Parallel Systems in Switzerland
A Status Report

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Introduction

The past decade has seen the emergence of many multi-processor machines. Research prototypes have been developed already in the 60's and 70's but only recently there are also parallel computers which are commercially available. Numerous approaches in the design of parallel systems may be identified, like Dataflow architectures, Graph Reduction machines or Neural Network circuits. However the most advanced and also available systems of today are the control-driven systems. They can roughly be split into two categories:

- **SIMD** systems with a very large number of simple identical processing elements operate under a central control synchronously on distributed data sets. The Connection Machine or the Maspar systems are examples for this machine type.
- **MIMD** systems are more general: they operate asynchronously and the processors are usually fully functional single computer chips. Two types of MIMD machines may be identified:
  - *Shared memory* systems consisting of a limited number of processors (bus based multi-processor systems)
  - *Distributed memory* systems consisting in processing nodes and an interconnection network. Some designs follow a fixed interconnection scheme where the hypercube topology is the most popular (e.g. Intel Hypercube). Other systems offer greater flexibility in the sense that the connection structures may be defined according to the users demands. Such systems are built around hardware building blocks consisting in processing and communication devices (e.g. Transputer together with Switching/Routing devices).

Common to both classes is the possibility of combining a large number of processing elements into one single computer system in order to achieve very high performance. In the domain of very high performance scientific computing the vector supercomputers have been the driving force during the last years. Those machines (e.g. Cray, NEC, Hitachi) consist today in few, but very powerful processors. However there seems to be a breakthrough for massively parallel systems since 1990: for the first time a massively parallel computer (CM-2) has demonstrated a higher (application) peak performance than any other system

[11] and the number of installations of this type of computers is continuously growing [12],[9]. Also extraordinary research & development efforts are being made in the field of parallel processing in many countries (US, European Community, UK, India, etc.).

Many activities in Switzerland related to parallel processing [1, 4, 2, 5, 6, 7, 3] have shown the interest and experience of Swiss institutions. A major effort in the field is now expected from the *Schwerpunktprogramm Informatik – Massive Parallelität* for the period of 1992-1995.

This paper gives an overview of parallel systems which are currently installed in Switzerland. Although the list may not be complete, it shows that many institutions have their own parallel systems. The many projects in progress at these sites are not presented here. Such an overview is given for the *Suisse Romande* in [10] and [7] shows many project at Swiss institutions. The paper is organised as follows: first the systems installed at universities and EPF/ETH are given in alphabetic order, followed by some example installations in industry and at other schools. It has to be noted, that in many places single or very small Transputer systems have been purchased, which are not listed here as well as networked workstations used for distributed computing. A short summary shows afterwards installations of classical (vector-) supercomputers. To get an idea of installations in other countries, some example installations in the Swiss neighborhood are listed.

Beside having the information of which systems are installed in Switzerland, this report is also motivated by the hope, that researchers in Switzerland might exchange their knowledge of using the different machines and make available their own systems also for others.

Parallel systems at Universities and EPF/ETH

Universität Basel, *Basel Parallel Processing Laboratory, Institut für Informatik*

M^3 **Multi–Microprocessor** 9,3, and 2 processor (M68020) shared memory machine with 4 MB shared memory running ORION with Modula-2 and Linda.

Multi-Transputer System 60 T800 machine with 480 MB memory running Occam Fortran 77 and C programs under TDS and Express. Hosted by PC.

Maspar 4096 node SIMD system with 64 KB local memory (per node) running with MPL, Maspar C Maspar Fortran 90. Hosted by DEC 5000.

Contact: Prof. H. Burkhart (burkhart@urz.unibas.ch)

Universität Basel, *Institut für anorganische Chemie*

Multi-Transputer System 43 T800 machine with 43 MB memory running Occam programs. Hosted by Apollo Workstation.

Contact: Dr. R. Eminger (eminger@urz.unibas.ch)

Universität Bern, *Fachgruppe Paralleles Rechnen, Institut für Informatik und angewandte Mathematik (IAM)*

Parsys Supernode SN1000 16 T800 with 64 MB memory running IDRIS V and standalone compilers (Occam,C). Hosted by Sun-3 and/or PC.

Meiko Computing Surface 8 node system (i860 / 2 T800) with 64 + 16 MB memory running CStools and C. Hosted by Sparcstation.

Multi-Transputer System 16 T800 reconfigurable machine with 32 MB memory running Occam and C programs or Express or Helios. Hosted by PC.

Contact: Dr. P. Kropf (kropf@iam.unibe.ch), Dr. K. Decker (decker@iam.unibe.ch)

Université de Fribourg, *Institut d'Informatique (IIUF)*

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iPSC/2 8 node (i386,i387) Hypercube with 32 MB memory running Unix with C, Ada, Strand and Topsys environment

iPSC/2 16 node (i386,i387) Hypercube with 128 MB memory running Unix with C, Ada, Strand and Topsys environment

Contact: Prof. B. Hirsbrunner (hirsb@cfruni52.bitnet)

Université de Genève, *Centre Universitaire Informatique de Genève (CUI)*

Connection Machine CM2-a SIMD machine with 8K processing elements and 256 Weitek Floating Point processors running CM-Fortran, *C and *Lisp under PRISM.

Volvox System 32 T800 with 128 MB memory running Occam and C. Hosted by Sun-3.

Contact: Dr. B. Chopard (chopard@divsun.unige.ch)

Universität Zürich, *Institut für Informatik*

Parsytec MC-2 32 T805 system with 128 MB memory running Occam. Hosted by Sparcstation.

Contact: E. Lederer (lederer@ifi.unizh.ch)

EPF Lausanne, *LITH*

Multi-Transputer System 16 T800 in Hypercube connection running Occam and C. Hosted by PC and Mac

Contact: Prof. G. Coray (coray@eldi.epfl.ch)

EPF Lausanne, *Département d'Informatique (DI)*

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iPSC/2 8 node (i386,i387) Hypercube with 32 MB memory running Unix with C and Fortran. Hosted by Sparcstation.

Contact: Prof. A. Schiper (schiper@lsesun1.epfl.ch)

EPF Lausanne, *LSP*

Multi-Transputer System up to 25 T800 with parallel disk array and graphics system running Occam and C. Hosted by PC.

Contact: Prof. R. D. Hersch (hersch@eldi.epfl.ch)

EPF Lausanne, *LTS*

ASP Associative String Processor machine. (in development)

Contact: Prof. M. Kunt (kunt@ltssun1.epfl.ch)

EPF Lausanne, *LAMI*

Multi-DSP System TMS 320C40 network.

VLSI Systolic VLSI chips for the realisation of Neural Networks (type Hopfield and Kohonen)

Contact: Prof. J.D. Nicoud (nicoud@eldi.epfl.ch)

ETH Zürich, *Institut für Technische Informatik und Kommunikationsnetze (TIK)*

Parsytec MC-2 32 T800 with 128 MB memory connected in a twisted torus running Occam and Dataflow architecture simulation software.

Contact: S. Murer (murer@tik.ethz.ch)

ETH Zürich, *Institut für Elektronik*

SYDEMA Dataflow architecture (22 and 55 processors)

MUSIC 60 DSP (M96000) + 20 T800 with 135 MB memory

Contact: Dr. A. Gunzinger (toni@nimbus.ethz.ch)

ETH Zürich, *Institut für theoretische Informatik*

Multi-Transputer System 16 T800 running Modula-2. Hosted by Mac.

Contact: A. Marzetta (marzetta@inf.ethz.ch)

ETH Zürich, *Institut für Informationssysteme*

Sequent Symmetry S81 12 processors (i386) with 80 MB memory running DYNIX(R) with Ingres 6.3/01 (sqs.us5/01).

Alliant FX80 6 and 8 processors

Contact: Prof. G. Weikum (weikum@inf.ethz.ch)

ETH Zürich, *Interdiziplinäres Projektzentrum für Supercomputing (IPS)*

Sequent Symmetry S81 26 processors (i386) with 160 MB memory running

Contact: PD Dr. M.Gutknecht (mhg@ips.id.ethz.ch)

ETH Zürich, *Institut für Biomedizinische Technik*

Multi-Transputer System 50 T800 with 4 MB memory each.

Contact: Dr. Y. Leharinger (Tel. 01 256 45 84)

Parallel Systems at Industry and Engeneering Schools

Landis & Gyr, Zug

Transputer Systems 32 T800 with 64 MB memory and various Mac based Multiprocessor boards running Occam and SPECS (Petri Net Simulations)

Contact: R. Esser, L & G, Corporate Research, 6301 Zug

ABB, Dättwil

Stardent Titan 3046 4 processors

Contact: Dr. W. Polifke, ABB, CRBT, Dättwyl

Others

There are many other companies using multi-processor systems within their products. Also at CERN in Geneva many Transputers are installed in embedded systems solution. They have also installed a Meiko Computing Surface, but other massiv parallel system installation are not known.

Ingenieurschulen (HTL)

Many schools have Multi-Transputer Systems used for educational purposes. However, the emphasis there is more on real-time aspects than on parallel processing. Example installations are:

Ingenieurschule Bern 8 PC hosted Transputer boards and small Multi- processor boards (4 Transputers) running Occam

Ingenieurschule Biel Multi-Transputer Systems, up to 65 processors, running Occam and Helios.

Supercomputers

The installations of classical supercomputers include the Cray systems at EPF Lausanne and ETH Zürich as well as the NEC SX3 at CSCS in Manno. Besides, there are various vector facilities attached to mainframes available (e.g. IBM and DEC vector facilities at ETH Zürich or in Bern).

Parallel Systems in other countries

France

IMAG, Grenoble 128 and 64 T800 Telmat Supernode, FPS Hypercube

ENS Lyon iPSC/16 node (i286,i827) Hypercube, 32 T800 Telmat Supernode

Université de Besancon 32 T800 Telmat Supernode

Université de Rennes 64 node iPSC/2 Hypercube

Sophia Antipolis iPSC/2 16 node Hypercube

INRIA, Paris CM-2, 32K

Italy

Università di Napoli 256 T800 Meiko Computing Surface,CM-200 8K

Università di Palermo 32 T800 Parsys SN1000 Supernode

Università di Bari 50 T800 Multi-Transputer System

Ispra 2 Parsytec MC-2 32 T800 systems and 2 32 T800 Telmat Supernodes

Università di Roma Large SIMD system (100 GFlops system) APE system

Cagliari CM-5 with 256 floating point processors planned

Università di Pisa CM-2a 8K

Università di Parma CM-2 8K

Germany

GMD Bonn 128 T800 Parsytec system, CM-2 16K

TU München iPSC/2 Hypercube with 32 processors and iPSC/i860 with 16 processors

Universität Karlsruhe 16K Maspar

Universität Paderborn 320 T800 Parsytec system

TU Aachen 256 T800 Parsytec Supercluster

Great Britain

RSRE 512 T800 Telmat Supernode

British Aerospace 200 T800 Parsytec Supercluster

EPCC Edinburgh 423 T800 Meiko Computing Surface, 64 node (i860/T800) Meiko System, 16 T805 Parsytec MC-2, AMT DAPs 608 and 510 and CM-2 16K

Netherlands

Shell 1000 (2000) T800 Parsytec Supercluster

Philips 200 node (M68020) system (PUMA)

Conclusions

The list presented here shows that parallel systems are installed at many sites in Switzerland. However the comparison with installations in other countries shows, that the parallel computers in Switzerland are all smaller with respect to the number of processors and thus also relative to the performance (except the classical supercomputers). However this does not mean that research in massiv parallelism is not possible, because much research in the filed is theory based and having in mind that a key issue in programming massively parallel systems is *scalability*, many results may be optained with smaller machines as well. However, there should be the possibility of verifying results on large machines too, and when considering applications, it is absolutely necessary to be equipped with appropriately sized parallel systems.

Another observation looking through this report, shows that almost no activity in the field of massiv parallelism may be found in industry. This is different in other countries:

companies using massively parallel systems include BMW, Volkswagen, AEG (Germany), EDF (France), ENEA (Italy), Shell, Philips (Netherlands) or British Aerospace (UK).

Concerning future developments, it may be observed that the race for the TeraFlop is in full progress [13, 14]. The first machines with this computational power are expected to emerge in 1993/94. But opposed to the very fast progress in hardware development, there is still a lack of suitable programming environments and models for massively parallel machines [8]. Thus much effort in the research of software development and of the foundations of massively parallel systems is needed.

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