



## CASE STUDY: RIKEN

### RIKEN Selects BigIron RX-32 for High Performance Simulation Application Software



#### SUMMARY

How to integrate experimental measurement data with theory to produce accurate forecasts is a major challenge facing scientific technology in the 21st century. Countries across the globe are vying for leadership status in this field and are making the development and use of supercomputers a top priority.

Japan has been especially focused on supercomputers. In 2006 the Ministry of Education Culture, Sports, Science and Technology (MEXT) launched the Next-Generation Super Computer Development Project. The project is designed to advance the development and construction of next-generation supercomputers, the development of software applications that can maximize the performance of such supercomputers, and the formation of first-rate academic and research institutions with next-generation supercomputers.

#### OBJECTIVE

RIKEN, Japan's Institute of Physical and Chemical Research, has a crucial role in the implementation and execution of this challenging project. As Japan's only comprehensive research institute in the natural sciences undertaking both basic and applied research, RIKEN conducts experimental research in a wide range of disciplines including physics, chemistry, engineering, biology, and medical science. In recent years, RIKEN has made significant progress in genome sciences and life science.

RIKEN is currently developing next-generation integrated living matter simulation application software within the next-generation supercomputer development project. Researching various phenomena within an organism from the molecular level to the body as a whole and the Fusion of Data and Analysis Approach incorporates large volumes of experimental data.

To develop software applications for these endeavors, RIKEN needed to build a high-performance PC cluster connecting 1,000-plus node processors.

#### SOLUTION

To build its high-performance PC cluster, RIKEN chose Foundry Networks® BigIron® RX-32. RIKEN constructed a cluster system containing 1,000-plus nodes and BigIron RX-32 as its core switch. The BigIron RX-32 was selected on the basis of its capability to pack 1,000-plus ports within a single rack unit and to simultaneously connect all ports at wire speed. Looking toward the future, RIKEN expects the BigIron switch's unsurpassed scalability will easily support upcoming research projects within the life sciences.

#### RESULTS

Foundry Networks BigIron switch satisfies RIKEN's need for single-unit, full bisection bandwidth. "This system is the main computation resource within the development of next-generation integrated living matter simulation application software," said Dr. Motoyoshi Kurokawa of RIKEN's Advanced Center for Computing and Communication. RIKEN is widely recognized as a pioneer in the building and use of PC clusters, and this new system will support this ongoing initiative.

[WWW.RIKEN.JP/ENGN/INDEX.HTML](http://WWW.RIKEN.JP/ENGN/INDEX.HTML)

#### INDUSTRY

Research

#### COMPANY DESCRIPTION

RIKEN is an independent administrative institution conducting comprehensive research for the advancement of science and technology. The institute is Japan's sole comprehensive research institute in the natural sciences and disseminates the results of its research work in physics, engineering, chemistry, biology, and medical sciences through joint-research initiatives and commissioned research works.

#### OBJECTIVE

- Achieve simultaneous connections of 1,000-plus ports at wire speed
- Attain greater system flexibility with port connectivity at uniform speeds
- Deploy high density, compact solution that supports 1,000 ports in a 1RU package

#### SOLUTION

- RIKEN constructed a high-performance PC cluster system containing 1,000-plus nodes with BigIron RX-32 at its core

#### RESULTS

- Well-balanced system connects 1,000-plus computational nodes at 1Gbps and storage at 40Gbps
- Cluster set the world's highest execution efficiency in terms of Gigabit PC cluster by wire rate speed
- High-performance per rack unit reduced overall footprint in the data center to 1/8 the size of previous footprint in 2004

According to Dr. Kurokawa, “The next-generation supercomputer is still being developed, and large-sized parallel processing will be crucial in securing performance. Our top priorities therefore were to secure a parallel computing system of 1,000-plus nodes and strike a balance between computation and communication performance on a cost-effective basis.”

Inter-node connectivity is a major problem for PC clusters of this scale. Even though individual nodes may demonstrate high processing performance, unless inter-node communication performance is evenly distributed, a bottleneck could dampen the overall performance. In addition, during the research and development phase, forecasting the structure of the hardware or the application software that will run on the hardware is impossible.

“To safeguard the flexibility of the system, we implemented a network switch selection criteria that required a full bisection bandwidth that was close to a crossbar connection for 1,000-plus ports. In other words, we ideally wanted to ensure that wire speeds could be achieved when all ports were in use, irrespective of port connectivity. Foundry Networks products satisfied the criteria with high performance,” said Dr. Kurokawa.

The BigIron also provided RIKEN with high port-density. At just under 10 square meters, the compact router switch accommodated 256 computational nodes and 1,000-plus ports per 1RU.

“The BigIron satisfied these demands without a problem,” said Dr. Kurokawa. “In fact, we previously built a PC cluster with similar computational performance in 2004. However, this system required 40 rack units. This time, we managed to build a system with the same performance in a space that was 1/8 the original footprint.”

RIKEN is also realizing that the BigIron offers unparalleled scalability and the world’s best gigabit execution efficiency. The network connects the switch and computation nodes at 1Gbps and the switch and storage at 10Gbps x 4. A benchmark test of the best execution efficiency rate for gigabit-connected PC clusters designated the RIKEN system at 480th within the global supercomputer ranking (as of June 2008).

Many gigabit PC clusters under perform, but not the RIKEN system. A PC cluster connecting 1,000-plus nodes based on an ordinary tree-topology gigabit can only produce an execution efficiency of between 40 percent and 60 percent. RIKEN met more than 70 percent execution efficiency when connecting the system to a full bisection bandwidth gigabit.

RIKEN completed the hardware deployment in March 2008, and the project will continue for another six years. “Our final objective is to attain a major breakthrough in the development of next-generation supercomputers and loop back the results of this research to the society on a practical level,” said Dr. Kurokawa. By overcoming this latest challenge, RIKEN—and BigIron—could pave the way for new possibilities in our lives.

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– Motoyoshi Kurokawa, Ph.D.,  
Technical Scientist,  
Advanced Center for Computing  
and Communication,  
RIKEN (The Institute of Physical  
and Chemical Research)

## FOUNDRY NETWORKS

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