

# Case Study

High Performance Computing (HPC)  
Intel® Xeon® Scalable Processors



## Ohio Supercomputer Center OnDemand Portal Accelerates Remote Learning

Web-based interface provides students with HPC virtual laboratories based on Intel Xeon Scalable processors

### Ohio Supercomputer Center Clusters

#### Pitzer

- Dell EMC PowerEdge C6420 servers with CoolIT Systems' Direct Contact Liquid Cooling coupled with Dell EMC PowerEdge R740 servers
- Intel Xeon Platinum 8268 processors
- Intel Xeon Gold 6148 processors

#### Owens

- Dell EMC PowerEdge servers including C6320, R730 and R930 servers
- Intel Xeon E5 2680 v4 processors



**Ohio Supercomputer Center**  
An OH-TECH Consortium Member



### Executive Summary

Because of the COVID-19 pandemic, students at Ohio State University (OSU) and many other schools have had to adapt to remote learning situations. This proved to be especially challenging for work normally done in labs for a wide range of areas such as science, math, computer science, statistics, business, and other disciplines.

But, thanks to the [Ohio Supercomputer Center](#) (OSC), OSU was well prepared for the switch to remote learning. Plus, they were able to provide other universities with virtual laboratory portals as well. The center provides these virtual computer labs by offering students an easy to use web-based interface in a tool they developed called [OnDemand](#). The students use customized dashboards developed by OSC for access to digital labs across multiple disciplines of classes including architecture, statistics, crop sciences and more. When students log on to OSC OnDemand, they have access to an OSC supercomputer capable of running large workloads with advanced processing capabilities not typically available to users on their own computers.

### Challenge

Historically, the high performance computing (HPC) community did their work via a command-line interface to enter system commands and move through files or directories, as well as run programs. Lack of a web-interface in HPC led to the perception that HPC work was lagging behind in ease of use.

Many students have only used web-based graphical user interfaces (GUIs) and are not interested in spending time learning about file systems, directories, and command line entries. Scientists and engineers would rather spend their time advancing their disciplines than learning HPC. Developing an easy-to-use web-based interface would lower the barrier to entry so that students, commercial clients, and government researchers have access to OSC supercomputer cluster systems.

### Solution

Alan Chalker, Ph.D., Director of OSC Strategic Programs, explained that the inspiration behind OSC OnDemand was that every other technology developed web-based user portals so end-users could easily interact with the technology.

OnDemand is an accessible web interface that allows anyone with OSC access to log into and use one of the OSC supercomputer clusters. This would allow students, researchers, or commercial customers need to meet their most challenging data processing and research simulation needs.

OnDemand's novel architecture ensures that clients can utilize any modern web browser and helps utilize the underlying system security and user management.

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OSC's OnDemand HPC environment includes clusters based on Intel Xeon Scalable processors. Pitzer, OSC's newest system, is an Intel Xeon Gold and Xeon Platinum processor-based cluster built by Dell. Recently this two-year-old, liquid-cooled cluster gained nearly 400 nodes and 20,000 cores, increasing the system to more than 650 nodes and almost 30,000 cores in total.

When students and customers log on to OSC OnDemand, they have access to a supercomputer capable of running large workloads with advanced processing capabilities not typically available to all users on their own computers. Running on an OSC cluster accelerates the time to insight during data analysis and works to lower the cost-per-terabyte during data processing.

OSC is also building customized OnDemand virtual remote dashboards for classes at other universities. For example, OSC created an OnDemand virtual lab for architecture students at Kent State University so that they can run Maya jobs that render complex drawing. "These are normally categories of students that wouldn't use HPC who are using it for coursework and being exposed to the power of HPC and supercomputers. Eventually, these students will take their exposure to using supercomputers into the workforce and realize the importance of access to high performance computing," stated Chalker.

OSC also created a special OnDemand portal for commercial customers called AweSim. One AweSim user, NASCAR, uses workflows developed by TotalSim to perform simulations of race cars.<sup>1</sup>

For System Administrators, OSC provides an easy-to-install web access to HPC resources. Tools include job management and monitoring applications along with graphics desktop

environments and desktop applications including RStudio Server, Jupyter Notebook, Matlab, Abaqus/CAE and other tools.

OnDemand allows users to upload or download files, create, edit, submit and monitor jobs, run GUI applications, connect via Secure Shell (SSH) and run and share applications. There is no client software to install and configure.

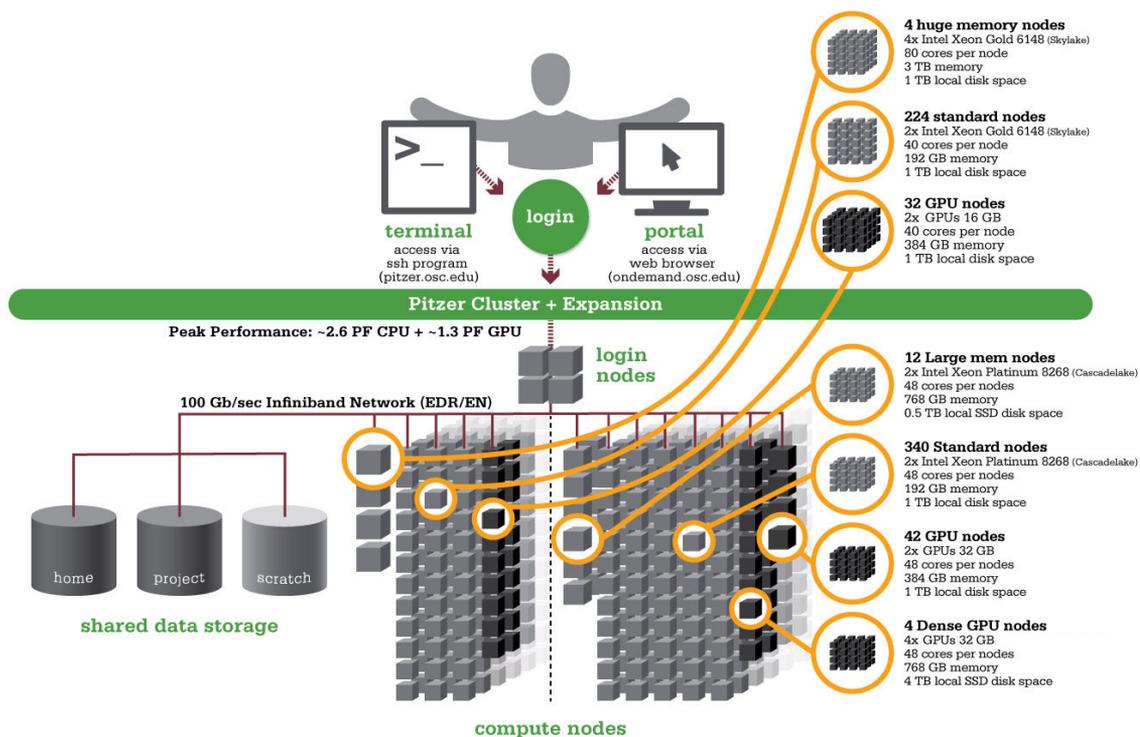
An OnDemand instance can be installed at other supercomputer centers, institutions, or research centers without connecting to OSC supercomputers. For example, the University of Alabama, Birmingham runs OnDemand as a single interface for all of its supercomputers.

## Results

In the fall of 2019, OSU began incorporating a laboratory component into their introductory statistics course for undergraduates with majors in the life sciences using RStudio via the OnDemand interface. While the class was not taught remotely last year—pre-pandemic, the students were in-person for the lab sessions, they did use the OSC supercomputer resources via OnDemand to carry out those labs. That experience better prepared them for setting up the remote virtual labs.

OSU is now conducting the RStudio labs for the third term using the remote web-based format. Being able to offer remote classes to students is even more important with the COVID-19 pandemic where no students are in a classroom at OSU.

OSC created a workflow that allows students access to RStudio for their statistics class through the OnDemand system running on the OSC Owens cluster. OSC sets aside



OSC Pitzer Cluster architecture

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four to eight nodes on the cluster, which allows up to 200 students to run their statistics labs. This saves time and the cost of setting up and maintaining a separate computer system for each student in the class.

OSC created workflows, the interface for the course, and uploaded links to the textbook, homework, and lab assignment information. "As an instructor, I revised course lab materials so they would work well in a web interface" Laura Kubatko, professor of statistics at OSU, explained. "OSC staff were fantastic, they attended the first session to help students get everything set up. I know that each student is having same experience during the remote session since they all see the same thing."

"The remote OnDemand sessions are popular with students" Kubatko continued. "I have seen more interest from students in this web-based format than in the fifteen years I have been teaching this class. OSU has decided to continue the class as an online lab even after students return to campus."

OSU is also moving other course labs to a remote format using OnDemand. Kubatko, who is also co-director of the Mathematical Biosciences Institute at OSU, indicates that OSU ran an undergraduate research experience in Topological Data Analysis during May 2020. Because the students were not able to travel to OSU for an onsite-session, OSC set up workflows so the session could be conducted via OnDemand. "During this session, students used OnDemand to run the Matlab application to do sophisticated computing for a large-scale topological data analysis. Some students had no access to a Matlab license, so the OnDemand web interface was the only way they could be involved in the session," states Kubatko.

With funding through the National Science Foundation (NSF), OSC also developed an open source version called [Open OnDemand](#) (OOD) that allows research institutions and universities to run their own instance of OnDemand. In addition, OSC created a special OnDemand portal for commercial customers called AweSim OnDemand. By working with modeling and simulation (M&S) experts, OSC created [AweSim with M&S-as-a-service](#). This program provides small-to-mid-sized manufacturers (SMMs) with

simulation-driven design to enhance innovation and strengthen economic competitiveness.

By clicking on specific links within Open OnDemand, clients can launch Open XDMoD, which provides detailed statistics and analyzes on jobs and resource utilization.

OnDemand, Open OnDemand, and AweSim OnDemand are used by a number of global institutions. As of 2019, OnDemand was used in 136 US locations and 70 international locations, including major universities, national laboratories, hospitals, and in commercial industry.

All OSC supercomputer clusters use Intel Xeon processors, which provide high performance, advanced reliability and hardware-enhanced security optimized for demanding workloads. In addition, the clusters have GPUs, interconnects, huge memory nodes, and shared data storage. The OSC cluster architecture is able to handle the most demanding HPC modeling and simulation jobs.

The recent Pitzer expansion lifts major constraints on the sizes of problems the system can tackle. It will enable OSC to resolve a much wider range of spatial and temporal turbulence scales. These include developing methods to reduce jet noise, evaluating vertical takeoff and landing loads on aircraft carriers and phenomena that dominate hypersonic flight. It provides the entire user community with additional needed computational resources such as processors, GPGPUs, and memory.

### Solution Summary

Due to the COVID-19 pandemic, students at OSU and many other schools are doing remote learning. It is especially difficult for students to do lab course work with remote learning. The Ohio Supercomputer Center created an easy to use web-based interface tool called OnDemand, which is being used to by students for remote web access for lab classes in disciplines such as architecture, math, crop sciences and more. OnDemand runs on OSC HPC systems giving students access to the power of a supercomputer. OSC has also created customized OnDemand virtual remote dashboards for classes at other universities as well as companies via their AweSim OnDemand portal.

OnDemand can be launched from workstations, PCs, laptops, or even mobile phones and tablets to access the incredible power of HPC. "OnDemand lowers the barriers to entry for researchers, scientists, students and instructors, which allows more people to utilize HPC more easily and in more ways," states Chalker.

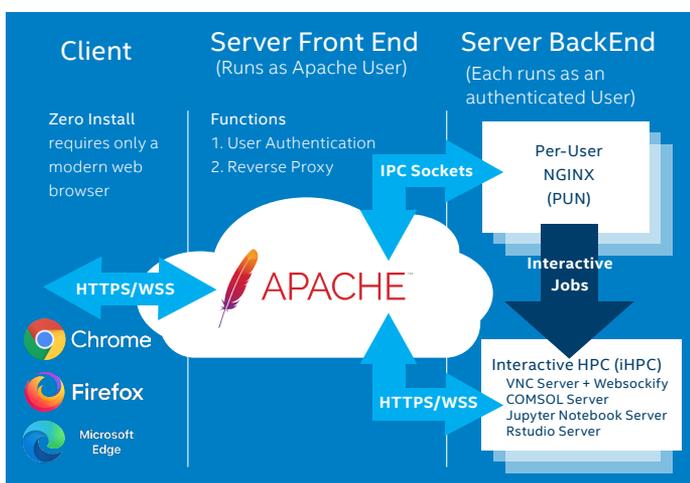
### OSC OnDemand Cluster Specifications

#### Pitzer Cluster:

- 658 Dell EMC PowerEdge server nodes
- Intel Xeon Platinum 8268 processors
- Intel Xeon Gold 6148 processors

#### Owens Cluster:

- 824 Dell EMC PowerEdge server nodes
- Intel Xeon E5 2680 v4 processors



**Open OnDemand's novel architecture ensures that clients can utilize any modern web browser, and utilizes the underlying system security and user management.**

## Learn More

Read more about [Ohio Supercomputer Center](#).

Learn about [Open OnDemand](#).

Find out more about [AweSim](#).

Learn more about [Intel HPC solutions](#).

Explore [Dell EMC HPC solutions](#).



<sup>1</sup> [https://www.awesim.org/sites/default/files/solutions/print-materials/2016\\_0506-NASCAR-RacingBehavior-CaseStudyFlier.pdf](https://www.awesim.org/sites/default/files/solutions/print-materials/2016_0506-NASCAR-RacingBehavior-CaseStudyFlier.pdf)