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Installation Instructions for Platform Suite for SAS® Version 4.1 for UNIX
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Chapter 1 - Introduction

This document describes how to install the Platform Suite for SAS, version 4.1, on UNIX hosts for use with SAS products and solutions. The 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. The Platform Suite for SAS is also included as part of the SAS Grid Manager product to enable:

- Distributed enterprise scheduling
- Workload balancing
- Parallelized workload balancing

The Platform Suite for SAS includes the following components:

- **Process Manager** – this is the interface used by the SAS scheduling framework to control the submission of scheduled jobs to LSF and manage any dependencies between the jobs. The Flow Manager and Calendar Editor clients are included with Process Manager 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 a 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** - is a scheduling client for a 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.
- **LSF** – dispatches all jobs submitted to it, either by Process Manager or directly by SAS, and returns the status of each job. LSF also manages any resource requirements and performs load balancing across machines in a grid environment.
- **Grid Management Services** – provides the run-time information about jobs, hosts and queues for display in the SAS Grid Manager Plug-in for SAS Management Console.
Job scheduling on a single machine requires that you install Platform Process Manager 7.0. During the Process Manager install, you will also install Platform LSF 7.02. See the section “Installing Process Manager and LSF” for the instructions on installing on a single server.
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 sample architecture. It is common to dedicate a machine to running the SAS metadata server, but you may choose to run the metadata server on the grid control server. The three machines types specific to a grid installation are defined as follows:

- **grid client** - a grid client submits work to the grid but is not part of the grid resources available to execute work. Examples of a grid client are:
  - a SAS Data Integration Studio client (Platform LSF not installed on this client machine)
  - a SAS Enterprise Miner client (Platform LSF not installed on this client machine)
  - a SASMC client using the Schedule Manager plug-in or any other applications scheduling SAS workflows. (Platform LSF not installed on this client machine)
  - a SAS foundation install (minimum Base SAS, SAS/CONNECT and Platform LSF) used to run a program that submits work, both whole programs or programs broken into parallel chunks, to the grid. Installation of the Platform LSF component is required in this case in order for SAS/CONNECT to submit the work to the grid.

- **grid control server** - any machine in the grid can be designated as the grid control server. More software is installed on the grid control server and more SAS metadata configuration takes place on this machine. You should start the installation of the Platform Suite for SAS on this machine. In a SAS Data Integration Studio and SAS Enterprise Miner scenario the grid control server runs a workspace server that executes programs that utilize SAS/CONNECT to...
• **grid node** - a grid node is a grid computing resource capable of receiving the work that is being distributed. Each grid node must be running a minimum of Base SAS, SAS/CONNECT and Platform LSF.

Installation of Platform Suite for SAS is performed first on the Grid control server and is followed by installation on all of the Grid Node machines. Installation of Platform LSF on the Grid control server can be installed as a part of the Process Manager installation or it can be installed by itself. This document will only show LSF being installed as part of the Process Manager installation.

Not only do machines that do processing for the grid need Platform LSF installed, but machines that submit jobs to run on the grid must also have Platform LSF installed on them. Grid clients such as DI Studio or Enterprise Miner do not submit jobs directly but rather work with a SAS Workspace Server or a Stored-Process Server that does the job submission. Since those grid clients do not submit jobs, they do not need Platform LSF installed, but the machine where the Workspace Server or Stored-Process server would need it installed. If you are writing your own grid-enabled SAS program in Foundation SAS and want to run the program, that grid client workstation must have Platform LSF installed since it will be doing the actual submission of jobs to the grid.


SAS Grid Manager Control Server requires Platform Process Manager 7.0 and Platform Grid Management Service 7.0. Platform LSF 7.02 will be installed during the Platform Process Manager 7.0 installation. See the section title “Installing Process Manager and LSF” for the instructions on installing Process Manager and LSF. See the section “Installing Grid Management Services (GMS)” for instructions on installing Grid Management Services. SAS Grid Manager Node and SAS Grid Manager Client require only Platform LSF 7.02. See the section title “Installing LSF on Grid Nodes or Foundation SAS Grid Clients” for the instructions on installing LSF.

### Installation Directories

**Caution:** Do not install Process Manager and LSF to the same directory.

The Platform Suite for SAS installation produces the following directory structure:

- **JS_TOP** is the local directory in which the Process Manager Server and Client files are installed, (for example, `/usr/local/pm`).
- **LSF_TOP** is the shared directory in which LSF files are installed (for example, `/usr/share/lsf`). Generally, LSF_TOP is mounted from a file server and all files associated with LSF (state files, binaries for the different architectures, configuration files) are stored in this file share. LSF_TOP must be a shared directory between all the machines in the grid. For increased high availability (HA) this file server could be a machine that is not part of the grid.
• The Grid Management Service (GMS) files are installed in the LSF directory structure under their own directory, gms (for example, /usr/share/lsf/gms).
• Machine-dependent files are installed under LSF_TOP/7.0/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 (man pages, configuration files, include files, examples, etc.)

**Pre-Installation Requirements**

1. Contact your system administrator to create a network share that all computers on your cluster can access. This can be an NFS mount, a directory on a SAN, a SAMBA share, 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 admin set that up based on the type of share. This will be referred to as LSF_TOP, the LSF top-level installation directory. This installation will assume that LSF_TOP is mounted on each machine as /usr/share/lsf. Make sure root has read/write access to this subdirectory. See the section titled “Prepare Shares to Install LSF on a File Server” for more details.
2. Create a directory on the grid control server that will contain the Process Manager files. This will be referred to as JS_TOP, the Process Manager top-level installation directory. This installation will assume that JS_TOP is /usr/local/pm.
3. Make a list of the names of all the computers that will participate in the cluster.
4. Choose a name for the cluster.
5. Locate the LSF92_* .txt file located in the sid_files directory in your SAS Software Depot. This file will license all components of Platform Suite for SAS. (For 9.1.3, the license is the PlatformJSxxxxxx .txt file sent by SAS.)
6. Determine the types of all computers in the grid using `uname -a` so that the correct tar files can be copied for the install. This will allow 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 install requires a pm7*.tar of the same operating system and CPU architecture as the single machine or grid control server. The install requires a lsf7.0_gms*.tar of the same OS/CPU type as the grid control server. The install requires the lsf7Update2*.tar.Z files for all other grid nodes OS/CPU types. The files are in the third_party directory of the SAS Software Depot. The pm7* files are in Platform_Process_Manager/7_00 directory under the sub-directory named for the host you are installing on. The lsf7.0_gms* files are in Platform_Grid_Management_Service/7_00 directory under the sub-directory named for the host you are installing on. The lsf7Update2* files are in Platform_LSF/7_02 directory under the sub-directory named for the host you are installing on. As an example, if the grid control server is a Solaris 10 SPARC system, but the grid contains Linux 2.6 machines with x86, and Linux 2.6 x86-64 machines, the following tar files will be needed:
   • Platform_Process_Manager/7_00/64-bit_Enabled_Solaris/pm7_sas_sparc-sol10-64.tar (which contains lsf7Update2_sparc-sol10-64.tar.Z)
   • Platform_LSF/7_02/Linux/lsf7Update2_linux2.6-glibc2.3-x86.tar.Z
   • Platform_LSF/7_02/Linux_for_x64/lsf7Update2_linux2.6-glibc2.3-x86_64.tar.Z
For 9.1.3 customers receiving the update through electronic software download, the pm7*, lsf7Update2*, and lsf7.0.gms* files are in CD directories in SAS Software Depot based on operating system.

- EM38S6 – Platform Computing manuals and documents
- EM49S4 – Linux
- EM50S4 – Linux for x64
- EM59S2 – Solaris 7-9 for Sparc
- EM60S2 – Solaris 10 for Sparc
- EM61S2 – Solaris 10 for x86-64
- EM62S2 – AIX
- EM63S2 – HP/UX for HP-PA Risc
- EM64S2 – HP/UX for ia64

**Prepare Shares to Install LSF on a File Server**

**Prerequisites for creating shares**

Regardless of whether you install on one host and share the distribution or whether you install on a dedicated server, the share must be set up so that root can write to the file system from the client. This is controlled with the root option of the Solaris share command, or the `exportfs` command in other UNIX platforms such as HP-UX.

**Create and share the LSF directories on the file server**

1. Log on to the file server host as root.
2. Create the share.
   
   **Solaris:**
   
   - Edit the `/etc/dfs/dfstab` file and add the line:
     ```
     share -F nfs -o rw,root=<grid control server>:<grid node 1>:<grid node 2>...:<grid node N> -d "LSF share" /export/lsf
     ```
   - Run the command `shareall`.
   
   **Other UNIX platforms:**
   
   - Edit the `/etc/exports` file and add the line:
     ```
     /export/lsf -root=<grid control server>:<grid node 1>:<grid node 2>...:<grid node N>
     ```
   - If the host has not shared a file system before, you may need to start the NFS service using a script in `/etc/init.d`, `/sbin/init.d`.
   - Run the command `exportfs` on the file server.
3. Make sure the NFS service is started and that NFS will start at boot. On many systems it is possible to share a file system but that will not automatically start NFS.
Mount directories on each machine in the grid (LSF hosts)

Repeat the following steps on each machine in the grid (LSF host).

1. Log on as root to each machine in the grid (LSF host) that will be running jobs.

2. Edit the /etc/fstab file (/etc/vfstab on Solaris) and add an entry such as:
   
   fileserver:/export/lsf /usr/share/lsf nfs hard,bg,intr 0 0
   
   Refer to your local man pages for fstab and mount to see the local format. The options 'hard,bg,intr' are recommended but not mandatory.

3. Make sure the /usr/share/lsf directory exists on each machine (host).

4. Mount the directory. Run the command:
   
   mount /usr/share/lsf

Post-Installation Tasks

Chapter 2 - Installing Process Manager and LSF

**Caution:** Do not install Process Manager and LSF to the same directory.

1. Log onto the machine as the administrator (lsfadmin).
2. Create a Process Manager install directory (i.e., /usr/local/pm_install) to hold the install files.
3. Copy the pm7_sas_* .tar file from the appropriate location (see step #6 from the pre-installation requirements section) to the install directory. If this is part of a grid installation and there are machines in the grid that are a different operating system or CPU architecture than the grid control server then copy the appropriate lsf7Update2_* .tar.Z files for those operating systems/CPUs.
4. Change the working directory to the Process Manager install directory.
5. Extract the pm7_sas_* .tar file. For example, under Linux you can use the command tar xvf pm7_sas_linux2.6-glibc2.3-x86.tar. This should create a pm7_sas_pinstall subdirectory in the Process Manager install directory.
6. Change into the pm7_sas_pinstall subdirectory.
7. Copy the license files obtained from SAS ('LSF*' in the sid_files directory in your SAS Software Depot) into the current directory and rename it license.dat.
8. Edit the install.config file and change the following sections:

<table>
<thead>
<tr>
<th>Required Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JS_TOP</td>
<td>Directory to install Process Manager. This does not need to be a network share. For example: JS_TOP=/usr/local/pm</td>
</tr>
<tr>
<td>JS_HOST</td>
<td>Host that will be the Process Manager host. Specify the machine’s fully qualified domain name (FQDN). For a grid installation this should be the grid control server.</td>
</tr>
<tr>
<td>JS_ADMINS</td>
<td>User ID of administrators. For example: JS_ADMINS=lsfadmin</td>
</tr>
<tr>
<td>LSF_INSTALL</td>
<td>Flag indicating whether to install LSF. This must be “true”.</td>
</tr>
<tr>
<td>LSF_TOP</td>
<td>Network share containing the LSF installation mentioned in the pre-installation requirements. For example: LSF_TOP=/usr/share/lsf</td>
</tr>
<tr>
<td>LSF_MASTER_LIST</td>
<td>List of servers that are going to participate as master candidates. The first server in the list will be considered the default LSF master machine. The LSF master machine is the grid control server for a grid installation and the machine containing Process Manager.</td>
</tr>
<tr>
<td>LSF_ADD_SERVERS</td>
<td>List of servers that are going to participate in the cluster.</td>
</tr>
<tr>
<td>LSF_CLUSTER_NAME</td>
<td>Name of cluster. For example: LSF_CLUSTER_NAME=sas_cluster</td>
</tr>
</tbody>
</table>
9. Optionally, these sections can be also specified:

<table>
<thead>
<tr>
<th>Optional Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JS_PORT</td>
<td>Process Manager port number. Use default of 1966 unless it is in use by another program.</td>
</tr>
<tr>
<td>JS_TARDIR</td>
<td>Path of directory to Process Manager distribution files. If not used, the tar files are expected to be in the current directory running jsinstall.</td>
</tr>
<tr>
<td>JS_LICENSE</td>
<td>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.</td>
</tr>
</tbody>
</table>
| JS_MAILHOST      | The name of the mail server host if you want to receive email 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. |

The resulting file should look something like this:

```
JS_TOP="/usr/share/pm"
JS_HOST="<Grid_Control_FQDN>"
# JS_PORT= (assumes default of 1966)
# JS_TARDIR= (assumes current directory)
JSADMINS="lsfadmin"
# JS_CONTROLADMINS= (assumes no control admins)
# JS_LICENSE= (assumes license.dat in current directory)
# JS_MAILHOST= (assumes no email)
LSF_INSTALL=true (ignored if installing LSF)
# LSF_ENVDIR= (ignored if installing LSF)
LSF_TOP="/usr/share/lsf"
LSF_CLUSTER_NAME="sas_cluster"
# LSF_TARDIR= (assumes current dir)
LSF_ADD_SERVERS="<Grid_Control_FQDN> <Grid_Node1_FQDN> ... <Grid_NodeX_FQDN>"
```

10. Change to the root user and execute the command ./jsinstall -f install.config. This will install LSF first and then Process Manager. 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.

The following screen shots will step you through the install process.
11. Read and agree to the LSF End User License Agreement.

This software is furnished under a license and may be used and copied only in accordance with the terms of such license and with the inclusion of the above copyright notice. This software or any other copies thereof may not be provided or otherwise made available to any other person. No title to and ownership of the software is hereby transferred.

You must have a software license key to run LSF. If you do not have a license key, contact your LSF vendor and obtain one before attempting to run LSF.

Have you purchased LSF? (y/n) [n] y
Do you accept the terms and conditions of the END USER SOFTWARE LICENSE AGREEMENT? (y/n) [n] y
12. When asked which architecture specific tar files to install, include all tar files for all OS/CPU machine types in your cluster.

<table>
<thead>
<tr>
<th>File</th>
<th>Edit</th>
<th>View</th>
<th>Terminal</th>
<th>Tabs</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

able to any other person. No title to and ownership of the software is hereby transferred.

You must have a software license key to run LSF. If you do not have a license key, contact your LSF vendor and obtain one before attempting to run LSF.

Have you purchased LSF? (y/n) [n] y
Do you accept the terms and conditions of the END USER SOFTWARE LICENSE AGREEMENT? (y/n) [n] y
You have accepted the terms and conditions
END USER SOFTWARE LICENSE AGREEMENT.
Thank you for installing LSF at your site.

LSF pre-installation check ...

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

/home/lsfadmin/lsfinstall/license.dat includes SAS license.

Checking LSF Administrators ...
LSF administrator(s): "lsfadmin"
Primary LSF administrator: "lsfadmin"

Searching lsf distribution tar files in /home/lsfadmin/lsfinstall Please wait ...

1) linux2.4-glibc2.3-ia64
2) linux2.4-glibc2.3-x86

List the numbers separated by spaces corresponding to the host types you want to install. (e.g. 1 3 7, or press Enter for all host types):  

13. Wait while the install unpacks the architecture specific files, creates the LSF working directories, adds server hosts, configures the cluster, configures the license file, and creates the `lsf_getting_started.html` and `lsf_quick_admin.html` files.

14. After the LSF install completes, the Process Manager install will start. You should see the following:

Type in 1 2 to install the Process Manager Server and Client. Press **Enter** to continue.
15. The install will extract files, create directories, and modify access to files. After all operations have been performed, you will see the following:

![Image of installation output]

16. Change into the LSF_TOP/7.0/install subdirectory (for example, /usr/share/lsf/7.0/install). Run the following command to set up the proper initialization files for future reboots:

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

![Image of command output]

This script sets up local host (LSF server or client) environment.

```
Setting up LSF server host "gridnode3" ...
Checking LSF installation for host "gridnode3.testgrid.com" ... Done
Copying /etc/rc.d/rc3.d/S95lsf and /etc/rc.d/rc5.d/K05lsf
Copying /etc/rc.d/init.d/lsf, /etc/rc.d/rc5.d/S95lsf and /etc/rc.d/rc5.d/K05lsf
Installing LSF RC scripts on host "gridnode3.testgrid.com" ... Done
LSF service ports are defined in /usr/share/lsf/conf/lsf.conf.
Checking LSF service ports definition on host "gridnode3.testgrid.com" ... Done
... Setting up LSF server host "gridnode3" is done
... LSF host setup is done.
```

```
[root@gridnode3 install]#
```

**Note:** There are two dashes "--" to the top and boot options.
17. Start up the LSF daemons. This can be done easily by rebooting the computer or doing the following as root:
   a. Set up the LSF environment by sourcing the profile.lsf file. This can be done by executing the following command: . <LSF_TOP>/conf/profile.lsf. Please note the period ‘.’ which is the command to ‘source’ the file.
      Note: Since all LSF commands require the environment set up by sourcing the profile.lsf file, it is a best practice to source the profile.lsf file in the default profile for the shell.
   b. Start the LSF lim and pim daemons with the command lsadmin limstartup.
   c. Start the LSF res daemon with the command lsadmin resstartup.
   d. Start the LSF sbatchd and optionally mbatchd and mschd daemons with the command badmin hstartup.
   e. Type ps –ef | grep <LSF_TOP> and make sure all daemons are running. mbatchd and mschd only run on the master machine so they may not show up.

18. Start up the Process Manager Server. This can be done easily by rebooting the computer or doing the following as root:
   a. Set up the Process Manager environment by sourcing the profile.js file. This can be done by executing the following command: . <JS_TOP>/conf/profile.js. Please note the period ‘.’ which is the command to ‘source’ the file.
      Note: Since all Process Manager commands require the environment set up by sourcing the profile.js file, it is a best practice to source the profile.js file in the default profile for the shell.
   b. Start the jfd daemons with the command jadmin start.
   c. To Start the jfd daemon at boot time, run the command bootsetup located in JS_TOP/7/install.
   d. Type ps –ef | grep jfd and make sure the daemon is running.
Testing the Installation

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

1. Log onto the machine as the administrator (i.e., lsfadmin).
2. Open a command prompt and set up the LSF environment by sourcing the profile.lsf file. This can be done by executing the following command: . <LSF_TOP>/conf/profile.lsf. Please note the period ‘.’ which is the command to ‘source’ the file.
   **Note:** Since all LSF commands require the environment set up by sourcing the profile.lsf file, it is a best practice to source the profile.lsf file in the default profile for the shell.
3. Make sure the LSF daemons are running by executing the command ps -ef | grep <LSF_TOP>. This should list multiple daemons such as lim, pim, res, sbatchd, mbatchd and mbschd.
4. Run the command lsid. This should display the cluster name and the grid control server (LSF master machine) name.
5. Run the command lshosts. This should display static information about the grid control server (LSF master machine).
6. Run the command lsload. This should display dynamic information about the grid control server (LSF master machine).
7. Run the command bsub sleep 100. This will submit a job to the grid control server since it is the only machine so far in the cluster.
8. Run the command bjobs. This will display the job information. As you repeat this command, you should see the job go from PEND, to RUN, to being removed from the queue. The following is sample output assuming the grid control server (LSF master machine) is grid3.testgrid.com.

9. Set up the Process Manager environment by sourcing the profile.js file. This can be done by executing the following command: . <JS_TOP>/conf/profile.js. Please note the period ‘.’ which is the command to ‘source’ the file.
   **Note:** Since all Process Manager commands require the environment set up by sourcing the profile.js file, it is a best practice to source the profile.js file in the default profile for the shell.
10. Run the command `jid`. When prompted for username and password provide the administrator (lsfadmin) credentials. This will display static information about the Process Manager Server.

11. Run the command `flowmanager`. This will execute a client application to verify client communication to the Process Manager Server.

**Note:** If you are installing Platform Suite for SAS for single machine scheduling, you are done and should stop here. If you are installing Platform Suite for SAS for use with SAS Grid Manager, continue with the next chapter.
Chapter 3 - Installing Grid Management Service (GMS)

Grid Management Service is a daemon that is used by the Grid Manager Plug-in for the SAS Management Console to display grid information. After installing this service, you should be able to use the SAS Management console to view grid information.

1. Log onto the grid control server as the LSF administrator (lsfadmin).
2. Create a Grid Management Service install directory to hold the install files.
3. Copy the lsf7_gms_install.tar.Z file from the appropriate location (see step #7 from the pre-installation requirements section) to the install directory along with the lsf7_gms_<platform>_tar.Z specific to the operating system and architecture of the grid control server.
4. Change the working directory to the Grid Management Service install directory.
5. Untar the lsf7_gms_install.tar.Z file. For example, under Linux you can use the command gunzip –d lsf7.0_gms_install.tar.Z followed by tar xvf lsf7.0_gms_install.tar. This should create an lsf7.0_gms_install subdirectory in the Grid Management Service install directory.
6. Change into the lsf7_gms_install subdirectory.
7. Edit the install.config file and change the following sections:

<table>
<thead>
<tr>
<th>Required Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSF_TOP</td>
<td>Network share containing the LSF installation mentioned in the pre-installation requirements. For example: LSF_TOP=/usr/share/lsf.</td>
</tr>
<tr>
<td>LSF_TARDIR</td>
<td>Path of directory to architecture specific tar files. If not used, the tar files are expected to be in the parent directory of the lsf7_gms_install.</td>
</tr>
<tr>
<td>GABD_PORT</td>
<td>Port GMS should use for incoming connections. If not specified, it will be 1976. Note: This configuration variable is not commented in the install.config file and needs to be added if the default is not wanted.</td>
</tr>
<tr>
<td>BOOT</td>
<td>Setting BOOT=&quot;Y&quot; will install a script that will start the service to start at boot time. Default is not to start at boot time.</td>
</tr>
</tbody>
</table>
8. Change to the root user and execute the following command: 

```
./gmsinstall -f install.config
```

This will install the Grid Management Service.

![Image](image.png)

9. Start the service by either rebooting the machine, running the script created in the 

<GMS_TOP>/bin directory, or using a service management tool available on your platform. In 

the example above, the following command would start the service (assuming you are logged on 

as 'root'):

```
/usr/share/lsf/gms/bin/gaadmin start
```

### Testing the Installation

Once SAS has been installed and configured, the SAS Grid Manager Plug-in in the SAS Management 

Console can be used to test that the Grid Management Service is working properly.
Chapter 4 - Installing LSF on Grid Nodes or SAS Foundation Grid Clients

When you filled out the install.config file, you listed machines that you want to be part of the grid. Some of those machines will 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. Log onto each newly added machine as root.
2. Make sure access to the shared directory where LSF was installed is available. Also, make sure the share is available for the boot initialization process.
3. Add the lsadmin user if this was not done before the installation process was started.
4. Change into the <LSF_TOP>/7.0/install share directory (in our example it is /usr/share/lsf/7.0/install).
5. Run the following command to set up the proper initialization files for future reboots:
   
   ```
   ./hostsetup --top="/usr/share/lsf" --boot="y"
   ```

A SAS Foundation client is a machine that is running SAS Foundation to submit jobs to the grid, but does not participate in processing jobs on the grid. If this install is for a SAS Foundation client, follow the steps in the “Converting a Grid Node Machine to a Grid Client” section below to prevent this machine from processing grid jobs.

Testing the Installation

Once the system has rebooted, you can follow these steps to make sure LSF on the cluster is operating properly.

1. Log onto the grid control server as lsadmin.
2. Open a command prompt and set up the LSF environment by sourcing the profile.lsf file. This can be done by executing the following command: . <LSF_TOP>/conf/profile.lsf. Please note the period ‘.’ which is the command to ‘source’ the file.

   Note: Since all LSF commands require the environment set up by sourcing the profile.lsf file, it is a best practice to source the profile.lsf file in the default profile for the shell.

3. Run the command lhosts. This should display static information about the grid control server and all grid node machines.
4. Run the command lsload. This should display dynamic information about the grid control server and all grid node machines.
5. Run the command bsub sleep 1000. This will submit a job to the cluster. Repeat this command once for each node in the cluster.
6. Run the command bjobs. This will display the job information. As you repeat this command, you should see the job go from PEND, to RUN, to being removed from the queue.
The following is sample output of a heterogeneous cluster where the grid control server (LSF master machine) is **D15003.testgrid.com** running the Windows operating system and the grid nodes are **grid1.testgrid.com**, **grid2.testgrid.com**, and **grid3.testgrid.com**, all running Linux. For a homogeneous cluster, all machines will be running the same operating system.

### Adding Nodes or SAS Foundation Clients to the Grid

A grid can have machines added to it at anytime 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 LSF cluster. To add a node to an existing LSF cluster, do the following:

1. Edit the `lsf.cluster.<cluster_name>` file (lsf.cluster.sas_cluster in our case) and add the new machine names in the host section. This section looks like

```
Begin Host
HOSTNAME model type server rlm mem swp RESOURCES
#Keywords
D15003.testgrid.com NTX86 1 - - - (nt)
grid1.testgrid.com LINUX86 1 - - - (linux)
grid2.testgrid.com LINUX86 1 - - - (linux)
grid3.testgrid.com LINUX86 1 - - - (linux)
End Host
```
For example, to add grid4.testgrid.com to the previous cluster, the resulting Host section would look like

```
Begin Host
HOSTNAME            model type    server rlm mem swp RESOURCES
#Keywords
d15003.testgrid.com !    NTX86      1    -    -    -   (nt)
grid1.testgrid.com   !    LINUX86    1    -    -    -   (linux)
grid2.testgrid.com   !    LINUX86    1    -    -    -   (linux)
grid3.testgrid.com   !    LINUX86    1    -    -    -   (linux)
grid4.testgrid.com   !    LINUX86    1    -    -    -   (linux)
End     Host
```

Then, follow the steps in the “Installing LSF on Grid Nodes or SAS Foundation Grid Clients” section.

**Converting a Grid Node Machine to a Grid Client**

In the case where you are only going to run SAS Foundation for the purposes of submitting jobs to the grid without allowing that machine to participate as a grid node and you installed Platform LSF on a machine as an “LSF Server” host type then the following steps will prevent jobs from running on the machine making it essentially a “LSF Client” machine. This is accomplished by changing the state of a machine to ‘closed’. To change a machine’s state to ‘closed’, do the following:

1. Log on as the LSF Administrator.
2. Run the command `badmin hclose <host_name>`.

When you run the `bhosts` command, the host should display 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 onto any host in the cluster and listing the contents of the `LSF_TOP/<version>` directory. If the host type currently exists, there will be a subdirectory with the name of the host type, and you should 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 LSF distribution tar file for the host type you want to add.
2. Log on as root to any host that can access the LSF install directory.
3. Change to the LSF install directory.
4. Edit `install.config`:
   a. For `LSF_TARDIR`, specify the path to the tar file. For example:
      ```
      LSF_TARDIR="/usr/share/lsf_distrib/7.0"
      ```
b. For LSF_ADD_SERVERS, list the new host names enclosed in quotes and separated by spaces. For example:

   LSF_ADD_SERVERS="hosta hostb"

   Run ./lsfinstall -f install.config

   This 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, from an install directory such as /usr/share/lsf/7.0/install:

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

   where "/usr/share/lsf" is the shared LSF directory.

8. Start LSF on the new host:

   lsadmin limstartup
   lsadmin resstartup
   badmin hstartup
## Chapter 5 - LSF Quick Reference

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>lsid</strong></td>
<td>Displays version number, cluster name, and the grid control server (LSF master host) name. Useful to see if the grid daemons are running and if running in SAS mode.</td>
</tr>
<tr>
<td><strong>lshosts</strong></td>
<td>Displays information about the hosts recognized by LSF along with their static resource information.</td>
</tr>
<tr>
<td><strong>lsload</strong></td>
<td>Displays the dynamic resource information for the hosts in the grid (cluster).</td>
</tr>
<tr>
<td><strong>bhosts</strong></td>
<td>Displays batch information about all hosts in the grid (cluster).</td>
</tr>
<tr>
<td><strong>bjobs</strong></td>
<td>Displays information about current user’s LSF jobs</td>
</tr>
<tr>
<td><strong>lsfstartup</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>lsfrestart</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>lsfshutdown</strong></td>
<td>Shuts down the LIM, RES, sbatchd, and mbatchd daemons daemons on all hosts in the cluster. Must be run as root and all hosts must be running rsh or ssh daemons.</td>
</tr>
<tr>
<td><strong>lsadmin</strong></td>
<td>Administrative tool for LSF available to LSF administrators. Useful subcommands are</td>
</tr>
<tr>
<td><strong>reconfig</strong></td>
<td>Restarts all LIMs in the cluster to read any changes in the configuration files.</td>
</tr>
<tr>
<td><strong>limstartup</strong></td>
<td>Starts LIM on the local host</td>
</tr>
<tr>
<td><strong>limrestart</strong></td>
<td>Restarts LIM on the local host</td>
</tr>
<tr>
<td><strong>resstartup</strong></td>
<td>Starts RES on local host</td>
</tr>
<tr>
<td><strong>resrestart</strong></td>
<td>Restarts RES on local host</td>
</tr>
<tr>
<td><strong>bhist</strong></td>
<td>Displays historical information about jobs. Useful parameters are</td>
</tr>
<tr>
<td><code>-p</code></td>
<td>Displays information about specific jobs (p pending, running, done, or all).</td>
</tr>
<tr>
<td><code>-l</code></td>
<td>Display in long format.</td>
</tr>
<tr>
<td>`-u &lt;user&gt;</td>
<td>all`</td>
</tr>
<tr>
<td><code>&lt;job ID&gt;</code></td>
<td>Displays only specified job information.</td>
</tr>
<tr>
<td>Command</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td><strong>badmin</strong></td>
<td>Administrative tool for LSF’s batch processing facility available to LSF administrators. Useful subcommands are</td>
</tr>
<tr>
<td><strong>reconfig</strong></td>
<td>Reconfigures the batch facility without restarting sbatchd or mbatchd to read any changes in the configuration files.</td>
</tr>
<tr>
<td><strong>hstartup</strong></td>
<td>Starts sbatchd on the local host</td>
</tr>
<tr>
<td><strong>hrestart</strong></td>
<td>Restarts sbatchd on the local host</td>
</tr>
<tr>
<td><strong>mbdrestart</strong></td>
<td>Restarts mbatchd. Needs to be done when new hosts are added to the grid (cluster).</td>
</tr>
<tr>
<td><strong>hclose &lt;host&gt;</strong></td>
<td>Closes a host preventing it from running jobs.</td>
</tr>
<tr>
<td><strong>hopen &lt;host&gt;</strong></td>
<td>Opens a host to allow it to run jobs.</td>
</tr>
<tr>
<td><strong>bsub</strong></td>
<td>Submit a job to the grid. Useful parameters are</td>
</tr>
<tr>
<td>-I</td>
<td>Interactive. Remote output displayed locally.</td>
</tr>
<tr>
<td>-m</td>
<td>Submit to a specific host.</td>
</tr>
<tr>
<td>-R “res_req”</td>
<td>Submit with specified resource</td>
</tr>
</tbody>
</table>

The LSF commands shown in this section show examples of typical output. The output you see will differ according to your local configuration.

The commands are described briefly so that you can easily use them as a “sanity check” for your LSF installation. See the LSF Reference for complete usage and command options. You can use these commands on any LSF host. If you get proper output from these commands, your cluster is ready to use. If your output from the commands discussed in this section has errors, see the LSF Reference for help.

### Check Cluster Configuration (lsadmin)

```
lsadmin ckconfig -v
```

The **lsadmin** command controls the operation of an LSF cluster and LSF configuration files. The -v flag displays detailed information about the LSF configuration:

```
lsadmin ckconfig -v
```

Checking configuration files ...

Platform EGO 1.2.3.108566, Sep 18 2008
Copyright (C) 1992-2008 Platform Computing Corporation

binary type: hppali-64
fixes:
Reading configuration from
/lsf/lsf_7.0/conf/ego/cnt_cluster/kernel/ego.conf
Mar 2 12:08:13 2009 17696 6 7.03 Lim starting...
Installation Instructions for Platform Suite for SAS for UNIX

Mar 2 12:08:13 2009 17696 6 7.03 LIM is running in advanced workload execution mode.
Mar 2 12:08:13 2009 17696 6 7.03 Master LIM is not running in
EGO_DISABLE_UNRESOLVABLE_HOST mode.
Mar 2 12:08:13 2009 17696 5 7.03 /lsf/lsf_7.0/7.0/hppa11i-64/etc/lim -C
Mar 2 12:08:13 2009 17696 7 7.03 setMyClusterName: searching cluster files ...
Mar 2 12:08:13 2009 17696 7 7.03 setMyClusterName: local host
garage.unx.sas.com belongs to cluster cnt_cluster
Mar 2 12:08:13 2009 17696 3 7.03 domanager():
/lsf/lsf_7.0/conf/lsf.cluster.cnt_cluster(13): The cluster manager is the
invoker <sascnn1> in debug mode
Mar 2 12:08:13 2009 17696 7 7.03 reCheckClass: numhosts 1 so reset
exchIntvl to 15.00
Mar 2 12:08:13 2009 17696 7 7.03 initReadLoad: I'm an HP 9000/800 running
B.11.11
Mar 2 12:08:13 2009 17696 3 7.03 initReadLoad(): open(/dev/kmem) failed,
Permission denied.
Mar 2 12:08:13 2009 17696 7 7.03 nlist found kernel in /stand/vmunix
Mar 2 12:08:13 2009 17696 Last message repeated 1 time(s).
Mar 2 12:08:13 2009 17696 7 7.03 getDesktopWindow: no Desktop time window
configured
Mar 2 12:08:13 2009 17696 6 7.03 Checking Done.

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

Tells you if your LSF environment is set up properly. Lsid displays the current 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

LSF 6.0, Jun 5 2006
Copyright 1992-2006 Platform Computing Corporation

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

If you see the message

Cannot open lsf.conf file
the LSF_ENVDIR environment variable is probably not set correctly. Use cshrc.lsf or profile.lsf to set up your environment.

lsload

Displays the current load levels of the cluster. The output contains one line for each host in the cluster. The status should be ok 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%  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%  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%  50  0  929M  931M  4000M
    hostf         avail

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 LSF, wait a few seconds and try lsload again to give the LIMs time to initialize. lsload also shows if LSF is licensed for the host. If you see the message

    Host does not have a software license

you must install a valid LSF 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:
Installation Instructions for Platform Suite for SAS for UNIX

badmin ckconfig -v
Checking configuration files ...
-----------------------------------------------
No errors found.
The messages shown above are the normal output from badmin ckconfig -v. Other messages may indicate problems with the Platform LSF Batch configuration. See the LSF Reference for help with some common configuration errors.

Find Out LSF Batch System Status (bhosts and bqueues)

bhosts
The bhosts command tells you if LSF Batch is running properly. Bhosts 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 should 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 message

```
lsbatch daemons not responding
```
after starting or reconfiguring LSF, 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 should be Open:Active.

```
bqueues

QUEUE_NAME PRIOR STATUS MAX JL/U JL/P JL/H NJOBS PEND RUN SUSP
owners 43 Open:Active - - - 6 -- - 0 0 0 0
priority 43 Open:Active - - - - - - 0 0 0 0
night 40 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**

<table>
<thead>
<tr>
<th>PRIO</th>
<th>NICE</th>
<th>STATUS</th>
<th>MAX</th>
<th>JL/U</th>
<th>JL/P</th>
<th>JL/H</th>
<th>NJOBS</th>
<th>PEND</th>
<th>RUN</th>
<th>SSUSP</th>
<th>USUSP</th>
<th>RSV</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>20</td>
<td>Open:Active</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>8</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**STACKLIMIT** MEMLIMIT

2048 K 5000 K

**SCHEDULING PARAMETERS**

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

**USERS:** all users

**HOSTS:** all hosts used by the LSF Batch system

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

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

There are a couple of other useful commands:

- The bparams command displays information about the LSF Batch configuration parameters.
- The bhist command displays historical information about jobs.
For More Information

See the LSF 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 Process Manager configuration and maintenance.

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

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