Union State Program

"Development and production of families of high-performance parallel computers (supercomputers) and supercomputer-based application systems"

Schedule time: 2000-2003

Brief description of technical solutions

We develop two families of composite ("hybrid") supercomputers with the following structure:

- cluster level (CL);
- configurable computing environment (CCE) level;
- Hardware and software tools for interaction of the two levels.

Combining two different (CL and CCE) approaches to high-performance computation in one installation is beneficial because every application can be decomposed into:

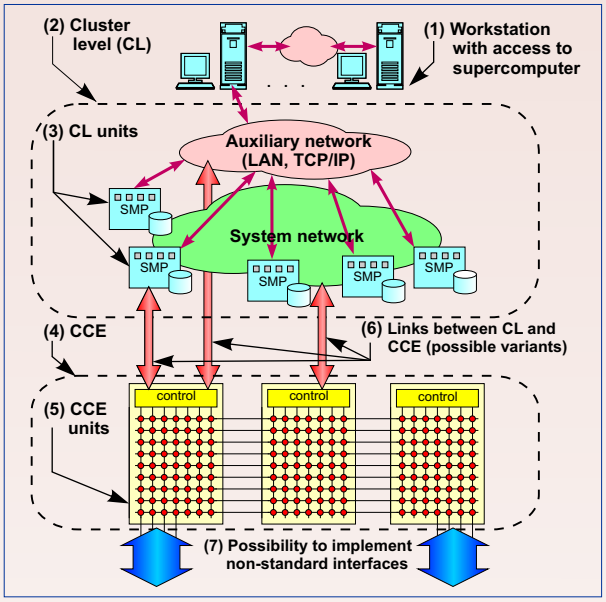
- fragments with complex computational logic and large-grain parallelism—such fragments can be effectively implemented upon the cluster level (using MPI or T-system);
- fragments with simple computational logic, with pipe-line and fine-grain parallelism, with large data flows to be processed in real-time—such processes can be efficiently implemented using CCE.

After an applied problem has been analyzed and decomposed, within the composite supercomputer concept one can choose optimal hardware configuration for this particular problem:

- optimum number of CL units, and
- optimum number of CCE units.

The architecture of supercomputers developed under the Program is open and scalable. No restrictions exist on the hardware platform for cluster level units, system network hardware and topology, configuration and performance range of the supercomputers developed.

Structure of SKIF family supercomputers



2000' Results

- Cabinets and racks for 1st family supercomputers have been developed.
- Two prototype SKIF supercomputers (cluster level only) have been assembled, tuned and tested.
- For these supercomputers the following cluster level software has been developed, installed and tested:
  - ☑system software (Linux, MPI, T-system, etc.);
  - ☑tests and benchmarks for T-system;
  - ☑alpha-version of the first application—a system for chemical PECVD-reactors design.
- VHDL model, programming tools for testing and design documentation for CCE level VLSI were developed.
- Macro-assembler level software for CCE has been developed and tested.

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Prototype SKIF family of supercomputers

Prototype SKIF family supercomputer
PSI RAS, Pereslavl-Zalessky, February 2001

Specifications of the prototype SKIF family supercomputers

Maximum peak performance:	**ab. 20 Gflops**
Number of processors:	**32**
Number of units:	**16**
RAM:	**16 × 0.5 = 8 Gbyte**
HDD:	**16 × 10 = 160 Gbyte**
System network, SCI (scalable coherent interface):	**2-D tore 4 × 4**
• latency (MPI, max.):	**6 μs**
• bandwidth (physical):	**400 Mbyte/s**
• bandwidth (MPI, point-to-point):	**up to 120 Mbyte/s**
Auxiliary network Switched FastEthernet	**100 Mbit/s**

Program Participants

Government customer-coordinator:
National Academy of Sciences,
Republic of Belarus
Responsible contractor on the RB side:
NIO "Kibernetika" Belarus NAS

Customer-coordinator:
the RF Ministry for industries, science and technology
Responsible contractor on the RF side:
Program Systems Institute, RAS

About twenty enterprises from Belarus and Russia form the pool of developers.
On the RF side: PSI RAS, CTTI MSU, NICEVT, IVV&BD, SCS enterprise etc.
On the RB side: NIO "Kibernetika", UE "Belmikrosistemy", UE "NII EVM", ITMO NAS RB etc.

Directions of the SKIF program

Cluster level:
- 1st family units;
- cluster with gigabit links;
- domestic manufacture of gigabit network devices;
- system software;
- languages and programming systems;
- advanced (2nd family) supercomputers.

Configurable computing environment (CCE):
- VLSI implementation of CCE processor elements;
- system software;
- languages and programming systems;
- advanced (2nd family) supercomputers.

CL and CCE interconnection layer:
- hardware;
- software.

Software tools:
- for supercomputer-based AI applications.

Application systems:
- gas-dynamics process modeling;
- radar and optical signals processing;
- Automatic target recognition and selection;
- data processing and visualization in a cardiology system;
- optical character and image recognition;
- simulating spread spectrum radar signals.

Support activities:
- education and support for users;
- telecommunication means for project participants.

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