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1 Executive Summary

The Center for High Performance Computing (CHPC) provides large-scale computer and networking resources (hardware, software and expertise) to facilitate advances in academic disciplines that require computing and network capabilities beyond those existing in individual colleges, departments or groups who use computers as a core instrument in their research.

Centers similar to CHPC are increasingly common at research universities in the United States. The membership of its professional association, the Coalition for Academic Scientific Computing (CASC, http://www.casc.org/) has increased its membership from 12 centers in 1992 to 57 in 2008. These Centers are the foundation on which the US academia is building the cyber infrastructure promoted by the National Science Foundation. As such CHPC provides a wide range of services and acts as advocate to encourage the development of the local and statewide cyber infrastructure to support the research goals of the University and the region.

CHPC has a half-time director and approved staffing level of approximately 28 FTEs. Its current base budget is roughly $2.6 million, plus one-time appropriations from both internal and external sources that are directed towards specific research projects. Budget and staff support the following set of activities:

- Hardware, systems and software for support for research users
- Desktop and networking support for researchers in the INSCC building, 7th and 8th floors of the William Browning Building and for some computational scientists in the new Sutton building.
- Advanced network and cyber infrastructure development
- IT test beds for networking and system development
- Visualization and production services
- Teaching and learning contributions
- Large-scale statistics support
- Consulting services for scientific computing and information technology

Within this wide range of activities CHPC supports numerous projects on campus. A comprehensive list of projects and programs that receive consistent support from CHPC is given in Appendix I. These projects have published 494 reports since 1996 (see Appendix II), and an average of over 50 academic papers per year (the past 5 years) acknowledging computer support from CHPC. In addition to these clearly identifiable projects, numerous faculty and students benefit from activities related to the use of infrastructure that CHPC provides campus wide. CHPC staff work closely at all levels with the Information Technology Office to integrate the high-end computing environments with campus wide information technology resources.

2 CHPC Overview

CHPC has a half-time director and approved staffing level of approximately 28 FTEs. Its current base budget is roughly $2.6 million, plus one-time appropriations from
both internal and external sources that are directed towards specific research projects. Budget and staff support the following set of activities:

- Hardware, systems and software for support for research users
- Desktop and networking support for researchers in the INSCC building, 7th and 8th floors of the William Browning Building and for some computational scientists in the new Sutton building.
- Advanced network and cyber infrastructure development
- IT test beds for networking and system development
- Visualization and production services
- Teaching and learning contributions
- Large-scale statistics support
- Consulting services for scientific computing and information technology

Within this wide range of activities CHPC supports numerous projects on campus. A comprehensive list of projects and programs that receive consistent support from CHPC is given in Appendix I. In addition to these projects, numerous faculty and students benefit from infrastructure-type or campus-wide services that CHPC provides. These services and their constituencies are described in the rest of this document.
2.1 CHPC Semi-Annual Metrics: 07/01/2008 to 12/31/2008

In 2008 CHPC started to report on the following metrics on a semi-annual basis. This data will be measured on June 30th and December 31st of every year.

**Computational Power (Theoretical Peak):**

<table>
<thead>
<tr>
<th></th>
<th>June 30, 2008</th>
<th>December 31, 2008</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHPC</td>
<td>13.77 Tflops</td>
<td>35.29 Tflops</td>
<td>156%</td>
</tr>
<tr>
<td>TOP 500 Mean</td>
<td>34.91 Tflops</td>
<td>50.80 Tflops</td>
<td>46%</td>
</tr>
<tr>
<td>CHPC/TOP500 Mean</td>
<td>39.44%</td>
<td>69.46%</td>
<td>76%</td>
</tr>
</tbody>
</table>

**Service Units (1 SU= 1 hour wallclock hour on 2.0 Ghz core):**

<table>
<thead>
<tr>
<th></th>
<th>Jan-Jun 2008</th>
<th>Jul-Dec 2008</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Service Units</td>
<td>12,863,920</td>
<td>15,895,283</td>
<td>24%</td>
</tr>
<tr>
<td>Available (Theoretical)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Service Units</td>
<td>9,826,950</td>
<td>11,469,745</td>
<td>17%</td>
</tr>
<tr>
<td>used (all systems)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilization</td>
<td>76%</td>
<td>72%</td>
<td>-4%</td>
</tr>
</tbody>
</table>

**Desktops Supported:**

<table>
<thead>
<tr>
<th></th>
<th>June 30, 2008</th>
<th>December 31, 2008</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux</td>
<td>112</td>
<td>140</td>
<td>25%</td>
</tr>
<tr>
<td>Windows</td>
<td>118</td>
<td>119</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Macintosh</td>
<td>25</td>
<td>43</td>
<td>72%</td>
</tr>
<tr>
<td>Total</td>
<td>255</td>
<td>302</td>
<td>18%</td>
</tr>
</tbody>
</table>

**Other Metrics:**

<table>
<thead>
<tr>
<th></th>
<th>June 30, 2008</th>
<th>December 31, 2008</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Users</td>
<td>665</td>
<td>839</td>
<td>+174 (+26%)</td>
</tr>
<tr>
<td>Total Publications (from 1988 to present)</td>
<td>469</td>
<td>494</td>
<td>+25</td>
</tr>
<tr>
<td>Backed Up</td>
<td>25.4 TB</td>
<td>31.1 TB</td>
<td>5.7 TB (+22%)</td>
</tr>
<tr>
<td>Total Disk for Home Directories</td>
<td></td>
<td>225 TB</td>
<td></td>
</tr>
</tbody>
</table>
3 Hardware, Systems and Software Support for Research Users

3.1 Computational Infrastructure and Cyber Infrastructure

The infrastructure CHPC deploys is key to our success in supporting research. Using various tools and system designs, CHPC is able to remove the strict dependence of applications on a particular build of the operating system, make updating and patching the operating system less disruptive to applications, maximize our uptime and schedule planned downtimes less frequently. CHPC actively monitors all areas of its infrastructure so staff can proactively address issues. Through campus collaborations, CHPC works with groups to ensure other areas of campus infrastructure meet the needs of the research community.

3.1.1 NFSRoot

Management of large HPC clusters represents significant challenges. Many solutions have been adopted ranging from home-grown scripts to more automatic proprietary and standard methods. CHPC has been using NFSRoot to manage computational clusters for almost five years. NFSRoot provides many benefits – rapid deployment of new/replacement hardware, single image to maintain in a central location and smaller and cheaper local hard drives. However, NFSRoot does have some shortcomings. Shortcomings that CHPC is attempting to mitigate and improve are: 1) single point of failure from the NFSRoot server; 2) shared resources that impact performance of non-related groups; 3) shared NFS root file systems that impact system performance; and, 4) the requirement of extra vigilance in image maintenance. CHPC continues to identify the benefits and shortcomings that come with NFSRoot and established options to address these deficiencies. Thus far, the benefits have strongly outweighed the shortcomings so CHPC continues to press forward with its work in this realm.

Accomplishments relating to NFS root:
- Installed 2nd NFS root server to handle meteorology expansion in the SSB machine room
- Began the migration NFSRoot from RedHat Linux version 4 to version 5.
- CHPC is in the process of implementing 2 servers named Northwindow and Southwindow for multiple NFSRoot support and for failover support.

3.1.2 CHPCFS

During the past two years CHPC has successfully migrated its file server support to a clustered SAN storage model. This is to provide greater ability to handle the storage needs of our supported research groups. This area has had explosive growth over the past two years.
The total space currently supported on CHPCFS is 225 TB of usable storage. Most recently we have added the following to the SAN.

- 110 TB usable SAN storage for Meteorology Department
- 60 TB usable SAN storage for Tom Cheatham (Medicinal Chemistry)
- 25 TB usable SAN storage for Phil Smith (ICES)
- CHPC has implemented a redundant fiber channel SAN with 2 Cisco MDS 9134, 16 port, 4 GB fiber channel switches. CHPC expanded this switch to currently use 14 of 16 optic links which run at 4 GB’s per second.
- CHPC has found Promise fiber channel storage trays that using Raid 6 produce 11+TB of usable storage per tray with 1 TB SATA drives. The initial tray is called a controller tray, containing 2 controllers, with each controller attaching its optic to one of the Cisco switches. The controller tray begins a storage array. These Promise Controller trays can attach up to 4 additional trays, called JBODS (Just a Bunch of Disks) with no optics or controllers at a reduced cost. A full array results in an incremental storage cost of less than $1,000 per usable terabyte.
- CHPC funded the purchase of an “archive” LTO4 tape drive to allow researchers to purchase tape media and have disaster “archives” of data that is not included in the home directories. They can option this once a quarter maximum.
- CHPC has been testing ISCSI storage trays to consider augmentation of the fiber channel SAN disk offerings. These trays are from tier 1 vendors, such as Dell and IBM. The early indications are the ISCSI technology provides equivalent end-user response time over NFS as our existing fiber channel offerings, but at a potential cost savings of 10-25%. As CHPC looks to upgrade the services of the home directory SAN’s hardware, we will be able to offer this opportunity to the researchers as well, which means that CHPC’s SAN would be both Fiber Channel and Ethernet based.
- CHPC has nearly completed the move of the entire home directory storage from a single server to multiple servers running RedHat Cluster Suite, which provides multiple server access to the disks and failover support.

### 3.1.3 Monitoring

CHPC staff have developed a monitoring infrastructure that encompasses the servers, desktops, clusters, network and physical infrastructure equipment. CHPC staff built a distributed system that pulls information back to central servers and provides visualization into incident management, trending and reporting. The system is based on open source tools of Groundwork, Nagios, Cacti, MRTG and other tools. These tools have allowed CHPC to visualize the doubling in bandwidth usage over the past year and the 4 GB spikes that roll through the network regularly. The tools also alert CHPC staff to emergencies, especially in the physical infrastructure. For example, CHPC has less than 20 minutes to respond in any HVAC outage in the cluster data center due to the heat load densities. The monitoring also allows CHPC to characterize the use of the clusters and how they impact the physical environment. Using multiple sensors and monitoring tools, CHPC can study the use of cluster nodes via heat signatures. CHPC's holistic approach to monitoring has helped with determining dependencies of the various pieces of infrastructure and how CHPC can enhance work flows, troubleshooting and alerting.
CHPC has been able to share this monitoring expertise and experience with other groups on campus through email lists, IT-Manager presentations, WestNet presentations and other forums. CHPC staff have met with individual groups to learn more about their environments and have taught classes to share the knowledge and experience that CHPC has gathered.

### 3.1.4 Metro Optical Ring

CHPC staff are actively collaborating with the Utah Education Network (UEN), the Office of Information Technology (OIT)/Information Technology Services (ITS), the Cyberinfrastructure Director and others to formulate a design and implementation plan for a Metro Optical network that would interconnect the University of Utah, UEN, the new data center downtown and the Level 3 Point of Presence (PoP). This network will allow the use of multiple lambdas (light frequencies) on the same pair of fiber and will allow strong utilization and flexibility of resources. This network will have the flexibility to enable better collaborations for the research, academic and clinical areas of the University of Utah. As a large consumer of network resources, CHPC staff actively participate in this project in order to further collaborations and position CHPC, the University of Utah and others for success.

### 3.1.5 Data Center

CHPC continues to occupy three geographically distributed data centers. CHPC staff are also actively collaborating with the new University of Utah Data Center Design group and Data Center Business group to come up with a plan for building/retro-fitting a 75,000 sq ft building in downtown Salt Lake City as a University Data Center. This facility will eventually house almost all of the campus’s critical enterprise and research data stores. This facility will also host tenants from outside the University of Utah. CHPC staff are also active in collaborating with data center operational staff from across the University of Utah in determining monitoring criteria and other operational criteria for the new data center. CHPC has a focus on improving air flow and cooling efficiencies with regards to dense systems in data center operations.

### 3.1.6 Other infrastructure accomplishments:

- Created a full “sand box” replica of CHPCFS (including the clustering) to give CHPC a place to validate OS updates and configuration choices before pushing things to the production system.
- Evaluating iSCSI as a cost effective SAN option for future storage projects.
- Experimented with Traffic Lab for remote department file system support.
- Maintaining Red Hat Satellite Server support for Campus site license.
- Improved air flow and cooling efficiencies with regards to dense systems by making some physical plant enhancements, including plexi-glass airflow management.
- Improved monitoring of physical plant by deploying water rope sensors, numerous temperature and humidity probes and electrical probes and other sensors.
- Deployed an out of band network for lights out management of all CHPC services complete with for alternate path connectivity.
- Deployed new low latency infiniband fabrics for new clusters.
• Characterizing 10Gig network interfaces as an alternative to more expensive low latency fabrics
• Investigating characteristics of samba in order to allow participating with the CHPC Active Directory Domain (AD) as well as the campus kerberos infrastructure. This investigation will allow a more uniform user experience. CHPC will soon setup this infrastructure on the LabFS (the sandbox version of CHPCFS) to validate this integration.
• Late in 2008, CHPC, along with John Hurdle and Mollie Poynton, began development of a HIPPA compliant environment.

3.2 Computational Resources

• Updraft Cluster – deployed 2008
  CHPC and the Principal Investigators (PI) have targeted the Updraft cluster for very large parallel work. The expectation is that the utilization of this cluster will be lower than the traditional CHPC clusters due to the cost of draining the queues.
  - Shared 2/3 by the ICSE/CSAFE and 1/3 general campus researchers
  - 256 dual-quad core nodes (2048 cores)
  - 16 GB Mem per node
  - Intel Xeon 2.8 Ghz cores
  - Infiniband network fabric
  - The scratch server for Updraft is running Solaris with the Sun ZFS file system. This has 12 TB usage for the Uintah research group and 4 TB
  - exploring the use of NFS and iSCSI over RDMA networks (IB or iWarp enabled 10 gigE)
• Sand Dune Arch Cluster – deployed 2007
  - Allocated to the general campus
  - 156 Nodes, Dual/Dual AMD
  - AMD 2.4 Ghz, 8 GB Mem
  - InfiniBand network fabric
  - Deployed private nodes for Schuster and Molinero research groups
    - Molinero Nodes: 24 Nodes, Dual Socket/Quad core 45nm Intel Harpertown, 16 GB mem, 80 GB hd, CISCO InfiniBand (IB)
    - Schuster’s Cluster Upgrade (Geology & Geophysics) 12 Nodes Dual Socket/Quad core 45nm Intel Harpertown, 16 GB mem, 80 GB hd, CISCO InfiniBand (IB)
• NIH Arches Clusters – legacy system, expect retirement over next 12-18 month
  - Block grants for awarding PIs with substantial compute capacity available to the general campus
  - Delicate Arch: 256 dual core nodes (512 cores)
  - Marching Men: 171 dual core nodes (342 cores)
  - Tunnel Arch: 62 dual core nodes (124 cores)
• Landscape Arch Cluster – legacy system, expect retirement over next 12-18 months. Condominium cluster with various speeds and node configurations. PIs supported include:
  - CHPC – single large memory node – access granted to general user committee as needed
  - Greg Voth, Chemistry
- Michael Zhdanov, Geology and Geophysics
- Jerry Schuster, Geology and Geophysics
- Jack Simons, Chemistry
- Feng Liu, Materials Science
- John Horel, Meteorology
- Jim Steenburgh, Meteorology
- Thomas Reichler, Meteorology

- Turret Arch Cluster – general statistical support – deployed 2007
- Telluride Cluster – (Greg Voth) deployed and expanded in 2007, 48 Nodes, Dual/Quad Intel Clovertown 2.3GHz, 16 GB mem, 500 GB HD, Qlogic InfiniBand, - Installed Expansion of Dr. Voth’s Cluster (Chemistry Dept.) 24 Nodes 2.6…. 9TB Fiber Channel Disk Expansion
- Sequence Cluster – (Department of Pathology) legacy system
- Meteorology Computation Cluster – deployed 2007, expanded in 2008. Added 21 meteo compute nodes under 2 separate NFSRoot images to handle Meteorology’s need for web services as well as individual PI compute needs.
- VNMR – legacy system requiring updates to support the continuing academic roles
- Virtual Machine Cluster for computational use deployed 2007; updated 2008
  - Primary PI use:
    - Mollie Poynton, BMI, Windows VM for SAS
    - Albert Lei, BMI, RHEL VM
    - Lewis Frey, BMI, RHEL VM
  - Transitioned from a non-redundant system with 8x1.8GHz cores, 16G RAM, and 1TB disk; to a redundant system with 24x2.8GHz cores, 72G RAM, and 10TB shared SAN disk.
  - Introduced a lab cluster with 8x2.5GHz cores, 16G RAM, and 500G shared storage
- Secure Cluster - Late in 2008, CHPC began the planning and implementation of a “Secure” cluster for use by the School of Medicine constituency that would support projects which have sensitive data. This cluster (called the “Secure” or “HIPPA” cluster) has finished the design phase and the initial hardware purchase has been made. We are currently awaiting feedback from the compliance office. Additional funding is being sought through the federal economic stimulus grant. The PIs on this grant will be John Hurdle and Mollie Poynton.

### 3.3 User Support for High-End Users

The User Services group at CHPC provides software support, training and trouble shooting for the high performance computing activities at CHPC. Each year during the fall semester we teach a series of presentations (see Appendix III) to assist users new to our resources and existing users who need refresher courses. We repeat our most popular and useful topics again each spring semester. These training courses are available to the entire University campus. In addition, CHPC provides an electronic service desk where the user community may send questions or problems. User Services also maintains the primary CHPC web site where extensive user documentation on how to use our systems is provided and continuously updated.
• Computational Software (see http://www.chpc.utah.edu/docs/manuals/software) – in addition to our regular software support offering, CHPC added the following software support:
  o Cambridge Structural Database (CSD)
  o Grid Tool (Globus) enablement to Arches – UberFTP, GridFTP
  o NLP (Natural Language Processing) software packages
  o License Collaboration (Flex) with other departments for applications (cost savings)
  o Wiki support of some of the www.chpc.utah.edu public web site content (Easier editing/revision history. Developed routines in PHP on www to facilitate pulling the content.)
• In early 2008 CHPC migrated from a homegrown problem tracking solution to the Jira product from Atlassian. See http://JIRA.chpc.utah.edu.
  o Created processes for tracking HPC cluster reservations and ensuring all post-reservation maintenance is performed in a timely manner.
• CHPC has consolidated all of its internal documentation into the Confluence Wiki from Atlassian. Prior to this move in 2007, CHPC had several systems in place. With the flexibility of the security features and license consolidation with OIT, the Atlassian wiki has streamlined CHPC documentation. This system is now the central repository for all CHPC internal and external documentation and is a supplement to our user documentation. See http://wiki.chpc.utah.edu.
  o Created a handful of templates to help with creation of consistent documentation
  o Integrated login to the wiki with campus uNID/password authentication.
  o Set up several pages with tables that replace older spreadsheets (storing information like the health of our compute nodes) to ease collaboration and information sharing within the department.
  o Used the wiki as the central repository for documenting the responsibilities that fall under the CHPC Cross Team Services initiative. The Cross Team Services initiative aims to improve our ability to fix problems with our cross-discipline services. This is especially important when the "owner" of a service is unavailable.
• Campus Mail migration complete in 2007. CHPC no longer supports users on our mail server. Our user community is encouraged to use the Umail system.
• Kerberos/Campus Authentication - In January 2007 we completed our conversion of all user accounts from an arbitrary authentication string to the campus uNID.
• Utilization/Implementation of Campus VPN for remote access/security
• Automated and streamlined account creation and maintenance completed in the Fall of 2008.
• Downtime consolidation to minimize user outage. CHPC went from 8-10 downtimes per year down to just 4 scheduled downtimes. We now reserve a Tuesday during the Spring, Fall and Winter breaks in the University’s academic calendar and an additional downtime during the summer months.
• Migrated to the campus Sympa list server from our own mailman list server.
• Created isolated project in our JIRA instance for the FURThER project (Joyce Mitchell, PI, and Oren Livne, Biomedical Informatics).
• Web Servers (see Appendix IV for a list of supported web servers)
  o Upgraded the OS on our webservers to RedHat 5. Also moved most web services to the VM Farm to improve isolation of services and consolidation of hardware.
  o Web Site (www.chpc.utah.edu)
  o Automated management of Gaussian license users.
  o Automated user shell, email, and profile changes.
  o Increased user account event tracking to help with record-keeping and troubleshooting of issues.
  o Conducted major interface redesign of www.chpc.utah.edu to update our compliance with the university web standards.
  o As part of web site interface redesign, added processor utilization stats, featured research section, and data center "weather" to home page.

3.4 Service Desk Statistics
In January 2008 CHPC implemented a new problem tracking system. The system was in full production by April 2008. From this new system we were able to get some statistics for the partial year. The total number of reports represented in the chart below was 1735. We handle on average 163 reports from our user community each month and around 2000 per year.

![Number of Problem Reports in 2008 (partial year) - by Type](chart)

- Desktop (26%)
- HPC (arches, updraft) (27%)
- Storage and other Servers (18%)
- Accounts and Allocations (10%)
- Network (10%)
- Webservers and Online Applications (4%)
- Backups (2%)
- Data Center (2%)
- Misc. (Projects with <10 reports) (1%)
### 3.5 Utilization of HPC Systems

Below are three different views of the HPC usage data from the past two years. This is only usage for the large, computational clusters and does not represent utilization on smaller servers or desktop systems. The first table is listed by Principle Investigator (PI), the second is by department and the third shows the usage in relation to the available cycles. All usage numbers are in Service Units, where 1 service unit (or SU) is equal to one wallclock hour per core, weighted relative to a 2.0 Ghz core.

<table>
<thead>
<tr>
<th>PI</th>
<th>Department</th>
<th>College</th>
<th>Year 2007</th>
<th>Year 2008</th>
<th>Two Year Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armentrout, Peter B.</td>
<td>Chemistry</td>
<td>Science</td>
<td>172,043</td>
<td>107,271</td>
<td>279,315</td>
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<tr>
<td>Belz, John W</td>
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<td>8,278</td>
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<tr>
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<td>Medicine</td>
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<td>36,982</td>
<td>42,746</td>
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<td>Med. Chemistry</td>
<td>Medicine</td>
<td>2,394,460</td>
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4 Desktop Computing, Network and Other Computing Support in INSCC, WBB and the Sutton buildings

4.1 Microsoft Windows Support virtualized with VMWare.

In addition to the virtual machines CHPC runs for computation, this technology has been implemented to support our Windows desktop environment, running virtual machines (VMs) for Windows application server/repositories, Microsoft virus protection, Microsoft patch management (Shavlic), and as a Microsoft Operating System Testing. The main server is running VM-ESX 3.5 on a Dell 1950 server with 16 GB Ram, 750 GB hard drive (mirrored with RAID for reliability) and 2 - Intel Harpertown 2.66 Ghz quad core - 8 CPUs total. The VMs supported for MS support are:

- (aztec.chpc.utah.edu) A 32bit Windows Server 2003R2. This box is the main file repository for the Windows world and it runs the WINS (Windows Internet Name Server) for the INSCC Domain. Also it runs a license server for HyperChem 8.0
- (bigben.chpc.utah.edu) A Windows NT4 SP6 server which is the Secondary Domain Controller for the INSCC Domain.
- (eastgate.chpc.utah.edu) This is a Windows NT4 SP6 test bed to facilitate testing in the INSCC Domain.
- (alpha.chpc.utah.edu) EPO Alpha is a 32bit (required for EPO) Windows 2003 R2 server that runs the McAfee E Policy Orchestrator. This allows us to control clients running McAfee Virusscan and set policies as needed. It controls updating of DAT files and scanning of disks. It also allows us to block unwanted types of programs and executables that we enter manually to the policy catalog.
- (pcg2.chpc.utah.edu) A test bed for supporting the statistical package, SASS. Not all of the SASS functionality is available through the Linux version. Currently running 32bit Windows XP SP3.
- (update.chpc.utah.edu) This is a 64bit Version of Windows XP SP2. Update is the VM that runs the Shavlic patching software. Also used for testing 64bit applications and PSTools, a Sysinternals management tool set.
- (seven-pc.xwalk.utah.edu) A VM running the beta version of Windows 7 for testing purposes.

4.2 Security Advisory Incident Response and Network Team (SAINT) Collaboration

CHPC systems support data critical to researchers; therefore, a disruption of resources could result in significant loss of research data, research time and man hours. We have extensive computing resources and network bandwidth capabilities that if compromised could be used maliciously.

Staff security awareness, vigilance and education are a high priority and CHPC is dedicated to employing the best practices level of security. CHPC is part of the campus Security Advisory Incident Response and Network Team (SAINT). This team provides
training, auditing and incident handling, as well as research products, methodology and techniques for securing systems and networks.

CHPC was one of the first locations on campus to introduce department-wide centralized operating system patches and anti-virus solutions. For the last two years we have subscribed to and maintained a server for Linux Red Hat network services. This provides us and several other participating departments with secure and up-to-date Linux systems. CHPC has also deployed a central server for its Microsoft Windows and Apple Macintosh anti-virus and system patching. See [http://www.iso.utah.edu/](http://www.iso.utah.edu/)

### 4.3 Backups

CHPC currently backs up 70 servers for a total of 35 TB full backups and 3 TB incremental backups each week. The retaining cycle for incremental backups is 2-3 weeks. CHPC also retains some specific requested data for 1-12 months. As another option, CHPC supports some specific disk-to-disk backups to an NFS mounted 4 TB file system in another building.

In 2008, due to researcher data needs, CHPC began offering a tape archive service. This archive service offering intends to offer a research professor the ability to purchase LTO4 tape media to backup data that the CHPC standard home directory backup service does not cover. Five research groups have adopted this service so far and that number is expected to double over the next several months. The frequency of the archives is set at a maximum quarterly.

#### 4.3.1 Backup Hardware

IBM X3850m2, with quad dual core Xeon processors (8 CPUs). Each runs at 2.5 Ghz each. There is 16 GB or RAM, and 145 GB of high speed local mirrored disk.

#### 4.3.2 Backup Library

IBM 3584  2 frames,  4 LTO1, 1 LTO2 and 1 LTO3, and 4 LTO4 tape drives. Due to the density compression of LTO4, we have been able to reduce from 580 LTO tapes with 73 TB of native space and 146 TB compressed to 360 tapes which are a mixture of LTO1, 2, 3, and 4.

### 4.4 RedHat Network

CHPC has been a Red Hat customer for the past few years and has aggressively used the automatic patch feature set. However, the standard automatic patch feature set has not been effective in disseminating patches in a timely, convenient and consistent manner. To address this problem CHPC, along with several other departments on campus, licensed the Red Hat "Satellite Server" product.

This solution allows CHPC to mirror all the latest software updates from the Red Hat Network and host them locally. This mirror greatly increased the speed with which clients receive software updates. CHPC and other departments can also manage the updates and client registration via a convenient web interface.

The CHPC server named "rhn.chpc.utah.edu" is the host for the mirror. CHPC recently upgraded this server to a Dell 2950 with the following specifications:
- 2 – 4 core 2.5 Ghz (8 total CPUs) Intel Harpertown processors
- 1.5 Terabytes of disk in a Perc6i hardware configuration

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4.5 Networking support for desktop computing

CHPC provides network support for all research groups in the INSCC building, for two floors of the William Browning building and for portions of two floors of the new Sutton building. This support includes maintenance and operation of the network to the wall plate for more than 700 systems throughout these buildings. CHPC is responsible for planning, monitoring and upgrading the network to assure that computationally-intensive research groups have access to the network services that they need. CHPC also provides network interconnectivity for three separate machine rooms that interconnect most of the local computational resources upon which these groups rely.

Prior to 2007, CHPC upgraded all closet network ports to gigabit speeds using inexpensive commodity switch hardware. This upgrade was in part an experiment to verify whether this type of hardware would provide the proper performance and feature set to support a rich research environment. Thus far, the experiment has proven highly successful. Some caveats have arisen with port aggregation feature sets but the commodity hardware has allowed a more rapid turnover of equipment where needed. The gigabit deployment to all desktop ports has proven beneficial for many of the researchers and they greatly appreciated the early deployment. They have used their connectivity in leveraging grants and moving large data sets between terabyte file systems.

The leveraging of commodity switch hardware allowed CHPC to upgrade to a 20 GB switch fabric backbone in fiscal year 2006/2007. CHPC deployed the 20 GB fabric between the three machine rooms that house the center's clusters and the various research group file servers and applications. This 20 GB fabric is supporting the continually growing multi-terabyte data sets. The 20 GB fabric is also necessary as CHPC collaborates with several research groups to provide a Storage Area Network that mounts directly to many of the clusters and to desktop machines. CHPC is in the process of implementing 10 GB Network Interface Cards (NICs) in main file servers and backup servers. This implementation will also require the 20 GB fabric as CHPC looks to drop backup times and enable lower latency and better bandwidth to the file servers.

In fiscal year 2008/2009 CHPC also expanded network services to the Sutton and Browning buildings. With the addition of these buildings CHPC has started to implement 10 GB uplinks to wiring closets. Fiscal year 2008/2009 has also allowed the expansion of visual collaborations into the realm of high definition video. The new buildings and the high definition video will put more pressure on the CHPC 20 GB fabric.

The provision of multi-gigabit and 10 GB connectivity to servers allows CHPC to better support virtualization of servers. CHPC is successfully utilizing virtualization images for development and production enterprise applications. Virtualization allows for better use of data center real estate and power/cooling. Virtual servers, however, have their limits in high performance and I/O intensive applications. CHPC has been growing its use of virtualized servers and experimenting with various scenarios to determine the limits of performance. CHPC has brought both a production vmware ESX server cluster and a lab vmware ESX server cluster online. CHPC has moved approximately 25 servers to the production server with another 20-25 servers remaining to migrate. The server cluster will have room to expand to over 60 production virtual servers. The lab vmware ESX cluster allows CHPC to push the performance limits and help the research groups
determine what hardware, if any, they need to purchase for their application servers. The production server cluster utilizes the growing Storage Area Network that provides storage for all the groups.

4.6 Other Desktop Computing Support Accomplishments

- Backup services upgrades to LTO4 and capacity/consumption reached 25TB (doubled in one year).
- Implemented new service for researches to be able to make periodic backups of data for archival purposes.
- Migration INSCC Microsoft to Active Directory from Windows NT.
- Shavlik implementation for patching Microsoft Software and spyware.
- Moved users from 32-bit systems and apps to 64-bit systems and apps. (15 done, 15 to go)
- Set up Mac system to enable users and admins to ‘archive’ data of past and soon to be past PI members. 6 TB external storage.
- Set up new Dell dual quad-core, 8 GB ram file server with internal and external SAS attached drives to replace two aging file servers. Adding disk capacity (13 TB to 22 TB) and enhanced performance (doubled the number of CPUs).
- Set up new Dell dual quad-core 8 GB ram, internal and external SAS attached disks as a VTL server.
- Set up Arkeia to do disk-to-disk backups to the VTL of the above 22 TB server – two full copies plus increamentals for a total of 51 TB.
- Archived aging servers (12 TB + 8 TB disk tray) data to LTO4 tape, before systems are re-tasked.
- Set up Mac with 2 TB external storage for group desktop backups (iMacs and MacBooks)
- Used backup to restore complete system after total disk failure. User completely restored in less than two hours of downtime.

5 CHPC Research

5.1 NLP

There is a growing group of faculty and students across the University’s campus interested in using natural language processing (NLP) in their research. NLP research requires an infrastructure like any kind of research, but NLP expertise and technology are hard to implement because NLP skills and technology are difficult to master without expert resource support. In response to this growing need, CHPC and the Biomedical Informatics (BMI) department hired Sean Igo.

Sean now consults with researchers who need NLP technology in their work, and systematically installs and maintains NLP-oriented programs and other NLP datasets (e.g., UMLS) to support an NLP mission. This constituency is also one that will be heavily utilizing the new secure cluster. Faculty expected to make use of the NLP services include John Hurdle, MD, PhD (Biomedical Informatics), Marta Heilbrun, MD (Radiology), Mollie Poynton, APN, PhD (Nursing), Matthew Samore, MD (Internal Medicine), Scott Narus, PhD (Biomedical Informatics and the FURTHeR project), Joyce
Mitchell, PhD (Biomedical Informatics and the FURThEr project), and Mark Supiano, MD (Geriatrics).

5.2 Utah phGRID demonstration project: grid-enabling the Environmental Public Health Tracking Network

CHPC has contributed extensively to the NCPHI phGRID project in 2008. These efforts resulted in collaboration with phGRID team, caGRID (Ohio State University) developers and the University of Washington phGRID team on Globus and grid service development.

A large amount of GRID service implementation was accomplished in 2008 including the creation of four secure data grid services that simulated the foundation for an Environmental Public Health Tracking Network (EPHTN) GRID application. Our EPHTN project was presented at the Public Health Information Network annual meeting in Atlanta, GA.

5.3 North American Association of Central Cancer Registries (NAACR) Grid Project

A significant amount of isolation exists between cancer centers in North America. A collaborative effort between the North American Association of Central Cancer Registries (NAACCR), Utah Cancer Registry, Huntsman Cancer Institute, the University of Utah Biomedical Informatics, Intermountain Health Care and CHPC developed to address and overcome the effects of this isolation. These collaborating groups created a prototype in 2008 that allows the groups to easily and securely share private data among themselves. The groups are focusing on the use of Grid services to help eliminate the isolation. The use of grid services also increases the ability of participants to collaborate.

For the NAACCR prototype, the participating groups implemented two secure data grid services: Demographic and CancerID. The groups executed functional federated queries across these two data grid services. The queries can utilize the CancerID at one health care entity while the Demographic unit could exist at a separate health care entity inside a different administrative domain.

5.4 caBIG

CHPC started working with caBIG and caGRID at a time when no material existed on how to fully implement a data grid service from scratch. After learning how to create a caBIG data grid service, CHPC contributed instructional material on how to implement data grid services and shared this information with the caBIG community. Creating analytic, data and legacy grid services is still a very new endeavor and limited documentation exists. CHPC’s four years of experience working with Globus enabled CHPC developers to contribute to caBIG by creating a set of best practices for GRID service development in caBIG. The CaBIG knowledge center has adopted this set of best practices. CHPC developers also completed the CaBIG developer boot camp and successfully implemented GRID authentication and authorization between the server-side and client-side of grid services. A caBIG video showcased CHPC’s data center and resource.
5.5 Federated Utah Research Translational Health e-Repository (FURTHeR)

FURTHeR is the data and knowledge management infrastructure for the new Center for Clinical and Translational Science (CCTS) at the University of Utah. The objective of FURTHeR is to deliver innovative and practical software tools and services that can directly support data and knowledge access, integration, and discovery. CHPC is directly supporting their development efforts by leveraging the use of our JIRA problem tracking system. In addition, this group will be one of the first groups to make use of the new secure cluster.

5.6 CEMI

Dr. Martin Cuma has worked for the last several years with Prof. Michael Zhdanov from the Geology and Geophysics Department. Martin is a researcher in Michael’s Consortium for Electromagnetic Modeling and Inversion (CEMI). He has worked on development and performance enhancement of programs for electromagnetic earth structure imaging. Martin has presented his work at the annual CEMI meetings and at the national Society of Exploration Geophysicists (SEG) annual conferences.

6 Large-scale Statistics

6.1 Statistical Software and hardware support

CHPC provides a suite of statistical software for researchers, including a number of comprehensive packages (i.e., SAS, R, S-PLUS, GAUSS and BMDP) and several other “special purpose” packages for analysis not commonly encountered (i.e., SUDAAN, LISREL & PRELIS and HLM). Additional software may be installed depending on user needs and requests.

Our main statistics server (STATS.chpc.utah.edu) is a dual-processor Linux machine (2 GHz), memory (4 GB), and large disk storage. SAS, S-PLUS, R, GAUSS, LISREL and PRELIS now run on this machine, as their vendors offer Linux versions. BMDP still resides on our older SOLARIS machine (a Sun Ultra 30 Spark II), which has memory (1 GB) and disk (4 GB scratch space). Faculty research groups utilizing the statistical hardware at CHPC include Lisa Cannon-Albright (Genetic Epidemiology), Julio Facelli (Biomedical Informatics), David Goldgar (Dermatology) and Joseph L. Lyon (Family and Preventive Medicine).

6.2 Statistical Consulting

Consulting services provided by CHPC run the spectrum of research activities from something as simple as getting statistical software to accomplish the desired task to helping formulate a whole research design. CHPC research scientists consult on appropriate tests and language to get a publication past a reviewer’s specific criticism in order to achieve publication. CHPC research scientists also support collegial participation that results in co-authored publications. Some of these publications list in the CHPC bibliography.
Consulting activities here at the University often involve students, most of whom are working on or preparing to defend their masters or doctorate graduate projects. This involvement varies from a single meeting held to resolve research issues to participating as a member of the student’s graduate committee. See Appendix V for a list of recent examples of statistical consultation and teaching activities.

7 Advanced Network Support and Cyberinfrastructure Development

CHPC provides institutional or research representation for several advanced network and cyberinfrastructure activities. In 2008, CHPC repositioned its Advanced Network Lab to become an Advanced Network and Cyberinfrastructure lab. This repositioning of the lab has allowed better integration and tighter coupling of activities that cover networking all the way through the application layers. Cyberinfrastructure and cloud computing development, networking, systems and applications can no longer be discrete components. Entities must look to tune the complex system for peak performance.

CHPC has continued work with Utah State University (USU), Southern Utah University (SUU), Weber State University (WSU), Utah Education Network (UEN), University of Utah Office of Information Technology (OIT) and others in investigating ideas of a "Utah Grid." CHPC staff are working with SUU and UEN to set up experiments interconnecting remote computational and storage resources, both directly and indirectly with CHPC resources. CHPC is also exploring similar experiments with WSU.

CHPC is currently exploring various 10Gig Network Interface Cards with specialized features dedicated to storage. CHPC is exploring the next generation of data center 10 Gig switches, Infiniband and other low latency fabrics. These new low latency fabrics will provide the infrastructure for future cluster interconnects, enterprise server and storage interconnects and even potential remote site interconnects. Exploration continues into how much network topologies are actually converging.

In fiscal year 2007-2008, CHPC collaborated with UEN to purchase high-end network test equipment. This equipment has been very useful in investigating new network equipment, network designs and troubleshooting existing equipment and designs. CHPC and OIT/ITS are exploring collaborations in the 2008-2009 fiscal year to expand this high-end test equipment to allow for greater flexibility in troubleshooting enterprise network applications such as firewalls.

Beyond high-end equipment, CHPC is actively exploring open-source tools such as DynaMIPs for testing and emulating network designs. CHPC is able to deploy a whole network within the confines of a handful of boxes and do a large number of tests with protocols and configurations. As this platform develops, CHPC is planning to add latency capabilities to make the networks more accurately emulate the Wide Area. These abilities help in laying out future designs for the Utah Grid and in prototyping. CHPC can also use the knowledge to help other entities around the state.

CHPC aggressively supports advanced applications requiring stringent network needs. CHPC staff are trained on end-to-end performance initiatives and investigating tools such as High Performance Networking Secure Shell. CHPC is working to increase
understanding of how to tune network stacks in various operating systems. Beyond network performance and stack tuning, CHPC works with advanced applications such as the Access Grid (video/audio/etc. collaboration) and has developed multiple Access Grid nodes in INSCC, which are used by numerous groups on campus. CHPC also helps to deploy these applications in sites across campus.

CHPC continues to explore newer protocols or protocols that are migrating into the enterprise space. These explorations allow CHPC to aid other entities in troubleshooting network issues as they deploy in a limited or enterprise manner. One example is the use of multicast within the enterprise. Another example is IPv6 in various network and applications. CHPC continues to collaborate with off-campus and on-campus groups in regards to protocol deployment and performance testing.

CHPC also continues to investigate and collaborate with different hardware vendors such as Woven, Arista Networks, Myricom, Blade Network, Chelsio, and NetXen. CHPC also collaborates with established market leaders such as Intel, Broadcom, Cisco and Foundry.

8 Visualization, Video Conference and Multimedia Services

CHPC uses tools, such as DVTS, to send uncompressed Digital Video (DV) directly to the network for transmission over multicast or unicast to remote sites. In the first quarter of 2008, CHPC obtained several high definition (HD) cameras and are now sending higher resolution streams to remote sites. Working with a group in New Zealand, CHPC hopes to start sending full HD streams. These large streams require close monitoring of networks in order to provide clean signals, especially during performances. CHPC uses applications of this nature to help extend the technical reach into the arts, humanities, health and medicine fields. CHPC is currently working with telemedicine groups around the United States for collaborations. CHPC has also collaborated with groups around the United States and internationally to put together several distributed performances.

For a list of the collaborations, programs and events supported by CHPC’s visualization group, see Appendix VI.

Visual Wall

In collaboration with a National Institute of Health (NIH) grant, CHPC built a visualization wall (viswall) in early 2004 in order to provide researchers with an environment in which to view, in stereo, their data. Designed with the idea of a “workspace,” the viswall was built to accommodate as many as twenty groups. The viswall resides in a well-lighted room that allows researchers to read or take notes while still viewing a bright stereo representation of their data on the display. This aging facility is still in use, though, in need of upgrading to support the new generation of science visualization. A proposal to NIH-NCRR (Julio Facelli, PI) has been submitted to secure hardware to upgrade these aging resources.

Posters on the Hill
The University’s Undergraduate Research Opportunity Program (UROP) pairs undergraduate students with University researchers in a variety of fields so that students may gain valuable work and academic experience. As part of this program, the students prepare posters that describe their research projects. These posters are displayed each year at the capitol during the first week of the annual legislative session. Robert McDermott of CHPC’s visualization group helps the UROP students format and produce these large posters. CHPC also assists the students during their poster presentations at the capitol. The Posters on the Hill program has been very successful in educating legislators about the important research that is conducted at the University of Utah. For a complete listing of the UROP students and their projects see Appendix VII.

9 Outreach and Campus Activities (including Teaching and Learning)

CHPC uses the collective knowledge that it gathers to help teach and aid others. CHPC staff members have taught, co-taught or aided in classes regarding the implementation of upcoming protocols, use of clusters, and how to setup clusters. CHPC is currently working with other Utah universities to implement clusters of their own and is partnering with some of the universities in networking and cluster projects that will further aid the scientists in their research. The CHPC director is participating in panels that review other supercomputer centers and other panels that are formulating ideas about the future direction of grid computing both in Utah and at a national level. CHPC staff actively aid others at the University of Utah with questions regarding high density computing and its effects on machine rooms, as well as networking questions and how applications will affect a given network design.

In the past, CHPC has worked with research groups with their applications. For example, CHPC assisted Meteorology as they developed applications to distribute weather information to much of the western United States. The Meteorology groups also actively monitor weather patterns in large fires. CHPC helped the Radiology group determine how to quickly transfer large MRI data sets to one of the clusters, run a very short burst computation on many parts of the data set simultaneously, and then shove the results back to online storage for research analysis. In addition to these highlighted outreach activities, please refer to Appendix VIII for other outreach accomplishments.

9.1 Highlighted Outreach Activities

9.1.1 CHPC Newsletter

CHPC publishes an 8-page semi-annual newsletter highlighting current research that uses CHPC computing resources, resource updates, staff activities and other information useful to our users. The newsletter is distributed to all University of Utah faculty and administrators and about 150 interested readers throughout the world.
9.1.2 **Collaboration with USU, UVU, SUU and Weber on the first Utah Summer Institute in High Performance Computing**

As part of the “Utah Grid” theme, CHPC collaborated with scientists and staff from Utah State University, Utah Valley University, Southern Utah University and Weber State University to host the first “Utah Summer Institute in High Performance Computing.” Guy Adams from CHPC worked with Dr. Mikhail Bouniaev of Southern Utah University to recruit industrial sponsors for representation, talks and funding. Dr. Julio Facelli worked as part of the Organizing Committee. CHPC staff led half of the workshops at the institute. ([https://secure.suu.edu/ciet/uacsi/main.htm](https://secure.suu.edu/ciet/uacsi/main.htm))

9.2 **Support for University of Utah Coursework**

CHPC regularly provides computational support for classes where specialized computational hardware is required. Over the past two years these courses include:

- Chemistry 7100 and 7130, Joel S. Miller
- Chemistry 7530, Valeria Molinero
- Math 6790, Thomas Reichler
- Chemistry 5720, Physical Chemistry lab for VNMR
- Chemistry 1220, Dr. Anita Orendt - summer 2008 semester

9.3 **University of Utah Committees:**

- Distance Education Task Force – Jimmy Miklavcic, member
- Cyberinfrastructure Faculty Committee – Jimmy Miklavcic and Joe Breen, members
- Cyberinfrastructure Council – Julio Facelli and Joe Breen, members
- Media on Demand Committee – Jimmy Miklavcic, member
- IT-Managers – several CHPC staff member regularly attend meetings
- Data Center Design Committee – Joe Breen, member
- Data Center Business Committee – Joe Breen, member
- Network Architecture Committee – Joe Breen, former chair/member
- Wireless Committee – Joe Breen and Dave Richardson, members
Appendices

I. CHPC Supported Projects (Jan 2007-Dec 2008)

* Catalyst Structure and Vibrational Spectroscopy
  Scott L. Anderson, Chemistry

* Investigation of alkali metal sulfur amino acid complexes (methionine, Cystine) + 6 other projects
  Peter Armentrout, Chemistry

* Insight into Biomolecular Structure, Dynamics, Interactions from Simulation
  Thomas Cheatham III, Medicinal Chemistry

* Bioinformatic/Genomic Microarray Analysis
  Samir Courdy, Huntsman Cancer Intitute – Informatics

* Statistical Modeling of Natural Language
  Hal Daume III, School of Computing

* Efficient User-level Event Notification
  Al Davis, School of Computing

* Lattice Quantum Chromodynamic
  Carleton DeTar, Physics

* Investigation of Several Crown Ether Complexes for Lease Energy Conformation and Computational Bindings Enthalpies
* Battery Electrolyte Optimization
  Ted Eyring, Chemistry

* Genetic Algorithms to Model Organic Crystals
* Parallel Genetic Algorithms Development and Applications
  Julio Facelli, Center for High Performance Computing and Bio-Medical Informatics

* Computational Methods for Multiphase Models of Biological Gels
  Aaron Fogelson, Mathematics

* Radiative-Dynamic Interactions in Terrestrial Clouds
* Numerical Simulations of Cirrus Cloud Evolution
  Tim Garrett, Meteorology
* Pcode: A Database and Toolset for Exploring the Recoding of mRNA Transcripts
Ray Gesteland, Human Genetics

* Ab Initio Study of NMR Chemical Shifts
Dave Grant and Ron Pugmire, Chemistry

* Sensitivity of Atmospheric Data Assimilation Methods to Observational Uncertainty
John Horel, Meteorology

* Stereochemistry of Marine Natural Products
Chris M. Ireland, Medicinal Chemistry

* Numerical Simulation of Physically-Based Wildland Fire Modeling and its Integration in Large-Eddy Atmospheric Models
Mary Ann Jenkins, Mines and Earth Sciences

* Colloid Transport and Deposition in Porous Media
* Fate and Transport of Colloids and Nanoparticles
William P. Johnson, Geology and Geophysics

* High Resolution Fly’s Eye and Telescope Array Experiments
John W. Belz, Physics

* Designing Graphene Spin Super Lattice
* First Principle Calculations of Semiconductors - Organic and Inorganic
Feng Liu, Material Science

* Computation of IR Frequencies and Vibrational Modes of N-heterocyclic Carboxylates to Accurately Characterize the Experimental Frequencies
Janis Louie, Chemistry

* Neutrino and Gamma Ray Expectations from HiRes Monocular Fits
Kai Martens, Physics

* 3D Multiphase Flow in Porous Media with the Lattice Boltzmann Fluid Flow Models
Jan D. Miller, Metallurgical Engineering

* Electronic Structure and Spin Interaction of Molecule-based Materials
Joel S. Miller, Chemistry

* Structure of Thermodynamics of Supercooled and Confined Water
* Mobility, Structure and Crystallization in Amorphous Materials
Valeria Molinero, Chemistry
* Simulation Study for MRI Guided High Intensity Focused Ultrasound Ablation
* Path Optimization Parametric Study for High Intensity Focused Ultrasound Cancer Treatment
Dennis L. Parker, Radiology

* Center for the Simulation of Accidental Fires and Explosions (C-SAFE)
David Pershing, Science and Engineering Colleges

* Numerical Simulations for Weather and Climate Studies
Zhaoxia Pu, Meteorology

* Dynamics and Variability of the Coupled Stratosphere-Troposphere System
* High-Resolution Numerical Simulations of the Atmosphere
Thomas Reichler, Meteorology

* Insertion of an Oxygen Atom Leads to the Formation of New Manganese Carbonyl Complexes
* Ligand Effect Studies on C-F Bond Activation in Manganese Carbonyl Complexes
Tom Richmond, Chemistry

* Microarray Classification
* Schmidtea Mediterranea Genome Project
Alejandro Sanchez Alvarado, Neurobiology and Anatomy

* Seismic Modeling, Imaging, and Tomography Project
Gerard Schuster, Geology & Geophysics

* Modular Oxazoline Minimization
* Probing ASAR in Amino-oxazoline Ligand Systems
Matt Sigman, Chemistry

* DNA Damage and Peptide Fragmentation
Jack Simons, Chemistry

* Proton Transport in Polymer Electrolyte Membrane (PEM)
* Molecular Simulations of Energetic Materials and Materials for Energy Applications
Grant D. Smith, Materials Science and Engineering

* Large Eddy Simulations of Turbulent Reacting Flows
* Validation of Heat Transfer to Containers in Large Transportation Fuel Pool Fires
* Determining Combustion Efficiency for Industrial Gas Flares
Phil Smith, Chemical and Fuel Engineering

* Numerical Weather Prediction Over the Intermountain West
Jim Steenburgh, Meteorology
* Large Eddy Simulation of the Atmospheric Boundary Layer
  Rob Stoll, Mechanical Engineering

* First Principles Total Energy and Structural Properties of Semiconductor Materials
* Studies on NMR & Crystallography and on Structure of Kerogen and Asphaltenes
  G. B. Stringfellow, Chemistry

* Computational Science and Engineering Online (CSEO)
* Computational Chemistry of Combustion, Nano-Catalysis, and Solvation
  Thanh N. Truong, Chemistry

* Effect of Weathering on the Stability of Questa Mine-Rock Piles: Geochemical Modeling Aspects
  Edward Trujillo, Chemical and Fuels Engineering

* Simulation of Fundamental Chemical Processes in Condensed Matter
  Gregory A. Voth, Chemistry

* Computational Biomechanics
  Jeffrey A. Weiss, Bioengineering

* Comparative Genomics and Genome Annotation
  Mark Yandell, Human Genetics

* Using Electromagnetic Integral Equation Methods in Forward and Inverse Modeling of Complex Geoelectrical Structures
  Michael Zhdanov, Geology and Geophysics
II. Bibliography 2007 – 2008

For a complete bibliography from 1992 to the present, go to http://www.chpc.utah.edu/docs/research/CHPCBibliography.pdf

2008 (50)


High Resolution Fly’s Eye Observatory in Stereoscopic Mode. Physics, Salt Lake City, UT, University of Utah. Ph.D.


2007 (38)


McDermott, R. (2007). Building Models to Transition From Dimension to Dimension. Bridges
Donostia -- Mathematical Connections in Art, Music and Science, San Sebastian (Donostia), Spain, Tarquin Publications.


III. Presentations Offered by CHPC

Overview of CHPC
by Julia Harrison

This presentation gives users new to CHPC, or interested in High Performance Computing an overview of the resources available at CHPC, and the policies and procedures to access these resources.

Topic covered will include:
- The platforms available
- Filesystems
- Access
- An overview of the batch system and policies
- Service Unit Allocations

Statistical Resources at CHPC
by Byron Davis

This presentation gives users (and potential users) of CHPC's statistical resources an overview of the equipment and software presently available. Additionally a list of specialized statistical software will be presented that we've supported over the past 10 years or so.

Introduction to Parallel Computing
by Martin Cuma

In this presentation, we first discuss various parallel architectures and note which ones are represented at the CHPC, in particular, shared and distributed memory parallel computers. A very short introduction into two programming solutions for these machines, MPI and OpenMP, will then be given followed by instructions on how to compile, run, debug and profile parallel applications on the CHPC parallel computers. Although this talk is more directed towards those starting to explore parallel programming, more experienced users can gain from the second half of the talk, that will provide details on software development tools available at the CHPC.

Introduction to programming with MPI
by Martin Cuma

This course discusses introductory and selected intermediate topics in MPI programming. We base this presentation on two simple examples and explain the MPI parallel development of them. The first example encompasses MPI initialization and simple point to point communication (which takes place between two processes). The second example
includes introduction to collective communication calls (where all active processes are involved) and options for effective data communication strategies, such as derived data types and packing the data. Some ideas on more advanced MPI programming options are discussed in the end of the talk.

**Using Gaussian03 and Gaussview**  
by Anita Orendt

This presentation will focus on the use of Gaussian03 and Gaussview on the CHPC clusters. Batch scripts and input file formats will be discussed. Parallel scaling and timings with the different scratch options (TMP, MM, SERIAL, PARALLEL) will also be presented, along with a discussion of scratch needs of Gaussian03. Finally several demonstrations on the use of GaussView to build molecules, input structures, set up input files and to analyze output files will be presented.

**NLP Services at CHPC (NEW Spring 2009)**  
by Sean Igo

This presentation is an overview of the equipment and software presently available at CHPC for Natural Language Processing (NLP). It will also cover related resources for general Artificial Intelligence use such as machine learning and data mining.

**Telematic Performance - InterPlay: Nel Tempo Di Sogno (Spring 2009)**  
by Jimmy Miklavcic and Beth Miklavcic

Telematic performance with the Access Grid technology. Exploring the ever elusive passage of time, through a live, distributed, surreal cinematic event, artists and technologist from six cities performed simultaneously and shared these performances through Access Grid technologies to create a work of unprecedented scale and innovation. Beth and Jimmy Miklavcic will show their latest DVD, InterPlay: Nel Tempo di Sogno and follow up with a discussion about the challenges of creating this telematic performance.

**Hybrid MPI-OpenMP Programming**  
by Martin Cuma

In this presentation we will introduce hybrid MPI-OpenMP programming model designed for distributed shared memory parallel (DSMP) computers. The CHPC clusters are representative of this family having two or more shared memory processors per node. OpenMP generally provides better performing alternative for parallelization inside a node and MPI is used for communication between the distributed processors. We will discuss cases when hybrid programming model is beneficial and provide examples of simple MPI-OpenMP codes.

**Parallel performance analysis with TAU**  
by Martin Cuma
TAU (Tuning and Analysis Utilities) is a profiling and tracing toolkit for performance analysis of parallel programs. In this talk, we will introduce TAU as a new and flexible tool for tracing of parallel programs on CHPC Arches clusters. We detail small changes necessary to turn on the tracing and then explain how to visualize the trace files in Vampir trace viewer. We will conclude with some specific examples and glimpse on other features that TAU provides.

**Introduction to Programming with OpenMP**
by Martin Cuma

This presentation introduces OpenMP, an increasingly popular and relatively simple shared memory parallel programming model. Two parallelizing schemes, parallel do loops and parallel sections, were detailed using examples. Various clauses that allow user to modify the parallel execution were also presented, including sharing and privatizing of the variables, scheduling, synchronization and mutual exclusion of the parallel tasks. Finally, few hints were given on removing loop dependencies in order to obtain effective parallelization.

**Fast Parallel I/O at the CHPC**
by Martin Cuma

In this presentation we explain how to perform fast parallel I/O operations on the CHPC computers. It should be beneficial for all users who are interested in speeding up their parallel applications via faster file operations. First, we describe in detail PVFS (Parallel Virtual File System), installed on arches. Then we go over several examples on how to perform parallel I/O on this file system, in particular, MPI-I/O extension to the MPI standard and native PVFS function calls. Subsequently we detail ways how to compile and run MPI-I/O applications on PVFS. We conclude with an insight into some more advanced aspects of MPI-I/O.

**Chemistry Packages at CHPC**
by Anita Orendt

This presentation will focus on the computational chemistry software packages - Gaussian, Amber, NWChem, Molpro, Dalton, Babel, GaussView, ECCE - that are available on CHPC computer systems. The talk will be an overview of the packages and their capabilities, and will focus on details of how users can access the installations at CHPC.

**Debugging with Totalview**
by Martin Cuma

This presentation introduces Totalview, a debugger that has become a standard in the Unix code development comunity. After short introduction to its major features, we will present three examples, serial, parallel OpenMP and parallel MPI codes. Using these examples, we will show common and specific features for debugging these codes, as well as point out differences in using Totalview on different CHPC platforms.
Mathematical Libraries at CHPC
by Martin Cuma

In this presentation we introduce the users to the mathematical libraries that are installed on the CHPC systems, which are designed to ease the programming and speed-up scientific applications. First, we will talk about BLAS, which is a standardized library of Basic Linear Algebra Subroutines, and present few examples. Then we briefly focus on other libraries that are in use, including freeware LAPACK, ScaLAPACK, PETSc and FFTW.

IV. Web Servers Hosted by CHPC

CHPC:
www.chpc.utah.edu
www-test.chpc.utah.edu
www-dev.chpc.utah.edu
wiki.chpc.utah.edu
jira.chpc.utah.edu (aka issues.chpc.utah.edu)
mirror.chpc.utah.edu

University:
artgrid.chpc.utah.edu
greatsaltlake.utah.edu
neogastropodtol.org
simons.hec.utah.edu
truong.hec.utah.edu
utam.geophys.utah.edu
www.ebms.utah.edu
www.grid.utah.edu
www.hec.utah.edu
www.inscc.utah.edu

Other:
anotherlanguage.org
sl-acs.chpc.utah.edu
urgyensamtenling.org

V. CHPC Statistical Consulting Activities (Dr. Byron Davis)

Statistical Consulting Activities in 2007:
• Upgraded out previous statistical software server “stats” to the new “Turretarch” server. This new server has the following attributes: 2 Opteron Dual-Core 2.8 GHz Processors, Memory 16 GB RAM, Local Scratch Disk 250 GB. It presently includes the following software: SAS 9.1.3 (GUI), R 2.5.1, S-Plus 7.0.3 and HLM.
• Continued to teach undergraduate statistics for the department of Family and Consumer Studies both fall and spring terms; approximately 150 students.
• Taught graduate statistics for the department of Family and Consumer Studies this spring term for the first time.
• Involved in Time Series consulting/publication effort with Dr. Julia Corbett, department of Communication, University of Utah.
• Regularly attend and participate in the monthly Population Studies seminars.
• Created and manage a Statisticians email list at the U.

Statistical Consulting Activities in 2008:

• Upgraded the statistical software on our server “Turretarch.” The hardware was not upgraded in 2008. It presently includes the following software: SAS 9.1.3 (GUI; includes Enterprise Miner), R 2.8.1, S-Plus 8.1.1, HLM and WEKA (Java based, open source data miner).
• Continued to teach undergraduate statistics for the department of Family and Consumer Studies both fall and spring terms; approximately 150 students.
• Included 2 graduate students from Anthropology in my fall term statistics class (for graduate credit) for the department of Family and Consumer Studies.
• Taught/mentored Ph.D. student Ms. Peggy Collier, College of Education (3 hours Independent Study) for statistics appropriate for use in completing her dissertation and several granted projects she is involved in.
• Continued my involvement in Time Series consulting/publication effort with Dr. Julia Corbett, department of Communication, University of Utah.
• Regularly attended and participation in the monthly Population Studies seminars.
• Continued to manage a Statisticians email list at the U.
• Provided statistical consultation to researchers including those from the College of Law, and the departments of Communication and FCS.

VI. Multimedia, Digital Communications & Visualization Support (Jimmy and Beth Miklavcic)

• SIGGRAPH 2007 Full Conference Proceedings DVD
• Authored in partnership with Stephen Spencer of University of Washington.
• Eccles Health Sciences Library, Regional Medical Libraries - Access Grid support and testing with Kansas University Medical Center, Creighton University Medical Library and University of Nebraska Medical Center.
• College of Humanities – Install Access Grid node in Language Lab, Orson Spence Hall
• Los Alamos National Labs – Assisted in Multicast Network trouble shooting.
• Eccles Health Sciences Library – Assist Chuck Norlin (HSC) in an Access Grid Meeting with the University of Oklahoma Medical Center
• Department of Chemistry, Dr. Joel Miller – Assisted in Access Grid meeting with Ohio State University
• Department of Chemistry, Jack Simons – Record, produce and distribute twelve one-hour lectures on Electron Structure Theory. All lectures are streamed from our video server in CHPC.
• Department of Metallurgical Engineering, Dr. Jan Miller – Access Grid meeting with the South Dakota School of Mines and Technology.
• Access Grid Virtual Institute – Beth Miklavcic, Jimmy Miklavcic presented a discussion on our telematic collaborative performances using Access Grid Technology
• Utah State University – Set up Always-On Access Grid between USU and Utah
• Eccles Health Sciences Library, Slice of Life Conference – Jimmy Miklavcic, Keynote
• Digital Resources for the Humanities and Arts, Dartington College of Art – Presented paper “InterPlay- Performing on a High Tech Wire”, authors: Beth Miklavcic and Jimmy Miklavcic
• Humanities and Technology Association Conference, Terre Haute, IN - Presented paper “InterPlay- Performing on a High Tech Wire”, authors: Beth Miklavcic and Jimmy Miklavcic
• Body, Space and Technology Journal, Brunel University – Paper “InterPlay-Performing on a High Tech Wire”, Beth Miklavcic and Jimmy Miklavcic published.
• National Center for Supercomputing Applications, George Estes – Assisted in Access Grid meeting for the NSF Graduate research Fellows Program.
• Indiana University, Purdue University, Indiana,- Collaborate with Scott Deal of the Donald Tavel Arts Technology Research Center in the School of Music to set up UltraGrid Nodes (High Definition Video Conference System) at each site.
• College Music Society Conference, Salt Lake City – Collaborative performance with Scott Deal, Beth Miklavcic and Jimmy Miklavcic
• Department of Meteorology, Lis Cohen – Assisted in Polycom video conference with Oregon State University
• Department of Physics, Carlton Detar – Design Consulting for distance education classroom in Physics building
• Department of Geology & Geophysics, Jerry Schuster – Recording, streaming and archiving UTAM meeting
• Eccles Health Sciences Library, Regional Medical Libraries - Access Grid support and testing with University of Colorado Health Science Center, Washington University St. Louis.
• Philadelphia Orchestra – Test high definition video and 5.0 surround audio multicast streaming of four live performances of the Philadelphia Orchestra from Verizon Hall, Philadelphia. Introduced this event to Director of School of Music, Robert Walzel
• InterPlay: Carnivale (Jimmy and Beth Miklavcic)– Telematic Performance in collaboration with Rochester Institute of Technology, University of Illinois at Urbana-Champaign Technology, Research, Education and Commercialization
Center (TRECC) and University of Utah Physics - Carlton Detar -- Distance learning consultation.

- Chemistry – Jack Simons, Electron Structure Theory Lecture DVD
- Eccles Health Sciences Library – Joan Stoddard, Jean Simpman, Assisted in Regional Medical Libraries rollout of Access Grid system for eight, Medical libraries and facilitated NML site visit, Kansas University Medical Center, Creighton University, University of Colorado-Denver, University of Nebraska, University of Wyoming, Washington University –St. Louis, University of Missouri
- College of Nursing, Voice over services for instructional video.
- Philadelphia Orchestra – Greg Landry, Global Concert Series, assisted in international broadcast of Philadelphia, Orchestra performances in HD.
- College of Science – James Degooyer, Multimedia Assistance
- School of Computing – David Johnson, Demonstration of VisWall
- Physical Therapy – Bo Foreman, Assisted in Motion Capture Lab Set up
- University of Montana, IUPUI, University of Colorado – Scott Deal, Charles, Nichols, Mara Helmuth, Access Grid Venue services for music performance
- School of Music, Continuing Education – Betsy Oswald, Consultation regarding distance education in Music from UU to SUU.
- ACM SIGGRAPH 2008 – Stephen Spencer, Video editing and DVD authoring for Full Conference Proceedings DVD
- ACM SIGGRAPH ASIA 2008 – Stephen Spencer, Video editing and DVD authoring for Full Conference Proceedings DVD
- Chemistry/Chemical Engineering – Marc Porter, Access Grid specifications and quote for IGERT proposal
- Department of Languages – Janet Theiss, Consultations regarding distance education classes between UU and BYU.
- Meteorology – Julia Paegle, Video conference with conference in Melbourne Australia

VII. Posters on the Hill (Dr. Robert McDermott)

2007 Posters on the Hill

- F. Ahmed and C. G. Farmer, Department of Biology, Thermo-Regulation in Alligator Mississippiensis
- G. Baird and S. Casjens, Department of Pathology, The Bacteria-Infecting Virus P22 Tail Needle
• M. Beutler and K. Roper, Department of Biomedical Engineering, *Surface Co-localization of Gold Nanoparticles and Oligonucleotides: A Novel Approach to Biosensing*

• A. Bucio and A. Doig, College of Nursing, *Enhancing Decision Making in the Intensive Care Unit with a Graphical Monitoring Display*

• M. Burton and C. Wright, Department of Family and Consumer Studies, *Windows into Young Children's Thinking: A Study of Children's Storytelling*

• M. Carlisle and D. Strayer, Department of Psychology, *Weighing the Risks and Benefits of Using a Cell Phone While Driving*

• G. Dobie and L. Miller, Department of Mathematics, *Effects of Various Angles of Attack on Flow Through Bristled Wings*

• E. Franchow and Y. Suchy, Department of Psychology, *Brain Injury and Return to Work: Subjective Ratings of Memory Predict Outcome Failures*

• A. Gully and K. Golden, Department of Mathematics, *The Electromagnetic Behavior of Sea Ice: Helping to Assess the Impact of Global Warming*

• A. Hansen and M. Horvath, Department of Biology, *DNA-Protein Complexes Hinge at the Ancestral Role for the Telomere-capping Proteins*

• B. Hansen and A. K. Balaji, Department of Mechanical Engineering, *Design of a Neurosurgical Cutting Device*

• B. Hatch and M. Howard, Department of Human Genetics, *Functional Characterization of a Highly Conserved RNA Structure*

• W. Hawkins and R. McDermott, Center for High Performance Computing, *An Interactive Polyhedral Model*

• L. Hubley and C. Burrows, Department of Chemistry, *DNA Damage from the Flood Mutagen Glycidamide: Investigation of Base Adducts*

• T. Meacham, and I. Harvey, Department of Electrical Engineering, *Initial Characterization and Testing of a Micro-deployable, Silicon-based Iris Structure*

• P. Murray and D. Herrin, Department of Family and Consumer Studies, *"Mean Girls" Grown Up and the Silenced side of Family Violence*

• G. Newman and D. Emery, University Writing Program, *ESL Tutoring Protocols Rethinking the Role of the Writing Center*

• Y. Nkwen-Tamo and R. Kesner, Department of Psychology, *Effects of Inactivation of Perfrontal Cortex and Ventral Hippocampus on Enduring and Retrieval of Memory*

• M. Ogilvie and P. Flynn, Department of Chemistry, *Properties of Encapsulated Proteins in Reverse Micelles*

• O. Olafsson and B. Greger, Department of BioMedical Engineering and Ophthalmology, *Developing a Neural Prosthesis for Restoring Vision in Profoundly Blind Patients*

• K. Osborn and E. Jorgensen, Department of Biology, *Molecular Events at Brain Synapses: Does Syntaxin Form a Rosette*

• M. Palionyte, B. McDonald, B. Duncan, J. Cahoon, and J. D. Symons, College of Health, *The Contribution from Ceramide to Vascular Dysfunction in Diet-induced Obesity*

• E. Patterson and D. Strayer, Department of Psychology, *Brains and Chips: A System for Analyzing Imagery*
• S. Price and J. DiSario, Department of Gastroenterology, *Balloon Sweeping for Suspected Bile Duct Stones With Normal Cholangiography*
• E. Ribble and P. Shirly, School of Computing, *Procedural Generation: Computers Generating Art*
• P. Slusser and A. Tiwari, Department of Materials Science and Engineering, *ZnO/LSMO Superlattice Structures for Ultra-low-field Magnetic-sensing Devices*
• N. Smith and J. Freire, Scientific Computing & Imaging Institute and School of Computing, *VisTrails for Interactive Multiple-View Visualizations*
• A. Subbiah and A. Letsou, Department of Human Genetics, *The CG9109 Gene Product Functions in Dorsal Closure*
• G. Tran and R. Kesner, Department of Psychology, *The Role of the Hippocampus Outputs via the Dorsal Fornix for Spatial Memory*
• L. Verzella and C. D. Whiteman, Department of Meteorology, *Identification and Understanding of Wasatch Frontr Canyons Air Outflow*
• N. Vu and N. Moghal, Department of Oncological Sciences, *An In Vitro System for the Growth and Differentiation of Normal Human Bronchial Epithelial Cells*
• S. Waltman and A. Fogel, Department of Psychology, *Engendering Change in Non-verbal Adults with Autism*
• Z. Warnock and R. Whitaker, Bioengineering, Scientific Computing & Imaging and School of Computing, *Microscopic Computed Tomographic Analysis of Phenotypic Defects in Mice with Tragedted Disruption of the Hox-d11 Gene*

### 2008 Posters on the Hill

• Zinovii Abolnik, Truston Boding and Anthea Letsou, Human Genetics, *Embryonic Development in Drosophila as a Model for Human Disease*
• Deisy Ramirez-Aguilar, Shontol Torres-Burkhalter, and Theresa Martinez, Sociology & H.S. LEAP, *Immigrant Health Project: Analyzing Health Care Disparities Among Latino Immigrants In Salt Lake City, UT*
• Deisy Ramirez-Aguilar, Shontol Torres-Burkhalter, and Theresa Martinez, *Affirming Equity: Creating Access to College Careers Among First generation Students of Color in Elementary Schools*
• Karl Boehm, Judd Cahoon, Bradlee Duncan, Justin Grisham, Devin Kearns, Jason Losee, Milda Palionyte, Scott Simpson, Jason Michael Tanner, C O H, of Endocrinology, Metabolism & Diabetes, *Inhibiting Vascular Ceramide Synthesis Prevents Arterial dysfunction & Hypertension in Mice with Diet-Induced Obesity*
• Michael DeLisi, Geoff Sawaya and Ganesh Gopalakrishnan, Computer Science, *Automated Model Checking*
• Muhammad Adeel and Dan Margalit, Mathematics, *Geometry of Mobious Transformation*
• Safia Ahmed and Lance Miller, Pediatric Nephrology, *Inactivation of GATA3 leads to nephrotic syndrome*
• Nathaniel L. Cornwell and Wayne Potts, Biology, *High fructose corn syrup diets increase mortality in female mice*
• Jenny Greer and Bruce Gale, Mechanical Engineering, *Minituriization of DNA Mutation Detection*
• Tiffany Sang- Mee Han and Grzegorz Bulaj, Biology, Engineering Conopeptide-Based Therapeutics for the Treatment of Pain
• Shane Michael Hawthorne and Alan Light MD, Anesthesiology, SOM, Calcium Imaging of Mouse DRG Neurons Yields Insight into the Possible causes of Chronic Fatigue and fibromyalgia Syndromes
• Austin Michael Hill and Robert Hitchcock, Bioengineering, Measurement of Interstitial pressures Utilizing Microminiature Probe
• Sharlei C. Hsu and Michael Bastiani, Biology, Ankyrin (unc-44) Functions in the Maintenance of the nervous System in C. Elegans
• Elliott Karren and Patrick Kiser, Bioengineering, Measuring the Cytotoxicity of Materials on the bacterial strain Lactobacillus jensenii
• Daniel Kopta and Erik Brunvand, Computer Science, Ray Tracing Software for a Custom Processor Architecture
• Warren Lake and Jim Martin, Exercise and Sports Science, Maximal Neuromuscular Function: The Effect of Temperature on Performance
• Ann Katie Miller and Darryl Kropf, Biology, Kinesin-5 Motors in Silvetia compressa
• Hannah Hyochan, Pradip Bandyopadhyay and Baldomero Olivera, Biology, Phylogenetic analysis of mollusk-hunting Conus species based on ITS sequences
• Lydia Potekhina and Richard A. Normann, Bioengineering, Control of micturition using Utah Slanted Electrode Arrays (USEA)
• Jamie Sue Rankin and Orest Symko, Physics, Amie Reynolds and Cynthia Berg, Psychology, Study of Piezoelectric Transducers for Converting Sound to Electricity in thermoacoustic Engines
• Christina Smith and Kevin Whitty, Chemical Engineering, Opportunities for Energy Production from Solid Waste in the Mexicali Region
• Rebecca Taylor and Les Chatelain, Health Promotion and Education, Natural Disaster Management
• Tania Thambyah and Alan Light MD, Anesthesiology, SOM, The Relevance of ASIC3, TRPV1, and P2X Receptors in Fibromyalgia and Chronic Fatigue Syndrome
• Jared Thomas Thorley and Patricia Flannery Pierce, College of Nursing, The Children's Computerized Physical Activity Reporter: Reliability and Validity
• David Toledo and Ashutosh Tiwari, Materials Science Engineering, High Throughput Production of Zinc Oxide Nanostructures by Low Temperature Solution-Based Technique
• Daniel Tucker and Ian Harvey, Mechanical Engineering, PDMS Lens for Iris Actuator Prototype
• Erick Michael Westbrook and Bradley Cairns, Oncological Sciences, Connecting Transcription to centromere Formation in S. pombe

VIII. Other Outreach accomplishments

• SC2007, SC2008: Each year CHPC represents the University of Utah at the ACM/IEEE SC conference. Our exhibit showcases University of Utah Research accomplished with support of the CHPC infrastructure, with digital visualizations,
posters. In 2007 we shared our exhibit space with three other entities: the Scientific Computing and Imaging (SCI) Institute; the Center for the Simulation of Accidental Fires and Explosions (C-SAFE); and The Center for High Performance Computing at Utah State University (HPC@USU). In 2008 the exhibit space was shared with High Performance Computing at Utah State University (HPC@USU).

- **Joe Breen** worked with national labs to increase network performance to some National Centers by 10-30% - still in progress. Joe has also begun performance tests with USU for Utah to USU portion of UtahGrid collaborating with the Utah Education Network.

- **Tom Ammon** collaborated with various departments to train and distribute monitoring of services and to begin prototype of campus enterprise monitoring. He also collaborated with campus groups on protocol deployment and performance.

- **Dr. Anita Orendt** has been involved in the local Salt Lake section of the American Chemical Society (chair – elect 2008) governance. The group does science outreach to local elementary schools, runs the high school Chemistry Olympiad program and has an annual National Chemistry Week hands-on event for children at the Salt Lake public library. She has also used the CHPC visualization wall for presentations for programs such as the UU Science Day and the HS chemistry summer enrichment program. She also acted as the advisor to the U of U ACS Student Affiliate group and was the Salt Lake local section representative on the ACS Northwest Regional Board. Dr. Orendt has collaborated with several research groups in the Department of Chemistry, including the groups of Professors David Grant, Ronald Pugmire, Peter Stang, Matt Sigman, and Charles Grissom. She also presented a poster “13C Chemical Shielding Calculations of Actinide Complexes” at the ACS National Meeting in March 2008.

- **Dr. Martin Cuma** wrote a performance paper on Infiniband on PCI/e with Qlogic and Cisco (Mellanox). In the Fall of 2007 he compared performance of two leading InfiniBand cards from Mellanox and Qlogic. The study was prompted by lack of similar evaluation in the public domain. He found that that the more expensive Qlogic card is superior for certain applications while for other programs the two cards perform similarly. The study results are of value to the community in purchasing decisions regarding these two products.

- **CHPC Staff** setup relationship between CHPC, SUU, Weber and USU system administrators to explore various technologies that would allow researchers at both institutions to better collaborate and share resources. At SUU we have hardware set up.

- **Steve Smith** volunteered as a CHPC representative for the 2008 "Employee Appreciation" day. He helped out by making snow cones for employees.

- **Ron Price** is CHPC’s collaborator on the Utah phGRID demonstration project. He co-presented GRID work at the Public Health Information Network annual meeting and collaborated with the University of Washington on grid development tips and tricks. He wrapped SaTScan (a spatial analysis tool) in a secure grid service and architected and implemented a way to stand-up SaTScan grid nodes on-demand in the Nimbus Cloud while collaborating with Argonne National Lab.