

Automated Management of UNIX/Linux Multi-Tiered SAS® Services: The Enhanced SAS_Ism Utility

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ABSTRACT

Have you tried to manually restart SAS servers to avoid loss of productivity and failed, causing delays? Have you encountered issues and struggled to analyze the appropriate SAS logs as part of the troubleshooting process?

After experiencing these issues, you can see that a utility that automates management of a SAS multi-tiered deployment's services would be a big benefit. To address these issues, SAS Technical Support developed the SAS Local Services Management (SAS_Ism) utility.

The SAS_Ism utility is now available via SAS® 9.4M5 and SAS Note 58231. It initially provided support for starting, stopping, and status checking a basic, multi-tiered deployment's services based on the sas.servers script. In version 3, SAS Technical Support has vastly improved SAS_Ism by adding the following support:

- metadata horizontal clustering services
- massively parallel processing SAS® LASR™ services
- user-defined services
- deployment maintenance (target start from/stop at tier)
- centralized log collection, analysis, and potential fix suggestions
- streamlined input for Technical Support track creation

This paper illustrates the expanded benefits of SAS_Ism. This includes a discussion of the new tier descriptors supported, features, and a practical demonstration that highlights the utility's configuration, typical usage scenario, problem-fix recommendation process, and simplified track-creation process. Now, grab a donut to go with your coffee, and let's examine the enhanced SAS_Ism utility!

INTRODUCTION

The SAS_Ism utility was first introduced at SAS Global Forum 2017. Its sole purpose was to orchestrate the management of SAS services for a simple UNIX/Linux based Metadata-Compute-Midtier (MCM) multi-tiered deployment by leveraging the sas.servers script that is deployed and configured with SAS installations. The utility enabled the administrator to start, stop, restart, and determine the status of all of these essential SAS services in their correct order across the tiers of a deployment. The utility was made available via [SAS Note 58231](#): "Utility that manages multi-tiered SAS® services for Unix/Linux deployments." In 2017, the utility was incorporated into SAS 9.4M5, located in the `!SASCONFIG/Lev1/Utilities` directory.

Note: It is critical that you review last year's SAS Global Forum paper, "[An Oasis of Serenity in a Sea of Chaos: Automating the Management of Your UNIX/Linux Multi-tiered SAS® Services](#)," to understand the fundamentals of SAS_Ism. Last year's paper described the steps needed to deploy, configure, and use the SAS_Ism utility for an MCM multi-tiered deployment and also provided helpful use cases. This year's paper focuses solely on the improvements included in the new version (SAS_Ism 3.0).

We have enhanced the SAS_Ism utility to support tiers that go beyond the fundamental MCM model based on the sas.servers script. It now contains additional, easy-to-configure descriptor templates for metadata horizontal clustering, massively parallel processing SAS LASR services, and user-defined services that can be SAS based or not.

SAS_Ism 3.0 supports targeted start and stop actions that simplify the management of your tier services

during the deployment-maintenance process. SAS_IsM 3.0 also has a centralized log-collection facility that analyzes errors and provides potential fix suggestions. The utility has streamlined the collection of artifacts necessary for track creation, which enables Technical Support to quickly begin their technical assessment if help is needed. This process eliminates the time-consuming, error-prone, and frustrating manual process of gathering critical problem information.

NEW PREREQUISITE AND FILES ASSOCIATED WITH THE SAS_LSM UTILITY

This section details the additional prerequisite that you need to use SAS_IsM 3.0 as well as the new files that have been added.

Note: Refer to last year's [paper](#) for a full listing of prerequisites and files.

NEW PREREQUISITE

If you are implementing support for massively parallel processing SAS LASR services, you must activate the XCMD system option on the tier where you start and stop these services. Note that the XCMD system option specifies that the `x` command is valid in the current SAS session.

NEW FILES

The new files that have been added to SAS_IsM 3.0 are listed in Table 1 below:

File	Notes
SAS_IsM.cfg-template	Text file for the expanded SAS_IsM configuration template that contains new tier-descriptor templates as well as the variables required to support log collection and analysis. This template replaces the SAS_IsM multi-tier-MCM.template file that was included in the 2.0 release.
SAS_IsM_LASR.tar	TAR file containing SAS code required to support the management of the optional massively parallel processing SAS LASR services.

Table 1. SAS_IsM Utility Files

THE CONFIGURATION-FILE DRIVEN PROCESS

You configure and run SAS_IsM from only a single server. It uses password-less Secure Shell (SSH) to navigate between the tiers in your deployment. Note that SSH works differently in batch when compared with interactive mode. In batch mode, SSH sources only the users' local shell profile, whereas in interactive mode, both system (for example, `/etc/profile`) and local shell (for example, `${HOME}/.bashrc`) profiles are sourced. Ensure that any variables specific to SAS that are located in a tier's system profile are replicated in the user's local shell profile as well when using SAS_IsM, because it operates in batch mode only.

The SAS_IsM utility is controlled by a deployment-specific configuration file that you customize using a copy of the SAS_IsM.cfg-template file referenced in Table 1 above. SAS_IsM 3.0 reads the deployment-specific configuration file, which in turn drives the execution of tier-specific services management utilities in their proper order. This section dissects the SAS_IsM.cfg-template file by describing the new miscellaneous configurable variables and tier descriptors required to support the enhancements.

Table 2 provides a description of these new miscellaneous configurable variables:

Note: Refer to last year's [paper](#) for a full listing of the pre-existing miscellaneous configurable variables.

Variable	Description	Notes
SSHOPTIONS	SSH batch command options	Configurable. Default value: "-q -o StrictHostKeyChecking=no -o PasswordAuthentication=no"
TRIMOFFSET	Offset in hours that is used to trim centralized log files	Configurable. Default value: 1 (1 hour)
SAS_LSM_BROWSER	Browser to be used when searching the internet for a potential resolution for tier-specific service issues	(Optional) Requires user input (for example, firefox)

Table 2. New Miscellaneous Configurable Variables in the SAS_lsm.cfg-template File

SAS_lsm 3.0 supports the following tier descriptors that are outlined in the SAS_lsm.cfg-template file:

- SAS based services tier descriptors
 - **New:** metadata horizontal clustering
 - sas.servers
 - **New:** massively parallel processing SAS LASR services
- **New:** user-defined services tier descriptor

Table 3 contains a description of the core variables that comprise the required base definition for ALL the SAS based services tier descriptors. Note that the new variables are highlighted in **bold**:

Variable	Description	Notes
TIERNAME[N]	Descriptive name for the tier	Requires user input
TIERINST[N]	User ID (instance owner) that executes the tier service management scripts	Absolute value set
TIERHOST[N]	Full-tier physical server host name value for the tier	Requires user input
TIERSTAR[N]	Absolute path to the tier-start script	Absolute value set
TIERSTOP[N]	Absolute path to the tier-stop script	Absolute value set
TIERREST[N]	Absolute path to the tier-restart script	Absolute value set
TIERSTAT[N]	Absolute path to the tier-status script	Absolute value set
TIERSTAS[N]	Defines search token to ensure that tier services are started	Absolute value set
TIERSTOS[N]	Defines search token to ensure that tier services are stopped	Absolute value set
TIERLOGD[N]	Defines root value for the tier's service log directory	Absolute value set
TIERTYPE[N]	Defines type of tier service	Absolute value set

Table 3. Variables That Comprise the Required Base Definition for All the Tier Descriptors

For the metadata horizontal clustering tier descriptor, the definition must start at TIER 1 (N=1), contain a minimum of three cluster nodes (TIERTYPE MDCN), and end with a single validation node (TIERTYPE MDCV).

- MDCN = **MetaData Cluster Node**
- MDCV = **MetaData Cluster Validation Node** (non-functional tier used to manage quorum status)

For the user-defined services tier descriptor, all tier variables described above require user input with the exception of TIERTYPE, which is set to **standard**.

The remainder of the paper focuses on an 11-tiered deployment that consists of a three-node metadata horizontal cluster, multiple sas.servers based compute tiers and midtiers, private and public LASR servers, and a user-defined service. Note that you can configure SAS_IsM 3.0 to accommodate as many tiers as you need. To customize the configuration, create additional tier stanzas using the appropriate tier-descriptor template and update the MAXTIERS value accordingly.

EXAMPLE 11-TIERED DEVELOPMENT DEPLOYMENT CONFIGURATION

This section provides an example configuration required to manage an 11-tiered SAS 9.4 development deployment for the fictional JGB Business Unit. Note that the tools-deployment path location of the SAS_IsM utility is arbitrarily assigned in this example. It is recommended that you maintain a separate, unique directory location outside of your SAS deployment for the utility, its configuration files, reports, and log files.

SAS_IsM 3.0 deployment details:

- Operating system: Red Hat
- Server name: tumprojects
- SAS_IsM owner: sastools
- Path to the tools-deployment location of SAS_IsM: `/usr/local/etc/SAS`
Note: For this example, it is presumed that the utility has already been deployed.
- Configuration filename: JGB-94-dev.cfg

Table 4 lists the values for the miscellaneous configurable variables in the JGB-94-dev.cfg file:

Variable	Description	Value
CONFIGDIR	Root directory for the deployment's tier-specific service management scripts	<code>/opt/sas94/dev/config/Lev1</code>
INSTID	User ID (instance owner) that executes the deployment's tier-specific service management scripts	<code>sasinst</code>
MAXTIERS	Number of tiers in the deployment	<code>11</code>
STATUSROOT	Root directory for all SAS_IsM generated reports and log files on the server where SAS_IsM is installed	<code>/usr/local/etc/SAS/reports</code>
SAS_LSM_BROWSER	Browser to be used when searching the internet for a potential resolution for service issues	<code>firefox</code>
SASADMIN	Email addresses for your deployment administrators	<code>sasadm1sm@gmail.com</code>

Table 4. Miscellaneous Configurable Variables in the JGB-94-dev.cfg File

Table 5 shows the values for individual tier definitions in the JGB-94-dev.cfg file:


Tier Name	Tier Descriptor Template	Tier Host Name	Start Order
Metadata cluster node (MDCN) [1-3] of 3	metadata horizontal clustering	metadata-1 metadata-2 metadata-3	1 2 3
Metadata cluster validation (MDCV)	metadata horizontal clustering	metadata-1	4
Enterprise Miner Compute	sas.servers	sasapp-1	5
Enterprise Miner Midtier	sas.servers	midtier-1	6
Visual Analytics Compute	sas.servers	sasapp-2	7
Visual Analytics Midtier	sas.servers	midtier-2	8
Private LASR (Port 10011)	massively parallel processing SAS LASR	sasapp-2	9
Public LASR (Port 10031)	massively parallel processing SAS LASR	sasapp-2	10
LASR monitor	user-defined	sasapp-2	11

Table 5. Tier Definitions in the JGB-94-dev.cfg File

PROCESS

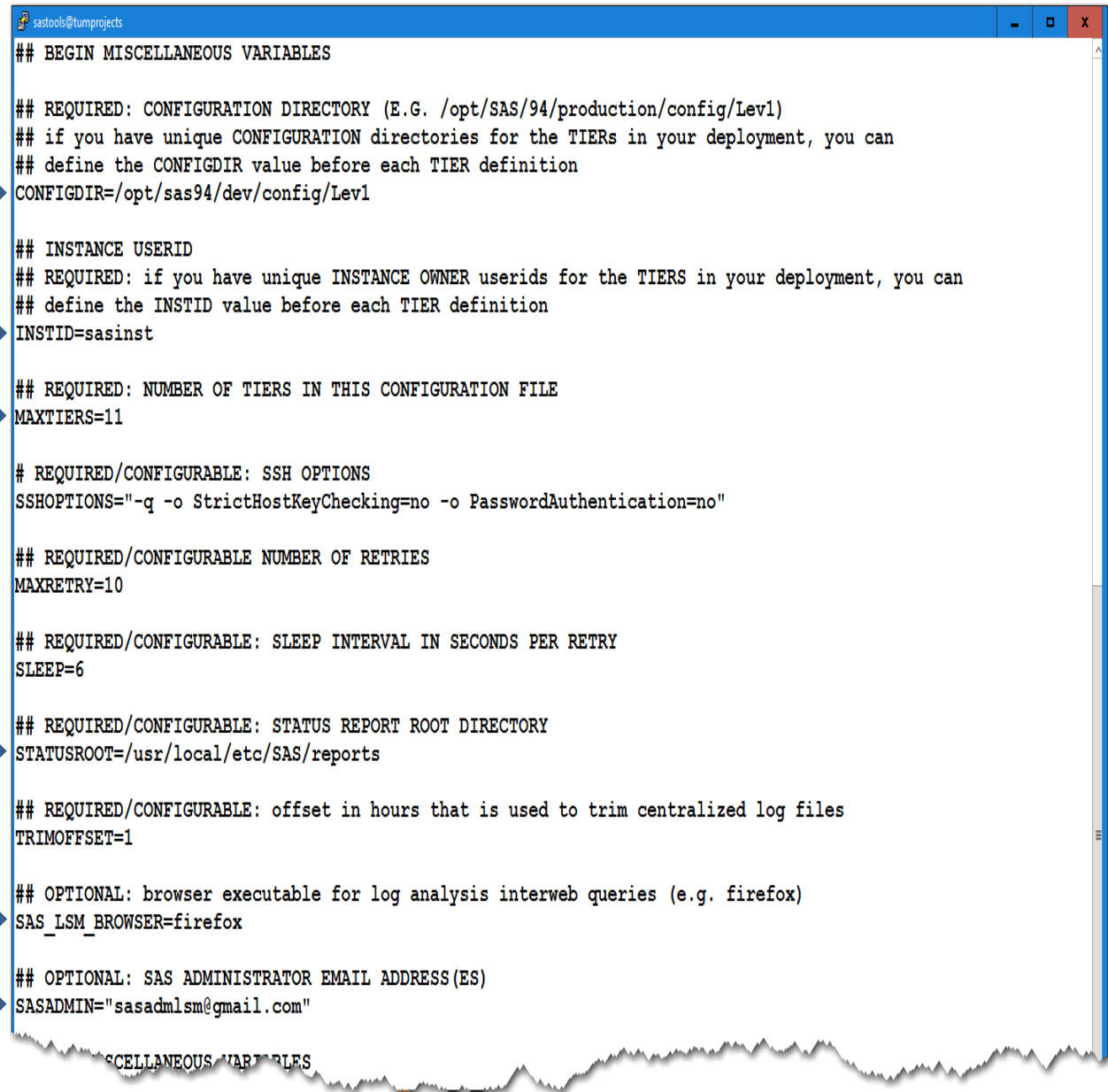
To configure the example above, follow this process after deploying SAS_lsm 3.0:

1. Ensure that all prerequisite conditions (Bourne and/or Bash shell installed, password-less SSH configured, XCMD activated on sasapp-2 [tier host name that manages LASR services]) have been met on all applicable deployment tier host names identified in Table 5.
2. Log on to the tools deployment server (tumprojects) as the SAS_lsm owner user ID (sastools).
3. Change your working directory to the tools deployment directory (`/usr/local/etc/SAS`).
4. Make a copy of the SAS_lsm.cfg-template to define and control the management of the SAS 9.4 JGB project-development deployment (JGB-94-dev.cfg).
5. Update the JGB-94-dev.cfg file to reflect the configuration input for the miscellaneous configurable variables and individual tier definitions 1-8 outlined in Table 4 and Table 5.

In the following displays, note that any required updates are identified by a blue arrow () in the left margin and that an ellipsis (...) indicates that repetitive information has been removed.

MISCELLANEOUS CONFIGURATION VARIABLES

Display 1 shows the updated miscellaneous configurable variables in the JGB-94-dev.cfg file:



```
## BEGIN MISCELLANEOUS VARIABLES

## REQUIRED: CONFIGURATION DIRECTORY (E.G. /opt/SAS/94/production/config/Lev1)
## if you have unique CONFIGURATION directories for the TIERS in your deployment, you can
## define the CONFIGDIR value before each TIER definition
→ CONFIGDIR=/opt/sas94/dev/config/Lev1

## INSTANCE USERID
## REQUIRED: if you have unique INSTANCE OWNER userids for the TIERS in your deployment, you can
## define the INSTID value before each TIER definition
→ INSTID=sasinst

## REQUIRED: NUMBER OF TIERS IN THIS CONFIGURATION FILE
→ MAXTIERS=11

# REQUIRED/CONFIGURABLE: SSH OPTIONS
SSHOPTIONS="-q -o StrictHostKeyChecking=no -o PasswordAuthentication=no"

## REQUIRED/CONFIGURABLE NUMBER OF RETRIES
MAXRETRY=10

## REQUIRED/CONFIGURABLE: SLEEP INTERVAL IN SECONDS PER RETRY
SLEEP=6

## REQUIRED/CONFIGURABLE: STATUS REPORT ROOT DIRECTORY
→ STATUSROOT=/usr/local/etc/SAS/reports

## REQUIRED/CONFIGURABLE: offset in hours that is used to trim centralized log files
TRIMOFFSET=1

## OPTIONAL: browser executable for log analysis interweb queries (e.g. firefox)
→ SAS_LSM_BROWSER=firefox

## OPTIONAL: SAS ADMINISTRATOR EMAIL ADDRESS(ES)
→ SASADMIN="sasadmlsm@gmail.com"

MISCELLANEOUS VARIABLES
```

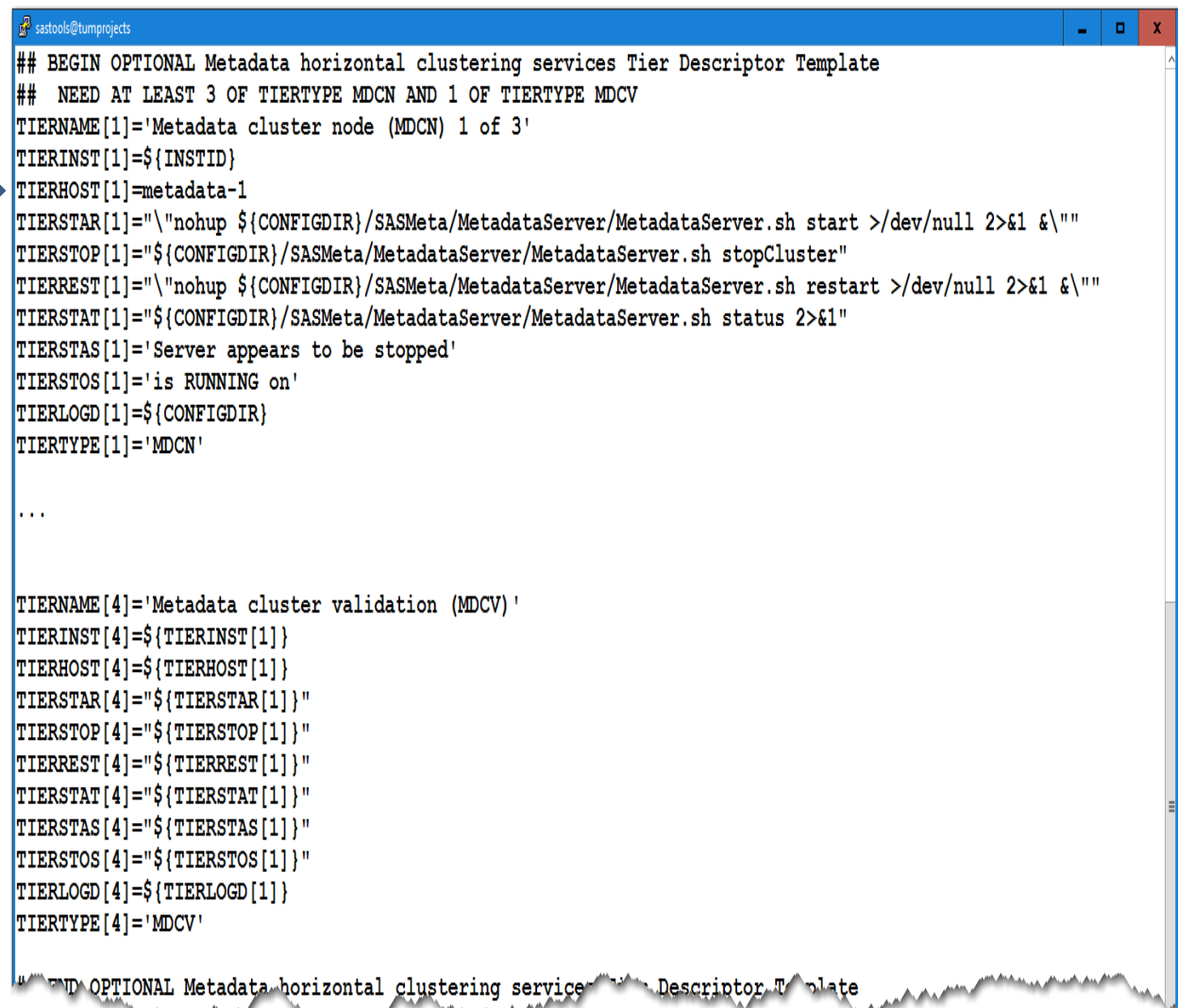
Display 1. Updated Miscellaneous Configurable Variables in the JGB-94-dev.cfg File

TEMPLATE-DRIVEN TIER CONFIGURATION

The following sections show the configuration required to support all the deployment-tier services for the JGB project. When configuring any template, you must remove the number sign (#) from column 1 of all the tier descriptors that you want to activate.

METADATA HORIZONTAL CLUSTERING SERVICES CONFIGURATION

Display 2 shows a fragment of the updated metadata horizontal clustering services tier descriptor in the JGB-94-dev.cfg file:



```
sastools@tumprojects
## BEGIN OPTIONAL Metadata horizontal clustering services Tier Descriptor Template
## NEED AT LEAST 3 OF TIERTYPE MDCN AND 1 OF TIERTYPE MDCV
TIERNAME[1]='Metadata cluster node (MDCN) 1 of 3'
TIERINST[1]=${INSTID}
TIERHOST[1]=metadata-1
TIERSTAR[1]="\`nohup ${CONFIGDIR}/SASMeta/MetadataServer/MetadataServer.sh start >/dev/null 2>&1 &\`"
TIERSTOP[1]="${CONFIGDIR}/SASMeta/MetadataServer/MetadataServer.sh stopCluster"
TIERREST[1]="\`nohup ${CONFIGDIR}/SASMeta/MetadataServer/MetadataServer.sh restart >/dev/null 2>&1 &\`"
TIERSTAT[1]="${CONFIGDIR}/SASMeta/MetadataServer/MetadataServer.sh status 2>&1"
TIERSTAS[1]='Server appears to be stopped'
TIERSTOS[1]='is RUNNING on'
TIERLOGD[1]=${CONFIGDIR}
TIERTYPE[1]='MDCN'

...

TIERNAME[4]='Metadata cluster validation (MDCV)'
TIERINST[4]=${TIERINST[1]}
TIERHOST[4]=${TIERHOST[1]}
TIERSTAR[4]="${TIERSTAR[1]}"
TIERSTOP[4]="${TIERSTOP[1]}"
TIERREST[4]="${TIERREST[1]}"
TIERSTAT[4]="${TIERSTAT[1]}"
TIERSTAS[4]="${TIERSTAS[1]}"
TIERSTOS[4]="${TIERSTOS[1]}"
TIERLOGD[4]=${TIERLOGD[1]}
TIERTYPE[4]='MDCV'

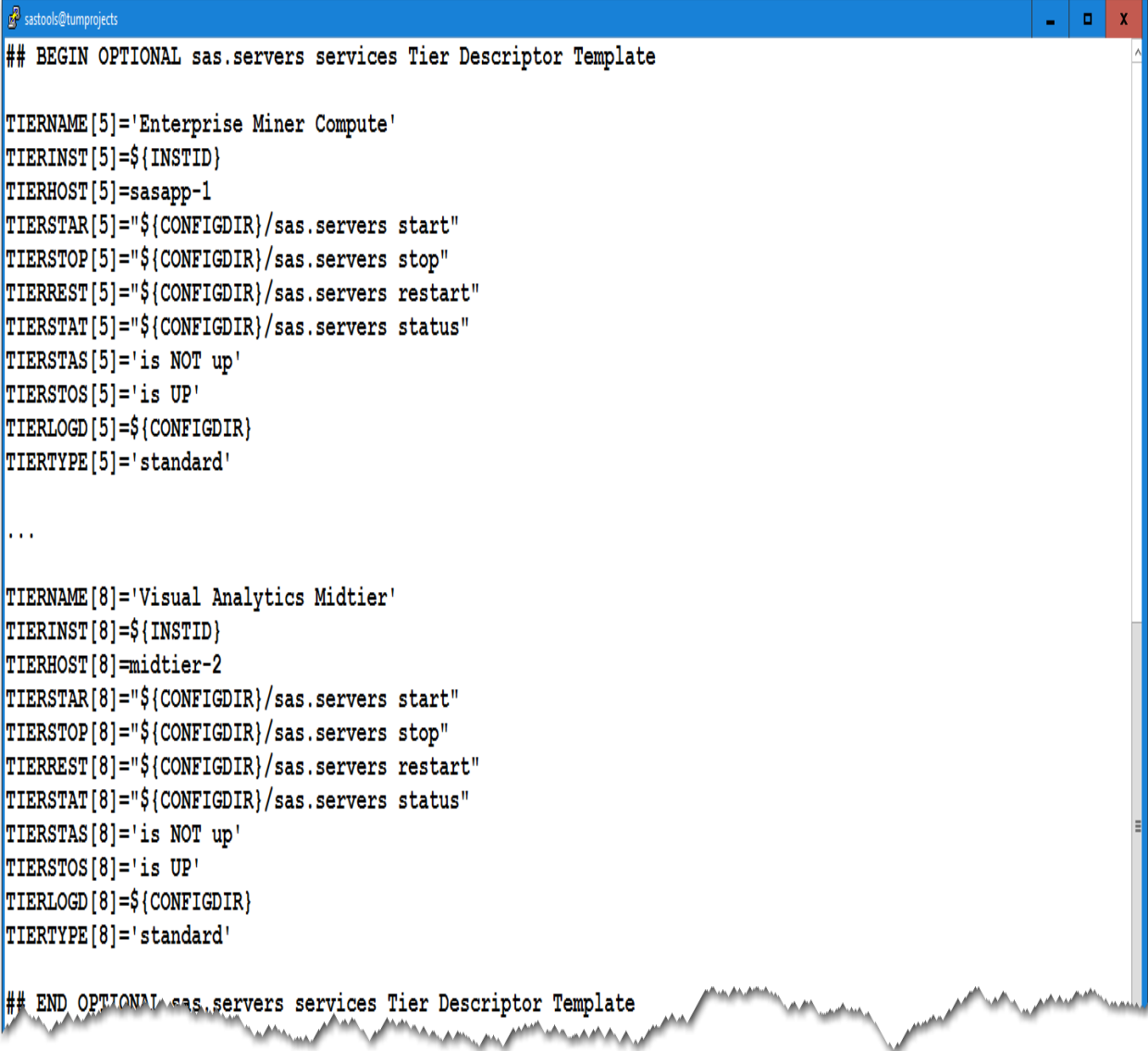
## END OPTIONAL Metadata horizontal clustering services Tier Descriptor Template
```

Display 2. Updated Metadata Horizontal Clustering Services Tier Descriptor

Note that even though a metadata cluster consists of a number of SAS_Ism tiers, it is treated as a single entity and must be started from or stopped to tier 1.

SAS.SERVERS SERVICE CONFIGURATION

Display 3 shows a fragment of the updated sas.servers services tier descriptor in the JGB-94-dev.cfg file:



```
sastools@tumprojects
## BEGIN OPTIONAL sas.servers services Tier Descriptor Template
TIERNAME[5]='Enterprise Miner Compute'
TIERINST[5]=${INSTID}
TIERHOST[5]=sasapp-1
TIERSTAR[5]="${CONFIGDIR}/sas.servers start"
TIERSTOP[5]="${CONFIGDIR}/sas.servers stop"
TIERREST[5]="${CONFIGDIR}/sas.servers restart"
TIERSTAT[5]="${CONFIGDIR}/sas.servers status"
TIERSTAS[5]='is NOT up'
TIERSTOS[5]='is UP'
TIERLOGD[5]=${CONFIGDIR}
TIERTYPE[5]='standard'
...
TIERNAME[8]='Visual Analytics Midtier'
TIERINST[8]=${INSTID}
TIERHOST[8]=midtier-2
TIERSTAR[8]="${CONFIGDIR}/sas.servers start"
TIERSTOP[8]="${CONFIGDIR}/sas.servers stop"
TIERREST[8]="${CONFIGDIR}/sas.servers restart"
TIERSTAT[8]="${CONFIGDIR}/sas.servers status"
TIERSTAS[8]='is NOT up'
TIERSTOS[8]='is UP'
TIERLOGD[8]=${CONFIGDIR}
TIERTYPE[8]='standard'
## END OPTIONAL sas.servers services Tier Descriptor Template
```

Display 3. Updated sas.servers Services Tier Descriptor

MASSIVELY PARALLEL PROCESSING SAS LASR SERVICES CONFIGURATION

You must deploy and configure additional code to manage massively parallel processing SAS LASR services. In this example, here are the SAS LASR tools deployment details:

- Operating system: Red Hat
- Server name: sasapp-2
- INSTID: SAS LASR tools instance owner: sasdemo
- LASRHD: absolute path to the SAS_Ism LASR tools deployment directory:
/usr/local/etc/SAS/LASR
- SASHD: absolute path to the sas program: /opt/sas94/dev/SASHome/SASFoundation/9.4

To configure the LASR services for the 11-tiered deployment example, follow the process outlined below:

1. Log on to the sasapp-2 LASR tools deployment server as the sasdemo LASR instance user ID.
2. Change your working directory to the SAS_IsM LASR tools deployment directory:
/usr/local/etc/SAS/LASR.
3. Copy (for example, scp) and then extract (for example, tar xvf) the contents of the SAS_IsM_LASR.tar file from the tumprojects server location /usr/local/etc/SAS. You receive the inventory shown in Table 6:

File	Description
mpp_start.sas	Program that starts LASR services
mpp_stop.sas	Program that stops LASR services
mpp_restart.sas	Program that restarts LASR services
mpp_checklasr.sas	Program that checks the status of the LASR services
meta_cfg.sas	Metadata credentials configuration file
SAS_IsM_LASR_config.sas	Program that pulls LASR specific service information from the metadata server and creates the appropriate LASR credentials configuration files

Table 6. Content of the SAS_IsM_LASR.tar File

4. Update the values in Table 7 for the metadata configuration variables in the meta_cfg.sas file:

Variable	Description	Value
MDSERVERHOST	Metadata server host name	metadata-1
MDSERVERPORT	Metadata server port number	8561
MDSERVERUSER	INSTID of user that queries the metadata server	sasdemo
MDSERVERPASS	pwencode encrypted metadata server password	{SAS002}XXXXXXXX

Table 7. Values Required to Update the Meta_cfg.sas Metadata Credentials Configuration File

Display 4 shows the updated meta_cfg.sas file:

```

sasdemo@sasapp-2
%let MDSERVERHOST=lsn-dev-metadata-1.tumprojects.sashq-d.openstack.sas.com;
%let MDSERVERPORT=8561;
%let MDSERVERUSER=sasdemo;
%let MDSERVERPASS={SAS002}XXXXXXXX;
  
```

Display 4. Updated Meta_cfg.sas File

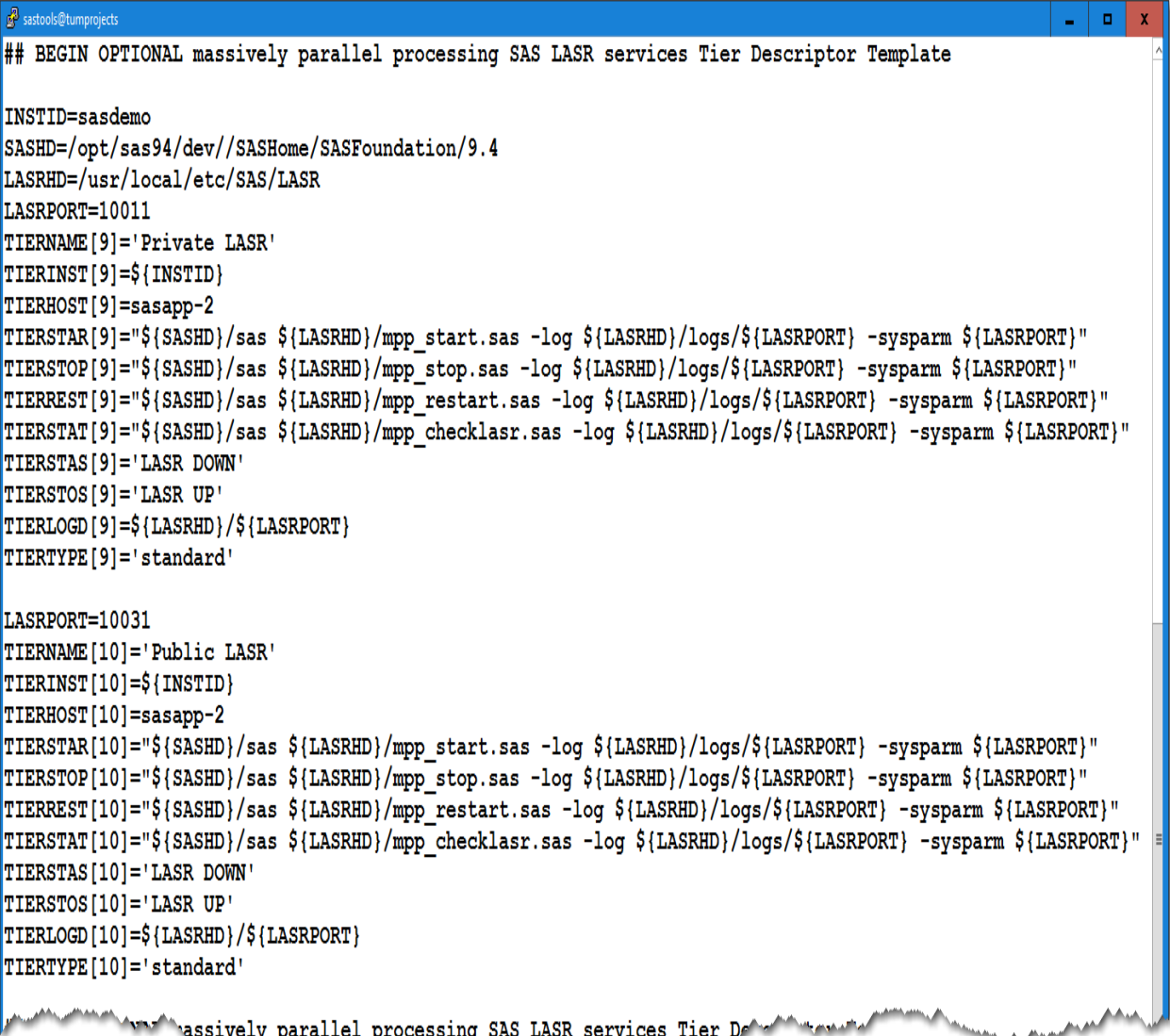
5. Run the SAS_IsM_LASR_config.sas program to generate LASR instance specific configuration files (for example, mpp_cfg_{PORT}.sas). For example, on the command line, enter the following:

```
/opt/sas94/dev/SASHome/SASFoundation/9.4/sas SAS_IsM_LASR_config.sas
```

Note that for this step to work, the metadata server needs to be operational. In this example, the following two LASR configuration files are created using Port 10011 and Port 10031:

- Private LASR configuration file: mpp_cfg_10011.sas
- Public LASR configuration file: mpp_cfg_10031.sas

6. Go to the sastools account on the tumprojects server and update the JGB_94_dev.cfg file with tier definitions. Display 5 shows a fragment of the updated massively parallel processing SAS LASR services tier descriptor in the JGB-94-dev.cfg file:



```
sastools@tumprojects
## BEGIN OPTIONAL massively parallel processing SAS LASR services Tier Descriptor Template

INSTID=sasdemo
SASHD=/opt/sas94/dev//SASHome/SASFoundation/9.4
LASRHD=/usr/local/etc/SAS/LASR
LASRPORT=10011
TIERNAME[9]='Private LASR'
TIERINST[9]={INSTID}
TIERHOST[9]=sasapp-2
TIERSTAR[9]="${SASHD}/sas ${LASRHD}/mpp_start.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERSTOP[9]="${SASHD}/sas ${LASRHD}/mpp_stop.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERREST[9]="${SASHD}/sas ${LASRHD}/mpp_restart.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERSTAT[9]="${SASHD}/sas ${LASRHD}/mpp_checklasr.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERSTAS[9]='LASR DOWN'
TIERSTOS[9]='LASR UP'
TIERLOGD[9]={LASRHD}/${LASRPORT}
TIERTYPE[9]='standard'

LASRPORT=10031
TIERNAME[10]='Public LASR'
TIERINST[10]={INSTID}
TIERHOST[10]=sasapp-2
TIERSTAR[10]="${SASHD}/sas ${LASRHD}/mpp_start.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERSTOP[10]="${SASHD}/sas ${LASRHD}/mpp_stop.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERREST[10]="${SASHD}/sas ${LASRHD}/mpp_restart.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERSTAT[10]="${SASHD}/sas ${LASRHD}/mpp_checklasr.sas -log ${LASRHD}/logs/${LASRPORT} -sysparm ${LASRPORT}"
TIERSTAS[10]='LASR DOWN'
TIERSTOS[10]='LASR UP'
TIERLOGD[10]={LASRHD}/${LASRPORT}
TIERTYPE[10]='standard'

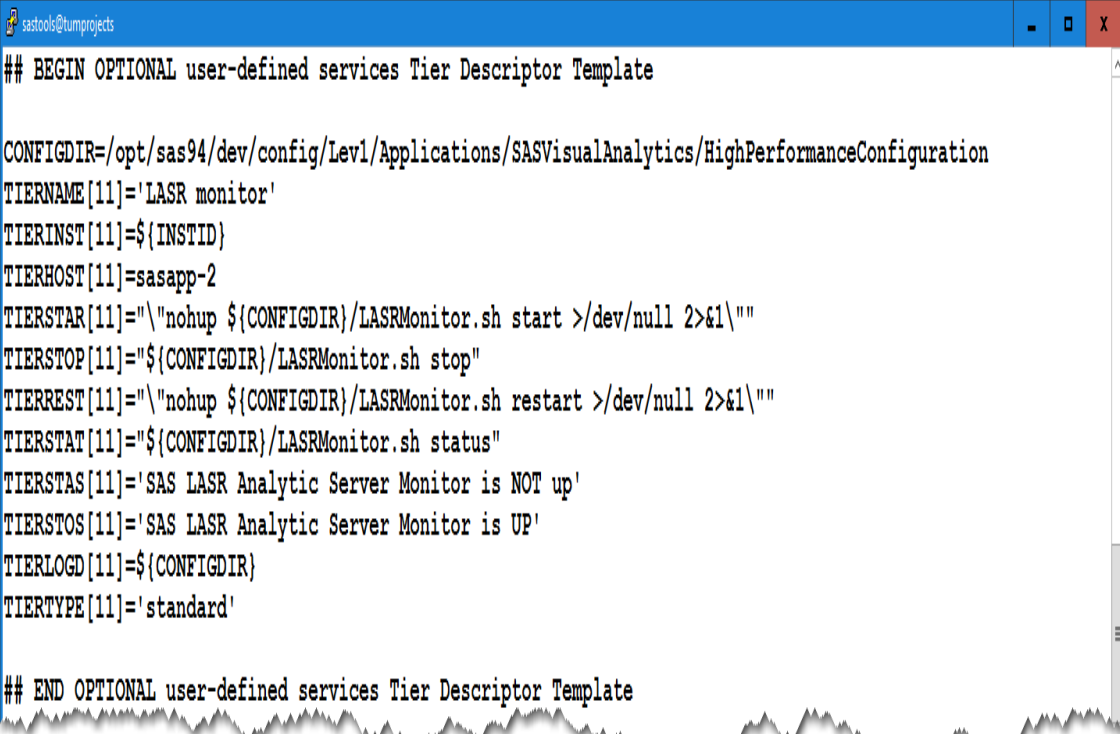
massively parallel processing SAS LASR services Tier D
```

Display 5. Updated Massively Parallel Processing SAS LASR Services Tier Descriptor

USER-DEFINED SERVICES CONFIGURATION

The special processing that is required for user-defined services entails running SSH commands from the server where SAS_ism 3.0 is deployed to start, stop, restart, and check status of the service. It also notes the text that is displayed that indicates whether the service is running or not.

Display 6 shows a fragment of the updated user-defined services tier descriptor in the JGB-94-dev.cfg file required to support the tier service LASRMonitor.sh:



```
## BEGIN OPTIONAL user-defined services Tier Descriptor Template

CONFIGDIR=/opt/sas94/dev/config/Levl/Applications/SASVisualAnalytics/HighPerformanceConfiguration
TIERNAME[11]='LASR monitor'
TIERINST[11]=${INSTID}
TIERHOST[11]=sasapp-2
TIERSTAR[11]="\`nohup ${CONFIGDIR}/LASRMonitor.sh start >/dev/null 2>&1\`"
TIERSTOP[11]="`${CONFIGDIR}/LASRMonitor.sh stop"
TIERREST[11]="\`nohup ${CONFIGDIR}/LASRMonitor.sh restart >/dev/null 2>&1\`"
TIERSTAT[11]="`${CONFIGDIR}/LASRMonitor.sh status"
TIERSTAS[11]='SAS LASR Analytic Server Monitor is NOT up'
TIERSTOS[11]='SAS LASR Analytic Server Monitor is UP'
TIERLOGD[11]=${CONFIGDIR}
TIERTYPE[11]='standard'

## END OPTIONAL user-defined services Tier Descriptor Template
```

Display 6. Updated User-Defined Services Tier Descriptor

CENTRALIZED REPORT OUTPUT AND LOG COLLECTION

SAS_ism 3.0 stores both report and log files in the configuration file named directory in the **STATUSROOT** directory that you defined in your SAS_ism configuration file. In this example, all reports and log files are stored in the `/usr/local/etc/SAS/reports/JGB-94-dev.cfg/` directory.

Table 8 lists the artifacts that you can expect as part of the centralized log collection and analysis process:

ARTIFACT	DESCRIPTION
report.status	A report containing details of the most recent status request
report.start	A report containing details of the most recent start request
report.stop	A report containing details of the most recent stop request
logfiles.BOM	A report listing tier-specific log files in which an error was detected
logfiles/	A directory containing the actual log files listed in logfiles.BOM Created only when the <code>-e</code> option is invoked from SAS_Ism
tarfile.YYYY-MM-DD-HH-MM.gz	A compressed TAR file of the <code>logfiles/</code> directory Created only when the <code>-e</code> option is invoked from SAS_Ism
logfiles.ANALYSIS	A report that contains information to be used when creating a track Created only when the <code>-e</code> option is invoked from SAS_Ism

Table 8. Report and Logging Artifacts

LOG COLLECTION AND ANALYSIS

In the event of a failure to successfully complete a start or stop action, SAS_Ism 3.0 creates a Bill Of Materials (BOM) file that identifies tier-specific logs of interest. Also, the utility creates a BOM file if a status action detects that a deployment that was previously started successfully has tier services that have failed to remain operational. You can review the generated BOM file to determine what prevented the successful completion of the start or stop action.

When a tier failure is detected, the SAS_Ism utility identifies all the tier-specific log files that have been modified in the last hour. The files are listed in the BOM file (logfiles.BOM) in the configuration file named directory in the `STATUSROOT` directory.

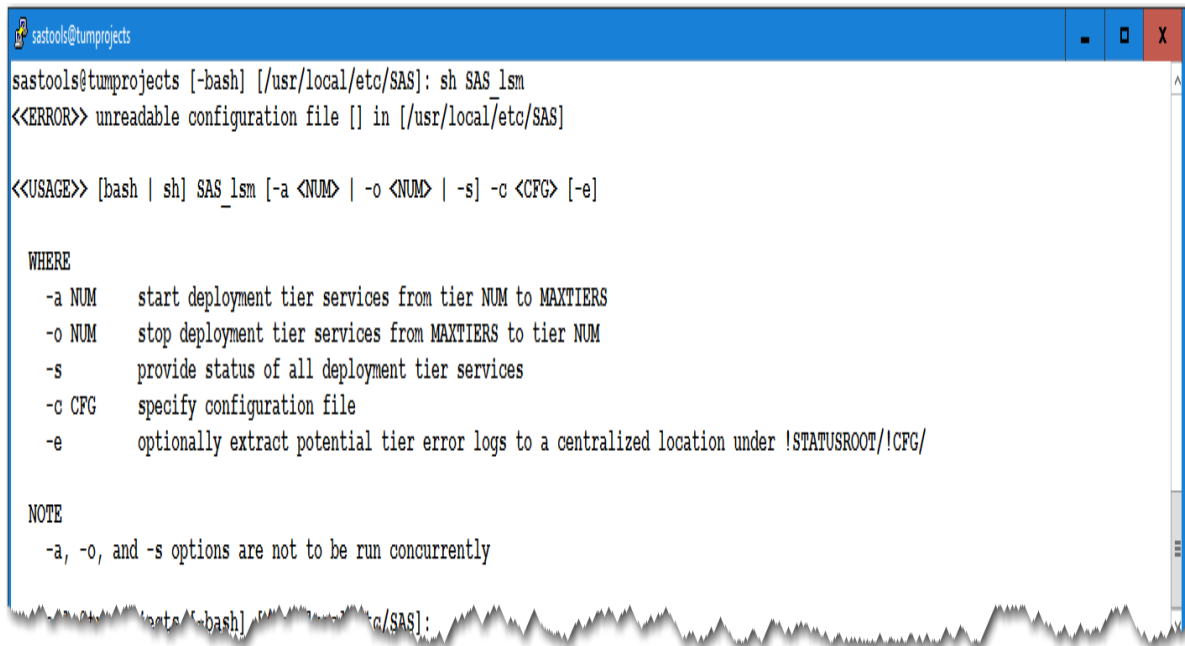
If you invoke SAS_Ism 3.0 with the `-e` option, the utility also extracts copies of the logs to the centralized location designated by the configuration file named directory in the `STATUSROOT` directory. Because SAS logs can be large, the utility trims the copy to reflect only the previous hours of activity as defined by the `TRIMOFFSET` variable. These logs are then analyzed for errors, and the user is presented with an ordered list of these errors. If the user has set the `SAS_LSM_BROWSER` value, they are presented with an option to select error messages to search for potential solutions at support.sas.com and communities.sas.com. Also, all log files are conveniently compressed into a TAR file that you can send to SAS Technical Support for review as needed. Information is then stored in an analysis file (logfiles.ANALYSIS) that you can use as input if opening a track.

GENERAL INVOCATION

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

To see the invocation options for SAS_Ism 3.0, follow this process:

1. Log on to the tumprojects tools deployment server with the sastools user ID.
2. Change your working directory to the tools-deployment directory (`/usr/local/etc/SAS`).
3. Run the `[bash | sh] SAS_ism` command to see the usage arguments as shown in Display 7:

A terminal window titled 'sastools@tumprojects' showing the output of the 'sh SAS_ism' command. The output includes an error message, usage instructions, and a list of options. The terminal window has a blue title bar and standard window controls (minimize, maximize, close) on the right side.

```
sastools@tumprojects [-bash] [/usr/local/etc/SAS]: sh SAS_ism
<<ERROR>> unreadable configuration file [] in [/usr/local/etc/SAS]

<<USAGE>> [bash | sh] SAS_ism [-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!/CFG/

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

sastools@tumprojects [-bash] [/usr/local/etc/SAS]:
```

Display 7. SAS_Ism 3.0 Usage Options

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

USE CASE: APPLYING TARGETED SERVICE TO A DEPLOYMENT

This use case demonstrates how to detect and recover from an issue with a deployment tier's services that should be operational and are not.

In step 1, we run a status check on a deployment that was previously operational by running the `bash SAS_ism -s -c JGB-94-dev-cfg -e` command. Display 8 shows example output:

```

sastools@tumprojects [-bash] [/usr/local/etc/SAS]: bash SAS_lsm -s -c JGB-94-dev-cfg -e

Note A { Configuration file validation [JGB-94-dev-cfg] status [begin]
         Configuration file validation [JGB-94-dev-cfg] status [end success]

Note B { Wed Jan 10 05:34:40 EST 2018: action [services_status] tier [4:Metadata cluster validation (MDCV)] host [metadata-1] status [begin]
         << EXECUTING >> ssh sasinst@metadata-1 /opt/sas94/dev/config/Levl/SASMeta/Metadataserver/Metadataserver.sh status 2>&1
         << EXECUTING >> ssh sasinst@metadata-2 /opt/sas94/dev/config/Levl/SASMeta/Metadataserver/Metadataserver.sh status 2>&1
         << EXECUTING >> ssh sasinst@metadata-3 /opt/sas94/dev/config/Levl/SASMeta/Metadataserver/Metadataserver.sh status 2>&1
         <<TIER STATUS>> ALL tier services are operational
                   cluster nodes started [metadata-1 metadata-3]
                   cluster nodes stopped [metadata-2]
                   cluster nodes paused [none]
                   cluster nodes unknown [none]
         Wed Jan 10 05:34:42 EST 2018: action [services_status] tier [4:Metadata cluster validation (MDCV)] host [metadata-1] status [end success]

Note C { Wed Jan 10 05:34:42 EST 2018: action [services_status] tier [5:Enterprise Miner Compute] host [sasapp-1] status [begin]
         << EXECUTING >> ssh sasinst@sasapp-1 /opt/sas94/dev/config/Levl/sas.servers status
         <<TIER STATUS>> ALL tier services are NOT fully operational
                   SAS OLAP Server 1 is UP
                   SAS Object Spawner 1 is NOT up
                   SAS DIP Job Runner 1 is UP
         Wed Jan 10 05:34:47 EST 2018: action [services_status] tier [5:Enterprise Miner Compute] host [sasapp-1] status [end success]

         ...

Note D { Wed Jan 10 05:34:52 EST 2018: action [centralize logfiles] status [begin]
         Wed Jan 10 05:35:07 EST 2018: action [centralize logfiles] status [end]

         Wed Jan 10 05:35:07 EST 2018: action [trim logfiles] status [begin]
         Wed Jan 10 05:35:08 EST 2018: action [trim logfiles] status [end success]

Note E { Please see /usr/local/etc/SAS/reports/JGB-94-dev-cfg/report.status for execution details
         /usr/local/etc/SAS/reports/JGB-94-dev-cfg/logfiles.BOM for a listing of logfiles
         /usr/local/etc/SAS/reports/JGB-94-dev-cfg/logfiles for the centralized logfiles

         If you would like to open a SAS problem report, see /usr/local/etc/SAS/reports/JGB-94-dev-cfg/logfiles.ANALYSIS for details

Note F { LOG ANALYSIS OF ERRORS AND WARNINGS for issue SAS_lsm [status] on host [sasapp-1]: SAS Object Spawner 1 is NOT up

         ITEM  OCCURENCES  TYPE  MESSAGE
           1         2    ERROR  - Unable to find APM ETL Processing resource
           2         2    ERROR  - APM configuration and discovery will not be run.
           3         1    ERROR  Metric Value not found Failed to invoke getProcState: Query did not match any processes: Pi

         Enter 4 to quit

         <<ACTION>> Please enter log analysis search item [1-4]

```

Display 8. Identify Failing Services and Analyze Logs for a Previously Operational Deployment

Display 8 Notes (For Status Action: `bash SAS_lsm -s -c JGB-94-dev-cfg -e`)

Note A: The user-specified configuration file (JGB-94-dev-cfg) was inspected to ensure that miscellaneous variables and tier definitions had been configured correctly. This is the first activity executed for every SAS_lsm action request.

Note B: This use case has a three-node metadata cluster (TIERTYPE MDCN) that requires special validation. The utility skipped status checking the individual MDCN nodes and used the fourth cluster validation tier (TIERTYPE MDCV) to determine if a quorum had been achieved. Although the MDCN node metadata-2 was stopped, a quorum had been achieved because two-thirds of the MDCN nodes were started (metadata-1 and metadata-3). The tier status reported that “ALL tier services are operational.”

Note C: When the status of the fifth tier (Enterprise Miner Compute) was validated, it detected that a service was not functional (“SAS Object Spawner 1 is NOT up”). Because of this issue, the tier status reported “All tier services are NOT fully operational.” Because an issue was detected, deployment-error processing was executed and artifacts were stored under the sastools owned STATUSROOT/CFGFILE directory (/usr/local/etc/SAS/reports/JFB-94-dev-cfg/) on the tumprojects server.

The utility searched for log files that had been accessed in the past hour on the failing fifth tier using the tier-specific TIERLOGD[5] directory (/opt/sas94/dev/config/Lev1) as the starting point. The information was then stored in the artifact logfiles.BOM file.

Note D: Because SAS_lsm was invoked with the `-e` option, the actual log files identified in the logfiles.BOM file were centralized under the artifact `logfiles/` directory. The process trimmed the log files to contain content only created as far back as the value specified by TRIMOFFSET (1 hour). A compressed TAR file artifact was then generated containing the centralized and trimmed log files (tarfile.YYYY-MM-DD-HH-MM.gz).

Note E: This section details the artifacts generated and stored in the sastools owned STATUSROOT/CFGFILE directory (/usr/local/etc/SAS/reports/JFB-94-dev-cfg/) on the tumprojects server:

- `report.status`: Report containing execution details of the status request
- `logfiles.BOM`: Report listing that tier 5 log files were updated in the past hour
- `-e` specific artifacts:
 - `logfiles/`: Directory containing the actual log files specified by the logfiles.BOM file trimmed to 1 hour of content
 - `tarfile.YYYY-MM-DD-HH-MM.gz`: Compressed TAR file of the `logfiles/` directory
 - `logfiles.ANALYSIS`: Report that contains information that you can use when creating a track

Note F: Because SAS_lsm was invoked with the `-e` option, the user was presented with an ordered listing of the errors detected in the `logfiles/` directory. Because the SAS_LSM_BROWSER variable was set to `firefox`, the user was allowed to make a selection that searched the internet (support.sas.com and communities.sas.com) for potential solutions.

The utility then sent an email to the SAS administrator (SASADMIN) indicating that the status check failed because it expected to report that the deployment tiers were operational.

In step 2, we stop the deployment down to and including the failing fifth tier by running the `bash SAS_lsm -o 5 -c JGB-94-dev-cfg -e` command. Display 9 shows example output:

```
sastools@tumprojects [-bash] [/usr/local/etc/SAS]: bash SAS_lsm -o 5 -c JGB-94-dev-cfg -e

Configuration file validation [JGB-94-dev-cfg] status [begin]
Configuration file validation [JGB-94-dev-cfg] status [end success]

Wed Jan 10 05:36:04 EST 2018: action [stop] tier [11:LASR monitor] host [sasapp-2] status [begin]
  << EXECUTING >> ssh sasdemo@sasapp-2 /opt/sas94/dev/config/Levl/Applications/SASVisualAnalytics/HighPerformanceConfiguration/LASRMonitor.sh stop
  << EXECUTING >> ssh sasdemo@sasapp-2 /opt/sas94/dev.config/Levl/Applications/SASVisualAnalytics/HighPerformanceConfiguration/LASRMonitor.sh status
  <<TIER STATUS>> ALL tier services have returned the proper status [SAS LASR Analytic Server Monitor is NOT up]
Wed Jan 10 05:36:10 EST 2018: action [stop] tier [11:LASR monitor] host [sasapp-2] status [end success]

...

Wed Jan 10 05:38:24 EST 2018: action [stop] tier [5:Enterprise Miner Compute] host [sasapp-1] status [begin]
  << EXECUTING >> ssh sasinst@sasapp-1 /opt/sas94/dev/config/Levl/sas.servers stop
  << EXECUTING >> ssh sasinst@sasapp-1 /opt/sas94/dev/config/Levl/sas.servers status
  <<TIER STATUS>> ALL tier services have returned the proper status [is NOT up]
Wed Jan 10 05:39:03 EST 2018: action [stop] tier [5:Enterprise Miner Compute] host [sasapp-1] status [end success]

Please see /usr/local/etc/SAS/reports/JGB-94-dev-cfg/report.stop for execution details

<<SUCCESS>> Deployment tier services are NOT operational from [11:LASR monitor] to tier [5:Enterprise Miner Compute]

sastools@tumprojects [-bash] [/usr/local/etc/SAS]:
```

Note A

Note B

Display 9. Successful Stop to Target Tier 5

Display 9 Notes (For Stop Action: `bash SAS_lsm -o 5 -c JGB-94-dev-cfg -e`)

Note A: Navigated through each tier of the SAS multi-tiered deployment using the reverse numerical tier definition order identified in the JGB-94-dev.cfg configuration file down to and including the target stop tier identified with the `-o` option. In this step, tiers 11 through 5 were stopped (leaving tiers 1 through 4 active) by following this process:

1. Execute a stop request by running the tier-specific stop command identified by TIERSTOP[N].
2. Execute a status request by running the tier-specific status command identified by TIERSTAS[N].
3. Analyze the results of the tier-specific status command and report the status of the tier.

In this step, each status request reported that "ALL tier services have returned the proper status." This message means that all tier services were stopped successfully. If there was an issue, a tier would report a status of "ALL tier services have NOT returned the proper status" and deployment-error processing would be executed.

Note B: Because all tiers down to and including the fifth tier were stopped successfully, the utility reported that "Deployment tier services are NOT operational from [11:LASR monitor] to tier [5:Enterprise Miner Compute]" and the artifact report.stop report was stored (`/usr/local/etc/SAS/reports/JGB-94-dev-cfg/`).

The utility sent an email to the SAS administrator (SASADMIN) indicating that these deployment tiers were successfully stopped.

In the final step, after the problem was resolved via the internet search or exemplary Technical Support assistance, we restarted the deployment starting at tier 5 by running the `bash SAS_lsm -a 5 -c JGB-94-dev-cfg -e` command. Display 10 shows example output:

```

sastools@tumprojects [-bash] [/usr/local/etc/SAS]: bash SAS_lsm -a 5 -c JGB-94-dev-cfg -e
Configuration file validation [JGB-94-dev-cfg] status [begin]
Configuration file validation [JGB-94-dev-cfg] status [end success]

Wed Jan 10 05:40:20 EST 2018: action [check dependencies tier started] tier [4:Metadata cluster validation (MDCV)] host [metadata-1] status [begin]
<< EXECUTING >> ssh sasinst@metadata-1 /opt/sas94/dev/config/Lev1/SASMeta/MetadataServer/MetadataServer.sh status 2>&1
<< EXECUTING >> ssh sasinst@metadata-2 /opt/sas94/dev/config/Lev1/SASMeta/MetadataServer/MetadataServer.sh status 2>&1
<< EXECUTING >> ssh sasinst@metadata-3 /opt/sas94/dev/config/Lev1/SASMeta/MetadataServer/MetadataServer.sh status 2>&1
<< TIER STATUS >> ALL tier services have returned the proper status [quorum achieved]
    cluster nodes started [metadata-1 lsm-dev-metadata-3]
    cluster nodes stopped [lsm-dev-metadata-2]
    cluster nodes paused [none]
    cluster nodes unknown [none]
Wed Jan 10 05:40:22 EST 2018: action [check dependencies tier started] tier [4:Metadata cluster validation (MDCV)] host [metadata-1] status [end success]

Wed Jan 10 05:40:22 EST 2018: action [check dependencies tier stopped] tier [6:Enterprise Miner Midtier] host [midtier-1] status [begin]
<< EXECUTING >> ssh sasinst@midtier-1 /opt/sas94/dev/config/Lev1/sas.servers status
<< TIER STATUS >> ALL tier services have returned the proper status [is NOT up]
Wed Jan 10 05:40:23 EST 2018: action [check dependencies tier stopped] tier [6:Enterprise Miner Midtier] host [midtier-1] status [end success]
...

Wed Jan 10 05:40:26 EST 2018: action [start] tier [5:Enterprise Miner Compute] host [sasapp-1] status [begin]
<< EXECUTING >> ssh sasinst@sasapp-1 /opt/sas94/dev/config/Lev1/sas.servers restart
<< EXECUTING >> ssh sasinst@sasapp-1 /opt/sas94/dev/config/Lev1/sas.servers status
<< TIER STATUS >> ALL tier services have returned the proper status [is UP]
Wed Jan 10 05:41:39 EST 2018: action [start] tier [5:Enterprise Miner Compute] host [sasapp-1] status [end success]
...

Please see /usr/local/etc/SAS/reports/JGB-94-dev-cfg/report.start for execution details

<< SUCCESS >> Deployment tier services are operational

```

Note A

Note B

Note C

Display 10. Successful Start from Target Tier 5

Display 10 Notes (For Start Action: `bash SAS_lsm -a 5 -c JGB-94-dev-cfg -e`)

Note A: Navigated through each tier of the SAS multi-tiered deployment using the numerical tier definition order identified by the JGB-94-dev.cfg configuration file. Each tier's status was checked to ensure that it reported the proper status relative to the target start tier identified with the `-a` option (tier 5 in this use case) by following this process:

1. Execute a status request by running the tier-specific status command identified by TIERSTAS[N].
2. Analyze the results of the tier-specific status command and report the status of the tier.

In this step, each status request reported that "ALL tier services have returned the proper status." This means that all tier services lower than the target tier 5 were UP, and all tier services higher than the target tier 5 were NOT UP. If there was an issue, a tier would have reported a status of "ALL tier services have NOT returned the proper status." Then, the request would be terminated, reporting that the deployment tier services dependency check failed.

Note B: Navigated through each tier of the SAS multi-tiered deployment in numerical tier definition order identified by the JGB-94-dev.cfg configuration file, starting at the tier identified by the `-a` option. In this step, tiers 5 through 11 were started following this process:

1. Execute a start request by running the tier-specific start command identified by TIERSTAR[N].
2. Execute a status request by running the tier-specific status command identified by TIERSTAS[N].
3. Analyze the results of the tier-specific status command and report the status of the tier.

In this step, each status request reported that "ALL tier services have returned the proper status." This message means that all tier services were started successfully. If there was an issue, a tier would report a status of "ALL tier services have NOT returned the proper status" and deployment-error processing would be executed.

Note C: Because all tiers were started successfully, the utility reported that "Deployment tier services are operational" and the artifact report.start report was stored (`/usr/local/etc/SAS/reports/JGB-94-dev.cfg/`).

The utility sent an email to the SAS administrator (SASADMIN) indicating that these deployment tiers were successfully started.

CONCLUSION

In 2016, SAS Technical Support created the SAS_ism utility, which gave SAS customers automated management of their UNIX or Linux multi-tiered deployment services. The only requirements for attaining this hands-free management are the following:

- Install the Bash and/or the Bourne shell on your Red Hat, AIX, and/or HP-UX operating system
- Configure password-less SSH
- (Optional) Enable XCMD
- Install and configure the SAS_ism utility

To make the utility more useful, the SAS_ism configuration file is extendable and flexible. Therefore, you can add tier stanzas and update the MAXTIERS value to accommodate the requirements of your system.

In 2017, SAS made further enhancements to the utility and released SAS_ism 3.0, which this paper has described. With the implementation of expansive tier configuration templates, you can now manage any command-line driven service such as the following:

- metadata horizontal clustering services
- massively parallel processing SAS® LASR™ services
- user-defined services

In addition, the process for tier service error log collection, analysis, and potential fix suggestions is now automated. You can use this self-help process to try to address an issue before opening a track with SAS Technical Support. If a Technical Support track is required, the creation process has been simplified because the utility collects the basic information and log files that are critical to start the debug and analysis process for your issue.

Finally, SAS made the utility a script so that you can easily incorporate it into your operating-system reboot procedures. With SAS_lsm 3.0, the days of time-consuming, error-prone manual management and/or error log analysis of your multi-tiered SAS deployments are behind you. Now, you can rely on the utility to provide you with automated management!

REFERENCES

SAS Institute Inc. 2017. "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.

Meyers, Cliff. 2017. "An Oasis of Serenity in a Sea of Chaos: Automating the Management of Your UNIX/Linux Multi-tiered SAS® Services." *Proceedings of the SAS Global 2017 Conference*. Cary, NC: SAS Institute Inc. Available at support.sas.com/resources/papers/proceedings17/SAS0339-2017.pdf.

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