



Cyclone™

# SGI Cloud Computing for HPC

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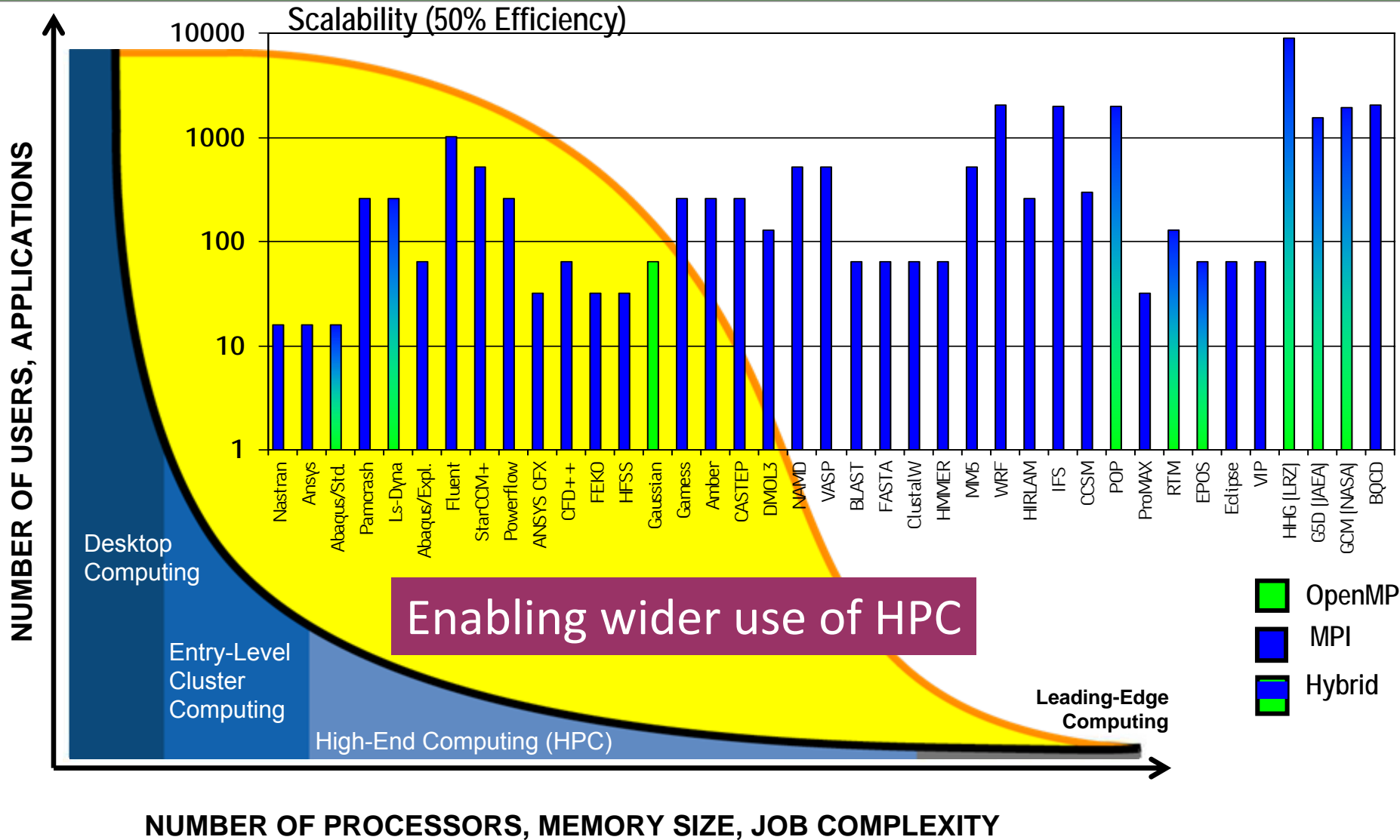
# Agenda

- Rationale for Cyclone SGI offering
- Role in SGI business model
- Cyclone service and usage models
- Partnerships
- Future Directions

# Limitations of Existing Cloud Services for HPC

- Most cloud systems built on virtualized instances only
- Limited scalability of available servers:
  - Scale-out clusters only
- Lack of high speed networks
  - Mostly GigE
- Lack of user control over node interconnect topology
  - MPI latency, core distribution, contiguous memory
- Lack of available HPC software stacks
- Lack of technical application specific configurations

# Benefit of HPC Cloud Computing



Source: Nimbis Services, 2010

Graphic adopted from OSC, Council on Competitiveness and the University of Southern California.

# Completing the need

Personal &  
Workgroup



Access & Compute

Traditional  
Data Center



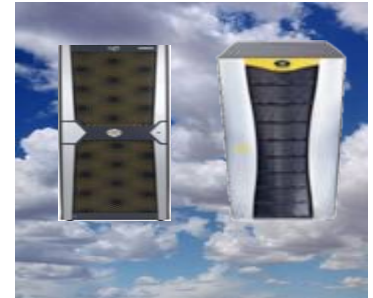
Scale & Control

Modular  
Data Center

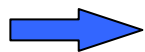


Modular & Mobile

Cloud



On Demand



Move freely between the environments



# SGI Cyclone- results on demand™

- Cloud computing dedicated to technical computing
- Cyclone Offers Flexible Choice of
  - Platform
    - Scale-up (Altix 4700 and Altix UV) and Scale-out (Altix ICE and Altix XE)
    - Hybrid systems with NVIDIA Tesla, ATI FireStream and Tileria accelerators
  - Operating System (SLES, RHEL)
  - Interconnect (NUMALink, InfiniBand, GigE)
  - Physicalization and virtualization
- Application-Specific Cloud
  - Application-tuned software stacks
  - Open source and close source applications
- Differentiators
  - Significantly broader platform flexibility
  - SGI Performance Suite for application acceleration
  - Deep Application Engineering expertise



# SGI Cyclone - Usage Models

## ■ Cloud Service for Customers

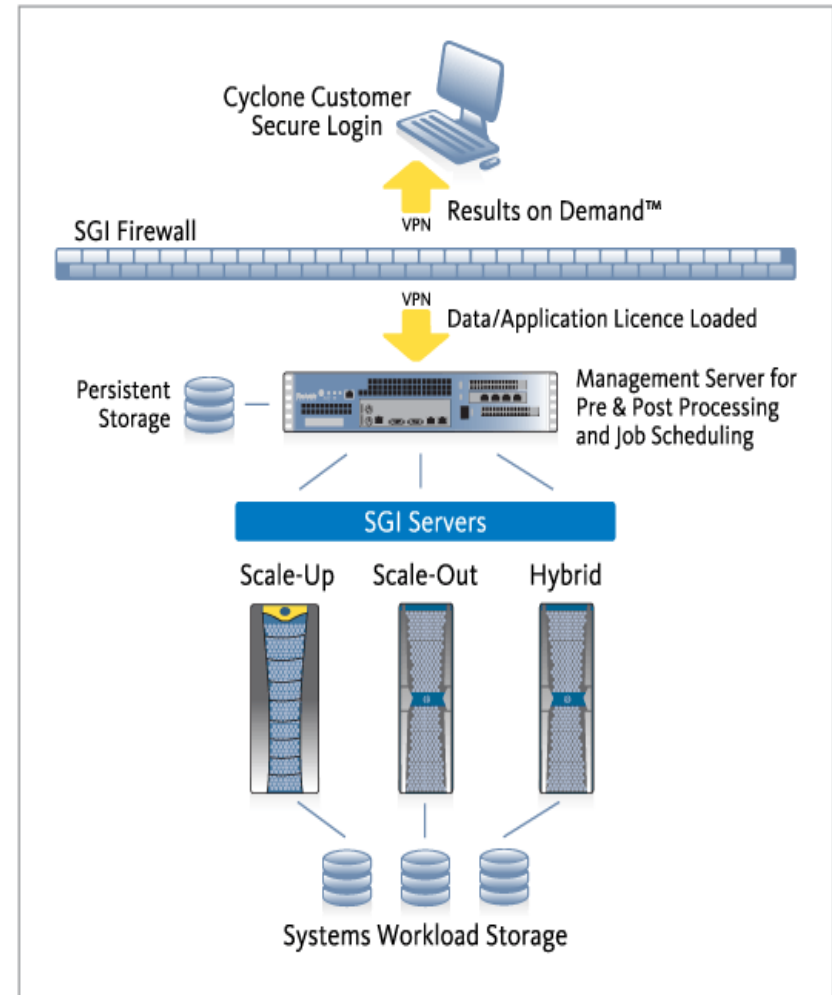
- SaaS and IaaS
- Bridge for overflow capacity
- Bridge for new system installation
- Hub for new applications and architectures

## ■ Cloud for Software Development

- SGI Solutions Partner Program

## ■ Internal Cloud

- Benchmarking
- Software development



# SGI Cyclone Domain and Application Focus

<b>Domain</b>	<b>Use Cases</b>	<b>Applications</b>
<b>Computational Biology (BIO)</b>	Genomics, proteomics, molecular modeling and drug discovery	BLAST, FASTA, HMMER, ClustalW
<b>Computational Chemistry and Materials (CCM)</b>	Nanotechnology, materials research (metal alloys, polymers, composites, ceramics and plastics)	Gaussian, Amber, Gamess, Namd, Gromacs, LAMMPS, DL_POLY
<b>Computational Fluid Dynamics (CFD)</b>	Automotive design, aerospace design, defense systems design and power generation design	StarCCM+, OpenFOAM, Acusolve, NUMECA
<b>Computational Structural Mechanics (CSM)</b>	Structural, heat transfer, fatigue and vibrational analysis for manufactured products	LS-DYNA
<b>Computational Electromagnetics (CEM)</b>	Design and analysis of antennas, antenna placement, EMC (shielding, coupling.), RF components and bioelectromagnetic analysis	FEKO
<b>Ontologies (ONT)</b>	Semantic Web, data mining	OntoStudio, SemanticMiner



Six Initial Domains: More to follow

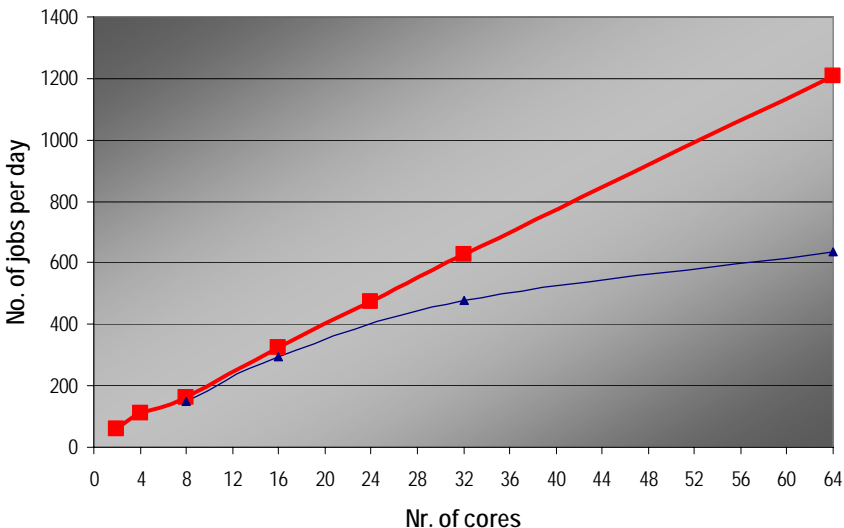
19 Supported Applications: More to follow





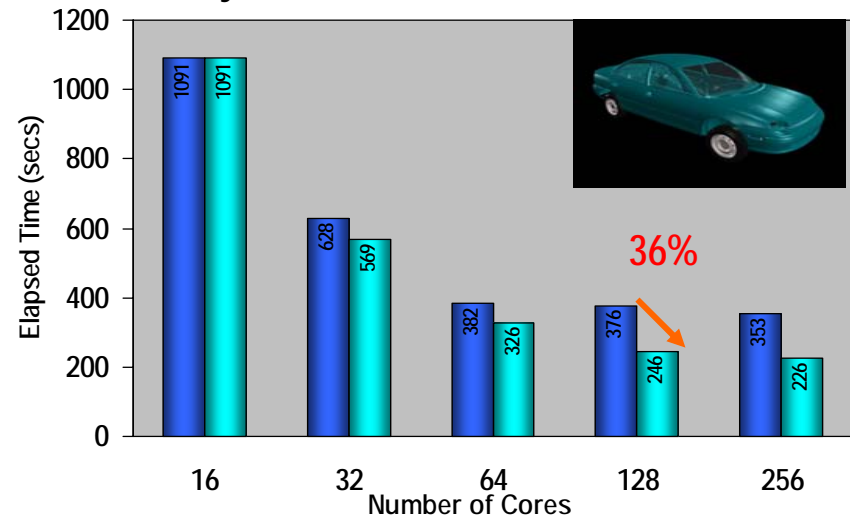
# SGI Cyclone System Architectures

Fluent Performance: FL5L3 9,7M cells



— Altix XE1200 Xeon 5160 3GHz IB — Altix XE1200 Xeon 5160 3GHz GigE

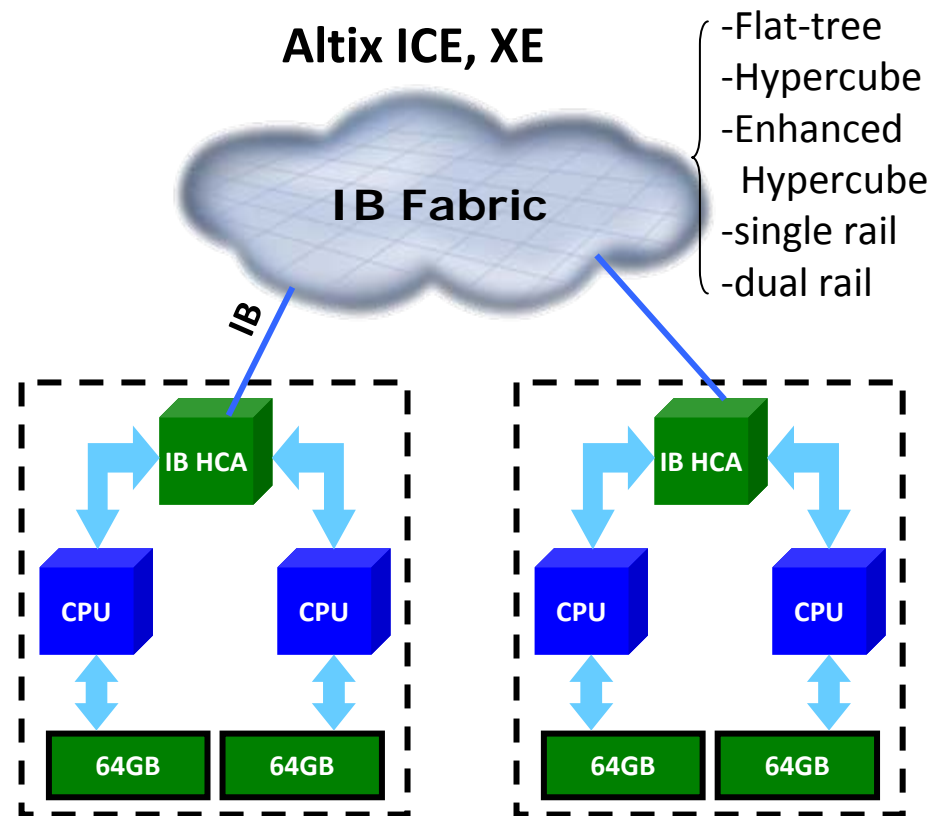
LS-Dyna Performance - Frontal Crash



■ MPT Single-rail, ICE 8200 ■ MPT Dual-rail, ICE 8200

## Cluster

Altix ICE, XE

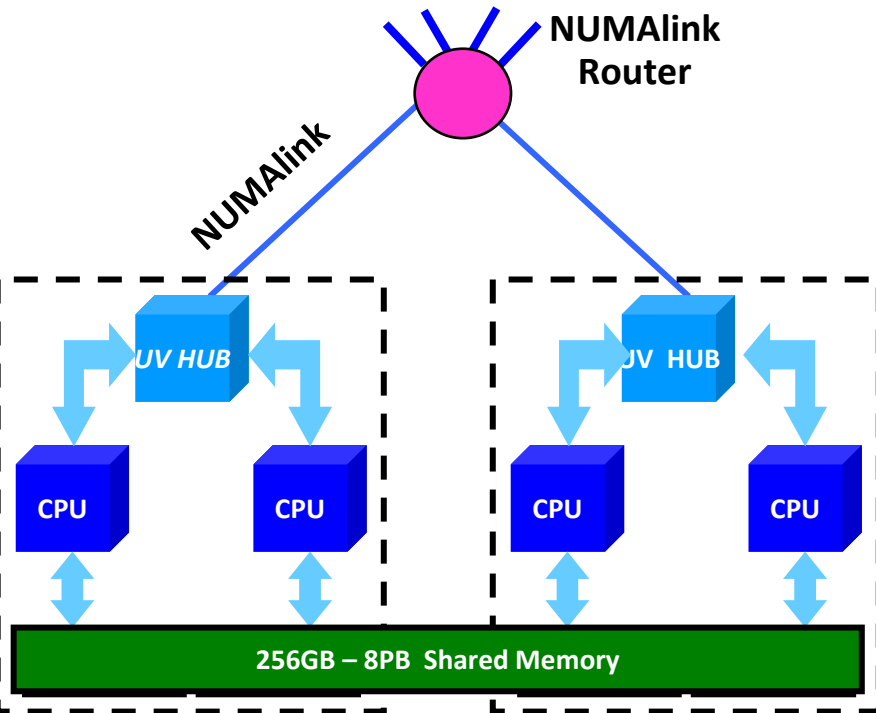


Platform interconnect choices determine the achieved application performance

# SGI Cyclone System Architectures

## SMP

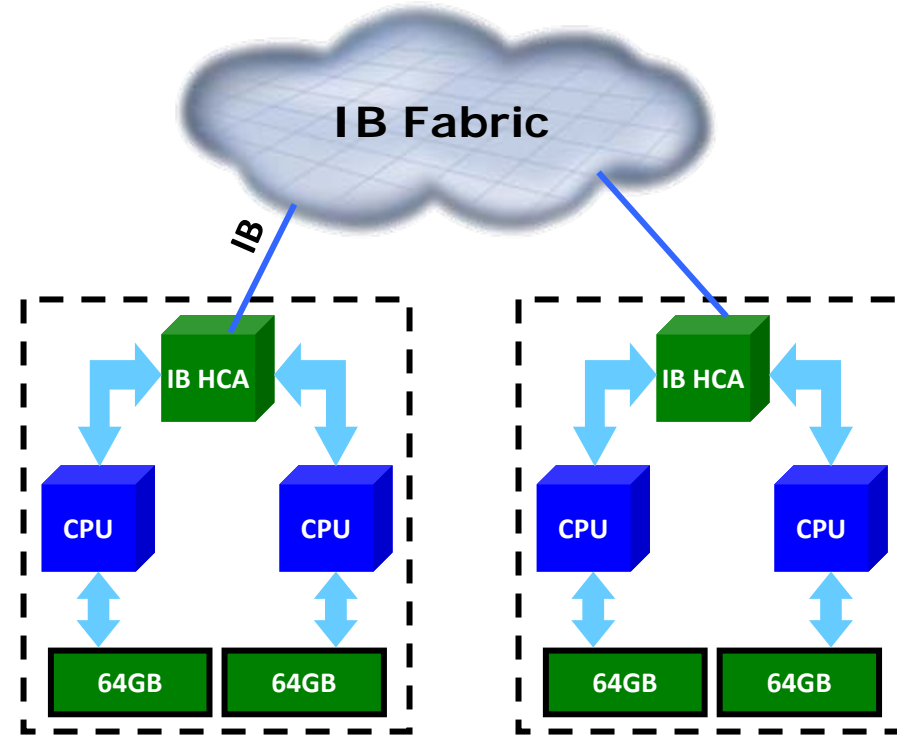
### Altix UV



- NUMAlink® 5 is the glue of Altix® UV
- Global Shared Memory
  - Sockets: 2 to 256 in in one OS image system
  - Memory: up to 16TB in one OS image system
  - NUMAlink5 BW: 15 GB/s aggregate

## Cluster

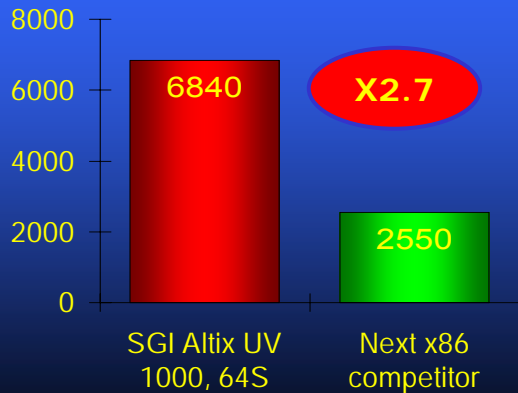
### Altix ICE, XE



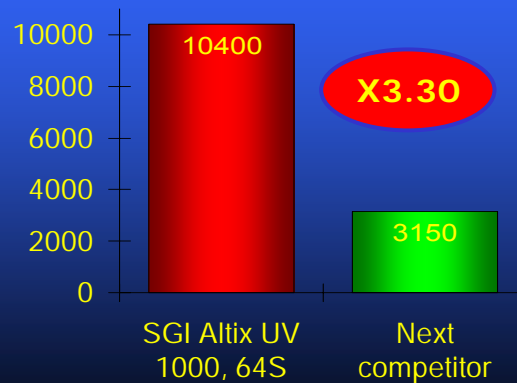
- MPI off-load engine on Altix® UV
  - MPI reduction, barrier -> Synchronization 3x - 10x
  - MPI short messages -> local Latency 2x
  - MPI next neighbor communication -> local BW 3x
  - MPI Barrier Latency <1usec (4096 thread)

# Performance Preview on Altix UV

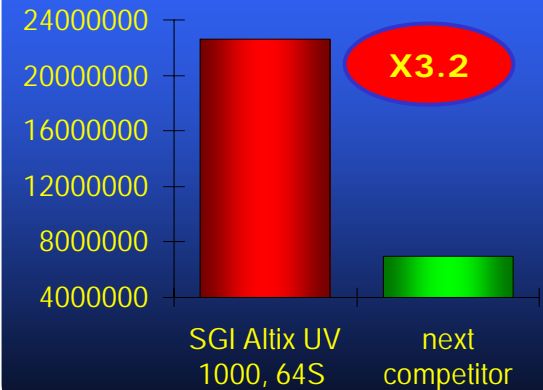
## SPECfp\_rate base2006



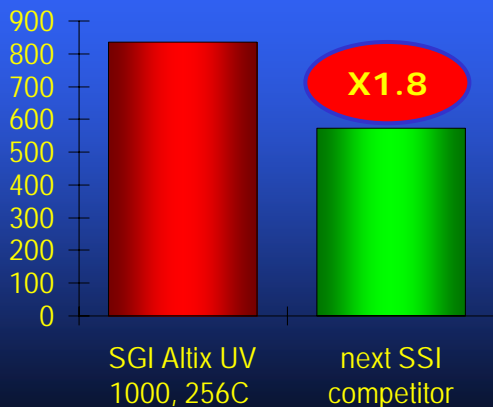
## SPECint\_rate base2006



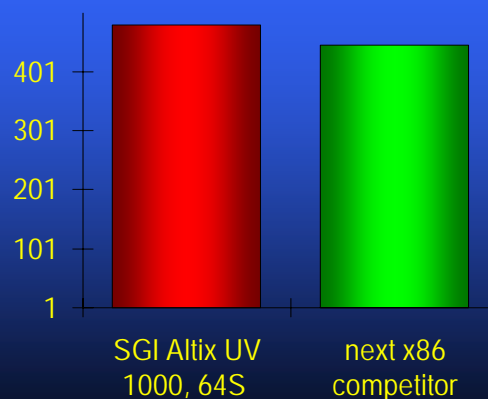
## SPECjbb2005\*



## GUPS\*



## STREAM\*

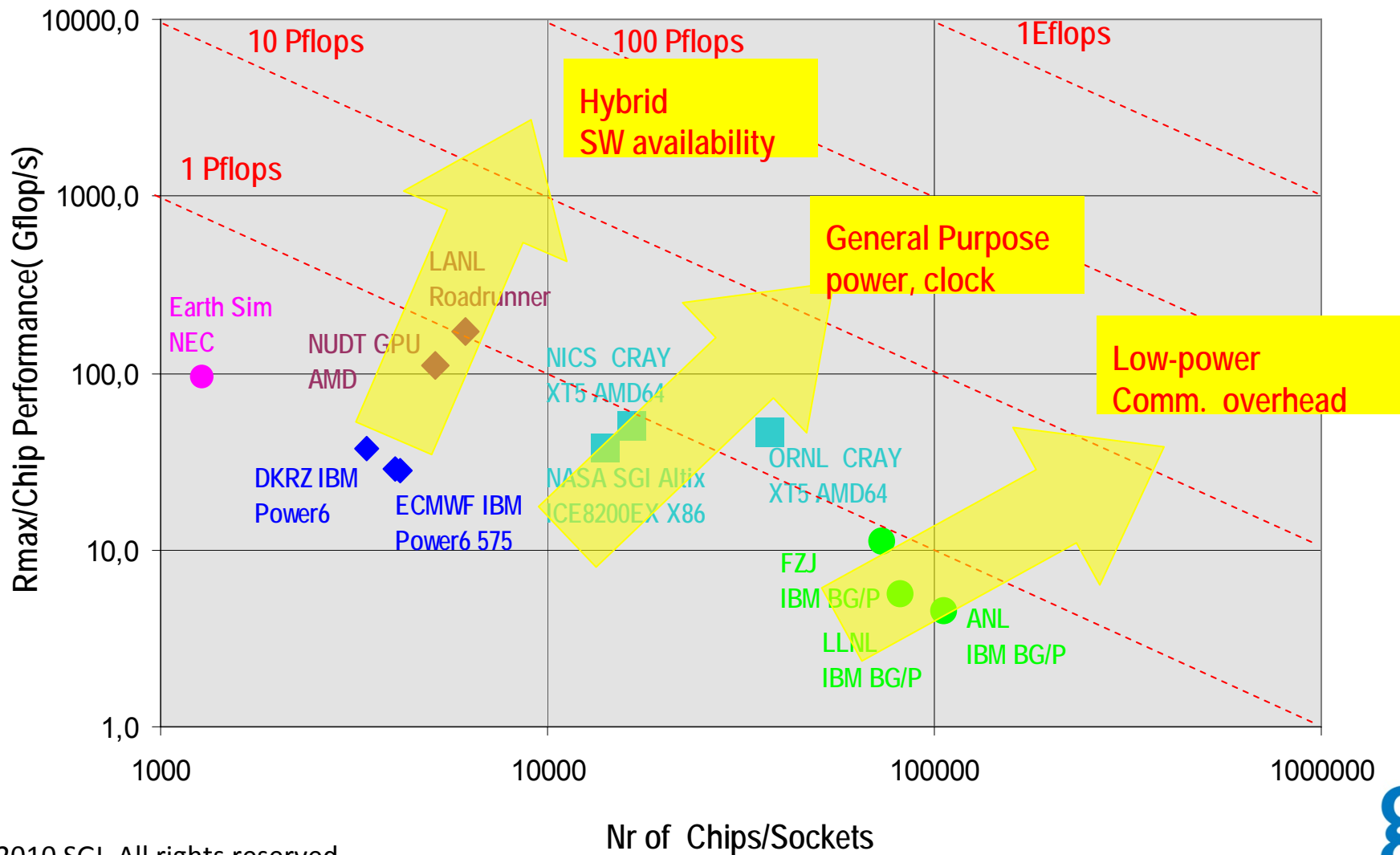


**SGI Altix UV is the industry's leading supercomputer in relevant performance metrics**

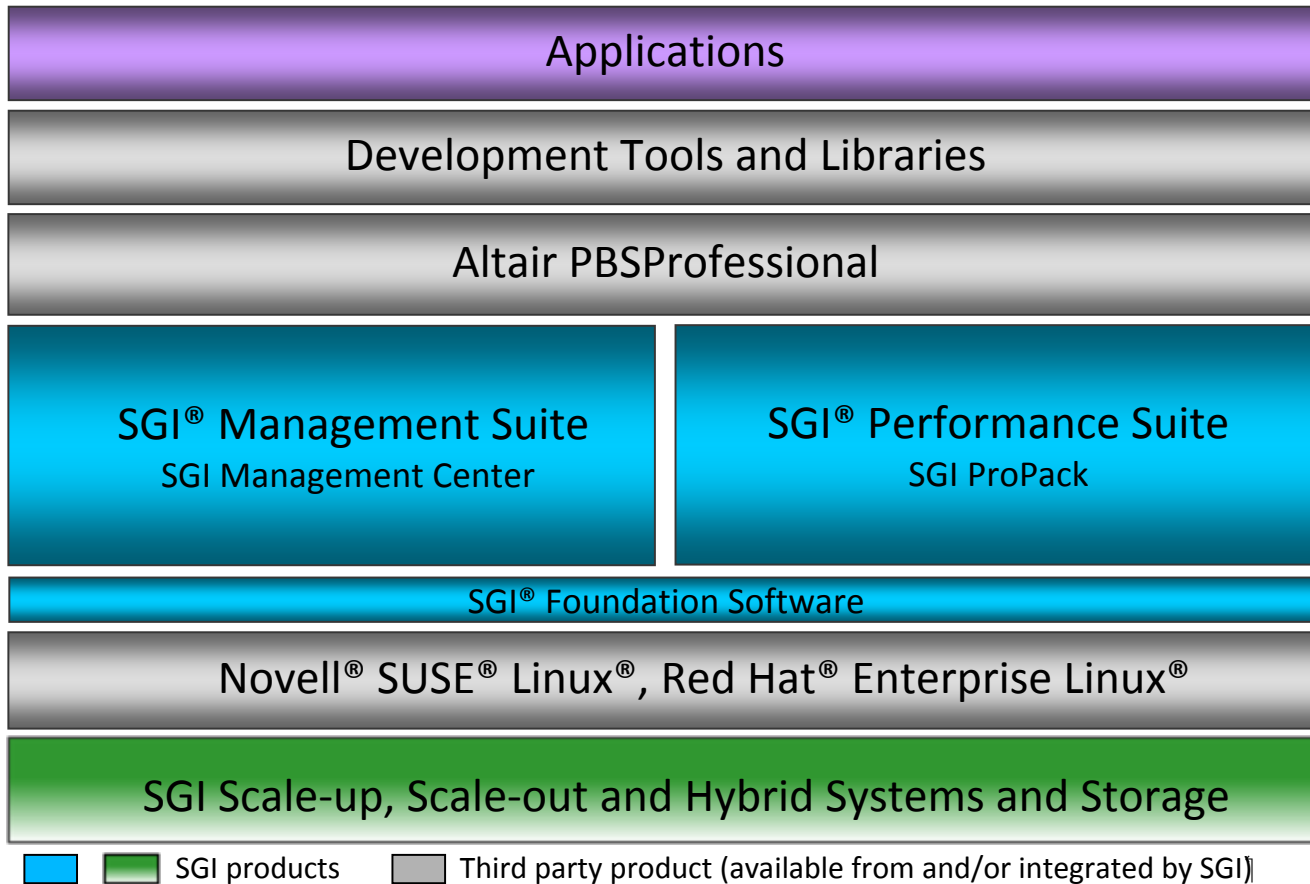
# Rationale for GPU

## Analytics of Top500 list, Nov 2009

System Performance = Chip Performance x Nr of Chips



# SGI Cyclone Software Stack



# SGI Performance Suite – Application Accelerator

## FFIO – IO Accelerator

linkless IO library that enhances performance for jobs that have much larger IO footprint sizes than free memory sizes on the systems.

## SGISolve

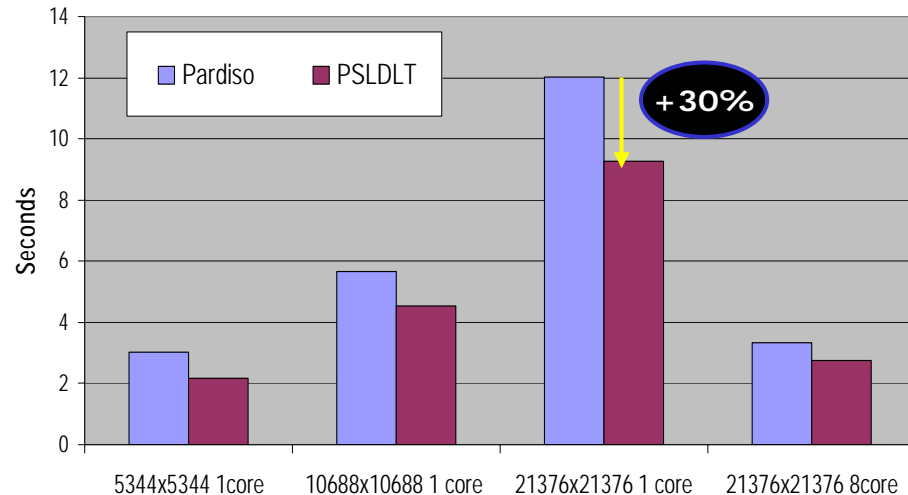
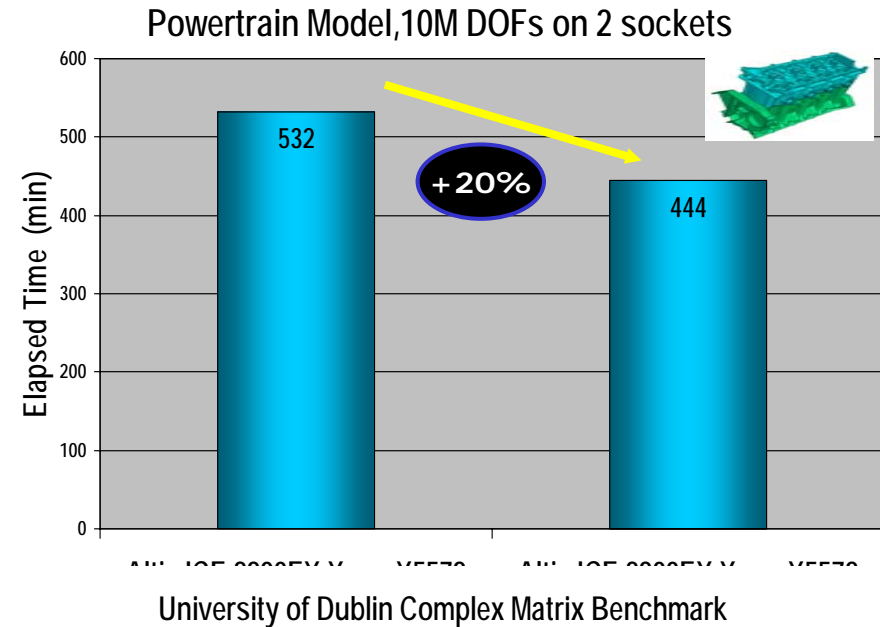
- Scalable SMP parallel in-core and out-of-core sparse solvers
- Parallel iterative solvers and preconditioners library

**MPT** - MPI offload engine for SMP and Clusters

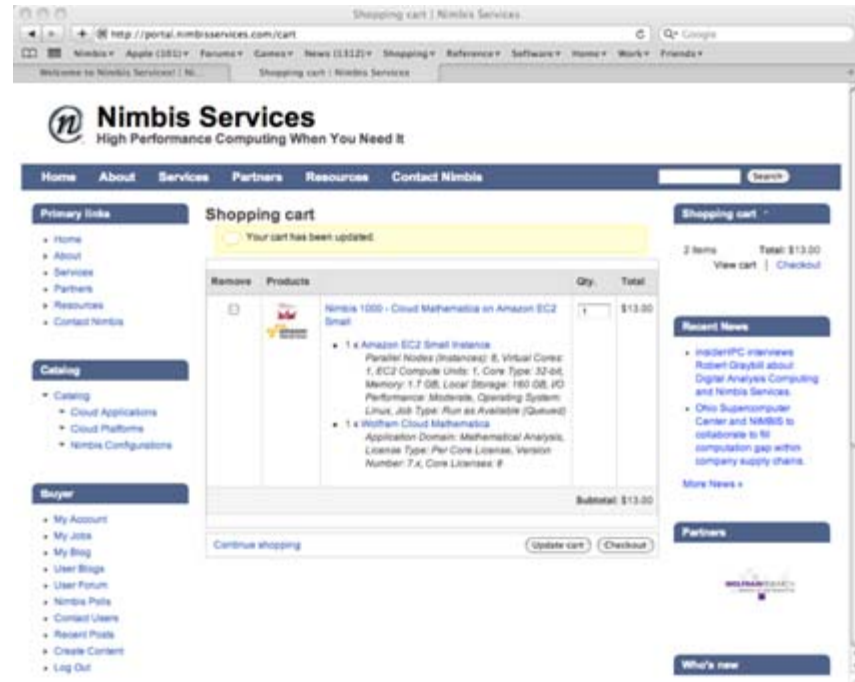
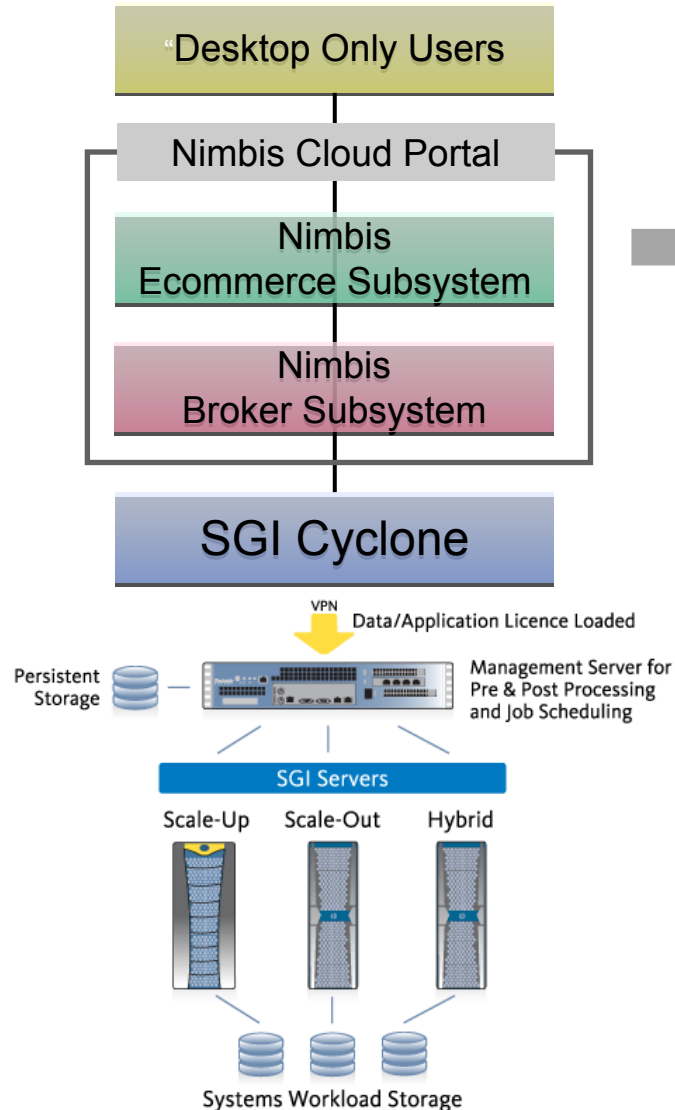
**PerfBoost**– Accelerate applications certified HP-MPI, Intel MPI or OpenMPI  
No recompile or re-linking needed

**XPMEM, XPNET** – fast cross-partition data transfer

**MPInside** – MPI performance modelling and projection tool

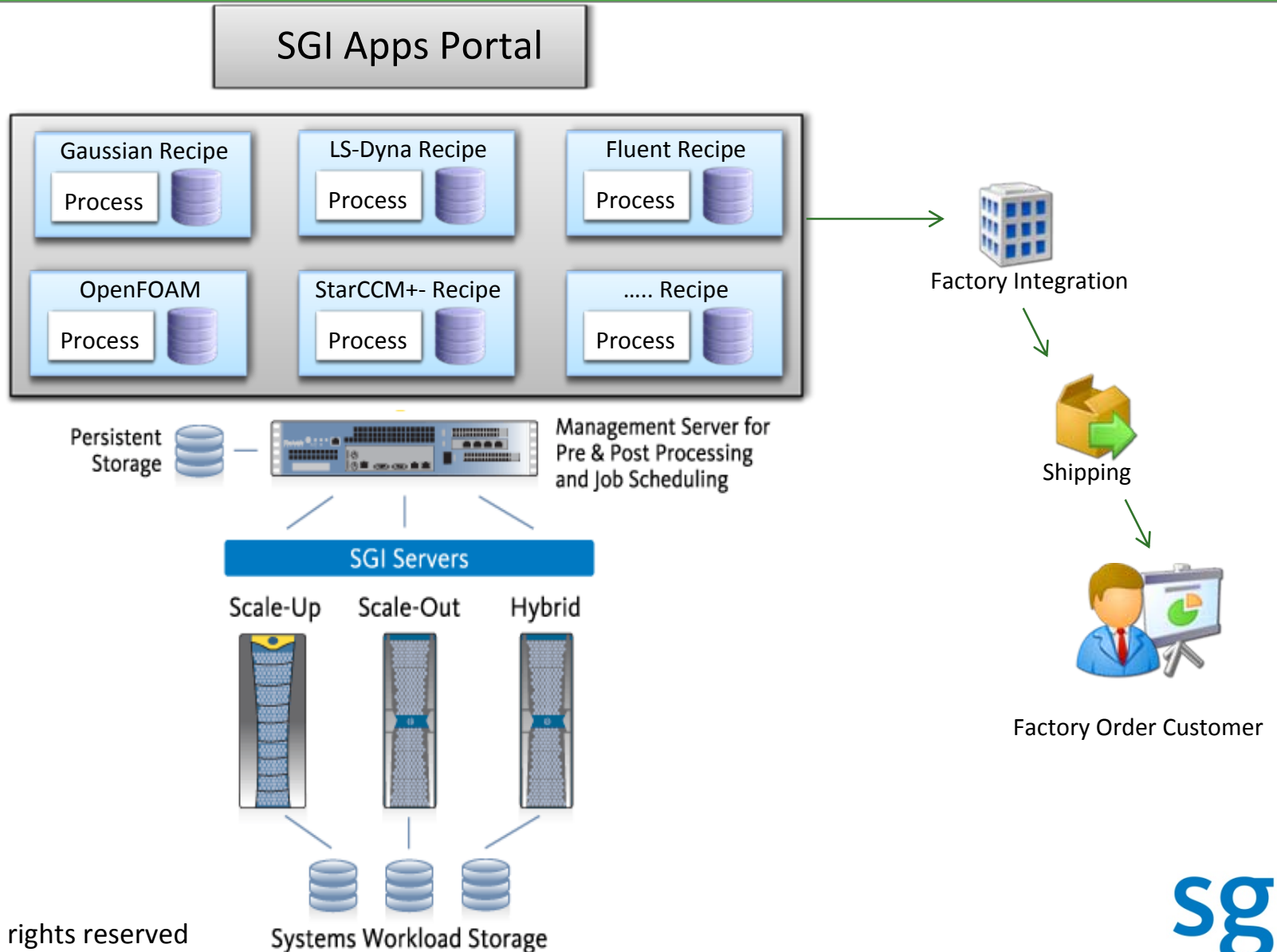


# Partnership - Nimbis Cloud Portal for SGI Cyclone



# Cyclone Technical Application Library

## Application-tuned HPC environments





# Conclusions

- Cyclone completes the need
- Specifically dedicated to technical computing
- Making HPC pervasive
- Fast access to new technologies