



@server

iSeries

Telnet

*Version 5 Release 3*







@server

iSeries

Telnet

*Version 5 Release 3*

**Note**

Before using this information and the product it supports, be sure to read the information in "Notices," on page 95.

**Sixth Edition (August 2005)**

This edition applies to version 5, release 3, modification 0 of IBM Operating System/400 (product number 5722-SS1) and to all subsequent releases and modifications until otherwise indicated in new editions. This version does not run on all reduced instruction set computer (RISC) models nor does it run on CISC models.

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# Contents

<b>Telnet.</b> . . . . .	<b>1</b>	INIT0100: Format of Device Description Information . . . . .	42
Print this topic. . . . .	2	INIT0100: Format of Connection Description Information . . . . .	44
Telnet scenarios . . . . .	2	Device termination exit program . . . . .	46
Telnet scenario: Telnet server configuration . . . . .	2	Sample Telnet exit programs. . . . .	46
Telnet scenario: Cascaded Telnet sessions . . . . .	4	Manage the Telnet client . . . . .	47
System request processing scenarios . . . . .	5	Control Telnet server functions from the client. . . . .	48
Using a group job . . . . .	7	5250 Telnet client sessions . . . . .	49
Telnet scenario: Secure Telnet with SSL . . . . .	9	Start a 5250 Telnet client session . . . . .	49
Configuration details . . . . .	11	3270 Telnet client sessions . . . . .	50
Plan for the Telnet server. . . . .	15	Start a 3270 Telnet client session . . . . .	51
Virtual device descriptions . . . . .	15	3270 full screen considerations . . . . .	52
Telnet security . . . . .	16	Using a display station . . . . .	53
Prevent Telnet access . . . . .	16	3270 keyboard mapping for Telnet servers . . . . .	54
Control Telnet access . . . . .	17	VTxxx Telnet client sessions . . . . .	56
Configure the Telnet server . . . . .	20	Start a VTxxx Telnet client session. . . . .	56
Start the Telnet server . . . . .	20	VTxxx full screen considerations . . . . .	58
Set the number of virtual devices . . . . .	21	VTxxx emulation options. . . . .	62
Automatically configure virtual devices . . . . .	21	VTxxx key values . . . . .	62
Create your own virtual devices . . . . .	22	VTxxx National Language Support . . . . .	67
Restrict privileged users to specific devices and limit sign-on attempts . . . . .	22	VTxxx national mode . . . . .	68
Set the session keep-alive parameter . . . . .	23	Numeric keypad. . . . .	70
Assign devices to subsystems . . . . .	24	Editing keypad . . . . .	71
Activate the QSYSWRK subsystem . . . . .	24	VTxxx key values by 5250 function . . . . .	73
Create user profiles. . . . .	25	VT220 workstation operating modes . . . . .	76
iSeries <sup>™</sup> supported emulation types . . . . .	25	VT220 top-row function keys . . . . .	76
Configure Telnet server for 5250 full-screen mode . . . . .	25	VT100 and VT220 Control Character Keywords . . . . .	77
Configure Telnet server for 3270 full-screen mode . . . . .	26	Establish a cascaded Telnet session . . . . .	78
<b>Supported 3270 terminal types.</b> . . . . .	27	Move between cascaded Telnet sessions . . . . .	79
Configure Telnet server for VTxxx full-screen mode . . . . .	28	End a Telnet client session . . . . .	79
Secure Telnet with SSL . . . . .	30	Troubleshoot Telnet problems . . . . .	80
Configure SSL on the Telnet server . . . . .	31	Determine problems with Telnet . . . . .	80
Remove port restrictions . . . . .	31	Ping your host server . . . . .	83
Assign a certificate to the Telnet server . . . . .	31	Troubleshoot emulation types . . . . .	83
Enable client authentication for the Telnet server (optional step) . . . . .	32	Troubleshoot your Telnet SSL server . . . . .	86
Enable SSL on the Telnet server. . . . .	34	Check system status . . . . .	86
SSL initialization and handshake . . . . .	35	Check for an active SSL listener . . . . .	86
Manage the Telnet server. . . . .	36	Check the Telnet job log . . . . .	86
Configure Telnet printer sessions . . . . .	36	SSL return codes. . . . .	87
Requirements for Telnet printer sessions. . . . .	37	TRCTCPAPP service program outputs . . . . .	89
End the server session. . . . .	37	Materials needed to report Telnet problems. . . . .	92
End Device Manager jobs. . . . .	38	Automatically generated diagnostic information . . . . .	93
Use Telnet exit point programs . . . . .	38	Related information about Telnet . . . . .	94
Device initialization exit program . . . . .	40		
Telnet Exit Point Format INIT0100: Required Parameter Group . . . . .	41		
INIT0100: Format of User Description Information . . . . .	42		
		<b>Appendix. Notices.</b> . . . . .	<b>95</b>
		Trademarks . . . . .	96
		Terms and conditions for downloading and printing information . . . . .	97
		Code disclaimer information. . . . .	97



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# Telnet

Telnet is a protocol that allows you to log on and use a remote computer as though you are connected directly to it within the local network. The machine (usually a PC), or system that you are physically in front of is the Telnet client. The Telnet server is the remote computer to which the client is attached. iSeries<sup>(TM)</sup> TCP/IP supports both the Telnet client and server.

One of the most important Telnet functions is its ability to negotiate the transmission of data streams between the Telnet client and the server. This type of negotiation makes it possible for either the client or the server to initiate or honor a request.

Several different emulation types are available for negotiating requests and converting them to output. For iSeries Telnet, the preferred type is 5250 emulation. iSeries Telnet also supports 3270, and VTxxx type workstations as well as RFC 2877 (TN5250E) printer support modes. The following information introduces Telnet and provides you with information to help you administer Telnet on your iSeries server.

**Note:** Read the “Code disclaimer information” on page 97 for important legal information.

**“Print this topic” on page 2**

If you want to read this information on paper, you can print the entire topic as a PDF file.

**“Telnet scenarios” on page 2**

This topic provides examples of Telnet use to introduce basic concepts and configuration tasks.

**“Plan for the Telnet server” on page 15**

This topic explains how to determine the number of virtual devices to associate with the workstations that are connected to your system. It also provides security procedures for controlling or preventing access to Telnet.

**“Configure the Telnet server” on page 20**

This topic explains how to configure your Telnet server for support of various emulation types.

**“Manage the Telnet server” on page 36**

This topic describes how to work with your Telnet server and use exit programs to control user access.

**“Manage the Telnet client” on page 47**

This topic provides steps to start a Telnet client session using different emulation types. This section also explains how to establish a cascaded Telnet session.

**“Troubleshoot Telnet problems” on page 80**

Find tips and instructions on troubleshooting the Telnet server, emulation types, and SSL.

**“Related information about Telnet” on page 94**

Find links to other information about Telnet.

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## Print this topic


To view or download the PDF version, select Telnet (about 728 KB).

### Saving PDF files

To save a PDF on your workstation for viewing or printing:

1. Right-click the PDF in your browser (right-click the link above).
2. Click **Save Target As...**
3. Navigate to the directory in which you would like to save the PDF.
4. Click **Save**.

### Downloading Adobe Acrobat Reader

If you need Adobe Acrobat Reader to view or print these PDFs, you can download a copy from the Adobe Web site ([www.adobe.com/products/acrobat/readstep.html](http://www.adobe.com/products/acrobat/readstep.html)) .

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## Telnet scenarios

» The following Telnet scenarios provide examples to help you understand how to configure and use Telnet.

### “Telnet scenario: Telnet server configuration”

This scenario depicts an administrator customizing a Telnet server.

### “Telnet scenario: Cascaded Telnet sessions” on page 4

This scenario demonstrates the ability to start Telnet sessions while you are still in a Telnet session. Once connected, you can move between systems using system request values. **“Telnet scenario: Secure Telnet with SSL” on page 9**

You can use SSL to secure Telnet on the iSeries<sup>™</sup>. This scenario provides a step-by-step configuration example. «

## Telnet scenario: Telnet server configuration



### Situation and Objectives

Ken Harrison is the administrator for a new iSeries<sup>™</sup> server for Culver Pharmaceuticals. He needs to configure the Telnet server to meet the following specifications:

- Allow up to 100 virtual devices to be created automatically.
- Always display sign-on.
- Restrict privileged users to specific devices.
- Limit each user to one device session.

### Prerequisites and assumptions

List your requirements or assumptions about the users' equipment, current state, or location in a larger process that must be met to use this scenario.

- Culver Pharmaceuticals is using an iSeries server at Version 5 Release 2.
- TCP/IP is configured.
- Ken has IOSYSCFG authority.



## Configuration details

### 1. Start the Telnet server

- a. Expand **your iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
- b. In the right pane, locate **Telnet** in the Server Name column.
- c. Confirm that **Started** appears in the Status column.
- d. If the server is not running, right-click **Telnet** and select **Start**.

### 2. Set the number of virtual devices

- a. In iSeries Navigator, select **your iSeries server**, —> **Configuration and Service** —> **System Values**.
- b. In the right pane, right-click **Devices** and select **Properties**.
- c. On the **Devices System Values** page, enable **Pass-through devices and TELNET** and set the **Maximum number of devices** to 100.

### 3. Configure Telnet server properties

- a. In iSeries Navigator, select **your iSeries server**, —> **Network** —> **Servers** —> **TCP/IP**.
- b. In the right pane, right-click **Telnet** and select **Properties**.

Click this tab...	And...
System Sign-On	Select: <ul style="list-style-type: none"><li>• Restrict privileged users to specific devices.</li><li>• Limit each user to one device session.</li></ul>
Remote Sign-On	Specify the number of sign-on attempts allowed and the action to take if the maximum number of sign-on attempts is reached.
Remote	Select the <b>Always display sign-on</b> option for <b>Use Telnet for remote sign-on</b> .
Time-Out	Specify the action to take when jobs reach a time-out. You can also specify how long to give an operation before the job times out. You can specify information for both inactive jobs and disconnected jobs.

#### Note:

These settings apply to all interactive devices and jobs on your iSeries server, not just Telnet.

### 4. Assign devices to subsystems

- a. At the character-based interface, type:  
`ADDWSE SBS(DQINTER) WRKSTNTYPE(*ALL)`

### 5. Activate the QSYSWRK subsystem

Check the status of the QSYSWRK subsystem:

- a. In the iSeries server character-based interface, type **WRKSBS** (Work with active subsystems).
- b. Verify that the following systems are displayed:
  - QSYSWRK
  - QINTER
  - QSPL

If the QSYSWRK subsystem is not active, complete the following steps:

- a. In the iSeries server character-based interface, type **STRSBS** (Start subsystem).
- b. Type **QSYSWRK** for the Subsystem description and **QSYS** for the library, then press **Enter**.

- c. Repeat for Subsystem name **QINTER** with Library **QSYS** and for Subsystem name **QSPL** and Library **QSYS**.
6. **Create Telnet user profiles**
  - a. Start iSeries Navigator and expand **your iSeries server**.
  - b. Right-click **Users and Groups** and select **New User**.
  - c. Enter the user name, description, and password.
  - d. To specify a job description, click **Jobs** and enter the job description.
  - e. Click **OK**.
7. **Verify Telnet is working**  
Ken starts a 5250 emulation session and connects to the Telnet server.

#### Related topics

For more information about this procedure, refer to:

- “Configure the Telnet server” on page 20
- “iSeries<sup>TM</sup> supported emulation types” on page 25 <<

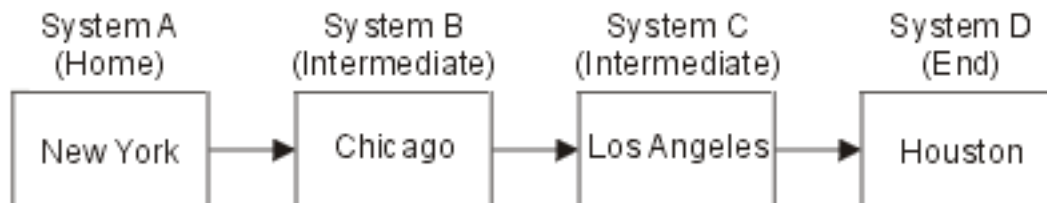
## Telnet scenario: Cascaded Telnet sessions

>> In this scenario, the user establishes Telnet sessions with multiple servers. This is known as a **cascaded Telnet session**. Using this method, she will be able to:

- Establish Telnet session between home office and Chicago.
- Connect to additional Telnet servers without ending the initial session.
- Move between sessions to return to a job on the New York system.

#### Situation and Objectives

Janice Lowe is the director of marketing at Culver Pharmaceuticals. She connects from the office in New York and accesses the main system in Chicago using Telnet. Once Janice has established a client session with the Telnet server in Chicago, she realizes that she needs to work with some files from the Los Angeles office. Janice uses the Chicago Telnet client to connect to the Los Angeles Telnet server. While connected to Los Angeles, she decides to establish a session with Houston.



This image depicts the connections Janice makes. The iSeries<sup>TM</sup> server she starts from in New York is called the home system. From there, she connects to intermediate system B in Chicago, then connects to intermediate system C in Los Angeles, which connects to end system D in Houston.

#### Details

This scenario makes the following assumptions:

- Telnet server running on all systems.
- Janice has a sign-on in all systems.
- All systems are iSeries servers running V4R5 or higher.

Janice completes the following steps to connect to the Telnet systems:

1. From the New York system, type STRTCPTELN CHICAGO.
2. On the Chicago system, type STRTCPTELN LA.
3. On the Los Angeles system, type STRTCPTELN HOUSTON.

Once she has connected to the Houston system, she wants to complete a task on the New York (Home) system.

1. Press the **System Request** key.
2. Select option 14 (Transfer to home system). This returns her to the alternate job on the New York system.

Once she has completed her work on the New York system, she can return to the Houston system by:

1. Press the **System Request** key.
2. Select option 15 (Transfer to the end system). This takes her from any intermediate or home system to the end system.

To sign off from all sessions, she uses the SIGNOFF command. This ends the current session and returns her to the sign-on display of the home system.

#### Related topics

For further details about cascaded Telnet sessions and examples of more complex cascaded sessions, refer to the following topics:

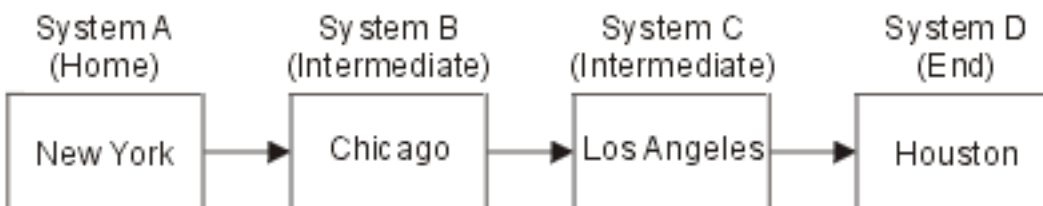
- “System request processing scenarios” contains scenarios for different cascaded systems.
- “Using a group job” on page 7 describes using alternate jobs and group jobs to work with multiple systems.
- “Establish a cascaded Telnet session” on page 78 provides more information about establishing cascaded sessions.
- “Move between cascaded Telnet sessions” on page 79 contains system request values for working with multiple sessions. <<

### System request processing scenarios

The following scenarios explain how system request processing works with multiple types of systems.

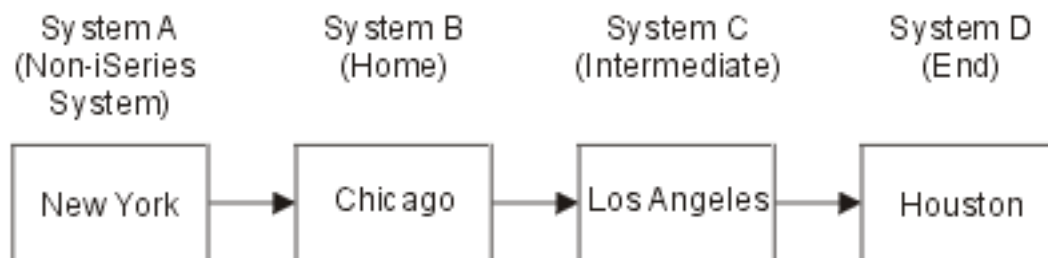
#### Scenario 1

All servers are iSeries<sup>™</sup> servers. System request processing works normally.



### Scenario 2

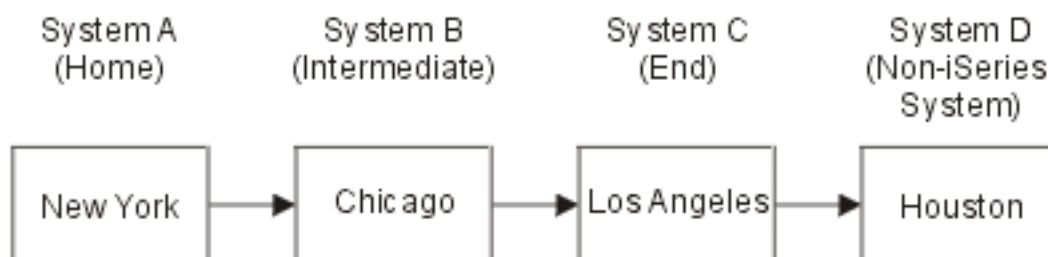
The New York system is a non-iSeries server using 3270 or VTxxx Telnet.



The system request processing works like the first scenario except consider Chicago as the home system. All system requests sent to the home system process on the Chicago system.

### Scenario 3

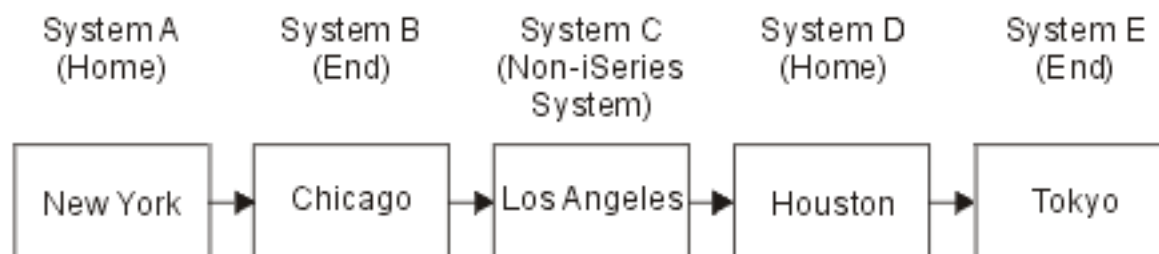
The Houston system is a non-iSeries servers using 3270 or VTxxx Telnet.



The system request processing works like the first scenario except consider Los Angeles as the end system for all system request processing. If you press the System Request key, and then press the Enter key, the System Request menu for Los Angeles displays.

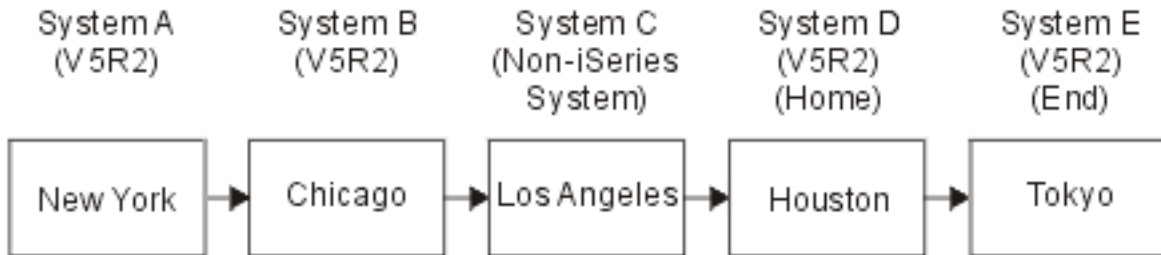
### Scenario 4

The Los Angeles system is a non-iSeries server using 3270 or VTxxx Telnet.



The system request processing works like the first scenario except consider the Chicago system as the end system for system request processing. If you press the System Request key and then press the Enter key, the System Request menu for Chicago displays.

If you want to send a system request to the Tokyo system, you can map a function key on the Houston system to the System Request key. If you map this function, then the Tokyo system is the end system, and Houston is the home system.



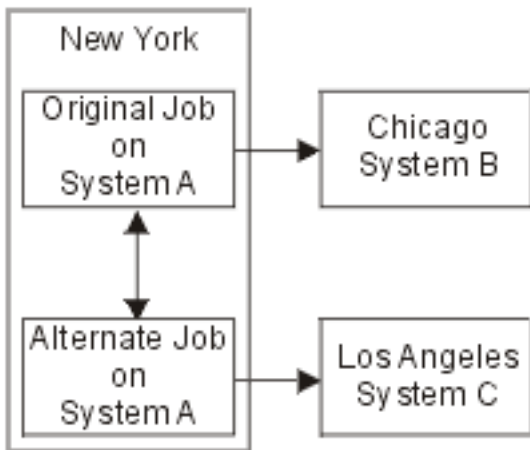
As an example of this mapping function for an iSeries 3270 Telnet server, the default keyboard mapping identifies the System Request key as a 3270 PF11 key. For an iSeries 3270 Telnet client, the F11 key is mapped to the 3270 PF11 key. If the Los Angeles system is a system that uses the 3270 data stream, then pressing F11 maps to the System Request key on the Houston system. The system request transmits to the Tokyo system, and the System Request menu for Tokyo displays.

**Note:**

This mapping function is complex especially if you are using the VTxxx data stream and are mapping between block data and character data.

**Using a group job**

You can use Telnet and the alternate job to connect to multiple systems from your home system. Consider the following example:



Telnet establishes a session from New York to Chicago. You also want to go to the Los Angeles system and remain connected to the Chicago system. You can start an alternate job on the New York system using System Request option 11. Use the Telnet command to establish a session to the Los Angeles system. You can get to another system (Houston, for example) by starting another Telnet session from the Chicago system or the Los Angeles system.

An alternative to using the alternate job is to use a group job. A group job is one of up to 16 interactive jobs that are associated in a group with the same workstation device and user. To set up a group job, do the following:

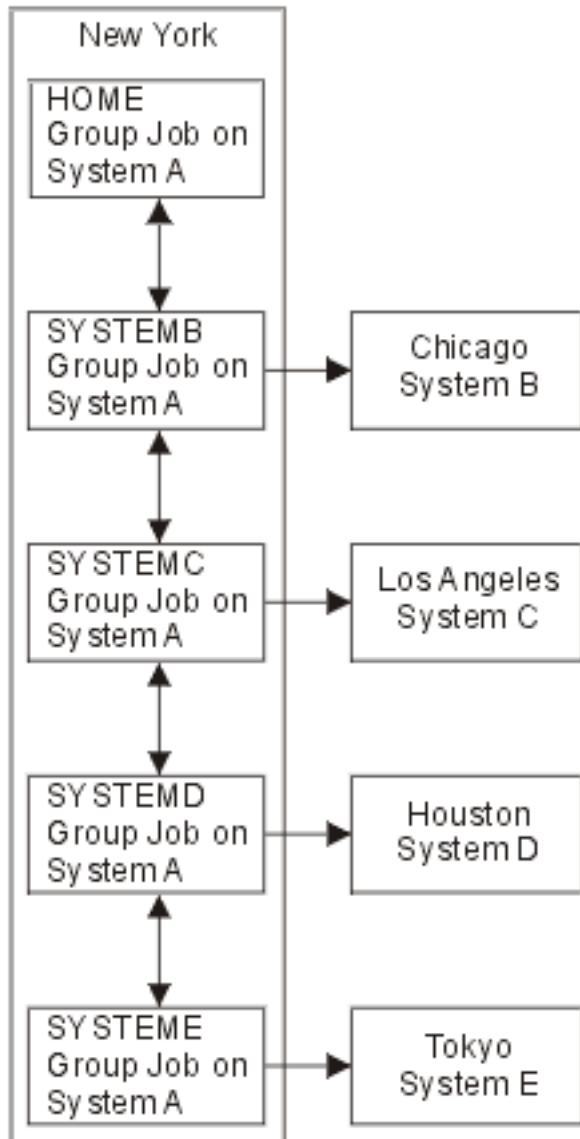
1. Change the current job to a group job by using the Change Group Attributes (CHGGRPA) command.  
 CHGGRPA GRPJOB(home)
2. Start a group job for the Chicago system by using the Transfer to Group Job (TFRGRPJOB) command.  
 TFRGRPJOB GRPJOB(CHICAGO) INLGRPPGM(QCMD)
3. Establish a Telnet session to the Chicago system.  
 Telnet CHICAGO
4. Return to your home system by pressing the ATTN key. Pressing the ATTN key shows you the Send Telnet Control Functions menu.
5. In the character-based interface for the Send Telnet Control Functions menu, type:  
 TFRGRPJOB GRPJOB(home)  
 This returns you to your original job.

You can start other group jobs and Telnet sessions similarly.

You can use the TFRGRPJOB GRPJOB(\*SELECT) command to select which group job you want. For example, if group jobs with the names CHICAGO, LOSANGELES, HOUSTON, and TOKYO start, the TFRGRPJOB GRPJOB(\*SELECT) command shows the following display:

```
+-----+
|                Transfer to Group Job                |
|                                                     |
|                        System: SYS198              |
| Active group job . . . : HOME                      |
| Text . . . . . :                                  |
| Type option, press Enter.                          |
|   1=Transfer to group job                          |
| -----Suspended Group Jobs-----                 |
| Opt  Group Job  Text                               |
|  -   TOKYO      |
|  -   HOUSTON    |
|  -   LOSANGELES |
|  -   CHICAGO    |
| Bottom F3=Exit F5=Refresh F6=Start a new group job F12=Cancel |
+-----+
```

You can then use Telnet to establish a session with each system from the appropriate job. The following is an example of a group job scenario:



Description: Group Job scenario

When you want to end the group job, use the End Group Job (ENDGRPJOB) command.

To switch to another group job while in a Telnet session:

1. Press the ATTN key.
2. Type TFRGRPJOB in the character-based interface.

## Telnet scenario: Secure Telnet with SSL

» This scenario describes how to secure Telnet with SSL.

### Situation

Bob is in the process of creating a home-based brokerage business. He has retired from his position as a stock broker at a major trading firm, and wants to continue to offer brokerage services to a small number of clients from his home. He runs his business on a small iSeries<sup>(TM)</sup> server, which he would like to use to provide account access to his clients, via 5250 Telnet sessions. Bob is currently working on a way to allow his clients continuous access to their accounts, so that they can manage their shareholdings. Bob wants

his clients to use 5250 Telnet sessions to access their accounts, but he is concerned about the security of his server, as well as his clients' sessions. After researching the iSeries server Telnet security options, Bob decides to use Secure Sockets Layer (SSL) to ensure the privacy of data over 5250 Telnet sessions between his iSeries server and clients.

## Objectives

In this scenario, Bob wants to secure his brokerage clients' 5250 Telnet sessions to their shareholder accounts on his iSeries server. Bob wants to enable SSL to protect the privacy of client data as it passes through the Internet. He also wants to enable certificates for client authentication to ensure that his server verifies that only his clients are accessing their accounts. Once Bob has configured the Telnet server for SSL and enabled client and server authentication, he can roll out this new account accessibility option to his clients, assuring them that their account access sessions will be secure. Once Bob has met the following objectives, he can roll out this new account accessibility option to his clients, assuring them that their 5250 Telnet sessions will be secure:

- Secure the Telnet server with SSL
- Enable the Telnet server for client authentication
- Obtain a private certificate from a Local Certificate Authority (CA) and assign it to the Telnet server.

## Details

### Bob's home-run brokerage business

- iSeries server running OS/400<sup>(R)</sup> Version 5 Release 2 (V5R2) and providing shareholder account access via 5250 Telnet sessions.
- The OS/400<sup>(R)</sup> Telnet server application is started on the iSeries server.
- The Telnet server initializes SSL, and checks the certificate information in the QIBM\_QTV\_TELNET\_SERVER application ID.
- If the Telnet certificate configuration is correct, the Telnet server begins listening on the SSL port for client connections.
- A client initiates a request for access to the Telnet server.
- The Telnet server responds by providing its certificate to the client.
- The client software validates the certificate as an acceptable, trusted source communicating with the server.
- The Telnet server requests a certificate from the client software.
- The client software presents a certificate to the Telnet server.
- The Telnet server validates the certificate, and recognizes the client's right to establish a 5250 session with the server.
- The Telnet server establishes a 5250 session with the client.

### Prerequisites and assumptions

Bob needs to ensure that he has met the following requirements of this scenario:

- iSeries server running OS/400 Version 5 Release 2 (V5R2)
- TCP/IP is configured.
- Bob has IOSYSCFG authority.
- "Configure the Telnet server" on page 20
- Bob has addressed the issues in Plan for SSL enablement.
- Bob has created a local Certificate Authority on his iSeries server.



## Task steps

There are two sets of tasks that Bob must complete to implement this scenario: One set of tasks allows him to set up his iSeries server to use SSL and require certificates for user authentication. The other set of tasks allows users on Telnet clients to participate in SSL sessions with Bob's Telnet server and obtain certificates for user authentication.

Bob performs the following task steps to complete this scenario:

### Telnet server task steps

To implement this scenario, Bob must perform these tasks on his iSeries server:

1. Remove port restrictions (page 11)
2. Create and operate Local Certificate Authority (page 11)
3. Configure Telnet server to require certificates for client authentication (page 12)
4. Enable and start SSL on Telnet server (page 13)

### Client configuration task steps

To implement this scenario, each user who will access the Telnet server on Bob's iSeries server must perform these tasks:

5. Enable SSL on the Telnet client (page 13)
6. Enable Telnet client to present certificate for authentication (page 14)

These tasks accomplish both SSL and client authentication by certificates, resulting in SSL-secured access to account information for Bob's clients using 5250 Telnet sessions.



## Configuration details

Complete the following task steps to "Telnet scenario: Secure Telnet with SSL" on page 9.

### Step 1: Remove port restrictions

Prior to V5R1, port restrictions were used because Secure Sockets Layer (SSL) support was not available for Telnet. Now you can specify whether SSL, non-SSL, or both are to start. Therefore, there is no longer a need for port restrictions. If you defined port restrictions in previous releases, you need to remove the port restrictions in order to use the SSL parameter.

To determine whether you have Telnet port restrictions and remove them so that you can configure the Telnet server to use SSL, follow these steps:

1. To view any current port restrictions, start iSeries<sup>(TM)</sup> Navigator and expand **your iSeries server** —> **Network**.
2. Right-click **TCP/IP Configuration** and select **Properties**.
3. Click the **Port Restrictions** tab to see a list of port restriction settings.
4. Select the port restriction that you want to remove.
5. Click **Remove**.
6. Click **OK**

By default the setting is to start SSL sessions on port 992 and non-SSL sessions on port 23. The Telnet server uses the service table entry for Telnet to get the non-SSL port and Telnet-SSL to get the SSL port.

### Step 2: Create and operate Local Certificate Authority

To use Digital Certificate Manager (DCM) to create and operate a Local CA on the iSeries server, follow these steps:

1. Start DCM.
2. In the navigation frame of DCM, select **Create a Certificate Authority (CA)** to display a series of forms. These forms guide you through the process of creating a Local CA and completing other tasks needed to begin using digital certificates for SSL, object signing, and signature verification.
3. Complete all the forms that display. There is a form for each of the tasks that you need to perform in order to create and operate a Local CA on the iSeries server. Completing these forms allows you to:
  - a. Choose how to store the private key for the Local CA certificate. This step is included only if you have an IBM<sup>(R)</sup> 4758-023 PCI Cryptographic Coprocessor installed on your iSeries. If your system does not have a cryptographic coprocessor, DCM automatically stores the certificate and its private key in the Local CA certificate store.
  - b. Provide identifying information for the Local CA.
  - c. Install the Local CA certificate on your PC or in your browser. This enables software to recognize the Local CA and validate certificates that the CA issues.
  - d. Choose the policy data for your Local CA.
  - e. Use the new Local CA to issue a server or client certificate that applications can use for SSL connections. If you have an IBM<sup>(R)</sup> 4758-023 PCI Cryptographic Coprocessor installed in the iSeries server, this step allows you to select how to store the private key for the server or client certificate. If your system does not have a coprocessor, DCM automatically places the certificate and its private key in the \*SYSTEM certificate store. DCM creates the \*SYSTEM certificate store as part of this task.
  - f. Select the applications that can use the server or client certificate for SSL connections. Note: Be sure to select the application ID for the OS/400<sup>(R)</sup> Telnet Server (QIBM\_QTV\_TELNET\_SERVER).
  - g. Use the new Local CA to issue an object signing certificate that applications can use to digitally sign objects. This creates the \*OBJECTSIGNING certificate store, which you use to manage object signing certificates. Note: Although this scenario does not use object signing certificates, be sure to complete this step. If you cancel at this point in the task, the task ends and you have to perform separate tasks to complete your SSL certificate configuration.
  - h. Select the applications that you want to trust the Local CA. Note: Be sure to select the application ID for the OS/400 Telnet Server (QIBM\_QTV\_TELNET\_SERVER).

Once you have completed the forms for this guided task, you can configure the Telnet Server to require client authentication.

### Step 3: Configure Telnet server to require certificates for client authentication

In order to activate this support, the System Administrator will indicate how SSL support will be handled. Use the Telnet Properties General panel in iSeries Navigator to indicate whether SSL, non-SSL, or support for both will start when the Telnet server starts. By default, the SSL and non-SSL support always starts.

The System Administrator has the ability to indicate whether the system requires SSL client authentication for all Telnet sessions. When SSL is active and the system requires client authentication, the presence of a valid client certificate means that the client is trusted.

To configure the Telnet server to require certificates for client authentication, follow these steps:

1. Start DCM.
2. Click **Select a Certificate Store**.
3. Select **\*SYSTEM** as the certificate store to open and click **Continue**.
4. Enter the appropriate password for \*SYSTEM certificate store and click **Continue**.

5. When the left navigational menu refreshes, select **Manage Applications** to display a list of tasks.
6. Select the **Update application definition** task to display a series of forms.
7. Select **Server** application and click **Continue** to display a list of server applications.
8. From the list of applications, select the **OS/400 TCP/IP Telnet Server**.
9. Click **Update Application Definition**.
10. In the table that displays, select **Yes** to require client authentication.
11. Click **Apply**. The **Update Application Definition** page displays with a message to confirm your changes.
12. Click **Done**.

Now that you have configured the Telnet server to require certificates for client authentication, you can now enable and start SSL for the Telnet server.

#### Step 4: Enable and start SSL on Telnet server

To enable SSL on the Telnet server, follow these steps:

1. Open iSeries Navigator.
2. Expand **My iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
3. Right-click **Telnet**.
4. Select **Properties**.
5. Select the **General** tab.
6. Choose one of these options for SSL support:
  - **Secure only**  
Select this to allow only SSL sessions with the Telnet server.
  - **Non-secure only**  
Select this to prohibit secure sessions with the Telnet server. Attempts to connect to an SSL port will not connect.
  - **Both secure and non-secure**  
Allows both secure and non-secure sessions with the Telnet server.

To start the Telnet server using iSeries Navigator, follow these steps:

1. Expand **your iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
2. In the right pane, locate **Telnet** in the Server Name column.
3. Confirm that **Started** appears in the Status column.
4. If the server is not running, right-click **Telnet** and select **Start**.

#### Step 5: Enable SSL on the Telnet client

To participate in an SSL session, the Telnet client must be able to recognize and accept the certificate that the Telnet server presents to establish the SSL session. To authenticate the server's certificate, the Telnet client must have a copy of the Certificate Authority (CA) certificate in iSeries key database. When the Telnet server uses a certificate from a Local CA, the Telnet client must obtain a copy of the Local CA certificate and install it in the iSeries key database.

To add a Local CA certificate from an iSeries so that the Telnet client can participate in SSL sessions with Telnet servers that use a certificate from the Local CA, follow these steps:

1. Open iSeries Navigator.
2. Right-click the name of your system.
3. Select **Properties**.

4. Select the **Secure Sockets** tab.

**Note:** This tab will not appear unless you have completed a selective install of iSeries Client Encryption (128-bit), 5722-CE3.

5. Click **Download**. This will download the iSeries Certificate Authority certificate automatically into the certificate key database.
6. You will be prompted for your key database password. Unless you have previously changed the password from the default, enter ca400. A confirmation message displays. Click **OK**.

The download button automatically updates the IBM<sup>(R)</sup> Toolbox for Java<sup>(TM)</sup> PC key database.

#### **Step 6: Enable Telnet client to present certificate for authentication**

You have configured SSL for the Telnet server, specified that the server should trust certificates that the Local CA issues, and specified that it require certificates for client authentication. Now, users must present a valid and trusted client certificate to the Telnet server for each connection attempt.

Clients need to use the Local CA to obtain a certificate for authentication to the Telnet server and import that certificate to IBM<sup>(R)</sup> Key Management database before client authentication will work.

First, clients must use DCM to obtain a user certificate by following these steps:

1. Start DCM.
2. In the left navigation frame, select **Create Certificate** to display a list of tasks.
3. From the task list, select **User Certificate** and click **Continue**.
4. Complete the **User Certificate** form. Only those fields marked "Required" need to be completed. Click **Continue**.
5. Depending on the browser you use, you will be asked to generate a certificate that will be loaded into your browser. Follow the directions provided by the browser.
6. When the **Create User Certificate** page reloads, click **Install Certificate**. This will install the certificate in the browser.
7. Export the certificate to your PC. You must store the certificate in a password-protected file.

**Note:** Microsoft<sup>(R)</sup> Internet Explorer 5 or Netscape 4.5 are required to use the export and import functions.

Next, you must import the certificate to the IBM<sup>(R)</sup> Key Management database so that the Telnet client can use it for authentication by following these steps:

You must add the Certificate Authority that created the client certificate to the PC key database, otherwise the import of the client certificate will not work.

1. Click **Start** —> **Programs** —> **IBM<sup>(R)</sup> iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup>** —> **iSeries Access for Windows Properties**.
2. Select the **Secure Sockets** tab.
3. Click **IBM Key Management**.
4. You will be prompted for your key database password. Unless you have previously changed the password from the default, enter ca400. A confirmation message displays. Click **OK**.
5. From the pull-down menu, select **Personal certificates**.
6. Click **Import**.
7. In the **Import key** display, enter the file name and path for the certificate. Click **OK**.

8. Enter the password for the protected file. This is the same password that you specified when you create a user certificate in DCM. Click **OK**. When the certificate has been successfully added to your personal certificates in IBM Key Management, you can use PC5250 emulator or any other Telnet application.

With these steps complete, the Telnet server can establish an SSL session with the Telnet client and the server can authenticate the user to resources based on the certificate that the client presents.

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## Plan for the Telnet server

Before configuring your Telnet server, there are some security and operational features you must consider. You need to know how many virtual devices you want Telnet to automatically configure or if you want to create your own virtual devices. The number of virtual devices automatically configured affects the number of sign-on attempts allowed. An increased number of sign-on attempts increases the chances of an unauthorized user gaining access to your server. You may also want to consider other security measures, such as having the Telnet server detect lost connections.

### “Virtual device descriptions”

Read more about configuring and naming virtual device descriptions.

### “Telnet security” on page 16

This topic provides procedures for securing Telnet on your server.

## Virtual device descriptions

» Telnet uses virtual device descriptions to maintain client workstation information for open Telnet sessions. A **virtual device** is a device description that is used to form a connection between a user and a physical workstation attached to a remote system. Virtual devices provide information about your physical device (display or printer) to the programs on the server. The server looks for the attaching client/server protocol to specify a virtual device. If the server cannot find a specified virtual device, it then looks for a designated virtual device in a registered exit program. If the server cannot find a virtual device, it then attempts to match a virtual device description with a device type and model similar to the device on your local system.

### Telnet naming conventions for virtual controllers and devices

The Telnet server uses the following conventions for naming automatically created virtual controllers and devices, according to the OS/400<sup>(R)</sup> standards:

- For virtual controller, the server uses the name QPACTL *nn*
- For virtual devices, the server uses the name QPADEV *xxxx*
- For named virtual devices, the server gives the virtual controllers the name of QVIRCD *nnnn*

#### Note:

- Under the OS/400 naming convention, the virtual controller must have a name of QPACTL *nn* where *nn* is a decimal number 01 or greater.
- The virtual device has a name of QPADEV *xxxx*, where *xxxx* is an alphanumeric character from 0001 to *zzzzz*, excluding vowels.
- You must grant the QTCP user profile authority to the user-created virtual devices.
- You can change the naming conventions for automatically created virtual devices by using the \*REGFAC option of QAUTOVRT. Refer to QAUTOVRT in the System Values topic for more information.

Only virtual devices that are attached to QPACTL *nm* count toward QAUTOVRT (QAUTOVRT= Devices System Values - Maximum number of devices). The number of sign-on attempts allowed increases with automatically configured virtual devices. The sign-on attempts total is equal to the number of system sign-on attempts that are allowed, multiplied by the number of virtual devices that can be created. The Sign-on System Values define the number of sign-on attempts allowed.

The Telnet server reuses available existing virtual devices that were automatically created by selecting virtual devices of the same device type and model. When no more device types and models match, but virtual devices are still available, then the device type and model are changed to match the client device and model negotiated. This is true for both automatically created (QPADEV *xxxx* ) virtual devices, and named virtual devices.

If you choose to manually create your own devices, you should establish naming conventions that allow you to easily manage your configuration. You can select whatever device names and controller names you want, provided the names conform to the OS/400 object naming rules.

For procedures for creating virtual devices, see “Set the number of virtual devices” on page 21. <<

## Telnet security

When you invoke Telnet across a TCP connection, you need to consider security measures that prevent or allow user access to the iSeries<sup>(TM)</sup> server through Telnet. For example, you should set limits and controls on the number of sign-on attempts, and the number of devices that a user can use to sign on.

See the following for information about controlling user access to Telnet:

### “Prevent Telnet access”

If you do not plan to use the Telnet server, use steps provided here to disable it. This will ensure that it will not be used without your knowledge.

### “Control Telnet access” on page 17

This topic provides tips for protecting your Telnet server from harm.

## Prevent Telnet access

▶ If you do not want anyone to use Telnet to access your iSeries<sup>(TM)</sup> server, you should prevent the Telnet server from running. To prevent Telnet access to your iSeries, complete the tasks below.

### Prevent Telnet from starting automatically

To prevent Telnet server jobs from starting automatically when you start TCP/IP, follow these steps:

1. In iSeries Navigator, expand **your iSeries Server** → **Network** → **Servers** → **TCP/IP**.
2. Right-click **Telnet** and select **Properties**.
3. Deselect **Start when TCP/IP starts**.

### Prevent access to Telnet ports


To prevent Telnet from starting and to prevent someone from associating a user application, such as a socket application, with the port that the iSeries normally uses for Telnet, do the following:

1. In iSeries Navigator, expand **your iSeries Server** → **Network** → **Servers** → **TCP/IP**.
2. Right-click **TCP/IP Configuration** and select **Properties**.
3. In the **TCP/IP Configuration Properties** window, click the **Port Restrictions** tab.
4. On the **Port Restrictions** page, click **Add**.
5. On the **Add Port Restriction** page, specify the following:



- **User name:** Specify a user profile name that is protected on your iSeries. (A protected user profile is a user profile that does not own programs that adopt authority and does not have a password that is known by other users.) By restricting the port to a specific user, you automatically exclude all other users.
- **Starting port:** 23 (for non-SSL TELNET) or 992 (for SSL TELNET)
- **Ending port:** 23 (for non-SSL TELNET) or 992 (for SSL TELNET)
- **Protocol:** TCP

**Note:**

These port numbers are specified in the Work with Service Table Entries (WRKSRVTBLE) table under .telnet....and .telnet-ssl. They may be mapped to ports other than 23 and 992. Repeat this process for each port you want to restrict. The Internet Assigned Numbers Authority (IANA) provides information about common port number assignments. 

6. Click **OK** to add the restriction.
7. On the **Port Restrictions** page, click **Add** and repeat the procedure for the UDP protocol.
8. Click **OK** to save your port restrictions and close the **TCP/IP Configuration Properties** window.
9. The port restriction takes effect the next time that you start TCP/IP. If TCP/IP is active when you set the port restrictions, you should end TCP/IP and start it again.



## Control Telnet access

» Following are security considerations and suggestions when you want Telnet clients to access your system:

### Client Authentication

Telnet server supports client authentication in addition to the SSL server authentication that is currently supported. When enabled, the iSeries<sup>(TM)</sup> Telnet server will authenticate both server and client certificates when Telnet clients connect to the Telnet SSL port. Telnet clients that do not send a valid client certificate when attempting to connect to the Telnet SSL port will fail to establish a display or printer session. For V4R5, a description of how to turn on SSL Client Authentication is found on the PTF Cover Letter 5769-SS1-PTF SF61427. Beginning with V5R1, SSL Client Authentication can be enabled or disabled using Digital Certificate Manager (DCM).

### Protecting passwords

Telnet passwords are not encrypted when they are sent between the traditional client and the server. Depending on your connection methods, your system may be vulnerable to password theft through .line sniffing. Telnet passwords are encrypted if TN5250E negotiations are used to exchange an encrypted password. In such a case, the sign-on panel can be bypassed and no .clear-text password is sent over the network. Only the password is encrypted with TN5250E, SSL is required to encrypt all traffic.

**Note:**

Monitoring a line by using electronic equipment is often referred to as **sniffing**.

However, if you use the SSL Telnet server and an SSL-enabled Telnet client, then all transactions, including passwords, are encrypted and protected. The Telnet SSL port is defined in the WRKSRVTBLE entry under .Telnet-ssl. Limiting the number of sign-on attempts: Although the QMAXSIGN system value applies to Telnet, you reduce the effectiveness of this system value if you set up your system to configure virtual devices automatically. When the QAUTOVRT system value has a value greater than 0, the unsuccessful Telnet user can reconnect and attach to a newly-created virtual device. This can continue until one of the following occurs:

- All virtual devices are disabled, and the system has exceeded the limit for creating new virtual devices.
- All user profiles are disabled.
- The hacker succeeds in signing on to your system.

Automatically configuring virtual devices multiplies the number of Telnet attempts that are available.

**Note:** To make it easier to control virtual devices, you might want to set the QAUTOVRT system value to a value that is greater than 0 for a short period of time. Either use Telnet yourself to force the system to create devices or wait until other users have caused the system to create sufficient virtual devices. Then set the QAUTOVRT system value to 0.

Telnet enhancements provide an option for limiting the number of times a hacker can attempt to enter your system. You can create an exit program that the system calls whenever a client attempts to start a Telnet session. The exit program receives the IP address of the requester. If your program sees a series of requests from the same IP address within a short time span, your program can take action, such as denying further requests from the address and sending a message to the QSYSOPR message queue. “Overview of the Telnet Exit Program Capability” provides an overview of the Telnet exit program capability.

**Note:** Alternatively, you could use your Telnet exit program to provide logging. Rather than having your program make decisions about potential break-in attempts, you could use the logging capability to monitor attempts to start Telnet sessions.

### Ending inactive sessions

Telnet sessions are included in the system’s QINACTITV processing. The QINACTMSGQ system value defines the action for the interactive Telnet sessions that are inactive when the inactive job time-out interval expires. If the QINACTMSGQ specifies that the job should be disconnected, the session must support the disconnect job function. Otherwise, the job will end rather than be disconnected. Telnet sessions that continue to use device descriptions that are named QPADEVxxxx will not allow users to disconnect from those jobs. Disconnection from these jobs is not allowed because the device description to which a user is reconnected is unpredictable. Disconnecting a job requires the same device description for the user when the job is reconnected. For more information, refer to “Set the session keep-alive parameter” on page 23.

### Limit sign-on attempts

The number of Telnet sign-on attempts allowed increases if you have “Automatically configure virtual devices” on page 21. The devices system values in iSeries Navigator defines the number of virtual devices that Telnet can create.

Use the sign-on system values to define the number of system sign-on attempts allowed. For instructions for setting this value in iSeries Navigator, refer to “Restrict privileged users to specific devices and limit sign-on attempts” on page 22.

### Restricting powerful user profiles

You can use the QLMTSECOFR system value to restrict users with \*ALLOBJ or \*SERVICE special authority. The user or QSECOFR must be explicitly authorized to a device to sign on. Thus, you can prevent anyone with \*ALLOBJ special authority from using Telnet to access your system by ensuring that QSECOFR does not have authority to any virtual devices. Rather than preventing any Telnet users who have \*ALLOBJ special authority, you might to restrict powerful Telnet users by location. With the Telnet



initiation exit point, you can create an exit program that assigns a specific iSeries device description to a session request based on the IP address of the requester.

### Controlling function by location

You might want to control what functions you allow or what menu the user sees based on the location where the Telnet request originates. The QDCRDEVD API (application programming interface) provides you with access to the IP address of the requester. Following are some suggestions for using this support:

- You might use the API in an initial program for all users (if Telnet activity is significant in your environment).
- You could set the menu for the user or even swap to a specific user profile based on the IP address of the user who requests sign-on.
- You can use the Telnet exit program to make decisions based on the IP address of the requester. This eliminates the need to define an initial program in every user profile. You can, for example, set the initial menu for the user, set the initial program for the user, or specify what user profile the Telnet session will run under.

In addition, with access to the IP address of the user, you can provide dynamic printing to a printer associated with the user's IP address. The QDCRDEVD API will also return IP addresses for printers, as well as for displays. Select the DEVD1100 format for printers, and DEVD0600 for displays.

### Controlling automatic sign-on

Telnet supports the capability for a iSeries Access for Windows<sup>(R)</sup> user to bypass the Sign On display by sending a user profile name and password with the Telnet session request. The system uses the setting for the QRMTSIGN (Remote sign-on) system value to determine how to handle requests for automatic sign-on. The table below shows the options. These options apply only when the Telnet request includes a user ID and password.

Option	How QRMTSIGN Works with Telnet
*REJECT	Telnet sessions that request automatic sign-on are not allowed
*VERIFY	If the user profile and password combination is valid, the Telnet session starts. <sup>1</sup>
*SAMEPRF	If the user profile and password combination is valid, the Telnet session starts. <sup>1</sup>
*FRCSIGNON	The system ignores the user profile and password. The user sees the Sign-On display.

<sup>1</sup>- A registered Telnet exit program can override the setting of QRMTSIGN by choosing whether or not to allow automatic sign-on for a requester (probably based on IP address).

This validation occurs before the Telnet exit program runs. The exit program receives an indication that the validation was successful or unsuccessful. The exit program can still allow or deny the session, regardless of the indicator. The indication has one of the following values:

- Value = 0, Client password/passphrase (or Kerberos ticket) was not validated or none was received.
- Value = 1, Client clear-text password/passphrase was validated
- Value = 2, Client encrypted password/passphrase (or Kerberos ticket) was validated

### Allowing anonymous sign-on

You can use the Telnet exit programs to provide .anonymous or .guest Telnet on your system. With your exit program, you can detect the IP address of the requester. If the IP address comes from outside your organization, you can assign the Telnet session to a user profile that has limited authority on your system and a specific menu. You can bypass the Sign-On display so the visitor does not have the opportunity to use another, more powerful user profile. With this option, the user does not need to provide a user ID and password.

## Overview of the Telnet Exit Program Capability

You can register user-written exit programs that run both when a Telnet session starts and when it ends. Following are examples of what you can do when you start the exit program:

- You can use the Client SSL certificate to associate a user profile to the certificate and assign that user profile to the Telnet session, bypassing the Sign-On display.
- You can use the Server (local) IP address on multi-homed iSeries servers to route connections to different subsystems based on the network interface (IP address).
- Allow or deny the session, based on any known criteria, such as the user's IP address, the time of day, and the requested user profile, the device type (such as printer), and so on.
- Assign a specific iSeries device description for the session. This allows routing of the interactive job to any sub-system set up to receive those devices.
- Assign specific National Language values for the session, such as keyboard and character set.
- Assign a specific user profile for the session.
- Automatically sign on the requestor (without displaying a Sign On display).
- Set up audit logging for the session.

For more programming information and examples, refer to the following topics:

“Use Telnet exit point programs” on page 38

Technical Studio: Telnet Exit Programs  

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## Configure the Telnet server

One of the most important Telnet functions is its ability to negotiate options between the client and the server. This type of open negotiation makes it possible for either the client or the server to initiate or to honor a request. Several different “iSeries<sup>(TM)</sup> supported emulation types” on page 25 are available to you for negotiating requests and converting them to output. The iSeries<sup>(TM)</sup> server can support 3270-type workstations and VTxxx workstations, but the preferred type is 5250 emulation.

To configure your Telnet server for use with one of the other emulation types supported, complete these tasks:

1. “Start the Telnet server”
2. “Set the number of virtual devices” on page 21
3. “Restrict privileged users to specific devices and limit sign-on attempts” on page 22
4. “Set the session keep-alive parameter” on page 23
5. “Assign devices to subsystems” on page 24
6. “Activate the QSYSWRK subsystem” on page 24
7. “Create user profiles” on page 25
8. “iSeries<sup>(TM)</sup> supported emulation types” on page 25

Once you have configured Telnet, you may want to “Secure Telnet with SSL” on page 30.

## Start the Telnet server

The active Telnet server has one or more instances of each of these jobs running in “Activate the QSYSWRK subsystem” on page 24: QTVTELNET and QTVDEVICE.

To start the Telnet server using iSeries<sup>(TM)</sup> Navigator, follow these steps:

1. Expand **your iSeries server** → **Network** → **Servers** → **TCP/IP**.
2. In the right pane, locate **Telnet** in the Server Name column.
3. Confirm that **Started** appears in the Status column.

4. If the server is not running, right-click **Telnet** and select **Start**.

For information on signing off, see “End the server session” on page 37.

#### What to do next:

If you are configuring the Telnet server for the first time, continue to “Set the number of virtual devices.”

## Set the number of virtual devices

» This topic provides instructions for setting the number of virtual devices automatically configured for the Telnet server and limiting the number of sign-on attempts allowed. For more information about virtual devices and Telnet naming conventions, refer to “Virtual device descriptions” on page 15.

You can enable the Telnet server to automatically configure a set number of virtual devices and controllers using the QAUTOVRT Devices System Values. You can specify the number of devices that are automatically started and the maximum number of devices that the iSeries<sup>(TM)</sup> server automatically configures. The iSeries server configures or creates one device at a time, as needed, up to a specified limit.

1. In iSeries Navigator, select **your iSeries server**, —> **Configuration and Service** —> **System Values**.
2. In the right pane, right-click **Devices** and select **Properties**.
3. On the **Devices System Values** page, enable **Pass-through devices and TELNET** and select an option for the automatic configuration of virtual devices. The options are:
  - **No maximum number of devices** - Allow an unlimited number of devices
  - **Maximum number of devices (1-32500)** - Specify a value between 1 and 32500 for the maximum number of devices that may be configured automatically.
  - **Run registered exit program** - Call the program registered for the Virtual Device Selection (QIBM\_QPA\_DEVSEL) exit point when a virtual device needs to be selected or automatically created.

For more information about virtual devices, refer to the following topics:

#### “Automatically configure virtual devices”

You can configure your Telnet server to automatically create virtual devices as needed up to a set maximum.

#### “Create your own virtual devices” on page 22

You can manually create virtual devices, with custom names or automatically generated names.

For more programming information and examples, see Technical Studio: Telnet Exit Programs .

#### What to do next:

“Restrict privileged users to specific devices and limit sign-on attempts” on page 22 

## Automatically configure virtual devices

You can enable the Telnet server to automatically configure your virtual devices and controllers using the QAUTOVRT Devices System Values in iSeries<sup>(TM)</sup> Navigator. You can specify the number of devices that are automatically started and you can specify the maximum number of devices that the iSeries server automatically configures. The iSeries server configures or creates one device at a time, as needed, up to a specified limit.

When automatically configuring virtual devices with Telnet, the Telnet server does not delete virtual devices and does not delete the devices when the session closes. The server does not delete the devices even if the number of devices attached to the virtual controllers exceeds the maximum number. If the devices already exist on the virtual controller, the Telnet server can use them. Telnet server will change the attributes of an existing device to match the client request if that virtual device is requested by name.

If you have never allowed automatic configuration of virtual devices on your server, the Devices System Value Maximum number of devices value is 0. A Telnet connection attempt will fail when the number of devices in use exceeds the Maximum number of devices. A device in use has the status ACTIVE or SIGNON DISPLAY. If you try to signon, you receive a message (TCP2504) indicating that the Telnet client session has ended and the connection is closed. In addition, the QTCPIP job in the remote iSeries server sends a message (CPF8940) indicating that a virtual device cannot be automatically selected.

If you change the Maximum number of devices to 10, the next Telnet connection attempt causes the Telnet server to create a virtual device. Telnet creates this virtual device because the number of virtual devices on the controller (0) is less than the number specified in the Maximum number of devices(10). Even if you change the specified number to 0 again, the next user attempting a Telnet connection succeeds. When a Telnet connection attempt fails because the iSeries server is not able to create a virtual device, the CPF87D7 message is sent to the system operator message queue on the Telnet server.

**Note:**

The Telnet server does not delete automatically configured virtual devices or named devices, even if the number of devices attached to the virtual controllers exceeds the Maximum number of devices.

The Devices system values specify whether pass-through virtual devices and Telnet full screen virtual devices that are attached to the QPACTLnn controllers are automatically configured. This system value does not affect devices attached to the QVIRCDnnnn controllers, because these are not default system devices. Typically, QPADEVnnnn devices are attached to QPACTLnn controllers while named devices, such as NEWYORK001, are attached to the QVIRCDnnnn controller.

For instructions to set this value in iSeries Navigator, refer to “Set the number of virtual devices” on page 21.

## Create your own virtual devices

You can create virtual controllers and devices. If you create your own virtual devices and allow your iSeries<sup>(TM)</sup> server to automatically select the device name, you must be aware of the following:

- The virtual controller will have the name QPACTL *nn*, where *nn* is a decimal number 01 or greater.
- The virtual device will have the name QPADEV *xxxx*, where *xxxx* is an alphanumeric character from 0001 to ZZZZ. The virtual device should have a device class of \*VRT. The location of the virtual device is under a virtual controller.

If you choose to create your own devices, you should be familiar with the “Virtual device descriptions” on page 15 used by the Telnet server. If you want to select your own device names (using a RFC 2877 client or the Virtual Terminal API’s) then the virtual controller will have the name QVIRCDnnnn, where nnnn is a decimal number 01 or greater.

## Restrict privileged users to specific devices and limit sign-on attempts

### Restrict privileged users to specific devices

» The OS/400<sup>(R)</sup> licensed program uses the sign-on system values to restrict or limit the devices to which a user can sign on. All object authority (\*ALLOBJ) allows the user to access any of the resources on the system. Service special authority (\*SERVICE) allows the user to perform specific service functions on the system. For example, the user with this type of authority would be able to debug a program, and perform display and alter service functions. To set these values using iSeries<sup>(TM)</sup> Navigator, follow these steps:

1. In iSeries Navigator, select **your iSeries server**, —> **Network** —> **Servers** —> **TCP/IP**.
2. In the right pane, right-click **Telnet** and select **Properties**.
3. On the **Telnet Properties - System Sign-On** page, select the following:

**Restrict privileged users to specific devices.**

This indicates that all users with all object (\*ALLOBJ) and service (\*SERVICE) special authority need explicit authority to specific workstations.

**Limit each user to one device session.**

Specifies whether a user can sign on at more than one workstation. This does not prevent the user from using group jobs or making a system request at the workstation. This reduces the likelihood of sharing passwords and leaving devices unattended.

### Limit sign-on attempts

Use the sign-on system values to define the number of system sign-on attempts allowed. The number of Telnet sign-on attempts allowed increases if you have virtual devices automatically configured.

1. In iSeries Navigator, select **your iSeries server**, —> **Network** —> **Servers** —> **TCP/IP**.
2. In the right pane, right-click **Telnet** and select **Properties**.
3. On the **Telnet Properties** page, click the **System Sign-On** tab.
4. On the **Telnet Properties - System Sign-On** page, you can specify the number of sign-on attempts allowed and the action to take if the maximum number of sign-on attempts is reached.
5. Click the **Remote** tab.
6. On the **Telnet Properties - Remote Sign-On** page, select an option for **Use Telnet for remote sign-on**. The options are:
  - **Always display sign-on** - All remote sign-on sessions are required to go through normal sign-on processing.
  - **Allow sign-on to be bypassed** - The system allows the user to bypass the sign-on panel. The user is still signed on to the system, but the sign-on panel is not displayed.

**Note:**

If **Use Pass-through for remote sign-on** is enabled, the options are selected automatically based on the settings you specify for **Use Pass-through for remote sign-on**. Telnet is still available for remote sign-ons if you select Pass-through.

### What to do next:

“Set the session keep-alive parameter” «

## Set the session keep-alive parameter

You can set the maximum idle time that the TCP protocol will allow before sending a probe to test for an inactive session using the TCP keep-alive parameter. The protocol will send keep-alive requests to the remote client any time the session remains idle for periods longer than the the keep-alive value. The idle period is defined by the Session keep alive timeout parameter in Telnet properties in iSeries<sup>(TM)</sup> Navigator or a parameter in the CHGTELNA command. When a session is deemed to be inactive (no

response from the remote client to any keep-alive probe), that session is ended, the virtual device associated with the session is returned to the free pool of virtual devices, and the iSeries operating system performs the action set in the QDEVRCYACN system value on the interactive job running on the virtual device. This action affects (only) named virtual devices. For automatically selected virtual devices (QPADEVxxxx), the interactive job always ends.

The Telnet server defaults the keep-alive setting to 600 seconds.

The setting takes effect at server startup. In addition to the session keep-alive timeout parameter, you may also want to review the Time out interval settings in the Inactive Jobs System Values in iSeries Navigator. This timeout parameter is used to limit the amount of time that any interactive job is allowed to be idle before the iSeries operating system performs the action set in the QINACTMSGQ system value on the interactive job. In the case of Telnet connected interactive jobs, an action of \*DSCJOB is only honored for named virtual devices. For automatically selected virtual devices (QPADEVxxxx), an action of \*DSCJOB will cause the interactive job to be ended.

» To set the keep-alive parameter for Telnet in iSeries Navigator, follow these steps:

1. In iSeries Navigator, select **your iSeries server**, —> **Network** —> **Servers** —> **TCP/IP**.
2. In the right pane, right-click **Telnet** and select **Properties**.
3. On the **Telnet Properties** page, click the **Time-Out** tab.
4. On the **Telnet Properties - Time-Out** page, specify the action to take when jobs reach a time-out. You can also specify how long to give an operation before the job times out. You can specify information for both inactive jobs and disconnected jobs. «

**What to do next:**

“Assign devices to subsystems”

## Assign devices to subsystems

Before a user can sign on to the iSeries<sup>(TM)</sup> server, the workstation must be defined to a subsystem. The workstation, for example, would be the virtual display device that is selected or automatically created by the Telnet server.

The workstation name or the workstation type should be specified in the subsystem description on the iSeries server. Use the Display Subsystem Description (DSPSBSD) command to see the workstation entries defined to the subsystem.

You can use the following command to add all workstation types to a subsystem that is named QINTER:

```
ADDWSE SBSD(QINTER) WRKSTNTYPE(*ALL)
```

Printer devices are always routed to the QSPL spooling subsystem.

The Add Workstation Entry (ADDWSE) command can be done when the subsystem is active. However, the changes may or may not take effect immediately. You may need to stop and restart the subsystem.

**What to do next:**

“Activate the QSYSWRK subsystem”

## Activate the QSYSWRK subsystem

The server job for a TCP/IP application must start in the QSYSWRK subsystem. The spooling subsystem, QSPL, needs to be active to run printer pass-through sessions.

To check the status of the QSYSWRK subsystem, complete the following steps:



1. In the iSeries<sup>(TM)</sup> server character-based interface, type WRKSBS (Work with active subsystems).
2. Verify that the following systems are displayed:
  - QSYSWRK
  - QINTER
  - QSPL

If the QSYSWRK subsystem is not active, complete the following steps:

1. In the iSeries server character-based interface, type STRSBS (Start subsystem).
2. Type QSYSWRK for the Subsystem description and QSYS for the library, then press Enter.
3. Repeat for Subsystem name QINTER with Library QSYS and for Subsystem name QSPL and Library QSYS.

If you do not know which subsystem to use for interactive jobs, type WRKSBSD \*ALL in the iSeries character-based interface. The Work Station Type entries show you which device is allocated to a subsystem.

**What to do next:**

“Create user profiles”

## Create user profiles

On the Telnet server, you can create Telnet user using iSeries<sup>(TM)</sup> Navigator.

To create Telnet user profiles, complete the following steps:

1. Start iSeries Navigator and expand **your iSeries server**.
2. Right-click **Users and Groups** and select **New User**.
3. Enter the user name, description, and password.
4. To specify a job description, click **Jobs** and enter the job description.
5. Click **OK**.

**What to do next:**

“iSeries<sup>(TM)</sup> supported emulation types”

## iSeries<sup>(TM)</sup> supported emulation types

The preferred emulation for the iSeries is 5250 emulation. However, the iSeries also supports 3270 and VTxxx emulation. Select the emulation type you want to configure your Telnet server to use:

- “Configure Telnet server for 5250 full-screen mode”
- “Configure Telnet server for 3270 full-screen mode” on page 26
- “Configure Telnet server for VTxxx full-screen mode” on page 28

## Configure Telnet server for 5250 full-screen mode

➤ You need to complete these steps before establishing your Telnet client session:

1. Start the Telnet server on the remote system (the system that you want to connect to using Telnet).
2. (Optional) Set the iSeries<sup>(TM)</sup> server to automatically configure virtual controllers and devices. Verify that the QVTTELNET and QTVDEVICE jobs in the QSYSWRK subsystem are active by completing the following steps:
  - a. Start iSeries Navigator and expand **your iSeries server** —> **Work Management**.
  - b. Right-click **Subsystems** and click **Open**.
  - c. Verify that the subsystem is active.

3. Check the QAUTOVRT system value. It should equal the maximum number of users that are signed on, using automatically configured virtual devices, at any one time. QAUTOVRT supports numeric values of 0 through 32500, and a special value of \*NOMAX. <<

### Configure Telnet server for 3270 full-screen mode

➤ 3270 full-screen support allows Telnet client users to sign on and run iSeries<sup>(TM)</sup> 5250 full-screen applications, even though 3270 full-screen support is negotiated. The server negotiates 3270 full-screen support with any Telnet client application that supports 3270 full-screen applications, rather than 5250 full screen applications. An example of a system that negotiates 3270 full-screen support is the S/390<sup>(R)</sup> family.

Telnet 5250 (TN5250) delivers the data stream between the two systems as EBCDIC. Because the 3270 data streams are translated into 5250 data streams, the workstation devices operate as a remote 5251 display to the iSeries server and application programs.

After you have completed the general configuration of the Telnet server, there are a few additional steps to enable server support for 3270 full-screen mode. Full-screen mode is a “block” mode as opposed to a “line” mode. “Line” mode is when data transmits one line at a time, while “block” or full-screen mode transmits the whole screen at one time.

For information about supported 3270 device capabilities, refer to “**Supported 3270 terminal types**” on page 27.

For 3270 full screen considerations such as screen size, keyboard mapping, cursor select key, and error messages and null characters, see “3270 Telnet client sessions” on page 50.

Complete the following tasks to configure the Telnet server for 3270 full-screen mode:

1. Check the QKBDTYPE system value (page 26)
2. Set the default keyboard map (page 26)
3. Change a keyboard map (optional) (page 27)
4. Change Message Queue (optional) (page 27)

#### Checking the QKBDTYPE system value

When the iSeries Telnet server automatically creates virtual display devices, it uses the QKBDTYPE system value to determine the keyboard type for the virtual device.

If the initial creation of the virtual device fails by using the QKBDTYPE system value, the Telnet server uses the keyboard value USB to attempt to create the device. If the second attempt to create the virtual display device fails using the value of USB, then a message (CPF87D7) is sent to the system operator message queue. This message indicates that the system cannot automatically select the virtual device.

#### Setting the default keyboard mapping

A 3270 display station connected to an iSeries server using Telnet appears to be a 5251 display station to an iSeries server. The 3270 display station keyboard has a 5251-equivalent keyboard map associated with it which allows it to complete 5251-equivalent functions on the iSeries server.

When a Telnet client system user first signs on in 3270 full-screen mode, the iSeries server automatically assigns the default keyboard map to the user’s 3277, 3278, or 3279 keyboard. Avoid this by including a user-defined keyboard map in the user’s profile sign-on procedure. This supplies the mapping needed for the 3270 keyboards to do most of the same functions as their 5250-equivalent keyboards do.

#### Displaying a keyboard map

You can use the Display Keyboard Map (DSPKBDMAP) command to see the current keyboard mapping. Another method is to use option 6 (Display 3270 keyboard map) on the Configure TCP/IP Telnet menu, while your terminal is in 3270 emulation mode.



### Changing a keyboard map

Use the Change Keyboard Map (CHGKBDMAP) command if you want to make minor changes to the default keyboard map. This command is available from the Configure TCP/IP Telnet menu as option 7 (Change 3270 keyboard map).

If you want to set a new keyboard map, use the Set Keyboard Map (SETKBDMAP) command. This command is option 7 (Change 3270 keyboard map) on the Configure TCP/IP Telnet menu. The key assignments you specify are in effect until you use these commands again to specify new key assignments or until you sign off.

**Note:**

The difference between CHGKBDMAP and SETKBDMAP is that with SETKBDMAP the system applies the defaults and then the changes in the SETKBDMAP are applied. With CHGKBDMAP, the system applies defaults plus any changes you have previously made during this session, and then the changes in the CHGKBDMAP are applied.

For more information on keyboard mapping see “3270 keyboard mapping for Telnet servers” on page 54

### Change Message Queue

A message queue is like a mail box for messages. The iSeries server has several message queues that hold messages that provide helpful information when finding and reporting problems. When your workstation message queue is in break mode, messages appear on the 3270 device exactly as they appear on the 5250 display. To receive messages in break mode, you must specify \*BREAK on the change message queue (CHGMSGQ) command. When your workstation is not in break mode, you receive the following message: A message has arrived on a message queue.

To retrieve this message and to continue using the workstation, follow these steps:

1. Press the function key assigned to the help function or the function key that is assigned to the error reset function.
2. Enter the Display Message (DSPMSG) command or the function key that is assigned to the system request function followed by option 4 (Display Message) to view the waiting message.
3. Set the workstation message queue to break mode to see the messages as they arrive.

### Resetting the display’s input-inhibited light

When using an iSeries server from a 5250-type terminal, pressing certain keys in certain situations causes input to be inhibited. When this occurs, the 5250 terminal displays an input-inhibited light.

Two asterisks shown in the lower-right corner of the display indicate the input-inhibited light. When the keyboard is inhibited, any keys mapped to the iSeries function keys are ignored.

To reset the keyboard press the Enter key or by press the key mapped to the iSeries Reset key. ⏪

**Supported 3270 terminal types:** The following table lists the capabilities of the 3270 devices supported by Telnet. Make sure that your Telnet client 3270 is negotiating one of the supported 3270 terminal types. The following table shows the supported terminal types.

**Table 1. Full-Screen Workstation Mappings**

Device Type	Device Capabilities
3277	This display station supports generic 3270 data streams. Extended attributes, such as underlining, blinking, reverse image, or color are not supported.

Device Type	Device Capabilities
3278	<p>This station supports extended attributes, such as blinking, reverse image, and underlining if requested by the OS/400<sup>(R)</sup> DDS (data description specifications) keywords.</p> <p><b>Note:</b></p> <ul style="list-style-type: none"> <li>• Extended attributes are not supported by some client implementations of Telnet 3270 full-screen mode (TN3270).</li> <li>• DBCS terminals that negotiate a 3278-2-E terminal type are supported.</li> </ul>
3279	<p>This display station supports color attributes and the extended data stream attributes sent for a 3278 device. The color attributes are determined (in the same manner as a 5292 Full Color Display) by interpreting the DDS attributes as blinking, high intensity, or the DDS color keywords.</p>

## Configure Telnet server for VTxxx full-screen mode

▶ VTxxx server support allows Telnet client users to log on and run iSeries<sup>(TM)</sup> 5250 full-screen applications even though VTxxx full-screen support is negotiated. The Telnet client application must be able to negotiate VTxxx terminal support. When VTxxx full-screen mode is negotiated, the iSeries Telnet server is responsible for mapping 5250 functions to VTxxx keys and vice versa.

Although the iSeries Telnet server supports VTxxx clients, this is not the preferred mode to use because the VTxxx terminal is a character-mode device. The iSeries server is a block-mode system. Most Telnet implementations support a TN3270 or TN5250 client that should be used when connecting to an iSeries Telnet server.

In general, when a key on a VTxxx terminal is pressed, the hexadecimal code associated with that key immediately transmits to the Telnet server. The Telnet server must process that keystroke and then echo that character back to the VTxxx terminal where it is displayed. This results in a large amount of overhead associated with each keystroke. In contrast, the 5250 and 3270 block mode devices buffer all keystrokes at the client system until an attention identifier (AID) key is pressed. When an AID key is pressed, the client sends the buffered input to the server for processing. The block-mode devices result in less overhead per keystroke and generally provide better performance than a character-mode device, such as the VTxxx terminal.

VTxxx delivers the data between the two systems as ASCII.

After you have completed the general configuration of the Telnet server, there are a few additional steps to enable server support for VTxxx full-screen mode.

Full-screen mode is a “block” mode as opposed to a “line” mode. “Line” mode is when data transmits one line at a time, while “block” or full-screen mode transmits the whole screen at one time.

For VTxxx full screen considerations, emulation options, and key values, see “VTxxx Telnet client sessions” on page 56.

Complete the following tasks to configure the server for VTxxx full-screen mode:

1. Check the QKBDTYPE system value (page 29)
2. Set the default keyboard map (page 29)
3. Set the default network virtual terminal type (optional) (page 30)

4. Set the ASCII/EBCDIC mapping tables (optional) (page 30)

### Checking the QKBDTYPE system value

When the iSeries Telnet server automatically creates virtual display devices, it uses the QKBDTYPE system value to determine the keyboard type for the virtual device.

If the initial creation of the virtual device fails using the QKBDTYPE system value, the Telnet server attempts to create the device again, using a keyboard type value of USB. If the second attempt to create the keyboard type fails, then the system sends a message (CPF87D7) to the QTCPIP job log. This message indicates that the system cannot automatically create the virtual device. The system also sends the message to the system operator message queue.

### Setting the default keyboard map

When a Telnet session negotiates in VTxxx full-screen mode, the system uses a default keyboard map. To display the default keyboard map for VTxxx, use the Display VT Keyboard Map (DSPVTMAP) command. To change the VTxxx keyboard map, use the Change VT Keyboard Map (CHGVMTMAP) command or the Set VT Keyboard Map (SETVTMAP) command. Refer to “VTxxx emulation options” on page 62 for information on working with the keyboard maps.

To find the special VTxxx key values for 5250 function refer to the “VTxxx key values by 5250 function” on page 73 table.

The “Numeric keypad” on page 70 shows the keys on the auxiliary keypad that normally transmit the codes for the numerals, decimal point, minus sign and comma.

The “Editing keypad” on page 71 shows the keys that transmit codes for the editing keypad keys.

Because the VTxxx keyboard does not have the same keys as a 5250 keyboard, a keyboard mapping must exist between the VTxxx keys and the iSeries functions. The iSeries server assigns a default keyboard mapping when a VTxxx session is first established. In some cases there can be more than one key or key sequence that maps to a particular iSeries server function. In these cases, you can use any of the defined keys to call the desired iSeries server function.

#### Note:

1. Each control character is a 1-byte value generated from a VTxxx keyboard by holding down the CTRL key while pressing one of the alphabetic keys. Both shifted and unshifted control characters generate the same hexadecimal values.
2. The escape sequences are multiple byte codes that are generated by pressing the Esc key followed by the characters that make up the desired sequence.
3. The iSeries server ignores the case of all alphabetic characters in an escape sequence. You can type alphabetic characters in escape sequences in either uppercase or lowercase.
4. The iSeries server F1-F12 functions are mapped to the Esc key followed by one of the keys in the top row of a VTxxx keyboard. The Esc key followed by a shifted key in the top row of a VTxxx keyboard maps the F13-F24 functions.
5. Some Telnet VTxxx client systems use Ctrl-S and Ctrl-Q for flow control purposes. This is generally referred to as XON/XOFF flow control. If you are using a client system that has XON/XOFF enabled, you should not use the values \*CTLS and \*CTLQ in your keyboard mapping.

### Setting the default network virtual terminal type

The default network virtual terminal type parameter specifies the mode to use when the Telnet server is not able to negotiate one of the supported terminal types.

To set the value of the Default network virtual terminal to either \*VT100 for VT100/VT220 mode, or \*NVT for ASCII line mode, complete the following steps:

1. Start iSeries Navigator and expand **your iSeries server** → **Network** → **Servers** → **TCP/IP**.
2. Right-click **TELNET** and select **Properties**.
3. Click the **General** tab and select the appropriate value next to **Default network virtual terminal**.
4. Click **OK**.

### Setting the ASCII/EBCDIC mapping tables

The iSeries Telnet server uses default ASCII-to-EBCDIC and EBCDIC-to-ASCII mapping tables based on the CCSID parameter in the TCP/IP Telnet attributes. The default is to use the DEC multinational character set (\*MULTINAT). Other 7-bit and 8-bit ASCII CCSIDs, and any of the 7-bit DEC national replacement character sets are also acceptable to use.

#### Note:

For VT220 8-bit mode, the mapping tables are not available. In this mode, the system uses the DEC replacement character sets. For the VT220 7-bit mode, you can use either the mapping tables or the DEC replacement character sets.

There are three ways to change the default. You can change the CCSID parameter, specify different values for the VTxxx outgoing (TBLVTOU) and incoming tables(TBLVTIN), or change the default tables for the current session.

- To change the values for the tables, complete the following steps:
  1. Start iSeries Navigator and expand **your iSeries server** → **Network** → **Servers** → **TCP/IP**.
  2. Right-click **TELNET** and select **Properties**.
  3. Click the **Mappings** tab.
  4. Select the **Use specified mapping tables** check box and click **Tables**.
  5. Select the **Use outgoing mapping table** and **Use incoming mapping table** check boxes to change the CCSID parameter.
  6. Click **OK**.
  7. Click **OK**.
- To change the default tables for the current session, use the Set VT Mapping Tables (SETVTTBL) command.

Another way to access this command is to use option 2 on the CHGTCPTELN command. <<

## Secure Telnet with SSL

With the Secure Sockets Layer (SSL) protocol, you can establish secure connections between the Telnet server application and Telnet clients which provide authentication of one or both endpoints of the communication session. SSL also provides privacy and integrity of the data that client and server applications exchange.

### “Configure SSL on the Telnet server” on page 31

This topic provides instructions for setting up SSL on your iSeries<sup>(TM)</sup> server.

### “SSL initialization and handshake” on page 35

This topic provides details about the interactions between Telnet servers, clients, and SSL.

For more information about SSL, refer to the following topics:

- Secure Sockets Layer (SSL)
- “Troubleshoot your Telnet SSL server” on page 86

## Configure SSL on the Telnet server

You can configure the OS/400<sup>(R)</sup> Telnet server to secure sessions with SSL (Secure Sockets Layer). The most important factor to consider when enabling SSL on the Telnet server is the sensitivity of the information that is involved in client sessions. If the information is sensitive, or private, then securing the iSeries<sup>(TM)</sup> Telnet server with SSL is a good idea.

To configure SSL on the Telnet server, follow these steps:

1. Install the following software to support Telnet SSL and to manage digital certificates:
  - TCP/IP Connectivity Utilities for iSeries, 5722-TC1
  - Digital Certificate Manager, 5722-SS1 - Boss Option 34
  - Cryptographic Access Provider, 5722-AC x
  - IBM<sup>R</sup> HTTP Server for iSeries, 5722-DG1
  - Developer Kit for Java<sup>TM</sup>, 5722-JV1
2. Ensure that you have “Remove port restrictions,” and allowed SSL to start.
3. “Assign a certificate to the Telnet server”
4. “Enable client authentication for the Telnet server (optional step)” on page 32
5. “Enable SSL on the Telnet server” on page 34
6. “Start the Telnet server” on page 20.

For additional information on solving SSL problems related to Telnet server, see “Troubleshoot your Telnet SSL server” on page 86. Sometimes understanding what goes on during SSL processing can also help you determine where a problem might have occurred. Review “SSL initialization and handshake” on page 35 for more information on SSL processing.

**Remove port restrictions:** Prior to V5R1, port restrictions were used because Secure Sockets Layer (SSL) support was not available for Telnet. Now you can specify whether SSL, non-SSL, or both are to start. Therefore there is no longer a need for port restrictions. If you defined port restrictions in previous releases, you need to remove the port restrictions in order to use the SSL parameter. In order to remove port restrictions, follow these steps:

1. To list the port restrictions, complete the following steps:
  - a. Start iSeries<sup>(TM)</sup> Navigator and expand **your iSeries server** → **Network**.
  - b. Right-click **TCP/IP Configuration** and select **Properties**.
  - c. Click the **Port Restrictions** tab.
2. To remove the Port Restriction, continue from the above step:
  - a. Select the Port Restriction that you want to remove.
  - b. Click **Remove**.
  - c. Click **OK**

By default the setting is to start SSL on port 992 and non-SSL on port 23. The Telnet server uses the service table entry for Telnet to get the non-SS port and Telnet-SSL to get the SSL port.

### What to do next:

“Assign a certificate to the Telnet server”

**Assign a certificate to the Telnet server:** When you enable the Telnet server on your system to use SSL, you can establish secure Telnet connections to your system from iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup> or

from any other SSL-enabled Telnet client, such as a Personal Communications emulator. Before you can configure the Telnet server to use SSL, you must have installed the prerequisite programs and set up digital certificates on your system.

1. Start IBM<sup>(R)</sup> Digital Certificate Manager (DCM).

**Note:**

If you have questions about how to complete a specific form while using DCM, select the question mark (?) at the top of the page to access the online help.

2. In the navigation frame, click **Select a Certificate Store** and select either **\*OBJECTSIGNING** or **\*SYSTEM** as the certificate store to open.
3. Enter the password for the certificate store and click **Continue**.
4. After the navigation frame refreshes, select **Manage Certificates** to display a list of tasks.
5. From the list of tasks, select **Assign certificate** to display a list of certificates for the current certificate store.
6. Select a certificate from the list and click **Assign to Applications** to display a list of application definitions for the current certificate store.
7. Select Telnet from the list and click **Continue**. A page displays with either a confirmation message for your assignment selection or an error message if a problem occurred.

**Note:**

The iSeries Access for Windows clients key database must contain a copy of any required Certificate Authority (CA) certificates. In this case, a CA certificate must exist in the key database for the certificate that you assign to the Telnet server application. The key database comes preconfigured with copies of CA certificates from almost all well-known public CAs. If you choose to assign a certificate to the telnet server that a Local CA issues, however, then you must add a copy of the Local CA certificate to the client key database. To learn how to add a copy of a Local CA certificate, see Step 5: Enable SSL on the Telnet client (page 13) in the "Configuration details" on page 11.

The OS/400<sup>(R)</sup> Telnet server supports client authentication as an optional component in SSL configuration. Client Authentication occurs when the server verifies the identity of the client by authenticating the client certificate passed up to the server application.

**What to do next:**

"Enable client authentication for the Telnet server (optional step)"

or

"Enable SSL on the Telnet server" on page 34

**Enable client authentication for the Telnet server (optional step):** The Telnet server supports the authentication of Telnet client certificates. This means that during the SSL handshake, not only will the server generate a server certificate for the client, but also may optionally check for a valid client certificate depending on how Digital Certificate Manager (DCM) is configured. The DCM will allow you to configure whether SSL Client Certificates are required for Telnet sessions.

In order to activate this support, the System Administrator will indicate how SSL support will be handled. Use the Telnet Properties General panel in iSeries<sup>(TM)</sup> Navigator to indicate whether SSL, non-SSL, or support for both will start when the Telnet server starts. By default, the SSL and non-SSL support always starts.



The System Administrator has the ability to indicate whether the system requires SSL client authentication for all Telnet sessions. When SSL is active and the system requires client authentication, the presence of a valid client certificate means that the client is trusted.

The system applies any negotiated RFC 2877 variables, and Telnet User exits variables after the satisfaction of SSL controls.

To update the application specifications in IBM<sup>(R)</sup> DCM and enable client authentication for the Telnet server, follow these steps:

1. Start IBM<sup>(R)</sup> Digital Certificate Manager (DCM). If you need to obtain or create certificates, or otherwise setup or change your certificate system, do so now. See Configure DCM for information on setting up a certificate system.
2. Click the **Select a Certificate Store** button.
3. Select **\*SYSTEM**. Click **Continue**.
4. Enter the appropriate password for \*SYSTEM certificate store. Click **Continue**.
5. When the left navigational menu reloads, expand **Manage Applications**.
6. Click **Update application definition**.
7. On the next screen, select **Server** application. Click **Continue**.
8. Select the **OS/400<sup>(R)</sup> TCP/IP Telnet Server**.
9. Click **Update Application Definition**.
10. In the table that displays, select **Yes** to require client authentication.
11. Click **Apply**.
12. DCM reloads to the **Update Application Definition** page with a confirmation message. When you are finished updating the application definition for the Telnet server, click **Done**.

For an example of what a client needs to do to enable client authentication by certificate for a Telnet application, see “Example: Enable client authentication for a PC5250 session.”

#### **What to do next:**

“Enable SSL on the Telnet server” on page 34

*Example: Enable client authentication for a PC5250 session:* After you have configured SSL for the Telnet server and specified to use client authentication, users will be required to provide a valid and trusted client certificate to the Telnet server for each connection attempt.

Clients need to create a user certificate and import that certificate to the IBM<sup>(R)</sup> Key Management database before client authentication will work.

#### **Create a user certificate in DCM**

1. Start IBM<sup>(R)</sup> Digital Certificate Manager (DCM). If you need to obtain or create certificates, or otherwise setup or change your certificate system, do so now. See Configure DCM for information about setting up a certificate system.
2. Expand **Create Certificate**.
3. Select **User Certificate**. Click **Continue**.
4. Complete the **User Certificate** form. Only those fields marked “Required” need to be completed. Click **Continue**.
5. Depending on the browser you use, you will be asked to generate a certificate that will be loaded into your browser. Follow the directions provided by the browser.
6. When the **Create User Certificate** page reloads, click **Install Certificate**. This will install the certificate in the browser.

7. Export the certificate to your PC. You must store the certificate in a password-protected file.

**Note:** Microsoft<sup>(R)</sup> Internet Explorer 5 or Netscape 4.5 are required to use the export and import functions.

### Import the certificate to the IBM Key Management

You must add the Certificate Authority that created the client certificate to the PC key database, otherwise the import of the client certificate will not work.

1. Click **Start** —> **Programs** —> **IBM iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup>** —> **iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup> Properties**.
2. Select the **Secure Sockets** tab.
3. Click **IBM Key Management**.
4. You will be prompted for your key database password. Unless you have previously changed the password from the default, enter ca400. A confirmation message displays. Click **OK**.
5. From the pull-down menu, select **Personal certificates**.
6. Click **Import**.
7. In the **Import key** display, enter the file name and path for the certificate. Click **OK**.
8. Enter the password for the protected file. This is the same password that you created in Step 7 of Create a user certificate in DCM. Click **OK**. When the certificate has been successfully added to your personal certificates in IBM Key Management, you can use PC5250 emulator or any other Telnet application.

### Start a PC5250 emulator session from iSeries Navigator

1. Open iSeries Navigator.
2. Right-click the name of your system that you have set up client authentication for Telnet.
3. Select **Display emulator**.
4. Select the **Communication** menu, then select **Configure**.
5. Click **Properties**.
6. In the **Connection** dialog box, select the **Use Secure Sockets Layer (SSL)**.
7. If you have more than one client certificate, select either **Select certificate when connecting** or **Use default** to determine which client certificate to use.
8. Click **OK**.
9. Click **OK**.

**Enable SSL on the Telnet server:** To enable SSL on the Telnet server, follow these steps:

1. Open iSeries<sup>(TM)</sup> Navigator.
2. Expand **My iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
3. Right-click **Telnet**.
4. Select **Properties**.
5. Select the **General** tab.
6. Choose one of these options for SSL support:
  - **Secure only**  
Select this to allow only SSL sessions with the Telnet server.
  - **Non-secure only**  
Select this to prohibit secure sessions with the Telnet server. Attempts to connect to an SSL port will not connect.



- **Both secure and non-secure**  
Allows both secure and non-secure sessions with the Telnet server.

#### **What to do next:**

“Start the Telnet server” on page 20

### **SSL initialization and handshake**

Sometimes understanding what goes on during SSL processing can help you determine where a problem might have occurred.

#### **What happens during SSL initialization?**

The Telnet server attempts to initialize SSL every time the server is started. During initialization, the Telnet server checks the certificate information in the QIBM\_QTV\_TELNET\_SERVER application. You can tell that the SSL initialization is successful when more than one active QTVTELNET job appears in the QSYSWRK subsystem. Of course, if the number of server jobs to start field in the Telnet properties General page is set to 1, you see only one active QTVTELNET job.

The Telnet server does not initialize SSL when you have a restricted telnet-ssl port. The Telnet server sends the TCP2550 message Access to port 992 is restricted to the QTVTELNET job log and to the QSYSOPR message queue.

When a certificate is incorrect or expired, initialization fails and the Telnet server sends message CPDBC nn to the QTVTELNET job log.

When no certificate or an expired certificate is in the QIBM\_QTV\_TELNET\_SERVER application, the Telnet server successfully initializes SSL. However, the SSL handshake fails when the client tries to connect to the Telnet server. The Telnet server sends message CPDBC nn to the QTVTELNET job log.

#### **What happens during SSL reinitialization?**

When the certificate in the QIBM\_QTV\_TELNET\_SERVER application changes, the Telnet server reinitializes SSL if a DCM change occurs. This means you can restore an expired certificate or add or remove user certificates and Telnet will pick up changes automatically. The process is the same as SSL initialization. New Telnet SSL client sessions use the new certificate. Telnet SSL client sessions that are already established use the original certificate. Once the Telnet server is ended and started again, all Telnet SSL client sessions use the new certificate.

If the SSL re-initialization fails, established SSL sessions use the original certificate that was initialized when the server started and new sessions are blocked from connecting. The next time you start the Telnet server, SSL initialization fails, although there will still be an active SSL listener. However, no new SSL connections will be successful until a change in the DCM forces Telnet server to re-initialize successfully.

#### **What happens during SSL handshake?**

An SSL handshake occurs when the Telnet SSL client connects to TCP port 992 and attempts an SSL negotiation with the server. While the client is connecting to the server, it displays status numbers or messages on the status bar of the open window.

If the SSL handshake fails, the Telnet session is not established. For example, a sign-on screen does not appear in the Telnet SSL client window. Consult the user guide or online help for your Telnet SSL client for information on specific status numbers or messages. The Telnet server sends message CPDBC nn to the QTVTELNET job log.

---

## Manage the Telnet server

The iSeries<sup>(TM)</sup> Telnet server allows a TCP/IP user on a remote Telnet client system to sign on to and run applications on the iSeries server. The iSeries Telnet server support negotiates the transmission of data with the remote Telnet client application for various operating modes.

The Telnet server and client applications negotiate these operating modes.. The functions available to you depend on the terminal type that is negotiated.

With minimal changes to the system values, the Telnet server can support Telnet connections when TCP/IP starts. For all operating modes except ASCII line mode, the iSeries server automatically sends the iSeries sign-on display when a Telnet connection is made. For ASCII line mode, a customer application that displays data must be active.

Review the following topics to learn how to successfully manage your Telnet server:

### **“Configure Telnet printer sessions”**

This section provides instructions for attaching to printers on the iSeries server from remote locations on the network.

### **“End the server session” on page 37**

This topic provides instructions for terminating a Telnet session. Ending the Telnet session frees the virtual device to be used by a new Telnet session.

### **“End Device Manager jobs” on page 38**

Sometimes it is necessary to end and restart the Device Manager jobs, for example, when applying a PTF to the program. This topic provides instructions for making the Device Manager jobs end and restart.

### **“Use Telnet exit point programs” on page 38**

Find information on using exit programs for your Telnet server.

## Configure Telnet printer sessions

In order for Telnet Printer emulation to work, a virtual iSeries<sup>(TM)</sup> printer device needs to be created (it will be a 3812 or 5553 device). Such a device is needed to generate the printer datastreams sent for the printer session. Printers used with Telnet printing can be attached to the PC or attached to the same network as the PC. Telnet printer sessions negotiate with a remote Telnet client on a system that supports Telnet printer emulation. Review the “Requirements for Telnet printer sessions” on page 37.

Telnet printer sessions deliver the printer data stream between the two systems as either EBCDIC or ASCII depending on the preferences of the requesting client.

Telnet printer sessions are active immediately after Telnet initialization. Printing functions do not require user profiles and passwords. However, if your security requires it, you can use Telnet exit point programs to block printer sessions from starting.

When using Telnet printer sessions, all print data is spooled to a printer writer queue for printing. You cannot print directly to a print device. The printer file commands create printer file (CRTPRTF), change printer file (CHGPRTF), and overwrite printer file (OVRPRTF) must use the default SPOOL (\*YES) parameter. Also, Telnet sets the printer writer or output queue to the same name as the printer.

To set up your Telnet printer sessions, follow these steps:

1. Check to make sure that the TCP stack is active. If not, issue the STRTCP command to start the TCP stack.
2. “Start the Telnet server” on page 20

3. "Set the number of virtual devices" on page 21
4. "Set the session keep-alive parameter" on page 23
5. "Create your own virtual devices" on page 22
6. "Activate the QSYSWRK subsystem" on page 24
7. Test the setup with a test print file.
8. Print a file through a Telnet printer session.

**Note:**

The QSYSWRK subsystem starts when the TCP stack starts.

## Requirements for Telnet printer sessions

If you intend to use Telnet printer sessions, check with your Telnet client vendor to see if they support the printer session function. These clients support the printer session function:

- IBM<sup>(R)</sup> iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup>
- Personal Communications
- IBM Host OnDemand

Telnet printer sessions support these generic EBCDIC printers:

- IBM-3812-1 for single-byte character set (SBCS)
- IBM-5553-B01 for double-byte character set (DBCS)

You can specify either of the generic device types by requesting the iSeries Host Print Transform (HPT) function and selecting the specific manufacturing type. If you are using iSeries Access for Windows, you can use the Printer Definition Table (PDT) or the Graphical Device Interface (GDI) to define specific hardware. The iSeries server sends the printer data stream in ASCII.

**System API enhancement** The System API Retrieve Device Description (QDCRDEVD) provides the IP address of the Telnet client. There are several fields for display (\*DSP) and print (\*PRT) devices: Network protocol, Network protocol address, and IP internet address in dotted decimal form. These fields supply sockets level information to your application about the client's TCP/IP connection.

For more information see:

Telnet server print support to iSeries Access for Windows Telnet client

## End the server session

When you are connected to an iSeries<sup>(TM)</sup> server, signing off does not necessarily end your Telnet server session. The virtual display or printer device is still active and cannot be used by another Telnet session. To end the session, you must enter a key or sequence of keys to put the Telnet client into a local command mode. You can then type the command to end the session. Use the following key sequences to end a Telnet server session.

- From the iSeries server, press the **Attention** key and then select option 99 (End TELNET session - QUIT).
- From most other systems, log off.

If you do not know what key or key sequence causes the client to enter command mode, consult either your system administrator or your Telnet client documentation.

You can also use the end connection (ENDCNN) parameter of the SIGNOFF command to sign off the system and end the Telnet connection. For example, SIGNOFF ENDCNN(\*YES) returns you to the client system (if you only have one Telnet session established). Or, if you have more than one Telnet session established, the command returns you to the previous system.

## End Device Manager jobs

Start and stop Telnet ends the Telnet server jobs, but not the Device Manager jobs. This is because the nature of the Device Manager jobs requires they be running all the time, or at least until the next restart of the system. In order to make the Device Manager jobs cycle, you have to do special steps 2 and 3. Then, the next time you start Telnet, it will see there are no Device Manager jobs running and will start them. Complete the following steps to end Device Manager jobs:

1. End active Telnet server jobs by completing the following steps:
  - a. Start iSeries<sup>(TM)</sup> Navigator and expand **your iSeries server** → **Network** → **Servers** → **TCP/IP**.
  - b. Right-click **Telnet** and select **Stop**.
2. Find all active Telnet device manager jobs by completing the following steps:
  - a. Start iSeries Navigator and expand **your iSeries server** → **Work Management**.
  - b. Select **Active Jobs**.
  - c. Look for QTVDEVICE.
3. End all jobs found in step 2 by right-clicking and selecting **Delete/End**. You must wait for all jobs to exit before doing the next step.
4. Start Telnet server and device manager jobs on the Delete/End panel.

Any Telnet virtual devices that are still in the process of ending when all Device Manager jobs have ended may become inaccessible until your next restart.

## Use Telnet exit point programs

With the use of exit programs, the experienced programmer can create customized processing during an application. If the Telnet server finds a program registered to one of the exit points for the server, it calls that program using parameters that are defined by the exit point.

An **exit point** is a specific point in the Telnet program where control may pass to an exit program. An **exit program** is a program to which the exit point passes control.

For each exit point, there is an associated programming interface, called an **exit point interface**. The exit point uses this interface to pass information between the Telnet application and the exit program. Each exit point has a unique name. Each exit point interface has an exit point format name that defines how information is passed between the Telnet application and the customer-written exit program.

Different exit points may share the same exit point interface. When this is the case, multiple exit points can call a single exit program.

For more information about using exit programs, see:

### **“Device initialization exit program” on page 40**

Allows you to associate your custom exit program with exit points on the iSeries<sup>(TM)</sup> Telnet server.

### **“Device termination exit program” on page 46**

Allows you to log session termination information.

### **“Sample Telnet exit programs” on page 46**

You can download sample TELNET exit programs to assist you in writing exit programs.

## Exit point performance

The Telnet server response time for your initial session request will include any time that it takes for the server to call, process, and return the QIBM\_QTG\_DEVINIT exit program. If your exit program is doing significant processing, the performance impact may result in a longer wait before your session is established. If you want to modify the default 60 second timeout value for user exit programs, you can

use the ADDEXITPGM command to add user data that will be read as the timeout value. In the following example, the PGMDTA parameter overrides the default 60 second timeout to 10 seconds:

```
ADDEXITPGM EXITPNT(QIBM_QTG_DEVINIT) FORMAT(INIT0100)
PGMNR(1) PGM(USEREXIT/DEVINIT2) REPLACE(*YES)
CRTEXTIPNT(*NO) PGMDTA(*JOB *CALC 10)
```

Once the Telnet program is established by way of a sign-on panel or other iSeries server panel, there is no performance impact. When this occurs, the exit program is no longer in the Telnet path. Established Telnet sessions experience no delays due to the QIBM\_QTG\_DEVINIT exit program.

There is no user-visible performance impact that is associated with disconnecting the session. Disconnecting means that you end your terminal emulation session, not that you sign-off and return to the sign-on panel. If you disconnect, then the QIBM\_QTG\_DEVTERM exit program is called, which will perform the disconnect processing for your session. Users will not see this because it occurs after the connection is broken.

### **Work management**

You can solve key work management problems by using a Telnet exit program. These problems include the capability to request device descriptions other than QPADEVxxxx, opening up the door for work management control of interactive virtual workstation jobs, and routing those jobs to specific subsystems.

### **Subsystem routing and device name selection**

The current recommendation is that any given subsystem, for example, QBASE, QCMN, or QINTER, services no more than 300 users.

Users can take advantage of better Telnet virtual device names and configure their interactive subsystems to subdivide the work, if necessary. This is done by using the Add Work Station Entry (ADDWSE) command. This command allows you to specify which devices a subsystem should or should not allocate a particular name of virtual terminal devices.

The following command has QINTER allocate all QPADEV\* workstations, which means that all such devices route to the QINTER subsystem:

```
ADDWSE SBS(D(QINTER) WRKSTN(QPADEV*)) AT(*SIGNON)
```

The following command has QINTER not allocating all QPADEV\* workstations, which means that these devices can be allocated to a different subsystem:

```
ADDWSE SBS(D(QINTER) WRKSTN(QPADEV*)) AT(*ENTER)
```

Users can develop their own device naming conventions to subdivide the work. For example, one kind of subdivision is to route certain devices to national language support (NLS) related subsystems in two locations.

### **Example**

For the purpose of this example, the two users are in Chicago and New York. The users are assigned to iSeries subsystems CHICAGO and NEWYORK, respectively, according to their geographic location. The characteristics of this example include:

- The IP addresses for Chicago start with 1.2.3.\*.
- The IP addresses for New York start with 2.3.4.\*.
- In order for all of the Chicago Telnet sessions to run in the CHICAGO subsystem the user exit program is employed. The exit program creates a virtual device name that starts with 'CHICAGO' for all Telnet connections from 1.2.3. The user exit program also creates a virtual device name that starts with 'NEWYORK' for all connections from 2.3.4.

- The user exit program assigns the virtual device name 'CHICAGO01' for an IP address of 1.2.3.47. The program assigns a virtual device name of 'NEWYORK01' for an IP address from 2.3.4.48. The program attaches a variable part ('01', '02', etc.) to a root name of 'CHICAGO' and checks to see if the device is not already in use before assigning it to the current user.

To ensure that virtual devices CHICAGO01 and NEWYORK01 go into subsystems Chicago and New York, respectively, set up the workstations entries as follows:

```
ADDWSE SBS(DQINTER) WRKSTN(CHICAGO*) AT(*ENTER)
ADDWSE SBS(DQINTER) WRKSTN(NEWYORK*) AT(*ENTER)
ADDWSE SBS(DCHICAGO) WRKSTN(CHICAGO*) AT(*SIGNON)
ADDWSE SBS(DNEWYORK) WRKSTN(NEWYORK*) AT(*SIGNON)
```

## Device initialization exit program

The Telnet server application includes exit points that allow you to hook into Telnet's sign-on and termination logic. You can use the iSeries<sup>(TM)</sup> WRKREGINF (Work with Registration Information) or ADDEXITPGM (Add Exit Program) commands to associate your custom exit program to an exit point. If the Telnet server finds a program registered to one of the exit points for the server, it calls that program using parameters defined by the exit point. These parameters include things like IP address, user name, and virtual device name. Your custom exit program then processes the information, for example, logs a message and returns control to the Telnet server. On return, your exit program tells the server whether to accept or reject this client and any optional user or password overrides.

Each exit point has a name and an exit point interface. The exit point interface is a list of input and output parameters the Telnet server exchanges with your exit program. There are two exit points for the Telnet server:

- QIBM\_QTG\_DEVINIT
- QIBM\_QTG\_DEVTERM

Required Parameter Group:

1	User description information	I/O	Char(*)
2	Device description information	I/O	Char(*)
3	Connection description information	Input	Char(*)
4	Environment options	Input	Char(*)
5	Length of environment options	Input	Binary(4)
6	Allow connection	Output	Char(1)
7	Allow autosign-on	Output	Char(1)

QSYSINC Member Name: ETGDEVEX  
Exit Point Name: QIBM\_QTG\_DEVINIT  
Exit Point Format Name: INIT0100

The Telnet server will optionally provide for selecting or setting the device name to be used over the Telnet session, and allow for a Telnet client to bypass traditional device initialization. Administrators may control these new features through the use of a new exit program, which will optionally start just after client session establishment. Several parameters will be supplied to the exit program to be used in the decision process, and the exit program can set or change various parameters before returning to the Telnet server. You can optionally register a second exit program to start just before the ending of the session. You can use this second exit program for session auditing or virtual device management.



**Telnet exit point format INIT0100:**

- “Telnet Exit Point Format INIT0100: Required Parameter Group”
- “INIT0100: Format of User Description Information” on page 42
- “INIT0100: Format of Device Description Information” on page 42
- “INIT0100: Format of Connection Description Information” on page 44

**Telnet Exit Point Format INIT0100: Required Parameter Group: User description information**

I/O; CHAR(\*) Information about the user that the system will use as part of the auto-signon process.

**Device description information**

I/O; CHAR(\*) Information that the system will use to create or change the device that it uses for this Telnet session.

**Connection description information**

I/O; CHAR(\*) Information about the client connection that the exit program can use.

**Environment options**

INPUT; CHAR(\*) An array containing all the RFC 2877 environment options negotiated by the client. These will be in the exact format that they were in when received from the client and specified by RFC 2877. The array will, in general, consist of 1 or more pairs of environment variable names and associated values. The RFC specifies that each variable name will always be preceded by either an X'01' or X'03' depending on whether it is an RFC 2877 defined VAR, or an application specific defined USERVAR. If a value is to be associated with a VAR (or USERVAR), that value will appear next in the array preceded by the RFC 1572 defined VALUE character - X'01'. This sequence of VAR/VALUE pairs will be repeated up to a maximum of 1024 total bytes of negotiation data.

RFC 2877 and the more general Telnet negotiation RFCs also allow for control characters to appear within the VAR/USERVAR variable names or their associated values. This is allowed through the use of the ESC character X'02' and rules that apply when the ESC character itself or Telnet IAC control characters must appear in the negotiation sequence. Refer to RFC 1572 for a more complete description of control character escaping rules.

While the environment options buffer will show negotiations by the client, including passwords, Telnet will always overlay any clear-text or encrypted password values in the buffer to avoid security exposures.

**Length of environment options**

The length of the environment options referenced in the preceding paragraph is typically 1024 bytes. Since option negotiations are of undefined length, any negotiations that exceed the length specified may be truncated to fit in the environment options buffer.

**Allow connection**

OUTPUT; CHAR(1) Applies to all devices and indicates to the Telnet server whether it should allow the client to connect. If the device type is DISPLAY and you have enabled auto-signon, then this client may also bypass the sign-on panel on the iSeries<sup>(TM)</sup> server. The valid values are as follows:

- 0 - Reject the request from the client
- 1 - Accept the request from the client

**Allow auto-signon**

OUTPUT; CHAR(1) Applies to DISPLAY device types, and indicates to the Telnet server whether the auto-signon operation should be allowed to proceed for this particular client. If auto-signon is allowed, then this client can bypass the sign-on panel on the iSeries server. The valid values are as follows:

- 0 - Reject the application request from the client. The system will ignore the User profile, Current library, Program to call, Initial menu, and Device name output parameters.

1 - Accept the application request from the client. The system may consider the User profile, Current library, Program to call, Initial menu, and Device Name output parameters valid if the exit program returns them.

**INIT0100: Format of User Description Information:** The auto-signon process will use the information about the user.

The following table shows the format of the user description information:

**Table 1. Format of User Description Information**

Offset Dec	Offset Hex	Type	Field
0	0	INT(4)	Length of user description information
4	4	CHAR(10)	User profile
14	E	CHAR(10)	Current library
24	18	CHAR(10)	Program to call
34	22	CHAR(10)	Initial Menu

### User Description Information Field Descriptions

#### Current library

The name of the library that is to be made the current library if you enable the auto-signon flag. This parameter is optional, but if you supply it, you must make certain to left-justify it and pad it with blanks. Valid values are as follows:

##### library name

The name of the library that you would like the system to designate as the current library

#### Initial menu

The name of the initial menu to display if you have enabled the auto-signon flag. Valid values are as follows:

##### menu name

The name of a menu to display

#### Length of user description information

Length of the user description information structure

#### Program to call

The name of a program that the system will call if you have enabled the auto-signon flag. This parameter is optional, but if you supply it you must left-justify it and pad it with blanks. Valid values are as follows:

##### program name

The name of a program that the system will start

#### User profile

The user profile that the system uses for the sign-on procedure if you have enabled the auto-signon flag. The system requires this parameter, and you must left-justify it and pad it with blanks.

**INIT0100: Format of Device Description Information:** Information that will be used to create or change the device used for this Telnet session.

The following table shows the format of the device description information, which describes the characteristics of the device to be associated with this session.



**Table 1. Format of the Device Description Information**

Offset Dec	Offset Hex	Type	Field
0	0	CHAR(10)	Device name
10	A	CHAR(8)	Device format
18	12	CHAR(2)	Reserved
20	14	BINARY(4)	Offset to device attributes structure
24	18	BINARY(4)	Length of device attributes structure
28	1C	CHAR(*)	Device attributes structure

**Device Description Information Field Descriptions****Device name**

The specific virtual device to be associated with this Telnet session. For DISPLAY devices, if the QAUTOVRT auto-create device system value allows for it, the device will be auto-created by the system if it does not already exist, and varied on. For PRINT devices, the system will auto-create the device if it does not already exist. If the exit program supplies no value, the Telnet server will default to using the traditional Telnet virtual device selection methods. Should be a valid DISPLAY or PRINT device description name and must adhere to standard OS/400<sup>(R)</sup> object naming conventions.

**Device format**

The specific virtual device type that is associated with this Telnet session. Currently only display devices that the system supports.

**DSPD0100**

Device is a display. The system returns display attributes.

**Reserved**

Reserved for future use.

**Offset to device attributes structure**

The offset from the start of the device description information to the start of the device attributes structure.

**Length of device attributes structure**

The length in the user space of the device attributes structure.

**INIT0100: Format of Display Device Description Information (DSPD0100)**

The following table shows the format of the display device description information, which describes the characteristics of the device to be associated with this session.

**Table 2. Format of Display Device Description Information (DSPD0100)**

Offset Dec	Offset Hex	Type	Field
0	0	CHAR(3)	Keyboard identifier
3	3	CHAR(1)	Reserved
4	4	BINARY(4)	Code page
8	8	BINARY(4)	Character set

**DSPD0100 Field Descriptions**

### Character set

Specifies the character set that the system is to use for this interactive job. You can find valid values in National Language Support. This field is identical to the Character set parameter of the Open Virtual Terminal Path QTVOPNVT API.

### Code page

Specifies the code page that the system is to use for this interactive job. You can find valid values in National Language Support. This field is identical to the Code page parameter of the Open Virtual Terminal Path QTVOPNVT API.

### Keyboard identifier

Specifies the 3 character keyboard identifier that the system is to use for this interactive job. The keyboard identifier implicitly specifies the code page and character set to be used, unless overridden as part of the Code page and Character set parameters. You can find valid identifiers in National Language Support. This field is identical to the keyboard Language type parameter of the Open Virtual Terminal Path QTVOPNVT API.

### Reserved

Reserved for future use

**INIT0100: Format of Connection Description Information:** Information about the client connection that the exit program can use.

The following table shows the format of the connection description information, which describes client and connection information for this session.

**Table 1. Format of Connection Description Information**

Offset Dec	Offset Hex	Type	Field
0	0	INT(4)	Length of connection description information
4	4	CHAR(20)	Client internet address
24	18	CHAR(1)	Client password validated
25	19	CHAR(12)	Workstation type
39	27	CHAR(1)	Secure socket layer connection
40	28	CHAR(20)	Server (local) internet address
60	3C	CHAR(1)	Client authentication level
61	3D	CHAR(3)	Reserved
64	40	INT(4)	Client certificate valid rc
68	44	INT(4)	Offset to client certificate
72	48	INT(4)	Client certificate length

### Connection Description Information Field Descriptions

#### Length of connection description information

Length of the connection description structure

#### Client internet address

This is the IP address (or type structure) of the requesting client, and is always provided to the exit program. The layout of the new fields are:

**Table 2. Client IP Address Layout**

Name	Size	Description
sin_len	CHAR(1)	Size of the sockaddr_in structure.
sin_family	CHAR(1)	Family or protocol. IP (Version 4) is hex 02.
sin_port	CHAR(2)	16-bit unsigned port number.
sin_addr	CHAR(16)	4-byte unsigned

### Client password validated

Specifies if Telnet validated the clients' encrypted password (if one was received). The system will set this value if TN5250E Clients send the encrypted password for validation. The password will be checked using service functions calls. This allows the exit program to guarantee secure client sign-on process.

- Value = 0, Client password/passphrase (or Kerberos ticket) was not validated or none was received.
- Value = 1, Client clear-text password/passphrase was validated
- Value = 2, Client encrypted password/passphrase (or Kerberos ticket) was validated

### Workstation type

The workstation type requested by the client, and will be one of the Internet Specifications listed in the Workstation and printer mappings (page 83) table.

### Secure socket layer

This indicates if the connection is a Secure Socket Layer (SSL) connection.

- 0 - Connection is not using Secure Sockets Layer (SSL).
- 1 - Connection is using Secure Sockets Layer (SSL).

### Server internet address

This is the IP address (or type structure) of the host (local) network interface, and is always provided to the Exit Point program. The layout of the new fields are:

**Table 3. Client IP Address Layout**

Name	Size	Description
sin_len	CHAR(1)	Size of the sockaddr_in structure
sin_family	CHAR(1)	Protocol family IP is hex 02, IPX is hex 06
sin_port	CHAR(2)	16-bit unsigned port number
sin_addr	CHAR(16)	4-byte unsigned network address

### Client authentication level

Indicates if client SSL certificates are required in order to connect to the server.

- 0 - No client certificate is required.
- 1 - A valid client certificate is required.

### Client certificate valid return code

Indicates the return code received during the SSL handshake operation when validating the client certificate.

### Offset to client certificate

Indicates the offset from the start of the Connection structure to the first byte of the client certificate.

### Client certificate length

Indicates the length of the client certificate that was received. If no certificate was received, then the length is 0.

### Device termination exit program

The QIBM\_QTG\_DEVTERM exit point occurs when a Telnet client ends the Telnet session. This gives customers an opportunity to log session termination information and to perform device reset or cleanup operations.

The following shows the parameters for the QIBM\_QTG\_DEVTERM exit point.

1	Device name	Input	Char(10)
---	-------------	-------	----------

QSYSINC Member Name: NONE

Exit Point Name: QIBM\_QTG\_DEVTERM

Exit Point Format Name: TERM0100

### Device name

The specific virtual device to be associated with this Telnet session.

The Telnet server will optionally provide for the stopping of the device, session auditing activities, and virtual device management related to the device associated with the ended Telnet session.

### Required Parameter Group

#### Device name

Input; CHAR(10) The specific virtual device that is associated with this Telnet session.

### Sample Telnet exit programs

▶ Example programs are available to help you use Telnet exit points on your server.

**Note:** Read the “Code disclaimer information” on page 97 for important legal information.

The sample download contains the following resources:

- **Example Create Telnet exit program CL utility code (TELCRT)**  
This is working example code for the utility program that creates, installs, and registers Telnet exit programs. It is written in OS/400<sup>(R)</sup> Command Language (CL) programming language.
- **Example Delete Telnet exit program CL utility code (TELDLT)**  
This is a working example of code for the utility program that uninstalls and deletes Telnet exit programs from your OS/400. It is written in OS/400 CL programming language.
- **The basic example Telnet initialization exit program (DEVINIT1)**  
The basic Telnet initialization exit program (DEVINIT1) lets you screen Telnet clients. You decide who is allowed to connect to your Telnet server and who is not. This example is basic because it is not designed to take advantage of the many other functions available to Telnet exit programs. The advanced Telnet exit program is designed to take advantage of those functions.  
It is recommended you start with the basic Telnet initialization exit program until you understand how it works, and then migrate to the advanced Telnet initialization exit program if you require Virtual Device mapping or other advanced functions.
- **The advanced example Telnet initialization exit program (DEVINIT2)**  
The advanced Telnet initialization (logon) exit program uses the access lists MAP and DISALLOW. By using the MAP list instead of the simpler ALLOW list, the advanced initialization program exploits more of the exit point interface than the basic version. It allows you to set or override Telnet session settings which is a function you normally see in Client Access environments. Here are some examples of the kinds of session settings you can:

- Select a particular Virtual Terminal device for this session
- Bypass the sign-on panel
- Set up NLS support
- **The example Telnet termination exit program (DEVTERM)**  
DEVTERM QCSRC is a simple logging program which logs a disconnect message.  
This is a companion program to both DEVINIT1 QCSRC and DEVINIT2 QCSRC. The termination messages it logs can be matched up with the initialization messages to determine Telnet session duration.

### Telnet exit program sample files

There are two file formats available for download: ZIP and SAVF. Both formats contain the same files.

The .zip files are in a format that is compatible with PCs. Choose the .zip file to download the program and information files to your PC, unzip them, then transfer them to your iSeries<sup>(TM)</sup> server. You'll need to rename most of files once you get them to your iSeries server.

A .savf file is an OS/400 save file. Download it to your PC, then transfer it to your iSeries server. IBM recommends that you create a temporary library on your iSeries and transfer the save file to that. Unpack the save file in the temporary library and follow the instructions in the README file.

Click the link for the file format you want, then choose **Save**.

- telnet.zip (924 KB)
- telnet.savf (5.45 MB)




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## Manage the Telnet client

The iSeries<sup>(TM)</sup> Telnet client allows an iSeries TCP/IP user to sign on to and use applications on a remote system with a Telnet server application.

Telnet allows you to log on to the remote computer and use it as if you were connected directly to it. You can run programs, change configurations, or do just about anything else you could do if you were sitting at the remote computer itself.

Telnet makes your computer act like a mainframe computer's workstation. In other words, when using Telnet, your computer (the client) pretends to be, or emulates, a terminal directly attached to the remote computer (the Telnet server).

The Telnet client also supports RFC 2877. RFC 2877 clients get more control over the Telnet server virtual device on the iSeries through several new parameters on the STRTCPTELN (TELNET) command. The new parameters are:

- Remote virtual display (RMTVRTDSP)
- Remote user (RMTUSER)
- Remote password (RMTPWD) (including support for new 128-byte passwords if the Telnet Server supports them)
- Remote password encryption (RMTPWENC) (including DES7 and SHA1 encryption)
- Remote initial program (RMTINLPGM)
- Remote initial menu (RMTINLMNU)
- Remote current library (RMTURLIB)
- Remote keyboard type (RMTKBDTYPE)
- Remote character set (RMTCHRSET)
- Remote code page (RMTCODPAG)

For more information about working the Telnet client, see the following:

**“Control Telnet server functions from the client”**

Control workstation processing on the Telnet server when you are in a client session.

**“5250 Telnet client sessions” on page 49**

This section provides information on using this emulation type to sign on and use applications on a remote system that has a Telnet server application.

**“3270 Telnet client sessions” on page 50**

This section provides information on using this emulation type to sign on and use applications on a remote system that has a Telnet server application. This section also provides more information on 3270 emulation.

**“VTxxx Telnet client sessions” on page 56**

This section provides information on using this emulation type to sign on and use applications on a remote system that has a Telnet server application. This section also provides more information on VTxxx emulation.

**“Establish a cascaded Telnet session” on page 78**

Learn how to establish another Telnet session while in a Telnet session. Once you establish a cascaded session, learn how to move between the different systems.

**“End a Telnet client session” on page 79**

Learn how to completely end your Telnet session.

## Control Telnet server functions from the client

The iSeries<sup>(TM)</sup> Telnet client has control functions that allow you to control workstation processing on the system when you are in a client session. The Telnet control functions allow you to invoke client to server commands that can affect the already established session.

Both the iSeries server name and the TCP/IP name are listed for each of the command functions.

To select which server functions that you want to control, you need to access the **Telnet Control Functions** menu. To get to this menu, press the **Attention** key on your 5250 keyboard.

The following list provides you with a brief description of each Telnet client control function:

### Interrupting a process on the system

**Interrupt process** or **IP**: This function cancels, interrupts, or suspends a process that has started on the server. For example, you can use IP when a process appears to be in a permanent loop, or if you have started a process by accident.

### Querying connection status when the system becomes inactive

**Query connection status** or **AYT**: This function provides a message from the server that lets you know that the system is still running. You can use this control function when the system is unexpectedly inactive for a long period of time.

### Discarding remote output before it reaches your workstation

**Discard remote output data** or **AO**: This function allows a process that is generating output to run to completion without sending the output to your workstation. This function removes already produced server-system output that has not yet displayed on your workstation.

### Clearing the data path between your system and the server

**Clear the data path** or **SYNCH**: This function discards all characters (except Telnet commands) between your system and the server. You can use this function when the network's flow control mechanisms cause other functions, such as **IP** or **AO**, to be buffered.

### Ending the Telnet session

**End Telnet session** or **QUIT**: This function ends the Telnet session and closes the TCP/IP connection to the system (remote system). You can request this function any time during the Telnet session, but you should sign off the remote system before selecting this function. If you do not sign off, you remain signed on to the system because the Telnet protocol does not provide an end session sequence.

### Using the Attention key to remote host option

**ATTN key to remote host**: Press the Attention key to display the Telnet Control Functions menu.

#### Notes:

This option only applies to 5250 mode.

If you are running VTxxx mode (VT100 or VT220), then there are two additional selections on this menu:

- For VT100 sessions, Option 6 (Change VT100 Primary Keyboard Map) and Option 7 (Change VT100 Alternate Keyboard Map).
- For VT220 session, Option 8 (Change VT220 Primary Keyboard Map) and Option 9 (Change VT220 Alternate Keyboard Map).

## 5250 Telnet client sessions

Telnet 5250 client support allows iSeries<sup>(TM)</sup> users to sign on to other systems and access full-screen 5250 applications. 5250 full-screen support can only be negotiated with a Telnet server application running on an iSeries server or a system that supports the Telnet 5250 server. Negotiating 525x workstation support with the remote Telnet server application activates 5250 full-screen support.

Refer to "Start a 5250 Telnet client session" to use 5250 emulation.

### Start a 5250 Telnet client session

**Note:** You should know the name or Internet address of the remote system with which you want to start the Telnet session. To display the Internet addresses and host names, complete the following steps:

1. Start iSeries<sup>(TM)</sup> Navigator and expand **your iSeries server** —> **Network**.
2. Right-click **TCP/IP Configuration** and click **Host Table** to display the Internet addresses and host names.

### Starting a Telnet client session

1. Type the STRTCPTELN command, or type TELNET at the iSeries command line and press **Enter**.
2. Type the name of the remote system, if you want to use optional parameters, press F10. Otherwise, press **Enter**.

If you typed \*INTERNETADR for the **Remote system** field, the server prompts you for the **Internet address** field.

3. Type the Internet address of the remote system, if you want to use optional parameters, press F10. Otherwise, press **Enter**. The display shows optional parameter values and the Internet address information.
4. To use the default parameter values, press **Enter**.
5. When starting a 5250 full-screen mode session, the following optional parameters are also applicable:



- Timeout wait for host (INZWAIT)
- Keyboard language type (KBDTYPE)
- Port number of the remote host server application (PORT)
- Remote Virtual Display (RMTVRTDSP)
- Remote User (RMTUSER)
- Remote password (RMTPWD)
- Remote password encryption (RMTPWDENC)
- Remote initial program (RMTINLPGM)
- Remote initial menu (RMTINLMNU)
- Remote Current library (RMTCURLIB)
- Remote Keyboard Type (RMTKBDTYPE)
- Remote character set (RMTCHRSET)
- Remote code page (RMTCODPAG)

The next display is the sign-on display for the remote system.

Note:

- The signon panel will be displayed only if none of the Autosignon parameters are entered on the STRTCPTELN command (RMTUSER, RMTPWD, RMTPWDENC) or if there was an error when these parameters were entered. If these values are entered correctly, no signon panel will display. The user is automatically signed on, and whatever initial screen defined for the user will display.
- In addition the following is also true:
  - If the STRTCPTELN command provides the correct RMTUSER, RMTPWD and RMTPWDENC parameters, and a correct RMTINLPGM parameter is also provided, then the user will be signed on. Also, the provided initial program will have run.
  - However, if an invalid RMTINLPGM is provided, the user will be signed on, but a 'job ended abnormally' message will display. The same actions are true for RMTINLMNU parameter.
- For the RMTCURLIB parameter, a correct value will result in the user being signed on. Also, any initial program or menu as defined either in the users profile or on the STRTCPTELN command, will execute. In addition the current library will be set to the parameter value. If in invalid RMTCURLIB parameter value is provided, then a signon panel will be displayed with a message stating that the current library value is invalid.
- Also, for all of the above items, if the RMTKBDTYPE, RMTCHRSET, and RMTCODPAG parameters are provided with valid values, they will have taken effect for the successful automatic signon attempts. They will not have taken effect for the invalid signon attempts.

**Note:** If the system does not find or configure a SOCKS server, or if errors occur using the SOCKS server, then a direct connection is established.

### TN5250 screen size

Telnet 5250 full-screen mode supports the following screen sizes:

- 1920-character (24 x 80) on all 5250 display stations.
- 3564-character (27 x 132) on all 3180 Model 2; 3197 Models D1, D2, W1, W2, and 3477 Models FA, FC, FD, FE, FG, FW.

To control server functions while you are in a client session, see "Control Telnet server functions from the client" on page 48.

## 3270 Telnet client sessions

Because the 3270 data streams are translated into 5250 data streams, the workstation devices operate as a remote 5251 display to the iSeries<sup>TM</sup> server and application programs.

The following topics provide more information about 3270 emulation:



### **“Start a 3270 Telnet client session”**

Start a Telnet client session using 3270 emulation.

### **“3270 full screen considerations” on page 52**

You should be aware of the issues presented in this topic when using 3270 emulation.

### **“Using a display station” on page 53**

This topic describes keyboard and display differences for using a display station during a Telnet 3270 full-screen session.

### **“3270 keyboard mapping for Telnet servers” on page 54**

This topic provides keyboard mapping for support of 3270 emulation.

## **Start a 3270 Telnet client session**

When the Telnet client negotiates 327x workstation support with the remote Telnet server application, the system activates the 3270 full-screen mode. Telnet client negotiates 3270 full-screen support with any Telnet server application that supports 3270 full-screen (rather than 5250) applications. The remote system application controls your display station. You receive the same displays and enter data the same way as you would for other 3270 devices locally attached to the remote system.

You need to start the Telnet server on the remote system (the server system that you want to connect to using Telnet).

You should know the name or IP address of the remote system with which you want to start the Telnet session. To display the IP addresses and host names, complete the following steps:

1. Start iSeries<sup>(TM)</sup> Navigator and expand **your iSeries server** —> **Network**.
2. Right-click **TCP/IP Configuration** and click **Host Table** to display the IP addresses and host names.

### **Starting a Telnet client session**

1. Type the STRTCPTELN command, or type TELNET at the command line and press **Enter**.
2. Type the name of the remote system. If you want to use the optional parameters, press F10, otherwise press **Enter**.

If you type \*INTNETADR for the **Remote system** name and press **Enter**, the server prompts you for the **IP address** field.

3. Type the IP address of the remote system. To use the optional parameters, press F10, otherwise press **Enter**. The display shows optional parameter values and the IP address information.
4. To use the default parameter values, press Enter. The connection to the Telnet server will start.
5. During a 3270 full-screen mode session, the following optional parameters are also applicable:
  - Timeout wait for host (INZWAIT)
  - Keyboard language type (KBDTYPE)
  - Page up (roll down) key (PAGEUP)
  - Page down (roll up) key (PAGEDOWN)
  - Cursor select key (CSRSLT)
  - Outgoing 3270 translation table (TBL3270OUT)
  - Incoming 3270 translation table (TBL3270IN)
  - Numeric lock keyboard (NUMLCK)
  - Change how nulls are handled (NULLS)
  - Port number of the remote host server application (PORT)

The next display is the sign-on display for the remote system.

To control server functions while you are in a client session, see “Control Telnet server functions from the client” on page 48.

For information on keyboardmapping, see “3270 keyboard mapping for Telnet servers” on page 54.

For information about using 3270 in full screen mode, see “3270 full screen considerations”

### 3270 full screen considerations

When using 3270 full-screen mode for your Telnet client, you should be aware of the following considerations:

- 3270 screen size
- The 3270 cursor select key
- 3270 error messages
- 3270 null characters

#### TN3270 screen size

Telnet 3270 full-screen mode requirements:

- If the negotiated 3270 device type requires 1920 characters, the iSeries<sup>(TM)</sup> Telnet client code will run with any 5250 device type as the client terminal.
- If the negotiated 3270 device type requires 3564 characters, the iSeries Telnet client code requires either a 3180 Model 2, 3197 Model D1, D2, W1, W2, or 3477 Model FA, FC, FD, FE, FG, or FW 5250 device type as the client terminal.
- There is a 27x132 display when a 3180 Model 2, 3197 Mode D1, D2, W1, W2 or 3477 Model FA, FC, FD, FE, FG or FW device type is negotiated. In previous releases a data area was needed to get this support
- To get a 24x80 display, execute the command CRTDTAARA DTAARA(libname/QTVNO32785) TYPE(\*CHAR) VALUE('1').

#### TN3270 cursor select key

The existing Cursor Select key is disabled if you choose to emulate the Cursor Select key. Specifying one of the following parameters for the STRTCPTELN command emulates the Cursor Select key:

Parameter	Value
Page Up (Roll Down) key	*CSRSLT
Page Down (Roll Up) key	*CSRSLT
Cursor Select key	*F-key (specify a function key *F1 to *F24)

#### TN3270 messages

When you are using Telnet 3270 full-screen mode, several types of error messages may display.

- Key entry errors appear as flashing 4-digit numbers on the lower left corner of the display. Press the Help key or F1 (Help) to obtain more information about the message. See the System Operation book if you cannot correct the error.
- System messages include Telnet messages and are issued from the iSeries server.
- For information on messages that are sent from the remote system, see the remote system documentation.

#### TN3270- Handling null characters

When a 3270 display station sends a data stream, all null characters are removed. Specify one of the following values for the handle nulls (NULLS) parameter on the STRTCPTELN command:

#### **\*REMOVE**

Removes beginning and embedded null characters

#### **\*BLANK**

The default value; changes beginning and embedded null characters to blanks. Trailing null characters are always removed for both values. For example, assume the data consists of the following (0 indicates a null):

0x0yz000

The data stream sent from a 5250 display station that runs Telnet 3270 full-screen with the default \*BLANK would contain the following:

bxbyz

The data stream sent from a 3270 display station or from a 5250 display station running a Telnet 3270 full-screen session when the value \*REMOVE is specified would contain the following:

xyz

The value \*REMOVE is valid for the following devices:

- Any locally attached display
- Displays attached to a remote 5394 controller
- Personal computer displays using the workstation function

### **Using a display station**

When using a display station during a Telnet 3270 full-screen session, you should be aware of keyboard and display differences. Other special considerations for Telnet 3270 mode include number of input fields, error messages, and ending a session.

#### **Specifying Keyboard and Character Sets**

The keyboard language type you specify for your workstation, using the keyboard language type parameter on the STRTCPTELN command, must be the same as the keyboard language type parameter of the remotely attached workstation. If you specify a keyboard language type that does not match, some of the characters do not display as expected.

#### **5250 and 3270 Keyboards**

The placement and function of keys are different on the 5250 keyboard (3196G, 3180 Model 2, or 5291) than on the 3278 keyboard.

#### **Note:**

For the Telnet client operating in a 3270 full-screen mode, the 3270 Clear function defaults to the key sequence Shift-Cmd-Backspace.

The System Operation for New Users book provides keyboard differences for the following keyboards

- IBM<sup>(R)</sup>-enhanced keyboard
- 122-key typewriter keyboard
- 5250 keyboard
- Personal computer or personal computer AT<sup>(R)</sup> style keyboard
- Personal computer or personal computer AT<sup>(R)</sup> 5250 style keyboard
- IBM-enhanced personal computer keyboard

## Personal Computer Keyboards

If your personal computer uses the iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup> Workstation Function (WSF), you can display the layout of your 5250 keyboard using the Workstation Function Keys (WSFKEYS) command. You can alter the style using the Configure Workstation Function (CFGWSF) command. These commands are discussed in the 'Client Access/400 for DOS with Extended Memory Setup' book. If your personal computer does not use the workstation function, refer to the appropriate documentation for your emulator (for example, OS/2<sup>(R)</sup> CM/2) to view or change the keyboard style.

### TN3270—Minus Sign

If you specified the value \*YES for the numeric lock keyboard parameter of the STRTCPTELN command, if you are using a data entry keyboard, and if the cursor is located in a numeric-only field, then do the following to display a minus sign.

To display a 5250 minus sign:

1. Press the Num (Numeric) key.
2. Press the minus sign (-) key.

To display a 3278 minus sign, press the minus sign key.

### TN3270—Page Down and Page Up

If the 3270 application has a display that does not allow all the input data fields to be viewed, use the 5250 Page Down and Page Up keys to enter data when the maximum number of input fields on the display is exceeded.

You can also assign PF and PA functions to the page keys by specifying their use on the STRTCPTELN command.

The cursor always appears as an underline on both 5250 and 3270 displays.

## 3270 keyboard mapping for Telnet servers

The following table shows the default PF key assignments to perform the various 5250 functions. You can use the Display Keyboard Map (DSPKBDMAP) command to see the current keyboard mapping. Or, you can use option 6 (Display 3270 keyboard map) on the Configure TCP/IP Telnet Menu, while your terminal is in 3270 emulation mode.

5250 function key	Default 3270 keys to select function
Help	PF1
3270 Help	PF2
Clear	PF3
Print	PF4
Display Embedded Attributes	PF5
Test Request	PF6
Roll Down	PF7
Roll Up	PF8
Error Reset	PF10 or Enter
Sys Req	PF11
Record Backspace	PF12
F1 through F12	Press PA1, then one of the following: PF1 through PF12
F13 through F24	Press PA2, then one of the following: PF1 through PF12 or PF13 through PF24 (if present)
Field Exit	Erase EOF, then Field Tab

5250 function key	Default 3270 keys to select function
Attention	For 3277 use Test Request, then PA1. For 3278/3279 use ATTN key

The following example CL program sets the keyboard map for a 327x-type workstation that is using Telnet to go to an iSeries<sup>(TM)</sup> server. This program maps the iSeries function keys to their equivalent function keys on the 327x workstation. If you attempt to run a CHGKBDMAP command from a workstation not in 3270 emulation mode, you will receive the CPF8701 message. By monitoring for it, the rest of the program goes unused in these circumstances.

```
PGM
MONMSG      MSGID(CPF8701 CPF0000)
CHGKBDMAP  PF1(*F1) PF2(*F2) PF3(*F3) PF4(*F4) PF5(*F5)
PF6(*F6) PF7(*DOWN) PF8(*UP) PF9(*F9)
PF10(*F10) PF11(*F11) PF12(*F12)
PA1PF1(*HELP) PA1PF2(*HLP3270)
PA1PF3(*CLEAR) PA1PF4(*PRINT)
PA1PF5(*DSPATR) PA1PF6(*TEST) PA1PF7(*F7)
PA1PF8(*F8) PA1PF9(*ATTN) PA1PF10(*RESET)
PA1PF11(*SYSREQ) PA1PF12(*BCKSPC)
ENDPGM
```

By storing this CL source as part of the QCLSRC file in library TCPLIB as member CHGKBD, you can create the CL program CHGKBD into the TCPLIB library by using the following CL command:

```
CRTCLPGM PGM(TCPLIB/CHGKBD) SRCFILE(TCPLIB/QCLSRC)
TEXT('Change the keyboard mapping for 327x terminals')
```

The CHGKBD program can then be called by anyone using Telnet to an iSeries server. It can also be called automatically at sign-on time by specifying the CHGKBD program for the Initial program parameter on the CHGUSRPRF command, or the CHGKBD program can be called by the profile's initial program.

### PA1 and PA2 keys on a PC keyboard

The PA1 and PA2 keys do not appear on a PC keyboard. A keyboard map in your 3270 emulator provides the function of these 3270 keys on a PC keyboard.

The default 3270 Telnet keyboard map uses these keys. Therefore, it is important that you know where these keys are on the keyboard before starting a 3270 Telnet session. This is especially important if you are planning to start a session without changing the keyboard mapping. You should refer to your emulator documentation for the keys or keystrokes required to provide these functions.

There are some 5250 key sequences for which there is no supported 3270 key sequence and, therefore, it is not possible to set these keyboard commands on a 3270. These key sequences are:

- Field Plus
- Field Minus
- Erase all input fields

The 5250 Field Exit Key function is performed on a 3270 keyboard using the Erase EOF key and then the tab key.

### Special Circumstances

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. Therefore, instructions like Press PF3 or Press PF4 should read: Press PA1 PF3 and Press PA1 PF4, prior to creating a new keyboard map.

Depending on the installation of the Telnet client for the host for example VM Telnet client, when pressing PA1 the user might get the instruction TELNET command: at the bottom line of the display. If the system displays this instruction type: PA1, press the Enter key, move the cursor to the command line and press the desired PF key. In this case the following commands may emulate PF1 to PF12:

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.

For additional keyboard mapping information, see Appendix D. TELNET 3270 Keyboard Mappings.

**Note:** The **Host Command Facility (HCF)** is a feature available on System/370<sup>(TM)</sup>, 43xx, and 30xx host systems. This feature enables a user on the host system to use applications on an iSeries server. If you use HCF to connect to an iSeries server and then use Telnet to sign on to another iSeries server from that iSeries server, you are in a 3270 full-screen mode session. The keyboard maps twice, once for the initial HCF session and once for the Telnet session. To use your PF keys the way you normally would, you must change the keyboard mapping on both iSeries server. Make sure that you use the same keyboard mapping on each iSeries server.

## VTxxx Telnet client sessions

Telnet VTxxx support allows iSeries<sup>(TM)</sup> users to sign on to non-iSeries servers as if they were on a VTxxx terminal locally attached to the system. Vtxxx client support allows an iSeries user to sign on to any remote system in a TCP/IP network that supports the Vtxxx byte stream. As an iSeries Telnet user, you should be aware of the physical and operational differences between VTxxx and 5250 sessions.

The following topics provide more information about VTxxx emulation:

### **“Start a VTxxx Telnet client session”**

Start a Telnet client session using VTxxx emulation.

### **“VTxxx full screen considerations” on page 58**

You should be aware of the issues presented in this topic when using VTxxx emulation.

### **“VTxxx emulation options” on page 62**

This topic provides information about customization options for your VTxxx emulation type.

### **“VTxxx key values” on page 62**

This topic provides keyboard mapping for support of VTxxx emulation.

## **Start a VTxxx Telnet client session**

You need to start the Telnet server on the remote system (the system that you want to connect to using Telnet).

**Note:**

You should know the name or IP address of the remote system with which you want to start the Telnet session. To display the IP addresses and host names, complete the following steps:

1. Start iSeries<sup>™</sup> Navigator and expand **your iSeries server** —> **Network**.
2. Right-click **TCP/IP Configuration** and click **Host Table** to display the IP addresses and host names.

**Starting a Telnet client session**

1. Type the STRTCPTLN command, or type TELNET at the iSeries command line and press **Enter**.
2. Type the name of the remote system, or type \*INTNETADR if you prefer to use the IP address. If you want to see the optional parameters, press F10. Otherwise, press **Enter**.  
If you typed \*INTNETADR for the **Remote system** field, iSeries prompts you for the **IP address** field.
3. Type the IP address of the remote system. To use the optional parameters, press **F10**, otherwise press **Enter**. The display shows optional parameter values and the IP address information.
4. To use the default parameter values, press **Enter**.
5. During a VTxxx full-screen mode session, the following optional parameters are also applicable:
  - Incoming ASCII translation table (TBLVTIN)
  - Outgoing ASCII translation table (TBLVTOUT)
  - Special table out (TBLVTDRWO)
  - Special table in (TBLVTDRWI)
  - Options selected (VTOPT)
  - Display character attributes (DSPCHRATTR)
  - Page scroll feature (PAGE\_SCROLL)
  - Answer back feature (ANSWERBACK)
  - Tab Stops (TABSTOP)
  - Timeout wait for host (INZWAIT)
  - Coded character set identifier (CCSID)
  - ASCII operating mode (ASCOPRMOD)— applies to initializing a VT220 session only (has no effect on negotiations)
  - Port number of the remote host server application (PORT)
  - Control Characters (CTLCHAR)

**Note:**

Unexpected characters may appear due to the incorrect configuration of the remote system. If this happens, verify that the workstation-type value is an appropriate value for a VTxxx full screen mode workstation. You can also use the set term command to change the full screen mode of the connection.

The next display is the sign-on display for the remote system.

If you are planning on using VTxxx in full screen mode, refer to “VTxxx full screen considerations” on page 58.

To control server functions while you are in a client session, see “Control Telnet server functions from the client” on page 48.

For more information on keyboard mapping, see “VTxxx key values” on page 62.



## **VTxxx full screen considerations**

As with any emulation type, you should be aware of certain considerations before using the VTxxx full-screen mode with your Telnet Server. These considerations include security concerns as well as possible error conditions and indicator lights. Become familiar with these considerations to better understand how to use VTxxx full-screen mode.

In addition to security concerns, there are many other concerns to consider before using VTxxx full-screen mode with your Telnet server. When using VTxxx full-screen mode, you should be aware of the following concerns:

- Security considerations for VTxxx full-screen Mode (page 58)
- Telnet and SNA 5250 pass-through considerations for VTxxx full-screen mode (page 58)
- System request processing for VTxxx sessions (page 58)
- Error conditions on 5250 keyboard (page 58)
- Display stations and VTxxx support (page 59)
- Operational differences (page 59)
- Keyboard characteristics (page 60)
- Screen characteristics (page 60)
- VTxxx screen size (page 61)
- VTxxx character attributes (page 61)

### **Security considerations for VTxxx full-screen Mode**

The number of sign-on attempts allowed increases if Telnet automatically configures virtual devices. The number of sign-on attempts is equal to the number of system sign-on attempts allowed multiplied by the number of virtual devices possible.

The QMAXSIGN system value defines the number of system sign-on attempts allowed. The QAUTOVRT system value defines the number of virtual devices Telnet can create.

### **Telnet and SNA 5250 pass-through considerations for VTxxx full-screen mode**

The iSeries<sup>(TM)</sup> server supports 5250 pass-through. 5250 pass-through is similar to Telnet, but runs on an Systems Network Architecture (SNA) protocol network rather than a TCP/IP network. 5250 pass-through uses virtual displays to direct output to the physical devices just as Telnet does. In 5250 pass-through, the iSeries server automatically creates virtual devices in the same way that it does for Telnet. Therefore, the Devices System Value controls the number of automatically configured virtual devices for both 5250 pass-through and Telnet.

### **System request processing for VTxxx sessions**

The system request processing for the VTxxx sessions is slightly different than that for a normal 5250 workstation.

When the System Request key is pressed on a 5250 workstation, a system request command line appears at the bottom of the display. If you press the Enter key, the System Request menu appears.

For VTxxx sessions when you call the system request function, the System Request menu displays immediately.

### **Error conditions on 5250 keyboard**

Certain error conditions cause a 5250 keyboard to lock and an error code to display on the message line. An example of such a condition is typing when the cursor is not in an input field. For VTxxx sessions, these errors cause a bell to sound on the VTxxx workstation and the keyboard to remain unlocked.

Certain iSeries applications also lock the 5250 keyboard and turn on the 5250 input-inhibited light. The user must press the Error Reset key before the keyboard unlocks. For VTxxx sessions, the locking of the



5250 keyboard causes a bell to sound on the VTxxx terminal whenever a key is pressed. To unlock the keyboard, the VTxxx key that is mapped to the Error Reset key must be pressed. In the default VTxxx keyboard map, the CTL-R key maps to the Error Reset key.

### **Display stations and VTxxx support**

When the system negotiates VTxxx support, the Telnet server transmits screens that are a maximum of 24 rows by 80 columns. The VTxxx client system sees these screens in much the same way as they appear on a 5251 Model 11 workstation. However, there are some differences.

A 5251 workstation has indicator lights on the right side that indicate: System Available, Message Waiting, Keyboard Shift, Insert Mode, and Input-Inhibited.

The VTxxx server support emulates the System Available light by putting an asterisk in column 80 of row 9. For Message Waiting, Insert Mode, and Input-Inhibited lights, the asterisk appears in column 80 of rows 11, 13, or 15, respectively. When an asterisk appears, the asterisk overwrites the character that was previously displayed at that screen location. By default, the VTxxx server does not display the indicator lights. You can enable or disable these indicators by typing the key sequence that is mapped to the toggle indicator lights function. The default key sequence for this function is ESC-T.

### **Note:**

- When using a VTxxx client to attach to the iSeries Telnet server, note that the Insert Mode and the Input-Inhibited lights may not always display as described above. 5250 supports the attachment as a local function while the VTxxx has no such facility. The System Available and Message Waiting indicators, however, will display correctly.
- A 5251 display supports a screen attribute known as a column separator. The **column separator** is a vertical line displayed between characters. This line does not take up a character space. The VTxxx does not support such an attribute. If an iSeries application generates a screen that uses the column separator attribute, that screen is displayed on the VTxxx client system with the column separator mapped to the VTxxx underline attribute.

### **Operational Differences**

As an iSeries Telnet user, you should be aware of physical and operational differences between VTxxx and 5250 terminals.

The 5250 is a block mode terminal. Data typed on a 5250 is accumulated in a buffer and only sent to the iSeries server when an AID (attention identifier) key is pressed. An AID key on a 5250 keyboard is a key that initiates a function. The following are the AID keys on a 5250 keyboard:

- Clear
- Command Function 1 through 24
- Enter/Rec Adv
- Help
- Print
- Record Backspace Function
- Roll Down (Page Up)
- Roll Up (Page Down)

VTxxx terminals operate in a character mode. Characters transmit immediately to the host when a key is pressed.

Another difference is the way the data arrives on the display. The system writes data to a VTxxx terminal one character at a time, and you see the data arrive as streams of characters. With the 5250, the system writes data in blocks, and all or part of the display changes at once.

### Keyboard characteristics

You should avoid using the 5250 cursor movement keys. Instead, you should use the function keys associated with the \*CSRUP, \*CSRDOWN, \*CSRRIGHT, and \*CSRLEFT keywords. By default these are keys F13, F14, F15, and F16, respectively. If you use the 5250 cursor movement keys, the VTxxx application you are using may not function as expected. This is because the results of using these keys do not transmit to the remote system until an attention identifier (AID) key is pressed.

For example, using Telnet to the RS/6000<sup>(R)</sup> and obtaining VT220 emulation, the SMIT command provides a menu driven interface to AIX<sup>(R)</sup>. Here the function keys associated with \*CSRxx keywords perform as you would expect the cursor movement keys to do. However, the 5250 cursor movement keys, while physically moving the cursor down the screen and correctly selecting the SMIT option, do not cause the selected option to be highlighted. The highlighting in reverse image remains with the first option on the SMIT menu, regardless of the key position.

Typing a control character on an iSeries keyboard is different than typing a control character on an actual VTxxx terminal. On a VTxxx terminal, press and hold down the control key while pressing the character associated with the control function.

When using the iSeries Telnet support, the equivalent is achieved by typing a 2 character control indicator followed by pressing the function key associated with the Send without Carriage Return (\*SENDWOCR) default function (the F11 key). For example, if the default keyboard map and the default STRTCPTELN command parameters are in effect, the VTxxx Control-C function can be entered by typing &C followed by pressing the F11 key. <F12> can also enter this function, using the default keyboard map. In case you are using an application where <F12> is remapped, this example is included, and illustrates the principle of the \*SENDWOCR key.

Use the CTLCHAR parameter of the STRTCPTELN command to select the character used to indicate a control character. The default is &. The &C characters must be the last characters typed before pressing the \*SENDWOCR function key or the &C is not interpreted as a control character. A control character only transmits when the \*SENDWOCR function key is pressed. You can assign frequently used VTxxx control characters to a function key. The following is a descriptive example of the Ctrl-C command. When using a Telnet client to connect to an RS/6000 system, the system typically negotiates VT220 emulation. The Ctrl-C sequence is an important one in AIX to end long running commands, such as PING. It is, therefore, important that you know how to do this before issuing any RS/6000 commands. By default the sequence is &C<F11>. Note that you have to enter these keys quickly, and it may take several attempts before the RS/6000 task accepts the input.

Press function key that is associated with the \*HIDE function, (F6 on the default keyboard map) if you do not want to display the typed characters. Use this function when typing a password.

If you want the characters that have been typed to be sent to the remote system for processing without pressing the Enter key, you should press the function key associated with the \*SENDWOCR function (F11 on the default keyboard map).

It is often useful to be able to recall previously entered commands. On the iSeries server, F9 often provides this function. On AIX, this can be activated by typing the command set -o vi and pressing Enter. After this, you can start retrieving commands with the sequence Esc-K. To perform this sequence using the default keyboard map while in VTxxx emulation, you should use the sequence <F5>k<F11>. The Esc character starts the command retrieval. Then use the k to retrieve further commands. While operating in this mode, the commands H for right, L for left, X for delete, I for insert, and R for replace apply. The sequence <F5>i<F11> switches this facility off.

### Screen characteristics

The character in the position just before the cursor position will always be blank. The actual character saves internally and shows when the display refreshes with the cursor in a different position.

A VTxxx application that uses row 1, column 1 of the display does not work the same when using iSeries Telnet client support. Most 5250-type display stations do not allow input to row 1, column 1. If the VTxxx application positions the cursor at row 1, column 1, the iSeries server puts the cursor at row 1, column 2 automatically.

Due to architectural differences, the system ignores certain unsupported commands or sequences. An example is downstream loadable character sets.

### **VTxxx screen size**

Telnet VTxxx full-screen mode supports the following screen sizes:

- On 3180 display stations:
  - 24 x 80 VTxxx screens should display as 24 x 80.
  - 24 x 132 VTxxx screens should display as 24 x 132.
- On 5250 display stations:
  - 24 x 80 VTxxx screens should display as 24 x 80.
  - 24 x 132 screens require the function key assigned to \*SHIFTDSP (F10 on the default keyboard map) to move the information on the screen right or left.

### **VTxxx character attributes**

A VTxxx terminal supports the following attributes:

- Blink
- Bold
- Reverse image
- Underline
- Any combination of the above

The 5250 data stream supports the previous attributes so that a 5250 display station can represent all of the VTxxx attributes. However, there are some limitations:

- The 5250 data stream can only support three of the character attributes at the same time. The underline, blink, and reverse image attributes display when the remote system selects all the VTxxx attributes at the same time. A 5250 display station cannot display the combination of underline, bold, and reverse image. Underline and reverse image displays when a VTxxx application selects this combination.
- The attribute byte takes up a space on the 5250 display stations that do not support extended attributes. Attributes do not take up space on a VTxxx terminal. This means that if you select character attributes, you do not see all of the data shown on the 5250 display. When receiving VTxxx data that is to display with character attributes, the 5250-attribute byte overlays the position before the data. The character that was displayed there is lost. If a character is to display in row 1, column 1 with the attributes set, that character is not displayed. You can choose not to have the character attributes displayed by specifying DSPCHRATTR(\*NO) on the STRTCPTLN command. This allows you to see all of the data on the display without attributes.

#### **Note:**

This restriction is not applicable for displays that support extended attributes such as the 3477 display.

### **VT100 keyboard indicator**

A VT100 terminal has a L1 indicator that can be programmed for different applications. This indicator is not emulated by the iSeries Telnet support.

## VTxxx emulation options

When using VTxxx full-screen mode with your Telnet server, there are a few optional procedures that you can do to personalize the emulation type. You can display the current keyboard map and then decide whether or not you want to change it. You can also change the control characters when using VT220 full-screen mode.

### Displaying a VTxxx keyboard map

To display the current keyboard map use the Display VT Keyboard Map (DSPVTMAP) command. This command has no parameters. You are shown the VTxxx keys that are mapped to the iSeries<sup>(TM)</sup> server functions.

The DSPVTMAP command is only valid when called from within an iSeries Telnet server session operating in VTxxx full-screen mode.

Type DSPVTMAP to see the following display, and then press the Page Down key to see the additional displays. You can display the VT keyboard map using option 3 from the Configure TCP/IP Telnet menu.

### Setting a VTxxx keyboard map

To change the default keyboard map, use the Set VT Keyboard Map (SETVTMAP) command. (This command is also available by using option 5 (Set VT keyboard map) from the Configure TCP/IP Telnet menu.) The shipped default keyboard map specified, restores after running the command without any user-specified parameters. You can specify up to four of the defined special values for each parameter. A special value cannot be used to specify more than one iSeries server function.

### Changing a VTxxx keyboard map

Like SETVTMAP, the Change VT Keyboard Map (CHGVTMAP) command allows you to customize the keyboard mapping when connected to an iSeries Telnet server in VTxxx mode. The parameters for the SETVTMAP command default to the shipped values. Whereas the parameters for the CHGVTMAP command default to the currently set values. Except for this distinction, the two commands are identical.

For more information on changing the VT keyboard map, see "VTxxx key values."

### VTxxx automatic wrap

The iSeries VTxxx server requires the VTxxx client to have the automatic wrap (autowrap) option turned on. When autowrap is on, a character written to column 80 of the VTxxx causes the cursor to move to column 1 of the next line. Refer to your VTxxx client documentation for details of how to set on this option.

### VT220 control characters

When VT220 8-bit emulation is negotiated, the range of characters X'80' through X'9F' are protected as C1 control characters as architecturally defined in the DEC VT220 Programmer Reference Manual. This may result in the system interpreting succeeding characters in a data stream as data in relation to these characters. If the system negotiates VT220 7-bit or VT100, then the full range of characters from X'80' through X'F'. is available for character translation. Interpret X'80' through X'9F' as C1 control characters in VT220 8-bit control mode only.

This has particular relevance to National Language Support (NLS), as several non-English languages use these values for language-specific characters. In these cases, the VT220 8-bit emulation may not function as anticipated.

## VTxxx key values

The client session support for both the VT100 and VT220 modes provides a primary and alternate keyboard map. To accommodate the additional keypad capabilities of the VT220 mode, you can save your keyboard map. By using the F6 key from the Change VTxxx Keyboard Map display, you can save all changes to these keyboard maps for later sessions. The data saves in the user profile, and once saved will automatically apply the next time Telnet VTxxx emulation is activated.

The keyboard option that you select from the Send Telnet Control Functions menu determines which keyboard map you use. Figures 2 through 9 show the VTxxx functions that correspond to the 5250 AID key. The following list gives the option number and the corresponding figures:

- Figure 2 and Figure 3 show option 6 (Change VT100 Primary Keyboard Map).
- Figure 4 and Figure 5 show option 7 (Change VT100 Alternate Keyboard Map).
- Figure 6 and Figure 7 show option 8 (Change VT220 Primary Keyboard Map).
- Figure 8 and Figure 9 show option 9 (Change VT220 Alternate Keyboard Map).

The level of support negotiated between the iSeries<sup>(TM)</sup> server and the Telnet server determines which options display on the Send Telnet Control Functions menu. The menu displays options 6 and 7 if the VT100 full-screen mode support negotiates initially. The menu displays options 8 and 9 if the VT220 full-screen mode support negotiates initially.

**Note:** There are no differences in the default values of the VT100 primary and alternate keyboard maps.

The following figures show the default keyboard mappings. You can change any of the values. If you press the Enter key, your changes save for the current session only. If you press F6 (Save), your changes save permanently and are in effect the next time you start a VTxxx Telnet session.

**Figure 1. Change VT100 Primary Keyboard Map (Display 1)**

```

+-----+
|                                     Change VT100 Primary Keyboard Map
| Type changes, press Enter:
| 5250 key          VT100 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
+-----+

```

**Figure 2. Change VT100 Primary Keyboard Map (Display 2)**

```

+-----+
|                                     Change VT100 Primary Keyboard Map
| Type changes, press Enter:
| 5250 key          VT100 function
| Function Key 17 . . *CTLD
| Function Key 18 . . *CTLE
| Function Key 19 . . *CTLF
| Function Key 20 . . *CTLG
| Function Key 21 . . *CTLH
| Function Key 22 . . *CTLI
| Function Key 23 . . *CTLJ
| Function Key 24 . . *CTLK
| Rollup key . . . . *CTLL
+-----+

```

```

Rolldown key . . . . *CTLM

                                                                    Bottom

F3=Exit  F6=Save  F12=Cancel

```

**Figure 3. Change VT100 Alternate Keyboard Map (Display 1)**

```

                                                                    Change VT100 Alternate Keyboard Map
Type changes, press Enter:
5250 key          VT100 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

```

**Figure 4. Change VT100 Alternate Keyboard Map (Display 2)**

```

                                                                    Change VT100 Alternate Keyboard Map
Type changes, press Enter:
5250 key          VT100 function
Function Key 17 . . *CTLD
Function Key 18 . . *CTLE
Function Key 19 . . *CTLF
Function Key 20 . . *CTLG
Function Key 21 . . *CTLH
Function Key 22 . . *CTLI
Function Key 23 . . *CTLJ
Function Key 24 . . *CLK
Rollup key . . . . *CTLL
Rolldown key . . . . *CTLM

                                                                    Bott

F3=Exit  F6=Save  F12=Cancel

```

You can switch between the primary and alternate keyboard maps during a VTxxx session using the function key assigned to the \*KEYPRI and \*KEYALT keywords. You can assign these keywords to any of

the available 5250 function keys. It is recommended that you assign \*KEYPRI to the Page Up 5250 function key and \*KEYALT to the Page Down 5250 function key for both primary and alternate keyboard maps.

**Figure 5. Change VT220 Primary Keyboard Map (Display 1)**

```
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
```

**Figure 6. Change VT220 Primary Keyboard Map (Display 2)**

```
Change VT220 Primary Keyboard Map
Type changes, press Enter:
5250 key      VT220 function
Function Key 17 . . *CTLD
Function Key 18 . . *CTLE
Function Key 19 . . *CTLF
Function Key 20 . . *CTLG
Function Key 21 . . *CTLH
Function Key 22 . . *CTLI
Function Key 23 . . *CTLJ
Function Key 24 . . *CTLK
Page up (rolldown) . *KEYPRI
Page down (rollup) . *KEYALT
Bottom

F3=Exit  F6=Save  F12=Cancel
```

**Figure 7. Change VT220 Alternate Keyboard Map (Display 1)**

```
Change VT220 Alternate 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 . . *CTLK
Function Key 13 . . *CSRUP
Function Key 14 . . *CSRDOWN
Function Key 15 . . *CSRRIGHT
Function Key 16 . . *CSRLEFT
More...

F3=Exit  F6=Save  F12=Cancel

```

Figure 8. Change VT220 Alternate Keyboard Map (Display 2)

```

Change VT220 Alternate Keyboard Map
Type changes, press Enter:
5250 key      VT220 function
Function Key 17 . . *CTLD
Function Key 18 . . *FINDKEY
Function Key 19 . . *INSERTKEY
Function Key 20 . . *REMOVEKEY
Function Key 21 . . *SELECTKEY
Function Key 22 . . *PREVSCN
Function Key 23 . . *NEXTSCN
Function Key 24 . . *CTLK
Rollup key . . . . *KEYPRI
Rolldown key . . . . *KEYALT
Bottom

F3=Exit  F6=Save  F12=Cancel

```

You can enter several types of VTxxx information to change the keyboard map. Here are some examples:

**Character data**

You can assign a character string to a function key. For example, you are on the iSeries server and are using Telnet to establish a connection with an RS/6000<sup>(R)</sup> system. To assign the character string set term=vt100 to the following function key:

```

Function Key 24 . . *CTLK

From the iSeries you would type:
Function Key 24 . . 'set term=vt100'

```

This allows you to press a function key rather than always having to type that character string.

When you press the function key during a VTxxx session the character string assigned to that function key transmits to the remote system with the carriage return, line feed characters added. If you type data before pressing the function key, the system adds the character string to the data that you type. This allows you to assign a frequently used command string to a function key. The character data that you type maps from EBCDIC to ASCII before transmission to the remote system.



**Control key keywords** You can assign a VTxxx control keystroke to a function key using a defined keyword. For example, if you wanted to assign a different VTxxx control keystroke to the following function key:

```
Function Key 24 . . *CTLK
```

You would type:

```
Function Key 24 . . *CTLZ
```

When you press the function key, the new control character assigned to the function key transmits to the remote system. If you type data before pressing the function key, the control character adds to the typed data and transmits to the remote system.

### Hexadecimal data

You can assign a hexadecimal string to a function key. When you press the function key, the hexadecimal data transmits to the remote system. The carriage return, and line feed characters are not added to hexadecimal data. If you type data before pressing the function key, the hexadecimal data adds to the typed data and transmits to the remote system. This allows you to type a character that is not on the 5250 keyboard (for example, square brackets). To assign a hexadecimal string, type X followed by a quoted string of hexadecimal characters, for example, X'1A1A'. The hexadecimal data does not map before transmission to the remote system.

### Local iSeries control functions

You can assign a keyword to be handled locally within the iSeries Telnet client session. These assignments or mappings may not result in the ASCII data stream traffic transmitting to the remote Telnet server session. These local control functions are \*HIDE, \*SHIFTDSP, \*KEYPRI, and \*KEYALT. The send without carriage return (\*SENDWOCR) function is also a local function, but in this case, the ASCII data streams transmit to the remote Telnet server session.

For additional information about VTxxx key values, refer to the following topics:

- "VTxxx National Language Support"
- "VTxxx national mode" on page 68
- "Numeric keypad" on page 70
- "Editing keypad" on page 71
- "VTxxx key values by 5250 function" on page 73
- "VT220 workstation operating modes" on page 76
- "VT220 top-row function keys" on page 76
- "VT100 and VT220 Control Character Keywords" on page 77

**VTxxx National Language Support:** There are alternative methods of selecting character mapping between the client and server systems with VTxxx emulation. These are:

- Coded character set identifier (CCSID)
- Multinational mode
- National mode

If none of these modes is suitable, you may set up and specify your own user-defined mapping tables.

**Note:**

VTxxx support is limited to a subset of single-byte character set (SBCS) languages. A list of the supported languages is found later in this section. Any of these supported single-byte language translation tables can be modified to map any single-byte language that is preferred, then identified in the appropriate parameter for starting Client Telnet.

Mode selection is done with the CCSID parameter of the Start TCP/IP Telnet (STRTCPTELN) command. The incoming ASCII/EBCDIC table (TBLVTIN) and outgoing EBCDIC/ASCII table (TBLVTOU) parameters of this command allow the specification of user-defined mapping tables. If these are not required, the default value of \*CCSID allows for character mapping by using the mode specified in the CCSID parameter.

### **VTxxx Multinational Mode**

The multinational mode supports the DEC multinational character set, which is an 8-bit character set that contains most characters used in the major European languages. The ASCII character set is included in the DEC multinational character set. The DEC multinational character set is used by default.

**VTxxx national mode:** The national mode supports the national replacement character set, which is a group of 7-bit character sets. Only one character set from the group is available for use at any one time. VT220 also supports the standard 7-bit ASCII character set as part of the national mode. The VT220 terminal supports the following national languages in 7-bit ASCII character sets:

- British
- Danish
- Dutch
- Finnish
- French
- French/Canadian
- German
- Italian
- Norwegian
- Spanish
- Swedish
- Swiss
- US English

To use a national mode, the system requires mapping tables to map incoming ASCII data into EBCDIC and outgoing EBCDIC data into ASCII when operating in VTxxx full-screen mode.

Use the CCSID parameter on the Telnet command to select a national mode that is, a NLS mapping table. See “Start a VTxxx Telnet client session” on page 56.

Entering a numeric value representing a registered CCSID value in the range 1-65553, is one way to identify the appropriate mapping table. The *International Application Development* book contains details of registered CCSIDs.

The NLS mapping tables are built dynamically to a remote system the first time Telnet is used, and are based on DEC national replacement character sets. Because the character sets are 7-bit based, they can contain only the unique characters from one country. Because the DEC multinational character set is 8-bit based, it allows for the inclusion of the unique characters from a group of countries.

### **Identifying Table Objects**

You can identify the table objects (\*TBL) using the Work with Object command: WRKOBJ OBJ(QUSRSYS/Q\*) OBJTYPE(\*TBL)

All of the system table objects are in QUSRSYS library.

The table objects are named Qxxxxyyzzz 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 figure 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.

For the incoming (ASCII-to-EBCDIC) table:

- The FROM code page ID is derived from the CCSID parameter used with the Telnet command.
- The TO character set and code page are taken from the character set ID and code page ID in QCHRID of message description CPX8416 (use WRKMSGD CPX8416 to display), 697 and 037 in the figure below from a US English based system.

**Figure 1. Example CPX8416 Message**

```

+-----+
|                                     System: SYSNAM01
| Message ID . . . . . : CPX8416
| Message file . . . . . : QCPFMSG
| Library . . . . . : QSYS
|
| Message . . . . . :
| QCHRID 697 37 QCURSYM $ QDATFMT MDY QDATSEP /
| QDECFMT QLEAPADJ 0 QCCSID 37 QTIMSEP : QLANGID ENU
| QCNTYID US QIGCCDEFNT *NONE
+-----+

```

CCSID	Character Set Actual ID	Character Set Table ID	Code Page Actual ID	Code Page Actual ID
MULTINAT	1290	A05	1100	A5U
BRITISH	1291	A06	1101	A5V
1292	A07	1102	A5W	
1293	A08	1103	A5X	
289	289	1104	A5Y	
1192	A8E	1020	A3M	
265	265	1011	A3D	
293	293	1012	A3E	
1297	BAB	1107	A52	
1195	A8H	1023	A3P	
1296	BAA	1106	A51	
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 that uses Telnet with CCSID(\*BRITISH), the tables would have the following names:

- Outgoing (EBCDIC-to-ASCII) Q285A06A5V
- Incoming (ASCII-to-EBCDIC) QA5V697285

**User-Defined Mapping Tables (ASCII Mode)**

Where the multinational or NLS mapping tables do not meet the requirements of a user, user-defined character mapping tables can be created and used.

You also have the ability to specify user-defined mapping tables using the outgoing ASCII-to-EBCDIC table (TBLVTOU) and incoming ASCII-to-EBCDIC table (TBLVTIN) parameters of the STRTCPTLN command. You can specify a user-defined mapping table for either the outgoing mapping table or the incoming mapping table and then use the system default value for the other.

**Numeric keypad:** The following table shows the keys on the auxiliary keypad that normally transmit the codes for the numerals, decimal point, minus sign, and comma.

Keyword	Mode	Hex Character Transmitted	Control Character Description
*NUM0	VT52 mode	X'30' or X'1B3F70' <sup>1</sup>	Numeric keypad 0 key
*NUM0	VT100 or VT220 7-bit mode	X'30' or X'1B4F70' <sup>1</sup>	Numeric keypad 0 key
*NUM0	VT220 8-bit mode	X'30' or X'8F70' <sup>2</sup>	Numeric keypad 0 key
*NUM1	VT52 mode	X'31' or X'1B3F71' <sup>1</sup>	Numeric keypad 1 key
*NUM1	VT100 or VT220 7-bit mode	X'31' or X'1B4F71' <sup>1</sup>	Numeric keypad 1 key
*NUM1	VT220 8-bit mode	X'31' or X'8F71' <sup>2</sup>	Numeric keypad 1 key
*NUM2	VT52 mode	X'32' or X'1B3F72' <sup>1</sup>	Numeric keypad 2 key
*NUM2	VT100 or VT220 7-bit mode	X'32' or X'1B4F72' <sup>1</sup>	Numeric keypad 2 key
*NUM2	VT220 8-bit mode	X'32' or X'8F72' <sup>2</sup>	Numeric keypad 2 key
*NUM3	VT52 mode	X'33' or X'1B3F73' <sup>1</sup>	Numeric keypad 3 key
*NUM3	VT100 or VT220 7-bit mode	X'33' or X'1B4F73' <sup>1</sup>	Numeric keypad 3 key
*NUM3	VT220 8-bit mode	X'33' or X'8F73' <sup>2</sup>	Numeric keypad 3 key
*NUM4	VT52 mode	X'34' or X'1B3F74' <sup>1</sup>	Numeric keypad 4 key
*NUM4	VT100 or VT220 7-bit mode	X'34' or X'1B4F74' <sup>1</sup>	Numeric keypad 4 key
*NUM4	VT220 8-bit mode	X'34' or X'8F74' <sup>2</sup>	Numeric keypad 4 key
*NUM5	VT52 mode	X'35' or X'1B3F75' <sup>1</sup>	Numeric keypad 5 key
*NUM5	VT100 or VT220 7-bit mode	X'35' or X'1B4F75' <sup>1</sup>	Numeric keypad 5 key
*NUM5	VT220 8-bit mode	X'35' or X'8F75' <sup>2</sup>	Numeric keypad 5 key
*NUM6	VT52 mode	X'36' or X'1B3F76' <sup>1</sup>	Numeric keypad 6 key
*NUM6	VT100 or VT220 7-bit mode	X'36' or X'1B4F76' <sup>1</sup>	Numeric keypad 6 key
*NUM6	VT220 8-bit mode	X'36' or X'8F76' <sup>2</sup>	Numeric keypad 6 key
*NUM7	VT52 mode	X'37' or X'1B3F77' <sup>1</sup>	Numeric keypad 7 key
*NUM7	VT100 or VT220 7-bit mode	X'37' or X'1B4F77' <sup>1</sup>	Numeric keypad 7 key
*NUM7	VT220 8-bit mode	X'37' or X'8F77' <sup>2</sup>	Numeric keypad 7 key
*NUM8	VT52 mode	X'38' or X'1B3F78' <sup>1</sup>	Numeric keypad 8 key
*NUM8	VT100 or VT220 7-bit mode	X'38' or X'1B4F78' <sup>1</sup>	Numeric keypad 8 key
*NUM8	VT220 8-bit mode	X'38' or X'8F78' <sup>2</sup>	Numeric keypad 8 key
*NUM9	VT52 mode	X'39' or X'1B3F79' <sup>1</sup>	Numeric keypad 9 key
*NUM9	VT100 or VT220 7-bit mode	X'39' or X'1B4F79' <sup>1</sup>	Numeric keypad 9 key
*NUM9	VT220 8-bit mode	X'39' or X'8F79' <sup>2</sup>	Numeric keypad 9 key
*NUMMINUS	VT52 mode	X'2D' or X'1B3F6D' <sup>1</sup>	Numeric keypad minus key
*NUMMINUS	VT100 or VT220 7-bit mode	X'2D' or X'1B4F6D' <sup>1</sup>	Numeric keypad minus key

Keyword	Mode	Hex Character Transmitted	Control Character Description
*NUMMINUS	VT220 8-bit mode	X'2D' or X'8F6D' <sup>2</sup>	Numeric keypad minus key
*NUMCOMMA	VT52 mode	X'2C' or X'1B3F6C' <sup>1</sup>	Numeric keypad comma key
*NUMCOMMA	VT100 or VT220 7-bit mode	X'2C' or X'1B4F6C' <sup>1</sup>	Numeric keypad comma key
*NUMCOMMA	VT220 8-bit mode	X'2C' or X'8F6C' <sup>2</sup>	Numeric keypad comma key
*NUMPERIOD	VT52 mode	X'2E' or X'1B3F6E' <sup>1</sup>	Numeric keypad period key
*NUMPERIOD	VT100 or VT220 7-bit mode	X'2E' or X'1B4F6E' <sup>1</sup>	Numeric keypad period key
*NUMPERIOD	VT220 8-bit mode	X'2E' or X'8F6E' <sup>2</sup>	Numeric keypad period key
*PF1	VT52 mode	X'1B50'	Numeric keypad PF1 key
*PF1	VT100 or VT220 7-bit mode	X'1B4F50'	Numeric keypad PF1 key
*PF1	VT220 8-bit mode	X'8F50' <sup>2</sup>	Numeric keypad PF1 key
*PF2	VT52 mode	X'1B51'	Numeric keypad PF2 key
*PF2	VT100 or VT220 7-bit mode	X'1B4F51'	Numeric keypad PF2 key
*PF2	VT220 8-bit mode	X'8F51' <sup>2</sup>	Numeric keypad PF2 key
*PF3	VT52 mode	X'1B52'	Numeric keypad PF3 key
*PF3	VT100 or VT220 7-bit mode	X'1B4F52'	Numeric keypad PF3 key
*PF3	VT220 8-bit mode	X'8F52' <sup>2</sup>	Numeric keypad PF3 key
*PF4	VT52 mode	X'1B53'	Numeric keypad PF4 key
*PF4	VT100 or VT220 7-bit mode	X'1B4F53'	Numeric keypad PF4 key
*PF4	VT220 8-bit mode	X'8F53' <sup>2</sup>	Numeric keypad PF4 key

<sup>1</sup>- A single-character is transmitted when in keypad numeric mode; a 3-character sequence is sent when in keypad application mode.

<sup>2</sup>- This sequence is a shortened version of the 7-bit sequence. It is either presented when operating in 8-bit mode, which can be called by the remote VT220 host or server, or it may be specified in the ASCOPRMODE parameter of the STRTCPTLN CL command.

**Editing keypad:** The following table shows the keys that transmit codes for the editing keypad keys.

Keyword	Mode	Hex Character Transmitted	Control Character Description
*CSRUP	VT52 mode	X'1B41'	Cursor-up key
*CSRUP	VT100 or VT220 7-bit Cursor Key Mode Reset	X'1B5B41'	Cursor-up key
*CSRUP	VT220 8-bit Cursor Key Mode Reset	X'9B41'	Cursor-up key
*CSRUP	VT100 or VT220 7-bit Cursor Key Mode Set	X'1B4F41'	Cursor-up key
*CSRUP	VT220 8-bit Cursor Key Mode Set	X'8F41'	Cursor-up key
*CSRDOWN	VT52 mode	X'1B42'	Cursor-down key
*CSRDOWN	VT100 or VT220 7-bit Cursor Key Mode Reset	X'1B5B42'	Cursor-down key
*CSRDOWN	VT220 8-bit mode Cursor Key Mode Reset	X'9B42'	Cursor-down key

Keyword	Mode	Hex Character Transmitted	Control Character Description
*CSRDOWN	VT100 or VT220 7-bit Cursor Key Mode Set	X'1B4F42'	Cursor-down key
*CSRDOWN	VT220 8-bit mode Cursor Key Mode Set	X'8F42'	Cursor-down key
*CSRRIGHT	VT52 mode	X'1B43'	Cursor-right key
*CSRRIGHT	VT100 or VT220 7-bit Cursor Key Mode Reset	X'1B5B43'	Cursor-right key
*CSRRIGHT	VT220 8-bit Cursor Key Mode Reset	X'9B43'	Cursor-right key
*CSRRIGHT	VT100 or VT220 7-bit Cursor Key Mode Set	X'1B4F43'	Cursor-right key
*CSRRIGHT	VT220 8-bit Cursor Key Mode Set	X'8F43'	Cursor-right Key
*CSRLEFT	VT52 mode	X'1B44'	Cursor-left key
*CSRLEFT	VT100 or VT220 7-bit Cursor Key Mode Reset	X'1B5B44'	Cursor-left key
*CSRLEFT	VT220 8-bit Cursor Key Mode Reset	X'9B44'	Cursor-left key
*CSRLEFT	VT100 or VT220 7-bit Cursor Key Mode Set	X'1B4F44'	Cursor-left key
*CSRLEFT	VT220 8-bit Cursor Key Mode Set	X'8F44'	Cursor-left key
*FINDKEY	VT220 7-bit mode	X'1B5B317E'	Editing keypad Find key
*FINDKEY	VT220 8-bit mode	X'9B317E' <sup>1</sup>	Editing keypad Find key
*INSERTKEY	VT220 7-bit mode	X'1B5B327E'	Editing keypad Insert Here key
*INSERTKEY	VT220 8-bit mode	X'9B327E' <sup>1</sup>	Editing keypad Insert Here key
*REMOVEKEY	VT220 7-bit mode	X'1B5B337E'	Editing keypad Remove key
*REMOVEKEY	VT220 8-bit mode	X'9B337E' <sup>1</sup>	Editing keypad Remove key
*SELECTKEY	VT220 7-bit mode	X'1B5B347E'	Editing keypad Select key
*SELECTKEY	VT220 8-bit mode	X'9B347E' <sup>1</sup>	Editing keypad Select key
*PREVSCN	VT220 7-bit mode	X'1B5B357E'	Editing keypad Prev Screen key
*PREVSCN	VT220 8-bit mode	X'9B357E' <sup>1</sup>	Editing keypad Prev Screen key
*NEXTSCN	VT220 7-bit mode	X'1B5B367E'	Editing keypad Next Screen key
*NEXTSCN	VT220 8-bit mode	X'9B367E' <sup>1</sup>	Editing keypad Next Screen key

**Note:** This sequence is a shortened version of the 7-bit sequence. It is only presented when operating in 8-bit mode, which can be called by the remote VT220 host or server, or it may be specified in the ASCOPRMOD parameter of the STRTCPTLN CL command.

VTxxx key values by 5250 function:

Default 5250 Function	Special Value	VTxxx Keys	Hexadecimal Value <sup>1</sup>
Attention	*CTLA	<CTRL-A>	X'01'
Attention	*ESCA	<ESC><A>	X'1B41'
Backspace	*BACKSPC	<Backspace or CTRL-H>	X'08'
Clear Screen	*ESCC	<ESC><C>	X'1B43'
Cursor Down	*CSRDOWN	<Down Arrow>	X'1B5B42'
Cursor Left	*CSRLEFT	<Left Arrow>	X'1B5B44'
Cursor Right	*CSRRIGHT	<Right Arrow>	X'1B5B43'
Cursor Up	*CSRUP	<Up Arrow>	X'1B5B41'
Delete	*DLT	<Delete>	X'7F'
Delete	*RMV	<Remove>	X'1B5B337E <sup>2</sup>
Delete	*RMV	<Remove>	X'9B337E <sup>3</sup>
Duplicate	*ESCD	<ESC><D>	X'1B44'
Enter	*RETURN	<Return or CTRL-M>	X'0D'
Erase Input	*CTLE	<CTRL-E>	X'05'
Error Reset	*CTLR	<CTRL-R>	X'12'
Error Reset	*ESCR	<ESC><R>	X'1B52'
Field Advance	*TAB	<TAB or CTRL-I>	X'09'
Field Backspace	*ESCTAB	<ESC><Tab or CTRL-I>	X'1B09'
Field Exit	*CTLK	<CTRL-K>	X'0B'
Field Exit	*CTLX	<CTRL-X>	X'18'
Field Exit	*ESCX	<ESC><X>	X'1B58'
Field Minus	*ESCM	<ESC><M>	X'1B4D'
Help	*CTLQST	<CTRL-Question Mark>	X'1F'
Help	*ESCH	<ESC><H>	X'1B48'
Home	*CTLO	<CTRL-O>	X'0F'
Insert	*ESCI	<ESC><I>	X'1B49'
Insert	*ESCDLT	<ESC><Delete>	X'1B7F'
Insert	*INS	<Insert Here>	X'1B5B327E <sup>2</sup>
Insert	*INS	<Insert Here>	X'9B327E <sup>3</sup>
New Line	*ESCLF	<ESC> <Line Feed or CTRL-J>	X'1B0A'
Page Down (Roll Up)	*CTLD	<CTRL-D>	X'04'
Page Down (Roll Up)	*CTLF	<CTRL-F>	X'06'
Page Down (Roll Up)	*NXTSCR	<Next Screen>	X'1B5B367E <sup>2</sup>
Page Down (Roll Up)	*NXTSCR	<Next Screen>	X'9B367E <sup>3</sup>
Page Up (Roll Down)	*CTLB	<CTRL-B>	X'02'
Page Up (Roll Down)	*CTLU	<CTRL-U>	X'15'
Page Up (Roll Down)	*PRVSCR	<Prev Screen>	X'1B5B357E <sup>2</sup>
Page Up (Roll Down)	*PRVSCR	<Prev Screen>	X'9B357E <sup>3</sup>
Print	*CTLP	<CTRL-P>	X'10'



Default 5250 Function	Special Value	VTxxx Keys	Hexadecimal Value <sup>1</sup>
Print	*ESCP	ESC	X'1B50'
Redraw Screen	*CTLL	<CTRL-L>	X'0C'
Redraw Screen	*ESCL	<ESC><L>	X'1B4C'
System Request	*CTLC	<CTRL-C>	X'03'
System Request	*ESCS	<ESC><S>	X'1B53'
Test Request	*CTLT	<CTRL-T>	X'14'
Toggle Indicator Lights	*ESCT	<ESC><T>	X'1B54'
F1	*ESC1	<ESC><1>	X'1B31'
F1	*F1	<F1> <sup>5</sup>	X'1B5B31317E <sup>2</sup>
F1	*F1	<F1> <sup>5</sup>	X'9B31317E <sup>3</sup>
F1	*PF1	<PF1>	X'1B4F50 <sup>2</sup>
F1	*PF1	<PF1>	X'8F50 <sup>3</sup>
F2	*ESC2	<ESC><2>	X'1B32'
F2	*F2	<F2> <sup>5</sup>	X'1B5B31327E <sup>2</sup>
F2	*F2	<F2> <sup>5</sup>	X'9B31327E <sup>3</sup>
F2	*PF2	<PF2>	X'1B4F51 <sup>2</sup>
F2	*PF2	<PF2>	X'8F51 <sup>3</sup>
F3	*ESC3	<ESC><3>	X'1B33'
F3	*F3	<F3> <sup>5</sup>	X'1B5B31337E <sup>2</sup>
F3	*F3	<F3> <sup>5</sup>	X'9B31337E <sup>3</sup>
F3	*PF3	<PF3>	X'1B4F52 <sup>2</sup>
F3	*PF3	<PF3>	X'8F52 <sup>3</sup>
F4	*ESC4	<ESC><4>	X'1B34'
F4	*F4	<F4> <sup>5</sup>	X'1B5B31347E <sup>2</sup>
F4	*F4	<F4> <sup>5</sup>	X'9B31347E <sup>3</sup>
F4	*PF4	<PF4>	X'1B4F53 <sup>2</sup>
F4	*PF4	<PF4>	X'8F53 <sup>3</sup>
F5	*ESC5	<ESC><5>	X'1B35'
F5	*F5	<F5> <sup>5</sup>	X'1B5B31357E <sup>2</sup>
F5	*F5	<F5> <sup>5</sup>	X'9B31357E <sup>3</sup>
F6	*ESC6	<ESC><6>	X'1B36'
F6	*F6	<F6>	X'1B5B31377E <sup>2</sup>
F6	*F6	<F6>	X'9B31377E <sup>3</sup>
F7	*ESC7	<ESC><7>	X'1B37'
F7	*F7	<F7>	X'1B5B31387E <sup>2</sup>
F7	*F7	<F7>	X'9B31387E <sup>3</sup>
F8	*ESC8	<ESC><8>	X'1B38'
F8	*F8	<F8>	X'1B5B31397E <sup>2</sup>
F8	*F8	<F8>	X'9B31397E <sup>3</sup>
F9	*ESC9	<ESC><9>	X'1B39'
F9	*F9	<F9>	X'1B5B32307E <sup>2</sup>

Default 5250 Function	Special Value	VTxxx Keys	Hexadecimal Value <sup>1</sup>
F9	*F9	<F9>	X'9B32307E' <sup>3</sup>
F10	*ESC0	<ESC><0>	X'1B30'
F10	*F10	<F10>	X'1B5B32317E' <sup>2</sup>
F10	*F10	<F10>	X'9B32317E' <sup>3</sup>
F11	*ESCMINUS	<ESC><Minus>	X'1B2D'
F11	*F11	<F11>	X'1B5B32337E' <sup>2</sup>
F11	*F11	<F11>	X'9B32337E' <sup>3</sup>
F12	*ESCEQ	<ESC><Equal>	X'1B3D'
F12	*F12	<F12>	X'1B5B32347E' <sup>2</sup>
F12	*F12	<F12>	X'9B32347E' <sup>3</sup>
F13	*ESCEXCL	<ESC><Exclamation>	X'1B21'
F13	*F13	<F13>	X'1B5B32357E' <sup>2</sup>
F13	*F13	<F13>	X'9B32357E' <sup>3</sup>
F14	*ESCAT	<ESC><At sign>	X'1B40'
F14	*F14	<F14>	X'1B5B32367E' <sup>2</sup>
F14	*F14	<F14>	X'9B32367E' <sup>3</sup>
F15	*ESCPOUND	<ESC><Pound>	X'1B23'
F15	*F15	<F15>	X'1B5B32387E' <sup>2</sup>
F15	*F15	<F15>	X'9B32387E' <sup>3</sup>
F16	*ESCDOLLAR	<ESC><Dollar>	X'1B24'
F16	*F16	<F16>	X'1B5B32397E' <sup>2</sup>
F16	*F16	<F16>	X'9B32397E' <sup>3</sup>
F17	*ESCPCT	<ESC><Percent>	X'1B25'
F17	*F17	<F17>	X'1B5B33317E' <sup>2</sup>
F17	*F17	<F17>	X'9B33317E' <sup>3</sup>
F18	*ESCCFX	<ESC><Circumflex Accent>	X'1B5E' <sup>1</sup>
F18	*F18	<F18>	X'1B5B33327E' <sup>2</sup>
F18	*F18	<F18>	X'9B33327E' <sup>3</sup>
F19	*ESCAMP	<ESC><Ampersand>	X'1B26'
F19	*F19	<F19>	X'1B5B33337E' <sup>2</sup>
F19	*F19	<F19>	X'9B33337E' <sup>3</sup>
F20	*ESCAST	<ESC><Asterisk>	X'1B2A'
F20	*F20	<F20>	X'1B5B33347E' <sup>2</sup>
F20	*F20	<F20>	X'9B33347E' <sup>3</sup>
F21	*ESCLPAR	<ESC><Left Parenthesis>	X'1B50'
F22	*ESCRPAR	<ESC><Right Parenthesis>	X'1B51'
F23	*ESCUS	<ESC><Underscore>	X'1B5F'
F24	*ESCPLUS	<ESC><Plus>	X'1B2B'
See note 4	*FIND	<Find>	X'1B5B317E'
See note 4	*FIND	<Find>	X'9B317E'
See note 4	*SELECT	<Select>	X'1B5B347E'

Default 5250 Function	Special Value	VTxxx Keys	Hexadecimal Value <sup>1</sup>
See note 4	*SELECT	<Select>	X'9B347E'

**Note:**

<sup>1</sup> - Unless otherwise identified, the hexadecimal value is in the VT100 mode.

<sup>2</sup> - VT220 7-bit control mode.

<sup>3</sup> - There is no 5250 function key that maps to this VT key.

<sup>4</sup> - The keys F1 through F5 are not available on a VT220 terminal. However, many VT220 emulators send these hexadecimal values when the F1 through F5 keys are pressed.

**VT220 workstation operating modes:** When the system negotiates the VT220 workstation type, there are several operating modes that are supported:

- VT200 mode with 7-bit controls is the default mode and uses the standard ANSI functions. This mode provides the full range of VT220 capabilities in an 8-bit communications environment with 7-bit controls. This mode supports the DEC multinational character set or national replacement character (NRC) sets, depending on the character set mode selected.
- VT200 mode with 8-bit controls uses the standard ANSI functions and provides the full range of VT220 capabilities in an 8-bit communications environment with 8-bit controls. This mode supports the DEC multinational character set or NRC sets, depending on the character set mode selected.
- VT100 mode uses standard ANSI functions. This mode restricts the use of the keyboard to VT100 keys. All data has a 7-bit restriction, and only ASCII, NRC, or special graphics characters generate.
- VT52 mode uses DEC private functions (not ANSI). This mode restricts the use of the keyboard to VT52 keys.

If VT220 mode is negotiated, then an initial operating mode for Telnet client is selected using the ASCII operating mode (ASCOPRMODE) parameter of the start TCP/IP Telnet (STRTCPTLN) or TELNET command.

**VT220 top-row function keys:** The following table shows the keys that transmit the codes for function keys on the top row of the VT220 keyboard in the **7-bit mode**.

Keyword	Hex character transmitted
*F6	X'1B5B31377E'
*F7	X'1B5B31387E'
*F8	X'1B5B31397E'
*F9	X'1B5B32307E'
*F10	X'1B5B32317E'
*F11	X'1B5B32337E'
*F12	X'1B5B32347E'
*F13	X'1B5B32357E'
*F14	X'1B5B32367E'
*F15 or *HELP	X'1B5B32387E'
*F16 or *DO	X'1B5B32397E'
*F17	X'1B5B33317E'
*F18	X'1B5B33327E'
*F19	X'1B5B33337E'
*F20	X'1B5B33347E'

This Table shows the keys that transmit the codes for the function keys on the top row of the VT220 keyboard in the **8-bit mode**.

Keyword	Hex character transmitted
*F6	X'9B31377E'
*F7	X'9B31387E'
*F8	X'9B31397E'
*F9	X'9B32307E'
*F10	X'9B32317E'
*F11	X'9B32337E'
*F12	X'9B32347E'
*F13	X'9B32357E'
*F14	X'9B32367E'
*F15 or *HELP	X'9B32387E'
*F16 or *DO	X'9B32397E'
*F17	X'9B33317E'
*F18	X'9B33327E'
*F19	X'9B33337E'
*F20	X'9B33347E'

#### VT100 and VT220 Control Character Keywords:

Control Character Description	Key Pressed with CTRL Key Down	Keyword	Hex Character Transmitted
Null	Spacebar	*NUL	X'00'
Start of heading	A	*SOH,*CTLA	X'01'
Start of text	B	*STX,*CTLB	X'02'
End of text	C	*ETX,*CTLC	X'03'
End of transmission	D	*EOT,*CTLD	X'04'
Enquire	E	*ENQ,*CTLE	X'05'
Acknowledge	F	*ACK,*CTLF	X'06'
Bell	G	*BEL,*CTLG	X'07'
Back Space	H	*BS,*CTLH	X'08'
Horizontal tabulation	I	*HT,*CTLI	X'09'
Line feed	J	*LF,*CTLJ	X'0A'
Vertical tab	K	*VT,*CTLK	X'0B'
Form feed	L	*FF,*CTLL	X'0C'
Carriage return	M	*CR,*CTLM	X'0D'
Shift out	N	*SO,*CTLN	X'0E'
Shift in	O	*SI,*CTLO	X'0F'
Data link escape	P	*DLE,*CTLP	X'10'
Device control 1	Q	*DC1,*CTLQ	X'11'
Device control 2	R	*DC2,*CTLR	X'12'
Device control 3	S	*DC3,*CTLS	X'13'

Control Character Description	Key Pressed with CTRL Key Down	Keyword	Hex Character Transmitted
Device control 4	T	*DC4,*CTLT	X'14'
Negative acknowledgement	U	*NAK,*CTLU	X'15'
Synchronous idle	V	*SYN,*CTLV	X'16'
End of transmission block	W	*ETB,*CTLW	X'17'
Cancel previous word or character	X	*CAN,*CTLX	X'18'
End of medium	Y	*EM,*CTLY	X'19'
Substitute	Z	*SUB,*CTLZ	X'1A'
Escape	[	*ESC	X'1B'
File separator	\	*FS	X'1C'
Group separator	]	*GS	X'1D'
Record separator	&eqv.	*RS	X'1E'
Unit separator	?	*US	X'1F'
Delete		*DEL	X'7F'

## Establish a cascaded Telnet session

You can start a Telnet session while currently in a Telnet session. The home system is the first client system that you use. The end system is the last Telnet server system that you access. The system that you pass through to get from the home system to the end system is an intermediate system. To better understand how you would use cascaded Telnet, refer to the “Telnet scenario: Cascaded Telnet sessions” on page 4.

### Starting a cascaded session

To start your cascaded session, sign on to the home system, then follow the steps to “Start a 5250 Telnet client session” on page 49. Repeat the steps for each system you want to connect to.

See “Move between cascaded Telnet sessions” on page 79 for further instructions on how to use cascaded sessions.

### Returning to server system

The SIGNOFF command ends the session and returns you to the sign-on display of the server system. When signed-on to the server system, the SIGNOFF command ends the current server job and returns you to the sign-on display of the server system.

You can use the end connection (ENDCNN) parameter of the SIGNOFF command to sign off the server system and end the TELNET connection. For example, `signoff endcnn(*yes)` returns you to your original session on the client system, or the previous session if you have more than one TELNET session established.

#### Note:

- There is no limit the number of systems to which you can establish a Telnet session.
- The home system intercepts System Request options 13 and 14 if entered on the System Request input line. This function may be helpful if you establish a Telnet session with a system to which you cannot sign on. In this case, you can end a session to that system by doing the following:
  - Press the System Request key.
  - Type 13 (Start system request at home system) on the System Request input line.
  - Type 2 (End previous request) on the System Request menu.

## Move between cascaded Telnet sessions

Once you start a cascaded Telnet session, press the **System Request** (Sys Req) key, and press **Enter** to display the System Request menu.

The System Request menu provides you with the following options:

System Request Option	Action	Description
10	Starting a system request at a client system	Displays the System Request menu on the previous client system
11	Transferring to the client system	transfers you to an alternative job on the previous client system
13	Starting a system request at the home system	takes you from an intermediate or end system to the System Request menu of the home system
14	Transferring to the home system	takes you from an intermediate or end system to the alternative job on the home system
15	Transferring to the end system	takes you from an intermediate or home system to the end system.

To bypass the System Request menu, press the **System Request** key and type 10 on the command line. This shortcut is applicable between iSeries<sup>(TM)</sup> servers only.

### For non-IBM<sup>(R)</sup> Telnet clients

You might drop a cascaded Telnet session when you try to use System Request options 10, 11, 13, or 14. For options 10 and 11, the client PC is the previous system. For options 13 and 14, the client PC is the home system.

Your Telnet client is compatible if it passes these two tests:

- You return to the home system after using options 13 or 14.
- You do not drop a session when using options 10 or 11 from the home system.

For incompatible clients, follow these steps instead of using System Request options 10, 11, 13, or 14:

1. Use System Request option 11 to move backward from system to system until you reach the home system. The home system is the first iSeries to which your Telnet client connected at the beginning of the session.
2. From the home system, use System Request option 1 to move forward from system to system.

## End a Telnet client session

When you are connected to an iSeries<sup>(TM)</sup> server, signing off does not necessarily end your Telnet server session. To end the session, you must enter a key or sequence of keys to put the Telnet client into a local command mode. You can then type the command to end the session. This table provides you with key sequences for ending a Telnet server session.

### Ending a Telnet client session

- From the iSeries server, press the **Attention** key and then select option 99 (End TELNET session - QUIT).
- From most other systems, log off.

If you do not know what key or key sequence causes the client to enter command mode, consult either your system administrator or your Telnet client documentation.

You can also use the end connection (ENDCNN) parameter of the SIGNOFF command to sign off the system and end the Telnet connection. For example, SIGNOFF ENDCNN(\*YES) returns you to the client system (if you only have one Telnet session established). Or, if you have more than one Telnet session established, the command returns you to the previous system.

---

## Troubleshoot Telnet problems

This topic provides helpful information to assist you in troubleshooting and correcting problems with Telnet. This is not a complete guide, however, this should serve as a useful first step. This topic provides the following information:

### **“Determine problems with Telnet”**

This section gives diagnostic information including a flowchart for server problem analysis, and a list of materials needed when reporting Telnet problems.

### **“Troubleshoot emulation types” on page 83**

This section gives more specific information on determining problems within the individual emulation type.

### **“Troubleshoot your Telnet SSL server” on page 86**

This section gives detailed information on troubleshooting your SSL server including system SSL return codes and a list of common SSL problems.

### **“TRCTCPAPP service program outputs” on page 89**

Run a VTM component trace with the user data field set to TELNET.

### **“Materials needed to report Telnet problems” on page 92**

This section describes what information your service representative may require.

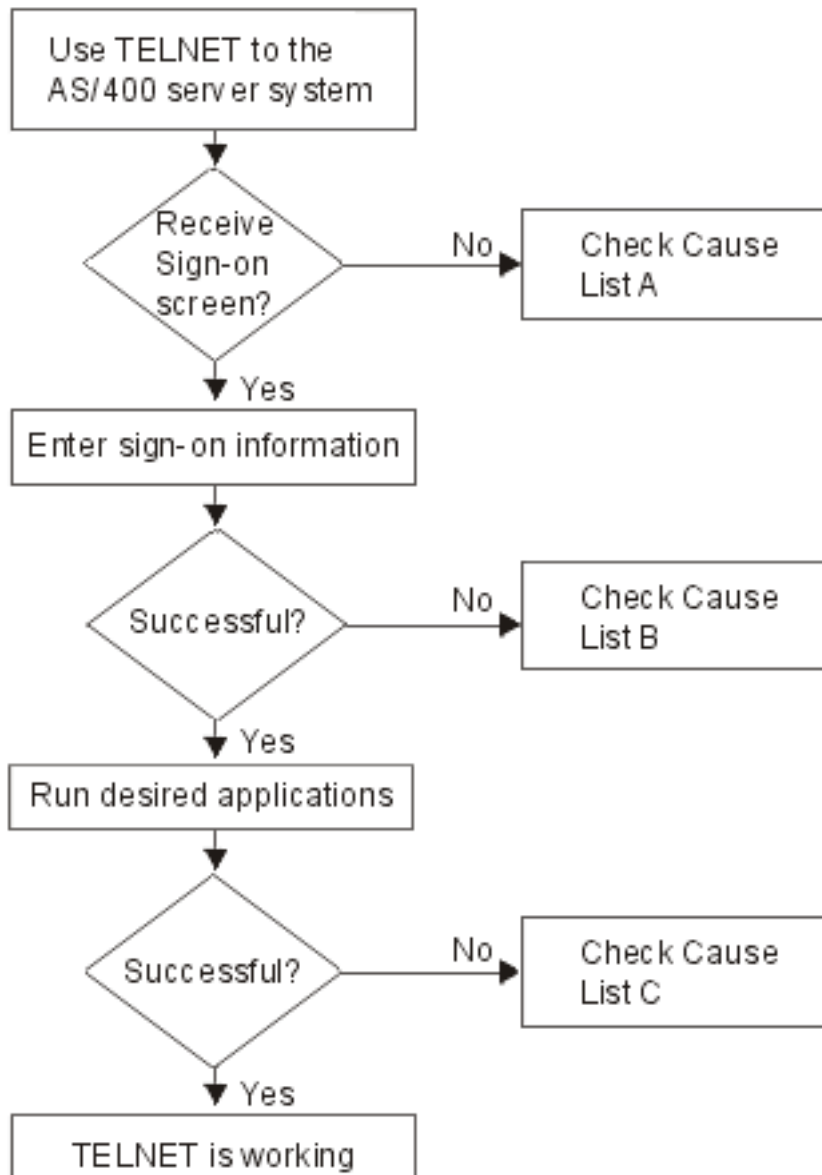
### **“Automatically generated diagnostic information” on page 93**

Some Telnet server errors will automatically generate diagnostic information. This section describes how to retrieve that information.

## Determine problems with Telnet

Use this flowchart after using the flowchart for general TCP/IP problems. If a problem is detected when using the iSeries<sup>(TM)</sup> Telnet server, use the following flowchart to identify the cause. The cause lists that follow identify potential problems.





Description: Telnet problem

analysis flow chart

#### Cause List A

1. Verify that the Telnet server jobs are active and that Telnet service is assigned to a valid nonrestricted port.
  - a. To verify that the QTVTELNET and QTVDEVICE jobs are active in the QSYSWRK subsystem, complete the following steps:
    - 1) Start iSeries Navigator and expand **your iSeries server** —> **Work Management**.
    - 2) Right-click **Active Jobs**, and look to see if QTVTELNET and QTVDEVICE are active.
  - b. If these jobs are not active, complete the following steps to start these jobs:
    - 1) Start iSeries Navigator and expand **your iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
    - 2) Right-click **Telnet** and select **Start**.
  - c. To verify that Telnet service is assigned to a valid port, complete the following steps:
    - 1) Start iSeries Navigator and expand **your iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
    - 2) Right-click **Connections** and select **Open**.
    - 3) Look for Telnet.

- d. For printers, insure that subsystem QSPL is active.
- e. Check for port restrictions by going to menu CFGTCP and selecting option 4 (Work with TCP/IP port restrictions).
2. Verify that the Devices system value on the iSeries server is properly set to allow the TELNET server to automatically create virtual devices.
3. Verify that the network connection between the iSeries server and the Telnet client is active by using the “Ping your host server” on page 83 in iSeries Navigator. If not active, see your network administrator.
4. Verify that the virtual devices on the iSeries server that are used by Telnet are defined to a subsystem under which the interactive Telnet jobs should run.
  - a. To see which workstation entries are defined to a subsystem, complete the following steps:
    - 1) Start iSeries Navigator and expand **your iSeries server** —> **Work Management**.
    - 2) Right-click **Subsystems** and select **Open**.
  - b. Use the Add Workstation Entry (ADDWSE) command to define workstations to a subsystem. For example, you could use the following command to allow all workstation types to run under the QINTER subsystem:
 

```
ADDWSE SBS(D(QINTER) WRKSTNTYPE(*ALL)
```
5. Verify that the interactive subsystem (QINTER) is active. Telnet connections fail if the interactive subsystem is not active. In this situation, the system does not write error messages to the QTVTELNET job log or the QTVDEVICE job log to show you the problem.
 

To verify that the subsystem is active, complete the following steps:

  - a. Start iSeries Navigator and expand **your iSeries server** —> **Work Management**.
  - b. Right-click **Subsystems** and select **Open**.
  - c. Verify that the subsystem is active.
6. If you are operating in VTxxx full-screen mode, verify that your local VTxxx client configuration specifies autowrap. When autowrap is on, the system will automatically wrap lines at column 80.
7. Check for a Telnet exit program registered to exit point QIBM\_QTG\_DEVINIT, format INIT0100, using the work with registration information(WRKREGINF) command. If there is a registered user exit program, check the Telnet server job log with job name QTVDEVICE for any errors related to that program. If errors exist, correct the errors in the exit program or remove the exit program with the remove exit program (RMVEXITPGM) command.
8. Ensure that your client is attempting to use the correct port to connect to Telnet.
 

To determine the port that Telnet service is assigned, complete the following steps:

  - a. Start iSeries Navigator and expand **your iSeries server** —> **Network** —> **Servers** —> **TCP/IP**.
  - b. Right-click **Connections** and select **Open**.
  - c. Look for Telnet.
9. Use the CFGTCP command to verify that the port your client is attempting to connect on is not restricted. Also look in the QTVTELNET job log for messages that indicate that the port that you are trying to use is restricted.
10. When attempting to connect using SSL Telnet, make sure that you have installed the Digital Certificate Manager (DCM) and one of the IBM<sup>(R)</sup> cryptographic provider products. This is in addition to the above items listed. Also, ensure that a valid, unexpired certificate is assigned to the Telnet server (QIBM\_QTV\_TELNET\_SERVER).

#### Cause List B

1. Verify your authority to the virtual display device. If you receive message CPF1110 when attempting to sign on the iSeries server, you are not authorized to the virtual display device. When the iSeries Telnet server creates virtual devices, the QCRTAUT system value is used to determine the authority granted to user \*PUBLIC. This system value should be \*CHANGE to allow any user to sign on using Telnet.

2. Verify that the QLMTSECOFR system value is correct if you are the security officer or have \*SECOFR authority.

### Cause List C

1. Verify your word processing choice. If you experience problems when using OfficeVision<sup>(R)</sup> or the Work with Folders (WRKFLR) command, you may need to change your configuration so that the Office Adapted Editor is used instead of the Standard Editor. To do this, have your system administrator change your word processing choice in the environment information associated with your office user ID.
2. If you are operating in VTxxx full-screen mode, verify that your local VTxxx client configuration specifies autowrap. When autowrap is on, the system will automatically wrap lines at column 80.
3. If characters do not display properly for your VTxxx session, verify that the correct mapping tables are in use for your session.
4. If your VTxxx client beeps every time you press a key, your keyboard may be locked. See Error Conditions on 5250 Keyboard (page 58).
5. Check the QTVTELNET job log and the QTVDEVICE job log for error messages on the iSeries server.

### Ping your host server

Use the PING command in iSeries<sup>(TM)</sup> Navigator to test your TCP/IP connection.

To ping your system, complete the following steps:

1. Start iSeries Navigator and expand **your iSeries server** —> **Network**.
2. Right-click **TCP/IP Configuration** and select **Utilities**.
3. Click **Ping** to display the Ping dialog box.
4. Type your host name in the Ping box (for example, companyname.com).
5. Click **Ping Now**.

Messages display in the **Results** box to tell you the status of your connection.

### Troubleshoot emulation types

When developing a Telnet client, it is important that you negotiate the correct emulation workstation type. The functions allowed vary with workstation type. The following is a guide to understanding the workstation type and the function capabilities of that workstation.

#### Workstation type negotiations and mappings

The Workstation and printer mappings table shows a list of virtual display stations that the server uses to match the physical display stations of the client system.

If you are not sure what emulation package you are running, you need to determine what your virtual display device is. You can use the Work with Job (WRKJOB) command to find out what it is. The job name displays at the top. This is the name of the virtual display device associated with your job. By default, the naming convention is QPADEV xxxx, where xxxx is an alphanumeric character.

To determine the device type, type:

```
WRKCFGSTS *DEV QPADEVxxxx
```

You can work with your device description. Type an 8 (Work with description) next to the name of the device. The system displays the device type. You can then determine from the device type whether you are running in full-screen mode for 3270, 5250, VT100, or VT220.

#### Table 1. Workstation and printer mappings

Supported workstation and (model)	Equivalent type and (model)	Internet specification	Description
5251 (11)		IBM-5251-11	24 X 80 monochrome display
5291 (1)	5291 (2)	IBM-5291-1	24 X 80 monochrome display
5292 (2)		IBM-5292-2	24 X 80 color graphics display; this workstation type is also emulated by a graphic workstation function.
3196 (A1)	3196 (A1) 3196(B1) 3196 (B2) 3476 (EA)	IBM-3196-A1	24 X 80 monochrome display; this workstation type is also emulated by a monochrome workstation function.
3486 (BA)		IBM-3486-BA	24 X 80 monochrome display
3487(HA) <sup>2</sup>	3487 (HG) <sup>2</sup> 3487 (HW) <sup>2</sup>	IBM-3487-HA	24 X 80 monochrome display; this workstation type is also emulated by a monochrome workstation function.
3487 (HC) <sup>2</sup>		IBM-3487-HC	24 X 80 color display;this workstation type is also emulated by a color workstation function.
3179 (2)	3197 (C1) 3197 (C2) 3476 (EC)5292 (1)	IBM-3179-2	24 X 80 color display; this workstation type is also emulated by a color workstation function.
3180 (2)	3197 (D1) 3197 (D2) 3197 (W1) 3197 (W2)	IBM-3180-2	27 X 132 monochrome display
5555 (B01)	5555 (E01)	IBM-5555-B01	24 X 80 double-byte character set (DBCS) monochrome display; this workstation type is emulated by a workstation function that supports DBCS display.
5555 (C01)	5555 (F01)	IBM-5555-C01	24 x 80 DBCS color display; this workstation type is emulated by a workstation function that supports DBCS display.
5555 (G01)		IBM-5555-G01	24 X 80 double-byte character set (DBCS) monochrome, graphics display; this workstation type is emulated by a workstation function that supports DBCS display.

Supported workstation and (model)	Equivalent type and (model)	Internet specification	Description
5555 (G02)		IBM-5555-G02	24 x 80 DBCS color graphics display; this workstation type is emulated by a workstation function that supports DBCS display.
3477 (FC)		IBM-3477-FC	27 X 132 wide-screen color display
3477 (FG)	3477 (FA) 3477 (FD) 3477 (FW)3477 (FE)	IBM-3477-FG	27 X 132 wide-screen monochrome display
3277 (0) <sup>3</sup>	3277 (DHCF)	IBM-3277-2	24 X 80 monochrome display
3277 (0) <sup>3,4</sup>	3278 (DHCF)	IBM-3278-2	24 X 80 monochrome display
3278 (0) <sup>3</sup>		IBM-3278-2-E <sup>5</sup>	24 x 80 monochrome display
3278 (0) <sup>3</sup>		IBM-3278-3	24 x 80 monochrome display
3278 (0) <sup>3</sup>		IBM-3278-4	24 x 80 monochrome display
3278 (0) <sup>3</sup>		IBM-3278-5	24 x 80 monochrome display
3279 (0) <sup>3</sup>	3279 (DHCF)	IBM-3279-2 IBM-3279-2-E <sup>5</sup>	24 X 80 monochrome display
3279 (0) <sup>3</sup>		IBM-3279-3	24 x 80 color display
3812 (1)		IBM-3812-1	3812 printer (SBCS)
5553 (B01)		IBM-5553-B01	5553 printer (DBCS)
VT100 (*ASCII) <sup>6</sup>		DEC-VT100 VT100(7) VT102 DEC-VT102 DEC-VT200 DEC-VT220 VT200(7) VT220(7)	24 x 80 monochrome ASCII display

### Considerations:

<sup>1</sup> - All 5250 workstations, except 5555 (B01) and 5555 (C01), can operate as 5251-11 workstations.

<sup>2</sup> - This workstation can be configured to be either 24 x 80 or 27 x 132. You must determine the mode of the workstation before setting the workstation type parameter value.

<sup>3</sup> - The iSeries<sup>(TM)</sup> server supports only 24 X 80 screens in remote 327x workstations. Remote 3277 (both distributed host command facility (DHCF), and regular) workstations are mapped to IBM-3277-2. Remote 3278 workstations are mapped to IBM-3278-2. Remote 3279 workstations are mapped to IBM-3279-2.

<sup>4</sup> - Some Telnet 3270 full-screen (TN3270) or 3278-2 emulator packages do not support write structured fields correctly. Because of this, 3278-2 type devices are mapped to 3277-2 devices by the iSeries Telnet server implementation to allow the iSeries server to work with those TN3270 implementations.

<sup>5</sup> - The extended attributes highlighting is supported. Underline, blink, and reverse video are included. 3270 DBCS processing is also supported.

<sup>6</sup> - The VT100 virtual device supports VT220 devices.

<sup>7</sup> - VT100, VT200, and VT220 are not official terminal type names. However, some implementations negotiate using these names as the terminal type value.

## Troubleshoot your Telnet SSL server

To identify problems with your Telnet SSL server, follow these steps:

1. “Check system status” to verify that the proper software has been installed and that the servers are started.
2. “Ping your host server” on page 83 to check that TCP/IP is started and the network is OK.
3. “Start the Telnet server” on page 20.
4. “Check for an active SSL listener” by using the NETSTAT \*CNN command.
5. “Check the Telnet job log” to find the SSL return code.
6. Look up the “SSL return codes” on page 87 for suggestions to solve the problem.

Incorrect digital certificates can cause many problems with SSL. Digital Certificate Manager lets you change your Certificate Authority or system certificates. To confirm that you have a valid system certificate, read how to start Digital Certificate Manager and then view the system certificate.

### Check system status

To confirm that your Telnet server is ready for SSL sessions, follow these steps:

1. Verify that you have the correct software installed to support Telnet SSL and to manage certificates:
  - TCP/IP Connectivity Utilities for iSeries<sup>(TM)</sup>, 5722-TC1
  - Digital Certificate Manager, 5722-SS1 - Boss Option 34
  - Cryptographic Access Provider, 5722-AC x
  - IBM<sup>(R)</sup> HTTP Server for iSeries, 5722-DG1
  - Developer Kit for Java<sup>(TM)</sup>, 5722-JV1
2. Verify that you have a secure Telnet server by “Assign a certificate to the Telnet server” on page 31 with the Telnet server application QIBM\_QTV\_TELNET\_SERVER.
3. “Ping your host server” on page 83 to verify your TCP/IP connection and network status.
4. Determine whether the “Start the Telnet server” on page 20
5. Determine whether the “Configure SSL on the Telnet server” on page 31.

### Check for an active SSL listener

The Telnet server must be active and ready to receive connection attempts. To check for an active SSL listener, follow these steps:

1. In the iSeries<sup>(TM)</sup> character-based interface, type NETSTAT \*CNN to show the Work with TCP/IP Connection Status display.
2. In the **Local Port** column, find the telnet- label for telnet-ssl. You will see only telnet- because the field is not long enough on the display.
  - Use the F22 key to display the entire Local Port field.
  - Use the F14 key to see the port numbers. The telnet-ssl entry will be port 992.

SSL initialization has failed if you do not find telnet-ssl in the Local Port column. For help fixing the problem, check the SSL diagnostic messages in the “Check the Telnet job log” running in the QSYSWRK subsystem. Only one QTVTELNET job will be running after an SSL initialization failure.

### Check the Telnet job log

When “SSL initialization and handshake” on page 35 fails, the Telnet server sends CPDBC nn diagnostic messages to the QTVTELNET job. (A *handshake* is the exchange of messages at the start of a SSL session that allows the client to authenticate the server using public key techniques and, optionally, for the server to authenticate the client.)

To check the Telnet server job log, follow these steps:

1. In iSeries<sup>(TM)</sup> Navigator, expand **your iSeries server** —> **Network** —> **TCP/IP Configuration** —> **IPv4**.
2. Click **Connections**.
3. Right-click the IP address of the client workstation that is failing and select **Jobs**. Note the job name.
4. Expand **Job Management** —> **Server Jobs**.
5. Right-click **QTVTELNET** in the Job name column.
6. Select **Job Log**.
7. Look for the CPDBC nn message in the Message ID column.

Here are some things to remember about the Telnet server jobs:

- Only one QTVTELNET job starts when the SSL listener fails to initialize.
- QTVDEVICE and QTVTELNET jobs start when the Telnet server starts after the system restarts.
- The same number of QTVTELNET and QTVDEVICE jobs start when the Telnet server starts an SSL listener.
- The ENDTCPSVR \*TELNET or ENDTCP command ends QTVTELNET jobs.
- When the QSYSWRK subsystem ends, the QTVDEVICE jobs end.

### SSL return codes

The following system SSL return code table shows the most common problems that can occur during SSL initialization or SSL handshake.

#### Before using the following return code table,

- You need to find the SSL return code in the QTVTELNET job log.
- In some cases, you will have to Work with the Digital Certificate Manager configuration to correct problems with Certificate Authority (CA) certificates or system certificates.
- When you copy the CA certificate information for your Telnet SSL client, remember to include the lines containing the words BEGIN CERTIFICATE and END CERTIFICATE.

#### Common return codes

Return code	Description
-2	<p><b>No system certificate is available for SSL processing</b>            The Telnet server successfully initializes SSL, but the SSL handshake fails. There is no sign-on panel in the SSL Telnet client window. The QIBM_QTV_TELNET_SERVER application does not have an assigned system certificate.</p> <p>View the system certificate and check that the value Yes shows in the Certificate assigned column. If the value is No, create a system certificate for the QIBM_QTV_TELNET_SERVER application. See Manage the certificate assignment for an application for instructions.</p>



Return code	Description
-4	<p><b>The CA certificate or system certificate is bad</b>  The system certificate is not private or trusted. The Private Key and Trusted fields on the server certificate are not correct. The Telnet SSL client window has no sign-on panel.</p> <p>Add Certificate Authority (CA) information in your Telnet SSL client. If you are using iSeries<sup>(TM)</sup> Access for Windows<sup>(R)</sup> as your Telnet SSL client, see Manage public Internet certificates for SSL communication sessions. Otherwise, see Obtain a copy of the private CA certificate for instructions.</p>
-16	<p><b>The peer system is not recognized</b>  This problem is the most common problem when a Telnet SSL client first attempts to establish an SSL session. The Telnet SSL client window has no sign-on panel.</p> <p>Add Certificate Authority (CA) certificate information to your Telnet SSL client.</p>
-18	<p><b>The system certificate is self-signed and server is using it as a CA certificate</b>  The system certificate assigned to the QIBM_QTV_TELNET_SERVER application must be trusted, signed by a certificate authority, and used within the valid time period. You need to create a CA certificate and associate it with the system certificate. The Telnet server does not initialize SSL if the system certificate is incorrect.</p> <p>Create a CA certificate and associate it with the system certificate. For instructions, see Create and operate a Local Certificate Authority.</p>
-23	<p><b>The system certificate is not signed by a trusted certificate authority</b>  The system certificate assigned to the QIBM_QTV_TELNET_SERVER application must be trusted, signed by a certificate authority, and used within the valid time period.</p> <p>Change the CA certificate to Trusted. For instructions, see Manage applications in DCM.</p>
-24	<p><b>The valid time period of the CA certificate has expired</b>  You are using an out-of-date certificate. The Telnet SSL client window has no sign-on panel.</p> <p>Renew the CA certificate that was used to build the system certificate.</p>
-93	<p><b>SSL is not available for use</b>  Telnet SSL clients cannot connect to a host because there is no active SSL listener.</p> <p>Install software requirements to support Telnet SSL and to manage certificates. For instructions, see "Check system status" on page 86</p>

#### Other SSL return codes

For the SSL return codes in the following table, use the Digital Certificate Manager to verify that the digital certificates meet these requirements:

- The CA certificate is valid and has not expired.
- The Telnet server application QIBM\_QTV\_TELNET\_SERVER has a value of Yes in the Certificate Assigned column.
- A certificate authority signs the system certificate.
- The system certificate is trusted.
- The system certificate is used within the timeframe stated on the certificate.

Return code	Description
-1	No ciphers are available or specified
-6	OS/400 <sup>(R)</sup> does not support the certificate type
-10	An error occurred in SSL processing. In the job log, check the CPExxxx message where xxxx is the sockets errno value.
-11	SSL received a badly formatted message
-12	A bad message authentication code was received
-13	Operation is not supported by SSL
-14	The certificate signature is not valid
-15	The certificate is bad
-17	Permission was denied to access object
-20	Unable to allocate storage required for SSL processing
-21	SSL detected a bad state in the SSL session
-22	The socket used by the SSL connection has been closed
-25	The date in the certificate is in a bad format
-26	The key length is bad for export
-90	Not a keyring file
-91	The password in the key database has expired
-92	Certificate is not valid or was rejected by the exit program
-94	SSL_Init() was not previously invoked for the job
-95	There is no keyring for SSL initialization
-96	SSL is not enabled
-97	The specified cipher suite is not valid
-98	The SSL session ended
-99	An unknown or unexpected error occurred during SSL processing
-1010	Double encryption is not allowed when using AC2 and IP-SEC

## TRCTCPAPP service program outputs

For the trace TCP/IP application (TRCTCPAPP) command, the listing of the VTM component trace shows up as a spooled file, called VTMTRACE with the user data field set to TELNET. The system places this file in

the default output queue of the profile that runs the TRCTCPAPP \*TELNET \*OFF call. At the same time, all server job flight recorders are dumped to spooled files called QTOCTTRC with user data set to QTVnnnnnn.

Here is an example of what you see in your interactive job log when you perform a TRCTCPAPP \*OFF call

```

+-----+
| Command Entry                               SYSNAM03
| Request level: 1
| All previous commands and messages:
| > trctcpapp *telnet *off
| Spooled printer file 1 opened for output.
| Trace data for application TELNET formatted: Spooled VTMTRACE user data 'TELNET'
| Trace data for application TELNET formatted: Spooled QTOCTTRC user data 'TV017231'
| Trace data for application TELNET formatted: Spooled QTOCTTRC user data 'TV017230'
| Trace data for application TELNET formatted: Spooled QTOCTTRC user data 'TV017229'
| Trace data for application TELNET formatted: Spooled QTOCTTRC user data 'TV017232'
| Trace data for application TELNET formatted: Spooled QTOCTTRC user data 'TV017233'
| Trace data for application TELNET formatted: Spooled QTOCTTRC user data 'TV017234'
|                                     More...
|
| Type command, press Enter.
| ===>
|-----|
| F3=Exit F4=Prompt F9=Retrieve      F10=Exclude detailed messages
| F11=Display full F12=Cancel  F13=Information Assistant F24=More keys
|-----|
+-----+

```

Here is an example of what you see in your default output queue

```

+-----+
|                               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
|
| Opt File      User      Queue      Device or      Sts  Total  Page
| VTMTRACE     JEFF     JEFFSOUTQ  TELNET         HLD  46     1
| QTOCTTRC     JEFF     JEFFSOUTQ  TV017231       HLD  4     1
| QTOCTTRC     JEFF     JEFFSOUTQ  TV017231       HLD  2     1
| QTOCTTRC     JEFF     JEFFSOUTQ  TV017231       HLD  2     1
| QTOCTTRC     JEFF     JEFFSOUTQ  TV017231       HLD  2     1
| QTOCTTRC     JEFF     JEFFSOUTQ  TV017231       HLD  2     1
|
| Parameters for options 1, 2, 3 or command
| ===>
|-----|
| F3=Exit  F10=View 4  F11=View 2  F12=Cancel  F22=Printers  F24=More keys
|-----|
+-----+

```

Only one file that is called VTMTRACE that is created. If SSL Telnet mode is operational on the server, you may have one or more QTOCTTRC files.

Here is an example of a QTOCTTRC file. This spooled file is a Telnet server job (QTVTELNET) as opposed to a QTVDEVICE job.

```

+-----+
|                               Display Spooled File
| File . . . . . : TV017231          Page/Line 1/6
| Control . . . . . :                   Columns 1 - 78
| Find . . . . . :
| *...+...1...+...2...+...3...+...4...+...5...+...6...+...7...+...
| 5769TC1 V4R4M0 990521 TRCTCPAPP Output SysName Date-12/11/98 Time-14:08:32 Page-
| TRCTCPAPP Attributes
| Application.....: Telnet Server
|-----|
+-----+

```

```

Buffer size (KB).....: 0
    (Default of 0 means 16MB buffer)
Trace full action.....: *WRAP
Job id.....: 017231/QTCP /QTVTELNET
Start date/time.....: Fri Dec 11 13:50:33 1998
End date/time.....: Fri Dec 11 14:08:34 1998
Trace buffer wrapped.....: No
Telnet Server Attributes
AutoStart server.....: 'Y'
Number servers.....: 2
Session keep alive timeout...: 0
Default NVT type.....: >*VT100<
Outgoing EBCDIC/ASCII table.: >*CCSID <
Incoming ASCII/EBCDIC table.: >*CCSID <
Coded character set id.....: 84542
Attributes version id.....: >V4R4M0 <
Trace_common buffer structure:
80000000 00000000 161A8753 14001074 | .....g.....| Byte 16
80000000 00000000 161A8753 14FFFFE4 | .....g....U| Byte 48
80000000 00000000 161A8753 14005820 | .....g.....| Byte 80
00FFF000 00000084 F0F1F7F2 F3F1D8E3 | ..0....d017231QT| Byte 112
C3D74040 40404040 D8E3E5E3 C5D3D5C5 | CP QTVTELNE| Byte 144
E340C699 8940C485 8340F1F1 40F1F37A | T Fri Dec 11 13:| Byte 176
F5F07AF3 F340F1F9 F9F8D8E3 E5F0F1F7 | 50:33 1998QTV017| Byte 208
F2F3F140 |231 | Byte 228
Flight Records:
qvtelnet: Job: QTVTELNET/QTCP/017231
(C) Copyright IBM Corporation, 1999
Licensed Material - Program Property of IBM.
Refer to Copyright Instructions Form No. G120-2083
ProdId: 5769-SS1 Rel: V4R4M0 Vers: V4R4M0 PTR: P3684767
qvtelnet: Program QTVTELNET dated 04 December 1998 running
qvtelnet: Source file: qvtelnet.pIC
qvtelnet: Last modified: Wed Dec 9 11:57:40 1998
qvtelnet: Last compiled at 12:00:10 on Dec 9 1998
qvtelnet: Arguments passed: 1
qvtelnet: Time Started: Fri Dec 11 13:50:34 1998
qvtelnet: sigaction() for SIGUSR1 is EndClientSession()
qvtelnet: Set Telnet Server job identity for OpNav
qvtelnet: Need to setup SSL_Init_Application()
qvtelnet: SSL_Init_Application() successful
qvtelnet: Find Telnet Server control block
qvtelnet: Lock Telnet Server control block
qvtelnet: Open driver to stream
qvtelnet: First Telnet Server Job...

F3=Exit    F12=Cancel  F19=Left F20=Right    F24=More keys

```

Here is an example of another QTOCTTRC file. This is a device manager spooled file, as opposed to the QTVTELNET server job:

```

-----
Display Spooled File
File . . . . . :      TV017230          Page/Line  1/6
Control . . . . . :                               Columns    1 - 78
Find . . . . . :
*...+...1...+...2...+...3...+...4...+...5...+...6...+...7...+...
TRCTCPAPP Attributes
Application.....: Telnet Server
Buffer size (KB).....: 0
    (Default of 0 means 16MB buffer)
Trace full action.....: *WRAP
Job id.....: 017230/QTCP /QTVDEVICE
Start date/time.....: Fri Dec 11 13:50:33 1998
End date/time.....: Fri Dec 11 14:08:39 1998
Trace buffer wrapped.....: No

```

```

Telnet Server Attributes
  AutoStart server.....: Y
  Number servers.....: 2
  Session keep alive timeout...: 0
  Default NVT type.....: >*VT100<
  Outgoing EBCDIC/ASCII table.: >*CCSID <
5769TC1 V4R4M0 990521 TRCTCPAPP Output SysName Date-12/11/98 Time-14:08:32 Page-
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
  Incoming ASCII/EBCDIC table.: >*CCSID <
  Coded character set id.....: 84542
  Attributes version id.....: >V4R4M0 <
Trace_common buffer structure:
  80000000 00000000 3DA86C25 5F001074 | .....y... | Byte 16
  80000000 00000000 3DA86C25 5FFFFFFE4 | .....y..U | Byte 48
  80000000 00000000 3DA86C25 5F002F64 | .....y... | Byte 80
  00FFF000 00000084 F0F1F7F2 F3F0D8E3 | ..0....d017230QT | Byte 112
  C3D74040 40404040 D8E3E5C4 C5E5C9C3 | CP QTVDEVIC | Byte 144
  C540C699 8940C485 8340F1F1 40F1F37A | E Fri Dec 11 13: | Byte 176
  F5F07AF3 F340F1F9 F9F8D8E3 E5F0F1F7 | 50:33 1998QTV017 | Byte 208
  F2F3F040 |230 | Byte 228
Flight Records:
qvtncsh: >>>> entry
(C) Copyright IBM Corporation, 1999.
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Refer to Copyright Instructions Form No. G120-2083
ProdId: 5769-SS1 Release: V4R4M0 Version: V4R4M0 PTR: P3684767
qvtncsh: Program QTVTNC SH dated 04 December 1998 running
qvtncsh: iActiveLogLevel: 0
qvtncsh: Source file: qvtncsh.c
qvtncsh: Last modified: Wed Dec 9 11:48:33 1998
qvtncsh: Last compiled at 11:59:42 on Dec 9 1998
qvtncsh: SignalHandler() registered with signal()
qvtncsh: Arguments passed: 4
qvtncsh: argc: 4
qvtncsh: argv[0]: >QSYS/QTVTNC SH<
qvtncsh: argv[1]: ><
qvtncsh: argv[2]: >lp<
qvtncsh: argv[3]: >s<
SignalHandler: >>>> entry
SignalHandler: Caught signal SIGSEGV

F3=Exit   F12=Cancel  F19=Left   F20=Right  F24=More keys

```

## Materials needed to report Telnet problems

Problems reported to IBM<sup>(R)</sup> may include one or more of the following as determined by your service representative:

- Telnet Server job logs:
  - QTVTELNET job log
  - QTVDEVICE job log
- Some details on the problem scenario. For example:
  - The type of remote host you were using to Telnet from or to, such as an iSeries<sup>(TM)</sup>, zSeries<sup>(TM)</sup>, or pSeries<sup>(TM)</sup> server. This is particularly useful if you are doing cascaded Telnet functions.
  - The type of client attempting to connect to the Telnet server, such as IBM<sup>(R)</sup> Personal Communications and iSeries Access for Windows<sup>(R)</sup>.
- The job log of the interactive job running Telnet client (when Telnet client is under investigation).
- The trace job (TRCJOB) output of the failing interactive job (especially important if running Telnet client).

**Note:**

Use TRCJOB \*ON to start this trace. The result is a QPSRVTRC spooled file in the interactive job.

- A communications trace of the failure, formatted for both ASCII and EBCDIC, which contains TCP/IP data only. Your service representative may direct you to include broadcast messages in this trace. In addition, you may need to filter this trace on a specific IP address if you have a large amount of traffic on your network, and know the IP address of the failing client.
- Any licensed internal code (LIC) logs with major code 0700 and minor code 005x from the time of failure. In addition, there may be some major code 0701, and minor code 005x informational LIC logs that may be useful but not necessarily critical.
- A Virtual Terminal Manager (VTM) LIC component trace. You can gather this trace using the trace TCP/IP application TRCTCPAPP command, or through the start system service tools(STRSST) command. For full details on using the trace TCP/IP application(TRCTCPAPP) command, see the "TRCTCPAPP service program outputs" on page 89.

You will have performance impacts when you run the VTM LIC trace. Some examples of using this command are:

- To trace all VTM activity:  
TRCTCPAPP APP(\*TELNET) SET(\*ON)
- To trace the activity on a specific device, when you know the device name:  
TRCTCPAPP APP(\*TELNET) SET(\*ON) DEVD(devicename)
- To trace the activity on a specific device, when you know the IP address of the client:  
TRCTCPAPP APP(\*TELNET) SET(\*ON) RMTNETADR(\*INET'www.xxx.yyy.zzz')
- To turn the trace off and spool file output:  
TRCTCPAPP APP(\*TELNET) SET(\*OFF)

**Note:** You should receive specific details of which trace parameters to use for your problem from your service representative prior to running this command. This ensures that you gather the correct information for your problem.

## Automatically generated diagnostic information

There may be some automatically generated diagnostic information produced when certain errors occur within the Telnet server. There will be times when your service representative will require this diagnostic information to properly analyze a Telnet server problem.

If any Telnet or device manager job fails with a first failure data capture (FFDC) error, you will see the spooled files under the WRKSPLF QTCP profile. When a job fails with an FFDC error, each failing job will automatically have two dumps. One is a dump made by calling DSPJOB \*PRINT, and DSPJOBLOG \*PRINT makes the other. This way, you get both the job log and job run attributes dumped and have the output from user data group together with a job number identifier. Then you can match up with any VTM component trace output.

You will see a total of four spooled files; two for the QTVTELNET job and two for the QTVDEVICE job. When the system encounters an FFDC error, these spooled files automatically generate. For an example, see the figure below:

**Figure 1. Work with All Spooled Files Display**

```

-----+-----
                                     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
-----+-----

```

Opt	File	User	Queue	Device or User Data	Sts	Pages
	QPJOBLOG	QTCP	QEZJOBLOG	TV016868	HLD	4
	QPDSPJOB	QTCP	QPRINT	TV016868	HLD	7
	QPJOBLOG	QTCP	QEZJOBLOG	TV016955	HLD	3
	QPDSPJOB	QTCP	QPRINT	TV016955	HLD	7
	QPJOBLOG	QTCP	QEZJOBLOG	TV017231	HLD	3
	QPJOBLOG	QTCP	QEZJOBLOG	TV017232	HLD	3
	QPDSPJOB	QTCP	QPRINT	TV017232	HLD	7
	QPDSPJOB	QTCP	QPRINT	TV017231	HLD	7

Parameters for options 1, 2, 3 or command  
 ===>  
 F3=Exit    F10=View 4    F11=View 2    F12=Cancel    F22=Printers    F24=More keys

---

## Related information about Telnet

If you need more information about Telnet, refer to the following sources:

### V4 TCP/IP for AS/400<sup>(R)</sup>: More Cool Things Than Ever




(about 700 pages)

Provides extensive information about TCP/IP, including sample scenarios that demonstrate common solutions with example configurations

### Internet Engineering Task Force (IETF) web site



Read Request for Comments (RFC), such as RFC 2877 5250 Telnet Enhancements 

### Internet Assigned Numbers Authority (IANA)



Find information about common port number assignments



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