Institute of Computer Science

Annual Activity Report 2003

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The Institute of Computer Technology is a university institute of Masaryk University Brno responsible for the development of information and communication technologies at the university. It is responsible for the operations and development of centralised computer equipment, information systems and the communication infrastructure of the university. It provides methodical assistance to Laboratories of Computer Technology and other specialised information and communication technologies located within the faculties, and takes part in research and education. The major areas of the ICT MU activity and the results achieved in 2003 were as follows:

1. CENTRALIZED COMPUTER FACILITIES

The Institute of Computer Technology of Masaryk University operates dozens of communication devices and central computing and data servers for centralized computer and library services, supercomputer systems, servers for automated management systems, web services for the university, administrative servers for operating and monitoring the university network, parts of the national academic network CESNET2, the metropolitan archive of medical and visual information, and many others. These facilities are operated in three air-conditioned and secured rooms with a back-up genset to ensure continuous power supply.

In 2003, particular attention was paid to the consolidation of the central servers of MU information systems. A new and more powerful application server on the Sparc/Solaris platform has been purchased, and the capacity of several other servers on the Intel platform has been enhanced. A new disk capacity was added to the dior central server for general services to provide for new applications that require centralized data storage. Funds from the HEDF were used to substantially enhance the computing and data capacity of servers in the University computer room in order that its infrastructure can also provide centralized authentication and data services for other study rooms and classrooms at MU.

2. SUPERCOMPUTER CENTRE

A part of the Institute is also the Supercomputer Centre Brno with nation-wide operations. The Centre uses very powerful computer technology and takes part in research and development in the field of supercomputers and extensive distribution systems, the so-called Grids. Its operation and research activities are coordinated in national and international projects, where its main partners in the CR are the CESNET, Institute of Computer Technologies of Charles University in Prague and the Centre for Information and Computer Technologies of the West Bohemian University in Pilsen. On the international level, the ICT cooperates with its counterparts in Poland (Poznan, Krakow), Hungary (SZTAKI Budapest), Germany (AEI Postupim, ZIB Berlin), Italy (INFN), Switzerland (CERN) and a number of others.

The ICT operates its own computer systems, specifically computers SGI Origin 2000 and PowerChallenge XL with a total of 52 processors MIPS R10000 and 20 GB storage capacity, as well as computer clusters of the CESNET association under the national project MetaCentrum. In 2003, the Institute operated 48 nodes of a cluster with 96 mainly Pentium 4 Xeon processors with the frequency of 2.4 GHz. Each processor had 0.5 GB storage capacity available, and in autumn, 64 processors had that capacity extended to 1 GB. The computing capacities are being supported by corresponding disk ca-

pacities (about 5 TB disks) and a tape library (under the MetaCentrum project) with 12 TB capacity without compression for data backuping and archiving, with nation-wide application.

Among the most important activities are Grid management and monitoring and the field of information systems for those environments. The Institute is developing the *Perun* system intended for the management of user accounts, authorisations and software information for the use of supercomputer centres and Grids. The Perun system is used not only at MU but nationally as a part of the MetaCentrum project, and, in the second part of the year, it was used internationally as part of the EU Grid Lab project. Also significant are ICT activities in the field of security of Grid, whose national infrastructure uses the Kerberos authentication system. Research has focused on interoperability between (mainly combinations of Kerberos, PKI and single-use passwords, with prospects of using hardware-based systems with tokens).

3. UNIVERSITY COMPUTER NETWORK, COMMUNICATION INFRASTRUCTURE

The Network Department of the ICT MU builds and operates the backbone of the Brno metropolitan computer network with a direct link to Prague with a capacity of 2.5 Gb/s. The metropolitan network backbone is based on the Gigabit Ethernet technology. At present, the metropolitan computer network comprises 86 nodes (sites) and almost 100 km of optical fibre cables with thousands of strands and tens of thousands of connecting cables. To connect places that are inaccessible by the optical network, directional radio transmitters operating in licensed as well as no-licence bands are used. The metropolitan network has thousands of peripheries (active and passive network elements) linked to it. To manage and maintain such an extensive network, the ICT has set up its own information system on the basis of geographic information system technologies (see IS BAPS).

In 2003, priorities with respect to the optical cable network changed. It was the reconstruction of old routes ether than building of new routes that was high on the list of priorities. The existing overhead cables had to be strengthened and put underground (these steps were prompted by a change in legislation requiring that easements be negotiated, and because the permission for cables from the first stage of the metropolitan network construction was to expire soon). In this manner, a total of 13 km of optical routes were reconstructed in 2003. As part of voice services enhancement, telephone exchanges of individual faculties were also connected to the metropolitan optical routes.

As part of a long-term research project of the ICT, the central server of the virtual private MU network was put to operation that provides for safe remote access to the university network resources from places outside the MU network proper. The system features authentication of the party requesting access and encoding of all the data carried through the public computer network.

4. VOICE COMMUNICATION NETWORK

In 2002, ICT MU was given responsibility for the *voice communication network* of the university, i.e. telephones, which use optical cables of the metropolitan computer network. When in 2003 the project was prepared and technologies selected, the building of a uniform university voice communication network started. The aim was to give its users a range of new services and, at the same time, to reduce the overall costs of telephone services at MU. The completion of the project is planned for 2004. For the voice communication network, the Avaya technology has been selected because it makes it possible to operate an extensive centrally controlled voice network based on “classical” telephony, IP telephony, or their combinations. For the MU voice network, an approach with a predominance of classical telephony features which makes it possible to use a majority of existing analogue phones was selected. The central unit of the system that controls the entire network is located in the communications room of the ICT MU. Connected to it are local phones of the Faculty of Informatics and the ICT, and, in a star topology, satellite exchanges of other faculties and large units within MU. The satellite exchanges are usually connected by optical fibre cables of the university computer network. In smaller

locations with a direct access to the MU backbone data network but where a satellite exchange would not be cost effective, IP telephony will be used instead.

By the end of 2003, the MU unified voice network will cover the Faculty of Informatics and the ICT, Faculty of Arts, School of Social Studies, Faculty of Economics and Administration, Faculty of Education and Faculty of Sports Studies. A call centre of centralized voice information services to external callers that will serve the entire university has been built and put in operation at the ICT. The rest of the MU institutions will be connected in 2004.

The transfer to the unified voice network is connected with a change in phone numbers. New numbers consist of the prefix 54949 valid for the entire university, followed by a four-digit number of the exchange (phone station). The range of numbers for extension stations (0000-9999) is divided into the institutional part (numbers allocated to positions irrespective of people currently serving in those positions), and the personal part (i.e. numbers allocated to persons irrespective of their current position and location: when a person is moved to another post or location within MU, he will retain his personal phone number). Because the telephone exchange of the MU unified voice network allows allocations of virtual numbers, one phone may have both the personal number and the "position" number allocated to it. A similar approach may be used in a situation when several workers are sharing one telephone apparatus: each of them may have his or her own number for incoming calls.

The unified voice network is gradually connected with the university information system, which will eventually enable a more effective management of the network and an immediate detailed information about its use.

5. UNIVERSITY COMPUTER ROOM

The university computer room was built on the MU premises at Komenského náměstí in 2000 to radically and at the same time effectively improve the accessibility to computers and to internal and general information services for all MU students. The room with 109 computers was built by the ICT, and it also operates it 24 hours a day, 7 days a week.

In 2003, the computer room was opened practically continuously for a total of 344 days. At that time, it was used by 13,272 students who spent at the computers there 459,588 hours during their 383,535 visits. The most important event last year was the replacement of all student computers, which were considerably worn-down after their three-year continuous operation. The new computers are sufficiently powerful and reliable for all the applications used, and they are also equipped with CD-RW and ZIP drives. Since autumn 2003, students in the ICT have been able to connect their own notebooks to the wireless (Wi-Fi) network at up to 54 Mb/s. The black-and-white laser printer put into operation in 2002 has also been intensively used by the students. In 2003, they printed 310,640 pages of text.

The acquisition of the new file server has made it possible to extend the disk space available to clients for the storage of their personal data (at present 50 MB of disk space are available for home directories of individual users.

6. UNIVERSITY INFORMATION SYSTEMS

The ICT is responsible for the development, maintenance and operation of several centralized and local subsystems that support the day-to-day operation of the university in all the key areas:

- science and research,
- economy and accounting,
- human resources and payroll applications.

The systems are a part of the integrated control and information system IRIS MU, whose concept and integrity are the responsibility of the ICT.

Library system

The R&D activities at MU are supported by the automated library system Aleph, which in 2003 partially (at the Faculty of Arts only) replaced the somewhat obsolete system TINLIB. At the same time, the programme support (transformation of data, unification procedures) for the transfer and physical unification of other faculty catalogues under the Aleph system in 2004 was completed.

At present, MU library systems hold over half a million (573,000 to be more precise) of bibliographic entries, and they have 33,000 registered clients. Services in the fields of cataloguing, loans, access to information on library holdings are fully automated both on local library stations and remotely in the www environment.

Research and development

Information on MU scientific and research activities is recorded in the *wwwdata MU intranet system*, which is developed by ICT. Long-term and regular R&D projects and approval processes for associate and full professorship appointments are registered centrally with references to respective departments and people (at present 1540 projects undertaken at MU since 1991 are registered at the database). In 2003, the system was extended to include the administration of scientific councils and other MU bodies by specialist R&D offices.

Economy, human resources

Finance, accounts and human resources issues at MU are administered using the Magion Vsetín economic information system, which is integrated with the personnel and payroll system developed by ICT and the MU intranet Inet superstructure. EIS Magion serves to about 250 users from economic offices, PaMS MU serves to about 50 users from human resources and payroll departments, Inet MU is regularly used by over 40 % employees (about 1400 people including staff of specialist units and managers at all levels of the hierarchy) and 18 % students (over 4800 clients), and it is accessed daily by 300–350 people on average.

The development of EIS Magion in 2003 focused on modifying and extending functions of the assets register module, with a particular attention to tax deductions, adjustments ensuing from changes to regulations, implementation to methodological guidelines, assets stocktaking and the numbering system for MU rooms and buildings. In 2004, the central register of small-value assets is to be built.

Inet and Clearing

The systematic development of the Inet MU economic section in 2003 continued primarily in the area of accounting reports and support to Clearing MU (the existing use of the clearing system for non-cash payments for accommodation and accommodation-related services at MU halls of residence will be extended in 2004 to include payments for meals at MU refectories, printing and copying services, etc.), and a new set of basic applications for the above asset records at MU workplaces was created (assets administration and stocktaking lists). Inet offer was also extended in the human resources and payroll sections, specifically with regards electronically recorded hours worked and personal maintenance of selected personal data, and new payroll funds use reports have been developed. The need to provide data and application support to the newly built voice network at MU led to the establishment in Inet of an independent new section of ICT services with structured lists of telephone charges. This base will be significantly extended in 2004.

Public www presentation of MU

A bilingual version of the Internet (web and wap) presentation of MU gives overall and detailed information on all institutions and offices at MU, using the principles of uniform information content, uniform presentation format and automated transfer of information from the IRIS MU databases. The presentation, which was visited in 2003 by almost 8 000 different IP addresses a week (1.3 times more than in 2002), is on a cluster of web servers. In 2003, the presentation of MU study programmes was completely overhauled in connection with the introduction of new codes for study programmes and areas of study.

IS-BACN

ICT services at MU are (besides the already mentioned Inet MU section) supported mainly by the Information System of the Brno Academic Computer Network (IS BACN) designed for the administration of information on BACN, especially for the support of decision-making concerning the use and further extension of the metropolitan network. Developed completely at the ICT MU, the system uses technologies of geographic information systems (GIS) and thereby enables precise visualisation of the position of elements of the network in a map. In 2003, its functionality was extended and a metadata system for BACN electronic and paper documentation was set up. At present, the IS BACN includes extensive information on about 500 cables, 3,000 devices, 7,000 interconnecting cables and 15,000 cable strands. This information and particularly the GIS technologies applied will be useful for the newly developed project of a system of assets management and MU buildings maintenance. In its first stage planned for 2004, a comprehensive electronic specification of MU buildings and rooms will be made.

Smart cards

To provide for controlled access to the university automated information systems, secured areas (including the university computer room), ordering and serving meals in refectories, as well as for general identification purposes, the ICT produces chip-based personal identification cards for students (ISIC cards) and for employees (ITIC and employee cards). In 2003, a total of 6,278 new chip-based cards were made.

7. ELECTRONIC INFORMATION RESOURCES FOR R&D AND STUDY PROGRAMMES

In recent years, the Library and Information Centre at the ICT has acted as a coordinator for the acquisition of professional electronic information sources for research and development, and for ensuring access to these sources. Most of these financially demanding resources are provided through the participation of MU in the Czech Ministry of Education – LI projects (information sources for research and development), providing financing from external (non-university) sources. For that reason, new consortium projects for electronic information sources for the new programme 1N of the MoE for the period 2004-2008 were prepared, and MU's participation in projects prepared by other entities was coordinated. In the first round of the selection process of the 1N programme at the end of 2003, MU was very successful when all its projects submitted were approved (5 of 16 projects approved in the first round were from MU). MU is involved in another 15 consortium projects as a co-author. These will be approved in the next rounds of the programme's selection process in 2004. If these projects are also approved, MU clients in 2004-2008 will have access to at least a similar range of electronic bibliographic, factual, fulltext resources and serials for R&D and teaching purposes as before.

8. RESEARCH AND PROJECTS

As an institution of higher education, the ICT has also a role to play in R&D activities nationally and internationally in addition to services it provides in the field of information and communication technologies.

For the fifth year, the ICT has continued work on the long-term research project "Digital Libraries" which covers the entire spectrum of the Institute's research and development. In 2003, 11 ICT workers and 6 external collaborators were directly involved in work on the project. Results were published in 32 scientific and academic texts, and presented at 20 national and international conferences.

As part of the project, several digital libraries have been built (e.g. the photographic collection of important MU personalities in the MU Archives has been completely digitized), and our contribution to the draft infrastructure of the WebArchive for archiving the Czech web was significant (collaboration with the Czech National Library). One of the most important activities undertaken and co-ordinated within the long-term research programme is the project *MeDiMed* to build and use a metropolitan archive of medical visual information obtained from medical diagnostic instruments via modern digital technologies. At the end of the year, the archive contained almost a million digital images comprising a total of 1.3 TB of data (twice as many as in 2002). The five Brno hospitals that make up the MeDiMed system were joined by two hospitals outside Brno in 2003, one in Kyjov and the other in Jihlava.

In research into digital libraries, the ICT MU cooperates with the Faculty of Informatics; both institutions are authors of the recently approved project of the 6th Framework Programme of the EU, Networks of Excellence in the field of Digital Libraries *DELOS* (2004–2007). In 2003, the international project *StraDiWare* (Formal Specification Tools for Strategic Planning, INCO COPERNICUS), coordinated by the ICT staff between 1998 and 2003, was completed and successfully presented.

Besides the long-term research programmes, another important ICT research group is at its supercomputer centre. In 2003, the ICT continued to be involved in the GridLab project of the 5th FP of the EU (where the ICT is responsible for the operation and monitoring of the international Grid infrastructure), and it also started work on the DidaS project (Distributed Data Warehouses) of the Development Fund of the CESNET association. The aim of the project is provide large distributed disk capacities for general applications. In the project, an installation of about 7 data depots with a total storage capacity of over 10 TB is expected. The capacity will be used mainly as a storage capacity for "interesting" items (e.g. video recordings of schools, CESNET association and other organizations, digital material provided by the Czech National Library, which is one of the co-authors), and a part of the capacity will be offered to the academic community. Throughout 2003, intensive work on the national project *MetaCentrum* continued. Its author is the CESNET association, and its aim is to build and operate a large distributed computing environment. In the second half of the year, the Supercomputer centre Brno (SCB) won a project of the CESNET Development Fund from the field of securing access using hardware tokens. Finally in September the SCB submitted (as the main author in cooperation with Charles University, West Bohemian University, Czech Technical University and Technical University Ostrava) an extensive project for the 1N programme of the Ministry of Education entitled National Supercomputer Centre. The project was approved and its implementation started in 2004.

On the international level, the SCB took part in the preparation of a number of projects for the 6th FP EU. Its project CoreGrid, a Network of Excellence uniting top European institutions in the field of grids, passed on to the next round. The project is to be started at the end of 2004.

In 2003, the university network development department continued its cooperation with the CESNET association in the strategic project *Implementation of IPv6 in the CESNET2 network*. The principal area of R&D is the use of programmable hardware (gate arrays). In the project, a family of gate accelerators COMBO has been developed. It is expected that they can be used in a number of projects and activities on the domestic and international levels. As part of extensive cooperation with the CESNET association, an experimental rectifier for IPv6 has been developed where the COMBO accelerator will be used to accelerate the route selection. This cooperation also takes place on the international level as part of the *6NET* project of the 6th FP EU. The ICT was also invited to participate in the project

SCAMPI (also 6th FP EU), where the COMBO accelerator is to be used for the monitoring and analysis of the high-speed network traffic (up to 10 Gbps). In 2003, the team consisting of members of the ICT MU staff, external workers and, very importantly, of undergraduates and doctorands, published 8 conference papers, 4 diploma theses and 12 technical reports.

9. SUMMARY OF ECONOMIC PARAMETERS

In 2003, the ICT MU budget totalled 180 million CZK (31% increase over 2002). Only about a half of that amount was direct subsidies from the MU budget, a quarter was investment funds and the remaining quarter came from grants and commercial activities. At the end of 2003, ICT MU administered property of an overall purchasing value of about 270 million CZK.