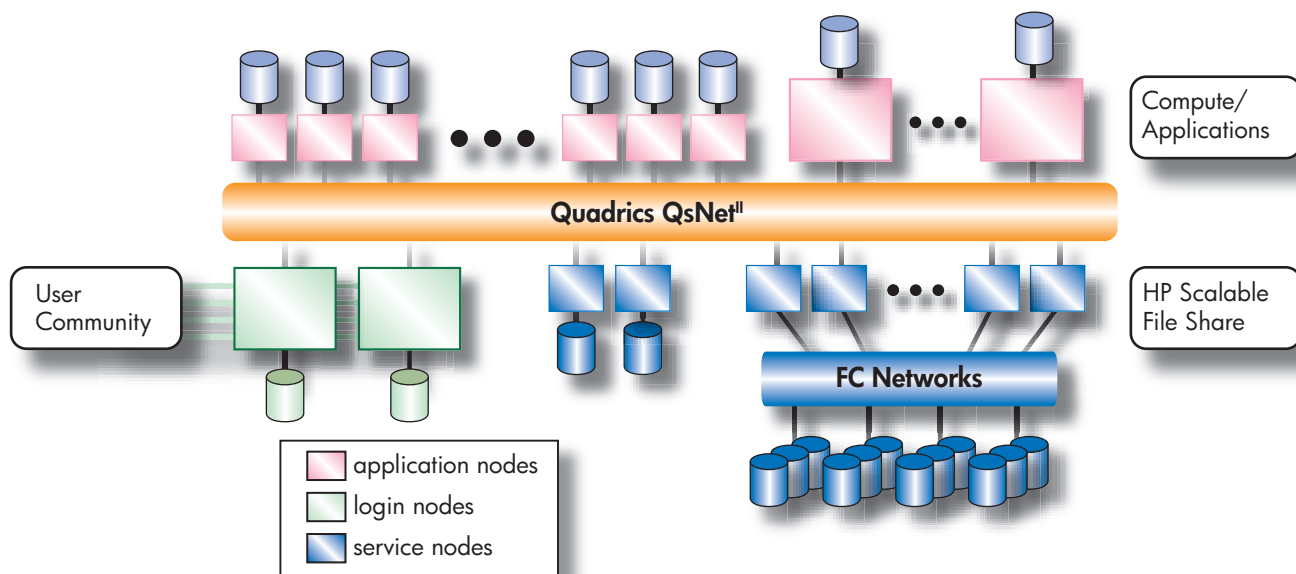




"The HP high performance supercomputing system is significantly advancing research and development work at the universities and research institutes in the state of Baden-Württemberg, Germany. In addition, the HP Cluster Platform 6000 provides a powerful, reliable, and easy to manage system for industrial users."

–Prof. Dr. Wilfried Juling, Director of the Computing Center, University of Karlsruhe





### Business need

The Scientific Supercomputing Center Karlsruhe (SSCK) provides high performance computational services and resources for the scientific and industrial communities in the State of Baden-Württemberg, Germany. SSCK needed an open, reliable, and powerful solution with high bandwidth and scalable storage for data management and sharing. SSCK realized that they were selecting more than just a computational solution. They needed a partner who was experienced and innovative—someone who would work with them to consistently meet the current and future demands of the rapidly changing research and industrial base the center served.

### Solution overview

SSCK partnered with HP, selecting an XC Cluster solution from HP's Unified Cluster Portfolio, an innovative, modular package of hardware, software, and services for scalable computation, data management, and visualization. SSCK's XC Cluster supercomputer includes a 312 processor HP Cluster Platform 6000 system, based on HP Integrity rx2600 and rx8620 servers with Intel® Itanium® 2 processors running the Linux operating system. HP XC System Software provides cluster management capability. An HP StorageWorks Scalable File Share (HP SFS), powered by eight ProLiant-based servers, is providing a scalable cluster file system. The Quadrics QsNetII cluster interconnect ensures high bandwidth and ultra low latency. By early 2006, the overall system will be upgraded to a total of 340 nodes.

### High performance computing

Located at the computing center of the University of Karlsruhe, SSCK cooperates with industrial and academic partners to plan and utilize appropriate state resources to promote science. It performs the tasks of a state-wide scientific high performance computing center by providing scientific users with computing power that cannot be covered locally because of the high system requirements.

SSCK also works closely with users to develop applications for high performance computing and pursues the shared utilization of computing resources within the network.

SSCK teamed up with the High Performance Computing Center (HLRS) from the University of Stuttgart and the Institute for Scientific Computing (Institut für Wissenschaftliches Rechnen or IWR) from the University of Heidelberg to build the High Performance Computing Competence Center Baden-Württemberg (hkz-bw). To maintain a permanent, competitive, international facility for high performance computing, the hkz-bw combines financial and personnel resources from all of the universities involved in the center.

### Massively parallel Integrity cluster

The test phase of the XC Cluster began in April 2004 and included 16 HP Integrity rx2600 servers, each with two Intel Itanium 2 CPUs. In December 2004, another 108 rx2600 systems and 8 ProLiant-based storage servers for the HP SFS server were installed. In February 2005, six 16 processor rx8620 nodes were added and integrated into the XC Cluster solution. The new system with 1.87 TFLOP/S and 312 processors easily secured a place in the TOP500 list of the world's fastest supercomputers.

By early 2006, the overall system will be upgraded to a total of 340 nodes. The new systems will use the next generation Itanium CPU, each with two processor cores. In addition, four 16 processor/32 core nodes will be integrated into the cluster by the end of 2006, bringing the total up to 344 nodes. The centrally managed nodes communicate via a Quadrics interconnect with a concurrent bidirectional data rate of up to two Gbytes per second. In 2006, the final configuration, with more than 1,300 CPU cores, is expected to achieve a total peak computing power of approximately 11 TFLOP/S and provide more than seven terabytes of main memory.

**Simple, cluster management using open, standard technology**

Key to SSCK's XC Cluster is the XC System Software, which provides a single, supported environment to manage a diverse and distributed user community and workload across the cluster. The comprehensive XC System Software is based on a standard release of Linux, enhanced with clustering technology from the open source community and integrated by HP engineering with cluster

**Scalable performance, capacity, and reliability**

The HP StorageWorks Scalable File Share (HP SFS) is a central parallel file system that supplements the SSCK XC Cluster. This shared file system is optimized for use with large Linux clusters and ensures the highest levels of I/O performance. It is highly scalable, based on open standards, and ensures easy and efficient management. The HP SFS will provide 40 terabytes of storage in its final configuration.

“Our customers are very satisfied by the high performance of the HP Cluster Platform 6000. Many applications show a near linear scaling because of the very low latency and the high bandwidth of the cluster interconnect. The large memory of the nodes allows us to perform simulations on this cluster that we could not accomplish before.”

Prof. Rudolf Lohner, Director, Applications and Software at SSCK.

tools and utilities developed by HP and its partners. The XC System Software includes the full Linux operating system, cluster management capabilities for installation and ongoing system administration, robust resource management and scheduling with Platform Computing's LSF, and integrated HP-MPI.

In order to enable the security and high availability of the cluster, certain functional areas are partitioned. In the unlikely event of a subsystem failure, any unaffected areas will remain fully functional.

Additional reliability is provided by the HP SFS. The technology used in HP SFS is designed to scale while maintaining resiliency, providing protection from inevitable hardware failures through transparent failover and recovery.

“HP SFS delivers the high performance shared storage that we require to maximize throughput in our HP Cluster Platform 6000. It allows parallel access to multiple compute nodes with high transfer rates and has demonstrated its reliability in our production environment. The scalability of HP SFS will allow us to easily extend the capacity to more than 40 TB and to increase the bandwidth as the cluster grows by adding more object storage servers,” said Nikolaus Geers, Director, Scientific Supercomputing at SSCK.



### The HPTC<sup>3</sup>—combined expertise

The University of Karlsruhe, HP, and Intel jointly established the High Performance Computing Competence Center (HPTC<sup>3</sup>) located at SSK to promote high performance technical computing. The goal of the center is to ensure the highest levels of reliability and usability of the HP XC Cluster solution. The center handles the integration of the cluster with the operating environment, such as the implementation of functions

included in the XC System Software, the monitoring of the cluster, and the protection of high availability for critical functions. At the center, the University of Karlsruhe, HP, and Intel provide training and education, and porting and optimization of applications from Independent Software Vendors (ISVs). In addition, they collaborate in the field of HPC applications for innovative research areas such as life sciences, energy and environmental research, and technical grid computing.

## Hardware

- 100 Nodes with two Intel® Itanium® 2 processors
  - 12 GB of main memory
  - Two local disks (2 \* 73 GB)
  - Single rail Quadrics QSNNet II interconnect
- 6 nodes with 16 CPUs each
  - 128 GB main memory per node
  - 1.1 TB local disk space per node
  - One Quadrics QSNNet II connector per partition

## Software

- HP XC System Software
- HP StorageWorks Scalable File Share
- GNU compilers
- Intel compilers
- NAGWare Fortran 95 compiler

## Challenge

- Offering a system for capability and capacity computing
- Support of open standards
- Easy access and administration of the cluster
- Scalability of I/O performance

## Solution

- HP XC Cluster with Cluster Platform 6000 system, based on HP Integrity rx2600 and rx8620 servers using Intel® Itanium® 2 processors
- Linux
- HP XC System Software
- HP StorageWorks Scalable File Share

## Results

- Peak performance of 2 TFLOP/S
- Researchers can attack problems they could not solve previously
- Easy porting of application codes; numerous open source development tools
- Single sign-on, single point of administration
- Accelerated application performance

For more information on how working with HP can benefit you, contact your local HP representative or visit us at <http://www.hp.com/go/hptc>

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