Efficient computing – accelerating systems science research

The School of Systems Science at Beijing Normal University uses Dell EMC's PowerEdge MX modular infrastructure to conduct systems science research. The solution has increased research computing capacity by a factor of more than 100.

北京师范大学系统科学学院
SCHOOL OF SYSTEMS SCIENCE

Research/higher education

China

Business needs

The School of Systems Science at Beijing Normal University needed to introduce virtual technologies to conduct parallel computing and create a high performance computing platform to drive systems research. The school's research spans the physical, biological, socio-economic and engineering sectors. The high performance computing (HPC) platform needed to offer a high level of performance and help researchers to quickly study the nature and evolution of various systems. It also needed to identify the commonalities of elements within a system, explore basic laws, and drive the application of systems concepts, general systems theory, systems analysis theory, systems methodology, and systems methodology.

Solutions at a glance

- Dell EMC PowerEdge MX
- Dell EMC Data Center networking solutions
- Dell EMC ProSupport Plus
- Dell EMC High Performance Computing

Benefits

- Increases research computing capacity by over 100x
- Uses 50% less space and 30% less power
- Dramatically improved IT efficiency and 30% lower TCO
- Articles published in the leading international New Journal of Physics

"During the implementation phase of the project, Dell EMC completed all installation-related tasks, including hardware systems and software installation and network debugging. During the maintenance phase, they provided us with specialized technical support services. Thanks to the strong collaboration of Dell EMC, we now have an efficient, intensive, and stable platform for high performance computing systems, with significantly greater IT efficiency and a 30% lower TCO."

Dr. Chen Jiawei, School of Systems Science, Beijing Normal University

The School of Systems Science at Beijing Normal University decided to use Dell's EMC PowerEdge MX solution, which increased computing capacity by a factor of more than 100.

The school's main research areas include systems theory, information theory, cybernetics, dissipative structure theory, synergetics, mutation theory, operational research, fuzzy mathematics, matter element analysis, pansystems methodology, system dynamics, grey system theory, systems engineering, computer science, and artificial intelligence studies. Other important areas of research include similarity theory, system scientific research in terms of similarity, hyper-entropy, strange attraction and chaos theory, disorder, and fuzzy logic. To improve research efficiency, the School of Systems Science introduced Dell EMC's PowerEdge MX solution, which has increased computing capacity by a factor of more than 100.

For example, in order to conduct a study of a complex network group, researchers need to map knowledge domains. This requires the retrieval of graph data structure for millions of nodes. Previously, parallel calculations were not very effective due to limited computer performance. A program had to be run for several days, and scientific progress was slow. Now, thanks to multiple virtual machines running on the PowerEdge MX solution, we are able to provide powerful parallel computing power, resulting in reduced uptime and over 100x increased efficiency. Programs that previously took a week to complete can now be run in just over an hour. At the same time, in terms of server management, virtual machines are easier to set up and deliver persistence. Adding and shutting down virtual machines helps to ensure that server resources are utilized more efficiently, enabling each member of the research team to quickly build and use compute resources and allocate compute resources effectively to avoid waste.

A high-performance, scalable Gigabit Ethernet fabric switch, the MX9116n provides line-rate 25GbE L2 and L3 forwarding capacity to all connected compute with no oversubscription and a sub 450ns latency.

The MX740c and MX840c compute sleds feature the Intel® Xeon® Gold 6148 processor, which operates at a base frequency of 2.4 GHz and a turbo frequency of 3.7 GHz. It has a 27.5 MB cache and supports up to 768 GB of memory. It is manufactured using the 14nm lithography process and features a 64-bit CPU architecture with 20 compute cores and up 40 threads. It also supports AVX 2.0, Intel Speed Shift,

"PowerEdge MX, with its kinetic infrastructure, is uniquely designed without a mid-plane which isolates potential failures and increases the reliability of the system. This design also allows storage and networking fabric to be upgraded without taking down the chassis."

Intel TSX-NI, Intel EnhancedSpeedStep, and Intel Instruction Replay and provides enhanced performance for customers in terms of power savings, computational efficiency, and computer security.

The PowerEdge MX solution provided by Dell EMC consists of a 7U eight bay MX7000 modular chassis, four two-socket single-width MX740c and two four-socket double-width MX840c compute sleds, and one MX9116n networking module.

Saves 50% of space and consumes 30% less power

PowerEdge MX benefits from comprehensive in-system management, including Dell EMC OpenManage Enterprise - Modular Edition (OME-Modular). A unified web/RESTful API interface manages all components including compute, storage and networking. This helps reduce costs, learning curve and consolidates multiple tools for ease of access and monitoring.

The high performance computing server platform, which features Dell's EMC PowerEdge MX7000 modular chassis, four MX740C servers, two MX840C servers, and a MX9116N networking

module, has already been assembled and debugged and offers excellent operational stability. Dr. Chen Jiawei from the School of Systems Science, one of the major driving forces behind the project to install the high performance computing solution, states, “The primary computing tasks for our systems science research are completed by this system. The launch of the solution effectively guarantees our computational efficiency in systems science research. Compared with previous solutions, Dell EMC’s PowerEdge MX infrastructure use 50% less storage space and consume 30% less power, which helps us to control our operational costs.”

Dramatically improved IT efficiency, 30% lower TCO

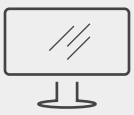
Beijing Normal University divides systems science research into multiple tiers: The first is engineering technology, including systems engineering, automated technology, and communication technology.The second is technical sciences, including operations research, system theory, cybernetics, and information theory. The third tier is basic systems science theories, and the final and most important tier is system concepts, which include philosophical and methodological perspectives of systems. This tier acts a bridge between systems science and philosophy. Dell EMC PowerEdge MX system can provide efficient support for research at each of these tiers.

Dr. Chen explained the reasoning behind the school’s decision: “Due to the large number of research tasks and tight schedule, we had to focus all of our energy on research. As a result, we were looking for a comprehensive high performance computing platform in the form of a turnkey project. Dell EMC was the perfect choice – during the planning phase of the project, they established a dedicated project group, which put itself in our shoes and constantly revised and refined the plan to meet our application needs. During the implementation phase, Dell EMC completed all installation-related tasks, including hardware system and software installation and network debugging. During the maintenance phase, they provided us with specialized technical support services. Thanks to the strong collaboration of Dell EMC, we now have an efficient, intensive, and stable high performance computing platform, with significantly greater IT efficiency and a 30% lower TCO.”

Articles published in the leading international journal New Journal of Physics

As Dr. Chen explains, “Thanks to Dell EMC’s PowerEdge MX, we were able to complete a Monte Carlo simulation for a sociodynamics project, which was published in the New Journal of Physics.This research project required repeated simulations of dynamic processes using different parameters and initial values on complex networks with hundreds to tens of thousands of nodes. Ordinary desktop workstations struggled to meet these computing demands due to the large number of parameters that had to be explored, the frequency with which the experiments had to be repeated, and the high computational complexity. Now, thanks to the establishment of virtual machines and the dynamic allocation of compute resources, the research team has access to multiple virtual machines for parallel calculations. This has greatly accelerated the progress of our simulation work and enabled us to complete our simulation tasks in less than one month.

The school’s research team also completed a multiple object simulation experiment. Dell EMC’s systems greatly reduced the amount of time required to complete the experiment. In the experiment, researchers had to emulate a multiple particle system that evolved over time. The system contained hundreds of particles, each of which interacted with its neighbors. The simulation involved millions of steps, and nearly one hundred comparison experiments had to be conducted due to the large number of parameters in the model. The researchers’ desktops were unable to complete such a large volume of computing tasks, so the initial stages of the experiment did not go well. Dell EMC’s PowerEdge MX solution with its powerful parallel computing power was the ideal choice for the team’s experiment. It reduced the amount of time required to run the team’s program by a factor of almost 100, a code which previously took one week to complete only took two hours. This significantly increased the efficiency of the simulation and helped the research team to achieve rapid progress. At the same time, by using virtual machine management, members of a research team can efficiently build and use compute resources. Each person can perform their own research projects using compute servers, which greatly increases the team’s overall progress.



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