

## SOLUTION BRIEF

Intel® Builders  
High Performance Computing

# RSC TORNADO SYSTEMS, AN INTEL® SELECT SOLUTION FOR SIMULATION AND MODELING

Build Your Next Supercomputing Solution for Scientific Discovery and Industrial Modeling with Ultrahigh-Dense, Energy-Efficient, and High-Performance Clusters



When it comes to compute-intensive research areas, like high-energy particle physics and weather modeling and prediction, or computer-aided engineering (CAE), simulation and modeling workloads need to run on high performance computing (HPC) clusters. To support those applications at scale, modern HPC systems require multi-core processors, high-bandwidth fabrics, and broad input/output (I/O) capabilities.

Because of the complexity and variety of technologies available on the market, assembling an HPC system can be time-consuming. And, integration and configuration of selected components can impact the performance of the solution. The level of expertise required to properly configure the combined solution can intimidate small to large organizations. RSC Group and its family of RSC Tornado and RSC Tornado Phi supercomputing solutions deliver ultrahigh-dense, energy-efficient, high-performance processing for organizations that need supercomputing resources quickly.

## RSC – A World Renowned Leader in Energy-Efficient, High-Performance Solutions

RSC Group ([www.rscgroup.ru/en](http://www.rscgroup.ru/en)) is a leading developer and integrator of innovative HPC clusters. Its RSC Tornado cluster solutions offer ultrahigh-dense, scalable, and energy-efficient multi-rack systems with 100 percent “hot water” liquid cooling, based on its patented direct liquid cooling technology.

RSC direct liquid cooling technology, with up to 63-degree Celsius inlet liquid temperature, does not require energy-demanding refrigeration and enables efficient heat reuse, record-breaking energy efficiency, and computing density.

RSC Tornado offers some of the world’s most advanced capabilities:

- Ultrahigh-dense configurations—306 nodes per rack
- Compute performance—1.41 petaFLOPS per rack
- Power density—200+ kW per rack
- Energy efficiency—PUE of 1.06 or lower at a customer site

RSC Tornado is based on the Intel® Scalable System Framework (Intel® SSF) with Intel® architecture and Intel® technologies:

- Intel® Xeon® Scalable processor family
- Intel® Xeon Phi™ Processor 7200 series
- Intel® Omni-Path Architecture (Intel® OPA) next-generation HPC fabric
- Intel® Optane™ SSD with Intel® Memory Drive Technology
- Intel® SSD Data Center Series for PCIe\* storage with NVMe\* over fabric technology
- Options for Intel® FPGA acceleration

RSC has delivered systems that have appeared on Top500, Green500, and HPCG lists and provided installations to the country’s leading scientific institutions, including the following:

- Joint Institute for Nuclear Research (JINR)
- Saint Petersburg Polytechnic University (SPbPU)
- Russian Academy of Sciences (JSCC RAS)
- Siberian Supercomputer Center (SSCC SB RAS)
- South Ural State University (SUSU)
- Institute of Oceanology of Russian Academy of Sciences (IO RAS)
- Russian Weather Forecast Agency (Roshydromet)
- Moscow Institute of Physics and Technology (MIPT)
- Aviation, Oil & Gas, Energy, Computer Graphics, and other vertical industries



## Patented Liquid Cooling Drives High Performance and Low PUE

Power consumption is at the core of challenges for institutions hosting and running today’s massive supercomputers. RSC Tornado is a unified, energy-efficient, and ultrahigh-dense architecture, enabling creation of advanced computing solutions that optimize power efficiency and performance. With its patented 100 percent hot water cooling technology, RSC systems can run with up to 63-degree Celsius inlet coolant temperature for efficient heat re-use, providing PUE of 1.06 or lower at 0.7 petaFLOPS in a standard 42U-high cabinet housing up to 153 nodes.

## High-Performance Enabling Ingredients

### Compute

The RSC Tornado blade is a high-performance dual-processor server based on Intel Xeon Scalable processors with direct liquid cooling of all electronic components. Intel Xeon Scalable processors, such as the Intel® Xeon® Gold 6154 processor, feature significant enhancements that benefit HPC applications, including improvements in I/O, memory, fabric integration, and Intel® Advanced Vector Instructions 512 (Intel® AVX-512). Optionally, Intel® Xeon® Platinum processors—with up to 28 cores—can be used to meet the most challenging compute needs,<sup>1</sup> depending on the requirements of the workload and other customer needs.

RSC Tornado Phi is a high-density, high-performance single-processor server with direct liquid cooling of electronic components based on innovative Intel® Xeon Phi™ 7290 processor intended specifically for high-performance computing, digital signal processing, and machine learning.

### Fabric

Intel OPA provides 100 gigabits per second (Gbps) bandwidth and a low-latency, next-generation fabric for HPC clusters. Its 48-port switch chip delivers a 33 percent increase in density over the traditional 36-port switch ASIC historically used for InfiniBand\* networking. The denser radix chip reduces the number of required switches, cutting costs and enhancing reliability. Intel OPA also reduces cabling-related costs, power consumption, space requirements, and ongoing system maintenance requirements. These advancements can lower fabric costs by up to 61 percent.<sup>2</sup>

### Intel® Optane™ SSD

Intel Optane SSD is a system acceleration solution for the latest generations of Intel® Xeon® processors. Intel® Optane™ technology, based on Intel® 3D XPoint™ Memory Media and using the Intel® Rapid Storage Technology (Intel® RST) driver is located between the processor and slower spinning and solid state storage devices (HDD, SSHD, or SATA SSD). It can store commonly used data and programs closer to the processor, so the system can access information more quickly with improved overall system responsiveness.

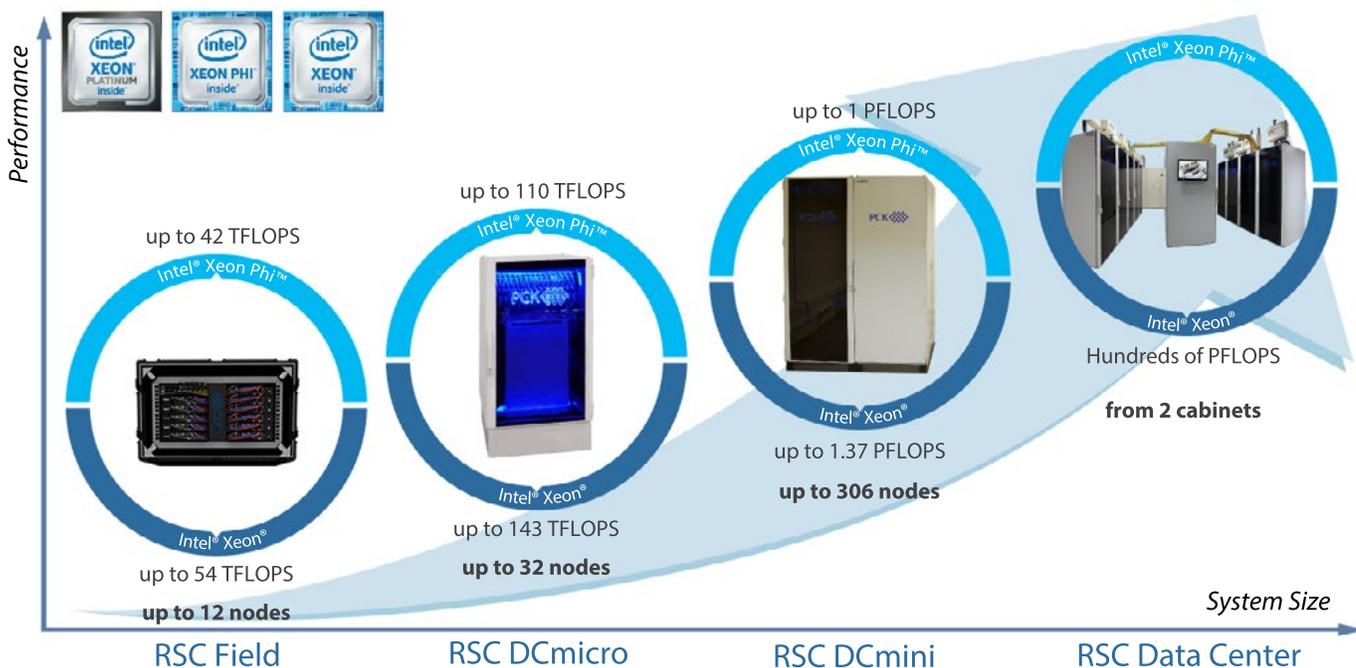
### Select Solution Configuration

Table 1 lists RSC Simulation and Modeling Solution typical configurations. Hardware and software specifications are determined by the overall workload requirements and operating system.

Table 1.

	RSC Tornado	RSC Tornado Phi
Architecture	x86 IA-64	Many Integrated Core (MIC)
Performance	up to 4.5 TFLOPS	3.4 TFLOPS
Compute Resources per Server Blade	2x Intel® Xeon® Scalable processor family, such as Intel® Xeon® Gold 6154 processor (or higher)	1x Intel® Xeon Phi™ 7200(F) processor family (incl. top-bin 7290)
Memory	16x DDR4-2400/2666, up to 512 GB	6x DDR4-2400, up to 192 GB + 16 GB MCDRAM
Local Data Storage	1x M.2 SATA 3.0 + 2x NVMe SSDs (incl. Intel® Optane™ SSD)	2x M.2 SATA 3.0 + 2x NVMe SSDs (incl. Intel Optane SSD)
Communication and I/O Interfaces	Intel® Omni-Path Architecture (Intel® OPA) 10/40/100 Gbps Ethernet	CPU-integrated I/O (CPU F option): Intel OPA, up to 200 Gbps (depending on CPU model)  Discrete I/O: Intel OPA 100 Gbps; 10/40/100 Gbps Ethernet
Node management	RSC BasIS – Fully integrated software stack for HPC: Single System Management Point, Flexible Software Configuration System, Complex Supercomputer, and Data Center view and management system  Intel® Node Manager Technology	
Operating System	Linux*, Windows*, ESXi, KVM	Linux, Windows
Job Management	SLURM, Altair PBS Professional, Adaptive Computing Moab, IBM Platform LSF	
Parallel File Systems	Lustre*, Panasas*, GPFS*, FhGFS*, and others	
Libraries, Compilers, and Tools	Intel® Parallel Studio XE Cluster Edition and others	
Power Type	400/230V AC or 400V DC	
Form Factor	High Density Expandable Blade (450x190x40 mm, 5 kg)	
Cooling	Water cooled, coldplate, “Hot Water” mode support (up to 63°C inlet water)	





**RSC's innovative supercomputing solutions deliver ultrahigh-dense, energy-efficient, high-performance systems for demanding MPI-based simulation and modeling applications. For more information, visit RSC Group at [rscgroup.ru/en](http://rscgroup.ru/en).**

**For more information on Intel Select Solutions, visit [intel.com/selectsolutions](http://intel.com/selectsolutions).**



1 Intel. "Performance Benchmarks and Configuration Details for Intel® Xeon® Scalable Processors." [intel.com/content/www/us/en/benchmarks/xeon-scalable-benchmark.html](http://intel.com/content/www/us/en/benchmarks/xeon-scalable-benchmark.html).  
 2 Configuration assumes a 750-node cluster, and the number of switch chips required is based on a full bisection bandwidth (FBB) fat-tree configuration. Intel® Omni-Path Architecture uses one fully populated 768-port director switch; the Mellanox EDR\* solution uses a combination of 648-port director switches and 36-port edge switches. Intel and Mellanox component pricing is from [kernelsoftware.com](http://kernelsoftware.com), with prices as of May 2016. Compute node pricing is based on the Dell PowerEdge R730\* server from [dell.com](http://dell.com), with prices as of November 2015. Intel Omni-Path Architecture pricing is based on estimated reseller pricing, which is based on projected Intel manufacturer's suggested retail price (MSRP) pricing at time of launch.

Tests document performance of components on a particular test, in specific systems. Differences in hardware, software, or configuration will affect actual performance. Consult other sources of information to evaluate performance as you consider your purchase. For more complete information about performance and benchmark results, visit [intel.com/benchmarks](http://intel.com/benchmarks).

Cost reduction scenarios described are intended as examples of how a given Intel-based product, in the specified circumstances and configurations, may affect future costs and provide cost savings. Circumstances will vary. Intel does not guarantee any costs or cost reduction.

Intel technologies' features and benefits depend on system configuration and may require enabled hardware, software or service activation. Performance varies depending on system configuration. No computer system can be absolutely secure. Check with your system manufacturer or retailer or learn more at [intel.com](http://intel.com).

For more complete information about performance and benchmark results, visit [intel.com/benchmarks](http://intel.com/benchmarks).

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