Installation Instructions for Platform Suite for SAS® Version 13.1 for UNIX

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Chapter 1 - Introduction

This document describes how to install Platform Suite for SAS, version 13.1, on UNIX/Linux hosts for use with SAS products and solutions. Platform Suite for SAS can be an individual addition to several SAS products and solutions to provide enterprise-level scheduling capabilities on a single server environment. Platform Suite for SAS is also included as part of SAS Grid Manager for Platform to enable:

- distributed enterprise scheduling
- workload balancing
- parallelized workload balancing

Platform Suite for SAS includes the following components:

- **IBM Spectrum LSF Process Manager for SAS** – The interface used by the SAS scheduling framework to control the submission of scheduled jobs to LSF (Load Sharing Facility), which manages any dependencies between the jobs. The Flow Manager and Calendar Editor clients are included with IBM Spectrum LSF Process Manager for SAS and may be optionally installed. These clients are not required by SAS; however, they do provide additional functionality.
  - **Flow Manager** - Provides a visual representation of flows that have been created for an IBM Spectrum LSF Process Manager Server. These include flows that were created and scheduled in SAS Management Console's Schedule Manager, as well as reports that have been scheduled through SAS Web Report Studio. Platform Flow Manager provides information about each flow's status and associated dependencies. You can view or update the status of jobs within a flow, and you can run or rerun a single job regardless of whether the job failed or completed successfully.
  - **Calendar Editor** - A scheduling client for an IBM Spectrum LSF Process Manager Server. This client enables you to create new calendar entries for time dependencies for jobs that are scheduled to run on the server. You can use it to create custom versions of the calendars that are used to create time dependencies for jobs.
- **IBM Spectrum LSF for SAS** – Dispatches all jobs submitted to it, either by IBM Spectrum LSF Process Manager for SAS or directly by SAS, and returns the status of each job. IBM Spectrum LSF for SAS also manages any resource requirements and performs load balancing across machines in a grid environment.

Note: *SAS and IBM Spectrum product version numbering follows different standards. The mapping between the two is as follows:*

- *IBM Spectrum LSF for SAS 10.1C is IBM Spectrum LSF 10.1.0.12.*

- *IBM Spectrum LSF Process Manager for SAS 10.3 is IBM Spectrum LSF Process Manager 10.2.0.12.*

Architecture

The following diagram illustrates how SAS schedules jobs:
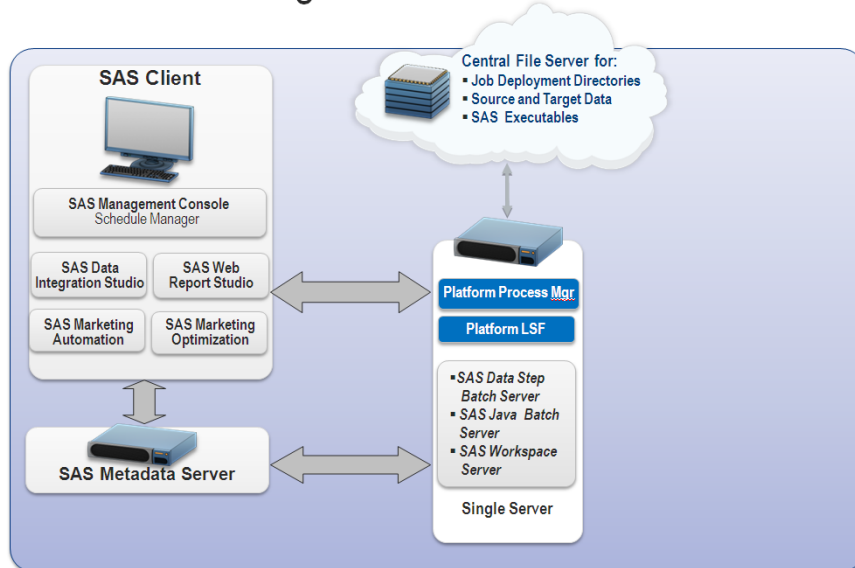
Job scheduling on a single machine requires you to install IBM Spectrum LSF Process Manager for SAS . During the installation of IBM Spectrum LSF Process Manager for SAS, you also install IBM Spectrum LSF for SAS . See "Chapter 2 - Installing IBM Spectrum LSF Process Manager for SAS and IBM Spectrum LSF for SAS" for the instructions on installing on a single server.

The following diagram illustrates the SAS grid computing architecture:

SAS® Grid Computing Architecture
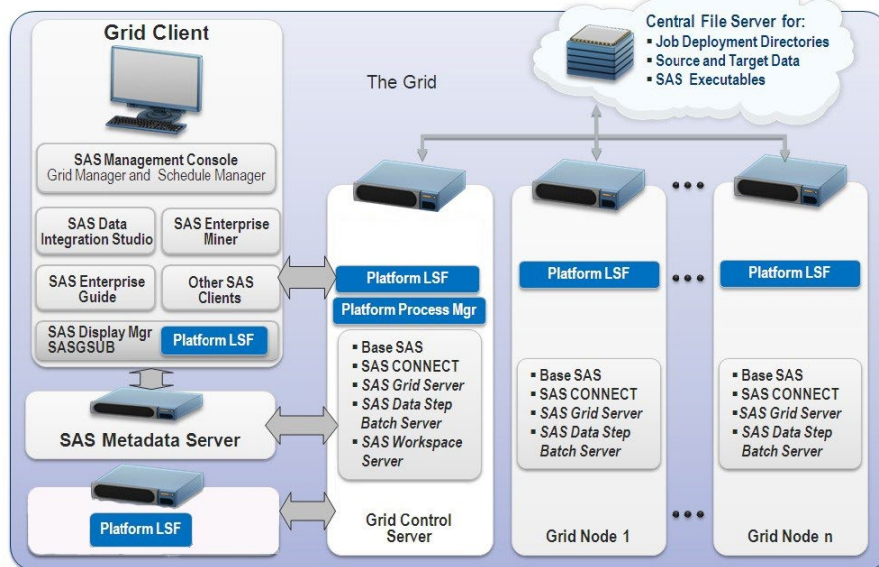
Several types of machines make up a SAS grid environment. These machines have been defined to clarify the software components that must be installed on each one, as well as the SAS metadata that must be configured. The SAS Metadata Server is shown on a separate machine in this example architecture.

In a typical deployment, a dedicated machine hosts SAS Metadata Server, but you might instead decide to run the metadata server on the grid control server. The three machine types that are specific to a grid installation are defined in the following table:

Type	Description	Examples
Grid client	Submits work to the grid but is not part of the grid resources that are available to execute work.	• SAS Foundation (at minimum, Base SAS, SAS/CONNECT, and IBM Spectrum LSF for SAS). Used to run a program that submits work— either whole programs or programs that are separated into parallel segments—to the grid. Installation of the IBM Spectrum LSF for SAS component is required in order for SAS/CONNECT to submit the work to the grid. • A SAS Data Integration Studio client (IBM Spectrum LSF for SAS is not installed on this client machine) • A SAS Enterprise Miner client (IBM Spectrum LSF for SAS is not installed on this client machine) • A SAS Management Console client using the Schedule Manager plug-in or any other applications scheduling SAS workflows (IBM Spectrum LSF for SAS is not installed on this client machine)
Grid control server	Any machine in the grid can be designated as the grid control	In a SAS Data Integration Studio and SAS Enterprise Miner environment, the grid control server runs a

	server. More software is installed on the grid control server and more SAS metadata configuration takes place on this machine. You will start the installation of Platform Suite for SAS on this machine.	workspace server that executes programs that use SAS/CONNECT to distribute work to the grid nodes. The grid control server can be configured as a grid resource capable of receiving work to execute or not, depending on the requirements of your environment.
Grid node	A grid computing resource that is capable of receiving the work that is being distributed.	Each grid node must be running a minimum of Base SAS, SAS/CONNECT, and IBM Spectrum LSF for SAS.

Installation of Platform Suite for SAS is performed first on the grid control server, followed by installation on all the grid node machines. IBM Spectrum LSF for SAS can be installed on the grid control server as a part of the IBM Spectrum LSF Process Manager for SAS installation, or it can be installed by itself. This document shows only IBM Spectrum LSF for SAS being installed as part of the IBM Spectrum LSF Process Manager for SAS installation.

Machines that perform processing for the grid and machines that submit jobs to run on the grid must have IBM Spectrum LSF for SAS installed. If you are writing your own grid-enabled program in Base SAS and want to run the program, that grid client workstation must have IBM Spectrum LSF for SAS installed because it processes the actual submission of jobs to the grid.

This document is intended to assist you with installing Platform Suite for SAS to create a cluster of computers and enable the cluster to work with the SAS Business Intelligence Platform. For more information, refer to the *Grid Computing in SAS document*, located at
http://support.sas.com/documentation/onlinedoc/gridmgr/index.html.

SAS Grid Manager for Platform Control Server requires IBM Spectrum LSF Process Manager for SAS. IBM Platform LSF is installed during the IBM Spectrum LSF Process Manager for SAS installation. The Platform Suite 13.1 for SAS System Requirements provides a list of compatible versions of required components. See "Chapter 2 - Installing IBM Spectrum LSF Process Manager for SAS and IBM Spectrum LSF for SAS" for the instructions to install these components.

SAS Grid Manager for Platform Node and SAS Grid Manager for Platform Client require only IBM Spectrum LSF for SAS 10.1C. See "Chapter 3 - Installing and Configuring IBM Spectrum LSF for SAS on Grid Nodes, SAS Foundation Grid Clients" for the instructions for installing IBM Spectrum LSF for SAS.

Note: *Software updates for SAS OEM version should use*
http://ftp.sas.com/techsup/download/hotfix/platformpatch.html *rather than*
https://www.ibm.com/support/fixcentral/.

Installation Directories

Caution: *Do not install IBM Spectrum LSF Process Manager for SAS and IBM Spectrum LSF for SAS to the same directory.*

Installing Platform Suite for SAS produces the following directory structure:

- JS_TOP is the local directory in which the IBM Spectrum LSF Process Manager for SAS Server and Client files are installed, for example, /usr/share/pm.

- `LSF_TOP` is the shared directory in which IBM Spectrum LSF for SAS files are installed (for example, `/usr/share/lsf`). Generally, `LSF_TOP` is mounted from a file server and all files associated with IBM Spectrum LSF for SAS (state files, binaries for the different architectures, configuration files) are stored in this file share. `LSF_TOP` must be a shared directory among all the machines in the grid. For improved high availability, this file server could be a machine that is not part of the grid.
- Machine-dependent files are installed under `LSF_TOP/`*`version`*`/`*`platform_name`*. These directories and the files underneath represent the machine-dependent files. Machine-dependent files are specific to a particular host type and are the LSF command binaries, server daemons, libraries, and utilities.
- Machine-independent files are independent of the host type and are shared by all host types (main pages, configuration files, include files, examples, etc.).

Pre-Installation Steps

Take the following steps to prepare for the installation:

1. If you are installing Platform Suite for SAS for use with SAS Grid Manager for Platform, read "Configuring Platform Web Services" in the Platform Web Services deployment documentation.

2. Ensure that the SAS install user account exists. Create it if necessary. The user account **sas** will be used throughout this document in examples where a specific user account name is necessary for clarity.

   Note: *SAS recommends that you use the same operating system account to deploy both SAS and IBM Spectrum LSF for SAS.*

3. Contact your system administrator to create a network share that all computers on your cluster can access. This share can be an NFS mount, a directory on a SAN, an SMBFS/CIFS mount, or any other method of creating a directory that is shared among all the machines in the grid. All machines in the grid must be able to access this share at boot time, so have your system administrator set that up based on the type of share.

   All machines in the grid must also have root access because any machine can become the grid master.

   All grid users must be able to read the share at run time. This directory is referred to as `LSF_TOP`, the IBM Spectrum LSF for SAS top-level installation directory. For this installation, `LSF_TOP` is mounted on each machine as `/usr/share/lsf`. Make sure that `root` has read/write access to this subdirectory.

4. On the grid control server, create a directory that contains the IBM Spectrum LSF Process Manager for SAS files. This directory is referred to as `JS_TOP`, the IBM Spectrum LSF Process Manager for SAS top-level installation directory.
   This installation guide assumes that `JS_TOP` is `/usr/share/pm`.

5. Make a list of the names of all the computers that participate in the cluster.

6. Choose a name for the cluster.

7. Locate the `SAS9*_*.txt` and `LSF*_*.txt` file located in the `sid_files` directory in your SAS Software Depot.

- The `LSF*_*.txt` file is used to license all components of Platform Suite for SAS in scheduling capabilities on a single server environment.

- The `SAS9*_*.txt` file is used to license all the components of Platform Suite for SAS as part of SAS Grid Manager for Platform.

8. Determine the types of all computers in the grid using `uname -a` so that the correct tar files can be copied for the installation. This allows you to determine the subdirectory in your SAS Software Depot that contains the software for all the UNIX operating system types and CPU architectures in the grid. The files are in the third-party directory of the SAS Software Depot.

For the IBM Spectrum LSF Process Manager for SAS installation files, navigate to `third_party/Platform_Process_Manager/10_30`. Under that directory are subdirectories named for the operating environment on which you are installing. For the purposes of these instructions, we use Linux for x64 as the operating environment. The following files are saved in these subdirectories:

IBM Spectrum LSF Process Manager for SAS installation files: `pm10.2.0.12_sas_1nx26-x64.tar`

As an example, if the grid control server is a Linux for x64 system, the following tar files are needed:

`Platform_Process_Manager/10_30/Linux_for_x64/pm10.2.0.12_sas_lnx26-x64.tar`

Note: The IBM Spectrum LSF Process Manager for SAS installation files include the IBM Spectrum LSF for SAS installation files.

IBM Spectrum LSF Process Manager for SAS Client-only tar files:

`pm10.2.0.12_clt_sas_1nx26-x64.tar.Z`

`pm10.2.0.12_sas_pinstall.tar.Z`

The file libstdc++.so.6 is required to install IBM Spectrum LSF Process Manager for SAS on Linux/UNIX.

9. If your operating system performs user authentication against an LDAP/PAM server, you must make some configuration changes to enable IBM Spectrum LSF Process Manager for SAS to use the PAM interface. The instructions for making those configuration changes are provided in Appendix – LDAP/PAM Authentication.

LSF uses RSH/RLOGIN by default to execute certain commands on machines in the grid. In order to use SSH instead, refer to the "Encrypt transmission of LSF commands for remote execution and login" section of the Platform LSF Security document for a list of required changes.

Chapter 2 - Installing IBM Spectrum LSF Process Manager for SAS and IBM Spectrum LSF for SAS

Caution: Do not install IBM Spectrum LSF Process Manager for SAS and IBM Spectrum LSF for SAS to the same directory.

1. Log on to the machine as the Primary LSF administrator.

   If you are performing an upgrade of Platform Suite for SAS or SAS Grid Manager for Platform in place, make sure that IBM Spectrum LSF Process Manager and IBM Spectrum LSF for SAS are shut down prior to performing this activity.

   For IBM Spectrum LSF Process Manager, run `jadmin stop`.

   For IBM Spectrum LSF for SAS:

   > Deactivate all queues to make sure that no new jobs can be dispatched during the upgrade. After you complete the upgrade, remember to activate the queues again so that pending jobs can be dispatched.

   > Deactivate all LSF queues by running the following command:

   > `badmin qinact all`

   > Back up your existing **LSF_CONFDIR, LSB_CONFDIR** and **LSB_SHARDIR** parameters according to the procedures at your site.

   > Run `lfsshutdown`.

2. If you are performing an upgrade from PSS11.1 or PSS12.1 to PSS13.1, you must rename the `LSF_TOP/10.1` directory to `LSF_TOP/9.1`.

3. Create a Process Manager installation directory (such as `/local/pm_install`) to hold the installation files.

4. Copy the `Platform_Process_Manager/10_3/`*operating-environment*`/*.tar` files from the appropriate location (see step 8 from the Pre-Installation Steps section) to the installation directory. The pm10.2.0.12_*.tar files contain both IBM Spectrum LSF for SAS and IBM Spectrum LSF Process Manager for SAS installation files.

   There are multiple files for each UNIX-based operating system/CPU:

   pm10.2.0.12_sas.<operating environment>.tar – installer tar file for your platform host.
   - install.config – configuration file where you define your installation prior to installing
   - jsinstall – installation script for installing the Process Manager Client

5. Change the working directory to the IBM Spectrum LSF Process Manager for SAS installation directory.

6. Extract the files from the pm10.2.0.12_sas.*operating-environment*.tar file that you copied to the installation directory. For example, you can use the following command on Linux:

   `tar xvf pm10.2.0.12_sas_operating-environment.tar`

This command creates a `pm10.2.0.12_sas_pinstall` subdirectory in the IBM Spectrum LSF Process Manager installation directory.

7. Change to the `pm10.2.0.12_sas_pinstall` subdirectory.

8. Copy the license file that you received from SAS (see step 7 from the Pre-Installation Steps section) into the current directory and rename it license.dat.

9. Edit the install.config file. If you are upgrading your installation, retain the values for the following:

   a. `JS_TOP`

   To upgrade, install IBM Spectrum LSF Process Manager for SAS to the same location in which the previous version of IBM Spectrum LSF Process Manager for SAS is installed (specify the same JS_TOP). The installer will preserve your existing work data and configuration.

   ```
   c. JS_HOST
   d. JS_PORT
   d. JS_ADMINS
   e. JS_CONTROL_ADMINS
   f. JS_MAILHOST
   ```

   For more information, see "Chapter 1: Managing Your Cluster," specifically the "Add a host of a new type using lsfinstall" section, in the *Administering IBM Spectrum LSF* document. This document is stored in the `docs` directory of your SAS Software Depot that contains IBM Spectrum LSF for SAS.

   Note: *In most SAS installation and configuration environments, JS_'name descriptions' and IBM Spectrum LSF for SAS 'name descriptions' as shown below are required. If the lines that contain these variables are not already uncommented, uncomment each line by removing the number sign (#).*

Required Section	Description
JS_TOP	Directory to install IBM Spectrum LSF Process Manager for SAS. Using a network share for this directory is recommended. For example: `JS_TOP=/usr/share/pm`
JS_HOST	Host that is assigned to be the Process Manager host. Specify the machine's fully qualified domain name (FQDN). For a grid installation this is in place to be the grid control server.
JS_ADMINS	Space-delimited list of user IDs that will serve as LSF administrators. SAS recommends using the SAS installation account as the Primary LSF administrator, which is the first name in the list. Examples: `JS_ADMINS=sas sas_admin1`
LSF_INSTALL	Flag indicating whether to install IBM Spectrum LSF for SAS. This must be "true".
LSF_TOP	Network share containing the IBM Spectrum LSF for SAS installation, which was mentioned in the pre-installation requirements. For example: `LSF_TOP=/usr/share/lsf`
LSF_CLUSTER_NAME	Name of cluster. For example: `LSF_CLUSTER_NAME=sas_cluster`

Required Section	Description
LSF_MASTER_LIST	List of servers that are going to participate as master candidates. The first server in the list is considered the default IBM Spectrum LSF for SAS master machine. The master list should be in the order of how the user prefers the cluster master succession should be listed. For example, HOSTA, HOSTB, and HOSTC means that HOSTA is the default master. When HOSTA expires, HOSTB will be the master and so on. The IBM Spectrum LSF for SAS master machine is the grid control server for a grid installation and the machine containing IBM Spectrum LSF Process Manager for SAS.
LSF_ADD_SERVERS	List of servers that are going to participate in the cluster that are **not** required to be included as master candidates.
LSF_ADD_CLIENTS	List of hosts that only submit jobs to the grid.

10. Optional sections can be specified as shown below:

Note: *If you are updating the version of IBM Spectrum LSF Process Manager for SAS, you might want to back up your JS_WORK_DIR and restore it after completing the new installation.*

Optional Section	Description
JS_PORT	IBM Spectrum LSF Process Manager for SAS port number. Use the default of 1966 unless it is in use by another program.
JS_TARDIR	Path of directory to Process Manager distribution files. If not used, the tar files are expected to be in the current directory running **jsinstall**.
JS_LICENSE	Full path to Process Manager/LSF license file. If not used, the license.dat file is expected to be in the current directory running **jsinstall**.
JS_MAILHOST	The name of the mail server host if you want to receive email notices from LSF. For example: `JS_MAILHOST=[SMTP|Exchange:]hostname`
LSF_TARDIR	Path of directory to architecture specific tar files. If not used, the tar files are expected to be in the current directory running **jsinstall**.
JS_WORK_DIR	Full path to where the work data is stored. If not specified, defaults to JS_HOME/work.

The resulting file contains content similar to this example:

```
# -------------------------
JS_TOP=/usr/share/pm
# -------------------------
# REQUIRED. You must uncomment this keyword and specify a value.

# -------------------
JS_HOST=myhost
# -------------------
# REQUIRED. You must uncomment this keyword and specify a value.

# --------------
# JS_PORT=
# --------------
# OPTIONAL. The default port number is 1966.

# ---------------------
JS_ADMINS=sas
# ---------------------
# REQUIRED. You must uncomment this keyword and specify a value.

# -----------------
LSF_INSTALL=true
# -----------------
# REQUIRED. You must uncomment this keyword and specify a value.

# -----------------
LSF_TOP="/usr/share/lsf"
# -----------------
# REQUIRED. You must uncomment this keyword and specify a value.

# -----------------
LSF_CLUSTER_NAME="sas_cluster"
# -----------------
# REQUIRED. You must uncomment this keyword and specify a value.

# -----------------
LSF_MASTER_LIST="myhost"
# -----------------
```

11. Change to the **root** user and execute the following command:

    ```
    ./jsinstall –f install.config.
    ```

    This command installs IBM Spectrum LSF for SAS first, and then IBM Spectrum LSF Process Manager for SAS. A directory is created for each component, and an Install.log file is created in each directory. All the events of the installation are logged here.

    ```
    $ ./jsinstall -f install.config

    Starting jsinstall...

    Verifying the working directory...

    Reading configuration file...

    Updating JS and LSF config files.
    This may take a few minutes...
    ```

12. Read and agree to the IBM Spectrum LSF for SAS End User License Agreement.

13. When asked which architecture-specific tar files to install, include all tar files for <u>all</u> operating system/CPU machine types in your cluster.

```
LSF pre-installation check ...

Checking the LSF TOP directory /usr/share/lsf ...
... Done checking the LSF TOP directory /usr/share/lsf ...

You are installing IBM Spectrum LSF - 10.1 Standard Edition.

Checking LSF Administrators ...
   LSF administrator(s):       "sas"
   Primary LSF administrator:  "sas"
Checking the configuration template  ...
CONFIGURATION_TEMPLATE not defined. Using DEFAULT template.
    Done checking configuration template ...
    Done checking ENABLE_STREAM ...
    Done checking ENABLE_CGROUP ...
    Done checking ENABLE_GPU ...

Checking the patch history directory  ...
Creating /user/share/lsf/patch ...
... Done checking the patch history directory /user/share/lsf/patch ...

Checking the patch backup directory ...
... Done checking the patch backup directory /user/share/lsf/patch/backup ...


Searching LSF 10.1 distribution tar files in /local/pm-install/pm10.3_sas_pinstall
Please wait ...

  1) linux2.6-glibc2.3-x86_64

Press 1 or Enter to install this host type:  1

You have chosen the following tar file(s):
    lsf10.1.0.12_linux2.6-glibc2.3-x86_64

Checking selected tar file(s) ...
... Done checking selected tar file(s).
```

14. Wait while the installation processes unpack the architecture specific files, create the IBM
    Spectrum LSF for SAS working directories, add server hosts, configure the cluster, configure the
    license file, and create the `lsf_getting_started.html` and `lsf_quick_admin.html` files.

```
Pre-installation check report saved as text file:
/install/pm_install/pm10.3_sas_pinstall/lsf10.1_lsfinstall/prechk.rpt.

... Done LSF pre-installation check.

Installing LSF binary files " lsf10.1.0.12_linux2.6-glibc2.3-x86_64"...
Creating /usr/share/lsf/10.1 ...

Copying lsfinstall files to /usr/share/lsf/10.1/install
Creating /usr/share/lsf/10.1/install ...
Creating /usr/share/lsf_/10.1/install/scripts ...
Creating /usr/share/lsf/10.1/install/instlib ...
Creating /usr/share/lsf/10.1/install/patchlib ...
Creating /usr/share/lsf/10.1/install/lap ...
Creating /usr/share/lsf/10.1/install/conf_tmp1 ...
... Done copying lsfinstall files to /usr/share/lsf/10.1/install


Installing linux2.6-glibc2.3-x86_64 ...

Please wait, extracting lsf10.1.0.12_linux2.6-glibc2.3-x86_64 may take up to a
```

```
few minutes ...

... Adding package information to patch history.
... Done adding package information to patch history.
... Done extracting /install/pminstall/pm10.
3_sas_pinstall/lsf10.1.0.12_linux2.6-glibc2.3-x86_64.tar.Z....

Creating links to LSF commands ...
... Done creating links to LSF commands ...

Modifying owner, access mode, setuid flag of LSF binary files ...
... Done modifying owner, access mode, setuid flag of LSF binary files ...

Creating the script file lsf_daemons ...
... Done creating the script file lsf_daemons ...

... linux2.6-glibc2.3-x86_64 installed successfully under /usr/share/lsf/10.1.

... Done installing LSF binary files "linux2.6-glibc2.3-x86_64".

Creating LSF configuration directories and files ...
Creating /usr/share/lsf/work ...
Creating /usr/share/lsf/log ...
Creating /usr/share/lsf/conf ...
Creating /usr/share/lsf/conf/lsbatch ...
... Done creating LSF configuration directories and files ...

Creating a new cluster "sas_cluster" ...
Adding entry for cluster sas_cluster to /usr/share/lsf/conf/lsf.shared.
Installing lsbatch directories and configurations ...
Creating /usr/share/lsf/conf/lsbatch/sas_cluster ...
Creating /usr/share/lsf/conf/lsbatch/sas_cluster/configdir ...
Added user group "lsfadmins" containing all cluster administrators.
Added host group "master_hosts" containing all master candidate hosts.
Creating /usr/share/lsf/work/sas_cluster ...
Creating /usr/share/lsf/work/sas_cluster/logdir ...
Creating /usr/share/lsf/work/sas_cluster/live_confdir ...
Creating /usr/share/lsf/work/sas_cluster/lsf_indir ...
Creating /usr/share/lsf/work/sas_cluster/lsf_cmddir ...

Adding server hosts ...

Host(s) "bb04cnt08" has (have) been added to the cluster "sas_cluster".

Adding LSF_MASTER_LIST in lsf.conf file...

... LSF configuration is done.
... Creating EGO configuration directories and files ...
Creating /usr/share/lsf/conf/ego ...
Creating /usr/share/lsf/conf/ego/sas_cluster ...
Creating /usr/share/lsf/conf/ego/sas_cluster/kernel ...
Creating /usr/share/lsf/work/sas_cluster/ego ...
... Done creating EGO configuration directories and files.
Configuring EGO components...
... EGO configuration is done.
... Creating resource connector configuration directories and files ...
Creating /usr/share/lsf/conf/resource_connector ...
Creating /usr/share/lsf/conf/resource_connector/ego ...
```

```
Creating /usr/share/lsf/conf/resource_connector/openstack ...
Creating /usr/share/lsf/conf/resource_connector/aws ...
Creating /usr/share/lsf/conf/resource_connector/softlayer ...
Creating /usr/share/lsf/conf/resource_connector/azure ...
Creating /usr/share/lsf/conf/resource_connector/google ...
... Done creating resource connector configuration directories and files.
... Finished resource connector configuration.

... LSF inventory tag file is installed.
... LSF license file is installed.
Creating lsf_getting_started.html ...
... Done creating lsf_getting_started.html

Creating lsf_quick_admin.html ...
... Done creating lsf_quick_admin.html

lsfinstall is done.

To complete your LSF installation and get your
cluster "sas_cluster" up and running, follow the steps in
"/tmp/sas_cluster_psfs_install.2104/pminstall/pm10.3_sas_pinstall/lsf10.1.0.12_ls
finstall/lsf_getting_started.html".

After setting up your LSF server hosts and verifying
your cluster "sas_cluster" is running correctly,
see "/usr/share/lsf/10.1/lsf_quick_admin.html"
to learn more about your new LSF cluster.

After installation, remember to bring your cluster up to date
by applying the latest updates and bug fixes.
```

15. If the LSF_STARTUP_PATH parameter in the /etc/lsf.sudoers file is set to an earlier IBM Spectrum LSF for SAS version, you must update the value to specify the LSF_SERVERDIR for the current version on all the hosts where it is configured.

16. After the IBM Spectrum LSF for SAS installation completes, the IBM Spectrum LSF Process Manager installation starts. You will see the following progress window:

```
Starting JS installation...


Logging installation sequence in
/install/pminstall/pm10.3_sas_pinstall/pm10.3_install/Install.log
Searching for Process Manager tar files in /install/pminstall/pm10.3_sas_pinstall,
Please wait ...

  1) [SAS] Linux2.6-glibc2.3-x86_64 Server
  2) [SAS] Linux2.6-glibc2.3-x86_64 Client
```

17. You are asked to list the numbers separated by spaces that you want to install. Type 1 2 to install the IBM Spectrum LSF Process Manager for SAS Server and Client. Press **Enter** to continue.

The installation process extracts files, creates directories, and modifies access to files. After all operations have been performed, you see the following progress window:

```
You have chosen the following tar file(s):
    pm10.3vr_sas_lnx26-x64
    pm10.3_clt_sas_lnx26-x64

Space required to install: 300000 kb.
Space available under /install/cfgsas1/pm11: 71480876 kb.
Do you want to continue installation? (y/n) [y] y
Info: Re-using JRE from LSF install...
International Program License Agreement
```

18. Read and agree to the End User License Agreement.

The installation extracts files, creates directories, and modifies access to files. After all operations have been performed, you see the following progress window:

```
Process Manager pre-installation check ...

Checking the JS_TOP directory /usr/share/pm ...
... Done checking the JS_TOP directory /usr/share/pm ...
Checking selected tar file(s) ...
... Done checking selected tar file(s).


Checking Process Manager Administrators ...
    Process Manager administrator(s):      "sasadm sasadm2"
    Primary Process Manager administrator:  "sasadm"

Checking Process Manager Control Administrators ...

/install/pminstall/pm10.3_sas_pinstall/license.dat includes SAS license.
... Done checking the license ...

Pre-installation check report saved as text file:
/install/pminstall/pm10.3_sas_pinstall/pm10.3_install/prechk.rpt.

... Done Process Manager pre-installation check.

Installing binary files " pm10.1_svr_sas_lnx26-lib23-x64
pm10.1_clt_sas_lnx26-lib23-x64"...
Creating /usr/share/pm/10.3 ...

Copying jsinstall files to /usr/share/pm/10.3/install
Creating /usr/share/pm/10.3/install ...
Creating /usr/share/pm/10.3/install/instlib ...
... Done copying jsinstall files to /usr/share/pm/10.3/install

Installing linux2.6-glibc2.3-x86_64 Server...

Please wait, extracting pm10.3_svr_sas_lnx26-lib23-x64 may take up to 5
minutes ...

... Done extracting
/install/pminstall/pm10.3_sas_pinstall/pm10.3_svr_sas_lnx26-lib23-
x64.tar.Z.

... linux2.6-glibc2.3-x86_64 Server installed successfully under
/usr/share/pm/10.3.

Installing linux2.6-glibc2.3-x86_64 Client...

Please wait, extracting pm10.29_clt_sas_lnx26-lib23-x64 may take up to 5
minutes ...

... Done extracting
/install/pminstall/pm10.3_sas_pinstall/pm10.3_clt_sas_lnx26-lib23-
x64.tar.Z.

... linux2.6-glibc2.3-x86_64 Client installed successfully under
/usr/share/pm/10.3.
```

```
Modifying owner, access mode of binary files ...

... Done modifying owner, access mode of binary files ...

Done installing binary files ...
Creating /usr/share/pm/work/templates ...

Creating configuration directories and files ...
Creating /usr/share/pm/work/alarms ...
Creating /usr/share/pm/log ...
Creating /usr/share/pm/conf ...
... Done creating configuration directories and files ...

Adding queue unicodecmd to
/usr/share/lsf/conf/lsbatch/sas_cluster/configdir/lsb.queues

Done creating configuration directories and files ...

... Process Manager license setup is done.
Creating /usr/share/pm/work/calendar/ ...
Creating /usr/share/pm/10.3/examples/flowdefs/ ...
Creating /usr/share/pm/properties/version ...
Please read /usr/share/pm/README for instructions on how
to start the Process Manager



jsinstall completed successfully. Done.
```

19. Change into the `LSF_TOP`/*version*/`install` subdirectory (for example,
    `/usr/share/lsf/10.3/install`).

20. Run the following command to set up the proper initialization files for future reboots:

    ```
    ./hostsetup --top="/usr/share/lsf" --boot="y" --profile="y"
    --start="y"
    ```

    Note: *Use two dashes "-- " for the options. See "Chapter 5 - IBM Spectrum LSF for SAS Quick Reference" for more information on the* `hostsetup` *command.*

    ```
    $ # ./hostsetup --top="/usr/share/lsf" --boot="y" --profile="y" --start="y"
    Logging installation sequence in /usr/share/lsf/10.1/log/Install.log


    ----------------------------------------------------------
        L S F   H O S T S E T U P   U T I L I T Y
    ----------------------------------------------------------
    This script sets up local host (LSF server, client or slave) environment.

    Setting up LSF server host "myhost" ...
    Checking LSF installation for host "myhost" ... Done
    Installing LSF RC scripts on host "myhost" ... Done
    LSF service ports are defined in /usr/share/lsf/conf/lsf.conf.
    Checking LSF service ports definition on host "myhost" ... Done

    ... Setting up LSF server host "myhost" is done
    ... LSF host setup is done.
    $
    ```

    Note: *Host setup does not require that the profile be sourced.*

21. Type `ps -ef | grep LSF_TOP` and make sure that all daemons are running. Note that mbatchd and mschd only run on the master machine and might not show up.

```
$ . profile.lsf
$ lsadmin limstartup
Starting up LIM on <myhost> ...... done
$ lsadmin resstartup
Starting up RES on <myhost> ...... done
$ badmin hstartup
Starting up slave batch daemon on <myhost> ...... done
$ ps -ef | grep /usr/share/lsf
root     12910     1  0 10:47 ?        00:00:00 /usr/share/lsf/10.3/linux2.6.0.1-
glibc2.3-x86_64/etc/lim
root     12911 12910  0 10:48 ?        00:00:00 /usr/share/lsf/10.3/linux2.6.0.1-
glibc2.3-x86_64/etc/pim
root     12912 12910  0 10:48 ?        00:00:00 /usr/share/lsf/10.3/linux2.6.0.1-
glibc2.3-x86_64/etc/pem
         sas 12913 12910  0 10:48 ?        00:00:00
/usr/share/lsf/10.3/linux2.6.0.1-glibc2.3-x86_64/etc/vemkd
         sas 12919 12913  0 10:48 ?        00:00:00
/usr/share/lsf/10.3/linux2.6.0.1-glibc2.3-x86_64/etc/egosc
root     12926     1  0 10:48 ?        00:00:00 /usr/share/lsf/10.3/linux2.6.0.1-
glibc2.3-x86_64/etc/res
root     12930     1  0 10:48 ?        00:00:00 /usr/share/lsf/10.3/linux2.6.0.1-
glibc2.3-x86_64/etc/sbatchd
root     12934 12930  0 10:48 ?        00:00:00 /usr/share/lsf/10.29/linux2.6.0.1-
glibc2.3-x86_64/etc/mbatchd -d /usr/share/lsf/conf
         sas 12941 12934  0 10:48 ?        00:00:00
/usr/share/lsf/10.3/linux2.6.0.1-glibc2.3-x86_64/etc/mbschd
root     12962 28334  0 10:49 pts/1    00:00:00 grep /usr/share/lsf
$
```

22. Start up the IBM Spectrum LSF Process Manager for SAS Server by restarting the computer.

23. Set up the IBM Spectrum LSF Process Manager for SAS environment by sourcing the `profile.js` file. This can be done by executing the following command:

    `. JS_TOP/conf/profile.js`

    The period '.' is the command to "source" the file.

    Note: *All IBM Spectrum LSF Process Manager for SAS commands require the environment to be set up by sourcing the* `profile.js` *file. Therefore, it is a best practice to source the* `profile.js` *file in the default profile for the shell.*

24. Start the **jfd** daemons with the command `jadmin start`.

    To start the jfd daemon at boot time, run the command `bootsetup`, which is located in `JS_TOP/version/install`.

25. Type `ps -ef | grep jfd` and verify that the daemon is running.

```
$ jadmin start
Starting up jfd ...
$ cd ../10.3/install
$ bootsetup
Logging installation sequence in /usr/share/pm/10.3/install/Install.log
Copying /etc/init.d/jstartup, /etc/init.d/rc5.d/S96jstartup and
/etc/init.d/rc4.d/K05jstartup
Installing Process Manager RC scripts on host "disuse" ... Done
... Process Manager boot setup is done.
$ ps -ef | grep jfd
         sas   16417     1  0 15:03 ?        00:00:00
/usr/share/pm/10.3/linux2.6.0.1-glibc2.3-x86_64/etc/jfd

root    16566   944  0 15:04 pts/0    00:00:00 grep jfd
$
```

26. Reactivate all IBM Spectrum LSF for SAS queues (which were deactivated in Step 2) by running the following command:

```
badmin_qact_all
```

Testing the Installation

Once the system has rebooted, you can follow these steps to make sure IBM Spectrum LSF for SAS on the grid control server or scheduling server is operating properly.

1. Log onto the machine as an LSFadministrator or user.

2. Make sure the LSF daemons are running by executing the following command:

```
ps –ef | grep LSF_TOP
```

This command lists multiple daemons, such as **lim**, **pim**, **res**, **sbatchd, mbatchd** and **mbschd**.

3. Run the command `lsid` to display the cluster name and the grid control server (IBM Spectrum LSF for SAS master machine) name.

If you cannot find the `lsid` command, you might have to source the profile first by opening a command prompt and executing the following command:

```
. LSF_TOP/conf/profile.lsf
```

Include the period '.' It is the command to "source" the file.

Note: *The* `hostsetup` *command automatically produces the sourced* `profile.lsf` *for each user, but if it does not, you need to source it yourself.*

4. Run the command `lshosts`. This displays static information about the grid control server (LSF master machine).

5. Run the command `lsload`. This displays dynamic information about the grid control server (LSF master machine).

6. Run the command `bsub sleep 29`. This command submits a job to the grid control server because it is the only machine in the cluster at this point in the installation.

7. Run the command `bjobs`. This displays the job information. As you repeat this command, you can see the job go from **PEND**, to **RUN**, to being removed from the queue.

The following example output assumes that the grid control server (IBM Spectrum LSF for SAS master machine) is `grid3.testgrid.com`:

```
$ lsid
IBM Spectrum LSF Standard 10.1.0.12, Sep 16 2022
Copyright International Business Machines Corp. 1992, 2016.
US Government Users Restricted Rights - Use, duplication or disclosure restricted
by GSA ADP Schedule Contract with IBM Corp.

My cluster name is sas_cluster
My master name is myhost
Cluster in ISV mode : SAS
$ lshosts
HOST_NAME      type    model  cpuf ncpus maxmem maxswp server RESOURCES

myhost       X86_64 Intel_EM  60.0    4 16048M  2055M    Yes (mg)
$ lsload
HOST_NAME       status  r15s  r1m  r15m   ut   pg  ls   it   tmp   swp   mem
myhost            ok   1.0  1.0  1.0  25%  0.0   1    1  365G 2043M   14G
$ bhosts
```

```
HOST_NAME              STATUS       JL/U    MAX  NJOBS    RUN  SSUSP  USUSP    RSV
myhost                 ok             -       1      0      0      0      0      0
$
```

8. Set up the IBM Spectrum LSF Process Manager environment by sourcing the `profile.js` file. This can be done by executing the following command: `. JS_TOP/conf/profile.js`. Include the period '**.**' It is the command to "source" the file.

    Note: *All IBM Spectrum LSF Process Manager for SAS commands require the environment to be set up by sourcing the* `profile.js` *file. Therefore, it is a best practice to source the* `profile.js` *file in the default profile for the shell.*

9. Run the command `jid`.

10. When prompted for username and password, provide the Primary LSF administrator credentials. This displays static information about the IBM Spectrum LSF Process Manager for SAS Server.

11. Run the command `flowmanager`. This executes a client application to verify client communication to the IBM Spectrum LSF Process Manager for SAS Server.

Note: *If you are installing Platform Suite for SAS for single-machine scheduling, the task is complete at this stage, and you can stop here. If you are installing Platform Suite for SAS for use with SAS Grid Manager for Platform, continue with the next chapter.*

Chapter 3 - Installing and Configuring IBM Spectrum LSF for SAS on Grid Nodes, SAS Foundation Grid Clients, or UNIX

When the `install.config` file was filled out, you listed machines that are to be part of the grid. Some of these machines process jobs, some may submit jobs and some may do both. Grid nodes process jobs for the grid and can optionally submit jobs to the grid. SAS Foundation Grid Clients only submit jobs to the grid without processing grid jobs.

1. Verify that the host information is already in the IBM Spectrum LSF for SAS cluster file `LSF_CONFDIR/lsf.cluster.`*cluster_name*. If it is not, edit the Host section of the cluster file to add the host. For more information, see "Chapter 1: Managing Your Cluster," "Adding a host" section, in the *Administering IBM Spectrum LSF* document found in the `docs` directory of your SAS Software Depot containing IBM Spectrum LSF for SAS.

2. Log onto each newly added machine as root.

3. Make sure access to the shared directory where IBM Spectrum LSF for SAS was installed is available. Also, make sure the share is available for the boot initialization process and all grid users can read the share.

4. Add the Primary LSF administrator user if this was not done before the installation process started.

5. Change into the `LSF_TOP/`*version*`/install` share directory (in our example, it is `/usr/share/lsf/`*version*`/install`).

6. Run the following command to set up the proper initialization files for future reboots:

   ```
   ./hostsetup --top="/usr/share/lsf" --boot="y" --profile="y"
   --start="y"
   ```

   Note: *Use two dashes "-- " for the options. See "Chapter 5 - IBM Spectrum LSF for SAS Quick Reference" for more information on the hostsetup command.*

7. Run the following two commands on the grid control node to make the new node known:

   ```
   lsadmin reconfig
   badmin reconfig
   ```

Note: *SAS recommends that you wait a few seconds between running lsadmin reconfig and badmin reconfig in order to ensure that badmin reconfig is running properly.*

Testing the Installation

Once the system has rebooted, you can follow these steps to make sure IBM Spectrum LSF for SAS on the cluster is operating properly:

1. Log on to the grid control server as an LSF administrator or user.

2. Run the command `lshosts`. This displays static information about the grid control server and all grid node machines.

3. Run the command `lsload`. This displays dynamic information about the grid control server and all grid node machines.

4. Run the command `bsub sleep 1000`. This submits a job to the cluster. Repeat this command once for each node in the cluster.

5. Run the command `bjobs`. This displays the job information. As you repeat this command, you see the job go from **PEND**, to **RUN**, to being removed from the queue.

The following is sample output of a homogeneous cluster where the grid control server (LSF master machine) is **myhost** running Linux and the grid nodes are **node1**.sas.com, **node2**, **node3**, and **node4**, all running Linux.

```
$ . /usr/share/lsf/conf/profile.lsf
$ lshosts
HOST_NAME      type     model  cpuf ncpus  maxmem maxswp server RESOURCES
myhost         X86_64  Intel_EM  60.0     1   3291M  2047M    Yes (mg SASApp)
node1.sas.com X86_64  Intel_EM  60.0     1    250M   511M    Yes (mg SASApp)
node2          X86_64  Intel_EM  60.0     1    250M   511M    Yes (mg SASApp)
node3          X86_64  Intel_EM  60.0     1    250M   511M    Yes (mg SASApp)
node4          X86_64  Intel_EM  60.0     1    250M   511M    Yes (mg SASApp)
$ lsload
HOST_NAME       status   r15s   r1m  r15m   ut     pg  ls    it    tmp    swp    mem
node3              ok    0.1   0.0   0.5    2%    9.3   0     8  9888G   510M   211M
node1.sas.com      ok    0.5   0.0   0.4    2%    8.2   0     7  9736G   510M   210M
node2              ok    0.6   0.7   0.8   17%  232.5   1     0  9888G   510M   168M
node4              ok    0.6   0.7   0.8   17%  230.2   1     0  9888G   510M   166M
myhost             ok    1.0   0.0   0.7   55%   16.4   1     0  8906G  2047M  3108M
$ bhosts
HOST_NAME       STATUS        JL/U    MAX  NJOBS    RUN  SSUSP  USUSP    RSV
myhost          ok              -      1      0      0      0      0      0
node1.sas.com   ok              -      1      0      0      0      0      0
node2           ok              -      1      0      0      0      0      0
node3           ok              -      1      0      0      0      0      0
node4           ok              -      1      0      0      0      0      0
$
```

Adding Nodes or SAS Foundation Clients to the Grid

A grid can have machines added to it any time in the future. If a new machine needs to be added to the grid after an initial install, the procedures are similar to adding grid nodes to a new IBM Spectrum LSF for SAS cluster. To add a node to an existing LSF cluster, do the following:

1. Edit the file `lsf.cluster.`*`cluster_name`* (`lsf.cluster.sas_cluster` in our case) and add the new machine names in the Host section. This section resembles the following example:

```
Begin Host
HOSTNAME             model type     server r1m   mem   swp   RESOURCES
#Keywords
myhost                 !    LINUX86    1     -     -     -    (linux)
node1.sas.com          !    LINUX86    1     -     -     -    (linux)
node2                  !    LINUX86    1     -     -     -    (linux)
node3                  !    LINUX86    1     -     -     -    (linux)
node4                  !    LINUX86    1     -     -     -    (linux)
End     Host
```

For example, to add **node5** to the previous cluster, the resulting Host section would resemble the following example:

```
Begin Host
HOSTNAME             model type     server r1m   mem   swp   RESOURCES
#Keywords
myhost                 !    LINUX86    1     -     -     -    (linux)
node1.sas.com          !    LINUX86    1     -     -     -    (linux)
```

```
node2                  !    LINUX86   1   -   -   -   (linux)
node3                  !    LINUX86   1   -   -   -   (linux)
node4                  !    LINUX86   1   -   -   -   (linux)
node5                  !    LINUX86   1   -   -   -   (linux)
End    Host
```

2. Follow the steps at the beginning of this chapter.

Converting a Grid Node Machine to a Grid Client

If you are running SAS Foundation to submit jobs to the grid but the machine will not participate as a grid node, and you installed IBM Spectrum LSF for SAS on a machine as an "LSF Server" host type, prevent jobs from running on the machine by making it, in effect, an "LSF Client" machine. Change the state of a machine to "closed" by following these steps:

1. Log on as the LSF Administrator.

2. Run the command `badmin hclose` *host_name*.

When you run the `bhosts` command, the host displays a status of '**closed**'.

Adding a New Machine Type to the Grid

Before adding a new machine type to an existing grid, verify that the host type does not already exist in your cluster by logging on to any host in the cluster and listing the contents of the `LSF_TOP/<version>` directory. If the host type currently exists, a subdirectory with the name of the host type is to display, and it's recommended that you edit the `LSF_CONFDIR/lsf.cluster.`*clustername* file to add the hostname in the `HOST` section. Then go to step 5 below. If the host type does not already exist, complete all the steps below.

1. Get the IBM Spectrum LSF for SAS distribution tar file for the host type you want to add.

2. Log on as root to any host that can access the IBM Spectrum LSF for SAS installation directory.

3. Change to the LSF installation directory.

4. Edit `install.config`:

    a. For `LSF_TARDIR`, specify the path to the tar file. For example:

        `LSF_TARDIR="/usr/share/lsf_distrib/`*version* `"`

    b. For `LSF_ADD_SERVERS`, list the new host names enclosed in quotes and separated by spaces. For example:

        `LSF_ADD_SERVERS="hosta hostb"`

    c. Run `./lsfinstall -f install.config`

        This command automatically creates the host information in `lsf.cluster.`*cluster_name*.

5. Run `lsadmin reconfig` to reconfigure LIM.

6. Run `badmin reconfig` to reconfigure mbatchd.

7. Run `hostsetup` to set up the new host and configure the daemons to start automatically at boot. For example, configure them to start from an install directory, such as `/usr/share/lsf/`*version*`/install`:

   ```
   ./hostsetup --top="/usr/share/lsf" --boot="y" --profile="y"
   --start="y"
   ```

   Note: *Use two dashes "-- " for the options. See "Chapter 5 - IBM Spectrum LSF for SAS Quick Reference" for more information on the* `hostsetup` *command.*

8. Start IBM Spectrum LSF for SAS on the new host:

   ```
   lsadmin limstartup
   lsadmin resstartup
   badmin hstartup
   ```

Setting up UNIX as an LSF Client Installation for Non-Access to a Shared Directory

Use this configuration setup if your machine does not have access to a shared directory.

Use slave.config to install a slave host. Note that slave.config is located in the same directory as install.config after you untar the installer package.

Note: *Seeing the term "UNAVAILABLE" display during installation is normal for an LSF client configuration that is not running LSF daemons.*

1. In slave.config, you need to specify the following params. Even though some parameters are not needed for the client, you must provide them for the installer to work.

   LSF_TOP -- This should be on a local directory but not the same one as noted for the master host.
   LSF_LICENSE – Identifies a path to the license where the entitlement and inventory tag files are stored.
   LSF_ADMINS -- Specifies the existing admins of the main cluster.
   LSF_ADD_CLIENTS -- Specifies the host you are installing on (that is the slave and client host).
   LSF_SERVER_HOSTS -- Specifies the master and master candidate hosts of the main cluster (in the same order as in the main cluster).
   LSF_LIM_PORT -- Specifies the LIM port of the main cluster.

   This setup allows you to run `sudo ./lsfinstall -s -f slave.config` to install it.

2. Add a line to the lsf .cluster.xxx file of the main cluster. Be sure to indicate the host is type client. For example,

   ```
   HOSTNAME   model    type        server   RESOURCES    #Keywords

   ...

   ib16b06              !      !        0          ()
   ```

3. Run the command `lsadmin reconfig`. (The `badmin reconfig` command is probably not needed, but it was run in this test).

4. On the client host, you can try `lsid` and `bsub` to submit a job. On `bsub`, specify `-R "type==any"` because IBM Spectrum LSF for SAS will not detect the host type of a client machine.

The client host does not refer to the `LSF_TOP` directory of the main cluster. The example below shows how lsf.conf looks on the client machine after these steps (from IBM Spectrum LSF for SAS 10.1.x):

```
LSF_GET_CONF=lim
LSF_CONFDIR=/usr/local/lsf/conf
LSF_LIM_PORT=3789
LSF_SERVER_HOSTS="myMasterHost"
LSF_VERSION=10.1.0.12
#LSF_LOCAL_RESOURCES="[hostname hosta][model model1][type type1][server
1][resource resource1][resourcemap n*resource1]"
LSF_TOP=/usr/local/lsf

# Daemon log messages
LSF_LOGDIR=/usr/local/lsf/log
LSF_LOG_MASK=LOG_WARNING
LSF_ENABLE_EGO=N
# LSF_EGO_ENVDIR=/usr/local/lsf/conf
LSB_ENABLE_HPC_ALLOCATION=Y
LSF_EGO_DAEMON_CONTROL=N
```

5. When running the boot (`hostsetup`) command for IBM Spectrum LSF for SAS with version 10.1.x, you might see a message about a missing "LSF Entitlement" in the dialog box.

   There are two possible solutions to correct this issue:

   1. Ignore the problem and let it display an error. No entitlement is needed.

   2. Deploy a workaround for the problem: Is there a bug in the `hostsetup` command? If so, set the following two environment variables before running the hostsetup script.

   ```
   IS_SAS_BUILD=Y
   LSF_LICENSE=path to the license.dat
   ```

   Example:

   ```
   a. [root@xxxx install]# export IS_SAS_BUILD=Y
   b. [root@xxxx install]# export LSF_LICENSE=/opt/sasinside/LSF_Share
      /license.dat

   c. [root@xxxx install]# ./hostsetup -- top="/opt/sasinside/LSF_Share
      /lsf" --boot="y" --profile="y" --start="y"
   ```

   Logging installation sequence in `/opt/sasinside/LSF_Share/lsf/log/Install.log`

Startup and Boot Setup for IBM Spectrum LSF for SAS and IBM Spectrum Process Manager for SAS

IBM Spectrum LSF for SAS Boot Setup with Startup

1. Change to the `LSF_TOP/10*/install` subdirectory. For example:

   ```
   [root@localhost] # cd /common/share/lsf/10/install
   ```

2. Run the following command initialization files for future reboots after sourcing the IBM Spectrum LSF for SAS profile. This will add the LSF daemons to the server startup and start up the required LSF daemons. Note the two dashes before each parameter.

```
[root@localhost] #  ./hostsetup --top="/common/share/lsf" --boot="y"
  --start="y"
```

PM (jfd) Boot Setup

1. Set up the IBM Spectrum LSF Process Manager environment by sourcing the profile.js file if it was not already run.

2. Run the PM/jfd "bootsetup" script:

```
[root@localhost] # . JS_TOP/conf/profile.js
```

```
[root@localhost] # JS_TOP/10*/install/bootsetup
```

Example:

```
[root@localhost] # .  /common/share/pm/conf/profile.js
```

```
[root@localhost] # /common/share/pm/10*/install/bootsetup
```

Remember that bootsetup (with no arguments) will install PM/jfd startup at boot time.

Chapter 4 – Installing the IBM Spectrum LSF Process Manager Client

The IBM Spectrum LSF Process Manager Client consists of the following components:

- The Calendar Editor
- The Flow Manager
- The Command Line Interface (CLI)

The client can be installed on any machine or machines.

The installation of the client is driven from the **pm10.2.0.12_clt_sas_lnx26-x64.tar.Z** file. If you are not sure which SAS Clients you should use when installing the IBM Spectrum LSF Process Manager Client, contact your SAS technical representative for assistance.

Install the IBM Spectrum LSF Process Manager Client

When you install IBM Spectrum LSF Process Manager Client, you install Flow Manager and Calendar Editor on the host. You use Flow Manager to trigger, monitor, and control running flows, and to obtain history information about completed flows. You use Calendar Editor to define calendars, which IBM Spectrum LSF Process Manager uses to calculate the dates when a job or flow should run. Calendars contain either specific dates or expressions that resolve to a series of dates.

1. Log on to the host on which you want to install. You can use any user account to install the IBM Spectrum LSF Process Manager Client.

2. Get the distribution tar files and copy them to the same directory.

3. You need an installation script tar file and a client tar file for the host type on which you want to install. For example, for Linux, you need the following files:

- pm10.2.0.12_clt_sas_lnx26-x64.tar.Z

- pm10.2.0.12_sas_pinstall.tar.Z

4. Extract the installation script tar file.

   ```
   zcat pm10.2.0.12_sas_pinstall.tar.Z|tar xvf-
   ```

   This creates a directory called pm10.2.0.12_sas_pinstall, containing the following:

- install.config—a configuration file where you define your installation prior to installing.

- jsinstall—installation script for installing the IBM Spectrum LSF Process Manager Client

5. Edit install.config and complete Section 1 to specify parameters for your client installation.

6. Run the installation script:

   ```
   ./jsinstall -f install.config
   ```

Set the Client Environment

After installing the client, configure the environment.

1. Set the IBM Spectrum LSF Process Manager environment on each client:

   - On csh or tcsh:

     ```
     source JS_TOP/conf/cshrc.js
     ```

   - On sh, ksh or bash:

     ```
     . JS_TOP_/conf/profile.js
     © Copyright IBM Corp. 1992, 2020, 17
     ```

     Note: *JS_TOP is the top-level IBM Spectrum LSF Process Manager for SAS installation directory, the value specified in the install.config file.*

2. After the IBM Spectrum LSF Process Manager for SAS Server has started, run the client applications to verify the success of the installation:

   a. Run the floweditor

   b. Run flowmanager

   c. Run caleditor

Both the Calendar Editor and the Flow Manager require a connection to the server in order to start. If you are unable to start either application, look for an error in the configuration, or else the Server has not started.

Note: *Flow Editor might not be installed if you purchased Platform Suite for SAS. For more information or to purchase Flow Editor, contact your SAS sales representative.*

Chapter 5 - IBM Spectrum LSF for SAS Quick Reference

Command	Description
lsid	Displays version number, cluster name, and the grid control server (IBM Spectrum LSF for SAS master host) name. Useful to see if the grid daemons are running and if running in SAS mode.
lshosts	Displays information about the hosts recognized by IBM Spectrum LSF for SAS along with their static resource information.
lsload	Displays the dynamic resource information for the hosts in the grid (cluster).
bhosts	Displays batch information about all hosts in the grid (cluster).
bjobs	Displays information about current user's LSF jobs
lsfstartup	Starts the LIM, RES, sbatchd, and mbatchd daemons on all hosts in the cluster. Must be run as root and all hosts must be running rsh or ssh daemons.
lsfrestart	Restarts the LIM, RES, sbatchd, and mbatchd daemons on all hosts in the cluster. Must be run as root and all hosts must be running rsh or ssh daemons.
lsfshutdown	Shuts down the LIM, RES, sbatchd, and mbatchd daemons on all hosts in the cluster. Must be run as root and all hosts must be running rsh or ssh daemons.
lsadmin	Administrative tool for IBM Spectrum LSF for SAS that is available to LSF administrators. Useful subcommands include the following: <table><tr><td>reconfig</td><td>Restarts all LIMs in the cluster to read any changes in the configuration files.</td></tr><tr><td>limstartup</td><td>Starts LIM on the local host</td></tr><tr><td>limrestart</td><td>Restarts LIM on the local host</td></tr><tr><td>resstartup</td><td>Starts RES on local host</td></tr><tr><td>resrestart</td><td>Restarts RES on local host</td></tr></table>
bhist	Displays historical information about jobs. Useful parameters including the following: <table><tr><td>-p | -r | -d | -a</td><td>Displays information about specific jobs (**p**ending, **r**unning, **d**one, or **a**ll).</td></tr><tr><td>-l</td><td>Display in long format.</td></tr><tr><td>-u <user> | all</td><td>Displays job for specified or all users.</td></tr><tr><td><job ID></td><td>Displays only specified job information.</td></tr></table>

badmin	Administrative tool for the batch processing facility that is available to LSF administrators. Useful subcommands include the following:	
	`reconfig`	Reconfigures the batch facility without restarting sbatchd or mbatchd to read any changes in the configuration files.
	`hstartup`	Starts sbatchd on the local host
	`hrestart`	Restarts sbatchd on the local host
	`mbdrestart`	Restarts mbatchd. Needs to be done when new hosts are added to the grid (cluster).
	`hclose <host>`	Closes a host, preventing it from running jobs.
	`hopen <host>`	Opens a host, enabling it to run jobs.
bsub	Submit a job to the grid. Useful parameters include the following:	
	`-I`	Interactive. Remote output displayed locally.
	`-m`	Submit to a specific host.
	`-R "res_req"`	Submit with specified resource.
hostsetup	Sets up a host to use the IBM Spectrum LSF for SAS cluster and configures LSF daemons to start automatically.	
	`--top`	Top-level installation directory that contains the cluster the local host belongs to. <path> must be accessible to local host where hostsetup is running
	`--boot`	Configure system scripts to automatically start and stop IBM Spectrum LSF for SAS at system startup and shutdown. The local host where hostsetup is running must be an LSF server in the cluster.
	`--profile`	Add cshrc.lsf and profile.lsf to system-wide environment and startup programs.
	`--start`	Start IBM Spectrum LSF for SAS on the local host after hostsetup. The local host where hostsetup is running must be an IBM Spectrum LSF for SAS server in the cluster.
	`--quiet`	Do not display detailed messages.

The LSF commands shown in this section include examples of typical output. The output you see differs according to your local configuration.

The commands are described briefly so that you can easily use them as a "confirmation check" for your IBM Spectrum LSF for SAS installation. See the *LSF Reference* for complete usage and command options. You can use these commands on any IBM Spectrum LSF for SAS host.

If you receive typical output from these commands, your cluster is ready to use. If you see errors in the output from the commands discussed in this section, see the *LSF Reference* for assistance.

Check Cluster Configuration (lsadmin)

lsadmin ckconfig –v

The `lsadmin` command controls the operation of an IBM Spectrum LSF for SAS cluster and LSF configuration files.

The -v flag displays detailed information about the LSF configuration. Here is an excerpt:

```
$ lsadmin ckconfig -v


Checking configuration files ...

…

  binary type: linux2.6-glibc2.3-x86_64

Nov  8 09:24:28 2022 32382 6 3.4.0 Lim starting...
Nov  8 09:24:28 2022 32382 6 3.4.0 LIM is running in advanced workload
execution mode.
Nov  8 09:24:28 2022 32382 6 3.4.0 Master LIM is not running in
EGO_DISABLE_UNRESOLVABLE_HOST mode.
Nov  8 09:24:28 2022 32382 5 3.4.0 /usr/share/10.1/linux2.6-glibc2.3-
x86_64/etc/lim -C
Nov  8 09:24:28 2022 32382 6 3.4.0 initEntitlement: EGO_AUDIT_MAX_SIZE
was not set. Default value <100> will be used.
Nov  8 09:24:28 2022 32382 6 3.4.0 initEntitlement:
EGO_AUDIT_MAX_ROTATE was not set. Default value <20> will be used.
Nov  8 09:24:28 2022 32382 6 3.4.0 LIM is running as IBM Spectrum LSF
Standard Edition.
Nov  8 09:24:28 2022 32382 6 3.4.0 LIM is running as IBM Spectrum
Conductor Edition.
Nov  8 09:24:28 2022 32382 6 3.4.0 LIM is running as EGO Edition.
Nov  8 09:24:28 2022 32382 6 3.4.0 reCheckClass: numhosts 1 so reset
exchIntvl to 15.00
Nov  8 09:24:28 2022 32382 6 3.4.0 Checking Done.
--------------------------------------------------------

No errors found.
```

The messages shown are typical of normal output from `lsadmin ckconfig –v`. Other messages may indicate problems with your LSF configuration. See the *LSF Reference* for help with some common configuration errors.

Find Out Cluster Status (lsid and lsload)

lsid

Informs you if your IBM Spectrum LSF for SAS environment is set up properly. Cluster status `lsid` displays the current IBM Spectrum LSF version number, cluster name, and host name of the current grid control server (LSF master host) for your cluster. The grid control server (LSF master) name displayed by `lsid` may vary, but it is usually the first host configured in the Hosts section of `LSF_CONFDIR/lsf.cluster.`*`cluster_name`*.

```
lsid


IBM Spectrum LSF Standard 10.1.0.6, Sep 16 2022
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disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

My cluster name is sas_cluster
My master name is myhost
Cluster in ISV mode: SAS
```

If you see the following message:

```
Cannot open lsf.conf file
```

It indicates that the LSF_ENVDIR environment variable is probably not set correctly. Use `cshrc.lsf` or `profile.lsf` to set up your environment.

The `lsload` command displays the current load levels of the cluster. The output contains one line for each host in the cluster. The status is correct for all hosts in your cluster. For example:

```
lsload


HOST_NAME status r15s  r1m r15m  ut   pg  ls   it  tmp  swp   mem
hosta        ok  0.0  0.0  0.0   6%  0.2   2 1365  97M  65M   29M
hostb        ok  0.0  0.0  0.0   9%  0.0   4    1 130M 319M   12M
hostc        ok  2.5  2.2  1.9  64% 56.7  50    0 929M 931M 4000M
hostd        ok  0.2  0.2  0.2   1%  0.0   0  367  93M  86M   50M
hoste      busy *6.0  2.2  1.9  64% 56.7  50    0 929M 931M 4000M
hostf   unavail
```

A `busy` status is shown for hosts with any load index beyond its configured thresholds. An asterisk (*) marks load indices that are beyond their thresholds, causing the host status to be `busy`. A minus sign (–) in front of the value `ok` means that RES is not running on that host.

If you see the message

```
LIM is down
```

or

```
LIM is not responding
```

after starting or reconfiguring IBM Spectrum LSF for SAS, wait a few seconds and try `lsload` again to give the LIMs time to initialize. Notice that `lsload` also shows whether IBM Spectrum LSF for SAS is licensed for the host.

If you see the following message:

```
Host does not have a software license
```

it indicates that you must install a valid IBM Spectrum LSF for SAS license or make sure that the license server is running properly.

There are also a couple of other useful commands:

- The `lshosts` command displays configuration information for LSF hosts and their static resource information.
- The `lsinfo` command displays cluster configuration information about resources, host types, and host models.

Check LSF Batch Configuration (badmin)

badmin ckconfig –v

The `badmin` command controls and monitors the operation of the LSF Batch system. Use the `badmin ckconfig` command to check the LSF Batch configuration files. The `-v` flag displays detailed information about the configuration:

```
badmin ckconfig –v
Checking configuration files ...
--------------------------------------------------------
No errors found.
```

The messages shown above are the normal output from `badmin ckconfig –v`. Other messages might indicate problems with the Batch configuration. See the *LSF Reference* for assistance with some common configuration errors.

Find Out LSF Batch System Status (bhosts and bqueues)

bhosts

The `bhosts` command tells you whether LSF Batch is running properly. Notice that it displays the status and other details about the grid nodes (LSF Batch server hosts) in the cluster:

- maximum number of job slots allowed by a single user
- total number of jobs in the system, jobs running, jobs suspended by users, and jobs suspended by the system
- total number of reserved job slots

The status is designed to be `ok` for all grid nodes (hosts) in your cluster. For example:

```
bhosts


HOST_NAME STATUS JL/U MAX NJOBS RUN SSUSP USUSP RSV
hosta ok            –    –     0    0     0     0    0
hostb ok            –    –     0    0     0     0    0
hostc ok            –    –     0    0     0     0    0
hostd ok            –    –     0    0     0     0    0

```

If you see the following message:

```
lsbatch daemons not responding
```

after starting or reconfiguring IBM Spectrum LSF for SAS, wait a few seconds and try `bhosts` again to give the SBDs time to initialize.

bqueues

LSF Batch queues organize jobs with different priorities and different scheduling policies. The
`bqueues` command displays available queues and their configuration parameters. For a queue
to accept and dispatch jobs, the status is to be `Open:Active`.

bqueues

```
QUEUE_NAME      PRIO  STATUS         MAX JL/U JL/P JL/H NJOBS  PEND   RUN  SUSP
owners           43   Open:Active     -    -    -    -     0     0     0     0
priority         43   Open:Active     -    -    -    -     0     0     0     0
night            40   Open:Inact      -    -    -    -     0     0     0     0
chkpnt_rerun_qu  40   Open:Active     -    -    -    -     0     0     0     0
short            35   Open:Active     -    -    -    -     0     0     0     0
license          33   Open:Active     -    -    -    -     0     0     0     0
normal           30   Open:Active     -    -    -    -     0     0     0     0
hpc_linux        30   Open:Active     -    -    -    -     0     0     0     0
hpc_linux_tv     30   Open:Active     -    -    -    -     0     0     0     0
unicodecmd       30   Open:Active     -    -    -    -     0     0     0     0
idle             20   Open:Active     -    -    -    -     0     0     0     0
```

The queue information displayed by `bqueues` is configured in `lsb.queues`. Eight queues are
defined by default in `lsb.queues`. Modify this file to add, delete, or change queues.

bqueues -l

To see more detailed queue information, use `bqueues -l`:

```
    bqueues -l normal
```

```
QUEUE: normal
  -- For normal low priority jobs, running only if hosts are lightly loaded.
This is the default queue.

PARAMETERS/STATISTICS
PRIO NICE STATUS          MAX JL/U JL/P JL/H NJOBS   PEND    RUN SSUSP USUSP   RSV
 30   20  Open:Active      -    -    -    -     0      0      0     0     0     0

SCHEDULING PARAMETERS
          r15s   r1m  r15m    ut     pg     io    ls    it    tmp    swp    mem
 loadSched   -     -     -     -      -      -     -     -      -      -      -
 loadStop    -     -     -     -      -      -     -     -      -      -      -

USERS: all
HOSTS:  all
```

`bqueues -l` shows the following kinds of information about the queue:

- The kinds of jobs that are meant to run in the queue.
- Resource usage limits.
- Nodes (hosts) and users that are able to use the queue.
- Scheduling threshold values:
  - `loadSched` is the threshold for IBM Spectrum LSF for SAS to dispatch a job
    automatically.
  - `loadStop` is the threshold for IBM Spectrum LSF for SAS to suspend a job
    automatically.

A couple of additional commands are useful:

- The `bparams` command displays information about the LSF Batch configuration
  parameters.

- The `bhist` command displays historical information about jobs.

Verifying the Network Setup

The first step in troubleshooting problems with a SAS grid is to verify that all computers in the grid can communicate with one another through the ports that are used by the grid middleware.

Host Addresses

Check the `/etc/hosts` file on each grid node to ensure that the machine name is not mapped to the 127.0.0.1 address. This mapping causes the sign-on connection to the grid node to fail or to hang. This happens because the SAS session being invoked on the grid node cannot determine the correct IP address of the machine on which it is running. A correct IP address must be returned to the client session in order to complete the connection. For example, delete the name "myserver" if the following line is present in the `/etc/hosts` file:

```
127.0.0.1 myserver localhost.localdomain localhost
```

Host Connectivity

You must verify that the network has been set up properly and that each machine knows the network address of all the other machines in the grid. Follow these steps to test the network setup:

1. Run the `hostname` command on every machine in the grid (including grid nodes, grid control servers, and SAS Foundation grid clients).
2. Run the `ping` command on all grid node machines and the grid control machine against every other machine in the grid (including grid client machines). When you ping a grid client machine, use the host name without the domain suffix.
3. Run the `ping` command on each grid client machine against every other machine in the grid (including itself). When a grid client machine pings itself using the value from the `hostname` command, verify that the returned IP address is the same IP address that is returned when the grid nodes ping the client. However, this might not occur on machines with multiple network adapters.

If the network tests indicate a problem, you must either correct the DNS server or add entries to each machine's `hosts` file. Contact your network administrator for the best way to fix the problem.

IBM Spectrum LSF for SAS assumes that each host in the grid has a single name, that it can resolve the IP address from the name, and that it can resolve the official name from the IP address. If any of these conditions are not met, IBM Spectrum LSF for SAS needs its own `hosts` file, which is located in its configuration directory (`LSF_ENVDIR/conf/hosts`).

Host Ports

You must verify that the ports that SAS and IBM Spectrum LSF for SAS use for communication are accessible from other machines. The ports might not be accessible if a firewall is running on one or more machines. If firewalls are running, you must open ports to verify that communication works between the LSF daemons and the instances of SAS.

To determine whether a port is open on a specific host, issue the following command:

```
nmap -p- remote_host | grep port
```

Where:
- *remote_host* is the IP address of the remote host.
- *port* is the port to check on the remote host.

The default ports that are used in a grid are shown in the following table:

Component	Default Ports	Configuration Files
IBM Spectrum LSF for SAS	6878, 6881, 6882, 7869, 7870, 7871, 7872	`LSF_ENVDIR/conf/lsf.conf` `EGO_CONFDIR/ego.conf`
IBM Spectrum LSF Process Manager	1966	`pm/conf/js.conf`

Modify the configuration files to change these ports.

If you change the IBM Spectrum LSF Process Manager for SAS port, you must also change the metadata for the Process Manager service.

Ports might be used by other programs. To check for ports that are in use, stop the LSF daemons and issue the command `netstat -an |<search-tool><port>`, where *search-tool* is `grep` (UNIX) or `findstr` (Windows). Check the output of the command for the IBM Spectrum LSF for SAS ports. If a port is in use, reassign the port or stop the program that is using the port.

SAS assigns random ports for connections, but you can restrict the range of ports SAS uses by using the `-tcpportfirst` *<first-port>* and the `-tcpportlast` *<last-port>* options. You can specify these options in the SAS configuration file or on the SAS command line. For remote sessions, you must specify these options either in the grid command script (`sasgrid.cmd` on Windows or `sasgrid` on UNIX) or in the **Command** field in the logical grid server definition in metadata. For example, adding the following parameters to the SAS command line in the grid script restricts the ports that the remote session uses to between 5000 and 5005:

```
-tcpportfirst 5000 -tcpportlast 5005
```

For More Information

See the *IBM Spectrum LSF for SAS Administrator's Guide* for more information about seeing the status of your cluster.

See the *LSF Reference* for detailed information about the commands described in this section.

See *Administering Process Manager* for detailed information about IBM Spectrum LSF Process Manager configuration and maintenance.

These documents are also available at:
http://support.sas.com/rnd/scalability/platform/index.html.

Appendix – LDAP/PAM Authentication

Configure LDAP/PAM Authentication for IBM Spectrum LSF Process Manager for SAS Server

On UNIX systems, IBM Spectrum LSF Process Manager for SAS supports LDAP/PAM authentication through PAM (pluggable authentication modules). PAM is a third-party tool that can be configured to use the `pam_ldap` module from the `libpam-ldap` package to log into the LDAP/PAM server for password checking.

To enable LDAP/PAM authentication for IBM Spectrum LSF Process Manager for SAS, perform the following steps:

1. Set `JS_LOGIN_REQUIRED=true` in js.conf.

   Modify the PAM configuration on your system to add a service name `eauth_userpass` for the module type authorization.

   For example, on Linux, create a new file `eauth_userpass` under the `/etc/pam.d` directory, and then add the following entry to the file:

   ```
   auth required /lib/security/$ISA/pam_ldap.so
   ```

   On Solaris, modify `/etc/pam.conf` to add the following entries:

   ```
   eauth_userpass auth requisite /usr/lib/security/64/pam_authtok_get.so.1
   ```

   ```
   eauth_userpass auth required /usr/lib/security/64/pam_dhkeys.so.1
   ```

   ```
   eauth_userpass auth required /usr/lib/security/64/pam_unix_cred.so.1
   ```

   ```
   eauth_userpass auth binding /usr/lib/security/64/pam_passwd_auth.so.1
   server_policy
   ```

   ```
   eauth_userpass auth required /usr/lib/security/64/pam_ldap.so.1
   ```

   On AIX, modify `/etc/pam.conf` to add the following entry:

   ```
   eauth_userpass auth required /usr/lib/security/64/pam_aix
   ```

   Note that the absolute path for the pam_ldap module might be different on your system. Be sure to specify the 64-bit pam_ldap module on 64-bit operating systems.

2. Restart IBM Spectrum LSF Process Manager for SAS server `jfd`.

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