

Case Study

Climate Research: System Upgrade at DKRZ

NEC HPCE installs a total system solution Upgrade at DKRZ.

The Deutsches Klimarechenzentrum GmbH(DKRZ), Hamburg, was founded in 1987 with the mission to provide state-of-the-art supercomputing, data handling and associated services, including high level visualization, to the German scientific community, to conduct large scale earth system and climate modelling.

DKRZ recently upgraded its computer systems and became one of Europe's fastest supercomputer facilities in production, used for climate research. They now have the latest supercomputers from NEC, the SX-6 series, a unified data management system, based on the Intel IA-64 (Itanium) architecture and Linux. These elements are the core of the modernization project costing Euro 34 million.

A New Reality

With the advent of new technology, one trend in high performance computing is the fusion of computation, simulation and data analysis. With advance satellite technology delivering massive data streams in the earth systems and climate area, the challenges and opportunities for fusing observational and/or experimental data with classical simulation have increased enormously.

To address this new reality, DKRZ developed a unified concept, capable of delivering a total solution with transparent access for the climate user community. In addition to the high compute servers, an integrated distributed data management system was specified as an essential part of this upgrade. To achieve this, new hardware and software had to be put in place to support the high numerical calculations, high networking demands and a scalable architecture unified shared file system and archive, to handle the massive volume of generated new data.

After a competitive procurement exercise the contract was awarded to NEC High Performance Computing Europe (HPC Europe), the only vendor offering the compute power and functionality to satisfy DKRZ's needs, as well as the system integration for a total solution. The solution offered by NEC was to take control of the total system integration process and deliver the service within the agreed budget. This involved using its long-established hardware and software engineering skills to select, install and maintain the total system, for delivering the services to fulfil the DKRZ mission.

The Solution Partner

NEC used its own excellent products, the NEC SX series high compute servers for numerical calculations and for data-handling the AsAmA servers. It also incorporated elements from other hardware and software vendors, Storagetek, the Legato hierarchical file system (GFS) and the ORACLE database running on top of Linux, to deliver an optimal solution.

NEC HPC Europe successfully completed the installation of the DKRZ system, a fine example of acting as a true total solutions provider. It supplied and set up a very complex hardware and software environment, performed system integration for a cutting edge task and delivered the

final system on time, by using competent project management and deployment of skilled engineers. This achievement was only possible by listening to and closely collaborating with the DKRZ management, the customer.

To put it in perspective, this upgrade required the integration of a large compute server with a powerful data server. The functionality and performance requirements for the data service are transparent access to migrated data, a high bandwidth for data transfer and a shared file system capable of adaptation in upgrade steps, whenever the usage profile changes. For this reason the data server and the HSM are running on top of the Linux operating system. The successful implementation at DKRZ demonstrates that NEC HPC Europe has the competence to use Linux in mission critical compute centre environments.

In addition, ORACLE is running in a production environment on top of NEC Linux, using the Intel IA-64 architecture, as implemented in the NEC TX7, Itanium based servers. The data server and HSM environment is one of the largest Linux based installations in the scientific/technical area. Although this implementation was targeted on typical HPC applications at DKRZ, the architecture adopted for the HSM environment could also be adapted to satisfy the requirements of businesses in computing, storage and archiving environments.

As Dr. Sell, director of DKRZ said: "What I admire most about NEC HPC Europe, is having listened to DKRZ ideas of how the final system should function, they looked for the most appropriate state-of-the-art technologies available in the market today, both NEC products and best system components from third party vendors, integrated them and delivered the most advanced solution for our application. This was done within the original budget, in a seamless non-disruptive fashion, while the production system was fully operational. The architecture adopted is scalable to allow expansion and open enough for the introduction of new hardware and software for at least the next decade."

The first phase of the DKRZ system went into operation with 64CPUs in spring 2002 and was able to process climate simulations forty times faster than the Cray computer it replaced. The second phase, in September 2002, doubled this to 128CPUs and the final phase with 192CPUs was installed in spring of 2003. The DKRZ now has the second most powerful NEC system outside Japan. In 2003 this supercomputer may well be viewed as one of the world's five fastest computer systems with regard to sustained productive performance delivered to climate application codes - a fact of which the DRKZ can be very proud.

Summary

To summarise briefly, DKRZ has a long history in climate simulation research and in year 2001 made the decision to replace their Cray systems with a large NEC SX-6 system. They were given a fixed budget and the RFP issued required a compute server, a data server and infrastructure, delivered in three phases and completed by 2003. In addition the system had to be balanced between compute power and data handling. The final phase required delivery of at least 0.5Tflop/s, sustained performance, at least 5GBytes/s of data rates, transparent data access and management for HSM, around 50TeraBytes of disk cache and 1.4PetaBytes of tape drives. Only NEC HPC Europe, offered a complete solution, the high performance compute server based on a 192CPUs vector parallel SX-6 system, a main memory of 1.5 Terabytes, 1.5Teraflop/s peak performance and the data-handling server based on the AsAmA series – TX7 system with Intel Itanium processors.

The DKRZ integrated system was delivered smoothly and on time. This enabled DKRZ to provide computing resources for climate research in Germany at the highest competitive international level. With this great success under its belt, HPC Europe is naturally and successfully expanding its solution business activities.

The Author of the Solution

NEC has distributed high performance computing systems in Europe since 1987 and provides wide-ranging support services and system integration. NEC's product portfolio includes SX series supercomputers, TX series high performance servers and NEC's trusted Linux clusters, which are mainly used for scientific and technical computing tasks in industry and research. NEC High Performance Computing Europe (HPCE) was founded in February 2003, formerly known as NEC European Supercomputer Systems, established in 1989. The European headquarter is in Düsseldorf, with branch offices located in Paris, London, Amsterdam, Lugano and Milan. NEC's competence centre for Linux technology and third party application tuning and support has its offices in Stuttgart. For additional information, please visit: <http://www.hpce.nec.com>