



Using a modular architecture to understand the mysteries of life

Beijing Genome Institute adopted the Dell modular infrastructure, enhancing its high performance computing (HPC) platform for biological computing and achieving a peak value of 288.5 teraflops (Tflops)



Biotechnology & Science

China

Business needs

BGI wanted an efficient, modular infrastructure to enhance the HPC platform behind its biological research

Solutions at a glance

- [Modular Infrastructure](#)
- [High Performance Computing](#)
- [Data Center](#)
 - [Dell PowerEdge FC630 server modules with Intel® Xeon® processors E5-2670 v3](#)

Business results

- The total peak value of the HPC platform for biological computing achieves 288.5Tflops
- Reduces the total cost of ownership of the biological computing HPC platform by 20%
- Around 214 thesis articles have been published in international top-tier magazines such as *Nature*
- The rate of references in leading international magazines is 8.37 times – higher than the national average of 6.51 times per article

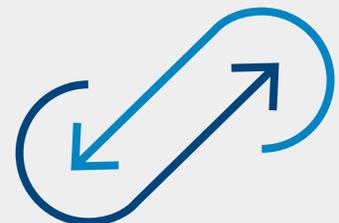
288.5

Tflops achieved for HPC platform



20%

reduction in TCO



By analyzing a drop of saliva and a blood sample, physical illness and its likely development can be determined. Well-known celebrities have used biological prediction to avoid serious illnesses in years to come. For a while now, leukemia and cancer have been predictable using biological gene sequencing technology, but the high cost of gene sequencing has made it unavailable to ordinary people.

The Beijing Genome Institute (BGI), a leading company in biological research, wanted to bring down the cost of sequencing to make it more widely accessible while enhancing its own biological research capability at the same time. To do this, BGI's strategic objective has been to continuously enhance the computing power of the high performance computing platform behind its sequencing activities.

The total peak value of the HPC reached 288.5Tflops

Founded in 1999, BGI has operations in more than 50 countries across four continents. The Institute provides local researchers with innovative biological services as well as application services of biotechnology applied biotechnological services in medical, agricultural and environmental industries.

To deliver these services, BGI has built a powerful HPC platform. To enhance the computing capability of the HPC platform, the institute brought in a Dell PowerEdge FX modular infrastructure solution to increase the platform's capacity. After the project was completed, BGI's biological computing HPC platform reached a total peak value of 288.5Tflops, and its memory reached 67.22 terabytes (TB) while its total storage capacity reached 35.09 petabytes (PB).

The highly efficient modular infrastructure supports continuous enhancement

Within the modular infrastructure, four Dell PowerEdge FC630 server modules are located in the Dell PowerEdge

FX2 chassis. Each Dell PowerEdge FC630 module contains two Intel® Xeon® processors E5-2670 v3 and 160 gigabytes (GB) of DDR4 memory, which can be scaled to 768GB in the future. The storage part includes two 2.5-inch hard disk drives or eight 1.8-inch solid-state disks. Because of higher hard disk speed requirements, the Dell PowerEdge FC630 modules feature Dell PowerEdge Express Flash Non-Volatile Memory Express (NVMe) Peripheral Component Interconnect Express (PCIe) solid-state disks.

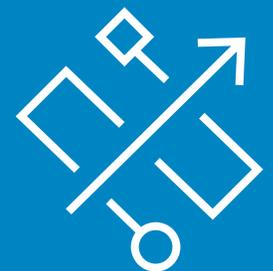
BGI's HPC platform also uses the Intel Lustre system. This system has superb performance, and supports a

“Using two FN IO Aggregators, we can have 10 GbE dual redundant paths among all four of the Dell PowerEdge FC630 nodes. These features pose great advantages in our enhancement of scientific computing efficiency.”

Yang Liping, Bio-Computing HPC Platform Engineer, Beijing Genome Institute

214

thesis articles
published



large memory capacity. In addition, the technology is advanced and highly reliable. It provides the HPC platform with speedy parallel memory capacity. In many research projects, BGI's computing requirement can exceed 50GB/s of I/O speed, and with the Dell FX integrated architecture and Lustre system, the environment achieves more than 70GB of data throughput. Furthermore, Intel's Lustre system can support 512PB of high-capacity storage, satisfying the application's requirements for processing scientific research data.

The Dell solution integrates with a previously deployed platform, featuring Dell PowerEdge R730 rack servers and Dell PowerEdge M630 blade servers. The platform also contains Dell PowerVault MD3460, MD3420 and MD3060e storage, and comes with Dell Networking MXL switching.

Yang Liping, Beijing Genome Institute's bio-computing HPC platform engineer, says, "The Dell modular infrastructure uses internal networking, which avoids the inconvenience of using an external switch and extra cabling. The on-board LAN network of the PowerEdge FX2 mainboard can provide four connections to every half-width compute node, and at the same time, Dell Networking FN IO Aggregators provide 10 gigabit Ethernet (GbE) high-

"The first Ethernet terminal connects to the management network, while the second Ethernet terminal allows a daisy chain connection for multiple FX2 chassis without the need for an external switch. It simplifies not only the wiring but also management."

Li Yan, Senior HPC platform Engineer,
Beijing Genome Institute

speed channels and multiple external 10GbE connections. Using two FN IO Aggregators, we can have 10GbE dual redundant paths among all the four of the Dell PowerEdge FC630 nodes. These features pose great advantages in our enhancement of scientific computing efficiency."

Flexible, high-powered solution enables more effective research

The highly efficient modular infrastructure enhances the computing capability of BGI's research allows the computing capability of BGI's research to be enhanced. Since deployment of the Intel Xeon processor-powered Dell PowerEdge FX unit, BGI has taken a leading position domestically. This has allowed BGI to develop the gene sequencing system, BGISEQ-500, a one-button sequencing technology that supports DNA sampling and delivers results analysis in just 24 hours.

Furthermore, the precision of human genome testing has reached the level of 99.99 percent. BGI has also enhanced the scientific research capability for genomic sequencing, genotyping, transcriptome sequencing, epigenome sequencing and protein mass spectrometry. Tens of thousands of theses have been written on these topics, and 214 thesis articles by BGI have been published in international magazines like *Nature*, *Science*, *Cells* and *The New England Journal of Medicine*.

Efficient management helps cut total cost of ownership (TCO) by 20%

BGI likes the fact that Dell provides the Dell integrated Remote Access Controller (iDRAC) management software, a carrier-grade Dell Chassis Management Controller (CMC) for every FC630 node. Li Yan, senior HPC platform engineer of the Beijing Genome Institute says, "When we insert the CMC module in the FX2, the CMC will provide two Ethernet connections and one DB-9 cluster communication port. The first Ethernet terminal connects to the management network, while the second Ethernet terminal allows a daisy chain connection for multiple



FX2 chassis without the need for an external switch. It simplifies not only the wiring but also management.”

Engineer Li Yan continues, “Dell has provided us with a Java-based terminal emulation application management program. Using the program, we can quickly understand the situation of the servers managed by the CMC on every node, including the usage of CPU resources, CPU temperature, memory usage, I/O speed and the system’s average power consumption. All of these have enhanced our management efficiency.”

In terms of scalability, each Dell PowerEdge FX2 chassis can carry four redundant ports directly to a 1GbE or 10GbE I/O module, but also comes with two Dell Networking FN IO Aggregators with more network functionalities. Its unique modular design also provides BGI with different combinations of flexible server, storage and network capabilities. The flexible configuration and scalability of the FX2 solution have benefited BGI with the capacity for continuous development.

BGI’s HPC capabilities have been greatly enhanced since the completion of the project, and the complexity of HPC management has been significantly reduced. As a result, management capacity has been strengthened, operating efficiency has improved, and cost has been lowered. The overall IT TCO for the Dell modular architecture is 20 percent lower, and there is a 30 percent saving in space utilization, as well as roughly a 40 percent reduction

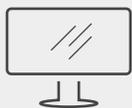
in power use. Network latency has also been cut to milliseconds. All these allow BGI’s HPC system to be a highly efficient and environmentally friendly development platform.

Simplification means upgrade costs reduced by 5 to 10%

The Dell PowerEdge FX2 chassis delivers a shared power source, cooling system, management and PCI connectivity, yet takes up only 2U of space. As a result, its initial set-up costs were 10 to 15 percent less than expected. The Dell and Intel FX modular infrastructure has reduced operating complexity and simplified data center management. It has delivered high availability while reducing manual maintenance costs by 20 percent. In addition to these, the innovative Dell Networking FN IO Aggregator has also simplified network deployment and improved the two-way communication in the chassis, reducing future upgrade and optimization costs by at least 5 to 10 percent.

Today, BGI has gained a leading position among other biological research organizations. The average number of references for BGI articles has reached 61 times per article, or 8.37 times better than the national average (6.51 times per article), and 9.8 times better than the global average (5.22 times per article). Through its research, the institute hopes to be able to bring gene sequencing costs down in order to make it more accessible to ordinary people.

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