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E-infrastructure in Baltic States and its application in astrophysics

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Abstract. E-infrastructure in Baltic States currently is rapidly developing. A large impact in this area is given by the European Commission FP6 project "Baltic Grid". A review of progress in this field as well as currently developed grid applications in astrophysics are presented.

Key words. Comuting: Grid computing – Calculations: parallel and distributed calculations – Spectroscopy: theoretical stellar spectra

1. Introduction

Inspired by the rapid development of Grid computing in the world (Foster & Kasselman 2004) and the great success of the world largest project "Enabling Grids for E-sciencE" (EGEE), scientists in the Baltic States have decided to develope the Grid infrastructure and start using it for research purposes as well. With the help of experienced partners from Sweden, Poland and the European Organisation of Nuclear Research (CERN, Switzerland), in November of 2005 the "Baltic Grid" project of 30 monts duration has been started. The main goal of the BalticGrid project it to extend the European Grid by integrating of new partners (Lithuania, Latvia and Estonia) in the European Grid research community and to foster the development of Grid infrastructure in these countries. Seeking for the further sutainability of Grid infrastructure, it is imortant to develope the national Grid infrastructures. Presently, the leading country among Baltic States in this field is Lithuania, which already has the governmental funded Grid programme "Lithuanian Grid". In the following sections we will describe the BalticGrid project, the LitGrid programme, and the Grid application in astrophysics. In the Baltic States, the first Grid application in astrophysics was developed by the Lithuanian astronomers of the Institute of Theoretical Physics and Astronomy of Vilnius University.

In Fig. 1 a map of countries involved in the BalticGrid project is presented.

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2. BalticGrid project

2.1. Objectives

The BalticGrid objectives are: 1) sustainable integration of the research and educational computing and communication infrastructure in the Baltic States into the European Grid infrastructure; 2) enable the formation of effective research collaborations in the Baltic States,

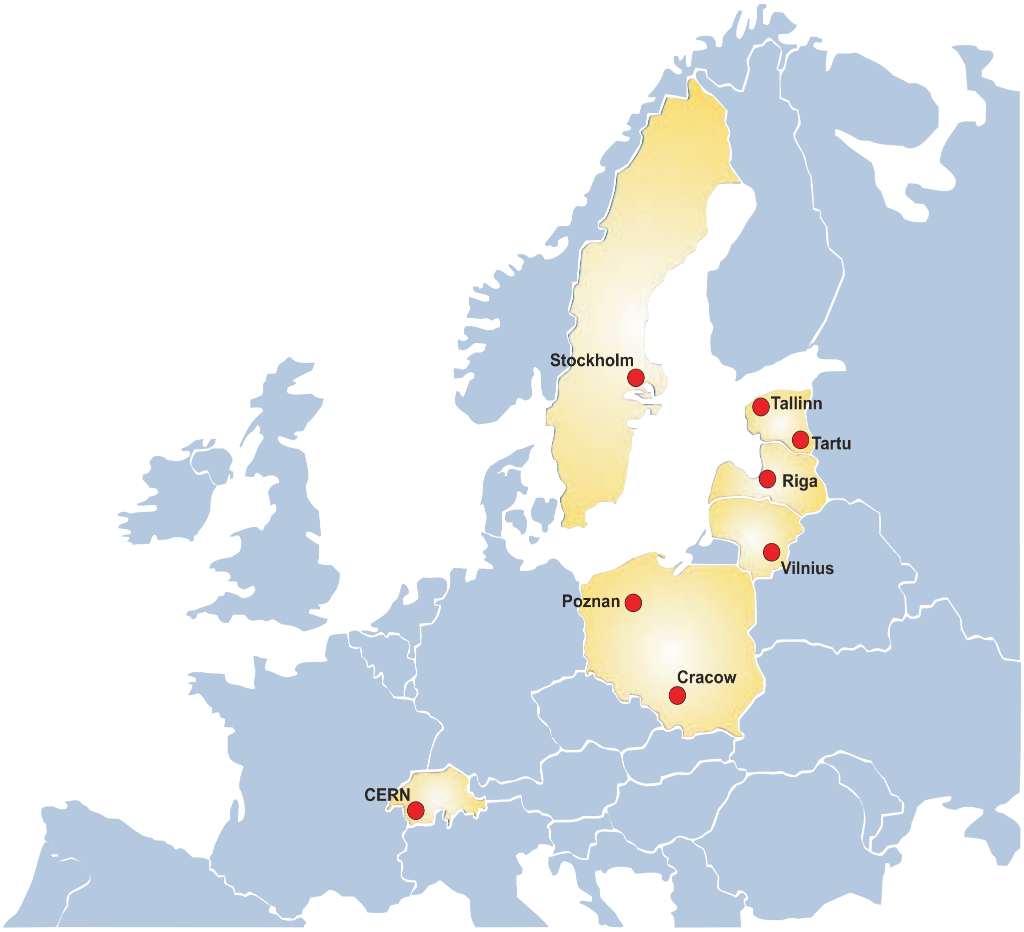

Fig. 1. The map of countries involved in the BalticGrid project.

within Europe and beyond; 3) enabling an efficient sharing of unique instruments and data.

2.2. Approach

The BalticGrid aims to maximize use of human resources for Grid development and deployment by implementing the Baltic Grid as an extension of EGEE. Grid Operations are coordinated with the EGEE North European Regional Operating Centre. We assure manageable co-existence with other European Grids as NorduGrid, DEISA and others. It is important to engage the Baltic States in Grid related policy and standards activities, to estabilish the account service level agreements and the dynamic account management.

The project is conducting intensive networking activities of education, training, dissemination and outreach, which are dedicated in activating new users of the Grid computing. A very lage work is going in new application identification and support. Specific service activities include the BalticGrid operation and network resource provisioning.

2.3. Partners

The coordinator of the project is the leading Swedish technical university Royal Institute of

Technology in Stocholm (KTH). KTH hosts the EGEE Northern Europe Regional operating centre, leads the EGEE Security Joint Research Activity, is a founding member of the Globus Alliance and of the European Grid Support Centre.

In the project there are involved by two institutions from every Baltic state. Estonia is represented by the Estonian Educational and Research Network (EENet), which is the Network operator in Estonia. National Institute of Chemical Physics and Biophysics (NICPB), the main Estonia's research institute in high-energy physics, chemical physics and biophysics.

From Latvia there is the Institute of Mathematics and Computer Science (IMCS UL), which is a hosts of LATNET, the Latvian academic network operator, and is the GEANT partner in Latvia. From Latvia there is also the leading university Riga Technical University (RTU).

Lithuania is represented by the most outstanding Vilnius University (VU) and the Institute of Theoretical Physics and Astronomy (ITPA), which is the largest Lithuanian research institute in astronomy and fundamental physics, and has hosted in the past the first computer in Lithuania.

There are two partners from Poland. The Poznan Supercomputing and Networking Center (PSNC) is responsible for the Polish network PIONIER, is a partner in GridLab and European Grid Support Centre, as well as a member of the Globus Alliance. The second institution is the Institute of Nuclear Physics, Kracow (IFJ PAN), the main field of research of which is high-energy and subatomic physics. IFJ PAN is a partner in EGEE.

The most famous partner of the BalticGrid project is the European Organisation of Nuclear Research (CERN), which is a leading European Centre in High-Energy Physics and Grid technologies and a leader of the EGEE project.

2.4. Achievements

The BalticGrid infrastructure can be described in the following numbers: in April 2008 there were 29 computing sites, more than 15 of them certified; the total number of CPU cores has reached 2018, the storage was of 210 TB.

All the sites are connected using NRENs and GEANT backbone with 1 Gbps links (Fig. 2). All the sites are running gLite.

The number of BalticGrid users has grown up from zero in November of 2005 to more than 280 in April of 2008. One million of hours were computed in 2007.

There are four local active Virtual Organisations (balticgrid, litgrid, gamess, biit) and two EGEE Virtual Organisations (cms, lhcb).

The usage of computing and networking Grid infrastructure of the project has a significant impact on scientific communities, validated through everyday work of the scientists studying the Baltic Sea environment, bioinformatics, high energy physic, astrophysics and other sciences. The real life example could be the SYNTSPEC application, which thanks to usage of project resources, is able to calculate synthetic stellar spectra of significant wavelength ranges and serves for the galactic and stellar research studies. In Sect. 4 the work of Stellar Spectra Computing special interest group will be shortly described.

3. LitGrid programme

As a great succes of the development of Grid computing in the Baltic states the national programme of Lithuanian Grid infrastructure LitGrid has to be mentioned. The LitGrid programme aims at: 1) mantainance of LitGrid operational infrastructure and its support; 2) development of parallel and distributed algorithms; 3) Grid deployment of datasets; 4) providing of education and dissemination services for LitGrid; 5) creation of a group of software developers for analysis, design and implementation of algorithms for the Grid infrastructure; 6) providing of administration and management services for LitGrid. See also the paper by Juozapavičius & Mažeika (2007).

The LitGrid is a network of computing facilities based on 11 Lithuanian academic institutions. At the moment the LitGrid has about 300 processors available for calculations. The

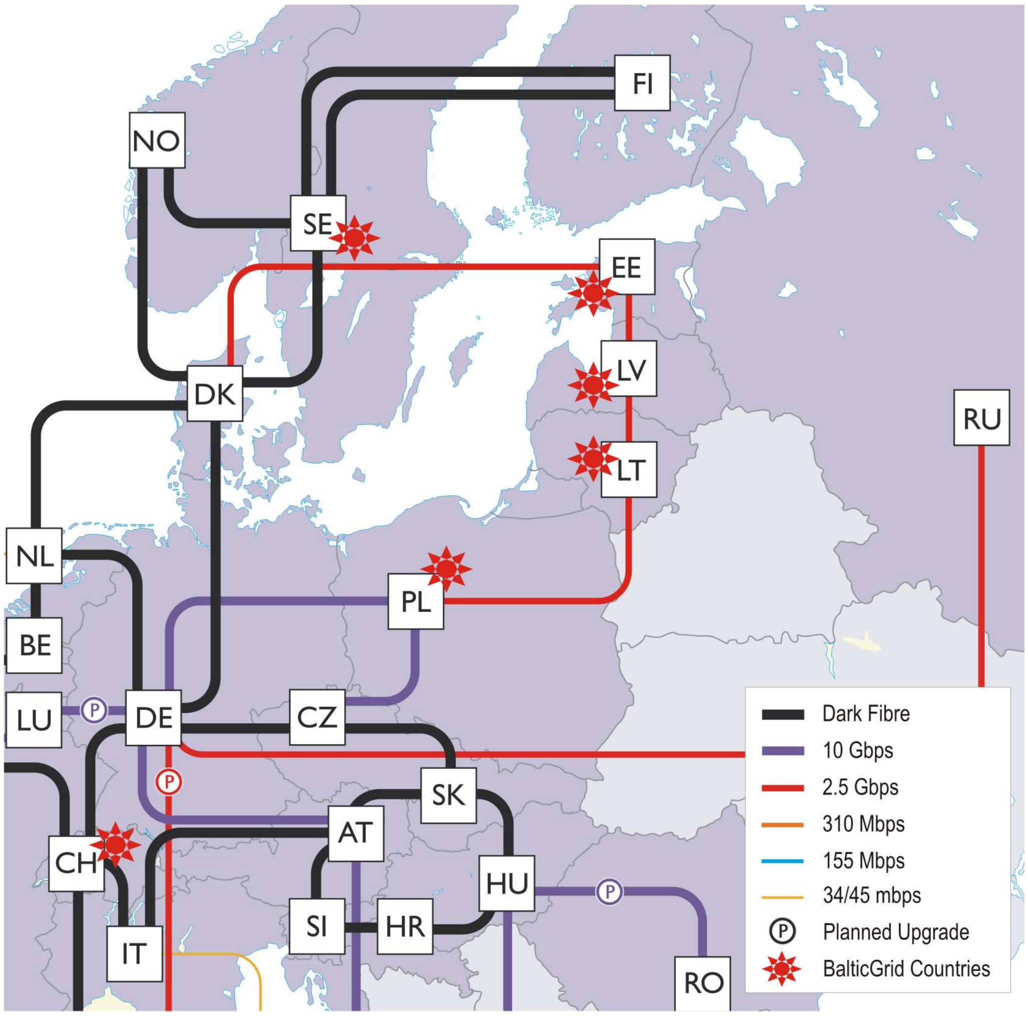

Fig. 2. BalticGrid countries (marked by red stars) in the European network scheme.

typical software recourses are Scientific Linux as a default Operating System and gLite middleware, compatible with the EGEE structure. Other software packages are usual compilers and libraries for uniform calculation environment (GNU C/C++, GNU FORTAN, GNU FORTRAN 95, MPICH C/C++, MPICH FORTAN, ATLAS BLAS and LAPACK) and special packages that could be installed upon request.

The LitGrid structure is using physical resources of Litnet network. The Litnet is a network of Lithuanian academic institutions, which serves networking recourses for universities, colleges, various types of schools, research institutes, distant laboratories and remote research facilities. The Litnet uses a 1 Gbps bandwidth ring around main Lithuanian cities and 10 Gbps connecting Kaunas and Vilnius. Almost all clusters are connected to the network by 1Gbps lines. The Litnet is a GEANT member and in GEANT2 phase connects to European academic networking structure with 2,5 Gbps bandwidth.

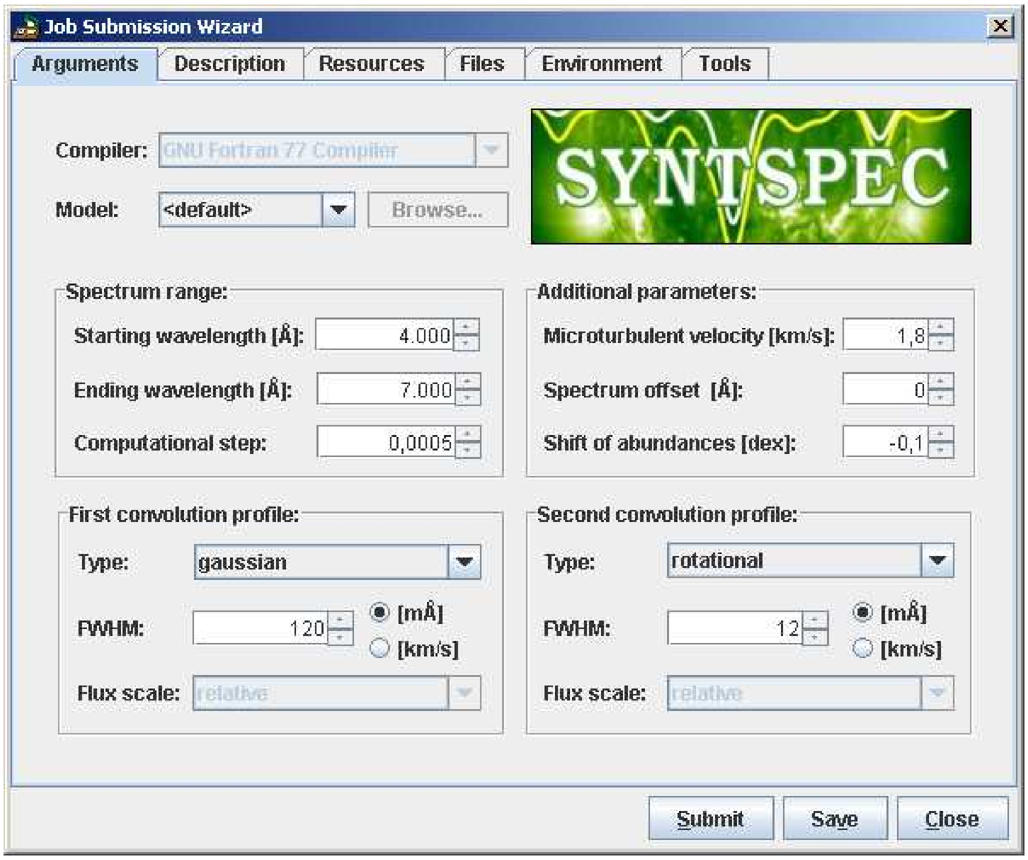

Fig. 3. The view of Migrating Desktop working window of the SYNTSPEC application.

4. Application in astrophysics

Within the framework of the BalticGrid and LitGrid projects the Stellar Spectroscopy group of the Institute of Theoretical Physics and Astronomy of Vilnius University has upgraded and gridified a program package initially created at the Uppsala Astronomical Observatory (Sweden) for the synthetic spectra modeling. The Stellar Spectra Modeling package SYNTSPEC is the first gridified tool for stellar spectra analysis in the Baltic States. The application brings the new quality to the research in the field of astrophysics in the Baltic States and accelerates the integration of science in the European Union.

The SYNTSPEC is a very good example of an application that benefits usage of the BalticGrid testbed because of the need of powerful computing resources and high network throughput. The application calculates normalized to the continuum stellar spectra that serve for determinations of e.g. chemical composition, effective temperatures and surface gravities of stars.

The usage of SYNTSPEC is simplyfied by integrating it with the Migrating Desktop software developed at the Poznan Supercomputing and Networking Center. In Fig. 3, a view of Migrating Desktop working window of the SYNTSPEC application is presented.

The SYNTSPEC is currently used for: chemical analysis of Galactic Red Clump stars, chemical analysis of open clusters in the Galactic disk, investigation of chemical evolution of the Galactic thick disk, chemical analysis of stars in neighboring galaxies, analysis of chromospherically active stars and other investigations. The first paper in which the Grid computing with SYNTSPEC was used is published by Tautvaišienė et al. (2007).

The possibility of using Grid infrastructure is a crucial way to accumulate enough resources for the analysis of massive data. This is very important in a preparation of infrastructure and procedures for analysis of large quantities of spectra that will be produced by the GAIA space observatory to be launched by the European Space Agency in 2011.

5. Final remarks

The BalticGrid project is of high strategic importance for the Baltic States. It helps to establish a production-level, interoperable and complementary with the EGEE Grid infrastructure, which enables scientists in the Baltic States to access critical resources, to form effective research collaborations and share efficiently unique instruments and data. It also rapidly increases the knowledge and use of Grids in the Baltic States.

The BalticGrid and LitGrid projects now provide a stable and reliable Grid infrastructure in Baltic States, and as a result more and more applications are coming, the applications in astrophysics are among them.

More information about the BalticGrid and LitGrid projects can be found at: www.balticgrid.org, infosite.balticgrid.org, ca.balticgrid.org, support.balticgrid.org, litgrid.lt.

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