Project Status Report

High End Computing Capability
Strategic Capabilities Assets Program

July 10, 2013

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New SGI System Selected to Augment Pleiades Supercomputer

• A team of high-end computing experts at NASA Ames selected SGI’s next-generation ICE X system to augment NASA’s HECC supercomputer environment.
  – The new system comprises 46 racks, each with 72 nodes containing two Intel Xeon E5-2680V2 (Ivy Bridge) processors;
  – The Ivy Bridge racks will replace the supercomputer’s 64 aging Intel Xeon E5472 (Harpertown) racks;
  – With the new resources, the computational capacity of Pleiades will increase from a peak of 1.78 petaflops (PF) to approximately 2.87 PF.

• The resources were selected through the NASA Advanced Supercomputing (NAS) Division’s formal NAS Technology Refresh (NTR) process.

• After installation and extensive testing, the new racks are scheduled for release to the general user community in late summer or early fall 2013.

Mission Impact: NASA’s supercomputing requirements are projected to continue growing exponentially over time, as the agency leverages technology to pursue its challenging missions. HECC must regularly and significantly upgrade and replace the supercomputing resources it provides to the agency.

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Facilities Team Coordinates Cooling Tower Pump Repairs at NAS Facility

- The HECC facilities team, in coordination with the NASA Ames maintenance contractor (IAP World Services), completed the removal, repair, and re-installation of two cooling tower pumps.
  - The pumps are a critical component of the NAS facility’s chilled water plant;
  - Issues were discovered with the pumps through ongoing inspection of the aging infrastructure;
  - Rebuilding the pumps extends the life of this critical equipment.
- Electrical testing to establish baselines was done at the time of installation; careful monitoring ensures that the hardware remains operational following installation.
- The team provided engineering solutions to ensure that adequate cooling was maintained during repairs, and that the repairs were made in a timely manner.

**Mission Impact:** Regular, effective maintenance of cooling tower pumps helps ensure that critical infrastructure at the NASA Advanced Supercomputing facility remains operational, especially during warm summer months when power outages could affect users’ access to supercomputing resources.

*POC:* Scott Prevost, scott.prevost@nasa.gov, (650) 604-4350, NASA Advanced Supercomputing Division, Computer Sciences Corp.

A newly repaired cooling tower pump is hoisted by crane at the NASA Advanced Supercomputing (NAS) facility, to be re-installed into the chilled water plant located behind the NAS building. Two of four pumps were repaired and then re-installed.
HECC Increases Storage Capacity for NASA Earth Exchange (NEX) Researchers

- The HECC Supercomputing Systems team installed a Network File System (NFS) server to increase the storage capacity available for the NASA Earth Exchange (NEX) project.
- The NFS server provides 350 terabytes (TB) of usable storage space on Pleiades to NEX project researchers, augmenting an existing 424-TB Lustre filesystem.
- The new storage system uses the industry-standard T10-PI protocol for end-to-end data integrity validation, which will provide protection from silent (undetected) data corruption.
- The HECC team will next enable access the NFS server from the NEX sandbox using 10-Gigabit Ethernet. This will reduce duplication of data and enable NEX users to make more effective use of the storage system.

Mission Impact: Increased storage capacity and performance will enable researchers in the NASA Earth Exchange (NEX) community to more fully utilize HECC computing resources.

POCs: Bob Ciotti, bob.ciotti@nasa.gov, (650) 604-4408, NASA Advanced Supercomputing Division;
Davin Chan, davin.s.chan@nasa.gov, (650) 604-3613, NASA Advanced Supercomputing Division, Computer Sciences Corp.
HECC Network Team Identifies Major Firewall Issue at MSFC

- In mid-March, the NASA Integrated Communication Services (NICS) support team upgraded NASA Ames’ peering to the wide area network (WAN) backbone from 1 gigabit per second (Gbps) to 10 Gbps. Immediately, data transfer rates to Marshall Space Flight Center (MSFC) dropped dramatically.
- MSFC system administrators created accounts to allow HECC network engineers to isolate the problem.
- Working directly with NICS and MSFC engineers, the HECC engineers were able to bypass the MSFC firewall and quickly identify the problem—demonstrating that the MSFC firewall is not able to handle 10-Gbps data packet bursts.
- Until MSFC can upgrade their firewall, HECC has implemented a workaround to restore previous performance levels of ~575 Mbps.

Mission Impact: HECC’s expertise and experience in high-speed networking, along with its collaborative approach, enables quick identification of, and solutions to, network performance issues.

POC: Nichole Boscia, nichole.k.boscia@nasa.gov, (650) 604-0891, NASA Advanced Supercomputing Division, Computer Sciences Corp.
Streamlined Account Request Process Saves Time for HECC Account Managers

- After reviewing the user account request process created when HECC began using the NASA Account Management System (NAMS), HECC account managers streamlined the process by removing the expiration date that was in the NAMS workflow.
- Improving the workflow of the user account request process saves HECC account managers at least 100 hours per year.
- HECC users will continue to renew their accounts annually using HECC’s online process.
- Account managers will update expiration dates for renewed accounts using HECC’s Login Account Maintenance System (LAMS).
- The improved process also reduces confusion for users because they will no longer get renewal reminders from NAMS—the reminders will come only from HECC.

**Mission Impact:** Streamlining administrative processes enables HECC account managers to focus their expertise on helping users achieve their project goals instead of on routine tasks.

**POC:** Catherine Schulbach, catherine.h.schulbach@nasa.gov, (650) 604-3180, NASA Advanced Supercomputing Division

This diagram shows the three steps (at right) that were eliminated to streamline the HECC account renewal process. Account managers no longer update the NASA Account Management System (NAMS) when an account is renewed, nor do they synchronize expiration dates between NAMS and HECC’s Login Account Maintenance System (LAMS). Account managers only update NAMS when an account is created or closed, so NAMS will still hold a record of users who have HECC accounts.
Security Team Completes Contingency Scenario Testing

- Under the direction of the NAS Security team, HECC successfully completed its annual testing of the contingency plan against a NASA Ames-provided training scenario that reflected significant agency-wide, temporary staff reductions.
  - HECC is required to perform a Functional Review or a Desktop/Classroom test each year;
  - A discussion-based Classroom exercise was chosen, since one such test is allowed within each three-year cycle and is less labor-intensive than the Functional Review.
- Representatives from all HECC groups took part in scenario-based discussions.
- Results of this year’s exercise showed that HECC systems would have remained operational throughout the scenario, due to cross-trained NAS personnel and sufficient spare parts on hand (acquired to avoid placing emergency orders by a procurement office with limited staff).

**Mission Impact:** Annual contingency scenario testing helps identify and update areas of the HECC contingency plan that need modification. Testing is required to maintain authorization to operate the HECC systems.

The Contingency Plan cycle: Staff training ensures familiarity with the plan, then staff members try out the plan with HECC systems to respond to the testing scenario, followed by applying the lessons learned to plan updates.

**POC:** Alfredo Ortiz, alfredo.a.ortiz@nasa.gov, (650) 604-0294, NASA Advanced Supercomputing Division, Computer Sciences Corp.
Magnetohydrodynamics Simulations Reveal Geyser-Like Plasma Eruptions on the Sun

- Researchers at NASA Ames and Stanford University, enabled by Pleiades’ massive computational resources, are running 3D, radiative magnetohydrodynamics (MHD) simulations to reproduce ubiquitous plasma eruptions on the Sun. The simulations have revealed:
  - The plasma eruptions are produced by turbulent magnetized vortex tubes generated by solar convection below the visible surface;
  - These vortex tubes, with high-speed swirling flows similar to tornados, are initiated by overturning and shearing convective flows, driven by the solar energy flux;
  - Excess pressure that accumulates in the low atmosphere causes magnetized vortex tubes to erupt in a manner similar to geyser eruptions.
- These findings, enabled by HECC experts in 3D visualization, contribute to our understanding of solar magnetic activity and its affect on Earth’s space environment.

**POCs:** Irina Kitiashvili, irinasun@stanford.edu, (650) 723-9596, Stanford University; Alan Wray, alan.a.wray@nasa.gov, (650) 604-6066, NASA Ames Research Center

*HECC provided supercomputing resources and services in support of this work*
Pleiades Enables Water Spray Simulation Models for SLS Launch Environment

- Researchers at Marshall Space Flight Center have simulated the effects of water suppression for a unique, wet launch pad validation case for the Space Launch System (SLS).
  - The simulation was based on a test case from the Ares I Scale Model Acoustic Test so that pressure predictions from across a full launch pad could be validated against real data;
  - Ignition overpressure and payload acoustics are design considerations that are consistent risk drivers for new launch vehicles;
  - Validations provided confidence in the results of CFD simulations, and had immediate impacts on design of the SLS.
- CFD prediction of acoustic effects for a full launch pad is computationally intensive, and would be very difficult without the resources of a supercomputer with Pleiades’ capability and capacity.

Mission Impact: A robust and validated computational fluid dynamics capability is critical to rocketry design, allowing NASA to quickly iterate through options that would be difficult to assess with traditional methods. Identifying and fixing design problems prior to fabrication provides significant cost savings to the agency.

POC: Gabriel Putnam, gabriel.c.putnam@nasa.gov, (256) 544-9577, NASA Marshall Space Flight Center, All Points Logistic, Inc.

* HECC provided supercomputing resources and services in support of this work
HECC Facility Hosts Several Visitors and Tours in June 2013

- HECC hosted 14 tour groups in June; guests learned about the agency-wide missions being supported by Pleiades/Endeavour, and viewed scientific results on the hyperwall system. Visitors this month included:
  - The Rector, Vice Rector, and Director of Research Institutes from the Kaunas University of Lithuania;
  - A group from the NASA Office of Inspector General, Computer Crime Division;
  - Javier Mendieta, Director General of the Mexican Space Agency;
  - Former NASA Deputy Director and Ames Center Director, Hans Mark, received a briefing by HECC Project Manager Rupak Biswas on the quantum computer project;
  - Liane Guild, Ames Coral Reef scientist, met with HECC visualization team lead Chris Henze and guests from NOAA and other ocean studies centers, to discuss future collaborations;
  - Two large student groups from the Summer Interns Program, Ames Office of Education.

POC: Gina Morello, gina.f.morello@nasa.gov, (650) 604-4462, NASA Advanced Supercomputer Division
Papers and Presentations

• **AIAA Fluids Conferences**, June 24-27, 2013, San Diego, California
  - “High Lift OVERFLOW Analysis of the DLR F11 Wind Tunnel Model,” T. Pulliam, A. Sclafani. *No online version available at this time.*

*HECC provided supercomputing resources and services in support of this work*
Papers and Presentations (cont.)

- **AIAA Fluids Conferences**, June 24-27, 2013, San Diego, California (cont.)

*HECC provided supercomputing resources and services in support of this work*
Papers and Presentations (cont.)

  http://arxiv.org/abs/1306.1050

  http://mnras.oxfordjournals.org/content/early/2013/06/17/mnras.stt879.full

  http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12279.html


* HECC provided supercomputing resources and services in support of this work
Papers and Presentations (cont.)


* HECC provided supercomputing resources and services in support of this work
News and Events

• NASA Launches Satellite to Study How Sun’s Atmosphere is Energized, NASA Press Release, June 27, 2013 – The Interface Region Imaging Spectrograph (IRIS) begins its two-year mission to observe the region between the Sun’s photosphere and lower atmosphere, which will include data processing and analysis on the Pleiades supercomputer.


– NASA Launches Satellite to Study How Sun’s Atmosphere is Energized, Space Fellowship, June 28, 2013.
HECC Utilization Normalized to 30-Day Month

Standard Billing Units

Alloc. to Orgs

July 10, 2013
National Aeronautics and Space Administration
High-End Computing Capability Project
Tape Archive Status

![Bar chart showing tape archive status]

- **Unique File Data**
- **Unique Tape Data**
- **Total Tape Data**
- **Tape Capacity**
- **Tape Library Capacity**

- **Capacity**
- **Used**
- **HECC**
- **Non Mission Specific**
- **NAS**
- **NLCS**
- **NESC**
- **SMD**
- **HEOMD**
- **ARMD**

*June 2013*
Tape Archive Status

- Tape Library Capacity
- Tape Capacity
- Total Tape Data
- Unique Tape Data

1: Library Expansion
2: LTO-4 media removed
3: LTO-5 media added
Pleiades:
SBUs Reported, Normalized to 30-Day Month
Pleiades:
Devel Queue Utilization

Standard Billing Units

May-12  Jun-12  Jul-12  Aug-12  Sep-12  Oct-12  Nov-12  Dec-12  Jan-13  Feb-13  Mar-13  Apr-13  May-13  Jun-13

NAS  NLCS  NESC  SMD  HEOMD  ARMD

Devel Queue Alloc.
Pleiades:
Monthly Utilization by Job Length

[Bar chart showing monthly utilization by job length, with job run times ranging from 0 - 1 hours to > 120 hours. The y-axis represents standard billing units, and the x-axis shows job run times. The chart indicates a peak in utilization for job run times of > 48 - 72 hours.]
Pleiades:
Monthly Utilization by Size and Mission

June 2013

Standard Billing Units

Job Size (cores)

1 - 32
33 - 64
65 - 128
129 - 256
257 - 512
513 - 1024
1025 - 2048
2049 - 4096
4097 - 8192
8193 - 16384
16385 - 32768

NAS
NLCS
NESC
SMD
HEOMD
ARMD
Pleiades: Monthly Utilization by Size and Length

June 2013
Pleiades: Average Time to Clear All Jobs

The chart shows the average time in hours to clear all jobs from July 2012 to June 2013. The data is categorized by ARMD, HEOMD/NESC, and SMD. The time varies significantly across the months, with the highest values in April and May 2013 and the lowest in July 2012.
Pleiades: Average Expansion Factor

![Average Expansion Factor Chart]

- Jul-12: 1.00
- Aug-12: 1.00
- Sep-12: 1.00
- Oct-12: 1.00
- Nov-12: 26.31
- Dec-12: 5.44
- Jan-13: 1.00
- Feb-13: 1.00
- Mar-13: 63.15
- Apr-13: 12.39
- May-13: 5.29
- Jun-13: 5.29

Legend:
- ARMD
- HEOMD
- SMD
- NESC
Endeavour: SBUs Reported, Normalized to 30-Day Month
Endeavour: Monthly Utilization by Job Length

<table>
<thead>
<tr>
<th>Job Run Time (hours)</th>
<th>Standard Billing Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 1 hours</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 1 - 4 hours</td>
<td>1000</td>
</tr>
<tr>
<td>&gt; 4 - 8 hours</td>
<td>2000</td>
</tr>
<tr>
<td>&gt; 8 - 24 hours</td>
<td>9000</td>
</tr>
<tr>
<td>&gt; 24 - 48 hours</td>
<td>13000</td>
</tr>
<tr>
<td>&gt; 48 - 72 hours</td>
<td>14000</td>
</tr>
<tr>
<td>&gt; 72 - 96 hours</td>
<td>4000</td>
</tr>
<tr>
<td>&gt; 96 - 120 hours</td>
<td>3000</td>
</tr>
<tr>
<td>&gt; 120 hours</td>
<td>12000</td>
</tr>
</tbody>
</table>

June 2013
Endeavour: Monthly Utilization by Size and Length

June 2013

Job Size (cores)
Endeavour:
Monthly Utilization by Size and Mission

June 2013