

An Oasis of Serenity in a Sea of Chaos: Automating the Management of Your UNIX/Linux Multi-tiered SAS® Services

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ABSTRACT

UNIX and Linux SAS® administrators, have you ever been greeted by one of these statements as you walk into the office before you have gotten your first cup of coffee?

- “Power outage!”
- “SAS servers are down.”
- “I cannot access my reports.”

Have you frantically tried to restart the SAS servers to avoid loss of productivity and missed one of the steps in the process, causing further delays while other work continues to pile up? If you have had this experience, you understand the benefit to be gained from a utility that automates the management of these multi-tiered deployments.

Until recently, there was no method for automatically starting and stopping multi-tiered services in an orchestrated fashion. Instead, you had to use time-consuming manual procedures to manage SAS services. These procedures were also prone to human error, which could result in corrupted services and additional time loss debugging and resolving issues injected by this process. To address this challenge, SAS Technical Support created the SAS Local Services Management (SAS_lsm) utility, which provides automated, orderly management of your SAS® multi-tiered deployments. The intent of this paper is to demonstrate the configuration and usage of the SAS_lsm utility. Now, go grab a coffee, and let's see how SAS_lsm can make life less chaotic.

INTRODUCTION

If you have a multi-tiered SAS deployment, you are aware of how challenging it can be to manually restart services after an outage. This process can be time-consuming and is prone to errors. Now there is a solution—the SAS Local Services Management (SAS_lsm) utility created by SAS Technical Support! This paper takes you through the steps needed to configure, and use the SAS_lsm utility, thus removing the need for stressful manual restarts of your multi-tiered SAS deployments.

During the SAS product or SAS solution installation process, the SAS® Deployment Wizard creates a unique sas.servers script on each UNIX tier of your multi-tiered deployment. The sas.servers script enables you to start, stop, restart, and determine the status of all of the essential SAS services on an individual tier in their correct order. While this is happening, the SAS_lsm utility leverages the script to manage the services for your entire SAS multi-tiered deployment.

The following analogy helps illustrate the necessity of using the proper order when starting and stopping a multi-tiered SAS deployment.

ANALOGY

A SAS multi-tiered deployment should be managed in the same way as a pyramid that has multiple sections. As shown in Figure 1 below, there is only one correct order with which to successfully construct or deconstruct a pyramid or start and stop a SAS multi-tiered deployment.

Here are some notes about the figures below:

- the sections of the pyramid represent individual SAS tiers
- constructing and deconstructing the pyramid is equivalent to starting and stopping individual SAS tier sas.servers scripts
- the start and stop order of the deployment is defined by a user-modified configuration file

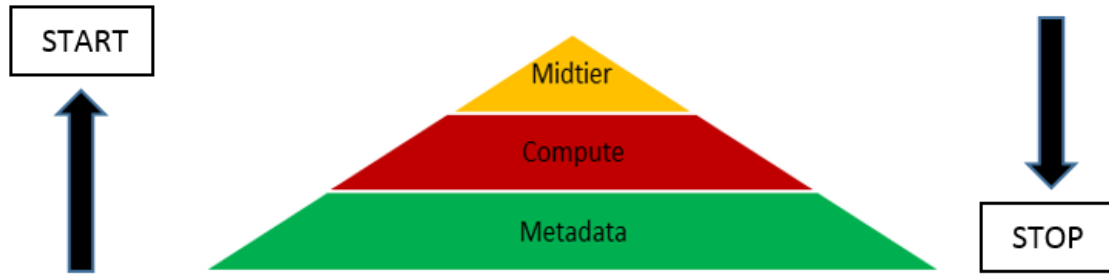


Figure 1. SAS Deployment Pyramid Started Correctly

Any deviation from this start and stop order results in failure, as shown in Figure 2 below.

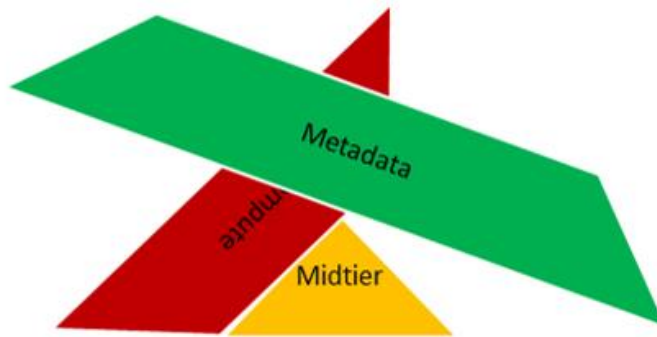


Figure 2. SAS Deployment Pyramid Started Incorrectly

Following this process is now much simpler with the SAS_lsm utility. See the benefits of using the utility below:

- provides orchestrated start and stop management of an entire SAS deployment from one location
- ensures that SAS deployment tier dependencies report the correct status before initiating a start request
- automates the status reporting of the overall SAS deployment and individual tiers for the start and stop requests
- provides on-demand status reporting of the overall SAS deployment and individual tiers

After reading the paper, you should be in an excellent position to automate the management of your entire SAS multi-tiered deployment and gain the benefits. This paper addresses the following topics:

- the configuration-file driven process
- the example configuration necessary to manage a deployment using a three-tiered scenario
- example-based use cases
 - checking deployment status
 - stopping a deployment
 - starting a deployment

PREEQUISITES AND FILES ASSOCIATED WITH THE SAS_LSM UTILITY

This section details the prerequisites that you need to use the SAS_lsm utility.

PREREQUISITES

To successfully configure, and use the SAS_lsm utility, you must first have a solid, working knowledge of your UNIX/Linux operating system. Each physical server of your SAS multi-tiered deployment must meet the following prerequisites:

- Red Hat, AIX, and/or HP-UX operating systems.
- Bash and/or Bourne shell must be installed.

The Bourne or **B**ourne **A**gain **S**hell (Bash) is required to execute the SAS_lsm utility. Bash is GNU's project shell and is a free software replacement for the Bourne shell (SH). Bash incorporates features from the Korn shell (KSH) and C shell (CSH).

- Multi-directional, password-less SSH must be enabled for the SAS installer ID across all tiers of the deployment.

Secure **S**hell (SSH) is a secure network protocol for operating-system services to be used over an unsecured network by connecting an SSH client application with an SSH server. The SAS_lsm utility exploits multi-directional, password-less SSH to remotely run commands seamlessly across all the tiers of your SAS multi-tiered deployment.

FILES

The files that comprise the SAS_lsm utility are listed below:

File	Notes
SAS_lsm	Script program
multi-tier-MCM.template	Text file for the Metadata, Compute, and Middle-tier configuration template
SAS_lsm.pdf	This configuration and usage document

Table 1. SAS_lsm Utility Files

THE CONFIGURATION-FILE DRIVEN PROCESS

SAS_lsm need only be configured and run from one tier server. It will use password-less SSH to navigate between the other tiers in your deployment.

The SAS_lsm utility is controlled by a deployment-specific configuration file that you customize using a copy of the multi-tier-MCM.template file referenced in the previous section. Display 1 shows the content of the multi-tier-MCM.template file:

```
sas@sasts010:/usr/local/etc/SAS
# SAS CONFIGURATION DIRECTORY (E.G. /opt/SAS/94/production/config/Levl)
# if you have unique SAS CONFIGURATION directories in your TIERED deployment, you
# can remove the SASCONFIG variable definition and then provide the absolute
# path to your SAS CONFIGURATION directory on a TIER by TIER basis
SASCONFIG=<SAS CONFIGURATION DIRECTORY>

# SAS INSTALLER USERID
# if you have unique SAS INSTALLER userids in your TIERED deployment, you
# can remove the SASINST variable definition and then provide the unique
# SAS INSTALLER userids on a TIER by TIER basis
SASINST=<SAS INSTALLER USERID>

# START IDENTIFY TIER DETAILS IN THEIR STARTUP ORDER (METADATA, COMPUTE, MIDTIER)
TIERNAME[1]='Metadata'
TIERINST[1]="${SASINST}"
TIERHOST[1]="<hostname for tier>"
TIERSTAR[1]="${SASCONFIG}/sas.servers start"
TIERSTOP[1]="${SASCONFIG}/sas.servers stop"
TIERREST[1]="${SASCONFIG}/sas.servers restart"
TIERSTAT[1]="${SASCONFIG}/sas.servers status"
TIERSTAS[1]='is NOT up'
TIERSTOS[1]='is UP'

TIERNAME[2]='Compute'
TIERINST[2]="${SASINST}"
TIERHOST[2]="<hostname for tier>"
TIERSTAR[2]="${SASCONFIG}/sas.servers start"
TIERSTOP[2]="${SASCONFIG}/sas.servers stop"
TIERREST[2]="${SASCONFIG}/sas.servers restart"
TIERSTAT[2]="${SASCONFIG}/sas.servers status"
TIERSTAS[2]='is NOT up'
TIERSTOS[2]='is UP'

TIERNAME[3]='Midtier'
TIERINST[3]="${SASINST}"
TIERHOST[3]="<hostname for tier>"
TIERSTAR[3]="${SASCONFIG}/sas.servers start"
TIERSTOP[3]="${SASCONFIG}/sas.servers stop"
TIERREST[3]="${SASCONFIG}/sas.servers restart"
TIERSTAT[3]="${SASCONFIG}/sas.servers status"
TIERSTAS[3]='is NOT up'
TIERSTOS[3]='is UP'
# END IDENTIFY TIER DETAILS IN THEIR STARTUP ORDER (METADATA, COMPUTE, MIDTIER)

# NUMBER OF TIERS
MAXTIERS=3

# NUMBER OF RETRIES
MAXRETRY=60

# SLEEP INTERVAL IN SECONDS PER RETRY
SLEEP=5

# STATUS REPORT ROOT DIRECTORY (default is /tmp unless otherwise specified)
STATUSROOT=/tmp

# offset in hours that is used to trim centralized log files
TRIMOFFSET=1

# SAS ADMINISTRATOR EMAIL ADDRESSES
SASADMIN="<ADDRESS1 ADDRESS2 ADDRESSN>"
~
~
~
"multi-tier-MCM.template" 61L, 2177C written 59,2 All
```

Display 1. SAS_Ism Configuration File Template (multi-tier-MCM.template)

The SAS_lsm utility reads the deployment-specific configuration file, which in turn drives the execution of tier-specific sas.servers product scripts in their proper order.

Table 2 below provides a description of the variables contained in the multi-tier-MCM.template file:

Variable	Description	Notes
SASCONFIG	Absolute path to the SAS deployment configuration directory	Requires user input
SASINST	User ID that owns the SAS deployment	Requires user input
	Tier Stanza 1	
TIERNAME[1]	Descriptive name for the tier	Default value: 'Metadata'
TIERINST[1]	User ID that owns the tier SAS deployment	Default value: "\${SASINST}"
TIERHOST[1]	Full-tier physical server hostname value	Requires USER input
TIERSTAR[1]	Absolute path to the tier sas.servers script passing start argument	Default value: "\${SASCONFIG}/sas.servers start"
TIERSTOP[1]	Absolute path to the tier sas.servers script passing stop argument	Default value: "\${SASCONFIG}/sas.servers stop"
TIERREST[1]	Absolute path to the tier sas.servers script passing restart argument	Default value: "\${SASCONFIG}/sas.servers restart"
TIERSTAT[1]	Absolute path to the tier sas.servers script passing status argument	Default value: "\${SASCONFIG}/sas.servers status"
TIERSTAS[1]	Defines search token to ensure that tier services are started	Absolute value: 'is NOT up'
TIERSTOS[1]	Defines search token to ensure that tier services are stopped	Absolute value: 'is UP'
	Tier Stanza 2	
TIERNAME[2]	Descriptive name for the tier	Default value: 'Compute'
TIERINST[2]	User ID that owns the tier SAS deployment	Default value: "\${SASINST}"
TIERHOST[2]	Full-tier physical server hostname value	Requires user input
TIERSTAR[2]	Absolute path to the tier sas.servers script passing start argument	Default value: "\${SASCONFIG}/sas.servers start"
TIERSTOP[2]	Absolute path to the tier sas.servers script passing stop argument	Default value: "\${SASCONFIG}/sas.servers stop"
TIERREST[2]	Absolute path to the tier sas.servers script passing restart argument	Default value: "\${SASCONFIG}/sas.servers restart"
TIERSTAT[2]	Absolute path to the tier sas.servers script passing status argument	Default value: "\${SASCONFIG}/sas.servers status"
TIERSTAS[2]	Defines search token to ensure that tier services are started	Absolute value: 'is NOT up'
TIERSTOS[2]	Defines search token to ensure that tier services are stopped	Absolute value: 'is UP'
	Tier Stanza 3	
TIERNAME[3]	Descriptive name for the tier	Default value: 'Midtier'
TIERINST[3]	User ID that owns the tier SAS deployment	Default value: "\${SASINST}"
TIERHOST[3]	Full-tier physical server hostname value	Requires user input
TIERSTAR[3]	Absolute path to the tier sas.servers script passing start argument	Default value: "\${SASCONFIG}/sas.servers start"
TIERSTOP[3]	Absolute path to the tier sas.servers script	Default value:

Variable	Description	Notes
	passing stop argument	"\${SASCONFIG}/sas.servers stop"
TIERREST[3]	Absolute path to the tier sas.servers script passing restart argument	Default value: "\${SASCONFIG}/sas.servers restart"
TIERSTAT[3]	Absolute path to the tier sas.servers script passing status argument	Default value: "\${SASCONFIG}/sas.servers status"
TIERSTAS[3]	Defines search token to ensure that tier services are started	Absolute value: 'is NOT up'
TIERSTOS[3]	Defines search token to ensure that tier services are stopped	Absolute value: 'is UP'
MAXTIERS	Defines the number of tiers in the deployment	Default value: 3
MAXRETRY	Defines the maximum number of retries for a sas.servers command	Default value: 60
SLEEP	Defines the time (in seconds) to wait between retries for a command	Default value: 5
STATUSROOT	Define the root directory for SAS_lsm reports and log files on the server where SAS_lsm is installed	Default is /tmp
TRIMOFFSET	Define offset in hours that is used to trim centralized log files	Default is 1
SASADMIN	Defines the email addresses for your SAS administrators	Requires user input

Table 2. SAS_lsm Configuration File Template Variable Descriptions

Note: You can include more than one SAS administrator for the SASADMIN variable. Separate the email addresses with a space.

This paper focuses on a three-tiered deployment (1-Metadata, 2-Compute, and 3-Midtier). However, you can configure the SAS_lsm utility to accommodate as many tiers as you need. To customize the configuration, create additional tier stanzas and update the MAXTIERS value accordingly.

At the end of this paper in an appendix, a [configuration worksheet](#) is provided for you to use when identifying your deployment-specific input.

EXAMPLE THREE-TIERED DEPLOYMENT CONFIGURATION

This section provides an example configuration, configuration-process details, and deployment-status reporting information. Note the tools-deployment location of the SAS_lsm utility is arbitrarily assigned in this example. You could choose to run the utility from the location where you installed SAS, however it's recommended that you maintain a separate directory location for the utility and its configuration files.

EXAMPLE

Here are the values used for variables in this example, which show the input required to configure a three-tiered SAS® 9.4 production deployment:

- Absolute path to the tools-deployment location of the SAS_lsm utility: `/usr/local/etc/SAS/`
- SAS installer user ID on all tiers: `sas`
- Absolute path to the SAS configuration directory on all tiers:
`/opt/SAS/94/production/config/Lev1`

- Table 3 below shows the deployment-tier topology:

Tier Name	Hostname	Start-Up Order	Shutdown Order
Metadata	sasts010	1	3
Compute	sasts011	2	2
Midtier	sasts012	3	1

Table 3. SAS Deployment 3-Tier Ordering

- SAS administrator's email address: `sasadm1sm@gmail.com`

This example configuration is used in every use case described later in this document. Table 4 lists the actual variable updates needed to implement the configuration for the example:

Variable	Value
SASCONFIG	<code>/opt/SAS/94/production/config/Lev1</code>
SASINST	<code>sas</code>
TIERHOST[1]	<code>"sasts010"</code>
TIERHOST[2]	<code>"sasts011"</code>
TIERHOST[3]	<code>"sasts012"</code>
SASADMIN	<code>"sasadm1sm@gmail.com"</code>

Table 4. Configuration-File Variables and Values

PROCESS

To configure the example above, follow this process:

1. Ensure that all prerequisite conditions (bash and/or bourne shell installed, appropriate operating system, and password-less SSH configured) have been met on all SAS deployment tiers (sasts010, sasts011, and sasts012).
2. Log on to the SAS Metadata Server (sasts010) with the SAS installer user ID (sas) and password credentials.
3. Change your working directory to the tools-deployment directory (`cd /usr/local/etc/SAS/`).
4. Make a copy of the multi-tier-MCM.template (multi-tier-MCM-94-production.cfg) that defines and controls the management of the SAS® 9.4 production deployment.
5. Update the multi-tier-MCM-94-production.cfg file to reflect the configuration input detailed in the **Example** section above.

Display 2 shows the updated configuration file with the new input highlighted in yellow.

```

sas@sasts010:/usr/local/etc/SAS
# SAS CONFIGURATION DIRECTORY (E.G. /opt/SAS/94/production/config/Levl)
# if you have unique SAS CONFIGURATION directories in your TIERED deployment, you
# can remove the SASCONFIG variable definition and then provide the absolute
# path to your SAS CONFIGURATION directory on a TIER by TIER basis
SASCONFIG=/opt/SAS/94/production/config/Levl

# SAS INSTALLER USERID
# if you have unique SAS INSTALLER userids in your TIERED deployment, you
# can remove the SASINST variable definition and then provide the unique
# SAS INSTALLER userids on a TIER by TIER basis
SASINST=sas

# START IDENTIFY TIER DETAILS IN THEIR STARTUP ORDER (METADATA, COMPUTE, MIDTIER)
TIERNAME[1]='Metadata'
TIERINST[1]="${SASINST}"
TIERHOST[1]="sasts010"
TIERSTAR[1]="${SASCONFIG}/sas.servers start"
TIERSTOP[1]="${SASCONFIG}/sas.servers stop"
TIERREST[1]="${SASCONFIG}/sas.servers restart"
TIERSTAT[1]="${SASCONFIG}/sas.servers status"
TIERSTAS[1]='is NOT up'
TIERSTOS[1]='is UP'

TIERNAME[2]='Compute'
TIERINST[2]="${SASINST}"
TIERHOST[2]="sasts011"
TIERSTAR[2]="${SASCONFIG}/sas.servers start"
TIERSTOP[2]="${SASCONFIG}/sas.servers stop"
TIERREST[2]="${SASCONFIG}/sas.servers restart"
TIERSTAT[2]="${SASCONFIG}/sas.servers status"
TIERSTAS[2]='is NOT up'
TIERSTOS[2]='is UP'

TIERNAME[3]='Midtier'
TIERINST[3]="${SASINST}"
TIERHOST[3]="sasts012"
TIERSTAR[3]="${SASCONFIG}/sas.servers start"
TIERSTOP[3]="${SASCONFIG}/sas.servers stop"
TIERREST[3]="${SASCONFIG}/sas.servers restart"
TIERSTAT[3]="${SASCONFIG}/sas.servers status"
TIERSTAS[3]='is NOT up'
TIERSTOS[3]='is UP'
# END IDENTIFY TIER DETAILS IN THEIR STARTUP ORDER (METADATA, COMPUTE, MIDTIER)

# NUMBER OF TIERS
MAXTIERS=3

# NUMBER OF RETRIES
MAXRETRY=60

# SLEEP INTERVAL IN SECONDS PER RETRY
SLEEP=5

# STATUS REPORT ROOT DIRECTORY (default is /tmp unless otherwise specified)
STATUSROOT=/tmp

# offset in hours that is used to trim centralized log files
TRIMOFFSET=1

# SAS ADMINISTRATOR EMAIL ADDRESSES
SASADMIN="sasadmin@gmail.com"

"multi-tier-MCM-94-production.cfg" 61L, 2107C written
59,2 All

```

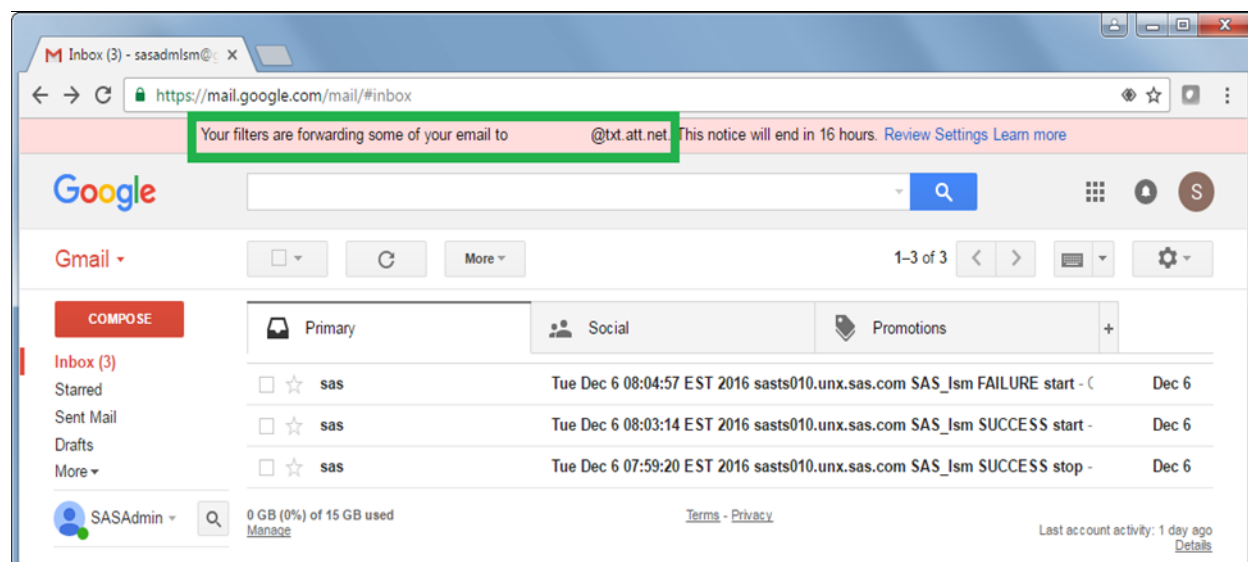
Display 2. Example Configuration File (multi-tier-MCM-94-production.cfg)

EMAIL

For any start or stop action, the SAS_Ism utility sends email to the SAS administrators as defined by the SASADMIN variable in the multi-tier-MCM-94-production.cfg file. The **Subject** line of the email takes this form: DATE HOSTNAME SAS_Ism STATUS ACTION. Here is an explanation of the different elements of the **Subject** line:

- DATE: The date on which the utility was run
- HOSTNAME: The name of the host on which the utility was run
- STATUS: Either SUCCESS or FAILURE
- ACTION: Either start or stop

Display 3 shows some example emails.



Display 3. Example Email Artifacts for Start and Stop Requests

Email utilities generally provide filtering capabilities. The green box in Display 3 above shows a filter that sends a text message to the administrator's cell phone when the email **Subject** line contains the phrase "SAS_Ism FAILURE". With this filter, any SAS_Ism utility failure is communicated instantaneously via text message so that the administrator can take corrective action without significant delay.

OUTPUT FILES

By default, SAS_Ism will store both report and log files underneath the root directory /tmp. The STATUSROOT variable in the SAS_Ism configuration file can be used to specify a directory of your choosing.

LOGGING

In the event of a failure to successfully complete a start or stop action, the SAS_Ism utility will create a Bill Of Materials (BOM) that identifies potential tier error logs of interest. The generated BOM file can be reviewed to assist in determining what prevented the successful completion of the start or stop action.

Additionally SAS_Ism will create a BOM file if a status action detects that a previously successfully started deployment has tier services that have failed to remain operational.

When a tier failure is detected, the SAS_Ism utility will identify all the tier specific SAS log files that have

been modified in the last hour. The files will be listed in the BOM file (logfiles.BOM) in the location specified by STATUSROOT.

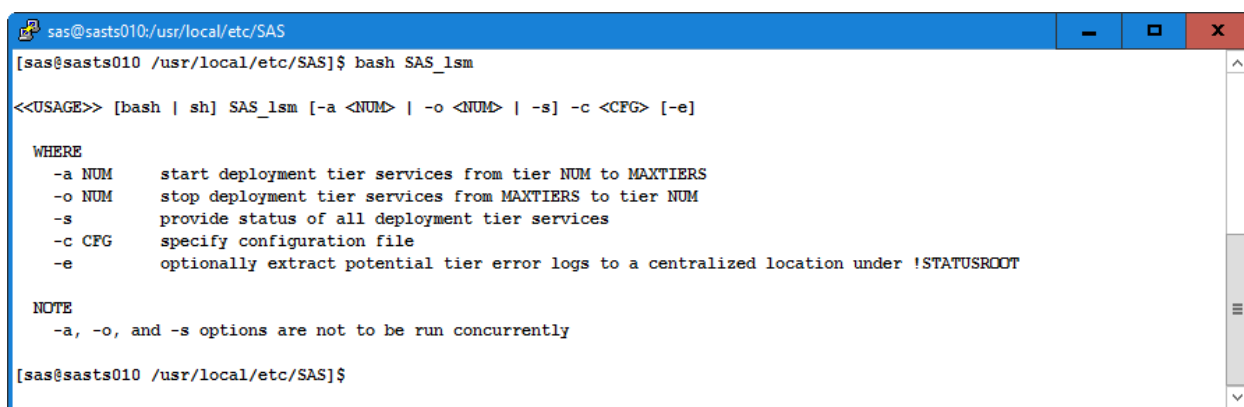
If SAS_lsm is invoked with the -e option, the utility will additionally extract copies of the logs to the centralized location designated by STATUSROOT. Because SAS logs can be large, the utility will trim the copy to only reflect the previous hour(s) of activity as defined by the TRIMOFFSET variable. These logs can then be conveniently reviewed or compressed and sent to SAS Technical Support for review.

GENERAL INVOCATION

Now that you have a better understanding of the utility and its configuration requirements, the second half of the paper covers several use cases to further explore the tool's capabilities.

To see the invocation options for the SAS_lsm utility, follow this process:

1. Log on to the SAS Metadata Server (sasts010) with the SAS installer user ID (sas) and password credentials.
2. Change your working directory to the tools-deployment directory (`cd /usr/local/etc/SAS/`).
3. Run the **[bash | sh] SAS_lsm** command to see the usage arguments as shown in Display 4:



```
sas@sasts010:/usr/local/etc/SAS
[sas@sasts010 /usr/local/etc/SAS]$ bash SAS_lsm

<<USAGE>> [bash | sh] SAS_lsm [-a <NUM> | -o <NUM> | -s] -c <CFG> [-e]

WHERE
  -a NUM      start deployment tier services from tier NUM to MAXTIERS
  -o NUM      stop deployment tier services from MAXTIERS to tier NUM
  -s          provide status of all deployment tier services
  -c CFG      specify configuration file
  -e          optionally extract potential tier error logs to a centralized location under !STATUSROOT

NOTE
  -a, -o, and -s options are not to be run concurrently

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 4. SAS_lsm Usage Options

Note: You cannot execute arguments -a (start), -o (stop), and -s (status) at the same time.

USE CASE 1: CHECKING THE DEPLOYMENT STATUS



To check the status of the deployment and each tier, follow this process:

1. Log on to the SAS Metadata Server (sasts010) with the SAS installer user ID (sas) and password credentials.
2. Change your working directory to the tools-deployment directory (`cd /usr/local/etc/SAS/`).
3. Run the **[bash | sh] SAS_lsm -s -c multi-tier-MCM-94-production.cfg [-e]** command.

After you complete this process, the SAS_lsm utility goes through the following steps:

1. Navigates through each tier of the SAS multi-tiered deployment using the numerical order (1-Metadata, 2-Compute, and then 3-Midtier) defined by the multi-tier-MCM-94-production.cfg

configuration file.

2. Verifies that SSH is properly functioning for each tier.
3. Executes a status request by running the tier-specific `sas.servers` command passing the status argument.
4. Analyzes the results of the tier-specific `sas.servers` status command, and reports the status of the tier before moving to the next tier in the sequence. The status of the tier is one of the following:
 - `ALL tier services are operational`: This means that the tier reports that services are up.
 - `ALL tier services are NOT operational`: This means that the tier reports that services are not up.
 - `ALL tier services are NOT fully operational`: This means that the tier reports that some services are up and some are not up.
5. Provides one of the following assessments of the overall status of the deployment after all tiers are analyzed:
 - `Deployment tier services are operational`: This means that all tiers report that `ALL tier services are operational`.
 - `Deployment tier services are NOT operational`: This means that all tiers report that `ALL tier services are NOT operational`.
 - `Deployment tier services are NOT fully operational`: This means that one or more tiers report that: `ALL tier services are NOT fully operational`.
6. Creates the `logfiles.BOM` file if the status action detects that a previously successfully started deployment has tier services that have failed to remain operational. The `-e` option will extract all files listed in `logfiles.BOM` to the centralized location, designated by `STATUSROOT`, and trim them based on the value set by `TRIMOFFSET`.

The next sections of this paper detail each of these possible assessments.

SCENARIO 1: STATUS CHECK WHEN THE DEPLOYMENT TIER SERVICES ARE OPERATIONAL

Display 5 shows example status output for a deployment that is operational after the successful completion of the start action. **Note:** The status reports are highlighted in yellow.

```
[sas@sasts010:/usr/local/etc/SAS] sh SAS_lsm -s -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 10:01:03 EDT 2017: action [services_status] tier [1:Metadata] host [sasts010] status [begin]
  << EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services are operational
                  SAS Metadata Server 1 is UP
Tue Jun 13 10:01:03 EDT 2017: action [services_status] tier [1:Metadata] host [sasts010] status [end success]

Tue Jun 13 10:01:03 EDT 2017: action [services_status] tier [2:Compute] host [sasts011] status [begin]
  << EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services are operational
                  SAS Web Infrastructure Data Server is UP
                  SAS OLAP Server 1 is UP
                  SAS Object Spawner 1 is UP
                  SAS Share Server 1 is UP
                  SAS CONNECT Spawner 1 is UP
                  SAS Cache Locator Service ins_41415 is UP
Tue Jun 13 10:01:04 EDT 2017: action [services_status] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 10:01:04 EDT 2017: action [services_status] tier [3:Midtier] host [sasts012] status [begin]
  << EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services are operational
                  SAS JMS Broker is UP
                  SAS Web Server is UP
                  SAS Web App Server SASServer1_1 is UP
                  SAS Web App Server SASServer11_1 is UP
                  SAS Web App Server SASServer2_1 is UP
Tue Jun 13 10:01:04 EDT 2017: action [services_status] tier [3:Midtier] host [sasts012] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.status for execution details

<<STATUS>> Deployment tier services are operational

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 5. Status Report for an Operational Deployment

In this scenario, all tiers (1-Metadata, 2-Compute, and 3-Midtier) reported the status ALL tier services are operational. Therefore, the overall status for the deployment was Deployment tier services are operational and no logfile.BOM was created.

SCENARIO 2: STATUS CHECK WHEN THE DEPLOYMENT TIER SERVICES ARE NOT OPERATIONAL

Display 6 shows example status output for a deployment that is not operational after the successful completion of the stop action. Note: The status reports are highlighted in yellow.

```
[sas@sasts010 /usr/local/etc/SAS]$ bash SAS_lsm -s -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 10:28:42 EDT 2017: action [services_status] tier [1:Metadata] host [sasts010] status [begin]
<< EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services are NOT operational
SAS Metadata Server 1 is NOT up
Tue Jun 13 10:28:43 EDT 2017: action [services_status] tier [1:Metadata] host [sasts010] status [end success]

Tue Jun 13 10:28:43 EDT 2017: action [services_status] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services are NOT operational
SAS Web Infrastructure Data Server is NOT up
SAS OLAP Server 1 is NOT up
SAS Object Spawner 1 is NOT up
SAS Share Server 1 is NOT up
SAS CONNECT Spawner 1 is NOT up
SAS Cache Locator Service ins_41415 is NOT up
Tue Jun 13 10:28:44 EDT 2017: action [services_status] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 10:28:44 EDT 2017: action [services_status] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services are NOT operational
SAS JMS Broker is NOT up
SAS Web Server is NOT up
SAS Web App Server SASServer1_1 is NOT up
SAS Web App Server SASServer11_1 is NOT up
SAS Web App Server SASServer2_1 is NOT up
Tue Jun 13 10:28:44 EDT 2017: action [services_status] tier [3:Midtier] host [sasts012] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.status for execution details

<<STATUS>> Deployment tier services are NOT operational

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 6. Status Report for a Deployment That Is NOT Operational

In this scenario, all tiers (1-Metadata, 2-Compute, and 3-Midtier) reported the status `ALL tier services are NOT operational`. Therefore, the overall status for the deployment was `Deployment tier services are NOT operational` and no logfiles.BOM was created.

SCENARIO 3: STATUS CHECK WHEN THE DEPLOYMENT TIER SERVICES ARE NOT FULLY OPERATIONAL

Display 7 shows example status output for a deployment that is not fully operational after the successful completion of the start action. **Note:** The status reports are highlighted in yellow.

```
[sas@sasts010 /usr/local/etc/SAS]$ sh SAS_lsm -s -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 10:57:19 EDT 2017: action [services_status] tier [1:Metadata] host [sasts010] status [begin]
<< EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services are operational
SAS Metadata Server 1 is UP
Tue Jun 13 10:57:19 EDT 2017: action [services_status] tier [1:Metadata] host [sasts010] status [end success]

Tue Jun 13 10:57:20 EDT 2017: action [services_status] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services are NOT fully operational
SAS Web Infrastructure Data Server is UP
SAS OLAP Server 1 is UP
SAS Object Spawner 1 is NOT up
SAS Share Server 1 is UP
SAS CONNECT Spawner 1 is UP
SAS Cache Locator Service ins_41415 is UP
Tue Jun 13 10:57:22 EDT 2017: action [services_status] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 10:57:22 EDT 2017: action [services_status] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services are operational
SAS JMS Broker is UP
SAS Web Server is UP
SAS Web App Server SASServer1_1 is UP
SAS Web App Server SASServer11_1 is UP
SAS Web App Server SASServer2_1 is UP
Tue Jun 13 10:57:22 EDT 2017: action [services_status] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 10:57:22 EDT 2017: action [centralize logfiles] status [begin]
<< COPY SCP >> sasts011/4/opt/SAS/94/production/config/Levl/ObjectSpawner/Logs/ObjectSpawner_2017-06-13_sasts011_25619.log
<< COPY SCP >> sasts011/4/opt/SAS/94/production/config/Levl/ObjectSpawner/Logs/ObjectSpawner_2017-06-13_sasts011_79879.log
<< COPY SCP >> sasts011/4/opt/SAS/94/production/config/Levl/ObjectSpawner/Logs/ObjectSpawner_console_sasts011.log
Tue Jun 13 10:57:23 EDT 2017: action [centralize logfiles] status [end success]

Tue Jun 13 10:57:23 EDT 2017: action [trim logfiles] status [begin]
Tue Jun 13 10:57:23 EDT 2017: action [trim logfiles] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.status for execution details
/tmp/multi-tier-MCM-94-production.cfg/logfiles.BOM for a listing of logfiles
/tmp/multi-tier-MCM-94-production.cfg/logfiles for the centralized logfiles

<<STATUS>> Deployment tier services are NOT fully operational

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 7. Status Report for a Deployment That Is NOT Fully Operational

In this scenario, tiers 1-Metadata and 3-Midtier reported the status ALL tier services are operational. However, tier 2-Compute reported the status ALL tier services are NOT fully operational due to the report (highlighted in blue) that the SAS Object Spawner 1 is NOT up.

Therefore the overall status for the deployment was Deployment tier services are NOT fully operational. The logfile.BOM file was created and 2-Compute tier logfiles centralized under the STATUSROOT directory /tmp

USE CASE 2: STOPPING THE DEPLOYMENT



To stop the deployment and each tier, follow this process:

1. Log on to the SAS Metadata Server (sasts010) with the SAS installer user ID (sas) and password credentials.
2. Change your working directory to the tools-deployment directory (`cd /usr/local/etc/SAS/`).
3. Run the `[bash | sh] SAS_lsm -o <NUM> -c multi-tier-MCM-94-production.cfg [-e]` command, and replace <NUM> with the numerical value (3, 2, or 1) that matches the tier number that you want to stop to.

After you complete this process, the SAS_lsm utility goes through the following steps:

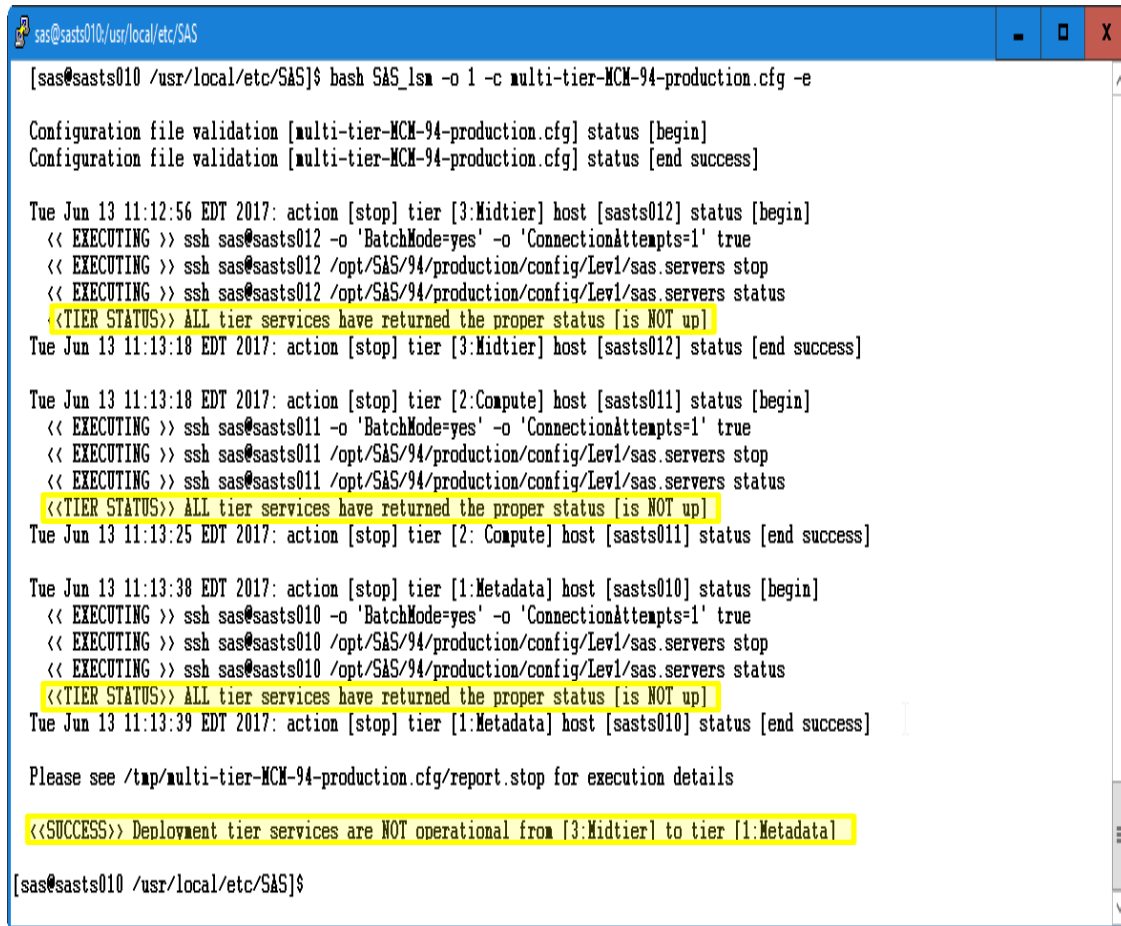
1. Navigates through each tier of the SAS multi-tiered deployment using the reverse numerical order (3-Midtier, 2-Compute, and then 1-Metadata) defined by the multi-tier-MCM-94-production.cfg configuration file.
2. Verifies that SSH is properly functioning for each tier.
3. Executes a stop request by running the tier-specific `sas.servers` command passing the stop argument.
4. Executes a status request by running the tier-specific `sas.servers` command passing the status argument.
5. Analyzes the results of the tier-specific `sas.servers` status command and reports the status of the tier, which is one of the following:
 - `ALL tier services have returned the proper status:` This means that all tier services are not up.
 - `ALL tier services have NOT returned the proper status:` This means that one or more tier services are up.

If a tier reports the status `ALL tier services have NOT returned the proper status`, the SAS_lsm utility provides additional detail about the status of the specific tier services that are up, and the utility stops processing tiers. Otherwise, the utility moves to process the next tier, continuing in reverse sequence up to and including the tier identified by the NUM variable.
6. Provides one of the following assessments of the overall status of the deployment after tier processing has completed.
 - `Deployment tier services are NOT operational:` This means that all tiers report that: `ALL tier services are NOT operational`.
 - `Deployment tier services are NOT fully operational:` This means that one or more tiers report that: `ALL tier services are NOT fully operational`.
7. Creates the `logfiles.BOM` file if the stop action fails to successfully stop tier services. The `-e` option will extract all files listed in `logfiles.BOM` to the centralized location, designated by `STATUSROOT`, and trim them based on the value set by `TRIMOFFSET`.
8. Sends an email to the SAS administrator using the email address defined by the `SASADMIN` variable in the `multi-tier-MCM-94-production.cfg` file after it reports the assessment of the overall status of the deployment. The email **Subject** line identifies whether the deployment was successfully stopped, as described in the [Email](#) section of this paper.

The next sections of this paper detail each of these possible assessments.

SCENARIO 1: SUCCESSFUL COMPLETION OF THE STOP ACTION FOR AN ENTIRE DEPLOYMENT

Display 8 shows example output for an entire deployment that is stopped successfully:



```
[sas@sasts010 /usr/local/etc/SAS]$ bash SAS_ls -o 1 -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 11:12:56 EDT 2017: action [stop] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:13:18 EDT 2017: action [stop] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 11:13:18 EDT 2017: action [stop] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:13:25 EDT 2017: action [stop] tier [2: Compute] host [sasts011] status [end success]

Tue Jun 13 11:13:38 EDT 2017: action [stop] tier [1:Metadata] host [sasts010] status [begin]
<< EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:13:39 EDT 2017: action [stop] tier [1:Metadata] host [sasts010] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.stop for execution details

<<SUCCESS>> Deployment tier services are NOT operational from [3:Midtier] to tier [1:Metadata]

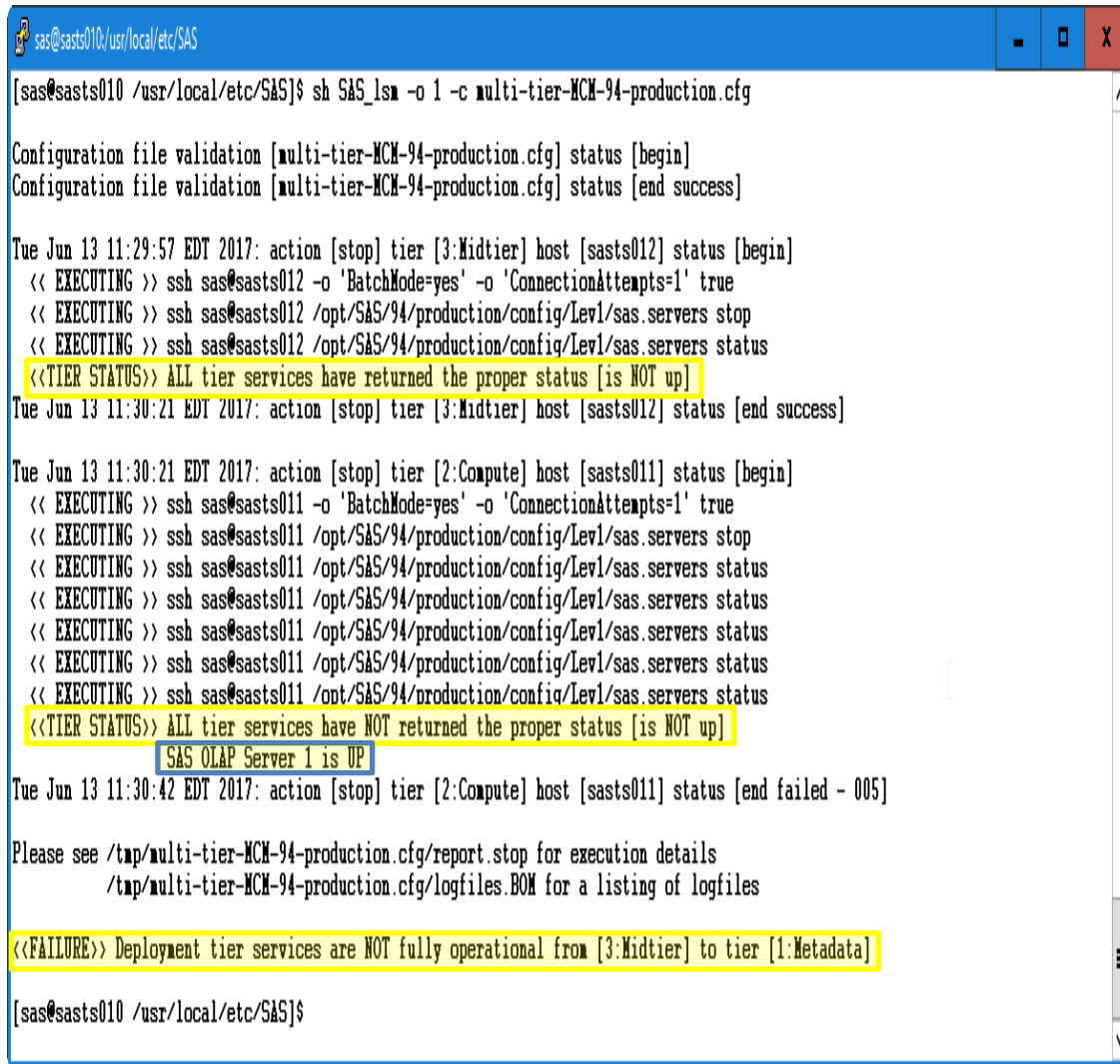
[sas@sasts010 /usr/local/etc/SAS]$
```

Display 8. Output from a Successful Stop Action for the entire deployment

In this scenario, all tiers (3-Midtier, 2-Compute, and 1-Metadata) reported the status ALL tier services have returned the proper status [is NOT up]. Therefore, the overall status for the deployment was Deployment tier services are NOT operational and no logfile.BOM was created.

SCENARIO 2: FAILED ATTEMPT OF THE STOP ACTION

Display 9 shows example output for a deployment that was not stopped successfully:



```
[sas@sasts010 /usr/local/etc/SAS]$ sh SAS_lsm -o 1 -c multi-tier-MCM-94-production.cfg

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 11:29:57 EDT 2017: action [stop] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:30:21 EDT 2017: action [stop] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 11:30:21 EDT 2017: action [stop] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have NOT returned the proper status [is NOT up]
SAS OLAP Server 1 is UP
Tue Jun 13 11:30:42 EDT 2017: action [stop] tier [2:Compute] host [sasts011] status [end failed - 005]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.stop for execution details
/tmp/multi-tier-MCM-94-production.cfg/logfiles.BOM for a listing of logfiles

<<FAILURE>> Deployment tier services are NOT fully operational from [3:Midtier] to tier [1:Metadata]

[sas@sasts010 /usr/local/etc/SAS]$
```

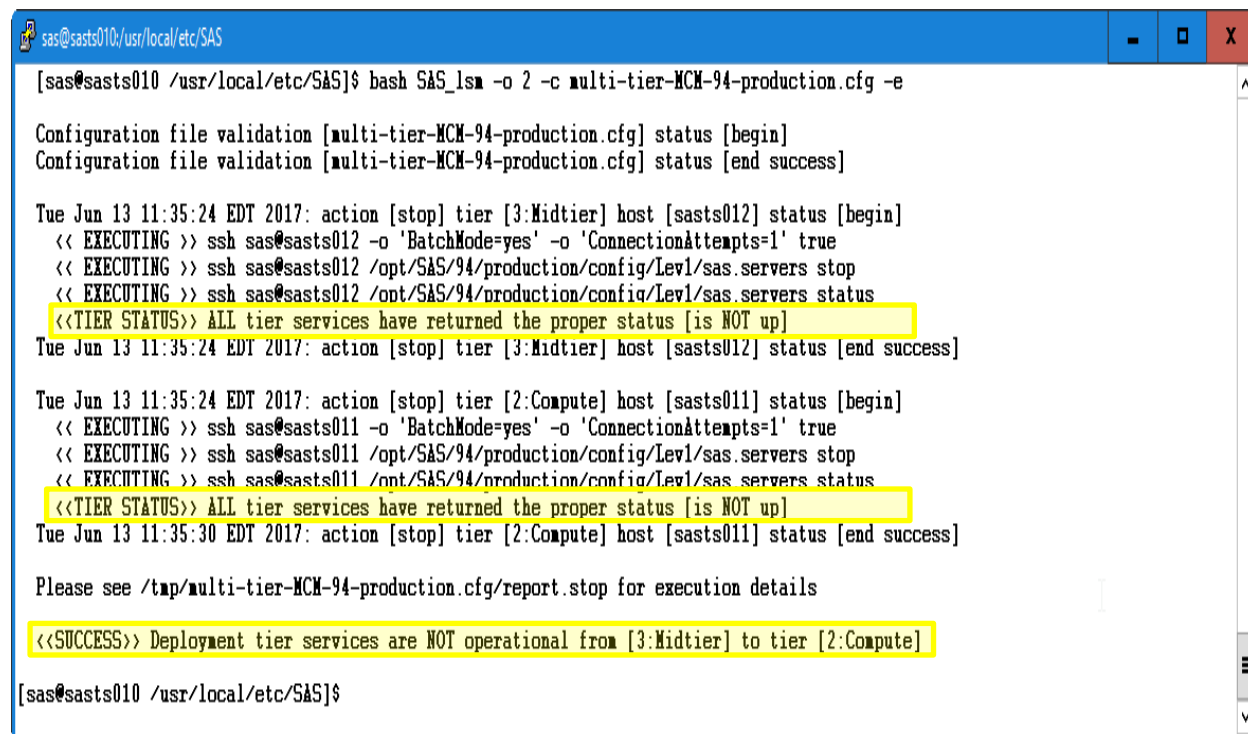
Display 9. Output from an Unsuccessful Stop Action

In this scenario, the tier 3-Midtier reported the status ALL tier services have returned the proper status [is NOT up]. Unfortunately, tier 2-Compute reported the status ALL tier services have NOT returned the proper status [is NOT up] due to the report (highlighted in blue) that the SAS OLAP Server 1 is UP. In this scenario, processing stopped and the overall status for the deployment was Deployment tier services are NOT fully operational. The logfile.BOM file was created. In this case, the -e option was not chosen and the 2-Compute tier logfiles were not centralized.

The utility sent an email to the SAS administrator indicating that the deployment was not successfully stopped. The SAS administrator must resolve the issue with SAS OLAP Server 1 before attempting to stop the deployment again.

SCENARIO 3: SUCCESSFUL ATTEMPT OF THE STOP ACTION FOR A PORTION OF A DEPLOYMENT TIERS

Display 10 shows example output for a deployment that was stopped successfully from the 3-Midtier to the 2-Compute tier leaving the 1-Metadata tier active:



```
[sas@sasts010 /usr/local/etc/SAS]$ bash SAS_ls -o 2 -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 11:35:24 EDT 2017: action [stop] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:35:24 EDT 2017: action [stop] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 11:35:24 EDT 2017: action [stop] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers stop
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:35:30 EDT 2017: action [stop] tier [2:Compute] host [sasts011] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.stop for execution details

<<SUCCESS>> Deployment tier services are NOT operational from [3:Midtier] to tier [2:Compute]

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 10. Output from a Successful Stop Action for the Midtier and Compute tier

In this scenario, all tiers (3-Midtier, 2-Compute) reported the status `ALL tier services have returned the proper status [is NOT up]`. Therefore, the overall status for the deployment was `Deployment tier services are NOT operational from [3:Midtier] to tier [2:Compute]` and no logfiles.BOM was created.

The utility sent an email to the SAS administrator indicating that those deployment tiers were successfully stopped.

USE CASE 3: STARTING THE DEPLOYMENT

Executing a deployment start request is a two-phased process. The first phase verifies tier-dependency status relative to the initial tier value specified. All tiers that are lower in numerical value than the initial tier value specified must be operational, and all tiers that are higher in numerical value than the initial tier value specified must be not operational.

This example attempts to start from the initial tier 2-Compute. Therefore, the tier 1-Metadata status must be operational, whereas the tier 3-Midtier status must be not operational to move to the second phase, which processes the actual start request.

To start the deployment and each tier, follow this process:

1. Log on to the SAS Metadata Server (sasts010) with the SAS installer user ID (sas) and password credentials.
2. Change your working directory to the tools-deployment directory (`cd /usr/local/etc/SAS/`).
3. Run the `[bash | sh] SAS_IsM -a <NUM> -c multi-tier-MCM-94-production.cfg [-e]` command, and replace <NUM> with the numerical value (1, 2, or 3) that matches the tier number that you want to start with.

After you complete this process, the SAS_IsM utility goes through the following steps:

1. Navigates through each tier of the SAS multi-tiered deployment using the numerical order (1-Metadata, 2-Compute, and then 3-Midtier) defined by the multi-tier-MCM-94-production.cfg configuration file. The initial tier value for the start request is defined by the NUM argument associated with the -a parameter. For example, the following command starts processing at tier 2, which in this use case is the Compute tier: **bash SAS_IsM -a 2 -c multi-tier-MCM-94-production.cfg**.
2. Verifies that SSH is properly functioning for each tier in the first phase.
3. Executes a status request by running the tier-specific sas.servers command passing the status argument.
4. Analyzes the results of the tier-specific sas.servers status command and reports the status of the tier based on tier-dependency status expectations. The status of the tier is one of the following:
 - ALL tier services have returned the proper status: This means that the tier-dependency status has been met.
If the deployment dependency checks pass, the SAS_IsM utility moves to the second phase, which is described below.
 - ALL tier services have NOT returned the proper status: This means that the tier-dependency status has not been met.
If a tier reports the status ALL tier services have NOT returned the proper status, the utility provides additional detail about the status of the specific tier services that have not met the expected dependency condition, and it stops processing tiers. In this scenario, the assessment of the overall status of the request is Deployment tier services dependency check failed. The SAS administrator must address the issues related to the dependency-check failure before attempting to start the deployment again.
5. Navigates through individual tiers and executes a start command by running the tier-specific sas.servers command passing either a restart or start argument. The utility always uses the restart argument for the initial tier, and uses the start argument for the subsequent tiers.
6. Executes a status request by running the same tier-specific sas.servers command passing the status argument.
7. Analyzes the results of the tier-specific sas.servers status command and reports the status of the tier, which is one of the following:
 - ALL tier services have returned the proper status: This means that all tier services are up.
The utility moves to process the next tier in sequence.
 - ALL tier services have NOT returned the proper status: This means that one or more tier services are not up.

If a tier reports the status ALL tier services have NOT returned the proper status, the utility stops processing tiers.

8. Provides one of the following assessments of the overall status of the deployment after tier processing has completed:
 - Deployment tier services are operational: This means that all tiers report that ALL tier services are operational.
 - Deployment tier services are NOT fully operational: This means that one or more tiers report that ALL tier services are NOT fully operational.
9. Creates the logfiles.BOM file if the start action fails to successfully start tier services. The `-e` option will extract all files listed in logfiles.BOM to the centralized location, designated by STATUSROOT, and trim them based on the value set by TRIMOFFSET.
10. Sends an email to the SAS administrator using the email address defined by the variable SASADMIN in the multi-tier-MCM-94-production.cfg file after it reports the assessment of the overall status of the deployment. The email **Subject** line identifies whether the deployment was successfully started, as described in the [Email](#) section of this paper.

The next sections of this paper detail each of these possible assessments.

SCENARIO 1: SUCCESSFUL COMPLETION OF THE START ACTION

Display 11 shows example output for a deployment that was started successfully from tier 1-Metadata when the initial deployment status was Deployment tier services are NOT operational:

```
sas@sasts010 /usr/local/etc/SAS
[sas@sasts010 /usr/local/etc/SAS]$ sh SAS_lsm -a 1 -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 11:41:16 EDT 2017: action [check dependencies tier stopped] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:41:17 EDT 2017: action [check dependencies tier stopped] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 11:41:17 EDT 2017: action [check dependencies tier stopped] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 11:41:17 EDT 2017: action [check dependencies tier stopped] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 11:41:17 EDT 2017: action [start] tier [1:Metadata] host [sasts010] status [begin]
<< EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers restart
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 11:41:42 EDT 2017: action [start] tier [1:Metadata] host [sasts010] status [end success]

Tue Jun 13 11:42:10 EDT 2017: action [start] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers start
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 11:42:54 EDT 2017: action [start] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 11:42:54 EDT 2017: action [start] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers start
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 11:49:03 EDT 2017: action [start] tier [3:Midtier] host [sasts012] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.start for execution details

<<SUCCESS>> Deployment tier services are operational

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 11. Output from a Successful Start Action

In this scenario, the initial tier value is 1-Metadata. The SAS_lsm utility checked all dependent tiers (2-Compute and 3-Midtier), and reported the status ALL tier services have returned the proper status [is NOT up]. Therefore, the tiers passed dependency-status checking.

Then, the SAS_lsm utility either restarted (1-Metadata) or started (2-Compute and 3-Midtier) all tiers (1-Metadata, 2-Compute, and 3-Midtier), and reported the status ALL tier services have returned the proper status [is UP]. Therefore, the overall status for the deployment was Deployment tier services are operational and no logfile.BOM was created. The utility sent an email indicating that the deployment was successfully started to the SAS administrator.

SCENARIO 2: FAILED ATTEMPT OF THE START ACTION

Display 12 shows example output for a deployment that failed to start from tier 1-Metadata when the initial deployment status was Deployment tier services are NOT operational:

```
[sas@sasts010 /usr/local/etc/SAS]$ bash SAS_lsm -a 1 -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 12:02:47 EDT 2017: action [check dependencies tier stopped] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 12:02:48 EDT 2017: action [check dependencies tier stopped] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 12:02:48 EDT 2017: action [check dependencies tier stopped] tier [3:Midtier] host [sasts012] status [begin]
<< EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas_servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 12:02:48 EDT 2017: action [check dependencies tier stopped] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 12:02:48 EDT 2017: action [start] tier [1:Metadata] host [sasts010] status [begin]
<< EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas_servers restart
<< EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas_servers status
<<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 12:03:12 EDT 2017: action [start] tier [1:Metadata] host [sasts010] status [end success]

Tue Jun 13 12:03:41 EDT 2017: action [start] tier [2:Compute] host [sasts011] status [begin]
<< EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers start
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers status
<< EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas_servers status
<<TIER STATUS>> ALL tier services have NOT returned the proper status [is UP]
SAS Object Spawner 1 is NOT up
Tue Jun 13 12:04:35 EDT 2017: action [start] tier [2:Compute] host [sasts011] status [end failed - 003]

Tue Jun 13 12:04:35 EDT 2017: action [centralize logfiles] status [begin]
<< COPY SCP >> sasts011/4/opt/SAS/94/production/config/Levl/ObjectSpawner/Logs/ObjectSpawner_2017-06-13_sasts011_10121.log
<< COPY SCP >> sasts011/4/opt/SAS/94/production/config/Levl/ObjectSpawner/Logs/ObjectSpawner_2017-06-13_sasts011_23848.log
<< COPY SCP >> sasts011/4/opt/SAS/94/production/config/Levl/ObjectSpawner/Logs/ObjectSpawner_console_sasts011.log
Tue Jun 13 12:04:39 EDT 2017: action [centralize logfiles] status [end success]

Tue Jun 13 12:04:39 EDT 2017: action [trim logfiles] status [begin]
Tue Jun 13 12:04:39 EDT 2017: action [trim logfiles] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.start for execution details
/tmp/multi-tier-MCM-94-production.cfg/logfiles.BOM for a listing of logfiles
/tmp/multi-tier-MCM-94-production.cfg/logfiles for the centralized logfiles

<<FAILURE>> Deployment tier services are NOT fully operational

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 12. Output from an Unsuccessful Start Action

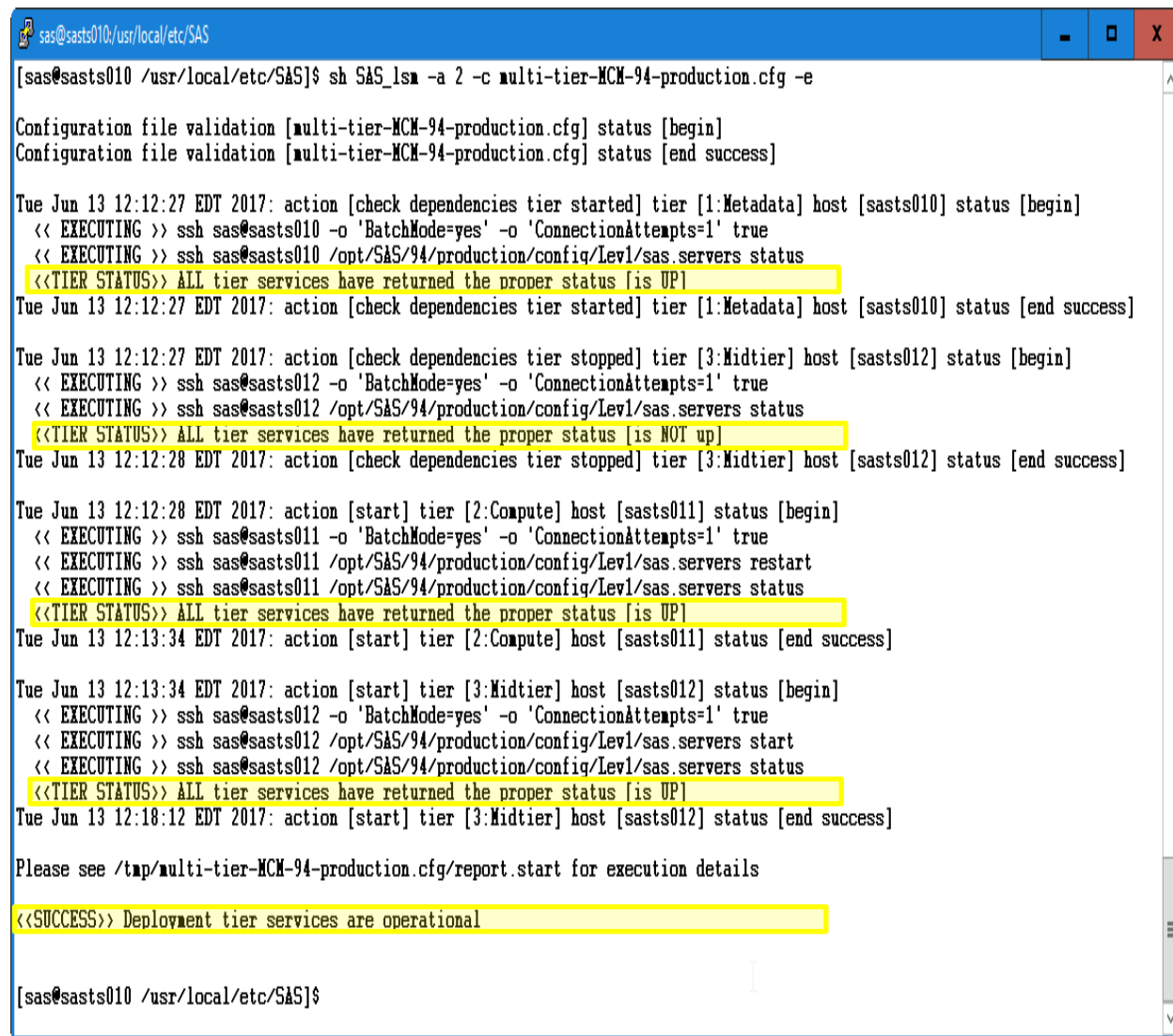
In this scenario, the initial tier value is 1-Metadata. The SAS_lsm utility checked the services of all dependent tiers (2-Compute and 3-Midtier), and reported the status ALL tier services have returned the proper status [is NOT up]. Therefore, the tiers passed dependency-status checking.

The SAS_lsm utility restarted tier 1-Metadata and reported the status ALL tier services have returned the proper status [is UP]. Tier 2-Compute failed to start properly and reported the status ALL tier services have NOT returned the proper status [is UP]. In this case, the status (highlighted in blue) indicated that SAS Object Spawner 1 is NOT up. Further tier processing stopped, leaving the overall status for the deployment as Deployment tier services

are NOT fully operational. The logfile.BOM file was created and 2-Compute tier logfiles centralized under the STATUSROOT directory /tmp. The utility sent an email to the SAS administrator indicating that the deployment was not successfully started. Scenario 3 in the following section addresses next steps.

SCENARIO 3: SUCCESSFUL COMPLETION OF THE START ACTION

Display 13 shows example output for a deployment that was started successfully from tier 2-Compute after that tier failed to start due to a SAS Object Spawner 1 service issue. This scenario builds on Scenario 2 in the previous section.



```
[sas@sasts010 /usr/local/etc/SAS]$ sh SAS_Isms -a 2 -c multi-tier-MCM-94-production.cfg -e

Configuration file validation [multi-tier-MCM-94-production.cfg] status [begin]
Configuration file validation [multi-tier-MCM-94-production.cfg] status [end success]

Tue Jun 13 12:12:27 EDT 2017: action [check dependencies tier started] tier [1:Metadata] host [sasts010] status [begin]
  << EXECUTING >> ssh sas@sasts010 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts010 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 12:12:27 EDT 2017: action [check dependencies tier started] tier [1:Metadata] host [sasts010] status [end success]

Tue Jun 13 12:12:27 EDT 2017: action [check dependencies tier stopped] tier [3:Midtier] host [sasts012] status [begin]
  << EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Tue Jun 13 12:12:28 EDT 2017: action [check dependencies tier stopped] tier [3:Midtier] host [sasts012] status [end success]

Tue Jun 13 12:12:28 EDT 2017: action [start] tier [2:Compute] host [sasts011] status [begin]
  << EXECUTING >> ssh sas@sasts011 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers restart
  << EXECUTING >> ssh sas@sasts011 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 12:13:34 EDT 2017: action [start] tier [2:Compute] host [sasts011] status [end success]

Tue Jun 13 12:13:34 EDT 2017: action [start] tier [3:Midtier] host [sasts012] status [begin]
  << EXECUTING >> ssh sas@sasts012 -o 'BatchMode=yes' -o 'ConnectionAttempts=1' true
  << EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers start
  << EXECUTING >> ssh sas@sasts012 /opt/SAS/94/production/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services have returned the proper status [is UP]
Tue Jun 13 12:18:12 EDT 2017: action [start] tier [3:Midtier] host [sasts012] status [end success]

Please see /tmp/multi-tier-MCM-94-production.cfg/report.start for execution details

<<SUCCESS>> Deployment tier services are operational

[sas@sasts010 /usr/local/etc/SAS]$
```

Display 13. Output from a Successful Start Action Starting at Tier 2-Compute

This scenario starts from an overall status for the deployment of Deployment tier services are NOT fully operational, because there was a failure in starting the SAS Object Spawner 1 service. After a quick call and excellent assistance from SAS Technical Support, the administrator resolved the issue and reattempted the start from the failed tier 2-Compute using the **bash SAS_Isms -a 2 -c multi-tier-MCM-94-production.cfg** command.

The initial tier value was 2-Compute. The SAS_Isms utility checked the services of the dependency tiers (1-Metadata) and (3-Midtier) and reported the status ALL tier services have returned the

proper status, passing dependency-status checking. In this case, tier 1-Metadata had a status of `is UP` and tier 3-Midtier had a status of `is NOT up`.

Then, the utility either restarted (2-Compute) or started (3-Midtier) the tiers, and reported the status `ALL tier services have returned the proper status [is UP]`. Therefore, the overall status for the deployment was `Deployment tier services are operational` and no logfiles.BOM was created. The utility sent an email indicating that the deployment was successfully started to the SAS administrator.

CONCLUSION

As this paper has illustrated, you can quickly have automated, orderly management of your SAS UNIX or Linux multi-tiered deployments by simply installing the Bash shell and/or Bourne on your Red Hat, AIX, and/or HP-UX operating system; configuring password-less SSH; and configuring the SAS_lsm utility. The SAS_lsm configuration file is extendable and flexible. You can configure it to accommodate more tiers as needed by creating additional tier stanzas and updating the MAXTIERS value accordingly.

Because the utility is a script, you can easily incorporate it into your operating-system reboot procedures. You will no longer need to engage in time-consuming, error-prone manual restarts of your multi-tiered SAS deployments. Instead, you can enjoy hands-free management!

REFERENCES

SAS Institute Inc. 2016. "Usage Note 58231: Utility that manages multi-tiered SAS® services for UNIX and Linux deployments." Cary, NC: SAS Institute Inc. Available at support.sas.com/kb/58/231.html.

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APPENDIX: CONFIGURATION WORKSHEET

Variable	Description	Notes	Value
SASCONFIG	Absolute path to the SAS configuration directory	Requires user input	
SASINST	Unix/Linux user ID that owns the SAS deployment	Requires user input	
TIER DEFINITION	Required for each tier of your SAS deployment		
TIERNAME[1]	Descriptive name for tier	Default Metadata	
TIERINST[1]	UNIX/Linux user ID that owns the SAS deployment on tier	Default \${SASINST}	
TIERHOST[1]	Full hostname value for tier	Requires user input	
TIERSTAR[1]	Absolute path to the tier-specific sas.servers script with start argument	Default \${SASCONFIG}/sas.servers start	
TIERSTOP[1]	Absolute path to the tier-specific sas.servers script with stop argument	Default \${SASCONFIG}/sas.servers stop	
TIERREST[1]	Absolute path to the tier-specific sas.servers script with restart argument	Default \${SASCONFIG}/sas.servers restart	
TIERSTAT[1]	Absolute path to the tier-specific sas.servers script with status argument	Default \${SASCONFIG}/sas.servers status	
TIERSTAS[1]	Defines token to check to ensure that tier-specific services are running	Absolute value 'is NOT up'	Do not alter
TIERSTOS[1]	Defines token to check to ensure that tier-specific services are not running	Absolute value 'is UP'	Do not alter
TIERNAME[2]	Descriptive name for tier	Default Compute	
TIERINST[2]	UNIX/Linux user ID that owns the SAS deployment on tier	Default \${SASINST}	
TIERHOST[2]	Full hostname value for tier	Requires user input	
TIERSTAR[2]	Absolute path to the tier-specific sas.servers script with start argument	Default \${SASCONFIG}/sas.servers start	
TIERSTOP[2]	Absolute path to the tier-specific sas.servers script with stop argument	Default \${SASCONFIG}/sas.servers stop	
TIERREST[2]	Absolute path to the tier-specific sas.servers script with restart argument	Default \${SASCONFIG}/sas.servers restart	
TIERSTAT[2]	Absolute path to the tier-specific sas.servers script with status argument	Default \${SASCONFIG}/sas.servers status	
TIERSTAS[2]	Defines token to check to ensure that tier-specific services are running	Absolute value 'is NOT up'	Do not alter
TIERSTOS[2]	Defines token to check to ensure that tier-specific services are not running	Absolute value 'is UP'	Do not alter
TIERNAME[3]	Descriptive name for tier	Default Midtier	
TIERINST[3]	UNIX/Linux user ID that owns the SAS deployment on tier	Default \${SASINST}	

Variable	Description	Notes	Value
TIERHOST[3]	Full hostname value for tier	Requires user input	
TIERSTAR[3]	Absolute path to the tier-specific sas.servers script with start argument	Default \${SASCONFIG}/sas.servers start	
TIERSTOP[3]	Absolute path to the tier-specific sas.servers script with stop argument	Default \${SASCONFIG}/sas.servers stop	
TIERREST[3]	Absolute path to the tier-specific sas.servers script with restart argument	Default \${SASCONFIG}/sas.servers restart	
TIERSTAT[3]	Absolute path to the tier-specific sas.servers script with status argument	Default \${SASCONFIG}/sas.servers status	
TIERSTAS[3]	Defines token to check to ensure that tier-specific services are running	Absolute value 'is NOT up'	Do not alter
TIERSTOS[3]	Defines token to check to ensure that tier-specific services are not running	Absolute value 'is UP'	Do not alter
MAXTIERS	Defines the number of tiers in the deployment	Default 3	
MAXRETRY	Defines the maximum number of retries for a sas.servers command	Default 60	
SLEEP	Defines the time (in seconds) to wait between retries for a sas.servers command	Default 5	
STATUSROOT	Define the root directory for SAS_lsm reports and log files on the server where SAS_lsm is installed	Default is /tmp	
TRIMOFFSET	Define offset in hours that is used to trim centralized log files	Default is 1	
SASADMIN	Defines the email addresses for your SAS administrators	Requires user input	