Experiences in PVM-based power plant simulation

European PVM users group meeting 1994

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ENEL - CRA

ENEL is the Italian Power Company.

CRA

is the Research Center for Automatics of ENEL

The departments of CRA are:

- Automation Technologies;
- Robotics;
- Diagnostic and Electronic Measurement;
- **Process Analysis and Control;**
- **Information Technologies.**

Much work has been carried out in the Process Analysis and Control Dept. for development of simulation software.

A research program is in progress in the Information Technologies Dept. on Parallel and Distributed Computing.

LEGO

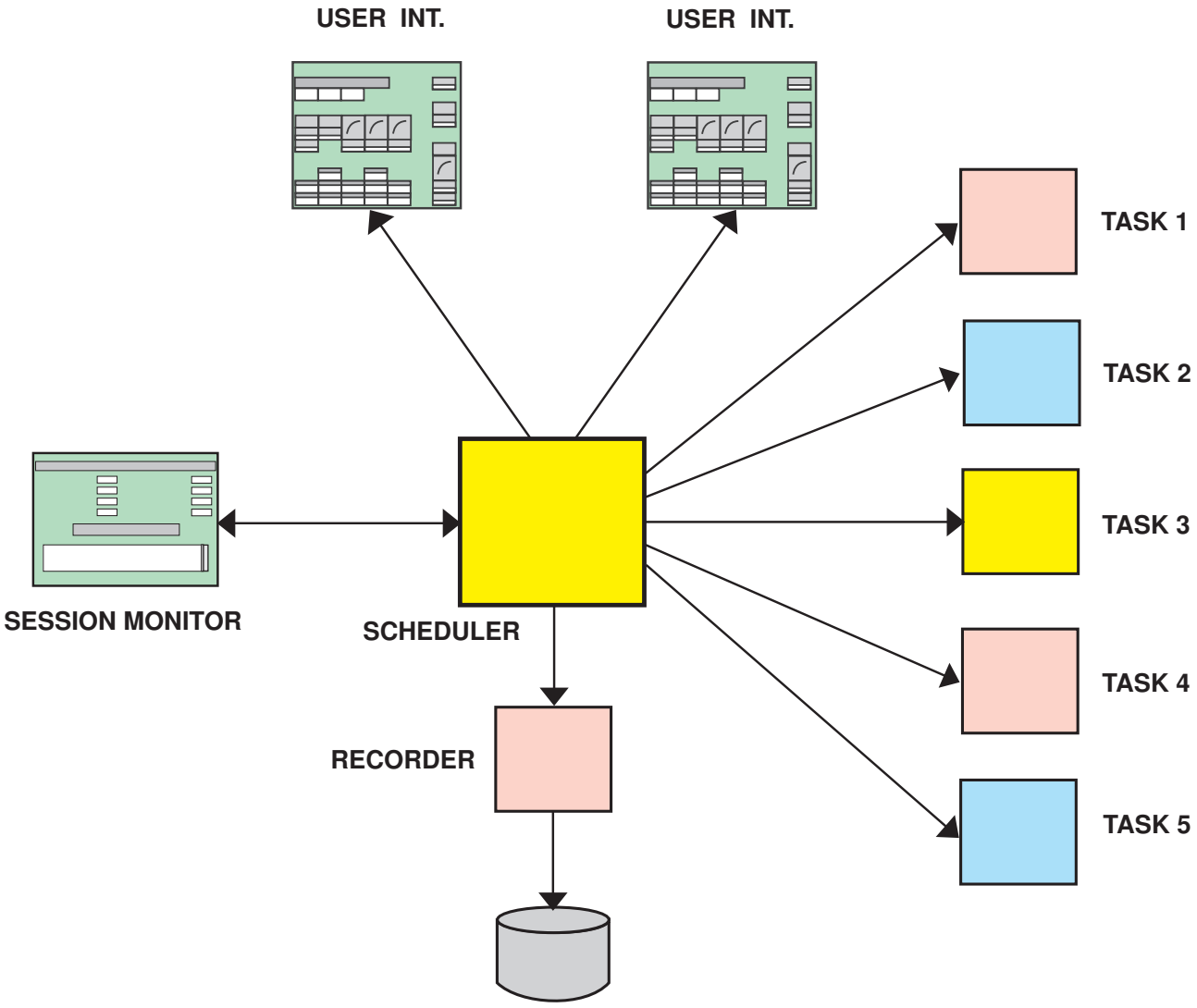
one of the simulation tools produced at CRA is called **LEGO**

Features of LEGO are:

- modularity;
- flexibility;
- reliability.

The original version of LEGO runs on a Unix or VMS workstation, as a set of independent processes communicating through a shared memory area.

Tasks in a LEGO simulator



LEGO tasks can be classified in three families:

user interfaces;
control systems;
process simulators.

PARALLEL LEGO

A parallel version of LEGO can solve some of the problems faced by current LEGO users:

- simulation **speed** can be improved by some factor;
- parallel architectures can use **lower cost** components to get the same performance;
- **more accurate** models can be developed.

PVM

The Parallel Virtual Machine is a library allowing parallel computing on a network of Unix workstations.

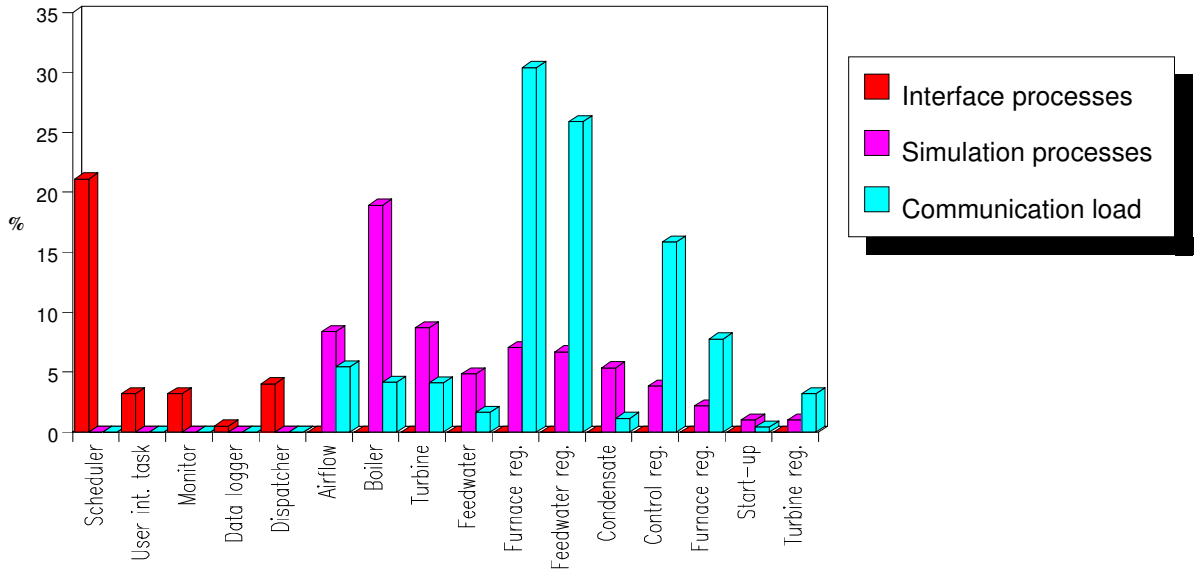
Key features of PVM are:

- Availability on existing hardware;
- Use of TCP/IP network protocols or dedicated communication hardware on parallel machines;
- Automatic conversions between different binary formats of data;
- Interprocess communication independently from task location.

Some computer vendors sell PVM versions particularly tuned for their specific hardware.

LEGO tasks

CPU and communication requirements



TASK MAPPING

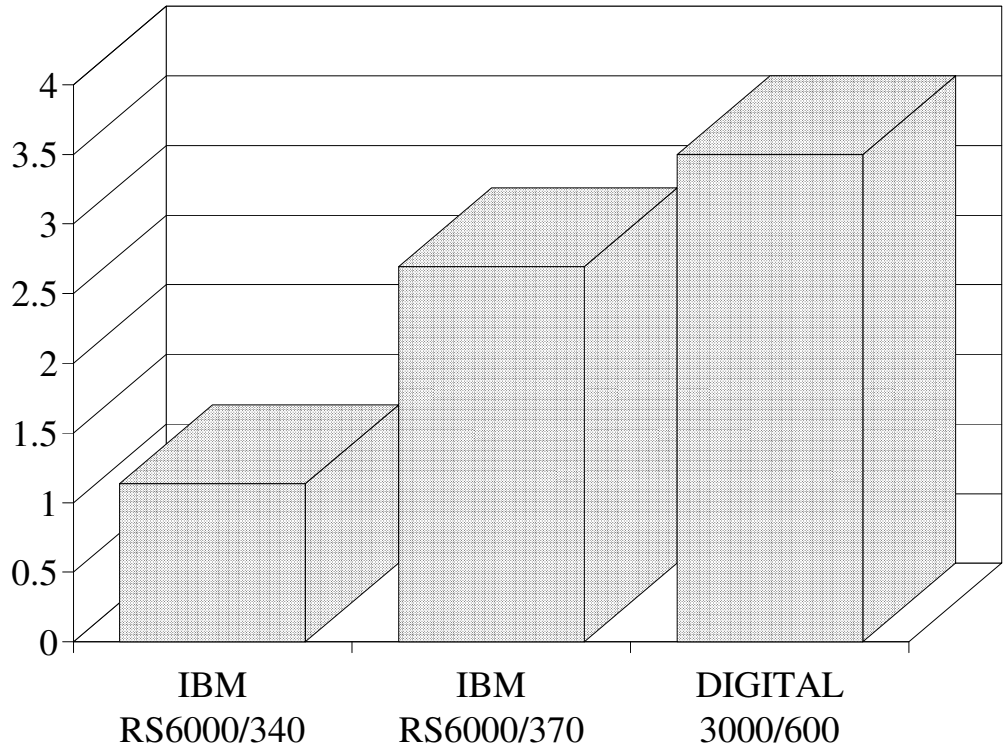
Task mapping is the activity of assigning the tasks to the available machines.

LEGO tasks are very dissimilar in terms of computing and communication needs.

The available machines in our laboratory differ sensibly in term of computing power.

The current version of PVM cannot take into account such differences when assigning tasks to hosts.

Single-machine simulation speeds



RESULTS

Good performance results can be obtained by hand-mapping processes to machines.

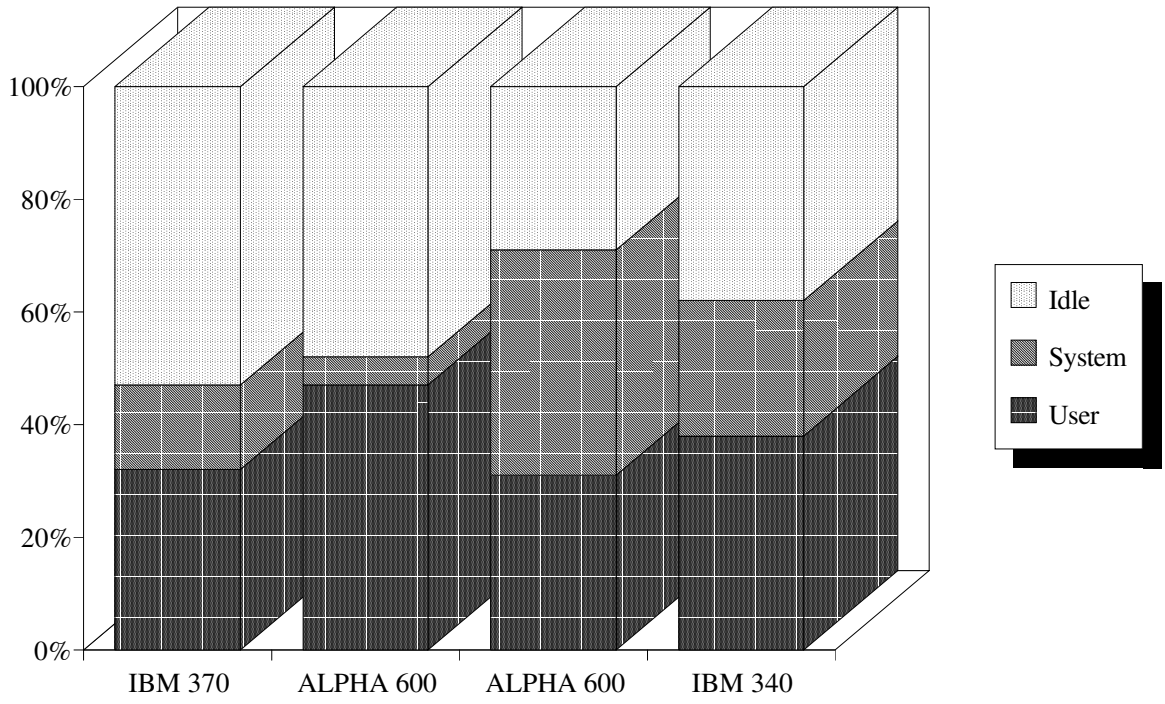
On a network of four heterogeneous workstations the simulation speed is 5.8 times faster than real time.

Performances are limited by the latency of the communications layers (PVM, socket interface, Ethernet interface) and by the serial implementation of the scheduler.

The bandwidth is not a limit:
Ethernet is used at 20% of its bandwidth.

The high idle time seen on the machines can be used to run more complex models or additional user interface processes.

Machine loads



UPGRADING TO FDDI

An upgrade of the network hardware in our laboratory gives us the opportunity to test the simulator on a FDDI LAN.

PVM benchmarks show that FDDI gives benefits only when transmitting big amounts of data in a single message.

For our application, the obtained simulation performance is substantially the same given by Ethernet.

FUTURE WORK

At another Research Center of ENEL (ENEL-CRIS) an IBM SP/1 parallel machine with 8 CPUs (faster than our mod. 370) is installed.

When PVMv3 is available on the SP/1, we can carry out similar tests on this faster architecture.

Once available the results from the SP/1 runs, it will be considered the restructuring of our scheduler process.