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SAS® Scalable Performance Data Server® 4.5

Administrator's Guide

SAS® Documentation

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Chapter 1

SPD Server 4.5 Product Notes

Overview

This document summarizes enhancements and changes in SPD Server 4.5.

- The SPD Server 4.5 installation includes client modules that are compatible with SAS 9.2.
- SPD Server 4.5 is not compatible with SAS versions earlier than SAS 9.2. Refer to the appropriate SPD Server UNIX or Windows installation guide for more information about SAS software requirements for use with SPD Server 4.5.

What's New in SPD Server 4.5?

Overview of SPD Server 4.5

The operating system requirements for SPD Server 4.5 have changed from the operating system requirements for SPD Server 4.4. For more detailed information about operating system requirements for SPD Server 4.5, see the SPD Server Pre-Installation and System Requirements Guide on page 7.

- SPD Audit logging has been enhanced to include the user LIBNAME in the proxy and SQL audit logs. For additional information, see the section on SPD Server auditing in "SPD Server Auditing" on page 189.
- You can now specify recycle times for the SPD Server Name Server log and the SPD Server Snet log. For additional information about configuring SPD Server log cycle times for Windows installations, see "Configuring SPD Server Software on Your Windows Host" on page 44. For additional information about configuring SPD Server log cycle times for UNIX installations, see "Configuring SPD Server Host Software for Your Site" on page 16.

- SPD Server now supports user formats with the put() function that are greater than 8 characters in length. An SPD Server host can read user format catalog files that were created by SAS running on Windows, or on the same machine as the SPD Server host. The spdsls list utility has been enhanced to add a **`-verbose`** option. The **`-verbose`** option provides information such as the number of observations, observation length, index segment size, partition size, and whether the table is compressed, encrypted, or is a member of a cluster. For more information about SPD Server list utilities, see "SPD Server Table List Utility Spdsls" on page 227.
- SAS implicit pass-through SQL now permits SQL queries to SPD Server that include supported SPD Server functions. The "SPD Server SQL Features" chapter of the *SAS Scalable Performance Data Server 4.5: User's Guide* contains a section, "Differences between SAS SQL and SPD Server SQL," that lists the functions that SPD Server supports via implicit pass-through SQL.
- The installation and delivery of the SPD Server 4.5 client components for SAS is now part of your SAS installation. For more detailed information about installing SPD Server 4.5 on a Windows platform, see "Before You Install: Precautions and Required Permissions" on page 38. For more detailed information about installing SPD Server 4.5 on a UNIX platform, see " Before You Install: Precautions and Required Permissions" on page 12.
- The installation and delivery of SAS Management Console components for SPD Server 4.5 is now part of your SAS Management Console installation. For more detailed information about installing SAS Management Console components for SPD Server 4.5 on a Windows platform, see "Before You Install: Precautions and Required Permissions" on page 38. For more detailed information about installing SAS Management Console components for SPD Server 4.5 on a UNIX platform, see " Before You Install: Precautions and Required Permissions" on page 12

SPD Server 4.5 Platform Support Changes

SPD Server 4.5 now supports the Linux x64 platform.

Part 2

Installation

Chapter 2

SPD Server Pre-Installation and System Requirements Guide

AIX Requirements and Tuning for 64-bit SPD Server

For complete information about AIX tuning for SAS SPD Server, see the white paper selection available on SAS Institute's external Web site at: **`www.sas.com/partners/directory/ibm/papers.html`**

HP-UX Requirements and Tuning for 64-bit SPD Server

System Requirements

- Required OS level: HP-UX 11i 64-bit OS (HP-UX 11.11 for PA-RISC or HP-IA64 64-bit OS (HP-UX 11i v2, HP-UX 11.23 for Itanium)

- Minimum System Configuration: HP-PA 2.0 server system with minimum 2Gb memory.

Kernel Tuning Requirements

The following kernel parameters are for HP-UX 11.11 and HP-UX 11.23. They need to be adjusted on the HP server system where you will run SPD Server.

After you make these kernel parameter changes, be sure to reboot the system before you attempt to use the SPD Server. In the following, MAX(a,b) means to take the maximum of the values a or b.

- ```
  dcb_max_pct = 10%
     dcb_min_pct = 2%
     max_thread_proc = 512
     maxdsiz_64 = 1Gb + MAX(SORTSIZE, INDEX_SORTSIZE)
     maxuprc = 4 + #concurrent SPD Server users
     nproc = current nproc value + 4 + #concurrent SPD Server users
  ```
- *Note:* SORTSIZE and INDEX_SORTSIZE are SPD Server parameters from the spdsserv.parm file. Increasing these SPD Server parameters may require adjusting the HP-UX kernel parameters accordingly. For more information on SPD Server parameters consult the "SPD Server UNIX Installation Guide " on page 11
- Other HP-UX kernel parameters that may need to be increased depending on the way you use the SPD Server include:
  - **ninode**= Maximum open inodes in memory. Adjust for the maximum number of concurrently open SPD tables multiplied by the maximum number of partitions in an SPD Server table.
  - **nfile**= System-wide open file limit. Adjust for the maximum number of concurrently open SPD Server tables multiplied by the maximum number of partitions in an SPD Server table.
  - **nflocks**= System-wide file lock limit. Adjust for the maximum number of concurrently open SPD Server tables.
  - **maxfiles_lim** = Process hard limit for open files. Adjust for the maximum number of concurrently open SPD Server tables multiplied by the maximum number of partitions in an SPD Server table. The minimum recommended setting is 8192

Required Patches

The following HP-UX 11.23 for Itanium (IA-64) patches should be applied for SPD Server 4.4:

- PHCO_30543 s700_800 11.23 Pthread library cumulative patch
- PHCO_30531 s700_800 11.23 libc cumulative patch
- The HP September 2004 Base Patch Bundle for HP-UX 11.23
  ```

Solaris on Sparc Requirements and Tuning for 64-bit SPD Server

System Requirements

The following kernel parameter needs to be adjusted on Solaris server systems where you will run SPD Server.

- **rlim_fd_max** = Process limit for open files. Adjust the parameter to accommodate the maximum number of the number of concurrently open SPD tables multiplied by the maximum number of partitions in an SPD Server table. The minimum recommended setting is 8192
- Required OS level: **Solaris Version 5.9**

Solaris on X64 Requirements and Tuning for 64-bit SPD Server

System Requirements

The following kernel parameter needs to be adjusted on Solaris server systems where you will run SPD Server.

- **rlim_fd_max** = Process limit for open files. Adjust the parameter to accommodate the maximum number of the number of concurrently open SPD tables multiplied by the maximum number of partitions in an SPD Server table. The minimum recommended setting is 8192
- Required OS level: **Solaris Version 5.10, Update 3**

Linux on X64 Requirements and Tuning for 64-bit SPD Server

System Requirements

- Required OS level: **Red Hat Enterprise Linux 4 and 5, SuSE Linux Enterprise Server 9 and 10.**

Windows Requirements and Tuning for 32-bit SPD Server

System Requirements

- Required OS level: **Windows NT 4.0 Service pack 3 or greater**
- Minimum System Configuration: NT server system.

SPD Server 4.5 Client Requirements

System Requirements

- Required SAS level: **SPD Server 4.5 requires SAS 9.2**.

Chapter 3

SPD Server UNIX Installation Guide

SAS Scalable Performance Data Server 4.5 and SAS Deployment Wizard

SAS Scalable Performance Data Server (SPD Server) 4.5 can be installed as part of your initial SAS 9.2 installation. Or, SPD Server 4.5 can be installed as an add-on product to an existing SAS 9.2 installation. In either case, the SPD Server 4.5 installation is facilitated by the SAS Deployment Wizard. The SAS Deployment Wizard installs SPD Server to the following location on your computer: **`<SASROOT>/SASScalablePerformanceDataServer/4.5/`**.

Note: <SASROOT> is a placeholder for the full path specification to the base directory of your SAS 9.2 installation.

Before You Install: Precautions and Required Permissions

Note: Before you install, see "SPD Server 4.5 Product Notes " on page 3 for important information about features in this release.

Review the following precautions and required permissions:

- Read "SPD Server Pre-Installation and System Requirements Guide " on page 7 .
- SPD Server 4.5 is distributed only as a 64-bit environment application for Solaris by Sun, AIX by IBM, Linux by SUSE or Red Hat, and HP-UX by Hewlett-Packard.
- SAS recommends that you use a UNIX user ID other than root to run your production SPD Server environment. Although there are no known security or integrity problems with SPD Server 4.5, root access is not required to run SPD Server. After you correctly configure UNIX directory ownership and you set permissions on your LIBNAME domains, there is no real need or benefit for root access to SPD Server. For more information and a list of options to use when configuring SPD Server, see"Notes for SPD Server Administrators" on page 32 .
- SAS recommends that you install SPD Server in a location that is adequately mirrored and backed up to assure reliability. The SPD Server installation location should use system space in which the SPD Server Administrator has full rights.
- General familiarity with the UNIX language is required to install SPD Server 4.5. At a minimum, installers should be familiar with basic UNIX shell entities (such as sh, csh, and ksh), Bourne shell scripts, the UNIX tar command, and how to modify files using a UNIX text editor.
- You need appropriate access permissions to create the installation directory for SPD Server on the file system where you install the server software. The owner of the SPD Server installation directory should be the UNIX user ID of the SPD Server administrator. For more information, see"Notes for SPD Server Administrators" on page 32 .
- You need Write access to your server machine's **`/etc/inet/services`** or **`/etc/services`** file, if you want SPD Server clients to connect to the SPD Server host using name services instead of specifying port numbers at invocation. Name services require you to define registered ports that use the services file appropriate to your machine.

- If your SPD Server clients access the SPD Server host using name services instead of specifying port numbers, you need Write access to the services files on the clients, in the path **`/etc/services`** or **`/etc/inet/services`**

  For Windows, the path is **`C:\winnt\system32\drivers\etc\services`**

- Insert the WORKPATH= server option in your spdsserv.parm file. Use the WORKPATH= option to configure your server to use a high-performance file system. Ideally this system has RAID-structured volumes with sufficient disk space to accommodate the transient storage needs for Server. The spdsserv.parm file is located in the root directory of your SPD Server host installation. For more information about the WORKPATH= option and configuring servers for performance, see the *SAS Scalable Performance Data (SPD) Server 4.5: User's Guide.*

Packing List for SPD Server Distribution

Directory Contents

Directory names in the packing list are subdirectories of your SPD Server host installation directory, whose path is represented by **`InstallDir/`**.

Note: **`InstallDir/`** represents the root directory where SPD Server is installed.

The **`bin/`** subdirectory contains the following binary files:

- **spdsnsrv** is the SPD Server Name Server.
- **spdsserv**is the SPD Server host.
- **spdsbase** is the LIBNAME proxy.
- **spdslog** is the message logger.
- **spdsaud** is the audit logger.
- **spdseng** is the SQL Pass-Through engine.
- **ixutil** is the data set index utility .
- **psmgr** is the password file utility.
- **spdssnet** is the ODBC, JDBC, and htmSQL gateway,
- **spdsperf** is the Performance server.
- **spdsls** gives physical file listings for a LIBNAME domain.
- **spdsbkup** performs full or incremental table backups.
- **spdsrstr** restores full or incremental table backups
- **spqldrive** is a stand-alone SQL Pass-Through driver.
- **spdsconv** is the SPD Server 3.*x* to SPD Server 4.*x* table conversion utility.
- **spdsclean** is the SPD Server disk cleanup utility.
- **dulibv3** is the SPD Server 3.*x* 64-bit version of the shared library used by spdsconv. The dulibv3 file is included only if your system previously supported SPD Server 3.*x* tables.
- **spdsbased** is the debug version of spdsbase.
- **spdsengd** is the debug version of spdseng.

- **spdsnlslib** is the NLS library.
- **spdsnlslibd** is the debug version of spdsnlslib.
- **spdsiotest** is the stand alone SPD Server I/O scalability test.

The **`lib/`** subdirectory contains the following SPD Server library files:

- **spdslib** is the run-time library that performs SQL Pass-Through from C and C++ applications to SPD Server.
- **spds.dll** is the application extension library that is accessed via the SAS ODBC Driver.

The **`samples/`** directory contains the following files of interest:

- **auditraw.sas**is used to read proxy audit files that do not include WHERE clause auditing.
- **auditwh.sas**is used to read proxy audit files that include WHERE clause auditing.
- **audit.sql.sas**is used to read an SQL audit file.
- **libnames.parm** is a sample SPD Server host LIBNAME configuration file. Use with the **`-libnamefile`** option for the **spdsserv** command.
- **libsamp.parm** is a more advanced example of a LIBNAME configuration file.
- **pwdb** is a script to start the Password Manager executable.
- **spdsserv.parm** is a sample SPD Server host parameter file. It sets the defaults for SPD Server options. Use this file with the -PARMFILE option for the spdsserv command.
- **rc.spds** is a Bourne shell script to start a standard SPD Server environment.
- **rc.perf** is a Bourne shell script to start a standard Performance Server.
- **killspds** is a shell script that kills all processes for a UNIX user beginning with the letters spds. Do not use the **killspds** script if you have any processes running in UNIX that do not belong to SPD Server, but whose executable names begin with the letters spds.
- **killrc** is a shell script that kills all processes related to a run of rc.spds. The killrc script is selective. It does not kill SPD Server processes that are not related to core processes started by rc.spds. Those core processes are initially started when rc.spds runs. The core processes are typically spdsnsrv, spdsserv, spdsbase, spdslog, and spdssnet, based on the rc.spds script the **`/samples`** directory.
- **doc_examples.sas** contains sample SAS code that is used in the *SAS Scalable Performance Data (SPD) Server 4.5: User's Guide* documentation. This guide provides SPD Server LIBNAME and data set usage and syntax options.
- **verify.sas** is a SAS installation verification job. You should run it after you install SPD Server.
- **spdsinst.sas** demonstrates the simple use of WHERE clauses and WHERE planner output.
- **passthru.sas** demonstrates SQL Pass-Through usage. It gives examples of simple, single-level Pass-Through and secondary libref and connection scenarios.
- **tempwork.sas** demonstrates temporary LIBNAME domain support. Files created in a temporary LIBNAME domain are automatically deleted when the SAS session ends.
- **paraload.sas** shows how to perform parallel loads from an existing table into an SPD Server table. This technique exploits a parallel load capability in the LIBNAME proxy.
- **aclcolrw.sas** shows the use of ACL row and column security features.

- **symbsub.sas** shows how symbolic substitution in SQL Pass-Through statements can provide row-level security in tables.
- **fmtgrpby.sas** shows how to use formatted parallel GROUP BY statements in SQL Pass-Through.
- **scale.sas** can be used to benchmark the scalability of your SPD Server.
- **dynamic_cluster*.sas** shows how to use dynamic clusters with a MIN and MAX variable list.
- **minmax*.sas**shows how to use a MIN and MAX variable list on an SPD Server table.
- **paralleljoin*.sas**shows the use of the SQL Parallel Join performance enhancement.
- **starjoin*.sas** shows the use of the SQL Star Join performance enhancement.
- **index_scan*.sas** shows the use of the SQL index scan performance enhancement.
- **materialize_view*.sas** shows the use of the SQL materialized view performance enhancement.
- **process_perf_log** is a Perl script that processes a Performance Server log and server log into data that can be read into a SAS data set for post-performance analysis. The parameters are detailed in the script.
- **PerfDataSample.sas** is used to read a processed Performance Server log into a SAS data set.

The `doc/` directory contains information to locate the online *SAS Scalable Performance Data (SPD) Server 4.5: Administrator's Guide* and the *SAS Scalable Performance Data (SPD) Server 4.5: User's Guide* in PDF format.

The `lic/` directory contains the SPD Server license file for your installation.

The spds.lic file is used by the SPD Server Name Server to validate SPD Server hosts for their target hardware configurations. Once you obtain a valid SPD Server SETINIT for a machine, you need to append it to this file.

The `msg/` directory contains SPD Server message files. The collection of `*.m` files are used by various SPD Server components to generate message text.

The `site/` directory is a storage directory for a user's site-specific customization of the sample SPD Server start-up and configuration files. No SPD Server files are delivered in this directory. It is for customer use only.

The `spdssmc/` directory contains the SAS Management Console files that support SPD Server.

Upgrading SPD Server 3.x to SPD Server 4.5

Overview of Upgrading from SPD Server 3.x to SPD Server 4.5

SPD Server 3.*x* tables are not compatible with SPD Server 4.*x* tables, including SPD Server 4.5. If you want to use your SPD Server 3.*x* tables with SPD Server 4.5, you must first convert your SPD Server 3.*x* tables to SPD Server 4.*x* format. For more information about converting SPD Server 3.x table for use with SPD Server 4.5, see "Introduction" on page 59.

Upgrading SPD Server 4.x to SPD Server 4.5

Overview of Upgrading from SPD Server 4.x to SPD Server 4.5

SPD Server 4.*x* tables are compatible for use with SPD Server 4.5. No conversion is required to use SPD Server 4.*x* tables with SPD Server 4.5. You can start SPD Server 4.5 using domains that include tables created by any SPD Server 4.*x* host.

Configuring SPD Server Host Software for Your Site

After you install SPD Server 4.5, you must configure SPD Server to run on your server machine. The SPD Server 4.5 installation contains only 64-bit components.

Complete the following steps to install the SPD Server system:

1. For ksh users:

   ```
   export PATH=$PATH:InstallDir/bin
   ```

   For csh users:

   ```
   set path = ($path InstallDir/bin)
   ```

2. Six files need to be copied from the **`InstallDir/samples`** directory to the **`InstallDir/site`** directory:

   ```
   rc.spds
   pwdb
   spdsserv.parm
   killrc
   libnames.parm
   rc.perf
   ```

3. In the **`InstallDir/site`** directory, edit the pwdb script file.

   Note: Depending on the shell that you are running, you have to make minor modifications to the script file.

   The pwdb file configuration must be modified to point to the INSTDIR= path, the path where your copy of SPD Server is installed.

   The INSTDIR= path in your pwdb file should be changed to

   ```
   INSTDIR=<explicit UNIX path to your SPD Server Installation Directory>
   ```

4. Invoke the pwdb script from the **`/site`** subdirectory to create an initial SPD Server password file. The password file is created in **`InstallDir/`** by executing the following command:

   ```
   pwdb
   ```

   First, use the Password Manager **groupdef** command to define a group called admingrp. Next, use the Password Manager **add** command to add an SPD Server user ID for yourself. (This is assuming that you are the SPD Server administrator). Both the

groupdef and **add** commands prompt you for values to enter. Use the following transcript file from a typical command sequence for reference. You should notice that the password prompt does not echo any characters as you type. If you want to verify your work, you can use the Password Manager **list** command to print the contents of the SPD Server password file, following the **add** command.

You should see content similar to the following:

```
SAS Scalable Performance Data Server Host 4.50
Password Manager Utility
Copyright (c) 1996-2009 by SAS Institute Inc, Cary NC 27513  USA

Enter command
> groupdef admingrp
Group admingrp defined

Enter command
> add
Enter username to add
> admin
Enter password for admin
>
Verify password
>
Enter authorization level (0 to 7) for admin:
> 7
Enter IP Address or <Return
>
Enter password expiration time in days
> 365
Enter group name or <Return>
> admingrp
Enter the maximum allowed time (in days) between successful logins <Default
= infinite>
>
Enter the maximum allowed login failures <Default = infinite>
>
Enter admin's performance class(1=LOW 2=MED 3=HIGH carriage return for LOW)
>
User admin added
Enter command
> quit
```

These commands initialize the user password database.

You should add other user IDs before opening the SPD Server system for use. Authorization level 7 is privileged. Authorization level 7 allows users to circumvent desirable SPD Server ACL security measures. Unlike the previous example, most or all users should be given authorization level 0 (which is non-privileged), so that SPD Server security cannot be bypassed. For more information, see "Notes for SPD Server Administrators" on page 32 .

Note: The administrator password expires during the first logon to the SPD Server host. For more information about passwords, see the **psmgr** utility reference documentation.

5. In the **`InstallDir/site`** directory, edit the libnames.parm file to add the site-specific LIBNAME domains that your SPD Server will support. This step requires some

thought and planning. You should decide how to organize your existing disk storage to best exploit the capabilities of the SPD Server. For more information, see "SPD Server Host Commands" on page 27 and the libsamp.parm file. For more information about managing resources, see "Managing Computing Resources with a Name Server" on page 67 .

6. Edit and configure the resource script file rc.spds. In the **`/InstallDir/site`** directory, use a UNIX text editor to open the rc.spds file. The tasks to configure the **rc.spds** file include the following:

   - Specify the SQL audit file cycle time and the file prefix using AUDTIME= and AUDFILESQL=.
   - Confirm settings for the INSTDIR= pointers to your installation directory.
   - Confirm settings for the INSTDIR= pointers to your **`/bin`** directory.
   - Specify whether to start up the SNET Server.
   - Check SNET port assignments if you use SNET.
   - Reassign SNET ports if there are conflicts.
   - Specify whether to create a log using LOGDIR=.
   - Specify the log cycle time and the file prefix using LOGTIME= and LOGFILE=.
   - Specify whether to create an audit file facility using AUDDIR=.
   - Specify the audit file cycle time and the file prefix with AUDTIME= and AUDFILE=.
   - Specify the location of your server user password database and parameter files.

Here is an example of a typical unmodified rc.spds file:

```
#!/bin/sh -x
# Sample startup script for SPDS.
# This script starts the SPDS Name Server
# data server and ODBC server processes
# using assumed install directories. Most
# paths are controlled through shell variables
# defined at the beginning of the script.
# If you change this script, copy it to
# the SPDS site directory and modify that
# copy just to make sure that a subsequent
# SPDS software upgrade doesn't wipe out
# your site modifications to the script.
#----------------------------------------
#
# Define some primary variables. INSTDIR is the
# root directory of your installation.  INSTDIR is
# initialized to run rc.spds from the site dir
# of your installation.
#
# NSPORT is the SPDS name server listen port;
#        if omitted uses "spdsname" service entry.
# SNSPORT is the SPDS ODBC server listen port;
#        if omitted uses "spdssnet" service entry.
#
# If you are running through a firewall the NSPORT and
# SNSPORT must be surfaced through the firewall.  In
```

```
# addition, the SPDS server listen port and operator port
# must be surfaced through the firewall. If you are not
# running through a firewall allow the server to choose
# these ports.
#
# SRVLPORT is the SPDS server listen port;
#        leave as 0 if NOT running through a firewall.
#
# SRVOPORT is the SPDS server operator port;
#        leave as 0 if NOT running through a firewall.
#
# Refer to the SPDS Admin Doc section on Security for
# more information on running SPDS through a firewall.
#
NSPORT=5190
SNSPORT=5191
SRVLPORT=0
SRVOPORT=0
INSTDIR=$PWD/..
PARMDIR=$INSTDIR/site
ACLDIR=$INSTDIR/site
LICDIR=$INSTDIR/lic
```

The rc.spds file configurations you need to examine are the following:

- **INSTDIR**: Your SPD Server installation directory assumes that you are running the rc.spds script from your **`/site`** directory. The INSTDIR= variable provides the relative path to the installation directory from your **`/site`** directory.
- **INSTDIR/bin**: The PATH=, LD_LIBRARY_PATH, and LIBPATH= statements in the default rc.spds file refer to the INSTDIR/**bin** directory. The PATH=, LD_LIBRARY_PATH, and LIBPATH= statements are in the following section of the rc.spds file:

  ```
  #
  # Define some secondary variables for server
  # parameter files
  #
     SPARM=$PARMDIR/spdsserv.parm
     LICFILE=$LICDIR/spds.lic
     PATH=$INSTDIR/bin
     export PATH
     MSGPATH=$INSTDIR/msg/
     export MSGPATH
     LPARM=$INSTDIR/site/libnames.parm
     LD_LIBRARY_PATH=$INSTDIR/bin
     export LD_LIBRARY_PATH
     LIBPATH=$INSTDIR/bin
     export LIBPATH
  ```

- **SNET**: The rc.spds script assumes that you want to start the SNET Server (spdssnet) to support OBDC, JDBC, or htmSQL access to SPD Server data stores. If this is not what you want, you can delete or comment out the following lines near the bottom of the rc.spds script.

  ```
  # Startup the spdssnet server. This server supports
  # ODBC access to SPDS data. Note the
  # only parameter is the optional spdssnet listen
  ```

```
# port number. If not explicitly specified it
# will default to the "spdssnet" service in /etc/services
#

/bin/sleep 2
if [ -z "$SNSPORT" ]; then
   spdssnet 1>$SNSLOG 2>&1 &
else
   spdssnet -listenport $SNSPORT 1>$SNSLOG 2>&1 &
```

- **SNET Port Assignments**: The rc.spds script assumes that you are running SPD Server concurrently with an SPD Server 3.*x* environment. It assumes that the SPD Server Name Server and the SNET Server will run using explicit port number assignments. The following lines at the beginning of rc.spds assign the ports numbers:

  ```
  NSPORT=5190  (name server port for spdsnsrv)
  SNSPORT=5191 (SNET Server port for spdssnet)
  ```

  If these ports are in use, or if resources specify otherwise, choose new port numbers. If you omit these assignments, rc.spds uses the name services entries SPDSNAME and SPDSSNET. If you do not run the Snet Server, you do not need to be concerned about the SNSPORT definition.

- **Logging**: The rc.spds script assumes that you want to keep the logs from messages written to STDOUT or STDERR of the **spdsnsrv** (SPD Server Name Server) and spdsserv (SPD Server host) processes. The shell variable LOGDIR= defines the directory where these logs are kept. If you do not want to keep these logs, change LOGDIR= and the rc.spds script will use **`/dev/null`**. If you want to keep the logs in another location besides **`InstallDir/log`**, change LOGDIR=.

  The DSRVFILE= and DSRVTIME= spdsserv options, NSRVFILE= and NSRVTIME= spdsnsrv options, and SNSFILE= and SNSTIME= spdssnet options are enabled by default with the following shell variables:

  DSRVFILE=spdsserv
  : Specifies the spdsserv process log file prefix.

  DSRVTIME=00:00
  : Specifies the time of day to cycle the spdsserv log file.

  NSRVFILE=spdsnsrv
  : Specifies the spdsnsrv process log file prefix.

  NSRVTIME=00:00
  : Specifies the time of day to cycle the spdsnsrv log file.

  SNSFILE=spdsnet
  : Specifies the spdssnet process log file prefix.

  SNSTIME=00:00
  : Specifies the time of day to cycle the spdssnet log file.

  These settings enable automatic log filename generation and cycling by specifying the log file prefix and the log file cycle time of day. The file path for the **`-LOGFILE`** option is generated by concatenating the LOGDIR= and LOGFILE= variables. For more information about these options, see “SPD Server Host Commands” on page 27. When automatic log filename generation and cycling are enabled, the only messages that go to the default log file are those written to STDERR. If you want to disable automatic log filename generation and cycling, change the settings to empty pointers such as the DSRVFILE= and DSRVTIME= options.

The LOGFILE= and LOGTIME= spdsserv options are enabled by default with the following shell variables:

`LOGFILE=spdsserv`

Specifies the spdsserv process log file prefix.

`LOGTIME=00:00`

Specifies the time of day to cycle the log file.

These settings enable automatic log filename generation and cycling by specifying the log file prefix and the log file cycle time of day. The file path for the -logfile option is generated by concatenating the LOGDIR= and LOGFILE= variables. For more information about these options, see "SPD Server Host Commands" on page 27. When automatic log filename generation and cycling are enabled, the only messages that go to the **`InstallDir/log/spdsserv.log`** file are those written to STDERR. If you want to disable automatic log filename generation and cycling, , change the settings to empty pointers, such as the LOGFILE= and LOGTIME= options.

- The rc.spds script allows you to use the SPD Server audit file facility, but the audit file facility is not enabled by default. Use the following shell variables to configure the SPD Server audit file facility:

  AUDDIR=
  Use the AUDDIR= shell variable to specify the directory for the audit log files.

  AUDFILE=
  Use the AUDFILE= shell variable to specify the prefix for audit log files.

  AUDFILESQL=
  Use the AUDFILESQL= shell variable to specify the prefix for SQL audit log files.

  AUDTIME=
  Use the AUDTIME= shell variable to specify the time of day (HH:MM) to cycle the audit log file.

  When AUDDIR= and AUDFILE= are set, you enable proxy audit file creation. When AUDDIR= and AUDFILESQL= are set, you enable SQL audit file creation. If AUDTIME= is set, automatic audit file cycling occurs at the specified time of day. For more information about the audit file facility, see "SPD Server Host Commands" on page 27.

- **User Password and Parameter Files**: The rc.spds script assumes that you keep your spdsserv.parm parameter file and your SPD Server user password file in the **`InstallDir/site`** directory. If you do not, you need to change the ACLDIR= and PARMDIR= assignments. You can include this script into your system start-up file so that it executeds as part of starting the system. Otherwise, the SPD Server administrator must manually start SPD Server after the system starts up.

- After you have finished making your changes, save and close the rc.spds file.

  Note: The example rc.spds script provided in the next step is a generic UNIX script. Some additional path changes might be required for other operating environments. For example, Linux operating systems do not keep the **ps** and **grep** commands in **`/usr/bin`**, so changes are required.

1. Assuming that you want to use registered ports for your SPD Server host, and you choose to use the default SPD Server Name Server port of 5190 and the SNET Server port of 5191, add the following services to your **`/etc/services`** or **`/etc/inet/services`** file on the SPD Server host machine.

   ```
   spdsname 5190/tcp # SPDS Name Server
   ```

Service declaration for the SPD Server Name Server

```
spdssnet 5191/tcp # SPDs SNET
```

Server Service declaration for the SNET Server.

You only need the SNET service if you plan to run the SNET Server. By default, the sample rc.spds script runs spdssnet.

If you choose to use different port addressses, replace the ???? strings with unused 4-digit port addresses. Also remember to update your rc.spds script accordingly. Determine unused port addresses by scanning the existing addresses and then choosing a number that does not appear. Choosing a number greater than 5000 avoids conflicts with reserved and system-defined port addresses.

```
spdsname ????/tcp # SPDS Name Server
```

Service declaration for the SPD Server Name Server

```
spdssnet ????/tcp # SPDS SNET Server
```

Service declaration for the SNET Server.

Note: If you installed a previous version of SPD Server software and you have the service name **spdsoper** defined, you should remove it from your **`/etc/services`** or **`/etc/inet/services`** file on the SPD Server system.

2. You are now ready to start SPD Server. Execute the **`InstallDir/site/rc.spds`** script that you customized in the previous steps. This starts the SPD Server environment in the context of your current UNIX user ID.

   The rc.spds script customization is important because it defines UNIX ownership and file access permissions on SPD Server resources. Ownership and file permissions are set in the context of the SPD Server run-time environment. If you plan to execute rc.spds from your system startup, the rc.spds script should be executed in the context of the appropriate UNIX user ID. Using the appropriate UNIX user ID ensures that the resources created in the startup configuration meet the necessary file ownership and permission requirements for SPD Server.

3. The rc.perf script is an example script to start the Performance Server.

Verify That SPD Server 4.5 Is Running

If you connected to SPD Server through a SAS connection, verify that both the SPD Server Name Server (spdsnsrv) and the SPD Server host (sdpsserv) processes are running. Issue the UNIX **ps** command. You should see processes for spdsnsrv, spdsserv, spdsbase (row level integrity proxy), and spdssnet as shown in the following example:

```
  PID TTY          TIME CMD
24012 pts/26   00:00:00 ksh
24114 pts/26   00:00:00 spdsnsrv
24116 pts/26   00:00:00 spdslog
24117 pts/26   00:00:00 spdsserv
24119 pts/26   00:00:00 spdslog
24120 pts/26   00:00:00 spdssnet
24130 pts/26   00:00:00 spdslog
24136 pts/26   00:00:00 spdsbase
24139 pts/26   00:00:00 ps
```

If the spds* processes are not running, check the log for errors. Unless you change the log file defaults in **rc.spds**, the log paths are the following:

- **InstallDir/log/spdsnsrv.log**
- **InstallDir/log/spdsnsrv_mmddyyyy_hh:mm:ss.spdslog**
- **InstallDir/log/spdsserv.log**
- **InstallDir/log/spdsserv_mmddyyyy_hh:mm:ss.spdslog**
- **InstallDir/log/spdssnet.log**
- **InstallDir/log/spdssnet_mmddyyyy_hh:mm:ss.spdslog**

If there were problems during start-up and any processes failed to initialize, terminate the remaining SPD Server processes before re-invoking the rc.spds script. Use the **killspds** shell script in the **\samples** directory, or terminate the process manually using the UNIX **kill** command as shown in the following example:

```
$ kill 834 831 832 836 835
```

Upgrade Notice: If you upgrade from SPD Server 3.*x* to SPD Server 4.5, when you are satisfied with your SPD Server installation, you should copy the libnames.parm file from your SPD Server 3.x location to your SPD Server 4.5 location. The new libnames.parm file overwrites the temporary file that was created when you verified your SPD Server 4.5 installation. The new file provides you with access to all of the SPD Server 3.*x* LIBNAME domains from your previous environment.

Configuring SPD Server Client Software

The SPD Server client software is used to make SAS LIBNAME connections and perform user-specified operations on the SPD Server host. The SPD Server client software is installed with SAS 9.2, and contains the following SAS modules:

- **sasspds** is the LIBNAME engine that is required to access the SPD Server environment from SAS 9.2.
- **sasspdo** is the SPD Server operator procedure that is required to access the SPD Server 4.5 environment from SAS 9.2.
- **spds.msg** is the SAS compatible message file for the SPD Server LIBNAME engine and SPD Server operator procedure.

The SPD Server client software is installed with SAS 9.2 Foundation at **<SASROOT>/SASFoundation/9.2/spdclient**. The SAS 9.2 configuration file automatically includes your SPD Server client software directory in its required path list.

Once the SPD Server environment is configured and running, you need to complete other installation functions on the SAS clients that will use SPD Server. This might include the system that is actually running SPD Server. Therefore, some of these steps might have already been performed during the installation of the SPD Server host. If so, skip the duplicated steps.

Perform the following steps on each SAS client that will access SPD Server:

1. If you want to access SPD Server through a registered port (name service), add the following service to your **/etc/inet/services** or **/etc/services** file if not already there:

   ```
   spdsname ????/tcp # SPDS Name Service
   ```

The service defines the port number for the SPD Server Name Server process. Make sure the added port number matches the port number used during the SPD Server installation. If you are running SAS with an existing SPD Server installation, this service name is probably already defined. You can either define another service name for the SAS client to use (for example, sp45name) or you can directly include the SPD Server port number in your SAS statements.

2. The SPD Server can be accessed with the SAS 9.2 ODBC Driver, JDBC Driver, and htmSQL driver. Each of these drivers can be downloaded from the **Support** tab at **support.sas.com**

   ODBC client applications require installation of the spds.dll application extension. Install the ODBC client application extension as follows

   - Install the SAS 9.2 ODBC Driver
   - Copy

   ```
   InstallDir/lib/spds.dll
   ```

   to

   ```
   <drive letter>:\Program Files\sas\shared files\general
   ```

   - Configure an ODBC data source for direct SPD Server access.

Testing Your SPD Server Installation Using SAS

Testing your SPD Server installation is simple. To verify, you make two SAS LIBNAME assignments using the SPD Server LIBNAME engine. The examples in this section refer to the SASSPDS engine, which is the engine for SAS 9.2.

1. Start the SPD Server environment by executing your customized rc.spds script. Execute this script from the UNIX user ID that owns the LIBNAME directories that are configured in the SPD Server LIBNAME file. For more information about the rc.spds script and SPD Server LIBNAME files, see"Notes for SPD Server Administrators" on page 32.
2. On a correctly configured client system, invoke SAS, and make the following LIBNAME assignments:

   ```
   LIBNAME test sasspds 'tmp'
     server=serverNode.port
     user='anonymous';
   ```

   serverNode is the server's node name and port is either the numeric value assigned to NSPORT from the rc.spds file, or the service name you use to access the SPD Server Name Server. If you used the sample rc.spds, your LIBNAME assignment would look similar to the following:

   ```
   LIBNAME test sasspds 'tmp'
     server=serverNode.5190
     user='anonymous';
   ```

   If you use the spdsname service, your LIBNAME assignment would look similar to the following:

```
LIBNAME test sasspds 'tmp'
  server=serverNode.spdsname
  user='anonymous';
```

In addition, you should verify that the row level integrity LIBNAME assignment works correctly:

```
LIBNAME testrl sasspds 'tmp'
  server=serverNode.port
  user='anonymous' locking=YES;
```

When you verify these statements, you confirm the connectivity between the SAS client and the SPD Server environment. Successfully performing these LIBNAME assignments means that the network configuration is correct and that most of the SPD Server configuration is correct.

Substitute **serverNode** with the node name that runs the SPD Server environment that you want to test. This is the node that invokes rc.spds. The test assumes the temporary LIBNAME definition in the sample libnames.parm file was not changed during installation.

Watch the SAS log for error messages. You might see failures to properly one or more required SPD Server components. Examples of common error messages are displayed. If you receive one of the following error messages, check your -PATH option to confirm that the directory in which you installed SAS components is correctly set:

```
ERROR:    Protocol version mismatch. Proxy version
          is 4.5 while engine version is 3.x.

ERROR:    Module TEST not found  in search paths.

ERROR:    Error in the LIBNAME or FILENAME
          statement.
```

If you receive the following (or similar) error message describing failures to access messages, check your -SASMSG option and confirm that the directory in which you installed SPD Server components is properly set:

```
ERROR: unable to access message 608.108
```

If the attempted connection to the SPD Server hangs for several minutes, check the -PATH option and confirm that the directory in which you installed SAS components is correctly set. The **spds45** client component directory needs to be at the beginning of the path option.

3. Once every LIBNAME is assigned, you can further verify by running the sample SAS program, **`InstallDir/samples/verify.sas`**. Submit the SAS command to execute the program:

   ```
   %include 'InstallDir/samples/verify.sas'/source2;
   ```

   This test exercises many features of the SPD Server LIBNAME engine and proxy, and verifies your installation configuration. The test performs a sequence of DATA and PROC steps using a generated data set. It checks the results expected from various DATA step queries. If any query fails to produce the expected result, the SAS job is terminated. The job **verify.sas** requires that the SAS librefs TEST and TESTRL are assigned as shown in Step 2.

4. Verify that SQL Pass-Through services are working in SPD Server by submitting the following SAS commands:

```
%let spdshost=serverNode;
%let spdsport=port;
%include 'InstallDir/samples/verptsql.sas'/source2;
```

serverNode and **port** are described in Step 2.

SPD Server Command Reference

SPD Server operation revolves around the executable files described in the packing list. The executables are in the **/bin** subdirectories. Each executable supports a set of command-line options that override default features, or provides site-dependent configuration information. The command-line options for each executable are provided in the following sections:

SPD Server Name Server Commands

The SPD Server LIBNAME engine connects to the SPD Server Name Server. The Name Server resolves LIBNAME domain names into physical file system paths for librefs. The Name Server also resolves host node and end-point (TCP port) addresses for each LIBNAME. Each SPD Server host process (spdsserv process) registers LIBNAME domain information from its configuration file with its appointed Name Server process (spdsnsrv process). Multiple SPD Server hosts can use the same Name Server to register their LIBNAME domains. The only requirement is that the combination of the LIBNAME= option values from the SPD Server host's LIBNAME configuration file must be unique across all SPD Server hosts connecting to the Name Server.

Part of the function of the Name Server process is to start an SPD Server logging process. The spdslog process performs message logging functions. Message logging functions are controlled using spdsnsrv command-line options. Message logging functions include automatic log filename generation and periodic log file cycling.

The spdsnsrv command-line options control automatic log filename generation and cycling properties. Name Server availability improves performance because you can periodically switch to a new Name Server log file without halting and restarting SPD Server. The default rc.spds script in the **samples/** directory of your SPD Server installation provides examples of spdsnsrv command-line options.

When using automatic log filename generation and cycling, remember to periodically clean the log files. Proper log file maintenance includes archiving logs using secondary or long-term storage.

Many users retain only a few generations of log files for quick reference. A shell script that runs on a regular basis (such as CRONTAB) is a good way to perform log maintenance on your server machine.

The SPD Server Name Server is invoked using the following command-line syntax:

```
spdsnsrv [-option [optval]...]
```

The **spdsnsrv** command supports the following options:

-listenport *port#*
Specifies the explicit TCP port number that the Name Server uses to accept connections from the SPD Server LIBNAME engine and its SPD Server hosts. If no port is specified, the Name Server queries the system for port addresses using the service name spdsname. If no such service has been registered, SPD Server chooses a dynamic port number for the Name Server to use.

-licensefile *lic-file*
License file keys are generated by SAS and provided to you. With this release of SPD Server, you receive an SPD Server license key for each machine where you license SPD Server. Each key must be entered into the license file by the SPD Server administrator. The SPD Server will not run on a machine without first entering a valid license key in the license file. License keys are plain text strings with product, site, and machine information along with the password that is required to use Server in this specific environment.

-logfile *fileSpec*
Selects automatic server log file creation by the logger process. **fileSpec** specifies a partial pathname or filename specification that is used to generate the complete log file path. For example, if you specified **fileSpec** as **\DOWNlogs\spdsnsrv**, the generated name would appear:**\DOWNlogs \spdsnsrv_mmddyyyy_hh:mm:ss.spdslog**, where **mmddyyyy** and **hh:mm:ss** are taken from the system time when the log file is created.

-logtime *hh:mm*
Specifies a time of day to cycle a new generation of the Name Server log file. At this time each day, the previous log file is closed and a new log file is opened.

SPD Server Host Commands

The SPD Server LIBNAME engine connects to the SPD Server host to access data in the server environment. The SPD Server host uses the SPD Server password file to validate each SPD Server user, and then creates a LIBNAME proxy process on behalf of each of them.

The SPD Server host is invoked using the following command-line syntax:

```
spdsserv [-option [optval]...]
```

Part of the function of the SPD Server host process is to start SPD Server logging processes. The spdslog process performs message logging functions. The spdsaud process performs audit logging functions. Message and audit logging functions are controlled using spdsserv command-line options.

Both message and audit logging facilities include automatic log filename generation and periodic log file cycling support. The spdsserv command-line options control automatic log filename generation cycling properties. Server availability improves because you can periodically switch to a new server log and audit log without halting and restarting SPD Server. The default rc.spds script shipped in the **samples/** directory of your SPD Server installation provides examples of the command-line options.

Audit log records are kept for all resources accessed by each LIBNAME proxy process. The audit log saves records in its own separate space, away from other server log files. A sample SAS job that processes the audit log and generates a report is provided. Check **samples/audit.sas** for information about processing the audit log and generating the report. To enable the audit log, use the **spdsserv** command with the -AUDITFILE option.

When using automatic server log cycling or audit log cycling, remember to periodically clean the log files. Proper log file maintenance includes archiving logs using secondary or long-term storage.

Many users only retain a few generations of log files for quick reference. A shell script that runs on a regular basis (such as CRONTAB) is a good way to perform log maintenance on your server machine.

The **spdsserv** command supports the following options:

-parmfile *file-spec*
Allows you to specify an explicit file path for the SPD Server host's parameter file. This file is mandatory and contains any SPD Server options. If this option is omitted, the SPD Server host assumes a parameter file named spdsserv.parm is in the process's current working directory. Option declarations in this file are of the following form:

```
Option[ = Value];
```

The recognized -PARMFILE option names are listed, but full descriptions are only available in online documentation. Most sites do not need to modify the default values in **InstallDir/site/spdsserv.parm**. For more information about the parameter file, see "Setting Up SPD Server Parameter Files" in the *SAS Scalable Performance Data (SPD) Server 4.5: User's Guide*.For more information about setting up server parameters, see"Introduction" on page 112.

-acldir *pwd-dir-path*
Specifies the directory path to the SPD Server host SPD Server password file. This option can be omitted if the PASSPATH option is declared in the SPD Server host's -PARMFILE option. A valid SPD Server password file is required even when running with the -NOACL option. You must use the SPD Server psmgr utility to create the password file and to populate it with the set of valid SPD Server user IDs.

-noacl
Disables SPD Server login validation for SPD Server LIBNAME engine connections to the SPD Server host.

-nameserver *node-name*
Specifies the node name where the Name Server process is running. This does not need to be the same node that is hosting the SPD Server host processes. This option is required.

-nameserverport *port#*
Allows you to specify an explicit TCP port number for the SPD Server host to use to connect to its Name Server. If no port is specified, the Name Server queries the system for a registered port address using the service name spdsname.

-libnamefile *file-spec*
Specifies the name of the file that contains the logical LIBNAME domain definitions that the SPD Server host supports. LIBNAME definitions can span multiple lines and must begin with the LIBNAME=name keyword. For more information about SPD Server LIBNAME parameter files, see "Introduction" on page 123.

-logfile *fileSpec*
Selects automatic server log file creation by the logger process. **fileSpec** specifies a partial path or filename specification that is used to generate the complete log file path. For example, if you specified **fileSpec** as **/logs/spds**, the generated name would appear as: **/logs/spds mmddyyyy_hh:mm:ss.spdslog**, where **mmddyyyy** and **hh:mm:ss** are taken from the system time when the log file is created.

-logtime *hh:mm*
Specifies a time of day to cycle a new generation of the server log file. At this time each day, the previous log file is closed and new log file is opened.

-auditfile *fileSpec*
Enables audit logging for the server and automatic audit log file creation by the audit process. **`fileSpec`** specifies a path or filename specification that is used to generate the complete audit file path. For example, if you specified **`fileSpec`** as **`/audit/spds`**, the generated name would appear as:

`/audit/spds_mmddyyyy_yyyy.spdsaudit`, where **`mmddyyyy`** is taken from the system date when the log file is created.

-audittime *hh:mm*
Specifies a time of day to cycle a new generation of the audit log file. At this time each day, the previous log file is closed and new log file is opened.

SNET Server Commands

The SNET Server is the connection point for clients accessing SPD Server data through ODBC, JDBC or htmSQL applications.

Part of the function of the SPD Server **snet** process is to perform SPD Server logging. The spdslog process manages SPD Server message logging functions. You configure SPD Server message logging functions using spdssnet command-line options.

Message logging facilities include automatic log filename generation and periodic log file cycling support. SNET server availability improves because you can periodically switch to a new Name Server log file without halting and restarting SPD Server.

The default rc.spds script in the **`samples/`** directory provides examples of the command-line options.

When using automatic SNET server log cycling, remember to periodically clean the log files. Proper log file maintenance includes archiving logs using secondary or long-term storage.

Many users only retain a few generations of log files for quick reference. A shell script that runs on a regular basis (such as CRONTAB) is a good way to perform log maintenance on your server machine.

The SNET Server is invoked with the following command-line syntax:

```
spdssnet [-listenport listen_port]
```

The **`spdssnet`** command supports the following options:

-listenport *listen_port*
Specifies the listen port number that spdssnet uses to accept connections from ODBC, JDBC, or htmSQL clients. If no listen port number is specified, spdssnet uses the name service spdssnet from the **`/etc/services`** file to determine its listen port.

-logfile *fileSpec*
Selects automatic server log file creation by the logger process. **`fileSpec`** specifies a partial path or filename specification that is used to generate the complete log file path. For example, if you specified **`fileSpec`** as **`\DOWNlogs\spdssnet`**, the generated name would appear as

```
\DOWNlogs\spdssnet_mmddyyyy_hh:mm:ss.spdslog
```

, where **`mmddyyyy`** and **`hh:mm:ss`** are taken from the system time when the log file is created.

-logtime *hh:mm*
Specifies a time of day to cycle a new generation of the SNET log file. At this time each day, the previous log file is closed and new log file is opened.

Password Utility Reference

The SPD Server psmgr utility allows the SPD Server administrator to create and maintain the data set containing the authorized SPD Server user IDs. This is the SPD Server analog of the normal UNIX user ID facility. If you choose to run SPD Server ACL support, you need to create and populate the SPD Server password file using this utility before starting the SPD Server. For more information about the Password Manager utility, see "The Password Manager Utility psmgr" on page 193.

Performance Server Reference

The SPD Performance Server is available to monitor and log the activity of the SPD Server processes. The SAS Management Console SPD Server Manager can connect to the Performance Server to provide real-time feedback about the SPD Server process activity.

For more information about SPD Server performance monitoring, see "Accessing the SPD Server Manager in SAS Management Console" on page 72.

SPD Server 4.5 and the SAS Management Console Utility

The SAS Management Console offers a standardized, common management tool that enables enterprises to support many technologies from a single point of administration. This client application uses an extensible plug-in architecture, allowing you to customize the console to support a wide range of administrative capabilities. When you install SAS 9.2 and SPD Server 4.5, you are prompted to install the SAS Management Console utility. For more information about SAS Management Console, see"Introduction" on page 59.

SPD Server Lightweight Directory Access Protocol (LDAP) Authentication

In SPD Server for Solaris, AIX, HP-UX, and HP Integrity Itanium, clients can be authenticated by psmgr, or by an LDAP Server such as Microsoft Active Directory, Sun Java System Directory Server, or OpenLDAP from www.openldap.org. LDAP authentication integrates with the SPD Server password facility and offers a centralized approach to user ID and password management. SPD Server clients that use LDAP authentication should have user accounts managed by the authenticating LDAP server. In addition the user ID and password information must be stored on an LDAP server that the SPD Server can access. The user ID must be entered into the SPD Server password database through psmgr or the SAS Management Console Utility to record all other SPD Server user information.

When a client uses LDAP authentication to connect to an SPD Server, the LDAP server that is configured in the SPD Server's parameter file does the authentication. After the client is verified, SPD Server uses the client's password database record for all other SPD Server operations.

To set up LDAP authentication, the following parameters must be added to the SPD Server's spdsserv.parm file:

Table 3.1 *Parameters for spdsserv.parm*

Parameter Description	Values	Default Setting
(NO)LDAP: directs user authentication to LDAP Server	LDAP/NOLDAP	NOLDAP
LDAPSERVER: LDAP Server IP address	a valid IP address	LOCAL_HOST
LDAPPORT: LDAP Server port number	0-65536	LDAP_PORT
LDAPBINDMETH: LDAP bind method	"LDAP_AUTH_SIMPLE" "LDAP_AUTH_SASL"	Null
LDAPBINDDN: LDAP bind distinguished name	char string	Null

The LDAP parameter turns on LDAP authentication. If the LDAP parameter is found during start-up, the SPD Server creates a context for LDAP authentication.

The LDAPSERVER parameter specifies a valid IP address, or the host machine for the LDAP server. This is usually the same address as the IP address of the SPD Server host. The default value for LDAPSERVER is the IP address of the SPD Server host.

The LDAPPORT parameter specifies the TCP/IP port that is used to communicate with the LDAP server. This is usually the default LOCAL_HOSTor port 389.

The LDAPBINDMETH parameter controls the way SPD Server clients are authenticated by the LDAP server. If it is found in the SPD Server parameter file, LDAPBINDMETH is a character string whose value is either LDAP_AUTH_SIMPLE or LDAP_AUTH_SASL.

The default authentication method, LDAP_AUTH_SIMPLE, sends the SPD Server client's user name and password to the LDAP server in clear text. LDAP_AUTH_SIMPLE should not be used in a secure environment.

When LDAPBINDMETH="LDAP_AUTH_SASL", the LDAP server authenticates SPD Server clients with the Simple Authentication and Security Layer (SASL) method. SASL is the preferred authentication method for secure environments. When authenticating with SASL, the SPD Server specifies that the DIGEST-MD5 mechanism is used.

DIGEST-MD5 is the most common LDAP authentication and is a requirement for all Version 3 LDAP server products.

The LDAPBINDDN parameter is the distinguished name (DN), or the location in the LDAP Server's database where the client's information is stored. The form of this string is the following:

```
"ID= , rdn1=RDN1, rdn2=RDN2, ...".
```

IDis the identifier for the relative distinguished name (RDN) of a user ID that exists in the LDAP server database. The default value of the DN is the following:

```
"uid= , dc=DOM1, dc=DOM2, dc=DOM3".
```

If no distinguished name is specified in the spdsserv.parm file, SPD Server uses the LDAP Server host's domain name to generate values for **DOM1**, **DOM2**, and **DOM3**. The SPD Server user ID becomes the value for **uid**. The resulting value becomes the default user location for LDAP database members.

For example, suppose the LDAP host machine is sunhost.unx.sun.com and the user ID is sunjws. The resulting default distinguished name is the following:

```
"uid=sunjws, dc=unx, dc=sun, dc=com".
```

The distinguished name is used to locate the user sunjws. Then the sunjws user password is compared to the password that is stored in the LDAP database. If there is a specific location for SPD Server users in your LDAP database, be sure to specify it using LDAPBINDDN.

See the LDAP Server administrator for your site if you need more information about LDAP parameters for your spdsserv.parm file. To use the default value for any LDAP parameter, omit the parameter specification from the spdsserv.parm file. Undeclared parameters automatically assume default values.

Note: Entering the LDAP_HOST value for LDAPSERVER can cause SPD Server to fail during start-up.

Notes for SPD Server Administrators

The SPD Server administrator performs the maintenance and configuration functions for SPD Server. Here are some guidelines for administrators:

UNIX User IDs

The SPD Server administrator needs a UNIX login ID on the SPD Server machine. Other SPD Server users do not need UNIX login IDs. You can control their access to SPD Server data resources using the SPD Server password facility without giving them specific login accounts. This adds a measure of security and control and SPD Server users are permitted physical access to the SPD Server machine.

You should add the **InstallDir/bin** directory to your PATH using your shell's login script. ksh users should modify .profile or .kshrc files. csh users should modify .login or .cshrc files, depending on where they currently set the PATH environment variable. This makes invoking the various SPD Server utility programs much easier.

SAS recommends that you run your SPD Server environment using the same UNIX user ID that was used to install SPD Server on the server machine. The user ID should also be the SPD Server administrator's user ID. The common user ID minimizes potential problems with file ownership and system access permissions on the server machine. You add SPD Server access controls to the resources created with SPD Server by using SPD Server user IDs and SPD Server ACLs. The SPD Server user IDs and ACLs provide fine-grained access controls to the SPD Server data resources.

Regardless of how the SPD Server run-time environment is configured, SPD Server processes always run with some UNIX user ID. That UNIX user ID owns all of the files that the SPD Server process creates. The UNIX user ID is governed by UNIX file access permissions. Remember this when starting SPD Server processes and running SPD Server administrator utilities! Otherwise, it is possible to create files with ownership and permissions that deny required access to the SPD Server processes. Performing all SPD Server installation and administration tasks from the same UNIX user ID makes subsequent SPD Server use much easier.

Here are some options for establishing the appropriate UNIX user ID for your SPD Server processes:

Establish a dedicated UNIX account for the SPD Server administrator. Always execute the rc.spds script from that account.

The rc.spds script that starts the SPD Server processes should use the setuid bit. It does not matter who executes the script, the user ID of the shell executing the script is the script owner. This ensures that SPD Server processes run with the correct UNIX user ID.

At system startup, use the UNIX **`su`** command to establish the proper UNIX user ID for the shell that executes the rc.spds script. To start the environment manually, you must enter the password for each UNIX account in your **`su`** command, unless you are root when you execute the **`su`** command.

SPD Server User IDs

The SPD Server system uses its own layer of access controls that overlay UNIX access permissions. SPD Server processes run in the context of a UNIX user ID, and that user owns all of the resulting SPD Server file resources that are created.

The SPD Server password file allows better access control to SPD Server's data resources than a native UNIX user ID. Many sites do not want to give UNIX accounts to SPD Server system users, but still want protection and ownership of the data resources created in the SPD Server environment. In this case, SPD Server user IDs provide the extra layer of access control.

The SPD Server administrator needs to be familiar with the psmgr utility in SPD Server.

If you do not use SPD Server user IDs, you still need the SPD Server password file. Without the SPD Server password file, the SPD Server host process does not function correctly. To disable the use of SPD Server user IDs at your site, specify the -NOACL option when you start SPD Server.

If you use SPD Server user IDs, add them to the SPD Server password file that was created during installation. The **`psmgr`** command reads its commands from **stdin** so you can pipe commands to it from another command, script, or input file.

LDAP Password Authentication

LDAP Authentication causes SPD Server to authenticate an SPD Server user password using LDAP, rather than using the password in the password database. LDAP authentication allows an SPD Server user to have the same user ID and password as their UNIX logon, as long as the UNIX logon meets the SPD Server character restrictions for user IDs and passwords.

You can select the mode of password authentication with server parameters. You can choose between using psmgr or LDAP. Once selected, all authentication is performed using the selected mode. When you use LDAP authentication, an SPD Server user must be entered in the SPD Server password database, in order to maintain other information that SPD Server requires, such as a user's groups and access levels.

For more information about SPD Server LDAP authentication, see "SPD Server Password Manager."

Troubleshooting

Troubleshooting networked applications is often difficult. Key information for SPD Server troubleshooting can be found in the Name Server and SPD Server host process log files. With those two log files, you can reconstruct SAS interaction with SPD Server components. Entries in these log files are time-stamped for reference. You should be able to correlate activities between the two logs by using the time-stamp information. The logs are formatted as plain text files.

Name Server Start-Up Failed

Check the Name Server log file. The log should contain information about the problem. Some common things to look for include:

1. Invalid -LICENSEFILE file specification.
2. -LICENSEFILE specifies a file with invalid contents.
3. The Name Server port is in use by another process. Check for another Name Server process running already on the same node.

```
ps -ef | grep -i spdsnsrv
```

SPD Server Host Start-Up Failed

Check the SPD Server host log file for information. Some common things to look for include:

1. -NAMESERVER node name is incorrect.
2. -NAMESERVERPORT specifies the wrong port number if the SPD Server Name Server is running with a non-standard port assignment.
3. -PARMFILE file specification is invalid, or the specified file does not exist.
4. -LIBNAMEFILE file specification is invalid, or the specified file does not exist.
5. The contents of the specified -LIBNAMEFILE does not conform to expected syntax. Check the SPD Server host log file for messages about invalid entries.
6. The -ACLDIR option was omitted from the command line.
7. The -ACLDIR option specifies an invalid directory path for the SPD Server password file, or the specified directory path does not contain a valid SPD Server password file.

SAS LIBNAME Assignment Failed

On the SAS side, first attempts to diagnose a failure depend on the error messages from the SPD Server LIBNAME engine through the SAS LOG output. In most circumstances you should be able to diagnose the reason for the failure from this message. Some common problems include:

1. Invalid specification of the LIBNAME engine selector in the LIBNAME statement. The SPD Server engine name is sasspds and is misspelled in the following LIBNAME statement.

```
1? libname foo sasspds 'test' server=sunspot.spdsname
   passwd='xxx';
ERROR: Module FOO not found in search paths.
ERROR: Error in the LIBNAME or FILENAME statement.
```

2. Invalid specification of the logical LIBNAME domain name in the LIBNAME statement. The domain name 'test' is not defined in the SPD Server Name Server sunspot.spdsname.

```
2? libname foo sasspds 'test' server=sunspot.spdsname
   passwd='xxx';
ERROR: ERROR: Libname path info not found in SPDS name server..
ERROR: Error in the LIBNAME or FILENAME statement.
```

3. No Name Server is running on the specified node name or no Name Server is available at the specified port address. In this case, no Name Server is running on the specified node stelling. This same message is generated if the port address is incorrect.

```
3? libname foo sasspds 'test' server=stelling.spdsname
   passwd='xxx';
ERROR: Unable to connect to SPDS name server.
ERROR: Connection refused.
ERROR: Error in the LIBNAME or FILENAME statement.
```

4. An invalid or unknown node name is specified in the LIBNAME statement. In this case, node **xxx** is not accessible in the network.

```
4? libname foo sasspds 'test' server=xxx.spdsname
   passwd='xxx';
ERROR: Unable to connect to SPDS name server.
ERROR: xxx.
ERROR: Error in the LIBNAME or FILENAME statement.
```

5. Invalid SPD Server user password specified in the LIBNAME statement. In this case, the SPD Server user ID is derived from the UNIX user ID running the SAS session. The SPD Server password file has an entry for this SPD Server user ID, but the password is not xxx.

```
8? libname foo sasspds 'test' server=sunspot.spdsname
   passwd='xxx';
ERROR: Error on server libname socket.
ERROR: SPD server has rejected login from user
sasetb.. ERROR: Error in the LIBNAME or FILENAME
statement.
```

6. Invalid SPD Server user ID specified in the LIBNAME statement. In this case, the SPD Server user ID xxx does not exist in the SPD Server host's password file. The resulting message is the same for the invalid password case.

```
10? libname foo sasspds 'test' server=sunspot.spdsname
    user='xxx' passwd='xxx';
ERROR: Error on server libname socket.
ERROR: SPD server has rejected login from user xxx..
ERROR: Error in the LIBNAME or FILENAME statement.
```

Using SETINIT to Extend SPD Server Software

When you receive SPD Server, licensing information is pre-initialized. When you renew the license, you receive a new license to replace your existing license. You must restart SPD Server to use the new license.

Note: You should not change the licensing information unless you are logged in with the user ID of the owner of SPD Server. You designated the owner of these files when you licensed the software.

Chapter 4

SPD Server Windows Installation Guide

SAS Scalable Performance Data Server 4.5 and SAS Deployment Wizard

SAS Scalable Performance Data Server (SPD Server) 4.5 can be installed as part of your initial SAS 9.2 order, or SPD Server 4.5 can be installed as an add-on to an existing SAS 9.2 order. In either case, your SPD Server 4.5 installation will be facilitated by the SAS Deployment Wizard utility. The SAS Deployment Wizard installs SPD Server to the following location on your computer: **<SASROOT>\SASScalablePerformanceDataServer\4.5**. See your SAS order documentation for more information about the SAS Deployment Wizard.

Note: <SASROOT> is a placeholder for the full path specification to the base directory of your SAS 9.2 installation.

Before You Install: Precautions and Required Permissions

Review the following precautions and list of required permissions before you install SPD Server:

- SPD Server is compatible with the Microsoft Win32 API. SPD Server 4.5 runs on computers using Windows NT, Windows XP, Windows Vista, and Windows 2000 operating environments.
- You need Write access to your server machine's **\etc\services** file if you want SPD Server clients to connect to the SPD Server host using name services instead of specifying port numbers at invocation. Name services require you to define registered ports that will use the services file appropriate to your machine.
- If your SPD Server clients access the SPD Server host using name services instead of specifying port numbers, you need Write access to the services files on the clients in the path **C:\winnt\system32\drivers\etc\services**.
- Insert the WORKPATH= server option in your **spdsserv.parm** file. Use the WORKPATH= option to configure your server to use a high-performance file system. Ideally, this system has a RAID-structured volume with sufficient disk space to accommodate the transient storage needs for SPD Server. The **spdsserv.parm** file is located in the **InstallDir\DOWN** directory of your SPD Server host installation.

Packing List for SPD Server Distribution

Directory Contents

Directory names in the packing list are subdirectories of your SPD Server host installation directory, whose path is represented by **InstallDir**.

Note: **InstallDir** represents the root directory where SPD Server is installed.

The **bin** subdirectory contains the following binary files:

- **spdsnsrv.exe** is the SPD Server Name Server.
- **spdsserv.exe**is the SPD Server host.
- **spdsbase.exe** is the LIBNAME proxy .
- **spdslog.exe** is the message logger .
- **spdsaud.exe** is the audit logger.
- **spdseng.dll** is the SQL Pass-Through engine.
- **ixutil.exe** is the data set index utility.
- **psmgr.exe** is the password file utility.
- **spdssnet.exe** is the ODBC, JDBC, and htmSQL gateway.
- **spdsperf.exe** is the Performance Server.
- **spdsls.exe** gives physical file listings for a LIBNAME domain.
- **spdsbkup.exe** performs full or incremental table backups.
- **spdsrstr.exe** restores full or incremental table backups.
- **spqldrive.exe** is a stand-alone SQL Pass-Through driver.
- **spdsconv.exe** is the SPD Server 3.*x* to SPD Server 4.*x* table conversion utility.
- **spdsclean.exe** is the SPD Server disk cleanup utility.
- **dulibv3.dll** is the SPD Server 3.*x* 64-Bit version of the shared library used by spdsconv. The dulibv3 file is included only if your system previously supported SPD Server 3.*x* tables.
- **spdsbased.exe** is the debug version of spdsbase.
- **spdsengd.dll** is the debug version of spdseng.
- **spdsnlslib.dll** is the NLS library.
- **spdsnlslibd.dll** is the debug version of spdsnlslib.
- **spdsiotest.exe** is the stand-alone SPD Server I/O scalability test.
- **spdsbat.exe** is an executable that is used to make SPD Server act as a service.
- **spdsmakesvc450.exe** is an executable that is used to install SPD Server as a service.

The **`lib\`** subdirectory contains the following SPD Server library files:

- **spdslib.dll** is the run-time library that performs SQL Pass-Through from C and C++ applications to SPD Server.
- **spds.dll** is the application extension library that is accessed via the SAS ODBC Driver.

The **`samples\`** directory contains the following files of interest:

- **auditraw.sas**is used to read proxy audit files that do not include WHERE clause auditing.
- **auditwh.sas**is used to read proxy audit files that include WHERE clause auditing.
- **audit.sql.sas**is used to read an SQL audit file.
- **libnames.parm** is a sample SPD Server host LIBNAME configuration file. Use this file with the **`-libnamefile`** option for the **spdsserv** command.
- **libsamp.parm** is a more advanced example of a LIBNAME configuration file.

- **spdsserv.parm** is a sample SPD Server host parameter file. It sets the defaults for SPD Server options. Use this file with the -PARMFILE option for the **spdsserv** command.
- **rc.spds** is a Bourne shell script to start a standard SPD Server environment.
- **doc_examples.sas** contains sample SAS code that is used in the *SAS Scalable Performance (SPD) Data Server 4.5: User's Guide*. This guide provides SPD Server LIBNAME and data set usage and syntax options.
- **verify.sas** is a SAS installation verification job. You should run it after you install SPD Server.
- **spdsinst.sas** demonstrates the simple use of WHERE clauses and WHERE planner output.
- **passthru.sas** demonstrates SQL Pass-Through usage. It gives examples of simple, single-level Pass-Through and secondary libref and connection scenarios.
- **tempwork.sas** demonstrates temporary LIBNAME domain support. Files created in a temporary LIBNAME domain are automatically deleted when the SAS session ends.
- **paraload.sas** shows how to perform parallel loads from an existing table into an SPD Server table. This technique exploits a parallel load capability in the LIBNAME proxy.
- **aclcolrw.sas** shows the use of ACL row and column security features.
- **symbsub.sas** shows how symbolic substitution in SQL Pass-Through statements can provide row-level security in tables.
- **fmtgrpby.sas** shows how to use formatted parallel GROUP BY statements in SQL Pass-Through.
- **scale.sas** can be used to benchmark the scalability of your SPD Server.
- **dynamic_cluster*.sas** shows how to use dynamic clusters with a MIN and MAX variable list.
- **minmax*.sas**shows how to use a MIN and MAX variable list on an SPD Server table.
- **paralleljoin*.sas**shows the use of the SQL Parallel Join performance enhancement.
- **starjoin*.sas** shows the use of the SQL Star Join performance enhancement.
- **index_scan*.sas** shows the use of the SQL index scan performance enhancement.
- **materialize_view*.sas** shows the use of the SQL materialized view performance enhancement.

The **`doc/`** directory contains information to locate the online *SAS Scalable Performance Data (SPD) Server 4.5: Administrator's Guide* and the *SAS Scalable Performance Data (SPD) Server 4.5: User's Guide* in PDF format.

The **`lic\`** directory contains the SPD Server license file for your installation.

The **spds.lic** file is used by the SPD Server Name Server to validate SPD Server hosts for their target hardware configurations. Once you obtain a valid SPD Server setinit for a machine, you need to append it to this file.

The **`msg\`** directory contains SPD Server message files. The collection of **`*.m`** files are used by various SPD Server components to generate message text.

The **`site\`** directory is a storage directory for a user's' site-specific customization of the sample SPD Server start-up and configuration files. For example:

- **spdsmakesvc.bat** is the "make SPD Server a service" batch file.
- **spdsremovesvc.bat** is the "remove SPD Server-service" batch file.

- **spdsstartsvc.bat** is the "start SPD Server service" batch file.
- **spdsstopsvc.bat** is the "stop SPD Server service" batch file.
- **spdsnsrv.bat** is the SPD Server Name Server start-up batch file.
- **spdssnet.bat** is the SPD Server SNET server start-up batch file.
- **spdsserv.bat** is the SPD Server start-up batch file.

The **spdssmc** directory contains the SAS Management Console files that support SPD Server.

Validating Default Port and Library Assignments

After you install SPD Server on your Windows server, you are almost ready to verify your installation. Before you verify, you must validate your Name Server port assignment and the path for the temporary LIBNAME domain called TMP.

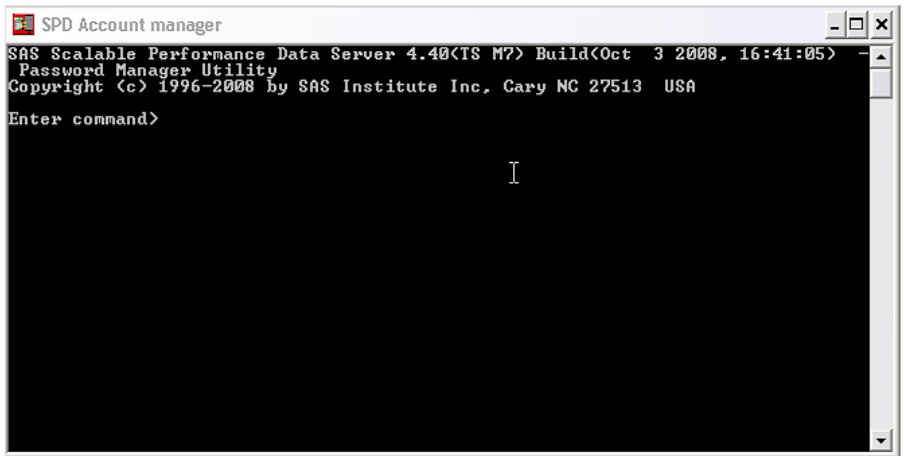
SPD Server documentation uses **InstallDir** as a placeholder. Any SPD Server configuration files that require editing are located in the **InstallDir\site** directory.

Check the following to make sure your Windows server environment meets the requirements from the installation procedure:

1. The default SPD Server installation configures port 5400 as the Name Server port. If you want to change the Name Server port, edit the spdsserv.bat file and spdsnsrv.bat file located in **InstallDir\site**. Edit the -LISTENPORT option to specify the port number. Use the -NAMESERVERPORT option in spdsserv.bat to specify the port number.
2. The default SPD Server installation configures port 5401 as the SNET Server port. If you want to change the SNET server port, edit the spdssnet.bat file located in **InstallDir\site**. Edit the -LISTENPORT option to specify the port number.
3. During installation, SPD Server creates a sample library parameter file called libnames.parm in **InstallDir\samples**. Copy the sample libnames.parm file to **InstallDir\site**. The libnames.parm file contains a LIBNAME domain definition for a temporary workspace called TMP. The TMP library uses the Windows temporary directory **C:\TEMP**. If your Windows installation does not include a **C:\TEMP** directory, you need to create the directory or specify an existing directory path to replace **C:\TEMP**. If you want to use a different path for TMP, you must modify the SPD Server libnames.parm configuration file in **InstallDir\site** to specify the new TMP domain path.
4. During installation, SPD Server creates a sample server parameter file calledspdsserv.parm, in **InstallDir\samples**. Copy the sample spdsserv.parm file to**InstallDir\site**. The spdsserv.parm file contains server parameters. The sample spdsserv.parm file should be used only to verify that SPD Server is running. You should edit your spdsserv.parm file immediately to specify the unique server parameters for your site.

Initializing the Password Manager Database

Before you can start SPD Server, you must initialize the SPD Server Password Manager database from the SPD Account Manager. To open the SPD Account Manager, use the Windows **Start** button to select:**Programs** ⇨ **SAS** ⇨ **SPD Server 4.5** ⇨ **SPD Account Manager**. The SPD Account Manager launches in a command window.



To initialize the SPD Server Password Manager database, add the group ADMINGRP to your site by issuing the following SPD Account Manager commands:

```
Enter Command> groupdef
Enter group name to define> admingrp
Enter Command> quit
```

Installing SPD Server as a Service

You must use Windows Services to start SPD Server. Here are some shortcuts:

Select **Start** ⇨ **Programs** ⇨ **SAS** ⇨ **SPD Server 4.5** ⇨ **Install SPD as a Service** to install services that start the SPD Server Name Server, the SPD Server host, and the SPD Server SNET server.

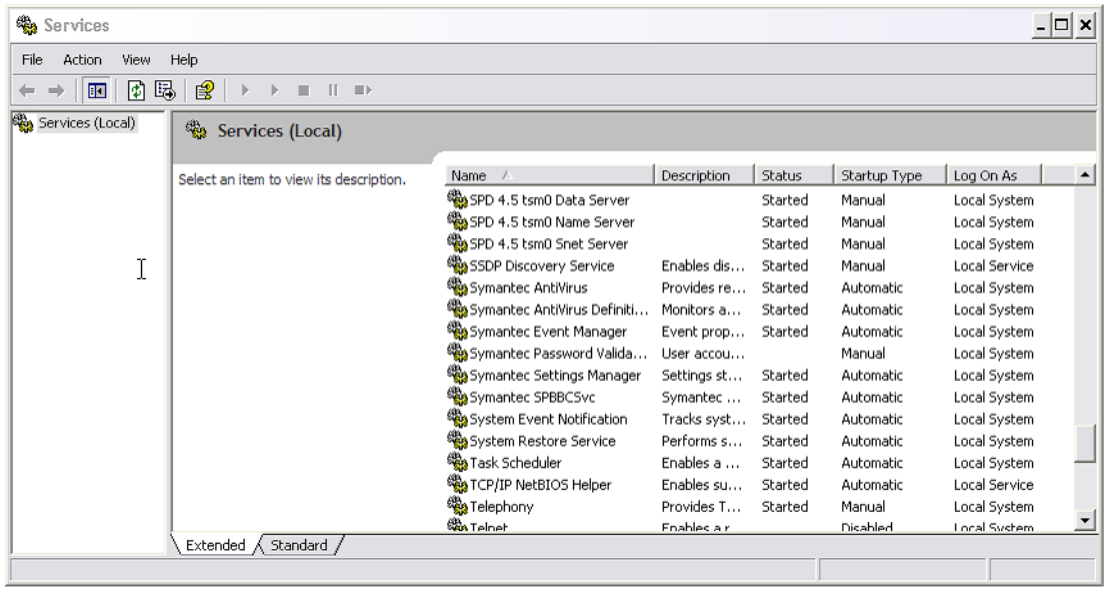
Select **Start** ⇨ ⇨ **SAS** ⇨ **SPD Server 4.5** ⇨ **Start SPD Service** to manually start SPD Server.

Select **Start** ⇨ **Programs** ⇨ **SAS** ⇨ **SPD Server 4.5** ⇨ **Stop SPD Service** to manually stop SPD Server.

After SPD Server is installed as a service, you can verify SPD Services through Windows Services. To open the Windows Services window, select:

Start ⇨ **Settings** ⇨ **Control Panel** ⇨ **Administrative Tools** ⇨ **Services**

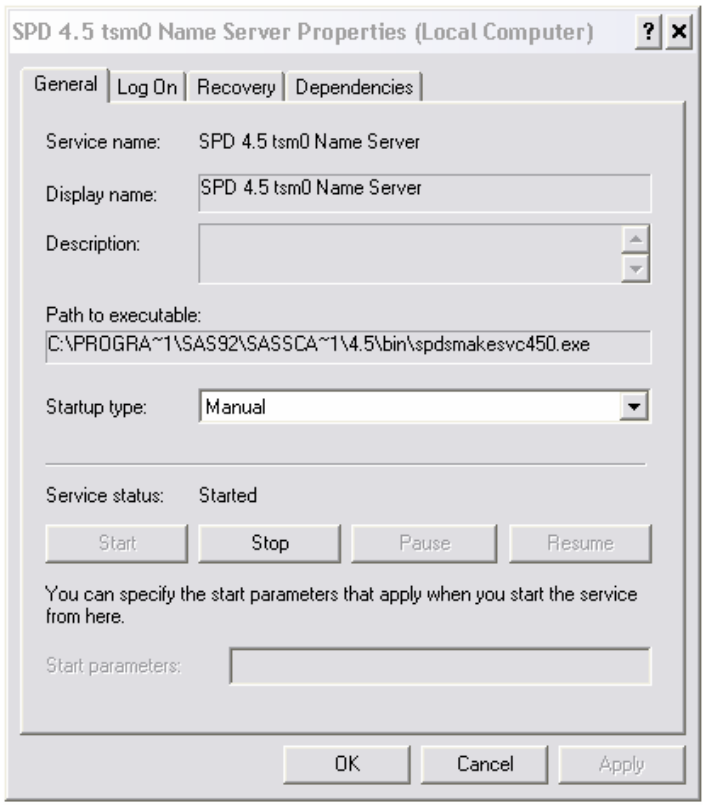
The main panel of the Services window contains a sortable list of Windows services. Scroll down the Services list to find entries for SPD 4.5 Name Server and the SPD 4.5 Data Server.



When you configure SPD Server in the Services window for the first time, the **Status** column for the servers will be blank, and the **Startup Type** column will be set to **Manual**.

Most users want to configure SPD Server to automatically start and stop the Name Server, Data Server, and SNET server. The Automatic setting loads the Name Server, Data Server, and SNET server without prompting. It stops the services without prompting when you close Windows.

To change the **Startup Type** for the Name Server, select the service in the list, and then right-click on it and select **Properties**. Use the properties window to configure the **Startup Type** setting for the Name Server.



Select **Automatic** from the **Startup type** list. This configures the Name Server service to automatically start and stop with the Windows operating environment. Select **OK** to apply the changes and close the window.

Repeat this process to change the **Startup type** setting for the Data Server and SNET Server. At this point, your Name Server, Data Server, and SNET Server services are configured to automatically start and stop with the Windows operating environment.

The first time you set your SPD Server services to **Automatic**, you need to manually start them by selecting **Start** ⇨ **Programs** ⇨ **SAS** ⇨ **SPD Server 4.5** ⇨ **Start SPD Service**. After you do that, the Name Server, Data Server, and SNET server automatically start and stop with Windows.

Configuring SPD Server Software on Your Windows Host

After you validate port and library assignments and start the Name Server and Data Server, you can begin configuring the LIBNAME domains and user password files.

1. You must configure the libnames.parm file with all of the LIBNAME domains that you use to store SAS tables and catalogs. Declaring all of your LIBNAME domains requires thought and planning and best exploits the parallel processing capabilities of SPD Server. For more information about the format of the libnames.parm file, see“ SPD Server Command Reference” on page 48 and the libsamp.parm file in **`InstallDir`** **`\`**. Any changes that you make to the libnames.parm file when SPD Server is running do not take effect until SPD Server is stopped and restarted.

2. Add your SPD Server user IDs to the SPD Server password file. You should run the SPD Account Manager to perform this function. You can add to or modify the SPD Server password file at any time, even when SPD Server is running.
3. Use the SPD Account Manager to add users and groups. For more information, see, "Connecting to SPD Server via ODBC, JDBC, and htmSQL" in the *SAS Scalable Performance Data (SPD) Server 4.5: User's Guide* . After you set up and configure your SPD Server host environment, examine the files in your **`InstallDir\`** directory. It contains various SAS programs to help you understand how to use various SPD Server features. The sample files are the following:
   - **auditraw.sas** is used to read proxy audit files that do not include WHERE clause auditing.
   - **auditwh.sas** is used to read proxy audit files that include WHERE clause auditing.
   - **audit.sql.sas** is used to read an SQL audit file.
   - **verify.sas** is a SAS installation verification job. You should run it after you install SPD Server.
   - **passthru.sas** demonstrates SQL Pass-Through usage. It gives examples of simple, single-level Pass-Through and secondary libref and connection scenarios.
   - **tempwork.sas** demonstrates temporary LIBNAME domain support. Files created in a temporary LIBNAME domain are automatically deleted when the SAS session ends.
   - **paraload.sas** shows how to perform parallel loads from an existing table into an SPD Server table. This technique exploits the parallel load capability in the SPD Server LIBNAME proxy. The LIBNAME proxy uses the same technology as the SQL LOAD TABLE statement.
   - **aclcolrw.sas** shows the use of ACL row and column security features.
   - **symbsub.sas** shows how symbolic substitution in Pass-Through SQL can provide row-level security in tables.
   - **fmtgrpby.sas** shows how to use formatted parallel GROUP BY in SQL Pass-Through.
   - **rcperf** is a Bourne shell script to start a "standard" Performance Server.
   - **dynamic_cluster*.sas** shows how to use dynamic clusters with a MIN and MAX variable list.
   - **minmax*.sas** shows how to use a MIN and MAX variable list on an SPD Server table.
   - **paralleljoin*.sas** shows the use of the SQL Parallel Join performance enhancement.
   - **starjoin*.sas** shows the use of the SQL Star Join performance enhancement.
   - **index_scan*.sas** shows the use of the SQL index scan performance enhancement.
   - **materialize_view*.sas**shows the use of the materialized view performance enhancement.

Upgrading SPD Server 3.x to SPD Server 4.5

Overview of Upgrading

SPD Server 3.*x* tables are not compatible with SPD Server 4.5. If you want to use your SPD Server 3.*x* tables with SPD Server 4.5, you must first convert your SPD Server 3.*x* tables.For more information about converting SPD Server 3.x tables for use with SPD Server 4.5, see SPD Server 3.x to SPD Server 4.5 Conversion Utility on page 59.

Upgrading SPD Server 4.4 to SPD Server 4.5

SPD Server 4.*x* tables are compatible with SPD Server 4.5. No conversion is required to use SPD Server 4.*x* tables with SPD Server 4.5. You can start SPD Server 4.5 using domains that include tables created by any SPD Server 4.*x* host.

Installing and Configuring SPD Server Clients

SPD Server client software makes SAS LIBNAME connections and performs user-specific functions on the SPD Server host. SPD Server client software is installed with SAS 9.2. It contains the following SAS modules:

- **sasspds**is the LIBNAME engine that is required to access the SPD Server environment from SAS 9.2.
- **sasspdo**is the SPD Server operator procedure that is required to access the SPD Server 4.5 environment from SAS 9.2.
- **spds.msg** is the SAS compatible message file for the SPD Server LIBNAME engine and SPDO operator procedure.

The SPD Server client software is installed with SAS 9.2 Foundation at **<SASROOT>\SASFoundation\9.2\spdclient**. The SAS 9.2 configuration file automatically includes your SPD Server client software directory in its required path list.

Once the SPD Server environment is configured and running, you need to complet other installation functions on the SAS clients that will use SPD Server. This might include the system that is actually running SPD Server. Therefore, some of these steps might have already been performed during installation of the SPD Server host. If so, skip the duplicated steps.

SPD Server media contains SAS client software modules for SAS 9.2 installations on Solaris by Sun, AIX by IBM, and HP-UX by Hewlett-Packard. Perform the following steps on each SAS client that will access SPD Server:

1. If you want to access SPD Server through a registered port (named service), add the following services to your client's **\etc\services** file if not already done:

   ```
   spdsname ????\tcp # SPDS Name service
   ```

   The **spdsname** service defines the port number for name services (if you are using the **spdsnsrv** Name Server process). Make sure that the port number you enter matches the

port number that was used during the SPD Server host installation. If you are already running SAS with an earlier version of SPD Server, this service name is probably already defined. You can either define another service name for the SAS client to use (for example, **sp45name**) or you can directly include the SPD Server port number in your SAS statements.

2. The SPD Server host can be accessed via the SAS ODBC driver, the SAS JDBC driver, and SAS htmSQL. Each of these drivers can be downloaded from the support link of the SAS Web at **http://support.sas.com**.

   For more information about connecting and configuring these applications, see Chapter 6 in the SAS Scalable Performance Data (SPD) Server 4.5: User's Guide, "Using SPD Server with Other Clients.".

   ODBC client applications require installation of the **spds.dll** application extension. Install the ODBC client application extension as follows:

   - Install the SAS/ODBC Driver Version 9
   - Copy

   ```
   InstallDir\lib\spds.dll
   ```

   into

   ```
   <drive letter>:\Program Files\sas\shared files\general
   ```

   - Configure an ODBC Data Source for direct SPD Server access.

Testing Your SPD Server Installation Using SAS

Testing your SPD Server installation is relatively simple. To verify, you only need to make two SAS LIBNAME assignments using the SPD Server LIBNAME engine. The examples in this section refer to the SASSPDS engine, the engine for SAS 9.2.

1. Start the SPD Server environment as described in step 3 of the section "Validating Default Port and Library Assignments" on page 41.
2. On the SPD Server client machine, invoke SAS and make the following LIBNAME assignments:

   ```
   libname test sasspds 'tmp' server=serverNode.port user='anonymous';
   ```

   ServerNode is the Name Server's network node name and **port** is either the numeric value used to start the Name Server or the named service you chose to use to access the SPD Server Name Server. Remember that name services allow you to connect to a Name Server using a character string instead of specifying a port number. Assuming you used the default numeric port assignment of 5400, your assignment would look like:

   ```
   libname test sasspds 'tmp' server=serverNode.5400 user='anonymous';
   ```

   Or if you were using **spdsname** to provide named services, your assignment would resemble this:

   ```
   libname test sasspds 'tmp' server=serverNode.spdsname user='anonymous';
   ```

   In addition, you should verify that the Row Level Integrity LIBNAME assignment works correctly:

   ```
   libname testrl sasspds 'tmp' server=serverNode.port user='anonymous' locking=YES;
   ```

When you use simple statements like these to verify assignments, you ensure that you have connectivity between the SAS client and the SPD Server host components. Successfully performing the LIBNAME assignments means that the network configuration is correct and that most of the SPD Server host configuration is correct. You will need to fill in **serverNode** with the network node name where the Name Server and Data Server processes reside. This assumes you left the 'tmp' LIBNAME definition that was included in the sample **libnames.parm** file you received with your distribution.

Watch the SAS log for error messages which indicate failure to properly locate one of the required SPD Server components. The messages that you will most likely encounter are included below.

```
ERROR: Module TEST not found in search paths. ERROR:
Error in the LIBNAME or FILENAME statement.
```

If you see this error, check the **-path** option is properly set to make sure you are accessing the directory where you loaded the SAS System client-side components.

```
ERROR: unable to access message 608.108
```

If you see the following or similar errors regarding failures to access messages, check the -sasmsg option to make sure the directory where you loaded the SAS System message file for SPD Server components is properly set.

3. Once the SPD Server host LIBNAMES are assigned, you can further verify your installation by running the sample SAS program, **`InstallDir\samples\verify.sas`**. Submit the following SAS command to execute the test stream:

   ```
   %include 'InstallDir\samples\verify.sas'\source2;
   ```

   This SAS stream exercises many of the features of the SPD Server LIBNAME engine and proxy to provide further confidence that the installation has been made correctly. It performs a sequence of DATA and PROC steps against a generated data set and performs self checking on the results expected from various DATA step queries of the test data set. If any one of these queries fails to produce the expected result, the SAS job is canceled. The job **verify.sas** assumes the SAS librefs TEST and TESTRL are assigned from Step 2 above.

4. You should also verify that SQL Pass-Through services are working in SPD Server by performing the following sequence of SAS commands:

   ```
   %let spdshost=serverNode;
   %let spdsport=port;
   %include 'InstallDir\samples\verptsql.sas'\source2;
   ```

   where **serverNode** and **port** are the same as in the previous LIBNAME assignment step.

SPD Server Command Reference

SPD Server executable files support command line options that override default features, or supply site-dependent configuration information for the program to use. The command options for the following programs are explained below .

Name Server Commands

The SPD Server LIBNAME engine connects to the Name Server. The Name Server resolves LIBNAME domain names into physical file system paths for librefs. The Name Server also resolves host node and end-point (TCP port) addresses for each LIBNAME. Each SPD Server host process (**spdsserv** process) registers LIBNAME domain information from its configuration file with its appointed Name Server process (**spdsnsrv** process). Multiple SPD Server hosts can use the same Name Server to register their LIBNAME domains. The only requirement is that the combination of the LIBNAME= option values from the SPD Server host's LIBNAME configuration file must be unique across all SPD Server hosts connecting to the Name Server.

The SPD Server Name Server is invoked using the following command line syntax:

```
spdsnsrv [-option [optval]...]
```

The **spdsnsrv** command supports the following options:

-listenport *port#*
: Used to specify the explicit TCP port number that the Name Server uses to accept connections from the SPD Server LIBNAME engine and its SPD Server hosts. If no port is specified, the Name Server queries the system for port addresses using the service name "spdsname". If no such service has been registered, the system chooses a dynamic port number for the Name Server to use.

-licensefile *lic-file*
: License file keys are generated by SAS Institute and supplied to you. With this production release of SPD Server, you receive an SPD Server license key for each machine where you license the SPD server and that key must be entered into this license file by the SPD Server administrator. The SPD Server will not run on a given machine without first entering a valid license key in this file. License keys are plain text strings that product, site, and machine information along with the password required to allow you to use the SPD Server in this specific environment.

SPD Server Host Commands

The SPD Server LIBNAME engine connects to the SPD Server host to access data in the server environment. The SPD Server host uses the SPD Server password file to validate each SPD Server user, and then creates a LIBNAME proxy process on behalf of each of them.

The SPD Server host is invoked using the following command line syntax:

```
spdsserv [-option [optval]...]
```

Part of the function of the SPD Server host process is to startup SPD Server logging processes. The spdslog process performs message logging functions. The spdsaud process performs audit logging functions. Message and audit logging functions are controlled using spdsserv command line options.

Both message and audit logging facilities include automatic logfile naming and periodic logfile cycling support. **Spdsserv** command line options control automatic logfile naming and cycling properties. Server availability improves because you can periodically switch to a new server log and/or audit log file without halting and restarting the SPD Server environment.

Audit log records are kept for all resource accesses by each LIBNAME proxy process. The audit log saves records in its own separate space, away from other server log files. A sample

SAS job which processes the audit log and produces a report is provided. Check **samples\audit.sas** for information about processing the audit log and generating the report. To enable the audit trail log, use the **spdsserv** command with the **-auditfile** option.

When using automatic server log cycling or audit log cycling, you should periodically clean up the log files. Proper log file maintenance normally includes archiving logs using secondary or long-term storage. Many users only retain a few generations for quick reference. A shell script which runs on a regular basis (such as crontab) is a good way to perform log maintenance on your server machine.

The **spdsserv** command supports the following options:

-parmfile *file-spec*
Allows you to specify an explicit file path for the SPD Server host's parameter file. This file is mandatory and contains any SPD Server options. If this option is omitted, the SPD Server host assumes a parameter file spdsserv.parm in the process's current working directory. Option declarations in this file are of the form:

```
Option[ = Value];
```

The recognized **-parmfile** option names are listed here, but are described in more detail in the online documentation. Most sites need not modify the defaults in **InstallDir\site\spdsserv.parm**. For more detailed information about server parameters, see the SPD Server Administrator's Guide section on “Introduction” on page 112"Setting Up SPD Server Parameter Files."

-acldir *pwd-dir-path*
Specifies the directory path to the SPD Server host password file. This option can be omitted if the PASSPATH= option is declared in the SPD Server host's **-parmfile**. A valid SPD Server password file is required even when running with the **-noacl** option. You must use the SPD Account Manager utility to create the password file and populate it with the set of valid SPD Server user IDs.

-noacl
Disables SPD Server login validation for SPD Server LIBNAME engine connections to the SPD Server host.

-nameserver *node-name*
Specifies the node name where the Name Server process is running. This does not need to be the same node that is hosting the SPD Server host processes. This option is required.

-nameserverport *port#*
Allows you to specify an explicit TCP port number for the SPD Server host to use to connect to its Name Server. If no port is specified, the Name Server queries the system for a registered port address using the service name "spdsname".

-libnamefile *file-spec*
Specifies the name of the file that contains the logical LIBNAME domain definitions that the SPD Server host supports. LIBNAME definitions can span multiple lines and must begin with the LIBNAME=name keyword. Each LIBNAME definition must be terminated with a ";" character.

-logfile *fileSpec*
Selects automatic server log file creation by the logger process. fileSpec specifies a partial path/file name parameter that is used to generate the complete log file path. For example if you specified fileSpec as **\DOWNlogs\spds**, the generated name would appear as follows:

```
\DOWNlogs\spds_
mmddyyyy_hh:mm:ss.spdslog
```

where **mmddyyyy** and **hh:mm:ss** are taken from the system time when the log file is created.

-logtime *hh:mm*
Specifies a time of day to cycle a new generation of the server log file. At this time each day, the previous log file will be closed and new log file will be opened.

-auditfile *fileSpec*
Enables audit logging for the server and automatic audit log file creation by the audit process. fileSpec specifies a partial path/file name parameter that is used to generate the complete audit file path. For example if you specified fileSpec as **\audit\spds**, the generated name would appear as follows:

```
mmddyyyy_yyyy.spdsaudit
```

where **mmddyyyy** are taken from the system date when the log file is created.

-audittime *hh:mm*
Specifies a time of day to cycle a new generation of the audit log file. At this time each day, the previous log file will be closed and new log file will be opened.

SNET Server Commands

The SNET server is the connection point for the clients accessing SPD Server data through ODBC, JDBC or SAS htmSQL applications.

The SNET server is invoked with the following command line syntax:

```
spdssnet [-listenport listen_port]
```

The **spdssnet** command supports the following options:

-listenport *listen_port*
Specifies the listen port number **spdssnet** will use to accept connections from ODBC, JDBC, or htmSQL clients. If not specified, **spdssnet** will use the named service **spdssnet** from the **\etc\services** file to determine its listen port.

-logtime *hh:mm*
Specifies a time of day to cycle a new generation of the SNET log file. At this time each day, the previous SNET log file will be closed and a new SNET log file is started.

PSMGR Password Utility

The SPD Server **psmgr** password utility allows the SPD Server administrator to create and maintain the data set containing the authorized SPD Server user IDs. If you choose to run SPD Server ACL support, you will need to create and populate the SPD Server password file before starting the SPD Server environment. You can use the **psmgr** utility or the SAS Management Console to manage passwords. For more detailed information, see the Help section on "The Password Manager Utility psmgr" on page 193.

SPD Server and the SAS Management Console

SPD Server provides a management console interface via the SAS Management Console utility. The SAS Management Console for SPD Server is installed with the SAS 9.2 Management Console utility. For more detailed information, see the SPD Server Help topic, "The SAS Management Console" on page 71.

Lightweight Directory Access Protocol (LDAP) Authentication

In SPD Server 4.5, clients can be authenticated by either the PSMGR password facility, or by a Lightweight Directory Access Protocol (LDAP) Server that is running on the SPD Server host. LDAP authentication integrates with the SPD Server password facility and offers a centralized approach to User ID and password management. SPD Server clients that use LDAP authentication should have accounts in the domain in which the LDAP and SPD Servers are running. The User ID and password information must be stored on an LDAP server that the SPD Server can access. The User ID must also be entered into the SPD Server's password database through PSMGR or the SPD Server 4.5 SAS Management Console Utility to record all other SPD User information.

When a client uses LDAP authentication to connect to an SPD Server, the LDAP server that is configured in the SPD Server's parameter file receives the client's user name and password. The LDAP server authenticates the client, then returns the result to the SPD Server. After the client is verified, SPD Server uses the client's password database record for all other SPD Server operations.

To set up LDAP authentication, the following parameters must be added to the SPD Server's spdsserv.parm file:

Table 4.1 *Parameters for the spdsserv.parm File*

Parameter Description	Values	Default Setting
(NO)LDAP: directs user authentication to LDAP Server	LDAP/NOLDAP	NOLDAP
LDAPSERVER: LDAP Server IP address	a valid IP address	LOCAL_HOST
LDAPPORT: LDAP Server port number	0-65536	LDAP_PORT
LDAPBINDDN: LDAP bind distinguished name	char string	Null

The LDAP parameter turns on LDAP Authentication. If the LDAP parameter is present during start up, the SPD Server creates a context for LDAP authentication.

The LDAPSERVER parameter specifies the network IP address, or the host machine for the LDAP server. This is usually the same as the IP address of the SPD Server host. The default value for LDAPSERVER is the IP address of the SPD Server host.

The LDAPPORT parameter specifies the TCP/IP port that is used to communicate with the LDAP server. This is usually the default "LOCAL_HOST" or port 389.

The LDAPBINDDN parameter is the "Distinguished Name" (DN), or the location in the LDAP Server's database where the client's information is stored. The form of this string is

```
"ID= , rdn1=RDN1, rdn2=RDN2, ...".
```

"ID" is the identifier for the Relative Distinguished Name of a User ID that exists in the LDAP Server database. The default value of the DN is

```
"uid= , dc=DOM1, dc=DOM2, dc=DOM3".
```

If no Distinguished Name is specified in the spdsserv.parm file, SPD Server uses the LDAP Server host's domain name to generate values for DOM1, DOM2, and DOM3. The SPD Server user's User ID becomes the value for "uid". The result becomes the default user location for LDAP database members.

For example, let the LDAP host machine be **sunhost.unx.sun.com** and the User ID be "sunjws". The resulting default Distinguished Name would be

```
"uid=sunjws, dc=unx, dc=sun, dc=com".
```

The Distinguished Name is used to locate the user "sunjws". Then, the sunjws user password is compared to the password that is stored in the LDAP database. If there is a specific location for SPD Server users in your LDAP database, be sure to specify it using LDAPBINDDN utility.

See the LDAP Server administrator for your site if you need more information about the LDAP parameters for your spdsserv.parm file. To use the default value for any LDAP parameter, simply omit it from the spdsserv.parm file. Undeclared parameters automatically assume default values.

Note: Entering the LDAP_HOST value for the LDAPSERVER can cause SPD Server to fail during start up. It is recommended that SPD Server and LDAP Server use the same hosts. The user password is sent to the LDAP server in clear text. If someone is "sniffing" the network, user passwords could potentially be intercepted.

Notes for SPD Server Administrators

The SPD Server administrator has the role of performing many of the maintenance and configuration functions for the SPD Server system. The following are some guidelines and ideas for helping out in this capacity.

SPD Server User IDs

The SPD Server system uses its own layer of system access controls as a clean layer over the file system access permissions. SPD Server processes run in the context of a Windows user ID, and that user owns all of the file resources that are created from this SPD Server.

The SPD Server password file allows you to control access to the SPD Server's data resources at a finer level of granularity than the UNIX user ID. Many sites will not want to give Windows accounts to SPD Server system users, but still want protection and ownership of the data resources created in the SPD Server environment. SPD Server user IDs allow for this extra layer of access control.

The SPD Server administrator needs to be familiar with the **Account Manager** utility provided with the SPD Server system.

If you choose not to use SPD Server user IDs, you will still need the SPD Server password file for the Data Server process to function properly. To disable the use of SPD Server user IDs at your site, supply the **-noacl** option when you startup the Data Server process.

If you use SPD Server user IDs, you will need to add them to the SPD Server password file created during the installation phase. The **Account Manager** command reads its commands from its **stdin** so you can pipe commands to it from another command, script, or from an input file.

Troubleshooting

Overview of Troubleshooting

Troubleshooting networked applications is often difficult. Key ingredients to SPD Server troubleshooting are the Name Server and SPD Server host process log files. With those two log files, you can reconstruct some of the SAS interaction with SPD Server components. Entries in these log files are time-stamped for reference. You should be able to correlate activities between the two logs by using the time-stamp information. The logs are formatted as plain text files.

Name Server Startup Failed

Check the Name Server log file. The log should contain good clues about the problem. Some common things to watch for include:

1. Invalid -licensefile file specification.
2. -licensefile specifies a file with invalid contents.
3. The Name Server port is in use by another process. Check for another Name Server process running already on the same node.

```
ps -ef | grep -i spdsnsrv
```

SPD Server Host Startup Failed

Check the SPD Server host log file for clues. Some common things to watch for include:

1. -nameserver node name is incorrect.
2. -nameserverport specifies wrong port number if SPD Server Name Server is running with a non-standard port assignment.
3. -parmfile file specification is invalid or specified file does not exist.
4. -libnamefile file specification is invalid or specified file does not exist.
5. Contents of specified -libnamefile does not conform to expected syntax. Check SPD Server host's log for messages about which entries are invalid.
6. -acldir option was omitted from the command line.
7. -acldir option specifies an invalid directory path for locating the SPD Server password file or the specified directory path does not contain a valid SPD Server password file.

SAS LIBNAME Assignment Failed

On the SAS side, first attempts to diagnose a failure depend on the error messages from the SPD Server LIBNAME engine via the SAS LOG output. In most circumstances you

should be able to diagnose the reason for the failure from this message. Some common problems include:

1. **Invalid specification of the LIBNAME engine selector in the LIBNAME statement.** The SPD Server engine name is sasspds and is misspelled in the following LIBNAME statement.

```
1? libname foo sasspds 'test' server=sunspot.spdsname
   passwd='xxx';
ERROR: Module FOO not found in search paths.
ERROR: Error in the LIBNAME or FILENAME statement.
```

2. **Invalid specification of the logical LIBNAME domain name in the LIBNAME statement.** The domain name 'test' is not defined on the SPD Server Name Server sunspot.spdsname.

```
2? libname foo sasspds 'test' server=sunspot.spdsname
   passwd='xxx';
ERROR: ERROR: Libname path info not found in SPDS name server..
ERROR: Error in the LIBNAME or FILENAME statement.
```

3. **No name server is running on the specified node name or no name server is available at the specified port address.** In this case, no Name Server is running on the specified node **stelling**. This same message would be generated if the port address is incorrect.

```
3? libname foo sasspds 'test' server=stelling.spdsname
   passwd='xxx';
ERROR: Unable to connect to SPDS name server.
ERROR: Connection refused.
ERROR: Error in the LIBNAME or FILENAME statement.
```

4. **An invalid or unknown node name is specified in the LIBNAME statement.** In this case, node xxx is not accessible in the network.

```
4? libname foo sasspds 'test' server=xxx.spdsname
   passwd='xxx';
ERROR: Unable to connect to SPDS name server.
ERROR: xxx.
ERROR: Error in the LIBNAME or FILENAME statement.
```

5. **Invalid SPD Server user password specified in the LIBNAME statement.** In this case, the SPD Server user ID is derived from the UNIX user ID running the SAS session. The SPD Server password file has an entry for this SPD Server user ID, but the password is not xxx.

```
8? libname foo sasspds 'test' server=sunspot.spdsname
   passwd='xxx';
ERROR: Error on server libname socket.
ERROR: SPD server has rejected login from user
sasetb.. ERROR: Error in the LIBNAME or FILENAME
statement.
```

6. **Invalid SPD Server user ID specified in the LIBNAME statement.** In this case, the SPD Server user ID xxx does not exist in the SPD Server host's password file. The resulting failure message is the same as for the invalid password case.

```
10? libname foo sasspds 'test' server=sunspot.spdsname
    user='xxx' passwd='xxx';
ERROR: Error on server libname socket.
ERROR: SPD server has rejected login from user xxx..
ERROR: Error in the LIBNAME or FILENAME statement.
```

Using SETINIT to Extend SPD Server Software

When you receive SPD Server software, the licensing information is pre-initialized. When you renew your license, you will receive a new license to replace your existing one. You must restart SPD Server to use your new license.

Note: You should not change the licensing information unless you are logged in under the user ID of the owner of SPD Server software. You designated the owner of these files when you first licensed the software.

Part 3

Migration

Chapter 5

SPD Server 3.x to SPD Server 4.5 Conversion Utility

Introduction

SPD Server 4.5 uses improved architectures that enable features like the ability to support data tables that contain over 2G observations. The new architectures provide functionality that is needed in today's data marts, but the current generation of SPD Server tables use metadata architectures that are not backwards compatible with SPD Server 3.x software.

SPD Server 4.x tables use architectures that utilize SAS 9 metadata. SPD Server 3.x tables use architectures that utilize SAS 8 metadata. The two metadata architectures are not compatible. However, SPD Server 4.5 provides a conversion utility SPDSCONV that permits SPD Server 3.x customers to convert existing tables for use with SPD Server 4.x. The SPDSCONV utility is designed to be run by the SPD Server Administrator.

Note: SPD Server Administrators should ensure that all images of the SPD Server 3.x data sets to be converted are completely backed up before beginning the conversion process.

Before You Convert

The SPDSCONV utility changes the format of SPD Server 3.x tables to SPD Server 4.x tables. The conversion is not reversible. Once you convert a table for use with SPD Server 4.x, the table cannot be read any longer by SPD Server 3.x. Before you start converting SPD Server tables, you should do a full back up all of your existing SPD Server 3.x tables. If you ever need to go back to your SPD Server 3.x tables, you can restore them.

If you need to temporarily use your tables with SPD Server 3.x and SPD Server 4.x, you can use PROC COPY to make copies of the tables before you convert them. You can use

SPDSCONV on the copied versions to convert them for use with SPDS 4.5, while maintaining archival versions of the SPD Server 3.x tables.

Overview of the SPDSCONV Utility

The SPDSCONV utility converts SPD Server 3.x metadata files for use with SPD Server 4.4. The conversion updates the physical structure of the metadata file and renames the files. The SPDSCONV utility will also update the data partition files if the SPD Server 3.x tables being converted contain compressed data.

You can identify SPD Server 3.x table files by the filename extension. SPD Server 3.x table files end with the filename extension **.spds8**. SPD Server 4.4 table files end with the filename extension **.spds9**. All tables that are upgraded to be compatible with SPD Server 4.4 will have the filename extension **.spds9**.

SPD Server 4.4 index files differ from SPD Server 3.x index files. SPD Server 4.4 index files allow greater numbers of observations than the SPD Server 3.x index files. SPD Server 3.x index files are not compatible with the SPD Server 4.0 and 4.4 environment.

The SPDSCONV table conversion utility does not recreate index files. When you use the SPDSCONV utility to convert tables from SPD Server 3.x to SPD Server 4.4 format, the utility automatically deletes physical files that were associated with the old 3.x indexes and are now obsolete. The SPDSCONV utility does offer an option to create a SAS job file that you can run in the SPD Server 4.4 environment to recreate the SPD Server 3.x index files for use with SPD Server 4.4.

If you choose to create the SAS job file to recreate SPD Server 3.x indexes for use in SPD Server 4.4, the code will resemble the following:

```
%let SPDSIASY=YES;
 PROC DATASETS lib=<spdsv4 libname>;
 modify MYTABLE;
 index create X1 [/Options];
 index create X2 [/Options];
 ...

 quit;
```

When you use the SPDSCONV utility, you can specify the destination directory for the SAS job file that you create, but the SPDSCONV utility names the job file that your create. The utility generates SAS job file names by adding the text string _v4ix.sasto the table name, resulting in names such as mytable_v4ix.sas. It's a good idea to defer index recreation because of the intensive computing it can require. Performing index re-creation as an off-peak batch job can be advantageous in busy computing environments.

After converting the indexes, some users may notice that SPD Server 4.4 metadata files are slightly larger than the SPD Server 3.x metadata files. The file size increase is related to the new structures that facilitate SPD Server 4.4's capability to use large tables that more than 2G rows of data.

How does SPDSCONV work? When converting a table, the SPDSCONV utility first reads the original SPD Server 3.x metadata file and creates a new SPD Server 4.4 metadata file. Both these files are locked during the conversion process. The lock prevents any outside access to the files by other users while changes are being made. If the conversion process encounters problems, the SPD Server 4.4 metadata file is deleted and the original SPD Server 3.x table remains intact.

SPDSCONV reads the SPD Server 3.x metadata file a section at a time, recreating each structure in the SPD Server 4.4 metadata file as it is read. After the SPD Server 4.4 metadata file is fully populated, the data partition file component is checked to determine if updates are required.

If SPDSCONV detects the presence of compression block headers, then the data partition file contains SAS 8 compression information that is not compatible in SPD Server 4.4, and the data partition files must be updated. SPDSCONV updates the data partition file by overwriting the compression block headers. SPDSCONV does not change the size of the data partition file, of any file components, or any of the data contained in the files. The increase in metadata file size is very modest and represents only a small percentage of storage space when compared to its corresponding data partition file component.

Once SPDSCONV updates the data partition file, there is no provision to restore or recreate the original SPD Server 3.x data partition file. You should ensure that you have complete backup images of the SPD Server 3.x datasets that you intend to convert prior to running the conversion.

After the SAS job file recreates the SPD Server 3.x indexes for use with SPD Server 4.4, all remnants of the SPD Server 3.x table are deleted. The SPDSCONV utility does not perform ACL checks during the conversion. The individual running the SPDSCONV utility (usually an SPD Server Administrator) cannot browse the contents of table rows from within the utility. During the metadata file conversion, no table rows are accessed, and there are no options to expose table row contents as part of logging or index job creation. The SPD Server 4.4 table retains the same SPD Server owner as the SPD Server 3.x table.

Using SPDSCONV

The SPDSCONV program is a command-line utility. You use a set of command-line options and parameters to specify the name and location of tables you wish to convert, then specify the options you desire for your conversion. If your SPD Server software is installed on a UNIX platform, refer to the "SPD Server UNIX Installation Guide " on page 11 for information on setup required prior to running SPDSCONV.

The form of the command line is as follows:

```
SPDSCONV <Options> [-a | table1 [table2]]
```

The order of options and table names on the command line does not matter. All of the currently available options are global options. Placing a global option before or after a table does not change the option setting for that table alone.

Options for the SPDSCONV command are:

-d pathname
: the directory path corresponding to an existing SPD Server LIBNAME domain. The pathname specification should be the same as the PATHNAME= directory path found in the libnames.parm file.

-l logpath
: the directory path to store SAS job files created during the conversion process. The default logpath setting is the directory where the SPDSCONV command is issued.

-a
: converts all SPD Server 3.x compatible tables in the -d pathnamedirectory to SPD Server 4.4 compatible tables.

-j
creates a SAS job in the log directory for each SPD Server 3.x table conversion where indexes are present. When run, the SAS job recreates the indexes on the SPD Server 4.4 table. The SAS job must be run after the SPDSCONV utility completes. Because index recreation may be computation-intensive, users may want to schedule SAS index recreation jobs as a SAS batch jobs for off-peak hours. The utility generates the name of the SAS job file as follows:

```
TableName_v4ix.sas
```

where TableName is the name of the SPD Server 4.4-compatible table. The SAS job file contains the SAS language statements necessary to recreate the indexes that the SPD Server 3.x table used. The job file will need to be edited prior to execution to ensure that the proper SPD Server 4.4 LIBNAME is used with the PROC DATASETS statement.

-v
create verbose output for the conversion process.

SPDSCONV Utility Examples

Suppose you have the LIBNAME parameter file for your SPD Server installation:

```
libname=usmkt pathname=/mdat1/usmkt
 roptions="datapath=('/dat11/usmkt'
                     '/dat12/usmkt'
                     '/dat13/usmkt'/
                     '/dat14/usmkt')
 indexpath=('/ix11/usmkt'
            '/ix12/usmkt')";

libname=sales pathname=/mdat1/sales
 roptions="datapath=('/dat21/sales'
                     '/dat22/sales'
                     '/dat23/sales'/
                     '/dat24/sales')

 indexpath=('/ix21/sales'
            '/ix22/sales')";
```

Converting a Simple Table

Suppose you have an SPD Server 3.x table named CT010299 that belongs to the **usmkt** domain, and you want to convert CT010299 to SPD Server 4.4 use. The table CT010299 has no indexes and you want a verbose output of the table conversion.

```
SPDSCONV -v -d /mdat1/usmkt CT010299
```

Converting Tables and Recreating Indexes

Suppose you want to convert all tables in the **sales** domain. You also want SPDSCONV want to create SAS jobs that you can run to recreate the indexes after the table conversion completes. You want the SAS jobs put into the directory $HOME/salesv9. You also want a verbose output of the conversion.

```
SPDSCONV -v -d /mdat1/sales -l $HOME/salesv9 -j -a
```

Part 4

Configuration

Chapter 6

Using the SPD Server Name Server to Manage Resources

Managing Computing Resources with a Name Server

The SPD Server name server gives system administrators the ability to manage computing resources without disturbing system users. The SPD Server name server maps logical names that are referenced in SAS programs to the physical location of SPD Server tables. Thus, a name server allows the system administrator to add, remove or reallocate disk space and computing power without having to change SAS source code. Nor is there the necessity of informing others about changes in resource allocation as long the name of the machine that hosts the name service remains the same.

The following example demonstrates how to configure SPD Server to spread the processing load across multiple machines in a network.

Configuring SPD Server on a Corporate Network

Inventory Available Corporate Network Servers

The example corporation maintains a network of computers. The corporate network contains a mix of computers and processing power: there are machines with multiple processors and large amounts of available disk space, smaller machines that are used for servers, and desktop machines for client users. Among the dedicated servers, we find

worldcpu
a data store for the company's worldwide operations.

asiacpu
a data store for the company's Asia department, which uses the data to generate reports, analysis, and so on.

namecpu
the machine that runs the name server.

Because data for worldwide operations is stored in an SPD Server table on **worldcpu**, the Asia department periodically must access **worldcpu**. The Asia users want to extract **worldcpu** data to create SPD Server tables that will reside on their own departmental server, **asiacpu**. The Asia users can then access tables which contain only Asia data, and transfer that information to their desktops for further analysis.

The SPD Server system administrator runs the name server on the **namecpu** machine. Consequently, **namecpu** must be accessed by every machine in the network that wants to locate an SPD Server table. Additionally, the administrator must run a data server on the **worldcpu** and **asiacpu** machines. The following section discusses how the administrator should configure the servers in order to distribute the processing load.

Running the Name Server on Machine Namecpu

Invoke the name server by using the **`-listenport`** option. The value that you specify for the option should be a valid TCP/IP port number. You will use the same port number when you invoke SPD Server on the **worldcpu** and **asiacpu** servers.

Configuring SPD Server on Worldcpu

The **libname.parm** file that resides on the **worldcpu** server contains the following line:

```
libname=world pathname=/spds;
```

This code instructs SPD Server to register the combination

```
(world, worldcpu, /spds)
```

with the name server. Thereafter, when a SAS LIBNAME statement contains the domain name 'world' in combination with the appropriate name server, it will locate SPD Server tables in the directory **`/spds`** on the **worldcpu** server. The SAS LIBNAME statement that invokes the SPD Server engine and makes this association is

```
libname worldlib sasspds 'world' server=namecpu.spdsname;
```

When your network uses an SPD Server name server, the users do not have to remember which machine houses a particular domain. Users only need to remember that the SAS domain named 'world' contains the tables that they need. The machine that stores the domain can even change without the users' knowledge and the users' SAS programs will continue to run as before.

Invoke SPD Server, specifying **namecpu** as the value for the **`-nameserver`** option. The value for the "nameserverport" must match the port number that you used to start the name server on that machine.

Setting Up asiacpu, the Asia Departmental Server

The **libname.parm** file that resides on **asiacpu** contains the line of code:

```
libname=asia pathname=/spds;
```

This line instructs the SPD Server running on **asiacpu** to register the combination

```
(asia, asiacpu, /spds)
```

with the name server. When a SAS LIBNAME statement contains the domain name 'asia' in combination with the appropriate name server, it will locate SPD Server tables in the directory **/spds** on machine **asiacpu**. The SAS LIBNAME statement that invokes the SPD Server engine and makes this association is

```
libname asialib sasspds 'asia' server=namecpu.spdsname;
```

Note that the value that follows the LIBNAME server specification is the same in all these LIBNAME statements. The reason is that both SPD Servers use a common name service. Asia departmental users do not need to know the name of the machine that provides storage for their domain.

Which SAS Program Statement Runs Where?

Assume a user in the Asia department needs to create an SPD Server table on the departmental server **asiacpu**. This task requires data to be extracted from an SPD Server table named **alldata**. The user knows that the **alldata** table resides in the domain 'world.' The user submits the following SAS code on a desktop SPD Server client:

```
libname worldlib sasspds 'world' server=namecpu.spdsname;
libname asialib sasspds 'asia' server=namecpu.spdsname;

data asialib.mydata;
set worldlib.alldata;
where region='Asia';
if country='Japan' then
    subreg=1;
run;
```

The submitted code extracts records from an SPD Server table named **alldata** which resides in the domain 'world.' The 'world' domain is stored on machine **worldcpu** in the directory **/spds**. Because the **alldata** table resides on **worldcpu**, and SPD Server processes certain SAS WHERE clauses, the search for the value 'Asia' is performed on **worldcpu**.

The SAS program runs on the Asia user's desktop machine. The desktop machine scans each row in the **alldata** table, looking for the string 'Japan'. If the string is found, the desktop client then forwards the row to the machine where the output table resides, which is **asiacpu** in this example.

Disk space for the output table **mydata** is allocated in the **/spds** directory on **asiacpu**. The processing work, transferring data received from the user's desktop machine to the SPD Server table, is performed by **asiacpu** as well.

The processing that was required to create the output SPD Server table was distributed across three machines. However, the user's desktop machine requires no permanent disk space, because SAS WHERE clauses execute on the machine that stores the source table. Only the selected rows that matched the submitted WHERE clause are sent over the network to the desktop client. This strategy significantly reduces network traffic, as well as the time that is needed to complete a SAS program.

Chapter 7

Administering and Configuring SPD Server Using the SAS Management Console

The SAS Management Console

The SAS Management Console is a Java application that provides a single point of control for managing multiple SAS application resources. Rather than using a separate administrative interface for each application in your enterprise intelligence environment, you can use SAS Management Console's single interface to perform the administrative tasks required to create and maintain an integrated environment.

SAS Management Console manages resources and controls by creating and maintaining metadata definitions for entities such as:

- server definitions

- library definitions
- user definitions
- resource access controls
- metadata repositories
- job schedules

Metadata definitions that are created through SAS Management Console are stored in a repository or on a SAS Metadata Server where they are available for other applications to use. For example, you can use SAS Management Console to create a metadata definition for a SAS library that specifies information such as the libref, path, and engine type (such as sasspds). After SAS Management Console stores the metadata definition for the library in the repository on the SAS Metadata Server, any other application can access the definition to access the specified library.

The SAS Management Console application is a framework. The metadata definitions are created using Java plug-ins, application modules that are designed to create metadata for a specific type of resource.

For example, administrators can use the SAS Management Console to configure SPD Server user and group passwords and ACLs instead of using the traditional SPD Server **psmgr** utility and PROC SPDO statements.

The SAS Management Console for SPD Server 4.5 is installed with the SAS 9.2 Management Console.

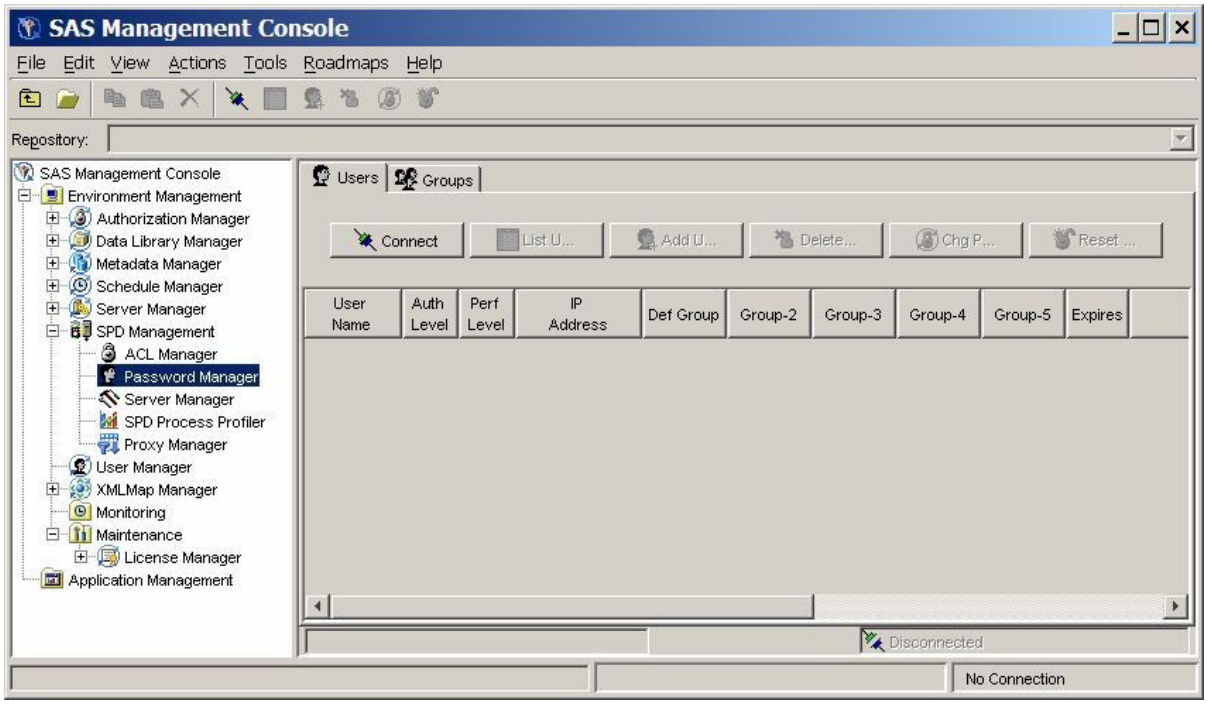
Accessing the SPD Server Manager in SAS Management Console

The left portion of the SAS Management Console contains a navigation tree of available management tools. Select the **SPDS Manager** folder to access SPD Server services. The **SPDS Manager** folder contains the SPD Server ACL Manager, Password Manager, Server Manager, Process Profiler, and Proxy Manager.

Password Manager

Overview of the Password Manager

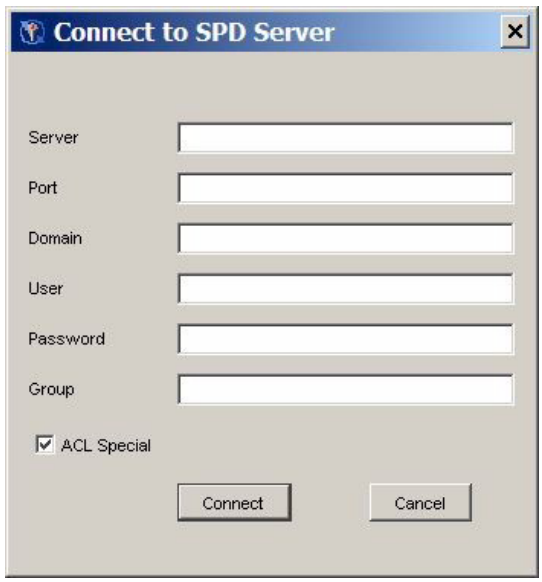
If you open the Password Manager in the SAS Management Console window when no server connection exists, the display resembles the following:



There are two window tabs: **Users** and **Groups**. When no server connection exists, no data is displayed and the only permitted operation is connecting to an SPD Server .

Connecting to an SPD Server

Select **Connect** on the **Users** tab of the SAS Management Console window to open the Connect to SPD Server window:



The Connect to SPD Server window contains input fields for the following components. The components follow the same usage as a LIBNAME statement to connect to an SPD Server host.

Server - the name of the SPD Server host

Port - the SPD Name Server listen port

Domain - the SPD domain

User - user name that has privilege to be ACL special

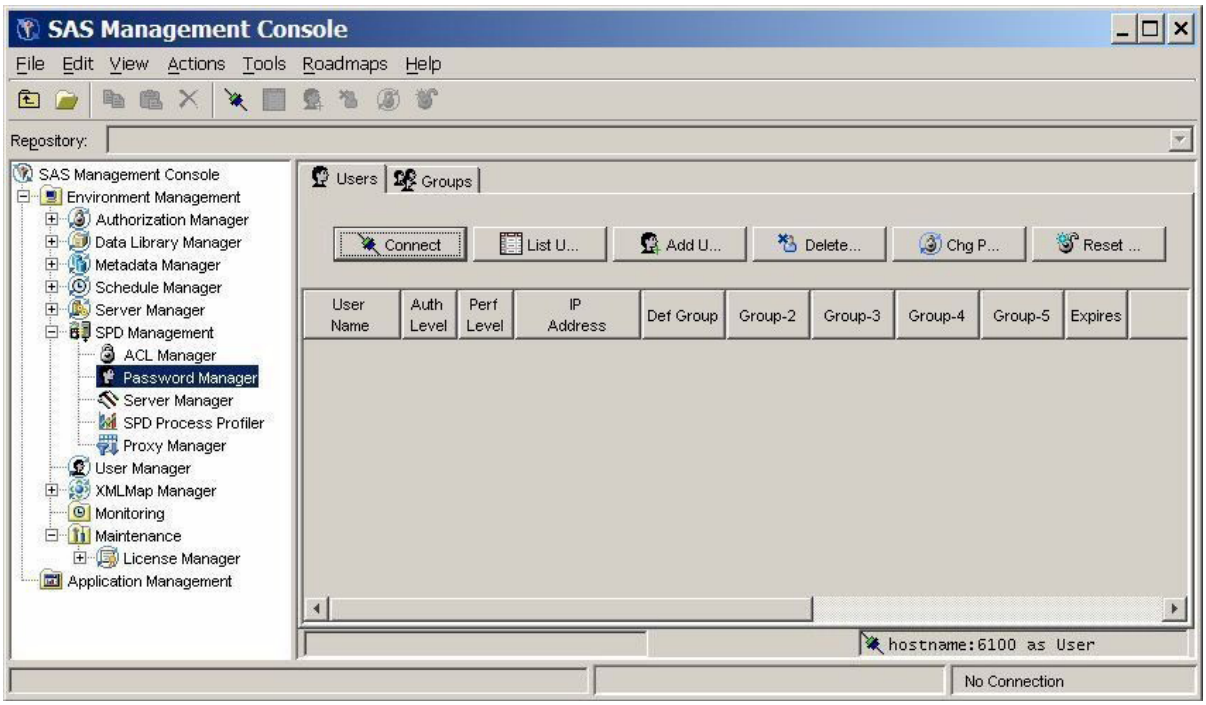
Password - password associated with the user name

Group - optional group name

ACL Special - select this box to enable ACL special privileges

Complete the required information, and then click **Connect**. After you connect to an SPD Server host, the remaining command buttons on the **Users** tab are enabled. The status bar at the bottom of the **Users** tab indicates that a connection exists.

Note: Do not confuse the SAS Management Console status indicator in the lower-right corner of the SAS Management Console window with the SPD Server connection status at the bottom of the **Users** tab.



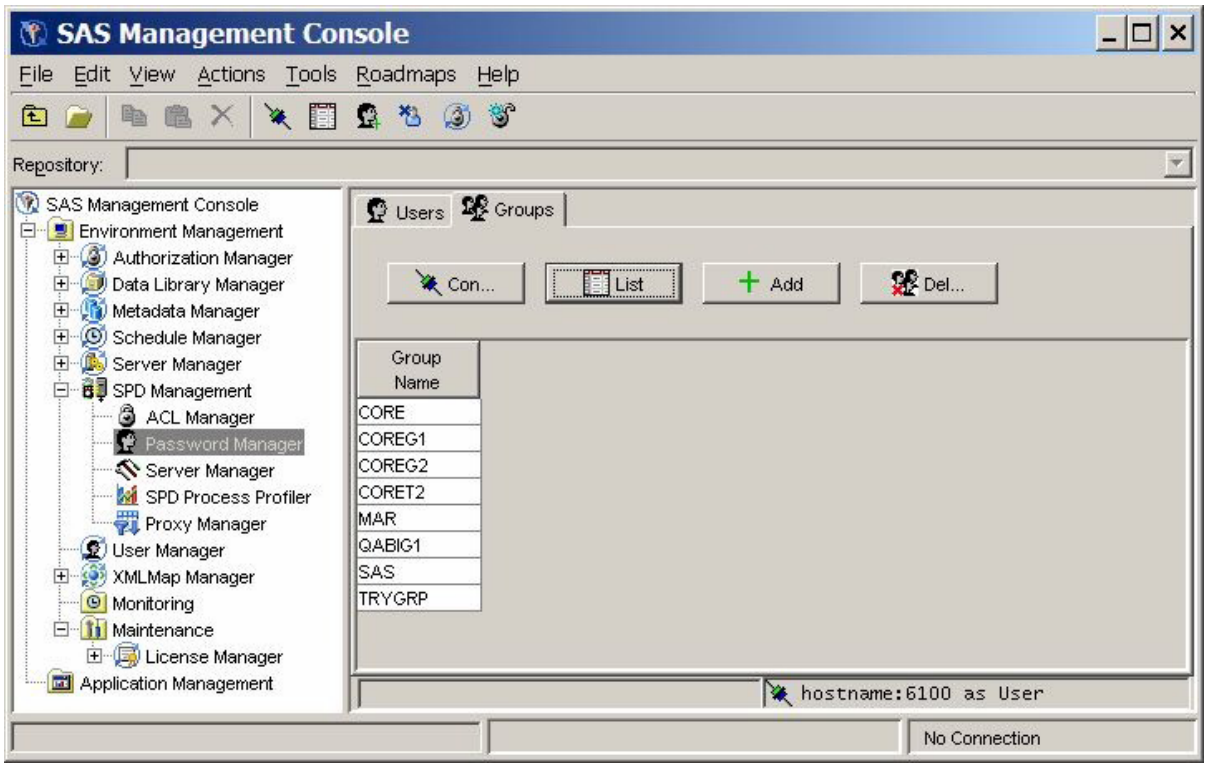
Users and Groups

Overview of Managing Users and Groups

Use the **Users** and **Groups** tabs in the SAS Management Console window to access either individual user or user group configuration information.

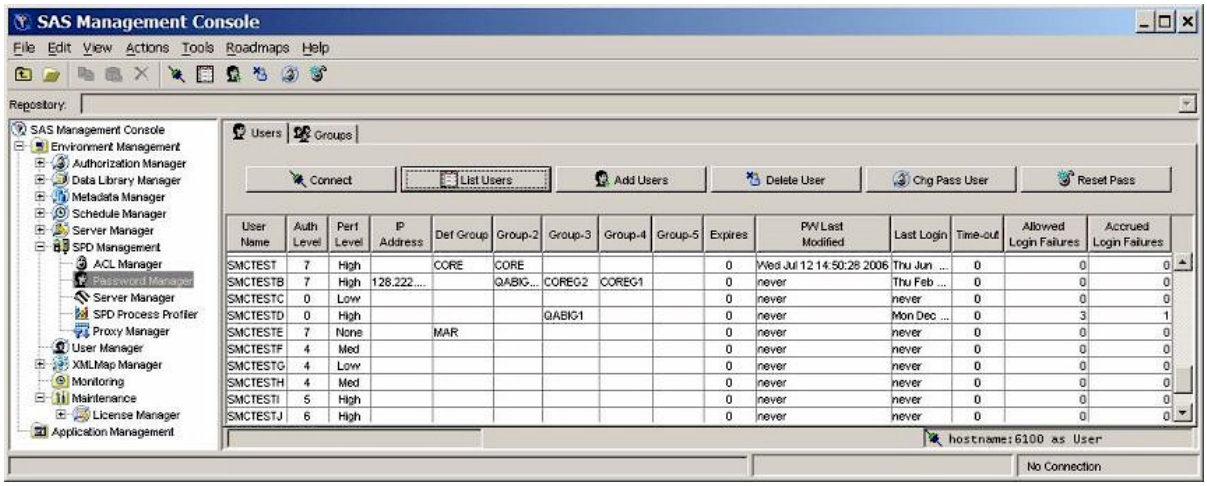
Groups Tab

On the **Groups** tab of the SAS Management Console window, click **List** to display the existing defined groups. When you first connect to the Password Manager or after you make changes to a group, the window lists existing defined groups by default.



Users Tab

On the **Users** tab of the SAS Management Console window, click **List** to display the defined users and groups.



The window contains the following components:

User Name - the name of the user. This field cannot be changed directly. To change a user name, delete the user and then add a new user.

Auth Level - the numeric authorization level, ranging from 0 to 7. To change the value, select the field and edit it.

Perf Level the Perf Level setting is not yet implemented in SPD Server . In the future, this field will be used to indicate to the server how to manage resources for the associated user.

IP Address - the IP address of the workstation that the individuals listed in the User Name column are using.

Def Group - the default group for a user. Use the drop-down list for the field to change the currently defined group.

Group 2 - Group 5 - shows the numbered groups 2 - 5 that are assigned to each user. Use the drop-down list to change the currently defined groups.

Expires - the number of days that are remaining until the current password expires. A zero value represents infinity.

PW Last Modified - the date and time of the last modification to a user's password.

Last Login - the date and time of the last user login.

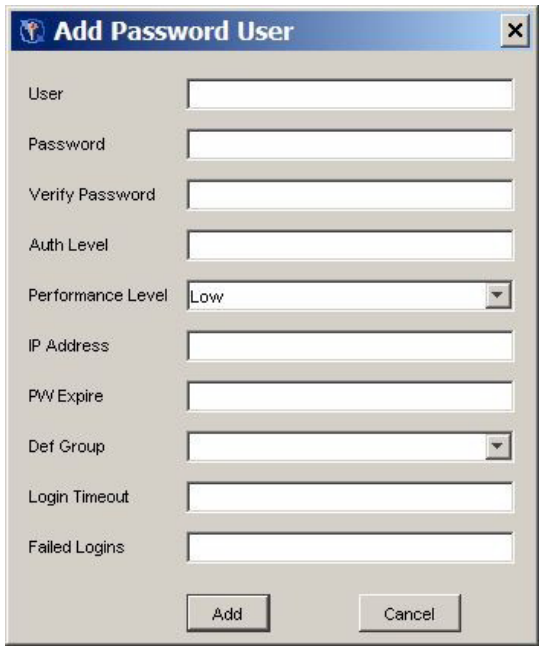
Time-out - the number of idle days since the user's last login. When the number of days since a user's last login equals the **Time-out** value, the user's access is disabled. For example, if the **Time-out** value is 7, and if a given user does not log on at least every seven days, the user's access is disabled. A zero value in the **Time-out** field represents infinity, so a user account with a zero value in the **Time-out** field never times out.

Allowed Login Failures - the number of consecutive login failures that is allowed before the user's access is disabled. A zero value indicates that unlimited login failures are allowed.

Accrued Login Failures - the current number of consecutive failed login attempts by this user.

Adding a User

To add a user, click **Add**. Complete the values for **User**, **Password**, **Auth Level**, **IP Address**, **PW Expire**, **Def Group**, **Login Timeout**, and **Failed Logins**.



User, **Password**, **Auth Level**, **Def Group**, and **Failed Logins**are required values. The **IP Address**, **PW Expire**, and **Login Timeout** are optional. If the optional settings are not specified, they default to "no limits".

Adding a Group

To add a group using the **Groups** tab of the SAS Management Console window, click **Add**. Enter a group name in the Add Group window and click **Add**. The group name is added and the list is updated.

Deleting a User

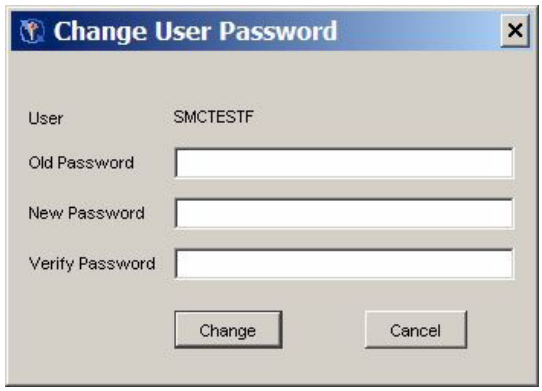
To delete a user using the **Users** tab of the SAS Management Console window, select the user from the list and click **Delete**. The user is deleted and the list is updated.

Deleting a Group

To delete a group using the **Groups** tab of the SAS Management Console window, select the group from the list and click **Delete**. The group is deleted and the list is updated.

Changing a Password

To change a user's password using the **Users** tab of the SAS Management Console window, select the user and click **Chg Pass**. Enter the user's old password and new password in the Change User Password dialog box, and click **Change**.



Resetting a Password

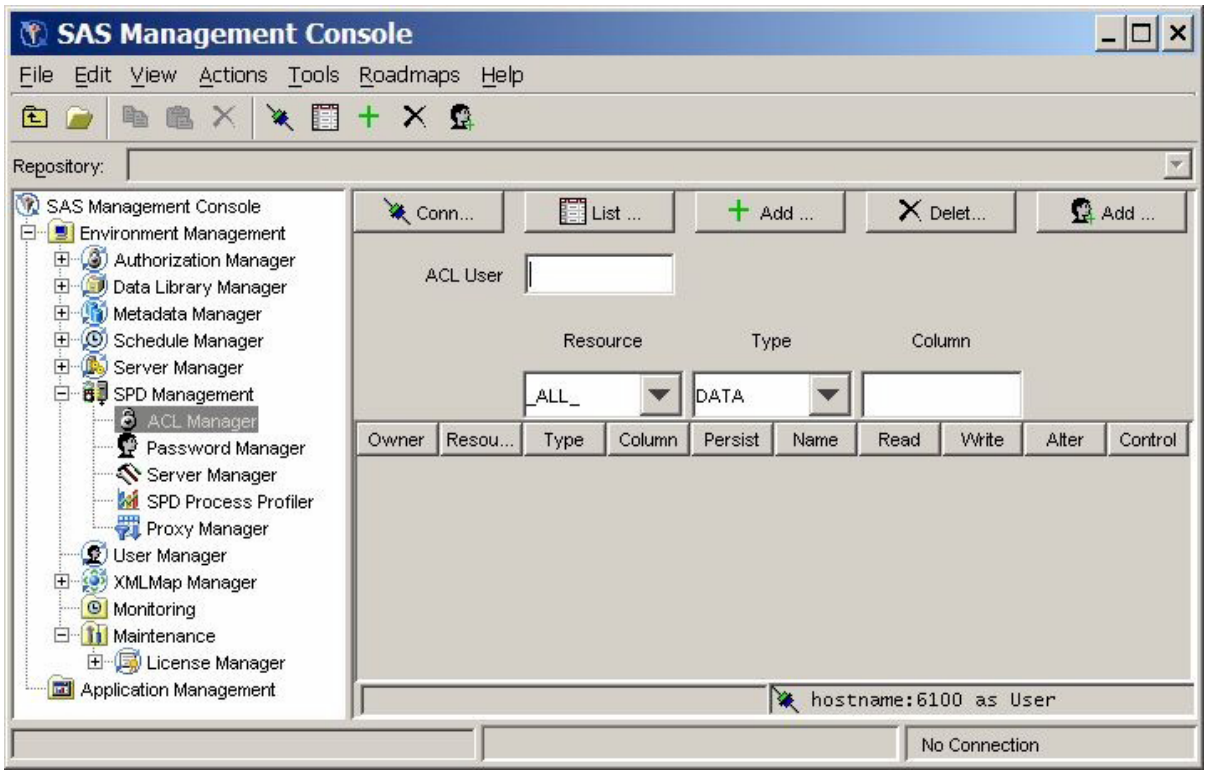
To reset the password for a selected user using the **Users** tab of the SAS Management Console window, click **Reset Pass**. Specify the user's new password and click **Change**. Resetting the password does not require that you know the user's current password. The user will be required to subsequently change the password before he can connect to the server.

You use the **Reset Pass** command to reset a user's password after a user has been disabled. Users can be disabled for excessive login failures or a login timeout.

ACL Manager

Overview of the ACL Manager

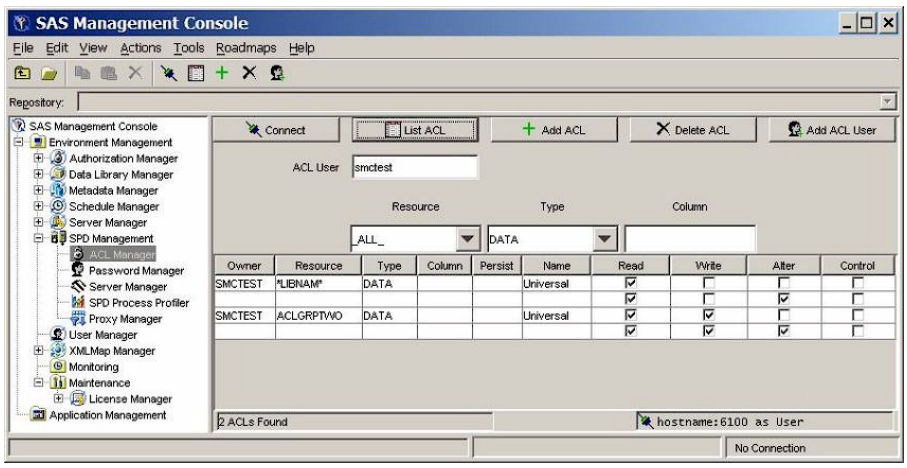
The ACL Manager's display area resembles the following display when no server connection exists:



You must connect to an SPD Server host machine before you can use the SPD Management utilities. The section "Connecting to an SPD Server " on page 73 provides detailed instructions on connecting to an SPD Server host.

Listing ACL Resources

Click **List ACL** in the ACL Manager of the SAS Management Console window to display the ACL resources that have been defined.



The ACL Manager display contains the following components:

Owner - the resource owner. This field cannot be changed directly. To change a resource owner, delete the resource and then add a new one.

Resource - the resource name. This field cannot be changed directly. To change a resource name, delete the resource and then add a new one.

Type - the type of resource (for example, DATA, CATALOG, VIEW, or MDDB). The **Type** field cannot be changed directly. To change the **Type** value, delete the current resource and then add a new one.

Column- the column name, if the resource is limited by a column constraint. The column name cannot be changed directly. To change the column name, delete the existing resource and then add a new one.

Persist - a Boolean flag. When set to Yes, **Persist** indicates that the ACL resource definition continues to exist if the referenced resource is deleted. When the **Persist** setting is left blank, the ACL resource definition is deleted when the referenced resource is deleted.

Name - name of a user or group to which the Read, Write, Alter, and Control permissions are applied for this resource. **Universal** represents the default setting for all unnamed groups or users.

Read - if selected, the specified user/group has permission to read this resource.

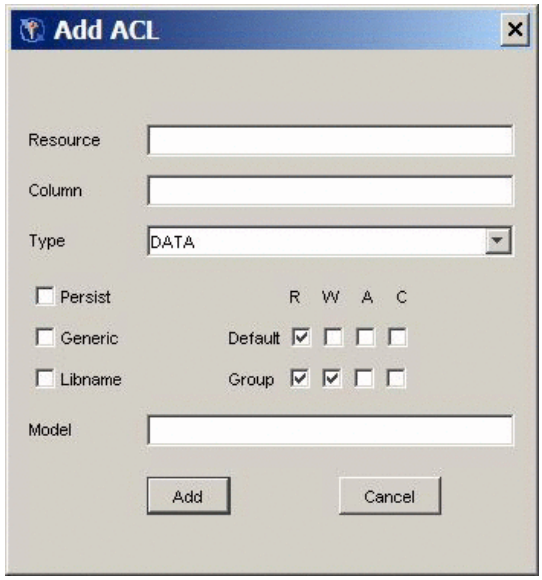
Write - if selected, the specified user/group has permission to write to this resource.

Alter - if selected, the specified user/group has permission to alter this resource.

Control - if selected, the specified user/group has permission to modify permissions of other users and groups associated with this resource.

Adding an ACL Resource

To add an ACL resource, click **Add ACL** in the ACL Manager of the SAS Management Console window, and then complete the values in the Add ACL window.



Resource - the name of the resource to add.

Column - the column restrictions for the resource to be added. If there are none, leave blank.

Type - the type of resource (for example, DATA, CATALOG, VIEW, or MDDB).

Persist a Boolean flag. When set to Yes, **Persist** indicates that the ACL resource definition continues to exist if the referenced resource is deleted. When the **Persist** setting is left blank, the ACL resource definition is deleted when the referenced resource is deleted.

Generic - select if the resource name is a generic name.

LIBNAME - select if the resource is a LIBNAME resource.

R, W, A, C - select the appropriate default and group permissions to grant Read, Write, Alter, and Control as appropriate.

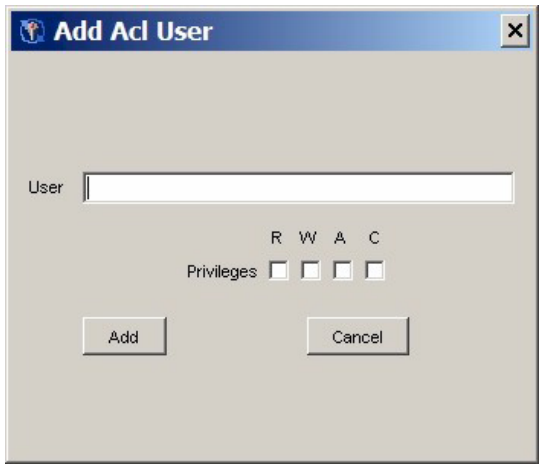
Model - specify the name of another existing ACL resource for this ACL resource to be modeled after.

Deleting an ACL Resource

To delete an ACL resource, select any row in the ACL resource table and click **Delete ACL**. The ACL resource is removed and the list is automatically updated.

Adding a User or Group to an ACL Resource

To add a user or group to an ACL resource, click **Add ACL User** in the ACL Manager. When the Add Acl User window opens, enter the **User** or group name, select the boxes that correspond to the default Read, Write, Alter, and Control permissions that you want to grant, and then click **Add**.



The user is added and the ACL listing is automatically updated. An individual user or group cannot be deleted from an ACL resource. To delete a user, delete the entire ACL resource, and then add it back in without the user.

Changing Resource Permissions

Each ACL resource has at least one set of permissions called universal permissions. Universal permissions are the default permissions for the ACL resource if no other permissions are applied. If any group or user names exist that have permissions for the ACL resource, they will be displayed.

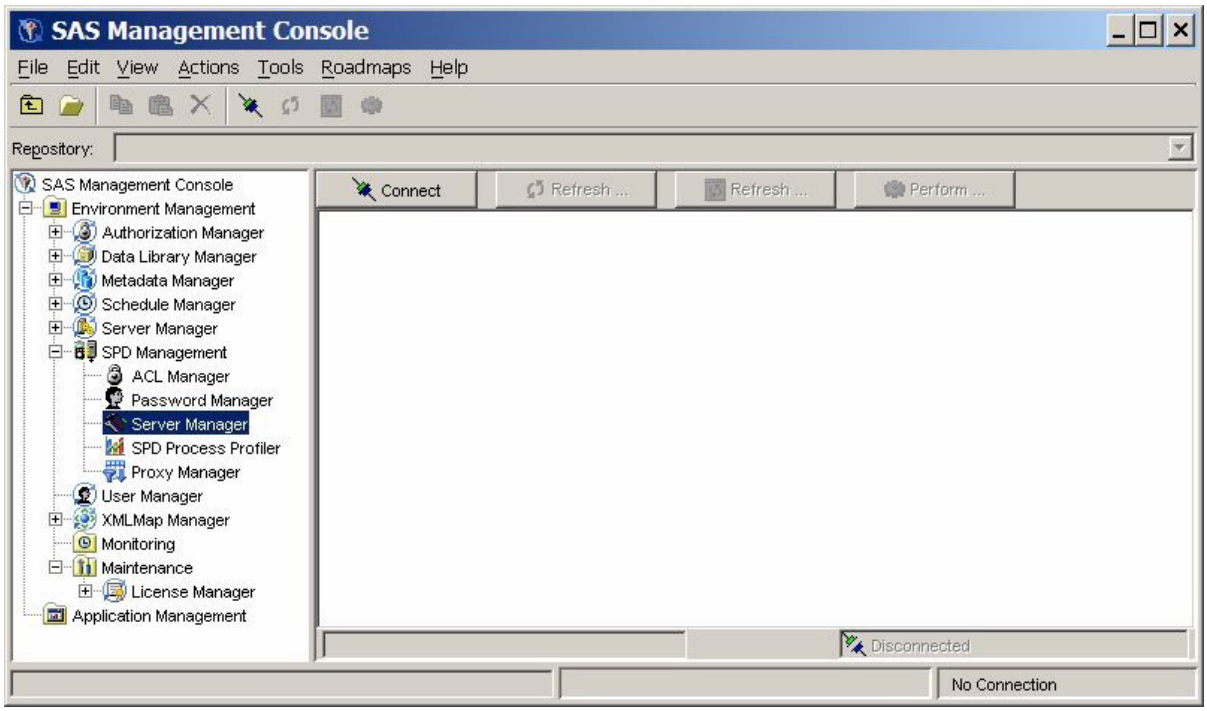
Each set of permissions has four attributes (Read, Write, Alter, Control). To enable the permission, simply select its box.

R, W, A, C - select the appropriate default and group permissions to grant Read, Write, Alter, and Control as appropriate.

Server Manager

Overview of the Server Manager

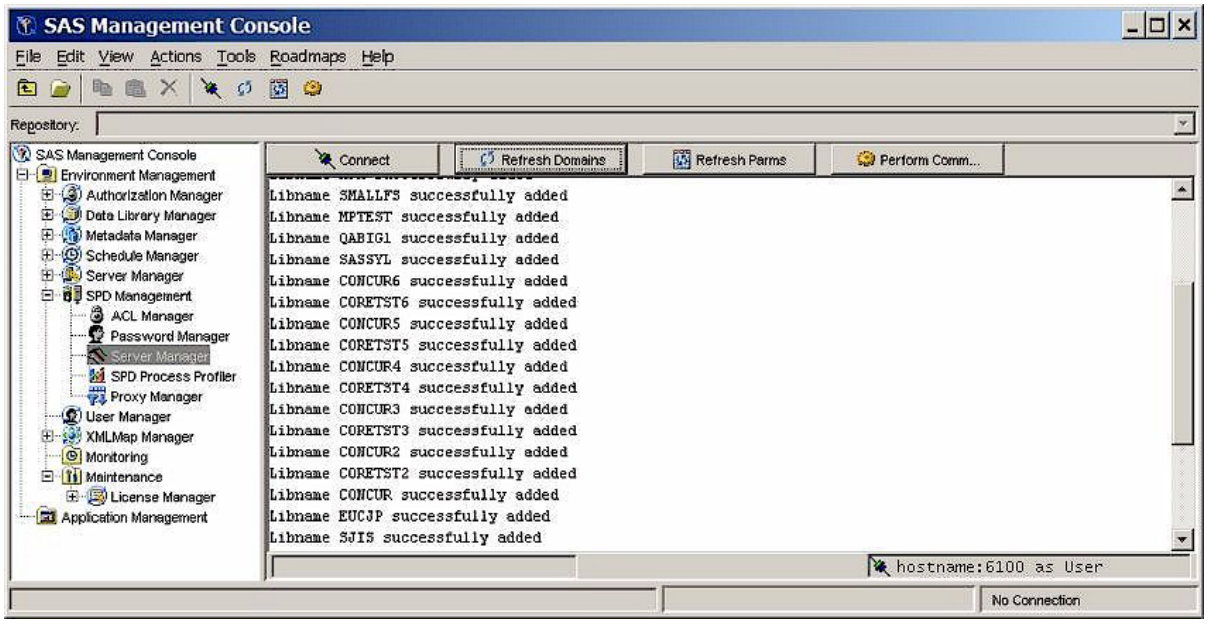
The **Server Manager** folder in the SPD Management utilities in the SAS Management Console window is used to refresh the server's configuration and to run selected SPD Server utilities.



You must connect to an SPD Server host machine before you can use the SPD Management utilities. For additional information, see "Connecting to an SPD Server " on page 73 provides detailed instructions on connecting to an SPD Server host.

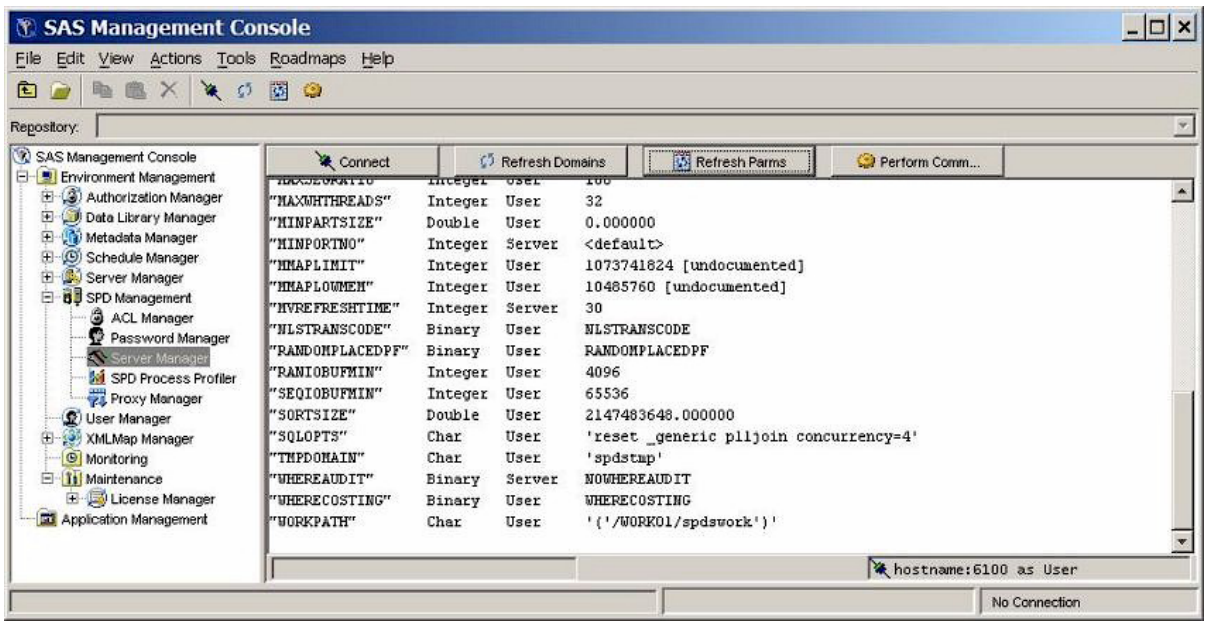
Refresh Domains

Click **Refresh Domains** in the Server Manager to reload the current libnames.parm file. The libnames.parm file describes the list of available domains.



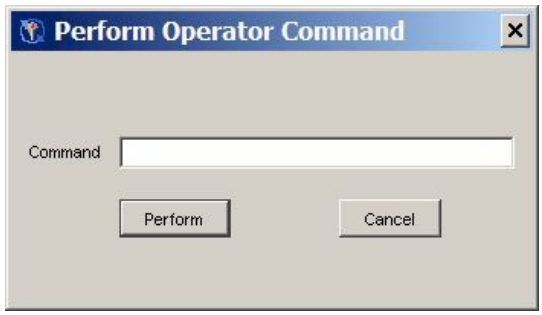
Refresh Parms

Click **Refresh Parms** in the Server Manager to reload the current **spdsserv.parm** file. The **spdsserv.parm** file controls server configuration and options.

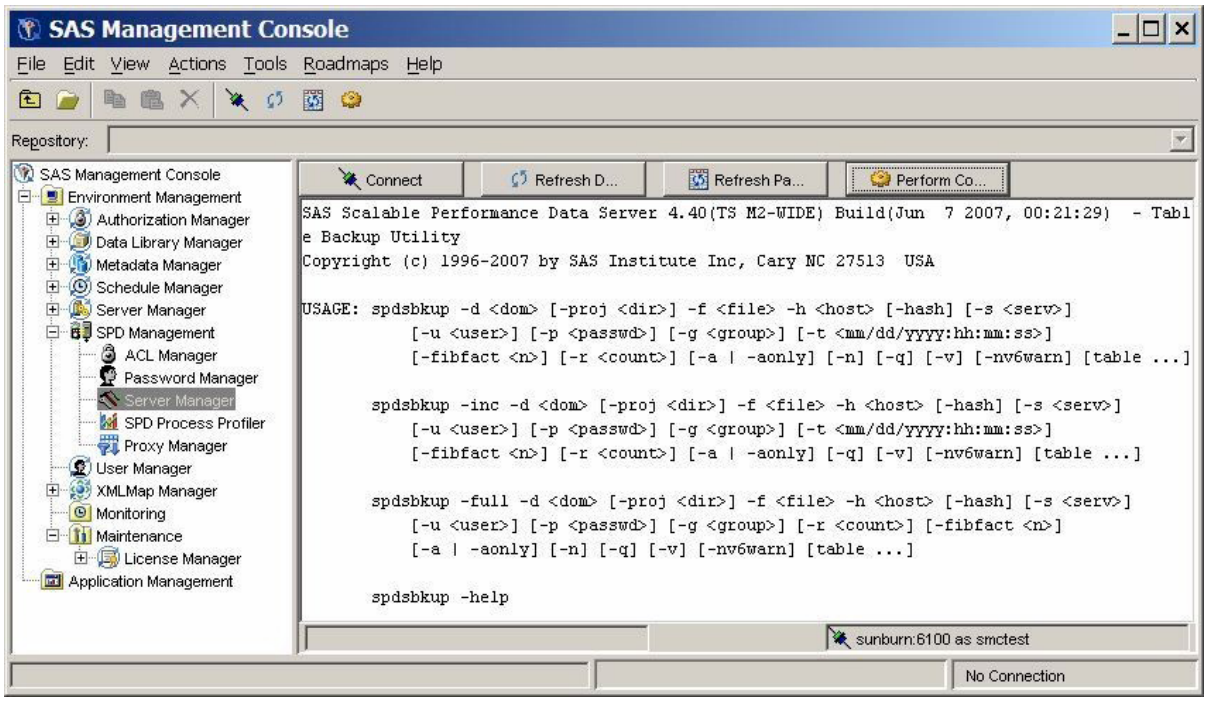


Perform Commands

To run an SPD Server operator command or utility function, click **Perform Command** in the Server Manager. Enter the command or utility in the window, and then click **Perform**.

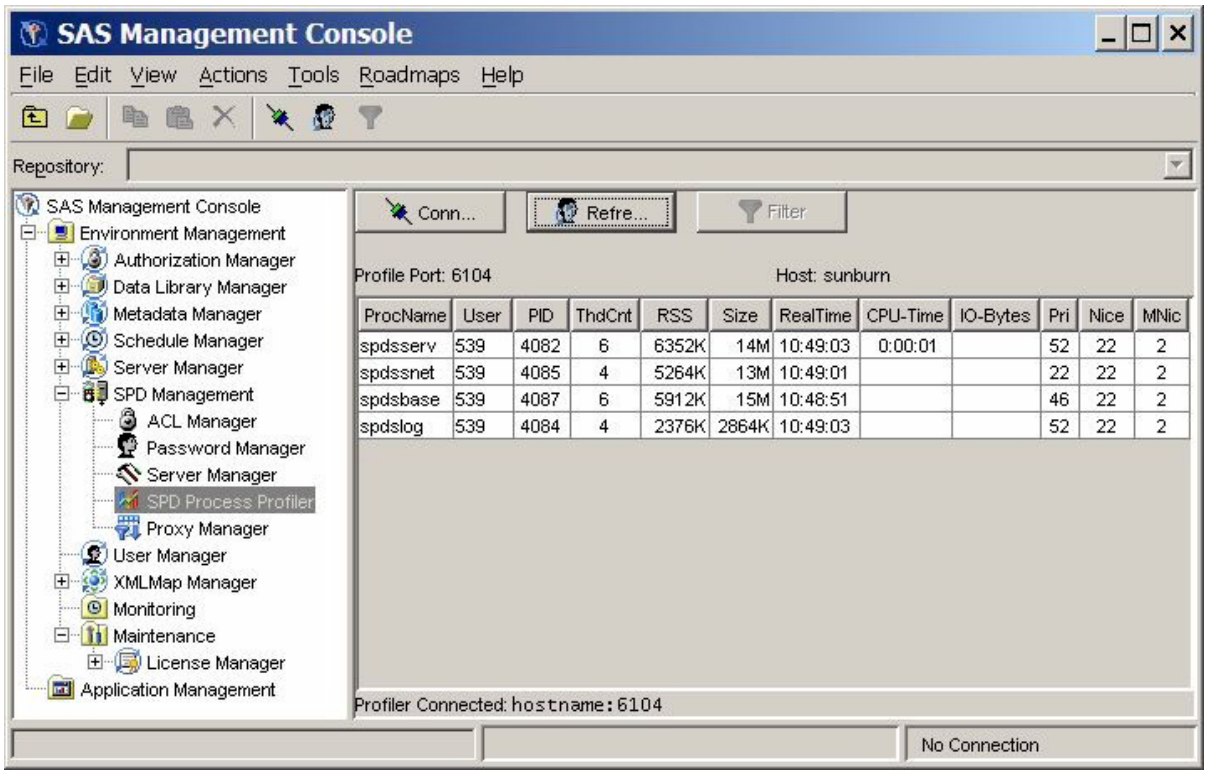


The following example below shows the Server Manager after using **Perform Command** to run a **spdsbkup** command:



SPD Process Profiler

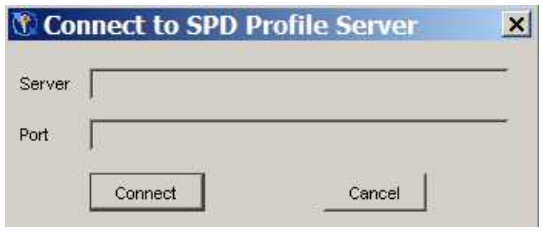
The **SPD Management** folder in SAS Management Console contains an SPD Process Profiler utility. Use the SPD Process Profiler to view server resources that are monitored by the SPD Server Performance Server.



The SPD Server Performance Server gathers SPD Server process performance information and distributes it across the SPD Management section of the SAS Management Console. The SPD Server process performance information consists of memory and resource allocations that are attributable to users and SPD Server processes that are spawned by an SPD Server Name Server. All SPD Server users must connect to an SPD Server Name Server before their SPD Server session can be spawned. Each SPD Server Name Server owns a dynamic family of subordinate SPD Server processes that are created and terminated by SPD Server users and jobs.

To access a server's process performance information, the SPD Server Performance Server application **spdsperf** must be running for the targeted SPD Server Name Server. SAS Management Console must be able to connect to the SPD Server Performance Server's listening port.

Like the other SPD Management utilities, you must first connect the SPD Process Profiler to the SPD Server Performance Server. Click **Connect** in the SPD Process Profiler to open the Connect to SPD Profile Server dialog box.



Enter your host name or server name, and the SPD Server Performance Server's listening port, and then click **Connect**. (The SPD Server Performance Server's listening port number is specified when you start the SPD Server Performance Server application.)

Once SAS Management Console is connected to the SPD Server Performance Server, the information that the Performance Server captures is displayed.

Note: Some host systems provide varying amounts of available resource information. Performance and resource information can vary from host to host.

The host performance profile information is automatically updated whenever the SPD Server Performance Server performs another capture. The frequency of the SPD Server Performance Server's information capture frequency is specified by the **-c**option when the SPD Server Performance Server is started. More information about Performance Server startup settings is available in the SPD Server Help chapter on "Setting Up SPD Server Performance Server " on page 141.

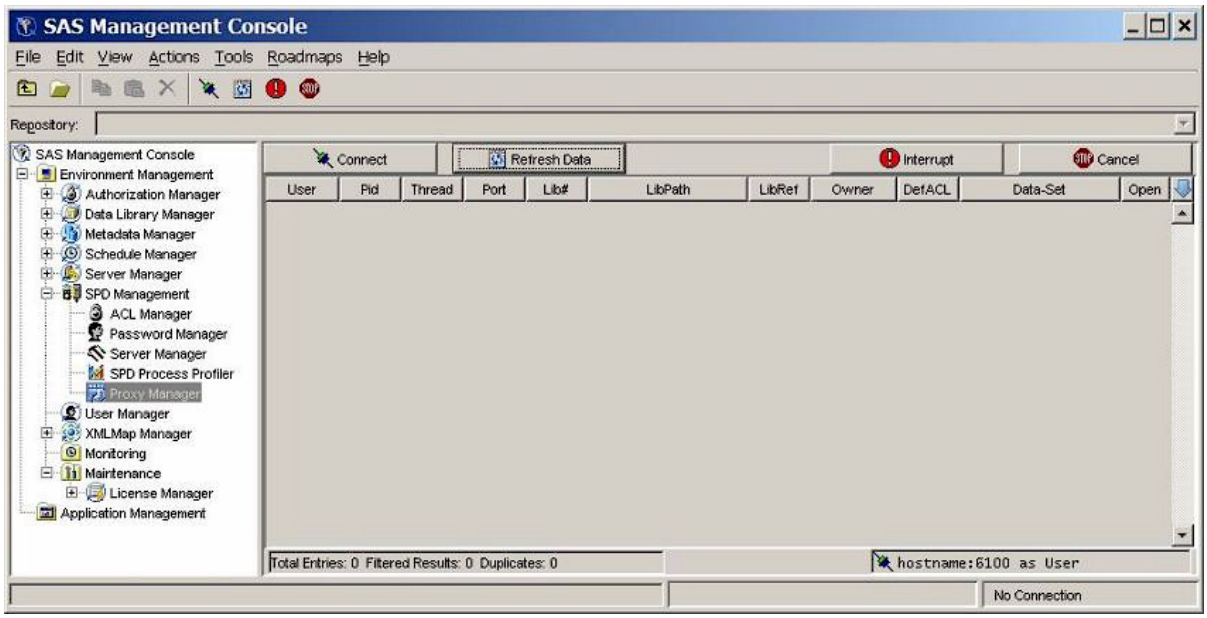
If the SAS Management Console user also connects to the same SPD Server Name Server via the ACL Manager, the Password Manager, or the Server Manager, the User information that is displayed will be the SPD Server user name that was used to connect with the LIBNAME statement. Otherwise, the user name of the user that started SPD Server and the component SPD Server processes is displayed.

Proxy Manager

Overview of the Proxy Manager

The SAS Management Console tree for SPD Server contains a folder called Proxy Manager. You use the Proxy Manager to display tables that list all users that access a specific SPD Server host. The current libref allocations are displayed for each user, as well as information about the proxy that serves each libref. Available proxy information includes the process ID, the port number, the library path, and if the libref was established with record locking, the thread ID. For each allocated libref, you can view every data set that is accessible to or open in the libref. If a libref was established with ACL special privileges, then all data sets in the specified domain are visible and accessible to that libref, regardless of any connection settings that are established through the SPD Management utilities in the SAS Management Console.

Before you can perform any operations in the Proxy Manager, you must be connected to an SPD Server host. The section "Connecting to an SPD Server " on page 73 provides detailed instructions on connecting to an SPD Server host. After you connect to an SPD Server host, click **Refresh Data** in the Proxy Manager to update the view on the table data.



You can filter, sort, reorder, and hide Proxy Manager table columns to display proxies of interest. You perform filtering and sorting by clicking on the column headings and selecting the appropriate choice from the menu.

Filtering can be specified for any number of the columns. Column filters offer three possible states:

- Show all values in the column.
- Show only the highlighted value or values in the column.
- Exclude the highlighted value or values in the column and show all others.

You can drag column headings to a new place in the table to reorder columns. To hide or reveal a column, use the blue down arrow located above the vertical scroll bar on the right side of the Proxy Manager.

Proxy Refresh

Click **Refresh Data** to update the table with the most current proxy data. Refreshing is necessary after an initial connection or after a proxy state has been manipulated. Because a proxy's state is dynamic, each refresh provides only an instantaneous snapshot of the proxies. Data status can change immediately after the data is refreshed, which is the nature of a dynamic client/server environment. If no users are currently logged on to the server, a window displays the message.

Proxy Interrupt

Click **Interrupt** to interrupt a selected libref's proxies. The proxy's activity is halted when it next processes data from its socket. The frequency with which the proxy accesses its socket is unpredictable and can vary depending on many variables, but the proxy interrupt operation is normally the first method used to halt a proxy from accessing a given data set or domain.

Proxy Cancel

Click **Cancel** to cancel all proxies in the selected libref. The proxy's activity is immediately halted, and any open data connections are immediately closed. Clicking **Cancel** to stop a proxy from accessing a data set or a given domain is recommended when the interrupt operation is unacceptably delayed.

Chapter 8

SPD Server SQL Query Rewrite Facility

Overview of the SQL Query Rewrite Facility

The SQL Query Rewrite facility in SPD Server examines SQL queries in order to optimize processing performance. Some SQL queries contain SQL statements and sub-queries that can be more rapidly evaluated in a separate space, as opposed to sequentially evaluating large blocks of SQL statements. When SPD Server detects and processes SQL statements or sub-queries in a separate space, intermediate result tables are produced. The original SQL query is dynamically rewritten, using intermediate results tables to replace the SQL code that was separately evaluated. The result is a dynamic process that evaluates and processes SQL queries more efficiently.

Inserting the derived intermediate data into the original SQL query does not change the quantitative results; it only expedites the processing that is required to calculate them. The SQL Query Rewrite Facility does not change the content of the query's answer row set. However, the order of the rows in the query answer set might vary if you compare the optimized query answer set with the query answer set SPD Server generates with the SQL Query Rewrite facility disabled.

Configuring Storage Space for the SQL Query Rewrite Facility

The SQL Query Rewrite Facility uses intermediate results tables to expedite original SQL queries. SPD Server administrators must provide adequate space for the generation and storage of the intermediate results tables. The intermediate results tables are formatted as SPD Server tables. Optional indexes are permitted.

Intermediate results tables are stored in a common SPD Server LIBNAME domain that the SPD Server administrator specifies. One dedicated SQL Rewrite Facility LIBNAME domain is sufficient to provide adequate intermediate results table storage for many

concurrent SPD Server users. Why is only one domain enough? The SQL Query Rewrite Facility uses the SPD Server TEMP=YES option setting when accessing the LIBNAME domain for intermediate result tables. The TEMP=YES option creates a processing environment where multiple SPD Server users can concurrently create tables with no name or resource contention issues. The TEMP=YES option also automatically cleans up the contents of the working storage area when users close their SPD Server session in a normal fashion.

SPD Server administrators and users can both specify LIBNAME domains for SQL Query Rewrite Facility intermediate results storage. SPD Server administrators can configure use the TMPDOMAIN= parameter in the spdsserv.parm file to specify the SQL Query Rewrite Facility intermediate results storage domain:

```
TMPDOMAIN=<DomainName>;
```

where <DomainName> is the name of a LIBNAME domain that is defined in the SPD Servers associated libnames.parm file.

SPD Server users can override the primary TMPDOMAIN= location by specifying their own LIBNAME domain for SQL Query Rewrite Facility intermediate results storage. Users specify their own LIBNAME domain by using the pass-through SQL RESET command with the TMPDOMAIN= option. For example, if an individual SPD Server user wanted to use the EMATMP LIBNAME domain for SQL Rewrite Facility intermediate results, the user would submit the following RESET command in his or her SQL job stream:

```
execute(reset tmpdomain=ematmp) by sasspds;
```

Setting TMPDOMAIN=EMATMP causes the EMATMP domain to take precedence over the TMPDOMAIN= setting that was specified in the spdsserv.parm file. Any LIBNAME domain that that an individual user submits as an SQL Query Rewrite storage location must be defined in the libnames.parm file of the SPD server that runs the pass-through SQL code.

Reassigning the SQL Query Rewrite Facility intermediate results storage location does not affect TMP=YES environment setting that permits concurrent access to tables in the domain by multiple SPD Server users. This means that multiple SPD Server users can specify and share remapped TMPDOMAIN= locations without table handling or contention issues.

Note: If the SPD Server parameter TMPDOMAIN is not configured and the SQL query rewrite is enabled, the query rewrite will fail with the following error:

```
SPDS_ERROR: Error materializing RWE context.
```

SQL Query Rewrite Facility Options

The SQL Query Rewrite Facility is enabled by default in SPD Server. That means when an SPD Server user submits SQL statements that contain sub-expressions that SPD Server can handle more efficiently by using the SQL Query Rewrite Facility, the software will optimize the SQL query. RESET options provide control over the SQL Query Rewrite Facility.

_QRWENABLE Option:

Use the _QRWENABLE reset option to disable the SQL Query Rewrite Facility. You might use this option if you suspect that the SQL Query Rewrite Facility is not enhancing

the performance of the SQL query execution. The SQL Query Rewrite Facility is enabled by default.

Examples:

Disable SQL Query Rewrite Facility:

```
execute(reset no_qrwenable) by sasspds; /* Disable query rewrite */
execute(reset _qrwenable=0) by sasspds; /* Another way to disable */
```

Re-enable SQL Query Rewrite Facility:

```
execute(reset _qrwenable) by sasspds; /* Re-enable query rewrite */
execute(reset _qrwenable=1) by sasspds; /* Another way to enable */
```

_QRW Option:

Use the _QRW reset option to enable diagnostic debugging and tracing outputs from the SQL Query Rewrite Facility in the log. The diagnostic debugging option is disabled by default.

Examples:

Enable diagnostic debugging function:

```
execute(reset _qrw) by sasspds; /* Enable diagnostics */
execute(reset _qrw=1) by sasspds; /* Another way to enable */
```

Disable diagnostic debugging function:

```
execute(reset no_qrw) by sasspds; /* Disable diagnostics */
execute(reset _qrw=0) by sasspds; /* Another way to disable */
```

Chapter 9

Using SPD Server With Other Clients

Overview

This chapter describes using SPD Server to connect with ODBC, JDBC, htmSQL, and SQL C API clients.

Scalable Performance Data Server provides ODBC, JDBC, htmSQL, and SQL C API access to SPD Server data stores from all supported platforms.

SPD Server can read tables exported from Base SAS software using PROC COPY, and, with the proper drivers installed on the network, allows queries on the tables from client machines that do not have SAS software.

There are four possible options:

- **ODBC:** Open Database Connectivity - This is an interface standard that provides a common interface for accessing databases. Many software applications running in a Windows environment are compliant with this standard and can access data created by other software. This is a good choice if you have client machines running Windows applications, such as Microsoft Excel or Microsoft Access.
- **JDBC:** Java Database Connectivity - This option allows users with browsers to log on to a Web page and make a query. The results of the request are formatted and returned to a Web page. This makes information available across a wide range of client platforms because all you need, after installing the JDBC driver on SPD Server, is a Web page with some Java code, and a client machine with a Java-enabled browser.
- **htmSQL:** HyperText Markup Structured Query Language - This option allows users with browsers to log on to a Web page and make a query. The results of the request are formatted and returned to a Web page. This makes information available across a wide range of client platforms. Why? After installing the htmSQL driver in SPD Server, all you need is an htmSQL Web page and a client machine with a browser.
- **SQL C API:**This option allows access to SPD Server tables from SQL statements generated by C/C++ language applications. This access is provided in the form of a C-language run-time access library. This library provides a set of functions that you can use to write custom applications to process SPD Server tables and to generate new ones. This library is designed to support multi-threaded applications and is available on all supported SPD Server platforms.

Note: GUI interfaces might not display all return codes or error messages that the server generates.

Using Open Database Connectivity (ODBC) to Access SPD Server Tables

Read this section if you do not have Base SAS software on the network client, but you want to access SPD Server tables on the network, using an ODBC compliant program, such as Microsoft Word, Query, Excel, or Access, and you have SPD Server tables available for use, somewhere on the network, or Scalable Performance Data Servers and SPD SNET servers running, or client machines in a Windows environment.

Why Use ODBC?

You have SPD Server tables available on your network, and one or more of the following might be true:

- You do not have Base SAS software running on the Windows client, but you need to view or change SPD Server tables.
- You need to view or change the SPD Server tables using a Microsoft spreadsheet, database or word processor.
- You need to view or change SPD Server tables in ways that cannot be predetermined or programmed into a Web page.

- You need to view or change SPD Server tables using Windows tools you are familiar with.

Installing OBDC Drivers on the Server

Instructions for installing the OBDC driver are included in the download package.

Configuring ODBC on the Client

1. Configure an ODBC data source.
2. Make your query using a Windows program.

Figure 9.1 *Configure ODBC to Connect SPD Server Client to SPD Server Host*

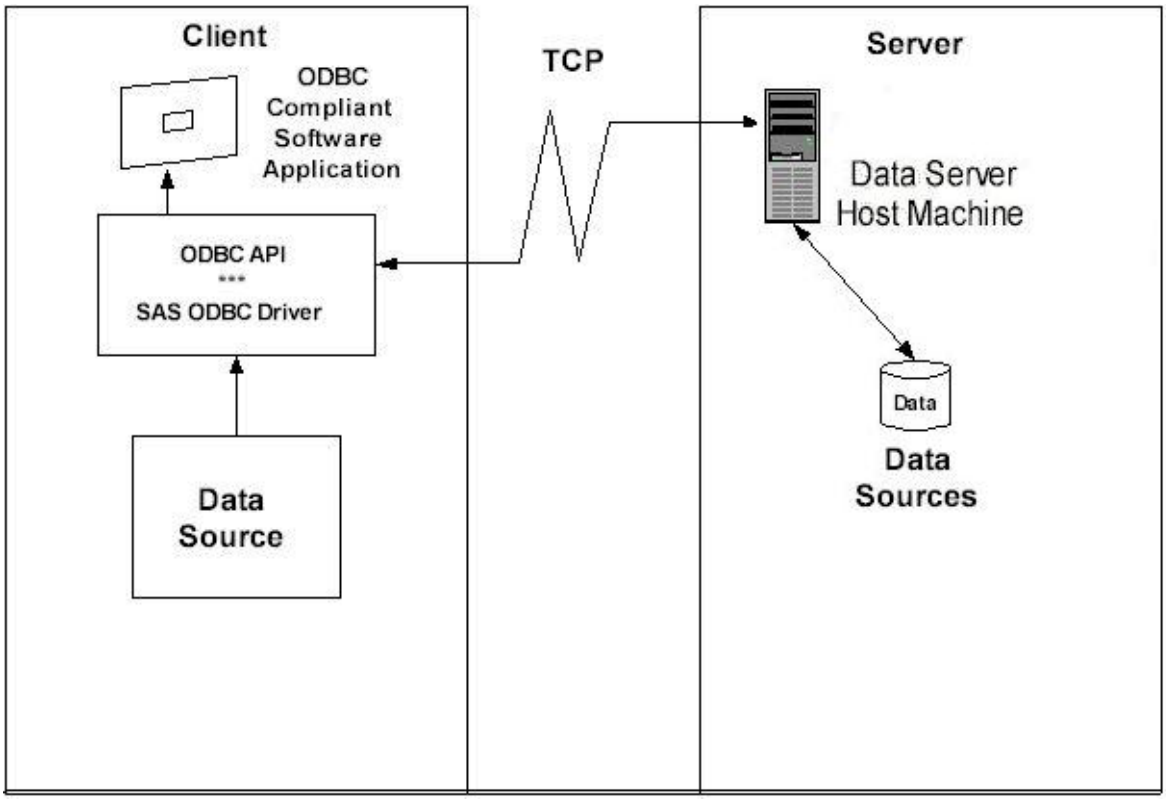
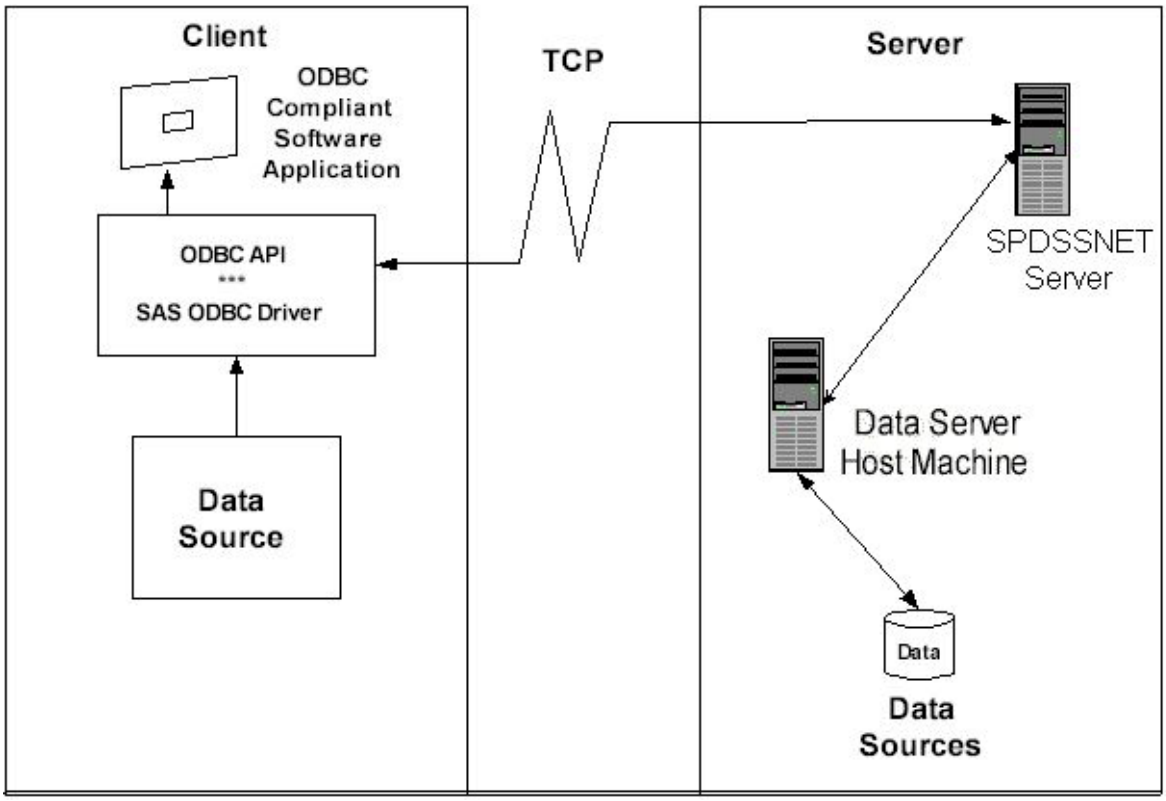


Figure 9.2 *Configure ODBC to Connect SPD Server Client to SPD SNET Server*



Preparing your Client Machine for ODBC Installation

Before you create OBDC data sources driver, you'll need the following information from your network administrator:

- a User Name and Password that is defined by an SPD Server administrator
- the primary LIBNAME domain of the SPD Server (also called the DBQ)
- the port number of the SPD name server (also called the SERV)
- the machine name or IP address of the SPD Server Name Server (also called the HOST)
- any secondary LIBNAME domains you want to assign to the ODBC connection.

Two Types of ODBC Connections

With SPD Server software you can connect directly to an SPD Server without going through the SPD SNET server. Although connecting directly is the preferred method, connections via the SPD SNET server are still supported.

Note that connections via the SPD SNET server are not supported in the SAS 9 ODBC Driver software. If you intend to connect via the SPD SNET Server you must install the SAS 8 ODBC Driver.

Primary and Secondary LIBNAME Domains

When a connection to the SPD server is established a primary LIBNAME domain is assigned. The primary LIBNAME domain is specified by the "DBQ" connection options parameter. Immediately after the connection is made the SAS ODBC Driver assigns the secondary LIBNAME domains which are configured through the Libraries tab of the SAS ODBC Driver Configuration window.

ODBC Connections via the SPD SNET server must have an **odbc.parm** file configured on the SPD SNET Server machine.

Configuring an ODBC Data Source to Connect Directly to an SPD Server

Once the SAS ODBC driver is installed, you will need to configure your ODBC data source. When you open the ODBC manager, you'll get a display screen that allows you to enter information that points the OBDC driver to the data on the SPD Server.

1. From the Windows Start button, select **Start** ⇨ **Settings** ⇨ **Control Panel**
2. Locate the ODBC Data Sources icon and open the Microsoft ODBC Data Source Administrator . The exact location of this program depends on your version of Windows.
3. Select the Add button, then select the SAS ODBC driver.
4. Enter a data source name (and description if desired.)
5. Select the Servers panel and type in your two-part server name.
6. Click on the Configure box. The TCP Options window appears:
   - **Server Address:** Enter the network address of the machine on which the SPD Server is running.
   - **Server User Name:** Enter the user name as configured for a DBQ (SPD Server primary LIBNAME domain) on the SPD Server to which you will connect.
   - **Server User Password:** Enter the user password as configured for a DBQ (SPD Server primary LIBNAME domain) on the SPD Server host to which you will connect.
   - **Connection Options:** Enter the Connection Options as follows:
     - **DBQ='SPD Server primary LIBNAME domain',**this is the SPD Server LIBNAME domain
     - **HOST='name server node name',**this is the location of the host computer
     - **SERV='name server port number',**this is the port number of the SPD Server name server running on the HOST.
     - Any other SPD Server LIBNAME options. For more information, see the User's Guide section on LIBNAME Options.
7. Click OK. Then, click Add, and select the Libraries panel.
8. Enter the DBQ name of a secondary LIBNAME domain in both the Name and Host File text fields.
9. Enter "spdseng" in the Engine text field.

10. Use SQL Pass-Through syntax rules for libref statements when you enter a value in the Options text field.

Configuring an ODBC Data Source for SPD SNET

Once the SAS ODBC driver is installed, you will need to configure your ODBC data source. When you open the ODBC manager, you'll get a display screen that allows you to enter information that points the OBDC driver to the data on the SPD Server.

1. From the Windows Start button, select **Start Settings Control Panel**.
2. Click on the ODBC icon and select the Add button.
3. Select the SAS ODBC driver.
4. Enter a data source name (and description if desired).
5. Select the Servers panel and type in the two-part server name. The second part of the server name should match the entry in the services file. In the example that follows that shows you how to edit the services file, the server name is **spdssnet**.
6. Click on the Configure box. The TCP Options window appears with four input fields that you fill:
   - **Server Address:** Enter the network address of the machine on which the SPD SNET server is running.
   - **Server User Name:** Enter the user name as configured for a DBQ (SPD Server primary LIBNAME domain) on the SPD Server to which you will connect.
   - **Server User Password:** Enter the user password as configured for a DBQ (SPD Server primary LIBNAME domain) on the SPD Server host to which you will connect.
   - **Connection Options:** Enter the connection options as follows:
     - **DBQ='SPD Server primary LIBNAME domain':**this is the SPD Server LIBNAME domain.
     - **HOST='name server node name':**this is the location of the host computer.
     - **SERV='name server port number':**this is the port number of the SPD Server name server running on the HOST.
7. Click OK, and then click Add.

Editing the Services File on Your Machine - ODBC Details

Editing the Services file is required only for ODBC connections via the SPD SNET Server.

1. Find the Services file on your Windows machine. In Windows, the Services file is usually located in `c:\windows\services`.
2. Open the Services file using a text editor.
3. The services file contains four columns. The rows of information can be sorted in port number order. Find the closest port number to the SPD Server port number, which you obtained from the network administrator. See "Preparing your Client Machine for ODBC Installation" on page 96). This is where you insert the new information.
4. Add an entry to the Services file, on its own line, in proper numeric order, using the following syntax:

Table 9.1 *How to Add Service Name and Port Number to the Services File*

column1 <service name>	column2 <port number & protocol>	column3 <aliases>	column4 <comment>
spdssnet	nnnn/tcp	not required	not required
spdssnet=name	nnnn=port number		
assigned to server	protocol is always /tcp		

Remember: The service name, **spdssnet** must match the server name that you used in step 6 of "Configuring an ODBC Data Source for SPD SNET" on page 98. The port number must match the port number on which the SPD SNET server is running.

Creating a Query Using an ODBC-Compliant Program

The following instructions create a query using Microsoft Access.

1. Start the SPD SNET server.
2. Start Microsoft Access.
3. From the Microsoft Access main menu, select **File** ⇨ **Get External Table** .
4. Select **Link Table**.
5. Select **Files of Type**.
6. Select **ODBC Databases**.
7. Select the data source.

Using JDBC (Java) to Access SPD Server Tables

Read this information if you do not have Base SAS software on the network client, but you want to use the power of the Java programming language to query SPD Server tables from any client on the network that has a browser. You must have SPD Server tables on the network and SPD Server and SPD SNET servers running on the same server as the Web server in order to use JDBC to access SPD Server tables.

Why Would I Want to Use JDBC?

You might want to use JDBC if you have SPD Server tables available on your network and one or more of the following is true:

- You do not have Base SAS software on the network client to process the data sets.
- You want to distribute the information across your corporate intranet through a Web page.
- The clients on your network are varied: UNIX boxes, Windows PCs, and workstations. One thing they might have in common is browser access to your intranet.

- The audience for the information understands Web browsing and wants point-and-click access to the information.
- You want to distribute the information over the World Wide Web.
- Your planned application requires the power of the Java programming language.

How Is JDBC Set Up on the Server?

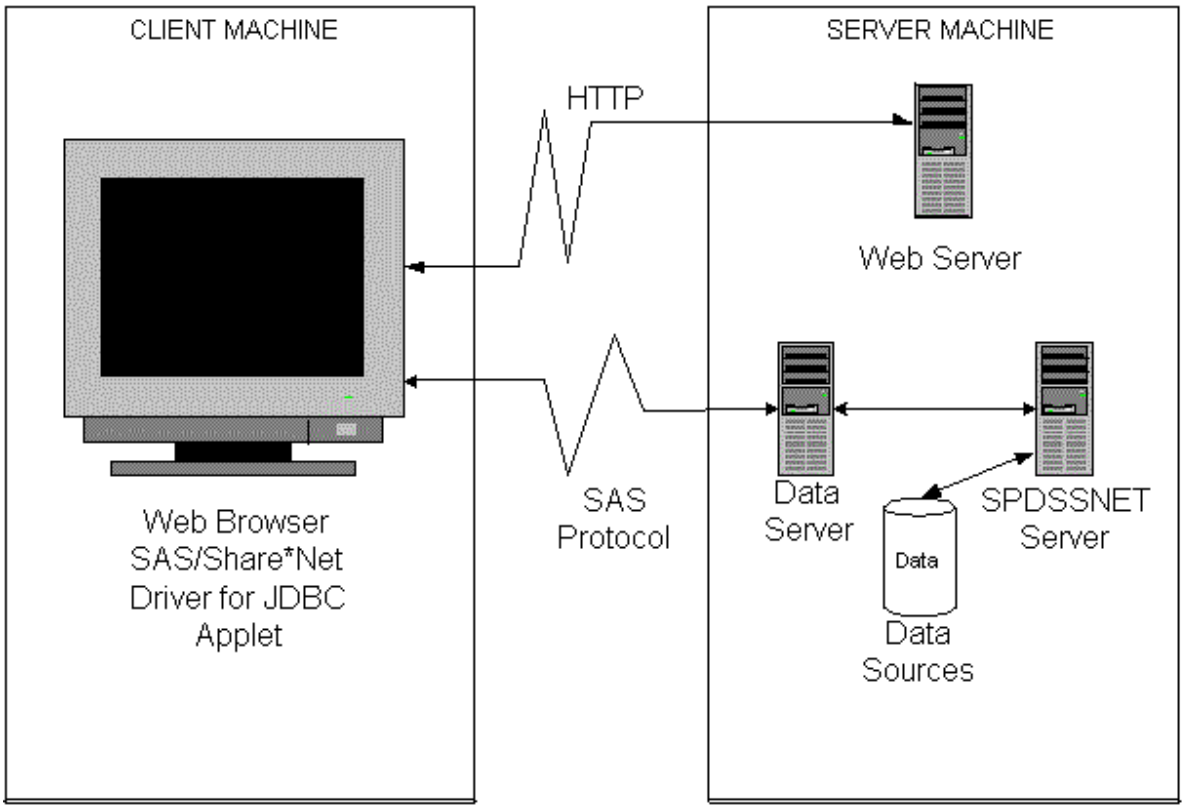
JDBC is usually set up on the server at the time the SPD Server is installed. The process is covered in the SPD Server installation manual.

How Is JDBC Set Up on the Client?

The client needs a browser set up to accept Java applets, such as

- Netscape Navigator, Release 3.0 or later
- Microsoft Internet Explorer, Release 3.02 or later.

Figure 9.3 *JDBC Set Up on an SPD Server Client*



How Do I Use JDBC to Make a Query?

1. Log on to the World Wide Web and enter the URL for the Web page that contains the JDBC code.
2. Click on the desired information.

3. JDBC handles the request, formats the information, and returns the result to the Web page.

JDBC Code Examples and Tips

The following lines must be a part of the HTML file for JDBC:

```
<applet code="CLASSPATH.*.class codebase="../ width=600 height=425>
<param name=url value="jdbc:sharenet://spdssnet_node:PORT">
<param name="dbms_options" value=DBQ='libname' HOST='host_node' SERV='NNNN'>
<param name="spdsuser" value="userid">
<param name="sharePassword" value="thepassword">
<param name="shareRelease" value="V9">
<param name="dbms" value="spds">
</applet>
```

Line 1:

- **CLASSPATH** points to the class path set up where the JDBC driver is installed.
- ***.class** is the name of the Java class that consumes all of the <PARAM name=...> lines.

Line 2:

- **spdssnet_node** is the node name of the machine on which the SPD SNET server is running.
- PORT=port number of the machine on which the SPD SNET server is running.

Line 3:

- **value=DBQ='libname'** is the LIBNAME domain of the SPD Server.
- **HOST='host_node'** is the location of the SPD SNET server.
- **SERV='NNNN'** is the port number of the name server.

Line 4:

- **spdsuser** value=**user ID** is the user ID that queries the SPD Server table.

Line 5:

- **sharePassword** value=**the password** is the password of the user ID that will make the query.

Line 6:

- **shareRelease** value=V9 is the version of the driver you are using. This must not be altered.

Line 7:

- Sets the foreign database property on the JDBC driver. This means that the server is not SAS and JDBC should not create a DataBaseMetaData object. See the examples below for how to get around this.

Limitations of Using JDBC with the SPD Server

JDBC Used with SAS Versus JDBC Used with the SPD Server

SPD Server is treated as a foreign database. SPD Server clients can't query the JDBC metadata class for available tables and other metadata. Users must write their own queries to do this.

Example JDBC Query for Getting a List of Tables

(JDBC Used with the SPD Server)

```
SELECT '' AS qual,
LIBNAME AS owner,
MEMNAME AS name,
MEMTYPE AS type,
MEMNAME AS remarks FROM dictionary.tables AS tbl
WHERE ( memtype = 'DATA' OR memtype = 'VIEW' OR memtype = 'SYSTEM TABLE' OR
        memtype = 'ALIAS' OR memtype = 'SYNONYM')
AND (tbl.libname NE 'MAPS' AND tbl.libname NE 'SASUSER' AND tbl.libname NE 'SASHELP')
ORDER BY type, qual, owner, name
```

Example JDBC Query for Getting Metadata about a Specific Table

(Your data file)

```
SELECT '' AS qual,
LIBNAME AS owner,
MEMNAME AS tname, name,
length AS datatype,
type || ' ',
length AS prec,length,
length AS scale, length AS radix, length AS nullable,label,
FORMAT FROM dictionary.columns AS tbl
WHERE memname = 'your data file'
AND (tbl.libname NE 'MAPS'
     AND tbl.libname NE 'SASUSER'
     AND tbl.libname NE 'SASHELP')
```

Using htmSQL to Access SPD Server Tables

Read this section if you do not have Base SAS software on the network client, but you want to use the point-and-click convenience of a Web page to query SPD Server tables from any browser-enabled client on the network. You must have SPD Server tables available for use, htmSQL loaded and configured on a UNIX or Windows operating system, and Scalable Performance Data Servers and SPD SNET servers running.

Why Would I Want to Use htmSQL?

You might want to use htmSQL if you have SPD Server tables available on your network and one or more of the following is true:

- You do not have Base SAS software on the network client to process the data sets.

- You want to distribute the information across your corporate intranet through a Web page.
- The clients on your network are varied: UNIX boxes, Windows PCs, and workstations. One thing they might have in common is browser access to your intranet.
- The audience for the information understands Web browsing and wants point-and-click access to the data.
- You would like to use the JDBC option to extract the information but cannot permit Java applets to run on your network browsers.
- You want to distribute the information over the World Wide Web.
- Your developers are familiar with SQL and HTML.

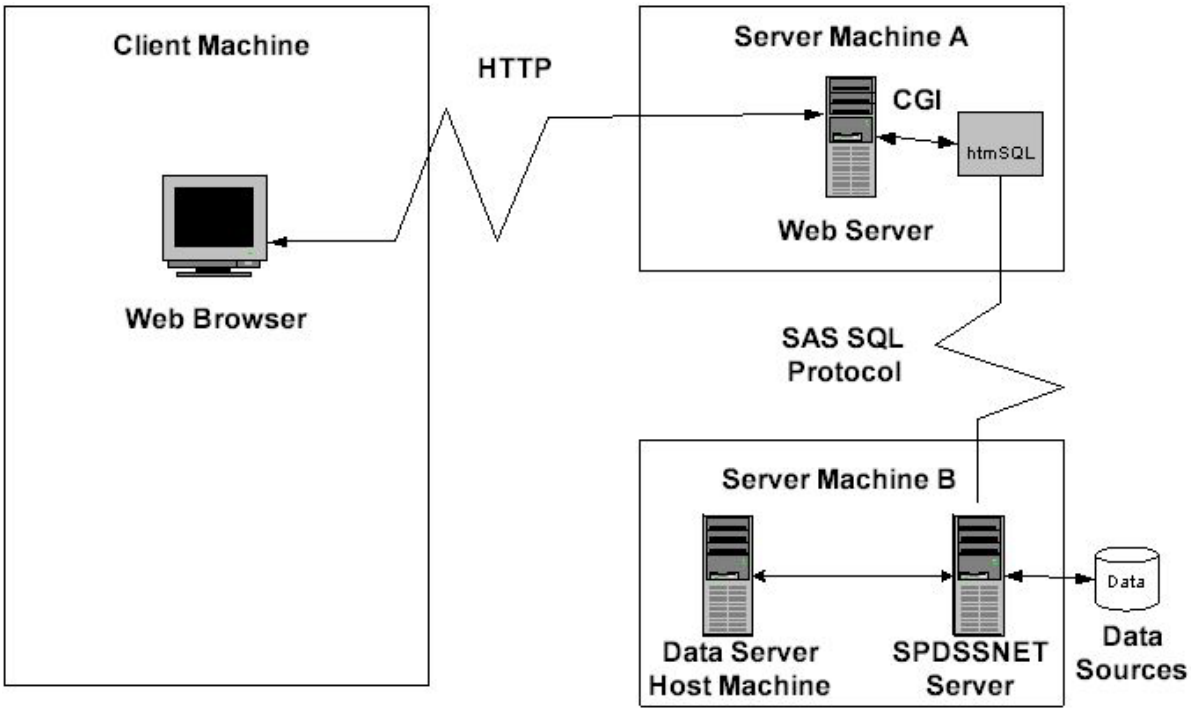
How Is htmSQL Set Up on the Server?

- htmSQL is usually set up on the server at the time the SPD Server is installed. The process is covered in the SPD Server installation manual.
- htmSQL must be installed on the Web server and you need the name of a data source that points to the SPD SNET server and to the specific LIBNAME domain that contains the SPD Server data you are interested in.

How Is htmSQL Set Up on the Client?

HtmSQL requires nothing more than a browser on the network or Web client.

Figure 9.4 *htmSQL Configured on an SPD Server Client*



How Do I Use htmSQL to Make a Query?

1. Log on to the World Wide Web and enter the URL for the Web page that contains the htmSQL code.
2. Click on the desired information.
3. htmSQL handles the request, formats the information, and returns the result to the Web page.

Examples of Setting Up an htmSQL Web Page

SAS Institute maintains a Web site that explains the technical details of setting up htmSQL Web pages. In some cases, there are references to the SAS/SHARE product. The rules for setting up htmSQL for either the SPD Server or SAS/SHARE are virtually the same.

The SAS Institute Web page for htmSQL is **http://support.sas.com/rnd/web/intrnet/htmSQL/index_admin.htm**

Using SQL C API to Access SPD Server Tables

Read this section if you do not have Base SAS software on the network client but you want to provide your network client machines with the capability of accessing SPD Server tables, using SQL query methods. You must have SPD Server tables available for use, SPD Servers and SPD SNET servers running, and Network client machines capable of running C/C++ programs.

Why Would I Want to Use SQL C API?

You have SPD Server tables available on your network and one or more of the following might be true:

- You do not have Base SAS software on the network client to process the data sets.
- You want to distribute the information across your corporate intranet.
- The clients on your network are varied: UNIX boxes, Windows PCs, workstations. One thing they might have in common is the ability to run C/C++ programs.
- Your developers are familiar with SQL and C/C++.

The chapter "SPD Server SQL Access Library API Reference" in the *SPD Server User's Guide* contains additional information about SQL C API.

Chapter 10

Configuring Disk Storage for SPD Server

Introduction

This section discusses how to manage very large SPD Server data stores. Read this topic if you manage large SPD Server data files that consume gigabytes of disk storage.

How you configure SPD Server disk storage is important, whether you have many SPD Server users or a just a few large-scale users. In order to effectively configure SPD Server disk storage for your installation, you need to understand the four types of component files that SPD Server creates, the relative sizes of the component files, and when the component files are created.

SPD Server Component File Types and Sizes

SPD Server uses four types of component files. Component files are physical file entities that SPD Server uses to track table and index metadata. Component files, when combined, form a logical structure that SPD Server understands and interprets as a single table. The relative sizes of the four types of SPD Server component files are:

```
File Type            File extension     Relative size      Number of
                                                        component files
-------------------------------------------------------------------------
```

Table Metadata	.mdf	Very small	1
Table Data	.dpf	Large	1 to many
Segmented Index(es)	.idx	Medium to Large	0 or more
Global Index(es)	.hbx	Medium to Large	0 or more

Creating SPD Server Component Files

Which Component Files Are Created for SPD Server Tables?

At a minimum, an SPD Server table consists of two component files, the metadata **.mdf** file and the data **.dpf** file. The size of the data file component depends on two factors: the size of a table column and the number of columns.

The data **.dpf** component file can be many gigabytes in size. SPD Server is not constrained by an operating system file system size limit. (Many readers are familiar with the 2-gigabyte limit on file size that some UNIX systems impose.)

Which Component Files Are Created for Indexes on SPD Server Tables?

The SPD Server index uses two index component files: the **.hbx** file and the **.idx** file. The **.hbx** file maintains a global view of the index, and contains an entry for each key that exists in the index. The **.idx** file maintains a segmented view of the index that includes a list of all of the segments that each key is a member of. A bitmap is used to determine the per-segment observations for each key.

The size of the **.hbx** file depends on the cardinality of the index keys. The higher the cardinality of the index keys, the larger the **.hbx** file. The size of the **.idx** file is much more difficult to determine because it depends on how the data for the index keys is distributed across segments. An index key that is in many segments will require a larger segment list, and larger segment lists require a larger number of per-segment bitmaps, as compared to an index key that is found only in a small number of segments.

The best case scenario for creating an optimally sized **.idx** file occurs when the table is sorted by the indexed columns, in order to minimize the number of segments that the key is in. The worst case scenario for creating an optimally sized **.idx** file occurs when the index keys are in a large number of segments, with a low cardinality of rows for each segment.

Configuring LIBNAME Domain Disk Space

The SPD Server system administrator defines the primary file system for each LIBNAME domain for the SPD Server user base. If desired, the system administrator can choose to define initial and overflow storage locations for the **.dpf** data component files as well as the two index component (**.hbx** and **.idx**) files.

Example 1: Primary File System Storage for All Component Files

The primary file system is the base directory that you assign to the LIBNAME domain by issuing a PATHNAME= statement in the SPD Server LIBNAME parameter file, **libnames.parm**. Here is an example of a **libnames.parm** parameter file entry:

```
spdsserv -acl
   -acldir InstallDir/site
   -nameserver samson
   -libnamefile libnames.parm
```

The following is an example of a **libnames.parm** file entry for a UNIX system:

```
libname=all_users pathname=/disk1/peruser_tables;
```

The following is an example of a **libnames.parm** file entry for Windows:

```
libname=all_users pathname=d:\peruser_tables;
```

When SPD Server users create new tables in a LIBNAME domain, there is a hidden system detail to consider. The metadata component (**.mdf**) must start in the primary file system. This detail is very important. If all of the available space in the primary file system is consumed, SPD Server cannot create new tables until disk space becomes available.

Example 1 stores all the component files: metadata, data and index data in the primary file system. This can present a problem if you use large tables. Large tables can quickly fill up the primary file system.

We recommend storing the data and index components separately from the primary file system. Example 2 shows how to do this using ROPTIONS= with your LIBNAME statement in your libnames.parm file.

Example 2: Using ROPTIONS= to Store SPD Server Table Data and Index Component Files in Other File Systems

The following SPD Server code invokes the **libnames.parm** file:

```
spdsserv -acl
   -acldir InstallDir/site
   -nameserver samson
   -libnamefile libnames.parm
```

Sample libnames.parm for a UNIX System

```
libname=all_users pathname=/disk1/peruser_tables
   roptions="datapath=('/disk2/userdata' '/disk3/userdata'
                       '/disk12/userdata' '/disk13/userdata')
   indexpath=('/disk4/userindexes' '/disk5/userindexes'
              '/disk14/userindexes' '/disk15/userindexes')";
```

Sample libnames.parm for a Windows System

```
libname=all_users pathname=d:\peruser_tables
   roptions="datapath=('e:\userdata' 'f:\userdata')
      indexpath=('g:\userindexes' 'h:\userindexes')";
```

In Example 2, the PATHNAME= directory stores metadata files for SPD Server tables in the 'all_users' LIBNAME domain. The initial and overflow stores for the data and index files are directed to other file systems. In Example 2, users who create large tables will not quickly exhaust the primary file system. The reason: the primary file system is reserved for only very small metadata files. The larger data and index files will be stored in the other file systems specified with the DATAPATH= and INDEXPATH= options in the LIBNAME parameter file.

Example 3: Adding More File Systems to a Path Option When Its File System Is Full

```
spdsserv -acl
   -acldir InstallDir/site
   -nameserver samson
   -libnamefile libnames.parm
```

Sample libnames.parm for a UNIX System

```
libname=all_users pathname=/disk1/peruser_tables
   roptions="datapath=('/disk2/userdata' '/disk3/userdata'
                       '/disk12/userdata' '/disk13/userdata')
   indexpath=('/disk4/userindexes' '/disk5/userindexes'
              '/disk14/userindexes' '/disk15/userindexes')";
```

Sample libnames.parm for a Windows System

```
libname=all_users
pathname=d:\peruser_tables
   roptions="datapath=('e:\userdata'
                       'f:\userdata'
                       'i:\userdata')
   indexpath=('g:\userindexes'
              'h:\userindexes'
              'j:\userindexes')";
```

In Example 3, SAS users can continue to create more SPD Server tables, as long as space is available for the metadata files in the primary file system. When the primary file system is exhausted, you might try to expand storage for the **.mdf** components by adding the METAPATH= specification to your ROPTIONS= value in your LIBNAME parameter file. Unfortunately, this will not solve your problem. Remember the SPD Server restriction mentioned earlier: all **.mdf** components must have their initial partition file created in the primary file system (the directory that was first specified by the PATHNAME= option for the LIBNAME domain).

To solve your problem, your only recourse in this situation is to create a new LIBNAME domain.

Recommended: Use ROPTIONS=

Here is why you should use ROPTIONS= instead of OPTIONS= in your libnames.parm file.

ROPTIONS= specifications override any corresponding options that your SAS users include in their programs. Example 3 demonstrates explicit control of disk usage by the system administrator. In the example, even if SAS users specify file systems using LIBNAME DATAPATH= and INDEXPATH= LIBNAME options during their LIBNAME connection, the administrator's use of DATAPATH= and INDEXPATH= with ROPTIONS= overrides the SAS users' specifications.

In contrast, when you (the administrator) use OPTIONS=, a keyword that is syntactically the same as ROPTIONS=, you are not overriding a user specification. Instead, you are supplementing the user-specified options. In this case, if a user specifies an option, the user's setting is implemented. If the user omits an option, your OPTIONS= specification in the libnames.parm file is used.

System Administration recommendation: Do not specify DATAPATH=, INDEXPATH=, and METAPATH= with OPTIONS=. If you use OPTIONS=, the disk allocation results cannot be predicted. Instead, use ROPTIONS= to explicitly control disk usage at your site.

Chapter 11

Setting Up SPD Server Parameter Files

Introduction

The **spdssrv** command, which starts an SPD Server host, requires a parameter file that is named **spdsserv.parm**. You specify the name of the **spdsserv.parm** file with the **-parmfile** command-line option.

Syntax for the -PARMFILE Option

The syntax for the **-parmfile** option is:

```
-parmfile file-spec
```

file-spec is an explicit file path for the SPD Server parameter file. The spdsserv.parm file is required because it maintains options that control the SPD Server processing behavior and use of server resources. If you do not specify your SPD Server parameter file with the **-parmfile** option, SPD Server assumes that **spdsserv.parm** is located in the current working directory.

Syntax for the spdsserv.parm Options

The syntax for **spdsserv.parm** file options is:

```
Option[ = Value] ;
```

Value is option dependent. All option keywords are case sensitive and must be capitalized. Comments are not allowed in the SPD Server parameter file. Any value that is a memory size is stated in bytes and can support an "m" or "M" suffix to specify megabytes, or a "g" or "G" suffix to specify gigabytes.

Examples of SPD Server parameter files are located in **`InstallDir/samples/spsdsserv.parm`**. These examples contain the recommended default settings for SPD Server. **`InstallDir`** is a placeholder for the path to the root directory of your SPD Server installation.

spdsserv.parm Options

BINBUFSIZE=

controls the amount of memory that is used for each bin buffer during sorting. Each bin is equal to the value that is specified for SORTSIZE. When the sort operation overflows a single sort bin, SPD Server writes the contents of the bin to disk and then merges the bin contents to produce the final, sorted results. This option sets the size of the I/O buffer that must be used to read each bin.

Usage

```
BINBUFSIZE= <bin-buffer-size> ;
```

Note: If you specify a value that is smaller than the record length of the sort bin, a bin buffer large enough to hold one record is created automatically.

FMTDOMAIN=

specifies a user defined format. The FMTDOMAIN= option specifies the domain where the user defined format is stored. To use user defined formats, you must create a domain that is named FORMATS. FMTDOMAIN= is used with FMTNAMENODE= and FMTNAMEPORT=.

Usage

```
FMTDOMAIN=FORMATS ;
```

FMTNAMENODE=

specifies a user defined format. The FMTNAMENODE= option specifies the server on which the user defined formats are stored. FMTNAMENODE= is used with FMTDOMAIN= and FMTNAMEPORT=.

Usage

```
FMTNAMENODE=d8488 ;
```

FMTNAMEPORT=

specifies a user defined format. The FMTNAMEPORT= option specifies the port number of the server on which the user defined formats are stored. FMTNAMEPORT= is used with FMTDOMAIN= and FMTNAMENODE=.

Usage

```
FMTNAMEPORT=5400 ;
```

GRPBYROWCACHE=

specifies the maximum amount of memory threads that are used during parallel group aggregations. The parallel group SELECT statement uses multiple threads up to the MAXWHTHREADS= limit to perform parallel group aggregations. The threads equally

share the memory that is specified using GRPBYROWCACHE to cache groups in memory; each thread receives 1/MAXWHTHREADS= of the cache.

Once a thread accumulates enough distinct groups to fill its cache, the groups are moved to secondary bins. At the completion of the parallel GROUP BY, the parallel group aggregations in memory and secondary bins are merged to produce the final sorted results. If the GRPBYROWCACHE option is not specified, the default value is a 2 megabyte cache per thread. Increasing the default value can result in improved aggregation performance with large numbers of groups. The trade-off is potentially allocating more memory than is needed for caching, which diminishes the available resources for processing by the excess amount of assigned memory.

Usage

```
GRPBYROWCACHE= <memory-cache-size> ;
```

IDLE_TIMEOUT=

specifies the interval of idle time that is permitted before the SPD Server client process automatically terminates the client connection. When IDLE_TIMEOUT= is specified as a value that is greater than 0, the option is enabled. If the value is less than or equal to 0, SPD Server does not enable idle timeouts. The default value is 0.

Usage

```
IDLE_TIMEOUT= <timeout_seconds> ;
```

INDEX_MAXMEMORY=

affects Read operations on SPD Server tables. The specified value restricts the amount of memory to allocate for each open index.

Usage

```
INDEX_MAXMEMORY= <maximum-allocated-index-memory> ;
```

INDEX_SORTSIZE=

controls the amount of memory to allocate for asynchronous (parallel) sort index creation or appends. The specified value is divided by the number (n) of indexes to be created or appended in parallel; each receives 1/nth of the memory allocation.

Usage

```
INDEX_SORTSIZE= <allocated-async-sort-index-memory> ;
```

LDAPSERVER=

specifies the network IP address or the host machine for the LDAP server. This is usually the same value as the IP address of the SPD Server host. The default value for LDAPSERVER= is the IP address of the SPD Server host.

Usage

```
LDAPSERVER=<ldap_server_host_ip> <LDAP-Server-IP-address-or-LDAP-Server-name>;
```

LDAPPORT=

specifies the TCP/IP port that is used to communicate with the LDAP server. The default value is LOCAL_HOST or port 389.

Usage

```
LDAPPORT=<ldap_server_tcpip_port_number> <port-number-or-port-name> ;
```

LDAPBINDMETH=

indicates the LDAP authentication security level. The default value for LDAPBINDMETH= is ANONYMOUS. The ANONYMOUS value is not recommended for use with secure environments. The following are valid LDAPBINDMETH= values:

- LDAP_AUTH_SIMPLE - The SPD Server user password is sent to the LDAP server in clear-text.
- LDAP_AUTH_SASL (UNIX platforms only) - SPD Server user authentication is performed via the SASL using the Digest-MD5 mechanism.
- LDAP_AUTH_NEGOTIATE (Windows platforms only) - The most appropriate authentication method is chosen from a list of available methods on both the SPD Server and LDAP server machines. Note that LDAP_AUTH_NEGOTIATE is not guaranteed to be secure.

Usage

```
LDAPBINDMETH=<LDAP_SERVER_BINDMETH_STRING> <LDAP-bind-method-string> ;
```

LDAPBINDDN=

specifies the Relative Distinguished Name (RDN) or the location in the LDAP server database where the information for the connecting client is stored. The SPD Server administrator can obtain RDN strings from the LDAP server administrator when the SPD Server is being configured to use LDAP authentication.

Usage

```
LDAPBINDDN=<ldap_server_binddn_string> <RDN-string> ;
```

MINPORTNO=/MAXPORTNO=

specifies a range of port numbers that can be used by the SPD Server user proxy processes to communicate with the client. You must set both the MINPORTNO= and the MAXPORTNO= option. This option is provided to support the use of SPD Server ports through an Internet firewall, in order to limit the range of ports that will be used by the server. If MINPORTNO= and MAXPORTNO= are not specified, then the SPD Server user proxy processes use any port that is available to communicate with the client.

Usage

```
MINPORTNO=<ldap_server_binddn_string> <lower-port-range-number> ; MAXPORTNO= <upper-port
```

MAXGENNUM=

specifies the maximum number of member tables that can be created within an SPD Server cluster table.

Usage

```
MAXGENNUM=<ldap_server_binddn_string> <maximum-number-of-member-tables> ;
```

MAXSEGRATIO=

controls segment candidate pre-evaluation for WHERE clause predicates with a hybrid index. The WHERE clause planner pre-evaluates the segment candidates for the predicate. Only the segment candidates are searched to resolve the WHERE clause. Some queries can benefit from no pre-evaluation, based on the ratio of the number of segments containing candidates, to the total number of segments in the file. If the percentage of possible segments exceeds the specified value, pre-evaluation is not performed and all of the segments are searched to resolve the WHERE clause. If a value is not specified, the default value is 75 percent.

Usage

```
MAXSEGRATIO=<ldap_server_binddn_string> <maximum-ratio-of-segment-candidates-to-segments
```

MAXWHTHREADS=

specifies the number of parallel threads to launch for a WHERE clause evaluation.

Usage

```
MAXWHRTHREADS=<ldap_server_binddn_string> <maximum-number-of-parallel-threads> ;
```

MINPARTSIZE=

ensures that large SPD Server tables cannot be created with arbitrarily small partition size. Large SPD Server tables with small partition sizes create an excessive number of physical files, which increases clutter and degrades I/O performance. The default value for MINPARTSIZE= is 16 MB. The most common values for the MINPARTSIZE parameter range from 128 MB to 256 MB.

Usage

```
MINPARTSIZE=<ldap_server_binddn_string> <minimum-partition-size> ;
```

[NO]BYINDEX

Controls whether to use an index for a BY-sort. The default is NOBYINDEX, which does not allow use of the index. The [NO]BYINDEX server parameter is used only when the SPDSNBIX= macro is set to NO (default value).

Usage

```
BYINDEX ; NOBYINDEX ;
```

[NO]COREFILE

controls whether the LIBNAME proxy creates a core file in the event of an unexpected process trap. The default value is NOCOREFILE.

Usage

```
COREFILE ; NOCOREFILE ;
```

[NO]LDAP

turns SPD Server LDAP user authentication on or off. If the LDAP option is found or set during SPD Server start-up, then the SPD Server host creates a context for LDAP user authentication.

Usage

```
LDAP ;

NOLDAP;
```

[NO]NLSTRANSCODE

enables or suppresses the server-side SPD Server NLS processing. The default value for NLSTRANSCODE is NONLSTRANSCODE if the option is not found in the spdsserv.parm file. The default **spdsserv.parm** file for SPD Server does not contain the NLSTRANSCODE option. Users must explicitly activate server-side transcoding in SPD Server 4.5.

Usage

```
NLSTRANSCODE ;

NONLSTRANSCODE ;
```

When NONLSTRANSCODE is specified, SPD Server treats all character column data as 8-bit raw bytes internally, regardless of the table's specified character set encoding (CEI). SPD Server 4.5 (with SAS 9) performs normal server-side processing of tables, ignoring the CEI of the table. SAS 9.2, however, will read the CEI value of the table and performs transcoding for any pertinent character data in the rows returned from SPD Server.

When NLSTRANSCODE is specified, SPD Server reads the table's CEI value and the CEI value of the associated SAS 9.2 session. SPD Server does not perform transcoding if these values are the same. If the CEI values are different, SPD Server restricts the types of WHERE clause predicates that are permitted in indexed lookups, and SPD Server ensures that data is returned to SAS 9.2 using the same encoding that the SAS 9.2 session uses.

[NO]WHERECOSTING

controls whether to use dynamic WHERE costing. The default value is NOWHERECOSTING. When dynamic WHERE costing is not enabled, SPD Server uses the rules-based heuristic WHINIT.

Usage

```
WHERECOSTING ;
NOWHERECOSTING ;
```

RANDOMPLACEDPF

invokes random placement of the initial data partition for all tables in a domain. The random placement strategy manages large tables efficiently and balances data loads without losing disk space. RANDOMPLACEDPF is enabled by default. To disable

RANDOMPLACEDPF in SPD Server 4.5, include a NORANDOMPLACEDPF statement in your **spdsserv.parm** file.

Usage

```
RANDOMPLACEDPF;
```

RANIOBUFMIN=

specifies the minimum random I/O buffer size. The specified value becomes the minimum I/O buffer size that is used by the proxy when it performs random I/O and table requests.

Usage

```
RANIOBUFMIN=<ldap_server_binddn_string> <minimum-random-i/o-buffer-size> ;
```

SEQIOBUFMIN=

specifies the minimum sequential I/O buffer size. The specified value specified becomes the minimum I/O buffer size that is used by the proxy when it performs sequential I/O and table requests.

Usage

```
SEQIOBUFMIN=<ldap_server_binddn_string> <minimum-sequential-i/o-buffer-size> ;
```

SORTSIZE

controls the amount of memory to allocate for sort operations. A larger value for this option can increase the paging activity for a file and degrade performance.

Usage

```
SORTSIZE=<ldap_server_binddn_string> <memory-allocated-for-sort-operations> ;
```

SQLOPTS=

overrides SQL default options for each SQL connect when it is specified on an SQL RESET command. If SQLOPTS= is not specified, SQL default options apply. See the SQL RESET command for possible RESET options you can set.

Usage

```
SQLOPTS= "RESET <SQL-option> [ <SQL-option>]" ;
```

TMPDOMAIN=

specifies an SPD Server domain that is defined in the libnames.parm file, which the query rewrite facility uses to store intermediate tables.

Usage

```
...
libname=qrw pathname=/IDX1/spdsmgr/spds45_sasdqh/qrw ;
...
TMPDOMAIN=qrw ;
```

WORKPATH=

specifies the LIBNAME proxy path for work files. If you think that the work files might overflow a single file system, you can specify multiple paths. When specifying multiple paths, enclose the complete path statement in double quotation marks.

Usage

```
WORKPATH=<ldap_server_binddn_string> "('DirPath1' 'DirPath2' ...)";
```

SPD Server Parameter File Configurations for LDAP

LDAP Server That Is Running on an SPD Server Host

For this configuration, assume that all other LDAP settings use the default configuration. To run an LDAP server on the SPD Server host, add the LDAP option to your SPD Server parameter file. User authentication is performed by the LDAP server, running at port LOCAL_HOST, on the SPD Server host.

LDAP Server Running on SPD Server Host Using Port Other Than LOCAL_HOST

For this configuration, assume that all other LDAP settings use the default configuration, and that you want to perform LDAP user authentication where the LDAP server is using a port number that is different from the port assigned to LOCAL_HOST. To run an LDAP server on the SPD Server host using a port assignment other than LOCAL_HOST, add the LDAP option and the LDAPPORT= port specification to your SPD Server parameter file.

LDAP Server and SPD Server Host That Are Running On Different Machines

For this configuration, assume that you want to perform LDAP user authentication, but the LDAP server and the SPD Server hosts are on different machines.

To run an LDAP server and the SPD Server hosts on different machines, add the LDAP option and the LDAPSERVER= specification (such as <host.domain.company.com>) to your SPD Server parameter file. LDAP user authentication occurs where the LDAP server is running at port LOCAL_HOST on host.domain.company.com.

The default SPD Server LDAP authentication mechanism is ANONYMOUS. ANONYMOUS LDAP authentication is not secure. When the SPD Server and LDAP server hosts are on different machines, use the SASL Digest-MD5 mechanism for secure authentication. To use SASL Digest-MD5 secure authentication, add the statement LDAPBINDMETH=LDAP_AUTH_SASL to your SPD Server parameter file.

SPD Server User IDs and Passwords That Are Not In Their Default Location in the LDAP Database

For this configuration, assume that you want to perform LDAP user authentication, but the SPD Server user IDs and passwords are not in their default locations in the LDAP database. Assume that all other LDAP settings use the default configuration.

First, add the LDAP option and the LDAPBINDDN= specification, where the LDAPBINDDN= property setting is ou=people, dc=domain, dc=company, dc=com. Adding this option and specification results in LDAP user authentication, where the LDAP server is running at port LOCAL_HOST on the SPD Server host machine. The LDAP server looks for SPD Server users at the location that corresponds to ou=people, dc=domain, dc=company, dc=com in its database.

SPD Server User IDs and Passwords That Are Not In Their Default Location in the LDAP Database and in the LDAP Server That Is Using TCPIP_PORT

For this configuration, assume that you want to perform LDAP user authentication, the SPD Server User IDs and Passwords are located at ou=people, dc=domain, dc=company, dc=com in the LDAP database, and the LDAP server is using the port TCPIP_PORT.

First, add the LDAP option and set the LDAPPORT= port specification to TCPIP_PORT in your SPD Server parameter file. Then, add the LDAPBINDDN= specification, where the LDAPBINDDN= property setting is ou=people, dc=domain, dc=company, dc=com.

User authentication is performed where the LDAP server is running at port TCPIP_PORT on the SPD Server host machine. The LDAP server looks for SPD Server users at the location that corresponds to ou=people, dc=domain, dc=company, dc=com in its database.

SPD Server Parameter File Configurations for Auditing

[NO]WHEREAUDIT

Enables audit logs for WHERE clauses that are submitted to SPD Server. The SPD Server administrator specifies the WHEREAUDIT option in the spdsserv.parm file. Unless this option is specified in the **spdsserv.parm** file, WHEREAUDIT is not enabled. The **spdslog** message logger logs messages, and the **spdsaud** audit logger logs audits. If you use the WHEREAUDIT option, both the **spdslog** log file and the **spdsaud** log file will contain WHERE statement information.

Usage:

```
WHEREAUDIT;

NOWHEREAUDIT;
```

The -WHEREAUDIT option enables audit logging for the server, and automatic audit log file creation by spdsaud. filespec specifies a partial pathname or filename specification that is used to generate the complete audit filename. For example, if you specified filespec as **`/audit/spds`**, the generated filename would appear as follows:

```
/audit/spds_mmddyyyy.spdsaudit
```

where mmddyyyy is taken from the system date when the audit log file is created.

WHAUDLEN=

Specifies the maximum size of the WHERE clause in the audit log when proxy auditing is enabled in SPD Server, and when the WHEREAUDIT option is specified.

Usage:

```
WHAUDLEN=<maximum-number-of-characters-in-WHERE-clause>
```

The default value for WHAUDLEN is 512 characters. The maximum value for WHAUDLEN is 4,096 characters.

SQLAUDLEN=

Specifies the maximum size of the SQL statement in the audit log when proxy auditing is enabled in SPD Server, and when the WHEREAUDIT option is specified.

Usage:

```
SQLAUDLEN=<maximum-number-of-characters-in-SQL-statement>
```

The default value for SQLAUDLEN is 1,024 characters. The maximum value for SQLAUDLEN is 4,096 characters.

Chapter 12

Setting Up SPD Server Libname Parameter Files

Introduction

On start-up, the SPD Server server reads the information stored in the **libnames.parm** file. The **libnames.parm** file establishes the names and file storage locations of SPD Server domains during the server session. SPD Server administrators can use the

libnames.parm file as a central tool to control SPD Server domain resources and user access to SPD Server domains.

Domain Naming Syntax for Libnames.parm

To define an SPD Server domain in the **libnames.parm** file, you must define the domain as a LIBNAME and define the path that points to the directory where data files for the domain are stored.

```
LIBNAME=domain-name PATHNAME=primary-metadata-path
<optional specifications>
   OPTIONS="option-1 <...option-n>"
   ROPTIONS="option-1 <...option-n>"
   OWNER=owner-id
   LIBACLINHERIT=<YES/NO>
   DYNLOCK=<YES/NO> ;
```

The domain name that is associated with the LIBNAME must follow standard SAS LIBNAME nomenclature rules. The PATHNAME= specification defines the computing path that will contain the metadata tables that are associated with the domain. By default, the PATHNAME= specification also will contain the data tables, index tables, and intermediate tables that the domain creates. SPD Server administrators and users can use "Domain Path Options" on page 124 to enhance computational performance by specifying separate paths for domain data, index, and work tables. All SPD Server domain names must be unique. Different SPD Server domains should never share the same domain path.

Examples of simple **libnames.parm** file domain declarations follow:

```
LIBNAME=spds123 PATHNAME=c:\data\spds123;

LIBNAME=123spds PATHNAME=c:\data\123spds;

LIBNAME=_under PATHNAME=c:\data\_under;

LIBNAME=under_ PATHNAME=c:\data\under_;
```

The **libnames.parm** file is the preferred method to declare domains for use in SPD Server. Users can connect to domains by submitting SAS code to SPD Server after a session has started. The example SAS code below connects to the first domain that was declared previously:

```
LIBNAME spds123 sasspds 'spds123'
  server=d8488.5200
  user='anonymous';
```

Domain Path Options

Overview of Data Path Options

You can specify optional path parameters for a domain in **libnames.parm** libref statements.

SPD Server domain optional path parameters are specified using either standard option statements or using reserved option statements. The difference between non-reserved and reserved option statements is that non-reserved option statements can be altered by subsequent libref statements that are submitted to SPD Server via SAS code.

Use the roption (reserved option) specification to ensure that the domain options that you declare in **libnames.parm** cannot be modified by subsequent libref statements submitted to SPD Server via SAS code.

All options specified in libnames.parm files must be either standard options or reserved options (roptions). You cannot specify a combination of reserved and non-reserved options in the **libnames.parm** file.

The syntax you use to specify optional path parameters in the libnames.parm file is identical for options and roptions:

```
LIBNAME=domain-name PATHNAME=primary-metadata-path ;
     OPTIONS="<option-1 ... option-n>";

LIBNAME=domain-name PATHNAME=primary-metadata-path ;
     ROPTIONS="<option-1 ... option-n>";
```

The following are LIBNAME domain path options for SPD Server:

DATAPATH=

Specifies a list of paths that will contain SPD Server data tables associated with the declared domain. DATAPATH= can be specified as an option or as a roption.

Usage:

```
DATAPATH=('/data1/spds123'
          '/data2/spds123'
          '/data3/spds123'
          '/data4/spds123')
```

INDEXPATH=

Specifies a list of paths that will contain SPD Server index tables associated with the declared domain. INDEXPATH= can be specified as an option or as a roption.

Usage:

```
INDEXPATH=('/idx1/spds123'
           '/idx2/spds123'
           '/idx3/spds123'
           '/idx4/spds123')
```

WORKPATH=

Specifies a list of paths that will contain temporary SPD Server work tables and temporary SPD Server intermediate files associated with the declared domain. WORKPATH= can be specified as an option or as a roption.

Usage:

```
WORKPATH=('/work1/spds123'
          '/work2/spds123'
          '/work3/spds123'
          '/work4/spds123')
```

METAPATH=

Specifies a list of paths that are allocated to contain overflow SPD Server metadata if the designated metadata space that is allocated in the PATHNAME= option statement becomes full. The additional metapaths provide a buffer space that can be used for update and append operations to existing SPD Server tables.

When the primary metadata space that is defined by the PATHNAME= option becomes filled, new tables cannot be added to the domain. The primary path should be located on a file system that is expandable and mirrored. As a conservative estimate for space, plan for 20 gigabytes of metadata for every terabyte of compressed physical data.

METAPATH= can be specified as an option or as a roption.

Usage:

```
METAPATH=('/meta1/spdsmgr/meta'
          '/meta2/spdsmgr/meta')
```

Consistency in Nomenclature

It is a suggested practice (but not a requirement) to match or closely match the LIBNAME, pathname, and other optional pathnames for consistency. The following examples illustrate a domain declaration that is easy to follow, and a domain declaration that requires more concentration to follow.

Example of intuitive names in a libnames.parm file:

```
LIBNAME=SPDS123 PATHNAME=c:\data\spds123
  OPTIONS="
    DATAPATH=('d:\data\spds123'
              'e:\data\spds123')
    INDEXPATH=('f:\idx\spds123')";
```

In the previous example, the declared domain name, pathname, data pathname, and index pathname are all "spds123".

Example of non-intuitive names in a libnames.parm file:

```
LIBNAME=BADEXAMPL PATHNAME=c:\data\myspds
  OPTIONS="
    DATAPATH=('d:\data\datapath1'
              'e:\data\datapath2')
    INDEXPATH=('f:\idx\index')" ;
```

The non-intuitive names example uses different names for the declared domain name, pathname, data pathname, and index pathname. The structure is technically valid, but is also unnecessarily complex.

In summary, it is a good idea to use the same name that is declared as a LIBNAME domain as the destination directory name for pathname, data path, and index path specifications.

The directories that are specified in domain pathname, data path, and index path statements should correspond to one and only one domain. In the intuitive names example, the pathname, data path and index path specifications point to separate, unique paths that end with the directory name, "pds123" which correspond to the domain "spds123". If a domain "spds456" exists, it should have its own unique domain pathname, data path, and index path specifications, and share no specified path with "spds123" or any other domain.

Domain Access Options

When you issue a libref statement to create a domain for SPD Server, you can use the following optional specifications to control the accessibility of resources among other SPD Server users:

OWNER=

Specifies the owner of a domain. The SPD Server owner controls the resources of the domain, and can create a LIBNAME ACL on the domain to grant or deny privileges to other SPD Server users. When the domain is specified with an owner, only the owner can use the TEMP=YES LIBNAME option with the domain.

The owner can use LIBNAME ACL to grant the following:

- READ access to allow a user or group to get a LIBNAME to the domain.
- WRITE access to allow a user or group to create new objects in the domain.
- CONTROL access to allow a user or group to modify the owner's LIBNAME ACL .

Usage:

```
OWNER=owner-id
```

LIBACLINHERIT=

The LIBACLINHERIT parameter file option controls the ACL precedence of permission checks. Precedence of permission checks includes inheriting the permissions of the LIBNAME ACL for resources owned by the domain owner. In this case, the LIBNAME ACL is used first to give READ or WRITE access to the domain, and then to inherit ACLs to resources that belong to the domain owner. When a user attempts to access resources in a domain where the domain owner specifies LIBACLINHERIT=YES, the following ACL precedence of permissions checks are made on the resource:

1. If user-specific permissions are defined on the object for the accessor, the accessor gets these permissions.
2. If group-specific permissions are defined on the object for the accessor's group, the accessor gets these permissions.
3. If LIBNAME ACL permissions are defined for the accessor, the accessor gets the LIBNAME ACL permissions on the object.

4. If LIBNAME ACL permissions are defined for the accessor's group, the accessor gets the LIBNAME ACL permissions on the object.
5. Else, the accessor gets UNIVERSAL ACLs on the resource.

An OWNER=<*owner-name*>LIBACLINHERIT=YES domain statement uses a slightly different methodology because of the OWNER= parameter. When specifying the OWNER= parameter with LIBACLINHERIT=YES, the owner can grant:

- READ access to allow a user or group to get a LIBNAME to the domain.
- ALTER access to allow a user or group to create new objects in the domain.
- CONTROL access to allow a user or group to modify the owner's LIBNAME ACL.

ALTER access can be used with OWNER= and LIBACLINHERIT=YES to allow a user or group to create a new resource in the domain. In some cases, ALTER access is preferable to WRITE access for an OWNER= domain, because ALTER access prevents users or groups that inherit WRITE access from writing to, updating, or deleting resources that were created by the domain owner. LIBNAME ALTER access with OWNER= and LIBACLINHERIT=YES allows the owner to grant privileges to users to create objects in the domain, and WRITE access can be used to inherit write access to the owner's resources.

The following is an example of SAS code submitted to SPD Server using LIBACLINHERIT. The example begins by showing information in the **libnames.parm** file where domain names and paths are declared.

Contents of the **libnames.parm file**:

```
LIBNAME=libinher
PATHNAME=/IDX1/spdsmgr/spds45test/libinher
LIBACLINHERIT=YES
OWNER=admin ;

LIBNAME=noinher
PATHNAME=/IDX1/spdsmgr/spds45test/noinher
OWNER=admin ;
```

SAS code submitted to SPD Server by the user:

```
LIBNAME libinher sasspds 'libinher'
  server=gomez.5129
  user='admin'
  password='spds123' ;

LIBNAME noinher sasspds 'noinher'
  server=gomez.5129
  user='admin'
  password='spds123' ;

data libinher.admins_table
  noinher.admins_table ;

  do i = 1 to 10 ;
    output ;
end ;
run ;
```

```
/* LIBNAME access for user anonymous */
  PROC SPDO library=libinher ;


/* Admin owns these ACLs */
  set acluser admin ;


/* Add a LIBNAME ACL to d1 */
  add acl / libname ;


/* Modify LIBNAME ACL Domain d1  */
/* Allow users in Group 1        */
/* read-only access to domain    */

modify acl / libname read ;

list acl _all_ ;
quit ;


/* Set up LIBNAME access for  */
/* user anonymous             */
PROC SPDO library=noinher ;


/* Specify who owns these ACLs */
  set acluser admin ;


/* add a LIBNAME ACL to d1 */
  add acl / libname ;


/* Modify LIBNAME ACL Domain d1 */
/* Allow users in Group 1 read- */
/* only access to the domain    */

modify acl / libname read ;

list acl _all_ ;
quit ;

LIBNAME a_inher sasspds 'libinher'
  server=gomez.5129
  user='anonymous' ;

LIBNAME a_noher sasspds 'noinher'
  server=gomez.5129
  user='anonymous' ;

PROC PRINT data=a_inher.admins_table ;
  title 'with libaclinher' ;
run ;
```

```
PROC PRINT data=a_noher.admins_table ;
  title 'without libaclinher'
run ;
```

DYNLOCK=

Overview of Dynamic Locking

Dynamic locking is an SPD Server feature that allows multiple users concurrent access to SPD Server tables. The tables can be concurrently accessed by multiple users for reading and writing, while maintaining the integrity of the table contents. When dynamic locking is enabled, users can insert, append, delete, and update the contents of an SPD Server table while doing concurrent reads on the table.

Dynamic locking is enabled or disabled at the domain level. All tables stored within the domain are subject to the enabled or disabled state of the dynamic locking feature. The DYNLOCK= statement should be used in **libnames.parm** file domain declarations.

How is dynamic locking different from SPD Server record-level locking? Clients that use dynamic locking connect to a separate SPD user proxy process for each LIBNAME connection in the domain. In SPD Server record-level locking, all clients share the same record-level locking proxy process.

Benefits of Dynamic Locking

SPD Server uses the dynamic locking feature to alleviate some of the problems and limitations that occur with record-level locking.

The dynamic locking method of using separate proxy processes instead of a single record-level proxy distributes resource allocations, which decreases the probability of a single proxy process hitting resource limits. Dynamic locking also removes a single record-level locking point of failure for the record-level proxy.

If there is a failure in an SPD Server user proxy when dynamic locking is being used, only the client that is connected to that proxy is affected. If there is a failure in an SPD Server record-level proxy, it all client connections are affected.

Dynamic locking can also provide better performance than record-level locking. Dynamic locking has performance advantages over record-level locking when concurrent read and write access to a table is required. This is due to the more distributed processing and parallelism of that occurs when multiple SPD Server user proxies are used. The performance benefit depends on the opportunities for parallelism and should be measured on a case-by-case basis.

Dynamic Locking Details

In order to use dynamic locking, SPD Server tables must be part of a named SPD Server domain. When dynamic locking is enabled for a domain, all of the SPD Server users that access tables in that domain will automatically use dynamic locking. The SPD Server clients do not need to set any additional parameters to take advantage of the domain's dynamic locking benefits.

When SPD Server proxy processes receive concurrent update, append, insert, and delete commands, they are sequentially queued and then executed in order of arrival. Only one update operation is performed on a table at any one time. Read requests can be executed at any point while an update is in progress. Read requests get the most recent information that is available in the table, based on the last physical update to disk.

Dynamic locking is not a replacement for using record-level locking in cases where the user requires SAS-style record-level integrity across multiple clients. Reading a record using dynamic locking does not guarantee that the record cannot change before a subsequent read or update is executed. If a true record-level lock is needed by a client, then the record-level locking protocol should be used.

It is not possible to use record-level locking on a domain that has dynamic locking enabled. Dynamic locking is also not supported for tables that use dynamic clusters.

Usage

To enable dynamic locking, use the DYNLOCK= statement in the **libnames.parm** file domain declarations. If the DYNLOCK= option is not specified, the default SPD Server setting for DYNLOCK is NO.

```
DYNLOCK=<YES/NO>
```

Organizing Domains for Scalability

Overview of Organizing Domains

SPD Server performance is based on scalable I/O. You can use the **libnames.parm** file to optimize the way SPD Server stores files in order to exploit scalable I/O. The "Domain Access Options" on page 127 section in this document provides instructions on how to specify named paths for the three data components of SPD Server tables (observation data tables, index data tables, metadata tables) as well as paths for temporary intermediate calculation tables. LIBNAME domain declaration statements can specify the system paths that are associated with each table space component, but the SPD Server administrator must allocate the correct amount of disk space and I/O redundancy to the various paths.

This section provides functional information about the table spaces that are defined by the DATAPATH=, INDEXPATH=, WORKPATH=, and METAPATH= options of the LIBNAME domain declaration statements. SPD Server administrators should use this information to determine the best sizing, I/O, and redundancy requirements to optimize performance and scalability for named SPD Server domain paths.

Data Table Space

When a domain is declared in a LIBNAME statement, data tables are stored in the space defined in the PATHNAME= specification, unless the DATAPATH= option is specified. The PATHNAME= space is designed to contain metadata tables for a domain, but it can also contain data tables. As a domain's size and complexity increases, so do the benefits for organizing data tables into their own DATAPATH= space.

Organizing your data table space significantly impacts I/O scalability. The disk space allocated to data tables stores permanent warehouse tables that users will access. It is important for this disk space to support scalable I/O because it facilitates both parallel processing and real-time multi-user access to the data. In a large warehouse, this disk space is likely to see the greatest proportion of read/write I/O.

Tables in the data table space are typically loaded or refreshed using batch processes during evenings or off-peak hours (such as weekends and holidays). Access to data table space is often restricted to read-only for all users except for the administrators who perform the load and refresh processes.

To ensure reliability, data table space is typically organized into RAID 1+0 or RAID-5 disk configurations. Very large warehouses should consider a RAID-5 configuration with a second storage array to mirror the data.

Index Table Space

When a domain is declared in a LIBNAME statement, index tables are stored in the space defined in the PATHNAME= specification, unless the INDEXPATH= option is specified. The PATHNAME= space is designed to contain metadata tables for a domain, but it can also contain index tables. As a domain's size and complexity increases, so do the benefits for organizing index tables into their own INDEXPATH= space.

Index space typically does not require the high-level scalability that data space, temporary table space, or work spaces need for I/O performance. When a process is using an index, the read access pattern is very different from a parallel I/O pattern of data or multiple user patterns against data.

Index space is typically configured as a large striped file system across a large number of disks and I/O channels. A typical configuration such as RAID 1+0 or RAID 5 will support some type of redundancy to ensure index space availability.

Metadata Table Space

When a domain is declared in a LIBNAME statement, metadata tables are stored in the space defined in the PATHNAME= specification. If the space configured in PATHNAME= fills, SPD Server stores overflow metadata for existing tables in the space defined in the optional METAPATH= specification, if it is declared. The PATHNAME= and METAPATH= spaces are specifically designed to contain metadata tables for a domain.

Compared to the other space categories, metadata space is relatively small and usually does not require scalability. If compressed data in a given warehouse uses 10 terabytes of disk space, there will be approximately 10 gigabytes of metadata.

As a rule of thumb, when setting up metadata space, plan to allot 20 gigabytes of metadata space for every 10 terabytes of physical data disk space. When new data paths are added to expand a server, additional metadata space should be added within the primary path of the server.

A table's metadata becomes larger when there are rows in the table that are marked as deleted. Bitmaps are stored in the metadata that is used to filter the deleted rows. The space required depends on the number of rows deleted and on their distribution within the table.

Although the space required for the metadata is small, the setup and configuration of the disk space is very important. The disk space must be expandable, mirrored, and backed up.

Work File Space

SPD Server administrators use statements in the body of the **spdsserv.parm** file to reserve a space for intermediate calculations and temporary files. The work space that is configured in **spdsserv.parm** is shared by all SPD Server users.

Some SPD Server users have data needs that might be constrained by using the common intermediate calculation and file space reserved for all users. SPD Server administrators can use the **libnames.parm** file to create and reserve a work space that is specifically associated with a single domain and its approved users. This presents improvement opportunities for both security and performance. As a domain's size and complexity increases, so do the benefits for organizing temporary and intermediate tables into their own workspace defined by WORKPATH=.

Work space refers to the area on disk that SPD Server software uses to store required files when the available CPU memory cannot contain the entire set of calculations. During events like these, some utility files are written to disk. Work space is important to scalability. Tasks such as large sorts, index creation, parallel group-by operations, and SQL joins can require dedicated work space to store temporary utility files.

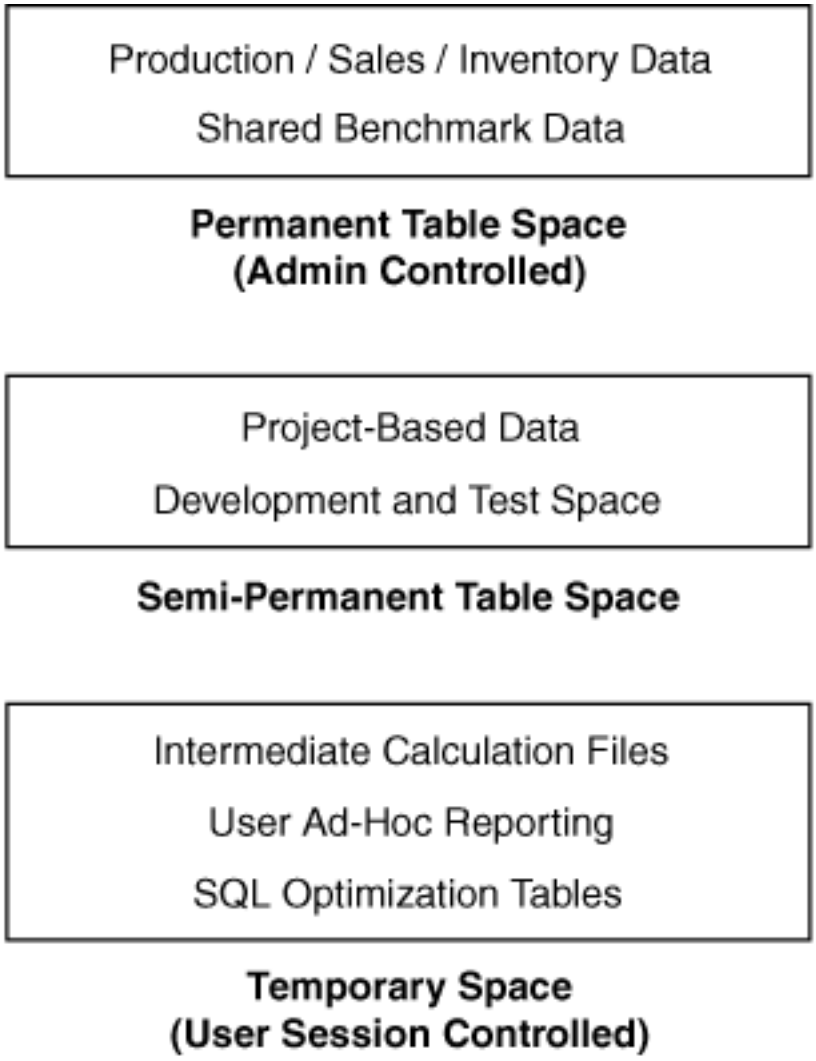
Work space is typically configured as part of a large striped file system that spans as many disks and I/O channels as possible. Workspace I/O can critically impact the performance behavior of an SPD Server host.

Work space on disk is typically a RAID 0 configuration or some hardware-redundant RAID design. RAID 0 configurations are risky to the extent that if the RAID 0 disk goes down, the system will also be affected and any process that was running at the time of failure will probably be affected.

Domains and Data Spaces

Overview of Domains and Data Spaces

SPD Server is a tool that can be configured to meet different organizational data requirements. When an organization needs different types of SPD Server domain space, administrators can use domain declarations in the **libnames.parm** file to configure spaces that balance processing speed, space, and growth needs with data security requirements. Typically, SPD Server users use most or all of the types of table spaces. The type of queries and reports that the user makes can indicate the type (or types) of data space that the user needs. There are three basic types of domain space.



Permanent Table Space

In SPD Server, large production, inventory, and sales data storage areas work best using permanent table space. A rolling five-year sales data table by division and company is an example of an SPD Server structure that is best suited to permanently allocated space on the enterprise computers. Organizations can rely on large quantities of production, inventory, or sales data that is updated on a day-to-day, or even shift-to-shift basis. These data repositories require permanent, secure processing space that only can be accessed by a select group of key users. Allocating permanent space for the data ensures that sufficient disk space required for the combination and manipulation of large amounts of data from multiple large warehouse tables is always available.

For example, an organization might call such a tightly controlled, permanently defined area the "production" data space. Data analysts in organizations typically manipulate production-type data to produce smaller, more focused reports. Analyst reports often benchmark specific areas of performance or interest. Regular analyst reports are frequently distributed across the organization. The distributed analyst reports, while not as critical as the production, inventory, or sales data, should also use permanently defined data spaces that are separate from the permanent production reporting table spaces. In such instances,

permanent table space should be accessible to the specific group (such as analysts) of regular SPD Server users.

The SPD Server administrator can use the **libnames.parm** file to configure paths that map to an area of reserved disk space on a host computer, creating a safe place for permanent tables with limited user access. To reserve permanent table space, the LIBNAME domain statement in the **libnames.parm** file should use the optional DATAPATH=, INDEXPATH=, and OWNER= statements to specify unique, appropriately sized disk areas for data tables and index tables. The OWNER= statement configures ownership and access. It is up to the SPD Server administrator to ensure that the paths named in domain declarations have access to sufficient disk space.

User access to permanent table spaces can be established via individual user account access privileges, or by establishing, through the owner of the domain, an ACL group of approved users. LIBNAME domain statements will create permanent table space by default.

Semi-Permanent Table Space

Organizations often have short-term data mining projects that rely on production, inventory, or sales data, but modify the way the data is processed, or augment the production, inventory, or sales data in some manner with additional information. Those projects should be conducted in a test data space, safely isolated from the permanent space that is dedicated to critical production, inventory, or sales data. This design allows development trials to be conducted without risk of corrupting mission-critical data.

For example, the test data space used for a month-long development project could be considered a semi-permanent space; it requires the SPD Server administrator to grant access to an area where data can safely exist, isolated from production, sales, or inventory data, for a specific period of time longer than a single SPD Server user session. The "test" environment should persist long enough for works-in-progress to mature to production-quality (if so destined), but after the project is completed, the data, metadata, and work tables that are associated with the development phase should be cleaned up and deleted from the test environment.

Semi-permanent table space can be configured by an SPD Server administrator or by SPD Server users. It is recommended that administrators allocate semi-permanent spaces using the **libnames.parm** file.

Temporary Table Space

Managers in an organization often ask analysts to query data warehouses for various types of information. Such ad hoc information requests might be as important as standard production, inventory, or sales reports, but ad hoc reporting has different data space needs. Ad-hoc reports tends to have a lower frequency of repetition and broader query scope than standard daily production, inventory, or sales reporting. Ad-hoc reports are usually best suited to temporary table space. The life spans of temporary table spaces begin and end with the user's SPD Server sessions.

Temporary table space is used for more than ad hoc user reporting. Even data warehouse queries and reports that use permanent table space use intermediate tables and calculation metadata to process queries. For example, the SPD Server SQL optimization process requires significant temporary table space while it heuristically finds the most efficient SQL strategy to resolve the query. Intermediate SPD Server tables and calculation metadata are normally deleted when the job terminates.

Any of the report types listed previously can require temporary table space for intermediate calculation tables. Temporary table space can be configured by normal SPD Server users via LIBNAME domain statements submitted during an SPD Server session. The key to

creating temporary table spaces is to use the optional TEMP=YES specification when the LIBNAME domain statement is issued in submitted SPD Server job code. All tables residing in temporary table space are lost at the end of the SPD Server user session, when temporary table space is automatically deleted.

Example Libname.parm File Configurations

The following SPD Server code examples illustrate the range of LIBNAME domains that can be created using the **libnames.parm** file. The code examples begin with the simplest forms of LIBNAME domain declaration and increase in complexity.

Example 1: Minimum Configuration for Domain Declaration

Example 1 demonstrates the syntax necessary for the simplest form of LIBNAME domain configuration:

```
LIBNAME=SKULIST PATHNAME=c:\data\skulist;
```

This statement creates the SPD Server LIBNAME domain SKULIST. All SPD Server tables that are associated with the SKULIST domain (table data, metadata, index data, and intermediate data) will reside in the single directory that is referenced in the path specification c:\data\skulist.

Example 2: Specify Domain Paths for Data, Index, and Workspace Tables

Example 2 demonstrates the syntax necessary to declare a LIBNAME domain with separate paths allocated for the domain data tables, index tables, and intermediate data files. The domain metadata will continue to be stored in the location specified by the PATHNAME= specification.

```
LIBNAME=SKULIST PATHNAME=/metadata/skulist
  options="
    DATAPATH=('/data01/skulist'
              '/data02/skulist'
              '/data03/skulist'
              '/data04/skulist'
              '/data05/skulist'
              '/data06/skulist')
    INDEXPATH=('/idx01/skulist'
               '/idx02/skulist'
               '/idx03/skulist'
               '/idx04/skulist')
    WORKPATH=('/work01/skulist'
              '/work02/skulist'
              '/work03/skulist'
              '/work04/skulist')";
```

Example 2 uses the domain path options DATAPATH=, INDEXPATH=, and WORKPATH=. Optimal performance can be achieved in this configuration when each domain path resides on a separate disk or on network components that can take advantage of parallelism opportunities.

The INDEXPATH= is designed to take advantage of multiple file systems. SPD Server 4.5, index components can take advantage of the SPD Server RANDOMPLACEDPF feature. The RANDOMPLACEDPF feature enables administrators to configure smaller disk partitions for index space, which benefits SPD Server backup and recovery operations.

The WORKPATH= specified for the Example 2 SKULIST domain allows domain users to override the default workpath, if any, specified in the **spdsserv.parm** file.

Example 3: Query-Rewrite Domain Configuration

Example 3 demonstrates how to use temporary tables to configure a LIBNAME domain for performance when using the SPD Server SQL query rewrite facility.

The SPD Server SQL query rewrite facility does 'behind the scenes' work to find the most processor-efficient method to evaluate submitted SQL statements. The SQL query rewrite facility uses numerous temporary tables that are distributed across a parallelized environment to rapidly evaluate and process the SQL statements.

At the end of the SPD Server session, temporary tables are automatically deleted. Some SPD Server users might use the QRW domain for its temporary table space, even if they are not submitting code for an SPD Server SQL query rewrite job.

Example 3 creates a query rewrite domain named 'QRW' that uses distributed temporary SPD Server tables. In order to use SPD Server QRW, the following must be done:

- A specific domain for the query rewrite operations should be created in the **libnames.parm** file. This example names the query rewrite domain 'QRW'.
- The **spdsserv.parm** file should contain a TMPDOMAIN=<QRW-domain-name> statement that references the QRW domain that was created in the **libnames.parm** file.

Libnames.parm file code (note the LIBNAME=QRW statement creates a specific domain for the query rewrite tables):

```
LIBNAME=QRW PATHNAME=/metadata/qrw
  options="
    DATAPATH=('/data01/qrw'
              '/data02/qrw'
              '/data03/qrw'
              '/data04/qrw'
              '/data05/qrw'
              '/data06/qrw'
              '/data07/qrw'
              '/data08/qrw'
              '/data09/qrw')
    INDEXPATH=('/idx01/qrw'
               '/idx02/qrw'
               '/idx03/qrw'
               '/idx04/qrw'
               '/idx05/qrw')";
```

Spdsserv.parm file code (note the TMPDOMAIN=QRW statement references the domain created for query rewrite tables):

```
SORTSIZE=128M;
INDEX_SORTSIZE=128M;
GRPBYROWCACHE=128M;
BINBUFSIZE=32K;
```

```
INDEX_MAXMEMORY=8M;
NOCOREFILE;
SEQIOBUFMIN=64K;
RANIOBUFMIN=4K;
MAXWHTHREADS=8;
WHERECOSTING;
RANDOMPLACEDPF;
MINPARTSIZE=128M;
TMPDOMAIN=QRW;
WORKPATH=('c:\temp\work1');
```

Example 4: Multiple Domain Types and Paths Configuration

Example 4 uses a combination of **libnames.parm**, **spdsserv.parm**, and user-issued SAS code submitted to SPD Server to create multiple domains that house the following:

- permanent production tables
- permanent to semi-permanent user tables
- temporary tables for intermediate calculations.

In the Example 4 environment, users can access information from permanent production-type tables, manipulate the information and save, and delete the results in a semi-permanent user space, and at the same time, use temporary tables with sufficient disk space to perform large or optimized intermediate table calculations. Multiple data and index paths are specified to take advantage of RAID-configured disk arrays.

Libnames.parm file code defines the domain named PROD, which contains permanent production and historical data tables:

```
LIBNAME=PROD PATHNAME=/metadata/prod
  options="
    DATAPATH=('/data01/prod'
              '/data02/prod'
              '/data03/prod'
              '/data04/prod'
              '/data05/prod'
              '/data06/prod'
              '/data07/prod'
              '/data08/prod'
              '/data09/prod')
    INDEXPATH=('/idx01/prod'
               '/idx02/prod'
               '/idx03/prod'
               '/idx04/prod'
               '/idx05/prod')";
```

Additional **libnames.parm** file code defines the domain named USERTBLS, which contains semi-permanent tables for user projects. Content in USERTBLS can be saved and deleted by SPD Server users.

```
LIBNAME=USERTBLS PATHNAME=/metadata/usertbls
  options="
    DATAPATH=('/data01/usertbls'
              '/data02/usertbls'
              '/data03/usertbls'
```

```
              '/data04/usertbls'
              '/data05/usertbls'
              '/data06/usertbls'
              '/data07/usertbls'
              '/data08/usertbls'
              '/data09/usertbls')
    INDEXPATH=('/idx01/usertbls'
               '/idx02/usertbls'
               '/idx03/usertbls'
               '/idx04/usertbls'
               '/idx05/usertbls')";
```

Finally, more **libnames.parm** file code defines the domain named SPDTEMP, which contains temporary table space that is automatically deleted at the end of the SPD Server session.

```
LIBNAME=SPDTEMP PATHNAME=/metadata/spdtemp
  options="
    DATAPATH=('/data01/spdtemp'
              '/data02/spdtemp'
              '/data03/spdtemp'
              '/data04/spdtemp'
              '/data05/spdtemp'
              '/data06/spdtemp')
    INDEXPATH=('/idx01/spdtemp'
               '/idx02/spdtemp'
               '/idx03/spdtemp'
               '/idx04/spdtemp')";
```

Spdsserv.parm file code uses the TMPDOMAIN=SPDTEMP statement to reference the domain that was created for temporary tables, and uses the WORKPATH= statement to identify an array of RAID-enable disk paths for temporary SPD Server work tables and temporary SPD Server intermediate files.

```
SORTSIZE=128M;
INDEX_SORTSIZE=128M;
GRPBYROWCACHE=128M;
BINBUFSIZE=32K;
INDEX_MAXMEMORY=8M;
NOCOREFILE;
SEQIOBUFMIN=64K;
RANIOBUFMIN=4K;
MAXWHTHREADS=8;
WHERECOSTING;
RANDOMPLACEDPF;
MINPARTSIZE=128M;
TMPDOMAIN=SPDTEMP;
WORKPATH="('/work1/spdswork'
           '/work2/spdswork'
           '/work3/spdswork'
           '/work4/spdswork'
           '/work5/spdswork')";
```

SAS code submitted to SPD Server by the user connects to the PROD, USERTBLS, and SPDTEMP domains, and configures SPDTEMP as a temporary domain space. Tables in the SPDTEMP domain will be automatically deleted at the end of the SPD Server session.

```
LIBNAME PROD sasspds "PROD"
  server=hostname.hostport
  user="user-id"
  password="password"
  IP=YES;

LIBNAME USERTBLS sasspds "USERTBLS"
  server=hostname.hostport
  user="user-id"
  password="password"
  IP=YES;

LIBNAME SPDTEMP sasspds "SPDTEMP"
  server=hostname.hostport
  user="user-id"
  password="password"
  IP=YES
  TEMP=YES;
```

Chapter 13

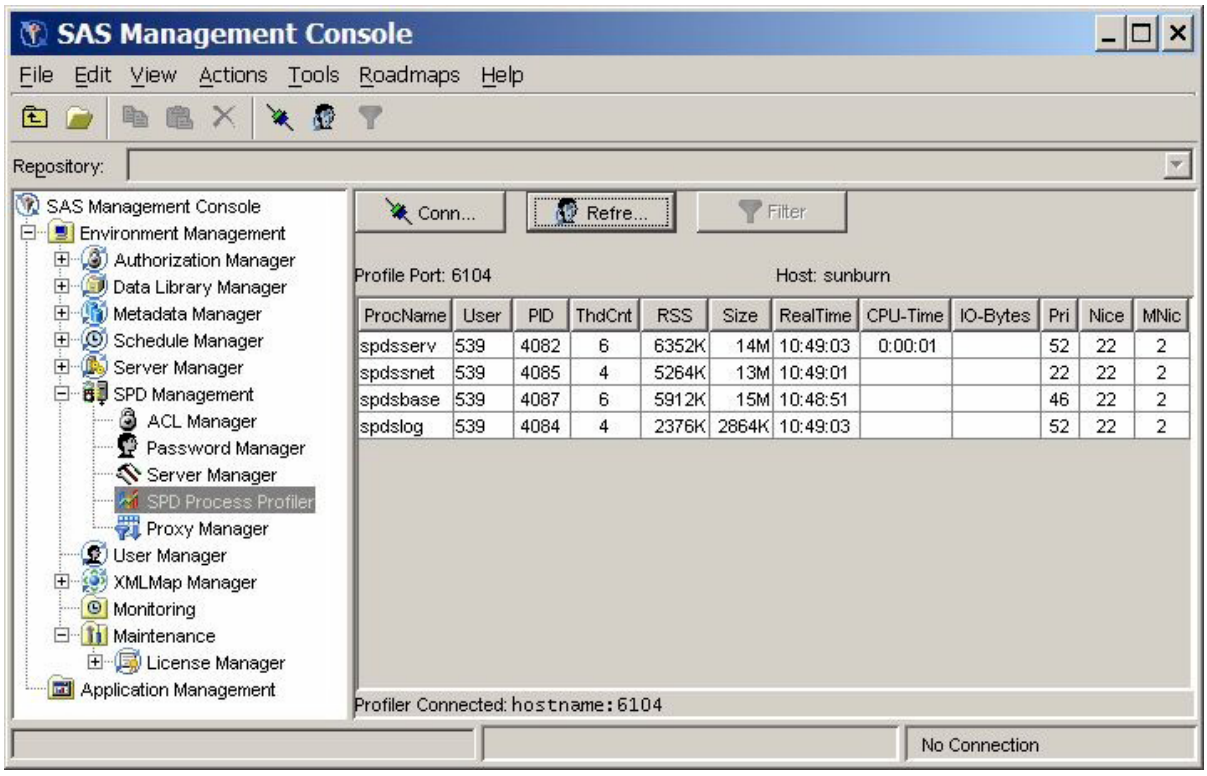
Setting Up SPD Server Performance Server

Introduction

SAS SPD Server 4.4 provides a performance monitoring server called **spdsperf**. The SPD Server Performance Server is an optional component and is not required for normal operation of SPD Server.

The purpose of the SPD Server Performance Server is to gather SPD Server process performance information and to post it to the SPD Server Management section of the SAS Management Console application. The SPD Server performance information consists of memory and resource allocations by users, and SPD Server processes spawned by an SPD Server Name Server. All SPD Server users must connect to an SPD Server Name Server before their SPD Server session is spawned. Each SPD Server Name Server owns a dynamic family of subordinate SPD Server processes that are created and terminated by SPD Server users and jobs.

The SPD Server Performance server information is stored in the SAS Management Console. The SAS Management Console has a folder that is reserved for SPD Server management. The **SPD Management** folder is a child to the **Environmental Management** folder in SAS Management Console. When you expand the **SPD Management** folder, the bottom-most utility is the **SPD Process Profiler**. When you highlight the **SPD Process Profiler** utility, the process information table that is located in the right panel displays performance summary statistics. Each row in the performance summary statistics table provides information about a single SPD Server process that was spawned on the SPD Server Name Server residing at the specified PID, or port ID.



The display of memory and resource allocations in the **SPD Process Profiler** allows SPD Server Administrators to use the SAS Management Console as a handy view point to review which SPD Server processes are occupying host computing resources, how the resources are distributed across users and processes at a given point in time, and whether the resource uses and distributions are appropriate for your computing environment.

The SPD Server Performance Server is not limited to displaying its performance summary statistics in the SAS Management Console application. You can also configure the SPD Server Performance Server, when you launch it, to create text log files that can be saved locally on the SPD Server host machine. SPD Server ships with a perl utility called **process_perf_log** that can parse the log that was created by the SPD Server Performance Server.

Starting the SPD Server Performance Server

Overview of Starting the Performance Server

The SPD Server Performance Server can be started in two different ways. The Performance Server can be invoked by command line, or it can be launched by calling an **rc.perf** script that is configured for your location's SPD Server installation.

The SPD Server Performance Server process is configured by default to output the captured performance data to the user's screen. To disable the user screen display, redirect **stdout/ stderr** to **/dev/null**. Redirecting the screen output also makes it easier to run **spdsperf** in the background, or as an orphan.

Start Performance Server from Command Line

You can start the SPD Server Performance Server from a UNIX command line. SPD Server and the SAS Management Console applications must be running before you start the Performance Server. If SPD Server must be restarted, the SPD Server Performance Server must also be shut down and restarted after SPD Server is restarted. The Performance Server utility is not compatible with SPD Server releases that preceded SPD Server 4.4.

Usage:

```
spdsperf -g SMA -n NSP -s SNP -p PLP -l LOG [-i SEC] [-c CNT]
```

where

- **SMA** is the shared memory address for the SPD Server Global Control Block (GCB). The GCB is an internal SPD Server data map that contains all of the options that are passed to the SPDSBase server when it starts. To get the value for the GCB address, SPD Server must be started. After the SPD Server Name Server starts the first SPDSBase process, issue a UNIX **ps** command and look in the output to view the address parameters that were passed to SPDSBase. The GCB shared memory address should be found in the **ps** output data.
- **NSP** is the process-ID number of the SPD Server Name Server whose family of spawned processes you want to monitor
- **SNP** is the process-ID number of the SPD Server SNet server.
- **PLP** is the listening port number that SAS Management Console will use to contact the Performance Server
- **LOG** is the path specification that you want to write the profile log to.
- **SEC** is the optional property that specifies the number of seconds that transpire between instances of performance monitoring data captures. The permissible range for SEC property values is integers that are greater than or equal to 1, and less than or equal to the declared SPD Server MAXINT value.
- **CNT** is the optional property that specifies the count, or number of performance monitoring data captures that you want the Performance Server to take. The permissible range for CNT property values is integers that are greater than or equal to 0, and less than or equal to the declared SPD Server MAXINT value. A CNT value of 0 requests an infinite number of data captures.

Start Performance Server from Rc.perf Script

You can also start the SPD Server Performance Server by calling the **rc.perf** script during start-up. The next section contains a **rc.perf** script that you can cut and paste into an editor of your choice, and customize for use with your SPD Server installation. SPD Server 4.4 also ships with a sample **rc.perf** script that you can modify. The sample **rc.perf** script is located in your SPD Server installation folders at: **`.../samples/perfmon/rc.perf`**

Either example file can be used to create your custom **rc.perf** script.

You must make the following changes when you customize your version of the **rc.perf** script:

1. The sample script below uses the default SPD Server installation path of **`usr/local/spds`**

   If your SPD Server installation uses a custom path, you must update the INSTDIR path settting to update your installation path setting.

2. You must update the UNIX environment setting for DISPLAY. This environmental variable tells the X server where to display the window for the Performance Server program.
3. The sample script uses the default SAS Name Server port (NSPORT) and SAS SNet port (SNPORT) assignments. If your SPD Server installation uses different NSPORT and SNPORT assignments, you must update the NSPORT and SNPORT settings in the sample script to the port addresses that are used in your SPD Server installation.
4. The script uses the –PARGS setting to specify how many times the Performance Server should capture performance information snapshots before shutting down. The sample **rc.spds** script below uses a -PARGS setting of 0, which requests an infinite number of performance information captures. If you do not change the default number of information captures from 0 (infinity), you may wish to modify your **rc.killspds** script to shut down the **rc.perf** process when you shut down SPD Server.

Sample Rc.perf Script

The sample code below is a typical **rc.perf** script that you can modify for use at your own site. Follow the instructions in the section above to customize the script for your SPD Server installation. In order to assist you, the values that you may need to change have been highlighted in a lighter color. It is recommended that you copy and paste the text below into a text editor of your preference, make your changes, and then save the file to your SPD Server installation in a location where the script can be called for execution.

```
#!/bin/ksh
#-------------------------------------------------------------------------
#
# PURPOSE:    Start the SPD Performance Profiler for the specified servers.
#
# PARAMETERS: version - Version of SPDS to build and run (e.g., dev, 403).
#
# NOTES:      Common optional parameters:
#               -nsport    overrides NSPORT for server.
#               -snport    overrides SNPORT for server.
#               -debug     use alternate port numbers for development.
#
#             The default repetition count for spdsperf is 3. This script
#             over-rides the default to run indefinitely. Supplying a -c
#             option to this script will over-ride this new default.
#
# HISTORY:    12Sep06 mjm Optimized for customer use.
#             02Aug06 mjm Created.
#
#-------------------------------------------------------------------------


#
# enable XPG4 versions of ps command on some platforms
#
export UNIX95=1


#
# initialize variables
```

```
#
NSPORT=6100
SNPORT=6101
DEBUG=
PARGS="-c 0"

#
# parse parameters
#
while [ $1 ]; do
    #echo "Parsing Option $1 of length ${#1}"
    case "$1" in
        -nsport) if [ $# -lt 2 ]; then
                    echo "$1 parameter value not specified"
                    exit 1
                    fi
                NSPORT=$2
                shift;;
        -snport) if [ $# -lt 2 ]; then
                    echo "$1 parameter value not specified"
                    exit 2
                    fi
                SNPORT=$2
                shift;;
        -debug)  DEBUG="YES";;
        -trace)  echo "********\n* Script: $0\n* Args: $*\n********"
                set -x
                trace="-trace"
                echo "Script tracing turned on";;
        *)       echo "Found unknown arg, passing on to profiler."
                                PARGS="$PARGS $1";;
        esac
    shift
    done

echo "NSPORT=$NSPORT"
echo "SNPORT=$SNPORT"
echo "DEBUG=$DEBUG"
echo "PARGS=$PARGS"


#
# Check for debug option
#
if [ -n "$DEBUG" ]; then
        NSPORT=9876
        SNPORT=9877
        echo "Using Debug Ports: NS=$NSPORT   SN=$SNPORT"
    fi


SSRVPID=$(ps -eo pid,ppid,args | grep spdsserv | grep 6100
  | tr -s "      " " " | sed -e "s/^ *//" | cut -d " " -f1)

SNETPID=$(ps -eo pid,ppid,args | grep spdssnet | grep 6101
  | tr -s "      " " " | sed -e "s/^ *//" | cut -d " " -f1)
```

```
SHMATID=$(ps -eo pid,ppid,args | grep spdsbase | grep $SSRVPID
  | tr -s "\t" " " | sed -ne "1s/^ *//p" | cut -d " " -f4)

echo "SPDSNSRV Pid: $SSRVPID"
echo "SPDSSNET Pid: $SNETPID"
echo "SHMATID:      $SHMATID"

INSTDIR=/usr/local/spds
PATH=$INSTDIR/bin
export PATH
LD_LIBRARY_PATH=$INSTDIR/bin
export LD_LIBRARY_PATH
LIBPATH=$INSTDIR/bin
export LIBPATH

# substitute user's display machine name below.
export DISPLAY=machine:0.0

#sleep 4
spdsperf -g $SHMATID -n $SSRVPID -s $SNETPID $PARGS
```

Performance Server Log File

The SPD Server Performance server can also be configured to save the process performance information to a text log file. Your SPD Server installation includes a perl utility called **process_perf_log** that is located in the **.../samples/perfmon** directory of your SPD Server installation. When you use the **process_perf_log** perl script with your SPD Server Name Server log files, they will be parsed and formatted for SAS processing.

There is a sample SAS script for importing the parsed log file data. The SAS script is located at

.../samples/perfmon/PerfDataSample.sas

in your SPD Server installation. .

Part 5

Security

Chapter 14

ACL Security Overview

ACL Security Overview

SPD Server uses Access Control Lists (ACLs) and SPD Server user IDs to secure domain resources. You obtain your user ID and password from your SPD Server administrator.

SPD Server also supports ACL groups, which are similar to UNIX groups. SPD Server administrators can associate an SPD Server user as many as five ACL groups.

ACL file security is turned on by default when an administrator brings up SPD Server. ACL permissions affect all SPD Server resources, including domains, tables, table columns, catalogs, catalog entries, and utility files. When ACL file security is enabled, SPD Server only grants access rights to the owner (creator) of an SPD Server resource. Resource owners can use PROC SPDO to grant ACL permissions to a specific group (called an ACL group) or to all SPD Server users.

The resource owner can use the following properties to grant ACL permissions to all SPD Server users:

READ
: universal READ access to the resource (read or query).

WRITE
: universal WRITE access to the resource (append to or update).

ALTER
: universal ALTER access to the resource (add, rename, delete, or replace a resource and add, delete indexes associated with a table).

The resource owner can use the following properties to grant ACL permissions to a named ACL group:

GROUPREAD
: group READ access to the resource (read or query).

GROUPWRITE
: group WRITE access to the resource (append to or update).

GROUPALTER
: group ALTER access to the resource (rename, delete, or replace a resource and add, delete indexes associated with a table).

SPD Server ACL Security Model

Overview of the ACL Security Model

SPD Server provides an Access Control List (ACL) based security system. The ACL-based security is enabled by default. You are encouraged to run SPD Server using ACLs. ACLs add little overhead to SPD Server in terms of execution speed and disk space consumption. ACLs keep files private to individual users and within groups.

Only disable ACLs if your computing environment requires free access of any user to any other user's files. Migrating from a non-ACL environment to an ACL-based environment is not simple, so use ACLs if you foresee needing security controls at a future time. Files created by SPD Server running ACLs only should be accessed by SPD Servers running

ACLs. Likewise, areas created without ACLs should be accessed only by SPD Servers using -NOACL.

SPD Server comes bundled with the SAS Management Console (SMC). The SAS Management Console is a GUI utility that an SPD Server administrator can use to manage passwords and ACLs. The SAS Management Console manages passwords using the same capabilities that the **psmgr** utility provides, and the SAS Management Console also manages ACLs using the same capabilities provided by PROC SPDO.

Enabling ACL Security

Overview of Enabling ACL Security

You enable SPD Server security with the -ACL option on the spdsserv command. Numerous security features are in effect with ACLs enabled.

UNIX File-Level Protection with ACL Security

Each session of SPD Server is attached to a user with some UNIX or Windows user ID. If SPD Server runs on UNIX, all files created by the software are protected according to the UNIX file creation permissions associated with that UNIX user's ID. The SPD Server only can read or write files that have the appropriate file and directory access permissions to the SPD Server's user's ID. Use the UNIX 'unmask' command to restrict the desired creation permissions.

User/Password Validation

SAS users must issue a user ID and password with the LIBNAME statement in order to connect to SPD Server. The user ID and password are verified against an SPD Server user ID table set up by the system administrator. Password expiration can be enforced by the system administrator via the psmgr administration tool for the user ID table or through the SAS Management Console, if it is installed and configured for SPD Server. In either of the two environments, the system administrator can prevent logins under the anonymous user ID by placing user 'anonymou' in the user ID table with a password unknown to the SAS users.

Control of LIBNAME Domains by the System Administrator with ACL Security

The system administrator defines the valid LIBNAME domains with entries in the libname parameter file for each SPD Server. The PATHNAME= specification defines the file system for the LIBNAME. LIBNAME= specifications provide the access route to the file system. Restricting knowledge of the LIBNAME= specification information restricts access to the corresponding file systems.

User Ownership of LIBNAME Domains

In the LIBNAME parameter file, the system administrator can attach the OWNER= specification to any defined LIBNAME domain. Only the system user whose user ID matches the OWNER= specification can create tables in this domain. (However, that user can grant other users read or write access rights through ACLs that were issued from the SAS LIBNAME statement.)

User Ownership of Tables

Each table created is tagged with the SPD user ID (referred to as the owner) who created it. Only the owner or ACLSPECIAL users can access a table. (However, the owner can grant access to other users through ACLs by adding a LIBNAME ACL with PROC SPDO.)

Example Server Setup with ACL Security

The following command invokes SPD Server with ACL support enabled and configures it with the specified LIBNAME domain definitions.

```
spdssrv -ACL -acldir
  InstallDir/site -nameserver samson
  -LIBNAMEfile libnames.parm
```

The libnames.parm file contains:

```
LIBNAME=public pathname=/disk1/public;
LIBNAME=qadata pathname=/disk2/qadata
  owner=qamgr;
LIBNAME=marketing pathname=/disk3/marketing
  owner=mktmgr;
LIBNAME=clinical pathname=/disk4/clinical
  owner=drzeuss;
```

SPD Server is invoked connecting to the name server running on machine 'samson'. The password file listing all valid system users resides in directory 'InstallDir/site'. LIBNAME domains 'public' 'qadata', 'marketing' and 'clinical' are registered with the name server. The **`/disk1/public`**, **`/disk2/qadata`**, **`/disk3/marketing`**, and **`/disk4/clinical`** directories must exist and the user ID that invokes **spdssrv** must have read and write access to them.

The following LIBNAME statements connect SAS clients to the data areas:

```
LIBNAME open sasspds 'public'
  host='samson'
  user='employee'
  prompt=yes;

LIBNAME pres sasspds 'clinical'
  host='samson'
  user='ceo'
  prompt=yes;

LIBNAME report sasspds 'marketing'
  host='samson'
  user='ceo'
  aclgrp='mrktng'
  prompt=yes;

LIBNAME efficacy sasspds 'clinical'
  host='samson'
  user='drfda'
  prompt=yes;
```

Additionally, ACLs can be created on the LIBNAME domains themselves and the resources that are created within them. The simplest way to do this is using PROC SPDO. The following example demonstrates this:

```
LIBNAME clin sasspds 'clinical'
  host='samson'
  user='drzeuss'
  prompt=yes;
```

```
PROC SPDO lib=clin;
set acluser;
add ACL /
  LIBNAME groupread;
modify ACL /
  LIBNAME drfgood=(y,y,,y);
quit;
```

The owner of the LIBNAME domain 'clinical' has granted permission to other members of his or her ACL group to the LIBNAME domain to have READ access to the domain. This permits these users to perform SAS LIBNAME assignments to the domain. Users not belonging to the owner's ACL group will not even be permitted to make LIBNAME assignments to the 'clinical' domain. The owner has also granted READ, WRITE and CONTROL access to the explicit user 'drfgood'. This enables 'drfgood' to make LIBNAME assignments and write new files to the 'clinical' domain, and to also alter the LIBNAME ACL permissions if desired.

Disabling ACL Security

Overview of Disabling ACL Security

You disable SPD Server security by using the -NOACL option with the **spdsserv** command. When ACLs are disabled, there are almost no security restrictions in the SPD Server environment. Anyone can access SPD Server, as long as they know the LIBNAMES that are defined by the system administrator in the -libname file.

UNIX File-Level Protection with ACL Security Disabled

In UNIX, each SPD Server session runs under a UNIX user ID. All files created by SPD Server therefore are protected according to the UNIX file creation permissions of that UNIX user ID. Use the UNIX 'umask' command to restrict the desired creation permissions. File permissions are based on the permissions of the directory where the file was created.

Control of LIBNAME Domains by the System Administrator without ACL Security

The system administrator defines the valid LIBNAME domains with entries in the LIBNAME parameter file for each SPD Server. PATHNAME= defines the file system for the LIBNAME. LIBNAME= provides the access route to the file system. Restricting knowledge of the LIBNAME= labels restricts access to the corresponding file system.

Example Server Setup without ACL Security

The following command invokes SPD Server without ACL security enabled.

```
spdssrv -noacl -acldir
InstallDir/site -nameserver samson
-libnamefile libnames.parm
```

The libnames.parm file contains:

```
LIBNAME=open_access
  pathname=/disk1/sas_tables;
LIBNAME=mgmt_access
  pathname=/disk2/managers/data;
```

SPD Server is invoked, connecting to the name server running on the machine called 'samson'. Despite no ACLs, a password file is still required in the directory called **`InstallDir/site`**.

Note: InstallDir is a documentation substitute for the actual path specification for the directory where SPD Server is installed on a particular machine.

LIBNAME domains 'open_access' and 'mgmt_access' are registered with the name server. The /disk1/sas_tables and /disk2/managers/data directories must exist, and the user ID that invokes spdssrv must have read and write access to those directories. The following LIBNAME statements connect a SAS client to the data areas:

```
LIBNAME open sasspds 'open_access'
  host='samson';
LIBNAME mgmt sasspds 'mgmt_access'
  host='samson';
```

Controlling SPD Server Resources with PROC SPDO and ACL Commands

Using PROC SPDO

Overview of PROC SPDO

PROC SPDO is the SAS procedure for the SPD Server operator interface.

PROC SPDO runs only on systems where the SAS is installed.

PROC SPDO Command Set

To invoke PROC SPDO, submit:

```
PROC SPDO LIB=libref ;
```

where libref is a LIBNAME that was previously allocated to the sasspds engine.

Currently there are two classes of PROC SPDO commands:

- ACL commands
- LIBNAME proxy commands.

The ACL commands are described below with some simple examples that demonstrate their syntax and usage. More detail on LIBNAME Proxy Commands are discussed in more detail in "SPD Server Operator Interface Procedure (PROC SPDO) " on page 209

Using ACL

An SPD Server Access Control List (ACL) permits three distinct levels of permission on a resource. First, you can grant UNIVERSAL permissions to SPD Server users who are not in the same ACL group as the resource owner. Second, you can grant GROUP permissions to SPD Server users who are in the same ACL group as the resource owner. Third, you can grant USER permissions to a specific SPD Server user ID. The precedence of permission checks is as follows:

1. Check user-specific permissions first. If defined, the accessor gets these permissions.

2. If a resource is owned by the same ACL group as the accessor, the accessor gets the resource's GROUP permissions.
3. If the resource is owned by a different ACL group than the accessor, the accessor gets the resource's UNIVERSAL permissions.

To turn on LIBACLINHERIT permissions in your spdsserv.parm file, submit the statement:

```
LIBACLINHERIT ; .
```

To turn off LIBACLINHERIT permissions in your spdsserv.parm file, submit the statement::

```
NOLIBACLINHERIT ; .
```

You can also use your libnames.parm file to turn on LIBACLINHERIT permissions.

To turn on LIBACLINHERIT permissions in your libnames.parm file, submit the statement:

```
LIBACLINHERIT=YES.
```

To turn off LIBACLINHERIT permissions in your libnames.parm file, submit the statement::

```
LIBACLINHERIT=NO.
```

If the LIBACLINHERIT parameter file option is turned on, the ACL precedence of permission checks changes. Turning on LIBACLINHERIT creates a LIBNAME ACL on the specified LIBNAME domain. The LIBNAME ACL grants users rights to all resources within the LIBNAME domain. When a LIBNAME ACL is created for a specified LIBNAME domain, the ACL precedence of permission checks becomes:

1. Check user-specific permissions first. If defined, the accessor gets these permissions.
2. If a resource is owned by the same ACL group as the accessor, the accessor gets the resource's GROUP permissions.
3. LIBNAME ACL permissions are used for domains where LIBACLINHERIT is turned on.
4. If the resource is owned by a different ACL group than the accessor, the accessor gets the resource's UNIVERSAL permissions.

ACL Concepts

ACL Groups

ACL groups are somewhat analogous to UNIX groups. Each SPD Server user ID can belong to one or more ACL groups.

The SPD Server administrator can affiliate a given SPD Server user ID with up to five ACL groups. When you connect to an SPD Server using a LIBNAME assignment, you assert a specific ACL group using the ACLGRP= option.

The ACLGRP= value in your LIBNAME assignment must match one of the five groups that the administrator defined for you. If you do not assert ACLGRP= in your LIBNAME assignment, the SPD Server affiliates you with your default ACL group. (This is the first group in the list of five.)

When defining user-specific ACL permissions, you can use an ACL group wherever you can use an explicit SPD Server user ACL. Using an ACL group grants privileges to the ACL group instead of only to a specific SPD Server user.

Column Security

SPD Server allows you to control access to table contents at the column level through the use of ACLs. Column security ACLs can be applied to individual users at the user level, or applied to collections of users at the group level. SPD Server enforces precedence for user and group ACL permissions: first user ACL permissions are applied, then group ACL restrictions are applied. SPD Server user permissions override SPD Server group permissions.

When you use an ACL statement to create a protected column in a table, all individual users or groups are automatically denied access to the protected column until they are explicitly granted ACL permission to access it. When you issue an ACL statement to grant **or deny** the contents of a table column to a single user or user group, the protected column automatically becomes unavailable to **all** individual users and user groups, unless they are specifically given access to the protected column.

Let's examine a scenario where a testing department hires a new member, Joe. Joe has applied for classified security clearance, but his security clearance level won't be certified for several weeks. All members of the department use an SPD Server table TESTING that contains a column of classified information. Joe needs access to all of the TESTING table except the protected column, and the rest of his group needs access to the whole TESTING table.

First, you submit a user-level ACL statement to restrict the secure column in table TESTING from Joe. Joe is explicitly denied access, but since the column is now a protected entity, all other TESTING table users are also denied access to the column by default. Once a column is protected via ACL security, explicit permissions must be granted in order for any user (or groups of users) to be able to access the column content. Instead of issuing user-level column ACL permissions to the rest of the testing group individually, you issue a group-level ACL column permission to the user group TESTGROUP that explicitly grants access to the protected column.

SPD Server reads the user-level ACL permissions first, and gives Joe access to the table TESTGROUP, but restricts him from the secure column. Then SPD Server reads the group ACL permissions, and grants all of the TESTGROUP members access to the full table, including the secure column. Joe is a member of TESTGROUP, but the user-level ACL permissions maintain precedence over group-level ACL permissions. This results in all of TESTGROUP having full table access, except Joe. Joe's user-level ACL column security restriction prevents him from accessing the classified column.

Now consider another scenario, where John manages a group DEVGROUP whose members record their billable project hours and codes in an SPD Server table. In that table, manager John keeps billing rate information based on employee salaries in a protected column RATE. Only John should be able to see the entire table, and the rest of the DEVGROUP should be able to see the table minus the RATE column. In this case, you create column security by protecting the RATE column with a user-level ACL permission statement for John. The DEVGROUP members can have full table permissions at the group level, but will not see the protected column because John's user-level column security ACLs will override any group-level ACLs for the DEVGROUP table.

Generic ACL

You can use generic ACL names for a class of resources that have a common prefix. You can use the asterisk symbol "*" as a wildcard. This permits you to make a single ACL entry instead of making explicit entries for each resource. For example, if you have tables named

SALESNE, SALESSE, SALESMW, SALESSW, SALESPW, and SALESNW, you could use the wildcard symbol to create the generic ACL name, SALES*, to cover them all. You then would define your ACL permissions on the SALES* generic ACL.

When using PROC SPDO, use the /GENERIC command option to identify a generic ACL.

Note: If you specify /GENERIC when defining a table column ACL, the /GENERIC applies to the table name, not to the column name. You cannot use wildcards with column names.

LIBNAME ACL

You can control access permissions to an entire LIBNAME domain with the SPD Server ACL facility. When using PROC SPDO, use the /LIBNAME option to identify the LIBNAME domain ACL.

Persistent ACL

A persistent ACL entry is an ACL that is not removed from the ACL tables when the resource itself is deleted. When using PROC SPDO, use the /PERSIST command option to identify a persistent ACL.

Resource

A PROC SPDO resource is

- a table (data set)
- a table column (data set variable)
- a catalog
- a catalog entry
- a utility file (for example, a VIEW, an MDDB, and so on)
- a LIBNAME domain.

Two-Part Resource Name

Two-part names identify a column entry within a table. Use the normal SAS convention of **table.column** when specifying the table and column that you want to secure.

When issuing SPDO commands, you can use two-part names in any context that defines, modifies, lists, or deletes table-related ACLs. You can also specify the reserved word _ALL_ as the column name when using SPDO commands that support the _ALL_ resource name.

Giving Control to Others

You permit other SPD Server users to alter your own ACL entry by granting a specific user/group ACL entry. See "MODIFY ACL and MODIFY ACL _ALL_" on page 160 for more information about user-specific ACL entries.

Overview of the ACL Command Set

This section describes PROC SPDO commands that you use to create and maintain ACLs on SPD Server resources.

To perform an ACL-related command, you must first assert an ACL user ID to define the scope of your access. In addition, you might want to set up a scoping member type to access ACLs for resource types other than DATA. Then you can ADD, MODIFY, LIST, or DELETE ACLs within the scope that you set up. You can switch the scope of a user and/

or member type at any point in a command sequence, and then continue with additional ACL commands in the new scope.

SET ACLTYPE memtype;

Sets the member type for subsequent ACL operations. Valid values are DATA, CATALOG, VIEW, and MDDB. The default is DATA.

SET ACLUSER [name];

Sets the SPD Server user scope for subsequent ACL operations. The user scope restricts your view to only those ACL records which have the specified user name as the owner of the ACL entry. If name is omitted, the default is the user who assigns the libref.

To actually perform an ACL operation on a resource entry, you must

- be the ACL entry owner, or
- have CONTROL access over the ACL entry, or
- have ACLSPECIAL=YES enabled on your PROC SPDO LIBNAME connection.

Note: You must first issue a SET ACLUSER command before issuing any of the following ACL commands.

ADD ACL acl1 acl2... [C=cat T=type] [/options]

Creates new ACL entries acl1 acl2... where ACL entries acl1 acl2 ... can be one-part resource names or two-part table column names.

Add ACL Options

READ
Grants universal READ access to the resource.

WRITE
Grants universal WRITE access to the resource.

ALTER
Grants universal ALTER access to the resource.

GROUPREAD
Grants group READ access to the resource.

GROUPWRITE
Grants group WRITE access to the resource.

GROUPALTER
Grants group ALTER access to the resource.

GENERIC
Specifies that acl1 acl2... are generic ACLs.

PERSIST
Specifies that acl1 acl2... are persistent ACLs.

LIBNAME
Identifies the special LIBNAME domain resource.

MODEL=*acl-name*
Specifies the name of another ACL. This option requests the software to copy all the access permissions and access list entries from this ACL.

C=cat
Identifies the specified ACL names acl1 acl2... as the names of catalog entries in the catalog **cat**. You pair this value with the T= option.

T=type
Identifies the catalog entry type to associate with the specified ACLs acl1 acl2... when you specify the C=cat option.

ADD ACL Examples

Add LIBNAME Domain ACL

This ACL grants universal READ and group WRITE access.

```
add acl/LIBNAME
   read
   groupwrite;
```

Add Resource ACL

This ACL for the resource MINE_JAN1999 grants universal READ and WRITE access.

```
add acl mine_jan1999/read write;
```

Add Generic ACL

This generic ACL for MINE* grants universal READ access.

```
add acl mine/generic read;
```

Add Column ACL

This ACL for the column MINE_JAN2006.SALARY grants group READ access and denies access to all others.

```
add acl mine_jan2006.salary/groupread;
```

Add Generic Column ACL

This ACL for the column MINE*.SALARY grants group READ access and denies access to all others.

```
add acl mine.salary/generic
   groupread;
```

Add Catalog ACL

This ACL for the MYCAT catalog grants universal READ and group READ/WRITE access.

```
set acltype catalog;
add acl mycat/read
 groupread
 groupwrite;
```

Add Generic ACL for Catalog Entries

This ACL for catalog entries, MYCAT.MY*.CATAMS, grants universal READ and group READ access.

```
set acltype catalog;
 add acl my
  c=mycat
  t=catams/generic
  read
  groupread;
```

MODIFY ACL and MODIFY ACL _ALL_

MODIFY ACL acl1 acl2... [C=cat T=type] /options user list;

MODIFY ACL _ALL_ /options user list;

Modifies existing ACLs for resources acl1 acl2... where ACL entries acl1 acl2... can be one-part resource names or two-part table column names. Specifying _ALL_ modifies all existing ACLs for which you have control access. Specifying _ALL_ as the table identifier in a two-part name modifies all tables for which the given column is matched. Specifying _ALL_ as the column identifier in a two-part name modifies all columns for which the given table is matched. The characteristics modified are specified by options and/or user list.

Modify ACL Options

READ
: Grants universal READ access.

NOREAD
: Removes universal READ access.

WRITE
: Grants universal WRITE access.

NOWRITE
: Removes universal WRITE access.

ALTER
: Grants universal ALTER access.

NOALTER
: Removes universal ALTER access.

GROUPREAD
: Grants group READ access.

NOGROUPREAD
: Removes group READ access.

GROUPWRITE
: Grants group WRITE access.

NOGROUPWRITE
: Removes group WRITE access.

GROUPALTER
: Grants group ALTER access.

NOGROUPALTER
Removes group ALTER access.

GENERIC
Specifies that acl1 acl2... are generic ACLs.

LIBNAME
Identifies the special LIBNAME domain ACL.

C=cat
Identifies the selected ACLs as names of catalog entries from the catalog cat. This value must be paired with the T= option.

T=type
Identifies the catalog entry type used to qualify the selected ACLs when the C=cat option is specified.

userlist
can be user name = (Y/N,Y/N,Y/N,Y/N) for (READ,WRITE,ALTER,CONTROL).

MODIFY ACL Examples

Modify LIBNAME Domain ACL

This modifies a LIBNAME domain to set READ and WRITE access for a given user.

```
modify acl/LIBNAME
  ralph=(y,y,n,n);
```

Modify ACL MINE

This modifies ACL MINE_JAN2003 to deny universal WRITE access and add user-specific permissions.

```
modify acl mine_jan2003/nowrite
  bolick=(y,n,n,n)
  johndoe=(n,n,n,n);
```

Modify Generic ACL

This modifies a generic ACL MINE* to add user-specific permissions.

```
modify acl mine/generic
  tom=(y,y,y,n);
```

Modify All ACLs

This modifies all ACLs to grant READ access to a given user.

```
modify acl _all_/gene=(y,,,);
```

Modify Column ACL

This modifies column ACL, MINE_JAN2006.SALARY, to add explicit READ and WRITE access for a given user.

```
modify acl mine_jan2006.salary/ralph=(y,y,n,n);
```

Modify Generic Column ACL

This modifies generic column ACL, MINE*.SALARY, to add explicit READ and WRITE access for a given user.

```
modify acl mine.salary/generic
 debby=(y,y,n,n);
```

Modify ACL for a Catalog

This modifies catalog MYCAT to remove universal READ and group WRITE access.

```
set acltype catalog;
  modify acl mycat/noread nogroupwrite;
```

Modify Generic ACL for Catalog Entries

This modifies a generic ACL for catalog entries, MYCAT.MY*.CATAMS, to remove universal READ access.

```
set acltype catalog;
 modify acl my
  c=mycat
  t=catams/generic noread;
```

LIST ACL and LIST ACL _ALL_

LIST ACL acl1 acl2... [/options];

LIST ACL _ALL_ [/options];

Lists information about specific ACLs acl1 acl2... where ACL entries acl1 acl2... can be one-part resource names or two-part (table.column) names. Specifying _ALL_ lists all existing resource ACLs for which you have control access. Specifying _ALL_ as the table identifier in a two-part name lists all tables for which the given column is matched. Specifying _ALL_ as the column identifier in a two-part name lists all columns for which the given table is matched.

List ACL Options:

GENERIC
: Specifies that acl1 acl2 are generic ACLs.

LIBNAME
: Identifies the special LIBNAME domain ACL.

C=cat
: Identifies the selected ACLs as names of catalog entries from the catalog cat. This value must be paired with the T= option.

T=type
: Identifies the catalog entry type used to qualify the selected ACLs when the C=cat option is specified.

VERBOSE
: Performs the requested table ACL listing, followed by the column ACLs for a specified table(s). This is equivalent to a LIST ACL table followed by a LIST ACL table._ALL_.

LIST ACL Examples

List All ACL Entries

This lists all ACL entries for the current ACL type setting.

```
list acl _all_;
```

List a Generic ACL

This lists a generic ACL entry for MINE*.

```
list acl mine/generic;
```

List All Column ACLS for a Table

This lists all column ACLs for table MINE_JAN2003.

```
list acl mine_jan2003._all_;
```

List All Column ACLs for All Tables

This lists all column ACLs for all tables.

```
list acl _all._all_;
```

List a Specific Column

This lists the column ACL for MINE_JAN2006.SALARY.

```
list acl
 mine_jan2006.salary;
```

List All ACL Data for a Table

This provides all ACL information for table MINE_JAN2006.

```
list acl
 mine_jan2006/verbose;
```

List All ACLs for Catalogs

This lists all ACLs for the ACL type 'catalog'.

```
set acltype catalog;
 list acl _all_;
```

List All ACLs for a Catalog

This lists all ACLs for catalog MYCAT.?.CATAMS.]

```
set acltype catalog;

  list acl _all_ c=mycat t=catams;
```

DELETE ACL and DELETE ACL _ALL_

DELETE ACL acl1 acl2... [C=cat T=type] /options

DELETE _ALL_[C=cat T=type] /options;

Deletes existing ACLs for resources acl1 acl2... where ACL entries acl1 acl2... can be one-part resource names or two-part table.column names. Specifying _ALL_ deletes all existing resource ACLs for which you have control access. Specifying _ALL_ as the table identifier in a two-part name deletes all tables for which the given column is matched. Specifying _ALL_ as the column identifier in a two-part name deletes all columns for which the given table is matched.

Delete ACL Options:

GENERIC
: Specifies that acl1 acl2 are generic ACLs.

LIBNAME
: Identifies the special *LIBNAM* ACL.

C=cat
: Identifies the selected ACLs as names of catalog entries from the catalog cat. This value must be paired with the T= option.

T=type
: Identifies the catalog entry type used to qualify the selected ACLs when the C=cat option is specified.

DELETE ACL Examples

Delete a LIBNAME ACL

This deletes a LIBNAME ACL.

```
delete acl/LIBNAME;
```

Delete All ACLs for Current ACL Type

This deletes all the ACLs for the current ACL type.

```
delete acl _all_;
```

Delete a Resource ACL

This deletes ACL MINE_JAN2003.

```
delete acl mine_jan2003;
```

Delete a Generic ACL

This deletes a generic ACL MINE*.

```
delete acl mine/generic;
```

Delete a Column ACL

This deletes a column ACL on MINE_JAN2003.SALARY.

```
delete acl mine_jan2003.salary;
```

Delete All Column ACLs on a Table

This deletes all column ACLs on table KBIKE.

```
delete acl kbike._all_;
```

Delete All Column ACLs on All Tables

This deletes all column ACLs on all tables.

```
delete acl _all_._all_;
```

Delete a Catalog ACL

This deletes an ACL on the catalog RBIKE.

```
set acltype catalog;
 delete acl rbike;
```

Delete a Generic ACL on Catalog Entries

This deletes a generic ACL on the catalog entries MYCAT.MY*.CATAMS.

```
set acltype catalog;
delete acl my
 c=mycat
 t=catams/generic;
```

Symbolic Substitution

SPD Server SQL supports symbolic substitution of the user's User ID using @SPDSUSR, group using @SPDSGRP, and whether the user is ACL Special using @SPDSSPEC in SQL queries. When the query is parsed, @SPDSUSR will be replaced by the User ID, @SPDSGRP by the group, and @SPDSSPEC will be "true" if the user has ACL Special privileges. The right hand side of symbolic substitution statements must be in all upper case text. Consider the example, "@SPDSUSR" = "SOMEUSER".

Symbolic Substitution Row Level Security

A powerful use of symbolic substitution is deploying row level security on sensitive tables that use views. Suppose there is a sensitive table that only certain users or groups can access. The administrator can use symbolic substitution to create a single view to the table that provides restricted access based on user ID or groups. The administrator could give universal access to the view, but only users or groups that meet the symbolic substitution constraints will see the rows.

For another example, imagine a table that contains sensitive information has one column that contains group names or user IDs. The administrator can use symbolic substitution to create a single view that allows users to access only the rows that contain his user ID or group. The administrator could give universal access to the view, but each user or group would be allowed to only see their user or group rows.

Symbolic Substitution Example

```
PROC SQL;
```

```
   connect to sasspds
     (dbq="path1"
      server=host.port
      user='anonymous');

/* queries comparing literal rows are  */
/* only selected if the symbolic       */
/* substitution evaluates as 'true'    */

  select *
  from connection
  to sasspds(
     select *
     from mytable
     where "@SPDSUSR" = "SOMEUSER");

  select *
  from connection
  to sasspds(
     select *
     from mytable
     where "@SPDSGRP" = "SOMEGROUP");

  select *
  from connection
  to sasspds(
     select *
     from mytable
     where "@SPDSSPEC" = "TRUE");

/* queries based on column values will only  */
/* select appropriate columns                */

  select *
  from connection
  to sasspds(
     select *
     from mytable
     where usercol = "@SPDSUSR");

  select *
  from connection
  to sasspds(
     select *
     from mytable
     where grpcol = "@SPDSGRP");

/* Create a view to worktable that allows    */
/* users FRED or BOB, groups BCD or ACD, or  */
/* someone with ACLSPECIAL to read the table */

  execute(create view workview as
      select *
      from worktable
      where "@SPDSUSR" in ("FRED", "BOB") or
            "@SPDSGRP" in ("BCD", "ACD") or
```

```
                "@SPDSSPEC" = "TRUE")
    by sasspds;

 /* Create a view to worktable that allows users    */
 /* to access only rows where the column "usergrp"  */
 /* matches their group. The userID BOSS can access */
 /* any group records where the column "userid" is  */
 /* "BOSS"                                          */

    execute(create view workview as
        select *
        from worktable
        where usergrp = "@SPDSGRP" and
        ("@SPDSUSR" = "BOSS" or userid != "BOSS"))
    by sasspds;
disconnect from sasspds;
quit;
```

ACL Security Examples

Overview of Security Examples

If LIBACLINHERIT=YES is added to a LIBNAME definition, the ACL precedence of permission checks changes. In this case, the LIBNAME ACL is used to first give READ or WRITE access to the domain, and then to inherit ACLs for resources that are owned by the domain owner. When a user accesses resources in an owned domain by using LIBACLINHERIT=YES, the following precedence of permissions checks on the ACL resource:

- If user-specific permissions are defined on the object for the accessor, the accessor gets these permissions.
- If group-specific permissions are defined on the object for the accessor's group, the accessor gets these permissions.
- If LIBNAME ACL permissions are defined for the accessor, the accessor gets these permissions on the object.
- If LIBNAME ACL permissions are defined for the accessor's group, the accessor gets these permissions on the object.
- Otherwise, the accessor gets UNIVERSAL ACLs on the resource.

The following are examples using LIBACLINHERIT:

Below is a listing of the libnames.parm files that are used in the code examples, along with a listing of users and groups in the password database.

```
libnames.parm:
---------------------------------
LIBNAME=d1
  pathname=/IDX1/spdsmgr/d1
  owner=admin ;
LIBNAME=d2
  pathname=/IDX1/spdsmgr/d2
  owner=prod1 ;
LIBNAME=colsec
```

```
  pathname=/IDX1/spdsmgr/colsec
  owner=boss ;
LIBNAME=onepath
  pathname=/IDX1/spdsmgr/onepath ;

Password database List:

User     Level  Entry Type  Group
---------------------------------
ADMINGRP   0   GROUP ENTRY
GROUP1     0   GROUP ENTRY
GROUP2     0   GROUP ENTRY
GROUP3     0   GROUP ENTRY
GROUP4     0   GROUP ENTRY
PRODGRP    0   GROUP ENTRY
ADMIN1     7   user ID     ADMINGRP
ADMIN2     7   user ID     ADMINGRP
PROD1      7   user ID     PRODGRP
PROD2      7   user ID     PRODGRP
USER1      0   user ID     GROUP1
USER2      0   user ID     GROUP2
USER3      0   user ID     GROUP3
USER4      0   user ID     GROUP4
USER5      0   user ID     GROUP1
USER6      0   user ID     GROUP2
USER7      0   user ID     GROUP3
USER8      0   user ID     GROUP4
BOSS       7   user ID     ADMINGRP
EMPLOYEE   0   user ID
```

Domain Security

When the libname.parm option OWNER= is specified, no other user can access the domain unless the user is given permissions by the domain owner. Permissions to access a domain are given using a LIBNAME ACL statement.

The code example below uses a LIBNAME ACL statement to give access permissions to different groups.

```
LIBNAME d2 sasspds 'd2'
  server=zztop.5162
  user='prod1'
  password='spds123'
  IP=YES ;

/* Give permissions to LIBNAME */

PROC SPDO library=d2 ;

/* assign who owns the ACLs */

  set acluser prod1 ;

/* Give specific groups access */
/* to the domain. */
```

```
  add ACL / libname ;
  modify ACL /
  LIBNAME prodgrp=(y,y,y,y)
    group1=(y,y,n,n)
    group2=(y,n,n,n)
    group3=(y,n,n,n) ;

/* Give spedific users access to */
/* the domain */

  modify ACL /
  LIBNAME user7=(y,n,n,n)
    admin1=(y,n,n,n) ;
  list ACL _all_ ;
quit ;
```

The ID 'prod2' is in the group which has permissions to control the LIBNAME ACL. Any ID in that group can modify the LIBNAME ACL.

Because the ACL was created by user 'prod1', the user 'prod2' must use the user ID 'prod1' in order to modify the LIBNAME ACL. This is allowed because the group was given control. User 'prod1' still remains the owner of the LIBNAME ACL.

```
LIBNAME prod2d2 sasspds 'd2'
  server=zztop.5162
  user='prod1'
  password='spds123'
  IP=YES ;

PROC SPDO library=prod2d2 ;

/* Set user ID as 'user1', who owns */
/* the ACL to be modified */

  set acluser prod1 ;
  modify ACL /
  LIBNAME group1=(n,n,n,n)
    group4=(y,n,n,n) ;
  list ACL _all_ ;
quit ;
```

The second way that the LIBNAME ACL can be changed is by using a user ID that has ACL Special privileges. In the example below, the user 'admin1' uses the ACLSPECIAL= statement to modify the LIBNAME ACL. As in the previous example, the user 'admin1' must use the user ID of 'prod1'.

```
LIBNAME admin1d2 sasspds 'd2'
  server=zztop.5162
  user='admin1'
  password='spds123'
  ACLSPECIAL=YES
  IP=YES ;

PROC SPDO library=admin1d2 ;
```

```
/* The ACLSPECIAL= statement allows */
/* the user 'admin1' to operate under */
/* the user ID 'prod1', allowing the */
/* ACLs to be modified. */

  set acluser prod1 ;
  modify ACL /
  LIBNAME admingrp=(y,n,n,n) ;
    list ACL _all_ ;
quit ;
```

LIBACLINHERIT

If the LIBACLINHERIT parameter file option is turned on, the ACL precedence of permission checks changes. Turning on LIBACLINHERIT creates a LIBNAME ACL on the specified LIBNAME domain. The LIBNAME ACL grants users rights to all resources within the LIBNAME domain. When a LIBNAME ACL is created for a specified LIBNAME domain, the ACL precedence of permission checks becomes:

1. Check user-specific permissions first. If defined, the accessor gets these permissions.
2. If a resource is owned by the same ACL group as the accessor, the accessor gets the resource's GROUP permissions.
3. LIBNAME ACL permissions are used for domains where LIBACLINHERIT is turned on.
4. If the resource is owned by a different ACL group than the accessor, the accessor gets the resource's UNIVERSAL permissions.

The following is an example using LIBACLINHERIT:

```
/* information from libnames.parm                 */
/*                                                */
/* LIBNAME=LIBINHER                               */
/*    pathname=/IDX1/spdsmgr/spds41test/libinher  */
/*    LIBACLINHERIT=YES                           */
/*    owner=admin;                                */
/* LIBNAME=noinher                                */
/*    pathname=/IDX1/spdsmgr/spds41test/noinher   */
/*    owner=admin;                                */


LIBNAME libinher sasspds 'libinher'
   server=zztop.5129
   user='admin'
   password='spds123';

LIBNAME noinher sasspds 'noinher'
   server=zztop.5129
   user='admin'
   password='spds123';

data libinher.admins_table
     noinher.admins_table ;

   do i = 1 to 10;
     output;
```

```
   end;
run;


/* Set up libname access for user anonymous */

PROC SPDO library=libinher;


/* set who will own these ACLs */

set acluser admin;


/* Add a libname ACL to d1 */

add acl / LIBNAME;


/* Modify libname ACL Domain d1     */
/* Allow users in Group 1 read-only */
/* access to the domain             */
modify acl / LIBNAME read;

  list acl _all_;
quit;


/* Set up libname access for user anonymous */

PROC SPDO library=noinher;


/* Specify who owns these ACLs */

set acluser admin ;


/* add a libname ACL to d1 */

add acl / LIBNAME ;


/* Modify libname ACL Domain d1      */
/* Allow users in Group 1 read-only  */
/* access to the domain              */

modify acl / LIBNAME read ;

  list acl _all_;
quit;

LIBNAME a_inher sasspds 'libinher'
   server=zztop.5129
   user='anonymous';
LIBNAME a_noher sasspds 'noinher'
```

```
   server=zztop.5129
   user='anonymous';

PROC PRINT data=a_inher.admins_table;
   title 'with libaclinher';
run;

PROC PRINT data=a_noher.admins_table;
   title 'without libaclinher';
run;
```

Anonymous User Account

The SPD Server uses a general ID that is called 'anonymous'. Any person that can connect to the server can do so using the anonymous user ID. The anonymous ID cannot be removed from the password database using the psmgr utility and the delete command. If you want to prevent anonymous user ID access, the SPD Server administrator must use the psmgr utility to add a user called, "anonymou" to the password database, and keep the password secret.

Any table that is created by the anonymous user ID can be viewed by all users who have access to that table's domain. The anonymous ID does have the ability to place ACLs on the table to limit access.

```
/* John logs in using the anonymous */
/* user ID and creates a table      */

     LIBNAME john sasspds 'onepath'
       server=zztop.5162
       user='anonymous'
       password='anonymous'
       IP=YES ;

     data john.anonymous_table ;
       do i = 1 to 100 ;
       output ;
       end ;
     run ;

/* Mary can also log in as anonymous  */
/* and read the table that John       */
/* created.                           */

     LIBNAME mary sasspds 'onepath'
       server=zztop.5162
       user='anonymous'
       IP=YES ;

     PROC PRINT data=mary.anonymous_table
       (obs=10) ;
       title
         'mary reading anonymous_table' ;
     run ;

/* user1 can log in and read the table */
/* that John created                   */
```

```
     LIBNAME user1 sasspds 'onepath'
       server=zztop.5162
       user='user1'
       password='spds123'
       IP=YES ;

     PROC PRINT data=user1.anonymous_table
       (obs=10) ;
       title
         'user1 reading anonymous_table' ;
     run ;

/* Tables created by user ID anonymous */
/* can have ACLs                       */

     PROC SPDO library=john ;

/* assign who owns the ACL */

     set acluser anonymous ;

/* The MODIFY statement sets an ACl so */
/* only user ID 'anonymous' can read   */
/* the table                           */

     add ACL anonymous_table ;
     modify ACL anonymous_table /
       anonymous=(y,n,n,n);

     list ACL _all_;
     quit ;

/* Now, only user ID 'anonymous' can */
/* read the table                    */

     LIBNAME user1 sasspds 'onepath'
       server=zztop.5162
       user='user1'
       password='spds123'
       IP=YES ;

     PROC PRINT data=user1.anonymous_table
       (obs=10) ;
       title
         'user1 trying to read anonymous_table' ;
     run ;

     LIBNAME mary sasspds 'onepath'
       server=zztop.5162
       user='anonymous'
       password='anonymous'
       IP=YES ;

     PROC PRINT data=mary.anonymous_table
       (obs=10) ;
```

```
       title
         'mary reading anonymous_table' ;
     run ;

/* Mary can't write to anonymous_table */

     data mary.anonymous_table ;
       do i = 1 to 100 ;
       output ;
       end ;
     run ;
```

Read Only Tables

A common security measure in SPD Server assigns an SPD Server ID to act as the owner of a domain and to provide control over it.

Typically, one or two user IDs administer table loads and refreshes . These user IDs can perform all the jobs that are required to create, load, refresh, update, and administer SPD Server security. Using one or two user IDs centralizes the data administration on the server. More than one ID for data administration spreads responsibility and still provides backup. The following example demonstrates how to allow different groups access to the domain, tables, and how different groups can control resources in the domain.

```
      LIBNAME d1 sasspds 'd1'
        server=zztop.5162
        user='admin1'
        password='spds123'
        IP=YES ;

      PROC SPDO library=d1 ;

/* assign who owns the ACLs */

      set acluser admin1 ;

/* add a LIBNAME ACL to d1  */

      add ACL / LIBNAME ;
```

The MODIFY statement in the code below enables the following actions:

- Any user in same group as admin can read, write, or alter tables and modify the LIBNAME access to the domain.
- Users in group1 and group2 receive read access to the domain.
- Users in group3 and group4 receive read and write access to the domain.

```
      modify ACL / LIBNAME
        admingrp=(y,y,y,y)
        group1=(y,n,n,n)
        group2=(y,n,n,n)
        group3=(y,y,n,n)
        group4=(y,y,n,n) ;

      list ACL _all_;
      quit ;
```

```
/* create two tables */

      data d1.admin1_table1 ;
        do i = 1 to 100 ;
        output ;
        end ;
      run ;

/* admin1 has write priviliges to */
/* the domain                     */

      data d1.admin1_table2 ;
        do i = 1 to 100 ;
        output ;
        end ;
      run ;


/* Generic ACLs allow all users to */
/* read tables created by admin1   */
/* unless a specific ACL is placed */
/* on a resource                   */

      PROC SPDO library=d1 ;

/* Assign who owna the ACLs */

      set acluser admin1 ;
```

The two ACL commands in the code below give read privileges to members of the ACL group 'ADMIN1' for any table that is created by admin1, who has read access to the domain.

This ACL is a good example for data marts and warehouses which DO NOT contain sensitive data. A GENERIC ACL gives broad access to tables in a domain. Generic ACLs must be used correctly (or not at all) if sensitive data needs to be restricted to specific users or groups of users.

If a table in a domain with generic ACLs is not specifically protected by its own ACL, there is a risk of allowing access by any user to sensitive data.

```
     add ACL / generic
       read ;
     modify ACL / generic read
       admingrp=(y,n,n,y) ;
     list ACL _all_;
     quit ;

/* Test access for a user in group1 */

    LIBNAME user1d1 sasspds 'd1'
      server=zztop.5162
      user='user1'
      password='spds123'
      IP=YES ;

    PROC PRINT data=user1d1.admin1_table1
      (obs=10) ;
      title
```

```
        'read admin1_table1 by user1' ;
    run ;

    PROC PRINT data=user1d1.admin1_table2
      (obs=10) ;
      title
        'read admin1_table2 by user1' ;
    run ;

/* Test access for a user in group2 */

    LIBNAME user2d1 sasspds 'd1'
      server=zztop.5162
      user='user2'
      password='spds123'
      IP=YES ;

    PROC PRINT data=user2d1.admin1_table1
      (obs=10) ;
      title
        'read admin1_table1 by user2' ;
    run ;

    PROC PRINT data=user2d1.admin1_table2
      (obs=10) ;
      title
        'read admin1_table2 by user2' ;
    run ;
```

When any ACL is placed on a specific table, that ACL takes precedence over the generic ACL. The ACL in the code below performs the following:

- Gives read access of admin1_table2 to group1.
- Gives the admingrp read and control of admin1_table2
- Takes precedence over the generic read ACL, which prevents users that are not granted specific access to admin1_table2 from reading, writing, altering, or controling the table.

```
    PROC SPDO library=d1 ;

/* Assign who owns the ACLs */

    set acluser admin1 ;

/* This ACL takes precedence over the */
/* generic ACL for users that try to  */
/* access admin1_table2.              */

    add ACL admin1_table2 ;
    modify ACL admin1_table2 /
      group1=(y,n,n,n)
      admingrp=(y,n,n,y) ;
    list ACL _all_;
    quit ;

/* Test access for a user in group1 */
```

```
    LIBNAME user1d1 sasspds 'd1'
      server=zztop.5162
      user='user1'
      password='spds123'
      IP=YES ;

    PROC PRINT data=user1d1.admin1_table2
      (obs=10) ;
      title
        'read admin1_table2 by user1' ;
    run ;

/* Test access for a user in group2 */

    LIBNAME user2d1 sasspds 'd1'
      server=zztop.5162
      user='user2'
      password='spds123'
      IP=YES ;


    PROC PRINT data=user2d1.admin1_table2
      (obs=10) ;
      title
        'read admin1_table2 by user2' ;
    run ;
```

Domain Security and Group Access

This section of code provides an overview of SPD Server domain security and group access using PROC SPDO.

Permissions are often granted to a group of users rather than individual users. The example below shows how to provide the different groups of users access to the domain owned by the user ID "Admin", and then extends the access to the tables. This makes administration both simpler and more secure. Admin1 is the owner of the domain and can determine access to the resources. In the following example, PROC SPDO permits the following:

- Any user ID in admingrp receives read/write/alter access to the domain
- Any user ID in group1 or group2 receives read access to the domain
- Any user ID in group3 or group4 receives read/write access to the domain

```
       LIBNAME d1 sasspds 'd1'
         server=zztop.5162
         user='admin'
         password='spds123
         IP=YES ;

       PROC SPDO library=d1 ;

 /* assign who owns the ACLs */

       set acluser admin ;

 /* add a LIBNAME ACL to d1 */
```

```
      add ACL / LIBNAME ;

/* Allow any user in same group */
/* as admin to read, write, or  */
/* alter tables in the domain   */

      modify ACL / LIBNAME
        admingrp=(y,y,y,n)
        group1=(y,n,n,n)
        group2=(y,n,n,n)
        group3=(y,y,n,n)
        group4=(y,y,n,n) ;

      list ACL _all_;

      run;

/* admin1 has write privileges to */
/* the domain                     */

      data d1.admin1_table1 ;
        do i = 1 to 100 ;
        output ;
        end ;
      run ;

/* Generic ACL allows all users to */
/* read tables created by admin1   */

      PROC SPDO library=d1 ;

/* assign who owns the ACLs */

      set acluser admin1 ;

/* Modify LIBNAME for groupread     */
/* and groupwrite.  The ACL MUST    */
/* inlcude groupread if other       */
/* users  in the same group as      */
/* admin2 need to be able to read   */
/* tables that were created by      */
/* admin2.                          */

      add ACL admin1_table1 /
        generic
        read
        groupread
        groupalter ;

      list ACL _all_;
      run;

/* admin1 has write privileges to    */
/* the domain                        */
```

```
       data d1.admin1_table2 ;
         do i = 1 to 100 ;
         output ;
         end ;
       run ;

/* generic ACL allows all users to    */
/* read the tables                    */

       PROC SPDO library=d1 ;

/* assign who owns the ACLs */

       set acluser admin1 ;

/* Add a table and modify LIBNAME ACL */
/* for groupread and groupwrite. The  */
/* ACL MUST include groupread to give */
/* users in the same group as admin2  */
/* the ability to read tables created */
/* by admin2                          */

      add ACL admin1_table2 /
        group1=(y,n,n,n)
        admingrp=(y,n,n,y) ;
        list ACL _all_;
      run;

/* admin2 has write privileges to the */
/* domain                             */

      data admin2d1.admin2_table ;
        do i = 1 to 100 ;
        output ;
        end ;
      run ;

/* Admin2 must use PROC SPDO to allow */
/* users read access to the table.    */
/* The PROC SPDO example below uses   */
/* generic syntax with a read.  This  */
/* provides any user outside of the   */
/* admingrp read access to tables     */
/* that were created by acdmin2.  The */
/* groupread and groupalter allow     */
/* access by users within admingrp.   */

     PROC SPDO library=admin2d1 ;

/* Assign who owns the ACLs */

     set acluser admin2 ;

/* Modify LIBNAME ACL for groupread   */
/* and groupwrite. The ACL MUST       */
/* include groupread if other users   */
```

```
/* in the same group as admin2 need   */
/* to read tables created by admin2.  */

     add ACL / generic
       read
       groupread
       groupalter ;

     list ACL _all_;

/* admin (same group) can read the     */
/* table                               */

     PROC PRINT data=d1.admin2_table
       (obs=10) ;
       title 'read by admin' ;
     run ;

/* Admin has been given the ability to */
/* modify or replace tables created by */
/* admin2 with 'groupalter'            */

     data d1.admin2_table ;
       do i = 1 to 100 ;
       output ;
       end ;
     run ;

/* Provide other users in same group   */
/* read access to the table            */

     PROC SPDO library=admin2d1 ;

/* assign who owns the ACLs */

     set acluser user3 ;

/* Modify LIBNAME ACL for groupread    */
/* and groupwrite. The ACL MUST        */
/* include groupread if other users in */
/* the same group as admin2 are to be  */
/* able to read tables that were       */
/* created by admin2                   */

     add ACL user3_table /
       groupread ;
     list ACL _all_;
```

Bringing a Table Offline to Refresh

When it is time to refresh the table, the first step is to revoke read privileges to all user IDs, except the ID that will perform the refresh.

```
 LIBNAME d2 sasspds 'd2'
   server=zztop.5162
   user='prod1'
```

```
        password='spds123'
        IP=YES ;
```

This example assumes that the Table **prod1_table** is already loaded in the domain and that the groups who use the table have access.

```
PROC SPDO library=d2 ;

/* assign who will owns these ACLs */

set acluser prod1 ;
```

Modify the table ACL in the following ways:

- Revoke read and control by user IDs that are in the same group. This prevents locks during table refreshes.
- Revoke read access by users that are in group1 through group4 to prevent locks during the refresh process.

  Note: If a user is actively accessing a data table when the ACLs for that table are modified, the user continues to have access. This situation can create a table lock that prevents the table refresh from occurring. By revoking the table's read privileges before the refresh occurs, new SPD Server jobs cannot access the table.

  Existing jobs will continue running and can finish under the lock. You can also use the special PROC SPDO operator commands to identify any users that might be running unattended jobs, and disconnect them so the refresh can take place.

```
modify ACL prod1_table /
  prodgrp=(n,n,n,n)
  group1=(n,n,n,n)
  group2=(n,n,n,n)
  group3=(n,n,n,n)
  group4=(n,n,n,n) ;
```

Now, modify table ACLs to allow the user ID prod1 to perform table refreshes. Because user ID prod1 is part of prodgrp, that ID loses access to the table when the permissions are changed. Prod1, the domain and table owner, can still modify ACLs to gain access.

```
modify ACL prod1_table /
prod1=(y,y,y,y) ;
list ACL _all_;
quit;
```

Now user ID prod1 has full access to refresh the table.

```
data d2.prod1_table ;
do i = 1 to 100 ;
output ;
end ;
run ;

PROC SPDO library=d2 ;

/* Specify who owns the ACLs */
```

```
set acluser prod1 ;
```

There is no need to issue an add ACL command for prod1_table. Deleting a table or replacing a table does not delete the ACLs. The ACL for that table remains until:

- The table ACL is deleted using PROC SPDO delete syntax.
- The table is deleted and another user creates a table with the same name.

At that time, the ACLs have not been deleted. Deleting the table releases any rights that owner has on the table. The exception is when persistent ACLs are used.

After the table has been refreshed, the ACL can be modified to allow read access once again.

```
modify ACL prod1_table /
prodgrp=(y,n,n,y)
group1=(y,n,n,n)
group2=(y,n,n,n)
group3=(y,n,n,n)
group4=(y,n,n,n) ;
list ACL _all_ ;
run ;
```

Bringing a Domain Offline to Refresh Tables

When it is time to refresh the table(s), one approach to minimize contention and table locking is to revoke privileges of users and groups who will not be involved in the refreshing of tables in the domain.

This example assumes that the tables are already loaded in the domain and that the groups who use them have access.

```
  LIBNAME d2 sasspds 'd2'
    server=zztop.5162
    user='prod1'
    password='spds123'
    IP=YES ;

  PROC SPDO library=d2 ;

/* Assign who owns the ACLs */

   set acluser prod1 ;
```

It is possible to revoke read access at the LIBNAME or domain level, which allows the IDs that are used to refresh the warehouse complete control of resources in the domain. This example turns off all read access to the domain, except for IDs that are in the production group (prodgrp).

By doing this, the production IDs have full control over the tables and resources.

Note: Any user that is currently accessing the domain will continue to have access until they are disconnected. This can cause a lock to occur. The PROC SPDO special operator commands can be used to identify the user and disconnect the process so the refresh can take place.

```
modify ACL / LIBNAME
```

```
prodgrp=(y,y,y,y)
group1=(n,n,n,n)
group2=(n,n,n,n)
group3=(n,n,n,n)
group4=(n,n,n,n);
list ACL _all_ ;
run ;

/* Modify ACL for tables to be refreshed */

PROC SPDO library=d2 ;

/* set who owns the ACLs */

set acluser prod1 ;

/* Modify table ACL to revoke read and */
/* control by user IDs in same group, */
/* which prevents locks during table */
/* refreshes. */

modify ACL prod1_table /
prodgrp=(n,n,n,n);

/* Modify table ACL to allow the */
/* 'prod1' user ID to refresh the */
/* table. */

modify ACL prod1_table /
prod1=(y,y,y,y) ;
list ACL _all_;

/* refresh warehouse table(s) */

data d2.prod1_table ;
do i = 1 to 100 ;
output ;
end ;
run ;

PROC SPDO library=d2 ;

/* Assign who owns the ACLs */

set ACLUSER prod1 ;

/* Allow users and groups access to */
/* the domain again. */

modify ACL / LIBNAME
group1=(y,n,n,n)
group2=(y,n,n,n)
group3=(y,n,n,n)
group4=(y,n,n,n) ;

list ACL _all_ ;
```

```
run ;
```

ACL Special Users

SPD Server user IDs have two levels, 0 through 3 and 4 through 7. Level 4 through 7 user IDs can log in as an SPD Server 'super user' that can:

- access any table
- change table ACLs
- disconnect users
- perform administrative functions in a pinch

In many ways, SPD Server super users must be able to take on database administrator functions. The SPD Server super user cannot change the ownership of a table but they can assume the identity of the table owner to do required work. Often, this function happens in a pinch when a user needs access and the table owner or domain owner is out of the office.

The following should be considered when giving a user SPD Server super user status:

- The user must be trusted, because SPD Server super users can access any data in any domain
- How many SPD Server super users do you want? Limit the number in order to maintain control access.
- SPD Server super users must be knowledgeable about the data and the database users' needs.

Assume the table **user1_table1** is loaded, and only read permissions have been given to users in group1. User4 is a member of group4, and group4 does not have read access to the table. User1 is the owner of **user1_table1** in domain d2. User1 is on vacation and user4 has been given an assignment which requires read access to the **user1_table1** to create a report for management.

Management has approved user4 access to the table. The super user prod1 uses the ACLSPECIAL= option to modify the ACLs and to give user4 read access to the table.

```
     LIBNAME prod1d2 sasspds 'd2'
       server=zztop.5162
       user='prod1'
       password='spds123'
       aclspecial=YES
       IP=YES ;

     PROC SPDO library=prod1d2 ;

/* assign to the user to who owns   */
/* the ACL that will be modified    */

     set acluser user1 ;

/* give user ID 'user4' read access */
/* to user1_table1                  */

     modify ACL user1_table1 /
       user4=(y,n,n,n) ;
```

```
list ACL _all_ ;
quit;
```

Column-Level Security

The goal of column-level security is to allow only privileged users to access sensitive columns of tables that other users cannot read.

```
LIBNAME user1 sasspds 'onepath' server=zztop.5161 user='user1'
       password='spds123';
LIBNAME user2 sasspds 'onepath' server=zztop.5161 user='user2'
       password='spds123' aclgrp='group2';
LIBNAME user6 sasspds 'onepath' server=zztop.5161 user='user3'
       password='spds123' aclgrp='group2';

/* generate some dummy data */
data user1.t;
id=1;
salary=2000;
run;

/* Example of only user2 in group2 */
/* being allowed to read column    */
/* salary                          */

PROC SPDO library=user1 ;

/* Assign who owns the ACLs */
set acluser;

/* Clean Up */
delete ACL t;
delete ACL t.salary;

/* Create an ACL on table t to     */
/* allow members of group2 to read */
/* table                           */

add ACL t;
modify ACL t / group2=(y,n,n,n);

/* Create an ACL on column t.salary*/
/* to only allow user2 of group2 to */
/* read the column                   */

add ACL t.salary;
modify ACL t.salary / group2=(y,n,n,n);
quit;

/* Let both users print the table */
/* Only user2 can access column    */
/* salary                          */

proc print data=user2.t;
run;

proc print data=user6.t;
```

```
run;

/* Example of every BUT user2 in */
/* group2 being allowed to read  */
/* column  salary               */

PROC SPDO library=user1 ;

/* Assign who owns the ACLs */
set acluser;

/* Clean Up Column ACL */
delete ACL t.salary;

/* Create an ACL on column t.salary*/
/* to only allow members of group2 to */
/* read the column                  */

add ACL t.salary;
modify ACL t.salary / user2=(y,n,n,n);


/* User permissions have priority over */
/* group permissions.  So now deny     */
/* user2 access to column salary       */

modify ACL t.salary / user2=(n,n,n,n);
quit;

/* Let both users print the table */
/* Only user6 can access column    */
/* salary                           */

proc print data=user2.t;
run;

proc print data=user6.t;
run;
quit;
```

DICTIONARY.PWDB and DICTIONARY.ACLS

Overview of Dictionaries

In addition to dictionary information for tables and columns, SPD Server provides information about the users in the password database and the ACL objects available. The column definitions for DICTIONARY.PWDB and DICTIONARY.ACLS are as follows:

```
DICTIONARY.PWDB {user char(8) Label = 'User'
  auth_lvl char(5) Label = 'Authorization Level'
  ip_addr char(16) Label = 'IP Address'
  defgrp char(8) Label = 'Default Group'
```

```
  othgrps char(40) Label = 'Other Groups'
  expire char(6) Label = 'Expire Period'
  mod_date char(32) Label = 'Password Last Modified'
  log_date char(32) Label = 'Last Login'
  timeout char(6) Label = 'Timeout Period'
  strikes char(6) Label = 'Failed Login Attempts'}

DICTIONARY.ACLS {owner char(8) Label = 'Owner'
  group char(8) Label = 'Group'
  defacs char(56) Label = 'Default Access'
  grpacs char(56) Label = 'Group Access'}
```

Example - Listing the Users in the Password Database using SQL Pass-Through

First, establish an SQL pass-through connection to SPD Server. To list all the users in the password database, submit the following:

```
select *
from connection
to sasspds
   (select *
    from dictionary.pwdb)
```

To select only the user name and last log in date, submit:

```
select *
from connection
to sasspds
   (select user, log_date
    from dictionary.pwdb);
```

Example - Listing ACL Objects using SQL Pass-Through

To list all ACL objects for a user making a pass-through connection, submit the following:

```
select *
from connection
to sasspds
   (select *
    from dictionary.acls);
```

To find any ACL objects where "Jones" is the owner, submit the following:

```
select *
from connection
to sasspds
   (select *
    from dictionary.acls
    where owner = "Jones");
```

Using SPD Server with an Internet Firewall

Overview of Using SPD Server with a Firewall

SPD Server and its clients communicate through ports that permit requests to be sent to the server and that send and receive data (such as table rows) between client and server. If the server is running with an Internet firewall, the ports that the client and server use must be configured so that the firewall will allow the communication. This section describes the SPD Server server and client ports, as well as how to assign and configure them for use with an Internet firewall.

SPD Server clients communicate with the SPD Server Name Server via the SPD Server Name Server listen port. The Name Server listen port is used by clients (such as Base SAS) when LIBNAME and SQL CONNECT statements are issued. The LIBNAME and SQL CONNECT statements must be able to pass through a firewall. The Name Server listen port is also used by ODBC data sources that need to communicate with the SPD Server Name Server.

SPD Server clients communicate with the SPD Server host whenever a client needs to complete a LIBNAME connection, or whenever a client needs to issue SPD Server operator commands. LIBNAME connections and operator commands must be able to access the SPD Server listen port and the SPD Server operator port through existing firewalls.

When an SPD Server server completes a client request for a LIBNAME connection, it creates an SPD Server Base user proxy process. The user proxy handles all of the client data requests. The proxy process requires multiple ports: a port to receive data commands from the client, a port to receive operator commands from the client, and a port for each open table to send and receive data between client and server. Therefore, the SPD Server Base user proxy requires a range of port numbers that must be accessible through the firewall.

Assigning SPD Server Ports that Require Firewall Access

SPD Server Name Server Listen Port

The SPD Server Name Server listen port can be specified using well-known port definitions that are declared in the operating system's services file, or by using the SPD Server command line interface to specify the listen port. In the services file, the **spdsname** specification corresponds to the listen port. The SPD Name Server listen port can also be defined for UNIX installations in the **rc.spds** start-up script. The NSPORT parameter in the **rc.spds** start-up script defines the SPD Server Name Server listen port. If NSPORT is not defined in the **rc.spds** start-up script, the SPD Name Server will use the **spdsname** service entry.

SPD Server Listen Port and SPD Server Operator Port

The SPD Server listen and operator ports can be specified using well-known port definitions that are declared in the operating system's services file, or they can be specified using the SPD Server command line interface. In the operating system's services file, the **spdsserv_sas** specification corresponds to the SPD Server listen port. The **spdsserv_oper** specification corresponds to the SPD Server operator port. The SPD Server listen and operator ports can also be defined in the **rc.spds** start-up script for UNIX installations. In a **rc.spds** start-up script, the **SRVLPORT** parameter defines the listen port,

and the **SRVOPORT** parameter defines the operator port. If the listen and operator ports are not defined, or are defined as a zero value, the SPD Server will by default use **spdsserv_sas** and **spdsserv_oper** in the operating system's services file. If there are no listen or operator ports defined in the operating system's services file, then SPD Server will choose any available ports for listen and operator port functions. This is the normal mode of operation when SPD Server clients and servers run in environments that have no firewalls.

SPD Server Base Proxy Ports

You must use the SPD Server MINPORTNO= and MAXPORTNO= server parameter specifications to define the available range of ports for the SPD Server Base Proxy processes. You must specify both the MINPORTNO= and MAXPORTNO= parameters when you define the range of port numbers that are available to communicate with SPD Server clients that might be outside of a firewall. If the SPD Server parameters for MINPORTNO= and MAXPORTNO= are not specified, an SPD Server Base Proxy process will use any port that is available to communicate with its SPD Server client. This is the normal mode of operation when SPD Server clients and servers run in environments that have no firewalls.

How many port numbers need to be reserved for SPD Server Base User proxy processes? Each SPD Server Base User Proxy process produces its own command port. The command port can be accessed via command-line specifications issued by an SPD Server client. The operator port for a command port can be accessed by using PROC SPDO operator commands.

Each SPD Server host table that is opened also creates its own port. Each SPD Server table port becomes a dedicated data transfer connection that is used to stream data transfers to and from the SPD Server client. SPD Server host table ports are normally assigned dynamically, unless MINPORTNO= and MAXPORTNO= parameters have been specified.

If MINPORTNO= and MAXPORTNO= parameters have been specified, then SPD Server host table ports are assigned from within the port range that is defined by the minimum and maximum port parameter statements. The port range that is specified by the MINPORTNO= and MAXPORTNO= parameters must be able to accommodate the maximum number of concurrent LIBNAME connections required at the server, as well as the I/O data streams that travel between the SPD Server Base processes on the host and the SPD Server clients.

SPD Server Auditing

Overview of SPD Server Auditing

SPD Server supports SQL audit logging of submitted SQL queries and proxy auditing of access to SPD Server resources. SPD Server proxy auditing and SQL audit logging (spdsaud) are enabled when the server is started using the -AUDITFILE or -SQLAUDITFILE parameters. You can enable proxy auditing or SQL audit logging, or both. For more information about start-up options, see the Help section in the SPD Server Administrator's Guide on “SPD Server Host Commands” on page 49 .

SPD Server auditing provides a way to log access to SPD Server resources, or to log implicit or explicit SQL pass-through queries that are submitted to SPD Server. Separate audit logs are created for proxy auditing and SQL audit logging. SPD Server includes three SAS programs (auditwithwhere.sas, auditraw.sas, and auditsql.sas) in the /samples directory of

your SPD Server installation. These programs enable you to input the audit logs into SAS tables. Then, you can query the SAS tables to determine access to SPD Server tables and resources.

Proxy Auditing

Proxy auditing provides a means to determine access to SPD Server resources. The audit record contains the following information:

- the activity timestamp
- the primary path of the domain that contains the resource
- the LIBNAME of the domain
- the user ID of the SPD Server user that is accessing the resource
- the resource name
- the resource type
- the SPD User ID of the resource
- the SPD Group ID of the resource
- the resource operation type for librefs:
  - ASSIGN
- the resource operation type for tables:
  - DELETE
  -
  - RENAME
  - OPEN
  - REOPEN
  - REPAIR
  - TRUNC
- the resource operation type for clusters:
  - CREATE
  - UNDOCL
  - ADDCL
- the resource operation type for a WHERE clause:
  - WHERE
- the resource operation mode for librefs:
  - ACCESS
- the resource operation mode for tables and clusters:
  - OUTPUT
  - INPUT
  - UPDATE
  - UTILITY

- Read permissions that were granted to an SPD Server user to access a resource
- Write permissions that were granted to an SPD Server user while accessing a resource
- the ACLs that are associated with a resource

WHERE Clause Auditing

WHERE clause auditing provides an audit record that contains the following information:

- the length of the WHERE clause
- the contents of the WHERE clause

WHERE clause auditing is enabled using the WHEREAUDIT option. The maximum size that can be allocated WHERE clauses is controlled by the WHAUDLEN option. For more information, see "SPD Server Parameter File Configurations for Auditing" on page 120.

SQL Query Auditing

SQL audit logging provides a record of the SQL queries that were submitted to the SPD Server server. The SQL audit record contains the following information:

- the SQL query timestamp
- the type of SQL query
  - SELECT
  - DROP
  - ALTER
  - CREATE
  - DESCRIBE
  - UPDATE
  - DELETE
  - RESET
  - BEGIN ASYNC
  - END ASYNC
- the number of rows that were returned for an SQL SELECT statement
- the elapsed time in seconds required to process the SQL query
- the user ID of the SPD Server user that submitted the query
- the group ID of the SPD Server user that submitted the query
- the default LIBNAME for the query, used for any table that is not referenced by a two part name
- the length of the query in characters
- the text of the submitted SQL query

The maximum size that can be allocated in the SQL log for an SQL statement is controlled by the SQLAUDLEN option. For more information, see "SPD Server Parameter File Configurations for Auditing" on page 120.

Chapter 15

Managing SPD Server Passwords, Users, and Table ACLs

Introduction

SPD Server user data is maintained in an internal SPD Server password table. Each record in the password table describes the specific attributes and capabilities that are associated with an individual user. SPD Server uses two types of user authentication. The first type of user authentication is LDAP (Lightweight Directory Access Protocol). The second type of user authentication is traditional authentication, which SPD Server performs internally. LDAP authentication is performed by an LDAP server that runs on the SPD Server host machine. The section, "LDAP Authentication Notes" on page 204, contains more details on using LDAP with SPD Server.

The Password Manager Utility psmgr

Overview of the psmgr Utility

The **psmgr** utility manages the password table that enables access to the SPD Server host. When you start SPD Server, the command line option -ACLDIR specifies the location

(directory path) where the table is located. The owner of the password table, typically the SPD Server administrator, can update the table.

The password table contains the following attributes and capabilities for each system user:

- a user ID
- a password
- an access privilege
- an optional IP address
- an optional password expiration time
- an optional ACL group name
- an optional time limit between successful logins
- an optional number of login failures before disabling the user
- an optional user performance class (currently not implemented)

A user ID is are restricted to 8 characters and does not have to correspond to any system user ID.

A passwords is also restricted to 8 characters.

A password for the **psmgr** table must have a minimum of 6 characters - at least one character must be numeric, and at least one character must be alphabetic. A new password must be different from a user's last six passwords. The password cannot contain the user ID.

If a user has three consecutive failed attempts to connect to the SPD Server host, his or her user ID is no longer enabled. Until an administrator resets the user ID, the user will not be able to connect to the SPD Server host.

If you are upgrading to SPD Server 4.5 from SPD Server 3.x, the SPD Server 4.5 **psmgr** utility must be re-populated from the SPD Server 3.x password table.

Invoking the psmgr Utility

You invoke the **psmgr** utility by entering the PSMGR command and specifying the directory path where the password table is located. (Or you can specify a password table that has not yet been created.)

For a UNIX system, use the command:

psmgr installdir/site

The command invokes the **psmgr** utility and specifies the directory path for the password table.

For a Windows system, use the command:

```
psmgr
```

The command invokes the **psmgr** utility and uses the directory where SPD Server was installed to access the password table.

Converting to a psmgr 4.x Table

With SPD Server 4.5, you must convert your SPD Server 3.x password file to 4.5 format. Converting your password file to 4.5. format enables you to use the same set of active SPD Server user IDs in SPD Server 4.5 that you used in SPD Server 3.x. To convert your SPD Server password file to 4.5 format from 3.x format, do the following:

1. Start the SPD Server 3.x **psmgr** utility using your SPD Server 3.x password table.
2. Export your SPD Server 3.x password table.
3. Start the SPD Server 4.5 **psmgr** utility with a new table.
4. Import the exported file from step 2 into the new password table.

Example:

```
/Installdir3_0/bin/psmgr /Installdir3_0/site

Enter Command > export /Installdir3_0/site/oldtable
Enter Command > quit

/Installdir4_0/bin/psmgr /Installdir4_0/site

Enter Command > import /Installdir3_0/site/oldtable
```

This creates a **psmgr** table from an old format **psmgr** table that exists at **/installdir3_0/site**.

Adding New Users with psmgr

Overview of Adding New Users

Whether you want to create the password for the user, or you want the user to create his own password, there are two methods to set up a new user.

Add a New User Who Creates His Own Password

This two-part method requires that the new user knows how to use one of the following LIBNAME options to change his password: CHNGPASS=, or NEWPASSWD=. The first part adds a new user. Perform the following steps:

1. Enter the PSMGR command and the password directory. For example:

   psmgr /SPDS/pwdir

2. Enter the ADD command and the user ID. For example:

   add debby

3. Enter a temporary password for the user. For example:

   temporarypassword

4. Re-enter the temporary password for accuracy. For example:

   temporarypassword

5. Enter an authorization level number from 0 to 7, depending on the authorization level that you want to assign to the user. For example:

   0

6. Enter the IP address of a client machine if you want to limit the user's access to the client machine, or skip this step by pressing **Enter**. For example:

   11.21.1.217

7. Enter the number of days you want the password to be valid. For example:

30

8. Enter the group name if the user is part of an ACL group, or skip this step by pressing **Enter**. For example:

```
groupname
```

The user **debby** is added. The temporary password is good for one logon.

The second part changes the user's password. Change the user's password with the NEWPASSWD= option. For example:

```
LIBNAME mylib sasspds "spdsdata"
 host="bubba"
 serv="5200"
 user="debby"
 password="temporarypassword"
 NEWPASSWD="abc123"
```

Or, change the user's password with the CHNGPASS= option. For example:

```
LIBNAME mylib sasspds "spdsdata"
  host="bubba"
  serv="5200"
  user="debby"
  password="xyz123"
  CHNGPASS=YES
```

The user will be prompted for a new password.

Add a New User and Set a Password for the User

The second method adds a new user to the password table using the **psmgr** utility. The password expires immediately after the user is created. The SPD Server administrator creates a new password for the user and sends it to him.

1. The SPD Server Administrator issues the CHGPASS command. For example:

   chgpass debby

2. The SPD Server administrator enters Debby's old password. For example:

   oldpassword

3. The SPD Server administrator enters Debby's new password. For example:

   newpassword

4. The SPD Server administrator re-enters the new password for accuracy. For example:

   newpassword

The SPD Server administrator can now inform Debby of her new password. The new password expires in the number of days that was specified in step 7 of the previous section.

psmgr Commands

The **psmgr** utility is an interactive program. It reads commands and operands from your computer, and prompts you for input when necessary. You can also send a file of commands to the utility, structuring each command so that no input is required.

The commands and operands are positional, and they must be separated by blank spaces. If you give an insufficient number of operands, the utility prompts you for the remaining operands. Password operands, which are obtained with a prompt, are not echoed back to the computer.

psmgr Command Details

ADD

adds a new user to the password table.

Syntax

```
add username passwd passwd privilege
    [ip_addr|-] [expiretime|-] [group|-]
    [timeout|-] [failures|-] [class|-]
```

Note: The new user's password expires during the first logon to SPD Server.

Arguments

username
: the user ID of an SPD Server user, which is restricted to 8 characters. The first character of the username can be either an alpha or an underscore. The remaining characters can be either an apha, numeric, or underscore. The SPD Server user ID does not have to correspond to any system user ID.

passwd
: the user's password, which is restricted to 8 characters. The **psmgr** table requires a password with a minimum of 6 characters - at least one character must be numeric, and at least one character must be alphabetic. The argument is repeated to verify the password.

privilege
: an authorization level number from 0 to 7. The authorization level number assigns access privileges to the user.

  The numbers 0-3 are equivalent. Use the numbers 0-3 to specify a normal, non-privileged user.

  The numbers 4-7 are equivalent. Use the numbers 4-7 to specify a special user. Special users can update the password table and override any ACL restrictions on SPD Server tables. You might want to restrict special privileges to only the SPD Server user ID and password for yourself, the SPD Server administrator.

ip_addr
: a numerical IP address; or a dash (-), which indicates that no IP address is specified. Use the IP address to restrict the user's access to SPD Server to that specific IP address.

  Note: The IP address is not verified.

expiretime
: a password expiration time; or a dash (-), which indicates that no password expiration time is being specified. The expiration time requires the user to change his password before the specified number of days has expired. The value, which is specified in days, represents the number of days from today (the current day) that the password is valid.

group
: the default group for the user; or a dash (-), which indicates that no default group is being specified. If specified, the group definition must exist, which means that it was created by a previous GROUPDEF command. Group affiliation can be changed by a GROUPMEM command.

timeout
: a maximum amount of time that is allowed between successful logins before the account is no longer enabled, or a dash (-), which indicates that no timeout is being specified.

failures
: the number of password failures; or a dash (-), which indicates that no failure limit is being specified. The value specifies the number of login failures allowed before the user is disabled. A disabled can be re-enabled by the psmgr administrator using the reset command.

class
: the performance class of the user. This field is currently not being used.

AUTHORIZE

authorizes a user to modify the password table.

Syntax

```
authorize username userspasswd
```

Arguments

username
: the user ID of an SPD Server user.

userspasswd
: a valid user's password.

Description

Only a special user can update the password table. In other words, to use modification commands such as ADD and DELETE, you must be a special user or the owner of the password table. If you are not the owner of the password table, you can use the AUTHORIZE command to authorize yourself to update the password table. Enter your user ID and password in the password table, and then mark the user ID as special (by specifying the authorization level as number 4 or higher).

For example, assume that the **psmgr** LIST command is used to obtain the following output:

```
  USER   AUTHORIZATION  IP ADDRESS
-------- ------------- ------------
bar            7
foo            1        192.149.173.5
```

You can grant yourself privileges by using the AUTHORIZE command and specifying bar as the user name bar, and include the bar password barpwd1.

Example

```
authorize bar barpwd1
```

CHGAUTH

changes the authorization level for a user.

Syntax

```
chgauth username authlevel
```

Arguments

username
: the user ID of an SPD Server user.

authlevel
: an authorization level for the user, which is specified using numbers 0 through 7. See the argument in the ADD command for an explanation of the numbers.

CHGEXPIRE

changes the expiration date for a given user's password. By default, a new user ID is created with an expired password.

Syntax

```
chgexpire username exptime
```

Arguments

username
: the user ID of an SPD Server user.

exptime
: a password expiration time. The expiration time requires the user to change his password before the specified number of days has expired. The value, which is specified in days, represents the number of days from today (the current day) that the password is valid.

CHGIP

changes the IP address from which the user must connect to the SPD Server. The IP address on which the SAS, ODBC, JDBC, or SQL client software is running must match the IP address that is entered in the password table.

Syntax

```
chgip username "New IP Address"
```

Arguments

username
: the name (user ID) of an SPD Server user that also exists in the password table.

IP Address
: the new IP address from which the user must connect to the SPD Server host. The IP address must be specified numerically using the xxx.xxx.xxx.xxx format. The IP address is not verified. Invalid and incorrect IP addresses are noted as errors in the SPD Server log and will cause that user's future logon attempts to fail. The default value is blank.

CHGTIMEOUT

changes the logon time-out date for a user's password.

Syntax

```
chgtimeout username timeoutperiod
```

Arguments

username
the user ID of an SPD Server user.

timeoutperiod
a password logon timeout period. The timeout period requires the user to successfully logon before the specified number of days has expired. The value, which is specified in days, represents the number of days from the last successful logon that the password is valid.

CHGPASS

changes the password for a user.

Syntax

```
chgpass username oldpwd newpwd
```

Arguments

username
the user ID of an SPD Server user.

oldpwd
the user's old password.

newpwd
a new password for the user. If you are prompted for the new password, you are prompted again to re-enter it for accuracy. The new password must be different from the last 6 passwords. The new password must also contain at least 6 characters - with at least one numeric character, and with at least one alphabetic character. The password cannot contain the user ID.

DELETE

deletes a user ID.

Syntax

```
delete username !
```

Arguments

username
the user ID of an SPD Server user.

!
verifies that you intend to delete the user ID from the password table. If you do not specify !, you will receive a Y or N prompt to verify the deletion.

EXPORT

exports the current password table into a flat file.

Syntax

```
export textfile
```

Arguments

textfile
name of the flat file to create that will contain the contents of the current password table.

Description

The EXPORT command generates a single line in the flat file for each record in the password table. User passwords are encrypted in the table.

What you see in the flat file is a representation of what is stored in the password table. When you have changes that affect many users, it might be easier to edit the flat file than to use the **psmgr** utility. After making changes in the file, you can use the IMPORT command to construct a new, modified password table.

GROUPDEF

defines a new ACL group entry.

Syntax

```
groupdef groupname
```

Arguments

groupname
: the name of a group. The name must be unique, and is restricted to 8 characters. The first character of the groupname can be either an alpha or an underscore. The remaining characters can be either an apha, numeric, or underscore. The groupname argument verifies that the groups that are specified with the GROUPMEM command are valid.

GROUPDEL

deletes an ACL group entry.

Syntax

```
groupdel groupname !
```

Arguments

groupname
: the name of a group.

!
: verifies that you intend to delete the group from the password table. If you do not specify **!**, you receive a Y or N prompt to verify the deletion.

GROUPMEM

updates the ACL group list for a user ID.

Syntax

```
groupmem username groupname [groupname|""]
         [groupname|""] [groupname|""] [groupname|""]
```

Arguments

username
: the user ID of an SPD Server user.

groupname
: the name of an ACL group. The name must be unique, and is restricted to 8 characters. Separate each ACL group name with a space. The first ACL group name that is specified becomes the default ACL group for the user. You can specify up to five groups.

  Note: If you specify fewer than five ACL groups, the utility prompts for additional ACL groups (up to five). Press **Enter** for the remaining ACL groups if no more are required.

Note: If you use the groupmem command in batch mode, the syntax requires you to submit five groupname arguments. If you want to update the user ID with less than five ACL group members, replace the empty groupname arguments with " ".

GROUPS

lists the all the ACL groups in the password table.

Syntax

```
groups
```

HELP

displays general or command-specific help for the **psmgr** utility.

Syntax

```
help [command]
```

Arguments

command
: a **psmgr** command. If you specify a command, a short description of the command is displayed. If you issue a HELP command without an operand, a list of all available **psmgr** commands is displayed.

IMPORT

imports user information from a flat file, which was created with the EXPORT command, to the password table.

Syntax

```
import textfile
```

Arguments

textfile
: the name of the flat file to import that contains the user definitions to add to the password table.

Description

The IMPORT command reads the flat file, interpreting each single line as a record in the password table. Typically, the flat file is output from a submitted EXPORT command that was issued on the same password table or another password table.

During the import, if the **psmgr** utility encounters an identical user name (SPD Server user ID) in the password table, it skips the line. The **psmgr** utility displays a message that states that the line was skipped.

LIST

lists the contents of the password table, or a specific user.

Syntax

```
list [username]
```

Arguments

username
: the user ID of an SPD Server user. If no username is specified, the entire password table is listed.

Example

```
list bar
```

This example might produce the following listing:

```
USER AUTHORIZATION IP ADDRESS
---- ------------- -----------
 bar       7
```

RESET

resets a password for a user. The RESET command resets a user's password after three consecutive failed attempts to connect to a server. After the third failed attempt, the user ID is no longer enabled. After the password has been reset, the user must change the password before he can connect to a server.

Syntax

```
reset username newpwd newpwd
```

Arguments

username
: the name (user ID) of an SPD Server user, up to 8 characters.

newpwd
: a new password for the user. The new password can be up to 8 characters maximum. The new password must contain at least 6 characters - at least one character must be numeric, and at least one character must be alphabetic. The argument is repeated to verify the password for accuracy. **Note:** The new password expires immediately and must be changed with the **psmgr** CHGPASS command.

Example

```
reset tom abc123 abc123
```

This example resets the password for **tom .**

QUIT

ends the session and exits from **psmgr**.

Syntax

```
quit
```

Using a File as Input to psmgr

You can create and then send a file of commands to the **psmgr** utility.

Example

Here is a command file named pscmds:

```
authorize bar barpwd
add newuser newpwd1 newpwd1 0 - - - - - -
list
quit
```

The command file contains the password barpwd for user **bar**. Because the command file contains user IDs and user passwords, you might want to secure access to the command

file. In UNIX environments, you can secure access to command files using native UNIX file permissions.

To run the **psmgr** utility using the command file named pscmds as input, use the appropriate syntax:

For UNIX:

```
psmgr /usr/local/SPDS/site < pscmds
```

For Windows:

```
psmgr d:\spds\site < pscmds
```

SAS Management Console

Overview of SAS Management Console

SPD Server supports the SAS Management Console. The SAS Management Console is an application that the SPD Server administrator can use to manage passwords and ACLs. Administrators that need to configure passwords and ACLs can choose between using the SAS Management Console or the traditional SPD Server management tools (PROC SPDO and the **psmgr** utility).

More extensive information about using SPD Server with the SAS Management Console is available in the section, "Administering and Configuring SPD Server Using the SAS Management Console " on page 71.

LDAP User Authentication

SPD Server users can be authenticated using LDAP or the **psmgr** utility. LDAP Authentication is performed by an LDAP server that runs on the SPD Server machine. When you use LDAP authentication, the operating system handles password maintenance. LDAP authentication adds the benefit of operating-system-level security and convenience.

LDAP Authentication Notes

Overview of LDAP Authentication

Remember the following information when you use an LDAP server to perform SPD Server user authentication:

- SPD Server users can be authenticated by an LDAP server, or by the **psmgr** utility, but not by both. The type of authentication to be performed is specified in the server.parm file, which is read when SPD Server is invoked.
- If you are changing from using the LDAP server to using the **psmgr** utility for authentication, all LDAP parameters must be removed from the SPD Server server.parm file. You must restart SPD Server so that the changes to the server.parm file are read.
- When you configure SPD Server to perform user authentication using the LDAP server, the **psmgr** utility is still needed. When using the LDAP server, a password database

record is required for each SPD Server user. SPD Server uses the **psmgr** utility's password database to perform user access control tasks and other tasks that are not related to user authentication.

- Users that connect to an SPD Server must have corresponding logon information on the LDAP server. The LDAP server user ID and the SPD Server user ID formats are the same. The logon password format is the host-operating-system format. A user ID must be 8 characters or less.
- Some LDAP server products might require users to enter host logon information. In these cases, confirm with your LDAP server administrator that the host logon information exists in the LDAP database.
- If you are using LDAP user authentication, and you create a user connection that uses the NEWPASSWORD= LIBNAME option, the user password is not changed. If you want to change a user password, follow the operating system procedures to change a user password, and check with your LDAP server administrator to ensure that the LDAP database records the password changes.

Configuring LDAP Authentication

Instructions and examples of how to configure SPD Server to use LDAP authentication can be found in the SPD Server "SPD Server Windows Installation Guide " on page 37 and in the SPD Server "SPD Server UNIX Installation Guide " on page 11.

Part 6

System Management

Chapter 16
SPD Server Operator Interface Procedure (PROC SPDO)

Special SPDO Commands

Overview of SPDO Commands

Note: For additional information on using PROC SPDO, see the chapter, "Controlling SAS Scalable Performance Data Server Resources with PROC SPDO and ACL Commands."

The following SPDO commands require that you have ACLSPECIAL= enabled for your SPDO LIBNAME connection.

To enable ACLSPECIAL=, you must first grant the SPD Server user ID ACLSPECIAL= access rights. Second, the user must request access for a specific connection. To request access, the user adds the ACLSPECIAL=YES option to the LIBNAME statement. The user can now submit the following SPDO commands:

```
SPDSCMD 'command'
```

This example runs the specified command in the context of the user ID for the spdsserv process that is associated with the LIBNAME connection that the user used to invoke PROC SPDO. No restrictions are placed on commands that are executed in this manner. Therefore, you must carefully consider which SPD Server users need ACLSPECIAL access rights.

SPDO Command Examples

1. List the WORKPATH directory:

```
spdscmd 'ls /spdswork/*.spds';
spdscmd 'dir d:\spdswork\*.spds';
```

2. Clean up WORKPATH files:

```
spdscmd 'rm /spdswork/*.spds';
spdscmd 'del d:\spdswork\*.spds';
```

LIBNAME Proxy Commands

Overview of Proxy Commands

To issue proxy commands, you must first select the SPD Server user proxy.

LIST USERS;
lists the proxy processes that are accessible to the PROC SPDO lib=<libname> statement that was dispatched from the SPD Server host. Accessible proxies are anonymous proxies and proxies that are owned by the LIBNAME owner. If the LIBNAME owner has ACLSPECIAL privileges, then all user proxies will be listed.

SET USER userID [portnumber];
allows you to use the port number to distinguish between two proxies that share the same user ID.

LIST USERS/LOCKING;
lists the user-locking proxy threads that are accessible by the PROC SPDO lib=<libname> statement that was dispatched from the SPD Server host and that were created with the LOCKING=YES LIBNAME option. Accessible proxies are anonymous proxies and proxies that are owned by the LIBNAME owner. If the LIBNAME owner has ACLSPECIAL privileges, then all user-locking proxies will be listed. For each user-locking proxy thread, SPD Server returns the SPD Server user ID, the client login, and the thread ID. You can select a user-locking proxy thread from the LIST USERS list by submitting a command in the following form:

SET USER/LOCKING [userID threadID=#];
Once a user-locking proxy is selected, you can get LIBNAME information by submitting the following commands:

SHOWLIBNAME libref | _ALL_;
SHOWLIBNAME libref / DATA=[_ALL_| dsname];
SHOWLIBNAME libref / DUMP=[_ALL_| dsname];
where libref is an explicit SPD Server LIBNAME name. Specify _ALL_ to see every currently assigned LIBNAME for the proxy.

If the /DATA= option is used with _ALL_, information about all of the open tables in the proxy for the given LIBNAME is displayed. If the /DATA= option is used with a data set name dsname, detailed information about the specified data set table is displayed.

If the /DUMP= option is used with _ALL_, information about all of the accessible tables in the proxy for the given LIBNAME is displayed. If the /DATA= option is

used with a data set name dsname, detailed information about the specified data set table is displayed.

LIBNAME Proxy Command Examples

1. List all of the users for the server 'sunburn.6100':

```
LIBNAME example sasspds
  host='sunburn'
  serv='6100'
  user='sassyl'
  passwd='abc123'
  aclspecial=YES;

PROC SPDO lib=example;
list users;

Users Currently Connected to SPD Server
UserName Pid   Portno
----------------------------------------
SASSYL   17704 58382
SASSYL   17614 58298
SASSYL   17613 58293
ANONYMOU 17611 58288
ANONYMOU 17610 58283
```

2. Set the user to ANONYMOU and specify process ID (Pid) 17610:

```
set user anonymou 17610;

NOTE: User ANONYMOU connected to proxy operator port with pid=17610.
```

3. Show every LIBNAME for user ANONYMOU for this proxy:

```
showlibname _all_;
LIBREF(FOO):Pathname assigned=/bigdisk/test/qabig1_dev/
LIBREF(FOO):ACL Owner=
LIBREF(FOO):ACL Defaults(R,W,A,C)=(Y,Y,Y,Y)
```

4. Show all of the open tables in LIBNAME FOO:

```
showlibname FOO/data=_all_;

NOTE: No data sets currently opened for LIBREF FOO.
```

5. Show all of the accessible tables in LIBNAME FOO:

```
showlibname FOO/dump=_all_;

LIBREF(FOO):Dataset name=BIGX
LIBREF(FOO):ACL Owner=ANONYMOU
LIBREF(FOO):ACL Defaults(R,W,A,C)=(N,N,N,N)
LIBREF(FOO):Dataset name=X
LIBREF(FOO):ACL Owner=ANONYMOU
LIBREF(FOO):ACL Defaults(R,W,A,C)=(N,N,N,N)
```

6. The user ANONYMOU performs a WHERE clause on the table BIGX. Show all of the open tables in LIBNAME FOO:

```
showlibname FOO/data=_all_;

LIBREF(FOO):Dataset name=BIGX
LIBREF(FOO):ACL Owner=ANONYMOU
LIBREF(FOO):ACL Defaults(R,W,A,C)=(N,N,N,N)
LIBREF(FOO):WHERE clause read thread active
```

7. User ANONYMOU performs a WHERE clause on the table BIGX and displays detailed information about the table BIGX:

```
showlibname FOO/data=bigx;

LIBREF(FOO):Dataset name=BIGX
LIBREF(FOO):ACL Owner=ANONYMOU
LIBREF(FOO):ACL Defaults(R,W,A,C)=(N,N,N,N)
LIBREF(FOO):WHERE clause read thread active
LIBREF(FOO):Type=
LIBREF(FOO):Label=
LIBREF(FOO):Number observations=5000000
LIBREF(FOO):Observation length=41
LIBREF(FOO):Wire blocksize=32718
LIBREF(FOO):Wire block factor=798
LIBREF(FOO):Data port number=58392
LIBREF(FOO):Active data socket=33
LIBREF(FOO):Metafile=/bigdisk/test/qabig1_dev/bigx.mdf.0.0.0.spds9
LIBREF(FOO):Metafile size=31
LIBREF(FOO):Datafile=
  /spds02/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.0.1.spds9:
  /spds03/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.1.1.spds9:
  /spds04/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.2.1.spds9:
  /spds01/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.3.1.spds9:
  /spds02/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.4.1.spds9:
  /spds03/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.5.1.spds9:
  /spds04/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.6.1.spds9:
  /spds01/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.7.1.spds9:
  /spds02/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.8.1.spds9:
  /spds03/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.9.1.spds9:
  /spds04/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.10.1.spds9:
  /spds01/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.11.1.spds9:
  /spds02/test/qabig1_dev/bigx.dpf._bigdisk_test_qabig1_dev.12.1.spds9
LIBREF(FOO):Datafile size=200196
LIBREF(FOO):Number of Indexes=0
```

8. List all locking users for the server 'sunburn.6100':

```
list users/locking;

Users Currently Connected to the Record Level Proxy
SPDUserName  Client Login   Thread Id
---------------------------------------
ANONYMOU     SASTEST        7
TEST         SASTEST        8
```

9. Set the user to ANONYMOU and specify thread ID 7:

```
set user/locking anonymou threadid 7;

NOTE: User ANONYMOU connected to record
level proxy operator port with thread=7.
```

10. Show every LIBNAME for locking user ANONYMOU:

```
showlibname _all_;

LIBREF(LOCKING):Pathname assigned=/bigdisk/test/qabig1/
LIBREF(LOCKING):ACL Owner=
LIBREF(LOCKING):ACL Defaults(R,W,A,C)=(Y,Y,Y,Y)
```

11. Show all of the open tables in LIBNAME LOCKING:

```
showlibname LOCKING/data=_all_;

NOTE: No data sets currently opened for LIBREF LOCKING.
```

Privileged OPER Commands

You must have ACLSPECIAL access rights (LIBNAME option ACLSPECIAL=YES) to run privileged OPER commands. With privileged OPER commands, you must first set yourself as the proxy operator by submitting the following command:

```
SET MODE OPER;
```

The SET MODE OPER command sets you as the operator of the user proxy that you are currently set to. There can be only one operator for a user proxy at any time. If you submit the SET MODE OPER command when someone is already established as operator of the user proxy, you get the following message:

```
ERROR: Operator mode owned by another connection.
Cannot grant this request.
```

After you have successfully set yourself as the operator, the following commands can be submitted:

OPER CANCEL [/DUMP];
: The OPER CANCEL command cancels and exits the user proxy. If the /DUMP option is specified for a non-locking user proxy, the proxy exits with an abort() call, which produces a core file. If you are the operator of a locking user proxy, the /DUMP option is ignored. The OPER CANCEL command initiates a hard exit of the user proxy. Hard exits might leave tables opened for UPDATE access, which is an inconsistent and unusable state. In this case, you can submit the PROC DATASETS REPAIR command to restore the tables to a usable state.

OPER DISCONNECT;
: The OPER DISCONNECT command drops the control socket from the user proxy to the client. This action causes the user proxy to terminate the next time it tries to communicate with the client. This termination initiates a hard exit of the user proxy. Hard exits might leave tables opened for UPDATE access, which is an inconsistent and

unusable state. In this case, you can submit the PROC DATASETS REPAIR command to restore the tables to a usable state.

The OPER DISCONNECT command differs from the OPER CANCEL command. When the OPER DISCONNECT command is submitted, the user proxy continues until it detects that the control socket connection has been dropped. As a result, the OPER DISCONNECT command has the potential to complete. However, when the control socket disconnect is detected by the user proxy varies, with different results.

OPER INTERRUPT;

The OPER INTERRUPT command sets a soft interrupt flag in any open tables that belong to the user proxy. During certain long-running operations, such as large table sorts, table scans with a WHERE clause, or index creations, the user proxy periodically checks for an interrupt flag in all of the open tables that are involved in the operation. If an interrupt flag is detected, the user proxy terminates the operation and any previously opened tables are closed.

Unlike the OPER CANCEL command or the OPER DISCONNECT command, the OPER INTERRUPT command initiates a soft exit of the user proxy. The user receives a message in the SAS log that states that the job has been interrupted. If the job did not finish, then the results might be incomplete. However, the user LIBNAME will be intact, and the user proxy will still be viable. Whether a job will be interrupted cannot be determined; it depends on the job that is currently running. To determine if a job can be interrupted, submit a SHOWLIBNAME libref / DATA=_ALL_ command before you submit the OPER INTERRUPT command to see all of the open tables. You can also submit the SHOWLIBNAME libref/ DATA=_ALL_ command after you submit the OPER INTERRUPT command, to see if all of the open tables were closed. If the tables are still open after the OPER INTERRUPT command has been submitted, you can wait and check again later. If the tables need to be closed immediately, you can use the OPER CANCEL command to cancel the user proxy.

TRUNCATE Command and Example

The TRUNCATE command is a PROC SPDO command that allows you to delete all of the rows in a table without deleting the table structure or metadata.

```
%let host=kaboom;
%let port=5191;
%let domain=path2;

LIBNAME &domain sasspds "&domain"
 server=&host&port
 user='anonymous'
 ip=YES;

/* create a table */

DATA &domain..staceys_table;

 do i = 1 to 100;
 output;
 end;
 run;
```

```
/* verify the contents of the created table */

PROC CONTENTS data=&domain..staceys_table ;
run;

/* SPDO Truncate command deletes the table */
/* data but leaves the table structure in */
/* place so new data can be appended */

PROC SPDO lib=&domain;
 SET acluser;
 TRUNCATE staceys_table;

 quit;

/* verify that no rows or data remain in */
 /* the structure of staceys_table */

PROC CONTENTS data=&domain..staceys_table;
 run;
```

Refreshing SPD Server Parameter and LIBNAME Files

The REFRESH Command

You can use PROC SPDO to dynamically refresh SPD Server parameter and LIBNAME files. If you make changes to your spdsserv.parm file or to your libnames.parm environment file for SPD Server, you can use the REFRESH command to avoid restarting the server. Submitting the REFRESH command refreshes the specified SPD Server file without restarting the server.

When you submit the REFRESH command, SPD Server refreshes the operating parameter file.

The syntax for the REFRESH command to refresh the libnames.parm file is:

```
REFRESH DOMAINS
```

The syntax for the REFRESH command to refresh the spdsserv.parm file is:

```
REFRESH PARMS
```

Each REFRESH operation completely refreshes and replaces the contents of the previous libnames.parm file or the spdsserv.parm file in the SPD Server environment.

REFRESH Command Examples

Add a new LIBNAME domain to your current libnames.parm file and use it without restarting the server:

```
LIBNAME spds44 sasspds 'spds44'
        server=estore.5180
        user='admin'
```

```
       password='spds123'
       aclspecial=YES
       prompt=YES;

PROC SPDO library=spds44;
  SET acluser admin;
  REFRESH PARMS;
  REFRESH DOMAINS;
quit;
```

Here is a more detailed example:

```
    /* Domain reftest is a pre-existing domain.  */
    /* Add domain reftest2 to libnames.parm and  */
    /* specify owner=admin                       */

       LIBNAME=tmp pathname=c:\temp;
       LIBNAME=formats pathname=c:\data\formats;
       LIBNAME=reftest pathname=c:\data\reftest
         owner=admin;
       LIBNAME=reftest2 pathname=c:\data\reftest2
         owner=admin;

    /* Run refresh job using admin with ACLSPECIAL */
    /* The SPD Server user must have ACLSPECIAL    */
    /* privileges to refresh domains.              */

       LIBNAME reftest sasspds 'reftest'
         server=d8488.5180
         user='admin'
         password='spds123'
         aclspecial=YES;

       PROC SPDO library=reftest;
         SET acluser admin;
         REFRESH DOMAINS;
       quit;

    /* Domains that have an owner= option such as  */
    /* reftest2 (owner=admin) must be reconnected  */
    /* to the domain again.                        */

       LIBNAME reftest2 sasspds 'reftest2'
         server=d8488.5180
         user='admin'
         password='spds123';
```

Commands to Nonexistent Users

In SPD Server, you can submit operator commands to a user after selecting the user with the SET USER or SET USER/RECORD command. However, user sessions are finite. The user that you select with SET USER or SET USER/RECORD might be unavailable when

the user ends the SAS session, or disconnects from a LIBNAME and the user proxy. If you submit an OPER command to a user that is no longer in session, or to a user that has ended a locking user proxy, you get the following message:

```
ERROR: Specified locking user no longer exists.
```

If the disconnected user used a non-locking user proxy, and you submit an OPER command, you get the following message:

```
ERROR: Specified user <userID> with pid <Process-ID> no longer exists.
```

Either of these messages indicates that the user that was selected is no longer valid. In this case, you must use SET USER or SET USER/RECORD to select a different user.

Chapter 17
SPD Server Index Utility Ixutil

The Index Utility Ixutil

The ixutil utility supports reorganizing an SPD Server hybrid index to improve query performance and minimize disk space. The utility also prints the disk usage statistics or the contents of indexes.

Ixutil Usage

`ixutil -crejidx` <data set1,column1> < data set2,column2> ...
<data set_n,column_n>**`-libpath`** <physical path> **`-joinparts`**< number of parallel join work units > ;

Create a join index for a pair of data sets in the same domain that can be used by the SPD Server Parallel Range Join optimization. The columns **must** already be indexed. The recommended number of parallel join work units is two times the number of processors.

`ixutil -deljidx` <data set1,column1> < data set2,column2> ...
<data set_n,column_n>**`-libpath`** <physical path> ;

Delete a join index.

`ixutil -lstjidx -libpath` <physical path> [**-verbose**] ;

List the join indexes in a domain.

ixutil -statjidx <data set1,column1> < data set2,column2> ... <data set_n,column_n>**-libpath** <physical path> ;

Gather statistics about the join index parts. Pay attention to the average join row percentage, which indicates the average number of rows that are read by a parallel join work unit. For example, a percentage of 75 indicates the parallel join work unit will use 75 percent of the rows it must read. The closer the percentage is to 100, the better the performance. The percentage will increase as the distribution of the data for the join column becomes more sorted.

ixutil -stats< indx1,indx2,...>**-dsn**<data set> **-libpath**<physical path> [**-dist**] ;

For a specified set of indexes that belong to a given table, print the disk usage statistics and segment list fragmentation statistics. Each value in the index has a segment list. A value's segment list can become fragmented when the index is updated. An index that is highly fragmented can degrade query performance and waste disk space. To improve performance and reclaim the wasted disk space, the index should be reorganized using the **-reorg** option of ixutil.

ixutil -runstats<indx1,indx2,...>**-dsn**< data set name> **-libpath**<physical path> [**-maxruns**<number>] ;

For a specified set of indexes that belong to a given table, print the run statistics for each index. Run statistics give an indication of how the values of a particular index are sorted in relation to their observation numbers. By default, ixutil run stats displays the ten longest runs in the data set. A run is defined as the number of successive observations that contain the same index value. The optional [**-maxruns**<number>] argument can be used to change from the default setting of 10 runs to any integer between 1 and 100. Ixutil run stats can be useful in constructing more efficient BY- and WHERE-clause constructs for the data set.

ixutil -reorg <index1,index2,...>**-dsn**< data set name> **-libpath**<physical path> ;

Reorganize the specified set of indexes in a table to reclaim wasted disk space and to aggregate the per-value segment lists. Reorganizing an index results in optimal disk usage and query performance.

ixutil -fixclustmem -dsn <data set name> **-libpath** < physical path>

Make cluster member tables accessible, if the CDF metadata is corrupted or deleted. Run this command for each member table in the cluster, and then remove the .cdf file from the directory path.

ixutil -help

Print the help menu.

Ixutil Options

-crejidx <data set1,column1> < data set2,column2> ... <data set_n,column_n>

Create a join index for SPD Parallel Join use.

-deljidx <data set1,column1> < data set2,column2> ... <data set_n,column_n>

Delete a Join index.

-dist

Include the distribution statistics with the index statistics.

-lstjidx-libpath<library path>

List the join indexes for a domain.

-statjidx < data set1,column1> <data set2,column2> ... < data set_n,column_n>

Get statistics about a join index.

-stats <index,index...>
For each specified index, prints the index disk usage statistics and value segment list statistics.

-runstats < index,index...> [
For each specified index, print the "run" statistics. "Runs" are defined as successive observations in a table that contain the same index value

-reorg <index,index...>
For each index, reorganize the index to reclaim any unused disk space and coalesce any fragmented value segment lists.

-joinparts <number of parallel join work units>
Specifies the number of parallel join work units for a join index. Parallel join threads will join the work units concurrently and then merge their partial results into the final result.

-dsn<data set name>
The SPD Server table that contains the index.

-libpath<physical path>
The physical path of the domain containing the table.

-help
Prints the ixutil help menu.

Note: Index names are case sensitive and MUST be specified exactly as listed in the PROC CONTENTS output.

Ixutil Examples

Create a Hybrid Index

Assume there is an SPD Server domain named **my domain** assigned to the directory **/spds** on a machine named **spot**. A user has created a table with the following SAS program:

```
libname my_data sasspds 'mydomain'
   server=spot.spdsname
   user='anonymous';

data my_data.test(index=(x));
   do i = 1 to 30000;
     x = mod(i,3);
     output;
   end;
run;

data my_data.test1;
   do i = 1 to 10000;
    x = mod(i,2);
    output;
   end;
run;

PROC APPEND
```

```
   base=my_data.test
   data=my_data.test1;
run;

PROC SQL;
   delete from my_data.test
     where x=1;
quit;
```

The SAS program above creates a hybrid index for column X of the table named **test**, on the machine named **spot**, in the directory named **/spds**.

Retrieve Disk Usage and Fragmentation Statistics

Use the **`-stats`** option of **ixutil** to get the disk usage and segment list fragmentation statistics for the index:

```
> ixutil -stats test -dsn test -libpath /spds

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Statistics for Index X:
-------------------------------------------------
+--segment_size         = 8192
+--n_segments_in_tbl    = 5
+--n_values_in_index    = 2
+--n_vdeleted_values    = 1
+--percent_vdeleted     = 33.33
+--n_seglist_values     = 2
+--n_seglist_chunks     = 3
+--avg_chunks_per_list  = 1.00
+--idx_file_bytes       = 13304
+--idx_garbage_bytes    = 4272
+--percent_idx_garbage  = 32.11


Ixutil completed successfully
```

The statistics include the following:

- The segment size of the index.
- The number of segments in the table.
- The number of distinct values for the index.
- The number of virtually deleted values (values that are no longer recognized by query indexes.)
- The percentage of virtually deleted values.
- The number of values that require segment lists (a value that is in only one segment does not require a segment list).
- The number of segment list chunks for all values of the index.

- The average number of chunks for any value in the index.
- The size of the idx file for the index. The idx file maintains the value segment lists and bitmaps.
- The number of garbage bytes in the idx file. This is space in the file that was thrown away and cannot be reclaimed. Garbage bytes can result from deleting values, updating values, or appending values.
- The percentage of garbage bytes in the idx file.

The average number of chunks for a segment list is a good indicator of the fragmentation level of the value segment lists. As this value increases, it can affect the query performance for the index. If the average number of chunks exceeds 10, you should consider reorganizing the index to consolidate the segment lists.

The number of garbage bytes and the percentage of garbage bytes indicate the amount of unused disk space being consumed by the index. To conserve and consolidate disk space, consider reorganizing the index. Reorganizing the index frees up disk space when the garbage content is high.

Retrieve Index Distribution Statistics

Use the **-dist** option of ixutil **-stats** to get the index distribution for the index:

```
> ixutil -stats x -dsn test -libpath /spds -dist
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Statistics for Index X:
-------------------------------------------------
+--segment_size         = 8192
+--n_segments_in_tbl    = 5
+--n_values_in_index    = 2
+--n_vdeleted_values    = 1
+--percent_vdeleted     = 33.33
+--n_seglist_values     = 2
+--n_seglist_chunks     = 3
+--avg_chunks_per_list  = 1.00
+--idx_file_bytes       = 13304
+--idx_garbage_bytes    = 4272
+--percent_idx_garbage  = 32.11

+--Distribution Stats for Non Unique Values
+----minimum segments for all values = 4
+----maximum segments for all values = 5
+----average segments of any value = 4
+----average percentage of segments of any value = 90.00

Ixutil completed successfully
```

The distribution statistics include the following:

- The number of unique values in the index.
- The number of non-unique values in the index.

- The minimum number of segments that any value is in.
- The maximum number of segments that any value is in.
- The average number of segments that all values are in.
- The average percentage of segments that all values are in.

The distribution statistics can be used to determine the effectiveness of the index. The index will perform better if the distribution of

the index values is clustered in a minimum number of segments. In general, the lower the average percentage of segments that all values are in, the better the index will perform.

Reorganize the Index

Use the **-reorg** option to reorganize the index to consolidate segment lists and retrieve unused disk space:

```
> ixutil -reorg x -dsn test -libpath /spds
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Reorg for Index x:
Reorg successfully completed
Ixutil completed successfully
```

Running the index utility program again to get the statistics shows that the segment lists for all of the values have been aggregated (the avg_chunks_per_list is 1.0) and the unused disk space has been freed (the idx_garbage_bytes is 0), resulting in a proportional decrease in the size of the index file.

Aggregating the segment lists and compacting the index file minimizes the reads on the index for a query. It will also increase the locality of segment data for an index key. The combination of these will give the best query performance for the index.

Review Disk Usage Statistics

Use the **-stats** option once more to review the index and segment list data, in order to view the improved performance statistics.

```
> ixutil -stats x -dsn test -libpath /spds
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Statistics for Index X:
----------------------------------------
+--segment_size        = 8192
+--n_segments_in_tbl   = 5
+--n_values_in_index   = 2
+--n_vdeleted_values   = 0
+--percent_vdeleted    = 0.00
+--n_seglist_values    = 2
```

```
+--n_seglist_chunks    = 2
+--avg_chunks_per_list = 1.00
+--idx_file_bytes      = 9008
+--idx_garbage_bytes   = 0
+--percent_idx_garbage = 0.00
```

Create a Join Index

Assume there are SPD Server tables in a domain in directory **`/tmp`**. A user has created two tables, **Table1** and **Table2** that can be joined on column **ID**. An SPD Server index exists on the column **ID** for both tables. A join index is created on the tables to allow a Parallel Range Join on column ID.

Use the **`-crejidx`** option of the SPD Server **ixutil** command to create the join index.

```
> ixutil -crejidx Table1,ID Table2,ID
  -libpath /tmp
  -joinparts 4

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Ixutil completed successfully.
```

Generate Join Index Statistics

Now, get statistics on the join index that you created, using the **`-statjidx`** option of the **ixutil** command. The statistics are printed for each join range of the index, as well as for the overall index. The range statistics identify each range (sobs=starting observation, eobs=ending observation), the number of unique join keys that exist in the range, and the number of keys that will be joined in the range for each table.

```
> ixutil -statjidx Table1,ID Table2,ID
  -libpath /tmp

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Stat of Join Index Table1.jdxid.table2.jdxid.0.0.0.spds9: Nranges=4
------------------------------------------------------------------------
+-Range 0
+----<Table1,ID>: sobs=1 eobs=25000 (Sorted)
+-------unique_keys=25000, max_occurance=1
+-------obs=25000, joinobs=25000, rangepct=100.00
+----<Table2,ID>: sobs=1 eobs=10000 (Sorted)
+-------unique_keys=10000, max_occurance=1
+-------obs=10000, joinobs=10000, rangepct=100.00
+-Range 1
```

```
+----<Table1,ID>: sobs=25001 eobs=50000 (Sorted)
+-------unique_keys=25000, max_occurance=1
+-------obs=25000, joinobs=25000, rangepct=100.00
+----<Table2,ID>: sobs=-1 eobs=0
+-------unique_keys=0, max_occurance=0
+-------obs=2, joinobs=0, rangepct=  0.00
+-Range 2
+----<Table1,ID>: sobs=50001 eobs=75000 (Sorted)
+-------unique_keys=25000, max_occurance=1
+-------obs=25000, joinobs=25000, rangepct=100.00
+----<Table2,ID>: sobs=-1 eobs=0
+-------unique_keys=0, max_occurance=0
+-------obs=2, joinobs=0, rangepct=  0.00
+-Range 3
+----<Table1,ID>: sobs=75001 eobs=100000 (Sorted)
+-------unique_keys=25000, max_occurance=1
+-------obs=25000, joinobs=25000, rangepct=100.00
+----<Table2,ID>: sobs=-1 eobs=0
+-------unique_keys=0, max_occurance=0
+-------obs=2, joinobs=0, rangepct=  0.00

Table Table1, Column ID average range join row pct=100.00
Table Table2, Column ID average range join row pct= 25.00

Ixutil completed successfully
```

Delete the Join Index

Use the **-deljidx** option of the **ixutil** command to delete the join index.

```
> ixutil -deljidx Table1,ID Table2,ID
-libpath /tmp

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Ixutil completed successfully
```

Parallel join work units are based on the ranges of the join keys. For example, range 0 will join ranges 1 through 100, range 1 can join range 101 to 200, and so on Ranges can overlap observations if the tables are not sorted by the join key. The more sorted the table is by the join key, the fewer rows a range work unit will need to read, in order to gather all of the rows in its range. The overall performance of the parallel join index depends on how well the table is sorted by the join key. The stronger the join key sort, the better the performance. If a range work unit has a range percentage of 0 for either table, then there are no rows in the table for that range, and that range will be discarded by a parallel work thread.

Chapter 18
SPD Server Table List Utility Spdsls

SPD Server Table List Utility Spdsls

Description

`Spdsls` lists the contents of an SPD Server domain directory, or given an SPD Server table component file, lists all other component files for the table. There are three purposes of the list utility:

- to furnish a complete list of tables for each SPD Server domain that you want to include in a backup.
- to provide, for a specified damaged or questionable component file, a list of all other component files for the table that might be affected.
- to provide information about the size of SPD Server tables

Usage

```
spdsls -l [-i] [-o] [-a] [-s] [-v] [-v8] [-v6] [-aonly] <libpath> [Table...]
spdsls -c [-i] [-o] [-a] [-v] <ComponentPath>
spdsls -info [-o] [-v] [-verbose] [-n] [-s] [-v8] [-v6] <libpath> [Table...]
```

spdsls -l
: For a specified SPD Server table in the LIBNAME domain, lists all component files for the table. If there is no table specified, lists all tables in the LIBNAME domain. The output list can be used with any system full backup utility.

spdsls -c
: For a specified component file (identified with a complete path), lists all other component files for the table. If you have a corrupted or deleted SPD Server table file, use this option to find all related component files which might be affected.

spdsls -info
For a specified SPD Server table in the LIBNAME domain, list information about the table. This option provides one line of information about the table as a whole rather than a listing for each component of the table.

Options

-a
Will include the domain ACL files in the listing. The files contain the ACLs (Access Control Lists) for any SPD Server table in the domain.

-aonly
Will include only the domain ACL files in the listing.

-c
For a specified component file (identified with a complete path), lists all other component files for the table. If you have a corrupted or deleted SPD Server table file, use this option to find all related component files which might be affected.

-help
Prints a list containing the command-line usage and option switches for the spdsls utility.

-i
Lists the index files.

-l
For a specified SPD Server table in the LIBNAME domain, lists all component files for the table. If there is no table specified, lists all tables in the LIBNAME domain. The output list can be used with any system full backup utility.

-n
Lists the number of component files.

-o
Lists the file owner.

-s
Lists the size of the component file in bytes. When used with **spdsls -info**, lists the size of the accumulated component file in bytes.

-v
Includes the version number in the listing.

-verbose
When used with **spdsls –info**, the **-verbose** option includes detailed information about an SPD Server table, including the number of observations in the table, observation length, the size of the index segment, the partition size, and whether the table is compressed, encrypted, or is a cluster member.

-v6
Only lists SAS 6.x data sets.

-v8
Only lists SAS 8.x or SAS 9.x data sets.

<LibPath>
The complete path of an SPD Server LIBNAME directory.

<ComponentPath>
The complete path of a specified table component file.

[Table...]
The table(s) to list. (If no table is specified, all tables in the LIBNAME domain are listed.)

Return Values

When **spdsls** exits, it generates a return value. If the **spdsls** return value is 0, the utility was successful. If the **spdsls** return value is 1, the utility was unable to complete normally.

Spdsls Examples

Use Spdsls to List All Components in a Domain

You can use the **-l** option of the **spdsls** command to display index, owner, and size information for component files in domain **/bigdisk/sas/data/public** as follows:

```
spdsls -l -i -o -s /bigdisk/sas/data/public
SAS Scalable Performance Data Server 4.5(TS M0) Build(Feb 26 2009, 11:51:36)  - Domain List
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ANONYMOU      31196 /bigdisk/sas/data/public/cars.mdf.0.0.0.spds9
                648 /bigdisk/sas/data/public/cars.dpf._bigdisk_sas_data_public.0.1.spds9
ANONYMOU      30588 /bigdisk/sas/data/public/a.mdf.0.0.0.spds9
               8000 /bigdisk/sas/data/public/a.dpf._bigdisk_sas_data_public.0.1.spds9
ANONYMOU      31956 /bigdisk/sas/data/public/trx.mdf.0.0.0.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.0.1.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.1.1.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.2.1.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.3.1.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.4.1.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.5.1.spds9
           16774912 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.6.1.spds9
            9430190 /bigdisk/sas/data/public/trx.dpf._bigdisk_sas_data_public.7.1.spds9
ANONYMOU      47328 /bigdisk/sas/data/public/ida.mdf.0.0.0.spds9
                 80 /bigdisk/sas/data/public/ida.dpf._bigdisk_sas_data_public.0.4.spds9
               8192 /bigdisk/sas/data/public/ida.idxx._bigdisk_sas_data_public.0.4.spds9
              24576 /bigdisk/sas/data/public/ida.hbxx._bigdisk_sas_data_public.0.4.spds9
```

Use Spdsls to List Sizing Information and Table Information for a Domain

You can use the **-info** option of the **spdsls** command to get size and verbose descriptive information about tables in the domain **/bigdisk/sas/data/public**.

```
spdsls -info -s -verbose /bigdisk/sas/data/public
SAS Scalable Performance Data Server 4.50(TS M0) Build(Feb 26 2009, 11:51:36)  - Domain List
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     DPF_SIZE      IDX_SIZE      MDF_SIZE      NUMOBS   OBSLEN  SEGSIZE    PARTSIZE CMP ENC

          648             0         31196           9       72     8192  1073740032  NO  NO
         8000             0         30588        1000        8     8192  1073741824  NO  NO
    126854574             0         31956      489786      259     8192    16774912  NO  NO
           80         32768         47328          10        8     8192    16777216  NO  NO
```

Chapter 19

SPD Server Backup and Restore Utilities

Introduction

The SPD Server Backup and Restore utilities have the ability to:

- perform a backup of an SPD Server table that is open for query access
- provide a detailed Help menu for each utility
- offer an enhanced user interface and user messages.

Overview of the SAS Scalable Performance Data Server Backup and Restore Utilities

The standard file system backup and restore facilities that native operating systems provide are generally inadequate for backing up and restoring SPD Server tables. SPD Server tables can be enormous in size, surpassing the file size limits maintained by some operating environments. SPD Server is also dependent on the operation environment's ability to detect a modifications to a table, such as an add, delete, or change of a record. A change in a table is normally a signal to ensure that the newly modified file is backed up.

When a standard utility subsequently performs an incremental backup, it processes the file change by backing up the entire table. If the table is very large, the backup time can be lengthy. In addition, the processing can consume considerable machine resources. For this reason, administrators frequently struggle with a dilemma: are incremental backups of large tables worth the resources they consume?

The Scalable Performance Data Server backup and restore utilities alleviate these problems because they 'sense' the table data . The backup utility is capable of a real incremental backup. That is, instead of backing up the entire table, the utility backs up only the records that changed after the previous table backup date. Further, if a later restore of the table becomes necessary, the restore utility can incrementally restore the table to its last backup state.

By backing up only the changed records, SPD Server conserves valuable system resources. This, in turn, encourages more frequent backups. The increased frequency realizes the ultimate goal of the utilities: to minimize possible loss or corruption of an SPD Server table for whatever reason. Moreover, the software gives you a choice for periodic full backups: you can use the SPD Server full backup and restore capabilities or you can use your system's full backup and restore facilities.

In summary, the SPD Server incremental backup and restore facilities, used with the full backup and restore capabilities of either SPD Server or your system, can furnish comprehensive backup and restore capabilities.

The SPD Server backup and restore utilities include

- **spdsbkup** Performs incremental or full backups of SPD Server tables, storing the information in an SPD Server backup data file.
- **spdsrstr** Performs incremental or full restores of SPD Server tables using the SPD Server backup data file created by the utility.

Using Utilities with SPD Server

SPD Server Utilities Path Requirements

SPD Server provides National Language Support (NLS) for multiple languages and character sets in database operations. As a result, all SPD Server utilities require access to the **`InstallDir/bin`** directory, and you must ensure that the **`InstallDir/bin`** directory is included in your SPD Server library path specification.

Here is an example of a statement that specifies the necessary path:

```
LD_LIBRARY_PATH=$LD_LIBRARY_PATH:InstallDir/bin
export LD_LIBRARY_PATH
```

Compatibility with Previous Versions

SPD Server 4.5 backup and restore utilities are not compatible with SPD Server 3.x and earlier releases. You cannot restore SPD Server 3.x backup files using SPD Server 4.5 utilities. You must use your SPD Server 3.x utilities to restore SPD Server 3.x backup files, and then archive the restored files using the SPD Server 4.5 utilities.

Privileged Access Protection

Running the SPD Server backup and restore utilities is a privileged operation. For a user to have access to SPD Server backup and restore utilities, one of the following must be true:

- The user ID that starts the SPD Server session must be identical to the user ID that performs the SPD Server backup and restore utilities (by definition, the user ID that starts the SPD Server session is a privileged user).
- The user has ACLSPECIAL=YES privileges.

To run the backup and restore utilities remotely using the SAS PROC SPDO **spdscmd.** The PROC SPDO **spdscmd** command requires similar access: either identical user IDs or ACLSPECIAL=YES user privileges. See **Usage Scenarios** for more information about running the SPD Server backup and restore utilities with PROC SPDO.

Access to the backup and restore utilities will be given to the special user "SPDSBKUP". Optional user and password options are available for the utilities that can be used to give access to a specific privileged user.

Spdsbkup - the Table Backup Utility

Description

Spdsbkup performs a full or incremental backup of an SPD Server table or LIBNAME domain. It also creates a backup file that contains full backups of newly created SPD Server tables or incremental backups of tables that have been backed up before.

During the backup process, the **spdsbkup** utility

- connects to a specified SPD Server
- uses the SPD Server Pass-Through Facility to generate SQL queries on SPD Server domain tables
- backs up the records returned by the query
- compresses the record data
- stores the data in a flat data file so that the restore utility can use it later when restoring the tables.

Important Details about Full Backup

- When you do a full backup of an SPD Server table, all of the table rows and attributes (indexes, partition size, compression, sorted) are backed up. When a full backup is restored, the table is created with those attributes, then all the rows are added. Any changes that were made to the table attributes since the last full backup was performed are not restored.
- ACL files must be in the same physical directory as the domain. If any ACL file does not meet this requirement, the ACLs will not be backed up, and a warning message will be sent to the log. The **spdsbkup** utility will continue to back up all specified tables.

Important Details about Incremental Backup

- When you perform an incremental backup of an SPD Server table, only changes that were made to the table rows since the last full backup are included in the backup. Changes to the table attributes are not backed up. When an SPD Server incremental backup is restored, the incremental changes to the rows are applied. Only attributes that were associated the table at the time of the last full backup (indexes, partition size, compression, sorted) are applied to the restored rows.

Return Values

When **spdsbkup** exits, it generates a return value. If the **spdsbkup** return value is 0, the utility was successful. If the **spdsbkup** return value is 1, one or more data sets could not be backed up. In that case, examine your SAS log for warning messages. If the **spdsbkup** return value is 2, a critical error caused an early process termination. Examine your SAS log for warning and error messages.

Backup Requirements

Client Access to an SPD Server Domain

The client that performs the backup does not have to execute on the same machine as the SPD Server. However, the client must be able to access the physical path of the SPD Server domain that is being backed up. Access by the client to the physical path of the domain can be direct or through a network connection.

LIBNAME Created with BACKUP= Option

Before a table is eligible for backup, you must create the SPD Server LIBNAME domain using the **BACKUP=YES** option in the parameter file. Here are two example LIBNAME entries from a data's server's libname parameter file, libnames.parm, to explain how domains are processed with and without the **BACKUP=** option:

Example Libnames.parm Statements

No Backup Statement and Can Backup Statement Examples

```
libname=nobackup pathname=/usr/foo/test;

libname=canbackup pathname=/usr/foo/test BACKUP=YES;
```

The entry for the LIBNAME domain called **nobackup** creates tables in the directory **/usr/foo/test**, but no **BACKUP=** option is specified. For this reason, tables created through this domain definition are ineligible for backup. In contrast, the entry for the LIBNAME domain **canbackup**, which also creates tables in the directory **/usr/foo/test**, has the **BACKUP=YES** option. As a consequence, tables created through this domain are eligible for backup.

When **spdsbkup** performs a backup, it checks every table in **/usr/foo/test**. However, based on our example parameter file entries, **spdsbkup** backs up only the eligible tables in **canbackup**. On the client connections created using pass-through or LIBNAME, the **BACKUP=NO** LIBNAME option can be used to override. Tables that are created when either of these is in effect will be able to be backed up.

Incremental Backups Requires a Prior Full Backup

Before you can do an incremental backup of an SPD Server table, you must do a full backup of the table. You have two alternatives for the full backup:

- Use the system's full backup utility, and then inform **spdsbkup** of the system's last full backup date.
- Use **spdsbkup** to perform a full backup, if none has been done before.

After a full backup has been performed for an SPD Server table, you can then proceed with an incremental backup strategy. The first incremental backup saves all table changes that were performed after the last full backup date. Each successive incremental backup saves the changes that were made after the previous incremental backup.

Backup Usage

```
spdsbkup -d <dom> -f <file> -h <host> [-hash] [-s <serv>] [-u <user>]
          [-fibfact <n>] [-p <passwd>][-t <mm/dd/yy:hh:mm:ss>] [-r <count>]
          [-a | -aonly] [-n] [-q] [-v] [-nv6warn] [-proj <dir>] [Table ...]
spdsbkup -inc -d <dom> -f <file> -h <host> [-hash] [-s <serv>] [-u <user>]
          [-fibfact <n>] [-p <passwd>][-t <mm/dd/yy:hh:mm:ss>] [-r <count>]
          [-a | -aonly] [-q] [-v] [-nv6warn] [-proj <dir>] [Table ...]
spdsbkup -full -d <dom> -f <file> -h <host> [-hash] [-s <serv>][-u <user>]
          [-fibfact <n>] [-p <passwd>] [-r <count>] [-a | -aonly] [-n] [-q]
          [-v] [-nv6warn] [-proj <dir>] [Table ...]
```

spdsbkup
Performs an incremental or full backup of SPD Server tables.

- If a table DOES NOT have a pre-existing full backup, it performs a full backup of the table and sets the last full backup date.
- If the table DOES have a pre-existing full backup, it performs an incremental backup. The incremental backup uses the latest full or incremental backup date as the beginning point for the incremental content change for the table.

spdsbkup -inc
Performs only incremental backups of SPD Server tables.

- If a full backup (required for an incremental) is unavailable, it prints a warning message and the table is not backed up.
- If a full backup is available, it performs an incremental backup of the table using the later of the two dates: the last full backup or the last SPD Server incremental backup for the table.
- Attribute changes to the table are not backed up in an incremental backup. Only the incremental changes for the rows since the last backup are backed up.

  Note: When an incremental backup is restored, only the incremental changes to the rows are applied. Any indexes defined for the table will be updated accordingly.

spdsbkup -full
Performs only full backups of SPD Server tables. All of the table observations and attributes (indexes, definitions, partition size, compression and sorted) are backed up. After each full table backup, it resets the last full backup date for the table. See the -n option for dependencies.

Note: When a full backup is restored, the table is created with those attributes and then all of the rows are added.

Backup Options

-a
Include the domain ACL files in the backup.

-aonly
Only include the domain ACL files in the backup. No tables will be backed up.

-d
The SPD Server LIBNAME domain.

Note: The system that performs the backup must be able to access the physical path for the domain locally or through a network connection.

-f
The prefix filename for the backup data file. This filename is concatenated with **_BK_ddmmmyyy_hhmmss.0.0.0.spds**. The complete name identifies it as an SPD Server backup file. If the backup file exceeds the system's file size limit, **spdsbkup** automatically extends the file, separating it into multiple backup files with a unique SPD Server filename extension (the "0.0.0" portion of the filenames will be different).

-fibfact <n>
Increase the File Information Block (FIB) metadata space by a factor of n, where n is greater than or equal to 2. The **`-fibfact`** option is necessary only if a backup fails due to insufficient file information block metadata space (fibspace). File information block metadata space shortages occur when the domain that is being backed up contains an unusually large number of data sets.

-full
Performs only full backups of SPD Server tables. All of the table observations and attributes (indexes, definitions, partition size, compression and sorted) are backed up. After each full table backup, it resets the last full backup date for the table. See the **`-n`** option for dependencies.

-h
The SPD Server host to use for the backup.

-hash
Prints the hash sign (#) to stdout for each 256K block that is compressed and written to the backup file.

-help
Prints the command-line usage syntax and option switch list for the **spdsbkup** utility.

-inc
Performs incremental backups of the SPD Server tables.

-n
Does not save index information for SPD Server tables when performing full backups. When the table is restored, the restore utility does not create indexes. Note that the index itself is not backed up, only the definition of the index is.

-nv6warn
Suppresses the 'Cannot back up v6 data set' warning. **Spdsbkup** 4.5 can only back up SPD Server and SPD Server data sets. Attempting to back up earlier versions of SPD Server data sets results in a warning message unless the **`-nv6warn`** option is invoked.

-p
The user password.

-proj <dir>
The domain project directory.

-q
Runs **spdsbkup** in quiet mode, which outputs only error messages and warning messages during a backup operation.

-r
The number of times **spdsbkup** should retry accessing a table that is not available to **spdsbkup** because it is being updated. A table that is being updated cannot be backed up. **Spdsbkup** 4.5 pauses five seconds, then retries the table if it was unavailable during the previous access attempt. The default retry count is one.

-s
The port number of the name server. If this is not specified, the default value is *spdsname*.

-t
The date/time of the last full system backup for the table(s) which are to be backed up.

When the **`-t`** option is used with **spdsbkup,** the utility performs a full backup only if a table was created after the specified date/time. Otherwise, it sets the last full backup date for the table to the specified date/time and performs an incremental backup from the last full system backup date.

When the **`-t`** option is used with **`spdsbkup -inc`**, the utility prints a warning message if it encounters a table that was created after the specified date/time. The message states that the table will not be backed up until a full backup of the table is completed. If **spdsbkup** encounters a table that was created before the specified date/time (that is, it is in the last full system backup), **spdsbkup** sets the last full backup date for the table to the specified time and performs an incremental backup of the table using the last full system backup date.

The **`-t`** option cannot be used with **`spdsbkup -full`**.

-u
The user name.

-v
Includes the full name of the backup file and the backup's table of contents file as part of a **spdsbkup** note.

[Table ...]
The list of tables in the domain that you want to include in the backup. If no tables are specified, all of the eligible tables in the domain are backed up.

Note: The list of tables to be backed up must be the last option that you specify.

Backup Return Values

When the **spdsbkup** utility exits, it generates a return value. If the **spdsbkup** return value is 0, then the utility was successful. If the **spdsbkup** return value is 1, one or more data sets could not be backed up. In that case, examine your SAS log for WARNING information. If the **spdsbkup** return value is 2, a critical error caused an early process termination. Examine your SAS log for WARNING and ERROR information.

Backup Data File

Backup Data File Nomenclature

The **spdsbkup** utility stores backup data in a file named **file_BK_ddmmmyyyy_hhmmss.0.0.0.spds**. The suffix, added to the filename, generates a unique backup file that indicates when the backup was performed. Because the suffix is unique, the same filename can be used for successive backups of a domain or a table, without overwriting an existing file.

Backup Data File Extensions

If the backup file exceeds the system file size limit, **spdsbkup** automatically extends the file, storing the excess data in additional files. The software identifies these files with a file extension after the date/time. (The SPD Server file extension is the "0.0.0" portion of the filename.) While the extensions for the files will vary, the date/time will be the same on all the files.

You must have a backup file complete with filename extension before you can begin a restore session.

Backup Table of Contents File

In addition to the backup file, **spdsbkup** creates a table of contents file using the name **file_TC_ddmmmyyyy_hhmmss.** The **TC** in the filename identifies it as a table of contents file. If the table of contents file is created in the same SPD Server operation, the timestamp for the backup file and the table of contents file are identical. The table of contents file does not have an SPD Server file extension. Unlike the backup file, the table of contents file is a normal system file and cannot be 'extended'. The table of contents file size is constrained only by the native operating system's file size limit.

The table of contents file contains the following information for each backed up table:

- Columns 1 - 32 contain the table name or ACL name if it is a domain ACL file.
- Columns 33 - 232 contain the backup filename.
- Columns 233 - 250 contain the last full backup date, using SAS datetime18. format.
- Columns 251 - 258 contain the incremental backup sequence number since the last full backup. For example, a value of 2 indicates that this is the second incremental backup since the last full backup.
- Columns 259 - 268 contain the number of rows that were backed up.
- Column 269 contains F for a full SPD Server backup, or I for an incremental backup.
- Columns 270 - 277 contain the number of indexes that were backed up during a full SPD Server backup. This field contains a 0 if an incremental backup is being performed.
- Column 278 is a Boolean ACL file indicator. Column 278 contains a T if a domain ACL file is being backed up, and an F if a table is being backed up. If the ACL file indicator is set to T, columns 1-32 are configured for ACL names.

The table of contents file is formatted so that it can be used as a table of contents for a SAS backup file. The SAS format for the table of contents file is

```
format lastfull datetime18.;
 input @1 table $32. @33 bk_file $200.
 @233 lastfull datetime18. @251 inc_seq 8.
 @259 rows 10. @269 bk_type $1.
 @270 num_idx 8.,
 @278 acls $1.;
```

After performing each SPD Server backup, you should append the resulting table of contents file to the SAS table of contents backup file. This is an important step because it saves the backup history, and assists later when restoring tables.

For example, if you want to determine which backup files you need to restore a specific table, using a last full backup with a known date, you could create the following SQL query:

```
select bk_file from foo.bkup_toc
where table = "dset"
and datepart(lastfull) >= 'ddmmmyyyy'd;
```

Backup User Messages

Confirm Your Backup Job Status

Three basic types of SPD Server **spdsbkup** backup user messages can appear in your SAS log:

- Successful Backup
- Warning: Table Cannot Be Backed Up
- Failed Backup: Error and Program Aborts.

Successful Backup

If **spdsbkup** successfully backs up a table, it writes some notes to **stdout**, unless the quiet `-q` option is specified. The notes include useful summary information, such as the name of the table that was backed up, the number of observations that were backed up, and whether the back up that was performed was a full backup or an incremental backup.

Warning: Table Cannot Be Backed Up

If **spdsbkup** cannot back up a table, it will print a warning message that states why the table could not be backed up.

Failed Backup

If the spdsbkup utility detects a serious failure condition, it will halt and print an error message that states the reason for the failure.

Spdsrstr - the SPD Server Table Restore Utility

Restore Description

Spdsrstr is a restore utility that uses a backup file to restore a specified set of SPD Server tables. Tables must meet restore requirements or the **spdsrstr** utility bypasses them. The **spdsrstr** utility can also provide a list of the tables in the backup file that are eligible for restoration.

- When an incremental backup is restored, only the incremental changes to the observations are applied.
- When a full backup is restored, the table is created with the attribute settings that existed when the full backup was performed, and then all of the rows are added.

Restore Requirements

Before you can use the **spdsrstr** utility to restore a table, the following must be true:

- The table to be restored must be identical to the table that was backed up. That is, the name and create date must match the name and create date of the backed up table.
- Incremental table restores must be performed in the same order as the incremental backups that were performed.
- The table must not have been modified between the incremental restore dates, assuring that the table is returned to the exact state at time of backup.
- The backup file (with any file extension) must be available.

If a table does not meet all of the criteria, **spdsrstr** prints a warning message to **stdout**, and does not restore the table. If **spdsrstr** is restoring multiple tables, it will restore only the tables that meet the restore criteria.

Restore Syntax

```
spdsrstr -d <dom> -h <host> {-f <fullfile> | -e <extfile>} [-hash]
 [-r <count>] [-a | -aforce] [-aonly] [-n] [-q] [-s <serv>]
 [-u <user>] [-p <passwrd>] [-proj <dir>] [table ...]

spdsrstr -v -d <dom> -h <host> {-f <fullfile> | -e <extfile>}
 [-s <serv>] [-u <user>] [-p <passwrd>] [-proj <dir>] [table ...]

spdsrstr -t {-f <fullfile> | -e <extfile>} [table...]

spdsrstr -help
```

spdsrstr
: Restores all or selected tables from a backup file.

spdsrstr -t
: Prints a table of contents for a backup file indicating when the backup file was created, and whether it is a full backup, and if so, the number of indexes. Further, it lists for each backed up table, the name, backup sequence, and the number of columns and records that are contained in the table.

spdsrstr -v
: Verifies all or selected tables from a backup file can be restored, but does not do the actual restore.

Restore Options

-a
: restore the backed up domain ACL (Access Control List) files if they do not already exist.

-aforce
restore the backed up domain ACL files if they do not exist or overwrite the current files if they do exist.

Note: This option should be used when restoring multiple files with the **-e** option to ensure that the domain ACL files are consistent with the last file restored.

-aonly
Only restore the domain ACL files, and nothing else.

-d
The SPD Server LIBNAME domain.

Note: The system that performs the restore must be able to access the physical path for the domain locally or through a network connection.

-e
<extfile> The backup filename prefix as specified in **spdsbkup** that can be used to restore ALL backup files in the directory with the name **<extfile>_BK_ddmmmyyyy_hhmmss.0.0.0.spds**. The backup files are restored in the order from oldest to newest as determined by the **ddmmmyyyy_hhmmss** component of the filename.

-f
<fullfile> The backup filename that contains the tables to restore.

Note: The filename must be the full filename (including its extension) created by the SPD Server backup utility.

-h
The host SPD Server to use for the backup.

-hash
Prints a hash sign (#) to stdout for each 256K compressed block that is read from the backup file.

-n
Does not create any indexes for a full restore of a table that was backed up with index information.

-p
The user password.

-proj <dir>
The domain project directory.

-q
Runs **spdsrstr** in quiet mode, which outputs only error and warning messages during a backup operation.

-r
Specifies the number of times **spdsrstr** will retry accessing tables which are not available during a restore operation because they were in query/update mode. **Spdsrstr** cannot restore a table if that table is in query/update mode when **spdsrstr** accesses it. **Spdsrstr** pauses five seconds and retries the table if it was in query/update mode. **Spdsrstr** will retry the file **-r** times before the restore fails. The default retry count for **-r** is one.

-s
The port number of the name server. If the port number is not specified, the default value is **spdsname**.

-u
The user name.

-v

Verify which tables in the backup file can be restored, but do not actually perform the restore operations.

[Table ...]

The list of tables to restore from the backup file. If no tables are specified, all tables in the file are restored.

Note: The list of tables **must** be the last option specified in your **spdsrstr** command.

Restore Return Values

When **spdsrstr** exits, it generates a return value. If the **spdsrstr** return value is 0, the utility was successful. If the **spdsrstr** return value is 1, one or more data sets could not be restored. In that case, examine your SAS log for WARNING information. If the **spdsrstr** return value is 2, a critical error caused an early process termination. Examine your SAS log for WARNING and ERROR information.

Restore User Messages

Successful Restore

If **spdsrstr** successfully restores a table, it writes some notes to **stdout**, unless the `-q` option is specified. The notes include useful information, such as the name of the table that was restored, the number of rows that were restored, and whether the restore that was performed was a full restore or an incremental restore.

Warning: Table Cannot Be Restored

If **spdsrstr** cannot restore a table, it will print an error message stating the reason for the failure. No tables are restored after the failure.

Failed Restore

If the **spdsrstr** utility detects a serious failure condition, it will halt and print an error message that states the reason for the failure.

Restore Usage Examples

Backup and Restore Utility Example Scenario

Here are some common SPD Server backup and restore utility examples. In our example scenario, the starting date for the backup cycle is Sunday, February 3, 2008. The weekly schedule includes

- a full backup of the SPD Server domain "test" every Sunday at 23:30
- an incremental backup of the domain at 23:30 the rest of the week.
- **Exclusive SPD Server Full and Incremental Backups**
- **SPD Server Incremental/Full Backups and System Full Backups**
- **Restoring a Single SPD Server Table**
- **Restoring an SPD Server Domain**

Example 1: Exclusive SPD Server Full and Incremental Backups

You can use SPD Server backup and restore utilities exclusively to perform full and incremental table backups and restores.

This example outlines the steps you use to perform a full backup of your domain once a week, and to perform incremental backups the rest of the week. The incremental backups will also fully back up any newly created tables.

1. On Sunday, February 3, 2008 at 23:30, run the SPD Server backup utility to do a full backup of the domain:

   ```
   spdsbkup -full -a -d test -h host -s serv -f backup
   ```

   The backup creates the backup data file **backup_BK_05Feb2006_233000.0.0.0.spds** and the backup table of contents file **backup_TC_03Feb2008_233000**. The backup file contains the full SPD Server backup for each table and any ACL files in the domain. The table of contents file contains information for each table that was backed up.

2. Archive the SPD Server backup file and source in the table of contents file into a SAS table of contents table.

3. On Monday night through Saturday night, use the SPD Server backup facility to perform incremental backups:

   ```
   spdsbkup -a -d test -h host -s serv -f backup
   ```

   This statement performs incremental SPD Server backups of tables that were previously backed up, performs a full backup of tables that were created after the previous night's backup, and also backs up any ACL files that are in the domain.

Example 2: SPD Server Incremental/Full Backups and System Full Backups

You can use SPD Server utilities to perform incremental backups on data sets that you have previously archived, as well as to perform full backups on new data sets that have never been backed up. You can also back up your SPD Server data sets using a system utility from your native operating environment. Which one should you use? The advantage in using system full backups is that a system utility does not parse the data set, and therefore usually runs faster than the SPD Server utility when performing a full backup. For example, system utilities often write directly to tape storage media. In contrast, the SPD Server utility first writes backup data to a file on the hard drive, and then the backup file is usually backed up to tape.

This example outlines the steps you use to perform a full system backup of the domain "test" using operating system utilities once a week, then use SPD Server to perform a domain back up on the remaining nights.

1. On Sunday, February 3, 2008 at 23:30, run the SPD Server list utility **`spdsls -l`** to produce a listing of the tables that belong to the domain "test" in preparation for a full backup.

   ```
   spdsls -l -a <physical_path_of_domain>
   ```

   Run the operating system backup utility to perform a full backup of the domain tables and ACL files, and then archive the backup.

2. On Monday, February 4, 2008 at 23:30, run the SPD Server backup utility **spdsbkup** and set the last full backup date to the previous night for the 'test' tables. **Spdsbkup** then performs an incremental backup of tables that have changed since the last full system backup, and performs a full backup of tables that were created after the last full system backup was performed.

   ```
   spdsbkup -d test -h host -s serv -t 02/04/08:23:30:00 -f backup
   ```

The utility creates the backup data file **backup_BK_04Feb2008_233000.0.0.0.spds** and a backup table of contents file **backup_TC_04Feb2008_233000**.

The backup file contains incremental changes for tables that were modified after 23:30:00 on February 3, 2008, and full backups of tables created after 23:30:00 on February 4, 2008. Only the tables that were modified or created since the last full backup date are included in the backup file. The table of contents file contains information for each table that was either incrementally or fully backed up.

3. Archive the SPD Server backup file and source in the table of contents file into a SAS table of contents table.
4. On Tuesday night through Saturday night, use the SPD Server backup facility to do incremental backups of previously backed up tables and full backups of the newly created tables:

```
spdsbkup -d test -h host -s serv -f backup
```

There is no last full backup date specified for the remaining week's incremental backups. The SPD Server backup utility performs incremental backups of tables that were previously backed up and full backups of tables that were created since the previous night's backup. Although the same filename prefix is specified each night, spdsbkup saves each night's backup to a different file, appending the date/time of the backup to the filename.

5. Archive the incremental data file and source in the table of contents file into a SAS table of contents table.

Example 3: Restoring a Single SPD Server Table

Use the following steps to restore a table that was accidentally deleted from the domain "test" on Friday, February 8, 2008.

1. If the table was backed up fully by the operating system backup utility, use the system restore utility to restore the table. (Restore the table to its last full backup image, taken on February 3, 2008.) If the table was backed up fully by the SPD Server backup utility, skip this step.
2. Run a SAS query on the backup table of contents table **bkup.toc**.

```
select bk_file from foo.bkup_toc
where domain = "test"
and table = "results"
and dttime >= '03Feb2008:23:30:00'd;
```

The query results indicate which SPD Server backup files are required to restore the table to its last full backup state.

3. Restore the archived SPD Server backup files and any extensions that are required to restore the table.
4. Run **spdsrstr** on each sequential SPD Server backup file to restore the table. The order runs from the oldest backup date to the most recent backup date. Our example table was backed up fully using the SPD Server backup utility on Sunday, February 3, 2008. The table was then backed up incrementally on Tuesday, February 5, and Thursday, February 7. Thus, the order of the statements required to restore the table are

```
spdsrstr -d test -h host -s serv -f backup_BK_03Feb2008_233000.0.0.0.spds results

spdsrstr -d test -h host-s serv -f backup_BK_05Feb2008_233000.0.0.0.spds results

spdsrstr -d test -h host -s serv -f backup_BK_07Feb2008_233000.0.0.0.spds results
```

Alternatively, you could use the **-e** option of spdsrstr and restore all of the files with one single command:

```
spdsrstr -d test -h hostname -s serv -e backup results
```

Note: When you restore a single table, you do not need to restore the ACL files, because they were not deleted.

Example 4: Restoring an SPD Server Domain

Use the following steps to restore an SPD Server domain named "test" that was lost due to a system media failure that occurred on Friday, February 15, 2008.

1. If the domain was backed up fully using the system backup utility, use the system restore utility to restore domain "test" to its state at the last full backup date of February 10, 2008. If the domain was backed up fully using the SPD Server utility, then skip this step.
2. Use SAS to run a query on the backup table of contents table **bkup_toc**.

   ```
   select bk_file from foo.bkup_toc
   where domain = "test"
   and dttime >= '10FEB2008:23:30:00'd;
   ```

   The query results identify which SPD Server backup files are required to restore the domain.
3. Restore the archived SPD Server backup files required to restore the domain.
4. Use the SPD Server restore utility to restore domain "test":

   ```
   spdsrstr -aforce -d test -h host -s serv -e backup
   ```

   The **-aforce** option will cause the domain ACLs to be updated for each restore file, resulting in the latest backup of the ACLs being restored.

Using PROC SPDO to Back Up and Restore SPD Server Tables

You can use the SAS **PROC SPDO spdscmd** to run the SPD Server backup and restore utilities. There is one constraint: you must submit the command using an SPD Server LIBNAME that has 'special' privileges. Backup and restore utilities require privileged access. To grant 'special', privileges, you must specify the LIBNAME option **ACLSPECIAL=YES**.

When you execute commands using the PROC SPDO **spdscmd**, the current working directory is the root directory of SPD Server. Output messages from the commands are echoed to the SAS log. In the next example, the SPD Server incremental backup and restore utilities reside in the SPD Server directory. The incremental backup and restore files are saved in the server directory **/spdsadm/bkup**.

Currently, there is a limitation when using the **-aforce** option with PROC SPDO to restore on Windows. The **-aforce** option fails if ACLs exist and there are active connections to the domain that were specified using the **-d** option during the restore. ACLSPECIAL= connections to a libref must specify a domain that is separate from the domain where you are attempting to restore the ACLs (if the ACLs currently exist). Making ACLSPECIAL= libref connections that specify the domain where you are attempting to restore the ACLs will cause the ACL restore operation to fail.

Use the following steps to use PROC SPDO to execute SPD Server backup and restore utilities:

1. Create an SPD Server LIBNAME, and specify 'special' privileges.

```
libname backup sasspds 'test'
 host='sunny'
 serv='5150'
 user='admin'
 passwd='admin'
 ACLSPECIAL=YES;
```

   Our example creates the LIBNAME backup for domain "test" on the host machine 'sunny'. The port number of the name server is 5150, and 'admin' is the SPD Server user ID and password.

2. Invoke PROC SPDO for the LIBNAME.

```
PROC SPDO lib=backup;
```

3. Use PROC SPDO remote system commands to issue backup and restore statements on the server. The following example performs a full SPD Server backup of the domain "tstdomn" at 23:30 on February 3, 2008.

```
spdscmd 'spdsbkup -a -full -d tstdomn -h sunny -s 5150 -f /spdsadm/bkup/test';
```

   The example statement creates the backup file **/spdsadm/bkup/test_BK_03Feb2008_233000.0.0.spds** and the table of contents file **/spdsadm/bkup/test_TC_03Feb2008_233000** on the server.

4. If a later restore operation is necessary, specify a run of the SPD Server restore utility to restore the domain to its last full backup state.

```
spdscmd 'spdsrstr -aforce -d tstdomn -h sunny -s 5150 -e /spdsadm/bkup/test
```

Back Up and Restore Table Indexes using SPD Server Full Backups

When you perform an SPD Server full backup of a table, by default the utility saves information to recreate the indexes. This information is subsequently used if the table is fully restored, to be able to recreate the indexes.

The SPD Server full backup utility does not save the index data, only the information necessary to recreate the indexes when the table is restored. Therefore, when backing up table indexes, the saved information requires no additional overhead and little additional space.

If you must fully restore a table later, there are two methods available for restoring the indexes:

1. You can allow the SPD Server restore utility to recreate the indexes when the table is created. In this method, as each observation is added to the table, the index will be dynamically updated.
2. Alternatively, you can use the **-n** option of the SPD Server restore utility. The **-n** option suppresses index creation. After the table is fully restored, you can use PROC DATASETS or PROC SQL to recreate the indexes.

Back Up and Restore SPD Server Table Indexes using System Full Backups

Back Up and Restore SPD Server Table Indexes Using System Full Backups

Restoring indexes from system full backups and restores is not as clean as restoring indexes from SPD Server full backups and restores. To understand why, consider the two available methods for restoring indexes from a system full backup:

- **restore the index dynamically as the table is restored**
- **recreate the index after the table is restored.**

What decides which method to use? You must balance the time and resources needed to back up the index against the time needed to re-create the index when the table is restored.

Method 1 – Restore the Index Dynamically

To restore the index dynamically, you must include the table index files in the full backup and restore of the table. To determine which index files to include, use **`spdsls`** with the **`-i`** index option. The output lists component files for each table in the domain that is intended for full backup.

When restoring a table, you must first restore the table metadata, data, and index files from the last full backup archive. Then use **`spdsrstr`** to perform incremental restores. As the tables are restored, the indexes are dynamically updated to include any new or modified records.

In summary, the first method trades the additional resources required for full backup of the table index files, which can be very large, against the potentially short time that might be required to restore them. You can restore indexes for a table that has not had any incremental changes after the system full backup by using a system full restore.

Method 2 – Recreate the Index after the Table Is Restored

If you use this method, you do not need to include the index files in the table's full backup. Thus, when running spdsls to list the component files for each table in the domain that you intend to back up, leave off the -i index option. The spdsls utility then outputs a list that excludes index files.

A cautionary note about method 2: If you do not save index information, you can experience problems when you attempt to fully restore the table. The reason: the table's metadata will have information about the index files which can be missing or out of date. As a result, the metadata no longer mirrors the table.

Before you can perform an incremental restore of the table, you must first repair the table metadata. To repair the metadata, use PROC DATASETS to modify the table and delete all of the indexes, then run spdsrstr to restore the table. After performing the incremental restores of the table, use PROC DATASETS again to modify the table and create the indexes.

The second method trades the resources that you save by not fully backing up the index files against the greater amount of time it can take to recreate the indexes fully, if the table must be restored.

Chapter 20

SPD Server Directory Cleanup Utility

Introduction

You use the SPD Server cleanup utility **spdsclean** to perform routine maintenance functions on

- directories that you use to configure SPD Server storage
- directories that SPD Server uses for working storage
- various system-specific directories that are designated for temporary files.

The **spdsclean** utility uses a simple command-line interface so users can control the level of cleanup performed and control the behavior of elements used in the utility.

CAUTION:

The spdsclean command line utility should be used only when SPD Server is not running. Do not run **spdsclean** when the SPD Server host is running. The directory cleanup utility does not ensure that files in the SPD Server cleanup area are not in use by others. Some cleanup actions can violate SPD Server file integrity, permitting concurrent access to file structures that were not designed to support concurrent access.

Using the Directory Cleanup Utility Spdsclean

The spdsclean program is a command-line utility. It supports a set of command-line options and parameters you use to specify the location and names of tables to convert, and behaviors that you want to control during the conversion process.

The command line is as follows:

spdsclean `<-options>`

The order of options on the command line does not matter. All options are global in scope.

Spdsclean Wildcards and Pattern Matching

Some **spdsclean** options, such as –DOMAINS use wildcards and pattern matching functions. The spdsclean utility uses the following wildcard and pattern matching rules:

- Character strings must match the LIBNAME domain name from the libname file. The match is not case sensitive.
- Using '**.**' or a '**?**' characters in the search pattern will wildcard match any single character in a LIBNAME domain name in the libname file.
- The '*****' character terminates the pattern and wildcard matches all remaining characters in the LIBNAME domain name in the libname file.

For example, the -domains pattern '**?test***' will match the domains '**ATEST1**', '**ATEST123**', '**ATESTXYZ**', '**CTEST1**', and so on, from a libname file. The -domains pattern '**test***' will match only the domain name '**TEST**' from the libname file.

Note: When you use wildcard characters in a -domains pattern, follow the rules for your command shell (such as ksh) to ensure that these characters are passed to the spdsclean command. For example, a ksh command shell user would need to enclose the wildcard pattern in quotation marks. The question marks ensure that the wildcard pattern matching occurs relative to the spdsclean command.

```
spdsclean -domains "?test*"
```

You can also disable command shell globbing for the execution of the **spdsclean** command.

Spdsclean Options

Spdsclean options fall into two classes. The first class of **spdsclean** options are options that define actions. The second class of **spdsclean** options are options that modify behavior. Examples for both classes of **spdsclean** options follow.

Spdsclean Options That Define Actions

The **spdsclean** utility uses the following option settings to define specific actions:

-parmfile parmFile

The **-parmfile** option to the spdsclean command runs cleanup on the specified SPD Server environment that is defined in the named SPD Server parameter file. The cleanup action empties all directory resources that are defined in the SPD Server parameter file. All files contained in the WORKPATH= path list are deleted. Options which modify **-parmfile** cleanup actions are described in "Spdsclean Options that Modify Behavior" on page 253

-libnamefile libnameFile

The **-libnamefile** option runs cleanup on the SPD Server environment specified in libnameFile,the LIBNAME parameter file. The cleanup action empties directory resources that are defined in LIBNAME statements in the specified LIBNAME parameter file. Cleaning directory resources removes files and file types that you specify in this action. Spdsclean always deletes residual lock files that were left behind in the domain directory. Residual temporary files in the allocated domain directories are deleted by default as well. You can include ACL files and the LIBNAME state file in the files to be deleted, as well as suppress the default deletion of residual temporary files. Use the **-domains** option with pattern matching to filter the domains that you want to clean in the libnameFile. See the description for the –DOMAINS option below for more information.

-logdir logPath

The **-logdir** option specifies the path for SPD Server to use when cleaning server log files. SPD Server searches the specified log path directories for .spdslog files. When .spdslog files are found, SPD Server checks them for aging criteria. You specify the aging criteria, which tells SPD Server how long to keep the log files using the **-logage** option. When **spdsclean** finds server log files that have a creation date that is older than **-logage** days, **spdsclean** deletes the files. Files aged less than or equal to the specified threshold are retained. For more information, see the -LOGAGE option under "Spdsclean Options that Modify Behavior" on page 253.

Spdsclean Options that Modify Behavior

The **spdsclean** utility uses the following option settings to modify specific behaviors:

-all

The **-all** setting is equivalent to specifying options using:

```
-tmp -acl -lib11.
```

-tmp

The **-tmp** setting enables deletion of residual temporary files in the LIBNAME domain path list. Deletion enabled is the default setting for the -tmp variable.

+tmp

The **-tmp** setting disables deletion of residual temporary files in the LIBNAME domain path list.

-acl

The **-acl** setting enables deletion of ACL files in the LIBNAME domain path list. Enabling the -acl setting deletes .spres11* and .sppro11* files from the selected LIBNAME domains in the specified **-libnamefile**. Use the **-acl** setting with care, since it applies to all selected LIBNAME domains. Deleting the ACL files does not give broader access to a given resource. Deleting the ACL files restricts the access to the resource owner. The default setting for **-acl** is enabled, or +acl.

+acl

The **+acl** setting disables deletion of ACL files in the LIBNAME domain path list.

-lib11
: The **-lib11** setting enables deletion of the domain state file, .spdslib11. The default setting is +lib11.

+lib11
: The **+lib11** setting disables deletion of the domain state file. This is the default setting for the lib111 variable.

-verbose
: The **-verbose** setting is equivalent to specifying **-vwork** and **-vdomain**,enabling logging for resource cleanup from WORKPATH, system workspace directories, and LIBNAME domain directories.

+verbose
: The **+verbose** setting is equivalent to specifying **+vwork** and **+vdomain**,disabling logging for resource cleanup from WORKPATH, system workspace directories, and LIBNAME domain directories.

-vwork
: The **-work** setting enables logging for resource cleanup from WORKPATH and system workspace directories.

+vwork
: The **+vwork** setting disables logging of resource cleanup for WORKPATH and system workspace directories. This is the default setting for this variable.

-vdomain
: The **-vdomain** setting enables logging for resource cleanup from LIBNAME domain directories.

+vdomain
: The **+vdomain** setting disables logging for resource cleanup from LIBNAME domain directories. This is the default setting for this variable.

-domains dompat1, [dompat2,]
: Use the **-domains** option to specify a domain list. The domain list is a comma-separated list of domain names and wildcard matching patterns which build the LIBNAME domains from the libname file when it is processed. Standard pattern matching rules and wildcards apply.

-logage ageDays
: Use the **-logage** option to set the age threshold, in days, for keeping .spdslog files in the SPD Server log directory when the **-logdir** option is specified. When the **-logdir** option is specified and the .spdslog files in the SPD Server log directory are older than the threshold ageDays value, they will be deleted. The default value for ageDays is seven days.

Spdsclean Examples

For the following examples, assume that the InstallDir/ for your SPD Server is the directory **/opt/spds45**.

Cleaning WORKPATH Files on Your Server

This **spdsclean** command cleans all of the files in the WORKPATH directory list designated by **/opt/spds45/site/spdsserv.parm**.

```
spdsclean -parmfile /opt/spds45/site/spdsserv.parm
```

If you want **spdsclean** to log the files it deletes, add the **-verbose** option to the command.

```
spdsclean -parmfile /opt/spds45/site/spdsserv.parm -verbose
```

Cleaning Residual Temporary LIBNAME Domain Files

This **spdsclean** command cleans all of the residual temporary files from all of the LIBNAME domains that are defined in the **-libnamefile** specified.

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm
```

If you want **spdsclean** to log the files it deletes, just add the **-verbose** option to the command.

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm -verbose
```

Cleaning Specific LIBNAME Domains

This **spdsclean** command cleans all residual temporary files from the LIBNAME domain TRIAL99.

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm -domains trial99
```

Suppose that you want to add domain UJOE04 to be cleaned also. The following command will do this:

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm -domains trial99, ujoe04
```

Suppose you want to clean all TRIAL9x domains and all domains that begin with UJOE from the specified -libnamefile. The following command will do this:

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm -domains trial9?, ujoe*
```

To log the domains processed and the files deleted from each, just add the -verbose option to any of these spdsclean commands.

Cleaning Other LIBNAME Domain File Classes

This **spdsclean** command only cleans the ACL files from LIBNAME domains that begin with ' UJOE' that are defined in the specified **-libnamefile**. Because of the **+tmp** option, deleting residual temporary files is suppressed. To log the LIBNAME domains cleaned and the ACL files deleted, add the **-verbose** option.

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm +tmp -acl -domains ujoe*
```

To clean domain state files from domains TRIAL9x for the specified **-libnamefile**. submit the following **spdsclean** command:

```
spdsclean -libnamefile /opt/spds45/site/libnames.parm
 -domains trial9? -lib11 +tmp
```

To log the LIBNAME domains that were cleaned and the files that were deleted, add the **-verbose** option.

Cleaning WORKPATH and LIBNAME Combinations

This **spdsclean** command cleans all of the WORKPATH files from the directory list specified in **-parmfile** and cleans residual temporary files from domain directories specified in **-libnamefile**.

```
spdsclean -parmfile /opt/spds45/site/spdsserv.parm
 -libnamefile /opt/spds45/site/libnames.parm -verbose
```

Logging occurs for the WORKPATH and LIBNAME domain directories and for the files that were deleted from each.

Cleaning Log Files

This **spdsclean** command cleans the .spdslog files from the specified **-logdir** directory that are more than seven days old.

```
spdsclean -logdir /opt/spds45/log
```

Suppose you want to keep log files older than 10 days from the date of execution. The following **spdsclean** command will do this:

```
spdsclean -logdir /opt/spds45/log -logage 10
```

If you want to see the files that were deleted, add the-**verbose** option to the **spdsclean** command.

Cleaning WORKPATH, LIBNAME Domain and Log Files

This **spdsclean** command cleans WORKPATH files from the directory list in **-parmfile**, residual temporary files from domain directories in **-libnamefile**, and cleans .spdslog files that are older than seven days from the **-logdir** directory.

```
spdsclean -parmfile /opt/spds45/site/spdsserv.parm
 -libnamefile /opt/spds45/site/libnames.parm
 -logdir /opt/spds45/log -verbose
```

Glossary

ACL Files
: When you create SPD Server Access Control Lists (ACLs), hidden ACL files are created in the primary directory of the LIBNAME domain. The hidden files are named .spres11* and .sppro11*. The hidden ACL files retain the state of the ACLs that were defined for the LIBNAME domain resources. Normally, you should not delete ACL files.

Domain State File
: The domain state file is also known as .spdslib11. The domain state file retains the set of directory paths that are configured for the LIBNAME domain. The directory path information is stored as an ordered list for each of the SPD Server domain storage classes.

  - METAPATH=
  - DATAPATH=
  - INDEXPATH=

  As you make LIBNAME assignments over the life of the domain, the new directories are appended to the end of the ordered lists for METAPATH=, DATAPATH=, and INDEXPATH= storage classes. The order of directories listed in the .spdslib11 file defines the order of data cycling and overflow sequencing for each of the respective classes.

Libnames.param File
: The libnames.parm file defines the SPD Server LIBNAME domains for the SPD Server environment. The libnames.parm file is a collection of LIBNAME statements. Each LIBNAME statement defines a storage domain that SPD Server uses with clients. You modify the libnames.parm file using the **`-libnamefile`** option with the **spdsserv** command.

Residual Lock File
: When SPD Server accesses a data resource or table within a LIBNAME domain, it creates a lock file. The local operating environment uses the locking mechanism to ensure that proper member-level locking is observed by all SPD Server processes that access the named data resource. If a LIBNAME proxy process terminates unexpectedly, the residual lock files remain in the LIBNAME domain. Residual lock files cause no problem upon subsequent accesses because the lock belongs to the operating environment. The lock is cleared when the process terminates and does not depend on the presence of the file itself. However, unused residual lock files can accumulate and create clutter in your primary domain directory.

Residual Temporary File
: SPD Server creates temporary files when you create a new resource in a LIBNAME domain. If the SPD Server LIBNAME proxy process terminates unexpectedly while you are creating a new file, the residual temporary files remain in the LIBNAME domain directories. These temporary files are named with a leading '$' character, which prevent the residual temporary files from appearing in a PROC DATASETS directory listing. You should periodically remove old or abandoned residual temporary files that were created by unexpected proxy process terminations.

Spdsserv.parm File
: The spdsserv.parm file defines the SPD Server operating parameters. The WORKPATH= statement in this file lists the directories that SPD Server will use for transient or working disk storage. To specify the spdsserv.parm file, use the spdsserv command with the **`-parmfile`** option.

System-Specific Temporary Files
: SPD Server uses pre-assigned directories (which vary by operating environment) that are designated for temporary files. The pre-assigned directories hold files, logs, and other temporary entities that SPD Server creates while running. SPD Server normally cleans up these temporary files when exiting. If SPD Server terminates abnormally, these temporary files might be left in the temporary directory. In UNIX operating environments, the temporary files would usually appear in the directories such as **`/tmp`** or **`/var/tmp`**. In Windows operating environments, the temporary files are usually stored in **`C:/TEMP`** (or wherever the user profile is configured to store temporary files).

Chapter 21
SPD Server Debugging Tools

Introduction

SPD Server includes debugging tools that system administrators will find useful. The debugging tools allow SPD Server system administrators to create debug images and to evaluate test images that will not interfere with a pre-existing production SPD Server environment. The debugging tools are for use with SPD Server 4.5 running on SAS 9.2. The debugging tools are organized into LIBNAME statement options for debugging, and server parameter file options for debugging.

SPD Server 4.5 LIBNAME Statement Debug Options

When you issue a LIBNAME statement in SPD Server 4.5, the following debug options are available:

DEBUG=

Description
Enables or disables launching of a debug image for base SPD Server (spdsbased) and SPD Engine (spdsengd).

Syntax
Use the following arguments:

```
DEBUG= YES | CORE | NO
```

YES
launches a debug image (spdsbased and spdsengd) which will enable a good traceback.

CORE
launches debug images and sets the SPD Server parameter file option for that proxy. This ensures a good core file.

NO
disables the debug image for the specified proxy, if one is present.

DEBUG= Examples

Launch a debug image and ensure that the LIBNAME proxy creates a core file in the event of an unexpected process trap:

```
libname mylib sasspds 'spdsdata' user='denettee' debug=core;
```

Disable the debug image:

```
libname mylib sasspds 'spdsdata' user='denettee' debug=no;
```

ALTPATH=

Description

Enables the use of an alternate binary path that is defined using the ALTBINPATH= option in the file. The ALTPATH= option will not search through entities in the PATH environment variable. If ALTPATH= does not find the ALTBINPATH= option specified in the file, a login failure error is issued. The ALTPATH= option is useful for SPD Server administrators who want to load a non-production copy of SPD Server (for example, testing a fix) without having to replace the production copy of SPD Server on a user basis.

Syntax

Use the following arguments:

```
ALTPATH= YES | NO
```

YES
enables use of the alternate binary path that is defined in as ALTBINPATH=.

NO
disables the alternate binary path for the specified proxy, if one is present.

ALTPATH= Example

Issue a LIBNAME proxy that uses the alternate binary path that is defined in ALTBINPATH=:

```
libname mylib sasspds 'spdsdata' user='denettee' altpath=y;
```

SPD Server 4.5 Server Parameter File Debug Options

SPD Server provides the following server parameter file options that system administrators can use as troubleshooting and debugging tools

ALTBINPATH=

Description

The ALTBINPATH= option specifies the path to an alternate executable binary file directory. An alternate binary file path allows system administrators to load a non-production copy of SPD Server without having to replace the production copy of SPD Server.

Syntax

The ALTBINPATH= server parameter file option is enabled when a LIBNAME statement that contains a valid ALTBINPATH= specification is issued.

```
ALTBINPATH= 'DirPath'
```

RECORDFLAGS=

Description

The RECORDFLAGS= option is used to control various startup and debug options for the SPD Server record level locking proxy. The default setting launches the optimized image.

Syntax

The RECORDFLAGS= option uses bit flag arguments for numeric values of 1, 2, and 4. To submit more than one argument, just submit the sum of the respective bit flags. For example, to choose option 1 and option 2, submit an argument of 3 (1+2=3). To choose options 1, 2, and 4, submit an argument of 7 (1+2+4=7).

```
RECORDFLAGS= 1 | 2 | 4
```

1
: launches a debug image for the SPD Server record locking process. If RECORDFLAGS=1 is not specified, the default setting launches the optimized image.

2
: loads the image that is specified in ALTBINPATH= for the SPD Server record locking process. If RECORDFLAGS=2 is not specified, the default setting uses the normal PATH setting.

4
: produces a core file if the SPD Server record locking process encounters an unexpected exception while running. If RECORDFLAGS=4 is not specified, the default setting terminates the client connection if an unexpected exception is encountered while running.

RECORDFLAGS= Examples

Suppose you want to use the RECORDFLAGS= option to launch a debug image for the SPD Server record locking process (bit flag 1), and to produce a core file if an unexpected exception is encountered while running (bit flag 4). To perform both actions, submit the sum of the bit flags (1+4) = 5 as the argument for your RECORDFLAGS= option statement:

```
RECORDFLAGS= 5
```

Use the RECORDFLAGS= option to launch a debug image for the SPD Server record locking process (bit flag 1), to load the image specified in ALTBINPATH= (bit flag 2),

and to produce a core file if an unexpected exception is encountered while running (bit flag 4). To perform all three actions, submit the sum of the bit flags (1+2+4) = 7 as the argument for your RECORDFLAGS= option statement:

```
RECORDFLAGS= 7
```

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