RSC Group

“Russian HPC trends: a view from a local vendor trench”

Alexander Moskovsky, Ph.D., co-founder, CEO

2nd ATIP workshop, CEO, 11 November 2018
Self-Introduction: RSC Group

- Leading innovative HPC solution provider in Russia/CIS
- **24% share** in local **Top50** rating (Russia/CIS)
- 4 supercomputers in **Top10** there
- #9 position in **IO500** list (hyper-converged system at JINR)
- Over 70% of all **Russian systems** in **HPCG** rating
- **National Champion rank** by the Russia’s Ministry of Economic Development
- One of the leading HPC solution providers in EMEA
- Single Russian company ranked in **Top10 HPC vendors by Top500**
- Over **4.5 PFLOPS** total performance of installed base
- Over 9 years of successful deployments
- **Intel HPC Data Center Specialist** elite status
- **Intel® Select Solution for Simulation and Modeling**
What is to be local in the world?

- Based on Nov 2017 data of Top500 rating
- Is Lenovo a US vendor? Then US has 0% foreign manufacturers
- Russian share of foreign vendors is larger in Top50 rating: ~50%
- Russian situation is a balance: user can choose, local technology have market

Russia is open, USA have deepest trenches
Russia’s HPC in numbers

Aggregate Peak Top50 (TFLOPS since 2004)

Top500 rating entries: 3 in Nov 2018

Aggregate HPC systems performance (in Top50 list): 18.3 PFLOPS

HPC Conference attendees
- ~300 out of 3000 on ISC HPC in Germany
- ~150 PCT (march)
- ~300 Russian SC Days (September 2018)

Data from http://top50.supercomputers.ru
#1: MSU Supercomputer Platforms

Technologies of supercomputing center:

- Intel Xeon 4/6/10/12... cores
- SMP node on 128 cores
- Intel Xeon Phi (KNL)
- NVIDIA 2070 / 2090 / K40 / P100
- IBM Power 8 / IBM Blue Gene/P
- Memory per node: from 12GB up to 2TB

Diversity is great but it is necessary to support numerous supercomputer applications...
## Russian HPC ecosystem

<table>
<thead>
<tr>
<th>Component</th>
<th>Technology/project</th>
<th>Developer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numerical simulation</td>
<td>Original sw development, contribution to open source (e.g. GROMACS, GAMESS).</td>
<td>Russian Academy of Sciences, major universities</td>
</tr>
<tr>
<td>Simulation for engineering</td>
<td>LOGOS, FlowVision and others,</td>
<td>VNIIEF, Rosatom organizations, RAS</td>
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<tr>
<td>Weather forecast/climate research</td>
<td>PLAV model</td>
<td>Keldysh IAM RAS/Roshydromet</td>
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<tr>
<td>OS, Management sw for HPC clusters</td>
<td>AltLinux, AstraLinux, Various projects</td>
<td>Vendors and RAS institutes</td>
</tr>
<tr>
<td>Programming tools</td>
<td>Parallel languages (T-system, COLAMO, DVM), auto-testing tools, libraries</td>
<td>RAS Institutes, South Federal University</td>
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<tr>
<td>Hardware systems</td>
<td>Computational clusters, massively parallel system, FPGA-based</td>
<td>Various vendors, South Federal University</td>
</tr>
<tr>
<td>CPU</td>
<td>Elbrus, ARM and MIPS based designs ...</td>
<td>Support from Ministry of Industry and Trade.</td>
</tr>
<tr>
<td>Interconnect</td>
<td>Angara, SMPO</td>
<td>VNIIEF, NICEVT</td>
</tr>
<tr>
<td>Dissemination: conferences, ratings,</td>
<td>Russian Supercomputing Days, PCT, PaCT, Top50 rating, Supercomputing frontiers</td>
<td>Lomonosov, MSU, South Ural State University, SSCC RAS, JSCC RAS</td>
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<td>journals</td>
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<tr>
<td>Education</td>
<td>Federal program on HPC education</td>
<td>Supercomputing Universities consortium</td>
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**Comprehensive set of ecosystem components**
Track of world records
RSC Tornado cluster solution

Highest computing density per rack* – 1.41 PFLOPS

Leading performance density – 490 TFLOPS/m³

Highest power density per rack – 200 kW

Leading computing density per rack* – 685.44 TFLOPS**

Highest performance density – 535 TFLOPS/m³

Leading power density per rack – 100 kW

Leading PUE*** = 1.027 (measured at the customer site)

* 42U rack 80x80 cm
** for Intel® Xeon® based solutions
*** Power Usage Efficiency is less than 6%
RSC TORNADO FLEXIBLE SOFTWARE DEFINED SOLUTIONS

RSC Tornado

Intel® Xeon® based node
- Two Intel® Xeon® Scalable (incl. top-bin) and Intel® Xeon® E5-2600 v4 (incl. top-bin)
- Up to 256GiB DDR4-2400 RAM
- Intel® Omni-Path, EDR IB, 10/40/100 GigE
- 2x Intel® SSDs SATA and 1x Intel® SSD with NVMe incl. Intel® Optane™ SSD DC P4800X

RSC Tornado Unified Cabinet
- Flexible configuration options:
  - Up to 153 RSC Tornado servers [685 TFLOPS]
  - Up to 153 RSC Tornado Phi nodes [528 TFLOPS]
  - Mixed RSC Tornado/RSC Tornado Phi nodes
  - From 1 to 9 fully independent domains
  - 0.64 m² / 6.9 ft² footprint, 2 m / 6.6 ft height

RSC Tornado Expansion Pack
- HPC, BigData, VDI, Security, Machine Learning Expansion Packs and others by request

RSC Tornado Power Supplies
- 220-400V AC/DC 12 kW
- 220-12V AC/DC 2.1 kW
- Direct liquid cooling & node-like design
- Thermal and power management
- Flexible redundancy (N+1 to N+N)
- Power conversion efficiency up to 96%

Other names and brands may be claimed as the property of others.
SPbPU supercomputer center

- The first Intel® Xeon® E5-2600 v3 based cluster in Russia and CIS
- Peak performance over 1.1PFLOPS
- The most advanced technology and one of the top powerful
- RSC’s direct liquid cooling for energy efficiency at scale
- Unique massively-parallel system

Solution components

**RSC Tornado**
- Performance - 830 TFLOPS
- Recent Intel Xeon E5-2697 v3 CPUs
- Intel® S2600KP Server boards
- Intel® SSD DC S3500/P3700
- RAM DDR4 – 64-128 GB per node
- VDI & I/O Expansion packs

**RSC PetaStream:**
- Performance - 295 TFLOPS
- Intel® Xeon Phi™ 5120D
- Service processors Intel Xeon E5-2600
- Intel® SSD DC S3700
- FDR InfiniBand
- 400V DC energy efficient power supply

- RSC BasIS software stack. Shared parallel storage - 1 PB (Lustre) + 0.5 PB cloud storage
Total peak performance of JSCC RAS supercomputer systems has been increased by 40% up to 900 TFLOPS
JSCC RAS Modernization

- Universal solution with 150 nodes per computing rack
- Liquid cooling in all the time **free-cooling** mode (24x7x365) with +38 °C outside temperature (maximum temperature in Moscow)
- Inlet liquid temperature +42°C for node
- Storage system with Intel® Omni-Path fabric support

New computing nodes based on:
- Top-bin 72-cores Intel® Xeon Phi™ 7290 processors
- Intel® Server Boards S7200AP
- Intel® Xeon® E5-2697A v4 processors
- Intel® Server Boards S2600KP
- Solid state drives Intel® SSD DC S3500 series (SATA, M.2)

Total peak performance of JSCC RAS supercomputer systems has been increased by **40%** up to **900 TFLOPS**
SSCC SB RAS Modernization

New supercomputer based on:
- Top-bin 72-cores Intel® Xeon Phi™ 7290 processors
- Intel® Server Boards S7200AP
- Intel® Xeon® E5-2697A v4 processors
- Intel® Server Boards S2600KP
- Intel® SSD DC S3500 series (SATA, M.2)
- Intel® Optane™ SSD DC P4800X
- High-speed interconnect on Intel Omni-Path (100 Gb/s per port)
- 200 TB data storage system на based on RSC Sea Breeze servers with parallel file system Lustre and Intel® Enterprise Edition for Lustre software

Total peak performance of SSCC SB RAS systems has been increased in 2 times – by 71% up to 197 TFLOPS
Russian HPC hype curve

- Based on Top500.org data
- Demonstrates shape similar to Gartner “hype curve”
- Expect more in the future:
  - Russian scientific sector re-organization is at the end
  - University 5-100 program revitalized
  - Federal program “Science”: ~4 trln roubles to boost scientific activity

Russian HPC on plateau of productivity