



AUTONOMOUS MINING

Cat® trucks get the job done with the help of an HPC cluster from Dell EMC



Caterpillar | Resource Industries | United States

Business needs

The Caterpillar Resource Industries product segment needed a high performance computing (HPC) cluster to rev up its autonomous mining program.

Solutions at a glance

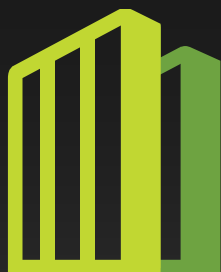
- Compute nodes based on 16 Dell EMC™ PowerEdge™ M630 blade servers
- Intel® Xeon® processor E5-2600 v4 product family
- Lustre storage solution (360TB)
- NFS storage cluster for archiving and backup (480TB)
- Networking switches from Mellanox and Dell EMC
- Dell EMC integration, installation, configuration and support services
- Remote Cluster Management with X-ISS

Business results

- A workload that might have taken nine months to run on a laptop computer now runs in about two hours.
- The HPC cluster helps the company's engineers quickly identify product issues and optimize the company's mining system and trucks on an ongoing basis.

16

Intel-based
Dell EMC
blade servers



840

terabytes
of raw storage
capacity



Putting autonomous vehicles to work

Autonomous vehicles (AVs) are getting a lot of attention lately, as they move from corporate R&D labs to public streets and highways. These vehicles are seen as a transformation that will make job sites safer, more predictable and more productive. But there's one thing that people may be missing when they talk about AVs being the next big thing. AVs have actually been with us for decades, operating efficiently in many industries.

Just ask the folks at Caterpillar, the company that introduced the industrial world to autonomous vehicles in 1996.¹ That legacy continues today in the Caterpillar autonomous mining program, which is working to take the driver out of the company's Cat® 793F mining trucks. With a 240-ton payload capacity, these powerhouses are built for the demands of hauling copper, coal, gold, iron ore and overburden on rugged mining sites in remote areas – with or without an operator in the cab.

Growing numbers of companies are capitalizing on Caterpillar's autonomous mining trucks and the system that runs them. Today, for example, there are more than 70 Cat 793F autonomous mining trucks on the job in mines in Western Australia. These trucks are guided by the Cat MineStar™ System, which functions as the brains of the autonomous system. Cat MineStar software manages how each truck goes to each loader, where it takes the material to, and how it avoids other trucks on the site – all without an operator on board.

Productivity, availability and safety

The productivity and cost benefits of Caterpillar's autonomous mining truck are pretty obvious. An autonomous truck doesn't need to stop for lunch breaks or shift changes and it doesn't need a backup operator for weeks when it is on vacation. It always works within specified operating parameters, saving wear and tear and improving availability. And if something does go wrong, the truck's system software alerts the service department to the problem and provides instant diagnostic information, helping to reduce equipment downtime.

¹ Caterpillar Facts Sheet, Q4 2016



"We laid out our requirements and the people at Dell EMC took those requirements and developed exactly what we needed."

Thomas McCauley
engineering manager, Caterpillar autonomous mining program

But that's only part of the story. The other side of the story is safety. Mining sites are by their nature inherently dangerous. Autonomous vehicles incorporate features designed to promote safer operations. In the case of trucks guided by the Cat MineStar system, sophisticated perception technologies allow the autonomous trucks to work safely with and around other mine equipment and onsite personnel, even in congested areas. When something unexpected gets in the way, the trucks come safely to a stop.

In another important safety benefit, autonomous trucks reduce the chances for injury on mining sites by limiting the number of people working around moving equipment. It all adds up to a safer worksite and a more predictable and efficient hauling operation.

"We're creating a safer environment with this technology," says Thomas McCauley, an engineering manager with the Caterpillar autonomous mining program.

HPC and data analytics on the backend

An autonomous mining program generates an enormous amount of data and the corresponding need for high performance computing (HPC) systems to mine through all that data. That's the way it is at Caterpillar, which leverages an Intel-based HPC system from Dell EMC to accelerate time to insights about product issues and optimization opportunities.

“Once you take the people out of the system, you still have to keep track of any issues that might arise on the trucks,” McCauley says. “Each truck has its own log, and we download that back to our main database. Then we use HPC to mine through that data to make sure everything is going well and as designed. And if it isn’t, HPC gives us the opportunity to dig into that data to find out what could be optimized, so we can address it faster.”

With HPC, the time to insight with large amounts of data is much faster than would be possible with the systems the company’s engineers use in their day-to-day work. How much faster depends on the issue and the amount of data involved in the analysis process.

“I was talking to one of our engineers the other day who told me that if he would have run one of these jobs on his laptop it would have taken him about nine months,” McCauley says. “On the HPC system, it took about two hours. So it’s a pretty dramatic improvement in efficiency.”

Even better, when you multiply those sorts of productivity gains across a large engineering team, the payoff for HPC becomes extremely attractive.

“We currently have about two dozen engineers working with the HPC system on a regular basis,” McCauley says. “It’s not just a couple of engineers. We want to have as many people as possible to realize the benefits of this computing system. As is the case with any large corporation, we are always driving for efficiency improvements on the development side. Our HPC system gives us the advantages that come with analyzing large amounts of data in a very timely manner.”

Inside the HPC cluster

For its HPC environment, Caterpillar runs custom and homegrown software in a compute cluster the company built with assistance from the Dell EMC professional services team. Dell EMC provided end-to-end professional services, from system design and implementation planning to installation, configuration and ongoing system support.

“The hardware is the key for us,” McCauley notes. “We need the power of HPC to get through the data efficiently and in a timely manner, so we can resolve any issues and improve the next generation of our product.”

The HPC system is based on EMC PowerEdge M630 blade servers with the Intel® Xeon® processor E5-2600 v4 product family. Other key components in the system include a 360TB Lustre storage solution, a 480TB NFS storage cluster for archiving and backup, a Mellanox InfiniBand switch and a Dell EMC Ethernet switch.

“There are a lot of advantages to working with Dell EMC,” McCauley says. “We laid out our requirements and the people at Dell EMC took those requirements and developed exactly what we needed. Our engineers were very pleased with that, because, obviously, we are all very busy doing other things. It was very nice to be able to hand this off to people who are experts in the field, who understood what our requirements were, and who could give us a product that actually met those requirements.”



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