is checked against the alias tables. If there are no entries that corresponds to this ID, both the system directory and the alias table will be updated. SMTP will generate a new SNADS user ID in the form of QSMxxxxx and SNADS address as QSMRMTAD. Both the address QSMRMTAD and prefix QSM are SMTP attribute defaults that can be changed using option 13 from the Configure TCP/IP menu. Look at the automatic directory registration fields in Figure 110 on page 134.

```
                         Change SMTP Attributes
                                                   System:   RCHASM02
Type choices, press Enter.

  Distribution retries first level:
    Retries . . . . . . . . . . . . . .   2          0-99
    Time interval . . . . . . . . . . .   1          0-99 (minutes)
  Distribution retries second level:
    Retries . . . . . . . . . . . . . .   1          0-9
    Time interval . . . . . . . . . . .   0          0-9 (days)
  Retry remote name server  . . . . . .   N          Y=Yes, N=No
  Automatic directory registration:
    Automatically add remote users to
      directory . . . . . . . . . . . .   Y          Y=Yes, N=No
    User ID prefix  . . . . . . . . . .   QSM
    Address . . . . . . . . . . . . . .   QSMRMTAD
    System name . . . . . . . . . . . .   TCPIP
    Alias table type  . . . . . . . . .   1          1=System
                                                     2=Personal
  User ID delimiter . . . . . . . . . .   *DFT

                                                              More...
F3=Exit   F12=Cancel
```

Figure 110. Change SMTP Attributes Display

You can tell SMTP to automatically add an entry either to the system or personal alias table. We suggest you use 1=System.

There are two main reasons for this automatic registration function. First, it enables a local user to reply to mail without having to manually add the remote user in the system directory or the alias table. Prior to V2R3 (or V2R2 with required PTFs), the system administrator has to conscientiously update the system directory and/or alias tables accordingly.

Second, it helps to reduce the number of undelivered mail items. This is particularly important if the AS/400 is used as an office gateway. Section 6.9, "Office Gateway Between SNADS and SMTP" on page 161 describes how the AS/400 is used as a office gateway.

6.2.1 Automatic Registration Example

Let us consider two systems in a TCP/IP network as shown in Figure 111.

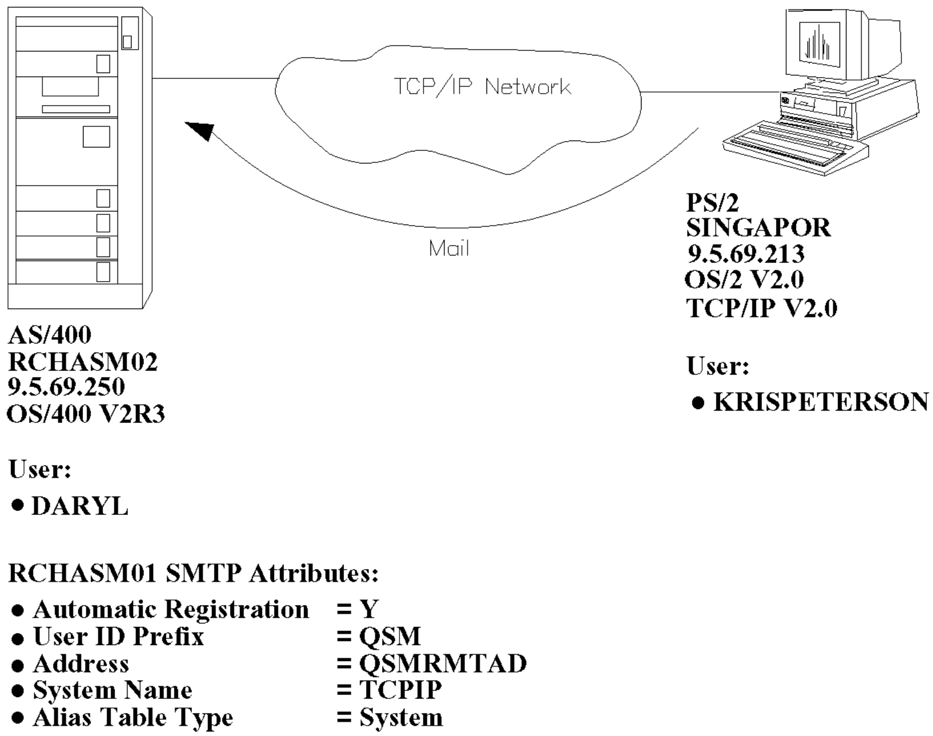

Figure 111. Sample Network for Automatic Registration

From the above network,

- KRISPETERSON of SINGAPOR wants to send mail to DARYL of RCHASM02.
- The system directory and alias tables of RCHASM02 do not contain entries for the incoming user KRISPETERSON.
- Once the mail is received by RCHASM02, SMTP will create a SNADS user ID QSM15 with address QSMRMTAD and system name TCPIP, and add it to the system directory. See Figure 112 on page 136. (QSM15 is only an arbitrary value. The ″xxxxx″ values in QSMxxxxx can range from 01 to 99999.)
- QSM15 is also added to the system alias table. It will correspond to the SMTP user ID KRISPETERSON@SINGAPOR. See Figure 113 on page 136.

```
                        Display Directory Entry Details

User ID/Address . . . . :   QSM15     QSMRMTAD
Description . . . . . . :   KRISPETERSON@SINGAPOR.RCHLAND.IBM.COM
System name/Group . . . :   TCPIP
User profile  . . . . . :
Network user ID . . . . :   QSM15     QSMRMTAD

Name:
  Last  . . . . . . . . :
  First . . . . . . . . :
  Middle  . . . . . . . :
  Preferred . . . . . . :
  Full  . . . . . . . . :

Department  . . . . . . :
Job title . . . . . . . :
Company . . . . . . . . :
                                                                     More...
Press Enter to continue.

F3=Exit   F12=Cancel   F14=Display X.400 O/R name
F18=Display location details
```

Figure 112. System Directory of RCHASM02 Updated with QSM15

```
                             Display Name for SMTP
                                                            System:   RCHASM02
User ID/Address . . . . . :   QSM15    QSMRMTHD


SMTP user ID  . . . . . . :   KRISPETERSON
SMTP domain . . . . . . . :   SINGAPOR.RCHLAND.IBM.COM




SMTP route  . . . . . . . :





Press Enter to continue.

F3=Exit   F12=Cancel
```

Figure 113. System Alias Table of RCHASM02 Updated with QSM15

The above example only describes a particular scenario whereby no directory or alias table entries at all were found. Table 5 on page 137 provides other possible scenarios.

Table 5. Creation of QSMxxxxx user IDs

Test Case No.	IF			THEN	
	Is remote user KRISPETERSON in RCHASM02 system directory ?	**Is remote user KRISPETERSON in RCHASM02 system alias table ?**	**Is remote user KRISPETERSON in Daryl's personal alias table ?**	**Changes to RCHASM02 system directory**	**Changes to RCHASM02 system alias table**
1	No	No	No	QSMxxxxx created	QSMxxxxx created
2	No	No	Yes *user id*-KRIS *address*-SINGAPOR *smtp id*-KRISPETERSON @SINGAPOR	QSMxxxxx not created but KRIS of SINGAPOR created	No change
3	No	Yes *user id*-KRIS *address*-SINGAPOR *smtp id*-KRISPETERSON @SINGAPOR	No	QSMxxxxx not created but KRIS of SINGAPOR created	No change
4	Yes *snads id*-KRIS *snads address*- SINGAPOR *system name*- TCPIP	No	No	QSMxxxxx created	QSMxxxxx created
5	Yes *snads id*-KRIS *snads address*- SINGAPOR *system name*- TCPIP	Yes *user id*-KRIS *address*-SINGAPOR *smtp id*-KRISPETERSON @SINGAPOR	No	No change	No change
6	No	Yes *user id*-*ANY *address*-SINGAPOR *smtp domain*- SINGAPOR	No	QSMxxxxx created	QSMxxxxx created[1]
7	Yes *snads id*-KRIS *snads address*- SINGAPOR *system name*- TCPIP	Yes *user id*-*ANY *address*-SINGAPOR *smtp domain*- SINGAPOR	No	QSMxxxxx created	QSMxxxxx created[1]

Notes:

1. QSMxxxxx user IDs are not generated if the SMTP user ID and domain of the sender is found in the alias table but the SNADS name listed in the alias table entry is not in the system directory (test cases 2 and 3). Notice that the SNADS name in the alias table is added to the system directory instead of the QSMxxxxx user IDs.

2. If the SMTP user ID and domain of the sender are each less than 8 characters, QSMxxxxx user IDs are not generated. The system directory is updated with the SMTP user ID as the SNADS user ID, the SMTP domain as the SNADS address and TCPIP (from SMTP attributes) as the system name. This scenario is not shown in the table because the domain name used in our example (Figure 111 on page 135) is longer than 8 characters – SINGAPOR.RCHLAND.IBM.COM.

[1] See Additional Notes (3)

3. Notice that if you specify *ANY in the system alias table, it does not apply to incoming mail (test cases 6 and 7). This explains why the QSMxxxxx user IDs are created. SMTP will look for exact matches for incoming mail.

6.3 Delimiters

Prior to V2R3, SMTP on the AS/400 system uses the question mark (?) as the default delimiter in SMTP user IDs to separate the SNADS user ID from the SNADS address.

For example, if a user on a non-AS/400 system wants to send mail to a user JAMES on the AS/400, he can specify the full SMTP address as follows:

```
JAMES?AS400SYS@AS400SYS.RCHLAND.IBM.COM
```

and when the mail arrives at the AS/400, the SMTP address will be “translated” into the SNADS address as shown in Figure 114 (assuming there are no alias table entries to do the SMTP to SNADS mapping). The first 8 characters before the delimiter becomes the SNADS user ID and the first 8 characters after the delimiter (but before the “@” or “%”) becomes the SNADS address.

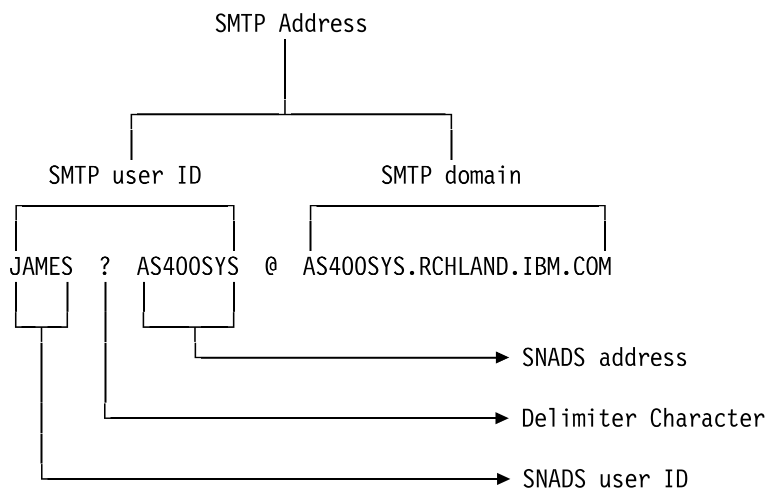

Figure 114. SNADS Name Is Built from SMTP User ID If No Alias Entries Exist

6.3.1 Supported Characters for Delimiters

With V2R3, the AS/400 supports the following characters as delimiter :

- Ampersand (&)
- Apostrophe (′)
- Asterisk (*)
- Dash (–)
- Dollar ($)
- Equal Sign (=)
- Forward Slash (/)
- Left and Right Parentheses ( )
- Period (.)
- Number sign (#)
- Plus (+)
- Question Mark (?)

- Quotation Marks (")
- Underline (_)

6.3.2 How to Change the Delimiter character

Before changing the delimiter character in the system, you have to be aware of the possible consequences. Changing the delimiter value causes the alias names that use the previous delimiter value to be unrecognized. It would also be advisable to inform all your remote host system administrators about the change so that they could change their alias tables accordingly. This will help prevent undeliverable mail.

To change the delimiter value,

1. Enter the command

   ```
   GO CFGTCP
   ```

2. Take option 13 from the Configure TCP/IP menu to change the SMTP attributes.

3. The following screen will be displayed.

```
                         Change SMTP Attributes
                                                        System:   RCHASM02
 Type choices, press Enter.

   Distribution retries first level:
     Retries . . . . . . . . . . . . . .   2            0-99
     Time interval . . . . . . . . . . .   1            0-99 (minutes)
   Distribution retries second level:
     Retries . . . . . . . . . . . . . .   1            0-9
     Time interval . . . . . . . . . . .   0            0-9 (days)
   Retry remote name server  . . . . . .   N            Y=Yes, N=No
   Automatic directory registration:
     Automatically add remote users to
       directory . . . . . . . . . . . .   Y            Y=Yes, N=No
     User ID prefix  . . . . . . . . . .   QSM
     Address . . . . . . . . . . . . . .   QSMRMTAD
     System name . . . . . . . . . . . .   TCPIP
     Alias table type  . . . . . . . . .   1            1=System
                                                        2=Personal
   User ID delimiter . . . . . . . . . . > ?

                                                                  More...
 F3=Exit   F12=Cancel
```

Figure 115. Change SMTP Attributes Display

4. Change the delimiter to the desired one.

5. To make this effective, you have to end and restart the QTMSMTP job in the QTCP subsystem and the TCPIPLOC job in the QSNADS subsystem. The QTMSMTP job is called the extended bridge function and it serves the QSMTPQ distribution queue. Before you end this job, make sure that no one is using SMTP in the system. Enter the command

   ```
   WRKSBSJOB QTCP
   ```

6. Look for the QTMSMTP and TCPIPLOC jobs and take option 4 to end it.

7. The QTMSMTP job will automatically be re-activated the next time mail is sent to the QSMTPQ distribution queue. The new delimiter value should be effective once this QTMSMTP job is restarted.

6.3.3 When to Use a Delimiter

A delimiter is normally not required when using SMTP. It is only required under one specific condition and this section will illustrate it.

In an AS/400 to AS/400 mail exchange (through SMTP), if the user on the remote AS/400 has a SNADS address that is different from the host system name, then a delimiter is required.

For example, suppose you are on the local AS/400 (LCLAS400) and you want to send mail to a user in a particular organization with an AS/400 (RMTAS400). In that organization, users are grouped into three departments – finance (FIN), marketing (MKT) and services (SVC). The system administrator categorizes them by giving them different SNADS addresses and the system directory is as shown in Table 6.

Assume that no alias table entries are defined in either system.

Table 6. Users in the RMTAS400 System Directory

SNADS user ID	SNADS address	System (Host) Name
SALLY	MKT	RMTAS400
DENNIS	FIN	RMTAS400
LUKE	SVC	RMTAS400

When you want to send mail to say, Sally, you would most probably define her User ID in your local system directory as shown in Table 7.

Table 7. LCLAS400 System Directory

SNADS user ID	SNADS address	System (Host) Name
SALLY 1	MKT	TCPIP
SALLY 2	RMTAS400	TCPIP

Without an alias table in your system to translate the SNADS name to an SMTP name, SMTP will automatically build the SMTP address. Thus if you use 1 to send the mail, SMTP will create the SMTP address as

```
SALLY@MKT
```

because SMTP assumes that your SNADS address is the remote host name. But if you use 2 to send the mail, then SMTP will create the SMTP address as

```
SALLY@RMTAS400
```

If the sending SMTP address is SALLY@MKT, then this mail will be rejected because the host MKT is not a valid one.

If the sending SMTP address is SALLY@RMTAS400, then when this mail arrives at RMTAS400, it will be translated (using the method described in Figure 132 on page 156) into the SNADS name SALLY RMTAS400, which is also not a valid SNADS name in RMTAS400. This mail will be returned to you with the error User SALLY not known.

To solve this problem, you have to define 2 alias table entries as in Figure 116 on page 141 and Figure 117 on page 141.

```
                          Add Name for SMTP
                                                        System:   LCLAS400
Type choices, press Enter.

  User ID . . . . . . . . .   SALLY      Character value, *ANY, F4 for list
  Address . . . . . . . . .   MKT        Character value, F4 for list

  SMTP user ID  . . . . . .   SALLY?MKT
  SMTP domain . . . . . . .   RMTAS400



F3=Exit   F4=Prompt   F12=Cancel
```

Figure 116. Add an Entry for SALLY MKT to System Alias Table of LCLAS400

```
                          Add Name for SMTP
                                                        System:   LCLAS400
Type choices, press Enter.

  User ID . . . . . . . . .   SALLY      Character value, *ANY, F4 for list
  Address . . . . . . . . .   RMTAS400   Character value, F4 for list

  SMTP user ID  . . . . . .   SALLY?MKT
  SMTP domain . . . . . . .   RMTAS400



F3=Exit   F4=Prompt   F12=Cancel
```

Figure 117. Add an Entry for SALLY RMTAS400 to System Alias Table of LCLAS400

Once this is done, if you send mail to either “SALLY MKT” or “SALLY RMTAS400”, the mail will be translated to the SMTP address SALLY?MKT@RMTAS400. This SMTP address will be correctly translated to “SALLY MKT” when the mail reaches RMTAS400.

6.4 Remote Name Server Retries

The Remote Name Server, if configured, is where the local system first sends a request to each time it needs to determine the internet address associated with a host system name. Refer to 3.3, “Name Server” on page 59 for more information about remote name servers.

Each time SMTP wants to send mail, TCP/IP will attempt to resolve the internet address of the remote system. Previously, an SMTP mail will be returned (in error) immediately to the sender if two conditions existed:

1. TCP/IP could not access the remote name server to resolve the internet address for the outgoing mail

2. The internet address was not in the local host table

In V2R3 (or V2R2 with the prerequisite PTFs), by specifying Y=Yes for retrying the remote name server, the remote name server will be accessed again if the attempt to resolve the internet address from the local host table is not successful. This will allow time for the problem with the remote name server to be resolved before the outgoing mail will be returned to the sender in error.

6.4.1 Enabling Remote Name Server Retries

There are two steps to enable the Remote Name Server retry function. The first step is to change the Remote Name Server access retry values and the second is to change the SMTP mail distribution retry values. For an example of how these values are used when a mail is sent, refer to 6.4.2, “Remote Name Server Retry Process” on page 144.

To change the Remote Name Server access retry values:

1. Select option 13 from the Configure TCP/IP menu to change the SMTP attributes.
2. The following screen will be shown. Specify the internet address of the remote name server as well as the frequency and retry interval values. Press Enter.

```
                        Change Remote Name Server
                                                          System:   RCHASM02
 Type choices, press Enter.

   Server address . . . . . . > 9.5.100.76            Internet address
   Server port  . . . . . . .   53                    0-65534
   Server protocol  . . . . .   *UDP                  *UDP, *TCP
   Retries  . . . . . . . . . > 3                     1-99
   Time interval  . . . . . . > 5                     1-99 (seconds)

 F3=Exit   F12=Cancel
```

Figure 118. Changing the Retry Values for Remote Name Server Access

To change the SMTP mail distribution retry values:

1. Select option 13 from the Configure TCP/IP menu to change the SMTP attributes.
2. The screen in Figure 119 on page 143 will be displayed. The parameters that need to be changed are the *first and second level distribution retries* as well as the *retry remote name server.* These will be the interval and frequency that SMTP will attempt to resend the mail. After changing, press Enter.

```
                          Change SMTP Attributes
                                                          System:   RCHASM02
Type choices, press Enter.

  Distribution retries first level:
    Retries . . . . . . . . . . . . . . > 4           0-99
    Time interval . . . . . . . . . . . > 1           0-99 (minutes)
  Distribution retries second level:
    Retries . . . . . . . . . . . . . . > 2           0-9
    Time interval . . . . . . . . . . . > 1           0-9 (days)
  Retry remote name server  . . . . . . > Y           Y=Yes, N=No
  Automatic directory registration:
    Automatically add remote users to
      directory . . . . . . . . . . . .   Y           Y=Yes, N=No
    User ID prefix  . . . . . . . . . .   QSM
    Address . . . . . . . . . . . . . .   QSMRMTAD
    System name . . . . . . . . . . . .   TCPIP
    Alias table type  . . . . . . . . .   1           1=System
                                                      2=Personal
  User ID delimiter . . . . . . . . . .   *DFT

                                                                More...
F3=Exit   F12=Cancel
```

Figure 119. Changing Remote Name Server Retries

3. You have to end and restart the QTMSMTP job in the QTCP subsystem to make the new SMTP attributes effective. The QTMSMTP job is called the extended bridge function and it serves the QSMTPQ distribution queue. Before you end this job, make sure that no one is using SMTP in the system. Enter the command

   ```
   WRKSBSJOB QTCP
   ```

4. Look for the QTMSMTP job and take option 4 to end it.

5. The QTMSMTP job will automatically be re-activated the next time a mail is sent to the QSMTPQ distribution queue. The new retry values should be effective once this QTMSMTP job has restarted.

6.4.2 Remote Name Server Retry Process

If a mail never reached its destination but is returned to the sender, then the question will arise: what is the minimum time it takes for the mail to be returned to the sender?

This question is answered in the following example:

Suppose that the remote name server retry function is enabled using the values as shown in Figure 120 and Figure 121.

```
                     Change Remote Name Server
                                                   System:   RCHASM02
Type choices, press Enter.

  Server address . . . . . .  9.5.100.76         Internet address
  Server port  . . . . . . .  53                 0-65534
  Server protocol  . . . . .  *UDP               *UDP, *TCP
  Retries  . . . . . . . . .  3                  1-99
  Time interval  . . . . . .  5                  1-99 (seconds)

F3=Exit   F12=Cancel
```

Figure 120. Remote Name Server Access Retry Values

```
                       Change SMTP Attributes
                                                   System:   RCHASM02
Type choices, press Enter.

  Distribution retries first level:
    Retries . . . . . . . . . . . . . .  2           0-99
    Time interval . . . . . . . . . . .  1           0-99 (minutes)
  Distribution retries second level:
    Retries . . . . . . . . . . . . . .  0           0-9
    Time interval . . . . . . . . . . .  0           0-9 (days)
  Retry remote name server  . . . . . .  Y           Y=Yes, N=No
                                                             More...
F3=Exit   F12=Cancel
```

Figure 121. SMTP Mail Distribution Retry Values

The sequence of events are summarized in Figure 122 on page 145.

Caution: This example only focuses on the remote name server retry process. It does not include cases where the mail is sent across to the remote system but is rejected for some other reasons. It also does not take into consideration if a mail router is configured. 6.5.2, "Mail Router Considerations" on page 147 provides a more complete picture where a mail router is used in conjunction with a remote name server.

```
TCP/IP tries           TCP/IP will                       SMTP will wait
to access R.N.S   n    search local  n                   for 1 min before
3 times at 5 sec ----> host table ---------------------> trying to send
intervals          ^   for internet                      the mail again
Successful?        |   address of                               |
    |              |   remote host                              |
    |y             |   Found?                                   |
    |              |        |y                                  |
    v              |        v                                   |
Is internet        |   SMTP sends                               |
address of   n     |   mail to                                  |
remote host -------+   remote host                              |
available                                                       |
in name server?                                                 |
    |y                                                          |
    v                                                           |
SMTP sends                                                      |
mail to                                                         |
remote host                                                     |
                                                                |
    +-----------------------------------------------------------+
    v
TCP/IP will try                                          SMTP will wait
to access R.N.S   n                                      for 1 min before
3 times at 5 sec ------------------------------------->  trying to send
intervals again                                          the mail again
Successful?                                                     |
    |y                                                          |
    v                                                           |
Is internet            Returns mail                             |
address of   n         to sender                                |
remote host ---------> - Host not                               |
available                known                                  |
in name server?                                                 |
    |y                                                          |
    v                                                           |
SMTP sends                                                      |
mail to                                                         |
remote host                                                     |
                                                                |
    +-----------------------------------------------------------+
    v
TCP/IP will try                                  Remote Name Server and
to access R.N.S   n                              SMTP retries have been
3 times at 5 sec ------------------------------> exhausted.  Mail is
intervals again                                  returned to sender
Successful?                                      - Host not known
    |y                                           **** End of Search ****
    v
Is internet            Returns mail
address of   n         to sender
remote host ---------> - Host not
available                known
in name server?        * End of Search *
    |y
    v
SMTP sends
mail to                                       Legend :
remote host                                     R.N.S = Remote Name Server
```

Figure 122. Example of Remote Name Server Retry Process

6.5 Mail Router

The mail router function allows you to specify an alternative system to which your outgoing mail is routed to if your local system is unable to deliver the mail to the destination system as specified in your note.

6.5.1 Mail Router Example

Consider the following network where a user DARYL on AS/400 RCHASM01 is trying to send mail to a user MARK on an RS/6000 RCHRS001.

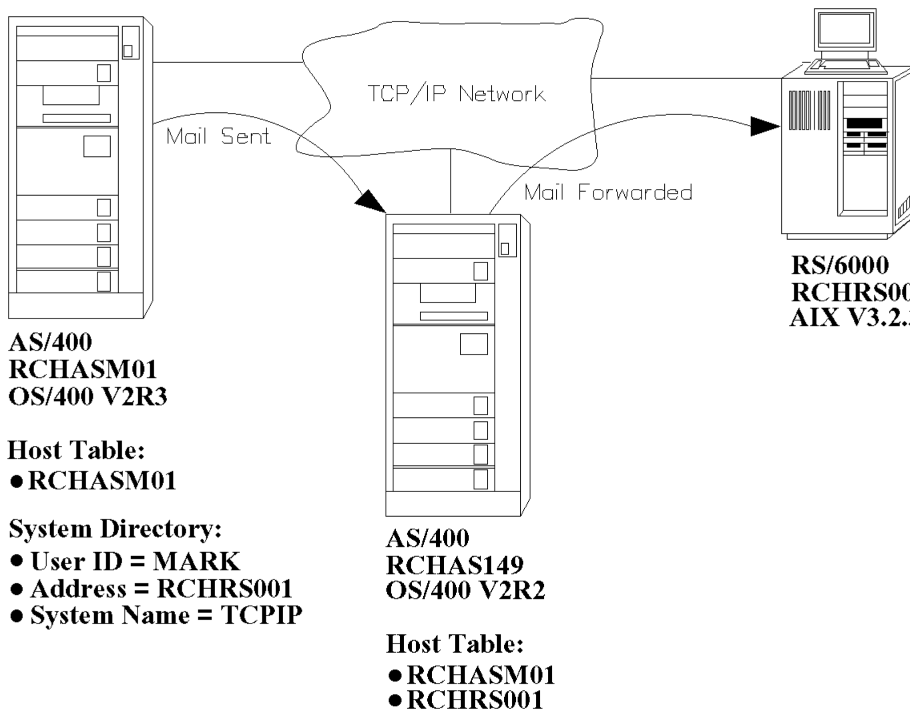

Figure 123. Sample Network for Mail Routing

To set the scenario, consider the following facts :

- RCHASM01 can PING to RCHAS149 but cannot PING to RCHRS001 (because it does not have RCHRS001 in its host table).
- RCHAS149 can PING to both RCHRS001 and RCHASM01.
- The remote user MARK is defined in the source system RCHASM01 directory.
- No alias tables are defined in the source and intermediate systems at all.
- If DARYL of RCHASM01 tries to send mail to MARK of RCHRS001, he will get a message that the mail cannot be delivered – "Host RCHRS001 not known".

To circumvent the above problem, you can define RCHAS149 as the mail router for RCHASM01. This will cause any mail that is meant for RCHRS001 to be routed through RCHAS149.

Defining a Mail Router in RCHASM01

In general, for a system to be a mail router, the pre-requisite is a host table that contains both the source and target systems. Therefore, you have to define both RCHASM01 and RCHRS001 in the host table of RCHAS149.

To define a mail router in RCHASM01:

1. Type CFGTCP on the command line.
2. You will be shown the Configure TCP/IP screen. Select option 13 to change the SMTP attributes.
3. Specify the mail router as shown in Figure 124. The mail router name has to be preceded with an "@" character. Hit enter.

```
                         Change SMTP Attributes
                                                     System:   RCHASM01
 Type choices, press Enter.

   Mail router . . . . . . . . . . . .   @RCHAS149.RCHLAND.IBM.COM




 F3=Exit   F12=Cancel
```

Figure 124. Defining a Mail Router

4. The above changes will take effect when the QTMSMTP job in the QTCP subsystem is ended and restarted. Before ending this job, make sure that no one is using SMTP in the system. Enter the command

   `WRKSBSJOB QTCP`

5. Look for the QTMSMTP job and take option 4 to end it.
6. The QTMSMTP job will automatically be re-activated the next time a mail is sent to the QSMTPQ distribution queue.

6.5.2 Mail Router Considerations

It is important to know some of the following considerations before implementing the mail router function.

1. The mail router function is only available with V2R3 (or V2R2 with pre-requisite PTFs). Therefore, the source system where you want to configure a mail router has to be at one of these system levels.
2. The intermediate system that is used as the mail router need not be an AS/400. The only thing that is required on this system is a host table that contains all the host systems it needs to route mail to.

   Note: If an AS/400 is used as the mail router (as in 6.5.1, "Mail Router Example" on page 146), it need not be at any particular system level.

3. There can only be one intermediate system for routing between the source and target systems. That is, no nesting of mail router is allowed. To illustrate this, look at Figure 125 on page 148.

```
  Source              Intermediate Systems              Target
  System                                                System

 ┌────┐              ┌────┐              ┌────┐              ┌────┐
 │Host│              │Host│              │Host│              │Host│
 │ A  │─────────────►│ B  │─────────────►│ C  │─────────────►│ D  │
 │    │              │    │              │    │              │    │
 └────┘              └────┘              └────┘              └────┘

Host Table:          Host Table:         Host Table:
- A, B               - A, B, C           - A, B, C, D

Mail Router:         Mail Router:
- B                  - C
```

Figure 125. Limitations of a Mail Router

D is not defined in the host tables of A and B. Mail routers are defined in systems A and B. If a user (USER1) in A sends mail to a user (USER2) in D, USER1 will receive a message that the mail cannot be delivered. A typical error message returned to USER1 is shown in Figure 126.

```
View Mail           |Skip                    |    |    |Adapted     |Pg 1
GNYT074956,*INTDOC                           |Typestyle 86 (12p)    |Ln 1
<2....:....3....:....4....:....5....v....6....:....7....:....8....:....9
*
Date: Sat, 20 Nov 93 15:07:00 .
From: QGATE@A.RCHLAND.IBM.COM
To: USER1?A@A.RCHLAND.IBM.COM
Subject: Undeliverable Mail

Host A.RCHLAND.IBM.COM not able to deliver mail to following recipient
    <@B.RCHLAND.IBM.COM:USER2@D>
A.RCHLAND.IBM.COM received negative reply from host:
    B
550 Host system D not known.
```

Figure 126. A Sample Undeliverable Mail

This shows that if the first mail router system (B) is unable to route the mail from source system (A), it will return an error message to A immediately. B will not activate the second mail router (C) because a mail router cannot call another mail router (no nesting).

4. The function of a mail router is similar to that of an SMTP route (See 6.1.3, “When to Use an Alias Table” on page 130 for an example of how to define an SMTP route). Both serve the purpose of routing mail items through intermediate system(s). However, there are major differences between them and Table 8 on page 149 spells out the important ones.

Table 8. Differences between a Mail Router and an SMTP Route	
Mail Router	**SMTP Route**
• Only one mail router is defined in a system. • No need to define the exact route for every remote host. • Only one intermediate system is allowed.	• Many SMTP routes are defined in a system. Each route will normally point to a specific remote host system. • Exact route to remote hosts has to be explicitly defined. That is, all intermediate systems have to be defined. • Several intermediate systems are allowed.

5. Section 6.4.2, "Remote Name Server Retry Process" on page 144 has provided a flow diagram of an example of how mail is routed when a remote name server is configured. However, when a mail router is used together with a remote name server, the routing process becomes more complicated. Figure 127 on page 150 provides a better understanding of this type of routing process.

   Note: The flow diagram in Figure 127 on page 150 is valid only if the PTF SF15326 is applied for V2R3. For V2R2 the PTF required is SF14866.

   Once the mail router receives the mail from the source system, it takes over the responsibility of delivering the mail to its destination. The flow diagram does not illustrate this because different mail routers have different ways of routing a piece of mail. If the mail router fails to deliver the mail successfully, it will pass the mail back to the source system with the appropriate error messages. Some common error messages are Host not known and User not known.

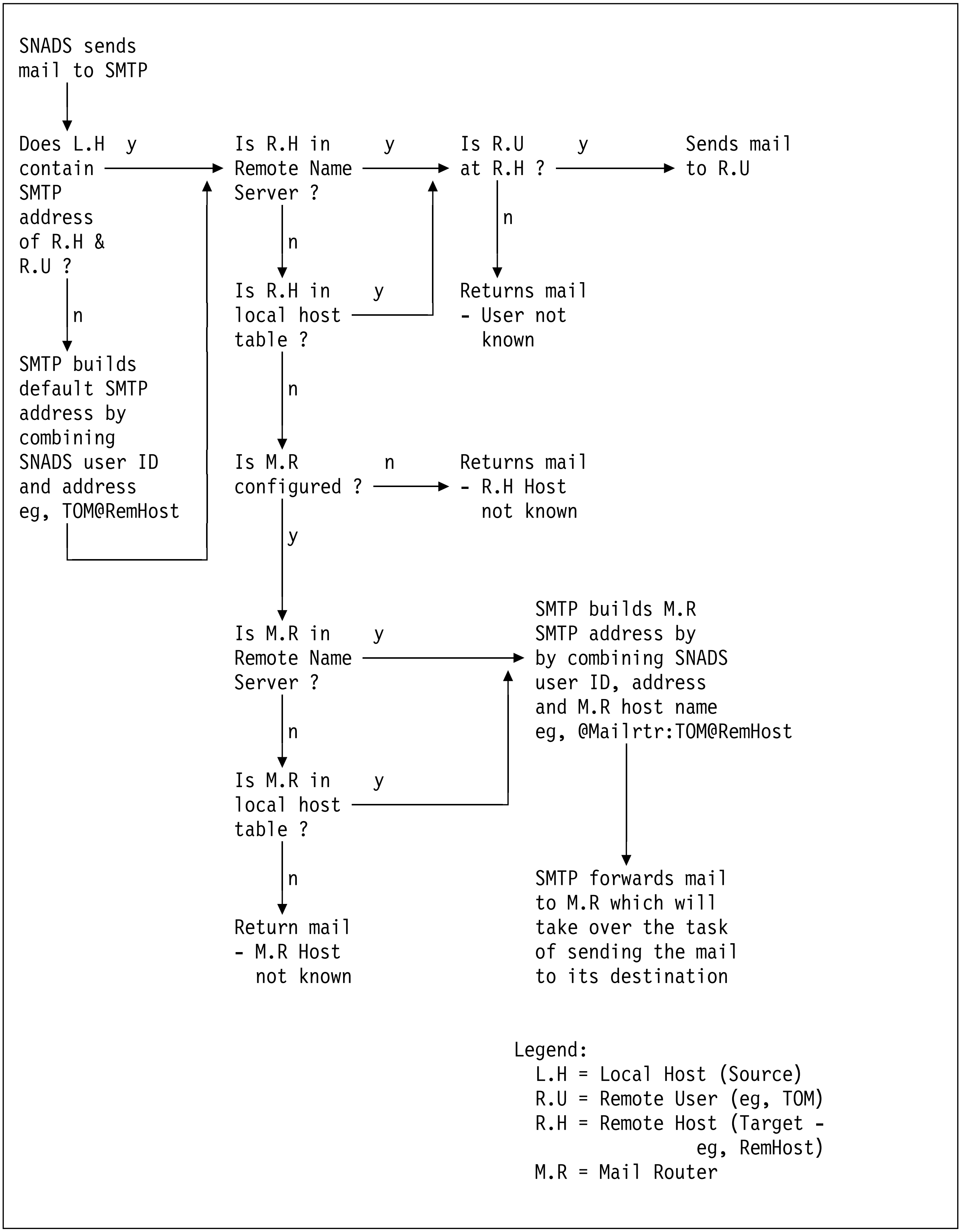

Figure 127. Decision Tree for Routing Mail in the Local Host (with PTF applied)

6.6 SNADS/SMTP Interrelationship

This section describes the interrelationship between SNADS and SMTP. It assumes that the mail router and remote name server are not configured so as to keep the explanation simple and easy to understand.

6.6.1 Sending Mail

Figure 128 on page 152 and Figure 129 on page 153 show how notes, messages and documents are routed through SNADS and SMTP when mail is sent. In this example, a message is being sent to user KRIS at a host named SINGAPOR. That is, the *recipient* is KRIS at SINGAPOR.

Mail goes through two phases before finally reaching their destination. In Phase 1, the AS/400 determines if the mail is meant to be sent over a TCP/IP link using SMTP. In Phase 2, SMTP determines where and how to send the mail to its destination.

PHASE 1 (Sending Mail)

1. To send a note, message, or document, the sender must specify a user ID and address. SNADS then searches the system directory for this user ID and address **1**.

   The system directory can have entries for individual users (local users have individual entries), or it can have group entries. Group entries have *ANY in the user ID portion, and an address in the address portion. There can also be only one entry that has *ANY in both the user ID and address portions though this is not recommended for TCP/IP because it may cause indefinite looping.

   a. When searching the system directory, SNADS scans the individual entries first. If a match is found, that entry is used.

   b. If no match is found, SNADS scans the group entries, looking for a match on the address portion only.

   c. If a match is found, that entry is used. If no match is found, the “*ANY *ANY” is used.

   d. If there is no “*ANY *ANY” entry, a message is returned to the sender indicating that the user ID or address is invalid. SNADS must find some sort of match in the system directory before it sends mail.

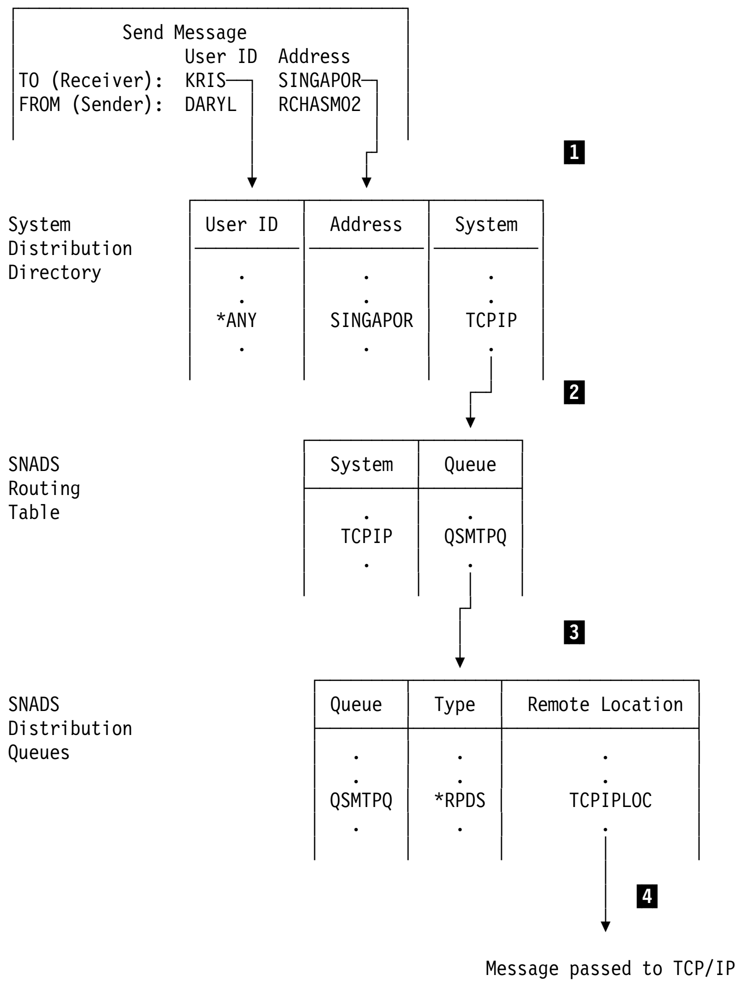

Figure 128. SNADS/SMTP Interrelationship—Phase 1 (Send Mail)

2. Once SNADS has found a match in the system directory, it takes the system name (normally TCPIP) specified in that entry and searches the SNADS routing table for a matching entry **2**.

   The distribution queue that is associated with this system name will be the queue used to send mail to the destination system. SNADS can have many distribution queues, but there is only one configured for SMTP - QSMTPQ.

3. The QSMTPQ queue will tell QSNADS which location **3** to direct the mail to first; that is, the first location in the chain to get the mail to its final destination.

   Because “TCPIPLOC” is specified as the remote location parameter of the QSMTPQ queue, SNADS will pass the mail to TCP/IP **4**.

Phase 1 (steps **1** through **4** in Figure 128) will occur regardless of where the mail is sent. Once a mail has been placed on the QSMTPQ for delivery and the SMTP bridge job is started, Phase 2 begins.

PHASE 2 (Sending Mail)

Once SMTP has received the mail, it uses its own configuration tables to determine exactly where to send the mail.

1. SMTP takes the *recipient's* user ID (KRIS) and address (SINGAPOR) from the mail and searches the alias tables **5**.

   There are two types of alias tables as described in 6.1.1, "Types of Alias Tables" on page 128. The personal alias table for DARYL will be searched first, and if a matching entry is not found or if DARYL does not have a personal alias table, then the system alias table is searched. This redbook will only focus on the system alias table.

```
        Message passed from
           SNADS to SMTP
                 |
                 v
 ┌──────────────────────────────────────┐
 │          Send Message                │
 │                User ID  Address      │
 │TO (Receiver):  KRIS──┐  SINGAPOR──┐  │
 │FROM (Sender):  DARYL │  RCHASM02  │  │
        ┌─────────────────┘            │
        │            ┌─────────────────┘
        v            v                5      System Alias Table
 ┌────────────┬────────────┬───────────────┬────────────────────────────┐
 │ Receiver's │ Receiver's │     SMTP      │       SMTP Domain or       │
 │  User ID   │  Address   │    User ID    │         SMTP Route         │
 ├────────────┼────────────┼───────────────┼────────────────────────────┤
 │     .      │     .      │       .       │             .              │
 │     .      │     .      │       .       │             .              │
 │    *ANY    │    HPUX    │               │    HPUX.RCHLAND.IBM.COM    │
 │    KRIS    │  SINGAPOR  │ KRISPETERSON  │ SINGAPOR.RCHLAND.IBM.COM   │
 │     .      │     .      │       .       │             .              │
                                                         │
              ┌──────────────────────────────────────────┘
              v                                            6
 ┌─────────────────────────┬──────────┐
 │        Host Name        │ Internet │   Local Host
 │                         │ Address  │   Table
 ├─────────────────────────┼──────────┤
 │            .            │    .     │
 │            .            │    .     │
 │ SINGAPOR.RCHLAND.IBM.COM│9.5.69.213│
 │            .            │    .     │
                                 │
        ┌────────────────────────┘
        v                      7
 ┌──────────┬──────────┬────────────┐
 │ Network  │   Line   │ First Hop  │   TCP/IP
 ├──────────┼──────────┼────────────┤   Route
 │    .     │    .     │     .      │   Entries
 │    .     │    .     │     .      │
 │    9     │ ITSCTRN  │   *HOME    │
 │    .     │    .     │     .      │
                 │            │
                 v            v
         Mail sent directly to internet
         address 9.5.69.213 via line ITSCTRN.
         The destination user is KRISPETERSON
         of SINGAPOR.RCHLAND.IBM.COM.
```

Figure 129. SNADS/SMTP Interrelationship – Phase 2 (Send Mail)

2. Thus assuming that DARYL does not have a personal alias table, SMTP will search the system alias table for a match on the user ID (KRIS) and address (SINGAPOR).

   a. If a match is found, the SMTP user ID and domain specified with this matching entry is used as the destination SMTP address. Recall from Figure 102 on page 128 that the SMTP address is a concatenation of the SMTP user ID and domain. In this example, the complete SMTP address of the receiver (the "TO" SMTP address) will be

      ```
      KRISPETERSON@SINGAPOR.RCHLAND.IBM.COM
      ```

      If an SMTP route is defined instead of an SMTP domain, then it will be used.

   b. If no match is found, SMTP will continue to search the group entries (*ANY) for a match in the address portion only. If a match is found, then the SMTP domain name associated with it will be used.

   c. If there is no entry in the system alias table for KRIS of SINGAPOR at all (including group entries), then SMTP will "build" its own SMTP address. It makes KRIS (SNADS user ID) as the SMTP user ID and SINGAPOR (SNADS address) as the SMTP domain. SMTP then searches the host table for SINGAPOR, and if found, the complete SMTP address will be KRIS@SINGAPOR. The mail will then be sent to KRIS@SINGAPOR.

3. SMTP will then use the domain name (SINGAPOR.RCHLAND.IBM.COM) it found in the alias table to search the host table ***** for a matching host name and its associated internet address **6**.

4. The mail will then be sent to this internet address using the route specified in the TCP/IP route entries **7**.

The above steps have shown how we can determine the "TO" SMTP address (KRISPETERSON@SINGAPOR.RCHLAND.IBM.COM).

The "FROM" SMTP address is determined also from the system alias table. There is a search for DARYL of RCHASM02 but if it is not found, then SMTP will also "build" its own "FROM" SMTP address. The SNADS user ID (DARYL) and SNADS address (RCHASM02) will be concatenated together, separated by a *delimiter* character (default delimiter is "?"), to form the SMTP user ID. The SMTP domain will be the local AS/400 system name (RCHASM02) concatenated with the local domain name (see Figure 102 on page 128). Therefore, the complete "FROM" SMTP address would be

```
DARYL?RCHASM02@RCHASM02.RCHLAND.IBM.COM
```

***** If a *Remote Name Server* is configured (see 6.4, "Remote Name Server Retries" on page 141 on how it is done), the local system (AS/400) will first send a request to the remote name server each time it wants to send mail. It will attempt to resolve the internet address of the SINGAPOR system using the remote name server's host table. If it is not found, then it will search its own host table as in step **6**. Please take note of this sequence of search.

6.6.2 Receiving Mail

Figure 130 shows how notes, messages, and documents are routed through SNADS and SMTP when mail is received.

In this example, a user DARYL on the AS/400 (RCHASM02) receives a message from GRACELEE of HPUX. Thus the receiver is DARYL and the sender is GRACELEE.

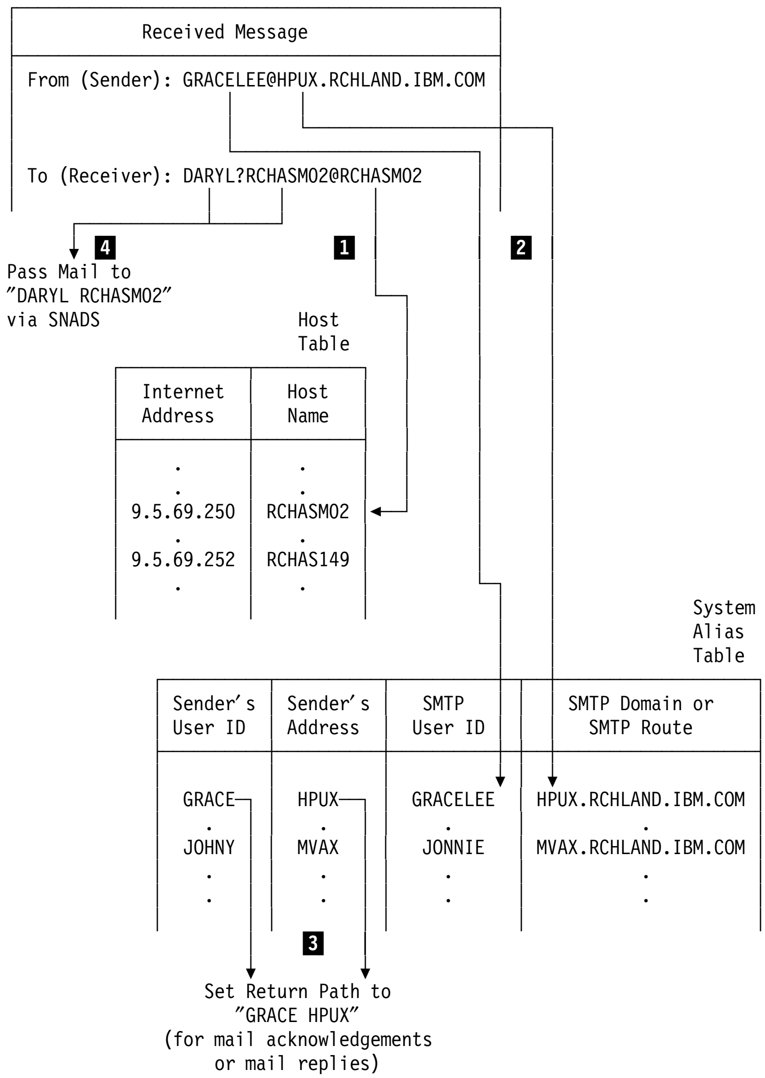

Figure 130. SNADS/SMTP Inter-Relationship—Receive Mail

1. When SMTP receives a mail item in the AS/400, it verifies that the SMTP domain of the receiver (RCHASM02) is a valid one **1**. It does this by checking against the local host table. If the domain name is not valid, the mail item will be rejected.

2. Next, the SNADS user ID and address of the receiver will be determined.

   a. If the receiver's SMTP user ID contains a delimiter character (? is the default), the first 8 characters before the "?" will become the SNADS user ID. The first 8 characters after the "?" but before the "@" or "%" will be the SNADS address. Figure 131 on page 156 illustrates this.

```
    SMTP user ID              SMTP domain
 ┌─────────────────┐     ┌───────────────────────┐
 │                 │     │                       │
DARYL  ?  RCHASM02  @  RCHASM02.RCHLAND.IBM.COM
 │   │    │       │
 └─┬─┘    └───┬───┘
   │          │
   │          │
   │          └─────────────────────────► SNADS address
   │
   └────────────────────────────────────► SNADS user ID
```

Figure 131. Determining the SNADS User ID from SMTP User ID

b. If the SMTP user ID of the receiver does not contain a delimiter, SMTP will search the system alias table for a matching SMTP user ID and domain. If a match is found, then the SNADS user ID and address associated with this match will be used.

c. If there is no match in the system alias table, SMTP will take the first 8 characters before the "@" or "%" to be the SNADS user ID and the first 8 characters after the "@" (but before the first period) to be the SNADS address. See Figure 132.

```
Suppose an incoming message is for the following user:

  JOHNLONG % HP9000UNIX @ HP9000UNIX.RCHLAND.IBM.COM
  │      │                │      │
  └──────┘                └───┬──┘
     │                        │
     │                        └──────► SNADS address
     │
     └───────────────────────────────► SNADS user ID

SMTP will deliver this message to a user in the system with
SNADS user ID JOHNLONG and address HP9000UN.
```

Note: If "JOHNLONG HP9000UN" is not in the local system directory, the mail will be returned to the sender as undelivered. But if this system is acting as the mail router for the sending (source) system, then this system will attempt to forward the mail to the destination, which is HP9000UN in this case.

Figure 132. How SMTP Builds its own SNADS User ID and Address

3. Next, the SNADS user ID and address of the sender will be determined **2**. This allows the receiver to reply to the sender. That is, it sets a return path to the sender **3**.

   a. First, the personal alias table of the receiver (DARYL) is checked for a match in the SMTP user ID and domain of the sender (GRACELEE). If a match is found, the SNADS user ID and address for this entry is used.

b. Assuming that DARYL does not have a personal alias table, SMTP will search the system alias table for a match in SMTP user ID and domain. If a match is found, the SNADS user ID and address associated with this match is used.

Note: *ANY group entries in the alias table are not applicable because SMTP will look for exact matches when receiving mail.

c. If SMTP cannot resolve the SNADS user ID and address, it means that the remote sender is unknown to the AS/400. There are two possibilities here :

(i) If you have indicated in the Change SMTP Attributes that you do not want the AS/400 to automatically register the remote sender to the local system directory, the mail will not be able to be replied to. If the receiver tries to reply to this mail, an error message ″User GRACELEE not found in system directory″ will be received.

(ii) If the AS/400 is set to automatically register remote senders, then a QSMxxxxx user ID will be generated for the sender and added to the system directory and alias table. QSMxxxxx user IDs are system-generated SNADS IDs. Refer to 6.2, "Automatic Registration of Incoming Users" on page 133 for more details on automatic registration.

4. Therefore, once SMTP has determined who the receiver is ("DARYL RCHASM02") the "Receive Mail" process is said to be successful, and the mail will be passed through SNADS into the mailbox of the receiver (DARYL). Whether the sender is resolved or not does not prevent the mail from being delivered.

6.7 Using SMTP Without OfficeVision/400

This section describes how to send and receive SMTP messages without using the OfficeVision/400 interface.

6.7.1 Sending a Message

Mail can be sent without using IBM OfficeVision/400 by using the SNDDST (Send Distribution) command. This command does not support notes. Enter the command

```
SNDDST
```

and press the F4 key. Figure 133 on page 158 shows the first command prompt screen for SNDDST. The highlighted information was entered.

```
                          Send Distribution (SNDDST)
Type choices, press Enter.
Information to be sent . . . . . > *MSG         *MSG, *DOC, *FIL
Recipient:
  User ID  . . . . . . . . . . . > JOHN            Character val
  Address  . . . . . . . . . . . > RCHAS149        Character value
             + for more values
Description  . . . . . . . . . . > 'Message 1'
Message  . . . . . . . . . . . . > 'Test message using SNDDST.'
Confirmation of delivery . . . .   *NO          *NO, *YES
Personal . . . . . . . . . . . .   *NO          *NO, *YES
Priority . . . . . . . . . . . .   *NORMAL      *NORMAL, *HIGH
                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Figure 133. SNDDST Prompt

The important parameters are *Information to be sent*, *User ID*, *Address*, *Description*, and *Message*. The *Information to be sent* parameter indicates the type of distribution being sent. *MSG is a message, *DOC is a document, *FILE is a document file and *IDP is an Interchange Document Profile.

The *User ID* and *Address parameters* identify the receiver and are the same as would be specified if IBM OfficeVision/400 were being used. The *Description* parameter describes the distribution and is a required parameter. Any character string up to 44 characters can be specified. The *Message* parameter is the text of the message to be sent.

Note: The SNADS commands SNDNETSPLF, SNDNETMSG, and SNDNETF are not supported by SMTP.

6.7.2 Receiving a Message

Mail can be received without using OfficeVision/400 by using the RCVDST command. In order to be able to use this command, you must know the distribution ID of the incoming mail item. This is determined by using the QRYDST (Query Distribution) command.

If the QRYDST command is executed without specifying any parameters, a one-line message will be returned to the bottom of the screen indicating if there is any incoming mail for the current user. No further information is supplied with this message. To get this information, it is necessary to re-execute the QRYDST command and specify an output file. After the command is executed, the output file will contain one record per incoming mail item, together with the contents of the mail.

For example, if the QRYDST command is executed as such:

```
QRYDST OPTION(*IN) OUTFILE(QGPL/DST)
```

a file called DST in library QGPL would be created with one record added as shown in Figure 134 on page 159.

.

```
                          Display Physical File Member
 File . . . . . . :   DST         Library  . . :  QGPL         Record       1
 Member . . . . . :   DST         Size . . . . :    160        Column       1
 Control  . . . . .
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
000001HPUX    TOM     0048JOHN    RCHAS149TOM     HPUX    199311200933000000002

                           ****** END OF DATA ******
                                                                       Bottom
 F3=Exit      F10=Display hexadecimal     F12=Cancel
 F19=Left     F20=Right
```

Figure 134. Display Physical File Member (DSPPFM) of Output File DST

The distribution ID is found in positions 7 to 26 of this record. In this case, it is

```
HPUX    TOM     0048
```

which is the host name, user ID of the sender and the sequence number. With this information, the RCVDST command can now be used. Figure 135 shows the first command prompt screen for RCVDST. The highlighted information was typed in.

```
                          Receive Distribution (RCVDST)
 Type choices, press Enter.
 Distribution identifier  . . . . > 'HPUX    TOM     0048'
 User identifier:
   User ID  . . . . . . . . . . . > *CURRENT      Character value, *CURRENT
   Address  . . . . . . . . . . . >               Character value
 Document . . . . . . . . . . . .   *NONE         Name, *NONE
 In folder  . . . . . . . . . . .   *NONE
 File to receive output . . . . . > MSG           Name, *NONE
   Library  . . . . . . . . . . . >   QGPL        Name, *LIBL, *CU
 Output member options:
   Member to receive output . . .   *FIRST        Name, *FIRST
   Replace or add records . . . .   *REPLACE      *REPLACE, *ADD
 Type of data for output  . . . .   *DFT          *DFT, *ALL, *DSTINFO, *MSG...
              + for more values
 Acknowledge receipt  . . . . . .   *YES          *YES, *NO
 Distribution ID extension  . . .   *NONE         1-99, *NONE
                                                                      More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 135. RCVDST Prompt

The important parameters are *Distribution identifier*, *Document*, and *File to receive output*. The Distribution identifier is that which was determined from the QRYDST output file command.

The mail item can either be received into a document or a file, so either must be specified. If neither is specified, the distribution will be deleted from the incoming mail. If *file name* is specified, a file is created with a record length of 615 bytes. It contains records with special DCA (Document Content Architecture) codes. The content of the message is placed into one or more of these records in such a way as to fill up the available space in each record. So, if this file is displayed, the message appears as one or more long strings of text.

If *document name* is specified, a document is created. Documents can be displayed on the AS/400 by using OfficeVision/400 or a PC with AS/400 PC Support (documents are stored in folders that can be accessed through shared folders function).

In summary, the steps to receive mail without OfficeVision/400 are:

1. Execute the QRYDST command to determine if there is any incoming mail.
2. If there is incoming mail, re-execute the QRYDST command and specify an output file.
3. Display the contents of the output file to determine the distribution ID.
4. Execute the RCVDST command to receive the mail, specifying the distribution ID and an output file to contain the mail.

Receiving mail without OfficeVision/400 is not a task for end users. It may be necessary to write a program to perform the above steps, receive the mail into a file and then display the file in a more readable manner.

Note: The QSNADS and QTCP subsystems must be started to be able to send and receive mail.

6.8 Using SMTP With Non-AS/400 Systems

The configuration process for SMTP is described in detail in section 2.5, "Using SMTP" on page 34. Using SMTP with systems other than an IBM AS/400 requires no special configuration. The host names should be added to the host table and entries may be required in the alias table. An alias table entry is only required for non-AS/400 systems if the user ID on the other system has greater than 8 characters or contains special characters. For more considerations on using alias tables, refer to 6.1, "Alias Tables" on page 127.

The term *other systems* is used to refer to all systems other than an AS/400.

6.8.1 Sending Mail from AS/400 to Non-AS/400 Systems

The process of sending mail through SMTP from an AS/400 to other systems is the same as for sending mail to another AS/400 except for user ID/user address being separated by "?". Most implementations of SMTP only have a one part name for the user ID.

There may be certain peculiarities associated with specifying the SMTP user IDs and domain names. For example, some systems implement sub-locations within the SMTP user ID. To be able to send mail to these systems it is necessary to be familiar with the naming syntax, so that alias table entries can be created on the AS/400 to convert the SNADS names to these special SMTP names. Alias table entries will also be required if mail is to be sent to users with SMTP user IDs or domain names longer than 8 characters.

Refer to section 6.6, "SNADS/SMTP Interrelationship" on page 151 for information on how mail is sent from an AS/400.

6.8.2 Sending Mail from Non-AS/400 to AS/400 Systems

Users on other systems need to be aware that users on the AS/400 are identified by a three-part name. That is, a SNADS user ID, a SNADS address and a system name. The SNADS user ID and address are combined (separated by a delimiter character) to form the SMTP user ID. That is, in the form:

```
userid?address
```

The SMTP domain or host name is specified in the normal manner by separating it from the SMTP user ID with an @. That is, in the form:

```
userid?address@SMTP domain
```

Refer to section 6.6, "SNADS/SMTP Interrelationship" on page 151 for information on how incoming mail is handled on the AS/400.

6.9 Office Gateway Between SNADS and SMTP

Customers who have a network that use SNADS and an office application for mail distribution may also want to connect to another network where TCP/IP and SMTP are used for mail distribution. These two logical office networks can be interconnected by using an AS/400, with both SNADS and TCP/IP configured, as an *office gateway*. Figure 136 shows an example of a mixed office network.

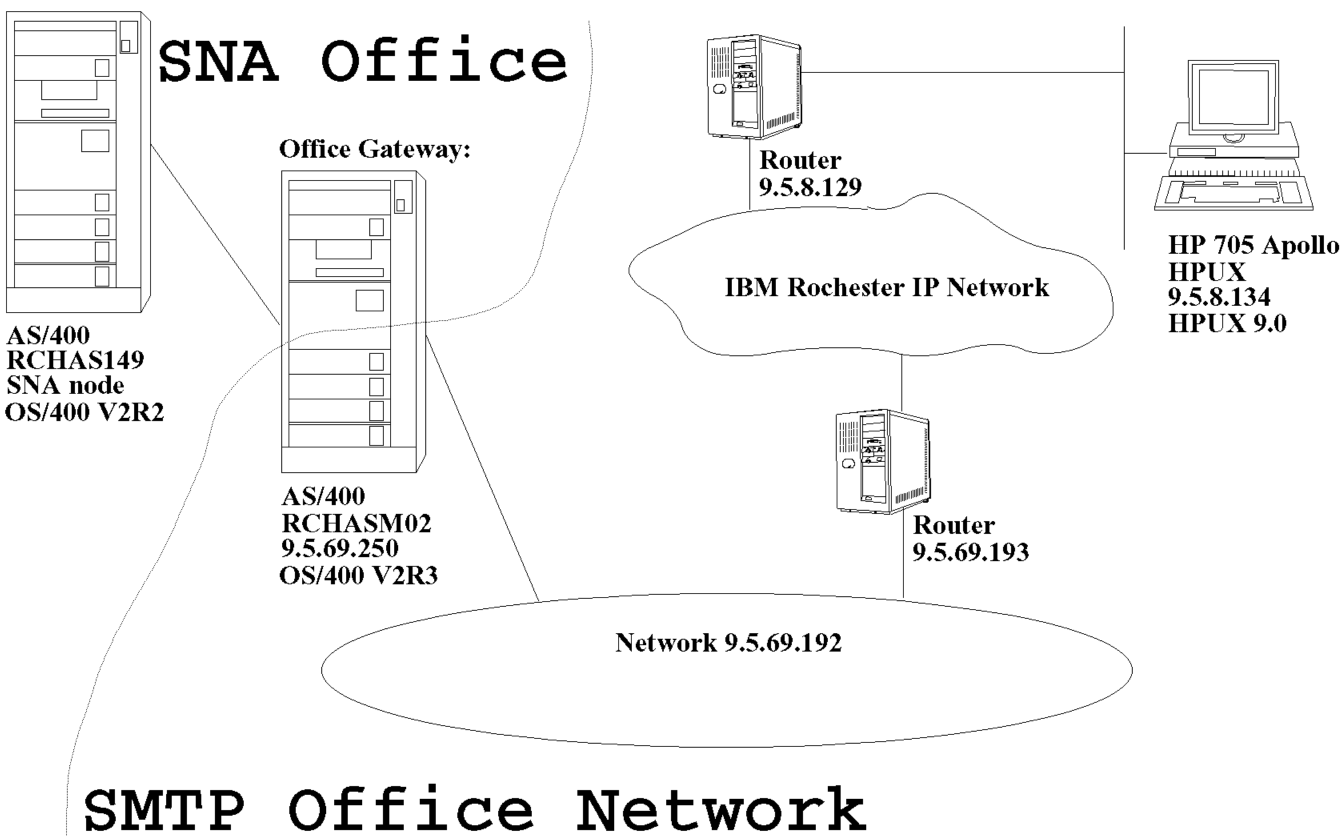

Figure 136. SNADS/SMTP Office Gateway

Any user on any system in the SNA office network is able to use the services of the office gateway to route mail to users in the SMTP office network. The systems in the SNA network use SNADS to send their mail to the office gateway. The mail is converted from a SNADS distribution to an SMTP distribution at the office gateway host, and is sent to the destination host using the SMTP function. The office gateway is the *only* system in the SNA office network that needs TCP/IP installed.

In our network example (as shown in Figure 136 on page 161) all the SNA systems were connected to the same token-ring LAN and the gateway to the SMTP network was also through token-ring, but this need not be the case. The connection to the SNA office network can be through any SNA connection type supported by the AS/400 and the connection to the SMTP office network can be through any TCP/IP connection type supported by the AS/400.

Additional configuration must be carried out before you can use the AS/400 as an office gateway to the SMTP network. The following examples will show how the AS/400 is used as a SNADS/SMTP office gateway. The first example provides a simple setup whilst the second one serves to demonstrate how the automatic registration function is implemented together with the office gateway function. The network diagram in Figure 136 on page 161 will be the reference for the following examples.

6.9.1 Example 1 - Basic Setup for AS/400 Office Gateway Function

Let us consider the scenario whereby the AS/400 RCHASM02 is used as the office gateway between the SNA and SMTP worlds. RCHAS149 uses only SNADS to distribute its mail; it does not have TCP/IP installed. The requirement is to allow users on RCHAS149 to exchange mail with users on the HP 705 Apollo host system. The assumption is that the TCP/IP network has already been setup (as described in 2.7, “Configuring AS/400 TCP/IP with Non-AS/400 Systems” on page 47).

Within the RCHAS149 system:

1. Define a group entry in the system directory, specifying that all mail to host HPUX is to be sent to the office gateway system at RCHASM02.

```
                          Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   *ANY      HPUX
   Description . . . . . .   To HPUX via Office Gateway RCHASM02
   System name/Group . . .   RCHASM02                    F4 for list
   User profile  . . . . .                               F4 for list
   Network user ID . . . .

   Name:
     Last  . . . . . . . .
     First . . . . . . . .
     Middle  . . . . . . .
     Preferred . . . . . .
     Full  . . . . . . . .

   Department  . . . . . .                               F4 for list
   Job title . . . . . . .
   Company . . . . . . . .
                                                                 More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 137. System Directory Entry in RCHAS149 for Host HPUX

If SNADS is not already configured between systems RCHAS149 and RCHASM02, a SNADS routing table entry and a distribution queue for system RCHASM02 will need to be configured on system RCHAS149. For details on configuring SNADS, refer to the: *IBM AS/400 Distribution Services Network Administrator's Guide (SC41-9588)*.

Within the RCHASM02 system:

Since this system is used as the SNA/SMTP office gateway, it must have both SNADS and SMTP configured.

1. First of all, ensure that there is a group entry in the system directory that points to the RCHAS149 system as shown in Figure 138 on page 164. This will cause any mail sent to the SNADS address RCHAS149 to be routed through SNADS to RCHAS149 system.

```
                         Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   *ANY      RCHAS149
   Description . . . . . .   To RCHAS149 system via SNADS
   System name/Group . . .   RCHAS149  ________     F4 for list
   User profile  . . . . .   __________             F4 for list
   Network user ID . . . .   _______________________________________________

   Name:
     Last  . . . . . . . .   ________________________________________
     First . . . . . . . .   ____________________
     Middle  . . . . . . .   ____________________
     Preferred . . . . . .   ____________________
     Full  . . . . . . . .   __________________________________________________

   Department  . . . . . .   __________             F4 for list
   Job title . . . . . . .   ________________________________________
   Company . . . . . . . .   __________________________________________________
                                                                        More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 138. System Directory Entry in RCHASM02 for RCHAS149

2. To be able to route mail from RCHAS149 in the SNA network to HPUX in the SMTP network, an entry to host HPUX is also necessary (Figure 139).

```
                         Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   *ANY      HPUX
   Description . . . . . .   To HP 705 Apollo Host System - HPUX
   System name/Group . . .   TCPIP     ________     F4 for list
   User profile  . . . . .   __________             F4 for list
   Network user ID . . . .   _______________________________________________

   Name:
     Last  . . . . . . . .   ________________________________________
     First . . . . . . . .   ____________________
     Middle  . . . . . . .   ____________________
     Preferred . . . . . .   ____________________
     Full  . . . . . . . .   __________________________________________________

   Department  . . . . . .   __________             F4 for list
   Job title . . . . . . .   ________________________________________
   Company . . . . . . . .   __________________________________________________
                                                                        More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 139. System Directory Entry in RCHASM02 for Host HPUX

The *system name* TCPIP is a common SNADS routing entry that is used for all mail distribution from the gateway host to all other hosts in the SMTP world.

3. If RCHASM02 is an office gateway to several hosts in the SMTP network, one entry is needed in the system directory for each host. Each of these entries will use the same SNADS routing table entry (TCPIP) and distribution queue for SMTP (QSMTPQ) as configured for host HPUX.

4. If, for example, a user in the HPUX system has an SMTP user ID longer than 8 characters or with special characters, then an alias table entry needs to be defined. For example, a user in HPUX has the SMTP user ID KRISPETERSON. An alias table entry is required because this user ID is longer than 8 characters. But before defining the alias table entry, create a SNADS user ID in the system directory for KRISPETERSON. In this example, the name KRIS HPUX is used to represent KRISPETERSON.

```
                         Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   KRIS      HPUX
   Description . . . . . .   User KRISPETERSON at HPUX
   System name/Group . . .   TCPIP     ________      F4 for list
   User profile  . . . . .   __________              F4 for list
   Network user ID . . . .   _______________________________________

   Name:
     Last  . . . . . . . .   ________________________________________
     First . . . . . . . .   ____________________
     Middle  . . . . . . .   ____________________
     Preferred . . . . . .   ____________________
     Full  . . . . . . . .   __________________________________________________

   Department  . . . . . .   __________              F4 for list
   Job title . . . . . . .   ________________________________________
   Company . . . . . . . .   __________________________________________________
                                                                        More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 140. System Directory Entry in RCHASM02 for User KRIS at HPUX

5. Next, an alias table entry has to be created to translate the SNADS user ID KRIS to the long SMTP user ID KRISPETERSON (Figure 141 on page 166).

   Thus when mail is being sent to “KRIS HPUX”, it will be translated to KRISPETERSON in this gateway system before being sent to the recipient at HPUX.

```
                          Add Name for SMTP
                                                         System:   RCHASM02
 Type choices, press Enter.

   User ID . . . . . . . . .  KRIS       Character value, *ANY, F4 for list
   Address . . . . . . . . .  HPUX       Character value, F4 for list

   SMTP user ID  . . . . . .  KRISPETERSON
   SMTP domain . . . . . . .  HPUX.RCHLAND.IBM.COM



 F3=Exit   F4=Prompt   F12=Cancel
```

Figure 141. Alias Table Entry for User KRISPETERSON

With the above setup, when a user in RCHAS149 sends mail to anyone with the SNADS address HPUX, the mail will be routed through SNADS to RCHASM02 and then through SMTP to the HPUX. And if a SNADS name needs to be translated to the longer SMTP name, the alias table of the office gateway system will be used (as in the case of KRISPETERSON).

Up till now, we have considered how mail is sent from the SNA network to the SMTP network. Let us take a look at how mail can be sent in the reverse direction.

Suppose a user in HPUX wants to send mail to a user JOHN in RCHAS149, the command that needs to be executed from the HPUX system is

```
$ Mail  JOHN?RCHAS149@RCHASM02.RCHLAND.IBM.COM
```

This mail will be sent to the host system RCHASM02 and to the SMTP user "JOHN?RCHAS149". (For more information of how a mail is received on the AS/400, refer to 6.6.2, "Receiving Mail" on page 155.) If there is no alias table to translate this SMTP user ID to the SNADS user ID and address, SMTP will build the following SNADS name "JOHN RCHAS149". And because of the system directory entry in Figure 138 on page 164, any mail that is meant for SNADS address RCHAS149 will be routed through SNADS to RCHAS149. Thus JOHN of RCHAS149 will receive the mail.

6.9.2 Example 2 - Using Automatic Registration with Office Gateway

We have looked at how to configure an AS/400 as the office gateway from the example in 6.9.1, "Example 1 - Basic Setup for AS/400 Office Gateway Function" on page 162. This section will demonstrate how automatic registration can be implemented in the network example we have just considered. It will also be based on the network diagram in Figure 136 on page 161.

A lot of times, new users are created or added to the SMTP network without the knowledge of the AS/400 system administrator. This makes the task of maintaining an updated list of new SMTP users in all the AS/400s′ system directory tedious and difficult. Thus by combining the automatic registration and office gateway functions together, the SNA/SMTP office communications is more dynamic and efficient.

The additional setup to be done in this section are:

- We will enable automatic registration in the RCHASM02 system with the SMTP attributes shown in Figure 142 on page 167. Thus if it receives mail for an SMTP user ID that is not in its alias table, QSMxxxxx user IDs (system-generated SNADS user IDs) with address QSMRMTAD will be generated. This will enable the recipient of this mail to reply to the sender. For a detailed discussion on automatic registration and how it is configured on the AS/400, refer to 6.2, “Automatic Registration of Incoming Users” on page 133.
- We will add an additional entry to the system directory of RCHAS149 as shown in Figure 143 on page 168 so that when it sends mail to any user with SNADS address QSMRMTAD, the mail will be routed to RCHASM02. We want to use RCHASM02 to distribute mail with address QSMRMTAD.

```
                        Change SMTP Attributes
                                                       System:   RCHASM02
Type choices, press Enter.

  Distribution retries first level:
    Retries . . . . . . . . . . . . . .   2_          0-99
    Time interval . . . . . . . . . . .   1_          0-99 (minutes)
  Distribution retries second level:
    Retries . . . . . . . . . . . . . .   1           0-9
    Time interval . . . . . . . . . . .   0           0-9 (days)
  Retry remote name server  . . . . . .   N           Y=Yes, N=No
  Automatic directory registration:
    Automatically add remote users to
      directory . . . . . . . . . . . .   Y           Y=Yes, N=No
    User ID prefix  . . . . . . . . . .   QSM
    Address . . . . . . . . . . . . . .   QSMRMTAD
    System name . . . . . . . . . . . .   TCPIP
    Alias table type  . . . . . . . . .   1           1=System
                                                      2=Personal
  User ID delimiter . . . . . . . . . .   *DFT

                                                               More...
F3=Exit   F12=Cancel
```

Figure 142. Configure Automatic Registration in RCHASM02

```
                          Add Directory Entry

 Type choices, press Enter.

   User ID/Address . . . .   *ANY      QSMRMTAD
   Description . . . . . .   Any mail for address QSMRMTAD goes via RCHASM02
   System name/Group . . .   RCHASM02  ________      F4 for list
   User profile  . . . . .   __________              F4 for list
   Network user ID . . . .   _______________________________________________

   Name:
     Last  . . . . . . . .   ________________________________________
     First . . . . . . . .   ____________________
     Middle  . . . . . . .   ____________________
     Preferred . . . . . .   ____________________
     Full  . . . . . . . .   __________________________________________________

   Department  . . . . . .   __________              F4 for list
   Job title . . . . . . .   ________________________________________
   Company . . . . . . . .   __________________________________________________
                                                                        More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F14=Add X.400 O/R name
 F18=Display location details
```

Figure 143. Add an Entry to System Directory of RCHAS149

Once the above steps are done, let us consider the following scenario:

- A new user called TOM of HPUX wants to send mail to JOHN of RCHAS149 using the command

  `$ Mail  JOHN?RCHAS149@RCHASM02.RCHLAND.IBM.COM`

- When the mail reaches RCHASM02, SMTP (of RCHASM02) will find that TOM is not defined in its alias table. Hence automatic registration occurs, and say, the SNADS name QSM50 QSMRMTAD is generated. This SNADS name will correspond to the SMTP name TOM@HPUX.RCHLAND.IBM.COM. The QSM50 QSMRMTAD is added to the system directory as well as to the system alias table of RCHASM02.
- The mail is then routed to JOHN of RCHAS149. JOHN will see that a new mail item from QSM50 QSMRMTAD has arrived.
- When JOHN replies to this mail, the replied mail will be addressed to QSM50 QSMRMTAD, which will then be sent through SNADS to RCHASM02.
- When RCHASM02 receives this replied mail, it does a check in its system directory as well as its alias table for QSM50 QSMRMTAD. Since it is found, it will translate this SNADS name to TOM@HPUX.RCHLAND.IBM.COM and send the replied mail to TOM of HPUX.
- When the replied mail reaches TOM, he will see that the mail is from JOHN of RCHAS149. The SMTP address of JOHN as seen by TOM will be JOHN?RCHAS149%RCHASM02@RCHASM02.RCHLAND.IBM.COM. where the characters after the % but before the @ represents the gateway system.

Thus we have seen that although TOM was not originally defined in either of RCHASM02 or RCHAS149′s system directory, he can send as well as receive mail from the SNA office network.

6.10 SMTP Problem Analysis

SMTP is designed much the same as the other TCP/IP functions and applications. Like the FTP application, the SMTP job (QTMSMTP) runs under the QTCP subsystem and produces a job log and spooled files with information associated with the SMTP job. If the SMTP job ends, both the job log and spooled files are used to determine the cause. If the mail is not getting to the desired user, the spooled files may contain information that helps with the problem analysis.

The SMTP job does not start unless both the QSNADS and QTCP subsystems are running.

Configuring an AS/400 system to use SMTP can be an extensive process. The benefits of this extensive configuration are in the usability of the product. After configuration, the use of SMTP is no different from any of the AS/400 mail protocols. The user does not need to know whether the mail is being delivered by SNADS to another SNA system, or through SMTP. A successful configuration should allow the typical user to use the SMTP protocol without having to understand what is involved in the the background.

6.10.1 General Considerations

The *IBM AS/400 TCP/IP Guide (SC41-9875)* gives a detailed description of TCP/IP problem determination. It also describes the SMTP problem determination steps. This section provides some additional checklist that might be useful for problem determination:

- **Is the remote system responding to the PING command?**

  Use PING to ensure that your local system can communicate with the destination system through TCP/IP. If it is unsuccessful, then there is no point in proceeding with SMTP. Either the system is not communicating, or your system is not routed correctly. This is always a good procedure to ensure that the basic TCP/IP setup is successful. See section3.1, “PING (VFYTCPCNN) - Verify TCP/IP Connection” on page 53 for more information.

- **Is the SMTP job (QTMSMTP) active in the QTCP subsystem?**

  Use WRKACTJOB to view the active members in the QTCP subsystem. One of the jobs should be QTMSMTP. If not, this indicates that SMTP is ′down′. If it is known that SMTP had been running, check the job log for the SMTP job by using the WRKOUTQ or WRKJOB command. The job log can be found in the default output queue associated with the QTMSMTP job. Also check the QSNADS subsystem. Remember that QTMSMTP only becomes active if both the TCPIPLOC and QOTCPIPLOC jobs are active in QSNADS. If all the jobs are in place, TCPIPLOC may be in a retry state for starting up QTMSMTP. The default value for retrying is five minutes.

- **Is an alias table entry necessary to reach the destination?**

  Alias table entries are required under specific conditions which are discussed in 6.1.3, “When to Use an Alias Table” on page 130.

- **Is the recipient in the local system directory?**

  All recipients must be listed in the system directory. You can verify this from the WRKDIR command. OfficeVision/400 does not allow a user to send mail to anyone not listed in the directory. You may want to consider enabling automatic registration for incoming users so that the task of maintaining an updated system directory is less tedious. When adding an entry to the system directory for SMTP purpose, make sure that the system and group names are exactly the same as the entry in the SNADS routing table that was configured to use SMTP. The SNADS routing table is viewed using option 2 of CFGDSTSRV command.

- **Has the recipient's address been configured to use SMTP?**

  A user's SNADS name consists of three parts; user ID, address and system name. Ensure that the system name associated with the recipient's SNADS address is configured to use the *RPDS distribution queue QSMTPQ. You can use option 2 of CFGDSTSRV command to see the queue used for a particular system name.

- **Are the local host and domain names correct?**

  Use option 4 of the "Configure TCP/IP" menu to obtain the local domain and host names. Ensure that the combination of the local host name and the local domain name is found in the local host table or in the remote name server (if it is configured). If this is not found, then ensure that at least the local host name is defined in the local host table or in the remote name server. Figure 144 shows an example of the local domain and host names.

```
                        Change Local Domain Name
                                                      System:   RCHASM02
 Type choices, press Enter.

   Local domain name . . . .   RCHLAND.IBM.COM

   Local host name . . . . .   RCHASM02



 F3=Exit   F12=Cancel
```

Figure 144. Example of the Local Domain and Host Names

It is always a good practice to have both the local host name as well as the combination of the local host and domain names to be in the local host table as shown in Figure 145 on page 171. The combination of the local host and domain names will become the name by which this host is known to other systems in the SMTP network.

```
                Work with TCP/IP Host Table Entries
                                                       System:   RCHASM02
 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display

        Internet            Host
 Opt    Address             Name
  _     9.5.69.250          RCHASM02
  _     9.5.69.250          RCHASM02.RCHLAND.IBM.COM
                                                                More...
 F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Position to
```

Figure 145. Entries in the Local Host Table

- **Did the outgoing mail ever get to SMTP?**

  Outgoing mail in the AS/400 is passed from SNADS to SMTP through the QSMTPQ *RPDS queue. To determine if the SNADS configuration for this mail is correct, you can use the WRKDSTQ (Work with Distribution Queue) command. The command shows all the SNADS queues and their current status and depth. By holding QSMTPQ, and then sending the mail, it is possible to see if the mail is even making it to SMTP. If it is not, the user you are sending the mail to is not known to SNADS as someone who can be reached through the SMTP queue. Either the directory or the SNADS routes are not set up correctly.

  By using the command WRKDSTQ you can see if the QSMTPQ is sending data or if entries are just being added to the queue, as shown in Figure 146.

```
                       Work with Distribution Queues

Type options, press Enter.
  2=Send queue  3=Hold queue  5=Work with queue entries
  6=Release queue  7=Reroute queue


                       Queue      -----Send Time------  -Queue Depth-
Opt  Queue Name        Priority   From     To    Force  Send  Current  Status
   QSMTPQ          Normal     :  -  :    :     1    1  Sending
   QSMTPQ          High       :  -  :    :     1    0  Ready



F3=Exit      F5=Refresh       F10=Configure distribution queues
F12=Cancel
```

Figure 146. Work with Distribution Queues

- **Is a mail router or remote name server configured?**

  If either one or both of these functions are configured, then you have to understand how they will affect the mail routing process. Refer to the flow diagrams in Figure 122 on page 145 and Figure 127 on page 150. Use them to help in your problem determination.

6.10.2 Problem Analysis for SMTP when using OfficeVision/400

When using SMTP with OfficeVision/400 for the first time, it is recommended that you change the defaults to confirm delivery of the note. This enables you to track the progress of the note and provides some indication of where things might go wrong.

To track the progress of your mail, take option 2 for mail from the main OfficeVision/400 Menu followed by function key F6 (outgoing mail status) from the Work with Mail screen. The following screens show the progress of a successful mail delivery (Figure 147 and Figure 148).

```
                     Display Outgoing Mail Status Details

Description . . . . . . . . . :   Testing successful mail
Date/Time sent  . . . . . . . :   11/30/93  01:27:14 p.m.
Confirm delivery  . . . . . . :   Y

            ------------------Sent To------------------  ------Confirmed-
Status      User ID   Address   Description              Date      Time
SENT        BOON      RCHAS149  Boon on 149 via tcpip




                                                                   Bottom
Press Enter to continue.

F3=Exit   F5=Refresh   F12=Cancel   F19=Display messages
```

Figure 147. View Outgoing Mail Status (1 of 2)

```
                     Display Outgoing Mail Status Details

Description . . . . . . . . . :   Testing successful mail
Date/Time sent  . . . . . . . :   11/30/93  01:27:14 p.m.
Confirm delivery  . . . . . . :   Y

            ------------------Sent To------------------  ------Confirmed-
Status      User ID   Address   Description              Date      Time
DELIVERED   BOON      RCHAS149  Boon on 149 via tcpip    11/30/93  01:28




                                                                   Bottom
Press Enter to continue.

F3=Exit   F5=Refresh   F12=Cancel   F19=Display messages
```

Figure 148. View Outgoing Mail Status (2 of 2)

If the mail fails for any reason, the sender will receive an outgoing mail status of "FAILED". The returned mail should provide some indication of what went wrong.

Some of the more typical error messages are shown in Figure 149 and Figure 150 on page 174.

```
View Mail           |Skip                    |    |    |Adapted      |Pg 1
GN8Q180914,*INTDOC                           |Typestyle 86 (12p)     |Ln 1
<2....:....3....:....4....:....5....v....6....:....7....:....8....:....9>
*
Date: Tue, 30 Nov 93 12:17:18 .
From: QGATE@RCHASM02.RCHLAND.IBM.COM
To: DARYL?RCHASM02@RCHASM02.RCHLAND.IBM.COM
Subject: Undeliverable Mail

Host RCHASM02.RCHLAND.IBM.COM not able to deliver mail to following recip
    <ROOT@RCHRS001>
Retries exhausted while attempting to connect to remote host system
RCHRS001

             ** Text of Mail follows **

Received: from RCHASM02 by RCHASM02.RCHLAND.IBM.COM (SMTP Version 2) Rele
Date: Tue, 30 Nov 93 12:12:51 .
From: DARYL?RCHASM02%RCHASM02@RCHASM02.RCHLAND.IBM.COM
To:    ROOT@RCHRS001
Subject: Testing error messages



TO: ROOT     RCHRS001  Security Officer on RCHRS001

FROM: DARYL    RCHASM02  Daryl's ID on RCHASM02

DATE: November 30, 1993
SUBJECT: Testing error messages

Simulating an error message with link to remote system down.

Regards,
Daryl


 F3=Exit        F8=Reset             F13=Edit options      F17=Functions
 F5=Goto        F10=Forward mail     F14=Delete mail       F19=Print
 F6=Find        F11=Reply            F15=File local        F21=Nondisplay
 F7=Window      F12=Cancel           F16=File remote
```

Figure 149. Mail Error Message (Example 1)

In the example shown in Figure 149, it is worth checking the following:

- The QTMSMTP job is active in the QTCP subsystem.
- There is a routing entry in the QSNADS subsystem for SMTP.
- The communication link to the remote host system is up.
- The remote host system is defined in your local host table.

- If a remote name server is defined, make sure that the link to this server is active. If the link is not active, then make sure that at least the remote host system is defined in your local host table.

```
View Mail           |Skip                    |    |    |Adapted     |Pg 1
GN8R092946,*INTDOC                           |Typestyle 86 (12p)    |Ln 1
<2....:....3....:....4....:....5....v....6....:....7....:....8....:....9>
*
Date: Tue, 30 Nov 93 13:08:38 .
From: QGATE@RCHASM02.RCHLAND.IBM.COM
To: DARYL?RCHASM02@RCHASM02.RCHLAND.IBM.COM
Subject: Undeliverable Mail

Host RCHASM02.RCHLAND.IBM.COM not able to deliver mail to following recip
    <JOHN@RCHAS149>
RCHASM02.RCHLAND.IBM.COM received negative reply from host:
    RCHAS149

550 User JOHN not recognized.

             ** Text of Mail follows **

Received: from RCHASM02 by RCHASM02.RCHLAND.IBM.COM (SMTP Version 2) Rele
Date: Tue, 30 Nov 93 13:07:26 .
From: DARYL?RCHASM02%RCHASM02@RCHASM02.RCHLAND.IBM.COM
To:   JOHN@RCHAS149
Subject: Testing non-existing user


TO: JOHN     RCHAS149  John on RCHAS149

FROM: DARYL    RCHASM02  Daryl's ID on RCHASM02

DATE: November 30, 1993
SUBJECT: Testing non-existing user

Simulating a scenario whereby the user is not found in remote system.


 F3=Exit       F8=Reset             F13=Edit options      F17=Functions
 F5=Goto       F10=Forward mail     F14=Delete mail       F19=Print
 F6=Find       F11=Reply            F15=File local        F21=Nondisplay
 F7=Window     F12=Cancel           F16=File remote
```

Figure 150. Mail Error Message (Example 2)

In the example shown in Figure 150, it is worth checking the following:

- The recipient's user ID is meant for a valid or existing user on the remote host system.
- The need for an alias table entry to map the SNADS name to the SMTP name. If any of the conditions mentioned in 6.1.3, "When to Use an Alias Table" on page 130 exists, then an alias table entry is required.

6.10.3 Problem Analysis for SMTP without using OfficeVision/400

Sending and receiving SMTP messages without OfficeVision/400 was covered in section 6.7, "Using SMTP Without OfficeVision/400" on page 157. It is achieved by using the AS/400 SNDDST (Send Distribution) and RCVDST (Receive Distribution) commands.

Though this method of sending and receiving mail may not be as presentable and friendly compared to using OfficeVision/400, it allows you to debug an SMTP problem without the complications of a mail agent like OfficeVision/400.

Once the sender has completed the SNDDST command as shown in Figure 133 on page 158 a message will be shown at the bottom of the screen stating:

```
Send distribution completed successfully
```

This is only a sign that the distribution has been sent and in no way indicates whether it has been received at the remote host.

Within the SNDDST command there is a 'Confirmation of delivery' parameter and it is recommended that this is entered as **YES*. In this way, a confirmation will be returned to the sender to indicate the status of the delivery and will help to indicate where the problem might be.

To view any received messages, the user must go through the steps in section 6.7, "Using SMTP Without OfficeVision/400" on page 157 where the commands QRYDST, DSPPFM and RCVDST were used. The following examples will show the type of information that can be obtained for mail sent and received.

Three messages in a typical send/receive mail environment are shown in Figure 151.

```
                         Display Physical File Member
File . . . . . . :   QRYF01             Library  . . . . :   QGPL
Member . . . . . :   QRYF01             Record . . . . . :   1
Control  . . . . .                      Column . . . . . :   1
Find . . . . . . .
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
000001QSMRMTADQSM58   0169DARYL   RCHASM02QSM58   QSMRMTAD199311301217500
000002QSMRMTADQSM58   0170DARYL   RCHASM02QSM58   QSMRMTAD199311301309110
000001QSMRMTADQSM59   0171DARYL   RCHASM02QSM59   QSMRMTAD199311301419590

                          ****** END OF DATA ******

                                                                  Bottom

F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 151. Example of Distributions Received by User DARYL

These three distributions were received into the output file RCV01 using the RCVDST command as shown in Figure 152 on page 176, Figure 153 on page 176 and Figure 154 on page 177.

```
                        Receive Distribution (RCVDST)

 Type choices, press Enter.

 Distribution identifier  . . . .   'QSMRMTADQSM58   0169'
 User identifier:
   User ID  . . . . . . . . . . .   *CURRENT      Character value, *CURRENT
   Address  . . . . . . . . . . .                 Character value
 Document . . . . . . . . . . . .   *NONE         Name, *NONE
 In folder  . . . . . . . . . . .   *NONE

 File to receive output . . . . .   RCV01         Name, *NONE
   Library  . . . . . . . . . . .     QGPL        Name, *LIBL, *CURLIB
 Output member options:
   Member to receive output . . .   *FIRST        Name, *FIRST
   Replace or add records . . . .   *REPLACE      *REPLACE, *ADD
 Type of data for output  . . . .   *DFT          *DFT, *ALL, *DSTINFO, *MSG...
               + for more values
 Acknowledge receipt  . . . . . .   *YES          *YES, *NO
 Distribution ID extension  . . .   *NONE         1-99, *NONE
                                                                     More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 152. Receiving the First Distribution into the File RCV01

```
                        Receive Distribution (RCVDST)

 Type choices, press Enter.

 Distribution identifier  . . . . > 'QSMRMTADQSM58   0170'
 User identifier:
   User ID  . . . . . . . . . . .   *CURRENT      Character value, *CURRENT
   Address  . . . . . . . . . . .                 Character value
 Document . . . . . . . . . . . .   *NONE         Name, *NONE
 In folder  . . . . . . . . . . .   *NONE

 File to receive output . . . . . > RCV01         Name, *NONE
   Library  . . . . . . . . . . . >   QGPL        Name, *LIBL, *CURLIB
 Output member options:
   Member to receive output . . .   *FIRST        Name, *FIRST
   Replace or add records . . . . > *ADD          *REPLACE, *ADD
 Type of data for output  . . . .   *DFT          *DFT, *ALL, *DSTINFO, *MSG...
               + for more values
 Acknowledge receipt  . . . . . .   *YES          *YES, *NO
 Distribution ID extension  . . .   *NONE         1-99, *NONE
                                                                     More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 153. Receiving the Second Distribution into the File RCV01

```
                    Receive Distribution (RCVDST)

 Type choices, press Enter.

 Distribution identifier . . . . > 'QSMRMTADQSM59   0171'
 User identifier:
   User ID . . . . . . . . . . .   *CURRENT      Character value, *CURRENT
   Address . . . . . . . . . . .                 Character value
 Document . . . . . . . . . . . .  *NONE         Name, *NONE
 In folder  . . . . . . . . . . .  *NONE

 File to receive output . . . . . > RCV01         Name, *NONE
   Library . . . . . . . . . . . >   QGPL        Name, *LIBL, *CURLIB
 Output member options:
   Member to receive output . . .  *FIRST        Name, *FIRST
   Replace or add records . . . . > *ADD          *REPLACE, *ADD
 Type of data for output  . . . .  *DFT          *DFT, *ALL, *DSTINFO, *MSG...
               + for more values
 Acknowledge receipt  . . . . . .  *YES          *YES, *NO
 Distribution ID extension  . . .  *NONE         1-99, *NONE
                                                                      More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 154. Receiving the Third Distribution into the File RCV01

All three incoming messages are appended into the same output file RCV01 so that they can be viewed simultaneously.

The following 8 screens show the contents of the output file RCV01 after the RCVDST commands are executed. Notice that the screens are obtained by either scrolling right or left using the function keys F20 and F19 respectively. Recall also that the RCV01 file has a record length of 615 bytes from 6.7.2, “Receiving a Message” on page 158.

```
                    Display Physical File Member
File . . . . . . :   RCV01             Library  . . . . :   DARYL
Member . . . . . :   RCV01             Record . . . . . :   1
Control  . . . . .   ___________       Column . . . . . :   1
Find . . . . . . .   ________________________________________
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+...
000001QSMRMTADQSM58   0169DARYL   RCHASM02QSM58   QSMRMTAD1993113012175000000O
000002QSMRMTADQSM58   0169DARYL   RCHASM02QSM58   QSMRMTAD1993113012175000000O
000003QSMRMTADQSM58   0169DARYL   RCHASM02QSM58   QSMRMTAD1993113012175000000O
000004QSMRMTADQSM58   0169DARYL   RCHASM02QSM58   QSMRMTAD1993113012175000000O
000005QSMRMTADQSM58   0169DARYL   RCHASM02QSM58   QSMRMTAD1993113012175000000O
000001QSMRMTADQSM58   0170DARYL   RCHASM02QSM58   QSMRMTAD1993113013091100000O
000002QSMRMTADQSM58   0170DARYL   RCHASM02QSM58   QSMRMTAD1993113013091100000O
000003QSMRMTADQSM58   0170DARYL   RCHASM02QSM58   QSMRMTAD1993113013091100000O
000004QSMRMTADQSM58   0170DARYL   RCHASM02QSM58   QSMRMTAD1993113013091100000O
000005QSMRMTADQSM58   0170DARYL   RCHASM02QSM58   QSMRMTAD1993113013091100000O
000001QSMRMTADQSM59   0171DARYL   RCHASM02QSM59   QSMRMTAD1993113014195900000O
000002QSMRMTADQSM59   0171DARYL   RCHASM02QSM59   QSMRMTAD1993113014195900000O
000003QSMRMTADQSM59   0171DARYL   RCHASM02QSM59   QSMRMTAD1993113014195900000O
000004QSMRMTADQSM59   0171DARYL   RCHASM02QSM59   QSMRMTAD1993113014195900000O
                         ****** END OF DATA ******
                                                                       Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 155. Received Messages (1 of 8)

```
                    Display Physical File Member
File . . . . . . :   RCV01             Library  . . . . :   DARYL
Member . . . . . :   RCV01             Record . . . . . :   1
Control  . . . . .   ___________       Column . . . . . :   79
Find . . . . . . .   ________________________________________
.8....+....9....+....0....+....1....+....2....+....3....+....4....+....5....+.
0100300002IBM AS/400   337256004010****
0100300002IBM AS/400   337256018105Undeliverable Mail
0100300002IBM AS/400   000000500800Date: Tue, 30 Nov 93 12:17:18 .         F
0100300002IBM AS/400   000000500800 Nov 93 12:12:51 .         From: DARYL?RC
0100300002IBM AS/400   000000003800
0104200002IBM AS/400   337256004010****
0104200002IBM AS/400   337256018105Undeliverable Mail
0104200002IBM AS/400   000000500800Date: Tue, 30 Nov 93 13:08:38 .         F
0104200002IBM AS/400   000000500800MTP id 0008.Date: Tue, 30 Nov 93 13:07:26
0104200002IBM AS/400   000000042800 is not found in remote system.
0071900002IBM AS/400   337256004010****
0071900002IBM AS/400   337256038105Problem Determination not using OV/400
0071900002IBM AS/400   000000500800Received: from RCHASM01.RCHLAND.IBM.COM by
0071900002IBM AS/400   000000219800       Boon on the local system
                         ****** END OF DATA ******
                                                                       Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 156. Received Messages (2 of 8)

```
                         Display Physical File Member
File . . . . . . :   RCV01             Library  . . . . :   DARYL
Member . . . . . :   RCV01             Record . . . . . :   1
Control  . . . . .   __________        Column . . . . . :   157
Find . . . . . . .   ________________________________________
...6....+....7....+....8....+....9....+....0....+....1....+....2....+....3....


rom: QGATE@RCHASM02.RCHLAND.IBM.COMTo: DARYL?RCHASM02@RCHASM02.RCHLAND.IBM.C
HASM02%RCHASM02@RCHASM02.RCHLAND.IBM.COMTo:   ROOT@RCHRS001Subject: Testin



rom: QGATE@RCHASM02.RCHLAND.IBM.COMTo: DARYL?RCHASM02@RCHASM02.RCHLAND.IBM.C
 .         From: DARYL?RCHASM02%RCHASM02@RCHASM02.RCHLAND.IBM.COMTo:   JOH



RCHASM02.RCHLAND.IBM.COM (SMTP Version 2) Release 2.0 with TCP.Received: fro
                    DATE: November 30, 1993SUBJECT: Problem Determinatio
                          ****** END OF DATA ******
                                                                      Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 157. Received Messages (3 of 8)

```
                         Display Physical File Member
File . . . . . . :   RCV01             Library  . . . . :   DARYL
Member . . . . . :   RCV01             Record . . . . . :   1
Control  . . . . .   __________        Column . . . . . :   235
Find . . . . . . .   ________________________________________
+....4....+....5....+....6....+....7....+....8....+....9....+....0....+....1..


OMSubject: Undeliverable Mail Host RCHASM02.RCHLAND.IBM.COM not able to
g error messages  TO: ROOT     RCHRS001  Security Officer on RCHRS001



OMSubject: Undeliverable Mail Host RCHASM02.RCHLAND.IBM.COM not able to
N@RCHAS149Subject: Testing non-existing user  TO: JOHN     RCHAS149  t



m RCHASM01 by RCHASM01.RCHLAND.IBM.COM (SMTP Version 2) Release 3.0 with BSMTP
n not using OV/400                                     Problem D not usi
                          ****** END OF DATA ******
                                                                      Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 158. Received Messages (4 of 8)

```
                         Display Physical File Member
File . . . . . . :   RCV01              Library  . . . . :   DARYL
Member . . . . . :   RCV01              Record . . . . . :   1
Control  . . . . .   ___________        Column . . . . . :   313
Find . . . . . . .   ________________________________________
..+....2....+....3....+....4....+....5....+....6....+....7....+....8....+....9


deliver mail to following recipient(s):    <ROOT@RCHRS001>Retries exhaust
                          FROM: DARYL    RCHASM02  Daryl's ID on RCHASM02



deliver mail to following recipient(s):    <JOHN@RCHAS149>RCHASM02.RCHLAN
est                                                     FROM: DARYL    RCH



 id 0004.Date: Tue, 30 Nov 93 14:19:23 .         From: BOON?RCHASM01@RCHAS
ng OV/400.
                          ****** END OF DATA ******
                                                                       Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 159. Received Messages (5 of 8)

```
                         Display Physical File Member
File . . . . . . :   RCV01              Library  . . . . :   DARYL
Member . . . . . :   RCV01              Record . . . . . :   1
Control  . . . . .   ___________        Column . . . . . :   391
Find . . . . . . .   ________________________________________
....+....0....+....1....+....2....+....3....+....4....+....5....+....6....+...


ed while attempting to connect to remote host system RCHRS001.
                                  DATE: November 30, 1993SUBJECT: Testin



D.IBM.COM received negative reply from host:    RCHAS149550 User JOHN not
ASM02  Daryl's ID on RCHASM02                                  DATE: Nove



M01.RCHLAND.IBM.COMTo:   @RCHASM02.RCHLAND.IBM.COM:DARYL@RCHASM02Subject:

                          ****** END OF DATA ******
                                                                       Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 160. Received Messages (6 of 8)

```
                         Display Physical File Member
File . . . . . . :   RCV01              Library  . . . . :   DARYL
Member . . . . . :   RCV01              Record . . . . . :   1
Control  . . . . .   ___________        Column . . . . . :   469
Find . . . . . . .   ________________________________________
.7....+....8....+....9....+....0....+....1....+....2....+....3....+....4....+.


  ** Text of Mail follows **Received: from RCHASM02 by RCHASM02.RCHLAND.IBM.
g error messages                                                       S



recognized.             ** Text of Mail follows **Received: from RCHASM
mber 30, 1993SUBJECT: Testing non-existing user




Problem Determination not using OV/400TO: DARYL    RCHASM02  Daryl on MO

                          ****** END OF DATA ******
                                                                       Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 161. Received Messages (7 of 8)

```
                         Display Physical File Member
File . . . . . . :   RCV01              Library  . . . . :   DARYL
Member . . . . . :   RCV01              Record . . . . . :   1
Control  . . . . .   ___________        Column . . . . . :   547
Find . . . . . . .   ________________________________________
...5....+....6....+....7....+....8....+....9....+....0....+....1....+....2....
                                                                  01RCHASM020
                                                                  01RCHASM020
COM (SMTP Version 2) Release 2.0 with BSMTP id 0007.Date: Tue, 3001RCHASM020
imulating an error message with link to remote system down.   01RCHASM020
                                                                  01RCHASM020
                                                                  01RCHASM020
                                                                  01RCHASM020
02 by RCHASM02.RCHLAND.IBM.COM (SMTP Version 2) Release 2.0 with BS01RCHASM020
                       Simulating a scenario whereby the user01RCHASM020
                                                                  01RCHASM020
                                                                  01RCHASM020
                                                                  01RCHASM020
2 via TCP/IP                                 FROM: BOON     M0101RCHASM020
                                                                  01RCHASM020
                          ****** END OF DATA ******
                                                                       Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 162. Received Messages (8 of 8)

The first distribution is an undelivered mail for the user DARYL of RCHASM02 system. This error indicates that the retries to the remote system have been exhausted. Notice that this message is exactly the same as that when OfficeVision/400 was used (Figure 149 on page 173).

The second distribution is also an undelivered mail for DARYL of RCHASM02. It indicates that the recipient user ID JOHN) is not a valid ID in the remote host system RCHAS149. This is the same message as that in Figure 150 on page 174 where OfficeVision/400 was used.

The third distribution is an incoming mail for DARYL of RCHASM02 that was sent by BOON of RCHASM01. Notice that you can read the contents of the mail if you scroll towards the right using the function key PF20.

6.11 SMTP Outgoing and Incoming Mapping Tables

The AS/400 uses the EBCDIC (Extended Binary Coded Decimal Interchange Code) form of hexadecimal data representation. Most UNIX or non-IBM systems, for example the HP 705 Apollo System, use ASCII (American National Standard for Information Interchange) for data representation. Thus an EBCDIC to ASCII conversion is required when mail is sent from the AS/400.

Figure 163 shows that the outgoing and incoming mapping tables for SMTP are left at *DFT. The system default EBCDIC to ASCII mapping table is called QTCPASC and the system default ASCII to EBCDIC mapping table is called QTCPEBC.

```
                    Change TCP/IP Attributes (CHGTCPA)

 Type choices, press Enter.

 Checksum on incoming messages  .   *NO          *SAME, *YES, *NO
 IP datagram forwarding . . . . .   *NO          *SAME, *YES, *NO
 TELNET inactivity timeout  . . .   0            0-2147483647, *SAME
 TELNET timemark timeout  . . . .   600          0-2147483647, *SAME
 TELNET default NVT type  . . . .   *VT100       *SAME, *VT100, *NVT
 SMTP - outgoing mapping table  .   *DFT         Name, *SAME, *DFT
                                      ______ Name, *LIBL, *CURLIB
 SMTP - incoming mapping table  .   *DFT         Name, *SAME, *DFT
                                      ______ Name, *LIBL, *CURLIB
 FTP - outgoing mapping table . .   *DFT         Name, *SAME, *DFT
                                      __________ Name, *LIBL, *CURLIB
 FTP - incoming mapping table . .   *DFT         Name, *SAME, *DFT
                                      __________ Name, *LIBL, *CURLIB
 VT100 - outgoing mapping table     *DFT         Name, *SAME, *DFT
                                      __________ Name, *LIBL, *CURLIB

                                                                 More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 163. Default Outgoing and Incoming Mapping Tables for SMTP

When OfficeVision/400 sends or receives mail, it uses the EBCDIC code page 500 regardless of the national language installed. Therefore, it is recommended that you specify a mapping table that maps code page 500 to whatever code page the destination system uses. For example, if an AS/400 wants to send mail to an RS/6000 which uses ASCII code page 850, specify the outgoing and incoming mapping tables for SMTP as shown in Figure 164 on page 183. When mail is sent from the AS/400, SMTP will convert the mail from code page 500 to code page 850, and vice versa when mail is received by the AS/400.

```
                    Change TCP/IP Attributes (CHGTCPA)

Type choices, press Enter.

Checksum on incoming messages  .   *NO           *SAME, *YES, *NO
IP datagram forwarding . . . . .   *NO           *SAME, *YES, *NO
TELNET inactivity timeout  . . .   0             0-2147483647, *SAME
TELNET timemark timeout  . . . .   600           0-2147483647, *SAME
TELNET default NVT type  . . . .   *VT100        *SAME, *VT100, *NVT
SMTP - outgoing mapping table  .   Q500337850    Name, *SAME, *DFT
                                     QUSRSYS     Name, *LIBL, *CURLIB
SMTP - incoming mapping table  .   Q850337500    Name, *SAME, *DFT
                                     QUSRSYS     Name, *LIBL, *CURLIB
FTP - outgoing mapping table . .   *DFT          Name, *SAME, *DFT
                                                 Name, *LIBL, *CURLIB
FTP - incoming mapping table . .   *DFT          Name, *SAME, *DFT
                                                 Name, *LIBL, *CURLIB
VT100 - outgoing mapping table     *DFT          Name, *SAME, *DFT
                                                 Name, *LIBL, *CURLIB

                                                                 More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 164. Changing the Outgoing and Incoming Mapping Tables for SMTP

Note: When using SNDDST or RCVDST, the code page used will be the one implemented in the system, not code page 500.

6.12 ICMP Redirect

Internet routing tables usually remain static for long periods. Hosts initiate them from a disk file at start up, and they are seldom changed during normal operations. If network interconnections change, routing tables in a particular host may become incorrect. Because gateways exchange routing information periodically to accommodate network changes and keep their routes up-to-date, a gateway usually knows better routes than a host. So, when a gateway detects that a host is using a non-optimum route, the gateway sends an *ICMP redirect* message to that host. It also forwards the original datagram on to its destination. These redirect messages are limited to interactions between a gateway and a host that are on the same network.

If the host that sends the original datagram is an AS/400, it receives the ICMP redirect message from the gateway and uses this information to update its *internal* routing table. The next datagram then is sent using the more optimum route received from the gateway. This updated routing information does *not* show up in the routing table that can be updated by the user, and is only “remembered” until the QTCP subsystem is restarted. Then this process is repeated.

If the gateway is an AS/400, it does not give ICMP redirect messages to other hosts. In Figure 165 on page 184, host A1 in network 2 is an AS/400, which sends a message to host A2 in network 3. The routing table in host A1 indicates that the first hop to host A2 is through gateway G1, which connects network 1 and 2. When this gateway receives the datagram, it forwards the datagram to gateway G2, which sends it to the host A2. Gateway G1 then sends an ICMP redirect message to host A1 to inform it that a better route to host A2 is to use gateway G2 as the first hop. This information updates the internal routing table in host A1, and the next datagram to host A2 in network 3 is sent to gateway G2 as the first hop. The gateway then sends the datagram to host A2. When the QTCP subsystem is stopped, the collected routing information is deleted and host A1 starts the learning process again.

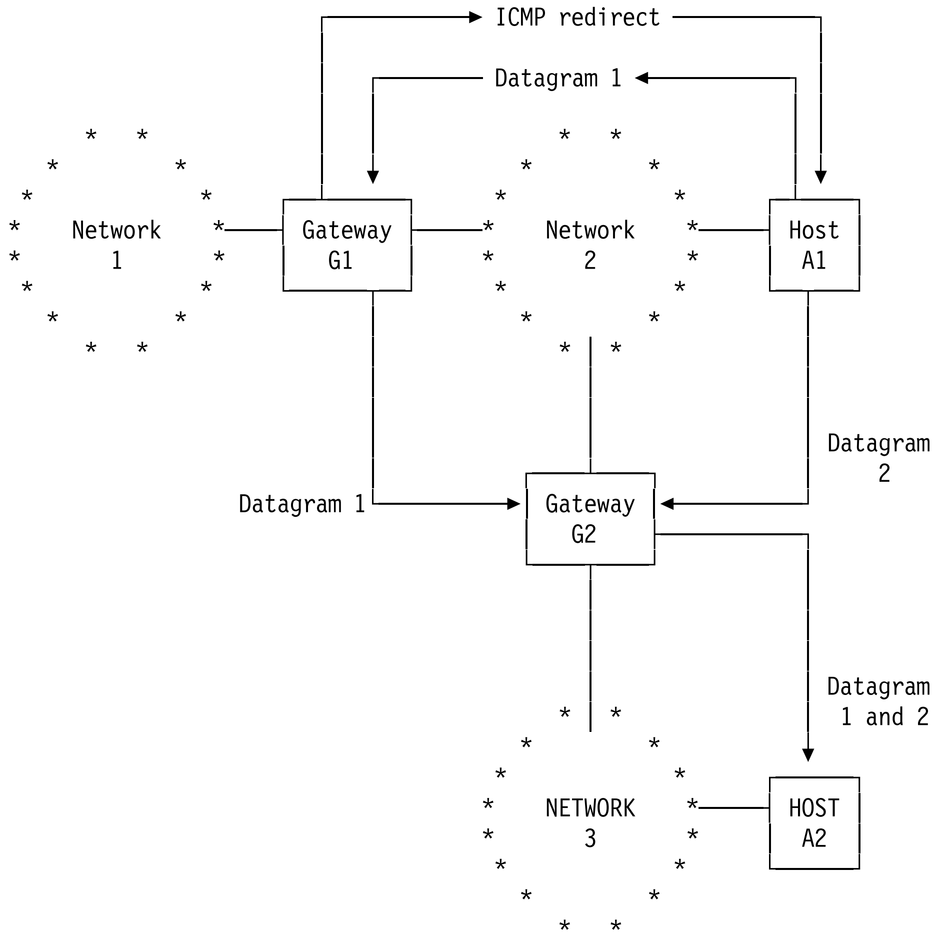

Figure 165. Example of ICMP Redirect

6.13 Central Host Maintenance

In a large network, it is more efficient to administer AS/400 TCP/IP from a central site.

Working with the host table and the SMTP alias table would be very time-consuming if each system is individually updated through the TCP/IP configuration menu. Updates can be made more quickly on one system and then copied to others. Before you can do this efficiently, you must make some changes to the shipped system.

AS/400 TCP/IP is designed so that its files, including the host table and the alias table, are protected. This means that you are not able to change the data in these files unless you use the Configure TCP/IP menu. File protection fulfills

Product security requirements. A method to circumvent the file protection is described in 6.13.1.1, "Loading Host Tables from Another System" on page 185.

A non-AS/400 generated host table is converted to the AS/400 format by specify a file member for updating the internal host table. This member could be a host table copied from another host. See Figure 166.

```
                      Convert TCP/IP Host Table
                                                     System:   RCHASM02
Type choices, press Enter.

  File . . . . . . . . . . . . . .   QATMTCP          Name
    Library . . . . . . . . . . . .    QUSRSYS        *LIBL, name
  Member  . . . . . . . . . . . . .   HOSTS            *FIRST, name
  File format . . . . . . . . . . .   *AIX             *AIX, *NIC
  Merge with host table . . . . . .   N                Y=Yes, N=No




F3=Exit   F6=Display job log   F12=Cancel
```

Figure 166. Convert TCP/IP Host Table

Host tables appear in two different formats—AIX and NIC. AS/400 can use both AIX and NIC formatted files as input to create a new internal host table. The AIX format is used in AS/400 and many other systems, both IBM and non-IBM. It only contains host names and their corresponding internet addresses. The NIC format contains host names, names and addresses of gateways, domain names, protocols used by gateways and other information.

The following suggestions to obtain a more suitable environment for central management concern:

- Loading host tables
- Working with the SMTP alias table

6.13.1.1 Loading Host Tables from Another System

The host table on the AS/400 is handled in the following manner. Option 1 (Work with host table) on the Configure TCP/IP menu updates a member called HOSTS in a file called QATMTCP in library QUSRSYS. When the update process is ended and the option to convert is taken, this member is copied to an internal host table, which is what the TCP/IP code actually uses. Option 25 (Convert host table) is used to copy another file member to the internal host table. This member could be a copy of the host table from another system. However, if Option 25 is used, the data in member HOSTS in file QATMTCP no longer matches the data in the internal table. It then becomes difficult to determine what is actually in the internal host table.

This problem can be overcome by copying the host table from another system into the HOSTS member in file QATMTCP and then running the convert procedure.

Because this is not an official way of loading the host table from another host, be sure that the data in the file is in the correct format. If it is not, results cannot be predicted. Anyone using this method should be familiar with AS/400 TCP/IP and the AS/400 system.

As mentioned, the host table is located in the HOSTS member of the protected file QATMTCP in library QUSRSYS. QATMTCP also contains other members – PROFILE, DATA and ALIASES. All these members are created when TCP/IP is configured for the first time. They contain the information that is entered using the TCP/IP panels.

The following steps show what must be done to be able to modify the QATMTCP file:

1. Use the CRTDUPOBJ command to save the QATMTCP file into another library.
2. Delete the QATMTCP file in library QUSRSYS.
3. Create a new QATMTCP file in library QUSRSYS with record length 512. The following command is used:

   ```
   CRTPF FILE(QUSRSYS/QATMTCP) RCDLEN(512) MAXMBR(*NOMAX)
   ```

   This new file is not protected.
4. Copy back all members from the saved QATMTCP file.
5. Replace member HOSTS with the host table received from another host. First, be sure that it has the correct layout. It must be AIX format as shown in Figure 167.
6. Convert the host table using the panels (for example, option 25 on panel Configure TCP/IP).

```
                         Display Physical File Member
File . . . . . . :   QATMTCP             Library  . . . . :   QUSRSYS
Member . . . . . :   HOSTS               Record . . . . . :   1
Control  . . . . .   ___________         Column . . . . . :   1
Find . . . . . . .   ________________________________________
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+...
9.5.65.254      RCHAS008 RCHAS008.RCHLAND.IBM.COM
9.5.69.198      RCHRS001 RCHRS001.RCHLAND.IBM.COM
9.5.69.213      SINGAPOR SINGAPOR.RCHLAND.IBM.COM
9.5.69.250      RCHASM02 RCHASM02.RCHLAND.IBM.COM
9.5.69.251      RCHASM01.RCHLAND.IBM.COM RCHASM01
9.5.69.252      RCHAS149.RCHLAND.IBM.COM RCHAS149
9.5.8.134       HPUX HPUX.RCHLAND.IBM.COM
9.5.8.138       SPARKY SPARKY.RCHLAND.IBM.COM
9.5.8.252       MVAX MVAX.RCHLAND.IBM.COM

                          ****** END OF DATA ******


                                                                        Bottom
F3=Exit   F12=Cancel   F19=Left   F20=Right   F24=More keys
```

Figure 167. Display Physical File Member HOSTS in File QATMTCP

Now that QATMTCP is not protected, it is possible to use FTP to PUT a file containing the host table from another host system, directly into the HOSTS member of the QATMTCP file. The step to convert the host table must still be run locally, but could be performed from another system through TELNET.

Chapter 7. Additional LPR/LPD Considerations

This chapter explains:

- General LPR/LPD considerations and sending AS/400 spool files to PSF/2. This section was originally published in *IBM AS/400 Printing III (GG24-4028)*.
- Configuration and use of AS/400 LPR to PSF/6000.
- National Language Support (NLS) considerations

7.1 Network Printing Using TCP/IP

New function in the IBM TCP/IP Connectivity Utilities/400 licensed program product for Version 2.0 Release 3.0 allows the AS/400 to send and receive spooled files across a Transmission Control Protocol/Internet Protocol (TCP/IP) network. This function is provided through the support of two TCP/IP functions: Line Printer Requester (LPR) and Line Printer Daemon (LPD).

Line Printer Requester comes from the Berkeley Software Distribution (BSD) Unix implementation of TCP/IP. LPR is the sending, or client portion, of the file transfer. Actual printing of files is done by the destination system′s printing facility. Along with sending the file, the LPR command also allows the user to select attributes and options associated with the file.

These attributes and options are not like the attributes which the AS/400 holds for a spooled file. They refer to information such as the names of the sending system and the sending user, and the name for the request. Some limited information about how the file should be printed is included, such as the number of copies and information about the separator page.

These attributes and options are sent to the destination system in a control file, which is always in ASCII format. The attributes and options are sent in a separate data file from the one containing the data stream to be printed. If the format of the data stream to be sent was not transformed to ASCII when the LPR command was issued, the data stream format is preserved within the data file.

Line Printer Daemon also comes from the BSD Unix implementation of TCP/IP. LPD is the corresponding process on the destination system that receives the file sent by the LPR command and places it on a local print queue. This is the receiving, or server portion of the file transfer.

The client/server relationship between LPR and LPD is shown in Figure 168 on page 190.

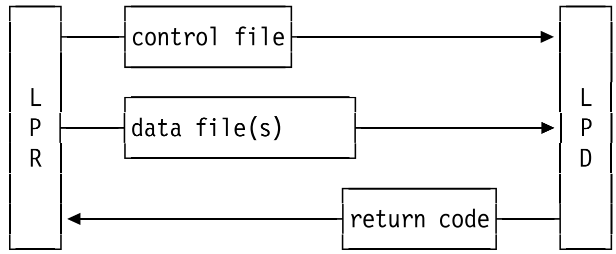

Figure 168. The Client (LPR) and Server (LPD) Relationship

7.1.1 AS/400 LPR and LPD

The first part of the AS/400 support is the LPR or Send TCP/IP Spooled File (SNDTCPSPLF) command, which will send a spooled file through TCP/IP to a destination system which supports an LPD process. The SNDTCPSPLF command has an "alias" of *LPR*, which results in the same panels being presented. The SNDTCPSPLF is part of the IBM TCP/IP Connectivity Utilities/400, (5738-TC1) licensed program product, and is owned by user profile QTCP.

The second part of the AS/400 support is the LPD process. This process receives LPR requests from both AS/400 and non-AS/400 systems. In addition to LPR requests, other print commands will be handled provided that they make use of TCP/IP and comply with the protocol defined in Request for Comments 1179 (RFC 1179) issued by the Internet Network Printer Working Group.

7.1.2 AS/400 as a Requester (LPR)

The Line Printer Requester command sends a file to a specified host and print queue through TCP/IP. The AS/400 implementation of this command handles the fact that there are different types of destination systems. This is done to provide the best possible print fidelity.

On the LPR command a full *library/output queue name* should be specified when sending to another AS/400. If no library name qualifier is given, the AS/400 looks for the specified output queue in library QUSRSYS. If the specified output queue is not found there, the spooled file is routed to the output queue QPRINT in the library QGPL.

In 7.1.3.1, "Security" on page 198, we discuss in more detail how the AS/400 decides which output queue to send the file to.

The LPR function can be automated through the use of a queue monitoring program. The source code for such a tool, LPRMON, is given in Appendix G, "AS/400 Program to Monitor and Reroute Output Queue" on page 281. This tool will continuously monitor any given AS/400 output queue. When a spooled file is placed in the output queue, the LPRMON tool will reroute the spooled file through the LPR support to another system. Without a tool of this type, it is necessary to manually issue the LPR command against every spooled file you wish to send to an LPD process on another system.

When sending to non-AS/400 systems, it may be necessary to refer to the LPD documentation for that system to determine the correct print queue values.

The AS/400 implementation of the LPR command is limited to sending spooled files with a device type attribute of PRINTER. No other types of spooled files, such as diskette spooled files, can be sent to another system using TCP/IP.

Return codes from the destination system are translated by the AS/400 LPR and sent to the message queue for the requesting user.

Spooled files which are in SCS format may be optionally transformed to ASCII. This is done using the Host Printer Transform function, which is described in more detail in *IBM AS/400 Printing III (GG24-4028)*.

The sending of any data stream type to any destination type is supported, but the destination system must be able to handle the data stream format received. For example, garbage will be printed if the destination type is PSF/2 and the data stream is IPDS. Table 9 shows the most likely combinations of values which should be used with the SNDTCPSPLF command.

Table 9. Common Parameter Settings when Using SNDTCPSPLF

Destination System Type	**Data Stream Type**	**Transform Value**	**Manufacturer Type and Model**
*AS400	*SCS	*YES	Prompt for correct choice
*AS400	ANY	*NO	Leave blank
*PSF2	*AFPDS	*NO	Leave blank
*PSF2	*SCS	*YES	*IBM5202[1]
*PSF2	*USERASCII[2]	*NO	Leave blank
*OTHER	*SCS	*YES	Prompt for correct choice
*OTHER	*USERASCII[2]	*NO	Leave blank

Notes:

1. Choose the highest function printer supported by PSF/2.
2. **USERASCII* does not necessarily mean that the spooled file data stream is ASCII. It only means that the data was spooled without being examined or validated by the AS/400.

Figure 169 on page 192 shows the prompt screen for the SNDTCPSPLF command. The various parameters, and their possible values, are discussed below.

```
                    Send TCP/IP Spooled File (SNDTCPSPLF)

 Type choices, press Enter.

 Remote system  . . . . . . . . .   *INTNETADR_________________________
____________________________________________________________________
____________________________________________________________________
_________________________________________________
 Printer queue  . . . . . . . . .   __________________________________
____________________________________________________________________
________
 Spooled file . . . . . . . . . .   __________     Name
 Job name . . . . . . . . . . . .   *_________     Name, *
   User . . . . . . . . . . . . .     __________   Name
   Number . . . . . . . . . . . .     ______       000000-999999
 Spooled file number  . . . . . .   *ONLY_         1-9999, *ONLY, *LAST
 Destination type . . . . . . . .   *OTHER         *AS400, *PSF2, *OTHER
 Transform SCS to ASCII . . . . .   *YES           *YES, *NO
 Manufacturer, type, and model  .   *IBM42011________
 Internet address . . . . . . . .   ________________
                                                                  More...
```

```
 Workstation customizing object     *NONE_____     Name, *NONE
   Library  . . . . . . . . . . .     *LIBL_____   Name, *CURLIB, *LIBL
 Delete file after sending  . . .   *NO            *NO, *YES


                                                                   Bottom
F3=Exit  F4=Prompt  F5=Refresh  F12=Cancel  F13=How to use this display
F24=More keys
```

Figure 169. The SNDTCPSPLF Command

- Remote system (RMTSYS)

  Specifies either the remote system name to which the print request will be sent or **INTNETADR*. The name must be valid and the systems must be able to communicate.

  If the parameter value is set to **INTNETADR*, the Internet address parameter value will be displayed and prompted for when Enter is pressed.

  The name or the Internet address of the remote system must have already been assigned using the Work with Host Table menu. Details of this command are found in the *IBM AS/400 TCP/IP Guide (SC41-9875)*.

- Printer Queue (PRTQ)

  Specifies the name of the destination printer queue. If the destination is an AS/400, this is the name of an output queue specified as *library-name/output-queue-name*. If the destination is not an AS/400, the name is system dependent, and may be the name of a device (OS/2) or the name of an output queue (UNIX).

  Note: On some systems, the name of the destination printer queue may be case sensitive. If the name of the destination printer queue is lower or mixed case, enclose the name in single quotes to prevent the AS/400 from capitalizing the name.

- Spooled file (FILE)

Specifies the name of the spooled file to be sent to the specified remote system. This name is seen when using the WRKSPLF command.

- Job name (JOB)

  Specifies the name of the job that created the spooled file. The fully qualified job name should be used, in the form: *job-name/user-name/job-number*

- Spooled file number (SPLNBR)

  Specifies the number of the spooled file from the job specified above. The parameter is specified in one of three ways:

  – A numeric value from 1-9999, corresponding to the spooled file number.

  – **ONLY* - only one spooled file from the job has the specified file name and no number is required.

  – **LAST* - the spooled file with the highest number.

- Destination type (DESTTYP)

  Specifies the type of the destination system. The parameter can take one of three values:

  – **AS/400* - the destination system is another AS/400.

  – **PSF2* - the destination is a PS/2 running PSF/2.

  – **OTHER* - the destination system is any system other than an AS/400 or PSF/2.

  The implications of each of these three possible values are discussed in more detail in 7.1.2.2, "Sending to Another AS/400 System" on page 195, 7.1.2.3, "Sending to PSF/2" on page 195, and 7.1.2.1, "Sending to Non-AS/400 Systems" on page 194.

- Transform SCS to ASCII (TRANSFORM)

  Specifies whether the spooled file will be transformed from the SCS data stream to ASCII. The possible values are either **YES* or **NO*. If the data stream is not SCS, a transform will *not* take place when this parameter is set to **YES*; the spooled file will not be sent, and a message will be sent to the sending user's job log.

  When sending an SCS file to another AS/400, it is most likely that you will not want the system to transform the file. This maintains the highest degree of print fidelity.

  When sending an SCS file to any other system (including PSF/2) it is most likely that you will want the system to transform the file into ASCII.

  The implications of whether or not to transform the file are discussed in more detail in 7.1.2.2, "Sending to Another AS/400 System" on page 195 and 7.1.2.3, "Sending to PSF/2" on page 195.

  When a transform from SCS to ASCII does occur, the Host Print Transform function is used. *IBM AS/400 Printing III (GG24-4028)* discusses the Host Print Transform in more detail.

- Manufacturer, type and model (MFRTYPMDL)

  Specifies the manufacturer, type and model for the destination printer, if the SCS data stream is to be transformed to ASCII. This parameter is, therefore, only prompted for when the TRANSFORM parameter is set to **YES*.

The list of supported printers is determined by the Host Print Transform function. A complete list of the IBM and non-IBM printers that are supported are found in the *AS/400 Programming for Printing*, SC41-8194. This list will also be displayed if you prompt on this parameter.

Should you wish to define an unsupported printer, or change some of the attribute values for the supported printer, you can specify a value of **WSCST* for this parameter. Examples of such attributes are character presentation, font specifications and control key sequences. In this case, you must first define a Workstation Customization Object, and you will be prompted for its name in the *Additional parameters*.

Details of how to do this are found in the publication *AS/400 Workstation Customization Function Programmer's Guide*, SC41-0056.

- Internet address (INTNETADR)

  Specifies the Internet address of the remote system to which the spooled file will be sent. This parameter will only be prompted for if you specified the value **INTNETADR* on the remote system parameter (RMTSYS).

- Workstation customization object (WSCST)

  Specifies an object that contains a table of attributes which have been used to customize a given ASCII printer. This parameter is only prompted for by pressing F10 for *Additional parameters*.

- Delete file after sending (DLTSPLF)

  Specifies whether or not the specified spooled file will be deleted after it has been successfully sent to the remote system. Successful, in this context, refers to the transmission. There is no guarantee that the file will print correctly at the remote system printer.

7.1.2.1 Sending to Non-AS/400 Systems

When sending to a non-AS/400 system, the conventional TCP/IP protocols are used, as defined by RFC 1179.

As well as sending the data, a control file is sent which may contain a number of printing options and attributes, such as width of output and font style.

This control file is part of the TCP/IP protocol. It is automatically built by the LPR, and when the information it contains has been retrieved by the LPD, it is discarded. The sending user will not see the control file. It is built automatically by the AS/400. Depending upon the implementation of the receiving system, the target user may be able to view and print the control file.

There is a new section in the *IBM AS/400 TCP/IP Guide (SC41-9875)*, on sending and printing files using TCP/IP which contains tables showing the control file options and attributes.

The AS/400 uses the new LPR subcommands Receive Control File First (RCFF) and Receive Data File of Unspecified Length (RDFUL). Some older LPD servers do not support these subcommands. If the server rejects the new subcommand when they are sent, then the AS/400 will retry using the original Receive Data File (RDF) and Receive Control File (RCF) subcommands. The server may issue a message indicating that an invalid request was made. Only LPR implementation-independent subcommands are sent.

Most non-AS/400 LPD receivers expect the data to be in ASCII format. If the spooled file is in SCS data stream format, you should specify *TRANSFORM(*YES)* in the SNDTCPSPLF command, and the Host Print Transform function will be used to convert to data stream from SCS to ASCII, using the attribute definitions for the printer.

7.1.2.2 Sending to Another AS/400 System

When sending a spooled file to another AS/400 system using TCP/IP, implementation-specific extensions to the LPR are available to retain the spooled file attributes. The control file is still sent, because it is part of the protocol, but the receiving AS/400 checks the control file extended print attribute, from which it can determine that the spooled file was sent from another AS/400.

In this case, the option and attribute information in the control file is not used, and all the attributes of the spooled file will be the same on both the sending and receiving systems.

When sending a spooled file to another AS/400 system using TCP/IP, you should specify *DESTTYP(*AS400)* and *TRANSFORM(*NO)* on the SNDTCPSPLF command. When sending to another AS/400, the spooled file created by LPD will be a duplicate of the spooled file sent.

In most cases you will not wish to transform the spooled file from SCS to ASCII when sending to another AS/400, but if you want to transform the SCS data stream to ASCII, you can. Just specify *TRANSFORM(*YES)*, and the Host Print Transform will be used to convert the file to ASCII prior to sending it.

Generally, if you wish to send a spooled file from one AS/400 to another, the SNDNETSPLF command will provide more flexibility than using the SNDTCPSPLF with TCP/IP. There are a number of reasons for this:

- SNDNETSPLF is part of OS/400, while the SNDTCPSPLF command is only available with the IBM TCP/IP Connectivity Utilities/400 licensed program product.
- SNDNETSPLF is integrated with the WRKSPLF command. From the list of spooled files displayed as a result of issuing the WRKSPLF command, you can select Option 1, Send, and you will be taken to the SNDNETSPLF command prompt.

7.1.2.3 Sending to PSF/2

IBM AS/400 Printing III (GG24-4028) discusses the capability of sending an IPDS data stream to the Distributed Print Function (DPF) of PSF/2, where it can be printed on many different types of printers.

Using the new LPR or SNDTCPSPLF commands, we also have the capability of sending an AFPDS data stream to PSF/2. The spooled file must have been created as an AFPDS spooled file, by ensuring that the Device type parameter in the printer file was set to **AFPDS*, prior to the creation of the spooled file.

It is also possible to send an SCS data stream to PSF/2 by using the transform option. For the best printed fidelity the value specified for Manufacturer type and model should be set to **IBM5202*.

If sending **USERASCII* data to PSF/2, you should make sure that the application which creates the ASCII data stream formats this data for an IBM 5202 printer. For example, if you are using a DOS application such as WordPerfect**, you would configure this application to print to an IBM 5202 printer, and then use PC Support/400 virtual print with printer data type 4 (ASCII data) to spool the output to the AS/400 as **USERASCII*.

**USERASCII* does not necessarily mean that the spooled file data stream is ASCII. It only means that the data was spooled without being examined or validated by the AS/400.

These methods of sending a spooled file to PSF/2 do not use the DPF functions.

From the LPR or SNDTCPSPLF command prompt screen (Figure 169 on page 192), you should specify the Destination type as **PSF2*. If you are sending AFPDS data ensure that the Transform SCS to ASCII parameter is set to **NO*.

In the Printer queue parameter you must specify the name of the PSF/2 printer device.

In order to send a spooled file, this is all that is necessary. When sending an AFPDS file you must also ensure that any resources that the AFPDS file requires are available on the PS/2, and referenced in the PSF/2 Resource Librarian. The remainder of this section discusses how to get the resources available on the PS/2.

The resources that the AFPDS spooled file might require are:

- A page definition - commonly known as a PAGEDEF
- A form definition - commonly known as a FORMDEF
- An overlay
- A page segment - commonly known as a PSEG
- Fonts

How each of these resources might be made available on the PS/2 is considered in greater detail in *IBM AS/400 Printing III (GG24-4028)*.

Note: It is very important to understand that when an overlay or a page segment is downloaded to PSF/2, it is available for anyone to use. There is no security as there is on the AS/400 to protect sensitive page segments or overlays from being misused.

7.1.3 AS/400 as a Server (LPD)

The server or Line Printer Daemon (LPD) process resides within the QTCP subsystem of the AS/400 and is owned by the user profile QTCP. Figure 170 on page 197 shows the screen display of the jobs which you would expect to see running in the QTCP subsystem.

```
                        Work with Active Jobs
                                                        03/08/93  10:25:31
CPU %:   26.0     Elapsed time:   01:16:14     Active jobs:   114

Type options, press Enter
  2=Change   3=Hold   4=End   5=Work with   6=Release   7=Display message
  8=Work with spooled files   13=Disconnect ...

Opt  Subsystem/Job  User        Type
     QTCP           QSYS        SBS      .0                    DEQW
       FTPSRV1      QTCP        BCH      .0                    DEQW
       FTPSRV12     QTCP        BCH      .0                    DEQW
       FTPS659021   QTCP        BCH      .0                    DEQW
       LPDSRV1      QTCP        BCH      .0                    DEQW
       LPDSRV2      QTCP        BCH      .0                    DEQW
       QTCPIP       QTCP        BCH     1.6  CMD-DSPJOBLOG     DEQW
       QTCPSTART    QTCP        ASJ      .0                    DEQW
       QTCPTIMER    QTCP        BCH      .4                    DEQW
       QTMSMTP      QGATE       BCH      .0  PGM-QTMSTSMT      DEQW
                                                                    More...
Parameters or command
===>
F3=Exit      F5=Refresh   F10=Restart statistics   F11=Display elapsed data
F12=Cancel   F23=More options   F24=More keys
```

Figure 170. Typical TCP Subsystem

When the QTCP subsystem is started it will start up two LPD server jobs, LPDSRV1 and LPDSRV2. Both server jobs listen for a valid connection request from an LPR. If either of the servers receives a valid request, that server immediately starts a new server job to replace itself. The new job will have a name of the form LPDSnnnnnn, where nnnnnn is a six-digit number chosen by the TCP/IP subsystem. The LPD then processes the request it has received and, when it has finished processing, terminates.

Two servers are started by default, to cover the unlikely event where two requests are received virtually simultaneously. If only one server were running and such an event happened, one request could be ignored.

In a very busy environment you may wish to run more than two server jobs. If you need to start an additional server job, issue the following command:

```
SBMJOB JOB(job-name) JOBD(QTCP/QTMPLPDS) RTGDTA(*JOBD) RQSDTA(*JOBD)
  CCSID(*HEX) USER(QTCP)
```

When this LPD receives a request, it will start up a new LPD, process the request, and terminate. The new LPD that it starts will have a name of the form LPDSnnnnnn.

If you wish to shut down a server, issue the following command:

```
ENDJOB JOB(QTCP/LPDSmmmmmm) OPTION(*IMMED) SPLFILE(*YES)
```

where mmmmmm is the number of the server job you wish to terminate.

The only daemon command supported by the AS/400 LPD is Receive Printer Job. If any other command is received, such as Print Any Waiting Jobs or Remove Jobs, LPD ignores them and sends return code 1, meaning failure, to the requesting system. The connection is immediately closed. LPD logs an error indicating "Unsupported Function."

The AS/400 is unique in that it requires all files that are to be printed to have spooled file attributes associated with the data. LPD checks the control file extended print attribute to determine if the spooled file attributes are being sent with the data. If they are not, default attributes are assigned to the spooled file by the receiving system, from those held in the QPTMPLPD default printer file in the QTCP library.

7.1.3.1 Security

Figure 171 on page 199 shows the way in which the AS/400 determines which output queue should receive the TCP/IP file.

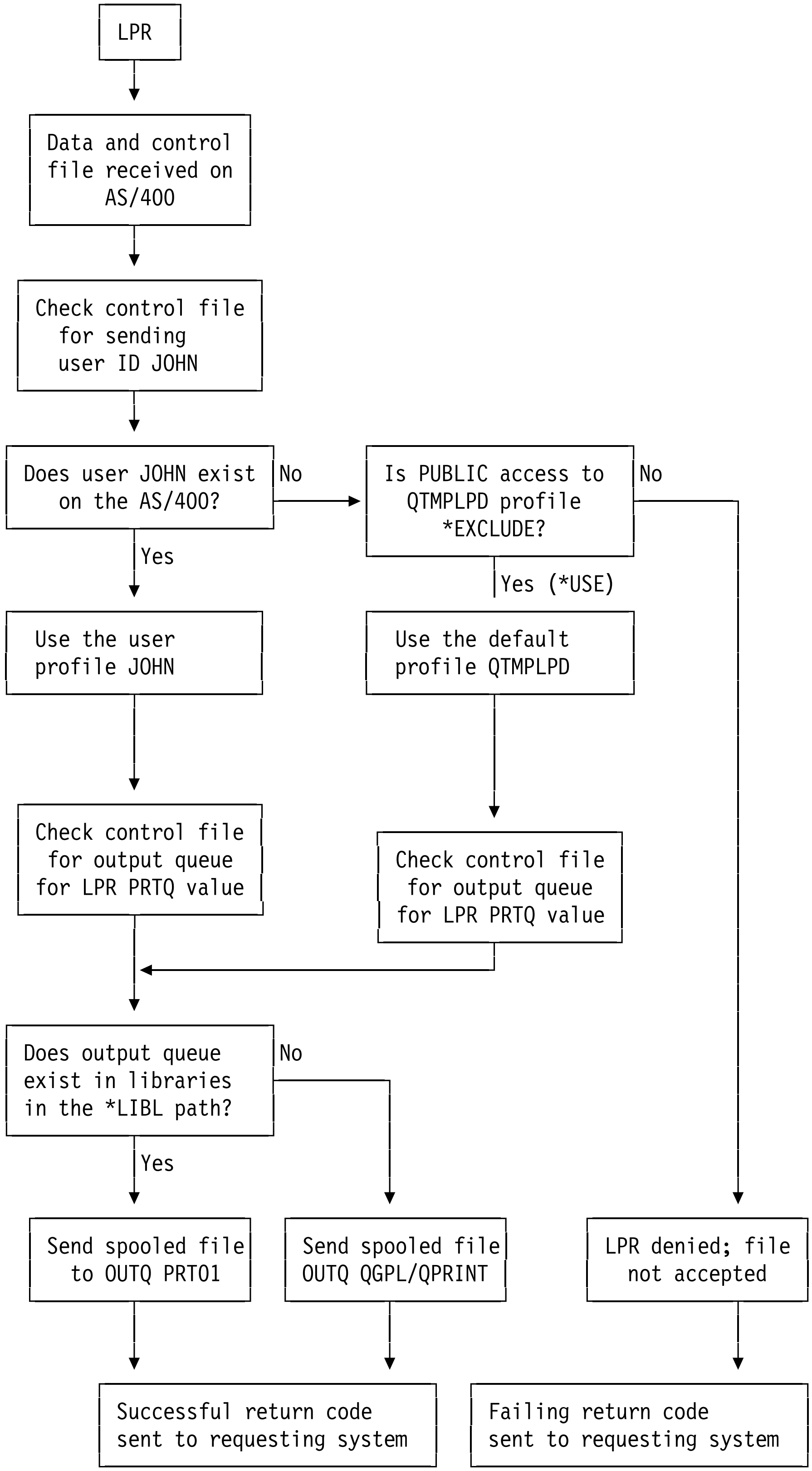

Figure 171. Flow for Determining Output Queue for a Spooled File

If the user ID and output queue are specified on the LPR command, an attempt will be made to create the spooled file on the specified output queue. If the requested output queue exists and is found in the specified library or QUSRSYS, and the PUBLIC parameter for both the user profile and the output queue is **USE*, the file will be placed on that output queue.

The sender may specify the destination output queue in the format *library/output queue*. This allows the LPD to exactly determine the location of the requested output queue.

If the user profile has the PUBLIC parameter set to **EXCLUDE*, the sending user ID must also exist on the AS/400. If it does not, an error is returned to the sender and the connection is terminated.

If the output queue has **EXCLUDE*, or if it does not exist, an attempt will be made to create the file on the output queue QPRINT in library QGPL. Success or failure will depend upon the setting of the PUBLIC parameter for the QPRINT output queue.

If the specified user does not exist on the destination AS/400, the public access for the user QTMPLPD will be checked. If it is **USE*, and the output queue is found, the file will be sent there. If the output queue is not found, the file will be sent to the output queue QPRINT in library QGPL.

In any of the above cases, a return code of 0, meaning success, is sent to the requesting system and the connection is closed.

If the QTMPLPD profile has public access set to *EXCLUDE, access to the output queue is denied, and the file is rejected by the AS/400 destination system. An error message is sent to the message queue of the requester, provided that requester has a user profile which exists on the destination system. If it does not exist, then the error message is sent to the QTMPLPD default user profile message queue.

WARNING

There is no mechanism to notify the requesting system that an authority error has been detected, since the TCP connection is usually closed by the time this is determined. Any success messages posted by the LPR client application will simply mean the file was temporarily received, but not necessarily retained. You should not delete any files until you have verified you have proper authority and that your files were received successfully on the destination system.

By providing the QTMPLPD profile with authorization to output queues, the destination AS/400 system administrator can set up output queues for any user on the network who wishes to send files to the AS/400, without the need to set up user profiles for them.

By restricting the QTMPLPD profile, the system administrator can limit the access to output queues.

The ability to associate different user IDs with spooled files avoids the problem of having only one user ID owning all the files. This provides the user more flexibility for ownership of spooled files and the ability to use the WRKSPLF command on any spooled files, subject to overall system security.

7.1.3.2 Receiving a File from Another AS/400 System

If the spooled file is being sent from another AS/400, the first file to arrive will always be the control file. If the spooled file has been sent without transformation from SCS to ASCII, the control file will contain the extended print attributes. The AS/400 LPD process will check the extended print attribute and determine that the spooled file attributes are being sent with the data.

In this case no further use is made of the control file, and the spooled file is recreated on the destination AS/400 using the spool APIs.

The spooled file will have exactly the same attributes on the receiving spool queue that it had on the sending spool queue.

If the original spooled file was in SCS format, and the TRANSFORM parameter on the SNDTCPSPLF command was set to **YES* the file will have been transformed to ASCII using the Host Print Transform function, and the manufacturer, type and model information given on the MFRTYPMDL parameter will have been used to determine the printer attributes to use in the ASCII data stream. The ASCII data stream will be received on the destination system without change.

7.1.3.3 Receiving a File from a Non-AS/400 System

If the spooled file is being sent from any system other than an AS/400 the LPD job will check the control file. From the control file information the AS/400 can establish that the file is not being sent from another AS/400. In this case, the AS/400 assumes that no spooled file attributes are being sent with the data.

Since the AS/400 requires that each spooled file must have attributes associated with it, default attributes will be given to the file using a default printer file, QPTMPLPD in the library QTCP.

The control file will arrive first if the LPR is using the new command, Receive Control File First (RCFF). Some older LPR clients do not support this command, and use the Receive Control File (RCF) and Receive Data File (RDF).

The AS/400 supports both the older RCF and RDF commands as well as the new RCFF command.

For non-AS/400 LPR requesters, best print results are obtained by understanding that minimal formatting of the data file occurs, other than what is provided by the destination printing system. The AS/400 LPD server does provide support for the print filters *v*, *l*, and *f* as described in RFC 1179. If the *f* filter is received, line feeds (LF) will be replaced with carriage return/line feeds (CRLF).

Control file support for banner pages is not supported by LPD because the AS/400 has its own separator page function.

If multiple copies are requested by the non-AS/400 LPR, this number will be reflected into the new spooled file attributes.

7.1.4 Additional Documentation

You can find additional information in the following publications:

- *IBM AS/400 TCP/IP Guide (SC41-9875)*.
- *TCP/IP Tutorial and Technical Overview (GG24-3376)*.
- *AS/400 Workstation Customization Function Programmer′s Guide*, (SC41-0056)
- *AS/400 Programming for Printing*, (SC41-8194)
- *AFP Utilities/400 User′s Guide and Reference*, (SH18-2416)

7.2 Using LPR to RS/6000

This section describes:

- How to configure LPD on the RS/6000 to allow an AS/400 to send a spooled file through LPR.
- How to configure device and virtual printer for AIX print output.
- How to configure a PSF/6000 printer for PSF/6000 print output.

7.2.1 Setup for LPD on the RS/6000

Use the following series of commands to follow through the RS/6000′s smit menus.

At the AIX command line prompt, enter:

```
smit
  Spooler (Print Jobs)
    Manage Remote Printer Subsystem
      Server Services
        Host Access for Printing
          Add a Remote Host
```

Enter the host name of the remote host that should be allowed to send spool files to the local LPD. In our case this will be RCHASM02. This name should also be in the RS/6000′s local host table.

```
                                Add a Remote Host

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                          [Entry Fields]
* Name of Remote HOST                                   rchasm02


F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 172. Add a Remote Host

7.2.2 Configure Device and Virtual Printer for AIX Printing

Two steps are needed for the following configurations on the RS/6000. First, we will take you through the steps to configure the AIX printer device. Then the RS/6000 virtual printer must be configured in the next step.

7.2.2.1 Configure the AIX Printer Device

To configure a non-IPDS printer so that it is recognized as an AIX printer perform the following steps. In our case, we had an IBM parallel attached 4029 printer.

At the AIX command line prompt, enter:

```
smit printer
  Printer/Plotter Devices
    Add a Printer/Plotter
      4029     IBM 4029 LaserPrinter (select printer, press Enter)
      parallel                       (select Interface, press Enter)
      ppa0 Available 00-00-0P Standard I/O Parallel Port Adapter
      p                              (select PORT number)
```

Figure 173 shows the final screen. Make any changes if necessary. If all the fields are correct, then press Enter.

```
                           Add a Printer/Plotter

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

[TOP]                                                [Entry Fields]
  Printer/Plotter type                              4029
  Printer/Plotter interface                         parallel
  Description                                       IBM 4029 LaserPrinter
  Parent adapter                                    ppa0
* PORT number                                      [p]                     +
  Type of PARALLEL INTERFACE                       [standard]              +
  Printer TIME OUT period                          [600]                   +#

  STATE to be configured at boot time              [available]             +
  The following attributes have meaning only
  when the Printer/Plotter is not used with
  a Print Queue:

[MORE...13]                 F2=Refresh             F3=Cancel

Es=Help             F2=Refresh      ext F3=Cancel          F4=List
F9=Shell            F10=Exit            Enter=Do
```

Figure 173. Printer Specifications

7.2.2.2 Configure Virtual Printer

At the AIX command line prompt, enter:

```
smit printer
  Manage Local Printer Subsystem
    Virtual Printers
      Add a Virtual Printer
```

```
    No.    Description
    1      Printer or Plotter Attached to Host
    2      Printer or Plotter Attached to Xstation
    3      Printer or Plotter Attached to ASCII Terminal
    4      Network Printer (Hewlett-Packard JetDirect)

Enter number from list above (press Enter to terminate):  -> 1
```

Figure 174. Select Option 1 Printer Attached to Host

```
     Name         Description
     lp0          IBM 4029 LaserPrinter

Enter device name (or, ! to exit):  ->  lp0
```

Figure 175. Enter the Printer Device Name Used and Press Enter

For the next series of panels, answer the questions. When in doubt, take the defaults.

Enter the print queue name to be used for printing with AIX, in this case asc.

```
                  IBM 4029 LaserPrinter
Header pages wanted?  (n=none; a=each file; g=each job):  -> (n)
Trailer pages wanted? (n=none; a=each file; g=each job):  -> (n)
NOTE:   The 4029 printer supports multiple print data streams.
        Each of the data streams will now be configured individually.
--------------------  PostScript  --------------------
Enter print queue name (or, ! to bypass configuration):   -> (ps)   !
--------------------  HP LaserJet II Emulation  --------------------
Enter print queue name (or, ! to bypass configuration):   -> (pcl)   !
--------------------  Plotter Emulation  --------------------
Enter print queue name (or, ! to bypass configuration):   -> (gl)   !
--------------------  IBM ASCII  --------------------
Enter print queue name (or, ! to bypass configuration):   -> (asc)   asc
Should this queue be the default queue? -> (y)  n
4029 (IBM ASCII) configured for print queue asc

Press Enter to continue
```

Figure 176. Virtual Printer Queue Configuration

7.2.3 Verify Your Configuration on the RS/6000

1. Verify the printer configuration by printing an RS/6000 file directly to the attached printer. Enter:

   ```
   cat /etc/qconfig > /dev/lp0
   ```

2. Now we will test that the virtual printer works correctly by entering:

   ```
   enq -P asc /etc/qconfig
   ```

3. The last step to verification will be to use LPR on the AS/400 to send a spool file to the RS/6000 to be printed using the AIX print queue asc. Find a

spooled file that you wish to send and write down the file, job and spool number information. Then complete the LPR command as below using the file, job and spool number of your spooled file.

Note: It is important to enclose the PRTQ parameter asc in side of quotation marks. This is because the RS/6000 is case sensitive, and you need the print queue name asc to be sent as it is in lower case.

```
LPR RMTSYS(RCHRS001) PRTQ('asc') FILE(FTPBATCHT) JOB(059016/HANS/FTPBATCHT)
    SPLNBR(1) DESTTYP(*OTHER) TRANSFORM(*YES) MFRTYPMDL(*IBM42011)
```

Symptom: When you enter enq -A at the RS/6000 to display the status of the print queue, the printouts to be printed are queueing in that print queue. If it has been offline for some time, the status of that queue could become 'DOWN'.

Problem:

1. Printer is offline
2. Printer status is DOWN
3. Printer paper jam

Solution:

1. Press the online button at the printer.
2. If the print queue status shows DOWN, enter the following RS/6000 command to get the print queue to READY status again:

   qadm -U asc

   where asc is the print queue name

3. To clear the paper jam and get the printer ready for printing again, do the following:
   - Clear the paper in the printer
   - Display the status of the print queue using command:

     enq -A

   - To clear any outstanding print jobs in the print queue (if necessary) enter the following command:

     qcan -xnn

     where nn is the job number in the status screen

   - If the status of the printer is DOWN, enter command:

     qadm -U asc

     where asc is the print queue name

   - Check the status of the print queue to make sure the status is READY and ensure that the printer is online.

7.2.4 Configure PSF for PPDS

The LPP PSF/6000 provides an intelligent print driver that accepts input data stream files including Advanced Function Printing data stream (AFPDS) and ASCII and different output data streams like PPDS or PCL.

To be able to use PSF/6000, a PPDS printer (or a PCL printer) is configured. Enter:

```
smit psfcfg
  Add a Printer or PSF/6000 Queue
    AIX-Defined (Parallel, Serial, or LAN)
```

Then enter the information below for Figure 177.

```
                  Add a PSF/6000 Queue for AIX-Defined Printer

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                      [Entry Fields]
* Data stream type                                  PPDS
* Printer NAME                                      psf6k                  /

* COMMAND to execute for printer output            [qprt -P asc -dp -Z!]    +
  Description
  a printer, select Change Characteristics of
  a Printer from the
  PSF/6000 Printer Definition panel.


F1=Help             F2=Refresh          F3=Cancel           F4=List
Esc+5=Reset         F6=Command          F7=Edit             F8=Image
F9=Shell            F10=Exit            Enter=Do
```

Figure 177. PPDS Printer and Queue Definition

Enter the name of the PPDS printer (this name is equal to the PPDS queue to be created).

Against COMMAND to execute for printer output enter the name of the AIX output queue asc, not the name of the PSF queue.

7.2.5 Verify Your Configuration of PSF/6000

To test that the path between the RISC System/6000, PSF/6000 queue, and the PSF/6000 printer is correct, enter:

```
enq -P psf6k /etc/qconfig
```

psf6k is the name of the PSF/6000 queue.

If the file prints correctly, AS/400 spooled files with AFP and SCS data stream can be sent and printed on the RS/6000 printer.

When sending spooled files to PSF/6000 always specify *OTHER for the LPR parameter Destination type.

For AFPDS specify *NO for parameter Transform SCS to ASCII. We used the AFP Utilities/400 through the STRAFPU command on the AS/400 to create an overlay named OVERLAY. It is this AFPDS spool file that we sent to the RS/6000 rchrs001 in Figure 178 on page 207. PSF/6000 will convert the AFPDS data stream into PPDS automatically. For more information about the AFP Utilities/400, please see *AFP Utilities/400 User's Guide and Reference*, (SH18-2416).

```
                        Send TCP/IP Spooled File (LPR)

 Type choices, press Enter.

 Remote system  . . . . . . . . .   rchrs001



 Printer queue  . . . . . . . . .   'psf6k'


 Spooled file . . . . . . . . . .   overlay       Name
 Job name . . . . . . . . . . . .   p23xyg41f     Name, *
   User . . . . . . . . . . . . .     hans        Name
   Number . . . . . . . . . . . .     060045      000000-999999
 Spooled file number  . . . . . .   *ONLY         1-9999, *ONLY, *LAST
 Destination type . . . . . . . .   *OTHER        *AS400, *PSF2, *OTHER
 Transform SCS to ASCII . . . . .   *no           *YES, *NO


                                                                       Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 178. Sending AFPDS to PSF/6000

For SCS datastream you must specify *YES for the Transform SCS to ASCII parameter. The AS/400 will then convert the SCS datastream from EBCDIC to ASCII (by Host Print Transform) which is then sent to PSF/6000 and properly printed. See Figure 179 for an example.

```
                        Send TCP/IP Spooled File (LPR)

 Type choices, press Enter.

 Remote system  . . . . . . . . . > RCHRS001



 Printer queue  . . . . . . . . . > 'psf6k'


 Spooled file . . . . . . . . . . > ftpbatcht     Name
 Job name . . . . . . . . . . . . > ftpbatcht     Name, *
   User . . . . . . . . . . . . . >   HANS        Name
   Number . . . . . . . . . . . . >   059016      000000-999999
 Spooled file number  . . . . . .   *ONLY         1-9999, *ONLY, *LAST
 Destination type . . . . . . . .   *OTHER        *AS400, *PSF2, *OTHER
 Transform SCS to ASCII . . . . . > *yes          *YES, *NO


                                                                       Bottom
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

Figure 179. Sending SCS to PSF/6000

7.3 National Language Support (NLS) Considerations

This section will address the issue of supporting NLS with both LPR and LPD on the AS/400.

7.3.1 NLS for AS/400 LPD

When the AS/400 LPD receives a printer data stream from a remote LPR client it does not provide any translation of the data stream. The remote LPR client must provide the NLS translation of the data to correctly match that of the AS/400 destination printer.

7.3.2 NLS for AS/400 LPR

When using LPR to send an AS/400 spooled output to a remote printer, the print result and the ability to translate data depend on the setting of several parameters in the LPR command:

Parameter	**Options**
TRANSFORM	Specifies whether or not to make use of the host print transform function to transform a spooled file of device type *SCS into ASCII data. If you specify DESTTYP(*OTHER), you would typically specify TRANSFORM(*YES). This is because most non-AS/400 destination systems do not support the printing of non-ASCII data. The non-AS/400 destination systems do receive and correctly process ASCII data.
MFRTYPMDL	Specifies the manufacturer, type, and model for a printer using the host print transform function. This parameter is only prompted when TRANSFORM(*YES) is specified.
WSCST	Specifies an object that consists of a table of attribute used to customize a given ASCII device, such as a workstation or printer. Character presentation, font specifications and control key sequences are examples of characteristics that can be customized. This parameter is only prompted when TRANSFORM(*YES) and MFRTYPLMDL(*WSCST) are specified. It is in the Workstation Customization Object that you can specify EBCDIC-to-ASCII code page mapping. This would be done with the EBCASCTBLE parameter as part of the Workstation Customization Object.

For detailed information about workstation customization objects refer to *IBM AS/400 Printing III (GG24-4028)*, and to *IBM OS/400 Workstation Customization Function Programmer's Guide (SC41-0056)*.

Chapter 8. Network Status

The network status function on the AS/400 system allows the user to get information about the status of TCP/IP routes, links and connections on your local system. This function also allows you to start and end TCP/IP connections and links.

8.1 Work with TCP/IP Network Status

To work with the TCP/IP network status functions:

1. Enter the command NETSTAT or
2. Select option 8 from the TCP/IP Administration menu.

The corresponding AS/400 command for NETSTAT is WRKTCPSTS.

The Work with TCP/IP Network Status menu will be presented as shown in Figure 180.

```
                       Work with TCP/IP Network Status
                                                        System:   RCHAS008
 Select one of the following:

      1. Work with TCP/IP link status
      2. Display TCP/IP route information
      3. Work with TCP/IP connection status



 Selection or command
 ===> ____________________________________________________________________

 F3=Exit   F4=Prompt   F9=Retrieve   F12=Cancel
```

Figure 180. Work with TCP/IP Network Status

- **Option 1** displays the link configuration information as configured in Figure 10 on page 18. It shows the status of each link, and allows the user to start or end a link.
- **Option 2** shows the TCP/IP route information as configured in Figure 12 on page 19.
- **Option 3** displays the actual connection status and provides detailed information for each of the connections. In addition it allows the user to end a connection.

8.2 Work with TCP/IP Link Status

When option 1 of the Work with TCP/IP Network Status is selected, the configuration information and the status of each link is presented as shown in Figure 181 on page 210.

```
                          Work with TCP/IP Link Status
                                                             System:   RCHAS008
Type options, press Enter.
  5=Display   9=Start   10=End

              Line          Internet           Link
Option     Description     Address            Type       State
  __       ETHLINE         9.5.65.240         *ELAN      Active
  __       TRNLINE         9.5.69.254         *TRLAN     Active
  __       X25LINE         9.5.67.242         *X25       Inactive




                                                                      Bottom
F3=Exit   F5=Refresh   F6=Print list   F12=Cancel   F17=Top   F18=Bottom
```

Figure 181. Work with TCP/IP Link Status

This display shows for each link: the name of the line description, the local internet address, the link protocol used, and the activity status. The link is in one of the following states:

- **Inactive**: The link is not active.
- **Starting**: Processing the start link request.
- **Activating**: Waiting for a response.
- **Active**: The link has started.
- **Recovering**: The system is attempting to recover from a link error.
- **Recovery cancelled**: The system operator has cancelled the link recovery.
- **Failed (VLIC error)**: An error was detected in the AS/400 Vertical Licensed Internal Code (VLIC). Consult with the system operator or the system operator message queue to recover from or report this problem.
- **Failed (TCP error)**: An error was detected in the AS/400 TCP/IP Utilities Licensed Program. Consult with the system operator or the system operator message queue to recover from or report this problem.

8.2.1 Display TCP/IP Link Status

From the Work with TCP/IP Link Status screen, select option 5 against each link you want more information about. Press the Enter key.

The Display TCP/IP Link Status menu is then presented as shown in Figure 182 on page 211.

If you have requested link status information for more than one link, press the Enter key to view the remaining displays.

```
                         Display TCP/IP Link Status
                                                     System:   RCHAS008
Line description . . . . . . . . . . . . . . :   ETHLINE
Internet address . . . . . . . . . . . . . . :   9.5.65.240
Link type . . . . . . . . . . . . . . . . . . :   *ELAN
State . . . . . . . . . . . . . . . . . . . . :   Active
Queue size . . . . . . . . . . . . . . . . . :   0



Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

```
                         Display TCP/IP Link Status
                                                     System:   RCHAS008
Line description . . . . . . . . . . . . . . :   TRNLINE
Internet address . . . . . . . . . . . . . . :   9.5.69.254
Link type . . . . . . . . . . . . . . . . . . :   *TRLAN
State . . . . . . . . . . . . . . . . . . . . :   Active
Queue size . . . . . . . . . . . . . . . . . :   0
TRLAN bit sequencing . . . . . . . . . . . . :   *MSB



Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

```
                         Display TCP/IP Link Status
                                                     System:   RCHAS008
Line description . . . . . . . . . . . . . . :   X25LINE
Internet address . . . . . . . . . . . . . . :   9.5.67.242
Link type . . . . . . . . . . . . . . . . . . :   *X25
State . . . . . . . . . . . . . . . . . . . . :   Inactive
Queue size . . . . . . . . . . . . . . . . . :   0
X.25 reverse charges . . . . . . . . . . . . :   *NONE
X.25 idle circuit timeout . . . . . . . . . . :   60
X.25 maximum virtual circuits . . . . . . . . :   32
X.25 DDN link . . . . . . . . . . . . . . . . :   *NO



Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

Figure 182. Display TCP/IP Link Status

Apart from the usual information shown for a link such as:

- The name associated with the line description
- The internet address associated with the link
- The link type : Token-ring, Ethernet or X.25
- The state as shown in figure 8.2, “Work with TCP/IP Link Status” on page 209

The following information is also shown:

- Queue size

  This is the number of envelope buffers queued for processing by the link. This is a modulo (2**31) sized number.

- X.25 Parameters

  The following parameters are only applicable if the Link type is *X25:

  – The manner in which the link deals with reverse charges:

    - *NONE - neither accept nor request
    - *REQUEST - request only
    - *ACCEPT - accept only
    - *BOTH - both accept and request

  – The idle virtual circuit timeout, values range from 1 to 600 seconds.

  – The maximum number of concurrent switched virtual circuits (SVC′s) the X.25 link is permitted to have at the same time. Values are from 1 to 32.

  – Specifies whether the link is an X.25 Defense Data Network Link.

8.2.2 Start TCP/IP Links

The Start TCP/IP Link (STRTCPLNK) command allows the user to start an existing TCP/IP link. The line associated with the link is varied on.

This command can be used to do the following:

- Start links that have been specified with the AUTOSTART(*NO) value on the Add TCP/IP Link (ADDTCPLNK) and Change TCP/IP Link (CHGTCPLNK) command prompts.
- Start a link that was previously ended by the End TCP/IP Link (ENDTCPLNK) command.

TCP/IP links can also be started from the Work with TCP/IP Link Status menu.

8.2.3 End TCP/IP Links

The End TCP/IP Link (ENDTCPLNK) command allows you to end an existing TCP/IP link immediately. This will cause all TCP/IP connections associated with this link to end immediately. However, other jobs using the line description associated with the link being ended will not be affected.

TCP/IP links can also be ended from the Work with TCP/IP Link Status menu.

8.3 Display TCP/IP Route Information

The display TCP/IP route information function allows you to view information about TCP/IP routes.

To display TCP/IP route information, select option 2 from the Work with TCP/IP Network Status menu.

The first Display TCP/IP Route Information display is shown in Figure 183 on page 213.

```
                    Display TCP/IP Route Information
                                                          System:   RCHAS008
                 Line                             Maximum
Network          Description  First Hop           Datagram Size
*DEFAULT         TRNLINE      9.5.69.193              *CALC
9                ETHLINE      *HOME                   *CALC
9                TRNLINE      *HOME                   1994
9                X25LINE      *HOME                   1024

                                                                     Bottom
Press Enter to continue.

F3=Exit   F6=Print list   F11=Display subnet information   F12=Cancel
F17=Top   F18=Bottom
```

Figure 183. Display TCP/IP Route Information (Display 1)

To view the second Display TCP/IP Route Information display, press the function key F11 to display *subnet information*. The subnet information is presented as shown in Figure 184.

```
                    Display TCP/IP Route Information
                                                          System:   RCHAS008

Network          Subnet Mask       Subnet Value
*DEFAULT         *NONE             *NONE
9                0.255.255.0       0.5.65.0
9                0.255.255.192     0.5.69.192
9                0.255.255.0       0.5.67.0

                                                                     Bottom
Press Enter to continue.

F3=Exit   F6=Print list   F11=Display lines/hops   F12=Cancel   F17=Top
F18=Bottom
```

Figure 184. Display TCP/IP Route Information (Display 2)

Note: All routes that appear on the Work With TCP/IP Routes panel under CFGTCP should appear here. If this is so, then there is a user error in the route configuration.

8.4 Work with TCP/IP Connection Status

The Work with TCP/IP Connection Status display allows the user to display or end a TCP/IP connection between the local host and a remote host.

To display the TCP/IP connection status, select option 3 from the Work with TCP/IP Network Status menu. Look at Figure 185 on page 214.

To view updates to the connection status, press the function key F5 for refresh.

```
                    Work with TCP/IP Connection Status
                                                              System:   RCHAS008
 Position to  . . . . .   _______________   Remote internet address

 Type options, press Enter.
   4=End   5=Display

      Remote
      Internet          Remote   Local    Connection
 Opt  Address           Port     Port       Number    User         State
  _   *                 *        FTP-C        1001    QTCP         Listen
  _   *                 *        FTP-C        1002    QTCP         Listen
  _   *                 *        FTP-C        1003    QTCP         Listen
  _   *                 *        TELNET       1000    QTCP         Listen
  _   *                 *        SMTP         1006    QGATE        Listen
  _   *                 *        LPD          1005    QTCP         Listen
  _   *                 *        LPD          1004    QTCP         Listen
  _   9.5.69.251        TELNET   1003         1007    DARYL        Established
  _   9.5.69.198        FTP-C    1004         1010    JOHN         Established

                                                                          Bottom
 F3=Exit   F5=Refresh   F6=Print list   F11=Display transmission information
 F12=Cancel
```

Figure 185. Work with TCP/IP Connection Status (Display 1 of 2)

After the QTCP subsystem is started, there should be three FTP, one TELNET, one SMTP and two LPD sessions, waiting for incoming connections at the Local Port. As there is no connection established yet, their *remote internet address* and *remote port* are marked with '*'. As soon as a connection is requested, the *remote internet address* and the *remote port* will be shown. The remote and local ports shown are your system port numbers or the well-known port names:

- FTP-D is FTP data port 20
- FTP-C is FTP control port 21
- TELNET is TELNET port 23
- SMTP is SMTP port 25
- LPD is LPD port 515

Each connection is assigned a number by the AS/400. The user shown is the user profile or name of the process on the AS/400 associated with the connection.

The TCP/IP connection processes can be in any of the following states:

- **Listen** Waiting for a connection request from any remote TCP host and port.
- **Syn-sent** Waiting for a matching connection request after having sent a connection request.
- **Syn-received** Waiting for a confirming connection request acknowledgment after having both received and sent a connection request.
- **Established** An open connection, data received can be delivered to the user. The normal state for the data transfer phase of the connection.
- **Fin-wait-1** Waiting for the remote host to acknowledge the local host's request to terminate the connection.
- **Fin-wait-2** Waiting for a connection termination request from the remote host.

- **Close-wait** Waiting for a connection termination request from the local user.
- **Closing** Waiting for a connection termination request from the remote host.
- **Last-ACK** Waiting for an acknowledgment of the connection termination request previously sent to the remote host.
- **Time-wait** Waiting for enough time to pass to be sure the remote host received the acknowledgment of its connection termination request.
- **Closed** this connection has ended.

To display more information on each of these connections, press the function key F11 for *transmission information*. See Figure 186.

```
                     Work with TCP/IP Connection Status
                                                             System:   RCHAS008
 Position to  . . . . .   _______________   Remote internet address

 Type options, press Enter.
   4=End   5=Display

      Remote
      Internet         Remote  Local        Bytes       Bytes  Idle
 Opt  Address          Port    Port          Out          In   Time
  _   *                *       FTP-C           0           0  019:25:26
  _   *                *       FTP-C           0           0  019:25:26
  _   *                *       FTP-C           0           0  019:25:27
  _   *                *       TELNET          0           0  019:25:44
  _   *                *       SMTP            0           0  019:11:14
  _   *                *       LPD             0           0  019:25:23
  _   *                *       LPD             0           0  019:25:24
  _   9.5.69.251       TELNET  1003           25         207  000:01:10
  _   9.5.69.198       FTP-C   1004         3394        1000  000:08:20

                                                                     Bottom
 F3=Exit   F5=Refresh   F6=Print list   F11=Display connection information
 F12=Cancel
```

Figure 186. Work with TCP/IP Connection Status (Display 2 of 2)

The information unique to this panel is as follow:

- Bytes Out - The number of bytes sent out on the connection shown, the size of this integer is limited to modulo(2**32).
- Bytes In - The number of bytes received on the connection shown, the size of this integer is limited to modulo(2**32).
- Idle Time - Length of time since the last activity on the connection presented in the form hhh:mm:ss.

8.4.1 Display TCP/IP Connections

More detailed information for TCP/IP connections is obtained from the Work with TCP/IP Connection Status display. Most of this information would be useful when running programs using the Application Program Interface to TCP/IP.

To display the detailed information of each TCP/IP connection, select option 5 against this connection and press the Enter key. A series of four displays for each connection is presented. Press the Page Down (Roll Up) key to view the remaining displays.

```
                     Display TCP/IP Connection Status
                                                        System:   RCHAS008
Connection identification:
  Remote internet address . . . . . . . . . :   9.5.69.198
  Remote host name  . . . . . . . . . . . . :   RCHRS001
  Remote port . . . . . . . . . . . . . . . :   FTP-C
  Local internet address  . . . . . . . . . :   9.5.69.254
  Local host name . . . . . . . . . . . . . :   RCHAS008.RCHLAND.IBM.COM
  Local port  . . . . . . . . . . . . . . . :   1004
  Connection number . . . . . . . . . . . . :   1010
  User  . . . . . . . . . . . . . . . . . . :   JOHN
TCP programming interface information:
  State . . . . . . . . . . . . . . . . . . :   Close-wait
  Connection open type  . . . . . . . . . . :   Active
  Data delivered  . . . . . . . . . . . . . :   No
  Pending TCP-receive buffers . . . . . . . :   No
  Send buffer availability  . . . . . . . . :   Sufficient
  Idle time . . . . . . . . . . . . . . . . :   000:08:20

                                                                   More...
Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

Figure 187. Display TCP/IP Connection Status (Display 1 of 4)

```
                     Display TCP/IP Connection Status
                                                        System:   RCHAS008
Security and precedence:
  Security  . . . . . . . . . . . . . . . . :   Unclassified
  Compartment . . . . . . . . . . . . . . . :   0
  Precedence  . . . . . . . . . . . . . . . :   Routine
Network round-trip information:
  Unacknowledged segments . . . . . . . . . :   0
  First free  . . . . . . . . . . . . . . . :   0
  First used  . . . . . . . . . . . . . . . :   0
  Round-trip time . . . . . . . . . . . . . :   .030
  Round-trip variance . . . . . . . . . . . :   .027
  Total acknowledged  . . . . . . . . . . . :   3
  Acknowledgements not counted  . . . . . . :   0
  Average trip time . . . . . . . . . . . . :   .052
  Maximum number unacknowledged . . . . . . :   1

                                                                   More...
Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

Figure 188. Display TCP/IP Connection Status (Display 2 of 4)

```
                        Display TCP/IP Connection Status
                                                          System:   RCHAS008
Network send information:
  User send next  . . . . . . . . . . . . . :   104884549
  Bytes out . . . . . . . . . . . . . . . . :   25
  Outgoing push number  . . . . . . . . . . :   0
  Outgoing urgency number . . . . . . . . . :   0
  Outgoing window number  . . . . . . . . . :   104900521
  Initial send sequence number  . . . . . . :   104884524
  Send next . . . . . . . . . . . . . . . . :   104884549
  Send unacknowledged . . . . . . . . . . . :   104884549
  Send window . . . . . . . . . . . . . . . :   15972
  Send last window update . . . . . . . . . :   4220744911
  Send last window update acknowledged  . . :   104884549
  Maximum send window . . . . . . . . . . . :   15972
  Maximum segment size  . . . . . . . . . . :   1452
  Backoff count . . . . . . . . . . . . . . :   0
  Congestion window . . . . . . . . . . . . :   4356
  Slow start threshold  . . . . . . . . . . :   7986
                                                                    More...
Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

Figure 189. Display TCP/IP Connection Status (Display 3 of 4)

```
                        Display TCP/IP Connection Status
                                                          System:   RCHAS008
Network receive information:
  User receive next . . . . . . . . . . . . :   4220744855
  Bytes in  . . . . . . . . . . . . . . . . :   207
  Incoming push number  . . . . . . . . . . :   4220744910
  Incoming urgency number . . . . . . . . . :   0
  Incoming window number  . . . . . . . . . :   4220761090
  Initial receive sequence number . . . . . :   4220744705
  Receive next  . . . . . . . . . . . . . . :   4220744912

                                                                     Bottom
Press Enter to continue.

F3=Exit   F6=Print   F12=Cancel
```

Figure 190. Display TCP/IP Connection Status (Display 4 of 4)

A great deal of information is shown in these screens. The following paragraphs will try to point out areas which may be of interest to people coding their own TCP/IP applications and those parameters which may be used for problem determination.

The information displayed unique to the first screen is as follows:

- Connection identification

  This covers configuration and connection information as given by the QTCP subsystem, which should already be known.

- TCP/IP programming interface information
  - Data delivered
    - No

This will be output if there have been pending TCP-receive buffers, but the data has not yet been delivered to the user.

- Yes

  This will be output if there have been pending TCP-receive buffers, but the data has now been delivered to the user.

– Pending TCP-receive buffers

- No

  This will be output if no TCP receive buffers have been supplied by the TCP client.

- Yes

  This will be output if the TCP receive buffers have been supplied by the TCP client.

– Send buffer availability

  The value of this parameter changes if the user attempts to queue message traffic too rapidly for the system to accommodate the user′s use of transmission buffers. This parameter can have two values:

- Sufficient

  This indicates that sufficient send buffer space has been available to queue messages.

- Insufficient

  This indicates that insufficient send buffer space has been available and the user has been suspended awaiting freed buffers.

– Idle time

  This indicates, in hhh:mm:ss format, the length of time since any type of communication traffic has been sent or received by this user on this connection.

The information displayed unique to the second panel is as follows:

- Security and precedence:
  - Security

    The default for this is “unclassified,” but other values can be used within API programs.

  - Precedence

    Precedence provides a hierarchy of importance for message traffic with the understanding that each implementation of the protocols above IP, for example TCP, will observe that hierarchy when queuing, scheduling and sending messages.

- Network round-trip information

  The items displayed here are based upon performance data that is gathered for each user and maintained by the TCP/IP subsystem.

The information displayed unique to the third panel is as follows:

- Network send information
  - User send next

This is the sequence number that will be associated with the next byte of data to be sent by the user (client). This is not to be confused with send next. The send next parameter is the sequence number of the next byte of data that the local TCP will send to the remote TCP. If the local TCP is retaining data that the user has sent but that TCP has not yet sent, then the user send next parameter will differ from the send next parameter.

– Outgoing push number

  If there is no push data in the send stream, then this is zero. Otherwise, this is the sequence number of the last byte of push data in the send stream.

– Outgoing urgency number

  If there is no urgent data in the send stream, then this is zero. Otherwise, this is the sequence number of the last byte of urgent data in the send stream.

– Initial send sequence number

  This is the sequence number of the original SYN sent on this connection.

– Maximum segment size

  This is the size of the largest segment that can be transmitted on this connection.

The information displayed unique to the fourth panel is the following:

- Network receive information:
  - User receive next

    This is the sequence number of the next data byte expected to be received by the user (client) from the local TCP.

  - Incoming push number

    This is zero if there is no push data in the receive stream. If there is push data in the receive stream, the incoming push number is the sequence number of the last byte of pushed data in the receive stream.

8.4.2 End TCP/IP Connections

The End TCP/IP Connection (ENDTCPCNN) command allows you to end a TCP/IP connection. This command forces a TCP/IP connection to close and should only be used when normal ending is not possible.

TCP/IP connections are ended either from the Work with TCP/IP Connection Status display or by using the End TCP/IP Connection (ENDTCPCNN) command. If you use the ENDTCPCNN command, you must first know the number of the TCP/IP connection you want to end.

| To end TCP/IP connections from the Work with TCP/IP Connection Status display, type 4 against the connections you want to end.

| The Confirm End of TCP/IP Connections display will be presented as shown in Figure 191 on page 220.

```
                    Confirm End of TCP/IP Connections
                                                          System:   RCHAS008
Press Enter to confirm your choices for 4=End.
Press F12 to return to change your choices.

     Remote
     Internet         Remote  Local   Connection
Opt  Address          Port    Port      Number    User        State
 4   *                *       FTP-C       1001    QTCP        Listen

                                                                    Bottom

F11=Display transmission information     F12=Cancel
```

Figure 191. Confirm End of TCP/IP Connections

To end the TCP/IP connections you have chosen, press the Enter key from the Confirm End of TCP/IP Connections display.

If you decide not to end a TCP/IP connection or want to change your choices, press the function key F12 to cancel your request.

To end TCP/IP connections using the ENDTCPCNN command:

1. Type ENDTCPCNN on the command line.
2. Press the F4 (Prompt) key.
3. Type the number of the TCP/IP connection you want to end.
4. Press the Enter key.

If an authorization list is associated with the CL command, then only authorized users can successfully perform this function.

Note: Should a user end a connection that a server process is using as a “listening” connection, the server will automatically re-open a “listening” connection.

Chapter 9. TCP and UDP Application Program Interface

The Application Program Interface (API) to the TCP and UDP layers on the AS/400 enables you to write programs that communicate with other systems through a TCP/IP communications link. This link is above the support provided by FTP, PING, SMTP, and TELNET. Much work has been done in the *IBM AS/400 TCP/IP Guide (SC41-9875)* to fully document the API, and to provide coding examples. This document does not duplicate that effort. It does, however, take the user through a compile, provide simple coding examples for two TCP and UDP applications, and elaborate on some of the features (and pitfalls) of writing TCP or UDP applications on the AS/400 system. It also introduces the user to the differences between the AS/400 Pascal-based API and the standard AIX C API.

To understand this chapter, you must be familiar with the AS/400 system and AS/400 Pascal. Refer to the *AS/400 Languages: Pascal User's Guide* (SC09-1209) and the *AS/400 Languages: Pascal Reference* (SC09-1210) for AS/400 Pascal questions.

9.1 Differences Between the TCP and UDP APIs

The API provided on the AS/400 system is through a call/return interface to AS/400 Pascal. Two interfaces are defined. One is TCP (the TCP in TCP/IP), which provides a reliable transfer of a stream of characters. The other is UDP (User Datagram Protocol), which provides a relatively unreliable transfer of data. PING, as an example, uses the UDP.

TCP and UDP have one thing in common: They both provide a method to multiplex demultiplex IP datagrams, using ports to direct the datagrams to a user application process.

In addition, TCP provides a connection-oriented, end-to-end reliable connection between a pair of processes. It features:

- Stream data transfer: The application does not need to chop data into datagrams.
- Reliability: TCP assigns sequence numbers to each byte transmitted, and expects positive acknowledgments.
- Flow control: TCP uses a window mechanism to lessen the chance of overflow in its internal buffers.
- Full Duplex: TCP provides for concurrent data streams in both directions.

You can see why TCP is used for such user application protocols as Telnet and FTP.

9.2 Client/Server Relationship

It is imperative that you understand the Client/Server relationship when you are writing TCP or UDP application programs. Traditionally, the Server program is initiated first. It opens a passive connection on a well-known protocol port and its internet address; waiting for remote clients to actively open the other end of the connection. Together, the protocol port and the internet address of the server become its local socket, a mailing address that guarantees uniqueness in the internet.

The Client program does not require its own local socket. It lets the TCP or UDP support provide that information at open time. The Client program must, however, at open time, specify the remote well-known port and internet address of the Server.

In this way, Client and Server establish a connection, and can send and receive data. The actual content of the data and the order it is sent are defined by the applications.

9.3 Compiling a TCP/UDP Application

The steps necessary to compile a TCP or UDP application program are described in the following example. For this example, you are to compile and run member TELESERVER from source file APPLIB/QPASSRC.

Before you can compile and run AS/400 Pascal TCP/IP application programs, you must have loaded onto your machine:

- AS/400 Pascal (library QPAS)
- AS/400 TCP/IP (library QTCP)

Also, you must add some of the TCP/IP includes to your program to use the external procedures definitions, type fields and constants. Use STRPDM to print out these includes. You then can see what each has to offer. They are members in QTCP/QATMPINC.

```
%INCLUDE QATMPINC(CMALLC) /*%includes both CMCOMM and CMCLIE      */
      /* QATMPINC(CMCOMM)   connect status info. %includes CMXOLD */
      /* QATMPINC(CMXOLD)   EBCDIC to ASCII conversion table      */
      /* QATMPINC(CMCLIE)   client/server type declarations       */
%INCLUDE QATMPINC(CMINTR) /*constants and host table lookup       */
%INCLUDE QATMPINC(CMRESG) /*resolver and name server routines     */
%INCLUDE QATMPINC(ONERROR)/*ONERROR definitions                   */
```

To compile a TCP/IP application program on the AS/400, you must first have both the QTCP and QPAS libraries in your library list:

```
ADDLIBLE QPAS
ADDLIBLE QTCP
```

Then issue the compile command:

```
CRTPASPGM PGM(APPLIB/TELESERVER) SRCFILE(APPLIB/QPASSRC) OPTION(*DEBUG)
          LANGLVL(*SYSTEM) GENOPT(*OPTIMIZE)
```

Once your program has passed the AS/400 Pascal syntax check, set the program information to bind your code to the external definitions found in the %INCLUDE files. This is done with the SETPGMINF command:

```
SETPGMINF ROOTPGM(APPLIB/TELESERVER)
          SUBPGM((QTMTCINT) (QTMCMHOS) (QTMCMTOK) (QTMCMRES)
                 (QTMCMCAS) (QTMCMPRC) (QTMCMHEX) (QTMTCUTS))
          LIBFILE((*PASLIB))
```

Finally, run TELESERVER:

```
CALL TELESERVER
```

9.4 Overview of a Typical API Program

To interface with the TCP or UDP services, your AS/400 Pascal program calls externally defined procedures. Most of the API procedure pass back a return code that indicates success or failure.

The general sequence of operations is as follows:

1. Start the TCP/IP service.
2. Specify a set of notifications that TCP or UDP may send you.
3. Open the TCP or UDP communications link.
4. Send or receive the data from the remote application.
5. Check the status returned to you.
6. Repeat steps 4 and 5 as needed.
7. Close the TCP or UDP communications link.
8. End the TCP/IP service.

The code examples found in section 9.5, "Typical Flow of TCP API (Client and Server)" and in section 9.6, "Typical Flow of UDP API (Client and Server)" on page 227 show in more detail the basic concepts of programming to the AS/400 system's API. These programs can compile and run, but much of the original programs have been deleted to make it easier to see the bigger picture.

To make these examples complete programs, you should:

1. Check all ReturnCodes and abort or retry when failures occur.
2. Send real data.
3. Use timers to make sure the program does not hang waiting for an event that will never occur.
4. Use your own host names and ports, or provide a way for the user to input them into the program. Host names and ports are hardcoded.
5. Code the mandatory OnError procedure as is described in *IBM AS/400 TCP/IP Guide (SC41-9875).*

9.5 Typical Flow of TCP API (Client and Server)

The following code examples provide a simple introduction to programming the TCP API. The TCP server program waits passively for a client to open a connection to its well-known port. Once the TCP connection has been opened, the TCP server sends a stream of characters to the client. The client, on the other hand, simply opens to the well-known remote server port, receives the stream of characters, and closes.

9.5.1 TCP Server Code

The TCP Server code example on the next page starts by doing a passive open to a well-known port and internet address hardcoded in the constants PortNumber and HostAddress. It does not specify the foreign socket information, because it accepts an open request from any remote client.

Once the TCP connection has been opened, the server immediately begins to send a single stream of characters from the Buffer. This is done through the TCPWaitSend procedure, which when it returns, gives an indication of success or failure in the ReturnCode. The code checks this ReturnCode, and keeps on trying to send the buffer while TCP indicates that no internal buffers are available.

When the ReturnCode=OK from TCPWaitSend, TCP has accepted the data and guarantees transmission. This is when the TCP server closes. The TCPClose waits for all of the pending outgoing data to have been successfully sent before initiating the closing sequence.

```
program TCPServer;
/* include all of the external procedures, types, constants for TCP/IP*/
%INCLUDE QATMPINC(CMALLC) /*%includes both CMCOMM and CMCLIE      */
      /* QATMPINC(CMCOMM)   connect status info. %includes CMXOLD */
      /* QATMPINC(CMXOLD)   EBCDIC to ASCII conversion table      */
      /* QATMPINC(CMCLIE)   client/server type declarations       */
%INCLUDE QATMPINC(CMINTR) /*constants and host table lookup       */
%INCLUDE QATMPINC(CMRESG) /*resolver and name server routines     */
%INCLUDE QATMPINC(ONERROR) /*OnError Definitions                  */
const
  BufferLength = 10;          /* Buffer length could be anything... */
  PushTrue     = True;        /* Send the TCP data right now        */
  UrgentFalse  = False;       /* This data is not urgent            */
  ShouldWait   = True;        /* Always wait for the next note      */
  HostAddress  = '090F0101'x; /* Server internet address '9.15.1.1' */
  PortNumber   = 7059;        /* Well-known port of the server      */
var
  ReturnCode   : integer;     /* Success = OK, Failure is not OK    */
  Buffer : packed array[1..BufferLength] of char; / * Recv data here */
  Note : NotificationInfoType;/* Recv notifications here            */
  Connectioninfo:StatusInfoType;/* Describes the TCP connection     */
begin
/* Start the TCP/IP service                                           */
BeginTCPIP(ReturnCode);
/* Tell TCP/IP that this program will handle all of the possible      */
/* notifications from GetNextNote.                                    */
Handle(AllNotes,ReturnCode);
/* Set up the connection record for the TCPWaitOpen.  Since this is a */
/* TCP server, we will wait forever listening for the remote client to*/
/* open.                                                              */
with Connectioninfo do
  begin
  Connection         := UnspecifiedConnection; /* Let TCP set conn #  */
  OpenAttemptTimeout := WaitForever;           /* Wait for remote open*/
  ConnectionState    := Listening;             /* Passive listening   */
  LocalSocket.address:= HostAddress;           /* Hard coded as const */
  LocalSocket.port   := PortNumber;            /* Wellknown port const*/
  Foreignsocket.address:=UnspecifiedAddress;   /* Don't care          */
  Foreignsocket.port := UnspecifiedPort;       /* Don't care          */
  end;
/* Now do the passive, wait until a remote client opens, TCPWaitOpen. */
/* When we come back from this, ConnectionInfo will be updated with   */
/* information related to the remote client.                          */
TCPWaitOpen(ConnectionInfo, ReturnCode);
/* The job of this TCP server is to send to the remote client a Buffer*/
/*   - PushTrue is a boolean telling TCP to begin sending the data    */
/*     right now, instead of waiting for an internal buffer to fill.  */
/*   - UrgentFalse is a boolean telling TCP that this data is no more */
/*     urgent than any other piece of data.                           */
Buffer := '1234567890'; /* Make up something to send */
TCPWaitSend(Connectioninfo.connection, PtrTo(Buffer[1]),BufferLength,
            PushTrue, UrgentFalse, ReturnCode);
```

```
/* ReturnCode should be OK, indicating that TCP has accepted the data,*/
/* and has started sending it to the remote.  But, we should check to */
/* see if the TCP support has run out of buffers to accept our data...*/
while ReturnCode = NoBufferSpace do
  begin
  /* Get the next note.  We are looking for a notification that tells */
  /* us that TCP has more room available to accept data. Wait forever.*/
  GetNextNote(Note,ShouldWait,ReturnCode);
  /* now this should be a note indicating more bufferspace is avail   */
  if note.notificationtag = BufferSpaceAvailable then
    begin
    /* Resend the buffer.                                             */
    TCPWaitSend(Connectioninfo.connection, PtrTo(Buffer[1]),
                BufferLength,PushTrue, UrgentFalse, ReturnCode)
    /* note - the above TCPWaitSend is crude.  We could have checked  */
    /* note.AmountOfSpaceInBytes field in the notification, and sent  */
    /* the min(note.AmountOfSpaceInBytes,BytesYetToSend), and looped  */
    /* until all of the buffer has been sent.                         */
    end
  else
    begin
    /* unexpected notification */
    end
  end;/*while*/
/* We will assume that TCP is busy sending the data.  We can close the*/
/* connection at this point, because TCP makes sure that the close    */
/* does not pass any of the data.  Also note that closing at this     */
/* time does a push of the data; our PushTrue in the TCPWaitSend      */
/* above was unnecessary.                                             */
TCPClose(Connectioninfo.Connection, ReturnCode);
/* Wait for the data to be pushed through, and for the remote client  */
/* to accept our close.                                               */
repeat
  GetNextNote(note, ShouldWait, ReturnCode);
until (note.notificationtag = ConnectionStateChanged) and
      (note.newstate        = NonExistent);
/* No longer using TCP/IP service.                                    */
EndTCPIP
end. /* of the TCP server example */
```

9.5.2 TCP Client Code

In the client code example the TCP client starts by attempting an active TCPWaitOpen to the well-known foreign port and internet address of the TCP server. Once the TCP connection has been established, the client loops while reading in all of the bytes into the Buffer.

When all of the bytes have been read in, the client closes its side of the connection using TCPClose.

```
program TCPClient;
/* include all of the external procedures, types, constants for TCP/IP*/
%INCLUDE QATMPINC(CMALLC) /*%includes both CMCOMM and CMCLIE      */
      /* QATMPINC(CMCOMM)   connect status info. %includes CMXOLD */
      /* QATMPINC(CMXOLD)   EBCDIC to ASCII conversion table      */
      /* QATMPINC(CMCLIE)   client/server type declarations       */
%INCLUDE QATMPINC(CMINTR) /*constants and host table lookup       */
%INCLUDE QATMPINC(CMRESG) /*resolver and name server routines     */
%INCLUDE QATMPINC(ONERROR) /*OnError definitions                  */
```

```
const
  BufferLength = 10;         /* Buffer length could be anything... */
  ShouldWait   = True;       /* Always wait for the next note      */
  HostAddress  = '090F0101'x; /* Server internet address '9.15.1.1' */
  PortNumber   = 7059;       /* Well-known port of the server      */
var
  ReturnCode   : integer;    /* Success = OK, Failure is not OK    */
  NumBytesRcv  : integer;    /* Keep track of the number of bytes  */
  BytesRead    : integer;    /* This many bytes read this time     */
  Buffer : packed array[1..BufferLength] of char; /* Recv data here */
  Note : NotificationInfoType;/* Recv notifications here           */
  Connectioninfo:StatusInfoType;/* Describes the TCP connection    */
begin
/* Start the TCP/IP service                                          */
BeginTCPIP(ReturnCode);
/* Tell TCP/IP that this program will handle all of the possible     */
/* notifications from GetNextNote.                                   */
Handle(AllNotes,ReturnCode);
/* Set up the connection record for the TCPWaitOpen.  Since this is a */
/* TCP client, we will actively try to open to a well-known socket.  */
with Connectioninfo do
  begin
  Connection         := UnspecifiedConnection; /* Let TCP set conn #  */
  OpenAttemptTimeout := WaitForever;           /* Wait for remote open*/
  ConnectionState    := TryingToOpen;          /* Active open         */
  LocalSocket.address:= UnspecifiedAddress;    /* Don't care          */
  LocalSocket.port   := UnspecifiedPort;       /* Don't care          */
  Foreignsocket.address:=HostAddress;          /* Hard coded const    */
  Foreignsocket.port := PortNumber;            /* Hard coded const    */
  end;
/* Now do the active, wait until we have a connection, TCPWaitOpen.  */
/* When we come back from this, ConnectionInfo will be updated with  */
/* information related to the remote server.                         */
TCPWaitOpen(ConnectionInfo, ReturnCode);
/* For this program, the Client will receive length(Buffer) number of */
/* bytes.  Let's loop until we get them all.                         */
NumBytesRcv := 0;     /* number of bytes received so far is zero     */
repeat
  /* Received the data into Buffer.  Note, BytesRead is like a Return */
  /* Code, if negative, then something has gone wrong.  A good program*/
  /* should check it...                                              */
  TCPWaitReceive(connectioninfo.connection,PtrTo(Buffer[NumBytesRcv+1]),
               length(buffer)-NumBytesRcv, BytesRead);
  /* add up the total bytes received so far                          */
  NumBytesRcv := NumBytesRcv + BytesRead;
until NumBytesRcv = BufferLength;
/* We have all of our data, so writeln it.                           */
writeln(output,'Data from the TCPserver=>', str(Buffer));
/* And close the connection.                                         */
TCPClose(Connectioninfo.Connection, ReturnCode);
/* Wait for the remote server to also close.                         */
repeat
  GetNextNote(note, ShouldWait, ReturnCode);
until (note.notificationtag = ConnectionStateChanged) and
      (note.newstate        = NonExistent);
/* No longer using TCP/IP service.                                   */
EndTCPIP
end. /* of the TCP server example */
```

9.6 Typical Flow of UDP API (Client and Server)

The following example UDP programs perform much like the PING command provided with AS/400 TCP/IP. In these examples, a UDP server program echoes back to the originator all the UDP datagrams it receives. The UDP client program sends data to a well-known UDP port, and expects back the same message. From this basic flow, however, more complicated programs can be written against the UDP.

The program can be improved by adding timers to indicate when something is wrong (such as the other side not responding in a reasonable amount of time). The examples contain mentions of where the use of timers is helpful.

Another improvement is to have the client UDP program test the datagram echoed back from the server to see whether it is the same as the datagram sent.

9.6.1 UDP Server Flow

The following example of a UDP server program on the next page started first on a host. It opens a well-known port of 7059, and then waits for a datagram to be sent to it. Once it receives the datagram, it echo′s it back to the originator. This program does not end by itself.

```
program UDPServer;
/* include all of the external procedures, types, constants for TCP/IP*/
%INCLUDE QATMPINC(CMALLC) /*%includes both CMCOMM and CMCLIE      */
      /* QATMPINC(CMCOMM)   connect status info. %includes CMXOLD */
      /* QATMPINC(CMXOLD)   EBCDIC to ASCII conversion table      */
      /* QATMPINC(CMCLIE)   client/server type declarations       */
%INCLUDE QATMPINC(CMINTR) /*constants and host table lookup       */
%INCLUDE QATMPINC(CMRESG) /*resolver and name server routines     */
%INCLUDE QATMPINC(ONERROR) /*OnError definitions                  */
const
  BufferLength = 10;          /* Buffer length could be anything... */
  ShouldWait   = True;        /* Always wait for the next note      */
  PortNumber   = 7059;        /* Well-known port of the server      */
  TheSunHasStoppedShining=False;/* Assume the Sun has not stopped   */
var
  ReturnCode   : integer;     /* Success = OK, Failure is not OK    */
  CallRC : CallReturnCodeType;/* Enumerated type for UDP return code*/
  HostName     : string(255); /* Local Host′s name                  */
  UserID : DirectoryNameType; /* Don′t care in this program         */
  DomainName   : string(255); /* Don′t care in this program         */
  TCPIPServiceName:DirectoryNameType;* Don′t care in this program */
  Localskt,                   /* Local port and internet address    */
  Foreignskt   : SocketType;  /* Foreign port and internet address  */
  Buffer : packed array[1..BufferLength] of char; /* Recv data here */
  Note : NotificationInfoType;/* Recv notifications here            */
  ConnIndex:ConnectionIndexType;/* Keep track of this UDP connection*/
begin
/* Start the TCP/IP service                                          */
BeginTCPIP(ReturnCode);
/* Tell TCP/IP that this program will handle all of the possible     */
/* notifications from GetNextNote.                                   */
Handle(AllNotes,ReturnCode);
```

```
/* Get the name of this host, as is configured.                    */
GetIdentity(UserID,HostName,DomainName,TCPIPServiceName,ReturnCode);
/* Have TCP/IP look up this Host's name and convert it into an     */
/* internet address.                                               */
GetHostNumber(HostName,Localskt.address);
/* This is the well-known port for this server.                    */
Localskt.port := PortNumber;
/* Open a UDP connection for this local socket.  Now, we have a socket*/
/* in which data can be received or sent.                          */
UDPOpen(Localskt,Connindex,CallRC);
/* start of repeat-forever loop                                    */
repeat
  /* Give TCP/IP a pointer to a buffer where it can move the datagram */
  /* (when it arrives).                                            */
  UDPReceive(ConnIndex,PtrTo(Buffer[1]),CallRC);
  /* ShouldWait is True, indicating that we are willing to wait    */
  /* forever for TCP/IP to send us a note indicating Buffer has data. */
  GetNextNote(note,ShouldWait,ReturnCode); /*Wait here for next note */
  /* Does this note tell us that a datagram has been moved in Buffer? */
  if note.notificationtag = UDPDatagramDelivered then
    begin
    /* When the note tells us that a datagram has been delivered, then*/
    /*   note.Foreignsocket.address is the remote host's internet addr*/
    /*   note.Foreignsocket.port    is the remote host's UDP port.   */
    /*   note.datalength            is the length (bytes) of the data.*/
    /*                                                               */
    /* Echo the same data out the connindx socket, back to the remote */
    /* socket it was receieved from.                                 */
    UDPSend(ConnIndex,note.Foreignsocket,
            PtrTo(Buffer[1]),note.datalength,CallRC)
    end
  else
    begin
    /* unexpected note, or if we are using timers, this could be a   */
    /* note indicating that one of our timers has gone off...such as  */
    /* to tell us that the sun has indeed stopped shining by now.    */
    end;
/* loop forever, echoing datagrams...                              */
until TheSunHasStoppedShining;
/* If the sun does stop shining, close UDP port                    */
UDPClose(ConnIndex,CallRC);
/* No longer using TCP/IP service.                                 */
EndTCPIP
end. /* of the UDP server example */
```

9.6.2 UDP Client Flow

The example of a UDP client program on the next page is started after the remote server. It opens to an unspecified local socket, and then prompts the user for some data. It then sends that data to a well-known server at a well-known port and internet address, and expects the data to be echoed back. The program then ends.

```
program UDPClient;
/* include all of the external procedures, types, constants for TCP/IP*/
%INCLUDE QATMPINC(CMALLC) /*%includes both CMCOMM and CMCLIE      */
      /* QATMPINC(CMCOMM)   connect status info. %includes CMXOLD */
      /* QATMPINC(CMXOLD)   EBCDIC to ASCII conversion table      */
      /* QATMPINC(CMCLIE)   client/server type declarations       */
%INCLUDE QATMPINC(CMINTR) /*constants and host table lookup       */
```

```
%INCLUDE QATMPINC(CMRESG) /*resolver and name server routines     */
%INCLUDE QATMPINC(ONERROR) /*OnError definitions                  */
const
  BufferLength = 10;         /* Buffer length could be anything... */
  ShouldWait   = True;       /* Always wait for the next note      */
  PortNumber   = 7059;       /* Well-known port of the server      */
  ServerName   = 'UDPServer'; /* Well-known host name of server    */
var
  i            : integer;    /* No program can do without...       */
  ReturnCode   : integer;    /* Success = OK, Failure is not OK    */
  CallRC : CallReturnCodeType;/* Enumerated type for UDP return code*/
  Localskt,                  /* Local port and internet address    */
  Foreignskt   : SocketType; /* Foreign port and internet address  */
  Buffer : packed array[1..BufferLength] of char; /* Recv data here */
  Note : NotificationInfoType;/* Recv notifications here           */
  ConnIndex:ConnectionIndexType;/* Keep track of this UDP connection*/
begin
/* start the TCP/IP service                                          */
BeginTCPIP(ReturnCode);
/* Tell TCP/IP that this program will handle all of the possible     */
/* notifications from GetNextNote.                                   */
Handle(AllNotes,ReturnCode);
/* We will let UDP assign us a local socket.                         */
Localskt.address := UnspecifiedAddress;
Localskt.port    := Unspecifiedport;
/* Open a UDP connection for this local socket.  Now, we have a socket*/
/* in which data can be received or sent.                            */
UDPOpen(Localskt,ConnIndex,CallRC);
/* Have TCP/IP look up the remote host's name and convert it into an */
/* internet address.                                                 */
GetHostNumber(ServerName,Foreignskt.address);
/* Well-known server port number.                                    */
Foreignskt.port := PortNumber;
/* Get the data to be sent to the remote server */
writeln('Type the message that will be sent to the remote server');
readln(Buffer);
/* Send Buffer to the Foreignskt.                                    */
UDPSend(ConnIndex,Foreignskt,PtrTo(Buffer[1]),BufferLength,CallRC);
Buffer := '';           /* Make sure TCP/IP is not cheating          */
/* Give TCP/IP a pointer to a buffer where it can move the datagram  */
/* (when it arrives).                                                */
UDPReceive(ConnIndex,PtrTo(Buffer[1]),CallRC);
/* ShouldWait is True, indicating that we are willing to wait forever */
/* for TCP/IP to send us a note indicating that Buffer now has data.  */
GetNextNote(note,ShouldWait,ReturnCode); /*Wait here for next note    */

/* Does this note tell us that a datagram has been moved into Buffer? */
if note.notificationtag = UDPDatagramDelivered then
  begin
  /* When the note tells us that a datagram has been delivered, then  */
  /*   note.Foreignsocket.address is the remote host's internet addr. */
  /*   note.Foreignsocket.port    is the remote host's UDP port.      */
  /*   note.datalength            is the length (bytes) of the data.  */
  /*                                                                  */
  /*   Writeln the data echoed from the remote UDP server.            */
  write(output,'Echo from UDPServer=');
  for i := 1 to note.datalength do
    begin
    write(output,Buffer[i]);
    end;
```

```
  writeln(output)
  end
else
  begin
  /* unexpected note, or if we are using timers, this could be a note */
  /* indicating that one of our timers has gone off...such as to tell */
  /* us that we have waited too long, and that the remote server      */
  /* might not be working.                                            */
  end;
/* Close the UDP port.                                                */
UDPClose(ConnIndex,CallRC);
/* No longer using TCP/IP service.                                    */
EndTCPIP
end./* of the UDP Client example */
```

9.7 A Comparison of AS/400 Pascal API with AIX C Sockets

Comparing the AS/400 Pascal API procedure calls to the equivalent function calls in AIX C is difficult because of their structural differences. Because of the TCP and UDP layers, a byte can be sent from a program written on one machine to a program written on another machine. *The appearance of the program or operating system does not matter as long as both programs OPEN, SEND/RECEIVE, and CLOSE according to the rules.* AIX C has different rules: for example, Socket, Bind, and Connect are used to build the TCP connection from your process to a remote.

This section provides a working example of an AIX C-Sockets program: TCPClientC. This program performs much like the AS/400 Pascal program TCPClient in 9.5.2, "TCP Client Code." Compare the two applications to see the similarities and differences. You can also compare TCPClientC with the AS/400 TCPServer program in 9.5.1, "TCP Server Code" to better understand the application.

TCPClientC is written on a machine that uses ASCII as its character set. TCPServer sends 10 bytes of EBCDIC data ('1234567890'). Neither program attempts to convert the EBCDIC data into ASCII. TCPClientC prints the data received in hexadecimal, which looks like this:

```
Received Bytes: 10
F1F2F3F4F5F6F7F8F9F0
```

'F0'x through 'F9'x are the hexadecimal equivalent of EBCDIC's '0' through '9'.

Note: This program is similar to the AS/400 Pascal programs, in that much of the error detection and correction has been removed. You must start the TCP Server before this program is run.

```
/* Program TCPClientC (written in C - AIX) */
#include <stdio.h>
#include <sys/types.h>
#include <netinet/in.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <netdb.h>
#define PORTNUMBER 7059       /* Well-known port of server    */
#define BUFFERLENGTH 10       /* Input buffer length      */
#define HOSTADDRESS 151978241 /* Server internet addr 9.15.1.1 */
```

```
main()
{
/* Declare the varibles */
        int source;
        int i;
        int rtcode;
        int NumBytesRcv;
        int BytesRead;
        char buffer[BUFFERLENGTH];
        struct sockaddr_in src,dst;

/* use any available local port */
        src.sin_family     = AF_INET;
        src.sin_addr.s_addr= INADDR_ANY;
        src.sin_port       = 0;

/* Socket creation.  SOCK_STREAM tells us that it is TCP (stream mode).*/
        if((source = socket(AF_INET, SOCK_STREAM, 0)) < 0) {
           printf("Error: socket()\n");
        }

/* Bind and Connect.  These are similar to the TCPOpen of AS/400 */
        if ( bind(source,&src,sizeof(src)) != 0 ) {
           printf("Error: bind()\n");
        }

        dst.sin_addr.s_addr = HOSTADDRESS; /* hard coded address */
        dst.sin_port = PORTNUMBER;         /* Well-know port */
        dst.sin_family = AF_INET;          /* internet comm */

       if ((rtcode = connect(source,&dst,sizeof(dst))) < 0 )  {
           printf("Error: connect(): ");
           printf("rtcode = %d: ",rtcode);
       }
/* Receive the  message */
        NumBytesRcv = 0;
        do  {

         if((BytesRead = recv(source,buffer,sizeof(buffer),0)) < 0) {
            printf("Error: sending message: rt=%d :\n",BytesRead);
            }
            else  {
              printf("Received Bytes: %d\n",BytesRead);
              NumBytesRcv += BytesRead;
            }
        }while ( NumBytesRcv < sizeof(buffer));

        for (i=0;i<NumBytesRcv;i++) {
           printf("%X",buffer[i]);
        }
        printf("\n");

/* Similar to the AS/400 TCPClose */
        shutdown(source,2); /* Close the Source connection    */
}
```

9.8 Data Transfer Hints

The following sections contain helpful information for TCP and UDP data transfers.

9.8.1 TCP Data Transfer

The user′s application sends a stream of data through the network to TCP that is automatically segmented into datagrams. Whether data is segmented and the number of segments has no effect on your sending application. Your receiving program should not be restricted to a certain number of TCPFReceive or TCPWaitReceives, which it invokes to receive the data into the program. The number of sends from one program may not be the same as the number of receives in another, but the number of bytes should be the same.

Design your application programs to record the number of bytes sent and received. In this way, the number of bytes still waiting to be received is monitored.

9.8.2 UDP Data Transfer

The UDP transmits data differently than does TCP. The UDP uses the datagram as a unit of transfer. For each datagram sent by one program, the target program receives a similar datagram. UDP is unreliable, however, and may lose or scramble an order, or duplicate datagrams.

To receive UDP datagrams, you must understand how the UDPReceive procedure works. When your program executes the UDPReceive, it gives UDP a buffer to *start* copying the datagram from an internal buffer. Your program must use GetNextNote and look for note.notificationtag=UDPDatagramDelivered before it can use (or reuse) the buffer; that is, for each UDPReceive, there must be a successful UDPDatagramDelivered notification.

UDP datagrams are delivered to your application program in the order they are received from IP. Multiple UDPReceives may be used; UDP simply copies the datagrams into your buffers in order.

Use caution to avoid overrunning the remote host and sending datagrams through large and complex networks. These situations may result in discarded datagrams.

9.9 Debugging Hints

The following sections describe some helpful debugging methods and procedures.

9.9.1 Always Check Return Codes

Most TCP and UDP API procedures pass a return code back to your program, indicating success or failure. Read the *IBM AS/400 TCP/IP Guide (SC41-9875)* carefully to understand exactly what success means in each case. For example, if the ReturnCode=OK from a PINGRequest, then the request has been initiated: the PING has *not* successfully completed. Your program must then call GetNextNote to obtain the result of the PING. In fact, if the ReturnCode=OK from the GetNextNote, then you only know that the GetNextNote has returned successfully. Your program must still check whether note.PingTurnCode=OK.

Only then do you know that the original PINGRequest was successful in PINGing the remote host.

Your Pascal program should always check the ReturnCode after every API procedure invoked. If the ReturnCode<>OK, then it should inform you of the nature of the problem, and exit. None of the API program examples in this section check the ReturnCodes.

For example, if UDPReceive gets a bad return code, a serious error has occurred. The following short segment of code informs the user that a bad return code was received, cleans up TCP/IP, and exits the program.

```
/* tell UDP to place the next available Datagram in the Buffer */
UDPReceive(ConnIndex,PtrTo(Buffer[1]),CallRC);
/* check the Call ReturnCode (it better be OK) */
if CallRC <> OK then
  begin
  /* Something bad has happened, tell the user via output.*/
  /* Use SayCalRe to translate CallRC to text.           */
  writeln(output,'Error on UDPReceive :',SayCalRe(CallRC));
  /* Clean up TCP/IP for this program */
  UDPClose(ConnIndex,CallRC);    /* No reason to check ReturnCode...*/
  EndTCPIP;                      /* Close TCPIP */
  return                         /* Exit the program, now. */
  end;                           /* if bad ReturnCode */
```

9.9.2 Debugging with Writeln

When debugging asynchronous communications programs, add permanent Writeln statements at key points to help you log the path taken by your TCP or UDP programs. These Writelns execute only when a boolean (Debug) is true. Debug is set at run time. Output could be to the screen, or to a file.

For TCP/IP, the following are the best locations in your program to put debugging Writelns:

- After data has been sent or received
- After GetNextNote
- After any TCP or UDP procedure that returns information
- Any place in which your program makes a decision based upon the results of a TCP or UDP procedure call.

The following example is programmed to log every note that indicates data has arrived. This happens only when debug=true.

```
GetNextNote(note,ShouldWait,ReturnCode); /*Wait here for next note    */
/* If this note tells us that a Datagram has been moved into Buffer */
if note.Notificationtag = UDPDatagramDelivered then
  begin
  /* DEBUG - write out the details of the note received */
  if debug then
    begin
    Writeln(Output,'Fields in the UDPDatagramDelivered note are:');
    Writeln(Output,'  - Data length    =',note.Datalength);
    Writeln(Output,'  - Foreign address=',note.ForeignSocket.Address);
    Writeln(Output,'  - Foreign port   =',note.ForeignSocket.Port)
    end
  /* continue with the rest of the program */
  end;
```

9.9.3 TCP/UDP Loopback Testing

Programs written to the TCP or UDP API can wrap back to the same machine. This means that you can test Client/Server programs on just one AS/400 machine, without physically having a remote host or a local TRN line. To do this, specify a special LOOPBACK host name in your programs, both client and server. LOOPBACK can be used as a local host name when a TRN line is configured, and when one is not.

9.9.4 AS/400 Start Debug Command

Another method of debugging on the AS/400 uses the STRDBG command. Its use is really outside the scope of this document, but is mentioned here because it is very useful.

One thing to always remember when your program has break points set, is that you have now changed the timing of the sends/receives and GetNextNotes as compared to the remote API program. This can cause your program to run down a different path and literally hide or change bugs.

9.9.5 Handle Problems Procedure

The Handle procedure allows an API program to specify a list of notification tags that can be sent. Specify AllNotes so that the program will not hang.

9.9.6 Porting from VM

Porting TCP/IP application programs from VM to the AS/400 is straightforward. Both systems are based upon the same model. Many of the differences occur because the two Pascals differ slightly in their extensions to the language. Following are some of the differences:

- VM′s TCPSend and TCPReceive must be converted to TCPFSend and TCPFReceive.
- VM uses the function ADDR(x) to get a pointer to the variable x. The AS/400 uses the function PTRTO(x) instead.
- VM can use integers and pointers interchangeably. The AS/400 cannot.
- AS/400 TCP/IP does *not* have an IP service and a C interface defined.

Appendix A. FTP Local Subcommands

When the connection is established with the remote system, you can enter the following subcommands:

ACCT Sends host-dependent account information.

APPEND Appends a local file member to a remote file.

ASCII Changes the file transfer type or representation to ASCII.

BINARY Changes the file transfer type or representation to image. The file contents are not interpreted as characters in binary transfers. The bits flow across the line in exactly the same form in which they are contained in the file.

CD Changes the working directory or file group on the remote host.

CLOSE Ends your session with the remote host.

DELETE Erases a file specified in the path name at the remote host.

DIR Gets a list of directory entries, library contents, or files in a file group in a remote host.

EBCDIC Changes file transfer type or representation to EBCDIC.

GET Copies a file from the remote host into the local host.

HELP Gives assistance with the FTP subcommands.

LOCSTAT Displays local status information.

LS Lists only the names of files in a remote set of files, file group, directory or library.

MDELETE Deletes multiple files on the remote host.

MGET Copies one remote file or more, and creates a corresponding number of local file members with the same name(s).

MODE Defines how data bits are transmitted, and specifies the mode, or data format, in which the file transfer is to take place.

MPUT Sends multiple file members to a remote host.

NOOP Determines whether the remote host is responding.

OPEN Connects to a remote host.

PASS Sends your password at the remote host.

PUT Copies a local file member into a file at the remote host.

PWD Displays the current directory or library of the remote host.

QUIT Ends FTP and disconnects from the remote host.

QUOTE Sends a command directly to the remote host FTP server.

RENAME Renames a file on the remote host.

SENDPORT Alters whether a PORT subcommand is sent on a put or MPUT subcommand.

SENDSITE Alters whether a SITE subcommand is sent when doing a PUT or MPUT.

SITE Sends information used by the remote host to provide services specific to the remote host system.

STATUS Retrieves status information from the remote host.

STRUCT Changes the file structure to file {F} - a continuous sequence of data bytes.

SUNIQUE Controls whether a STOU or STOR server command is sent automatically when doing a PUT or MPUT.

SYSCMD Passes an AS/400 CL command to your local AS/400 system.

SYSTEM Prints the name of the operating system on the remote host.

TYPE Specifies the file-transfer type, or the representation in which the transfer is to take place. Image, ASCII or EBCDIC.

USER Identifies you to the remote host.

Appendix B. FTP Return Codes

Code	Description
110	Restart marker reply
120	Service ready in nn minutes
125	Data connection already open; transfer starting
150	File status okay; about to open data connection
200	Command okay
202	Command not implemented; not used on this host
211	System status, or system help reply
212	Directory status
213	File status
214	Help message
220	Service ready for new user
226	Closing data connection; requested file action successful
230	User logged on; proceed
250	Requested file action okay, completed
257	Path name created
331	Password required
425	Cannot open data connection
426	Connection closed; transfer ended abnormally
450	Requested file action not taken; file busy
451	Requested action ended abnormally; local error in processing
452	Requested action not taken; insufficient storage space in system
500	Syntax error; command unrecognized
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad command sequence
504	Command not implemented for that parameter
530	Not logged on
532	Need account for storing files
550	Requested action not taken; file not found or no access
551	Requested action ended abnormally; page type unknown
552	Requested file action ended abnormally; exceeded storage allocation
553	Requested action not taken, file name not allowed.

Appendix C. Theoretical Network Example

This appendix describes the routing and configuration considerations in a mythical ABC company. This example is given to show how an AS/400 can be *physically* linked to different subnetworks at the same time.

Figure 192 shows the network for the sales department of ABC company.

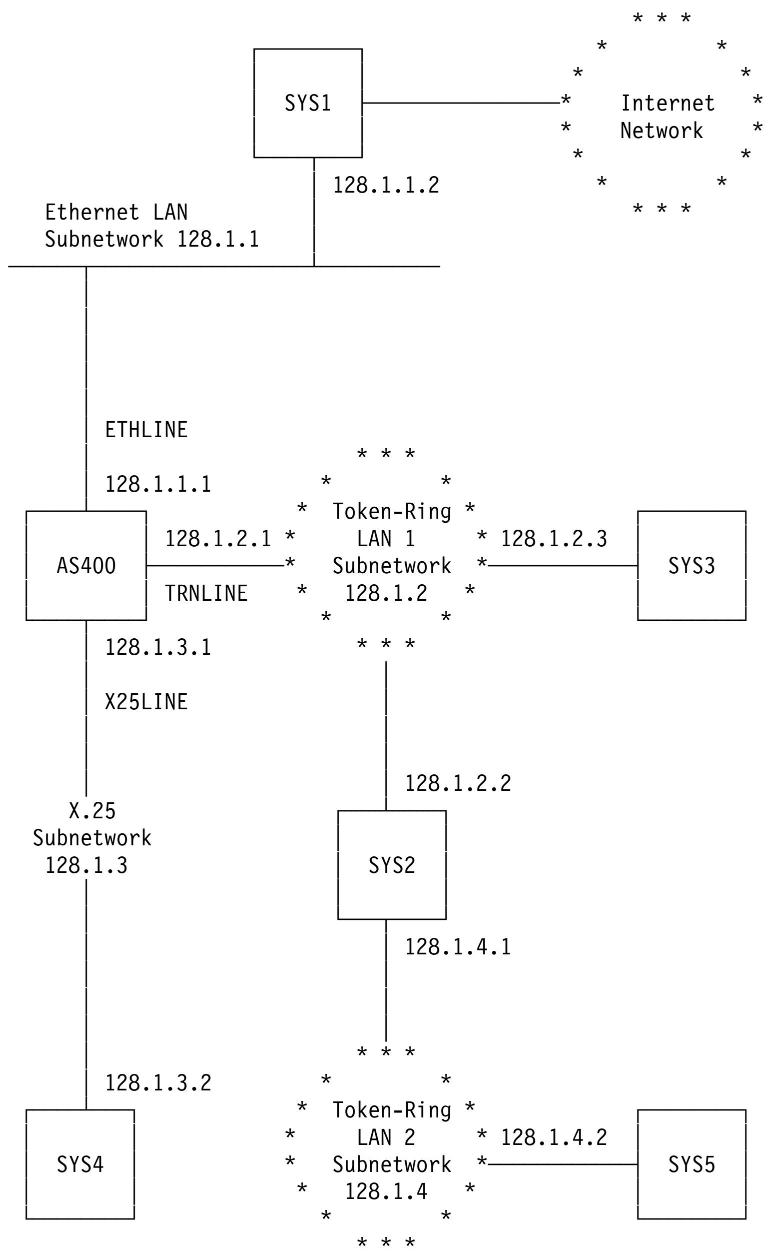

Figure 192. Sales Department of ABC Company

The ABC company was assigned the Class B Internet address 128.1 and the domain name ABC.COM. Thus all systems in this network have internet addresses that start with 128.1, and domain names that end with ABC.COM.

SYS1 at your headquarters provides the gateway to the other divisions of the ABC company and it also provides a gateway to the Internet as well.

The network administrator at SYS1 has reserved subnetwork addresses 128.1.1 through 128.1.10 for your use with the domain name of SALES.ABC.COM.

You have an AS/400 with host name AS400 and you chose to name the other host systems as SYS2, SYS3, SYS4 and SYS5. You also chose subnetwork addresses 128.1.1 for systems on the Ethernet LAN, 128.1.2 for systems on the token-ring LAN 1, 128.1.3 for systems in the X.25 public data network, and 128.1.4 for systems on token-ring LAN 2. You then assigned addresses for each system as shown.

In this scenario, we will be working from the AS/400 system and will show the TCP/IP configuration required for this system to communicate with other systems through TCP/IP.

We assume that the AS/400 line descriptions have already been created. If not, refer to *IBM AS/400 TCP/IP Guide (SC41-9875)* for details.

C.1 Configure Local Link Information

The AS/400 system supports multiple communication lines and each line has a unique internet address. You need to tell your system the internet address associated with each line.

In this example you would enter the information as shown in Figure 193.

```
                           Work with TCP/IP Links
                                                          System:   AS400
Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display   9=Start   10=End

           Line          Internet            Link
Opt     Description     Address             Type
__      __________
__      ETHLINE         128.1.1.1           *ELAN
__      TRNLINE         128.1.2.1           *TRLAN
__      X25LINE         128.1.3.1           *X25

                                                                 Bottom
F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Top   F18=Bottom
```

Figure 193. TCP/IP Link Information for Sales Department of ABC Company

C.2 Configure Route Information

The AS/400 system requires the following routing information to access each subnetwork.

The information required is shown in Figure 194 and Figure 195 on page 242.

```
                         Work with TCP/IP Route Entries
                                                               System:   AS400
 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display

                           Line                               Maximum
 Opt  Network          Description  First Hop           Datagram Size
  _   _______________
  _   *DEFAULT         ETHLINE      128.1.1.2              576
  _   128.1            ETHLINE      *HOME                  1493
  _   128.1            TRNLINE      *HOME                  1994
  _   128.1            TRNLINE      128.1.2.2              1994
  _   128.1            X25LINE      *HOME                  *CALC

                                                                          Bottom
 F3=Exit          F5=Refresh   F11=Display subnet information   F12=Cancel
 F15=Print list   F17=Top      F18=Bottom
```

Figure 194. TCP/IP Routes (1 of 2)

- The *DEFAULT network entry in the example takes care of network addresses that are not defined in our system. For example, if you wish to communicate with a system in the Internet Network, you will have to make use of SYS1 (128.1.1.2) to route your data. Thus SYS1, being the gateway system, has to be defined as the *First Hop* to the "outside" world.
- Specifying *HOME for *First Hop* tells TCP/IP that traffic with internet address belonging to the same subnetwork as the local host will be routed by the local system itself, without going through any intermediate systems. Thus as seen from Figure 194, traffic for SYS1, SYS2 and SYS3 will be routed directly by the local system.

  Traffic for SYS4 goes directly across the X.25 line. Routing is also done by the local system.

  Traffic for SYS5 (belonging to subnetwork 128.1.4) will be routed through SYS2 (128.1.2.2) because SYS2 is the first system between AS400 and subnetwork 128.1.4.

  To see which subnetwork each of these entries belong to, press F11. Figure 195 on page 242 shows the subnet masks and IDs.

```
                        Work with TCP/IP Route Entries
                                                          System:   AS400
Type options, press Enter.
  1=Add   2=Change   4=Remove   5=Display


Opt  Network          Subnet Mask      Subnet Value
 _   ______________
 _   *DEFAULT         *NONE            *NONE
 _   128.1            0.0.255.0        0.0.1.0
 _   128.1            0.0.255.0        0.0.2.0
 _   128.1            0.0.255.0        0.0.4.0
 _   128.1            0.0.255.0        0.0.3.0

                                                                    Bottom
F3=Exit   F5=Refresh   F11=Display lines/hops   F12=Cancel   F15=Print list
F17=Top   F18=Bottom
```

Figure 195. TCP/IP Routes (2 of 2) - After Pressing Function Key F11

- The *packet, or datagram,* size specifies the maximum number of bytes in a datagram that can be sent over the specified route. A datagram is a basic unit of information passed over an internet network.

  The maximum datagram size that is entered depends on the type of line being used, but is between 512 and 1994 bytes. For example :

  – X.25 (1024)

  – Token-Ring (1994) for any speed token-ring

  – Ethernet, Version 2 IEEE (1493)

  – Ethernet, 802.3 (1496)

  Specifying *CALC for the *Datagram* parameter means that the size is calculated for you based on values from the line descriptions:

  – For token-ring, the *Maximum Frame Size* value in the line description is compared with the *SSAP Frame Size* of that line. The lesser of this is taken as the maximum datagram size for the route.

  – For Ethernet 802.3, there is no *Maximum Frame Size* parameter. Thus the value specified in the *SSAP Frame Size* (maximum of 1496) will be the maximum datagram size for the route.

  – For Ethernet Version 2 IEEE, there are no *Maximum Frame Size* and *SSAP Frame Size* parameters. Thus the maximum datagram size of 1493 will be used for the route.

  – For X.25, do not confuse the maximum datagram size with the maximum packet size of the X.25 line description. Just remember to set the latter to be the same as the former. The *Maximum Frame Size* value of your X.25 line description will be used as the maximum datagram size (maximum of 1024) that IP sends to the controller of this line.

    The actual size of TCP/IP packets sent over the X.25 line is determined by packet size negotiation at SVC establishment time. When you initiate an X.25 connection to a remote system, the packet size negotiated will normally be the value of the *Default Packet Size* in the line description.

  Specifying *CALC is acceptable for a single token-ring network. However, in a more complex scenario where there are bridges connecting the token-ring to other networks, the datagram size for any particular route should be set to the maximum datagram size that any bridge on that route can accept. If datagrams must pass through multiple bridges, then the datagram size should be set to that of the one with the lowest maximum. Failure to do this may result in datagrams being discarded by the bridge. For example, if an IBM 8209 LAN Bridge is part of a route, then the maximum datagram size for this route should be 1500 bytes because this is the maximum that the bridge can support.

Note: If the route is going through unknown networks, specifying 576 would be the safest because this is the mandatory size that all TCP/IP hosts must support.

- The *subnet mask* is a bit mask associated with one internet address. The mask identifies which part of the internet address defines the subnetwork. Typically, it will be of differing octets depending on the network class. For example, a subnet mask of 0.0.255.0 defines a subnet consisting of all the bits in the third byte of the class B internet address. The subnet mask should be consistent in each host.

  The *subnet value* is combined with the network address and the subnet mask to define a unique subnetwork. For example, a network address of 128.1 combined with a subnet mask of 0.0.255.0 and a subnet value of 0.0.3.0 defines the subnetwork 128.1.3.

Note: Any changes made to the routing information take effect immediately.

C.3 Configure Remote System Information

To connect to SYS4 in this scenario, an X.25 link is being used. You have already assigned an internet address to SYS4 (128.1.3.2). Thus you have to map this internet address to the X.25 network address of the X25LINE line. If your local or remote system is an AS/400, the X.25 network address is determined by using the Display Line Description (DSPLIND) command on that system.

To define this internet-to-network address relation, select option 6 to Work with TCP/IP Remote System Information from the Configure TCP/IP menu. The following screen will be displayed.

```
                  Work with TCP/IP Remote System Information
                                                          System:   AS400
 Type options, press Enter.
   1=Add   4=Remove

        Internet            Network
 Opt    Address             Address
        ___________

   (No remote system information)

                                                                    Bottom
 F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Top   F18=Bottom
```

Figure 196. Work with TCP/IP Remote System Information

To add an entry, take option 1. Specify the internet address and network address as shown in Figure 197 on page 244.

To access this screen directly, you can use the AS/400 command ADDTCPRSI.

```
                    Add TCP/IP Remote System (ADDTCPRSI)

Type choices, press Enter.

Internet address . . . . . . . . > '128.1.3.2       '
Network address  . . . . . . . .   4758890

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 197. Add TCP/IP Remote System Information

Note: Any changes made to the remote system information take effect immediately.

C.4 Configure Host Table

In our scenario the AS/400 has three different internet addresses since it is on three separate networks. When configuring the host table there is a problem in trying to show that the host is contacted at any of these internet addresses. Each internet address has to be associated with a unique host name. The way to solve this problem is to give a "dummy" host name for each internet address.

For this example, use AS400ETH at 128.1.1.1, AS400TRN at 128.1.2.1 and AS400X25 at 128.1.3.1.

The same situation happens at SYS2. Thus define SYSLAN1 (token-ring LAN 1) at 128.1.2.2 and SYSLAN2 (token-ring LAN 2) at 128.1.4.1.

Figure 198 on page 245 summarizes the final host table.

```
                         Work with TCP/IP Host Table Entries
                                                              System:   AS400
 Type options, press Enter.
   1=Add   2=Change   4=Remove   5=Display

        Internet             Host
 Opt    Address              Name

  _     _______________
  _     128.1.1.1            AS400ETH
  _     128.1.1.1            AS400ETH.SALES.ABC.COM
  _     128.1.1.2            SYS1
  _     128.1.1.2            SYS1.SALES.ABC.COM
  _     128.1.2.1            AS400TRN
  _     128.1.2.1            AS400TRN.SALES.ABC.COM
  _     128.1.2.2            SYS2LAN1
  _     128.1.2.2            SYS2LAN1.SALES.ABC.COM
  _     128.1.2.3            SYS3
  _     128.1.2.3            SYS3.SALES.ABC.COM
  _     128.1.3.1            AS400X25
  _     128.1.3.1            AS400X25.SALES.ABC.COM
  _     128.1.3.2            SYS4

                                                                    More...
```

```
        Internet             Host
 Opt    Address              Name

  _     _______________
  _     128.1.3.2            SYS4.SALES.ABC.COM
  _     128.1.4.1            SYS2LAN2
  _     128.1.4.1            SYS2LAN2.SALES.ABC.COM
  _     128.1.4.2            SYS5
  _     128.1.4.2            SYS5.SALES.ABC.COM

                                                                   Bottom
 F3=Exit   F5=Refresh   F12=Cancel   F15=Print list   F17=Position to
```

Figure 198. Final Host Table for Sales Department of ABC Company

Note: It is important to remember that in a given network domain, here 128.1, the host tables should be exactly the same on every system. This is to simplify central network management. An alternative is to use a remote name server to hold the host table.

C.5 Enable IP Forwarding

The AS/400 in this example is physically residing on three networks at the same time. If SYS3 or SYS5 wants to communicate with SYS1 or any other system in the Internet Network, the traffic would have to be routed through the AS/400 system. Therefore, it is *mandatory* that the AS/400 system has the capability to route IP datagrams from one network to another.

You can enable the *IP forwarding* function of the AS/400 by changing its TCP/IP attributes as shown in Figure 199 on page 246.

Note: After the TCP/IP attributes are changed, the QTCP subsystem has to be re-started for the changes to be effective.

```
                       Change TCP/IP Attributes (CHGTCPA)

 Type choices, press Enter.

 Checksum on incoming messages  .   *NO           *SAME, *YES, *NO
 IP datagram forwarding . . . . . > *YES          *SAME, *YES, *NO
 TELNET inactivity timeout  . . .   0             0-2147483647, *SAME
 TELNET timemark timeout  . . . .   0             0-2147483647, *SAME
 TELNET default NVT type  . . . .   *VT100        *SAME, *VT100, *NVT
 SMTP - outgoing mapping table  .   *DFT          Name, *SAME, *DFT
                                                  Name, *LIBL, *CURLIB
 SMTP - incoming mapping table  .   *DFT          Name, *SAME, *DFT
                                                  Name, *LIBL, *CURLIB
 FTP - outgoing mapping table . .   *DFT          Name, *SAME, *DFT
                                                  Name, *LIBL, *CURLIB
 FTP - incoming mapping table . .   *DFT          Name, *SAME, *DFT
                                                  Name, *LIBL, *CURLIB
 VT100 - outgoing mapping table     *DFT          Name, *SAME, *DFT
                                                  Name, *LIBL, *CURLIB

                                                                 More...
 F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
 F24=More keys
```

Figure 199. Enabling IP Forwarding

C.6 Configure Local Domain Name

The *local domain name* is used with SMTP and FTP. But now there is the question of which host name should be used. The decision is arbitrary, but normally the name associated with the most busy route is used. Here we will assume it to be 128.1.2.1 and will use AS400TRN.SALES.ABC.COM as the local domain name.

If you are using SMTP, there are some important considerations that you need to take note of. Refer to C.11, "Using SMTP" on page 248.

```
                          Change Local Domain Name
                                                          System:   AS400
 Type choices, press Enter.

   Local domain name . . . .   SALES.ABC.COM

   Local host name . . . . .   AS400TRN



 F3=Exit   F12=Cancel
```

Figure 200. Local Domain Name for Sales Department of ABC Company

C.7 Configure a SNADS Routing Entry

This procedure is the same as that shown in STEP 3 of section 2.5, "Using SMTP" on page 34.

C.8 Create a SNADS Distribution Queue

This procedure is the same as that shown in STEP 4 of section 2.5, "Using SMTP" on page 34.

C.9 Create a SNADS Routing Table

This procedure is the same as that shown in STEP 5 of section 2.5, "Using SMTP" on page 34.

C.10 Update the System Directory

One system directory entry should be set up for each host to whom mail is to be sent. *ANY should be specified for the *user ID*, and the host name should be specified for the *address*. The *system name* parameter should hold the name entered in the "system name" parameter of the Add Routing Table Entry.

Figure 201 shows the system distribution directory entry of system AS400.

```
                          Work with Directory

 Type options, press Enter.
   1=Add      2=Change   4=Remove   5=Display details   6=Print details
   7=Rename   8=Assign different ID to description   9=Add another description

 Opt  User ID   Address   Description
  _
  _   *ANY      SYS1      Any user on SYS1 via TCPIP
  _   *ANY      SYS2LAN1  Any user on SYS2 LAN1 via TCPIP
  _   *ANY      SYS2LAN2  Any user on SYS2 LAN2 via TCPIP
  _   *ANY      SYS3      Any user on SYS3 via TCPIP
  _   *ANY      SYS4      Any User on SYS4 via TCPIP
  _   *ANY      SYS5      Any user on SYS5 via TCPIP
  _   QSECOFR   QSECOFR   Security Officer
  _   QSMTPDMY  QSMTPSYS  QSMTP user - do not delete

                                                                    Bottom
 F3=Exit      F5=Refresh   F9=Work with nicknames   F10=Search directory
 F12=Cancel   F13=Work with departments   F17=Position to   F24=More keys
```

Figure 201. System Distribution Directory of System AS400

Since V2R1.1 of OS/400, it is possible to specify *ANY *ANY in the system distribution directory. The purpose of this is to provide a SNADS route for all recipients that are not known to the system. This route will direct the mail to a system which has a working directory of all of the users on the network. However, be careful when configuring a system for *ANY *ANY. The system name associated with this entry should never be one configured to use the QSMTPQ queue; only a SNADS queue should be used.

C.11 Using SMTP

If users on the AS/400 system want to exchange mail with users on other systems, the situation becomes tricky because the AS/400 has three names – AS400TRN, AS400ETH and AS400X25.

We will describe two common problems and recommend ways to circumvent them.

C.11.1.1 Potential Problem 1

This case applies to SYS1, SYS4 and systems in the Internet Network.

Consider this scenario:

- We have defined the *local domain name* of the AS/400 to be AS400TRN.SALES.ABC.COM from C.6, "Configure Local Domain Name" on page 246.
- Recall from the local host table that the AS/400 is known to SYS4 as AS400X25.SALES.ABC.COM (internet address 128.1.3.1).
- The local user James is defined in the system directory as shown in Figure 202 on page 249.
- When James of AS400 sends a mail to a user (say) User04 on SYS4, the mail should reach User04 successfully through the X25LINE. The mail header will show that the sender is:

```
James ? AS400 % AS400TRN @ AS400TRN.SALES.ABC.COM
|___________|   |______|   |____________________|
      |             |                |
      |             |                |
      |             |                |------------> Host Domain Where
      |             |                                Mail Originates
      |             |
      |             |-------------------------------> Gateway System
      |
      |---------------------------------------------> SMTP User ID of Sender
```

- The host domain where this mail originates seems to be AS400TRN instead of AS400X25.

  This is where the actual problem lies. When User04 tries to reply to James, SYS4 will attempt to search its host table for the domain name AS400TRN.SALES.ABC.COM, but of course, this cannot be found. Therefore, the mail cannot be replied.

<u>Recommended Solution for Problem 1</u>

You have to define an alias for the host name AS400X25. If SYS4 is an RS/6000, the way to define a host alias is as shown in Figure 203 on page 249. Different systems have different ways of implementing host aliases.

```
                    Display Directory Entry Details

User ID/Address . . . . :   JAMES     AS400
Description . . . . . . :   JAMES on AS400 System (Local)
System name/Group . . . :   AS400
User profile  . . . . . :
Network user ID . . . . :   JAMES    AS400

Name:
  Last  . . . . . . . . :
  First . . . . . . . . :
  Middle  . . . . . . . :
  Preferred . . . . . . :
  Full  . . . . . . . . :

Department  . . . . . . :
Job title . . . . . . . :
Company . . . . . . . . :
                                                                 More...
Press Enter to continue.

F3=Exit   F12=Cancel   F14=Display X.400 O/R name
F18=Display location details
```

Figure 202. Defining a Local User in System Directory

```
                  Change / Show Characteristics of a Host

Type or select values in entry fields.
Press Enter AFTER making all desired changes.

                                                     [Entry Fields]
Current INTERNET address                             128.1.3.2
New INTERNET ADDRESS (dotted decimal)                []
HOSTNAME                                             [AS400X25.SALES.ABC>
ALIAS(ES) (if any - separated by blank space)        [AS400TRN.SALES.ABC>
Comments (if any - for host entry)                   [Alias for Host AS4>



F1=Help        F2=Refresh       F3=Cancel        F4=List
```

Figure 203. Example of How to Define a Host Alias in RS/6000

C.11.1.2 Potential Problem 2

This case applies to all systems.

If a user on any system sends a mail to James of AS400 by specifying the mail address to be:

JAMES@AS400TRN.SALES.ABC.COM

then when this mail arrives in AS400, it will be translated into the SNADS user "JAMES of AS400TRN". We know from Figure 202 that this is not a valid system directory entry. Therefore this mail will be rejected.

Recommended Solutions for Problem 2

There are two solutions to this problem.

1. Give instructions to users on other systems on how to send mail to users on the AS/400:

   - Suppose a user on SYS3 wants to send mail to James of AS400, the format of the mail address should be in the form:

     ```
     JAMES?AS400@AS400TRN.SALES.ABC.COM
     ```

     so that the mail will be sent to host AS400TRN and to the SMTP user ID JAMES?AS400. When the mail arrives in AS400, the SMTP user ID will be translated to the SNADS user "JAMES of AS400".

     For more information on how AS/400 receives mail, refer to 6.6, "SNADS/SMTP Interrelationship" on page 151.

   - If a user on SYS5 wants to send mail to James, then the mail address should be:

     ```
     @SYS2LAN2:JAMES?AS400@AS400TRN.SALES.ABC.COM
     ```

     so that the mail will be routed to AS400TRN through SYS2.

2. Alternatively, you can define alias entries in the AS/400 system as shown in Figure 204.

```
                              Add Name for SMTP
                                                          System:   AS400
 Type choices, press Enter.

   User ID . . . . . . . . .  JAMES      Character value, *ANY, F4 for list
   Address . . . . . . . . .  AS400      Character value, F4 for list

   SMTP user ID  . . . . . .  JAMES
   SMTP domain . . . . . . .  AS400TRN.SALES.ABC.COM




   SMTP route  . . . . . . .




 F3=Exit   F4=Prompt   F12=Cancel
```

Figure 204. Add Entry for User James to System Alias Table of AS400

   - With this alias table entry, the remote user can simply specify the mail address to be:

     ```
     JAMES@AS400TRN.SALES.ABC.COM
     ```

   - When this mail arrives at AS400, the SMTP user ID JAMES will be translated to the correct SNADS user "JAMES AS400".

     Continue to define alias entries for users on the AS/400 system so that any incoming SMTP mail can be correctly mapped to the recipient's SNADS user ID.

Note: It is also recommended that you enable automatic registration for incoming users in the AS/400 system. It will help reduce administrative and maintenance tasks. Refer to 6.2, "Automatic Registration of Incoming Users" on page 133 for a detailed explanation.

Appendix D. TCP/IP Communications Traces

The TCP/IP flows between systems can be recorded using the AS/400 Communications trace. A trace is started either by taking option 1 then option 3 from the System Service Tools menu (use the STRSST command) or by using the STRCMNTRC command. Having run the trace it should be formatted for TCP/IP data (Format TCP/IP data only) and normally ASCII (Data representation 1). The exceptions are TN5250 and TN3270, since these TELNET modes use EBCDIC datastreams, they are normally best formatted using Data representation option 2 (EBCDIC).

Once the trace has been run, the data recorded must be analyzed. In this section we have recorded traces for the common events and have analyzed the traces to a degree in order to give a general idea of what you should expect to see in a trace. For a more detailed analysis, refer to *TCP/IP Tutorial and Technical Overview* (GG24-3376) or the relevant RFC. Appendix F, "Request for Comment Letters (RFCs)" on page 279 has a list of the RFCs used by the AS/400 TCP/IP Connection Utilities/400.

D.1 TN5250 TELNET Server

The traces analyzed here were taken with the AS/400 performing the TELNET server role. If the AS/400 were the TELNET client, the flows should be very similar with the send (S) and receive (R) roles reversed.

This is a communications trace of a 5250 full-screen TELNET server session. This trace was formatted for TCP/IP and EBCDIC (TN5250 datastreams are EBCDIC encoded). The trace shows the events up to and including the signon screen being sent. GG24-3376-03 and TELNET RFC's were used to break this down. Page numbers referenced are from GG24-3376.

```
 COMMUNICATIONS TRACE       Title: TN5250 TELNET Server            01/05/94  08:43:24                         Page:      3
 Record       Data    Record    Data    Controller  Destination   Source        Frame              Number  Number    Poll/
 Number  S/R  Length  Timer     Type    Name        MAC Address   MAC Address   Format  Command  Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------  ------  ----------  ------------  ------------  ------  -------  ------  --------  -----  ----  ----
<<< client opens connection
     34   R       49   2106.1                       10005A9D0098  40000F75B901   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP       IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
>>> FRAME BREAK DOWN
                     Data . . . :  00000008004500002CF8ED00003A066E5F0905017C090505FA0745001779   *.........8.....>:...@.........*
        SNAP HEADER pg 280         ......||||.|..||||....||||..||....||||||||........||||....||
           Protocol id or org. code-++++++||||.|..||||....||||..||....||||||||........||||....||
           EtherType - '0800'x for IP ----++++.|..||||....||||..||....||||||||........||||....||
                       '0806'x for ARP        .|..||||....||||..||....||||||||........||||....||
                       '8035'x for rarp       .|..||||....||||..||....||||||||........||||....||
                                              .|..||||....||||..||....||||||||........||||....||
        IP HEADER  pg 22                      .|..||||....||||..||....||||||||........||||....||
           Version - 4 -----------------------+|..||||....||||..||....||||||||........||||....||
   ***     Length - Usually 5(counted in 32 bit)..||||....||||..||....||||||||........||||....||
           Type of Service ---------------------++||||....||||..||....||||||||........||||....||
           Total Length---------------------------++++....||||..||....||||||||........||||....||
           Identification-----------------------------++++||||..||....||||||||........||||....||
           Flags/Fragment Offset -------------------------++++..||....||||||||........||||....||
           Time to Live---------------------------------------++||....||||||||........||||....||
   ***     Protocol - 6 for TCP (see appendix B for protocols)--++....||||||||........||||....||
           Header Checksum---------------------------------------++++||||||||........||||....||
           Source IP Address  (provided by formatter)-----------------++++++++........||||....||
           Dest IP Address (provided by formatter) --------------------------++++++++||||....||
        TCP HEADER pg 83 (determined by protocol in IP header)                       ||||....||
   ***     Source Port (see Appendix B for Port assignments) -------------------------++++....||
   ***     Dest Port See Appendix B for Port assignments) --------------------------------++++||
           SeqNumber (first byte of 4) ------------------------------------------------------++

DATA second line -                 EED601000000000060024000E7620000020405AC                     *.O.....-. .X.......          *
           SeqNumber (cont) --------++++++........|...||||....||||..||....
           AckNumber----------------------++++++++|...||||....||||..||....
   ***     Offset---------------------------------+...||||....||||..||....
              This offset is usually 5. When the   ...||||....||||..||....
              connection opens, this offset is     ...||||....||||..||....
              usually 6.                           ...||||....||||..||....
           Flags----------------------------------+++||||....||||..||....
             URG..................................2+||||....||||..||....
             ACK..................................1+||||....||||..||....
             PSH...................................8||||....||||..||....
             RST...................................4||||....||||..||....
             SYN...................................2||||....||||..||....
             FIN...................................1||||....||||..||....
             In this case, the Flag is SYN          ||||....||||..||....
           Window-------------------------------------++++....||||..||....
           Checksum-------------------------------------------++++||||..||....
           Urgent Pointer-------------------------------------------++++..||....
           Option------------------------------------------------++++++++
             Kind...............................................++||....
             Length...............................................++....
             Data...................................................++++
             In this case, the option is Maximum segment size.
```

When debugging a trace, I normally don't break all these fields down. I do look at: in the IP header the length and protocol used, in the TCP header source and destination ports, (to tell what application is used - i.e TELNET) and data offset and flags. The data offset will tell where the user or application data will start. In the flags you will want to look for the ACK and PSH most of the time.

```
>>> AS/400 responds
     35   S      49   2106.1                      40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002CE33500003C068217090505FA0905017C0017074503   *.........T.....B........@.....*
                                    C922D479EED60260124000BEC300000204079D                         *I.M..O.-. ..C......           *
     AS/400 sends ACK and SYN       ................++
     we also send segment option with size of '079D'x = 1949 decimal
<<< Client sends ACK with no data
     36   R      45   2106.1                      10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000028F8EE00003A066E620905017C090505FA0745001779   *.........8.....>....@.........*
                                    EED60203C922D550103E64DA050000                                 *.O..I.N&.......               *
The TELNET server and client  applications now 'negotiate' with each other which TELNET mode to use etc:
```

- The server first asks the client if it is able to negotiate a terminal type by sending the command FD18. FD is 'saying' I would like you to DO and x'18' (decimal 24) 'says' TERMINAL TYPE.
- The client replies agreeing to terminal type negotiation by sending the command FB18. FB is 'saying' I WILL and x'18' (decimal 24) is 'saying' negotiate TERMINAL TYPE.
- The server then asks the client to send a terminal type by sending the command FA1801FFF0. FA implies SUB-NEGOTIATION and x'18' (decimal 24) is 'saying' negotiate a particular TERMINAL TYPE. 01 says SEND a terminal type. The command F0 says ??
- In this case the client asks to use a terminal type of IBM-3179-2 by sending the command FA180049424D2D333137392D32FF. 0049424D2D333137392D32 is saying my terminal IS IBM-3179-2 (x'49424D2D333137392D32' is IBM-3179-2 in ASCII).
- The server and client then negotiate to use END OF RECORD (???) and to use BINARY datastreams. They do this by exchanging DOs and WILLs for option 19 (decimal 25) and option 00 which respectively are the END OF RECORD and BINARY options.
- Having completed the negotiation phase, the AS/400 sends a 5250 passthru header followed by a signon screen.

```
>>> AS/400 Server does a DO Terminal type.
     37   S      48   2106.2                      40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002BE33600003C068217090505FA0905017C0017074503   *.........T.....B........@.....*
                                    C922D579EED60250184000C0600000FFFD18                           *I.N..O.&. .{-.....            *
     Telnet Data Breakdown .. see Telnet section 3.2 - pg 109 ....FFFD18 = IAC DO Term-Type (option) (pg 111-113 and 282)
                                                                  FF = Interpret as Command
                                                                    FD = DO
                                                                      18 = option number in hex (x'18'=24 decimal which is the terminal type)
<<< Client ACK no Data
     38   R      45   2106.4                      10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000028F8EF00003A066E610905017C090505FA0745001779   *.........8.....>/...@.........*
                                    EED60203C922D850103E61DA050000                                 *.O..I.Q&../....               *
<<< Client Will terminal type
     39   R      48   2106.4                      10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  00000008004500002BF8F000003A066E5D0905017C090505FA0745001779   *.........8O....>)...@.........*
                                    EED60203C922D850183E64C1FB0000FFFB18                           *.O..I.Q&...A......            *
                                                                  FF = Interpret as Command
                                                                    FB = WILL (desire to begin or confirm)
                                                                      18 = Terminal-type option number
>>> AS/400 server -- send terminal type.
     40   S      51   2106.5                      40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002EE33700003C068213090505FA0905017C0017074503   *.........T.....B........@.....*
                                    C922D879EED60550183FFDC06B0000FFFA1801FFF0                     *I.Q..O.&...{,.......0         *
                                                                  FF = IAC
                                                                    FA = SB = INDICATES SUB NEGOTIATION OF OPTION INDICATED
                                                                      18 = option dec 24 = Term-Type
                                                                        01 = Send (defined in RFC 1091)
                                                                          FF = IAC
                                                                            F0 = end of sub-commands
<<<< Client sends terminal type (in ASCII)
     41   R      61   2106.5                      10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000038F8F100003A066E4F0905017C090505FA0745001779   *.........81....>|...@.........*
                                    EED60503C922DE50183E6493E90000FFFA180049424D2D333137392D32FF   *.O..I..&...LZ........(........*
     00 after the terminal option means IS.............................++|||||||||||||||||||
     My Terminal type IS................................................ I B M - 3 1 7 9 - 2
                                    F0                                                             *0                             *
>>> Server then negotiates DO/WILL End of Record/ Binary
     42   S      57   2106.5                      40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  000000080045000034E33800003C06820C090505FA0905017C0017074503   *.........T.....B........@.....*
                                    C922DE79EED61550183FEDC7370000FFFD19FFFB19FFFD00FFFB00         *I....O.&...G...............   *
                                                                  FF = interpret as command
                                                                    FD = DO
                                                                      19 = option number in hex (25 - x'19' = end of record)
                                                                        FF = interpret as command
                                                                          FB = WILL
                                                                            19 = option number in hex (25 - x'19' = end of record)
                                                                              FF = interpret as command
                                                                                FD = DO
                                                                                  00 = option number in hex (binary)
                                                                                    FF = interpret as command
                                                                                      FB = WILL
                                                                                        00 = option number in hex (binary)
```

```
<<< In the next frames, the client responds.
     43   R       48   2106.5                        10005A9D0098  40000F75B901   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  00000008004500002BF8F200003A066E5B0905017C090505FA0745001779   *.........82....>$...@.........*
                                    EED61503C922EA50183E64C0D60000FFFB19                           *.O..I..&...{O.....            *
     44   R       48   2106.5                        10005A9D0098  40000F75B901   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  00000008004500002BF8F300003A066E5A0905017C090505FA0745001779   *.........83....>!...@.........*
                                    EED61803C922EA50183E64C0D10000FFFD19                           *.O..I..&...{J.....            *
     45   R       48   2106.5                        10005A9D0098  40000F75B901   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  00000008004500002BF8F400003A066E590905017C090505FA0745001779   *.........84....>....@.........*
                                    EED61B03C922EA50183E64D9D00000FFFB00                           *.O..I..&...R}.....            *
     46   R       48   2106.5                        10005A9D0098  40000F75B901   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  00000008004500002BF8F500003A066E580905017C090505FA0745001779   *.........85....>....@.........*
                                    EED61E03C922EA50183E64D9CB0000FFFD00                           *.O..I..&...R......            *
>>> AS/400 ACKS without data.
     47   S       45   2106.6                        40000F75B901  10005A9D0098   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  000000080045000028E33900003C068217090505FA0905017C0017074503   *.........T.....B........@.....*
                                    C922EA79EED61850103FEAD8440010                                 *I....O.&...Q...               *
>>> AS/400 sends Do/WIll binary
     49   S       51   2108.8                        40000F75B901  10005A9D0098   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002EE33A00003C068210090505FA0905017C0017074503   *.........T.....B........@.....*
                                    C922EA79EED62150183FE1DC380010FFFD00FFFB00                     *I....O.&............          *
<<< Client ACKS.
     55   R       45   2109.0                        10005A9D0098  40000F75B901   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000028F8F600003A066E5A0905017C090505FA0745001779   *.........86....>!...@.........*
                                    EED62103C922F050103E64D9CB0000                                 *.O..I.O&...R...               *
>>>> AS/400 sends first 5250 data.  The data has a special 5250 passthru header in front of it.  This header is specified in RFC 120
      or the 5250 Interface Specification handout and WSF document handout.
      Notice the PSH bit is on. This sends data when the buffer is not full. This is used frequently on interactive sessions.
     56   S     1029   2109.0                        40000F75B901  10005A9D0098   LLC     UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500400E33E00003C067E3A090505FA0905017C0017074503   *.........T.....=........@.....*
                                    C922F079EED62150183FE1E3F1000003D612A00000040000030440041100   *I.O..O.&...T1...O......... ...*
     See also RFC 1205                              ||||...........||||....||||..||||..||||||||||
5250 Header.........................................................||||....||||..||||..||||||||||
   Logical Record Length ...........................................++++....||||..||||..||||||||||
   Record Type (Always 12A0) ...........................................++++||||..||||..||||||||||
   Reserved.....................................................................++++..||||..||||||||||
   Variable header (4).............................................................++||||..||||||||||
   Flags..............................................................................++++..||||||||||
      ERR ..........................................................................8   ..||||||||||
      ATN ..........................................................................4   ..||||||||||
      SRQ ...........................................................................4  ..||||||||||
      TRQ ...........................................................................2  ..||||||||||
      HLP ...........................................................................1  ..||||||||||
   Opcode....................................................................................++||||||||||
5250 Data Stream ...............................................................................||||||||||
  The 5250 data stream is described in SA21-9247.  (5250 Functions Reference Manual)
  Enhancements can be found in SC30-3533-00 (5494 Remote Control Unit Functions Reference).
                                    18110101110101110101010700000018000000110117224040404040404040   *......................        *
                                    404040404040E289879540D695020137402011030520E4A28599404B404B   *      SIGN ON... .....USER . .*
                                    404B404B404B404B404B404B407A2011031D1D402024000A000000000000   * . . . . . . :..... ..........*
                                    0000000011033720E2A8A2A38594404040407A2011034420E2E8E2F1F9F8   *........SYSTEM    :.....SYS198*
                                    40402011041D1D402027000A11043720E2A482A2A8A2A38594407A201104   *  ..... ........SUBSYSTEM :...*
                                    4420D8C9D5E3C5D940404040402011050520D799968799819440404B404B40   *..QINTER    .....PROGRAM  . . *
                                    4B404B404B404B407A2011051D1D402024000A000000000000000000000011   *. . . . :..... ...............*
                                    053720C489A2979381A84040407A2011054420D8D7C1C4C5E5F0F0F0F420   *...DISPLAY   :.....QPADEV0004.*
                                    11060520D48595A4404B404B404B404B404B404B404B404B407A2011061D   *....MENU . . . . . . . . :....*
                                    1D402024000A00000000000000000000011063720C49989A5859940404040   *. ..................DRIVER    *
                                    7A2011064420E5F2D9F3D4F040F1F4F02011070520C3A499998595A340D3   *:.....V2R3MO 140.....CURRENT L*
                                    898240404B404B404B404B407A2011071D1D402024000A000000000000000   *IB  . . . . :..... ...........*
                                    000000110B0838F1F1F14040404040404040F9F9F9F9F9F9404040404040   *.......111        999999      *
                                    40404040020B29F820110B343AC3969494A495898381A3899695A240C485   *    ...8.....COMMUNICATIONS DE*
                                    A585939697948595A320110C0738F1F1F1F1404040404040F9F9F9F9F9F9   *VELOPMENT.....1111      999999*
                                    11040520D781A2A2A6969984404B404B404B404B404B404B407A2011041D   *....PASSWORD . . . . . . :....*
             <some of the data has been removed>
                                    270204270011175022E281A585A240969540C68999A2A340E388A499A284   *.......&.SAVES ON FIRST THURSD*
                                    81A840968640C5A58599A840D49695A3884081A340F1F07AF0F0D7D44B02   *AY OF EVERY MONTH AT 10:00PM..*
                                    18500004520000FFEF                                             *.&.......                     *
   required End of Record marker option ..........++++
```

D.2 VT100 TELNET Server

This is a comm trace of a TELNET server session on the AS/400. This commtrace is formatted for ASCII and TCP/IP. This can be broken down using GG24-3376 and TELNET RFC′s. Page numbers referenced are from GG24-3376-03 unless otherwise noted.

This trace shows the events up to and including the signon screen being sent.

```
 COMMUNICATIONS TRACE       Title: VT100 TELNET Server             01/05/94  08:43:24                         Page:       3
 Record       Data    Record     Data    Controller  Destination   Source        Frame             Number  Number    Poll/
 Number  S/R  Length  Timer      Type    Name        MAC Address   MAC Address   Format  Command   Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------   ------  ----------  ------------  ------------  ------  -------   ------  --------  -----  ----  ----
<<< client opening connection
     18   R       49   2007.2                        10005A9D0098  40000F75B901   LLC     UI                           OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
>>> FRAME BREAK DOWN
                      Data . . . :  00000008004500002CF83200003A066F1A0905017C090505FA0742001779   *.....E..,*2..:.O........*.B..Y*
        SNAP HEADER pg 280          ......||||.|..||||....||||..||....||||||||........||||....||
           Protocol id or org. code-++++++||||.|..||||....||||..||....||||||||........||||....||
           EtherType - ′0800′x for IP ----++++.|..||||....||||..||....||||||||........||||....||
                       ′0806′x for ARP        .|..||||....||||..||....||||||||........||||....||
                       ′8035′x for rarp       .|..||||....||||..||....||||||||........||||....||
                                              .|..||||....||||..||....||||||||........||||....||
        IP HEADER  pg 22                      .|..||||....||||..||....||||||||........||||....||
           Version - 4 -----------------------+|..||||....||||..||....||||||||........||||....||
   ***     Length - Usually 5(counted in 32 bit)..||||....||||..||....||||||||........||||....||
           Type of Service --------------------++||||....||||..||....||||||||........||||....||
           Total Length--------------------------++++....||||..||....||||||||........||||....||
           Identification----------------------------++++||||..||....||||||||........||||....||
           Flags/Fragment Offset ------------------------++++..||....||||||||........||||....||
           Time to Live--------------------------------------++||....||||||||........||||....||
   ***     Protocol - 6 for TCP (see Appendix B for protocols) -++....||||||||........||||....||
           Header Checksum---------------------------------------++++||||||||........||||....||
           Source IP Address  (provided by formatter)----------------++++++++........||||....||
           Dest IP Address (provided by formatter) --------------------------++++++++||||....||
        TCP HEADER pg 83 (determined by protocol in IP header)                       ||||....||
   ***     Source Port ( see Appendix B for Port assignments)------------------------++++....||
   ***     Dest Port (see appendix B for Port assignments) ------------------------------++++||
           SeqNumber (first byte of 4) ----------------------------------------------------++

DATA second line -                  29920100000000600240002C2B0000020405AC                     *)*.......@.,+.....*           *
           SeqNumber (cont) --------++++++........|...||||....||||..||....
           AckNumber---------------------++++++++|...||||....||||..||....
   ***     Offset--------------------------------+...||||....||||..||....
              This offset is usually 5. When the  ...||||....||||..||....
              connection opens, this offset is    ...||||....||||..||....
              usually 6.                          ...||||....||||..||....
           Flags----------------------------------+++||||....||||..||....
             URG..................................2+||||....||||..||....
             ACK..................................1+||||....||||..||....
             PSH...................................8||||....||||..||....
             RST...................................4||||....||||..||....
             SYN...................................2||||....||||..||....
             FIN...................................1||||....||||..||....
             In this case, the Flag is SYN          ||||....||||..||....
           Window-------------------------------------++++....||||..||....
           Checksum-------------------------------------------++++||||..||....
           Urgent Pointer-------------------------------------++++..||....
           Option------------------------------------------------++++++++
             Kind...............................................++||....
             Length...............................................++....
             Data.................................................++++
             In this case, the option is Maximum segment size.
```

When debugging a trace, I normally don't break all these fields down. I do look at: in the IP header the length and protocol used, in the TCP header source and destination ports, (to tell what application is used - i.e TELNET) and data offset and flags. The data offset will tell where the user or application data will start. In the flags you will want to look for the ACK and PSH most of the time.

```
>>> Server responding
     19   S       49   2007.2                       40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002CE2DC00003C068270090505FA0905017C0017074202   *.....E..,**..<.*P...*.......B.*
                                    A044C87929920260124000E2C000000204079D                         **D*Y)*...@.**.....*           *
<<< Client ACK with no data or options
     20   R       45   2007.2                       10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000028F83300003A066F1D0905017C090505FA0742001779   *.....E..(*3..:.O........*.B..Y*
                                    29920202A044C950103E64FE020000                                 *)*..*D*P.>D*...               *
>>> Server DO terminal type (See TELNET RFC's on option negotiation)
     21   S       48   2007.2                       40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002BE2DD00003C068270090505FA0905017C0017074202   *.....E..+**..<.*P...*.......B.*
      determine the ports being used is one the Telnet port?.........................++++++++
                                    A044C979299202501840000E45D0000FFFD18                          **D*Y)*.P.@.*!..**.            *
      user/application data starts here .........................++++++
      see pg 111 for TELNET cmd structure                         FF = dec 255 = Telnet IAC (interpret as command)
                                                                    FD = dec 253 = command code DO (pg 112 or RFC 854)
                                                                      18 = dec 24  = terminal type (pg 282 or RFC 1091)
<<< Client Will Terminal Type and other options.
     22   R       60   2007.4                       10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000037F83400003A066F0D0905017C090505FA0742001779   *.....E..7*4..:.O........*.B..Y*
                                    29920202A044CC50183E64C9270000FFFD01FFFD03FFFB18FFFDC8FFFB1F   *)*..*D*P.>D*'..**.**.**.*****.*
      data                          .............................+++++++++++++++++++++++++++++++
                                                                  FFFD01 = IAC DO ECHO (01 = ECHO pg 282)
                                                                        FFFD03 = IAC DO Suppress Go Ahead ( pg 282)
                                                                              FFFD18 = IAC DO Terminal Type
                                                                                    FFFDC8 = IAC DO this is an unknown option see next frame
                                                                                          FFFB1F = IAC WILL(FB) 1F = dec 31 = Window Size (pg 282)
>>>> Server sends SEND Terminal Type
     23   S       63   2007.4                       40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500003AE2DE00003C068260090505FA0905017C0017074202   *.....E..:**..<.*....*.......B.*
                                    A044CC7929921150183FF120310010FFFB01FFFB03FFFA1801FFF0FFFCC8   **D*Y)*.P.?* 1..**.**.**..******
                                    FFFE1F                                                         ***.                           *
     data breakdown -                                             FFFB01 = IAC WILL ECHO
                                                                        FFFB03 = IAC WILL Suppress Go Ahead
                                                                              FFFA1801=IAC SB TERM TYPE SEND (SB= subcommand follows (pg 111),
                                                                                       01 = send (RFC 1091))
                                                                                     FFF0   = IAC SE (SE = end of subcommand (pg 111)
                                                                                         FFFCC8 = IAC WONT (option C8)
                                    FFFE1F = IAC DONT Window Size
<<< Client sends vt100 terminal type.  Note that this is in lower case which I believe violates the RFC
     24   R       62   2007.5                       10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000039F83500003A066F0A0905017C090505FA0742001779   *.....E..9*5..:.O........*.B..Y*
                                    29921102A044DE50183E64FE600000FFFA18007674313030FFF0FFFEC8FF   *)*..*D*P.>D*...**..VT100*******
                                    FC1F                                                           **.                            *
     data                                                         FFFA18007674313030 = IAC SB Term Type vt-100 (ascii)
                                                                                    FFF0   = IAC SE
                                                                                        FFFEC8 = IAC DONT C8 (this is a confirmation)
                                                                                              FFFC1F = IAC WONT Window Size
>>> Server doesn't recognize terminal type and tells client to send another terminal type.
     25   S       51   2007.5                       40000F75B901  10005A9D0098   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500002EE2DF00003C06826B090505FA0905017C0017074202   *.....E...**..<.*K...*.......B.*
                                    A044DE7929922250183FE0E4460010FFFA1801FFF0                     **D*Y)*"P.?**F..**..**         *
     data                                                         FFFA1801 = IAC SB Term-Type SEND
                                                                          FFF0     = IAC SE
```

```
<<< Client sends DEC-VT100 (in upper case).
     26   R       60   2007.5                      10005A9D0098  40000F75B901   LLC      UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000037F83600003A066F0B0905017C090505FA0742001779   *.....E..7*6..:.O........*.B..Y*
                                    29922202A044E450183E64B5BE0000FFFA18004445432D5654313030FFF0   *)*".*D*P.>D**..**..DEC-VT100***
     data                                                  FFFA18004445432d5654313030 = IAC SB TERM-TYPE IS DEC-VT100
                                                                                       FFF0 = IAC SE
<<< Client sends again to say that there is no other terminal that it supports. BREAKDOWN SAME AS 26
     27   R       60   2008.8                      10005A9D0098  40000F75B901   LLC      UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                      Data . . . :  000000080045000037F83700003A066F0A0905017C090505FA0742001779   *.....E..7*7..:.O........*.B..Y*
                                    29922202A044E450183E64B5BE0000FFFA18004445432D5654313030FFF0   *)*".*D*P.>D**..**..DEC-VT100***
>>> Server ACK with no data
     30   S       45   2009.9                      40000F75B901  10005A9D0098   LLC      UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  000000080045000028E2E000003C068270090505FA0905017C0017074202   *.....E..(**..<.*P...*.......B.*
                                    A044E47929923150103FD1FC3B0010                                 **D*Y)*1P.?**;..               *
>>> Server ACK with no data.
     31   S       45   2009.9                      40000F75B901  10005A9D0098   LLC      UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  000000080045000028E2E100003C06826F090505FA0905017C0017074202   *.....E..(**..<.*O...*.......B.*
                                    A044E47929923150103FD1FC3B0010                                 **D*Y)*1P.?**;..               *
>>> Server Sends VT100 signon and data stream.........
     32   S     1168   2010.3                      40000F75B901  10005A9D0098   LLC      UI                         OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                      Data . . . :  00000008004500048BE2E200003C067E0B090505FA0905017C0017074202   *.....E..***..<......*.......B.*
                                    A044E47929923150183FD163B600001B5B3F336C1B5B3F37681B5B3F336C   **D*Y)*1P.?*C*...O?3L.O?7H.O?3L*
                                                  ||||............|||||
Start of Data Stream............................................|||||   note 1B5B = CSI = Control Sequence Introducer
A DEC manual will be needed to intepret this data stream.         1B5B3F336C = SET COLUMN MODE TO 80 COLUMNS
                                                                            1B5B3F3768 = SET AUTO WRAP
                                                                                      1B5B3F336C = SET COLUMN MODE TO 80 COLUMNS
                                    1B5B3F37681B5B313B31481B5B324A1B5B306D201B5B313B323348201B5B   *.O?7H.O1;1H.O2J.O0M .O1;23H .O*
                                    1B5B3F3768 = AUTO WRAP
                                              1B5B313B3148 = CURSOR POSITION (1B5Bxx3Byy48) xx= line, yy= column
                                                          1B5B324A = ERASE THE COMPLETE LINE
                                                                  1B5B306D = TURN OFF CHARACTER ATTRIBUTES
                                                                          20 = SPACE IN ASCII (SEE ASCII CHART)
                                                                            1B5B313B323348 = CURSOR POSITION
                                                                                          20 = SPACE IN ASCII (SEE ASCII CHART)
                                    316D20202020202020202020202020205369676E204F6E20202020202020   *1M               SIGN ON       *
       note: first two byte from previous line 1B5B316D = SELECT BOLD ATTRIBUTE
                   the rest of this line is ASCII - breakdown using ASCII chart
                                    202020201B5B306D201B5B333B35482055736572202E202E202E202E202E   *    .O0M .O3;5H USER . . . . .*
                                    202E202E202E203A20201B5B346D2020202020202020201B5B306D201B   * . . . :  .O4M          .O0M .*
                                    5B333B3535482053797374656D20202020203A202053595331393820202020   *O3;55H SYSTEM    :  SYS198    *
                                    2020202020202050617373776F7264202E202E202E202E202E202E203A20   *       PASSWORD . . . . . . : *
                                    201B5B306D20202020202020202020201B5B343B3535481B5B306D205375   * .O0M             .O4;55H.O0M SU*
                                    6273797374656D203A202051494E544552202020202020202020202020205072   *BSYSTEM :  QINTER            PR*
                                    6F6772616D20202E202E202E202E202E202E203A20201B5B346D20202020   *OGRAM  . . . . . . :  .O4M    *
                                    2020202020201B5B306D201B5B353B3535482044697370617920202020203A   *      .O0M .O5;55H DISPLAY   :*
                                    2020515041444556303030342020202020204D656E75202E202E202E20   *  QPADEV0004       MENU . . . *
                                    2E202E202E202E203A20201B5B346D2020202020202020201B5B30   *. . . . . :  .O4M           .O0*
                                    6D201B5B363B35354820447269766572202020203A2020563252334D3020   *M .O6;55H DRIVER    :  V2R3M0 *
                                    3134302020202020202020437572726656E74204C696220202E202E202E202E   *140       CURRENT LIB  . . . .*
                                    203A20201B5B346D2020202020202020201B5B306D201B5B31313B3848   * :  .O4M           .O0M .O11;8H*
                                    2031313120202020202020203939393939392020202020202020202020203838   * 111        999999          88*
                                    383838201B5B31313B35324820436F6D6D756E69636174696F6E732044   *8888 .O11;52H COMMUNICATIONS D*
                                    6576656C6F706D656E742020202020202020202031313131202020202039   *EVELOPMENT          1111      9*
                                    39393939393939392020202020203838383838383838383838201B5B3132   *999999999      8888888888 .O12*
                                    3B3539482041726561205379737465D201B5B31333B354820313131313131   *;59H AREA SYSTEM .O13;5H 11111*
                                    31202020203939392020202020202020393939202020383838202020202020   *1    999         999   888     *
                                    2038383820 1B5B31343B384820313131202020203939392020202020202020   * 888 .O14;8H 111    999        *
                                    2039393920202038383820202020202038383838201B5B31353B3848203131   * 999   888       888 .O15;8H 11*
                                    3120202020393939202020202020202039393920202020383838383838383838   *1    999         999   8888888*
                                    383838201B5B31363B38482031313120202020203939393939393939393939   *888 .O16;8H 111     9999999999*
                                    393939202020203838383838383838383838201B5B31373B38482031313120   *999    8888888888 .O17;8H 111 *
                                    20202020203939393939393939393939392020203838382020202020202038   *    999999999999   888       8*
                                    3838201B5B31383B38482031313120202020202020202020202020202020202039   *88 .O18;8H 111                9*
                                    3939202020383838202020202020203838201B5B31393B38482031313120   *99   888       888 .O19;8H 111 *
                                    20202020202020202020202020203939392020202038383820202020202038   *              999   888      8*
                                    3838201B5B31393B35344820537973746656D2041646D696E697374726174   *88 .O19;54H SYSTEM ADMINISTRAT*
                                    696F6E201B5B32303B3548203131313131313131312020203939393939393939   *ION .O20;5H 111111111   999999*
                                    39393939202020202020203838383838383838383838201B5B32303B36324820   *9999      8888888888 .O20;62H *
                                    332D32323530201B5B32313B354820313131313131313131202020202039   *3-2250 .O21;5H 111111111     9*
                                    3939393939202020202020202020202020203838383838383838201B5B32333B383048   *99999          888888 .O23;80H*
                                    2053617665732006F6E20466972737420546875727364617920 6F66204576   * SAVES ON FIRST THURSDAY OF EV*
                                    657279204D6F6E7468206174203130 3A3030504D2E1B5B333B333048       *ERY MONTH AT 10:00PM..O3;30H  *
```

D.3 VT220 TELNET Client

This trace is the AS/400 being a client and the RS/6000 as a server. It shows a selection sequence for terminal type. It first rejects TN5250, then TN3270 and finally selects the VT220. GG24-3376-03 and TELNET RFC′s are used to break down the frames. TELNET main RFC is RFC 1094. Each option used in TELNET has its own RFC to document the option. As we see options in this trace the first time I will point out the RFC used. Page numbers listed are from GG24-3376.

The trace shows the events up to and including the signon screen being sent.

```
 COMMUNICATIONS TRACE       Title: VT220 TELNET Client              01/05/94  08:43:24                          Page:       3
 Record       Data    Record    Data    Controller  Destination   Source        Frame             Number  Number    Poll/
 Number  S/R  Length  Timer     Type    Name        MAC Address   MAC Address   Format  Command  Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------  ------  ----------  ------------  ------------  ------  -------  ------  --------  -----  ----  ----
>>> CLIENT OPENS CONNECTION TO SERVER >>>
     44   S       49  4709.8                        40000D20CB20  90005A9D11A9   LLC     UI                          OFF     AA    AA
                      Routing Information . . . . . . . . :  0630F011B200
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124     IP Dest Addr:9.5.1.112
>>> FRAME BREAK DOWN
                      Data . . . :  00000008004500002C8DA400003C06C3B50982197C090501700427001713   *.....E..,**..<.**.*.....P.′...*
       SNAP HEADER pg 280         ......||||.|..||||....||||..||....|||||||........||||....||
          Protocol id or org. code-++++++||||.|..||||....||||..||....|||||||........||||....||
          EtherType - ′0800′x for IP ----++++.|..||||....||||..||....|||||||........||||....||
                      ′0806′x for ARP       .|..||||....||||..||....|||||||........||||....||
                      ′8035′x for rarp      .|..||||....||||..||....|||||||........||||....||
                                            .|..||||....||||..||....|||||||........||||....||
       IP HEADER  pg 22                     .|..||||....||||..||....|||||||........||||....||
          Version - 4 ----------------------+|..||||....||||..||....|||||||........||||....||
   ***    Length - Usually 5(counted in 32 bit)..||||....||||..||....|||||||........||||....||
          Type of Service --------------------++||||....||||..||....|||||||........||||....||
          Total Length--------------------------++++....||||..||....|||||||........||||....||
          Identification----------------------------++++||||..||....|||||||........||||....||
          Flags/Fragment Offset ------------------------++++..||....|||||||........||||....||
          Time to Live------------------------------------++||....|||||||........||||....||
   ***    Protocol - 6 for TCP (see Appendix B for protocols)--++....|||||||........||||....||
          Header Checksum---------------------------------------++++|||||||........||||....||
          Source IP Address  (provided by formatter)----------------++++++++........||||....||
          Dest IP Address (provided by formatter) --------------------------++++++++||||....||
       TCP HEADER pg 83 (determined by protocol in IP header)                      ||||....||
   ***    Source Port (see Appendix B for Port assignments)--------------------------++++....||
   ***    Dest Port (see Apeendix B for Port assignments) -------------------------------++++||
          SeqNumber (first byte of 4) ----------------------------------------------------++

DATA second line -                 A19504742AA4E86002400062D400000204079D                  ***.T***..@.B*.....*           *
          SeqNumber (cont) --------++++++........|...||||....||||..||....
          AckNumber----------------------++++++++|...||||....||||..||....
   ***    Offset---------------------------------+...||||....||||..||....
             This offset is usually 5. When the   ...||||....||||..||....
             connection opens, this offset is     ...||||....||||..||....
             usually 6.                           ...||||....||||..||....
          Flags----------------------------------+++||||....||||..||....
            URG..................................2+||||....||||..||....
            ACK..................................1+||||....||||..||....
            PSH...................................8||||....||||..||....
            RST...................................4||||....||||..||....
            SYN...................................2||||....||||..||....
            FIN...................................1||||....||||..||....
            In this case, the Flag is SYN          ||||....||||..||....
          Window-------------------------------------++++....||||..||....
          Checksum-------------------------------------++++||||..||....
          Urgent Pointer-------------------------------------++++..||....
          Option-----------------------------------------------++++++++
            Kind...............................................++||....
            Length...............................................++....
            Data.................................................++++
            In this case, the option is Maximum segment size.

When debugging a trace, I normally don′t break all these fields down.  I
do look at: in the IP header the length and protocol used, in the TCP
header source and destination ports, (to tell what application is used -
i.e TELNET) and data offset and flags. The data offset will tell where
the user or application data will start. In the flags you will want to
look for the ACK and PSH most of the time.
```

```
<<< SERVER RESPONDS WITH ACK AND MAX SEGMENT SIZE <<<
    45   R      49  4709.8                     10005A9D11A9  C0000D21DB20   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  06A0F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                    Data . . . :  00000008004500002CCB4C00003906890D090501700982197C00170427C7   *.....E..,*L..9.*....P.*.....'**
    notice protocol SAP still x'06' which is TCP --------------++
                                  42B20113A1950560123E64061F0000020405AC                         *B*..**...>D.......*           *
    we also have options being returned.........................++++++++
>>> CLIENT ACK WITH NO OPITONS >>>
    46   S      45  4709.9                     40000D20CB20  90005A9D11A9   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  0630F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                    Data . . . :  000000080045000028 8DA500003C06C3B80982197C090501700427001713   *.....E..(**..<.**.*.....P.'...*
                                  A19505C742B202501040001C280010                                 ***.*B*.P.@..(..               *
>>> CLIENT SENDS "WILL" TERMINAL TYPE COMMAND IN TELNET DATA >>>
    47   S      48  4709.9                     40000D20CB20  90005A9D11A9   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  0630F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112

                    Data . . . :  00000008004500002B8DA600003C06C3B40982197C009050170017042713   *.....E..+**..<.**.*.....P.'...*
                                  A19505C742B2025018400004310000FFFB18                           ***.*B*.P.@..1..**.            *
    notice actual TELNET data in this frame                        ++++++
    pg 109 to 115 or RFC's 854 and 1091 -                         FF = dec 255 = IAC (INTERPRET AS COMMAND - RFC 854)
                                                                    FB = dec 251 = WILL(desire to begin or confirm - RFC 854)
                                                                      18 = dec 24  = TERMINAL-TYPE option - RFC 1091
<<< SERVER ACKS PREVIOUS FRAME 46 <<<
    48   R      45  4710.0                     10005A9D11A9  C0000D21DB20   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  06A0F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                    Data . . . :  000000080045000028CB4F00003906890E090501700982197C00170427C7   *.....E..(*O..9.*....P.*.....'**
                                  42B20213A1950850103E611DD40000                                 *B*..**.P.>A.*..               *
<<< SERVER ACKS PREVIOUS FRAME 47 AND SENDS TELNET COMMANDS <<<
    49   R      48  4710.1                     10005A9D11A9  C0000D21DB20   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  06A0F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                    Data . . . :  00000008004500002BCB5000003906890A090501700982197C00170427C7   *.....E..+*P..9.*....P.*.....'**
                                  42B20213A1950850183E6105CB0000FFFD18                           *B*..**.P.>A.*..**.            *
    notice actual TELNET data in this frame                        ++++++
    pg 109 to 115 or RFC's 854 and 1091 -                         FF = dec 255 = IAC (INTERPRET AS COMMAND - RFC 854)
                                                                    FD = dec 253 = DO (perform) - RFC 854
                                                                      18 = dec 24  = TERMINAL-TYPE option - RFC 1091
>>> CLIENT SENDS ACK >>>
    50   S      45  4710.2                     40000D20CB20  90005A9D11A9   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  0630F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                    Data . . . :  0000000800450000288DA700003C06C3B60982197C090501700427001713   *.....E..(**..<.**.*.....P.'...*
                                  A19508C742B20550103FFD1C250010                                 ***.*B*.P.?*.%..               *
<<< SERVER SENDS COMMAND TO "SEND" TERMINAL TYPE <<<
    51   R      51  4710.2                     10005A9D11A9  C0000D21DB20   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  06A0F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                    Data . . . :  00000008004500002ECB51000039068906090501700982197C00170427C7   *.....E...*Q..9.*....P.*.....'**
                                  42B20513A1950850183E6405D30000FFFA1801FFF0                     *B*..**.P.>D.*..**..**         *
                            data                                   ++++++++++++
                                                    IAC SB TERM-TYPE SEND IAC SE
                                                        SB = what follows is sub-negotiation
                                                        01 = SEND - RFC 1091 because we are doing TERM-TYPE
                                                        SE = end sub-negotiation
>>> CLIENT SENDS ACK ADDITIONAL DATA >>>
    52   S      61  4710.3                     40000D20CB20  90005A9D11A9   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  0630F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                    Data . . . :  0000000800450000388DA800003C06C3A50982197C090501700427001713   *.....E..8**..<.**.*.....P.'...*
                                  A19508C742B20B50183FF7D6240000FFFA180049424D2D333137392D32FF   ***.*B*.P.?**$..**..IBM-3179-2**
                                  F0                             +++++++++++++++++++++++++++++   **                             *
                                  ++          data = IAC SB TRM-TYPE IS I B M - 3 1 7 9 - 2 IAC SE
                                                                          00 = IS RFC 1091
                                              (look for IBM-3179-2 eye-catcher in ASCII text to the right!)
<<< SERVER DOES NOT LIKE TERMINAL TYPE THE CLIENT SENT. IT REQUEST ANOTHER "SEND" <<<
    53   R      51  4710.4                     10005A9D11A9  C0000D21DB20   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  06A0F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                    Data . . . :  00000008004500002ECB520000390689050905 01700982197C00170427C7   *.....E...*R..9.*....P.*.....'**
                                  42B20B13A1951850183E6405BD0000FFFA1801FFF0                     *B*..**.P.>D.*..**..**         *
>>> CLIENT SENDS "IS" FOR NEXT TERMINAL TYPE AVAILABLE >>>
    54   S      62  4710.5                     40000D20CB20  90005A9D11A9   LLC     UI                        OFF     AA    AA
                    Routing Information . . . . . . . . :  0630F011B200
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                    Data . . . :  0000000800450000398DA900003C06C3A30982197C090501700427001713   *.....E..9**..<.**.*.....P.'...*
                                  A19518C742B21150183FF1B40C0000FFFA180049424D2D353235312D3131   ***.*B*.P.?**...**..IBM-5251-11*
                                  FFF0                                                           ***                            *
use manuals and data provided earlier with ASCII chart to breakdown data.
(or look in eye catcher)
```

```
<<< SERVER DOES NOT LIKE TERMINAL TYPE THE CLIENT SENT. IT REQUEST ANOTHER "SEND" <<<
NOTE: this sequence repeats thru frame 63 when we send the "IS" DEC-VT220. goto frame 64
    55   R       51  4710.6                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  00000008004500002ECB53000039068904090501700982197C00170427C7   *.....E...*S..9.*....P.*.....'**
                                   42B21113A1952950183E6405A60000FFFA1801FFF0                     *B*..**)P.>D.*..**..**         *
>>> CLIENT SENDS "IS" FOR NEXT TERMINAL TYPE AVAILABLE >>>
    56   S       63  4710.7                       40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  00000008004500003A8DAA00003C06C3A10982197C090501700427001713   *.....E..:**..<.**.*.....P.'...*
                                   A19529C742B21750183FEBA8BC0000FFFA180049424D2D333237382D322D   ***)*B*.P.?***..**..IBM-3278-2-*
                                   45FFF0                                                         *E**                           *
<<< SERVER DOES NOT LIKE TERMINAL TYPE THE CLIENT SENT. IT REQUEST ANOTHER "SEND" <<<
    57   R       51  4710.7                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  00000008004500002ECB54000039068903090501700982197C00170427C7   *.....E...*T..9.*....P.*.....'**
                                   42B21713A1953B50183E64058E0000FFFA1801FFF0                     *B*..**;P.>D.*..**..**         *
    58   S       61  4710.8                       40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  000000080045000388DAB00003C06C3A20982197C090501700427001713   *.....E..8**..<.**.*.....P.'...*
                                   A1953BC742B21D50183FE5D5F10000FFFA180049424D2D333237382D32FF   ***;*B*.P.?***..**..IBM-3278-2**
                                   F0                                                             **                             *
    59   R       45  4710.8                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  000000080045000028CB55000039068908090501700982197C00170427C7   *.....E..(*U..9.*....P.*.....'**
                                   42B21D13A1954B50103E541D830000                                 *B*..**KP.>T.*..               *
    60   R       51  4710.8                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  00000008004500002ECB56000039068901090501700982197C00170427C7   *.....E...*V..9.*....P.*.....'**
                                   42B21D13A1954B50183E6405780000FFFA1801FFF0                     *B*..**KP.>D.X..**..**         *
    63   S       60  4710.9                       40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  0000000800450000378DAC00003C06C3A20982197C090501700427001713   *.....E..7**..<.**.*.....P.'...*
                                   A1954BC742B22350183FDFD2E60000FFFA18004445432D5654323230FFF0   ***K*B*#P.?***..**..DEC-VT220***
<<< SERVER SENDS ACK WITH NO DATA <<<
    64   R       45  4711.0                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  000000080045000028CB57000039068906090501700982197C00170427C7   *.....E..(*W..9.*....P.*.....'**
                                   42B22313A1955A50103E641D5E0000                                 *B*#.**ZP.>D.:..               *
<<< SERVER SENDS MORE DATA (Telnet options and screen data) <<<
    65   R      106  4711.1                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  000000080045000065CB580000390688C8090501700982197C00170427C7   *.....E..E*X..9.**...P.*.....'**
                                   42B22313A1955A50183E645F6E0000FFFB01FFFB03FFFD1FFFFCC8FFFD01   *B*#.**ZP.>D_N..**.**.**.*****.*
                           Telnet options                 ++++++++++++++++++++++++++++++
                             read as - IAC WILL ECHO, IAC WILL SUPPRESS GO AHEAD,
                                       IAC DO WINDOW SIZE, IAC WONT "C8", IAC DO ECHO   (pg 282 for options, C8 not listed)
         last two lines of frame - 0D0A0D0A41495820746656C6E657420286E6974726F2E7263686C616E642E   *....AIX TELNET (NITRO.RCHLAND.*
 this is screen data read as ASCII- 69626D2E636F6D290D0A0D000D0A0D00                              *IBM.COM)........              *
>>> CLIENT SENDS ACK AND "DO" ECHO confirmation >>>
    66   S       48  4711.2                       40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  00000008004500002B8DAD00003C06C3AD0982197C090501700427001713   *.....E..+**..<.**.*.....P.'...*
                                   A1955AC742B26050183FA21ADA0000FFFD01                           ***Z*B*.P.?*.*..**.            *
<<< SERVER SENDS ADDITIONAL SCREEN DATA <<<
    67   R       87  4711.3                       10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  000000080045000052CB590000390688DA090501700982197C00170427C7   *.....E..R*Y..9.**...P.*.....'**
                                   42B26013A1955D50183E644F8100000A0D0049424D20526F636865737465   *B*..**!P.>DO*.....IBM ROCHESTE*
                                   7220414653200A0D0041495820332E32200A0D006C6F67696E3A20         *R AFS ...AIX 3.2 ...LOGIN:    *
>>> CLIENT SENDS BACK TELNET OPTIONS >>>
    68   S       57  4711.3                       40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA     AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  0000000800450000348DAE00003C06C3A30982197C090501700427001713   *.....E..4**..<.**.*.....P.'...*
                                   A1955DC742B26050183FA21D990000FFFE03FFFC1FFFFC01FFFC18         ***!*B*.P.?*.*..**.**.**.**.   *
                                                          ++++++++++++++++++++++++
           read as - IAC DONT SUPPRESS GO AHEAD, IAC WONT WINDOW SIZE, IAC WONT ECHO , IAC WONT TERM-TYPE pg 112
```

```
>>> CLIENT SENDS ACK >>>
    69   S       45  4711.4                        40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  0000000800450000288DAF00003C06C3AE0982197C090501700427001713  *.....E..(**..<.**.*.....P.'...*
                                   A19569C742B28A50103F781BC40010                                ***I*B**P.?X.*..               *
<<< SERVER SENDS TELNET OPTIONS <<<
    70   R       57  4711.4                        10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  000000080045000034CB5A0000390688F7090501700982197C00170427C7  *.....E..4*Z..9.**...P.*.....'**
                                   42B28A13A1956950183E641AA10000FFFC03FFFE1FFFFE01FFFE18        *B**.**IP.>D.*..**.**.**.**.   *
                                                             ++++++++++++++++++++++++
            read as - IAC WONT SUPPRESS GO AHEAD, IAC DONT WINDOW SIZE, IAC DONT ECHO, IAC WONT TERM-TYPE
>>>CLIENT SENDS ACK >>>
    71   S       45  4711.5                        40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  0000000800450000288DB000003C06C3AD0982197C090501700427001713  *.....E..(**..<.**.*.....P.'...*
                                   A19569C742B29650103F6C1BC40010                                ***I*B**P.?L.*..               *
>>> CLIENT SENDS WONT ECHO CONFIRMATION >>>
    81   S       48  4712.5                        40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  00000008004500002B8DB500003C06C3A50982197C090501700427001713  *.....E..+**..<.**.*.....P.'...*
                                   A19569C742B29650183F6C1ACC0000FFFC01                          ***I*B**P.?L.*..**.            *
<<< SERVER SENDS ACK <<<
    82   R       45  4712.6                        10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  000000080045000028CB5D0000390689000905017009821970C00170427C7  *.....E..(*!..9.*....P.*.....'**
                                   42B29613A1956C50103E641CD90000                                *B**.**LP.>D.*..               *
>>> CLIENT SENDS USERID JEBER >>>
    93   S       52  4714.2                        40000D20CB20  90005A9D11A9   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  0630F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.130.25.124    IP Dest Addr:9.5.1.112
                     Data . . . :  00000008004500002F8DB900003C06C39D0982197C090501700427001713  *.....E../**..<.**.*.....P.'...*
                                   A1956CC742B29650183F6CD2E900006A656265720D0A                  ***L*B**P.?L**..JEBER..        *
What happens after this is a series of sends and receives between the client and the server.
Eventually, the user JEBER is logged onto the RS/6000.
<<< SERVER SENDS SCREEN <<<
<<< USER DATA SENT TO THE SCREEN IN DEC-VT220 7-bit MODE FORMAT <<<
    A DEC MANUAL WILL BE NEEDED TO BREAKDOWN ORDERS AND COMMANDS IN THIS
    DATA STREAM. AN EXAPMLE IS THE x'1B5B' IN THE FIRST TWO BYTES OF DATA,
    THIS REPRESENT THE 'CONTROL SEQUENCE INTRODUCER, (CSI). WHAT FOLLOWS
    IS A STRING OF BYTES THAT WILL BE A COMMAND OR ORDER. I HAVE BROKEN
    DOWN THIS FRAME AT THE BOTTOM. I DID NOT BREAK DOWN ACTUAL ASCII DATA
    THAT WILL BE PLACED ON THE SCREEN.

    NOTE: FOR YOUR INFORMATION, THE DATA STREAM FOR DEC-VT220 8-bit MODE
    WOULD HAVE A CONTROL SEQUENCE INTRODUCER (CSI) OF x'9B', INSTEAD OF
    THE x'1B5B' USED FOR 7-bit MODE.

   989   R      304  4900.9                        10005A9D11A9  C0000D21DB20   LLC     UI                      OFF     AA    AA
                     Routing Information . . . . . . . . :  06A0F011B200
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.112       IP Dest Addr:9.130.25.124
                     Data . . . :  00000008004500012BCD520000390686080905017009821 97C00170427C7  *.....E..+*R..9.*....P.*.....'**
                                   42B90913A1958650183E64A17E00001B5B3F376C1B5B3F316C1B28421B5B  *B*..***P.>D*....0?7L.0?1L.(B.0*
                                   3F3235681B5B306D1B28421B5B481B5B324A352F32372F39331B5B353843  *?25H.0OM.(B.0H.02J5/27/93.058C*
                                   56657273696F6E1B5B43332E37301B5B323B32324856561B5B431B5B431B  *VERSION.0C3.70.02;22HVV.0C.0C.*
                                   5B431B5B4356561B5B374355551B5B431B5B431B5B431B5B4355551B5B37  *0C.0CVV.07CUU.0C.0C.0C.0CUU.07*
                                   434949494949491B5B333B32324856561B5B431B5B431B5B431B5B435656  *CIIIIII.03;22HVV.0C.0C.0C.0CVV*
                                   1B5B374355551B5B431B5B431B5B431B5B4355551B5B394349491B5B343B  *.07CUU.0C.0C.0C.0CUU.09CII.04;*
                                   32324856561B5B431B5B431B5B431B5B4356561B5B374355551B5B431B5B  *22HVV.0C.0C.0C.0CVV.07CUU.0C.0*
                                   431B5B431B5B4355551B5B394349491B5B353B32324856561B5B431B5B43  *C.0C.0CUU.09CII.05;22HVV.0C.0C*
                                   1B5B431B5B4356561B5B374355551B5B431B5B431B5B431B5B4355551B5B  *.0C.0CVV.07CUU.0C.0C.0C.0CUU.0*
                                   39434949                                                      *9CII                          *
                           commands and orders in this frame
                                1B5B3F37 6C = RESET AUTO WRAP OFF
                                1B5B3F31 6C =RESET CURSOR KEY MODE
                                1B2842 = CHARACTER SET SELECTION (SCS) -  US CHARACTER SET
                                1B5B3F32 3568 = SET CURSOR ENABLE MODE
                                1B5B306D = SELECT GRAPHIC RENDITION - TURN OFF CHARACTER ATTRIBUTE
                                1B2842 = CHARACTER SET SELECTION (SCS) -  US CHARACTER SET
                      (DEC commands continue...)
```

D.4 TN3270 TELNET Server

This is a communications trace of a 3270 client using TELNET to the AS/400. This is a communications trace formated for TCP/IP only and formatted in EBCDIC. GG24-3376-03 and TELNET RFC′s were used to break this down. Page numbers referenced are from GG24-3376.

The trace shows the events up to and including the signon screen being sent.

```
 COMMUNICATIONS TRACE       Title: TN3270 TELNET Server              01/05/94  08:43:24                           Page:       3
 Record       Data    Record    Data    Controller  Destination   Source        Frame            Number  Number    Poll/
 Number  S/R  Length  Timer     Type    Name        MAC Address   MAC Address   Format  Command  Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------  ------  ----------  ------------  ------------  ------  -------  ------  --------  -----  ----  ----
>>>> client Requests connection
      6   R       49   1929.5                       10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
>>> FRAME BREAK DOWN
                      Data . . . :  00000008004500002CF7D200003A066F7A0905017C090505FA0740001778   *.........7K....?:...@..... ...*
        SNAP HEADER pg 280          ......||||.|..||||....||||..||....||||||||........||||....||
           Protocol id or org. code-++++++||||.|..||||....||||..||....||||||||........||||....||
           EtherType - ’0800’x for IP ----++++.|..||||....||||..||....||||||||........||||....||
                       ’0806’x for ARP        .|..||||....||||..||....||||||||........||||....||
                       ’8035’x for rarp       .|..||||....||||..||....||||||||........||||....||
                                              .|..||||....||||..||....||||||||........||||....||
        IP HEADER  pg 22                      .|..||||....||||..||....||||||||........||||....||
           Version - 4 -----------------------+|..||||....||||..||....||||||||........||||....||
   ***     Length - Usually 5(counted in 32 bit)..||||....||||..||....||||||||........||||....||
           Type of Service ---------------------++||||....||||..||....||||||||........||||....||
           Total Length---------------------------++++....||||..||....||||||||........||||....||
           Identification-----------------------------++++||||..||....||||||||........||||....||
           Flags/Fragment Offset -------------------------++++..||....||||||||........||||....||
           Time to Live---------------------------------------++||....||||||||........||||....||
   ***     Protocol - 6 for TCP (see Appendix B for protocols)--++....||||||||........||||....||
           Header Checksum----------------------------------------++++||||||||........||||....||
           Source IP Address  (provided by formatter)-----------------++++++++........||||....||
           Dest IP Address (provided by formatter) ---------------------------++++++++||||....||
        TCP HEADER pg 83 (determined by protocol in IP header)                        ||||....||
   ***     Source Port (see Appendix B for Port assignments)--------------------------++++....||
   ***     Dest Port (see Appendix B for Port assignments) -------------------------------++++||
           SeqNumber (first byte of 4) -------------------------------------------------------++

DATA second line -                  90400100000000600240007EC60000020405AC                         *. .....-. .=F......           *
           SeqNumber (cont) --------++++++........|...||||....||||..||....
           AckNumber----------------------++++++++|...||||....||||..||....
   ***     Offset---------------------------------+...||||....||||..||....
              This offset is usually 5. When the   ...||||....||||..||....
              connection opens, this offset is     ...||||....||||..||....
              usually 6.                           ...||||....||||..||....
           Flags-----------------------------------+++||||....||||..||....
             URG....................................2+||||....||||..||....
             ACK....................................1+||||....||||..||....
             PSH.....................................8||||....||||..||....
             RST.....................................4||||....||||..||....
             SYN.....................................2||||....||||..||....
             FIN.....................................1||||....||||..||....
             In this case, the Flag is SYN            ||||....||||..||....
           Window-------------------------------------++++....||||..||....
           Checksum---------------------------------------++++||||..||....
           Urgent Pointer-------------------------------------++++..||....
           Option-------------------------------------------------++++++++
             Kind.................................................++||....
             Length.................................................++....
             Data.....................................................++++
             In this case, the option is Maximum segment size.
```

When debugging a trace, I normally don't break all these fields down. I do look at: in the IP header the length and protocol used, in the TCP header source and destination ports, (to tell what application is used - i.e TELNET) and data offset and flags. The data offset will tell where the user or application data will start. In the flags you will want to look for the ACK and PSH most of the time.

```
>>>>> AS/400 responds and acknowleges request. The AS/400 also sends its segment size option of x'079D'
      7   S       49   1929.6                    40000F75B901  10005A9D0098   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                    Data . . . :  00000008004500002CE2C900003C068283090505FA0905017C0017074000  *.........SI....BC.......@... .*
                                  FB38E4789040026012400042E500002204079D                         *..U.. .-. ..V......          *
>>>>> client ACKS with no data
      8   R       45   1929.6                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  000000080045000028F7D300003A066F7D0905017C090505FA0740001778  *.........7L....?'...@..... ...*
                                  90400200FB38E550103E645E270000                                 *. ....V&...;...              *
>>>>> Server Starts option negotiations. See TELNET RFC's or GG24-3376 for discussion of Options.
                                   Each option has its own RFC.
      9   S       48   1929.6                    40000F75B901  10005A9D0098   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                    Data . . . :  00000008004500002BE2CA00003C068283090505FA0905017C0017074000  *.........S.....BC.......@... .*
                                  FB38E5789040025018400044820000FFFD18                           *..V.. .&. ..B.....           *
>>>> Client ACKS with no data.
     10   R       45   1929.8                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  000000080045000028F7D600003A066F7A0905017C090505FA0740001778  *.........7O....?:...@..... ...*
                                  90400200FB38E850103E615E270000                                 *. ....Y&../;...               *
>>> Client response with DO terminal type
     11   R       48   1929.9                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  00000008004500002BF7D700003A066F760905017C090505FA0740001778  *.........7P....?....@..... ...*
                                  90400200FB38E850183E64461D0000FFFB18                           *. ....Y&..........           *
>>> AS/400 sends Sub Negotation, terminal type  send
     12   S       51   1929.9                    40000F75B901  10005A9D0098   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                    Data . . . :  00000008004500002EE2CB00003C06827F090505FA0905017C0017074000  *.........S.....B".......@... .*
                                  FB38E87890400550183FFD448D0000FFFA1801FFF0                     *..Y.. .&............0        *
>>> client responds with terminal type.  The terminal type is in ASCII.
     13   R       63   1929.9                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  00000008004500003AF7D800003A066F660905017C090505FA0740001778  *.........7Q....?....@..... ...*
                                  90400500FB38EE50183E64EAC30000FFFA180049424D2D333237382D322D  *. .....&....C........(........*
                                                                           I B M - 3 2 7 8 - 2 -
                                  45FFF0                                                         *..0                          *
                                   E
>>> AS/400 likes terminal type and so it process with DO/WILL End of Record, DO/WIll Transmit Binary
     14   S       57   1930.0                    40000F75B901  10005A9D0098   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                    Data . . . :  000000080045000034E2CC00003C068278090505FA0905017C0017074000  *.........S.....B........@... .*
                                  FB38EE7890401750183FEB4B590000FFFD19FFFB19FFFD00FFFB00         *..... .&...................  *
>>>> client replies with WILL End of Record
     15   R       48   1930.0                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  00000008004500002BF7D900003A066F740905017C090505FA0740001778  *.........7R....?....@..... ...*
                                  90401700FB38FA50183E6444F60000FFFB19                           *. .....&....6.....           *
>>> client replies with DO End of Record
     16   R       48   1930.0                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  00000008004500002BF7DA00003A066F730905017C090505FA0740001778  *.........7.....?....@..... ...*
                                  90401A00FB38FA50183E6444F10000FFFD19                           *. .....&....1.....           *
>>> client replies with WILL binary
     17   R       48   1930.0                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  00000008004500002BF7DB00003A066F720905017C090505FA0740001778  *.........7.....?....@..... ...*
                                  90401D00FB38FA50183E645DF00000FFFB00                           *. .....&...)0.....           *
>>> client Replies with DO Binary
     18   R       48   1930.0                    10005A9D0098  40000F75B901   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                    Data . . . :  00000008004500002BF7DC00003A066F710905017C090505FA0740001778  *.........7.....?....@..... ...*
                                  90402000FB38FA50183E645DEB0000FFFD00                           *. .....&...)......           *
>>>> AS/400 sends WILL/DO binary followed by 3270 data stream.  In this case the data stream is a 3270 query.
     A 3270 query will be sent if the negoitated device type is 3278-2-E or 3279-2-E.
     19   S       60   1930.0                    40000F75B901  10005A9D0098   LLC     UI                      OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                    Data . . . :  000000080045000037E2CD00003C068274090505FA0905017C0017074000  *.........S.....B........@... .*
                                  FB38FA7890402350183FDF5D500010FFFD00FFFB0011000001FFFF02FFEF  *..... .&...)&................*
```

```
>>>>> client responds with a query reply.. A 3270 data stream manual will be needed if you wish to break this down.
      The manual that I used is GA23-0059-06.
     20   R      166   1930.1                      10005A9D0098  40000F75B901   LLC     UI                    OFF     AA    AA
                       Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                       Data . . . :  0000000800450000A1F7E000003A066EF70905017C090505FA0740001778   *.........7.....>7...@..... ...*
                                     90402300FB390950183E64E477000088001681860008 00F4F1F1F2F2F3F3   *. .....&...U...H..AF...4112233*
                                     F4F4F5F5F6F6F7F7000D81870400F0F1F1F2F2F4F4001781810100005000   *44556677..AG..0112244..AA...&.*
                                     180100010003000100030 60B0780001B81858200060B0000000007000000   *...............AEB...........*
                                     02B900250100F103C30136001181A600000B010000500018005000180005   *......1.C....AW......&...&....*
                                     818800000B8180808185868788A6FFEF                               *AH...A..AEFGHW..              *
>>> AS/400 sends ACK with no data..
     30   S       45   1931.9                      40000F75B901  10005A9D0098   LLC     UI                    OFF     AA    AA
                       Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                       Data . . . :  000000080045000028E2CE00003C068282090505FA0905017C0017074000   *.........S.....BB.......@... .*
                                     FB39097890409C50103F665C570010                                 *..... .&...*...               *
>>> AS/400 sends the signon screen.    This is all 3270 data.
    Note that the 3270 data stream here is different than the data stream used in the manual.  Typically, TELNET will use the 3270
    commands associated with the 3274 B and D controllers (as compared to the commands used by the 3274 A and C controllers).
    This mapping can be found in the 3274 controller programing guide.
    TELNET 3270 command      SNA 3270 command   Command name
-------------------------------------------------------------------
          0F                    6F          erase all unprotected
          05                    F5          erase write
          0D                    7E          erase write alternate
          02                    F2          read buffer
          06                    F6          read modified
          01                    F1          write
          11                    F3          write structured field

     31   S     1330   1932.2                      40000F75B901  10005A9D0098   LLC     UI                    OFF     AA    AA
                       Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                       Data . . . :  00000008004500052DE2CF00003C067D7C090505FA0905017C0017074000   *.........S.....'@.......@... .*
                                     FB39097890409C50183F66460A00001104FD4000F5C21140401140401140   *..... .&.......... .5B.  .  . *
     Start of data                                                         +++++++
        The 11 is translate to F3 (Write Structure Field)
                                     401140D62902C0E841004040404040404040404040404040E289879540D695   * . O..{Y..              SIGN ON*
                                     3C40F7402902C060410011C2E42902C0604100E4A28599404B404B404B40   *. 7 ..{-...BU..{-..USER . . . *
                                     4B404B404B404B404B407A2902C060410011C27C2902C04041F400000000   *. . . . . :..{-...B@..{ .4....*
                                     0000000000001DF011C3D62902C0604100E2A8A2A38594404040407A2902   *.......O.CO..{-..SYSTEM    :..*
                                     C060410011C3E32902C0604100E2E8E2F1F9F840402902C060410011C44C   *{-...CT..{-..SYS198  ..{-...D<*
                                     2902C04C410011C4D71DF011C4E62902C0604100E2A482A2A8A2A3859440   *..{<...DP.O.DW..{-..SUBSYSTEM *
                                     7A2902C060410011C4F32902C0604100D8C9D5E3C5D9404040402902C060   *:..{-...D3..{-..QINTER    ..{-*
                                     410011C5C42902C0604100D79996879981944040 4B404B404B404B404B40   *...ED..{-..PROGRAM  . . . . . *
                                     4B407A2902C060410011C55C2902C04041F4000000000000000000001DF0   *. :..{-...E*..{ .4...........O*
                                     11C5F62902C0604100C489A2979381A84040407A2902C060410011C6C329   *.E6..{-..DISPLAY   :..{-...FC.*
                                     02C0604100D8D7C1C4C5E5F0F0F0F92902C060410011C6D42902C0604100   *.{-..QPADEV0009..{-...FM..{-..*
                                     D48595A4404B404B404B404B404B404B404B404B407A2902C060410011C6   *MENU . . . . . . . . . :..{-...F*
                                     6C2902C04041F40000000000000000000001DF011C7C62902C0604100C499   *%..{ .4...........O.GF..{-..DR*
                                     89A58599404040407A2902C060410011C7D32902C0604100E5F2D9F3D4F0   *IVER    :..{-...GL..{-..V2R3M0*
                                     40F1F4F02902C060410011C7E42902C0604100C3A499998595A340D38982   * 140..{-...GU..{-..CURRENT LIB*
                                     40404B404B404B404B407A2902C060410011C77C2902C04041F400000000   *  . . . . :..{-...G@..{ .4....*
                                     0000000000001DF0114CE72902C0604100F1F1F140404040404040 40F9F9   *.......O.<X..{-..111         99*
                                     F9F9F9F94040404040404040403C4DC9F82902C0604100114DD32902C0   *9999              .(I8..{-...(L..{*
                                     604100C3969494A495898381A3899695A240C485A585939697948595A329   *-..COMMUNICATIONS DEVELOPMENT.*
                                     02C0604100114DF62902C0604100F1F1F1F1404040404040F9F9F9F9F9F9   *.{-...(6..{-..1111      999999*
                                     F9F9F9F94040404040403C4E5BF82902C0604100114E6A2902C0604100C1   *9999       .+$8..{-...+...{-..A*
                                     99858140E2A8A2A385942902C0604100114FC42902C0604100F1F1F1F1F1   *REA SYSTEM..{-...|D..{-..11111*
                                     F140404040F9F9F94040404040404040F9F9F9404040F8F8F84040404040   *1    999         999   888    *
                                     40F8F8F82902C06041001150D72902C0604100F1F1F140404040F9F9F940   * 888..{-...&P..{-..111    999 *
                                     40404040404040F9F9F9404040F8F8F8404040404040F8F8F82902C06041   *       999   888      888..{-.*
                                     0011D1E72902C0604100F1F1F140404040F9F9F9404040404040404040F9F9   *..JX..{-..111    999         99*
                                     F9404040403CD24BF82902C060410011D2F72902C0604100F1F1F1404040   *9    .K.8..{-...K7..{-..111   *
                                     4040F9F9F9F9F9F9F9F9F9F9F9F9F9404040403CD35BF82902C060410011   *  9999999999999    .L$8..{-...*
                                     D4C72902C0604100F1F1F1404040404040F9F9F9F9F9F9F9F9F9F9F9F940   *MG..{-..111      999999999999 *
                                     4040F8F8F8404040404040F8F8F82902C060410011D5D72902C0604100F1   *  888      888..{-...NP..{-..1*
                                     F1F14040404040404040404040404040404040F9F9F9404040F8F8F840404040   *11                999   888    *
                                     4040F8F8F82902C060410011D6E72902C0604100F1F1F140404040404040   *  888..{-...OX..{-..111        *
                                     40404040404040F9F9F940404040F8F8F8404040404040F8F8F82902C060   *       999    888      888..{-*
                                     410011D7D52902C0604100E2A8A2A3859440C18494899589A2A39981A389   *...PN..{-..SYSTEM ADMINISTRATI*
                                     96952902C060410011D7F42902C0604100F1F1F1F1F1F1F1F1F1404040F9   *ON..{-...P4..{-..111111111   9*
                                     F9F9F9F9F9F9F9F9F94040404040403CD85BF82902C060410011D86D2902   *999999999      .Q$8..{-...Q_..*
                                     C0604100F360F2F2F5F02902C060410011D9C42902C0604100F1F1F1F1F1   *{-..3-2250..{-...RD..{-..11111*
                                     F1F1F1F14040404040F9F9F9F9F9F94040404040404040404040403CD9E9F829   *1111     999999           .RZ8.*
                                     02C060410011C3F42902C0604100D781A2A2A6969984404B404B404B404B   *.{-...C4..{-..PASSWORD . . . .*
                                     404B404B407A2902C060410011C44C2902C04C41003CC4D700115C6F2902   * . . :..{-...D<..{<...DP..*?..*
                                     C0F04100E281A585A240969540C68999A2A340E388A499A28481A8409686   *{O..SAVES ON FIRST THURSDAY OF*
                                     40C5A58599A840D49695A3884081A340F1F07AF0F0D7D44B3C5D7F000011   * EVERY MONTH AT 10:00PM..)"...*
                                     C27D130005090001FFEF                                           *B'.......                    *
```

D.5 SMTP Server

This is a trace of this AS/400 receiving a request from a remote AS/400. GG24-3376-03 section 3.6.2 (How Mail Works) can be used to see the normal data flow. I have also included at the end of this trace a list of the replies and meanings and valid replies for each command. RFC-821 can also be used to see normal flows, commands and responses.

```
 COMMUNICATIONS TRACE       Title: SMTP/MSG                         01/05/94  08:43:24                             Page:       3
 Record       Data    Record    Data    Controller  Destination   Source        Frame               Number  Number    Poll/
 Number  S/R  Length  Timer     Type    Name        MAC Address   MAC Address   Format  Command  Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------  ------  ----------  ------------  ------------  ------  -------  ------  --------  -----  ----  ----
>>> remote system opens connection
     7   R       49  3015.8                         400001013653  400001021075   LLC     UI                         OFF    AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
>>> FRAME BREAK DOWN
                      Data . . . :  00000008004500002C583A00003C0616778001080D8001080C03EA001917   *.....E..,X:..<..W*...*....*...*
        SNAP HEADER pg 280          ......||||.|..||||....||||..||....||||||||........||||....||
           Protocol id or org. code-++++++||||.|..||||....||||..||....||||||||........||||....||
           EtherType - '0800'x for IP ----++++.|..||||....||||..||....||||||||........||||....||
                       '0806'x for ARP        .|..||||....||||..||....||||||||........||||....||
                       '8035'x for rarp       .|..||||....||||..||....||||||||........||||....||
                                              .|..||||....||||..||....||||||||........||||....||
        IP HEADER  pg 22                      .|..||||....||||..||....||||||||........||||....||
           Version - 4 -----------------------+|..||||....||||..||....||||||||........||||....||
   ***     Length - Usually 5(counted in 32 bit)..||||....||||..||....||||||||........||||....||
           Type of Service ---------------------++||||....||||..||....||||||||........||||....||
           Total Length---------------------------++++....||||..||....||||||||........||||....||
           Identification-----------------------------++++||||..||....||||||||........||||....||
           Flags/Fragment Offset -------------------------++++..||....||||||||........||||....||
           Time to Live--------------------------------------++||....||||||||........||||....||
   ***     Protocol - 6 for TCP (see Appendix B for protocols)--++....||||||||........||||....||
           Header Checksum---------------------------------------++++||||||||........||||....||
           Source IP Address  (provided by formatter)-----------------++++++++........||||....||
           Dest IP Address (provided by formatter) --------------------------++++++++||||....||
        TCP HEADER pg 83 (determined by protocol in IP header)                        ||||....||
   ***     Source Port (see Appendix B for Port assignments)-------------------------++++....||
   ***     Dest Port (see Apeendix B for Port assignments) ------------------------------++++||
           SeqNumber (first byte of 4) -------------------------------------------------------++

DATA SECOND LINE -                  B3A0E47542C5EC600240004E5800000204079D                         ****UB**..@.NX.....*           *
           SeqNumber (cont) ---------++++++........|...||||....||||..||....
           AckNumber----------------------++++++++|...||||....||||..||....
   ***     Offset---------------------------------+...||||....||||..||....
              This offset is usually 5. When the   ...||||....||||..||....
              connection opens, this offset is     ...||||....||||..||....
              usually 6. (x4)                      ...||||....||||..||....
           Flags----------------------------------+++||||....||||..||....
             URG..................................2+||||....||||..||....
             ACK..................................1+||||....||||..||....
             PSH...................................8||||....||||..||....
             RST...................................4||||....||||..||....
             SYN...................................2||||....||||..||....
             FIN...................................1||||....||||..||....
             In this case, the Flag is SYN          ||||....||||..||....
           Window------------------------------------++++....||||..||....
           Checksum--------------------------------------++++||||..||....
           Urgent Pointer------------------------------------++++..||....
           Option------------------------------------------------++++++++
             Kind...............................................++||....
             Length...............................................++....
             Data...................................................++++
             In this case, the option is Maximum segment size.
```

When debugging a trace, I normally don't break all these fields down. I do look at: in the IP header the length and protocol used, in the TCP header source and destination ports, (to tell what application is used - i.e TELNET) and data offset and flags. The data offset will tell where the user or application data will start. In the flags you will want to look for the ACK and PSH most of the time.

```
<<< local system responds with ack and seg size option
     8   S      49  3015.9                       400001021075  400001013653   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                    Data . . . :  00000008004500002C583800003C0616798001080C8001080D001903EA14   *.....E..,X8..<..Y*...*......*.*
                                  0BF0F417B3A0E560124000847600000204079D                        *.**.***..@.*V.....*           *
>>> remote system acks
     9   R      45  3016.0                       400001013653  400001021075   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                    Data . . . :  000000080045000028583B00003C06167A8001080D8001080C03EA001917   *.....E..(X;..<..Z*...*....*...*
                                  B3A0E5140BF0F5501040009E0C0010                                ****..**P.@.*...               *
<<< local system sends 220 telling remote that the server is ready
    11   S     123  3016.2                       400001021075  400001013653   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                    Data . . . :  0000000800450000765839000003C06162E8001080C8001080D001903EA14  *.....E..VX9..<...*...*......*.*
                                  0BF0F517B3A0E55018400060DE000032323020423230337432E4544552E49   *.**.***P.@..*..220 B207C.EDU.I*
         SMTP or user data ...................................... 2 2 0 ...
           see formats at bottom - 220 will have domain name and msg.  This code can be seen in the eye-catcher above, right.
    Note the ending 0D0A at the end of the data.
    The data is ASCII text.
                                  424D2E434F4D2072756E6E696E672049424D2041532F34303020534D5450   *BM.COM RUNNING IBM AS/400 SMTP*
                                  2061742020576564 2C203035204A616E2039342030383A34323A3537202E   * AT  WED, 05 JAN 94 08:42:57 .*
                                  2E0D0A                                                        *...                           *
>>> the remote sends ack
    12   R      45  3016.3                       400001013653  400001021075   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                    Data . . . :  000000080045000028583C00003C0616798001080D8001080C03EA001917   *.....E..(X<..<..Y*...*....*...*
                                  B3A0E5140BF14350103FB29E0C0010                                ****..*CP.?**...               *
>>> the remote sends HELO command
    13   R      69  3016.4                       400001013653  400001021075   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                    Data . . . :  000000080045000040583D00003C0616608001080D8001080C03EA001917   *.....E..@X=..<...*...*....*...*
                                  B3A0E5140BF14350183FB211E6000048454C4F2042323037442E4544552E   ****..*CP.?*.*..HELO B207D.EDU.*
                                  49424D2E434F4D0D0A                                            *IBM.COM..                     *
         The HELO commands is an introduction - Hello I AM - domain name
<<< local sends ack
    14   S      45  3016.5                       400001021075  400001013653   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                    Data . . . :  000000080045000028583A00003C06167B8001080C8001080D001903EA14   *.....E..(X:..<..{*...*......*.*
                                  0BF14317B3A0FD50103FE89DBE0010                                *.*C.***P.?***..               *
<<< local sends 250 reply to HELO command and domain
    16   S      70  3016.8                       400001021075  400001013653   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                    Data . . . :  000000080045000041583B00003C0616618001080C8001080D001903EA14   *.....E..AX;..<..A*...*......*.*
                                  0BF14317B3A0FD50183FE88C6000003235302042323037432E4544552E49   *.*C.***P.?**...250 B207C.EDU.I*
                                  424D2E434F4D202E0D0A                                          *BM.COM ...                       *
>>> ack
    17   R      45  3016.9                       400001013653  400001021075   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                    Data . . . :  000000080045000028583E00003C0616778001080D8001080C03EA001917   *.....E..(X>..<..W*...*....*...*
                                  B3A0FD140BF15C50103F999DF40010                                ****..*.P.?***..               *
>>> Remote sends MAIL command with reverse path
    18   R      87  3017.0                       400001013653  400001021075   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                    Data . . . :  000000080045000052583F00003C06164C8001080D8001080C03EA001917   *.....E..RX?..<..L*...*....*...*
                                  B3A0FD140BF15C50183F993AE400004D41494C2046524F4D3A3C5249434B   ****..*.P.?*:*..MAIL FROM:<RICK*
                                  3F42323037444042323037442E4544552E49424D2E434F4D3E0D0A        *?B207D@B207D.EDU.IBM.COM>..   *
<<< ack
    19   S      45  3017.1                       400001021075  400001013653   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                    Data . . . :  000000080045000028583C00003C0616798001080C8001080D001903EA14   *.....E..(X<..<..Y*...*......*.*
                                  0BF15C17B3A12750103FBE9DA50010                                *.*..**'P.?***..               *
<<< 250 reply
    20   S      54  3017.5                       400001021075  400001013653   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                    Data . . . :  000000080045000031583D00003C06166F8001080C8001080D001903EA14   *.....E..1X=..<..O*...*......*.*
                                  0BF15C17B3A12750183FBEB3F60000323530204F4B2E0D0A              *.*..**'P.?***..250 OK...      *
    21   R      45  3017.6                       400001013653  400001021075   LLC     UI                           OFF     AA    AA
                    Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                    Data . . . :  000000080045000028584000003C0616758001080D8001080C03EA001917   *.....E..(X@..<..U*...*....*...*
                                  B3A127140BF16550103F909DCA0010                                ***'..*EP.?***..               *
```

```
>>> remote sens RCPT command (or commands) with forward paths
    22   R       86  3017.7                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  000000080045000051584100003C06164B8001080D8001080C03EA001917   *.....E..QXA..<..K*...*....*...*
                                   B3A127140BF16550183F90C06F00005243505420544F3A3C425249414E3F   ***'..*EP.?**O..RCPT TO:<BRIAN?*
                                   4232303743404232303743 2E4544552E49424D2E434F4D3E0D0A           *B207C@B207C.EDU.IBM.COM>..    *
    23   S       45  3017.8                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  00000008004500002858 3E00003C0616778001080C8001080D001903EA14   *.....E..(X>..<..W*...*......*.*
                                   0BF16517B3A15050103F959D9C0010                                 *.*E.**PP.?***..               *
<<< 250 reply
    24   S       54  3018.2                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  000000080045000031583F00003C06166D8001080C8001080D001903EA14   *.....E..1X?..<..M*...*......*.*
                                   0BF16517B3A15050183F95B3ED0000323530204F4B2E0D0A               *.*E.**PP.?***..250 OK...      *
    25   R       45  3018.3                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  000000080045000028584200003C0616738001080D8001080C03EA001917   *.....E..(XB..<..S*...*....*...*
                                   B3A150140BF16E50103F879DA10010                                 ***P..*NP.?***..               *
>>> remote sends DATA command to tell RCPT's are done
    26   R       51  3018.4                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  00000008004500002E584300003C06166C8001080D8001080C03EA001917   *.....E...XC..<..L*...*....*...*
                                   B3A150140BF16E50183F87F8160000444154410D0A                     ***P..*NP.?**...DATA..         *
    27   S       45  3018.5                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  000000080045000028584000003C0616758001080C8001080D001903EA14   *.....E..(X@..<..U*...*......*.*
                                   0BF16E17B3A15650103F8F9D930010                                 *.*N.**VP.?***..               *
<<< local sends 354 with msg and terminating sequence
    28   S      120  3018.6                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  000000080045000073584100003C0616298001080C8001080D001903EA14   *.....E..SXA..<..)*...*......*.*
                                   0BF16E17B3A15650183F8F81C5000033353420456E746572206D61696C20   *.*N.**VP.?***..354 ENTER MAIL *
                                   626F64792E20456E64206D61696C207769746820612027 2E2720696E2063   *BODY. END MAIL WITH A '.' IN C*
                                   6F6C756D6E2031206F6E2061206C696E65206279206974 73656C662E0D0A   *OLUMN 1 ON A LINE BY ITSELF...*
    29   R       45  3018.7                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  000000080045000028584400003C0616718001080D8001080C03EA001917   *.....E..(XD..<..Q*...*....*...*
                                   B3A156140BF1B950103F3C9D9B0010                                 ***V..**P.?<**..               *
>>> remote sends data and ends with crlf . crlf as requested
    30   R      319  3018.8                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  00000008004500013A584500003C06155E8001080D8001080C03EA001917   *.....E..:XE..<..¬*...*....*...*
                                   B3A156140BF1B950183F3C79F8000052656365697665643A2066726F6D20   ***V..**P.?<Y*..RECEIVED: FROM *
                                   4232303744206279204232303744 2E4544552E49424D2E434F4D2028534D   *B207D BY B207D.EDU.IBM.COM (SM*
                                   54502056657273696F6E2032292052656C6561736520332E302077697468   *TP VERSION 2) RELEASE 3.0 WITH*
                                   2042534D54502069642030303033 2E0D0A446174653A205765642C203035   * BSMTP ID 0003...DATE: WED, 05*
                                   204A616E2039342030383A34323A3436202E202020202020202020200D0A46   * JAN 94 08:42:46 .          ..F*
                                   726F6D3A205249434B3F4232303744254232303744404232303744 2E4544   *ROM: RICK?B207D%B207D@B207D.ED*
                                   552E49424D2E434F4D0D0A546F3A202020425249414E3F4232303743 4042   *U.IBM.COM..TO:   BRIAN?B207C@B*
                                   3230374 32E4544552E49424D2E434F4D0D0A5375626A6563743A204E4F20   *207C.EDU.IBM.COM..SUBJECT: NO *
                                   5355424A4543540D0A0D0A546869732069732061206D6573736167652075   *SUBJECT....THIS IS A MESSAGE U*
                                   73696E6720534D54502E0D0A00200D0A2E0D0A                         *SING SMTP.... .....           *
    31   S       45  3018.9                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  000000080045000028584200003C0616738001080C8001080D001903EA14   *.....E..(XB..<..S*...*......*.*
                                   0BF1B917B3A26850103E7D9D480010                                 *.**.**HP.>}*H..               *
<<< local send 250
    32   S       66  3019.4                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  00000008004500003D584300003C06165D8001080C8001080D001903EA14   *.....E..=XC..<..!*...*......*.*
                                   0BF1B917B3A26850183E7D91ED0000323530204D61696C2064656C697665   *.**.**HP.>}**..250 MAIL DELIVE*
                                   7265642E0D0A                                                   *RED...                        *
    33   R       45  3019.5                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  000000080045000028584600003C06166F8001080D8001080C03EA001917   *.....E..(XF..<..O*...*....*...*
                                   B3A268140BF1CE50103F279C890010                                 ***H..**P.?'**..               *
>>> remote sends QUIT command
    34   R       51  3020.2                      400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                     Data . . . :  00000008004500002E584700003C0616688001080D8001080C03EA001917   *.....E...XG..<..H*...*....*...*
                                   B3A268140BF1CE50183F27F4D70000515549540D0A                     ***H..**P.?'**..QUIT..         *
    35   S       45  3020.3                      400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                     Data . . . :  000000080045000028584400003C0616718001080C8001080D001903EA14   *.....E..(XD..<..Q*...*......*.*
                                   0BF1CE17B3A26E50103E779D330010                                 *.**.**NP.>W*3..               *
```

```
<<< server sends 221 reply - server closing connection
     37   S      135  3021.9                        400001021075  400001013653   LLC     UI                             OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000082584500003C0616168001080C8001080D001903EA14   *.....E..*XE..<...*...*......*.*
                                    0BF1CE17B3A26E50183E77776A00003232312042323037432E4544552E49   *.**.**NP.>WWJ..221 B207C.EDU.I*
                                    424D2E434F4D2072756E6E696E672049424D2041532F34303020534D5450   *BM.COM RUNNING IBM AS/400 SMTP*
                                    2056657273696F6E20322052656C6561736520332E302E20436F6E6E6563   * VERSION 2 RELEASE 3.0. CONNEC*
                                    74696F6E20636C6F73696E672E0D0A                                 *TION CLOSING...               *
<<< server sends FIN bit in TCP header
     38   S       45  3021.9                        400001021075  400001013653   LLC     UI                             OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000028584600003C06166F8001080C8001080D001903EA14   *.....E..(XF..<..O*...*......*.*
                                    0BF22817B3A26E50113E779CE80000                                 *.*(.**NP.>W**..               *
     40   R       45  3022.0                        400001013653  400001021075   LLC     UI                             OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028584800003C06166D8001080D8001080C03EA001917   *.....E..(XH..<..M*...*....*...*
                                    B3A26E140BF22950103ECC9C830010                                 ***N..*)P.>***..               *
>>> remote sends FIN
     41   R       45  3022.1                        400001013653  400001021075   LLC     UI                             OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028584900003C06166C8001080D8001080C03EA001917   *.....E..(XI..<..L*...*....*...*
                                    B3A26E140BF22950113ECC9C920000                                 ***N..*)P.>***..               *
     42   S       45  3022.2                        400001021075  400001013653   LLC     UI                             OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000028584700003C06166E8001080C8001080D001903EA14   *.....E..(XG..<..N*...*......*.*
                                    0BF22917B3A26F50103E769CD80010                                 *.*).**OP.>V**..               *
* * * * *   E N D   O F   C O M P U T E R   P R I N T O U T   * * * * *


*************************************************************************
REPLY CODES

211  System status or system help reply
214  Help message
220  <domain> Service ready
221  <domain> Service ready
250  Requested mail action okay, completed
251  User not local, will forward to <forward path>
354  Start mail input, end with <CRLF>.<CRLF>
421  <domain> Service not available, closing transmission channel
450  Requested mail action not taken: mailbox unavailable
451  Requested action aborted: local error in processing
452  Requested action not taken: insufficient system storage
500  Syntax error, command unrecognized
501  Syntax error in parameters or arguments
502  Command not implemented
503  Bad sequence of commands
504  Command paramter not implemented
550  Requested action not taken: Mailbox unavailable
551  User not local: please try <forward path>
552  Requested mail action aborted: exceeded storage allocation
553  Requested action not taken: mailbox name not allowed
554  Transaction failed
```

```
**********************************************************************
SMTP commands

DATA (DATA)
      The receiver treats the lines following the command as mail data
      from the sender. It is terminated by "<CRLF>.<CRLF>. this puts
      a period on a line by itself.

EXPAND (EXPN)
       This command asks the receiver to confirm that the argument
       identifies a mailing list, and if so, to return the membership
       of that list.

HELLO (HELO)
      This command is used to identify the sender-SMTP to the receiver-
      SMTP. The argument field contains the host name of the sender.

HELP (HELP)
     This command causes the receiver of the command to send helpfull
     information to the sender of the help command.

MAIL (MAIL)
      This command is used to initiate a mail transaction in which mail
      is delivered to one or more mailboxes. The argument field contains
      the reverse path.

NOOP (NOOP)
     This requires only a reply from the receiver. No other action
     is taken.

QUIT (QUIT)
     This command specifies the receiver must send an OK reply, and close
     the transmission channel or connection.

RECPIENT (RCPT)
      This command is used to identify an individual recipient of mail
      data; multiple recipient are specified by multiple use of this
      command. The argument will have the forward path.

RESET (RSET)
      This command specifies that the current mail transaction is to be
      aborted.

SEND (SEND)
      This command is used to initiate a mail transaction in which
      mail is delivered to one or more terminals. The argument field
      contains a reverse path.

SEND OR MAIL (SOML)
      This command is used to to send mail the the recipients terminal
      if allowed, otherwise to the recipients mailbox. The argument field
      contains the reverse path.

SEND AND MAIL (SAML)
      This command will deliver the mail to the terminal and the mailbox.
      The argument field contains the reverse path.

TURN (TURN)
     This command specifies that the reciever must either (1) send an OK
     and then take the role of sender or (2) send a refusal reply and
     retain the roll of receiver.

VERIFY (VRFY)
      This command asks the receiver to confirm that the argument
      identifies a user.
```

D.6 LPR/LPD Client

This trace is from a sending (LPR) AS/400 to a remote AS/400 LPD system. SC42-9875 Chapter 10 and RFC-1179 can be used to help break down the LPR/LPD portion of the trace. GG24-3376-03 is used on the IP and TCP portion. NOTE: There are also several ARP frames at the start of this trace. I have left them in as a sample. GG24-3376-03 section 2.5 can be used to break down the ARP frame and figure 47 will show the flow of an ARP packet on the receiving system. This file is in ASCII to show the breakdown of the control file.

There are two versions of LPD. The AS/400 will support both versions. We will send the RCFF first and then the RDFUL. If this fails we will use the older style which sends RDFF and then RCF. (RCF = receive controfile, RCFF = receive control file first, RDF = receive data file, RDFF = receive data file first, RDFUL = receive data file unspecified length). See sub-command codes at the end. The control file will always be ASCII. The data file can be either ASCII or EBCDIC.

```
 COMMUNICATIONS TRACE       Title: LPR/LPD Client                    01/05/94  08:43:24                           Page:       3
 Record       Data    Record    Data    Controller  Destination   Source        Frame            Number  Number    Poll/
 Number  S/R  Length  Timer     Type    Name        MAC Address   MAC Address   Format  Command  Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------  ------  ----------  ------------  ------------  ------  -------  ------  --------  -----  ----  ----
>>> local system receives ARP
     20   R       33   653.1                        FFFFFFFFFFFF  C00001013653   LLC     UI                        OFF     AA    AA
                      Routing Information . . . . . . . . :  8220
                      Frame Type:ARP

Frame break down -    Data . . . :  000000080600060800060400014000010136538001080C00000010A00680   *.............@...6S*.......*.**
    SNAP Header see pg 280 .........++++++++++....||||..||....||||||||||||........||||||||||||..
         org code all 0’s  .........++++++||||....||||..||....||||||||||||........||||||||||||..
         Ether type 0806 = ARP ...........++++....||||..||....||||||||||||........||||||||||||..
    ARP packet  page 67                       ....||||..||....||||||||||||........||||||||||||..
         hardware address space ..............++++||||..||....||||||||||||........||||||||||||..
         protocol address space ..................++++..||....||||||||||||........||||||||||||..
         hardware address length byte (n) ............++||....||||||||||||........||||||||||||..
         protocol address length byte (n) ..............++....||||||||||||........||||||||||||..
         operation code         ..........................++++||||||||||||........||||||||||||..
         hardware address of sender ..........................++++++++++++........||||||||||||..
         protocol address of sender ......................................++++++++||||||||||||..
         hardware address of target ..............................................++++++++++++..
         protocol address of target ..........................................................++
 frame break down secondline -     01080D                                                          *...                            *
   Protocol address of target cont..++++++
<<< local system sends its own broadcast ARP
     21   S       33   653.1                        FFFFFFFFFFFF  C00001013653   LLC     UI                        OFF     AA    AA
                      Routing Information . . . . . . . . :  8220
                      Frame Type:ARP
                      Data . . . :  000000080600060800060400014000010136538001080C00000010A00680   *.............@...6S*.......*.**
                                    01080D                                                         *...                            *
>>> remote responds to ARP - notice op code and addresses
     22   R       33   653.7                        400001013653  400001021075   LLC     UI                        OFF     AA    AA
                      Frame Type:ARP
                      Data . . . :  000000080600060800060400024000010210758001080D40000101365380   *.............@....U*...@...6S**
                                    01080C                                                         *...                            *
```

```
     23   S       49   653.7                        400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
 >>> FRAME BREAK DOWN
                      Data . . . :  00000008004500002C581700003C06169A8001080C8001080D0100020309   *.....E..,X...<..**...*........*
        SNAP HEADER pg 280          ......||||.|..||||....||||..||....||||||||........||||....||
           Protocol id or org. code-++++++||||.|..||||....||||..||....||||||||........||||....||
           EtherType - '0800'x for IP ----++++.|..||||....||||..||....||||||||........||||....||
                       '0806'x for ARP        .|..||||....||||..||....||||||||........||||....||
                       '8035'x for rarp       .|..||||....||||..||....||||||||........||||....||
                                              .|..||||....||||..||....||||||||........||||....||
        IP HEADER  pg 22                      .|..||||....||||..||....||||||||........||||....||
           Version - 4 -----------------------+|..||||....||||..||....||||||||........||||....||
   ***     Length - Usually 5(counted in 32 bit)..||||....||||..||....||||||||........||||....||
           Type of Service ---------------------++||||....||||..||....||||||||........||||....||
           Total Length---------------------------++++....||||..||....||||||||........||||....||
           Identification-----------------------------++++||||..||....||||||||........||||....||
           Flags/Fragment Offset -------------------------++++..||....||||||||........||||....||
           Time to Live---------------------------------------++||....||||||||........||||....||
   ***     Protocol - 6 for TCP (see Appendix B for protocols)--++....||||||||........||||....||
           Header Checksum----------------------------------------++++||||||||........||||....||
           Source IP Address  (provided by formatter)-----------------++++++++........||||....||
           Dest IP Address (provided by formatter) ---------------------------++++++++||||....||
        TCP HEADER pg 83 (determined by protocol in IP header)                        ||||....||
   ***     Source Port (see Appendix B for Port assignments)--------------------------++++....||
   ***     Dest Port (see Appendix B for Port assignments) -------------------------------++++||
           SeqNumber (first byte of 4) -------------------------------------------------------++

 data second line -                 84924C7541A261600240008FAB00000204079D                         ***LUA*A..@.**.....*           *
           SeqNumber (cont) --------++++++........|...||||....||||..||....
           AckNumber----------------------++++++++|...||||....||||..||....
   ***     Offset---------------------------------+...||||....||||..||....
              This offset is usually 5. When the   ...||||....||||..||....
              connection opens, this offset is     ...||||....||||..||....
              usually 6. (x4)                      ...||||....||||..||....
           Flags-----------------------------------+++||||....||||..||....
             URG....................................2+||||....||||..||....
             ACK....................................1+||||....||||..||....
             PSH.....................................8||||....||||..||....
             RST.....................................4||||....||||..||....
             SYN.....................................2||||....||||..||....
             FIN.....................................1||||....||||..||....
             In this case, the Flag is SYN            ||||....||||..||....
           Window-------------------------------------++++....||||..||....
           Checksum---------------------------------------++++||||..||....
           Urgent Pointer-------------------------------------++++..||....
           Option-------------------------------------------------++++++++
             Kind.................................................++||....
             Length.................................................++....
             Data.....................................................++++
             In this case, the option is Maximum segment size.
```

When debugging a trace, I normally don't break all these fields down. I do look at: in the IP header the length and protocol used, in the TCP header source and destination ports, (to tell what application is used - i.e PRINTER) and data offset and flags. The data offset will tell where the user or application data will start. In the flags you will want to look for the ACK and PSH most of the time.

```
 >>> open connectopn with TCP segment size option
     24   R       49   654.7                        400001013653  400001021075   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:128.1.8.13       IP Dest Addr:128.1.8.12
                      Data . . . :  00000008004500002C581700003C06169A8001080D8001080C0203010008   *.....E..,X...<..**...*........*
                                    D8A8240984924D60124000F64000000204079D                         ***$.**M..@.*@.....*           *
 <<< ack
     25   S       45   655.3                        400001021075  400001013653   LLC     UI                         OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP          IP Src Addr:128.1.8.12       IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000028581800003C06169D8001080C8001080D0100020309   *.....E..(X...<..**...*........*
                                    84924D08D8A825501040000FD70010                                 ***M.**%P.@..*..               *
```

```
<<< LPR sends x'02' Receive a Printer job command with outq then LF.
    We start the break down at the data. Notice the port number tells us
    this is for print spooler. (x'0203' = 515 dec)
     26   S       61   656.3                        400001021075  400001013653   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000038581900003C06168C8001080C8001080D0100020309   *.....E..8X...<..**...*........*
 data line 2 breakdown -            84924D08D8A825501840001B0B0000026A6C6F636B652F6A616C6F757471   ***M.**%P.@......JLOCKE/JALOUTQ*
     LPR/LPD data -   x02 Daemon command and queue ............++ J L O C K E / J A L O U T Q
 data line 3 - x'0A' (LF) ......... 0A                                                             *.                             *
>>> ack
     27   R       45   656.4                        400001013653  400001021075   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028581800003C06169D8001080D8001080C0203010008   *.....E..(X...<..**...*........*
                                    D8A8250984925D50103FF00FD70010                                 ***%.**!P.?*.*..               *
>>> Server system sends Status return code x'00' meaning success
     28   R       46   657.9                        400001013653  400001021075   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000029581900003C06169B8001080D8001080C0203010008   *.....E..)X...<..**...*........*
                                    D8A8250984925D50183FF00FDE000000                               ***%.**!P.?*.*...              *
  x'00' status code ............................................++
     29   S       45   658.1                        400001021075  400001013653   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000028581A00003C06169B8001080C8001080D0100020309   *.....E..(X...<..**...*........*
                                    84925D08D8A82650103FFF0FC70010                                 ***!.**&P.?*.*..               *
<<< LPR system x'04' receive control file subcommand - length - Name of data file - LF
    notice the name of the data file starts with a C.
     34   S       73   661.0                        400001021075  400001013653   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000044581B00003C06167E8001080C8001080D0100020309   *.....E..DX...<...*...*........*
data second line -                  84925D08D8A82650183FFF85B9000004363920636641313137423230374 3   ***!.**&P.?***...69 CFA117B207C*
    x'04' RCFF subcommand  ......................................++||||||......................
    length of the control file followed by a space .................++++++......................
    Name of the data file (begins with C for control file) ...............++++++++++++++++++++++
data third line -                   2E4544552E49424D2E434F4D0A                                     *.EDU.IBM.COM.                 *
     Name of data file continued ...++++++++++++++++++++++++..
     termination LF  ......................................++
     35   R       45   662.1                        400001013653  400001021075   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028581A00003C06169B8001080D8001080C0203010008   *.....E..(X...<..**...*........*
                                    D8A8260984927950103FD40FD60010                                 ***&.**YP.?*.*..               *
>>> LPD system returns x'00' sucess return code
     37   R       46   663.4                        400001013653  400001021075   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000029581B00003C0616998001080D8001080C0203010008   *.....E..)X...<..**...*........*
                                    D8A8260984927950183FD40FDD000000                               ***&.**YP.?*.*...              *
     38   S       45   663.5                        400001021075  400001013653   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000028581C00003C0616998001080C8001080D0100020309   *.....E..(X...<..**...*........*
                                    84927908D8A82750103FFE0FAB0010                                 ***Y.**'P.?*.*..               *
<<< LPR system sends control file options. See chapter ten for options
    supported. This frame is x'48' (H) - host file name - LF
     39   S       64   663.6                        400001021075  400001013653   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  00000008004500003B581D00003C0616858001080C8001080D0100020309   *.....E..;X...<..**...*........*
data second line -                  84927908D8A82750183FFEF3280000484232303743 2E4544552E49424D2E   ***Y.**'P.?**(..HB207C.EDU.IBM.*
     control file option H .......................................++||||||||||||||||||||||||||
     host name  ..................................................++++++++++++++++++++++++++++
data third line                     434F4D0A                                                       *COM.                          *
     host name continued ...........++++++..
     LF    ..............................++
>>> ack
     40   R       45   663.8                        400001013653  400001021075   LLC     UI                          OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028581C00003C0616998001080D8001080C0203010008   *.....E..(X...<..**...*........*
                                    D8A8270984928C50103FC10FD50010                                 ***'.***P.?*.*..               *
```

```
<<< LPR sends P, L, N and X control file options. See chapter 10 for name
    of option. Notice each option ends with x'0A' LF.
     41   S       96   663.9                        400001021075  400001013653   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  00000008004500005B581E00003C0616648001080C8001080D0100020309   *.....E..¢X...<..D*...*........*
                                    84928C08D8A82750183FFE7C330000504A4C4F434B450A6C646641313137   ****.**'P.?*.3..PJLOCKE.LDFA117*
                                    42323037432E4544552E49424D2E434F4D0A4E515359535052540A584153   *B207C.EDU.IBM.COM.NQSYSPRT.XAS*
                                    2F3430300A00                                                   */400..                        *
     42   R       45   664.3                        400001013653  400001021075   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028581D00003C0616988001080D8001080C0203010008   *.....E..(X...<..**...*........*
                                    D8A827098492BF50103F8E0FD50010                                 ***'.***P.?*.*..               *
>>> LPD returns x'00' return code.
     43   R       46   665.4                        400001013653  400001021075   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000029581E00003C0616968001080D8001080C0203010008   *.....E..)X...<..**...*........*
                                    D8A827098492BF50183F8E0FDC000000                               ***'.***P.?*.*...              *
<<< LPR sends x'05' Receive Data File with Unspecified Length. ( if this
    was the old style LPD you would see x'03' and a byte count with the
    number of bytes in the data file.)
     44   S       70   665.6                        400001021075  400001013653   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000041581F00003C06167D8001080C8001080D0100020309   *.....E..AX...<..}*...*........*
data second line                    8492BF08D8A82850183FFD6706000005646641313137423230 37432E4544   ****.**(P.?*G....DFA117B207C.ED*
     X'05' RDFUL followed by file name. Notice D, for data file ..+++++++++++++++++++++++++++++++
     this will continue on line 3 and end with LF.
                                    552E49424D2E434F4D0A                                           *U.IBM.COM.                    *
     45   R       45   665.7                        400001013653  400001021075   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000028581F00003C0616968001080D8001080C0203010008   *.....E..(X...<..**...*........*
                                    D8A828098492D850103F750FD40010                                 ***(.***P.?U.*..               *
>>> ack
     54   R       46   672.2                        400001013653  400001021075   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.13      IP Dest Addr:128.1.8.12
                      Data . . . :  000000080045000029582000003C0616948001080D8001080C0203010008   *.....E..)X ..<..**...*........*
                                    D8A828098492D850183F750FDB000000                               ***(.***P.?U.*...              *
     55   S       45   672.3                        400001021075  400001013653   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  000000080045000028582000003C0616958001080C8001080D0100020309   *.....E..(X ..<..**...*........*
                                    8492D808D8A82950103FFC0F4C0010                                 ****.**)P.?*.L..               *
<<< LPR system sends the data file. In this case EBCDIC.
     56   S     1994   672.5                        400001021075  400001013653   LLC     UI                          OFF     AA     AA
                      Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:128.1.8.12      IP Dest Addr:128.1.8.13
                      Data . . . :  0000000800450007C5582100003C060EF78001080C8001080D0100020309   *.....E..*X|..<..**...*........*
                                    8492D808D8A82950183FFC0B14000000000CE500000CE5E2D7D3C1F0F2F0   ****.**)P.?*.......*...*********
                                    F0000000100000E9007541946298800066000000100000037075 41946298   **......*.UA*B**.F.......PUA*B**
                                    800066C4E2D7F0F14040404040D1D3D6C3D2C540404040F0F0F1F5F9F0D8   **.F*****@@@@@******@@@@********
                                    E2E8E2D7D9E34040400000000015CE2E3C44040404040404040404040 4040   *******@@@.....***@@@@@@@@@@@@@*
  .
 data and frames continue (not shown here)
  .
* * * * *   E N D   O F   C O M P U T E R   P R I N T O U T   * * * * *
Subcommands and format. Command x'02' and options can be found in
chapter 10 of the TCP/IP manual SC41-9875-02.
subcommand  name                  format
x'01'       Abort                 01 - LF
x'02'       Receive Control File  02 - byte count - SP - name - LF
x'03'       Receive Data File     03 - byte count - SP - name - LF
x'04'       Receive Control       04 - byte count - SP - name - LF
            File First
x'05'       Receive Data File     05 - name - LF
            With Unspecified Length
```

D.7 FTP Server

This is a communications trace of an FTP session. A user on a RS/6000 will use FTP to an AS/400. This is a communications trace formatted for ASCII and TCPIP. To break down see GG24-3376. Page numbers referenced are from GG24-3376- 03 for the SNAP, IP, and TCP headers. SC41-9875-02 pages will used when we are in the FTP data.

FTP uses 2 ports. One for data, x'14' dec 20, and one for commands or control, x'15' dec 21.

```
 COMMUNICATIONS TRACE       Title: FTP Server                        01/05/94  08:43:24                           Page:       3
 Record       Data    Record    Data    Controller  Destination   Source        Frame            Number  Number    Poll/
 Number  S/R  Length  Timer     Type    Name        MAC Address   MAC Address   Format  Command  Sent    Received  Final  DSAP  SSAP
 ------  ---  ------  --------  ------  ----------  ------------  ------------  ------  -------  ------  --------  -----  ----  ----
>>> This is the FTP client attempting to connect to the AS/400.
    I have completely broken down the TCP and IP headers for this first packet.
     14   R       49   1838.2                       10005A9D0098  40000F75B901   LLC     UI                        OFF     AA    AA
                      Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
>>> FRAME BREAK DOWN
                      Data . . . :  00000008004500002CF75F00003A066FED0905017C090505FA073B001577   *.....E..,*_..:.O*.......*.;..W*
        SNAP HEADER pg 280 app B    ......||||.|..||||....||||..||....||||||||........||||....||
           Protocol id or org. code-++++++||||.|..||||....||||..||....||||||||........||||....||
           EtherType - '0800'x for IP ----++++.|..||||....||||..||....||||||||........||||....||
                       '0806'x for ARP        .|..||||....||||..||....||||||||........||||....||
                       '8035'x for rarp       .|..||||....||||..||....||||||||........||||....||
                                              .|..||||....||||..||....||||||||........||||....||
        IP HEADER pg 22                       .|..||||....||||..||....||||||||........||||....||
           Version - 4 -----------------------+|..||||....||||..||....||||||||........||||....||
   ***     Length - Usually 5(counted in 32 bit)..||||....||||..||....||||||||........||||....||
           Type of Service ---------------------++||||....||||..||....||||||||........||||....||
           Total Length---------------------------++++....||||..||....||||||||........||||....||
           Identification-----------------------------++++||||..||....||||||||........||||....||
           Flags/Fragment Offset -------------------------++++..||....||||||||........||||....||
           Time to Live---------------------------------------++||....||||||||........||||....||
   ***     Protocol - 6 for TCP (see Appendix B for protocols) -++....||||||||........||||....||
           Header Checksum----------------------------------------++++||||||||........||||....||
           Source IP Address  (provided by formatter)-----------------++++++++........||||....||
           Dest IP Address (provided by formatter) ---------------------------++++++++||||....||
        TCP HEADER pg 83                                                              ||||....||
   ***     Source Port (see Appendix B for Port assignments) -------------------------++++....||
   ***     Dest Port (see Appendix B for Port assignments)--------------------------------++++||
           SeqNumber--------------------------------------------------------------------------++

                                    D7AE01000000006002400011860000020405AC                         ***.......@..*.....*           *
                                    ++++++........|...||||....||||..||....
           AckNumber----------------------++++++++|...||||....||||..||....
   ***     Offset---------------------------------+...||||....||||..||....
              This offset is usually 5. When the   ...||||....||||..||....
              connection opens, this offset is     ...||||....||||..||....
              usually 6.                           ...||||....||||..||....
   ***     Flags-----------------------------------+++||||....||||..||....
             URG....................................2+||||....||||..||....
             ACK....................................1+||||....||||..||....
             PSH.....................................8||||....||||..||....
             RST.....................................4||||....||||..||....
             SYN.....................................2||||....||||..||....
             FIN.....................................1||||....||||..||....
             In this case, the Flag is SYN            ||||....||||..||....
           Window-------------------------------------++++....||||..||....
           Checksum---------------------------------------++++||||..||....
           Urgent Pointer-------------------------------------++++..||....
           Option-------------------------------------------------++++++++
             Kind.............................................++||....
             Length.............................................++....
             Data.................................................++++
             In this case, the option is Maximum segment size.
```

When debugging a trace, I normally don't break all these fields down. I do look at: in the IP header the length and protocol used, in the TCP header source and destination ports, (to tell what application is used - i.e FTP) and data offset and flags. The data offset will tell where the user or application data will start. In the flags you will want to look for the ACK and PSH most of the time.

```
<<<   The AS/400 responds to set up the connection.  No data is passed.
      Note the port being used is x'15' for FTP control.
     15   S       49   1838.4                         40000F75B901  10005A9D0098   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                     Data . . . :  00000008004500002CE26600003C0682E6090505FA0905017C0015073B27   *.....E..,*F..<.**...*.......;'*
                                   4A242C77D7AE0260124000C40D000002204079D            ||||        *J$,W**...@.*......*            *
     Here we have SYN on and Segment size option ....+...........++++++++            ||||
     The source Port is the FTP control port ........................................++++
>>>  The RS/6000 returns an ack (notice the 1 in the 5010)
     16   R       45   1838.4                         10005A9D0098  40000F75B901   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000028F76000003A066FF00905017C090505FA073B001577   *.....E..(*...:.O*.......*.;..W*
                                   D7AE02274A242D50103E64DF4F0000                                 ***.'J$-P.>D*O..                *
      ACK..........................................+
<<<  The AS/400 sends the initial FTP information.  Note that the data starts 6 bytes after the x'5018'.
     For FTP this is just ASCII data.  This can be read at the right of the com trace.
     The length of the data can be found by taking the IP Packet size (in this case x'85') and subtracting x'28'.
     (x'85'-x'28'=x'5D' or 93 decimal)

     The 220 in the ASCII data is an FTP return code. See page 8-15 of SC41-9875-02. After the return
     you will see user, or human, text. The return code is used by FTP code to change internal states.
     the first 220 has a dash after it. This indicates the text will be over multi-lines. The last line
     will also have a 220 followed by a space which designates the last line of text.
     There can be multiple return codes in a single frame.
     22   S      138   1839.7                         40000F75B901  10005A9D0098   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000085E26700003C06828C090505FA0905017C0015073B27   *.....E..**G..<.**...*.......;'*
                                   4A242D77D7AE02501840000BF700003232302D5154435020617420535953   *J$-W**.P.@..*..220-QTCP AT SYS*
                                                 ||||............||||||||||||||||||||||||||||
     Offset/Flags---------------------------------++++            ||||||||||||||||||||||||||||
     Data------------------------------------------------------------++++++++++++++++++++++++++++
                                   3139382E5243484C414E442E49424D2E434F4D2E0D0A32323020436F6E6E   *198.RCHLAND.IBM.COM...220 CONN*
    220 and space to indicate last line of data ................................++++++++
                                   656374696F6E2077696C6C20636C6F7365206966206964C65206D6F7265   *ECTION WILL CLOSE IF IDLE MORE*
                                   207468616E2035206D696E757465732E0D0A                           * THAN 5 MINUTES...             *
>>>  This packet is just an acknowlegment with not data.  This can be verified by checking the sequence numbers.
     Unless I expect an acknowlegment problem, I normally don't check the numbers.  Acks without data are easy
     To spot.  They usually have the 5010.  The length of the packet is 28.  Fortunately, the 28 is right above the 10.
     24   R       45   1839.8                         10005A9D0098  40000F75B901   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000028F76700003A066FE90905017C090505FA073B001577   *.....E..(*G..:.O*.......*.;..W*
     Length-----------------------------------------++
                                   D7AE02274A248A50103E64DEF20000                                 ***.'J$*P.>D**..                *
     Offset/Flags---------------------------------++++
>>>  RS/6000 sends the FTP command "USER JEBER"  These are terminated by x'0D0A'.
     See chapter 8 for the FTP commands and the and parameters needed (if any).
     30   R       57   1841.6                         10005A9D0098  40000F75B901   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000034F76800003A066FDC0905017C090505FA073B001577   *.....E..4*H..:.O*.......*.;..W*
                                   D7AE02274A248A50183E644BF0000055534552206A656265720D0A         ***.'J$*P.>DK*..USER JEBER..   *
                                                 ||||........... U S E R   J E B E R
<<<   AS/400 ACKS  (with no data).
     31   S       45   1841.6                         40000F75B901  10005A9D0098   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000028E26800003C0682E8090505FA0905017C0015073B27   *.....E..(*H..<.**...*.......;'*
                                   4A248A77D7AE0E50103FF4DD460010                                 *J$*W**.P.?**F..                *
<<<   AS/400 sends return code and asks for password.
     33   S       66   1842.4                         40000F75B901  10005A9D0098   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.5.250       IP Dest Addr:9.5.1.124
                     Data . . . :  00000008004500003DE26900003C0682D2090505FA0905017C0015073B27   *.....E..=*I..<.**...*.......;'*
                                   4A248A77D7AE0E50183FF4473C000033333120456E746572207061737377   *J$*W**.P.?*G<..331 ENTER PASSW*
                                   6F72642E0D0A                                                   *ORD...                         *
>>>> RS/6000 ACKS (with no data).
     34   R       45   1842.6                         10005A9D0098  40000F75B901   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000028F76900003A066FE70905017C090505FA073B001577   *.....E..(*I..:.O*.......*.;..W*
                                   D7AE0E274A249F50103E64DED10000                                 ***.'J$*P.>D**..                *
>>>> RS/6000 Sends Password.
     40   R       57   1844.1                         10005A9D0098  40000F75B901   LLC     UI                          OFF     AA    AA
                     Frame Type:DOD IP        IP Protocol:TCP           IP Src Addr:9.5.1.124       IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000034F76A00003A066FDA0905017C090505FA073B001577   *.....E..4*J..:.O*.......*.;..W*
                                   D7AE0E274A249F50183E6442E0000050415353206A656265720D0A         ***.'J$*P.>DB*..PASS JEBER..   *
```

```
<<<  The general idea....
    41   S       45   1844.1                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000028E26A00003C0682E6090505FA0905017C0015073B27   *.....E..(*J..<.**...*.......;'*
                                   4A249F77D7AE1A50103FE8DD310010                                 *J$*W**.P.?**1..                *
    47   S       67   1844.7                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  00000008004500003EE26B00003C0682CF090505FA0905017C0015073B27   *.....E..>*K..<.**...*.......;'*
                                   4A249F77D7AE1A50183FE8C7420000323330204A45424552206C6F676765   *J$*W**.P.?**B..230 JEBER LOGGE*
                                   64206F6E2E0D0A                                                 *D ON...                        *
    48   R       45   1844.8                         10005A9D0098  40000F75B901   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000028F76B00003A066FE50905017C090505FA073B001577   *.....E..(*K..:.O*.......*.;..W*
                                   D7AE1A274A24B550103E64DEAF0000                                 ***.'J$*P.>D**..                *
>>>> RS6000 sends PORT command. Notice the format. It is number containing the IP address and 2 8 bit
    port address. In this frame the PORT address is 7,61 decimal which converts to PORT x'073D'.
    79   R       66   1856.6                         10005A9D0098  40000F75B901   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                     Data . . . :  00000008004500003DF76C00003A066FCF0905017C090505FA073B001577   *.....E..=*L..:.O*.......*.;..W*
                                   D7AE1A274A24B550183E64D16F0000504F525420392C352C312C3132342C   ***.'J$*P.>D*O..PORT 9,5,1,124,*
                                   372C36310D0A                                                   *7,61..                         *
    80   S       45   1856.6                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000028E27200003C0682DE090505FA0905017C0015073B27   *.....E..(*R..<.**...*.......;'*
                                   4A24B577D7AE2F50103FD3DD1B0010                                 *J$*W**/P.?**...                *
    81   S       86   1856.7                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000051E27300003C0682B4090505FA0905017C0015073B27   *.....E..Q*S..<.**...*.......;'*
                                   4A24B577D7AE2F50183FD3912A000032303020504F525420737562636F6D   *J$*W**/P.?***..200 PORT SUBCOM*
                                   6D616E64207265717565737420737563636573736756C2E0D0A            *MAND REQUEST SUCCESSFUL...    *
    82   R       51   1856.7                         10005A9D0098  40000F75B901   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                     Data . . . :  00000008004500002EF76D00003A066FDD0905017C090505FA073B001577   *.....E...*M..:.O*.......*.;..W*
                                   D7AE2F274A24DE50183E642FB900004E4C53540D0A                     ***/'J$*P.>D/*..NLST..          *
    83   S       45   1856.7                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000028E27400003C0682DC090505FA0905017C0015073B27   *.....E..(*T..<.**...*.......;'*
                                   4A24DE77D7AE3550103FCDDCF20010                                 *J$*W**5P.?***..                *
 <<<< This frame is a portion of the data transfer. Notice the PORTs.
    84   S       49   1856.8                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  00000008004500002CE27500003C0682D7090505FA0905017C0014073D01   *.....E..,*U..<.**...*.......=.*
                                   89F6B073FC006260024000C8D400000204079D               ++++      ****S*.B..@.**.....*            *
    Port...................................................................||||
    85   R       49   1856.8                         10005A9D0098  40000F75B901   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                     Data . . . :  00000008004500002CF76E00003A066FDE0905017C090505FA073D001477   *.....E..,*N..:.O*.......*.=..W*
                                   FEBE010189F6B160123E640AAF0000020405AC                         ***..***..>D.*.....*            *
    86   S       45   1856.9                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  000000080045000028E27600003C0682DA090505FA0905017C0014073D01   *.....E..(*V..<.**...*.......=.*
                                   89F6B177FEBE025010400020B80010                                 ****W**.P.@. *..                *
   109   S       64   1864.5                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  00000008004500003BE27D00003C0682C0090505FA0905017C0015073B27   *.....E..;*}..<.**...*.......;'*
                                   4A24DE77D7AE3550183FCD11FD0000313235204C69737420737461727465   *J$*W**5P.?*.*..125 LIST STARTE*
                                   642E0D0A                                                       *D...                           *
   110   R       45   1864.6                         10005A9D0098  40000F75B901   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.1.124        IP Dest Addr:9.5.5.250
                     Data . . . :  000000080045000028F76F00003A066FE10905017C090505FA073B001577   *.....E..(*O..:.O*.......*.;..W*
                                   D7AE35274A24F150103E64DE580000                                 ***5'J$*P.>D*X..                *
   111   S     1497   1864.6                         40000F75B901  10005A9D0098   LLC      UI                          OFF     AA     AA
                     Frame Type:DOD IP        IP Protocol:TCP            IP Src Addr:9.5.5.250        IP Dest Addr:9.5.1.124
                     Data . . . :  0000000800450005D4E27E00003C067D26090505FA0905017C0014073D01   *.....E..**...<.}&...*.......=.*
                                   89F6B177FEBE02501840001F92000041504E46494C450D0A42494E444654   ****W**.P.@..*..APNFILE..BINDFT*
                                   50530D0A4348415244554D500D0A43484B4F424A0D0A4350594350590D0A   *PS..CHARDUMP..CHKOBJ..CPYCPY..*
                                   4352544C50444A4F42440D0A435254544335041500D0A4352554E43480D   *CRTLPDJOBD..CRTTCPAPP..CRUNCH.*
                                   0A4352554E4348310D0A4332580D0A433258310D0A444655544553540D0A   *.CRUNCH1..C2X..C2X1..DFUTEST..*
                                   44535046494C450D0A4543484F0D0A4543484F434841520D0A464958444F   *DSPFILE..ECHO..ECHOCHAR..FIXDO*
                                   4D41494E0D0A465450434C49454E540D0A4745544355524C49420D0A474F   *MAIN..FTPCLIENT..GETCURLIB..GO*
 ...
After this you can read the ASCII translation of the FTP commands sent and
received between the client and the server.  Use SC41-9875 for this.
 ...
```

Appendix E. Supported SNADS Characters

The following table shows the characters that are valid for SNADS user IDs, addresses and system names.

Alphabet	A LA02	B LB02	C LC02	D LD02	E LE02	F LF02	G LF02	H LH02	I LI02	J LJ02	K LK02	L LL02	M LM02				
	N LN02	O LO02	P LP02	Q LQ02	R LR02	S LS02	T LT02	U LU02	V LV02	W LW02	X LX02	Y LY02	Z LZ02				
	a LA01	b LB01	c LC01	d LD01	e LE01	f LF01	g LG01	h LH01	i LI01	j LJ01	k LK01	l LL01	m LM01				
	n LN01	o LO01	p LP01	q LQ01	r LR01	s LS01	t LT01	u LU01	v LV01	w LW01	x LX01	y LY01	z LZ01				
Extended Alphabet	Á LA12	À LA14	Â LA16	Ä LA18	Ã LA20	Å LA28	Æ LA52	Ç LC42	Đ LD62	É LE12	È LE14	Ê LE16	Ë LE18	Í LI12	Ì LI14	Î LI16
	Ï LI18	Ñ LN20	Ó LO12	Ò LO14	Ô LO16	Ö LO18	Õ LO20	Ø LO62	Þ LT64	Ú LU12	Ù LU14	Û LU16	Ü LU18	Y' LY12		
	á LA11	à LA13	â LA15	ä LA17	ã LA19	å LA27	æ LA51	ç LC41	ð LD63	é LE11	è LE13	ê LE15	ë LE17	í LI11	ì LI13	î LI15
	ï LI17	ı LA61	ñ LN19	ó LO11	ò LO13	ô LO15	ö LO17	õ LO19	ø LO61	ß LS61	þ LT63	ú LU11	ù LU13	û LU15	ü LU17	ў LY11
	ÿ LY17															
Numerics	0 ND10	1 ND01	2 ND02	3 ND03	4 ND04	5 ND05	6 ND06	7 ND07	8 ND08	9 ND09						
Specials	. SP11	, SP08	/ SP12	' SP05	& SM03	$ SC03	# SM01	@ SM05	– SP10	µ SM17	º SM20	ª SM21				

RSLQ059-3

Figure 205. List of Supported Characters for SNADS

Take note that the Specials here are not the special characters referred to in SMTP. When a character in an SMTP name is not found within this table, then the character is regarded as a special SMTP character. This SMTP name then needs to be defined in the alias table.

An example of a special SMTP character is the ! (exclamation point). This character does not appear in Figure 205 and yet could be a valid character in an SMTP name.

Appendix F. Request for Comment Letters (RFCs)

The Internet protocol suite is evolving through the mechanism of Request for Comments (RFC). Research ideas and new protocols (mostly application protocols) are brought to the attention of the Internet community in the form of an RFC. Some protocols are so useful that they are recommended to be implemented in all future implementations of TCP/IP; that is, they become recommended protocols. Each RFC has a status attribute to indicate the acceptance and stage of evolution this idea has in the TCP/IP protocol suite.

RFCs are generally very detailed and technical documents. Software developers use RFCs as a reference to write TCP/IP software. All RFCs can be purchased from:

```
Government Systems, Inc.
Attn: Network Information Center
14200 Park Meadow Drive
Suite 200
Chantilly, VA 22021
1-800-365-3642
```

The following RFCs may be of interest to you:

RFC number	Description
RFC 1122 and 1123	Host Requirements
RFC 768	User Datagram Protocol
RFC 791	Internet Protocol
RFC 792	Internet Control Message Protocol
RFC 793	Transmission Control Protocol
RFC 821	Simple Mail Transfer Protocol
RFC 823	The DARPA Internet Gateway
RFC 826	An Ethernet Address Resolution Protocol
RFC 854	TELNET Protocol Specification
RFC 856	TELNET Binary Transmission
RFC 885	TELNET End-Of-Record
RFC 930	TELNET Terminal Type Option
RFC 1205	5250 TELNET Interface
RFC 950	Internet Standard Subnetting Procedure
RFC 952	DOD Internet Host Table Specification
RFC 959	File Transfer Protocol
RFC 974	Mail Routing and the Domain System
RFC 1035	Domain Names - Implementation and Specification
RFC 1034	Domain Names - Concepts and Facilities
RFC 1118	Hitchhikers Guide to the Internet

Appendix G. AS/400 Program to Monitor and Reroute Output Queue

LPRMON provides the ability to reroute spooled files from a designated output queue to a specified LPD server.

To use LPRMON, a data queue must first be created (DTAQ), and then an output queue must be created which is associated with the data queue (the DTAQ parameter of the CRTOUTQ command). The names of the destination system and the destination printer must be known as well. STRLPRMON is used to start the LPR monitor.

```
/**********BEGININCLUDE*************/
/*                                */
/* LPRMON include file            */
/*                                */
/* Author: Kevin L. Zemanek       */
/*                                */
/**********************************/

/**********************************/
/**********************************/
/**           Macros            **/
/**********************************/
/**********************************/

/****************************/
/* Sizes of things in OS/400 */
/****************************/
#define OS400_NAME_SIZE       10
#define OS400_RECTYPE_SIZE     2
#define OS400_QUALNAME_SIZE  (2 * OS400_NAME_SIZE)
#define OS400_JOBNBR_SIZE      6
#define OS400_JOBID_SIZE     ((2 * OS400_NAME_SIZE) + OS400_JOBNBR_SIZE)

/*****************************************/
/* Number of packed digits after integer  */
/* to packed decimal conversion.          */
/*****************************************/
#define NUM_PACKED_DIGITS 5

/*********************************/
/* Number of digits in fractional */
/* part of packed decimal.        */
/*********************************/
#define FRACTION         0

/*********************************/
/* Positions of parameters within */
/* the command source file.       */
/*********************************/
#define DATAQ_PARAM      1
#define RMTSYS_PARAM     2
#define PRTQ_PARAM       3
#define DESTTYPE_PARAM   4
#define TRANSFORM_PARAM  5
#define MFRTYPMDL_PARAM  6
#define WSCST_PARAM      7
```

```
#define DLTSPLF_PARAM     8
#define INTNETADR_PARAM   9

/***************************/
/* Lengths of parameters.   */
/***************************/
#define DATAQ_LEN        OS400_QUALNAME_SIZE
#define RMTSYS_LEN      255
#define PRTQ_LEN        128
#define DESTTYPE_LEN      6
#define TRANSFORM_LEN     4
#define MFRTYPMDL_LEN    15
#define WSCST_LEN        OS400_QUALNAME_SIZE
#define DLTSPLF_LEN       4
#define INTNETADR_LEN    15
#define FILE_LEN         OS400_NAME_SIZE
#define JOBNAME_LEN      OS400_JOBID_SIZE

#define MAX_PARM_LEN    256
#define BLANK           ' '

/***************************/
/* Max size of "keyword() " */
/***************************/
#define KEYWORD_LEN   12

/************************************************/
/* Values used to build SNDTCPSPLF command      */
/************************************************/
#define SNDTCPSPLF_CMD "SNDTCPSPLF "
#define RMTSYS         "RMTSYS(%s) "
#define PRTQ           "PRTQ(%s) "
#define FILE           "FILE(%.*s) "
#define JOB            "JOB(%s/%s/%s) "
#define SPLNBR         "SPLNBR(%d) "
#define DESTTYP        "DESTTYP(%s) "
#define TRANSFORM      "TRANSFORM(%s) "
#define MFRTYPMDL      "MFRTYPMDL(%s) "
#define WSCST          "WSCST(%s) "
#define DLTSPLF        "DLTSPLF(%s) "
#define INTNETADR      "INTNETADR(%s) "

/*****************************************/
/* How long to wait for a data queue entry */
/*****************************************/
#define WAIT_FOREVER      -1

/***************************************************/
/* Size of the buffer to hold the SNDTCPSPLF command */
/***************************************************/
#define CMD_BUFF_SIZE     1024

/************************/
/* Define TRUE and FALSE */
/************************/
#ifndef TRUE
   #define TRUE  1
#endif
```

```
#ifndef FALSE
   #define FALSE 0
#endif

/*******************************************************************/
/*******************************************************************/
/**                  Structures and Datatypes                     **/
/*******************************************************************/
/*******************************************************************/

/**********************************************/
/* JOBSTRUCT is used to make the parts       */
/* of the qualified job name more accessible. */
/**********************************************/

typedef struct _JOBSTRUCT
{
   char acJobName[OS400_NAME_SIZE];
   char acUserName[OS400_NAME_SIZE];
   char acJobNumber[OS400_JOBNBR_SIZE];
}JOBSTRUCT;

typedef JOBSTRUCT *PJOBSTRUCT;

/********************************************/
/* QUALNAME is used to pass a qualified     */
/* object name to OS/400 APIs and commands. */
/********************************************/
typedef struct _QUALNAME
{
   char acName[OS400_NAME_SIZE];
   char acLibrary[OS400_NAME_SIZE];
}QUALNAME;

typedef QUALNAME *PQUALNAME;

/**********************************************************/
/* DATAQ_ENTRY is used to retrieve an entry written onto  */
/* a data queue due to a spooled file going to RDY status */
/**********************************************************/
typedef struct _DATAQ_ENTRY
{
   char      acFunction[OS400_NAME_SIZE];
   char      acRecordType[OS400_RECTYPE_SIZE];
   JOBSTRUCT jQualJobName;
   char      acSplFileName[OS400_NAME_SIZE];
   int       iSplFileNumber;
   QUALNAME  qnOutputQueue;
   char      acReserved[56];
}DATAQ_ENTRY;

typedef DATAQ_ENTRY *PDATAQ_ENTRY;

/************************************************/
/* MAIN_PARAMS is used to retrieve the parameters */
/* passed in from the STRLPRMON command.         */
/************************************************/
typedef struct _MAIN_PARAMS
{
```

```
   QUALNAME qnDataQueue;
   char     szRemoteSystem[RMTSYS_LEN + KEYWORD_LEN + 1];
   char     szPrintQueue[PRTQ_LEN + KEYWORD_LEN + 1];
   char     szDestType[DESTTYPE_LEN + KEYWORD_LEN + 1];
   char     szTransform[TRANSFORM_LEN + KEYWORD_LEN + 1];
   char     szMfrTypMdl[MFRTYPMDL_LEN + KEYWORD_LEN + 1];
   char     szWsCstObj[WSCST_LEN + KEYWORD_LEN + 1];
   char     szDltSplf[DLTSPLF_LEN + KEYWORD_LEN + 1];
   char     szIntNetAddr[INTNETADR_LEN + KEYWORD_LEN + 1];
}MAIN_PARAMS;

typedef MAIN_PARAMS *PMAIN_PARAMS;

/*******************************************************/
/* Internal function prototypes.                       */
/*******************************************************/
static void Trim(char *    pszString,
                 const int iLen);

static void RetrieveParams(PMAIN_PARAMS pmpMainParams,
                           char        *argv[]);

int main(int argc, char *argv[]);


/********************************************************************/
/********************************************************************/
/**                    External functions                          **/
/********************************************************************/
/********************************************************************/

#pragma linkage(QRCVDTAQ, OS)
extern void QRCVDTAQ(char *, char *, char *, char *, char *);

/**********************ENDINCLUDE**********************/
```

G.1 LPRMON Source Code

```
/*****************************************************************/
/*****************************************************************/
/*                                                               */
/*  LPRMON - LPR Output Queue Monitor and Rerouter               */
/*                                                               */
/*  LPRMON provides the ability to reroute spooled files from    */
/*  a designated output queue to a specified LPD server.         */
/*                                                               */
/*  To use LPRMON, a data queue must first be created (DTAQ)     */
/*  and then an output queue must be created which is associated */
/*  with the data queue (the DTAQ parameter of the CRTOUTQ       */
/*  command).  The names of the destination system and the       */
/*  destination printer must be known as well.  STRLPRMON is     */
/*  used to start the LPR monitor.                               */
/*                                                               */
/*  Author: Kevin L. Zemanek                                     */
/*                                                               */
/*****************************************************************/
/*****************************************************************/
```

```
#include <stdio.h>    /* sprintf                                   */
#include <string.h>   /* memcpy, memset, strcpy, strcat            */
#include <stdlib.h>   /* system                                    */
#include <ctype.h>    /* isspace                                   */

#include <xxcvt.h>    /* QXXITOP                                   */

#include "lprmon.h"   /* LPRMON specific structures and macros   */


/**************************************************/
/*    function Trim()                              */
/*                                                */
/* Parameters:                                    */
/*                                                */
/* char      *pszString                           */
/* const int iLen                                 */
/*                                                */
/* Functions used:                                */
/*                                                */
/* isspace()                                      */
/*                                                */
/* Description:                                   */
/*                                                */
/* Trim removes trailing whitespace from          */
/* character arrays and places a NULL ('\0')      */
/* after the last non-space character.  A max     */
/* length for the string is passed in (iLen).     */
/**************************************************/
static void Trim(char      *pszString,
                 const int iLen)
{
   int iIndex = 0;

   /**************************************************************/
   /* While we are not at the last char AND a char is not         */
   /* whitespace AND not '\0' keep going towards the end of string */
   /**************************************************************/
   while ((iIndex < iLen) &&
          (!(isspace(pszString[iIndex]))) &&
          (!('\0' == pszString[iIndex])))
   {
      iIndex++;
   }

   /**********************************************/
   /* if iIndex > 0, we found 1 or more chars,  */
   /* so mark end of string with a '\0'         */
   /**********************************************/
   if (iIndex > 0)
   {
      pszString[iIndex] = '\0';
   }
   /**********************************************/
   /* else iIndex == 0, which means we didn't   */
   /* find anything but whitespace.             */
   /**********************************************/
   else
```

```
   {
      pszString[0] = '\0';
   }

   return;
}

/**************************************************/
/*    function RetrieveParams()                   */
/*                                                */
/* Parameters:                                    */
/*                                                */
/* PMAIN_PARAMS pmpMainParams                     */
/* char         *argv[]                           */
/*                                                */
/* Functions used:                                */
/*                                                */
/* memcpy()                                       */
/* sprintf()                                      */
/*                                                */
/* Description:                                   */
/*                                                */
/* Trim removes trailing whitespace from          */
/* character arrays and places a NULL ('\0')      */
/* after the last non-space character.  A max     */
/* length for the string is passed in (iLen).     */
/**************************************************/
static void RetrieveParams(PMAIN_PARAMS pmpMainParams,
                           char        *argv[])
{
   char acTmpBuff[MAX_PARM_LEN];

   /*************************************/
   /* Retrieve the data queue to monitor */
   /*************************************/
   if ((char *)NULL != argv[DATAQ_PARAM])
   {
      memcpy(&(pmpMainParams->qnDataQueue), argv[DATAQ_PARAM], DATAQ_LEN);
   }

   /***********************************/
   /* Retrieve the remote system name */
   /***********************************/
   if ((char *)NULL != argv[RMTSYS_PARAM])
   {
      memcpy(acTmpBuff, argv[RMTSYS_PARAM], RMTSYS_LEN);
      Trim(acTmpBuff, RMTSYS_LEN);
      sprintf(pmpMainParams->szRemoteSystem, RMTSYS, acTmpBuff);
   }

   /*****************************************/
   /* Retrieve the target printer queue name */
   /*****************************************/
   if ((char *)NULL != argv[PRTQ_PARAM])
   {
      memcpy(acTmpBuff, argv[PRTQ_PARAM], PRTQ_LEN);
      Trim(acTmpBuff, PRTQ_LEN);
      sprintf(pmpMainParams->szPrintQueue, PRTQ, acTmpBuff);
   }
```

```
/*********************************/
/* Retrieve the destination type */
/*********************************/
if ((char *)NULL != argv[DESTTYPE_PARAM])
{
   memcpy(acTmpBuff, argv[DESTTYPE_PARAM], DESTTYPE_LEN);
   Trim(acTmpBuff, DESTTYPE_LEN);
   sprintf(pmpMainParams->szDestType, DESTTYP, acTmpBuff);
}

/*******************************/
/* Retrieve the transform flag */
/*******************************/
if ((char *)NULL != argv[TRANSFORM_PARAM])
{
   memcpy(acTmpBuff, argv[TRANSFORM_PARAM], TRANSFORM_LEN);
   Trim(acTmpBuff, TRANSFORM_LEN);
   sprintf(pmpMainParams->szTransform, TRANSFORM, acTmpBuff);
}

/*******************************************/
/* Retrieve the manufacturer type and model */
/*******************************************/
if ((char *)NULL != argv[MFRTYPMDL_PARAM])
{
   memcpy(acTmpBuff, argv[MFRTYPMDL_PARAM], MFRTYPMDL_LEN);
   Trim(acTmpBuff, MFRTYPMDL_LEN);
   sprintf(pmpMainParams->szMfrTypMdl, MFRTYPMDL, acTmpBuff);
}

/*****************************************************/
/* Retrieve the workstation customization object name */
/*****************************************************/
if ((char *)NULL != argv[WSCST_PARAM])
{
   memcpy(acTmpBuff, argv[WSCST_PARAM], WSCST_LEN);
   Trim(acTmpBuff, WSCST_LEN);
   sprintf(pmpMainParams->szWsCstObj,
           WSCST, acTmpBuff);
}

/*****************************************/
/* Retrieve the delete spooled file flag */
/*****************************************/
if ((char *)NULL != argv[DLTSPLF_PARAM])
{
   memcpy(acTmpBuff, argv[DLTSPLF_PARAM], DLTSPLF_LEN);
   Trim(acTmpBuff, DLTSPLF_LEN);
   sprintf(pmpMainParams->szDltSplf, DLTSPLF, acTmpBuff);
}

/**************************************************/
/* Retrieve the Internet address                  */
/**************************************************/
if ((char *)NULL != argv[INTNETADR_PARAM])
{
   memcpy(acTmpBuff, argv[INTNETADR_PARAM], INTNETADR_LEN);
   Trim(acTmpBuff, INTNETADR_LEN);
```

```
      sprintf(pmpMainParams->szIntNetAddr, INTNETADR, acTmpBuff);
   }

   return;
}
/***************************************************************************/
/***************************************************************************/
/**                              MAIN                                    **/
/***************************************************************************/
/***************************************************************************/

int main(int argc, char *argv[])
{
   char        acWaitDuration[NUM_PACKED_DIGITS],
               acDataLen[NUM_PACKED_DIGITS],
               acSndTcpSplfCmd[CMD_BUFF_SIZE],
               szFile[FILE_LEN + KEYWORD_LEN],
               szJob[JOBNAME_LEN + KEYWORD_LEN],
               szSplNbr[sizeof(int) + KEYWORD_LEN];
   MAIN_PARAMS mpMainParams;
   DATAQ_ENTRY deData;

   /*************************************/
   /* Retrieve the parameters passed in  */
   /* by the STRLPRMON command.          */
   /*************************************/
   RetrieveParams(&mpMainParams, argv);

   /***********************************************************/
   /* Convert integers to packed decimals for call to QRCVDTAQ. */
   /* QXXITOP is doc'd in the EPM User's Guide and Reference in */
   /* the chapter on The Extended Program Model Application     */
   /* Library.                                                  */
   /***********************************************************/
   QXXITOP(acDataLen, NUM_PACKED_DIGITS, FRACTION, sizeof(DATAQ_ENTRY));
   QXXITOP(acWaitDuration, NUM_PACKED_DIGITS, FRACTION, WAIT_FOREVER);

   /*************************************************/
   /* Loop forever waiting for entries to appear on  */
   /* the data queue.  When an entry shows up, parse */
   /* the entry, build the SNDTCPSPLF command, and   */
   /* submit the command.                            */
   /*************************************************/
   while (TRUE)
   {
      QRCVDTAQ(mpMainParams.qnDataQueue.acName,
               mpMainParams.qnDataQueue.acLibrary,
               acDataLen,
               (char *)&deData,
               acWaitDuration);

      /*************************************/
      /* Parse the parameters from QRCVDTAQ */
      /*************************************/
      Trim(deData.acSplFileName, OS400_NAME_SIZE);
      sprintf(szFile, FILE, OS400_NAME_SIZE, deData.acSplFileName);

      Trim(deData.jQualJobName.acJobName, OS400_NAME_SIZE);
      Trim(deData.jQualJobName.acUserName, OS400_NAME_SIZE);
```

```
            Trim(deData.jQualJobName.acJobNumber, OS400_JOBNBR_SIZE);

            sprintf(szJob, JOB,
                    deData.jQualJobName.acJobNumber,
                    deData.jQualJobName.acUserName,
                    deData.jQualJobName.acJobName);

            sprintf(szSplNbr, SPLNBR, deData.iSplFileNumber);

            /********************************/
            /* Build the SNDTCPSPLF command */
            /********************************/
            memset(acSndTcpSplfCmd, '\0', CMD_BUFF_SIZE);
            strcpy(acSndTcpSplfCmd, SNDTCPSPLF_CMD);
            strcat(acSndTcpSplfCmd, mpMainParams.szRemoteSystem);
            strcat(acSndTcpSplfCmd, mpMainParams.szPrintQueue);
            strcat(acSndTcpSplfCmd, szFile);
            strcat(acSndTcpSplfCmd, szJob);
            strcat(acSndTcpSplfCmd, szSplNbr);
            strcat(acSndTcpSplfCmd, mpMainParams.szDestType);
            strcat(acSndTcpSplfCmd, mpMainParams.szTransform);
            strcat(acSndTcpSplfCmd, mpMainParams.szWsCstObj);
            strcat(acSndTcpSplfCmd, mpMainParams.szDltSplf);
            strcat(acSndTcpSplfCmd, mpMainParams.szIntNetAddr);
            strcat(acSndTcpSplfCmd, mpMainParams.szMfrTypMdl);

            /*********************************/
            /* Submit the SNDTCPSPLF command */
            /*********************************/
            system(acSndTcpSplfCmd);
         }
         return(0);
      }
```

G.2 STRLPRMON CL Command Source

```
/*********************************************************************/
/*                                                                   */
/*  COMMAND NAME:  STRLPRMON                                         */
/*  COMMAND TITLE: Start LPR Monitor                                 */
/*  DESCRIPTION: Start a server to monitor a data queue for          */
/*               spooled files.  When one arrives, send it           */
/*               using the SNDTCPSPLF (LPR) command.                 */
/*  STRLPRMON    DTAQ( ) RMTSYS( ) PRTQ( ) DESTTYP( ) TRANSFORM( )   */
/*               MFRTYPMDL( ) INTNETADR( ) WSCST( ) DLTSPLF( )       */
/*                                                                   */
/*  ASSOCIATED PGM: LPRMON                                           */
/*                                                                   */
/*  AUTHOR: Kevin L. Zemanek                                         */
/*                                                                   */
/*********************************************************************/
 STRLPRMON:  CMD  PROMPT('Start LPR Monitor')
         PARM KWD(DTAQ)                 +
               TYPE(QDTAQ)              +
               MIN(1) MAX(1) FILE(*NO)   +
               FULL(*NO) EXPR(*NO) VARY(*NO)       +
               PROMPT('Data queue to monitor')
         PARM KWD(RMTSYS)                                     +
```

```
                 TYPE(*CHAR) LEN(255) RSTD(*NO)                 +
                 PASSATR(*NO)                                   +
                 FILE(*NO) FULL(*NO) EXPR(*NO) VARY(*NO)        +
                 SPCVAL((*INTNETADR *INTNETADR))  MIN(1) MAX(1) +
                 PROMPT('Remote system')
           PARM  KWD(PRTQ)                                    +
                 TYPE(*CHAR) MIN(1) MAX(1)                    +
                 LEN(128) RSTD(*NO) VARY(*NO) PASSATR(*NO)    +
                 EXPR(*YES) FILE(*NO)                         +
                 PROMPT('Destination printer queue')
           PARM KWD(DESTTYP)                +
                 TYPE(*CHAR) MIN(0) MAX(1)  +
                 LEN(6) RSTD(*YES)          +
                 VALUES(*AS400 *PSF2 *OTHER) DFT(*OTHER)  +
                 PROMPT('Destination type')
           PARM KWD(TRANSFORM)                 +
                 TYPE(*CHAR) MIN(0) MAX(1)     +
                 LEN(4) RSTD(*YES) DFT(*YES)   +
                 VALUES(*YES *NO)              +
                 PROMPT('Transform SCS to ASCII')
           PARM KWD(MFRTYPMDL)                         +
                 TYPE(*CHAR) MIN(0) MAX(1) EXPR(*YES)  +
                 LEN(15) RSTD(*NO)                     +
                 DFT(*IBM42011)                        +
                 CHOICE(*PGM)                          +
                 CHOICEPGM(QSYS/QDCPVDPA)              +
                 PMTCTL(TRNSFRM)                       +
                 PROMPT('Manufacturer type and model')
           PARM KWD(WSCST)                  +
                 TYPE(QWSCST)               +
                 MIN(0) MAX(1) FILE(*NO)    +
                 SNGVAL((*NONE)) DFT(*NONE) +
                 PMTCTL(TRNSFRM)            +
                 PROMPT('Workstation customizing object')
           PARM KWD(DLTSPLF)                   +
                 TYPE(*CHAR) MIN(0) MAX(1)     +
                 LEN(4) RSTD(*YES) DFT(*NO)    +
                 VALUES(*NO *YES)              +
                 PROMPT('Delete file after sending')
           PARM KWD(INTNETADR)                                +
                 TYPE(*CHAR) LEN(15) RSTD(*NO) MIN(0) MAX(1)  +
                 FILE(*NO) FULL(*NO) EXPR(*NO) VARY(*NO)      +
                 PASSATR(*NO)                                 +
                 PMTCTL(INTNETA)                              +
                 PROMPT('Internet address')
TRNSFRM: PMTCTL CTL(TRANSFORM) +
                 COND((*EQ *YES))
INTNETA: PMTCTL CTL(RMTSYS) +
                 COND((*EQ *INTNETADR))
QDTAQ:  QUAL TYPE(*NAME) LEN(10) RSTD(*NO) MIN(0)     +
                 EXPR(*YES) VARY(*NO) PASSATR(*NO)
        QUAL TYPE(*NAME) LEN(10) RSTD(*NO) MIN(0)     +
                 DFT(*CURLIB) VARY(*NO) EXPR(*YES)    +
                 PASSATR(*NO)                         +
                 SPCVAL((*LIBL) (*CURLIB *CURLIB))    +
                 PROMPT('Library')
QWSCST: QUAL TYPE(*NAME) LEN(10) RSTD(*NO) MIN(0)     +
                 EXPR(*YES) VARY(*NO) PASSATR(*NO)
        QUAL TYPE(*NAME) LEN(10) RSTD(*NO) MIN(0)     +
```

```
                    DFT(*LIBL) VARY(*NO) EXPR(*YES)         +
                    PASSATR(*NO)                            +
                    SPCVAL((*LIBL) (*CURLIB *CURLIB))       +
                    PROMPT('Library')
```

G.3 CL Program To Build LPRMON and STRLPRMON

```
CRTCPGM PGM(MYLIB/LPRMON) +
        OPTION(*SRC *NOXREF *SHOWUSR *NOSHOWSKP *EXPMAC *NOAGR +
               *DEBUG *PRINT *GEN *NOSECLVL *NOPPONLY *LOGMSG) +
        MAXPARMS(9)                                           +
        LANGLVL(*EXTENDED) PRTFILE(QSYSPRT)                   +
        GENOPT(*NOLIST *GEN *NODUMP *NOOPTIMIZE)              +
        USRPRF(*OWNER)                                        +
        TEXT('LPR Monitor')

CRTCMD  CMD(STRLPRMON) PGM(LPRMON) TEXT('Start LPR Monitor')
```

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