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Maciej Twardy
Deputy Director
Academic Computer Center (ACC) Cyfronet

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**Academic Computer Center Cyfronet**
(at AGH University of Science and Technology in Kraków)

**INDUSTRY**
Education

**SOLUTION**

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Polish Computer Center Trusts Hitachi Data Systems to Provide Efficient File Sharing System for Zeus Supercomputer

Academic Computer Center (ACC) Cyfronet was established in 1973 and is the oldest academic computing institution in Poland. In 1999, it became an autonomous unit, in terms of organization and finances, of Stanislaw Staszic AGH University of Science and Technology in Kraków. In 2011, the Zeus computing cluster operated by Cyfronet was named the fastest computer in Poland, for the 4th consecutive year, and was ranked 88th globally, according to Top 500 (www.top500.org). Computing results generated by the supercomputer must be kept on extremely efficient and safe storage solutions. To meet these requirements, Cyfronet selected a hardware and software solution from Hitachi Data Systems.

“Our cluster is a universal machine,” says Maciej Twardy, deputy director of ACC Cyfronet. “Various computing tasks are initiated on it, and it is used by hundreds of users at the same time. Certainly, it would be impossible to design such a heterogeneous computing environment with mass storage resources for the needs of any specific application. Therefore, as soon as the concept stage, we had to approach all assumptions in the way that allowed us to find a flexible solution, which would be the best possible match for the broad profile of computing needs of its users.”

Millions of Scientific Files

Such an extended and demanding environment also requires efficient and flexible mass storage, ready to meet any workload. As such, this disk storage system should not support any particular database with a predictable load; it is impossible to fine-tune its parameters. Hence, the need appeared to implement a universal solution, able to meet totally different needs. For example, the solution would need to ensure a high capacity of large file transfers and, on the other hand, a very high count of I/O operations per second (IOPS) when providing access to very small files.

“For Zeus users and for the type of work carried out by Zeus, we need to ensure a high availability rate, as if it supported business operations in a commercial undertaking,” emphasizes Marek Magryś, who is responsible for the mass storage systems of the

Background

ACC Cyfronet makes all its telecom and IT resources available to the entire scientific community. This includes institutions located in Kraków, Małopolska Region and southern Poland [universities, institutes of PAN (Polish Academy of Sciences), PAU (Polish Academy of Arts and Sciences), and research and development units]. Simultaneously, Cyfronet participates autonomously or in cooperation with other scientific institutions, in various projects under 5th, 6th and 7th Development Program (including Crossgrid, EGEE, CoreGRID, GREDIA, EGI Inspire, URBAN FLOOD and EUSAS). Cyfronet also participates in cooperation with its partners from the PIONIER and PL-Grid consortium in several scientific and targeted projects (Interactive Television, PL-Grid, PLGrid PLUS, Platon, POWIEW and others).

The Zeus cluster consists of 1,200 servers with processors having more than 13,000 cores, over 200 GPGPU cards and 30TB RAM in total. The cluster is controlled by the operating system Scientific Linux 5, and its performance rate is 276 Tflops.
Zeus supercomputer. “We cannot afford any interruption to its operations and, most importantly, the loss of any data. That’s why we try to have as much infrastructure as possible in a redundancy model. This applies to both power supply and air conditioning, and network connections between servers, or to the data storage and protection policy.”

An enormous challenge for administrators of the Zeus cluster was the characteristics of files that would be secured. Statistically, there are tens of millions of small files (about 90% below 16KB), stored in user directories and usually containing research results (small binary or text files) or input data for computing. The mass storage environment that Cyfronet needed would ensure not only access to those resources in an extremely short time, but also their flawless preservation.

**Extreme Performance: Only with Hitachi Data Systems**

The nature of the data and the scale of the computing tasks carried out concurrently defined the scope of the search of a mass storage system to be adopted by Cyfronet. With the continuous expansion of computing resources, the existing solution, based on classic NFS file servers, was unable to support such a large volume of small files. Therefore, users had to wait for a long time to access their data. Additional delays occurred as files containing the code of applications started on the nodes of the computing cluster needed to be uploaded from the network file server.

Besides the required performance and high availability, the Cyfronet administrators also sought to add the option to create snapshot copies and logical storage media exceeding 2TB. They wanted to ensure an easy enhancement of the system.

An analysis was started to examine those solutions available in the market that could meet the requirements of such a complex and challenging environment. It covered consultations with peer centers, examinations of documentation of mass storage systems and participation in international conferences. Those activities enabled Cyfronet to prepare a technical specification, which is required to start a tender under the public procurement proceeding.

“A perfect scenario should allow us to run proper tests of the hardware we were interested in,” recalls Magryś. “But it would be extremely difficult to implement in practice because of 2 main reasons. First, the workload of our environment is so unpredictable that it is difficult to simulate any real-life situation or select any software for tests, as all those steps should run in the production mode. Second, the implementation of the logistic process connected with tests of such a large solution would be most likely unprofitable for both parties. That’s why we opted for a detailed study of the functionalities of various hardware and the results of performance tests carried out by independent organizations, like SPEC and Storage Performance Council.”

The entire process was closed with a public tender, won by Wasko, which offers mass storage solutions of Hitachi Data Systems. Their bid was most favorable in terms of the price, but also met all the requirements formulated by Cyfronet in connection with the key parameters of the solution. It covered such areas as performance, safety or redundancy, and included issues connected with the raw capacity of the storage.

**How to Connect?**

Cyfronet purchased 2 Hitachi Data Systems products: Hitachi Adaptable Modular Storage (AMS) 2500 and Hitachi NAS Platform (HNAS) 3080, powered by BlueArc®. The AMS 2500 storage system consists of dual active-active storage controllers, 32GB cache memory and 175 SAS 600GB disk drives (15K RPM). It is connected to the local network via 8 ports of the Fibre Channel 8Gb/sec interface and 4 iSCSI 10Gb/sec ports.

The second system, HNAS 3080, is a 2-node network attached storage (NAS) cluster, offering high availability. HNAS is also equipped with FPGA hardware accelerating systems, which allow, for example, for the extremely fast production of snapshot copies at the file system level. The number of IOPS (proven and actually achieved during performance tests) is 40K and the transfer for a single node is 700MB/sec. The HNAS 3080 cluster is connected with AMS 2500 storage, uses its storage media and has 10Gb/sec Ethernet interfaces, which share files in CIFS and NFS systems that are used to store hundreds of millions of small files in home directories and directories of research results.

Since implementing the system, Cyfronet noticed immediate results. “The solution provided by Hitachi Data Systems not only met our requirements, but also positively surprised us. In some cases, its performance, and especially the number of input/output operations per second, exceeded the manufacturer’s catalog parameters,” Twardy said.

“We are very satisfied with the implementation process itself. The operation went according to plan, from supply to installation of the solution to training. The customer service level ensured by Hitachi Data Systems and Wasko is really very high. The high-level professionalism of HDS and top quality of their products became clearly visible as soon as the system went live,” Twardy concluded.