"Development and Production of High-Performance Parallel-Architecture Computer (Supercomputers) Family and Supercomputer-Based Applications "

An outline of results SKIF
supercomputer program of Union state (2000-2004)

Supercomputing Program "SKIF"

The "SKIF" program has been conducted during the years 2000-2004. Ten companies from the both Russia and Belarus took part in the program. The lead organizations were: Program Systems Institute of Russian Academy of Science from Russia and United Institute of Informatics Problems of National Academy of Sciences of Belarus.

"SKIF" Family of Clusters

The "SKIF" family (series 1 and series 2) of high-performance computing systems has been developed during 2000-2004, possessing parallel architectures and a broad spectrum of performance capabilites. The design and construction documentation has been developed , as wel as 16 samples were manufactured, with various performance (see fig. 1), preliminary and the final (state) testing were conducted. The most powerful models are:

- **"SKIF K-500"** — 716.8 Gflops peak performance, Linpack performance is 425 GFlops – 407 place in the Top 500 list of November 2003.
- **"SKIF K-1000"** — 2,534 TFlops peak performance , 2,023 Gflops – Linpack, 98 position in November 2004 Top 2005 list.

During years of the "SKIF" program implementation, the most powerful "SKIF" model has been produced every year: "Firstborn",VM-5100, "Firstborn-M", "SKIF K-500", "SKIF K-1000".Linpack performance of these models (TopSKIF) grew approximately 3.7 times each year (or 185 times since December 2000 till December 2004). At the same time, the performance of top super-computers of the world high-performance computing industry (Top 10, Top 100, Top 500) grew approximately 1.8…2 times each year.

In the November 2004, samples of SKIF supercomputers occupied 14% of "Top 50" supercomputer rating of Commonwealth of Independent States (CIS, ex-USSR) and provided one-fourth of total performance and one-third of aggregated Linpack performance of super-computers in the rating. This demonstrates that effi-ciency (ratio between peak (theoretical) performance and Linpack performance) of SKIF clusters is above the average by 50%, over both domestic and international origin supercomputers installed in CIS countries.
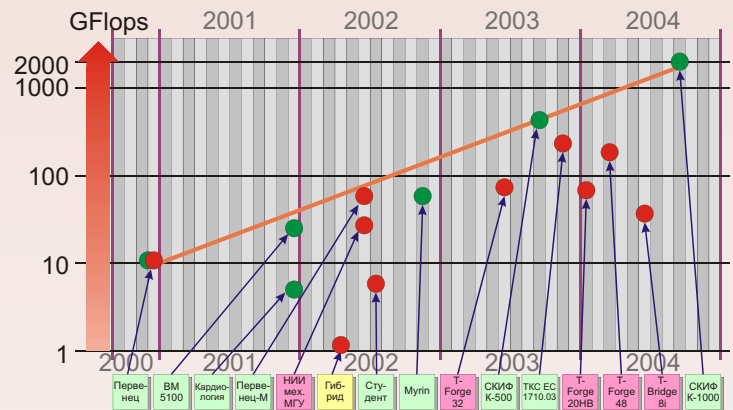

Fig. 1 Linpack performance
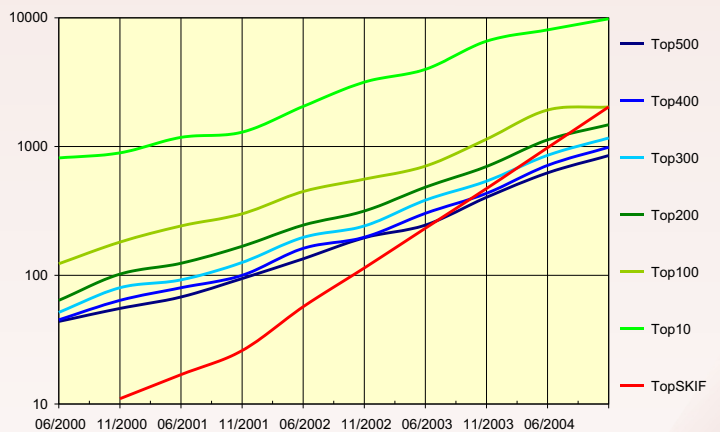of 16 SKIF supercomputer experimental samples

Fig. 2 Growth of the Linpack performance
of the top supercomputer models in the world
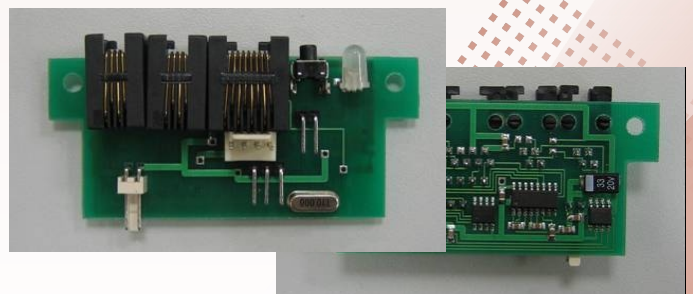(Top10 .. Top 500) and in SKIF family (TopSKIF)

Fig 3. SKIF-ServNet ver 2
management adaptor, reduced size (66x33 mm),
price per one module is $40

Software for the Clusters of SKIF Family

The system-level software has been developed during the years 2000-2004, including:

- Kernel of Linux-SKIF OS
- PVFS-SKIF — parallel cluster file system
- OpenPBS-SKIF — batch queue system
- FLAME-SKIF — monitoring and management system for SKIF clusters (including interface to power on/off, reset)
- OpenTS — the T-system with the open architecture
  - T++ language compiler (TG++) and converter (t++)
  - T-Fortran converter (T-Fortran →T++)
- TDB — interactive, distributed environment debugger for MPI and T++ programs (an analog of Totalview)
- 6 applications on Open TS.
- 12 adapted open source packages, applications and libraries
- 14 applications of own development (including 3 of AI)
- Compatibility with third-party engineering simulation packages

Open TS is a system for automatic dynamics parallelization of computation. In contrast with many analogs, T-system supports SMPs, computational clusters, MPI, PVM, as well as meta-cluster environments and GRID networks.

SKIF Service network (SKIF Servnet)

Service network (fig 3) is designed to facilitate remote management of supercomputer/cluster nodes. SKIF-Servnet network allows following remote operations for a node or a group of nodes:

- Power On/Off
- Reset
- Provides serial console to a node
- "Black box"– saves few screens of output to the node's serial console in adaptor's memory

Production capabilities

The base of cluster manufacturing has been deployed. The SKIF program participants (PSI RAS, OAO "NICEVT", "T-platforms" company) are capable to produce:

- Supercomputers up to 15 GFlops performance with technology solutions verified on SKIF famility of supercomputers
- SCI cluster fast interconnect adaptors – analogs of Dolphin SCI adapters (SCI PCI 66/64 Dolphin ICS, 1D and 2D – torus, D330, D337, D335)
- Service network adaptors (SKIF/Servnet)

Applications of SKIF clusters

In-House Designed Applied Systems (More Than 20 Projects)

1. Mutligen@Open TS
- biological activity forecast, drug-design

2. Meteorology:
- PSI RAS, Roshydromet: weather forecast with V.M. Losev's model and others
- UIIP NAS, Belarus republic meteorological center: 48 hours regional forecast model, numerical wea-ther prediction methods

3. AIReC of PSI RAS: three applied AI systems
- AKTIS: automated text classification by classes, defined on learning stage (high relevance, deep text analysis)
- INEX: data extraction system for natural language (filling relational database from a number of texts)
- MIRACLE@Open TS: development tool for AI systems

4. Russia, Belarus: SKIF applications to cardiology
- UIIP NAS, RNPC "Cardiology"and "NIIEVM": computer system for eye-ball diagnostics in cardi-ology
- ADEPT-C by IVViIS: real-time expert cardiology system

Commercial Engineering Packages Utilization (10 Projects)

1. "Belarus" tractors:
- simulation of next-generation tractor hull

2. BelAZ:
- simulation of supporting construction of BelAZ heavyweight lorry, mine linings

3. Borisov Units Plant, Industrial Ministry of Belarus:
- simulation of diesel engine turbo-charger

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