7th European Computer Science Summit – ECSS 2011
The Informatics Europe Curriculum Best Practices Award

Parallelism & Concurrency: Changing the Landscape of IT-Education

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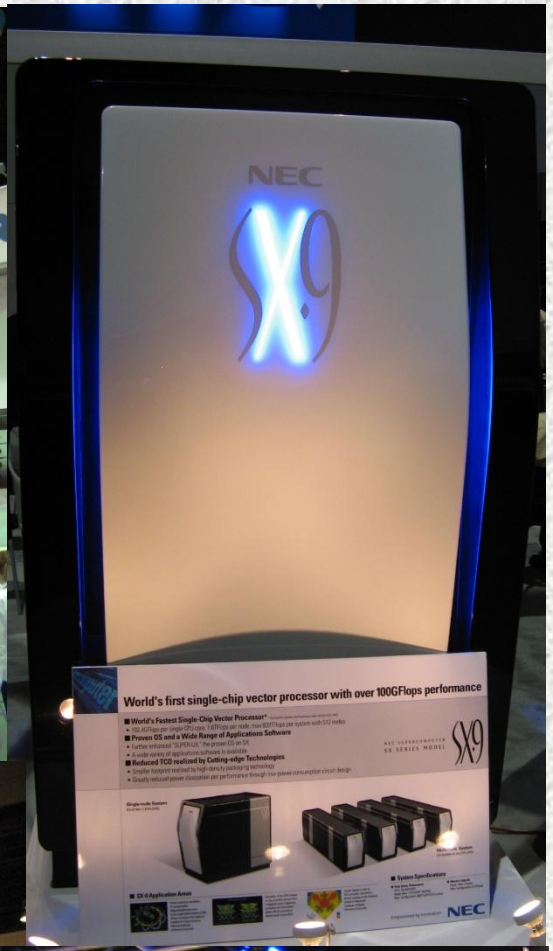
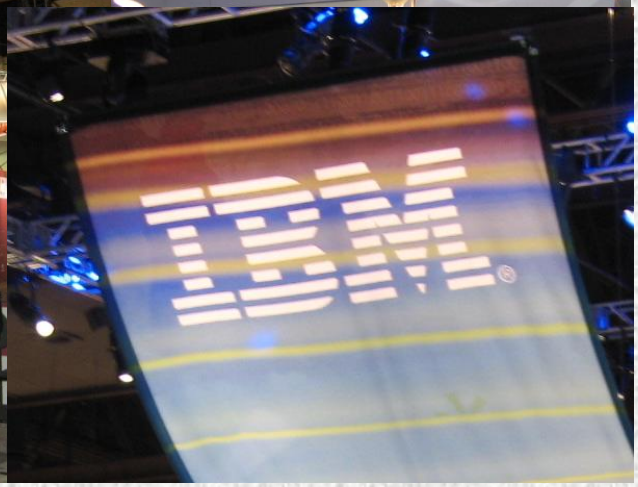
Verari
systems
bladeswithoutboundaries
intel
Xeon
inside

CRAY


NEC
SX-9
World's first single-chip vector processor with over 100GFlops performance
Proven OS and a Wide Range of Applications Software
Reduced TCO realized by Cutting-edge Technologies
NEC

Sun Constellation System
TACC partners with Sun to deliver over 500 TFLOPS
Based on:
Sun Blade 6048 Modular System
Sun Datacenter Switch 3456
Over 13,000 AMD Opteron Quad core processors
Sun StorageTek disk and tape
Sun Grid Engine
TACC

hp
FUJITSU


IBM

Educational Infrastructure in P&C

(basics of the project)

- *Interaction with government, ministries, funding agencies.*
- *Tight contacts with leading IT companies and research institutes.*
- *Strong interuniversity collaboration.*
- *Body of knowledge on Parallelism & Concurrency.*
- *Different target groups: students, teachers,…*
- *Courses, textbooks, intensive practice, trainings on P&C…*
- *Individual work (projects) of students.*
- *Collective bank of exercises and tests on P&C.*
- *Internet university of supercomputing technology.*
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- *…*

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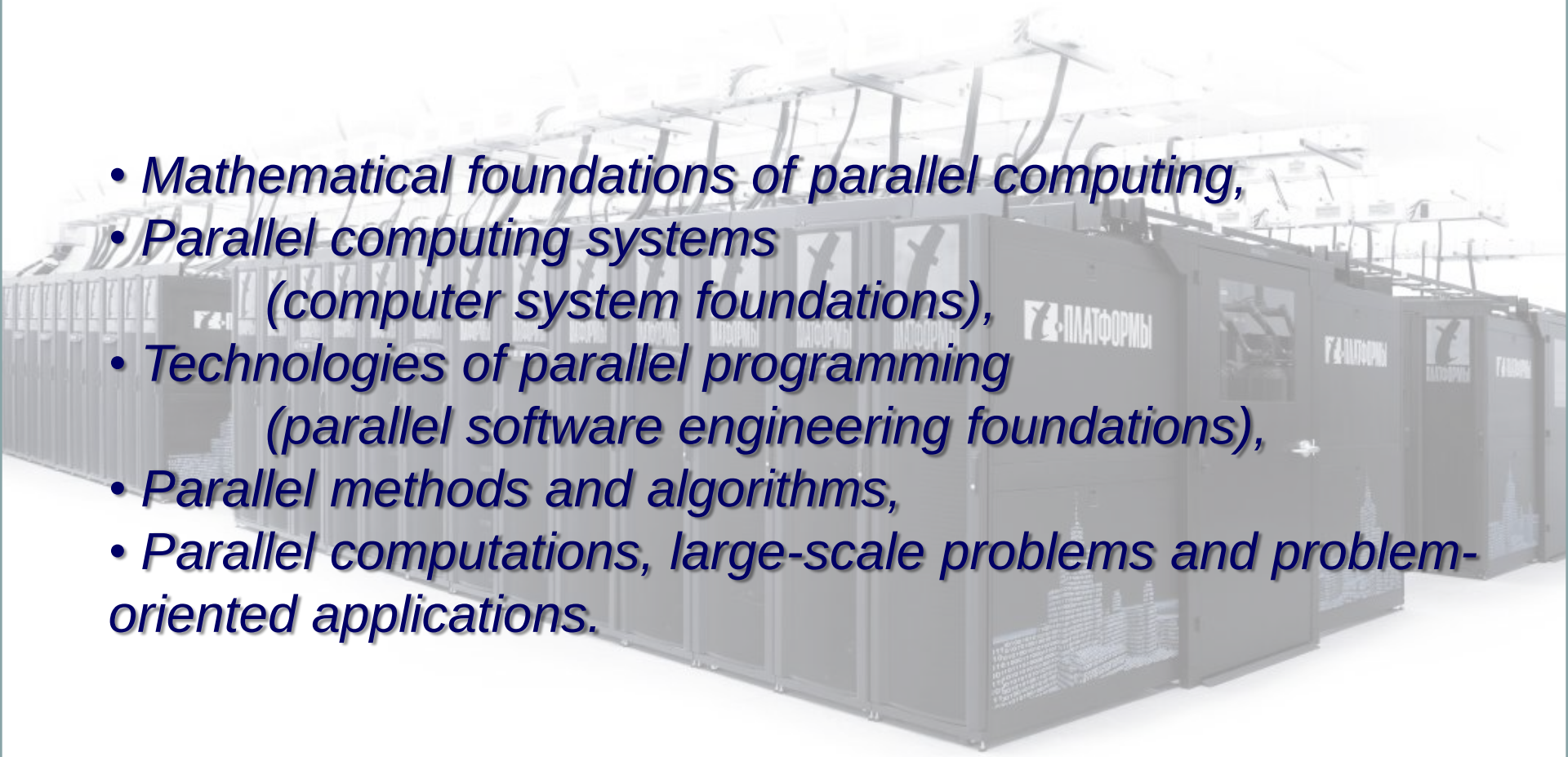
Joint MSU&NNSU project

Body of Knowledge in P&C

(what is inside P&C area?)



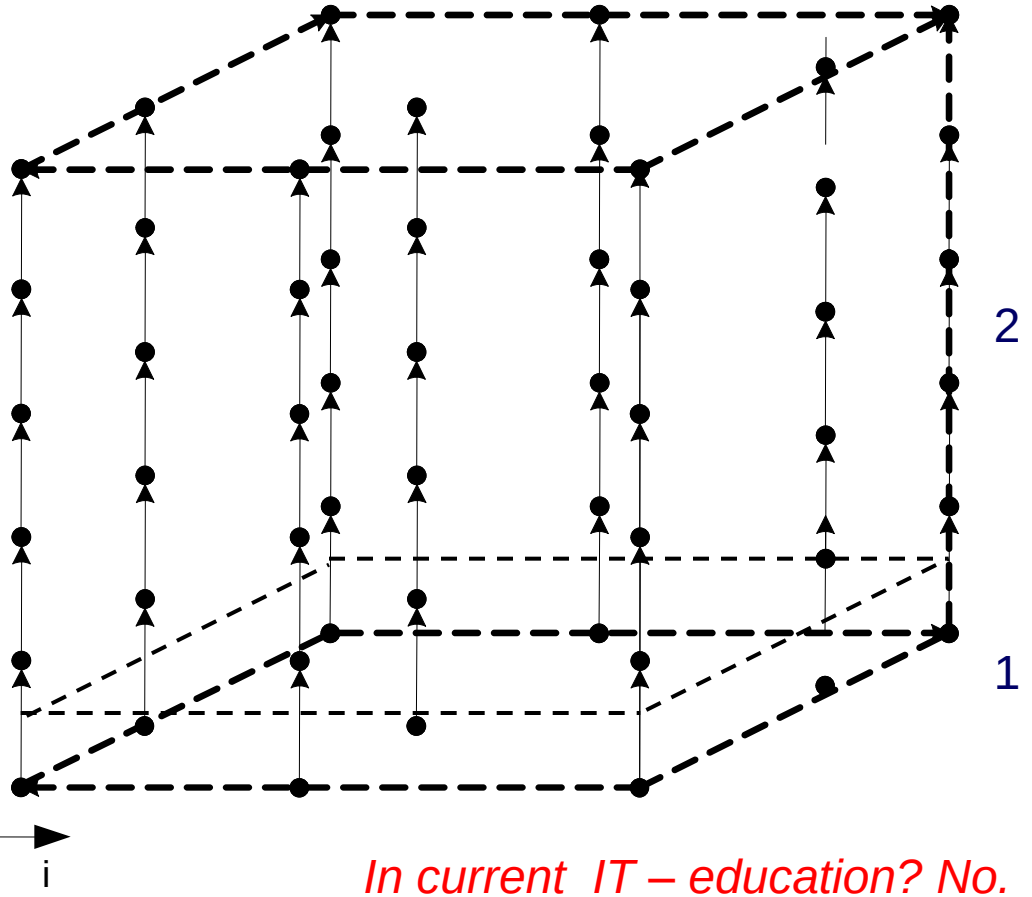
- *Mathematical foundations of parallel computing,*
- *Parallel computing systems (computer system foundations),*
- *Technologies of parallel programming (parallel software engineering foundations),*
- *Parallel methods and algorithms,*
- *Parallel computations, large-scale problems and problem-oriented applications.*

Informational Structure is a Key Notion

(matrix multiplication as an example)

```
      Do i = 1, n
        Do j = 1, n
1         A(i,j) = 0
          Do k = 1, n
2           A(i,j) = A(i,j) + B(i,k)*C(k,j)
```

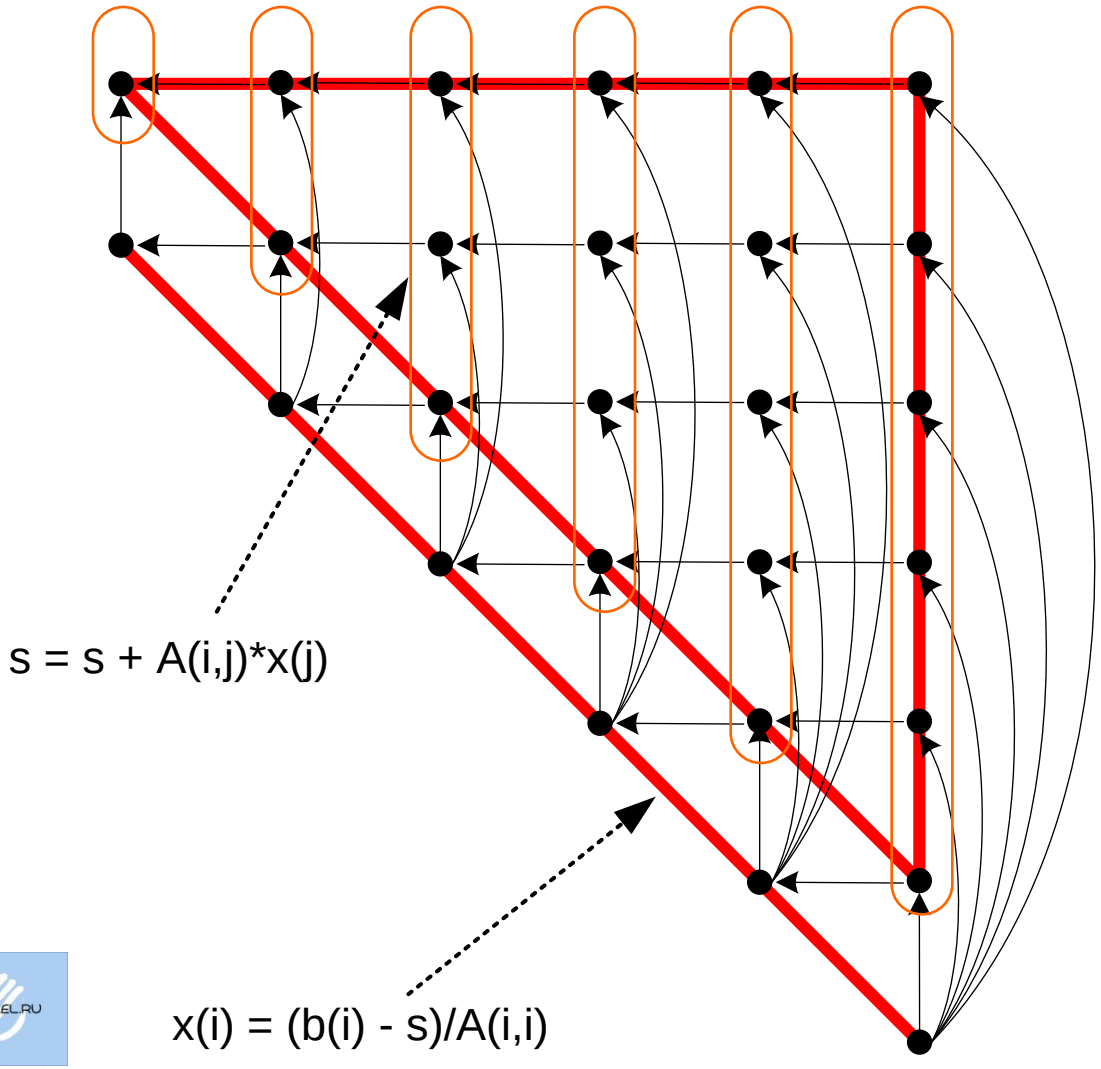
$$\begin{cases} 1 \le i \le n \\ 1 \le j \le n \\ k = 1 \\ \begin{cases} i_1 = i \\ j_1 = j \end{cases} \\ из\ (1) \end{cases} \qquad \begin{cases} 1 \le i \le n \\ 1 \le j \le n \\ 2 \le k \le n \\ \begin{cases} i_1 = i \\ j_1 = j \\ k_1 = k - 1 \end{cases} \\ из\ (2) \end{cases}$$



In current IT – education? No.

GAUSS elimination: method and algorithm

(informational structure)




```
do i = n, 1, -1
   s = 0
   do j = n, i+1, -1
      s = s + A(i,j)*x(j)
   end do
   x(i) = (b(i) - s)/A(i,i)
end do
```

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Educational Courses and Textbooks

(elements of P&C educational infrastructure)

- *Parallel computing (Vl.Voevodin, MSU).*
- *High Performance Scientific computing: parallel programming model, tools and performance analysis (N.Popova, V.Bakhtin, MSU).*
- *Introduction to Parallel Programming (V.Gergel, NNSU).*
- *Parallel programming tools (V.Gergel, I.Meyerov, et al. NNSU).*
- *New languages for parallel programming (V.Gergel, et al. NNSU).*
- *…*

MSU&NNSU Team: Trainings & Schools

Trainings on Intel programming tools. Optimization and tuning of user's applications (speed-up %5 – 400%).

Training on Accelrys Material Studio

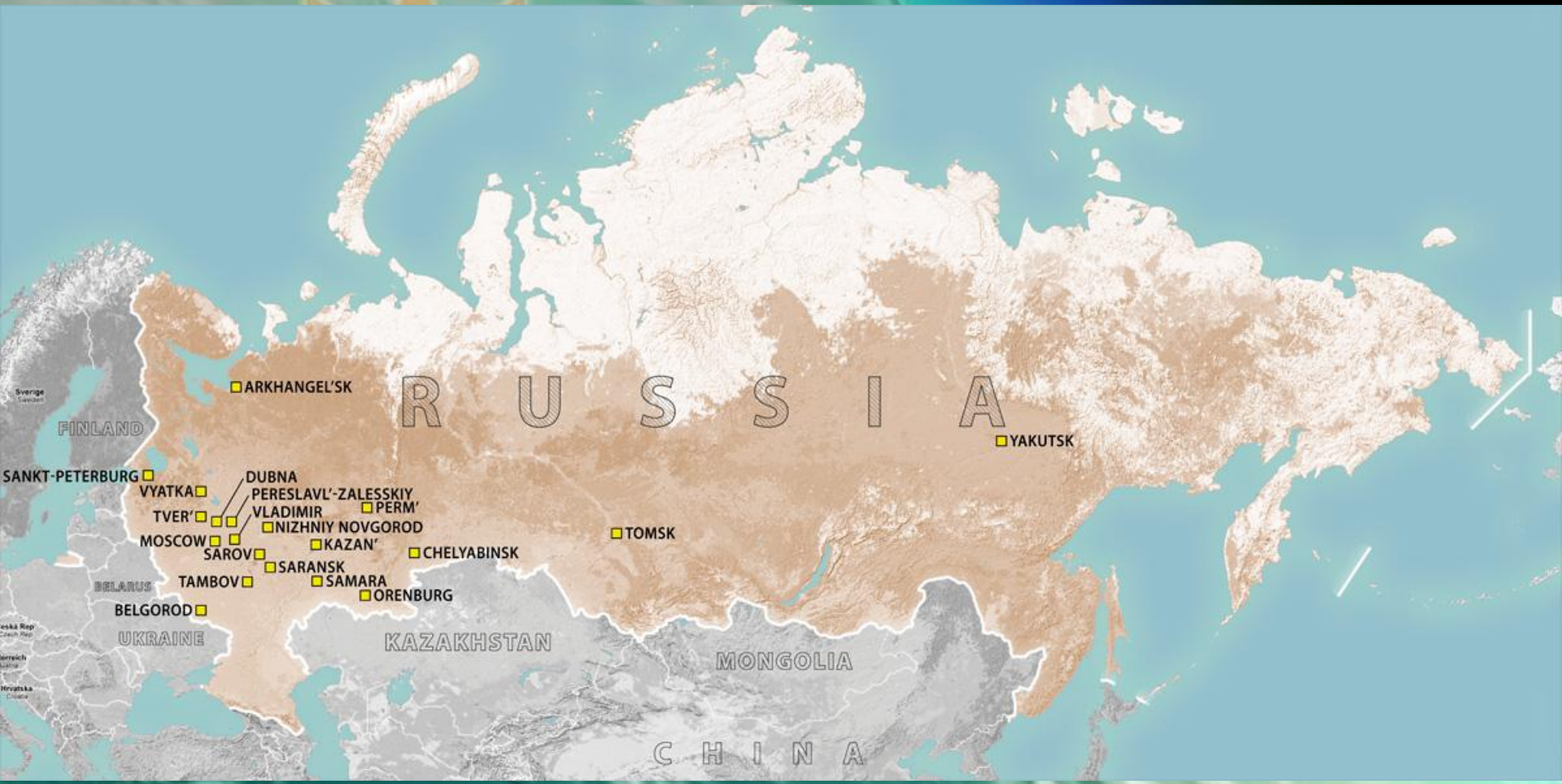
Youth summer schools on parallel programming technologies

MSU&NNSU Project: numbers and facts

(different forms of involving)

- *Studying courses on P&C in MSU/NNSU – 400+, every year*
- *Intensive training in HPC areas in MSU/NNSU – 70+, every year*
- *Research and educational projects – 100+, every year*
- *Teaching of teachers at MSU/NNSU – 50+, every year*
- *Youth schools of MSU/NNSU – 100+ participants, every year*
- *Internet university on supercomputing technology – 300+, annually*
- *Passed through the Sigma e-testing system – 1700+*
- *…*

Teaching of Teachers and Students: where?



MSU&NNSU's educational activities are in more than 20 cities of Russia

MSU “Lomonosov” supercomputer, 2011

M.V.Lomonosov
1711 – 1765

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Contacts with leading IT-Companies

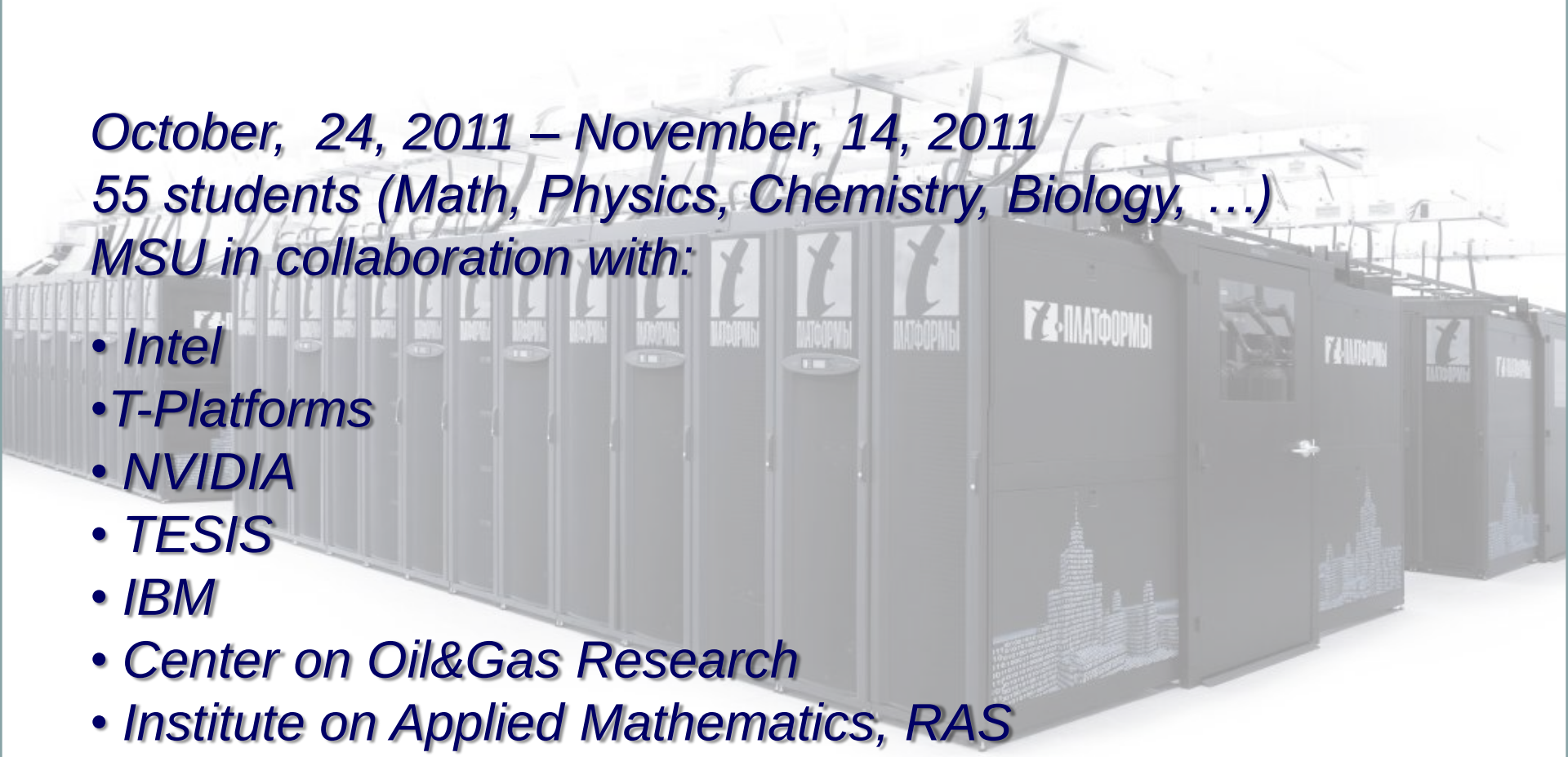
(industry collaboration)

- *Joint MSU – Intel center on High Performance Computing*
- *Joint MSU – Intel Student Lab*
- *Joint NNSU – Intel center on High Performance Computing*
- *Joint NNSU – Intel Student Lab*
- *Microsoft Competence Center for High Performance Computations in NNSU*
- *Joint MSU – T-Platforms Center on Exascale Computing*
- *Agreements between MSU/NNSU and Hewlett-Packard, NVIDIA, TESIS,… on Supercomputing Education*
- *…*

Joint MSU/NNSU-Intel student Labs and Centers on HPC

IT-Companies and Research Institutes & Edu

(special group of students on Parallel Software Development)



October, 24, 2011 – November, 14, 2011
55 students (Math, Physics, Chemistry, Biology, …)
MSU in collaboration with:

- *Intel*
- *T-Platforms*
- *NVIDIA*
- *TESIS*
- *IBM*
- *Center on Oil&Gas Research*
- *Institute on Applied Mathematics, RAS*
- *Institute of Numerical Mathematics, RAS*

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Quarterly: “Supercomputers”

Excursions for Schools and Universities

(to supercomputing center #1 in Russia)

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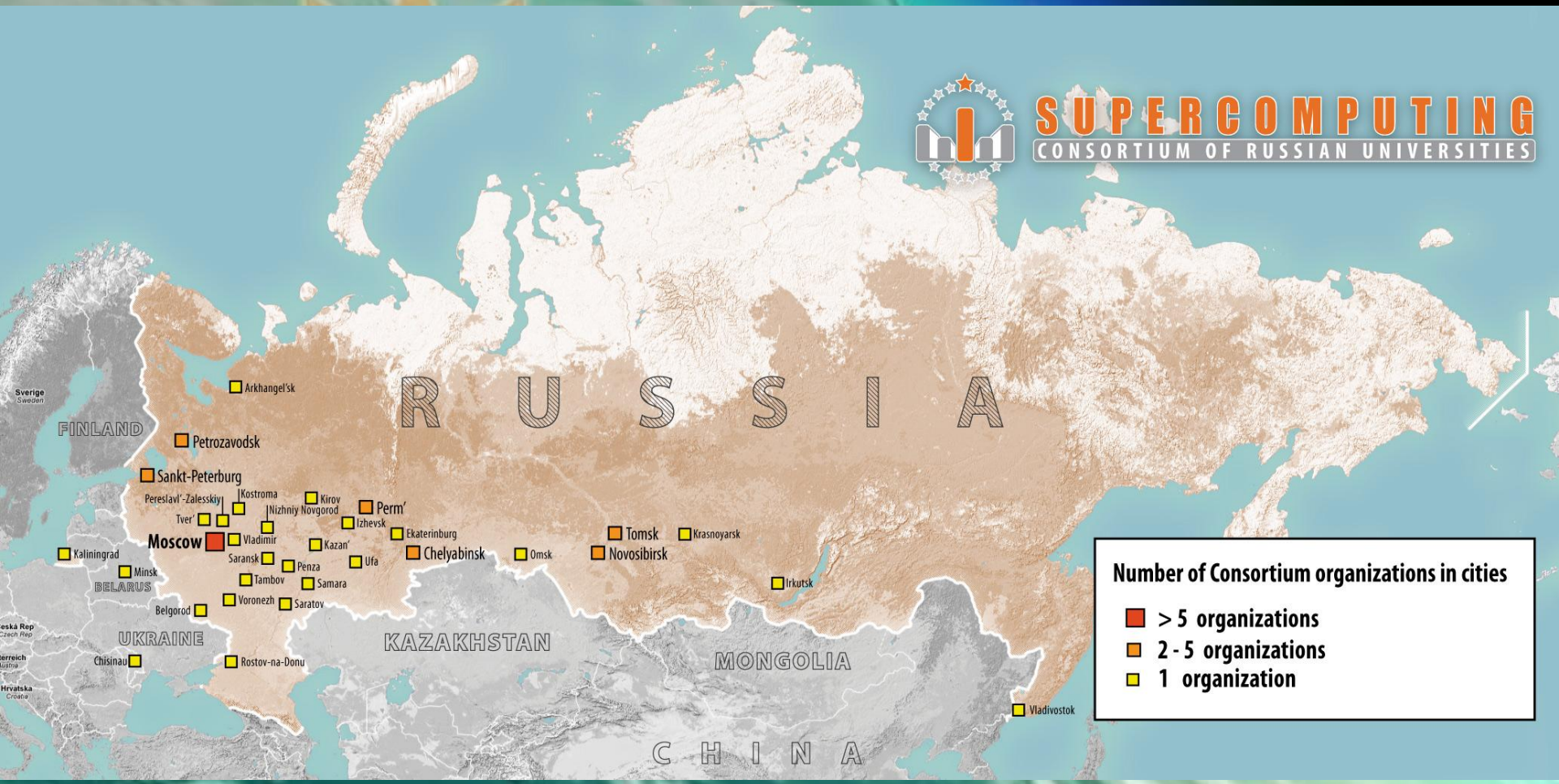
Supercomputing Consortium & Education



2011: 50 full and associated members

Primary goal of the Consortium: Supercomputing Education

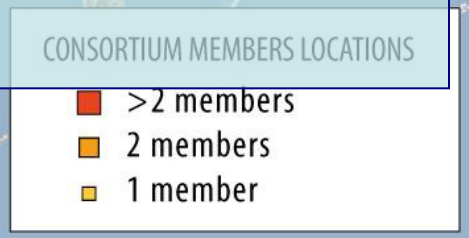
Commission for Modernization and Technological Development of Russia's Economy

Chairman of the commission: D.Medvedev, President of Russian Federation

Approved project of the commission: "Supercomputing Education"

Duration: 2010 – 2012

Project's Leader: rector of MSU, academician V.Sadovnichy



Informatics Europe & Education on P&C = ?

(next steps)

- *New working group within Informatics Europe: "Parallel Computing (Supercomputing) Education in Europe: State-of-Art"*

- *First output of WG – a survey "Supercomputing (or P&C) Education in Europe"*

- *Expected outputs: a roadmap and set of recommendations to universities and government agencies on curricula, bachelor/master/PhD programs, etc… to be developed to support new generations of parallel computers and parallel computing technologies.*

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