SGI®

Many core computing Solutions

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Nvidia Tesla series

| Features | M2075 | M2090 | K10 | K20 | K20X |
|--|-------------------------|------------------|--|-----------------------|-----------------------|
| Number and Type of GPU | 1 Fermi GPU | 1 Fermi GPU | 2 Kepler GK104s | 1 Keple | r GK110 |
| Peak double precision floating point performance | 515 Gigaflops | 665 Gigaflops | 190 Gigaflops (95 Gflops per GPU) | 1.17 Tflops | 1.31 Tflops |
| Peak single precision floating point | 1030 | 1331 | 4577 Gigaflops | 3.52 | 3.95 |
| performance | Gigaflops | Gigaflops | (2288 Gflops per GPU) | Tflops | Tflops |
| Memory bandwidth | 150 | 177 | 320 GB/sec | 208 | 250 |
| (ECC off) | GBytes/sec | GBytes/sec | (160 GB/sec per GPU) | GB/sec | GB/sec |
| Memory size (GDDR5) | 6 GB | 6 GB | 8 GB | 5 GB | 6 GB |
| | | | (4 GB per GPU) 3072 | | |
| CUDA cores | 448 | 512 | 5072 (1536 per GPU) | 2496 | 2688 |
| | | | _ | | SOI |

Intel® Xeon Phi[™] Coprocessor

| | <u>5110P</u> | <u>3120A</u> | <u>3120P</u> | <u>7120P</u> | <u>7120X</u> | <u>5120D</u> |
|--|-----------------------|----------------|----------------|--------------|--------------|------------------------|
| Code Name | Knights Corner | | | | | |
| # of Cores | 60 | 57 | 57 | 61 | 61 | 60 |
| Clock Speed | 1.053 GHz | 1.1 GHz | 1.1 GHz | 1.238 GHz | 1.238 GHz | 1.053 GHz |
| Peak double precision floating point performance | | | | | | 1.011 TFlops |
| Peak single precision floating point performance | | | | | | 2.022 TFlops |
| Cache | 30 MB | 28.5 MB | 28.5 MB | 30.5 MB | 30.5 MB | 30 MB |
| Max TDP | 225 W | 300 W | 300 W | 300 W | 300 W | 245 W |
| Max Memory Size | 8 GB (16 channels) | 6 GB | 6 GB | 16 GB | 16 GB | 8 GB |
| Max Memory Bandwidth | 320 GB/s | 5 GB/s | 5 GB/s | 5.5 GB/s | 5.5 GB/s | 5.5 GB/s |

SGI Development Suite

- For Linux software development
- Supports 2-4 developers









- Technical Computing Performance for SGI Systems
- Consists of SGI Accelerate, SGI MPI, SGI REACT, SGI UPC
- Tech support via SGI Support contract

- Software development tool suite tuned for application performance and code robustness
- Consists of C++ & Fortran compilers, Math Kernel Library, Integrated Performance Primitives, Threading Building Blocks
- Includes 1 yr tech support

- Dynamic source code, thread, and memory debugging for C, C++ and Fortran HPC applications
- Consists of TotalView, MemoryScape, ReplayEngine, and CUDA debugging
- Includes 1 yr tech support



Intel® Xeon Phi[™] compared to a GPU

- Intel[®] Xeon Phi[™] is a multi-core architecture with the following characteristics :
 - based on Pentium 4 in-order cores with a vector extension
 - OpenMP programming
 - "UV on a chip"
 - PCIe x16 Gen 2 (~ 6.7 GB/s)
 - Ease-of-Use
- NVIDIA Fermi GPU use streaming multi-processors with currently 32 SIMD engines
 - A very high number of threads (10s of thousands) hides latency to memory
 - Minimal context switching time between threads
 - HW thread dispatcher
 - PCIe x16 Gen (~ 11.3 GB/s) [Kepler 10]

GPU-ACCELERATED APPLICATIONS

| 01 Person blinker Education and Summer to | on CASINO Code for performing Quantum Monte Code | CPI Is to determine omtain hindingsites | Borrows-Wheeler Transformation | only | calculations of a wide variety of pricing and | irav rendering | in Maximus supported GPU simulation using | Element 3D | Accurathar Stonteller Weather graphice Pool time |
|--|---|---|---|--|---|--|---|---|--|
| 01 Research: Higher Education and Supercomputer COMPUTATIONAL CHEMISTRY AND BIOLOGY NUMERICAL ANALYTICS | g CASINO Code for performing Quantum Monte Carlo (QMC) electronic structure calculations for finite and periodic systems | Allows fast processing of large ligand databases | Borrows-Wheeler Transformation, Dynamic Programming, Multi-GPU support Vac | only Intuvision Panoptes 3.0 Video Analytics Object recognition and change detection Yes | calculations of a wide variety of pricing and risk measures on a broad range of asset classes and derivatives | iray rendering Yes Inventor 3D mechanical design, documentation, and | CUDA | 3D objectbased particle system Faster effects Yes POPULAR GPU-ACCELERATED APPLICATIONS | Accuweather Storyteller Weather graphics Real-time Single only ASI/CA Regional stmoorphasic model Entire model |
| NUMERICAL ANALY IICS PHYSICS 06 Defense and Intelligence | tinite and periodic systems TBD Yes CP2K Program to perform atomistic and | databases Single only BUDE Molecular docking program Empirical Free | Yes UGENE Opensource Smith-Waterman for SSE/ CUDA, Suffix array based repeats finder and | recognition and change detection Yes LuciadLightspeed Geospatial Visualization and Analysis Geospatial Situational Awareness Single | Existing models code in C# supported | Inventor 3D mechanical design, documentation, and product simulation Uses BIM for intelligent building | Maxon Cinema 4D 3D modeling, animation, and | POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 11 | ASUCA Regional atmospheric model Entire model Yes CAM - SE Global atmosphere model for climate |
| 06 Computational Finance | molecular simulations of solid state, liquid, | Energy Forcefield Single only | dotplot | | transparently, with minimal code changes, Supports multiple backends including | components to improve design accuracy | rendering Increased model complexity at interactive rates | Video Copilot Optical Flares | research |
| 07 Manufacturing: CAD and CAE COMPUTATIONAL FLUID DYNAMICS | molecular and biological systems DBCSR (space matrix multiply library) Yes | Core Hopping Rapid screening of novel cores to improve | Fast short read alignment Yes WideLM Fits numerous linear models to a fixed | MotionDSP Ikena ISR Real-time Full Motion Video and WAMI | CUDA and OpenCL, Switches transparently between multiple GPUs and CPUS | Single only Revit Building Information Modeling (BIM) for | Single only NewTek Lightwave 3D modeling, animation, and | Lens flares plug-in for After Effects Faster effects Single only Video Copilot Twitch Video effects plug-in for After | Dynamical core Yes COSMO Regional atmospheric model Entire model |
| COMPUTATIONAL STRUCTURAL MECHANICS COMPUTER AIDED DESIGN | GAMESS-UK The general purpose ab initio molecular | drug properties GPU accelerated application Yes | design and response Parallel linear regression on multiple | enhancement and analytics Real-time super-resolution-based video | depending on the deal support and load factors | structural engineering, and construction Modeling (BIM) to design, build, and | rates | Effects Faster effects Single only | Yes GEOS-5 Global climate model Entire model Yes |
| ELECTRONIC DESIGN AUTOMATION 09 Media and Entertainment | electronic structure program for performing SCF-, DFT- and MCSCF-gradient | FastROCS Molecule shape comparison application Real-time shape similarity searching/ | similarly-shaped models Yes | enhancement, filtering, mosaicing, video analytics, and transcoding | Yes Manufacturing: CAD and CAE | maintain higher-quality, more energyefficient buildings | Single only Otoy Octane Render GPU Renderer CUDA-based | EDITING APPLICATION DESCRIPTION SUPPORTED | HOMME Dynamical core for global atmospheric model |
| ANIMATION, MODELING AND RENDERING COLOR CORRECTION AND GRAIN | calculations (ss(ss) type integrals within calculations | comparison Yes | POPULAR GPU-ACCELERATED APPLICATIONS | Yes Nerwe ViD SrX Video Analytics Object recognition | COMPUTATIONAL FLUID DYNAMICS APPLICATION DESCRIPTION SUPPORTED | Single only NVIDIA Iray A ready-to-integrate, physically-based, | GPU final-frame rendering Yes Pixologic Sculptris 3D sculpting Increased model | FEATURES MULTI-GPU SUPPORT Adobe Photoshop CC Image editing Over 30 effects | Dynamical core Yes HYCOM Ocean circulation model Dynamical core |
| MANAGEMENT COMPOSITING EINISHING AND EFFECTS | using Hartree-Fock ab initio methods and density functional theory. Supports | Interactive Molecule | CATALOG MAR14 05 NUMERICAL ANALYTICS APPLICATION DESCRIPTION SUPPORTED | and tracking Yes Net/ve Visual Search | FEATURES MULTI-GPU SUPPORT Altair AcuSolve General purpose CFD software | photorealistic rendering solution law Interactive: Irav Photoreal: Irav | complexity at interactive | | Single only Meteo Earth Weather graphics Real-time Single only |
| EDITING ENCODING AND DIGITAL DISTRIBUTION | organics and inorganics. | Molecular visualization based on a raytracing engine Written for use only on GPUs Yes | FEATURES MULTI-GPU SUPPORT ArrayFire Comprehensive GPU function library | Solution (NVSS) Video/Image Live and Forensic Search Video and | Linear equation solver Yes ANSYS Fluent General purpose CFD software | Cluster. Fast interactive ray tracing; Physically-based, global-illumination | Single only Redshift Renderer GPU-accelerated, biased rendere | tor smoother image manipulation in Mercury Graphics Engine Single only Adobe Premiere Pro CC Video editing Mercury | MITgcm Ocean circulation model Dynamical core |
| ON-AIR GRAPHICS ON-SET. REVIEW AND STEREO TOOLS | GAMESS-US Computational chemistry suite used to simulate atomic and molecular electronic | Molegro Virtual Docker 6 Method for performing high accuracy | Hundreds of functions for math, signal/ | Image content search Yes OpCoast SNEAK Electromagnetic signals | Radiation heat transfer model, linear equation solver | rendering; Distributed cluster rendering | CUDA-based GPU final-frame rendering Yes | Playback Engine for real-time video editing & accelerated rendering | Single only NEMO Ocean circulation model Entire model (GYRE |
| SIMULATION | structure Libqc with Rys Quadrature Algorithm, | flexible molecular docking | image processing, statistics, and more. Yes | propagation modeling for complex urban and terrain | Yes Autodesk Moldflow Plastic mold injection software | Dassault Systemes CATIA | rendering Maximus-supported GPU simulation using | Yes | config) Yes NIM Dynamical core for global atmospheric |
| WEATHER AND CLIMATE FORECASTING 13 Oil and Gas | Hartree-Fock, MP2 and CCSD | Energy grid computation, pose evaluation and guided differential evolution | Mathematica Wolfram A symbolic technical computing language | environments | Linear equation solver Single only | - Live Rendering Photorealistic rendering Interactive. Fully integrated | Single only | Single only | model Dynamical core Yes |
| POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 01 | Yes Gaussian | Single only PIPER Protein Docking Protein-protein docking | and development environment Development environment for CUDA and | Ray tracing, DTED and remote sensing inputs | CPFD Barracuda-VR and Barracuda | in CATIA V6. Network rendering | The Foundry Mari 3D paint Increased model complexity at interactive | Avid Media Composer Video editing Faster video effects, unique stereo 3D | Weather Central Fusion Studio |
| Research: Higher Education and Supercomputing COMPUTATIONAL CHEMISTRY AND BIOLOGY | (In development) Predicts energies, molecular structures, | program Molecule docking TBD PyMol User-sponsored molecular visualization | OpenCL Yes | Yes PCI Geomatics GXL Geospatial Visualization Image | Fluidized bed modelingsoftware Linear equation solver, particle | Yes Bunkspeed Suite Easy to use photorealistic renderin software | rates ngSingle only | capabilities Single only | Weather graphics Real-time Single only WRF Regional numerical weather prediction |
| Molecular Dynamics | and vibrational frequencies of molecular systems | system on an open-source foundation Lines: 460% increase | MATLAB by Mathworks GPU acceleration for MATLAB (high-level | orthorectification and additional image processing | calculations Single only FluiDyna Culises for | software Iray-based ray-tracing. Animation support. | 10 POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 | Grass Valley Edius Video editing Faster effects Single only | model WSM5, WSM3, Ice Microphysics models Yes |
| FEATURES MULTI-GPU SUPPORT ACEMD GPU simulation of molecular mechanics | Joint NVIDIA, PGI and Gaussian collaboration | Cartoons: 1246% increase Surface: 1746% increase | technical computing language) Support for 200+ of most used MATLAB functions (incl. Signal Processing, Image | Yes GAIA Multi-GPU, Multi-Machine distributed | FluiDyna Culises for OpenFOAM | Network rendering | COLOR CORRECTION AND GRAIN | Single only Harris Velocity Video editing Faster effects Single only | WSI TrueView Max Weather graphics Real-time Single only |
| force fields, implicit and explicit solvent Written for use only on GPUs Yes | Yes GPAW Real-space grid DFT code written in C and | Spheres: 753% increase Ribbon: 426% increase | functions (incl. Signal Processing, Image Processing, Communications Systems, etc) | object store providing SQL style query capability, advanced geospatial query | Solver library for general purpose CFD software | Yes RTT DeltaGen Redefines high-end 3D visualization and | APPLICATION DESCRIPTION SUPPORTED | Quantel Qube Broadcast video editing Faster video effects, unique stereo 3D | Single only POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 13 |
| AMBER Suite of programs to simulate molecular dynamics on biomplexite | Python Electrostatic poisson equation, | Single only VEGA ZZ Molecular Modeling Toolkit Virtual logP, | Yes NMath Premium GPU-accelerated math and | capability, heatmap generation, and distributed rasterization services | Linear equation solvers Yes FluiDyna LBultra General purpose CFD software | realtime interaction. This latest version gives users a broad suite of robust new | Adobe SpeedGrade CC Color grading Real-time grading and finishing with | capabilities Single only | Oil and Gas APPLICATION DESCRIPTION SUPPORTED |
| PMEMD Explicit Solvent and GB Implicit | orthonormalizing of vectors, residual minimization method (rmm-diis) | molecular surface values Single only VMD Visualization and analyzing large biomolecular | statistics for .NET, automatically detects the presence | Built for GPUs, scales to many machines and many cards without end user ouery | Lattice-Boltzmann solver Yes Prometech Particleworks Particle-based CFD | features to truly revolutionize processes and help increase visual guality, speed, and | Lumetri Deep Color Engine Single only | Sony Vegas Pro Video editing Faster video effects and encoding Single only | FEATURES MULTI-GPU SUPPORT |
| Yes CHARMM MD package to simulate molecular | Yes | eventerme in 2 D american | of a CUDA-enabled GPU at runtime | and many cards without end user query modification or pre-meditation | Prometecn Particleworks Particle-based CFD software Implicit and explicit solvers Single only Vratis ARAEL General purpose CFD software based | flexibility | Assimilate Scratch Color grading and finishing | ENCODING AND DIGITAL DISTRIBUTION | AxRTM AxRTM |
| dynamics on biomolecule | Jaguar A high-performance ab initio package for performing gas and solution phase | High quality rendering, large structures (100M atoms), analysis and visualization | and seamlessly redirects appropriate computations to it. | Yes Computational Finance APPLICATION DESCRIPTION SUPPORTED | Vratis ARAEL General purpose CFD software based on FVM with OpenFOAM compatibility | Interactive ray tracing and global illumination. Integration with Siemens | Accelerated debayering for real-time digital finishing | APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT | AxKTM Seismic Processing RTM, Kirchhoff, control source, |
| Implicit (5x), Explicit (2x) Solvent via OpenMM. Native CUDA port in | simulations TBD Yes | tasks, multiple GPU support for display of molecular orbitals | Automatically offloads computations to the GPU | FEATURES MULTI-GPU SUPPORT | Linear equation solver Yes | TeamCenter. Cluster support Realtime & Offline Production Process Integration | Single only Blackmagic DaVinci | Cinnafilm Tachyon Standards conversion Video procession and encoding Yes | electromagnetism, forward modeling Yes |
| development Yes | LATTE Density matrix computations CU_BLAS, SP2 Algorithm Yes MOLCAS Methods for calculating general electronic | Bioinformatice | Single only PHYSICS | Aaon Benfield Pathwise™ | Turbostream Ltd. CFD software for turbomachinery flows Explicit solver Yes | and scene building. Scene Analysis, Xplore DeltaGen, SDK for DeltaGen | Resolve Color grading Real-time color correction, real-time | Digimetrics Aurora Automated video and audio test and | CGGV GeoVation Seismic Processing Multiple algorithms (RTM, etc) Yes ffA Geoteric Seismic Interpretation Attributes |
| DESMOND High-speed molecular dynamics simulations of biological systems on | atmatures is males derevatems is both | APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT | APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT | Specialized platform for real-time hedging, valuation, pricing and risk management | Vratis SpeedIT extreme for OpenFQAM | Yes PTC Creo Parametric Parametric design solution | denoising Yes | measurment Video encoding and video processing Single only | ffA Geoteric Seismic Interpretation Attributes calculations, geobodies |
| simulations of biological systems on conventional commodity clusters. The code uses novel parallel algorithms | ground and excited states CU_BLAS Single only | BarraCUDA Sequence mapping software Alignment of short sequencing reads, | Chroma Lattice Quantum Chromodynamics (LQCD) Wilson-clover fermions, Krylov solvers, | Spreadsheet-like modeling interfaces, Python-based scripting environment and | Solver library for general purpose CFD software | suite Anti-aliasing, better lighting and enhanced shaded-with-edges mode. GRID Support | Cinnafilm Dark Energy Application and plug-in for image | Elemental Live Live streamingvideo processing and encoding | extraction Yes |
| and numerical techniques to achieve high performance and accuracy | MOLPRO Used for accurate ab initio quantum chemistry calculations | alignment of indels with gap openings and extensions | Domain-decomposition Yes | Grid middleware Yes | Linear equation solvers Yes RESEARCH CFD DEVELOPMENTS | Single only Siemens PLM NX and | enhancement Image de-noising and restoration. | Video encoding and video processing Yes Elemental Senar Eile-based video processing and | ffA SVI Pro Seismic Interpretation Attributes calculations, geobodies |
| Yes DI -POLY Simulate macromolecules polymers ion | Density-fitted MP2 (DF-MP2), density fitted ic local correlation methods (DF-RHF, DFKS), DFT | Yes CUDASW++ Open source software for Smith- | ENZO 3D block-structured AMR code for cosmological structure formation | Hanweck Associates Real-time options analytical engine (Volera) Real-time options analytics engine | FEFLO (GMU-Lohner) General purpose CFD | Teamcenter Product lifecycle management solutions | Image de-noising and restoration. Simultaneous active and background rendering | encoding Video encoding and video processing Yes isovideo Viarte Video standards conversion CUDA- | extraction ver |
| systems, etc on a distributed memory | Yes | Waterman | Accelerated magneto hydrodynamics | Yes Murex MACS Analytics | compressible and incompressible flows | from design to simulation to production to | Yes | accelerated video procession and | IfA SEA3D Pro Seismic Interpretation Attributes |
| parallel computer Two-body forces, Link-cell pairs, Ewald | MOPAC2013 Semiempirical Quantum Chemistry Pseudodiagonalization, full diagonalization, and density matrix assembling | protein database searches on GPUs Parallel search of Smith-Waterman | solvers Yes | Library | Implicit and explicit solver Yes SD++ (StanfordJameson) | service Design software, NX, and PLM viewer | Digital Vision Nucoda Color grading Real-time color correction Single only | encoding Yes | calculations, geobodies extraction |
| SPME forces, Shake VV Yes | Single only | database Yes | GTC Simulates microturbulence and transport in magnetically confined fusion plasma | Analytics library for modeling valuation and risk for derivatives across multiple asset | General purpose CFD software for compressible flows. | applications, TcVis and Active Workspace Client. | Marquise Technologies Rain | MainConcept CUDA H.264/AVC Encoder SDK | Yes GeoStar Seismic Suite Seismic Processing Multiple algorithms (RTM etc.) Yes |
| studies | t NWChem Calculations Triples part of Reg-CCSD(T) CCSD and | , CUSHAW Parallelized short read aligner Parallel, accurate long read aligner for | Electron push and shift (accounting for >80% of run time) | classes. Market standard models for all asset | Explicit solver Yes S3D (Sandia and Oak | Single only POPULAR GPU-ACCELERATED APPLICATIONS | Color grading CUDA-based real-time color correction Single only Quantel Pablo Rio Color grading and finishing Real | H.264 video encoder Video encoding and video processing Yes Sorenson Squeeze Video transcoding application ar | Hooduran Suite Sciemia letermetation Attributes |
| protein folding, misfolding, aggregation, and related diseases | EOMCCSD task schedulers Yes | large genomes Ver | Yes GTS Simulates microturbulence and the motion | classes paired with the most efficient resolution methods (Monte Carlo | Ridge NL) Direct numerical solver (DNS) for turbulent | CATALOG MAR14 09 ELECTRONIC DESIGN AUTOMATION | Quantel Pablo Rio Color grading and finishing Real time color correction Yes | Sorenson Squeeze Video transcoding application ar plug-In Video encoding and video processing Yes | dcalculations, Volume Rendering Yes HUE HUEspace Seismic Interpretation Interpretation |
| Powerful distributed computing molecular dynamics system: implicit solvent and | Octopus Used for ab initio virtual experimentation and quantum chemistry calculations | 04 POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 | of charged particles and interactions in fusion plasma | simulations and Partial Differential Equations) | combustion Chemistry model Yes | APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT | Red Digital Cinema REDCINE-X | Snell Alchemist on Demand | development platform Yes OpenGeo Solutions |
| folding Yes | Full GPU support for ground-state, real-time calculations; Kohn-Sham | GATK The Genome Analysis Toolkit or GATK is a software package developed at the | Push and shift for both electron and ion | Yes Numerical Algorithms | DualSPHysics SPH-based CFD software SPH mode | Agilent Technologies ADS Simulation tool for design of RF, microwave | Color grading CUDA-accelerated debayering Single | Video standards conversion Video procession and | OpenSeis Seismic Processing Spectral Decomposition Yes |
| | | | | | | | | | |
| GPUGrid.net A distributed computing project that | Hamiltonian, orthogonalization, subspace | Is a sortware package developed at the Broad Institute to analyse next-generation | dynamics Yes MII C Lating Questum Chromotynomics (LOCD) | Group (NAG) | Yes NASA FUN3D General purpose CFD software Lines | r and high speed digital circuits | only SGO Mistika Color grading and finishing Real-time | encoding Yes Telestream Vantage Video transcoding and | Seismic Processing Spectral Decomposition Yes Panorama Tech Seismic Processing, Modeling Multiple algorithms (BTM, etc) Yea, |
| GPUGrid.net A distributed computing project that uses GPUs for molecular simulations | Hamiltonian, orthogonalization, subspace diagonalization, poisson solver, time propagation | Broad Institute to analyse next-generation resequencing data. The toolkit offers a wide variety of tools, with a primary focus on | dynamics Yes MILC Lattice Quantum Chromodynamics (LQCD) codes simulate how elemental particles | Group (NAG) Random number generators, Brownian bridger and PDE science | equation solver Single only 081 POPULAP OPULACCELEPATED | of RF, microwave r and high speed digital circuits Signal integrity simulation Single only Agient Technologies | color correction and finishing Single only The Pixel Farm PEClean Image restoration and | Telestream Vantage Video transcoding and processing Video encoding and video processing Ye | Panorama Tech Seismic Processing, Modeling IsMultiple algorithms (RTM, etc) Yes Paradigm Echos RTM Seismic Processing RTM |
| GPUGrid.net A distributed computing project that uses | Hamiltonian, orthogonalization, subspace diagonalization, poisson solver, time propagation yes Q-CHEM Computational chemistry package designe | Broad Institute to analyse next-generation resequencing data. The toolkit offers a wide variety of tools, with a primary focus on variant discovery and genotyping as well as distrong emphasis on data quality assurance. | codes simulate how elemental particles are formed and bound by the "strong force" to create larger particles like protons and | Group (NAG) Random number generators, Brownian bridges, and PDE solvers Monte Carlo and PDE solvers Single only RMS Catastrophic risk modeling for FSI | equation solver Single only 08 POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 COMPUTATIONAL STRUCTURAL MECHANICS | rr and high speed digital circuits Signal integrity simulation Single only Agilent Technologies EMPro Modeling and simulation environment for | color correction and finishing Single only The Pixel Farm PFClean Image restoration and remastering CUDA-based image processing acceleration | Telestream Vantage Video transcoding and processing Video encoding and video processing Ye ON-AIR GRAPHICS APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT | Panorama Tech Seismic Processing, Modeling sMulphe algorithms (RTM, etc) Yes Paradigm Echos RTM Seismic Processing RTM algorithm Yes Paradigm SKUA Reservoir Modeling Faults, Horizons |
| GPUGrid.net A distributed computing project that uses GPUs for molecular simulations | Hamiltonian, orthogonalization, subspace diagonalization, poisson solver, time propagation yes O-CHEM Computational chemistry package designe for HPC clusters iff Various features including RI-MP2 TBD | Broad Institute to analyse next-generation resequencing data. The toolkik offers a wide variety of tools, with a primary focus on variant discovery and genotyping as well as distrong emphasis on data quality assurance. Variant Calling: > 70X speedup Yes GPU-BLAST Local search with fast it-tuole heuristic | codes simulate how elemental particles are formed and bound by the "strong force" to create larger particles like protons and neutrons Staggered fermions, Krylov solvers, | Group (NAG) Random number generators, Brownian bridges, and PDE solvers Monte Carlo and PDE solvers Single only RMS Catastrophic risk modeling for FSI (earthquakes, hurricanes, terrorism, infectuous diseases) | equation solver Single only 08 POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 COMPUTATIONAL STRUCTURAL MECHANICS APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT | rand high speed digital circuits Signal integrity simulation Single only Agilent Technologies EMPro Modeling and simulation environment for analyzing 3D EM effects of high speed and PEM/scrumse component | color correction and finishing Single only The Pixel Farm PFClean Image restoration and remastering CUDA-based image processing acceleration Single only COMPOSITING. FINISHING AND EFFECTS | Telestream Vantage Video transcoding and processing Video encoding and video processing Video ON-AIR GRAPHICS APPLICATION DESCRIPTION SUPPORTE FEATURES MULTI-GPU SUPPORT Avid On-air Graphics Motion Graphics Real-time arabhics rendering Single only | Panorama Tech Seismic Processing, Modeling stMultiple algorithms (RTM, etc) Yes Paradigm Echos RTM Seismic Processing RTM algorithm Yee |
| GPUGrid.net A distributed computing project that uses GPUs for molecular simulations High-performance all-atom biomolecular biomone, explicit solvent and binding GROMACS Simulation of biochemical molecules w complicated bond interactions Implicit (50, Explicit (22) Solvent Yes | Hamiltonian, orthogonalization, subspace diagonalization, poisson solver, time propagation yes Q-CHEM Computational chemistry package designe for HPC clusters ithVarious features including RI-MP2 TBD OUICK QUICK is a GPU-enabled ab initio quantum | Broad Institute to analyse next-generation resequencing data. The tookil offers a wide variety of tools, with a primary focus on variant discovery and genophysig as well as distrong emphasis on data quality assurance. Variant Calling. > 70X speedup Yes GPU-BLAST Local search with fast k-tuple heuristic Probein alignment accordingto BLASTP Single only mCLDA-MEBC Unstast scalable motif discovery | codes simulate how elemental particles are formed and bound by the "strong force" to create larger particles like protons and neutrons Staggered fermions, Krylov solvers, Gauge-link fattening Vere | Group (NAG) Random number generators, Brownian bridges, and PDE solvers Monte Carlo and PDE solvers Single only RMS Catastrophic risk modeling for FSI (earthquakes, hurricanes, terrorism, infectours diseases) Risk analytics Yes Tanay ZX Lib (Fuzy | equation solver Single only 06 POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 COMPUTATIONAL STRUCTURAL MECHANICS APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT Abaqua/Standard Simulation and analysis toolfor structural | rand high speed digital circuits Signal integrity simulation Single only Agient Technologies EMPro Modeling and simulation environment for analyzing 3D EM effects of high speed and RF/Microware components FDTD solver Yes ANSYS Nexiom Circuit simulation engine for | color correction and finishing Single only The Pixel Fam PFClean Image restoration and remastering CUDA-based image processing acceleration Single only COMPOSITING, FINISHING AND EFFECTS APPLICATION DESCRIPTION SUPPORTE FEATURES MULTI-GPU SUPPORT | Telestream Vantage Video transcoding and processing Video encoding and video processing Ye ON-AIR GRAPHICS APPLICATION DESCRIPTION SUPPORT FEATURES MULTI-GPU SUPPORT Avid On-air Graphics Motion Graphics Real-time graphics rendering Single only Brainstorm Estudio Virtual Sets and motion graphic: | Panorama Tech Seismic Processing, Modeling skulupis algorithm (RTM, etc) Yes Paradigm Echos RTM Seismic Processing RTM algorithm Yes Paradigm SKUA Reservoir Modeling Faults, Horizons and Flow Simulation Grid Yes Paradigm Geophysical V oxel@eo |
| GPUGrid net A distributed computing project that uses GPUs for molecular simulations High-performance all atom bioindecular simulations, explicit solvent and binding GROMACS Simulation of bioindemical molecules w complicated bond interactions implicit for, Explicit (24) Solvent Yes HALMD Large-scale simulations of simple and comdex (uside | Hamiltonian, orthogonalization, subspace diagonalization, poisson solver, time propagation yes Q-CHEM Computational chemistry package designe for HPC dusters filt Various features including RI-MP2 TBD OUCK QUICK I a GPU-enabled ab intio quantum chemistry software package Running Hartner Fock and DFI energy on | Broad institute to analyse next-generation resequencing data. The tookit offens a wide variety of tools, with a primary focus on variant discovery and genotyping as well as distrong emphasis on data quality assurance. Vehical LASTS, 70X speecuby 70X-upple heuristic Provise alignment according to BLASTP Single only mCLDA-MEME Utrafasts scalable motif discovery algorithm | codes simulate how elemental particles are formed and bound by the "strong force" to create larger particles like protons and neutrons Staggered fermions, Krytov solvers, Gauge-Inik fattening Yes PiConQPU & relativistic Particle-In-Cell code that | Group (NAG) Random number generators, Brownian bridges, and PDE solvers Monte Carlo and PDE solvers RMS Classification and PDE solvers (earthquakes, humicanes, terrorism, infectious diseases) (earthquakes, humicanes, terrorism, framy ZAV, bit (Prazy Logic) Financial analytics and data mining library Monte | equation solver Single only del POPULAR GPU-ACCELERATED APPLICATIONS CATALOG MAR14 COMPUTATIONAL STRUCTURAL MECHANICS APPLICATION DESCRIPTION SUPPORTED FEATURES MULTI-GPU SUPPORT Abagus/Standard Simulation and analysis toolfor structural mechanics Direct saarse solver Yes | rand high speed digital circuits Signal integrity is mutation Single only Aglent Technologies EMPro Modeling and simulation environment for analyzing 3D EM effects of high speed and RPDT basker Yes ANSYS Nexodin Circuit simulation engine for RF/snatog/ mixed-signal IC detain: IBIS-401 analysis | color correction and finishing Single only The Picel Fam Piclaan Image restoration and remastering CUDA-based image processing acceleration Single only COMPOSITING, FINISHING AND EFFECTS COMPOSITING, FINISHING AND EFFECTS APPLICATION DESCRIPTION SUPPORTED FEATURES MULT GPU SUPPORT ABSoft Neat Video Video noise reduction plug-in CUDA-based acceleration Sindle only | Telestream Vantage Video transcoding and processing Video Processing Video Processing Video Processing Video Processing Video Processing Video Processing Video Pract Tables Motion Graphics Real-time graphics rendering Single only Brainstorm Estudio Vinual Sets and motion graphics Real-time graphics rendering Single only Convent Vigeo K Chowie graphics call-time graphics Convent Vigeo K Chowie graphics and time graphics Convent Vigeo K Chowie graphics Real-time graphics Conventioned Real-time Real-time Brance Vigeo Real-time | Panorama Tech Seinnic Processing, Modeling Buklyse lagotimter (RM, ect) est Paradign Echos RTM Seismic Processing RTM algorithm Yes Panadigm SKUA Reservoir Modeling Faults, Horizons and Froir Smulachico Rd Yes Panadigm Recorptrical Vosardia Imperational Volume Rendering, Horizon Plattering Yes Roser BMS Persenvir Modelinn Minii (201 |
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Software Development Ecosystem for Intel Xeon Phi Open Source Commercial

| Compiler | gcc (kernel build only, not for applications), Python | Intel Parallel Studio XE (C++ & Fortran) Intel Cluster Studio XE (C++ & Fortran) CAPS HMPP compiler (beta) |
|-------------------------------|---|--|
| Debugger | gdb | Intel Debugger Rogue Wave TotalView (beta) Allinea DDT |
| Libraries | TBB (in Intel Studio XE) MPICH2 FFTW NetCDF | Intel MKL, Intel MPI, OpenMP, Intel IPP, Cilk™ Plus (in Intel Studio XE products), NAG Rogue Wave IMSL |
| Profiling & Analysis Tools | | Intel VTune Amplifier XE Intel Trace Analyzer & Collector Intel Inspector XE |
| Workload Scheduler | | Altair PBS Professional, Adaptive Computing Moab |
| System Management | | SGI Management Center Bright Cluster Manager (beta) |

For more information:

http://software.intel.com/en-us/articles/intel-and-third-party-tools-and-libraries-available-with-support-for-intelr-xeon-phitm



Next generation XEON: Haswell

Tick/Tock Development Model

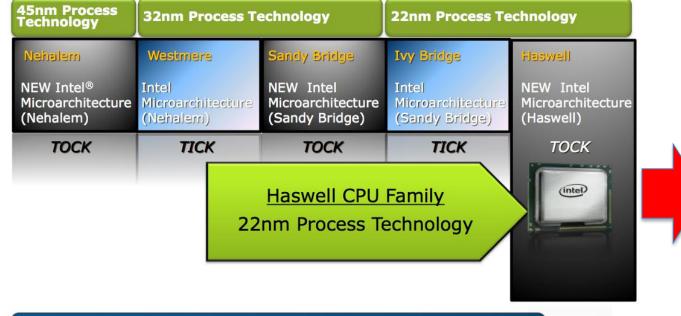
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| Nehalem | Westmere | Sandy Bridge | Ivy Bridge | Haswell | |
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Builds upon innovations in the 2nd and 3rd Generation Intel® Core™ i3/i5/i7 Processors

IDF2012

Next-next generation HPC XEON

Tick/Tock Development Model



Builds upon innovations in the 2nd and 3rd Generation Intel® Core™ i3/i5/i7 Processors

IDF2012 INTEL DEVELOPER FORUM



PHI





"Pyramid 1U"



NVIDIA GPU accelerator support:

• 3x K10, K20, K20X

NVIDIA graphics GPU support:

Quadro Plex 7000

Intel accelerator support:

• 3x Phi

| Model | C1104G-RP5 |
|---------------------------|---|
| Chassis Profile | 1U standard-depth |
| Servers/System | One dual-socket |
| Chipset | Intel® C600 |
| Max. Processors | Two Intel® Xeon® processor E5-2600 series |
| Max. CPU TDP | 115W |
| Memory Slots | 8 DIMM slots |
| Memory Type | 1600/1333/1066/800 MHz DDR3 ECC Reg |
| Max. Hard Disk Drives | 4 x 2.5" drives |
| _ | Three PCIe 3.0 x16 |
| Expansion Slot | double-width slots |
| | One external PCIe 3.0 x8 low-profile slot |
| Networking (Onboard) | Dual-Port GigE controller (Intel® I350) |
| IPMI Remote Management | Integrated IPMI 2.0 |
| Power Supply | 1800W Redundant* Platinum Level |



"Pyramid 2U"



NVIDIA GPU accelerator support:

• 4x K10, K20, K20X

NVIDIA graphics GPU support:

Quadro Plex 7000

Intel accelerator support:

• 4x Phi

| Model | C2110G-RP5 | | |
|------------------------|---|--|--|
| Chassis Profile | 2U standard-depth | | |
| Servers/System | One dual-socket | | |
| Chipset | Intel® C600 | | |
| Max. Processors | Two Intel® Xeon® processor E5-2600 series | | |
| Max. CPU TDP | 130W | | |
| Memory Slots | 8 DIMM slots | | |
| Memory Type | 1600/1333/1066/800 MHz DDR3 ECC Reg | | |
| Max. Hard Disk Drives | 10 x 2.5" drives | | |
| | Four internal PCIe 3.0 | | |
| Evenneine Slot | x16 double-width | | |
| Expansion Slot | (optional riser card for 2 additional external | | |
| | PCIe 3.0 x16 double width slots), One external PCIe 3.0 x8 low profile and one | | |
| | PCIe 2.0 x4 full height | | |
| Networking (Onboard) | Dual-Port GigE controller (Intel® I350) | | |
| IPMI Remote Management | Integrated IPMI 2.0 | | |
| Power Supply | 1800W Redundant** Platinum Level | | |

SGI UV 2000 Within a Single Standard 19" Rack



Up to:

- 64 socket/512 cores/1024 threads
 - Or **34 CPU + 30 Intel[®] Xeon[®] Phi**™
 - Or 36 CPU + 28 NVIDIA® Tesla®
 K20,K20X, or K40 (2 partitions)

- 16TB memory
- 63 x16 PCIe Gen 3 Links



SGI UV and Scale-out Compared

| Feature | Standard Scale-out Servers | SGIUV |
|---------------------------------------|--|---|
| Architecture Reference Terms | Scale Out Cluster Distributed Memory | Scale Up Single System Image Shared Memory |
| System Limit | 16 cores, 0.5 TB memory | 2048 cores, 64 TB memory |
| CPU | x86 Intel® Xeon® or AMD Opteron™ | X86 Intel® Xeon® |
| Memory, Storage, networking | Industry standard | Industry Standard |
| Interconnect or System Fabric | Ethernet or InfiniBand | SGI NUMAlink |
| Hardware Package or Building Block | Blades or Rackmount, 19" rack | Blades (UV2000) or Rackmount(UV20), 19" rack |
| Software | Off the Shelf | Off the Shelf |
| Applications | Small scale single apps cluster or "MPI" apps | Small <i>or large</i> single apps Cluster or "MPI" apps also |
| Cost | Lowest cost x86 architecture | 20-75% > scale-out, ~1/3 the cost of 'Big Iron'. |

sgi

SGI_® Value Propositions

- Long history of working with accelerators
 - "Home-brewed" Geometry Engine, TPU (Tensor Processor Unit)
 - FPGA's (RASC[™] technology), GPUs, SOCs
 - 50 application experts focused on it
- Accelerators in both a scale-up and scale-out environment
 - 32 Intel® Xeon® Phi[™] coprocessors in SGI® UV[™] 2000 (COSMOS and TGAC)
 - SGI: the only vendor able to deliver hybrid scale-out and scale-up solutions
- Everything you need in a powerful solution
 - Factory-integrated, tested, rack level delivery plug in and go
 - Starter kits
 - Worldwide customer support
- Fully-managed, with SGI Management Center and Performance Suite software



SGI[®] Integrated Clusters for Intel Xeon Phi

- A complete, managed GPU solution of software and hardware, all you need for a powerful deployme
- Hardware stack
 - Rackable™ C2108 head node
 - Either/or Rackable C1104G or C2110G compute nodes
 - Infiniband NICs and Switch
 - Ethernet switch for management
 - Add SGI InfiniteStorage solutions, either direct-attached to the head NAS

Software stack

- SGI Management Center software
- Altair PBSpro Load Management software
- Complete Factory Test & Integration

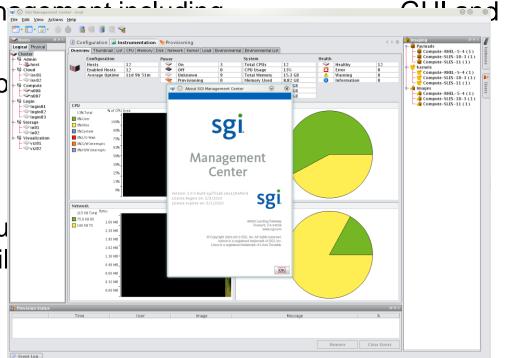




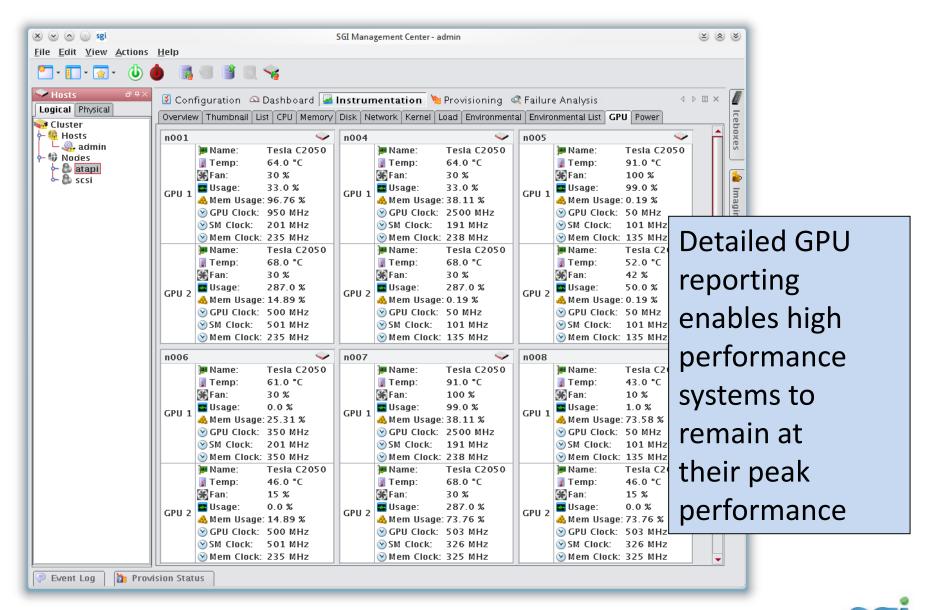
SGI_® Management Center

Premium Edition offers Accelerator Monitoring and Management!

- Single system management console with remote server monitoring and control
- Ease of use, full system man
 CLI
- Policy driven, fine grained po computing
- Advanced fault, event, improved reliability
- Advanced capabilities inclu management, and high avail



SMC Premium Edition–Accelerator Monitoring



Optimized for HPC & Big Data Solutions

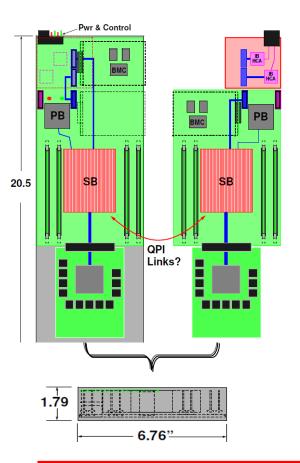
- SGI_® ICE[™] X
- SGI UV™ 2000







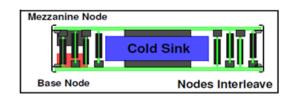
SGI ICE X Compute Node with GPU



<u>One</u> dual socket node w/ <u>two</u> coprocessors in <u>one</u> blade slot!

- Two Intel[®] Xeon[®] processor E5-2600 series
- Two NVIDIA® TESLA® K20
- FDR InfiniBand single or dual plane
- Four DDR3 DIMMs per socket @ 1600 MT/s
- Up to one 2.5" SATA HDD/ SSD drives
- Liquid cold sinks

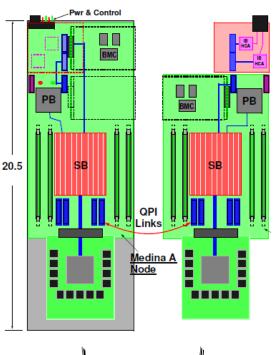
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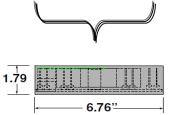
FDR + 1:1 processor to coprocessor ratio = <u>Balanced Throughput</u>

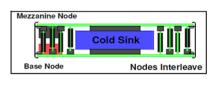


SGI ICE X Compute Node with Phi



- Two Intel[®] Xeon[®] processor E5-2600 series
- Two Intel® Xeon Phi™ 5120D Coprocessor
- FDR InfiniBand single or dual plane
- Four DDR3 DIMMs/ socket @ up to 1600 MT/s
 - Expect 1866 MT/s support w/1 DPC populated (w/ Ivy Bridge-EP)
- Up to one 2.5" SATA HDD/ SSD drive
- Liquid cold sinks







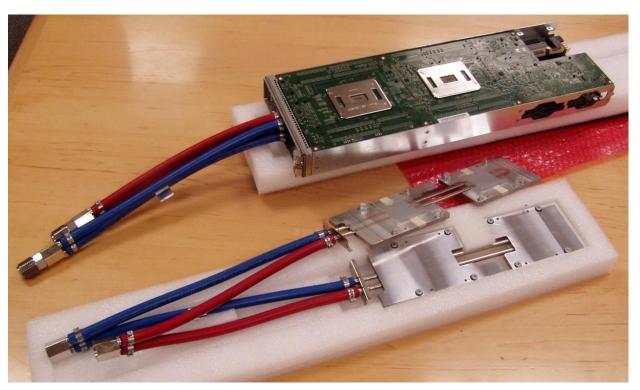


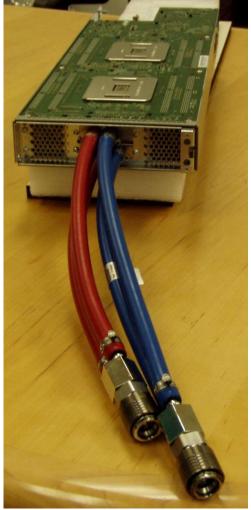
<u>One</u> dual socket node w/ <u>two</u> coprocessors in <u>one</u> blade slot!

FDR + 1:1 processor to coprocessor ratio = <u>Balanced Throughput</u>

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SGI Cold Sink Technology – Twin Blades







SGI Meets All Accelerator Needs!

- SGI has the longest history with accelerators
- Accelerators have gone mainstream, we are supporting them across our product line
- The only vendor to be able to deploy scaleup, scale-out and hybrid landscapes with accelerators everywhere.



SGI ICE: Sample ICE Customers

BAW - Bundesanstalt für Wasserbau **Bridgestone Central Research Inst of Electric Pwr Ind CSIR - Centre for** Mathematical Modeling and Compute **Exeter University GENCI HLRN Berlin HLRN Hannover** ICHEC **ICR** Idaho National Laboratory **IFREMER Imperial College IMSc** INMET JAMSTEC **Korean Air Force**

KU Leuven **Mazda Motor Corporation McLaren Motor Racing Ltd Mercedes-Benz GP** MPO **NASA Ames NASA Langley** NIIFI NIMS NMCAC NOAA (CSC) NTNU Onera ORNL **Pontificia Universidade** Catolica – PUC-Rio Rosshydromet **Scientific Analysis Group** Semiconductor Energy Labs Sikorsky **Skoda Auto TI-09 Tokyo University – ISSP** Total Tovota U.S. Air Force - Arnold AFB **U.S. Navy/NRL Universidade Catolica** Universite Paul Sabatier – **CICT/Calmip University of Arizona** University of Hyderabad **University of Oxford** University of São Paulo – **USP/IAG** University of Rio de Janeiro – NACAD University of Rio Grande do Sul – CESUP **US Army TACOM**

Hungary 2011-2014

NIIFI supercomputers for non-profit customers:

- Cluster: SGLICE
 Debrecen (18TFlops, 1536 core; 6TB ram)
- Cluster + GPU: HP Szeged (14TFlops, 2304 core; 5,6TB ram, 6xM2070)
- SMP/ccNUMA: SGI UV Pécs (10TFlops, 1152 core, 6TB ram)

http://www.niif.hu/szolgaltatasok/szuperszamitastechnika/altalanos_ismerteto

Hungary 2015

- Cluster: 200+ Tflops (200pc GPU or PHI)
- Cluster: 30+ GPU or PHI
- Cluster: SGLICE
 Debrecen (18TFlops, 1536 core; 6TB ram)
- Cluster + GPU: HP Szeged (14TFlops, 2304 core; 5,6TB ram, 6xM2070)
- SMP/ccNUMA: SGI UV
 Pécs (10TFlops, 1152 core, 6TB ram)



