AIX Connections Release 2

By Denise Genty, Michael Lew, and Rakesh Sharma

The AIX Connections feature of AIX has a single goal: to provide the premier solution for integrating IBM-compatible and Macintosh® personal computers with UNIX solutions. AIX Connections allows files and printers to be shared by different networked PCs.[1]

AIX Connections Release 2 integrates the functionality of three separate servers from the initial release into a uniform framework of commands, realms, services, and interfaces. From a hierarchal perspective, AIX Connections is based on several different object types. The highest object level, the system, encompasses all of the AIX Connections components: the three realms, file and print objects, and different types of interfaces, as shown in Figure 1.

The three realms, based on the type of service offered, relate to three servers in Release 1, as shown in Figure 2. Most of the configuration and administration of AIX Connections is based on the realm type.

In addition to these realms, the Client component enables an AIX® workstation to behave as a network client so that AIX users can mount remote Server Message Block (SMB)-compatible and NetWare®-compatible volumes and share resources. The clients can access and view services, such as file,

Denise Genty

Michael Lew

Rakesh Sharma

The Hierarchy			Command
System			tnsystem
	Realm		tnrealm
		Service Type	tnstype
		Service	tnservice
			Volume References tnvref
			Printer References tnpref
			Attach Points tnattach
			Client tncdct
	Transports		tntransport
		Interfaces	tniface
	Volumes		tnvolume
	Printers		tnprinter
	Users		tnuser, tnpasswd

Figure 1. Object hierarchy

[1] For information on the technical aspects of AIX Connections Release 1, see "AIX Connections" by Bret R. Olszewski and Kay Chang in *AIXpert*, November 1995.

AIX Connections Servers and Realms

Server	Realm
Lsserver	NetBIOS (NB) clients
NWserver	NetWare® (NW) clients
Macserver	AppleTalk® (AT) clients

Figure 2. AIX Connections servers and realms

terminal, print, and NetWare Virtual Terminal (NVT). Either the AIX machine or the client can configure and administer these services. Clients also can locate each individual service by name.

A system may have multiple services defined and available to clients. Services have many attributes, such as command, path, encryption, depending on the type of service. Some service examples include the following:

- Transports are low-level networking protocol suites, such as NetBIOS or IPX/SPX. Transports contain interfaces and represent a set of networking interfaces used by each realm.
- A Volume is a directory on the UNIX file system that can be exported through a defined file service.
- A Printer is a UNIX print queue that can be exported through file and print services.

New Features in Release 2

AIX Connections Release 2 provides interoperability with existing AIX features, such as Distributed Computing Environment (DCE) and High Availability Clustered Multiprocessing (HACMP), plus enhanced system administration and configuration capabilities. New features include the following:

- DCE integration
- HACMP support
- Forward (Proxy) Authentication
- OS/2® extended attributes support
- Token Ring for the AT realm
- Web-based administration tool
- System Management Interface Tool (SMIT) enhancements
- NetBIOS WINS server
- TotalPrint print queue enhancements

DCE Integration

AIX Connections Release 2 includes integration with DCE and the Distributed File System (DFS) for the NetBIOS realm. DCE Security Services can authenticate AIX Connections clients. Once authenticated, clients can access DCE and DFS resources. DCE Login is completed under the covers for the PC clients with their normal workstation logons—no additional steps are required.

Key features of the AIX Connections DCE Integration are as follows:

- Supports PC clients (Windows® 95, Windows NT™, Windows for Workgroups (WFW), and OS/2) with the client software shipped with the PCs
- Uses DCE Security server for client authentication; provides a single point of security control and avoids the problem of supporting passwords on every AIX Connections server
- Provides access to DCE resources with full Access Control List (ACL) support

The following startup steps are necessary for DCE Integration:

1. Install and configure DCE and DFS client components. You will need—at a minimum—the following software and any prerequisites for these components: DCE Security Services Client, DCE Cell Directory Services (CDS) Client, and DFS Client (if DFS access is necessary).
2. Run DCE Integration Setup Script `acsetup.dcecp`, which can be customized for the DCE administration policies of your organization. The script `acunsetup.dcecp` can undo the setup. These scripts are located in the directory `/usr/tn`.

3. Enable users to access DCE Integration features. Run the `tndcepasswd` command for each user who will be accessing DCE. It updates DCE Security registry with AIX Connections-specific information for the AIX Connections user or DCE principal. The current release also requires the DCE principal to be an AIX user. This command can be used to change the user's DCE and AIX Connections passwords.

4. Define an AIX Connections Service for DCE access. This service must have the command attribute as `/usr/tn/smb/DCE_LM` file. It can be defined through SMIT or the Web-based administration tool.

5. Start AIX Connections DCE Support. You must be DCE authenticated as `aconnadm` to start the service. Use SMIT or the AIX Connections `tnstart` command to start the NetBIOS realm.

HACMP Support

AIX Connections works with a variety of HACMP configurations to provide highly available services. AIX Connections supports the following configurations:

- Hot standby
- One-sided takeover
- Mutual takeover

These configurations must be set up to meet the following criteria:

- The `/usr/tn` directory and the home directories of AIX Connections users are located on the shared volumes, and symbolically linked from their normal locations.

- The system authorization files (`/etc/passwd`, `/etc/group`, `/etc/security/passwd`, and `/etc/security/group`) are kept in sync across the configuration.

- AIX Connections start and stop commands are specified to HACMP.

AIX Connections does not support HACMP concurrent access mode.

AIX Connections Release 2 provides interoperability with existing AIX features, such as HACMP, plus enhanced system administration and configuration capabilities.

Forward (Proxy) Authentication

Release 2 includes the Forward (Proxy) Authentication feature in the NB and NW realms. This feature enhances interoperability with Windows NT, OS/2 Domains, and Novell® NetWare servers.

When proxy authentication is enabled for a file service, all login requests are forwarded to the file server that is configured as the Proxy. You can configure this feature from the AIX Connections SMIT panels or the Web-based administration tool. When you create a new file service, complete the authentication proxy field by entering a service name, including the file type. The authentication proxy can be the name of a Windows NT, OS/2, NetWare, or AIX Connections file server.

Once proxy authentication is enabled, the AIX Connections service that is enabled for the feature forwards the authentication request to the configured Proxy server. The Proxy server maintains a list of authenticated users and passwords for all file services in its realm. Although this feature allows PC clients to be authenticated by a Proxy server, it still requires the PC clients to have an AIX user account.

OS/2 Extended Attribute Support

Release 2 supports OS/2 Extended Attributes, that is, High Performance File System (HPFS) Extended Attributes. An example of an extended attribute is a file type that indicates whether the file is a command, a text

file, or an executable. This feature allows many PC applications, such as the OS/2 Presentation Manager® drive browser, to function correctly. Without extended attribute support, this browser cannot display file names correctly.

AIX Connections FDDI Support

Release 2 now includes Fiber-optic Data Distribution Interface (FDDI) LAN support, which enables 100 Mbps communications connectivity support to AIX Connections servers. These new product features support FDDI:

- RFC (TCP/IP) NetBIOS support over FDDI
- Additional FDDI IPX/SPX support; FDDI_SNAP and FDDI_802.2 frame types now supported
- Enhanced SMIT supports FDDI capabilities and auto detection of IPX network numbers and frame types

MAC Token-Ring Support

AIX Connections Release 1 ran strictly across the Ethernet™ interface—the IEEE® 802.3 standard. Release 2 supports the Token-Ring interface in addition to Ethernet. Note that the AT server can only be run over one interface in the system. If more than one interface is configured, the server and its daemons will not start.

The AT server interface can be configured two ways. The simplest is to use the Quick Start option from SMIT, which allows you to easily configure the server. Other options include configuring the interface via SMIT, the command line, or the Web-based administration tool.

Web-based Administration Tool

The Web-based graphical user interface allows administrators to change server parameters dynamically and manage the server using a standard Web browser—either from the host or from a remote location such as a client. The administration tasks are secure because the tool requires an AIX password login before any configuration or administration activities can be performed.

The Web-based system administration tool automatically starts when the system boots or it can be manually started and stopped from the command line or through SMIT.

Installation. The Web-based tool includes a `httpd` daemon that is normally configured to run on port 7777. The installation process configures the Web-based tool to use a default port number 7777 for access. Users can access the tool from any Web browser by entering http://fully_qualified_hostname:7777 and the Initial Selection menu page will be displayed.

Main Menu. See Figure 3 for the Main menu.

Access. To access the Tools menus, users must enter a valid AIX user ID and password on the initial screen. From the initial screen, users can choose which part of AIX Connections they want to work with: the initial setup, the Main menu, status, or TotalPrint. After viewing the initial selection screen and choosing a Main menu option, you must enter a user ID and password.

Contents. The Main menu contains seven subjects, shown in Figure 3. The General Management and System sections handle the overall system functions and allow

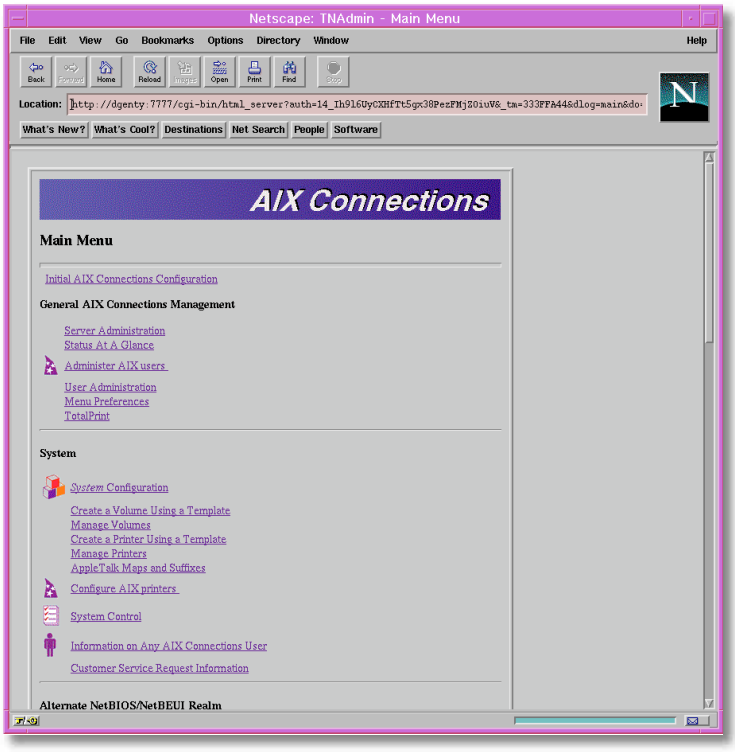

Figure 3. Web-based Administration Main Menu

users to view status, create user IDs, create and manage volumes, printers, and create customer service information requests for problem determination.

The remainder of the Main menu is divided into realm-specific sections for NetBIOS, NetWare, and AppleTalk®. Within each of these sections, users can configure and administer the realm.

The last bullet on the Main menu allows users to get to the Online Publications—Welcome Page.

Help. Many screens and input fields offer help—available by clicking on the "?" button.

Wizards. Wizards step administrators through configuration windows to ensure that all related items are configured. The wizard lists all necessary steps for adding and/or configuring an item, such as the initial AIX Connections configuration after installation.

Other wizards are available for configuring NetBIOS, IPX/SPX, and AT transports. These wizards follow lists that configure transports and their associated interfaces, routes, and so on. This ensures that all necessary items for the transport to function are configured simultaneously.

Templates. Templates are files that contain commonly used function attribute sets. For example, a user can create a template to add a shared-mode service. The attributes of the specific service are saved in the template. Once a template is created, menu items allow service, volume, and printer creation to create the object using a template. If the template is correct, the system administrator's tasks of creating objects becomes easier and consistent.

Status at a Glance. The Status at a Glance page provides a detailed status of each realm, indicating whether the overall system is up. It also lists the configured services, displaying the status of each service plus the number of clients that are connected. This page is automatically updated every 30 seconds to reflect the current status of the AIX Connections system. See Figure 4.

Customer Service Request Information. The shell script `csr.tn` helps determine configuration problems in AIX

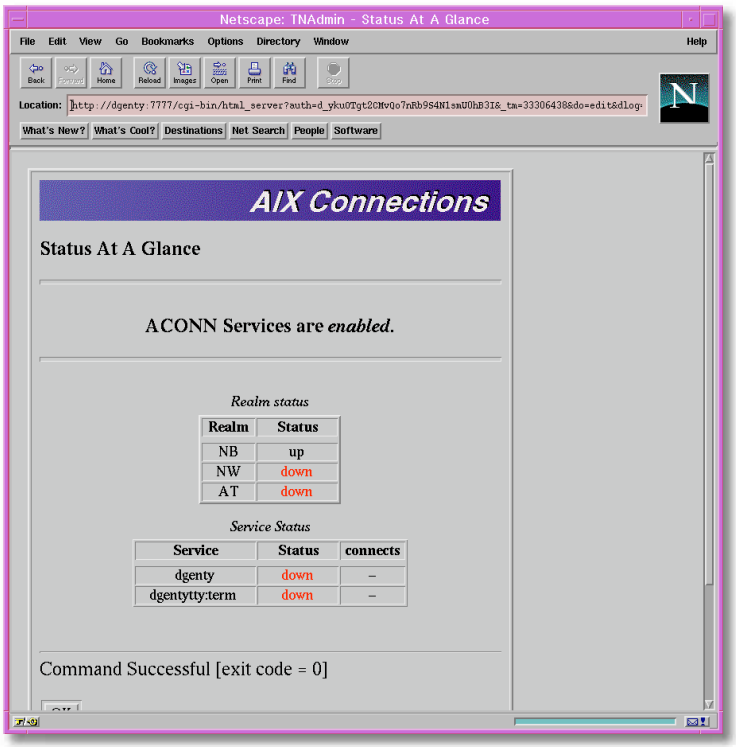

Figure 4. Status at a Glance

Connections. It records configuration parameters, log information, and connection statistics. This information is written to `stdout` and contains output from the `netstat` command, `ifconfig`, `tninfo`, `tnck`, `tnstat`, environments. It also displays the configuration files `/usr/tn/config.tn`, `profile.file`; the services files; the software listing; and any log file information. This information can also be used for debugging purposes if it is redirected to a file.

Online Publications. Online Publications provides a list of all current documents, such as Quick Beginnings and the Administration Guide—a useful feature of this Web-based tool. Located at the bottom of the Main menu is an entry "Online AIX Connections Documentation." Click on this entry to see the publication's "Welcome Page," shown in Figure 5.

You can also view the latest AIX Connections README file. Click on one of the documents, such as Quick Beginnings, which displays a table of contents with links to specific chapters and sections for easy retrieval of information.

From the bottom of each page, you can navigate to the top of the document, to the next document in the list on the Welcome Page, back to the Welcome Page, or to the glossary, which provides links to specific AIX Connections commands. You can also quickly view the appendices of each document.

New Commands and Utilities

New commands that operate on all realms or a specific realm now replace many AIX Connections Release 1 commands. You can now perform administration tasks from the command line or from the Web-based tool. The AIX Connections Reference Guide has a complete listing of the commands. Figure 6 shows some of the new commands.

SMIT Enhancements

Many changes that occurred in the configuration of the AIX Connections servers caused us to modify the SMIT configuration

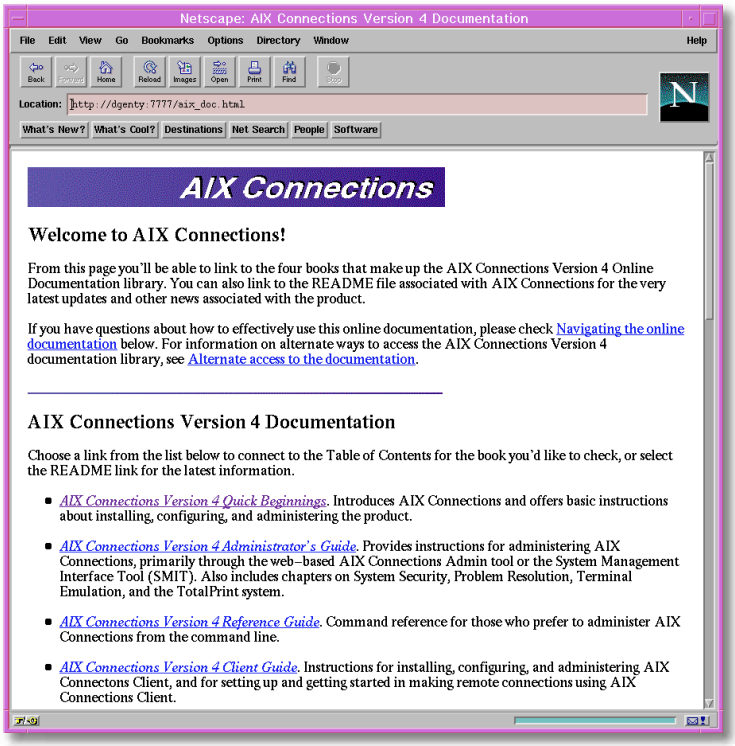

Figure 5. Online Publications—Welcome Page

New Commands in AIX Connections Release 2

Administration

`tnstart`	Start the service processes and allow client connections
`tnshut`	Performs an orderly shut down of AIX Connections; can specify the number of minutes until disconnect
`tnaccept`	Changes the state of selected services to accept client connections
`tnistat`	Displays the status of the IPX/SPX network interfaces; reports the status of the `tnipx` protocol streams module; shows the IPX routing information
`tnkill`	Disconnects one or more service clients
`tnreject`	Rejects attempts by new clients to connect to file services

Configuration

`tnservice`	Add, modify, or delete file and non-file (terminal) services. Services are defined by providing service names to clients so they can locate and acquire access to share resources on the server
`tnvolume`	Add, modify, or delete volume configurations
`tnvref`	Add, modify, or delete volume references defined for file services. A volume reference must be created for a volume to be accessible in a realm since volumes are created at the system level
`tntransport`	Add, modify, or delete transport configuration options. Transports are low-level networking protocols defined at the system level and referenced from the support realms by using the `tntransport` command
`tniface`	Add, modify, or delete transports for networking interfaces; transports contain a set of network interfaces over which they operate
`ipxprobe`	Displays the frame types and network numbers that are active on an interface. This information is used when configuring the interfaces in the NW realm

Figure 6. New commands in AIX Connections Release 2

process. We also incorporated two new menu options from the main AIX Connections menu: the Quick Start and the Client options. The Quick Start option creates a basic configuration that enables the servers to come up and begin serving clients quickly. The Client option makes it easier to use the client part of the AIX Connections package.

How the volume for a file service is managed shows the differences between the two SMIT versions. In Release 1 of AIX Connections, you first choose the server, then the part of the configuration that you want to work on. For example, if you wanted to configure a Macserver volume, you would first go to `smit aconn->MACserver->File and Print Services-> Configuration-> volume`.

This is a two-step process in AIX Connections Release 2. You do a `smit aconn-> Configuration->Volumes-> Manage Volumes->Volume Name` to create the volume (see Figure 7). You then go through `smit aconn-> Configuration->Manage Volume References` to make the Volume accessible by the realm you want to use (see Figure 8). Once the volume is created, you only need to reference it by the different realms that need to use it.

The advantage of Release 2 is that the administration and configuration is very similar for all the different realms. The configuration screens step you through the process much better, which makes it easier to maintain the servers.

Quick Start

The Quick Start option on the AIX Connections Main menu is a new SMIT option available for configuring and starting up the three server realms. This option was designed to allow end users to quickly create a basic server configuration.

Users choose the interface, services specific to a realm, volumes, volume references, and printer references for the AIX printers that are already defined to create the configuration. Once the configuration is created, the Quick Start option starts the daemons for the server, starts the services, and sets up the services to allow connections from clients. User passwords and accounts must be configured by the `tnpasswd utility`, SMIT, or the Web-based tool before these services can be accessed.

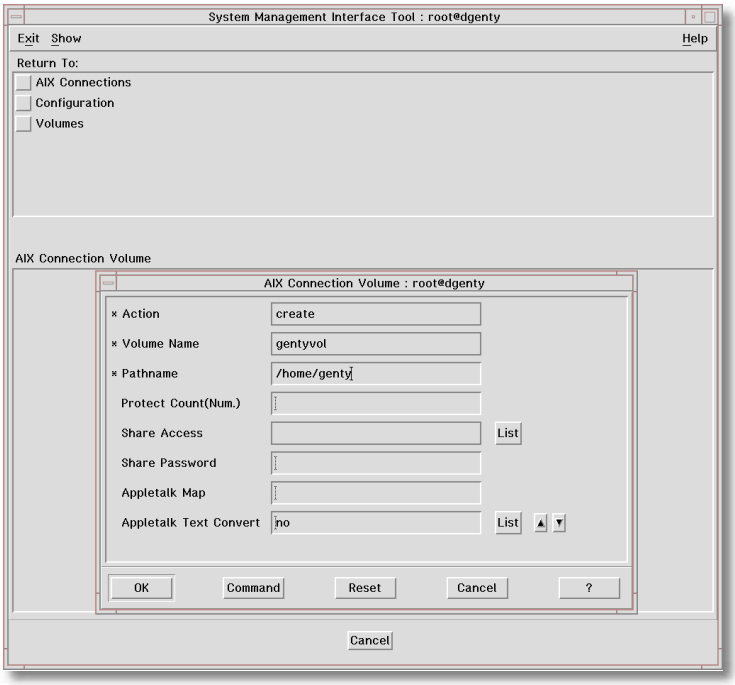

Figure 7. Volume configuration

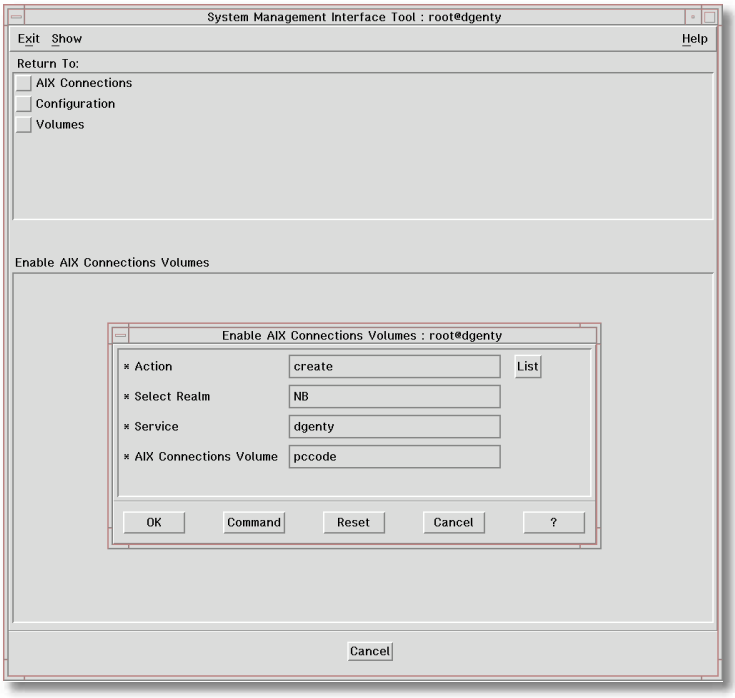

Figure 8. Volume reference configuration

NetBIOS Configuration and Administration

The existing NetBIOS for AIX Administration utility (`mcsadm`) operates as a shell for NetBIOS for AIX software components. It allows users to create and configure LAN Adapters (LANAs), create Resource Control (RC) scripts, manage error log files, start/stop the NetBIOS daemons, and display the status of NetBIOS for AIX.

Users currently enter `mcsadm` on the UNIX command line to invoke the utility, which is a series of panels that allows users to configure or display status or configuration. A NetBIOS command-line interface is available for quick usage. For example, a user may enter `nbix status` to view the status of all configured LANAs instead of viewing them within the `mcsadm` utility. Most of the existing `nbix` options perform the same functions as the screen interface of `mcsadm`.

A new SMIT interface manages NetBIOS for AIX in order to provide a consistent system management interface for AIX Connections and NetBIOS. The SMIT NetBIOS screens allow users to create and manage LANAs, view status, obtain trace files, and manage the WINS server.

The NB realm needs LANAs in order to work. Two types of LANAs can be configured—RFC (TCP/IP) or NetBEUI—depending on the type of protocol needed by the user. Using the SMIT NetBIOS "Add LANA Configuration Option", users input the type of LANA to create, then SMIT automatically creates the necessary Transport Provider Interface (TPI) configuration to run the LANA.

From an AIX Connections view, NetBIOS will be configured with LANAs to get the NB realm running with automatic configuration through the Quick Start option.

NetBIOS WINS Server

The WINS database protocol registers and queries NetBIOS computer names to IP address mappings in a routed network. Using WINS avoids IP broadcasts for NetBIOS names resolution. WINS is well-suited for large, routed IP networks because it reduces the use of local broadcast messages (which reduces network traffic) for name resolution and allows applications to easily locate systems on remote networks. WINS is specially critical in networks that include WAN links. The WINS server can run on the same AIX system as AIX NetBIOS or on a separate system.

The Quick Start option on the AIX Connections Main menu is a new SMIT option available for configuring and starting up the three server realms.

The WINS server software, configured using SMIT, is automatically installed with the NetBIOS software. WINS configuration has two components: the server on AIX and configuration of client software. The WINS server receives NetBIOS name queries and registrations, which are saved in a database. The clients have WINS software enablement and must be configured to register their name with the WINS server.

Client configuration usually involves inputting the WINS server IP address on the client. Operating systems, such as Microsoft's Windows 95 or Windows NT, can use the AIX WINS server directly. The client registers its name and IP address to the WINS server; the WINS server adds the name and address to the database.

The server ensures that the name is not already used. If a name already exists, the server verifies whether the name is still being used. Once a name is registered, the application can query the WINS server, for example, to identify the IP address of the machine to send data to when a client wants to build a packet. The client software can then send a directed message (as opposed to a broadcast message) to the machine.

WINS SMIT Interface

The following sections describe the configuration of the WINS SMIT interface.

Configuration Updates to mcs0

To configure the NetBIOS WINS server, you must determine the IP interface (or all interfaces) over which the server will run. Advanced configuration options can alter the way in which the WINS server software operates, such as Hash Table size and number of threads. Enter `smit netbwins` to get to the WINS Main menu.

Once the data has been entered on the SMIT server configuration screen, the configuration information is saved in `/etc/mcs0`. A new option was added to the `/etc/mcs0` script—`start_wins`. This option allows users to start the WINS server manually from the command line instead of using the SMIT interface.

When the server is configured through SMIT, you can configure the WINS server to start up at boot time. This adds an entry in `/etc/inittab` after the NetBIOS modules are loaded.

You can start and stop the WINS server and view the status from the SMIT menu. Figure 9 shows the WINS Server Configuration menu.

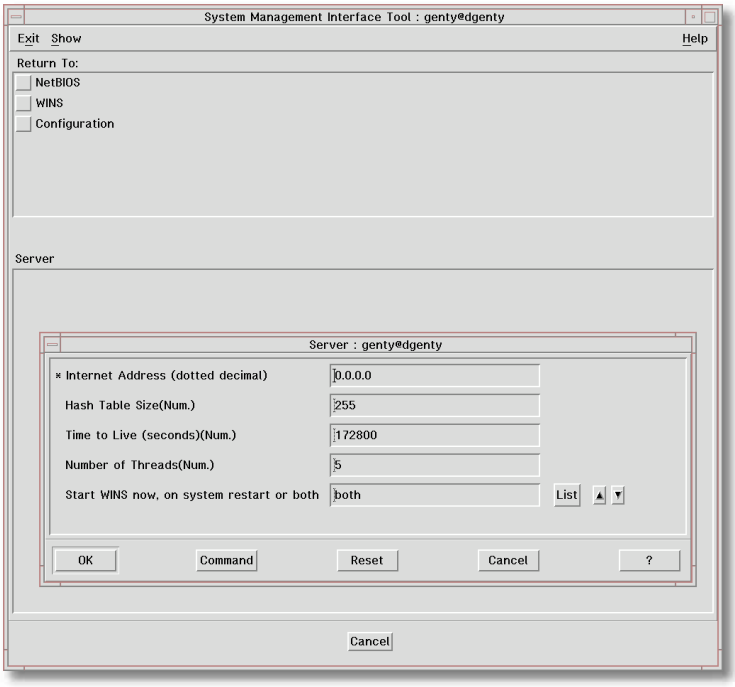

Figure 9. WINS Server Configuration menu

Names

The WINS server maintains two types of names: static and dynamic. For static names, you can enter the machine names in the WINS server table that should have hard-coded IP addresses. These names remain in the table until they are removed through SMIT; they do not require a refresh from the client. There are four different types of static names: unique, group, internet_group, and multihomed.

Clients that are configured to use the WINS server can add dynamic names to the WINS table. The names are added to the table when the client registers, generally at boot time.

The current names in a database can be saved to a file that users can edit. The "Backup Names to file" SMIT option saves the names to an ASCII file. This is useful to save the names for restoration after boot. A SMIT option, "Restore Names from file", restores the names.

By listing entries in the names database, users can determine if the WINS server is working correctly. If clients are configured to use the WINS server (and have been booted since the WINS configuration), the client's machine name will be displayed from the SMIT path: `NetBIOS -> WINS -> Configuration -> Names -> List of Defined Names`. Each name in the database should have an entry similar to the following, which shows the name of the client, the type of name, and its IP address:

```
ascii—ACONN_NTW
hex—41 43 4F 4E 5F 4E 54 57 20 20 20 20
20 20 03
Type: Unique; State: Dynamic; Index: 21
IP Address: 9.3.149.253; Age: 0
```

TotalPrint

TotalPrint provides the features not commonly found in standard AIX print spoolers. PC clients of the AIX Connections servers can submit jobs to the TotalPrint print queue, and then modify those jobs by accessing the queue from a standard Web browser.

TotalPrint includes all standard spooler features such as `lp` or `lpr` with as many features found in mainframe spoolers. These include the following:

- Unlimited number of printers
- Alignment pages
- Job restart
- Job priorities
- Job queue control
- Printer state control
- Automatic user-transparent post-processing of output
- Comprehensive security and accounting features
- Customization and native language support

TotalPrint has comprehensive network support including transparent sharing of jobs and printers across TCP/IP networks, and transparent sharing of jobs and printers using MS-DOS/Windows workstations.

AIX Connections servers can handle print jobs from clients using an AIX print spooler such as `lp`. Depending on the AIX Connections configuration, the TotalPrint spooler can do one of the following:

- Spool jobs to a queue where they will immediately be sent to the print device. The options for the spool command are set in the service-specific configuration file.

- Spool jobs to a queue where they will remain until the queue is notified to print the file, via a separate AIX application that also has the ability to modify the print job's attribute.

A Web browser using command-line applications on its back-end controls the AIX applications that manage the printers and print queues. The client prints jobs as it normally does—by submitting jobs to a network printer. If the job has been spooled to a queue requiring notification to print (as described in the second bullet above), the client must interactively send the job to be printed, using a Web browser, after the job has been "printed" by the local application. This allows the client to modify the attributes of the job before it is sent to the print device.

Security

Access to all print objects (printers, queues, and jobs) is determined according to the AIX user and group of the person attempting to access them. The print objects are represented by AIX files; regular AIX file permissions are used to control access.

SMIT vs. Web-Tool vs. Command-line Configuration

SMIT, the Web-based administration tool, and the command line provide a way to configure the AIX Connections servers. The following example demonstrates some differences between the three methods.

A sample configuration of the NB realm server using SMIT Quick Start follows:

- At an AIX command prompt, type `smit ezaconn`.
- Select NB.
- Select the NetBIOS protocol (for TCP/IP, select RFC; otherwise, select NetBEUI).
- Select the device interface for running NetBIOS.
- Specify Service Name; the default is your AIX System hostname.
- Press Enter.

These steps will configure a file server and a terminal server. It will create the AIX Connections interface, create and start a NetBIOS LANA running over the selected interface, and start the server. Note that the Quick Start option should be used only for an initial configuration. If it is used to reconfigure a server, the results are unpredictable. Use the SMIT Configuration options to further configure or modify your servers.

A sample configuration from the Web-based tool would be similar to the following:

- Create and start the NetBIOS LANA's for the server interface. Use SMIT NetBIOS to do this.
- Connect to the http server through your favorite browser.
- Select Initial AIX Connections Configuration.
- Log in as root.
- Select AIX Connections Initial Configuration.
- Select Configure Administration Information. AIX Connections is required to be the admin user and group.
- Select Update Enable Alternate NetBIOS and specify your server name (your AIX System hostname is a good choice).
- Select the interface that will have to be configured using the NetBIOS configuration procedures before the server can be started.
- Specify your domain.
- Select Update NetBIOS Configuration.
- Go to the Main menu.
- Select File Services and choose your file service.
- Select Volume References and create your volume reference.
- Specify the volume you want the reference to and submit.
- Go back (select back arrow) to the Alternate NetBIOS/NetBEUI Service screen.
- Select Printer Reference and create a printer reference.
- Select Start Service.

The file service that you created should now be accessible.

```
/use/tn/tnstype -A -r NB -t file -a type=0x20 \
            -a description="IBM NetBIOS file service"

/usr/tn/tnstype -A -r NB -t term -a type=0x20 -a \
            description="IBM terminal service NetBIOS"

/usr/tn/tntransport -A -n altnb -a template-only=off

/usr/tn/tnservice -A -r NB -s <server name>:file -a \
           command=/usr/tn/NB/LMfile -a transport=altnb \
           -a persistent=off -a client-encryption=on -a \
           description="NB server on <server name>"

/usr/tn/tnservice -A -r NB -s <server name>tty:term -a \
            description="NB term on <server name>" -a \
            command="/usr/tn/NB/NBtty /usr/bin/login"
```

Figure 10. SMIT NetBIOS commands

For the same configuration that you would get from the SMIT NB realm Quick Start, follow these steps on the command line:

- Create and start the NetBIOS LANAs for the interface that you want to run the server over by using SMIT NetBIOS.
- Run the commands shown in Figure 10.
- Run the following for all of your AIX printers:

```
/usr/tn/tnpref -A -r NB -s <server name>:file -p ${i}
```

where `${i}` is an AIX printer.

- Create volume references for pccode and home volumes, as shown in Figure 11.
- Create your interface.

```
/usr/tn/tniface -A -i <interface> -n altnb \
                  -a device=/dev/lana<number>
```

- Start your server.

```
/usr/tn/tnstart -r NB
```

```
/usr/tn/tnvref -A -r NB -s <server name>:file  -v home
/usr/tn/tnvref -A -r NB -s <server name>:file -v pccode
```

Figure 11. Volume references for pccode and home volumes

Similar configurations can be created for the NW and AT realms. Additionally, you can configure everything separately from both the SMIT configuration and the Web-based administration tool.

Denise Genty, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Ms. Genty is a staff software engineer in the RS/6000 Division currently working on AIX Connections and NetWare for AIX. Her primary areas of concentration are AIX device system configuration and communications applications. Ms. Genty has a BS in Computer Science from Texas A&M University.

Michael S. Lew, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Lew is a software engineer on the PC Interconnectivity team in the RS/6000 Division. His area of focus is hardware diagnostics, communications, and AIX software development. He has a BS in Electrical Engineering from Texas A&M University.

Rakesh Sharma, IBM Corporation, 11400 Burnet Road, Austin, TX 78758. Mr. Sharma is an advisory programmer with a specialty in networking protocols, TCP/IP, and UNIX interoperability with PCs. He is currently working with NT/PC interoperability for AIX. He has a BS in Electrical Engineering from ITT Kanpur in India and an MS in Computer Science from North Dakota State University.