White Paper

The Cluster Computing Revolution: Bringing More Computer Power to a Greater Number of Companies

Table of Contents

1.0 Introduction

Recent years have seen a dramatic rise in the adoption of cluster computing solutions, changing the face of high performance computing (HPC) worldwide. Now representing more than half of the HPC market, cluster computing offers the potential for more compute power with a greater degree of scalability to a wider range of users than ever before.

Those companies that have turned to HPC cluster solutions cite better price and performance, greater system throughput and increased capabilities to handle new science as top drivers.

As the trend toward cluster computing grows, however, users are also identifying areas of concern. Technical problems have included disappointing processing capacity, high power and cooling requirements and the prohibitive cost of third party software. Additionally, cluster computing users have struggled with system management capabilities and the complexity of implementing parallel algorithms. SGI, with its 20 plus years of expertise in solving the most demanding compute and data-intensive problems, addresses those concerns and more in its cluster computing solutions.

2.0 Top Performance with Less Hardware, Less Space, Lower TCO

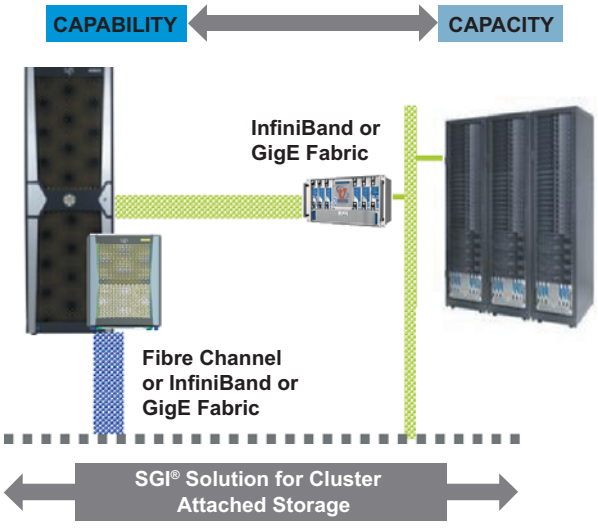
The SGI® Altix® XE cluster platform applies technology innovation to cluster challenges with enhanced reliability and management to deliver flexibility, performance and value for a wide range of workflows, from the simplest, to the most complex.

With their highly integrated design, Altix XE cluster solutions make maximum use of limited datacenter real estate, helping to meet the growing demand for reliable, space-efficient solutions. Available in two configurations, Altix XE1200 or Altix XE1300, the HPC-optimized cluster solution is built around industry-leading SGI Altix XE servers and integrates energy-efficient Dual- and Quad-Core Intel® Xeon® Processors with high-speed connectivity technology and a rich solution stack. The x86-64 workgroup servers include Altix XE210, XE240 and XE310 servers configured with the choice of industry standard operating environments, including SUSE® Linux Enterprise Server, Red Hat® Enterprise Linux®, and Microsoft® Windows® Compute Cluster Server 2003.

Its flexible packaging and configurable cluster components extend SGI Altix XE high performance servers to provide a cost-effective solution that optimally addresses current and changing needs through a rich set of expansion options, efficiently handling mixed workload and capability requirements.

Altix® Capability Servers:

- Top performance & scalability
- Modular blade design for “plug and solve” configurability
- High levels of interactivity
- Intel® Itanium® 2 Processor-based



Altix® XE Cluster and Servers:

- Cost-effective, easy to build and deploy
- Comprehensive cluster solution stack
- Flexible packaging to optimally meet customer needs
- Intel Dual- and Quad-Core Xeon Processor-based

SGI® InfiniteStorage :

- Browser based GUI-driven
- Easy to deploy with “plug and play” configurability
- Top reliability, speed, availability

Fig. 1

Because Altix XE servers easily integrate with SGI InfiniteStorage, the Altix XE cluster solution offers a comprehensive storage infrastructure that stores, manages and accesses data across heterogeneous data sources, with up to 224TB of stored data on a single storage appliance.

The Altix XE's comprehensive cluster solution stack incorporates unified cluster and system management tools. The solution also includes cluster interconnect fabric with Gigabit Ethernet and Infiniband; Altair PBS Pro job scheduling system; Scali Manage cluster management and monitoring tools; and MPI toolkits and Intel development tools.

In addition to its industry-leading cluster and workload management tools, the cluster solution also includes SGI® ProPack to extend Altix XE with advanced performance, administration and development capabilities. ProPack on Altix XE includes features designed to drive performance and simplify tuning for cluster configurations, including enhanced performance with FFIO, CPUSETS and NUMATOOLS and simplified system administration with Performance Co-Pilot, ESP and Cluster Manager.

3.0 The Servers

Altix XE servers provide the foundation of the Altix XE cluster solution. Featuring the Dual- and Quad-core Intel Xeon 5000 Processor architecture, the Altix XE210 and Altix XE240 deliver an innovative cluster platform designed to manage cluster challenges with superior reliability and management. The Altix XE210, a stand-alone server or cluster compute node, offers enhanced density and flexibility for a cost-optimized HPC platform. The Altix XE240 is an ideal cluster compute node, head node or stand-alone server, and features additional I/O expansion options, extended internal storage, high reliability and maximum scalability.

The recently introduced Altix XE310 is a high density cluster compute node, based on a pioneering design that packs 16 cores into a 1U chassis. Designed to maximize efficiency of both data center space and power usage, the Altix XE310 is available as a stand-alone server or in Altix XE1300 cluster configurations.

SGI® ProPack®	
Linkless FFIO	Set as environment variable to accelerate I/O calls. Drives dramatic performance enhancement in I/O intensive cluster configurations.
Intel Runtime Libraries	Current version packaged with ProPack for customer convenience.
CPUSETS	Used directly by cluster workload manager, provides ability to allocate specific CPU for system daemons, etc for improved performance, decreased CPU contention.
ESP	Tool used by administrators to monitor system health.
XVM	Provides disk striping, mirroring – makes nodes "CXFS" ready.
NUMATOOLS	Used to specify CPU, memory usage characteristics & fine tuning – accessible by developers, users to tune application execution.
Performance Co-Pilot™	System monitoring tool; used to view processor activity, loads, etc.
Storage Administration Tools	Additional tools for managing disk resources – xscsi, udev, LSI commands. Not provided by standard Linux® OS.
Failover / Cluster Manager	Basic tool for cluster failover management.

Altix XE System Comparison			
	Altix XE210	**Altix XE240**	**Altix XE310**
Chassis	1U	2U	1U
Processors	Dual- or Quad-Core 2 sockets	Dual- or Quad-Core 2 sockets	Dual- or Quad-Core 4 sockets (2 per node)
Hot-swap Hard Drives	3 x 3.5”	5 x 3.5”	4 x 3.5” (2 per node)
Hard Drive Interfaces Supported	SATA or SAS	SATA or SAS SAS controller on mid-plane (option for IOP-based HW RAID5)	SATA
Memory	8 DIMM 32GB DDR2	8 DIMM 32GB DDR2	16 DIMM (8 per node) 64GB DDR2
Optical Drive	One slim optical	One slim optical	
Power	600W	750W 1+0 (redundant option)	980W (for 2 compute nodes)
Add-in Card Support	1 PCI-X (133MHz) 1 PCIe (x8)	3 PCI-X, 2 PCIe (x4) OR 1 PCI-X & 2 PCIe (x4) 2 PCIe (x4) or 1 PCIe (x8)	2 PCIe (x8) (1 per node)
System fans	5 non-redundant	6 redundant & hot swap standard	Non-redundant
Benefits	- Moderate density - Stand-alone or cluster compute node	- I/O rich - Stand-alone or cluster head node	- Ultra-dense, cost-efficient - Cluster compute node

4.0 The Clusters

The Altix XE platform supports two factory-integrated cluster offerings: the Altix XE1200 and the Altix XE1300.

Developed in response to the demand for cluster computing solutions that are easy to manage but still offer industry leading scalability and performance, the Altix XE1200 and Altix XE1300 are customizable, factory-integrated cluster solutions that offer a selection of interconnect choices, including Gigabit Ethernet and 4x SDR or DDR InfiniBand. The Altix XE cluster software environment offers cost and convenience advantages over traditional piece-built commodity clusters. Altix XE clusters also include bundles of popular third-party software solutions and tools, along with numerous options that enable users to maximize the performance and flexibility of their Altix XE clusters. The Altix XE cluster solution software stack includes:

- Scali Manage™, a cluster management and monitoring system that allows users to provision, manage and maintain clusters, grids of clusters and clustered file system installations up to more than 1,000 nodes.
- Intel MPI Library Runtime Environment to help developers and users optimize clusters by deriving maximum performance from such Intel MPI-based applications as LS-DYNA, FLUENT, STAR-CD and PAM CRASH.
- Intel Compiler Runtime Environment to allow any application compiled with Intel C++ Compiler or Intel Fortran Compiler to run on the cluster without the installation of any additional software.

Altix XE clusters also include optional software and cluster components to further improve ease of use and performance:

- Altair PBS Professional, an open workload management and queuing software solution that works with Scali Manage to manage workloads across the Altix XE cluster.
- SGI ProPack, a set of enhancements that include system administration, development, and performance monitoring tools.

Altix XE1200 clusters include the SGI cluster solution stack, Altix XE240 head nodes, and Altix XE210 compute nodes.

Altix XE1300 clusters include the SGI cluster solution stack, Altix XE240 head nodes, and ultra-dense Altix XE310 compute nodes, providing a cost-optimized solution designed specifically for HPC.

Designed for maximum efficiency and cost-effectiveness, the Altix XE1300 features a tightly integrated board architecture compact enough to fit two nodes, eight cores each, in a single 1U chassis, making optimal use of datacenter space.

5.0 Spotlight on Benefits

The SGI Altix advanced cluster platform provides top performance for enhanced productivity. Benefits include:

- **Flexible Packaging to Meet Diverse Customer Needs**
  The Altix XE1200 cluster offers advanced extensibility, with a rich set of expansion and I/O options to address the widest possible range of compute requirements. The SGI Altix XE1300 supports 16 processor cores per 1U package, delivering industry-leading performance density and cost efficiency.
- **Reduced Total Cost of Ownership (TCO)**
  The innovative new board design of the AltixXE1300 cluster drives enhanced customer value, with ultra-high dense packing resulting in a reduced footprint and lower infrastructure expenses by minimizing space and power requirements. Onboard InfiniBand reduces the amount of interconnect cabling and cards, which simplifies deployment, decreases cost and increases reliability. Fewer cards mean better cluster reliability, while reduced floor space and cooling requirements lower overall costs. Together, these features deliver breakthrough customer value.
- **Custom-Configured Factory Integrated Clusters for Simplified Deployment**
  SGI Altix XE clusters can be custom-configured to support the full spectrum of customer requirements and are fully integrated and tested at the factory prior to shipment, making them ready to deploy upon delivery. Systems are up and running faster, resulting in increased performance levels.

6.0 Backed by SGI

SGI is known for industry leadership and technology excellence, with over 20 years of experience in delivering scalable, reliable, high performance systems to solve customers most challenging compute problems. With the Altix XE platform, SGI delivers exceptional value in an innovative and cost-effective line of Intel Xeon Processor-based servers and clusters designed to optimally address customer needs.

In addition to its deep technology experience, SGI boasts a world-class Professional Services team that specializes in building and deploying top performance cluster, capability and hybrid systems.

Together, the combination of innovative technology and an experienced, dedicated professional services team delivers cluster solutions designed to maximize cost-effectiveness, performance, and reliability.

Corporate Office
1140 E. Arques Avenue
Sunnyvale, CA 94085
(650) 960-1980
www.sgi.com

North America +1 800.800.7441
Latin America +55 11.5185.2860
Europe +44 118.912.7500
Japan +81 3.5488.1811
Asia Pacific +1 650.933.3000

3995 [04.17.2007]
J15263