

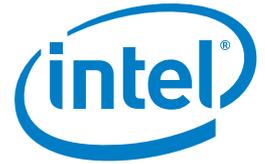
## CASE STUDY

### Intel® Xeon® processor 5600 series

Education

Technical Computing in the Cloud

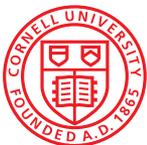
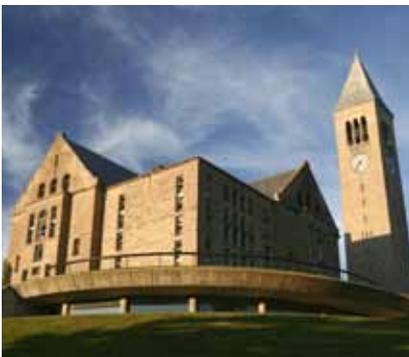
High-Performance Computing



# Looking to a Cloud for On-Demand Research

Cornell University builds its flexible and scalable Red Cloud service using Dell servers with Intel® Xeon® processors

The Cornell University Center for Advanced Computing (CAC) needed a cloud computing platform configured to meet the unique needs of research scientists and engineers from Cornell, other academic institutions, and industry. The solution was to build “Red Cloud”—a cloud computing service designed specifically for research that provides Infrastructure-as-a-Service (IaaS) using Dell PowerEdge C\* servers equipped with the Intel® Xeon® processor 5600 series and Intel® Ethernet 10 Gigabit Server Adapters. With this new service, CAC is helping researchers in a broad range of fields to access the outstanding compute performance they need, when they need it, without excessive costs.



“We want to offer researchers the latest and greatest technologies to help them get the performance they need, when they need it, without deploying systems that would be underutilized. Intel® Xeon® processors provide a strong differentiator for CAC and help us continue to attract researchers with cutting-edge projects.”

— David Lifka,  
Director, Cornell University  
Center for Advanced Computing

## CHALLENGES

- **Provide on-demand HPC resources.** Facilitate cutting-edge research, education, and outreach in a variety of fields by offering cost-effective access to on-demand resources.
- **Maximize flexibility and scalability.** Complement existing traditional HPC clusters to fulfill research computing needs—from temporarily extending HPC clusters and hosting research wikis and science gateways to providing virtual workstations and computer labs. Red Cloud runs on Eucalyptus to ensure compatibility with Amazon Elastic Cloud Compute (EC2) so that users can scale beyond the capacity of Red Cloud as needed.

## SOLUTION

- **Red Cloud with Dell servers and Intel® Xeon® processors.** The Red Cloud IaaS service uses Dell PowerEdge C servers equipped with the Intel Xeon processor 5600 series and Intel® Ethernet 10 Gigabit Server Adapters.

## TECHNOLOGY RESULTS

- **Outstanding performance.** Built on Intel Xeon processor-based servers, Red Cloud helps researchers accelerate results from days to hours compared with existing departmental resources.

## BUSINESS VALUE

- **On-demand flexibility.** The IaaS offering provides on-demand resources for short- and long-term needs without requiring research groups to purchase and maintain their own infrastructure. A second offering—Red Cloud with MATLAB—is a Software-as-a-Service (SaaS) targeting MATLAB users.
- **Seamless scalability.** Researchers can easily scale up to Red Cloud from departmental workstations and scale out from Red Cloud to larger commercial cloud environments.
- **Broad research support.** CAC provides systems and application-level consulting to facilitate exciting new research with cloud computing.

CAC is dedicated to providing robust HPC resources to researchers in a broad array of fields, from computational biology and genetics to engineering and applied physics. The center’s 19 Intel® processor-based clusters have supported recent projects that

have analyzed the global rhythm of moods (by mining 2.4 million Twitter messages) and modeled the superconducting cavity of an electron injector and linear accelerator that would be 1,000 times brighter than any X-ray beam in existence.



## Intel® Xeon® processors deliver the processing power and memory bandwidth for cutting-edge research

“Researchers are always hungry for processing power, and many need large memory bandwidth to help accelerate certain types of workloads, such as genomic sequencing. The Intel® Xeon® processor 5600 series is the right fit for these rigorous research requirements.”

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### LESSONS LEARNED

- Maximize flexibility. Red Cloud can support the need for both long-term resources and short-term “burst” computing capacity.
- Ensure scalability. With Red Cloud, researchers can scale up from departmental workstations and scale out to large-scale commercial clouds.
- Incorporate the latest processing and networking technologies. With Intel® processors and server adapters, Red Cloud IaaS can deliver the compute performance and low-latency communication required for cutting-edge research.

Despite the wealth of resources offered, CAC realized that not all researchers could access precisely what they needed. “There were researchers who wanted root access to systems but didn’t have the budget to buy and manage their own infrastructure,” says David Lifka, director at CAC. “Some needed a small amount of computing for a long time for a research wiki, so they could collaboratively share data and post publications. Others needed a large amount of computing for a short time—‘burst’ computing—so they could meet a research deadline or generate additional insights fast. We wanted to find a flexible and scalable solution that could accommodate both these use cases, which to date were not being addressed in a cost-effective or sustainable manner.”

### Building Red Cloud on Intel Xeon Processors

With interest in cloud computing growing among researchers, CAC decided to build its own cloud environment to provide the flexible, on-demand services that researchers required. Having established strong relationships with Intel and Dell, CAC made the clear choice to select Dell PowerEdge servers based on Intel Xeon processors.

The initial cloud service, named Red Cloud, is a 96-core IaaS environment built on Dell PowerEdge C6100 servers with the Intel Xeon processor 5600 series. “Researchers are always hungry for processing power, and many need large memory bandwidth to help accelerate certain types of workloads, such as genomic sequencing,” says Lifka. “The Intel Xeon processor 5600 series is the right fit for these rigorous research requirements.”

As utilization of Red Cloud increases, CAC anticipates adding servers with the Intel Xeon processor E5 family.

“We want to offer researchers the latest and greatest technologies to help them get the performance they need, when they need it, without deploying systems that would be underutilized,” says Lifka. “Intel Xeon processors provide a strong differentiator for CAC and help us continue to attract researchers with cutting-edge projects.”

The Dell servers are also equipped with Intel® Ethernet 10 Gigabit Server Adapters, which can help deliver low-latency communication. “We have always had a good experience with Intel Server Adapters—in particular, the Intel drivers are much more stable and reliable than those from other vendors,” says Lifka. “Using these server adapters with the Force10\* switch we chose will help us reduce latency and offer more tightly coupled computing between virtual systems, all in a cost-effective solution.”

### Providing Cloud as a Service, Without Hidden Costs

CAC now provides two cloud-based offerings to researchers. The Red Cloud IaaS, which runs the open-source Eucalyptus cloud computing platform on a user-customizable CentOS\* operating system, gives subscribers root access to virtual servers and virtual disks. The center also offers Red Cloud with MATLAB, a 64-core SaaS environment also built with Dell PowerEdge servers with Intel Xeon processors. This service enables subscribers to program applications on their desktops and then scale up to Red Cloud with MATLAB using MATLAB Distributed Computing Server\*.

CAC designed Red Cloud to avoid some of the potential pitfalls of public, commercial cloud environments. “Researchers can access the resources and support they need without the surprise fees that some

of our researchers have encountered using commercial clouds. With the Red Cloud subscription model, researchers pay only when their image is booted and their workload is running. Unlike many cloud providers, we do not oversubscribe our cores or charge for data movement in and out of the cloud," says Lifka. Because CAC does not oversubscribe their cores, Red Cloud provides researchers with consistent and reproducible Intel Xeon CPU performance. Lifka continues, "In addition, we designed the Red Cloud infrastructure specifically for research workloads. Users don't have to pay extra for the compute power, memory, and network bandwidth typically required for research projects."

### **Delivering On-Demand Compute Power**

Red Cloud gives users the flexibility to access robust HPC resources when they need them. "Researchers no longer have to wait in long queues or relegate workloads to small departmental workstations," says Paul Redfern, assistant director of strategic partnerships at CAC. "By offering on-demand performance, Red Cloud helps researchers run more workloads and complete projects faster than before."

The cloud model also allows researchers to avoid the costs and potential complexity of IT administration. "Without having to purchase and maintain their own hardware, researchers can spend more of their time and resources on their core competency—their research," says Redfern.

### **Scaling from Workstations to Large-Scale Clouds**

Red Cloud is also designed to provide the scalability for accommodating changing needs. "Some researchers might need to scale a MATLAB simulation from a single

workstation or small departmental server to larger compute resources. By scaling up to Red Cloud with MATLAB, they can work in a much more interactive time frame, reducing the time for completion from days or weeks to just hours or minutes," says Lifka. "Researchers can also scale beyond Red Cloud into larger, public cloud environments. The Eucalyptus platform we chose for Red Cloud IaaS provides the compatibility needed for a smooth transition."

### **Serving a Broader Community and Driving Breakthrough Research**

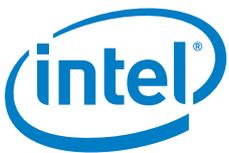
By providing the flexibility and scalability that many researchers require, Red Cloud plays a vital role in fulfilling CAC's commitment to the Cornell research community. "Our center strives to attract and support a very broad community, with a fairly diverse set of requirements," says Lifka. "So far, researchers have used Red Cloud to simulate the neural circuitry of the brain, develop optimization methods to calibrate climate change models, analyze bacteria that threatens U.S. citrus production, and more. With Red Cloud, we can accommodate the needs of more researchers, in a wider variety of fields, and help them produce exciting new research results."

"Red Cloud also facilitates a better educational experience," continues Lifka. "Rather than spending time acquiring and preloading software for a one-time educational workshop, students can access software on demand from Red Cloud, thus saving time and money and ensuring everyone has the same learning experience."

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## **SPOTLIGHT ON CORNELL UNIVERSITY CENTER FOR ADVANCED COMPUTING (CAC)**

The Cornell University Center for Advanced Computing (CAC) is a leader in high-performance computing systems, applications, and data solutions that enable research success. Located on the Ithaca, N.Y., campus, CAC serves the computational needs of Cornell faculty, staff, and student researchers and their collaborators—from astronomers searching for pulsars and physicists analyzing high-energy collisions to life scientists analyzing gene sequences and social scientists securely mining U.S. Census data. Cornell faculty and staff that use CAC resources have sponsored program research awards from the National Science Foundation, National Institutes of Health, the U.S. Department of Defense, NASA, the U.S. Department of Agriculture, and other public and private funding agencies. CAC collaborates with industry through its corporate program. Interested in Red Cloud services? Visit [www.cac.cornell.edu/redcloud](http://www.cac.cornell.edu/redcloud)



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