

## Case study

# Tomorrow's cloud today

University of Utah's CloudLab harnesses the power of HP Moonshot for research



### Industry

Cloud Computing

### Objective

Build an academic research environment to study the future of cloud computing

### Approach

Engage with HP and Matrix Integration to design a lab consisting of seven fully loaded HP Moonshot 1500 Chassis with HP ProLiant m400 Server Cartridges

### Results

- Support cloud research on flexible platform requiring much less space, energy, and cost than traditional infrastructures
- Empower researchers and educators across the U.S. to explore the future of cloud architectures and applications
- Enable researchers to monitor and better understand power and thermal properties of the systems they build, which is critical in cloud environments
- Provide researchers with a direct control switching component for software-defined networking (SDN)

**“The features of the HP Moonshot System will provide the researchers using CloudLab with the performance, flexibility, and efficiency they need to explore the future of the cloud.”**

– Robert Ricci, Research Assistant Professor of Computer Science at the University of Utah

Led by the University of Utah, CloudLab is a flexible, scientific infrastructure for conducting research on the future of cloud computing. CloudLab provides a platform for researchers across the U.S. to build their own clouds, and in doing so, to experiment with new cloud architectures and new types of applications. In order to enable new breakthroughs and high-impact research, it's critical for CloudLab to give researchers access to equipment that takes into account both the present and future needs of cloud architecture. By deploying the HP Moonshot System, researchers using CloudLab receive the performance, flexibility, and efficiency they need to explore the future of the cloud.



## Build your own cloud

Everybody is talking about the cloud. Which applications can be moved there? Which will thrive and which will fail? It's become a buzzword for the future of computing in general, and it's become a metaphor for the kind of flexibility and scalability IT professionals wish they had in their own data centers.

In cold, hard numbers, cloud is a market sector that's expected to top \$100 billion in 2016<sup>1</sup>, and \$270 billion by 2020<sup>2</sup>. It's just one reason some of the world's top universities have begun asking some critical questions about where cloud computing is headed.

## Research in the cloud, for the cloud

Welcome to CloudLab, led by the University of Utah. "It's our mission to empower researchers and educators by giving them access to the technology that will help them build tomorrow's cloud today," explains Robert Ricci, research assistant professor of Computer Science at the University of Utah. "We want our researchers to work on the fundamentals of the way that things such as power, security, networking, and virtualization are managed in the cloud, and ultimately, re-architect the cloud so that all kinds of applications can find a home there."

Actually building an architecture so flexible that it can be custom-configured by research teams is another story.

It helps to have the right technology partner. The university and Matrix Integration, an HP Elite Partner, embarked on building a lab with maximum compute density and unprecedented flexibility. "Working together with HP and Matrix Integration has really given us the broad view of how to build a next-generation lab for cloud research, complete with the expertise to bring it to fruition," Ricci says.

## A different kind of building block

From a hardware perspective, Ricci knew what he needed. "Three key considerations for our platform are lower cost, higher density, and energy efficiency," Ricci says. "And all those requirements are met by the ARM® 64-bit system-on-chip design of the HP ProLiant m400 Server Cartridge."

Offering the university 64GB of RAM—twice the memory of typical mid-range servers—and eight cores per cartridge, the HP Moonshot System with ProLiant m400 Server Cartridges enables dramatic performance gains while reducing energy costs.

With dual built-in 10Gb Ethernet interfaces at the cartridge level, and modular switching options available at the Moonshot 1500 Chassis level, it's a platform equipped for next-generation networking as well.

"Future clouds will also require highly flexible and programmable networking, a need perfectly met by the software-defined networking (SDN) capabilities of the HP Moonshot-45XGc Switch Modules in the

<sup>1</sup> Forbes Magazine: "Roundup Of Cloud Computing Forecasts And Market Estimates, 2015"

<sup>2</sup> Market Research Media, Report: "Global Cloud Computing Market Forecast 2015-2020"

Moonshot 1500 Chassis,” Ricci explains. “Taken together, the features of the HP Moonshot System will provide the researchers using CloudLab with the performance, flexibility, and efficiency they need to explore the future of the cloud.”

The HP Moonshot-45XGc Switch Module provides high-speed, low-latency connectivity while dramatically reducing cost and complexity of deploying solutions at scale. The 45XGc Switch Module, together with the HP Moonshot-4QSFP+ Uplink Module, provides 10GbE network connections to cartridges and extends HP’s 10/40GbE SDN fabric into a highly resilient HP FlexFabric 12900 data center switching core.

## Paradigm shift computing delivered

With HP Technology Services providing installation and deployment, the team at the university was up and running quickly. And the team continues to receive support from HP as it delves further into the capabilities of its new environment. “I’ve never received such great support from a vendor before,” Ricci relates.

For potential researchers, it’s a system that offers new levels of configurability. Hari Sundar, an assistant professor in the University of Utah School of Computing, calls it a unique opportunity for himself and his colleagues.

“For the kind of large-scale distributed computing research I do, this is really exciting for me, because I think we’re in a sort of tumultuous period in HPC right now,” Sundar explains. “In this context, the HP Moonshot System at CloudLab represents a very significant shift from standard cluster architectures. I think this is where the future is.”

## 64-bit benefits

One of the distinct advantages to the Moonshot platform is ease of scalability, Sundar relates. “Traditional x86 architectures are power-hungry and space-challenged, but they’ve been the standard building block because they work. We’ve been waiting for this transition to low-energy solutions that can match the kind of performance we expect from x86, and Moonshot is leading the way.”

Moonshot ProLiant m400 Server Cartridges with ARM processors have taken the platform to the next level with 64-bit processing. “64-bit is exciting for a number of reasons,” Sundar says. “At its simplest level, it allows you to have a much larger memory available per node or per process—which is hugely important if you’re dealing with tons of data and you want to keep some of it in cached memory.”

In the case of scientific simulations, 64-bit plays well too. “If you’re running precise computations, then you want to do double-precision computation,” Sundar explains. “64-bit gives you improved performance and accuracy for those simulations. In this regard I see HP Moonshot being ideal for both data-based applications as well as high-performance computing applications.”

## Form-factor for the future

Fellow researcher Eric Eide agrees. “HP Moonshot gives you a lot of compute power in a very dense, highly configurable form factor,” says Eide, a research assistant professor in the University of Utah School of Computing. “We’re able to configure it for our needs quite easily, and as a platform, it gives users the control they need to advance cloud computing as a whole.”

## Customer at a glance

### Hardware

- HP Moonshot 1500 Chassis
- HP ProLiant Moonshot m400 Server Cartridges
- HP Moonshot-45XGc Switch Module

### Services

- HP Technical Services

### Software

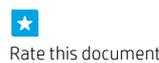
- Emulab Testbed control software
- Ubuntu 14.04 and 14.10

In a time when technology is changing so quickly, very few platforms have emerged to make good on the promise of responsible energy savings while delivering industry standard performance. “Researchers are trying to move the ball forward,” says Eide. “If you start from a position that’s way back on the technological curve, you have a longer distance to cover. That’s why we work with cutting-edge technology, and we’re getting that with HP Moonshot.”

## Company Profile

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