

Customer
Grid Technology Research Center

Industry
Research Consortium



Applications
Grid Technology

Highlights
Gfarm Cluster 1, a high performance system that employs large-scale parallel processing of 90 nodes. GTRC chose the E600 switch/router from Force10 Networks.

Force10 Network Solutions Enable Japan's Grid Technology Research Center to Achieve New Levels of Computational Speed and Performance

Grid Computing Takes Center Stage

The rapid succession of technical developments in the world of information technology (IT) are leading to new computational performance horizons — and one of the topics that is currently commanding a great deal of attention is Grid computing. That's because by integrating a single unit that combines a "grid" of multiple computers and storage devices, researchers are discovering they can share data scattered across many locations throughout the world and attain computational speeds exceeding that of a traditional mainframe computer.

While private enterprises are engaging in experiments to further the establishment and expansion of Grid technology, much of the pioneering work in this exciting arena is being done by research consortiums. One such organization is the Grid Technology Research Center (GTRC), established as the first Grid research unit of its kind in Japan's National Institute of Advanced Industrial Science and Technology. "As the largest domestic research group focused on Grid technology, we're helping to contribute to the realization of the technology's potential," said Dr. Mitsuo Yokokawa, Deputy Director of the GTRC. "We're also promoting



technical standardization and educational activities through various international conventions, in collaboration with other research organizations."

Making the Net Work

Conventional wisdom has long held that improving computational speeds entails increasing both the throughput of a system's CPU as well as the overall size of the computer. Grid computing, by comparison, takes a completely different approach. By connecting two or more computers in a network, researchers can create a highly efficient virtual computer capable of achieving higher levels of throughput and storage capacity. Even if the performance of each individual computer in the grid is relatively low, the overall system can perform high-speed bulk processing by interconnecting the computers and engaging in parallel processing.

Challenge	Solution
Non-blocking forwarding in cluster network	<ul style="list-style-type: none"> • Use the E-Series for high performance switching • Provides non-blocking performance for guaranteed wire speed
Throughput of wire speed 10 Gbps Ethernet connections in clusters and between clusters	<ul style="list-style-type: none"> • Use the E-Series as a high performance router • The E-Series achieves uplink connections to 10 Gbps Ethernet LAN and WAN environments
A highly reliable, sustainable system	<ul style="list-style-type: none"> • Provides superior reliability through redundancy in devices

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Achieving such performance entails assigning computational processing to computers that are scattered across remote locations. In pursuit of this goal, the GTRC developed "Ninf-G" and "Gfarm" middleware, which were initially showcased in demonstrations shown at SC2003, held in Phoenix, Arizona. Connecting storage devices and networked computers validated the superior performance of the approach and furthered the development of the "Grid Data Farm," which functions as a single memory medium.

Gfarm middleware has made the Grid Data Farm a reality by making it possible to access data from locations worldwide, as though that information was immediately at hand. SC2003 also hosted successful demonstrations of Grid environments where a half dozen Japan-U.S. bases were interconnected, leading to the

awarding of the "Distributed Infrastructure (Base Technology) Prize" to the Grid Technology Research Center.

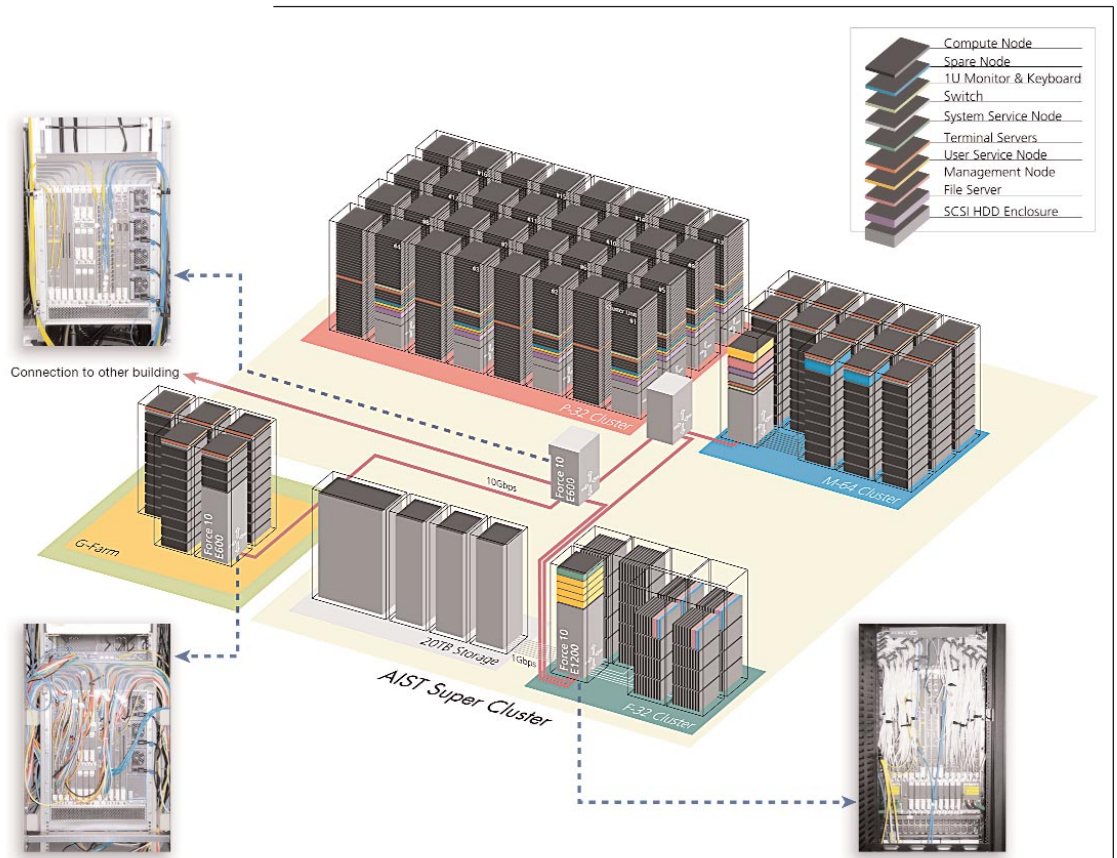
Force10 E-Series: Data Forwarding and Non-Blocking

In concert with the development of its Gfarm middleware, the GTRC built the Gfarm Cluster 1, a high performance system that employs large-scale parallel processing of 90 nodes. And when it came to selecting a data-forwarding device for use in the Gfarm Cluster 1, the researchers at the GTRC chose the E600 switch/router from Force10 Networks.

"Within the Gfarm Cluster 1, a very high level of forwarding capability is required. Non-blocking performance becomes essential," said GTRC team member Dr. Osamu Tatebe, "and that's one of the

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Cluster Technology Team
Senior Researcher,
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big advantages Force10 provides. In addition, in order to make the Grid Data Farm a reality, we had to connect bases that are scattered not only within the closed cluster, but throughout the world as well. Accordingly, a highly efficient uplink capability was required."

Powered by the Force10 E600, the Gfarm Cluster 1 performs data forwarding at 13 Gigabits per second within a cluster, and uplinking at 10 Gigabits per second. As a result, Gfarm Cluster 1 earned 181st place in the performance-ranking Top 500 list of computers for computational technology, an achievement that reflects both the technical capabilities of the Grid Research Technology Center and the performance of the E600.

Force10: At the Heart of the AIST Super Cluster

The Force10 E600 also plays a significant role in a new core system known as the AIST Super Cluster, which has been in operation since May of 2004. This Grid technology-based cluster system offers a theoretical peak performance of 14.6TFLOPS, 9.6TB of main memory and storage of 803 TB—enabling it to achieve the highest capacity developed to date in Japan.

The AIST Super Cluster consists of three main cluster parts: the P-32 focuses on overall calculation performance; the M-64 weighs the memory capacity for each computer, and the F-32 processes simultaneous independent computation. These three parts are interconnected by 10 Gigabit Ethernet, with the Force10 E600 serving as the switch/router to uplink the system to the Internet.

There's more. During the time when GTRC researchers were building Gfarm Cluster 1, Force10 introduced its next-generation E1200, which builds on the foundation provided by the E600. GTRC tested the new device and verified that it fully satisfied the requirements inherent in the group's Grid technology activities. As a result, the E1200 is now employed as a data-forwarding switch of the F-32 cluster part in the AIST Super Cluster.

Expanding the Range of Grid Technology Applications

Grid technology has already entered the realm of practical use from the GTRC's previous phase of demonstration experiments. The Ninf-G middleware is being used in weather simulations, while Gfarm is now being employed for experimental data analysis of accelerators in particle physics applications. And Force10 has been involved every step of the way.

"The Force10 E-Series has fully responded to our demand for speed and reliability, providing stable service," said Dr. Yuetsu Kodama, Cluster Technology Team Senior Researcher. "We've had no trouble whatsoever since the start of operations." Added technical staff member Mr. Hirofumi Okazaki: "The Force10 E-Series, with its simple operations, is easy to use. And it's easy to manage the equipment."



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