

DoD High Performance Computing Modernization Program

HPC Portal Program

Overview

Topics / Agenda

- HPC Portal Overview
- Portal Demonstration / Q&A
- Architecture
 - Utility Server
 - The “Edge Service” Node on HPC
- Portal Software Development Kit

Secure, Web Based Software-as-a-Service for HPC Applications,
Accessible via Browsers, Hosted at DOD Supercomputing
Resource Centers

- Removes Barriers Preventing Access to HPC Resources & Data
- A Transparent & User Friendly Interface for Non-Traditional Users
 - Eliminates Steep Learning Curves for HPC Novice Scientist/Engineer
 - Provides Comprehensive and Consistent HPC Workflow
- Securely Delivers Applications & Data World-Wide On-Demand
- Increases Project Life Cycle Effectiveness
 - No More Maintaining Desktop Applications
 - Rollout Apps to All Users Instantly, Provide Updates Frequently
 - No Desktop Installations or Kerberos Kits Required

Portal: Web Based Applications –Easy, Secure, Powerful

Safe and Secure Single Sign On

DoD Hosted OpenID for CAC & Yubikey Users
No Kerberos Kit Required



“Zero Footprint” Browser Access

Only a web browser is required
Java Plugin Support (Virtual Apps) for Legacy Browsers



Secure HPC Access World-Wide – BYOD

Comprehensive & Consistent Workflow
Software as a Service: Instant Updates to All Users
Software near increasingly large datasets
Collaboration Tools

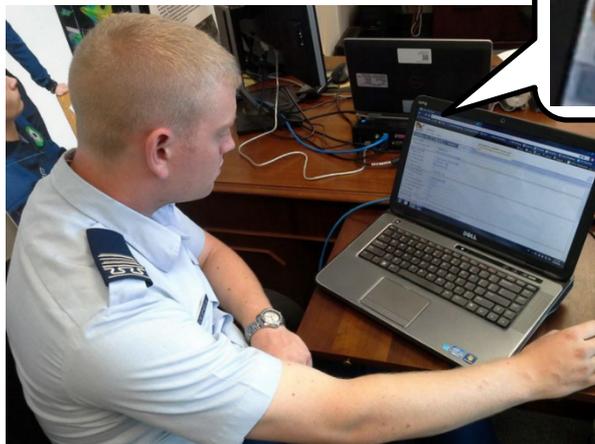


Software Development Kit

SDK Provides a Complete Portal in a Virtual Machine
MHPCC Development Environment w/Dedicated HPC



Success Story: USAFA Aero Course



Lt. Col. Andrew Lofthouse, Ph.D.

Professor and Director, Modeling & Simulation Research Center, USAFA. Uses CREATE-AV Kestrel on Portal

- Users focus on CFD: All the tedious elements of the workflow go away:
 - Upload mesh, download solution, remote X-session, kerberos kit install, desktop software install, configuration of solver (all these issues are eliminated)
 - 144 core cluster out of warranty, no need for another cluster
- 60 cadets each year
 - Portal has all the tools the students need, from mesh generation, to computation, to visualization. 2-D airfoils and 3-D wings looked at in the course

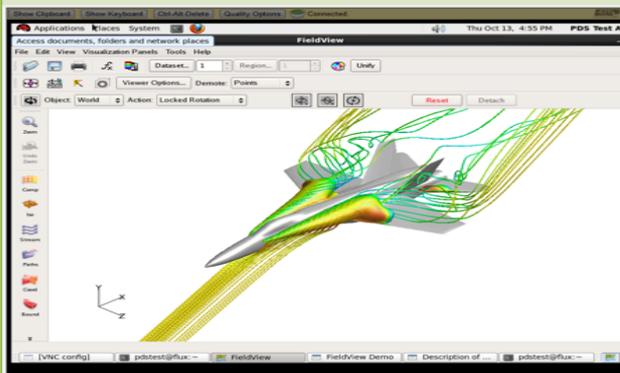


Cadets go on TDY for the semester for the flying team, and they missed 1.5 weeks at the end of the semester. They couldn't access the USAFA cluster for analysis remotely -- but now they can complete the coursework with the HPC Portal.

Portal Application Delivery Mechanisms

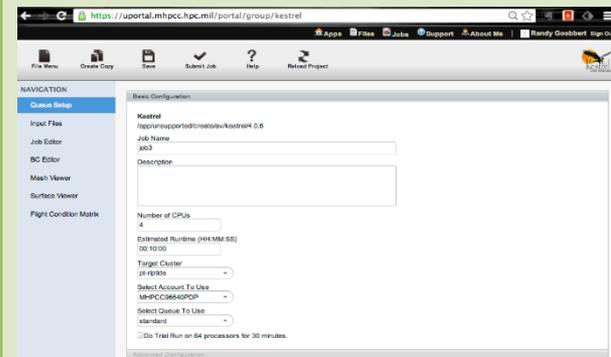
- “Zero Footprint” Browser Applications w/Java Plugin Support for Legacy Browsers
- HTML5 / WebGL Native Web Apps and Virtual Network Computing Apps:

Virtual Applications



- Remote Rich Client Displayed via Browser (VNC)
- Remotely interact with Traditional GUI
- Hosted Applications Remain Unchanged
- Quick standup for legacy apps or COTS
- Complement Web Based Apps by Supporting Pre-Post Processing in a Unified Workflow

Web-Based Applications

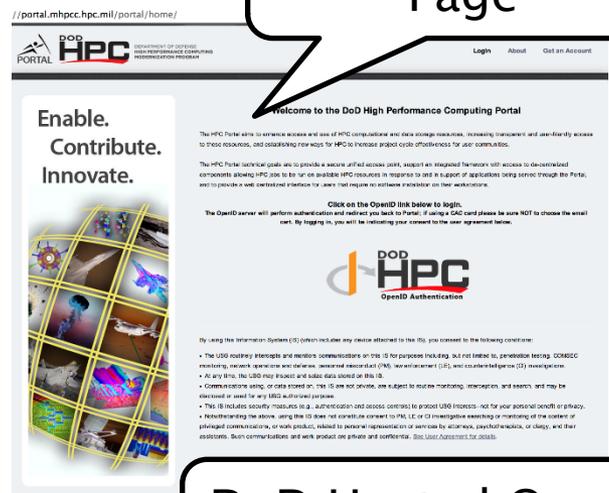


- Delivered as HTML5 web application
- Includes Modern Browser Technologies
 - WebGL, Web Sockets, etc.
 - ReST API (2015)

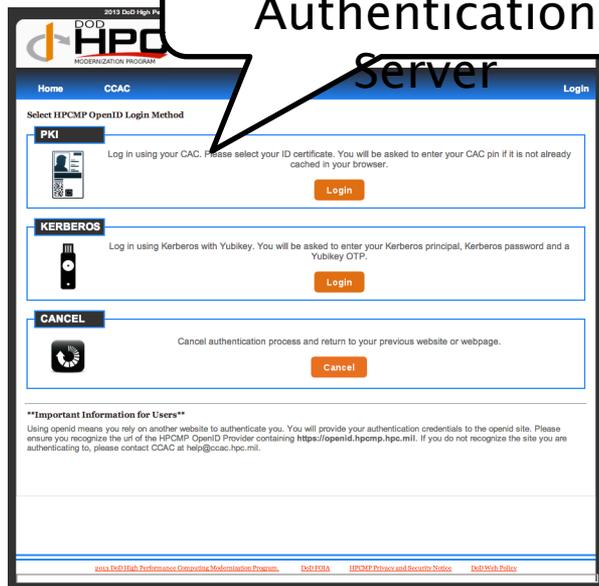
1. Logging in / Authenticating
2. Applications
3. File Management
4. Job Management
5. Example Web Application (CREATE-AV “Kestrel”)
6. Virtual Applications

Logging In / Authenticating / Apps

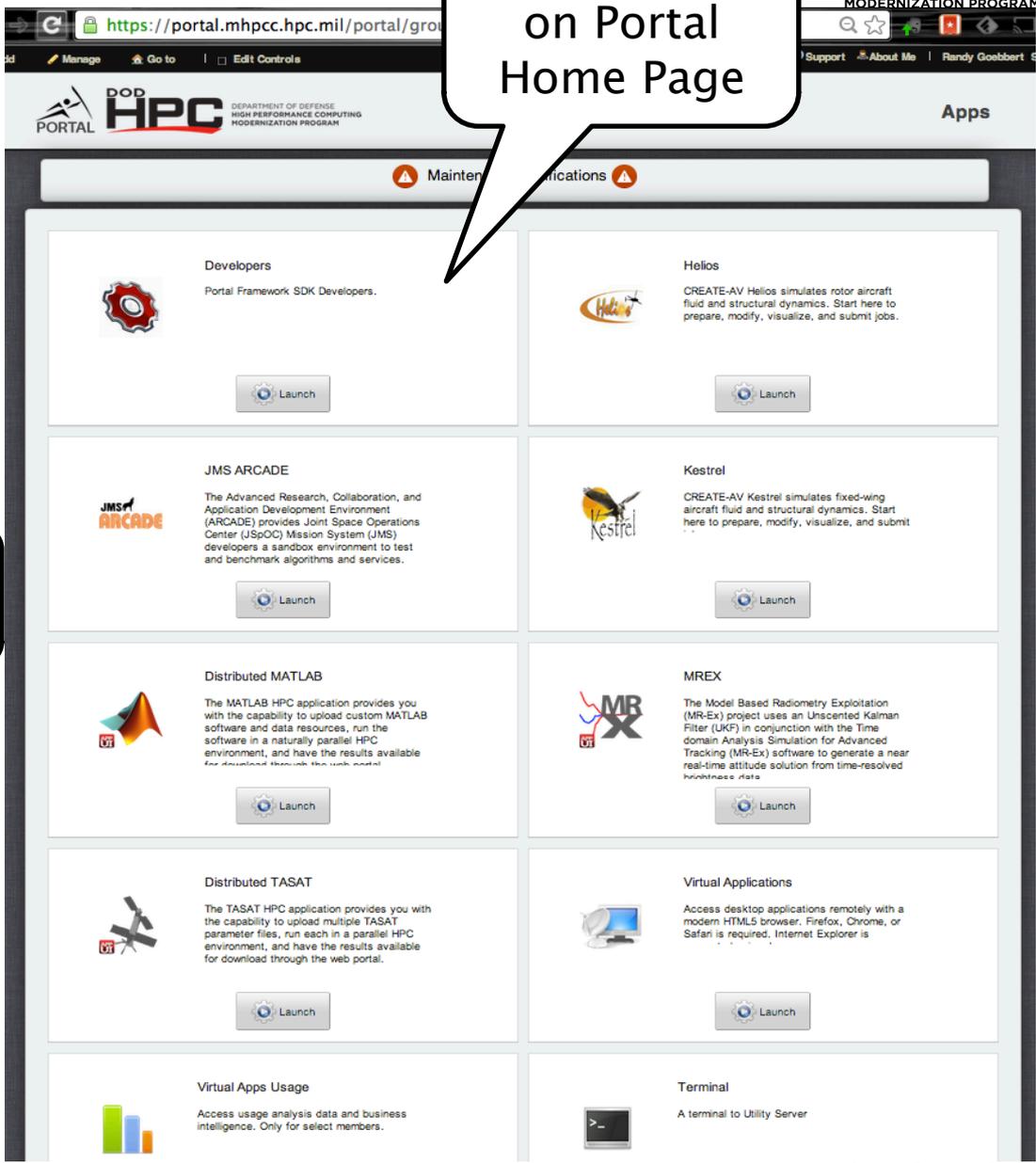
Portal Landing Page



DoD Hosted OpenID Authentication Server



Applications on Portal Home Page



Portal File Management

Browse US & HPC File-Systems Seamlessly

The screenshot shows the HPC Portal File Manager interface. On the left is a navigation pane with a tree view of folders: Utility Server, CENTER, HOME (selected), folder2, WORKDIR, /, Kilrain, CENTER, HOME, WORKDIR, /, Haise, Armstrong, and Shepard. The main area shows the current directory path `/u/home/randyg` and a table of files:

NAME	TYPE	FILESIZE	DATE	PERMISSIONS
folder2	DIRECTORY	4.1 KB	Sun Aug 10 04:44:20 GMT 2014	rx-x---
Screen Shot 2014-06-18 at 1.43.35 PM.png	FILE	73.8 KB	Thu Jun 19 02:33:49 GMT 2014	rw-r----
matlab_crash_dump.8068-1	FILE	0 bytes	Fri Oct 03 01:32:23 GMT 2014	rw-r--r--
wwing.log	FILE	3.6 KB	Tue Aug 05 22:01:28 GMT 2014	rw-r----

Below the table, a context menu is open over the file `Screen Shot 2014-06-18 at 1.43.35 PM.png`. The menu items are: Properties, Download, Rename, Delete, Edit, View, Cut, Duplicate File, Copy, New Folder, and New File.

Context Sensitive Menus

Drag & Drop from Local Desktop to Portal

The HPC Portal File Manager provides access to user files via the browser on both the Utility Server and DSRC supercomputer file systems. Users may **upload, download, create, copy, edit, delete, modify permissions, and transfer files between clusters or the Utility Server** at any given DSRC.

HPC Portal Job Manager

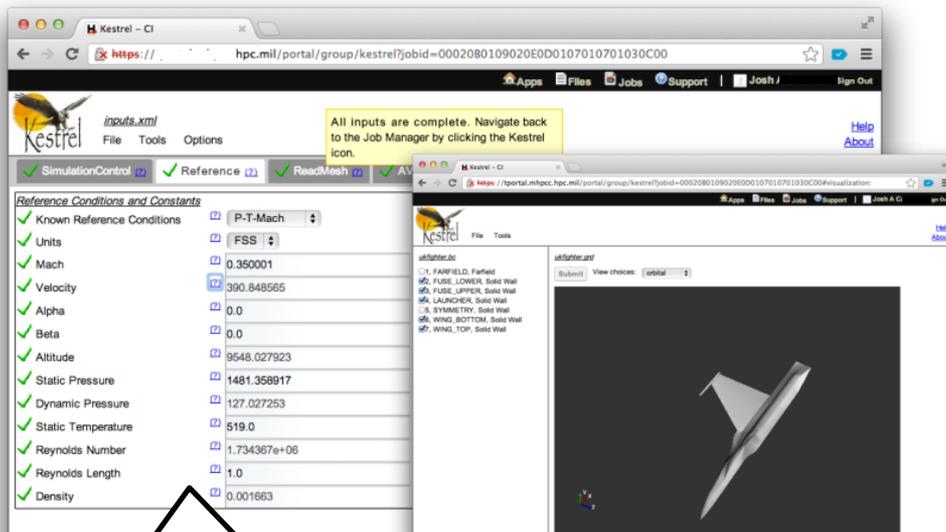
- Monitor Job Status
- Re-Load Existing Jobs Directly

	NAME	APPNAME	STATUS	CREATEDATE
	Kestrel 2014/04/24 05:12:59 GMT	Kestrel	NOT_STARTED	2014-04-24
	Kestrel 2014/05/06 03:49:19 GMT	Kestrel	FINISHED	2014-05-06
	Kestrel 2014/05/06 06:34:59 GMT	Kestrel	NOT_STARTED	2014-05-06
	Kestrel 2014/06/03 21:29:23 GMT	Kestrel	NOT_STARTED	2014-06-03
	Kestrel 2014/06/14 00:53:55 GMT	Kestrel	NOT_STARTED	2014-06-14
	Kestrel 2014/07/11 05:52:17 GMT	Kestrel	FINISHED	2014-07-11
	Kestrel 2014/07/11 05:58:26 GMT	Kestrel	FINISHED	2014-07-11
	Kestrel v4 vwing 2014/04/02 02:33:53 GMT	Kestrel	FINISHED	2014-04-02
	job1 pizza	JMS ARCADE	FINISHED	2014-04-02
	job100	Distributed MATLAB	NOT_STARTED	2014-12-02
	job101	Distributed MATLAB	FINISHED	2014-12-02
	job13	JMS ARCADE	ERROR	2013-09-27
	job14	JMS ARCADE	NOT_STARTED	2013-09-27
	job2	JMS ARCADE	NOT_STARTED	2014-01-23
	job4	JMS ARCADE	FINISHED	2014-04-02
	job60	Distributed MATLAB	FINISHED	2014-11-19
	job73	Distributed MATLAB	FINISHED	2014-11-19
	job99	Distributed MATLAB	ERROR	2014-11-19
	jobV3.0	Distributed MATLAB	ERROR	2014-11-18

Load
Clone

HPCMP CREATE™ Kestrel

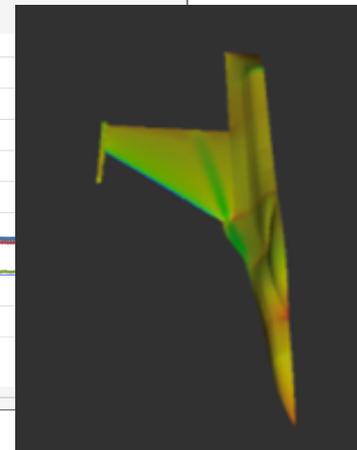
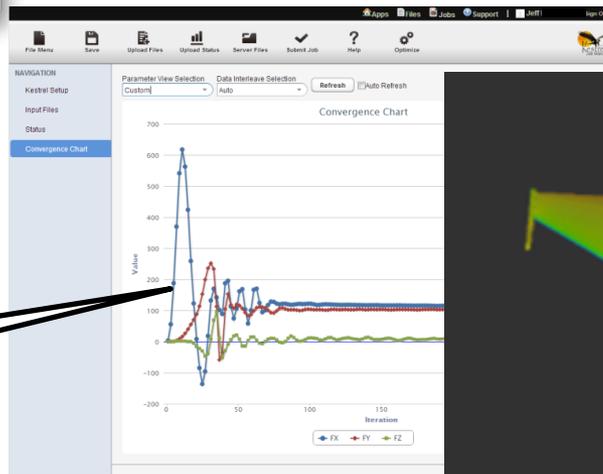
Computational Fluid Dynamics (CFD)



Implemented As Modern Browser Based Application Including WebGL Components to Match Existing Kestrel Desktop “Thick Client”

Guided inputs of Aircraft, Flight Conditions, etc.

Interactive Result Plots



Kestrel / Portal Workflow

1. Upload Job Resources via Portal File Manager
2. Use HPC Portal for Surface Visualization
3. Select Flight Conditions via Web Application
4. Job Submission to Selected Cluster/Queue
5. Real-Time Job Monitoring
6. Post-Processing Visualization on HPC Portal

Virtual Applications

https://portal.mhpc.hpc.mil/nachos/index.jsp

Start	Name	Description
	High Definition XTerm	High Definition X Terminal for doing command line work on the HPC systems.
	XTerm	Standard X Terminal for doing command line work on the HPC systems.
	OneSAF	One Semi-Automated Forces. Graphical representation of Knowledge Acquisition/Knowledge Engineering Development/Deployment/Installation. Restricted access only.
	KUI v4.0.13	Kestrel User Interface, restricted access only.
	KUI v4.0.13 Job View	Job View Launcher for the Kestrel User Interface, restricted access only.
	Pointwise	Reliable CFD Meshing.
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	Pointwise	Reliable CFD Meshing.
	DaVinci v2	DaVinci User Interface, Version 2.
	SENTRI v4.0.2	Scalable Engineering Tools for RF Integration, Computer Aided Engineering Software for DoD Electronics Accuracy, Extensibility/Maintainability/Reliability that runs on Wide Range of Computers.
	FieldView Hardware Accelerated	Model and Mesh viewer using Hardware Acceleration.
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	EnSight Hardware Accelerated	FEA and CFD Post processing and Visualization.
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	ParaView Hardware Accelerated	Interactive/Batch 3D Application for the Analysis, Exploration, and Visualization of Data.
	Tecplot 360 Hardware Accelerated	CFD Visualization Tool to analyze data, arrange layouts, communicate results with images and animations.
	MATLAB	Development environment for data analysis, visualization, and computation. Starts in Projects directory. Restricted access for privileged users only.
	Capstone v4.0.1	Software system for producing analyzable representations. Restricted to CREATE MG group users.
	Blacksmith	GUI that assists the user by providing: conversion routines, a grid soundness check, grid manipulation utilities, and the ability to create a Cobalt boundary condition file.
	Ligase	GUI that assists the user by providing: conversion routines, a grid soundness check, grid manipulation utilities, and the ability to create a Cobalt boundary condition file.
	ANSYS	Comprehensive multi/single physics tool which includes structural, thermal, fluid and both High/Low frequency electromagnetic analysis; also contains solutions for both direct/sequentially coupled physics problems.
	ABAQUS/CAE	Complete environment for creating, managing, and monitoring ABAQUS analysis jobs, as well as visualizing results from the ABAQUS/Standard and ABAQUS/Explicit.

https://portal.mhpc.hpc.mil/nachos/nachos.jsp?tab=1

App List Running Apps Help

Connect	Name	Running Since
	High Definition XTerm	Sat Feb 15 2014 23:14:05 GMT-1000 (HST)

Sessions w/
Configurable
Timeouts
Span Logins

Return to App Manager Show Clipboard Show Keyboard Ctrl-Alt-Delete Quality Options Connected.

```

randyg@muvappsg-0002:~$ ls -lart
total 2208
-rw-r--r-- 1 randyg hands 33 Oct 26 2012 .bash_logout
-rw-r--r-- 1 randyg hands 176 Oct 26 2012 .bash_profile
-rw-r--r-- 1 randyg hands 124 Oct 26 2012 .bashrc
-rw-r--r-- 1 randyg hands 515 Oct 26 2012 .ewacs
-rw-r--r-- 1 randyg hands 102 Oct 26 2012 .cshrc
drwx----- 2 randyg hands 4096 Jul 10 2013 .ssh
drwx----- 2 randyg hands 4096 Jul 10 2013 .ftplib
-rw-r--r-- 1 randyg hands 857 Jul 17 2013 .viinfo
drwx----- 3 randyg hands 4096 Jul 17 2013 .matlab
drwx----- 2 randyg hands 4096 Jul 17 2013 .subversion
drwx----- 2 randyg hands 4096 Jul 17 2013 .gnome2_private
drwx----- 3 randyg hands 4096 Jul 17 2013 .gnome2
drwx-----x 5 randyg hands 4096 Jul 17 2013 .mozilla
drwx----- 3 randyg hands 4096 Jul 17 2013 .alsa
-rw-r--r-- 1 randyg hands 256 Jul 17 2013 .pulse-cookie
-rw-r--r-- 1 randyg hands 16 Jul 17 2013 .esd_auth
drwx----- 2 randyg hands 4096 Jul 17 2013 .cache
drwx----- 2 randyg hands 4096 Jul 17 2013 .autouse
-rw-r--r-- 1 randyg hands 125 Jul 17 2013 .bashrc
-rw-r--r-- 1 randyg hands 39 Jul 19 2013 .flexirc
drwx----- 3 randyg hands 4096 Jul 18 2013 .rvm
drwx----- 2 randyg hands 4096 Jul 25 2013 .gconf
drwx----- 2 randyg hands 4096 Jul 26 2013 .gconfd
drwx----- 2 randyg hands 4096 Aug 20 11:38 .vnc
-rw-r--r-- 7 randyg hands 4096 Sep 12 08:43 .ensight100
-rw-r--r-- 1 randyg hands 765 Dec 5 15:58 .bash_history
drwx----- 6 randyg hands 4096 Dec 21 20:50 .config
-rw-r--r-- 1 randyg hands 0 Jan 22 16:06 abaqus_acis_log
drwx----- 3 randyg hands 4096 Jan 22 16:06 abaqus_plugins
-rw-r--r-- 1 randyg hands 756 Jan 22 16:06 abaqus_rpy
-rw-r--r-- 1 randyg hands 0 Jan 23 16:06 core_7365
drwx----- 20 randyg hands 8192 Jan 23 15:05 ..
drwx-----x 128 root root 28672 Feb 12 10:52 ..
-rw-r--r-- 1 randyg hands 1024 Feb 15 22:16 .rmd
drwx----- 2 randyg hands 4096 Feb 15 22:16 .vapps
randyg@muvappsg-0002:~$
    
```

X-Terminal
Supported

Virtual
App List

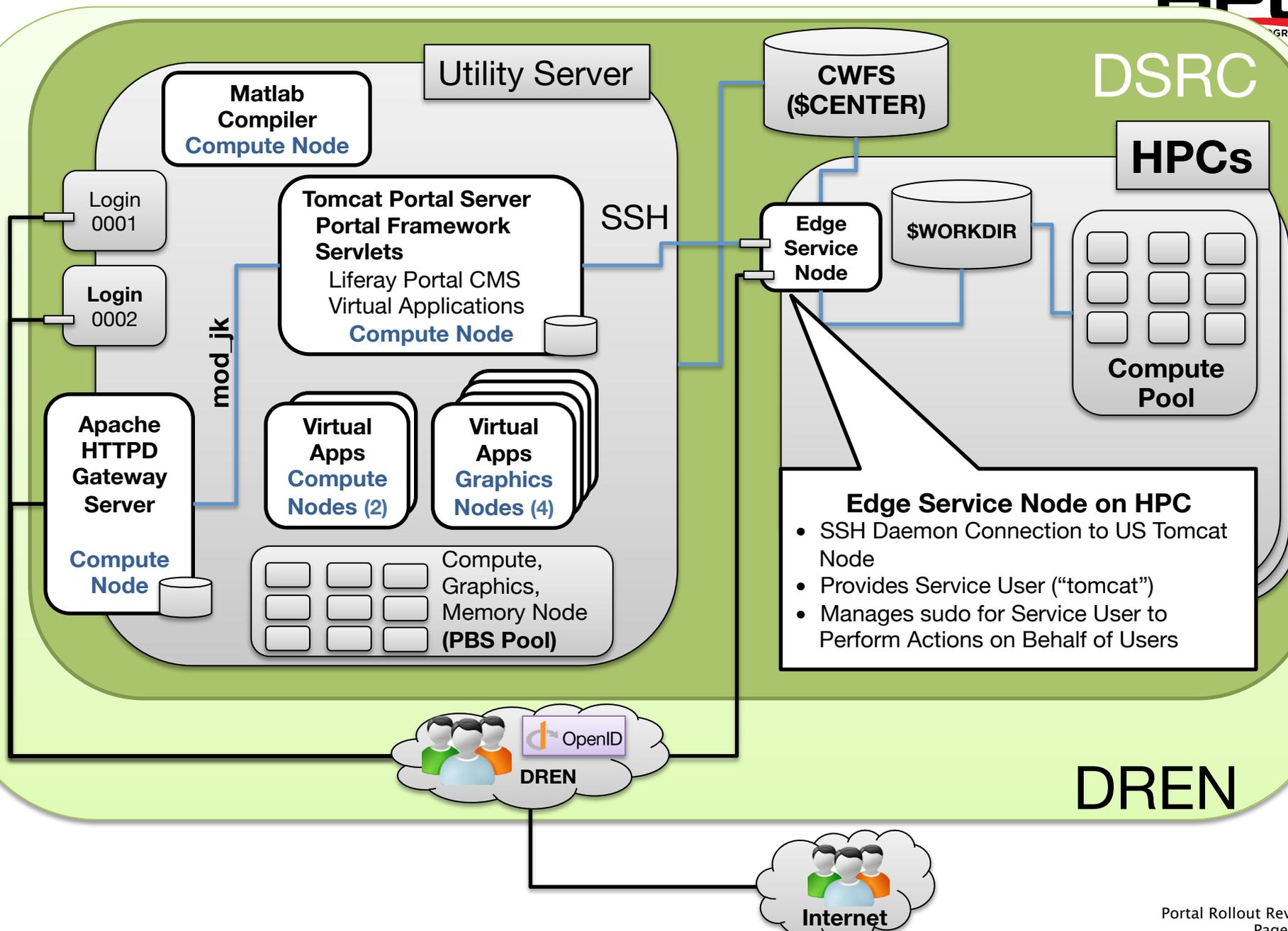
Portal Architecture at DSRCs

- Common Utility Server and Center Wide File System Supports Portal Across DSRCs
- Portal Infrastructure is Open Source / DoD GOTS
 - Linux/Apache/MySQL w/Liferay Content Management System
 - Java Portlets Support Common Framework
 - Vaadin Java Based Open Source for “Rich Internet Applications”
 - Server Side Web Application Framework w/AJAX
 - ReST API in 2015
 - Leverages Center Wide File System (CWFS)
 - CWFS Mounted on Utility Servers and Cluster Login Nodes
 - Portal Home Directories Hosted on CWFS
 - Provides Job Submission & Monitoring from US to Clusters
 - Utility Server Also Hosts “Virtual” Applications
 - Provides User Options to Select Cluster
 - Within a single DSRC

US Reserved Node Summary

Reserved Node	Type	Purpose	OS Boot
utilc-0041	Compute Node	matlab compiler node	Remote Image
utilc-0042	Compute Node	vapps compute node	Remote Image
utilc-0043	Compute Node	vapps compute node	Remote Image
utilc-0044	Compute Node	Tomcat/ Liferay/ MySQL/Apps	Local Disk
utilc-0045	Compute Node	Apache Node	Local Disk
utilg-00[0-3]	GPGPU Nodes	Vapps Graphics Node	Remote Image

Portal General Architecture Overview



DREN

- Standardized Mechanism for Portal Application Deployments
- Facilitates Fast Standup of Web Apps Using Common Framework
 - Job Submission & Management
 - File Manager
 - Common User Interface Elements & Workflow
- Pre-Configured Downloadable VM Based Linux Environment
- **A Complete Portal in a Virtual Machine:**
 - Liferay/Tomcat/Java/Torque Framework
 - Runs Server via Eclipse (Egit, Spring, M2E, Liferay IDE)
 - HPCMP Kerberos Kit and SSH installed
 - Pre-setup for tunnels to current Git repositories and development cluster nodes
 - Instructions Provided via Portal Wiki
 - Apache Maven installed and pre-configured to use the current maven repo where all portal artifacts are available for download

- HPC Portal is a New Paradigm for Secure DoD User Access to Supercomputing
 - Rollout Apps to All Users Instantly, Provide Updates Frequently
 - No Installation or Kerberos Kits Required
- Multiple Applications successfully deployed to the HPC Portal, supporting common user workflows. 2 Examples:
 - Significant CREATE-AV Kestrel multi-physics capability is available to every DoD desktop today with NO local software installation, configuration, or maintenance
 - JMS/ARCADE introduces new methods of User Interaction: a Test Bed Environment with User Supplied Plug-In HPC Components and Includes a WorkFlow Tool for Connecting These Components
- The Portal Software Development Kit Provides a Ready-Made Environment for Standing Up New Applications