

# MSI Facilities Statement

Established in 1983, the Minnesota Supercomputing Institute (MSI) is the University of Minnesota's principle center for computational and data intensive research. MSI provides services to over 880 active groups that sponsor more than 4,500 unique users from 19 different university colleges, maintaining an array of systems dedicated to the computational and data intensive research needs of investigators in the state of Minnesota's higher education institutions and their collaborators.

## **High Performance Computing**

MSI's High Performance Computing (HPC) systems are designed with high speed networks, high performance storage, GPUs, and large amounts of memory in order to support some of the most compute and memory intensive programs developed today. MSI's HPC systems are comprised of over 40,000 X86 64-bit compute cores and 145 TB of RAM, which can support over 1.6 PFLOPS of peak performance. HPC nodes are equipped with between 64 GB and 2 Tb of RAM to support applications that require small and large amounts of memory, 32 nodes have Solid State Drives (SSDs) to support applications with demanding input and output (I/O) requirements, and 57 nodes include various configurations of the NVidia general purpose GPU accelerators (K40 and VT100), from 2- to 8-way.

## **Interactive Computing and Scientific Visualization**

In collaboration with the Laboratory of Computational Science and Engineering, MSI supports a visualization laboratory. The Lab can accommodate up to 24 people and is located in the same building as the MSI. MSI also supports specialized interfaces (i.e., NICE EnginFram and Jupyter Notebooks) and hardware for remote visualization and interactive computing. Interactive HPC systems allow real-time user inputs in order to facilitate code development, real-time data exploration, and visualizations. Interactive HPC

systems are used when data are too large to download to a desktop or laptop, software is difficult or impossible to install on a personal machine, or specialized hardware resources (e.g., GPUs) are needed to visualize large data sets.

### **Cloud Computing**

MSI supports an on premise cloud computing platform built on OpenStack to support special data use agreements and to allow quick deployment of web, database, and other non-High Performance Computing systems. The virtual instances in this environment are available for a fee in a variety of sizes depending on the number of processors and the amount of memory and disk space required for the project.

### **Data Storage**

All MSI researchers have access to a high-performance parallel storage platform. This system provides 6.4 PB (PetaBytes) of storage with sustained read and write speeds of up to 48 GB/sec. The integrity of the data is protected by daily snapshots and tape backups. High value data sets are backed up to an off site facility as a part of the institute's disaster recovery plan. MSI also supports a second tier storage solution designed to address the growing need for resources that support data-intensive research. The system is tightly integrated with other MSI storage and computing resources in order to support a wide variety of research data life cycles and data analysis workflows and uses Amazon's S3 (Simple Storage Service) interface, so that researchers can better manage their data, more seamlessly share data with other researchers, and migrate entire data analysis pipelines to cloud-based platforms.

### **Data Centers, Network Connectivity, and Office Facilities**

MSI enables interdisciplinary research through its robust data center facilities with over 1 MW of IT capacity to support leading edge computational and data storage systems. MSI supports two data centers, both of which are

connected to the campus network with speeds up to 100 Gbps. Campus networks connect to our regional optical network and Internet2 at 100 Gbps giving our researchers the network capacity and capability needed to collaborate with researchers from around the world. Located in the Walter Library building, MSI office and data center space (~ 18,000 sq. ft) are centrally located on the Minneapolis campus. MSI also maintains office spaces on the Saint Paul campus where additional researchers are located. MSI also provides computer and teaching laboratories, which are primarily used for outreach and teaching workshops.