

SAS installation guidelines on Digital UNIX

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This document will describe setup, installation, configuration, and tuning guidelines of SAS software on Digital UNIX from a software centric point of view without using exact hardware part numbers.

General description

The SAS System on Digital UNIX is a 64-bit application. SAS's virtual address pointers are all 64-bits. Given a large (greater than 2 GB) virtual address space, the SAS system will take advantage of that address space for things like data caches, temporary sort space, code, I/O buffer space, Multi-Dimensional Data Base(MDDB), and generated Alpha code.

Configuration of the I/O subsystem

The Alpha systems are one of the fastest systems for running the SAS System. Because of the CPU power offered by Alpha based systems, a great deal of attention must be given to the configuration of the I/O subsystem. The SAS System requires a file system. It does not use raw disks. The two general rules to follow are:

1. Spread the I/O load over multiple disk drives, even if this means using a larger number of small drives versus using a fewer number of larger drives where the total storage requirement is small.
2. Connect the disk drives to multiple SCSI controllers.

Throughout this document I will use SCSI controllers as the way to connect the storage. The use of RAID controllers is encourage. It is suggested that all disks be 7200 RPM, 16-bit wide drives in wide storage shelves or faster. 10000 RPM disks are becoming available now, these could be used for very active data storage areas.

The ideal file system layout would look like this:

```
/ and /usr on one disk
swap on one or more disk
/sas on one disk
/users on one volume
/saswrk on one volume
/sasdata on one volume
```

Ideally each of the above files system disks/volumes will be connected to a separate SCSI controller. Except for the boot disk, use the entire disk, which is the c partition. Do not use multiple partitions on the same disk for different file systems or mount points. This will cause additional seeking on the disk and reduce performance.

Looking at each file system layout in more detail, / is on the a partition and it's default size may need to be increased. /usr is created by combining g & h partitions together into one big g partition leaving the h partition with 0 size. You can create a small swap space using the b partition but it is better for performance to have additional swap space on disks separate from the boot disk.

The "Installation Instructions for the SAS System for Digital UNIX" suggests that the SAS System be installed in */usr/local*. However, I suggest that the SAS System be installed in */sas*. This will off load the system disk by moving the SAS files to a different disk. On configurations with a small number of disks, the SAS System could be installed in */usr/local*. The entire SAS 6.12 kit for all products, maps, tutorials, and samples uses approximately 500 MB of disk space. Installing the SAS System on a separate disk is suggested to improve performance by balancing the I/O load, not because of disk space reasons.

/users is the location for all users login directory. This will be the users home directory thus the location for the */sasuser* subdirectory that contains SAS catalog and user profile files that are specific to each user. The users home directory would be a common location for each users specific SAS program files. It will also be the location for the SAS program logs and listing files for each associated SAS program.

/saswrk is the temporary SAS working directory space. It needs to be created with mode 777 so that the SAS System can create a temporary subdirectory for each active SAS process. You can view */saswrk* like */tmp*. See the SAS configuration section below for more comments about the */saswrk* directory. The */sasdata* is the mount point for the permanent SAS data sets.

Locate */saswrk* and */sasdata* on separate volumes. These areas will have the most I/O activity on the system. These two areas are therefore best configured using disk stripping (RAID 0). You can use either hardware supported RAID or software support via LSM (Logical Storage Manager) or a combination of both. Combine two, three or four physical disks to create a striped volume. I have found that more than four member stripe sets do not have a major increase in throughput. Each physical disk should be connected to a separate SCSI controller so that parallel transfers can happen on each disk. These striped volumes should be used for */saswrk* and */sasdata*. RAID 1 or RAID 5 can be used for high availability requirements. The */saswrk* by its very nature of being temporary for a given SAS session is less critical to be made RAID 1 or RAID 5. In fact, because of its percentage of writes versus reads, RAID 1 or 5 are not a good choice for */saswrk*. Using RAID 5 on the */sasdata* is reasonable because it will have a larger percentage of reads over writes and provides high availability for permanent data.

The use of "Advanced File System" (AdvFS) has many advantages which allows on-line configuration modifications to the file systems. The AdvFS component is licensed with the Digital UNIX operating system, while the Advanced File System Utilities is a separately licensed layered product. AdvFS Utilities enables multivolume file systems where you can add and remove volumes, balance used space between volumes, create read-only fileset clone to perform online backups, volume defragmentation, and stripe a file across several volumes in a file domain. The key advantage of AdvFS for a SAS environment is the ability to dynamically add and remove volumes to the */saswrk* and/or */sasdata* areas. These areas are very dynamic in their storage needs and AdvFS provides a very nice way to add and remove storage space as required without taking the system down. Systems containing four or more disks are an environments where using AdvFS is advantageous. Systems with more disks should use striped volumes that are added to AdvFS domains.

Digital UNIX Installation

This section will discuss the minimum requirements the SAS System needs during the installation of Digital UNIX on your Alpha System. These requirements are in two categories. The installable Base Operating System Software Subsets and the Kernel options.

The optional Base Operating System Software Subset required by SAS:

UNIX SVID2 Compatibility

OSFSVID2

AlphaServers without a graphics interface that will be used to run the System in windows graphic mode displaying the X11 graphics output on X11 graphics capable desktop systems should include the "Windowing Environment Software Subsets". These subsets are installed automatically on systems with graphics capabilities. Namely:

Basic X Environment	OSFX11
CDE Desktop Environment	OSFCDEDT
CDE Minimum Run-time Environment	OSFCDEMIN

The Kernel Option required to mount the SAS software distribution CD:

ISO 9660 Compact Disc File System (CDFS)

(Note: Starting with Digital UNIX V4.0D, the CDFS is dynamically loaded and enabled whenever you specify the `-t cdfs` option with the `mount` command. Therefore, you no longer need to select the CDFS as a kernel option.)

The SAS System does not require LSM or AdvFS modules but they should be included subsets and kernel options if you plan on using them for the file system environment. (See the "Configuration of the I/O Subsystem" section above.)

Digital UNIX configuration Attributes and Parameters

This section will discuss various Digital UNIX kernel subsystem parameters and attributes that have an impact on the SAS application environment. Please read **System Administration** manual chapter 5 and the **System Tuning and Performance Management** manual for more detail.

Use the `/sbin/sysconfig -q` command to determine the value assigned to subsystem attributes. We will be interested in the `vm`, and `proc` subsystems. Any attributes not discussed should be left at their value determined during the kernel build process or the default value as the system is shipped.

Use the `/sbin/sysconfig -q vm` command to query the virtual memory subsystem. The following attributes are of interest.

`ubc-minpercent` This value should be at least 10 (default) or greater.

`ubc-maxpercent` The default of 100 is acceptable. Most normal usage, this should be 50 or larger.

`vm-mapentries` The default is 200. This needs to be increased by 25 for each concurrent SAS process that would be normally running on the system. Example: System with 20 SAS users running on the system, $\text{vm-mapentries} = 200 + 20 \times 25 = 200 + 500 = 700$

`vm-maxvas` The default is 1073741824 for a one GB virtual address space. Large SAS applications can perform better with more virtual address space. This value can be increased. Example: `vm-maxvas = 8589934592` for an 8 GB virtual address space environment. It is common to have a virtual address space that is bigger than the amount of physical memory on the system.

`vm-vpagemax` The default is 16384. This should be increased to 32768. Without increasing the value of `vpagemax`, SAS users are likely to get the following error message into the SAS log:

WARNING: mprotect failed for codegen phase.

Then a SEGV results because SAS tried to jump to the code that it just emitted, but didn't have execute permission to run it due to the failure of the `mprotect()` system call.

`gh-chunk` The default is 0. Contact the author of this paper if `gh-chunk` is non-zero.

Use the `/sbin/sysconfig -q proc` command to query the process subsystem. The following attributes are of interest:

`max-per-proc-address-space`
`max-per-proc-data-size`
`max-per-proc-stack-size`

These are the maximum values for the current limits of the attributes per-proc-address-space, per-proc-data-size, and per-proc-stack-size. These values should be set the same ratio that vm-maxvas is changed.

Example:

```
vm-maxvas = 8589934592
max-per-proc-address-space = 8589934592
per-proc-address-space = 8589934592
```

SAS configuration

Once you have installed the SAS System, you need to make it available to your users. You can use either of the following methods to accomplish this task:

- Edit each user's shell startup scripts so that the SASROOT directory is included in the search path.
- Make a link to the SAS command (sas) to a directory that is already in the search path by issuing a command similar to the following:

```
ln -s /sas/sas612/sas /usr/bin/sas
```

The link method has the advantage that you do this command only once and do not need to edit each user's shell startup scripts. Also, if the location of the SAS System changed you only need to make one change.

The SAS System options control many aspects of your SAS session, including output destinations, the efficiency of program execution, and the attributes of SAS files and data libraries. SAS system options can be specified in one or more ways:

- in a configuration file
- in the SAS6xx_OPTIONS environment variable (where xx is 11 for 6.11 or 12 for 6.12)
- in the SAS command
- in a OPTIONS statement (either in a SAS program or in an autoexec file)
- in the OPTIONS window.

This discussion will only focus on the important options in the configuration file. The UNIX System Administrator can edit the configuration file so that it contains whatever options are appropriate for your system. This configuration file is located in the directory where the SAS System is installed. Using the recommendations of I/O configurations above, this directory would be */sas/sas612*. The file is called **config.sas612**. The three options within the **config.sas612** that will be discussed below are **-work**, **-memsize**, and **-sortsize**.

The **-work** option specifies where to create the SAS work library. This library is temporary and any SAS data sets created there will be deleted when the SAS process terminates successfully. This work area should point to */saswrk* area that was discussed in the I/O subsystem section above. There are times when the SAS process does not terminate properly. This will leave leftover WORK directories in the */saswrk* area. The */sas/sas612/utilities/bin/cleanwork /saswrk* command will delete any leftover WORK directories whose associated SAS process has ended. **cleanwork** will not delete a directory any SAS process still active.

The **-memsize** option is the amount of virtual address space that the SAS System will attempt to use. The **-sortsize** option is the amount of virtual address space that SAS sort is allowed to use to perform a SORT procedure. The default values of **memsize** and **sortsize** are too small for AlphaSystems, except for AlphaSystems configured with 64 MB or less of physical memory. A suggested good starting value for **memsize** is the amount of physical memory configured on the system. Always make **sortsize** no greater than 16 MB less than **memsize**. Values of **memsize** greater than 1024 MB can be specified but the value of **vm-maxvas** and process parameters must be changed as well. See the **Digital UNIX configuration Attributes and Parameters** section above. Example values:

```
-memsize 1024M
-sortsize 1008M
```

References

"Installation Instructions for the SAS System for Digital UNIX" Release 6.12 TS040

Digital UNIX "Logical Storage Manager" AA-Q3NCE-TE

Digital UNIX "Installation Guide" AA-QLGB-TE

Digital UNIX "System Administration" AA-PS2RE-TE

Digital UNIX "System Tuning and Performance Management" AA-Q0R3E-TE

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