CASE STUDY

# Scaling High-Performance Fracture Analysis with the Right Economics

**CLIENT:** **McMaster University**

**CHALLENGE:** Deliver the interconnect performance of a centralized switch at a smaller, more affordable scale.

**SOLUTION:** A highly performant scale fabric that effortlessly scales down to manage a 12-node cluster and can expand at any time.

**RESULTS:** The cost savings on the interconnect enabled the purchase of 50% more compute servers, delivering more research faster.

# Overview

Scientists use fracture analysis to ensure critical infrastructure such as bridges, buildings and nuclear power plants are safe by predicting when and where cracks will develop. It can also be used to improve industrial processes, such as glass cutting or hydraulic fracturing.

For 20 years, Blaise Bourdin, Professor of Mathematics and Statistics at McMaster University in Hamilton, Ontario, and Canada Research Chair, has combined solid mechanics, scientific computing, and applied mathematics in a multidisciplinary approach to unlock the mysteries of fracture using mechanical modeling, mathematical analysis and high-performance computing (HPC).

Building private HPC resources for small clusters is a delicate balancing act because centralized switches in traditional networks have fixed port counts and are expensive, which can limit choices for how the entire cluster is designed.

Dr. Bourdin turned to Rockport Networks to find a solution that was cost-effective, easy to set up, legacy-compatible and performant for a 12-node cluster.

# Modern Networking Architecture Enables Greater Flexibility

Fracture analysis is both latency and bandwidth sensitive, making interconnect performance the key consideration. Adopting a traditional centralized switching network architecture would necessitate the purchase of a 24-port InfiniBand switch, which was more capacity than he needed. The expense of the switch would also mean he could only afford to purchase eight servers.

Other important considerations included support for the Message Passing Interface (MPI) and scientific computing libraries that use MPI-based communications, as Dr. Bourdin writes the application part of his code and uses most of the linear algebra provided by the Portable, Extensible Toolkit for Scientific Computation (PETSc).

Dr. Bourdin also wanted the flexibility to share his infrastructure with other departments, which was challenging in centralized switch environments. "With traditional networking approaches," said Dr. Bourdin, "I would have to think, 'Can I afford to allocate a port on my switch to the Math Department?'"

> *InfiniBand switches are really expensive and they're big. Bigger than what most single departments can afford. So we would be forced into buying something that is bigger than what we need at a very high price.*

**Dr. Blaise Bourdin**

Canada Research Chair in Mathematical and Computational Aspects of Solid Mechanics

## Scale Fabric Delivers Performance

Dr. Bourdin ultimately decided the next-generation Rockport scale fabric best suit his requirements. The fabric uses the Rockport NC1225 network card to connect 12 nodes. The Rockport card replaces standard network interface cards (NIC) within servers and storage enclosures, along with the layers of switches that form traditional network fabrics. It adaptively aggregates the bandwidth of multiple parallel network paths, drawing from 300 Gbps of available network capacity.

Installing in a matter of hours, the Rockport scale fabric is easy to activate and manage compared to traditional networks, which often can take weeks to deploy.

## Cost-Effective Without Limitations

Deploying Rockport enabled the new cluster to be extremely performant. "I was willing to take a bit of a performance hit for the opportunity to increase the overall computational capacity of the cluster, but with Rockport we got the performance we needed at the right scale," said Dr. Bourdin.

Rockport also supports the required protocols and libraries for Dr. Bourdin's research. "If you had told me I'd be tied to some proprietary MPI, I would have had to go with something else," said Dr. Bourdin. "Legacy compatibility is absolutely essential in this field."

In addition, Rockport makes the cluster easy to share. "We can afford to run all the service of the Math Department and my cluster on two virtualized machines and are bouncing back and forth between two sets of hardware," said Dr. Bourdin.

Rockport also gives Dr. Bourdin control over the growth of his network – allowing him add more cards easily in the future as needed, rather than as dictated by external factors. "I'm not limited by the size of my switch or rack space. I can see myself each year looking at what's left over from grants and buying a couple more nodes, if necessary," said Dr. Bourdin. "The big development will be sharing infrastructure and network connectivity to the outside world. Because a lot of my projects are collaborative, I need to make sure that my colleagues in California can access the data I store at McMaster easily and quickly."

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# About McMaster University

McMaster University, in Hamilton, Ontario, Canada, is a globally renowned institution of higher learning and a research community committed to advancing human and societal health and well-being. Its focus on collaboratively exchanging ideas and approaches makes McMaster uniquely positioned to pioneer ground-breaking solutions to real-world problems leading to a brighter world.

Within The Faculty of Science, The Department of Mathematics and Statistics at McMaster University offers vibrant undergraduate and graduate programs in pure and applied mathematics, statistics, and data science. Its mission is to provide high quality training and education on mathematical and statistical sciences across a range of interdisciplinary programs and to support excellence in research. The department currently has 42 full-time faculty members and approximately 100 graduate students and 15 postdoctoral fellows.

For more information, please visit **math.mcmaster.ca.**

ABOUT CERIO

Cerio, creating new scale economics for the AI and Cloud era, delivers an open systems platform for a more sustainable data center. Built on the foundation of a supercomputing underlay fabric, the Cerio platform provides standards-based, low-code composability services for the cost-effective and efficient management of AI/ML infrastructure.

Formerly Rockport Networks, Cerio is headquartered in Ottawa, Canada, with offices and projects spanning international markets, and Centers of Excellence in Europe and North America.

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