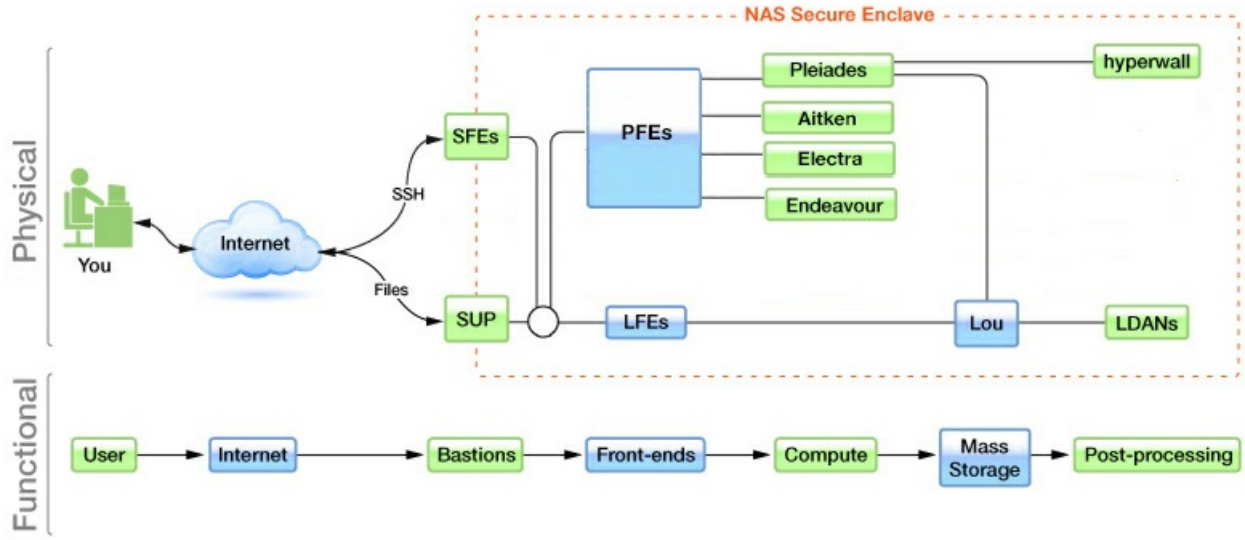
HPC Environment Overview

Our HPC environment is operated by staff in the NASA Advanced Supercomputing (NAS) Division at Ames Research Center located at Moffett Field, CA. The supercomputers and support staff are funded by NASA's High-End Computing Capability (HECC) Project.

The topics in this section summarize the system components, such as the compute nodes, secure network connections, front-end systems, and data storage facilities; and the user environment, including information about the Linux operating system and the various filesystem directories that are available for your use.

Systems Overview

The systems available for your use are all protected within a secure environment. The figure below shows both the physical connections among all the components and their functional relationships through a typical user workflow. The environment is described in more detail in the following sections.



The Secure Enclave

NAS supercomputing components are protected within a secure enclave that can be accessed only by authenticated users through the following secure bastions:

- Secure front ends (SFEs)
- Secure Unattended Proxy (SUP)

Components protected within the secure enclave include:

- Supercomputers: Pleiades, Aitken, Electra, Endeavour
- Front-end nodes: Pleiades, Aitken, Electra, Endeavour (PFEs), Lou (LFEs)
- Lou mass storage system
- Lou data analysis nodes (LDANs)
- hyperwall visualization system

The following sections give an overview of each component of the secure enclave.

Bastions

Secure Front Ends (SFEs)

The secure front ends (SFEs) provide inbound connection from your local system to the secure enclave. The first time you access the HECC systems within the enclave, you will authenticate through an SFE. Subsequently, you can use any of the bastions to access systems in the enclave.

For an overview of the initial authentication process, see Logging in for the First Time. For more information about the SFEs, see the article Role of the Secure Front Ends.

Secure Unattended Proxy (SUP)

The Secure Unattended Proxy (SUP) allows you to pre-authenticate to the secure enclave for one-week periods, during which you can perform unattended (batch) file transfers. After you complete the setup process, SUP is the most efficient and convenient method for transferring files from your remote system. For more information, see Using the Secure Unattended Proxy (SUP).

Front Ends

The HECC supercomputers Pleiades, Aitken, Electra, and Endeavour share the Pleiades front-end systems (PFEs). You can use the PFEs to edit files, compile your code, run short debugging and testing sessions, and submit batch jobs to the Pleiades, Aitken, or Electra compute nodes or to Endeavour. See the following articles for more information:

- Pleiades Front-End Usage Guidelines
- Pleiades Front-End Load Balancer

Compute Nodes

There are currently four supercomputers available for users: Pleiades, Aitken, Electra, and Endeavour.

Pleiades

NASA's flagship supercomputer, and one of the most powerful production systems in the world, Pleiades is an HPE/SGI ICE cluster containing multiple generations of Intel processors. See the following articles for more information:

- Pleiades Resource Page
- Pleiades configuration and usage guidelines

Aitken

Aitken, NASA's newest supercomputer, is housed in the Modular Supercomputing Facility, an environmentally-friendly module located a short distance from the main NAS building. Aitken uses the Pleiades front ends (PFEs), filesystems, PBS server, and job queues. See the following articles for more information:

- Aitken Resource Page
- Aitken Configuration Details
- Preparing to Run on Aitken Cascade Lake Nodes
- Preparing to Run on Aitken Rome Nodes

Electra

Electra is NASA's first prototype modular supercomputing system, housed near the main NAS building. Electra uses the Pleiades front ends (PFEs), filesystems, PBS server, and job queues. See the following articles for more information:

- Electra Resource Page
- Electra Configuration Details
- Preparing to Run on Electra Skylake Nodes
- Preparing to Run on Electra Broadwell Nodes

Endeavour

Endeavour is an HPE Superdome Flex system that provides resources for user applications needing access to large cache-coherent, global shared-memory capabilities in a single system image (SSI). Endeavour uses the Pleiades front ends (PFEs) and filesystems, and shares some of the Pleiades InfiniBand fabric. However, Endeavour uses its own designated Portable Batch System (PBS) server and job queues. See the following articles for more information:

- Endeavour Resource Page
- Endeavour Configuration Details
- Preparing to Run on Endeavour

Mass Storage System

The NAS facility provides long-term storage space on a single mass storage system, known as Lou. This HPE/SGI system has 7.6 petabytes (PB) of disk space and is capable of storing up to 1040 PB (1 exabyte) on tape. See the following articles for more information:

- Your Mass Storage Directory
- Lou Mass Storage System

Post-Processing Systems

Systems provided for post-processing include the Lou data analysis nodes (LDANs), designated as ldan[*11-14*], and the hyperwall visualization system. For a summary on using these systems for post-processing work, see Post-Processing Your Data. For detailed information, see also the following articles:

- Pleiades Front-End Usage Guidelines
- Lou Data Analysis Nodes
- Visualization System: hyperwall

Networks

The NAS high-speed network (NASLAN) includes a 10 gigabit-per-second (Gb/s) local area network and 10 Gb/s peering with other high-speed networks such as the NASA Integrated Communications Services (NICS), Internet2, and the Consortium for Educational Networks in California (CENIC). For an overview, see Networking Resources.

To access the HECC resources inside the secure enclave, you will use the SSH protocol to connect from your desktop system to a bastion (usually the SFEs) through a wide area network and the NASLAN.

User Environment

All HECC systems run the Linux operating system. If you are new to Linux, you can find a lot of helpful information at the user-supported community website Linux.org, including a Beginners Learning Course that provides instruction on the basic directory structure of Linux, how to get around in the directories, how to access Linux documentation (man pages), useful commands, and much more. You can also find support at the Linux forum.

When your NAS account is created, your default Linux shell is set to be the C shell (csh); this is assumed to be the case throughout this guide. If you want to use a different shell as your default, such as bash, call the NAS Control Room staff at (800) 331-8737 or (650) 604-4444 or send an email message to support@nas.nasa.gov to request the change. After the change is made, the new default shell of your choice applies to all of your jobs.

Once you complete the initial setup for your NAS account, you will have access to the Pleiades front-end (PFE) systems, the home filesystems, the Lou mass storage filesystems, and the scratch (/nobackup) filesystems. Your NAS account is authorized to run jobs on all HECC compute systems.

NAS supercomputers use the Portable Batch System (PBS) from Altair Engineering, Inc., for job submission, monitoring, and management. For more information about PBS, see Submitting and Running Jobs.

Filesystems

Pleiades, Aitken, Electra, and Endeavour share the same home and scratch (/nobackup) filesystems. When you log into a PFE, you will have access to the following directories:

- A home directory on the Pleiades home filesystem, which you can use to store a small number of files such as source code, small input files, and so on
- A /nobackup directory on a Lustre filesystem, which you can use to temporarily store larger files for reading and writing large amounts of data while running jobs

For long-term data storage, you also have access to a home directory on the Lou mass storage systems. The /nobackup filesystems are mounted on Lou, so you can easily copy files there directly from your /nobackup directory.

The Pleiades and Lou home filesystems are backed up each night. These backups are stored for approximately one year. The scratch (/nobackup) filesystems are *not* backed up.

Quota limits are enforced on all filesystems. Two kinds of quotas are supported:

- Limits on the total disk space occupied by your files
- Limits on the number of files you can store, irrespective of size; for quota purposes, directories count as files

See Quota Policy on Disk Space and Files for more information.

Your Home Directory

Your home directory is located on the Pleiades home filesystem, which is accessible from Pleiades, Aitken, Electra, and Endeavour. Use your home directory to store a limited number of smaller files such as source code and input files. For temporary, short-term storage of larger files, use your /nobackup directory. For long-term data storage, use the Lou mass storage systems. See Pleiades Home Filesystem for more information.

Your Scratch (/nobackup) Directory

Use your /nobackup directory to temporarily store large files that read and write large amounts of data when you run jobs. Your /nobackup directory resides on one of several Lustre filesystems, designated /nobackupp*X*. To find out which Lustre filesystem your /nobackup directory is located on, run:

pfe*21*% ls -ld /nobackup/*your_nas_username*

The /nobackup filesystems are also mounted on the Lou mass storage system, so you can access data in your /nobackup directory from Lou without going through Pleiades, Aitken, Electra, or Endeavour.

WARNING: The /nobackup filesystems mean just that: they are not backed up. While this is stating the obvious, some users have lost important data by storing it on these systems over long periods of time. It is your responsibility to copy essential data to either your home directory, to archival storage on the Lou systems, or to your remote system.

See Pleiades Lustre Filesystems for more information.

Your Mass Storage Directory

For safe, long-term data storage, transfer your files to your Lou home directory. The Lou mass storage filesystem allows you to

retrieve your stored files quickly and securely whenever you need them.

You can log into the Lou system just as you would any other HECC system and save data to mass storage by copying your files to your Lou home directory: Lou:/u/*your_nas_username*.

There is no specified data-size quota for your Lou home directory, but you can store up to 250,000 files.

For more information, see The Lou Mass Storage System.

The Data Migration Facility

Data stored on Lou is migrated to tape, as needed, to make space on the disks for more data. Migrated files are retrieved to active disk when you attempt to read or write to them. These migration and retrieval processes are managed by HPE/SGI's Data Migration Facility (DMF), which also enables you to manually list, put, find, and get files that are on tape.

When your data is migrated to tape, two copies are written to two separate tape media in automated tape libraries located in two different buildings. See Data Migration Facility Commands for more information.

The Lou Filesystem

Lou is composed of the Lou front ends (LFEs), designated lfe[*5-8*]. The /nobackup filesystems are mounted on the LFEs, so you can easily copy files there directly from your /nobackup directory.

Although you cannot perform post-processing tasks on the LFEs, the Lou data analysis nodes provide PBS resources to perform post-processing tasks on your Lou mass storage data. For more information, see the following articles:

- The Lou Mass Storage System
- Lou Data Analysis Nodes

Software Modules and Packages

HECC provides many software programs such as compilers, pre- and post-processing programs, analysis tools, and math and scientific libraries. The software is managed through the use of packages and modules that you can load into your home directories.

For more information, see the following articles:

- Software on NAS Systems
- Customizing Your UNIX Environment

Article ID: 25
Last updated: 08 Dec, 2021
Updated by: Moyer M.
Revision: 101
New User Orientation -> HPC Environment Overview
https://www.nas.nasa.gov/hecc/support/kb/entry/25/