Gateway to the e-World

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PIONIER – the Polish National Research and Academic Network, which is based on the academic community's own optical fibers – enables extensive partnership in developing the new generation of network technologies, grids and portals, and in advancing the widely-defined field of computational sciences

A growing number of computationally-intensive scientific applications are demanding distributed computing and faster and more reliable networks than are available today. Many other applications, such as telemedicine or telelearning, also require the acquisition of large sets of data and very fast shared connections. Thanks to the PIONIER project, Poland is actively involved in creating the next generation of network technologies, services and applications.

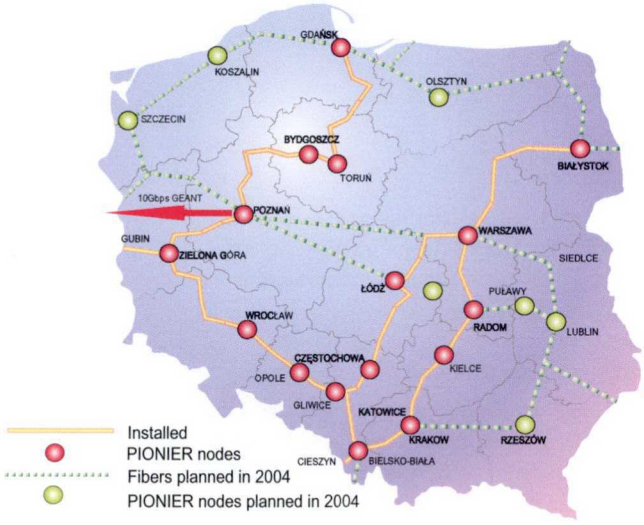
PIONIER beginnings

The rapid evolution of the Internet and its impact on society have given rise to such programs as Internet2 in the USA and Information Society Technologies in Europe. In Poland, in turn, the State Committee for Scientific Research (KBN) program to develop an information infrastructure for the Polish research and academic community has been successfully underway since 1993. It has resulted in the creation of 5 High Performance Computing (HPC) Centers (in Warszawa, Kraków, Poznań, Wrocław and Gdańsk), 21 academic Metropolitan Area Networks (MANs), and the POL-34 broadband National Research and Education Network (NREN), based on links leased from telecommunications operators. These projects set the backdrop for the program enti-

TCN NCU

One component of the European VLBI: a Polish radio telescope located in Piwnice near Toruń. Thanks to the PIONIER network, Poland is among the first countries to embark on new real-time type of VLBI astronomical observations

Polish optical internet



Jan Węglarz

Present status of the PIONIER network. The state of progress that has been achieved since November 2001, when the first tranche of investment funds was transferred from the State Committee for Scientific Research

tled "PIONIER: Polish Optical Internet - Advanced Applications, Services and Technologies for the Information Society," which was presented for discussion in November 1999 and finally accepted by the KBN in September 2000. The main goals of the PIONIER program were as follows:

- to develop information infrastructure for the research and academic community in Poland so as to meet the demands of modern science and education,
- to develop and test next-generation information society applications,
- to facilitate full international cooperation and partnership in the field of computational sciences and new information technologies.

The idea of the program is to develop a wide range of advanced applications using network services (middleware), implemented in a research-specialized infrastructure. Further on, the program will focus on the advanced network infrastructure, i. e. on the Polish national research and education network, dubbed the PIONIER network for short.

From an idea to a reality

Advanced network applications and services require a new generation of network infrastructure, defined dynamically down to the physical level, enabling scalable transmission of universally generated broadband traffic. This leads to an optical network based on Dense Wavelength Division Multiplexing (DWDM) transport technology, aggregating many transmission technologies and offering a large scale of interfaces. The rapid growth of scientific applications' bandwidth requirements, reliability issues in the wide sense, and economic considerations led us to the conclusion that the national research and education network should be based on the research community's own optical fibers. Note that this decision was made in 2000, after the first DWDM over such a fiber was tested in Poland, and a demonstration of pilot, λ-based applications (where λ denotes a wavelength) was performed. We are happy to notice that more and more European NREN's (Holland, Switzerland, the Czech Republic, and recently, the United Kingdom and Ireland) are following the same line of thought and working on such networks as well. The similar National Lambda Rail project was also announced in the United States in 2003. As no fiber offers were forthcoming from Polish telecommunications operators, the decision was made to build fibers for the academic community. Since this time, the Poznań Supercomputing and Networking Center, as the operator of the Polish NREN and the representative of the Consortium of Academic MAN's, has been acting as an investor and coordinator of the project.

The state of progress that has been achieved since November 2001, when the first tranche of the investment funds was transferred from the KBN, can be briefly described as encompassing 2600 km of fiber installed and 16 MAN's connected. It should be stressed that fibers were built in cooperation with different telecommunications operators, and with financial participation proportional to the fiber ratio in the cables. Since then, due to several constraints, the realization of the entire project has been delayed. On the other hand, as urgent needs for high bandwidth links (e. g. for CERN and VLBI applications - see below) have been expressed, a decision was made in 2002 to buy 10 GE (10Gbps Ethernet) transmission equipment, as an intermediate solution until the target 40 Gbps DWDM system is installed. Then the former equipment will be moved to regional networks. The PIONIER network is thus at present based on Ethernet solutions and achieves transmission speeds of up to 10 Gbps (presently a world-class speed), but in the future its fibers will support much higher transmission rates of nλ, with λ= 40 Gbps and n > 10.

Gateway to the e-world

Information infrastructure, in particular the networking infrastructure, provides the Polish research and academic community with a true gateway to the e-world. It has already enabled our research teams to participate in numerous international projects, such as under the 5th Framework Programme of the EU. Let us now only mention two big grid projects being coordinated by PSNC and Cyfronet Kraków, respectively, the first one being considered by Ian Foster, one of the founders of grid technology, to be one the most important projects in this area. It is also worth noting, partly as a side-effect of our grid activity, the first monograph devoted to grid resource management, edited by Nabrzyski, Schopf and Węglarz.

Unlike the 5th FP, which was rather tool-oriented, the 6th FP will focus on real applications of advanced information technologies with Gbps bandwidth requirements. Among them I would like to mention such projects as EGEE (Enabling Grids for e-Science and Industry in Europe), and HPC Europe, which have been already approved with the involvement of Polish teams.

Present applications

One of the scientific projects that use the PIONIER network is ATLAS, one of the four experiments of the LHC (Large Hadron Collider) at CERN in Switzerland. By providing transmission rates at the required 2.5 Gbps level in specially dedicated bandwidth, the PIONIER network enables the Kraków CYFRONET and Warszawa ICM computers in Poland to immediately and effectively access huge amounts of data from the LHC detectors.

Another project that uses PIONIER is Very Long Baseline Interferometry (VLBI). The European VLBI Network (EVN), is a collaborative group of the major radio astronomical institutes in Europe, Asia and South Africa. This interferometric array of radio telescopes (including the Polish ones located in Piwnice near Toruń) conducts unique, high resolution, radio astronomical observations of cosmic radio sources. Thanks to the collection of extremely large telescopes that contribute to the network, the EVN is the most sensitive VLBI array in the world. VLBI provides astronomers with the sharpest views of the most dynamic phenomena in the universe, including expanding supernovae, pulsars, flare stars, star-forming regions in molecular clouds, the environment surrounding nearby and distant galaxies, gravitational lenses, starburst galaxies and distant active galactic nuclei. The EVN telescopes observe the same cosmic radio source simultaneously, but until now the data were recorded on high capacity magnetic tapes, which were later replayed and combined at a special-purpose data processing center in Dwingeloo. With the arrival of the increased throughput offered by NREN's, real-time computations and adjustments of radio telescope positions have recently started to be performed, opening up fascinating new prospects in the field. Thanks to the PIONIER network, Poland is among the first countries to embark on this new type of astronomical observations. ■

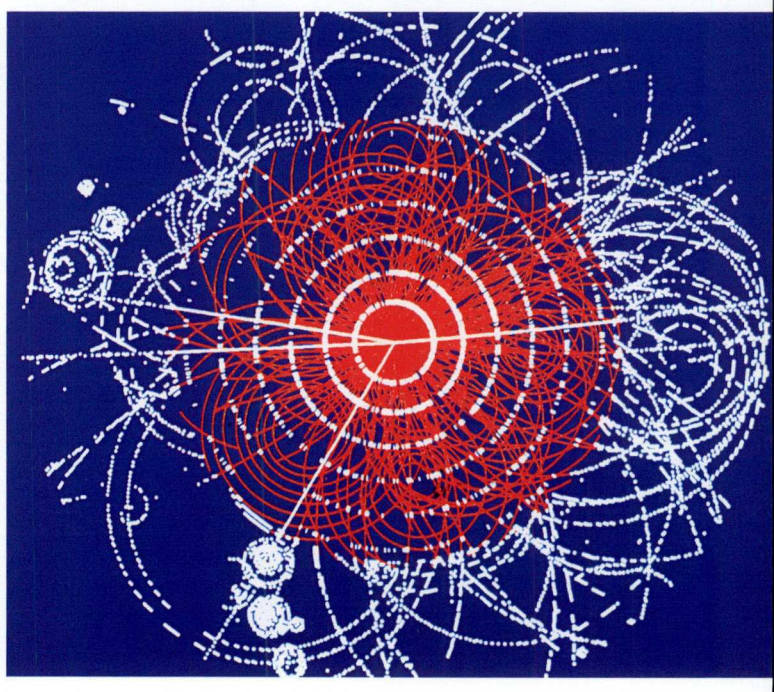
Further reading:

Arthur Binczewski, Norbert Meyer, Jarosław Nabrzyski, Stanisław Starzak, Maciej Stroiński, Jan Węglarz (2001). First Experiences with the Polish Optical Internet. *Computer Networks, 37*, 747-759.

Steve Corbato (2003). Status Report on national and Regional Optical Networking Initiatives in the U. S. http:/www. terena. nl/conferences/tnc2033/programme/slides/s6b3. pdf

Ian Foster (2003). The Grid: Computing Without Bounds. *Scientific American, 288, 4*, 78-85.

Jarek Nabrzyski, Jennifer M. Schopf, Jan Węglarz (Eds.) (2003). *Grid Resource Management*. Boston: Kluwer.



CERN

Simulation by the CERN ATLAS experiment of the decay of a Higgs boson into 4 muons (yellow tracks). Huge amount of data collected in such CERN experiments can only be processed with distributed computer network. Polish part of such CERN grid is connected by PIONIER fibers