

HPC Activities and Directions in Russia



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HPC User Forum

- **Strategic HPC targets**
- **Main HPC customers**
- **Key HPC drivers and constraints**
- **Russia in HPC ratings**
- **RSC's role and projects**

- **Top500**
- **Russian Top50**
- **RSC's Russian market data**
- **Open publications**

- **Economy boost with innovations**
- **Drive high tech industries to avoid strong Oil&Gas economy dependency**



Main HPC Customers

- **University/Academia orgs**
- **Government orgs**
- **Manufacturing design bureaus**
- **Digital content creation studios**
- **Finance (very small market)**



Key Drivers and Constraints

- **Cost of electricity**

OPX **1 MW per year = \$1M**

- **Cost of floor space**

CAPEX **\$15K/sq.m. Tier2, \$26K/sq. m. Tier3**

- **Cost of Telecom**

CAPEX **~\$150K, OPX ~\$30K/yr**

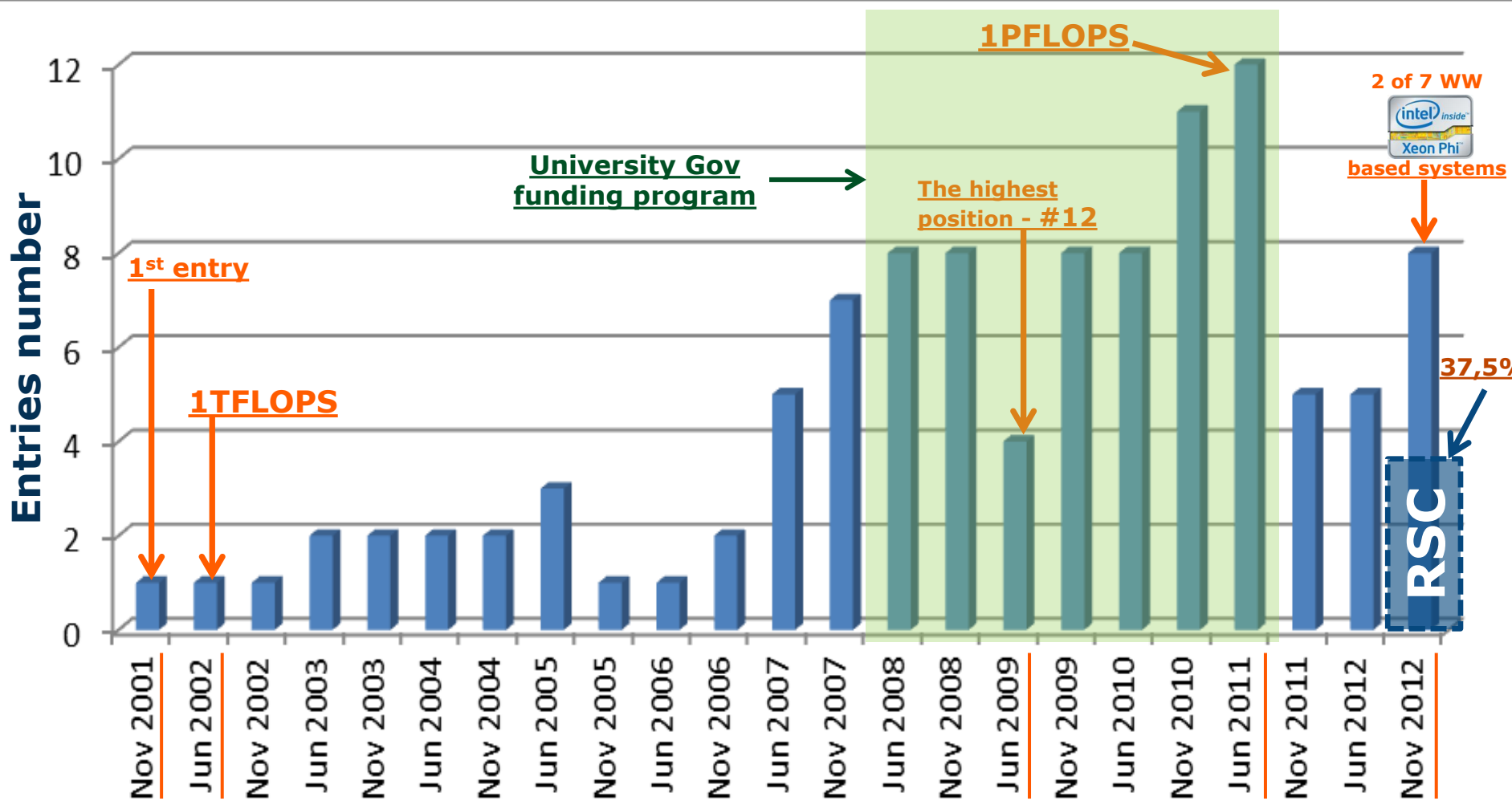
- **Cost of workforce**

\$180K per person/year (incl. all payments)

**To collect all
in one place
in one DC**

Est. total Russia HPC Year Revenue ~ \$55-80M

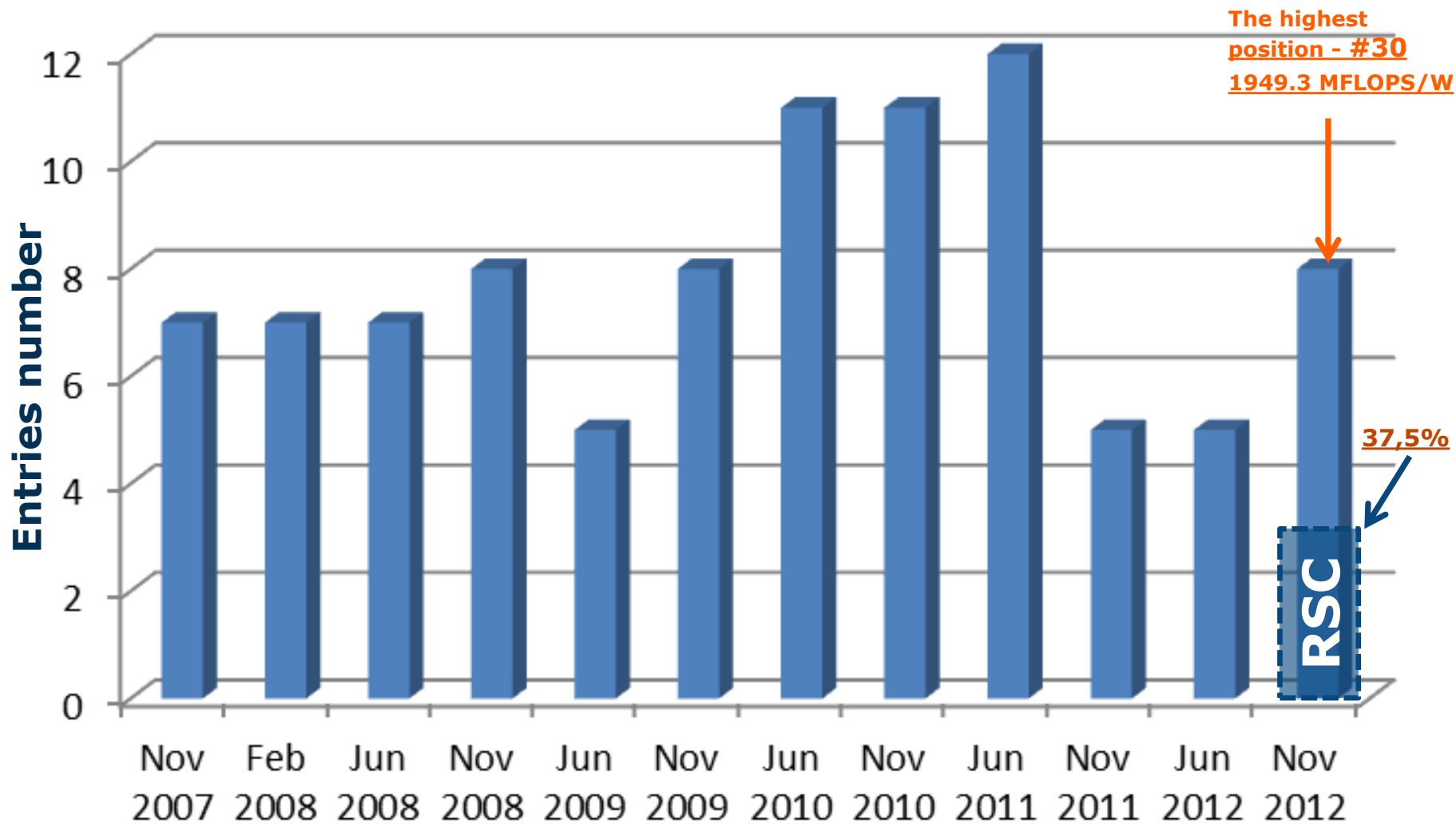
11 years of Russian HPC





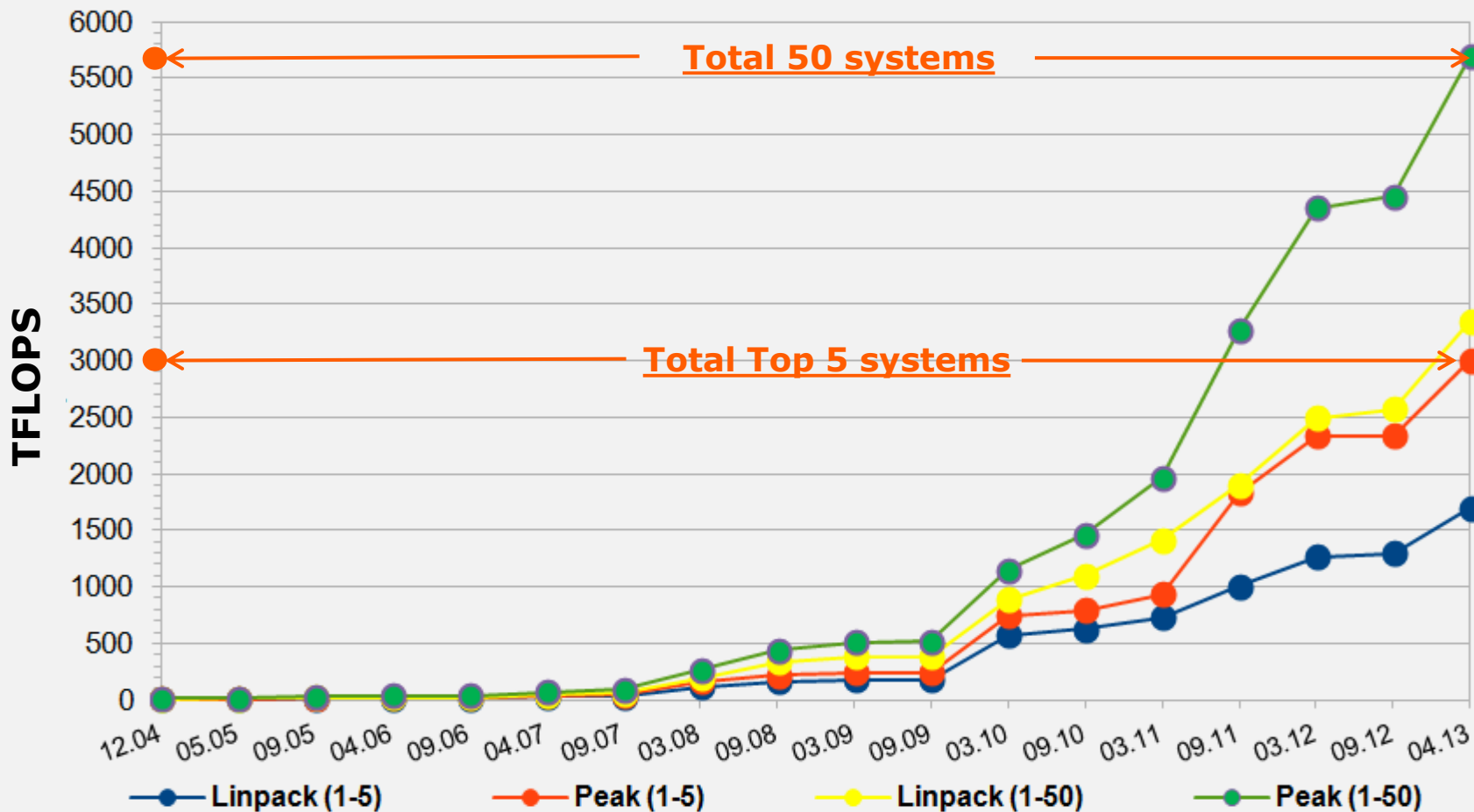
Russia in Green500

5 years of green Russian HPC evolution

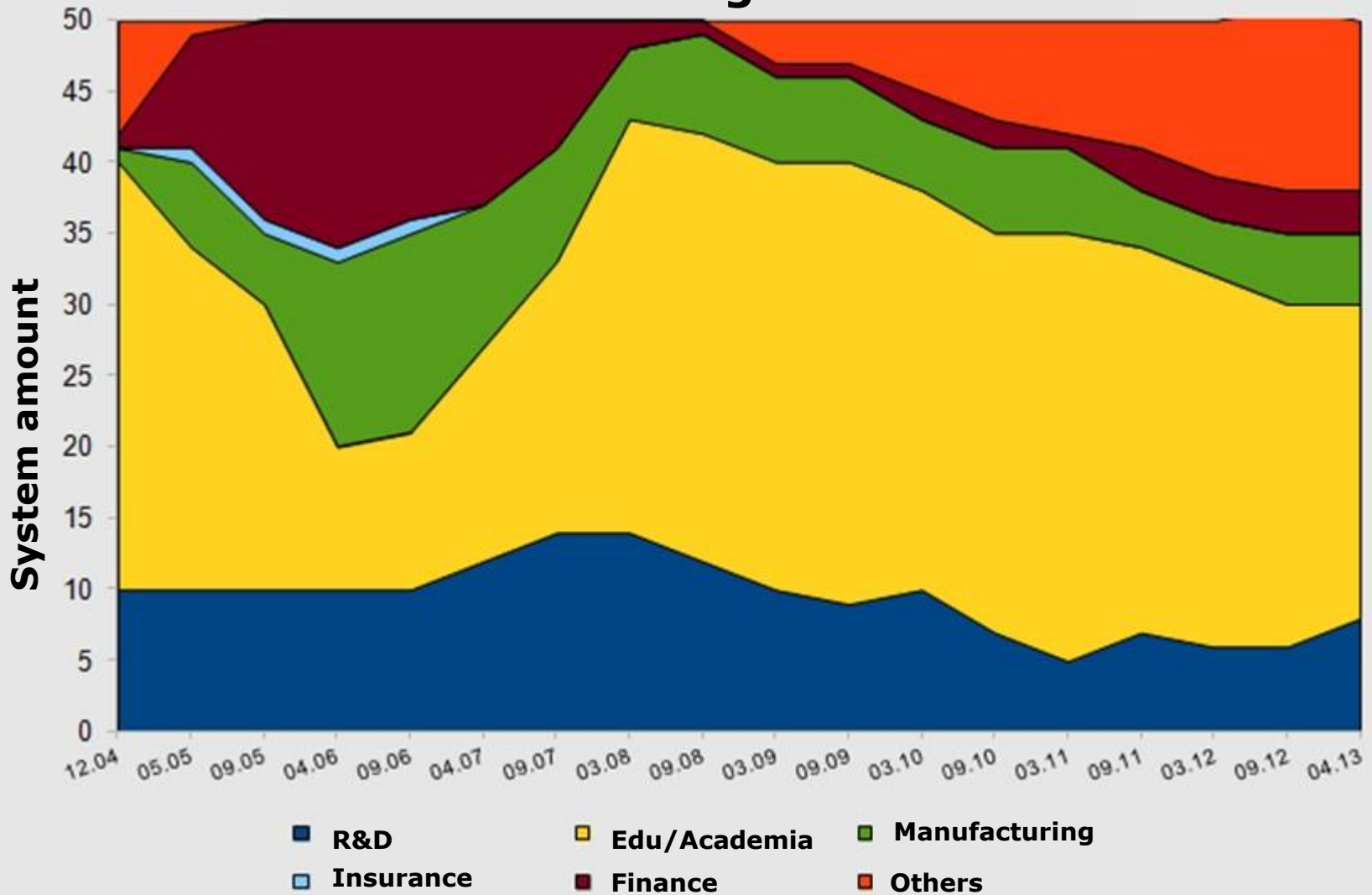


9 years of Russian rating

Performance



Customer segmentation



- **Russian HPC has market similar trends as European and US markets**
- **Market size is significantly smaller than EU or US**
- **Government NRE is not a widely used practice in Russia**
- **Commercial companies invest in IP**
- **Russian companies own leading HPC technologies in some areas**



Mission and Profile

Innovative HPC system developer and system integrator

- Founded in Jan, **2009** in Moscow, Russia
- Year revenue – **\$15-20 millions** (hw, sw, services). Employees – **30**.
- In-house **HPC server design with liquid cooling** and software development
- **Leading HPC** developer and solution provider in **Russia/CIS**

We focused on achieving the new levels in

- Efficiency
- Performance
- Productivity
- Usefulness
- Availability



Create **innovative technologies**
for the **world leading HPC and cloud systems**



Focus Activities

Development of energy efficient complete HPC solution based on *RSC Tornado architecture*

- Project proofed efficient liquid cooling
- Based on industry standard COTS CPUs and server boards
- Up to 128 x 2 socket server 80 x 80cm x 42U
- Achieving the world leading cooling PUE (1.06)



RSC Basis – self developed HPC/Cloud software stack based on standard components



RSC Tornado 3rd Generation

**3rd generation of RSC Tornado architecture -
with newest Intel® Xeon Phi™ coprocessor**

- **Unique computing density:**

- **181 TFLOPS per rack** or **141 TFLOPS/m³**

- **3.8X higher than the previous world record** for x86 architectures

- **Two RSC's projects with Intel Xeon Phi in Russia** out of 7 systems worldwide at Top500 – first outside of the USA





New breakthrough

RSC Tornado computing nodes based on Intel® Xeon® E5-2690 with Intel® Xeon Phi™ coprocessors and liquid cooling

- Record level performance – 2.5 TFLOPS per node
- Fully integrated energy efficient solution
- Used in JSCC, SUSU projects





RSC Tornado Product Line

RSC HPC/Cloud Management

RSC Data Center
Up to PFLOPS

Electricity

RSC DCmicro
16-64 nodes



RSC DCmini
64-256 nodes



Performance



MVS-10P Supercomputer, JSCC RAS

The largest Intel® Xeon Phi™ based system outside the US to date



Prototype for **10PFLOPS** system

#2 in Russia/CIS by Top50 (April'13)

#59 in Top500 (Nov'12)

#30 in Green500 (Nov'12). #1 in Russia

20 sq. m. data center

523.8 TFLOPS Rpeak

375.7 TFLOPS Rmax (LINPACK)

- **1949.3 MFLOPS/W**





- **207 nodes, each with:**
 - 2 x **Intel® Xeon® E5-2690** (8 cores, 2.9 GHz)
 - 2 x **Intel® Xeon Phi™ coprocessor SE10X** (61 cores)
 - Intel® SSD 330**
 - Intel® S2600JF server board**
- **Total RAM 3.2 TB**
DDR3-1600, low voltage green memory
- **Total disk storage: 24.8 TB**
- **Interconnect: Infiniband FDR, 56 Gbps**
- **Service network:**
two independent sensor and control networks





- **192 Nodes:**
 - 2x Intel® Xeon® X5680 3.33
 - Intel® Xeon Phi™ coprocessor SE10X
 - Intel® SSD 330
- **#4 in Russia/CIS by Top50 (April'13)**
- **#170 in Top500 (Nov'12)**
- **#40 in Green500 (Nov'12)**
- **236.7 TFLOPS Rpeak**
- **146.8 TFLOPS Rmax (LINPACK)**
- **995 MFLOPS/W**





South Ural State University *(Chelyabinsk, Russia)*

- Peak performance — **117 TFLOPS**
- **#8 in Top50 (Russia/CIS), #303 in Top500** (max — **#87**)
- 5 racks based on Intel® Xeon® X5680 (3.33 GHz, 130 W)



Moscow Institute of Physics and Technology

MIPT, Moscow Region (Russia)

- I-SCALARE Laboratory – dedicated to life-science applications (biomedicine, etc.)
- **83.5 TFLOPS** in two racks, 224 nodes
- **#10 in Top50 (Russia/CIS)**
-



Roshydromet *(Moscow, Russia)*

Russian Meteorology Service, 1 of 3 WW weather forecast centers

- **35 TFLOPS** in one rack, 96 nodes in 1.3 m³
- **First HPC project on Intel® Xeon® E5-2690** in Russia/CIS
- Record-level **PUE=1.057**
- **Most efficient system in Top50 — 90%** on LINPACK
- **#27 in Top50 (Russia/CIS)**

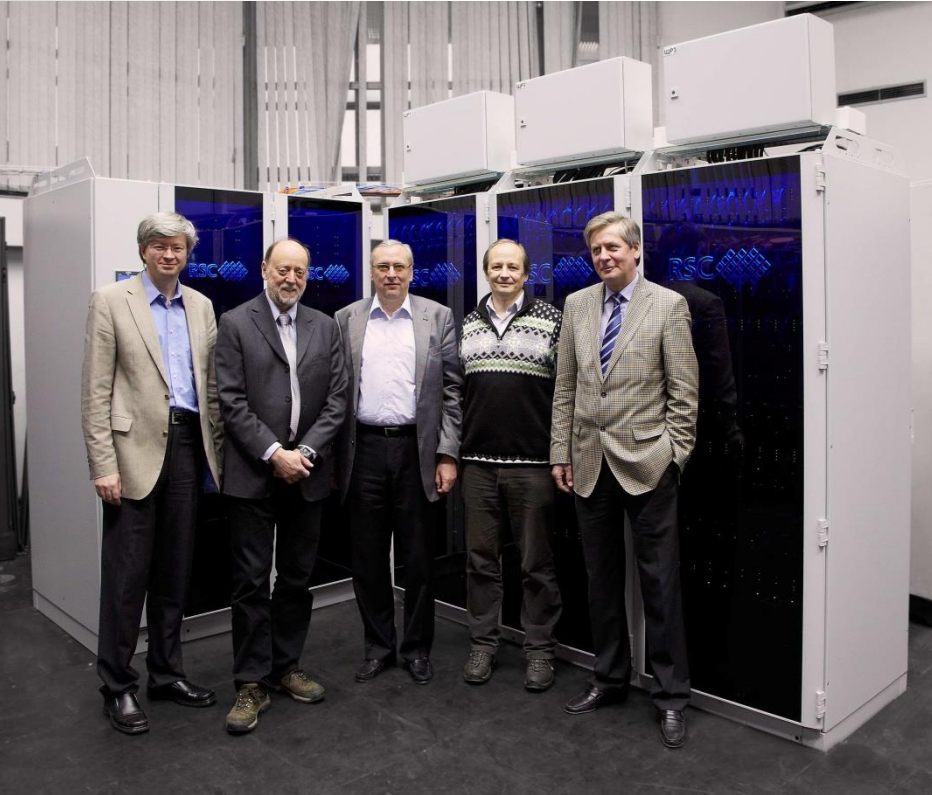


- RSC Tornado architecture is leading on the HPC market in Russia/CIS – press award «Breakthrough of the Year-2012» (LAN Magazine)
- Customers achieve new levels of application speed up and 2X reducing of expenses on electricity and maintenance
- **7+ Mln kW*h electricity saved in Russia by RSC's customers since 2009**





Jack Dongarra at RSC's sites



"Both SUSU and JSCC RAS are state of the art high performance computing centers with competent staff running the highly ranked Top500 and Green500 powerful and energy efficient supercomputers. The facilities both use RSC Tornado based systems with innovative liquid cooling and newest Intel Xeon Phi coprocessors which provide impressive high performance capabilities and energy efficient solutions to solve very demanding science research and engineering problems." – said Jack Dongarra.



Contact

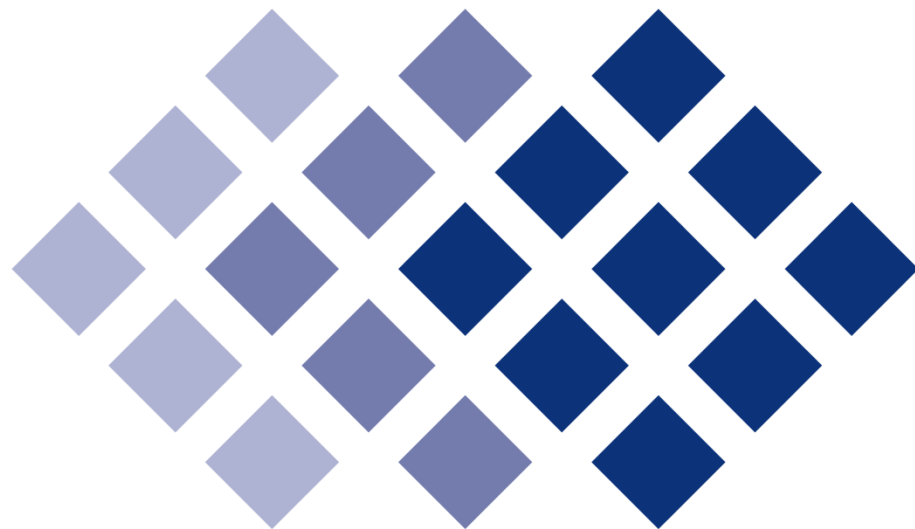
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