

Key Requirements for SAS® Grid Users

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ABSTRACT

Considering the fact that SAS® Grid Manager is becoming more and more popular, it is important to fulfill the user's need for a successful migration to a SAS® Grid environment. This paper focuses on key requirements and common issues for new SAS Grid users, especially if they are coming from a traditional environment. This paper describes a few common requirements like the need for a current working directory, the change of file system navigation in SAS Enterprise Guide® with user-given location, getting job execution summary email, and so on. The GRIDWORK directory has been introduced in SAS Grid Manager, which is a bit different from the traditional SAS WORK location. This paper explains how you can use the GRIDWORK location in a more user-friendly way. Sometimes users experience data set size differences during grid migration. A few important reasons for data set size difference are demonstrated. We also demonstrate how to create new custom scripts as per business needs and how to incorporate them with SAS Grid Manager Platform.

INTRODUCTION

SAS Grid is becoming more and more popular over the traditional departmental SAS servers. SAS Grid provides many benefits including organizations to optimally utilize the available resources. But until it does not fulfill the users/ business need and requirement, it would be difficult to adopt SAS Grid. Sometimes it becomes difficult for the users who are coming from PC SAS or standalone SAS servers to adopt Grid easily. It might happen due to many reasons like change in way of execution, change in functionality, access restriction etc.

This paper explains the key challenges/ requirements for new Grid users and explains how Grid can be modified to meet user needs. To meet these requirements we might need to write some scripts, change the SAS installer scripts or configurations. This paper enlightens an operational level approach to provide these functionalities. These requirements have been classified in three categories as given below:

SAS Grid:

- Current Working Directory with SAS Grid Execution
- Grid Working Directory Permission Change
- Change File Navigation in SAS Enterprise Guide

SAS Enterprise Guide:

- Schedule SAS Jobs through SASGSUB
- Execute LSF commands through SAS Enterprise Guide
- WORK vs RMTWORK in SAS Enterprise Guide with SAS Grid

Platform LSF:

- Default Email Behavior of LSF
- Multiple Domain User Authorization

Note – Though the overall SAS Grid concept doesn't change much with operating system but approach described in this paper is based on SAS Grid installed on Linux operating system.

REQUIREMENTS/ CHALLENGES

1. CURRENT WORKING DIRECTORY (CWD) WITH SAS GRID EXECUTION

There are multiple ways to launch SAS or to execute the SAS code. Generally in Linux-SAS server, users get a soft link to call SAS executable. In this case, the default Present Working Directory, chosen by SAS is known as Current Working Directory (CWD). In non-Grid SAS environment CWD refers to the location, from where SAS gets launched. It means if user is reading or writing a file in SAS code without full qualified location then SAS will try to read/ write that file at the location from where SAS was called.

```
1? x 'pwd';
```

NOTE: Current working directory is '/delta/zxa9529/staging/testcwd'.

```
2? x 'ls -lrt';
total 0
3? data _null_; set sashelp.air; file 'writecwd.txt'; put date; run;
```

NOTE: The file 'writecwd.txt' is:
Filename=/delta/zxa9529/staging/testcwd/writecwd.txt,
Owner Name=zxa9529,Group Name=sashare,
Access Permission=rw-r--r--,
Last Modified=Sat Jan 9 10:28:08 2016

NOTE: 144 records were written to the file 'writecwd.txt'.
The minimum record length was 5.
The maximum record length was 5.

NOTE: There were 144 observations read from the data set SASHELP.AIR.

NOTE: DATA statement used (Total process time):
real time 0.01 seconds
cpu time 0.01 seconds

```
4? x 'ls -lrt';
total 8
-rw-r--r-- 1 zxa9529 sashare 864 Jan 9 10:28 writecwd.txt
5?
```

As shown in the example-1 log, the current working directory is at the same location from where SAS was launched.

```
[zxa9529@gridclient ~/staging]$ pwd
/delta/zxa9529/staging
[zxa9529@gridclient ~/staging]$
/sasbase/sasgsubclient/sasconfig/Levl/Applications/SASGridManagerClientUtilit
y/9.4/sasgsub -GRIDRUNSASLM
```

```
SAS Grid Submit Utility Version 9.40 (build date: Dec 4 2013)
Copyright (C) 2009-2013, SAS Institute Inc., Cary, NC, USA. All Rights
Reserved
Job <112492> is submitted to queue <normal>.
Job ID: 112492
Waiting for grid job to connect...
```

```

. . . . .
. . . . .
1? x 'pwd';

```

NOTE: Current working directory is
 '/sasbase/controlserver/sasconfig/Lev1/SASApp'.

```
2? data _null_; set sashelp.air; file 'writecwd.txt'; put date; run;
```

ERROR: Insufficient authorization to access
 /sasbase/controlserver/sasconfig/Lev1/SASApp/writecwd.txt.

NOTE: The SAS System stopped processing this step because of errors.

NOTE: DATA statement used (Total process time):

```

real time          0.00 seconds
cpu time           0.00 seconds

```

```
3?
```

In example-2 log, the current working directory is the SASApp home location. PWD is not the location where sasgsub was called from.

As it shown in example 2, if users try to read or write the file at the location from where they call sasgsub, then SAS program will end up with an error message that users don't have access to write the SASApp home location. In non-Grid SAS environment users don't face this problem since by default SAS goes to the same location where SAS is invoked.

CWD location is set by the script "sasgrid". This script is located at /sasbase/controlserver/sasconfig/Lev1/SASApp/GridServer. This file contains the section for "If we are starting SAS interactively in line mode,". This section of script contains the command to launch SAS from the SASApp home location. When this script is called by SAS it always refer to SASApp home irrespective of user location to invoke SAS Grid. To change the default location to user location, "sasgrid" script needs to be edited to add "cd \$OLDPWD &&" before calling the SAS, as shown in below screen print.

```

# /-----
# |
# | If we are starting SAS interactively in line mode,
# |
# \-----
# \*****
if [ "${RUNMODE}" = "LINEMODE" ]
then
    echo "SASGRID: Running Line mode" >> ${debugfile}

# /-----
# | Run SAS under the STDIO redirector
# \-----
# \*****
echo "SASGRID: SAS Line Mode Command= ${BASESASDIR}/utilities/bin/redirectIO -host ${SASDAEMONHOST} -port ${SASDAEMONPORT} ${SASREDIRSASOPTS} -cmd ${SASEXEFILE} -nodms ${SASLMOPTS} ${SASUSERARGS}" >> ${debugfile}
eval "cd $OLDPWD && ${BASESASDIR}/utilities/bin/redirectIO -host ${SASDAEMONHOST} -port ${SASDAEMONPORT} ${SASREDIRSASOPTS} -cmd ${SASEXEFILE} -nodms ${SASLMOPTS} ${SASUSERARGS}" >> ${debugfile} 2>&1
SASRC=$?
echo "SASGRID: SAS Line Mode RC=${SASRC}" >> ${debugfile}
fi

```

In below example3, sasgrid script was edited for "SASApp" application server context. When SASGSUB is called for SASApp, it refers the user's current location as CWD.

```
1? x 'pwd';
```

NOTE: Current working directory is '/delta/zxa9529/staging/testcwd'.

```

2? x 'ls -lrt';
total 8
-rw-r--r-- 1 zxa9529 sashare 864 Jan  9 10:28 writecwd.txt
3?
4? data _null_; set sashelp.air; file 'writecwdlm.txt'; put date; run;

```

NOTE: The file 'writecwdlm.txt' is:
 Filename=/delta/zxa9529/staging/testcwd/writecwdlm.txt,
 Owner Name=zxa9529, Group Name=sashare,
 Access Permission=-rw-r--r--,
 Last Modified=09Jan2016:18:04:59

NOTE: 144 records were written to the file 'writecwdlm.txt'.
 The minimum record length was 5.
 The maximum record length was 5.

NOTE: There were 144 observations read from the data set SASHELP.AIR.

NOTE: DATA statement used (Total process time):
 real time 0.03 seconds
 cpu time 0.00 seconds

```

5? x 'ls -lrt';
total 16
-rw-r--r-- 1 zxa9529 sashare 864 Jan  9 10:28 writecwd.txt
-rw-r--r-- 1 zxa9529 sashare 864 Jan  9 18:04 writecwdlm.txt
6?

```

In the same way it can be changed for batch job and SAS Display Manager.

```

# -----
# Run SAS pointing to the program in the GRIDWORKDIR and
# logging and listing files into GRIDWORKDIR
# -----
echo "SASGRID: SAS Batch Command=${SASREDIRCMD} ${SASEXEFIL} ${SASLOGCFGFILE} -noterminal ${SASWRK} -sasuser work ${SASCHKPTOPTS} -sysin ${SASPGM} ${SASLOG} ${SASLST}
${SETGRIDWORK} ${SASUSERARGS}" >> ${debugfile}
eval "cd $OLDPWD && ${SASREDIRCMD} ${SASEXEFIL} ${SASLOGCFGFILE} -noterminal ${SASWRK} -sasuser work ${SASCHKPTOPTS} -sysin ${SASPGM} ${SASLOG} ${SASLST} ${SETGRIDWOR
K} ${SASUSERARGS}" >> ${debugfile} 2>&1
SASRC=$?

```

```

# -----
# If we are starting SAS interactively in DMS mode,
# -----
if [ "${RUNMODE}" = "DMSMODE" ]
then
echo "SASGRID: Running DMS mode" >> ${debugfile}

# -----
# Run SAS in DMS mode after setting up the X Windows
# display environment variable. We run it redirecting the
# STDOUT/STDERR only so that the client can see if some
# setting is wrong for DMS session
# -----
DISPLAY=${SASDMSDISPLAY}
export DISPLAY

echo "SASGRID: SAS DMS Mode DISPLAY= ${DISPLAY}" >> ${debugfile}
echo "SASGRID: SAS DMS Mode Command= ${BASESASDIR}/utilities/bin/redisStdIO -host ${SASDAEMONHOST} -port ${SASDAEMONPORT} -outonly ${SASREDIRASOPTS} -cmd ${SASEXEFIL}
${SASDMSOPTS} ${SASUSERARGS}" >> ${debugfile}
eval "cd $OLDPWD && ${BASESASDIR}/utilities/bin/redisStdIO -host ${SASDAEMONHOST} -port ${SASDAEMONPORT} -outonly ${SASREDIRASOPTS} -cmd ${SASEXEFIL} ${SASDMSOPTS} ${S
ASUSERARGS}" >> ${debugfile} 2>&1
SASRC=$?

```

CWD can be verified for interactive SAS by invoking SAS Grid in DMS mode like below:

```

gridpmgr01$
/sasbase/sasgsubclient/sasconfig/Lev1/Applications/SASGridManagerClientUtilit
y/9.4/sasgsub -GRIDAPPSERVER SASApp -GRIDRUNSASDMS $DISPLAY

```

2. CHANGE PERMISSION OF GRID WORKING DIRECTORY

As we saw in 1st section Current Working Directory, the default working directory is set to SASApp home directory. End users do not get permission to write to SASApp home location. There are two work directories in SAS Grid environment; WORK and GRIDWORK. WORK location works in same way as SAS WORK with SAS Foundation but, a new work directory is introduced in SAS Grid as GRIDWORK. It contains the log, list and other files other than temporary SAS files.

For each user, SAS creates a sub directory inside the GRID WORK location, named as per user's system id. When user executes any SAS program, it creates a sub directory in user's system directory located in GRID WORK. The naming convention of job's gridwork can be found in */sasbase/controlserver/sasconfig/Lev1/SASApp/GridServer/sasgrid* script. For user zxa9529 there is a gridwork subdirectory in */work/gridwork*. It's like below:

```
drwxr-xr-x  2 zxa9529 sas          512 Aug 17 16:22 zxa9529
```

As shown above, zxa9529 directory has permission as 755. Sometimes this "world read" permission creates security problems for some business units. It may require not having world read permission for the user's grid work directory. There are multiple ways to change this directory permission. The script *sasgrid* in *SASAppHome/GridServer* can be edited to change the directory permission. But it's not advisable to make frequent change in *sasgrid* script all time. It's good if this can be left untouched and *sasgsub* can handle user/ business growing requirement. This way it would be easy for Grid administrator to fulfill organization need without impacting other business units.

To make the user's Grid work directory as 700 (so that other user can't see other's work), *sasgsub* script can be modified. *UMASK* can be added in the *sasgsub* script to change the user's GRIDWORK directory permission. For example if user's want 700 permission to their grid work directory the *umask 077* can be added in *sasgsub* script.

```
[zxa9529@gridclient 9.4]$ pwd
/sasbase/sasgsubclient/sasconfig/Lev1/Applications/SASGridManagerClientUtility/9.4
[zxa9529@gridclient 9.4]$ more sasgsub700
#!/bin/sh -p
#*          SASGSUB Execution Script          */
umask 077
```

After making the above *umask* change in *sasgsub* utility it will create user's gridwork directory like below in */work/gridwork*:

```
drwx----- 28 zxa9529 sashare 32768 Jan  6 21:47 zxa9529
```

Now only respective user can see their GRIDWORK directory.

As discussed above, in SAS Grid environment it creates a new directory for GRIDWORK for each execution, so SAS Administrator needs to make sure that GRIDWORK is getting cleaned properly. Otherwise it will fill the GRIDWORK directory. It depends on the business need and requirement that for how long user need their log, list etc from GRIDWORK. Since Gridwork also copy the sas code executed so this concept also helps user to make sure that what code was ran for that particular execution. That may be helpful for versioning perspective.

3. SCHEDULE SAS JOBS THROUGH SASGSUB

The three main clients which are being discussed in this paper are SAS Enterprise Guide, SASGSUB and SAS Display Manager. Out of these clients, SAS Enterprise Guide is the only client which has direct scheduling capability but it schedules the SAS job at client side. This means, if it gets disconnected from network before scheduled time then job will not be sent to SAS Grid. SAS Display Manager does not have even basic functionality of scheduling. SAS Display Manager uses `rsubmit` to run SAS code, so it works very similar to batch processing.

In this section, authors are discussing SASGSUB utility (in Linux environment) for job scheduling purpose. SASGSUB can be used for asynchronous execution. There is no such any option available with SASGSUB which can be to schedule the SAS job. To use SASGSUB as scheduler, it can be used with "at" linux utility. "at" will trigger SASGSUB at specified time, like below::

```
/sasbase/sasgsubclient/sasconfig/Levl/Applications/SASGridManagerClientUtility/9.4/sasgsub -GRIDSUBMITPGM test1.sas | at 9:56PM
```

If job needs to be scheduled on specific SAS appserver then:

```
/sasbase/sasgsubclient/sasconfig/Levl/Applications/SASGridManagerClientUtility/9.4/sasgsub -GRIDSUBMITPGM test1.sas -GRIDAPPSERVER SASApp | at now
```

If any other thin client is being used to schedule the SAS jobs on Grid then one needs to make sure that LSF profile is sourced properly before calling SASGSUB. A UNIX script can be created to prompt the time for user input. It depends on the thin client's flexibility that how friendly SASGSUB can be used. For example if client is trying to call SASGSUB from bash shell then, bash-LSF profile needs to be called first and then SASGSUB utility can be called to run SAS job. Wrapper script can also be created as below to call instead of SASGSUB which handles the user input for scheduling the SAS Job.

```
#!/bin/sh
dateformat=`date +%I %P %m/%d/%Y`
echo -n "Enter SAS program needs to be executed with absolute path : "
read sasfile
if [ -f "$sasfile" ];
then
echo ""
echo -n "Enter time to schedule the job in format 'Time am/pm mm/dd/yyyy'
(Example $dateformat) : "
read scheduletime
echo
"/sasbase/sasgsubclient/sasconfig/Levl/Applications/SASGridManagerClientUtility/9.2/sasgsub -GRIDSUBMITPGM $sasfile" | at $scheduletime
echo ""
else
echo ""
echo "*** Specified SAS code does not exist. Please check the file."
echo ""
echo ""
fi
```

Now this script can be called instead of SASGSUB utility. As per below sample it will prompt for sas code and time to schedule.

```
[zxa9529@gridclient scheduler]$ ./scheduler
Enter SAS program needs to be executed with absolute path : warning.sas

Enter time to schedule the job in format 'Time am/pm mm/dd/yyyy' (Example
10 pm 01/09/2016) :10:27 pm 01/09/2016
job 102 at 2016-01-09 22:27

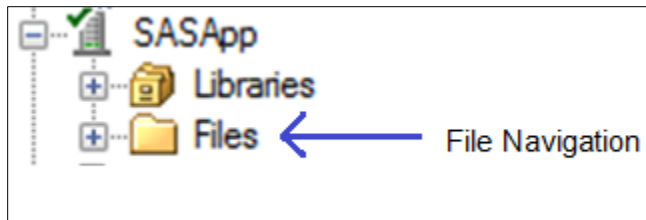
[zxa9529@gridclient scheduler]$
```

Output 1. Call LSF-Macro in SAS Enterprise Guide

4. CHANGE FILE NAVIGATION IN SAS ENTERPRISE GUIDE

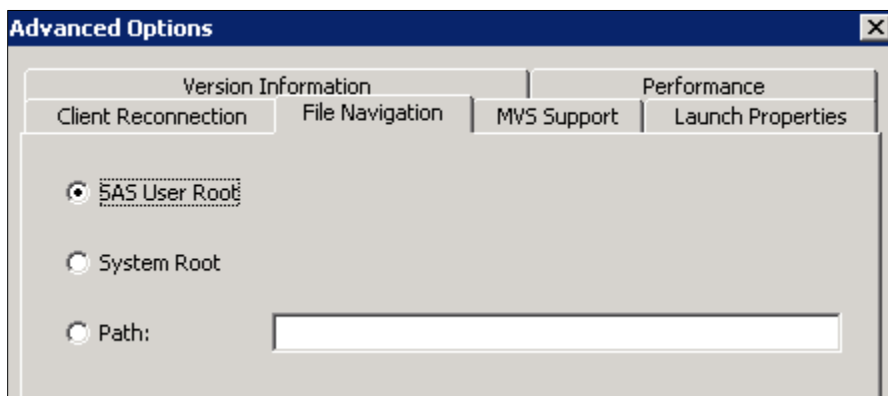
SAS Enterprise Guide creates two default links “Libraries” and “Files” for users. “Libraries” is group of SAS libraries. When user launches SAS Enterprise Guide, libraries get assigned automatically by SAS. If user will assign any new library by libname statement, it will be added here and when user refresh “Libraries” it will display new libraries in the tree. “Files” (as shown in the below screen print) is the link where users get the default location to save the files (SAS code, project etc...) on disk storage.

Sometimes business users want to have their own default location for users to start with. In this case users would like to see their own storage, attached with “Files” link in SAS Enterprise Guide tree.



Display 1. SAS Enterprise Guide Tree for SASApp

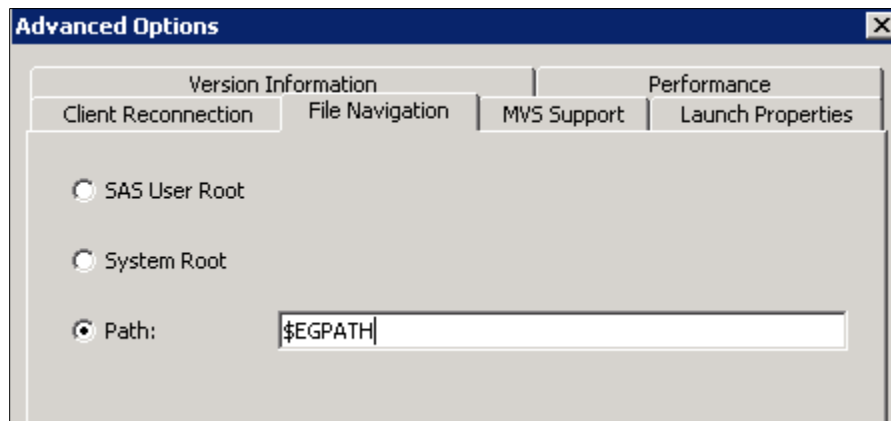
Files setting can be viewed in SAS Management Console by *SAS Management Console -> Server Manager -> SASApp Server -> SASApp – Logical Workspace Server -> SASApp –Workspace -> Right Click and Select Properties -> Click on “Options” tab -> Click on “Advanced Options...” -> Click on “File Navigation” tab* (as shown in below screen print). There are three default locations for SAS Enterprise Guide. As shown in display 2, the file location navigates to user’s home/ root location.



Display 2. Default File Navigation Tab in SAS Management Console

To allow the user to change this default location automatically, there should be a way to dynamically assign the location to “Files” when EG gets launched by user. SAS Enterprise Guide works with SAS Workspace Server to establish the connection with SAS Grid. Ultimately SAS Workspace Server calls *workspace_usermods.sh* script to read the configuration options (other than default). This file can be used to give additional option to override the default value for “Files” location.

To make it dynamically assigned by user the “Path” option should be selected under “File Navigation”. After selecting “Path”, any macro (which can be used to assign a location dynamically) or a specific location other than SAS User Root and System Root can be given in Path value. Macro can be assigned as per user input and can assign the user given value to workspace server. Below diagram shows how it works for end users.



Display 3. File Navigation Tab in SAS Management Console

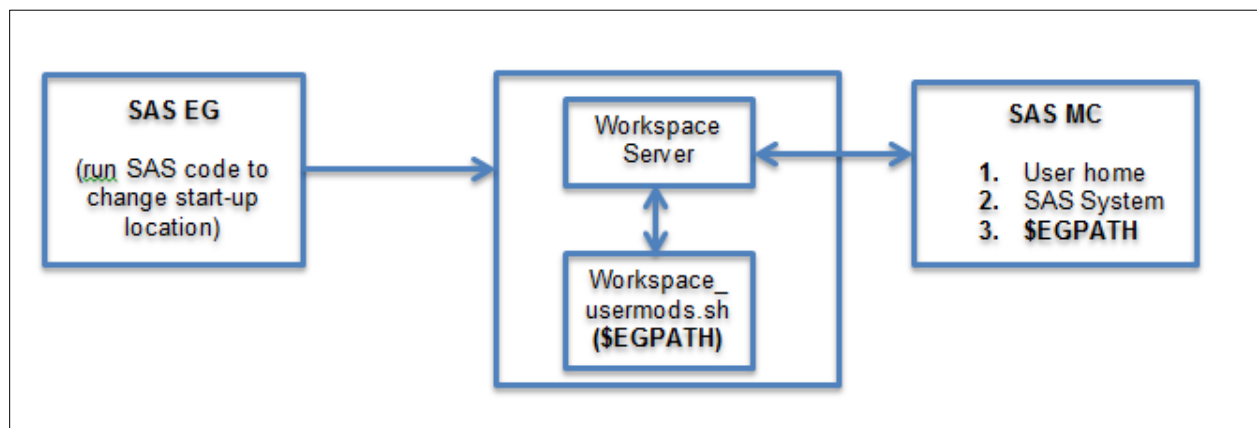


Figure 1. Design Flow of Dynamic File Allocation

/SASApp_HOME/WorkspaceServer/WorkspaceServer_usermods.sh script can be changed like below to accept user provided location.

```

USERMODS_OPTIONS=
export
$HOME/egl.sh
EGPATH=$(cat $OPTSA/eglf.txt)
export EGPAT

```


Content of egl.sh script:

```
dir=$(cat $HOME/egli.txt)
if [ -d "$dir" ]; then
echo $dir > $OPTSA/eglf.txt
else
echo "Please enter valid location." | mail -s "Invalid Location for FSN !"
$USER@org.com
fi
```

egli.txt is the file which can be changed by users to enter the desired location for SAS EG to start with as "Files". egli.txt file contain `"/delta/zxa9529/staging/"`

Note – After making the changes in SAS Management Console, SAS Workspace Server needs to be refreshed to make the new change effective. Above script just gives an approach to make it dynamic. Shell scripts can be changed or can be written in different way too to achieve the dynamic value for file.

5. EXECUTE LSF COMMANDS THROUGH SAS ENTERPRISE GUIDE

How SAS Enterprise Guide user can run the LSF command from Enterprise Guide? Sometimes it is not productive for users to run SAS code from SAS Enterprise Guide and then check the job status through Linux command line. Running LSF commands in SAS Enterprise Guide session help users to save time and it becomes more helpful if users are not friendly with Linux operating system. Since LSF commands produce the command line output, so it requires some wrapper code to execute these LSF commands, read and display the output in Enterprise Guide window.

In the example given below, SAS code can be executed from SAS Enterprise Guide which shows the result of "lsid" LSF command. As it shown below, profile needs to be sourced before calling `lsid` LSF command. Since user's had C-SHELL, so in this case C shell LSF profile is called below before running `lsid` command.

Actual `lsid` commands produce the following output from command line execution:

```
[zxa9529@gridclient ~]$ lsid
Platform LSF 8.0.1, May 29 2012
Copyright 1992-2011 Platform Computing Corporation

My cluster name is SAS_GridCluster1
My master name is gridmaster1.am.orgnm.com
Cluster in ISV mode : SAS
[zxa9529@gridclient ~]$
```

Output 2. lsid command output

Now we "*lsid*" can be called in SAS code, as shown below:

```

filename bhosts pipe "source /sas/platformcomputing/lsf/conf/cshrc.lsf;
lsid";
data lsf_info ;
    infile lsid truncover;
    input SchedulerInfo $80. ;
    run;

title "lsid Information";
proc print data=lsf_info ;
run;
title;

```

Above SAS code for “lsid” command produce the following result:

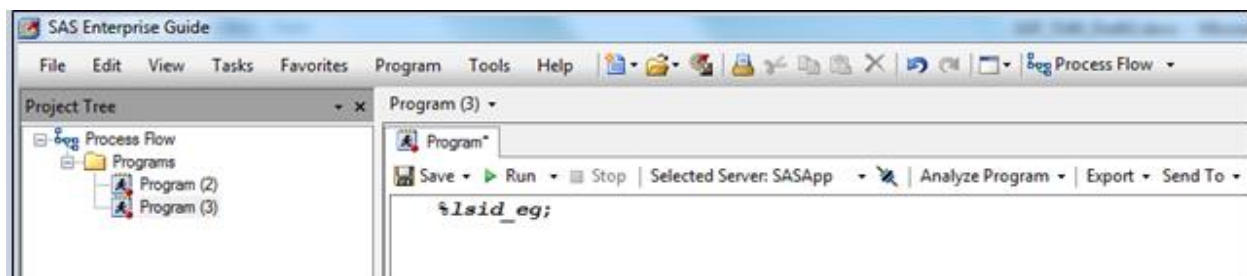
lsid Information	
Obs	SchedulerInfo
1	Platform LSF 8.0.1, May 29 2012
2	Copyright 1992-2011 Platform Computing Corporation
3	
4	My cluster name is SAS_GridCluster
5	My master name is gridmaster1.am.orgnm.com
6	Cluster in ISV mode : SAS

Page Break

Output 3. lsid command output in SAS Enterprise Guide

But it would be difficult for each user to write the SAS codes for each LSF command. For better environment management it would be better if set of SAS codes can be created for each user LSF commands, so that there is no need for users to write their own SAS codes for respective LSF commands. To make it more user friendly, these codes can be placed in common location as macro and can be called in SAS Enterprise Guide session. This will help user to just call a macro like any other default SAS macro instead of running the entire SAS code in Enterprise Guide session.

SAS code for LSF command can be placed in `/SASAppHome/SASEnvironment/SASMacro` to make it available for all users. For example the above sas code for bhosts is saved as `bhosts_eg.sas` in `/SASAppHome/SASEnvironment/SASMacro` directory then it can be called in SAS Enterprise Guide session as below:



Display 4. Call LSF-Macro in SAS Enterprise Guide

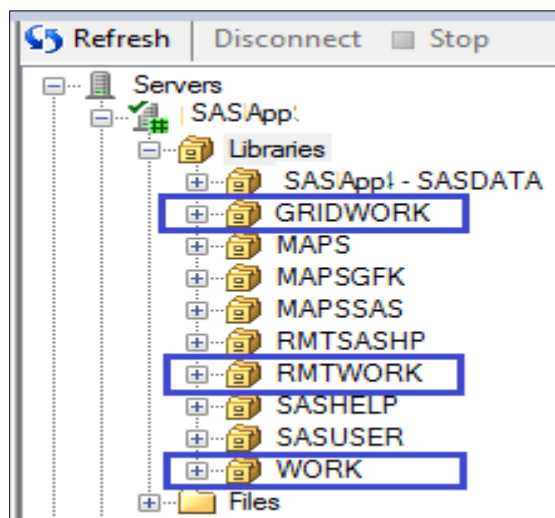
6. WORK VS RMTWORK IN SAS ENTERPRISE GUIDE WITH SAS GRID

In SAS Grid, there are two work directories displayed in SAS Enterprise Guide (Display 5), when load balancing is done without “*launch servers via grid*”. This confuses the SAS users as generally they are very familiar with traditional WORK library but not with RMTWORK.

RMTWORK is the library where user's temporary files get created. During connecting SAS Enterprise Guide with SAS Workspace Server, once user gets authenticated with SAS Metadata Server, user gets connected with SAS Grid through remote sign-on (1st connection). During this connection SAS establish the WORK location for SAS execution.

But after establishing the connection (1st connection); when user submits the job, it goes through load balanced mechanism and chooses the least busy server (2nd connection) for user's job execution. This 2nd connection finds the server which gets connected to the user directly and all subsequent jobs get executed on this server.

Since during 1st connection SAS has already created a temp folder as WORK, SAS needs a different temp location during 2nd connection for SAS execution purpose. For code execution, SAS gives new name as RMTWORK (since WORK library assigned during first connection) on this server which contain the user's SAS job related temporary data sets.



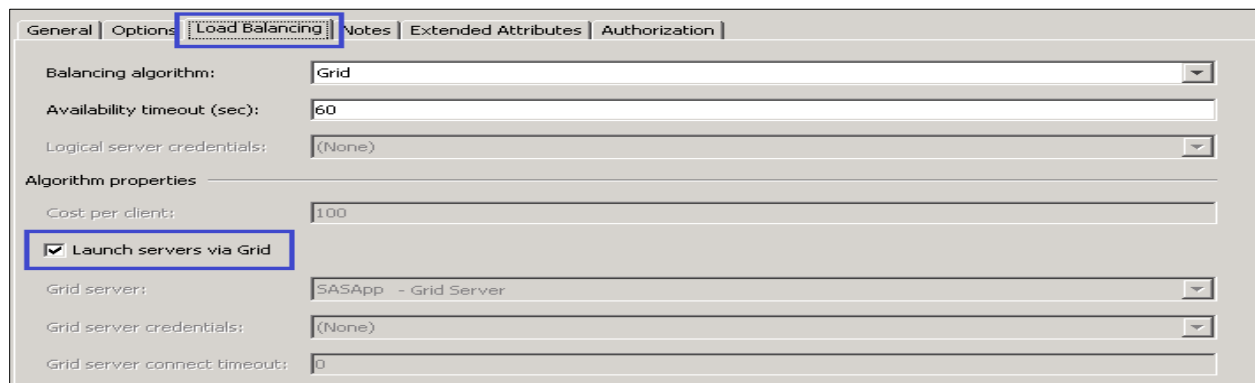
Display 5. SAS Enterprise Guide Tree with Non - Grid Launched Workspace Server

SAS Grid introduces a new workspace server called as “grid launched”. Grid-Launched workspace server is introduced with SAS9.4. Once work spaces server is converted to grid-launched, RMTWORK library disappears (Display 6). Since the work space server is now launched by grid itself, so everything (execution and SAS temporary files) is available on the same server where first connection got established. With Grid-Launched work space server, the libraries in SAS Enterprise Guide become much simpler than non-grid launched. Now there is only one WORK library and user can navigate this to see temporary files rather than getting confuse between WORK and RMTWORK.



Display 6. SAS Enterprise Guide Tree with Grid Launched Workspace Server

As per Display 7, SAS Application Server can be converted by changing the logical workspace server to “Launch servers via Grid”. SAS Management Console -> Server Manager -> SASApp Server -> SASApp – Logical Workspace Server -> Right Click and Select Properties -> Click on “Load Balancing”



Display 7. Logical Workspace Server Properties from SAS Management Console

7. DEFAULT EMAIL BEHAVIOR OF LSF

SAS Grid environment works with LSF to execute the SAS jobs. LSF send the email for job information to user's operating system (OS) email account. But very few users check there operating system email account. This operating system email can be forwarded to user's mail box by placing “.forward” (hidden file) in user's home directory. This file contains the user's email account, used for official activity (if other than OS email account like outlook). These Grid-LSF emails will be forwarded to the address mentioned in .forward file. Generally LSF is configured to send this email by default (without user intervention).

Sometimes user does not want to get the email for each job submitted to SAS Grid. User executes many SAS codes before production migration and if they receive email for each execution, their email box may be full with so many job submission emails. Which ultimately create the requirement that user wants email when they need. User needs some conditional input which asks users if they need email confirmation when SAS job finish. To fulfill this requirement, we need to figure out the variable which cause this email generation.

LSB_JOB_REPORT_MAIL is the environment variable which controls the LSF behavior, whether LSF will send job information to user or not. Now we can set this variable to yes or no based on whether we need the LSF email or not. LSB_JOB_REPORT_MAIL variable can be set in sasgsub script before invoking SAS

for execution. As per below example SASGSUB can be modify to provide user input for LSB_JOB_REPORT_MAIL, during SASGSUB execution. Below given piece of code can be added to sasgsub script to prompt for user input:

```
echo -n "Is email required (y/n)? "
read answer
if echo "$answer" | grep -iq "^y" ;then
    LSB_JOB_REPORT_MAIL=Y
    export LSB_JOB_REPORT_MAIL
else
    LSB_JOB_REPORT_MAIL=N
    export LSB_JOB_REPORT_MAIL
fi
```

This way, each time SASGSUB will prompt for user to provide the input for selecting yes/no, whether they want LSF generated email. In other way, if user does not want to get this email at all, then LSB_JOB_REPORT_MAIL can be set to "N" which prevents users to receive the LSF email.

Users can create their own version of SASGSUB script with desired option of LSB_JOB_REPORT_MAIL to control the Grid-LSF email behavior.

```
[zxa9529@gridclient 9.4]$ pwd
/sasbase/sasgsubclient/sasconfig/Levl/Applications/SASGridManagerClientUtilit
y/9.4
```

```
[zxa9529@gridclient 9.4]$ ./gsubemail -GRIDSUBMITPGM
/home/zxa9529/staging/warning.sas
Is email required (y/n)? n
. . .
. . .
```

Output 4. SASGSUB Utility with Email Prompt

Above SASGSUB execution user gave the value "n" to prompt, so in this case Grid will execute the SAS code but will prevent the LSF email. Another advantage of having this kind of customize SASGSUB script is, user will have good control of default LSF behavior. User can set other LSF environment variable too to get desired working functionality.

8. MULTIPLE DOMAIN USER AUTHORIZATION

SAS Management Console is the key admin tool to add the users in SAS Metadata Server. Until users are not added to SAS Metadata, users are not allowed to run their SAS jobs. In SAS grid, LSF needs to be aware of user domain for which it allows to use SAS Grid.

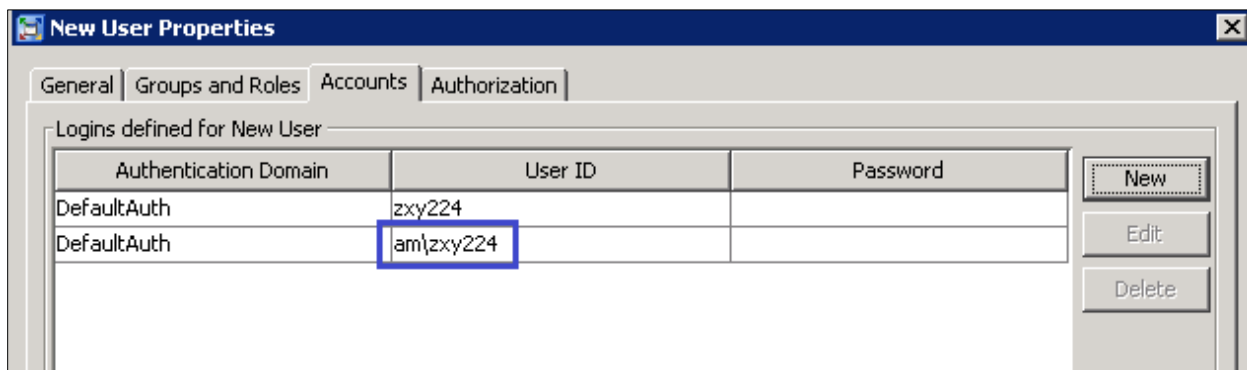
Variable, LSF_USER_DOMAIN is the key variable which controls the domain-user to use SAS Grid. This variable is defined in lsf.conf in conf directory under LSF deployment. This file can be used to restrict or allow the specific domain users to use SAS Grid.

```
[zxa9529@gridclient conf]$ pwd
/sas/platformcomputing/lsf/conf
[zxa9529@gridclient conf]$ more lsf.conf | grep -i domain
#RTM# LSF_USER_DOMAIN=TM:tm
LSF_USER_DOMAIN=TM:tm:EU:eu
[zxa9529@gridclient conf]$
```

User's domain is primarily required when SAS Display Manager is used to access the SAS Grid platform. There might be the situation when there are multiple domains in the organization and user's ids are associated with specific domain. In this case users need to enter their id with domain.

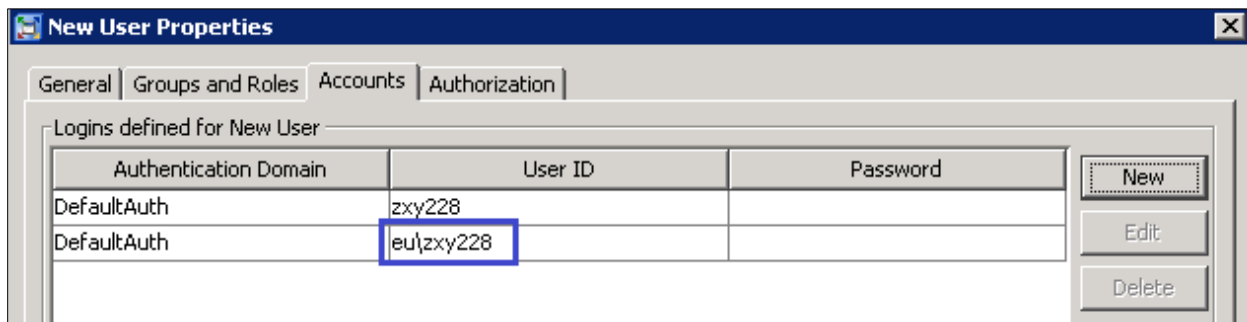
```
options metaserver='SASMetadataServerName';
options metaport=port;
options metauser='Domain\userid';
options metapass='passwd';
%let rc=%sysfunc(grdsvc_enable(_all_, resource=SASApp));
```

Even if `lsf.conf` file contains the `LSF_USER_DOMAIN` variable with appropriate domains added to accept the job but, until users are not added with multiple entry including respective domain in SAS Metadata Server, users won't be able to use SAS Grid.



Display 8. User Management in SAS Management Console

As shown in the above screen print, user is added with user id with and without domain. This new user will be able to send the SAS job from Display Manager for SAS Grid execution. If this user moved to different domain or if there is a user from EU domain then it needs to be added like:



Display 9. User Management in SAS Management Console

CONCLUSION

The key challenges given in this paper can be utilized to provide better/ smooth working environment for business users. Solutions given in the paper solve a very specific SAS-Grid issue/ challenge depending on the customer's Grid environment (operating system, SAS Version etc.).

These solutions can be further enhanced based on the user's Linux scripting, SAS and operating system capabilities. For example "Execute LSF commands through SAS Enterprise Guide" in section 5, can be further enhanced for other LSF command as well. It totally depends on the Grid administrator and business need to have these commands to be available for the users who are not very familiar with UNIX/Linux terminal.

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