Computational Research Center - University of North Dakota

Facilities and Equipment

SandyBridge High Performance Computing Cluster - The Computational Research Center recently received funding to purchase a 6 teraflop, HPC linux cluster. This system is comprised of 32 compute nodes and a single head node. Each compute node is a Dell PowerEdge 720 server and has 64GB of RAM, a set of mirror raided 15K RPM SAS drives, and dual 3.3GHz four-core E5-2643 SandyBridge processors. Each server has multiple PCIe 3.0 expansion slots, and is capable of hosting two full-size Intel MIC or NVidia Tesla K10/20 GPU cards. A second smaller HPC cluster, comprised of a single head node and four compute nodes (identical to those described above), was purchased for code testing purposes. The installation of these clusters was completed July 2012.

Eight NVidia Tesla K20 accelerator cards and eight Intel Xeon Phi cards are scheduled to be installed in CRC clusters during Q3 and Q4 of 2013.

Multiple networks have been employed to implement the HPC environment. The head node is connected to 10Gb public network, and is accessible from the Northern Tier Network Consortium's research network. The cluster has two private networks: a 1Gbit administration network, and a 56Gbit FDR 1-to-1 InfiniBand (IB) interconnect for MPI applications. Both the 32 compute node cluster and the test cluster utilize the same network infrastructure.

Storage and Data Transfer - A 144TB (usable 110TB in a RAID 6 configuration) High-Availability NSS Dell storage appliance was purchased in conjunction with new HPC systems described above. The storage appliance uses a Red Hat implementation of the XFS file system, and is mounted to both SandyBridge clusters via NFS over the InfiniBand network. The storage appliance is currently capable of being expanded to 512TB, but potentially is expandable to 1PB upon an RHEL OS update expected to be released in December of 2012. In addition to the IB network, the storage appliance is also accessible via the 10GbE network. Storage backup is provided through an SLA with the North Dakota University System (NDUS) SITS organization.

WinHPC System - The CRC currently maintains a six node WinHPC 2008 R2 cluster. Each compute node has dual AMD Opteron 1.9GHz four-core processors and 16GB of RAM. The system has 5TB of usable storage available through a Windows drive share hosted within the WinHPC private network.

CRC/ITSS Support Staff - The CRC maintains a full-time HPC Specialist (HPCS) and the FTE equivalent of a full-time system administrator through an SLA with the NDUS SITS. The HPCS works closely with faculty and graduate researchers to implement their research codes and off-the-shelf applications within the CRC's HPC systems. This position also works closely with HPC stakeholders to identify needed software and hardware resources as well as application expertise. The HPCS is also the university's Campus Champion representative to XSEDE.

Software Support - The CRC maintains a number of operating systems, compilers, and software applications for its HPC and Visualization environments. These include (but not limited to) Matlab, IDL, PGI Compilers, Intel Compilers, GCC compilers, CUDA, Ansys Fluent, Autodesk Maya, Schrodinger Suite, MOAB HPC Suite, RHEL 5.4, RHEL 6.2, WinHPC 2008 R2, and more.

Computational Research Center - University of North Dakota

Facilities and Equipment

Visualization System - The CRC collaborates with the UND Digital and New Media Working Group (DNM) to provide visualization services to university researchers. The CRC Cyviz Viz3D stereoscopic projection system is located in the DNM laboratory, and is available for use upon request. 3D modeling and educational media consulting can be obtained from the DNM as well.

Volunteer Computing and the ND Science Grid - The CRC collaborates with the CS department to host a portion of the UND Volunteer Computing (VC) infrastructure. This infrastructure is based on the BOINC middleware environment for VC. VC is a form of distributed computing where the general public volunteers computing power to a research project. The usual use case has a member of the general public download a computing client to that person's personal computer. Whenever the personal computer becomes idle, the computing client runs research code, and then returns the results back to the research project via the Internet.

UND CRC, UND Dept of CS, and staff and faculty at North Dakota State University have formed a group to investigate the development of the *ND Science Grid (NDSG)*, a science gateway for ND-based VC projects. Initially, the NDSG website will be little more than a set of links to various volunteer computing projects. Eventually, a series of downloadable curriculum packets would be available for educators to use in K-12 classrooms. These packets will discuss the science behind each VC project that is made accessible through the NDSG website. As part of the curriculum packets, educators will be provided instruction on how to install the grid client on K-12 clusters at their schools and establish a K-12 computing team. Teams that generated the most volunteered compute cycles would win prizes. UND and NDSU would work with EDUCTECH to promote the VC competition and recruit vendors to sponsor prizes. In this way, the NDSG will double as a K-12 science education outreach program, and a mechanism to harvest free compute cycles for scientific computing projects implemented at ND universities.