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
The HPC Portal

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

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.

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

Performed by HPCMP CREATE, MHPCC HPC Portal, and US Air Force Academy
**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:

<table>
<thead>
<tr>
<th>Virtual Applications</th>
<th>Web-Based Applications</th>
</tr>
</thead>
</table>
| - 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 | - Delivered as HTML5 web application  
  - Includes Modern Browser Technologies  
    - WebGL, Web Sockets, etc.  
    - ReST API (2015) |
Demonstration

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
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

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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

- "Virtual App List"
- "Sessions w/ Configurable Timeouts"
- "X-Terminal Supported"
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

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<th>Purpose</th>
<th>OS Boot</th>
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<td>matlab compiler node</td>
<td>Remote Image</td>
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Portal Software Development Kit (SDK)

- 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
Summary

- **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**