



# University of Notre Dame Center for Research Computing

Building a high-performance computing landscape for multi-disciplinary research



The Center for Research Computing (CRC) at the University of Notre Dame is an innovative and multidisciplinary research environment, which has computational expertise in data intensive areas spanning engineering, life and geospatial sciences.

Dr. Jarek Nabrzyski, the Director of the CRC, explains: “Computing has become a third pillar of how science and research are performed today, complementing theoretical and experimental studies. The CRC provides infrastructure and support services for faculty members and students who need access to computational resources in their research.”

## Growing demand for high-performance computing

“Over the past five years, our user-base has grown five-fold, from 300 to 1,500, and the number of cores in our cluster has grown from 8,000 to more than 20,000,” says

### Overview

How do oceans interact with the atmosphere? What effect do shockwaves have on different materials? To complement theoretical and experimental methods of answering such fundamental questions about the universe, researchers at the University of Notre Dame need to harness modern approaches such as computational simulation. To this end, Notre Dame’s Center for Research Computing (CRC) has built a new high-performance computing environment based on NeXtScale System technology, which supports a range of important research projects – delivering results at the speed researchers need to meet their deadlines.

“The NeXtScale System gives us the platform we need to keep up with ever-growing demands.”

—Dr. Jarek Nabrzyski,  
Director of the Center for Research Computing,  
University of Notre Dame



Dr. Nabrzyski. “This growth brings us many challenges. We need systems that offer high performance, that are very easy to maintain, that are modular and can grow over time, and that work with our open source software tools.”

In partnership with two other universities, the CRC gained funding from the Department of Energy to build a new cluster to support multi-scale/multi-physics simulation projects. It also obtained funding from the university to upgrade its existing infrastructure to support the general Notre Dame research community.

To meet both of these objectives, the CRC needed to find a new system that was versatile enough to support many different types of computing workloads.

### Finding the right solution

Dr. Nabrzyski explains: “Timing was very important in this case. The NeXtScale System™ not only ticked all the boxes in terms of our requirements – it could also be deployed very quickly because it was delivered as an Intelligent Cluster, a pre-tested, pre-packaged solution. We were also confident that the Lenovo sales and engineering support team had the skills to build a system that would be tuned to offer the performance we need.”

The new NeXtScale cluster comprises compute nodes powered by Intel® Xeon® dual 10-core processors, with 2 GB of memory per core for a total of 2,880 cores of compute capacity. The NeXtScale racks are currently half-populated, allowing plenty of room to install extra nodes or next-generation accelerator/GPU cards as demand for computing resources increases in the future.

High-speed networking is provided by the Mellanox FDR Infiniband, which ensures smooth application performance across the whole cluster. The operating system is Red Hat Enterprise Linux, and provisioning is managed by the open-source Extreme Cluster/Cloud Administration (xCAT) toolset.

“We have a lot of experience with xCAT – it’s very powerful, and it’s free, so it was important to us that the new NeXtScale infrastructure can integrate seamlessly with our existing xCAT tools,” says Dr. Nabrzyski.

### Supporting research – at speed and scale

With the NeXtScale System cluster in place, the CRC is able to support exciting new research projects in a wide variety of fields. For example, as part of the multi-scale/multi-physics initiative, materials science researchers at Notre Dame are working on shockwave processing of advanced reactive materials. Other research teams are using the infrastructure to support life science genomics, atmospheric and oceanic analysis projects, and analyzing how structures perform under turbulent wind loads.

#### Solution components

##### Hardware

- NeXtScale System™ with Intel® Xeon® processors
- Mellanox FDR Infiniband

##### Software

- Red Hat Enterprise Linux 6.X
- Extreme Cluster/Cloud Administration Toolkit (xCAT)

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“The NeXtScale architecture is very energy-efficient and has a good thermal profile for our air-cooled data center,” says Dr. Nabrzyski. “It’s also very reliable, which is important because our researchers are often working to tight time-frames, and need the HPC environment to give them their results on time, every time.”

He concludes: “Today, science is increasingly data-driven, and we are experiencing huge growth in the number of big data problems that our researchers are working on. We’re helping our faculty develop the software tools they need to analyze this data – but we also need to put the right computing infrastructure in place. The NeXtScale System gives us the platform we need to keep up with these ever-growing demands.”

### For more information

To learn more about NeXtScale System, contact your Business Partner or visit: [lenovo.com/systems](http://lenovo.com/systems)

For more information about the Center for Research Computing at the University of Notre Dame, visit: [crc.nd.edu](http://crc.nd.edu)

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