Policy document on sustainable e-Infrastructure in Baltic States and Belarus

Document Filename: BGII-DNA4-3-v.1.0-RTU-
Policy document on sustainable e-Infrastructure in Baltic States and Belarus

Activity: NA4

Partner(s): KTH, EENet, IMCS UL, VU, ITPA, NICH BNTU, UIIP NASB

Lead Partner: RTU

Document classification: PUBLIC

Abstract: This document is a strategy document on development of sustainable e-Infrastructure in the Baltic States and Belarus. It is based on strategic policy documents of EU Commission, policy coordinating organizations and the best practice cases of other projects. Analysis of current situation in the Baltic States and Belarus is made and strategic development plans of each country are presented.

Conclusion is made that e-Infrastructures in Baltic States and Belarus are in the different maturity stage compared to the rest of Europe. All BG-II partner countries do not have NGI organisations yet, but are planning to join EGI as eligible members and their representative organisations signed MoU to join this organization in future. This is taken into account in elaborating a long term strategy for a coherent e-Infrastructure development in Baltic States and Belarus for joining the European e-Infrastructure and ERA.
### Document review and moderation

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<td>Ake Edlund</td>
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<td>PMB</td>
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### Document Log

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<th>Version</th>
<th>Date</th>
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<tr>
<td>0.1</td>
<td>02/10/2009</td>
<td>Plan and structure of the deliverable</td>
<td>Ilmars Slaidins</td>
</tr>
<tr>
<td>0.2</td>
<td>22/10/2009</td>
<td>Initial draft</td>
<td>Ilmars Slaidins, Olgerts Belmanis</td>
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<tr>
<td>1.0</td>
<td>26/10/2009</td>
<td>Final</td>
<td>Ilmars Slaidins, Olgerts Belmanis</td>
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1. INTRODUCTION

1.1. PURPOSE
The purpose of this document is to give a policy background for development of sustainable e-Infrastructure the Baltic States and Belarus, to coordinate these activities with National Grid Initiatives and the European Grid Initiative.

1.2. APPLICATION AREA
This policy document will be used as a blueprint for coordinated development of sustainable and inter-linked e-Infrastructures.

1.3. REFERENCES

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<td>SEEGRID</td>
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<td>TERENA</td>
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<td>t-Infrastructure</td>
<td>t-Infrastructure is the training infrastructure (computing equipment, communications, software, data, support staff etc.)</td>
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2. EUROPEAN UNION POLICY ON SUSTAINABLE E-INFRASTRUCTURES

In the FP7 Capacities Programme [1] a task is set by EU Commission to “…support an innovative way of conducting scientific research (referred to as e-Science) by the creation of a new environment for academic and industrial research in which virtual communities share, federate and exploit the collective power of European scientific facilities.”

e-Infrastructure is claimed to be the technological basis for the unified European Research Area fostering the cooperation among scientist for the mutual benefit. The term e-Infrastructure refers to the research environment in which all researchers—whether working in the context of their home institutions or in national or multinational scientific initiatives—have shared access to unique or distributed scientific facilities (including data, instruments, computing and communications), regardless of their type and location in the world [1].

The term e-Infrastructure is very much linked to grid computing which started from the needs of high energy physics to process large amounts of data and later on it evolved into a tool widely used by scientists from many research fields.

One of the major BG-II project aims is to provide a sustainable and coordinated development of Grid infrastructure in the Baltic States and Belarus. In the work package NA4 development of long term strategy for coherent e-Infrastructure development in Baltic States and Belarus was planned. This strategy for sustainable e-Infrastructure must be coordinated with National Grid Initiatives and EGI.

From the very start of grid infrastructure development EU Commission stressed importance of coordination of effort and policy development. The e-Infrastructure Reflection Group (e-IRG) was founded in 2003 to define the policy and elaborate recommendations for the European e-Infrastructure development. It consists of official government delegates from all the EU countries. The e-IRG produces white papers, roadmaps and recommendations.

As e-Infrastructure until now was developing on the basis of separate EU supported projects and National resources it was recommended to create an organization for coordination the National Grid Initiatives at European level. This initiative was supported by EU Commission and the European Grid Initiative (EGI) Design Study project.

2.1. EUROPEAN COMMISSION POLICY ON E-INFRASTRUCTURES

In the Communication from European Commission “ICT Infrastructures for e-Science” [2] is stated that the European Commission and Member States have made already significant investments in e-Infrastructures and here is a vision for next 10 years:

„Research in 2020 cannot be imagined without the intensive use of sophisticated e-Infrastructures, so Europe needs to commit to a renewed strategy to tackle the associated challenges and priorities.”

„Striving for world leadership in e-Science, establishing e-Infrastructures as a sustainable utility and exploiting them to promote innovation are the three vectors of a renewed European strategy to support the ground-breaking science of 2020 and beyond.”

Consequently, e-Science and innovation based on sustainable pan-European e-Infrastructures is the basis for the knowledge economy in future. For the successful implementation of a
renewed strategy EU Commission encourages Member States to take to the concrete and coordinated actions [2]:

- Member States are invited to reinforce the coordination of national and European policies in the area of Research and Education Networks.
- Member States are invited to consolidate and further develop National Grid Initiatives (NGIs) as a basis for a renewed European strategy.
- Member States and scientific communities are invited to step up investment in scientific data infrastructures and promote the sharing of best practices.
- Member States are invited to scale up and pool investment in support of PRACE as well as in related research areas in full articulation with the Commission.
- Member States and research communities are invited to embrace the e-Science paradigm by continuing to exploit the benefits of e-Infrastructures.

European Commission itself supports these development strands by financing the Framework Programme 7 (FP7).

2.2. E-IRG POLICY DOCUMENTS AND RECOMMENDATIONS

The main objective of the e-Infrastructure initiative is to support the creation of a political, technological and administrative framework for a user friendly and cost-effective shared use of distributed electronic resources across Europe. The e-IRG mission is to pave the way towards a general-purpose European e-Infrastructure. The vision for the future is an open e-Infrastructure enabling flexible cooperation and optimal use of all electronically available resources [3].

After a first decade of straight forward and fast development of the European e-Infrastructure next decade seems to be controversial and challenging due to eventual paradigm shifts. There is a growing need for diverse and reliable e-Infrastructure services. This will attract new user communities and will result in a need for reassessing the components of e-Infrastructure services.

In earliest White Papers of e-IRG policies for resource usage and interoperability, user authentication, authorization and accounting, as well as user education, training and support were in focus. In the recent e-IRG White Paper focus is on policies for sustainability, security, virtualisation and remote instrumentation. A new important topic in the recent White Paper has appeared - cloud computing as an alternative to grid. Policies must be developed on how and if these two approaches can be integrated into the e-Infrastructure.

Policies and standards for development of sustainable data management infrastructures must be elaborated for the common benefit of all multidisciplinary users of e-Infrastructures. The e-IRG Data Management Task Force (DMTF) was created to elaborate these issues.

To attract new users of e-Infrastructure services policy coordination efforts with ESFRI were undertaken and special e-Infrastructure working group (e-IWG) was established. Interdisciplinary and international collaboration among scientist is fostered.

Baltic Grid

The Baltic Grid project is represented in e-IRG policy development activities by Norbert Meyer (Poland) and Ilmars Slaidins (Latvia) as representatives from respective countries. The bi-annual Workshops organized by e-IRG attract much larger audience from Baltic Grid.

2.2.1. e-IRG Recommendations on sustainable e-Infrastructure

Starting from the moment of creation of e-IRG this organization elaborated several Recommendations to EU Commission and Member States on a ways to foster development of sustainable e-Infrastructure.

During the Greece presidency in 2003 among other Recommendations is one related to the role of e-IRG itself:

„The e-Infrastructures Reflection Group should consider and communicate clear messages on e-Infrastructure Policy issues to both the European Commission and existing e-Infrastructure projects on policy matters”

During the Greece presidency many problems seeking for solution were already raised and formulated as a recommendations, for example, interoperability, authorisation, authentication and accounting, reliability, trust, cooperation etc.

In Dublin White Paper e-IRG expresses support to developments in authentication and authorisation:

„The e-IRG notes the timely operation of the EUGridPMA in conjunction with the TACAR CA Repository. ... The e-IRG endorses the principle of the EUGridPMA and TACAR. The e-IRG welcomes this development which positions Europe in the forefront of Grid and e-Science interoperability. The e-IRG strongly encourages the EUGridPMA / TACAR to continue their valuable work and recommends that they be supported by the relevant EU / national projects and agencies.”

In the Luxembourg White Paper policy development towards the national Grid Initiatives is recommended:

„The e-IRG would like to promote the idea of the National Grid Initiatives i.e. a governance model to guide Grid infrastructure deployment and operation at country-level in an application-neutral way. The e-IRG believes that the adoption of the NGI idea across Europe would be a requirement for the evolution to the next phase of the e-Infrastructures that is expected to be implemented in FP7, and encourages all countries to work on this.”

2.2.2. Recommendations from the e-IRG Task Force on NGI

Based on this Recommendation from the Luxembourg White Paper was created a task force to elaborate on the issue of National Grid Initiatives in more detail and then in 2006 came recommendations [3]:

Recommendation I. Governments and the Commission should develop policies and mechanisms to encourage increased investment in a more coherent and interoperable way across Europe.

Recommendation II. The existing e-Infrastructure projects must be superseded by integrated sustainable services at national and European levels.
Recommendation III. e-Infrastructures must be application-neutral and open to all user communities and resource providers. National funding agencies should be encouraged to fund multi-disciplinary and inclusive infrastructures rather than disciplinary-specific alternatives.

Recommendation IV. e-Infrastructures must inter-operate and adopt international standard services and protocols in order to qualify for funding.

Recommendation V. The Commission should, within the seventh Framework Programme, develop a pan-European e-Infrastructure which explicitly encourages the further integration of national e- Infrastructure initiatives.”

Beyond the recommendations the Task Force encourages to strengthen the integration of industrial efforts and SMEs into sustainable infrastructures, keep e-Infrastructures state of the art, pay attention to their ease of use and more attention pay to education and training.

2.2.3. e-IRG Recommendations on Education and Training

During the Finnish presidency (2006) education and training as an issue of high importance was recognized and the e-IRG Education and training task force was created. Following recommendation was released from the Finnish presidency:

“The e-IRG recommends that the EC support the launch of an ERA-wide activity to coordinate education and training efforts, with an emphasis on the efficient exploitation of e-Infrastructures by EU citizens. It is recommended that investments in education and training be adjusted in accord with the findings of this coordination activity.”

From the e-IRG Education and training task force Report issued in 2008 was follows some important conclusions:

• The national, regional or European commitment and investment in education and training on the use of e-Infrastructures should be increased to make it comparable with the investment that is going into e-Infrastructure provision.

• Academic institutions should develop undergraduate and postgraduate courses and provide the harmonisation of education in the use of e-Infrastructures according to the Bologna process to support student mobility and mutual recognition of qualifications within the European Qualification Framework.

• Standards for student and teacher identification that would enable access to educational grid facilities and authorization/management of the resources used should be based on the EDUROAM. e-Infrastructure courses should build on creative commons for sharing all educational material and the EGI should mediate agreement between NGIs on sharing t-Infrastructure.

Later on these conclusions were edited and issued as e-IRG Recommendations of Czech presidency in 2009.

2.2.4. e-IRG Recommendations from Czech Presidency in 2009

During the Czech presidency, besides education and training issues, were discussed and issued recommendations on global collaboration, grid and cloud computing, security, virtualisation, remote instrumentation and sustainability. The last one state:
“The e-IRG notes the importance of the steps undertaken by the EGI and PRACE initiatives to promote sustainability of the computing-related e-Infrastructure, such as the development of policies, business models and funding schemes for the new required structures. The e-IRG recommends that adequate levels of funding should be granted by the EC and Member States for the development of the new structures both on the national and European levels.

The e-IRG recommends that major e-Infrastructures initiatives such as EGI and PRACE cooperate closely in order to define complementary and interoperable environments for the benefit of European researchers. This environment should ensure that access to resources in Europe is granted through an open and transparent process, based on international standards and interoperable middleware.

The e-IRG recommends the funding of activities that help national user communities to cooperate with corresponding user communities in other countries, in order to foster the European research activities in using the e-infrastructure.”

In the e-IRG White Paper from 2009 the following Recommendations are issued related to cloud computing [3]:

“Investigate the integration of cloud-like technologies, especially virtualisation, into existing e-Infrastructures. Publicly funded grids should attempt to run utility computing and deliver cloud-, as well as advanced services. Both grid and cloud computing requirements should be elevated to include high-level availability goals;

Promote the development of open-source components to build clouds, as well as standards-based grid interfaces to cloud services;

Explore the application of grid technology for the federation of clouds.”

2.3. CONCLUSION

European Commission has made a very clear strategic statement calling to develop all elements of e-Infrastructures: Research and Education Networks, NGIs, scientific data infrastructures, supercomputing facilities and e-Science.

The White Papers, Roadmaps and Recommendations elaborated by e-IRG forum and assigned Task Forces are very valuable as guidance on the way to sustainable, properly functioning, user-friendly e-Infrastructure in Europe serving as a technological base for ERA. e-IRG promotes policy measures and action plans stimulating development towards a general-purpose European e-Infrastructure.

Recommendations made by e-IRG are good guidance to Baltic Grid project in developing strategy for sustainable infrastructures in Baltic States and Belarus.
3. BEST PRACTICE ON DEVELOPMENT OF SUSTAINABLE E-INFRASTRUCTURES

There are many e-Infrastructure related projects and initiatives in Europe and around the world. In most of them sustainability issues are addressed, some recommendations formulated and results achieved.

In this chapter are analysed some best practice cases and recommendation for projects on how to maintain sustainability of e-Infrastructures.

3.1. EGEE PROJECT

Enabling Grids for E-sciencE (EGEE) is Europe's leading grid computing project which started in 2004. The current stage EGEE-III started on 1 May 2008 (for 2 years) and actively contributes to establishment of a sustainable grid infrastructure in Europe through the European Grid Initiative.

EGEE collaborates with dozens of international projects, including BalticGrid Project. Collaboration with BalticGrid-II Project is based on MoU. The specific goals of the collaboration are:

- Ensure provision of regional operational grid support to the Baltic States and Belarus resource centres.
- Support the porting of BalticGrid-II applications to the projects’ infrastructures.
- Support the transition to an operational model based on National Grid Initiatives.

The EGEE-III Project must prepare the migration from a project-based model of grid computing support to a sustainable federated infrastructure based on National Grid Initiatives. EGEE in 2009 is focused on transition to a sustainable operational model, while maintaining reliable services for its users. The resources currently coordinated by EGEE will be managed through the European Grid Initiative (EGI) as of 2010. All project activities work in close collaboration with the European Grid Initiative Design Study project (EGI_DS).

3.2. EGI-DS PROJECT

The European Grid Initiative (EGI) Design Study is a project funded by the European Commission’s 7th Framework Programme. The EGI Design Study represents an effort to establish a sustainable grid infrastructure in Europe enabling virtual collaboration and resource sharing of scientists in the European Research Area (ERA). The main foundations of EGI are the National Grid Initiatives (NGI), which operate the grid infrastructures in each country. The goal of the EGI Design Study (EGI_DS) is to evaluate use cases for the applicability of a coordinated effort, to define the structure and to initiate the creation of the EGI organization [4].

Coordinated project based development led to good results and grid technology is recognised as a fundamental component for e-Infrastructures. Consolidation and integration of European e-Infrastructure based on National grid infrastructures and national academic networks is very
important for successful implementation of ERA concept. Many countries have already established their National Grid Infrastructures. It is found reasonable to foster further coordination of effort at European level under the European Grid Initiative.

3.2.1. Requirements for National Grid Initiatives

In EGI-DS project deliverable D4.3 clear demands for the NGI’s status are elaborated. EGI organisation as a legal entity is binding together National Grid Initiatives (NGIs) therefore it is important to ensure that all NGI’s have harmonised legal status. The NGIs own the EGI organisation and voice their views on any major EGI strategy through the EGI council. Furthermore NGIs may buy services from the EGI organisation, which will organise these services for the NGIs.

It is clear that there are implicit assumptions about the NGIs structure. The aim of this paragraph is to describe and argue those assumptions. This should help NGIs, which are in the state of creation to understand what is expected from them when joining the EGI collaboration, i.e. joining the EGI organisation as a member.

There are mandatory requirements which will be described in the following paragraph. Following the idea of the EGI collaboration an NGI must:

(a) have the capacity to sign the Statutes of EGI.org – either directly or through a legal entity representing it.

(b) have a mandate to represent its national Grid community in all matters falling within the scope of EGI.org

(c) be the only organisation having the mandate described in (b) for its country and thus provide a single contact point at national level.

(d) be able to commit to EGI.org financially i.e. to pay EGI.org membership fee and – if there is a demand for such services in the NGI – order EGI.org services and pay for these services.

(e) nominate a representative duly authorised to deliberate, negotiate and decide on all matters falling within the mandate of the EGI.org Council.

(f) have a sustainable structure or represented by a legal structure which has a sustainable structure in order to commit to EGI.org in the long term.

Some explanations of these mandatory requirements follow:

(a): In order to become member of EGI, an NGI must have the capacity to sign the Statutes of EGI and to commit to the EGI financially. It is our belief that the best and easiest way to achieve this mandatory goal would be for the NGIs to have an independent legal entity. However, it doesn’t matter how the NGIs arrange this with their national funding agencies, state authorities or research organisation, as long as this criteria is fully achieved. Any organisation or institution delegating this mandate to an NGI should be fully aware of the consequences of becoming member of an independent legal entity such as EGI will be, therefore this point should be thoroughly discussed at national level.
(b): Structuring the EGI organisation by national bodies – the NGIs – is obviously only possible if this organisation has a political mandate. It is up to the national Grid communities how they organise that delegation process. It could be done by a ministerial decree or a decision by a high-level scientific council or any other form which is appropriate. The NGI should convey this to the other NGIs in an appropriate form when applying for membership in the EGI organisation, a draft is following.

(c): It is clear that there can be only one organisation per country (the NGI) which represents the national Grid community in EGI.

(d): Membership fees are necessary to guarantee a minimum financial flexibility for actions of the EGI organisation. Even if the option of payments “in kind” is implemented, there are limitations to that sort of “payments” as there are items, which in the long term must be paid by the EGI organisation in “cash” (like office space etc.). This is the rationale for demanding a budget with an EGI related budget line for an NGI. It is however the NGIs responsibility to find funding, i.e. through national funding agencies or membership fees from VOs and users.

(e): It is necessary to have one person as formal representative of the NGI in EGI (being substituted by a deputy, if necessary).

(f). “The EGI shall ensure the long-term sustainability of the European Grid infrastructure.” (EGI Draft Statutes, Article I) For EGI to be sustainable, it is of utmost importance that NGIs are also sustainable structures and that they commit to be members of EGI on the long term. EGI will not require from its members that they present a funding plan for the first years following the creation of EGI, but this point should be clear on the national level.

A clause might be added to the actual draft Statutes that any NGI signing them will thus commit to being a member of EGI (including a financial commitment) for at least the first three years of its operation.

It is not mandatory that an NGI has its own Grid related development program.

Unfortunately national infrastructures in Europe are in a very different level of maturity caused by historical circumstances. Most of Western European, Central European and some Eastern European countries started development of their grid infrastructures with support from EU programmes and national governments much earlier than others. Baltic States were invited and joined grid community just in 2005 and still are not receiving support (Estonia, Latvia) from their national governments.

Countries are also very different in size, population, economical development etc. This must be considered in EGI - NGI model to maintain harmonized development of e-Infrastructure across Europe.

3.2.2. Baltic States – NGI status and issues

Baltic States are keen to join this organisation and therefore in the framework of the BG-II are proposing their vision and recommendations on the constitution of this organization.
Scientific communities in Baltic States and Belarus are dominated by small and diverse groups of researchers – as a consequence, the grid computing is most suitable for computing tasks. Unfortunately most frequently scientists preferably use local IT resources instead of distributed computing like Grid. Therefore our task is to explain Grid accessibility and to raise user awareness on Grid capability. At the same time the expenses and benefits of participation of NGIs in EGI must be evaluated. This issue is fairly important for the governmental funding institutions of Baltic States and Belarus.

Management of EGI-NGI model have to be discussed in terms of the definition and functions of Virtual Organizations which have to be modified, in legal, organizational and technical aspects, enabling users to make convenient and flexible joint groups of research in the common area of EGI. Nevertheless, consolidation and integration of European e-Infrastructure based on National grid infrastructures and national academic networks are important for e-Science emerging in Baltic countries and Belarus.

**Recommendations to EGI_DS project elaborated in the BG-II project** for successful transition from EGEE-centred infrastructure to EGI are the following:

- The EC should co-fund activities of EGI and the entire infrastructure at the European cross-border level;
- The recognition, types and functions of Certification Authority, as it is established in many countries or projects, have to be reviewed, modified and extended;
- The application and users support systems (like ticketing systems), now organized in very different ways on various grid projects has to be unified or synchronized in an appropriate way;
- The definition and functions of Virtual Organizations have to be modified, in legal, organizational and technical aspects, enabling users to make convenient and flexible joint groups of research in the common area of EGI;
- EGI will need efficient and user/application-centred accounting system enabling countries, institutions or user groups to evaluate their input in EGI and/or between NGIs.

### 3.3. EELA PROJECT

EELA-2 project [5] “E-science grid facility shared by Europe and Latin America” is co-funded by the European Commission as an Integrated Infrastructure Initiative within the 7th Framework Programme. EELA-2 began on 1st April 2008 and will run for 2 years.

Four main objectives define the content of the project:

- Build a powerful, functional and well supported Grid Facility;
- Address a large community of users;
- Assert the financial & management schemes to operate and support the e-Infrastructure on the long range;
• Anticipate the handover of the e-Infrastructure operation and support.

The current infrastructure has 22 Resource Centres (11 in Europe and 11 in Latin America) mobilising about 5800 computing cores and more than 192 Terabytes of storage. Two Core Service Centres deployed (EU and LA), providing a full set of Grid Services (information systems, data and metadata catalogues, etc.) and the services developed by JRA1.

NGI organizational structure in Latin America is evolving into The Latin American Grid Initiative (GridLGI) similar to EGI.

GridLGI is composed of three layers, each of them including Grid and Network components:

• At the lower Institute level:
  – The Resource Centre (RC) is the actual site of the Grid computing resources;
  – The backbone LAN or MAN network connects the Computing and Storage Elements (CE & SE) at the RC site;

• At the intermediate national level:
  – The National Grid Initiative (NGI) integrates all Grid Institutions in the country and federates under its Grid Operation Centre (GOC) all their RCs in a National Grid (GridNGI);
  – The underlying National Research & Education Network (NREN) links country-wide the Research and Education Institutes and optimizes / monitors their network activity via its associated Network Operation Centre (NOC);

• At the upper international layer:
  – The Latin American Grid Initiative (LGI) which brings together all NGIs and supervises the various GridNGIs operation from its Grid Support Centre (GSC);
  – CLARA: it is the WAN network which integrates the Latin American NRENs and supervises the overall RedCLARA network activity by means of its Network Support Centre (NSC).

NGIs are formally established in Argentina, Brazil, Chile, Colombia, Ecuador, France, Ireland, Italy, Mexico, Panama, Peru, Portugal, Spain, Venezuela. A typical solution is to join them with NREN.

There were special actions planned with Decision Makers for awareness raising of NGI. In depth discussions took place with EELA-2 presentations, e-Science status in the country, e-Science Virtual days etc. Special dissemination materials were used.

Still there are risks not to get the GridLGI as a sustainable e-Infrastructure in Latin America, because there a too few number of NGIs and the difficulty to get the LGI accepted. This is a
real risk as the advance of Grid computing in Latin America is not yet at the level of what it is in Europe.

3.4. SEEGRID PROJECT FOR SUSTAINABLE E-INFRASTRUCTURE

SEE-GRID project [6] intends to provide specific support actions to pave the way towards the participation of the SE European countries to the Pan-European and worldwide Grid initiatives. This will be accomplished through dissemination conferences and training material including cookbooks, pilot and demonstration test-beds for hands-on experience, applications' adaptations to be able to use the Grid, operational and support centre schemes and organisation, and finally feasibility studies and roadmaps for the integration of the SEE to the European Research Area (ERA) via an extended Pan-European Grid infrastructure.

Another related project is SEE-GRID-SCI (SEE-GRID e-Infrastructure for regional eScience) [7]. It is a 2 year project co-funded by the European Commission, starting on 01/05/2008. e-Infrastructure in Europe has reached a mature state where the GEANT network forms a communications backbone on top of which a distributed computing infrastructure - the Grid - provides processing and storage services for e-Science research. The South-East European e-Infrastructure initiatives are committed to ensuring equal participation of the less-resourced countries of the region in European trends. SEEREN initiative has established a regional network and its GEANT connection and the SEE-GRID initiative the regional Grid.

Among SEE-GRID-SCI project objectives (actions) are mentioned consolidating actions towards long-term sustainability and European Grid Initiative inclusion. As a result project is claiming to be pioneer of the NGI concept and reached significant developments in a number of areas: organisational stability, operational maturity, national-level support. Project is providing active support for NGI establishment in other developing regions.

Project deliverables may be useful guidance of best practice on how to establish NGIs and provide evaluation:

- DNA2.1 - NGI metrics specification (44 detailed metrics, quarterly reporting and analysis);
- DNA2.2 - NGI cookbook (detailed NGI setup guidelines, distributed to all other regions);
- DNA2.3a - NGI intermediate assessment (detailed assessment and recommendations).

Guidelines from “The NGI Cookbook” on how to establish NGIs are presented at EELA-2 Conference paper [8] as consecutive steps:

1. Get in touch with diverse research institutes interested in scientific computing, National Research Network and get consensus towards common strategy for Grid development in the country.
2. Sign a MoU (Memorandum of Understanding) within the consortium which would define your common goal in setting up an NGI, developing the Grid infrastructure and general Grid activities in the country.

3. Write together a national strategy document. This document could also define structure of the NGI and its decision mechanisms and internal organisation.

4. Approach relevant ministries with the national strategy document, and try to get a ministry to support your work.

5. Establish a legal entity or make sure an established legal entity represents NGI on behalf of the consortium.

6. With the support letter from the Ministry you can have an official inauguration event of the National Grid Initiative.

7. Seek national funding programme by proposing a national-level project.

8. Consider technical aspects: choice of middleware, establishing pilot resource centres even with basic resources, aim to support core services for the pilot national VO, use the VO to establish the sharing culture. Establish a web presence visible to a wider community.

9. Define and adopt the national-level policies.

There are also discussed organisational models of NGI, operational aspects and financing models. There are proposed 3 main options for funding [8]:

- a national Grid project which is explicitly allocated to those organizations in charge with Grid infrastructure development and operation;
- a national Grid programme where the thematic is larger than infrastructure itself including also application deployment and user communities activation topics. The budget is allocated to projects on competition basis.
- Grid aware research projects funded by other national research programmes which address Grid as a support technology.

3.5. THE BEST PRACTICE CASE – POLISH NGI

Several institutions in Poland are partners in EGEE project and in BalticGrid project as well. Grid computing development in Poland is already in a stage of high maturity and may be presented as a best practice case on how to manage sustainability of e-Infrastructures.

On 1st June 2009 the contract on co-financing the PL-Grid project “Polish Infrastructure for Information Science Support in the European Research Space” [9] was signed between the Polish Ministry of Science and Higher Education and ACC Cyfronet AGH. Project duration is
The goal of the PL-Grid project is to provide the Polish scientific community with an IT platform based on Grid computer clusters, enabling e-science research in various fields. This infrastructure will be both compatible and interoperable with existing European and worldwide Grid frameworks. The system will ensure scalability and enable the integration of additional local clusters, belonging to universities, research institutions and technology platforms. We foresee exploitation of PL-Grid by state authorities, crisis management teams and industrial partners.

The Project will establish a country-wide Polish Grid infrastructure supporting scientific research through integration of experimental data and results of advanced computer simulations carried out by geographically-dispersed teams.

The Project is realized by the PL-Grid Consortium, created in January 2007, which consists of 5 organizations: Academic Computer Centre Cyfronet AGH, Krakow (ACK CYFRONET AGH), Interdisciplinary Centre for Mathematical and Computational Modelling, Warsaw University (ICM UW), Poznan Supercomputing and Networking Centre (PCSS), Academic Computer Centre, Gdansk (CI TASK) and Wroclaw Centre for Networking and Supercomputing (WCSS).

The PL-Grid Consortium is managed by the Consortium Council, which performs establishing and supervising functions. The Council consists of the persons delegated by the Consortium members. The Consortium Council is managed by the Chairman, who is chosen by the council for the three years' term of office.

The Consortium Council is responsible for:

- strategy and the factual program of the Consortium functioning,
- establishment of the rules of using and sharing the financial means as well as the assets and values of the intellectual properties obtained as a result of the activity of the Consortium,
- assessment of the factual and financial reports submitted by the Coordinator,
- making decisions about admitting a new member of the Consortium.

The Consortium Council appoints the PL-Grid Consortium Director, who manages the activity of the Consortium and coordinates its actions in the country and on an international forum.

In order to ensure the efficient functioning of the Consortium, the Consortium Council appoints the Consortium Management Board for a given term of office of the Consortium Council.
On 25th June 2009, the ACC Cyfronet AGH (the coordinator of the PL-Grid), signed in the name of the Project the Memorandum of Understanding (MoU) concerning creation of EGI (European Grid Initiative). The signatories of the MoU will be the representatives of the National Grid Initiatives from other European countries and associated states to the EU FP7. The aim of the document is preparation of the structure leading to the creation of EGI.

The e-infrastructure realized in the framework of the Project will be the base, on which we will create the specialized systems specific for various fields of science, involving services and tools oriented on the used types of applications.

The solutions used during building of this e-infrastructure will be from the beginning integrated with similar platforms in the world, and in particular - with grid systems created as a result of the EGEE and DEISA projects.

The e-infrastructure software will comprise (going from the user to the hardware):

- user's tools like: portals, systems for applications' management and monitoring, result visualization and other purposes, compatible with the lower-layer software used in the Project,
- software libraries,
- virtual organizations' systems including: certificates and accounts' subsystems, accounting, security subsystem,
- data management system: metadata catalogues, replica management, file transfer,
- resource management system including: job management, applications, grid services and infrastructure monitoring, license management, local resource management.

The above mentioned systems will be built on the base of the software created in the framework of the EGEE and DEISA projects (the greatest number of users is using it currently) as well as a result of the development of the software created in the framework of other EU IST projects, mainly those, in which the Polish groups participated. The software will be installed in such a way, that the e-infrastructure resources could be used - as a production platform - by the users of these systems.

Within the Project there will exist 3 types of the infrastructure: production, developer and testing one. For the proper functioning of the Project in the future, it is necessary to monitor the progress in the area of the grid systems, and - on this base - suggesting the improvements to the e-infrastructure being created.

The general assumptions of the Project functioning have been presented below:

- Support for the EGI and DEISA production systems. The EGI and DEISA systems will be supported according to the rules applied in these infrastructures, with full cooperation with organizations (projects) which coordinate and develop them. The Project's infrastructure will follow the changes, which will occur in software and...
management procedures in these systems, to keep the full compatibility. Most of the resources of the system will be made available to users in the framework of the mentioned grid systems. In their framework we foresee creation of the Virtual Organizations connecting Project and other European centers’ resources.

- Opening to the new grid systems. The new grid systems and the supporting software, developed either in the Project or in the independent institutions, will be connected to the production e-infrastructure in the scope of existing or foreseen needs. The procedure of their testing and verification will be elaborated.

- The effective management of resources. Due to the fact, that the hardware resources of the e-infrastructure will be used in various ways (in many testbeds), we will introduce the monitoring and resources management system. We will elaborate the procedures of the agreement of the resources usage schedule; these procedures will be based on the resources management policy of each of the Partners, which should however respect the Project's arrangements. The base rule of the e-infrastructures resources' management is the openness of the resources management policy as well as its realization. The details of the resources negotiation by the groups of users (represented by VO) will be realized directly between VO and centres of the resources by use of the tools which facilitate this process. The important element is collecting the resource usage data (accounting), involving also local (non grid) usage. The results of the resources' usage, supplemented with the users' opinion about the centres, will be presented to the Consortium Council connected to the project; the Council may report some remarks concerning the change of the resource policy conducted by the given centre.

- Cooperation with the network provider. The built e-infrastructure, as an important client of the PIONEER (the network provider), should have well-defined requirements in the scope of access to the computer network; the fulfilment of these requirements should be monitored. It is especially important for the part of the Project users, for whom the special links will be configured. The example of this type of application is ATLAS.

- Support of applications' adaptation. We plan to organize a group, which will support the adaptation of new applications and organize the users' environment. A set of technical and consulting services will be created; these services will provide support to the users' groups on all stages of their entering into the grid environment and using it.

The most critical issues to maintain the sustainable e-Infrastructure in the country are:

- Operations Centre in PL-Grid. One of the key factors - which is evidence of success of the initiative consisting in provision of the e-infrastructure for science - is possibility of using this infrastructure by scientists in their daily work. It requires ensuring availability and reliability of the infrastructure on the production level. Therefore,
Separate task has been created in the framework of the Project: Operations Centre. The main aim of this Task is ensuring the proper functioning of the e-infrastructure. The Operations Centre will, in addition, coordinate usage of the resources made available in the framework of various types of this infrastructure, including usage for production and research purposes. The infrastructure will be made available to all research groups having the objective need for using it.

- Separating the resources for the research. In the framework of the e-infrastructure it is possible to separate a small set of distributed resources, which then could be used for some special aims. Some number of machines is destined for this aim, and it is possible to pass them to the interested group of users for the certain time. This procedure will be used to make the resources available for the research testbeds (new grid software, experiments requiring dedicated resources, etc.), as well as for the testbeds created to test new versions of the production software and additional software connected into these systems.

- Cooperation of the production systems. The built e-infrastructure should assure proper usage of computational power by the users, who will use many computational frameworks. We assume that the EGI and DEISA platforms will be placed symmetrical in the e-infrastructure; it means that neither EGI, nor DEISA software will be the base (preferred) platform. The cooperation of these frameworks should assure smooth movement of the computational power between EGEE and DEISA frameworks and other types of the infrastructure. In this area the mechanisms elaborated in other projects (like D-GRID, GRIP, GIN) will be checked and introduced.

- The development of the infrastructure for science. In the framework of the Project we plan to develop the software, which will supplement in the future the set of services offered by the environment. The components developed in the framework of the Project will be chosen considering their usefulness for the users.

In the framework of cooperation with EGI, PL-Grid project will be involved:

- in the Global Tasks:
  - O-E-5: Grid operation and oversight of the e-Infrastructure. EGI.org,
  - O-E-10: Coordination of resource allocation and of brokering support for VOs from NGIs,

- in the International Tasks (like all other NGIs),

- to a large extent in the Computational Chemistry – organization and management of Computational Chemistry and Material Science and Technology Specialized Support Centre (CCMST SSC) and EGI liaisons,

- in Development of Unified Middleware via European Middleware Initiative,
• in scientific application porting, especially concerning UNICORE architecture, within Application Porting SSC.

PL-Grid will engage in collaboration with end users from its inception, providing training services for many participants and undertaking joint development activities on new applications and domain-specific services.

It is also intended to provide efficient access to computing resources for research teams operating outside national HPC centres. The emergence of the PL-Grid framework is consistent with European Commission policies which actively encourage development and integration of computing Grids.

3.6. THE BEST PRACTICE CASE - CROATIAN NGI

Creation and operation of NGI in Croatia could be presented as a best practice example [10]. The poly-project CRO-GRID (composed of projects: Infrastructure, Middleware Systems, Applications) under the auspices and financed by the Ministry of Science, Education and Sports introduced the first grid technologies to Croatia in between 2004 and 2006.

One of the results of the CRO-GRID Infrastructure Project led by Srce was the establishment of the first grid infrastructure in Croatia as well as the successful integration with the European grid project EGEE-II. The established grid infrastructure is the basis of CRO NGI. CRO NGI operates 8 grid sites around the country with 1080 CPU cores, 64,9 T B storage and 14 central servers.

The Coordinator of CRO NGI is the University Computing Centre (Sveučilišni računski centar - Srce). The CRO NGI Board, appointed by the minister responsible for science, the Council of Partners and the Council of Users take part in the management. CRO NGI is financed as a separate unit in the State Budget of the Republic of Croatia.

The CRO NGI Coordinator ensures planning, development, maintenance and everyday operations of the Croatian national grid infrastructure.

The Coordinator of CRO NGI is the University Computing Centre (Sveučilišni računski centar, Srce). CRO NGI budget is ensured through Srce budget, as a public institution financed by the State Budget. Srce provides a legal entity of CRO NGI as well.

The Coordinator is providing operative (technical) management, maintenance and development of CRO NGI; providing administrative and technical support to the Board and the Councils; proposing annual working plans and usage policy to the Board; planning and managing the resources assigned by the State Budget; preparing annual operational and financial reports; representing CRO NGI in international bodies and projects; accepting new partners and users; organizing annual meetings, dissemination and outreach as well as user support, education and training activities.

The Board is the highest body of CRO NGI and CRO-GRID, which makes strategic decisions regarding CRO NGI. The Board is appointed by the Minister of Science, Education and Sports for the period of 3 years. Coordinator prepares an annual operation plan and annual report. The Board has 9 members. Board of CRO NGI:
• discusses and adopts strategic guidelines for the development, usage policy, support to other national grid projects, international cooperation,;

• decides on special rights of partners of CRO NGI and acceptance of the partner status for subjects outside the academic and research community;

• together with the Coordinator, takes part in planning and fund raising from the State Budget, discusses and approves the annual operational plan, annual report

The Council of Partners of CRO NGI is a body composed of one representative per each partner, a representative of the Coordinator, a representative of CARNet and a representative of the Ministry of Science, Education and Sports.

The Council of Partners make proposals for operation and usage plans and development and has the obligation to discuss the technical plans and development plans of CRO NGI, the policy of use and cooperation of CRO NGI with similar infrastructures in Europe and worldwide.

The Council of Users of CRO NGI is a body composed of one representative per each user institution. A member of the Council of Users is a representative of the Coordinator as well. The Council of Users proposes necessary development measures from user perspective, discusses the needs of the users of CRO NGI, the reports on the use and the development plans for CRO NGI.

3.7. CONCLUSION

All projects are working to establish and strengthen e-Infrastructures in their partner countries to maintain their sustainability.

EGEE project in close cooperation with the EGI Design Study project is working on preparing transition to a sustainable operational model. There are guiding principles elaborated and agreed on NGI status in the country to make it eligible for joining EGI. In SEE-GRID-SCI project NGI cookbook is elaborated with detailed NGI setup guidelines.

There are possible several models for NGI as follows from best practice analysis in different project and countries. In Poland NREN and NGI have separated, but in Croatia merged in one organization. Latin American experience supports the one organisation model.

As NGI funding model the best would be permanent allocation from the state budget, but in reviewed cases there and long term funding is provided in the framework of national programme or national project.

Technical operational aspects of e-Infrastructures are also very important and well elaborated in all reviewed cases. MoU between EGEE and BG-II coordinates common actions to maintain stable operation of grid infrastructures and user support in Baltic States and Belarus in accordance with a new model.

Still sustainable e-Infrastructure in Latin America is under risk, as the advance of Grid computing in Latin America is not yet at the level of what it is in Europe and creation of common e-Infrastructure (GridLGI) is not well accepted.

Conclusions related to BG-II will be given in the following chapter.
4. STRATEGY FOR SUSTAINABLE E-INFRASTRUCTURE DEVELOPMENT IN BALTIC STATES AND BELARUS

Situation in e-Infrastructure development in each country is different even though there are also commonalities. Baltic States and Belarus started to establish grid infrastructure 3-4 years ago, later than many European States, and did not yet reached maturity. Strong driving source for pan-European grid project EGEE is CERN and countries with large research communities, but in Baltic States and Belarus dominant are small and groups of researchers covering diverse research fields. Baltic States and Belarus are not partners of EGEE project, but have close cooperation. Further integration of Baltic States and Belarus in pan-European e-Infrastructure based on National grid infrastructures and national academic networks is very important for emerging e-Science.

Here is presented history of development, current status and future prospects of e-Infrastructure developments in Baltic States and Belarus.

4.1. BELARUS

UIIP NASB is the head organization for NGI development in Belarus. UIIP NASB is committed to advancing grid technologies from 2006 and supercomputer systems for many decades.

In June 2009 UIIP NASB has signed EGI Letter of intention (LoI) and Memorandum of Understanding (MoU). NGI in Belarus has permanent funding in 2009-2010 due to activities in the national grid program. Current status in the EGI council is observer since Belarus is not a member of EU. To change the status to be a full member of EGI is the main priority for Belarusian NGI.

It is planned to allocate 500 CPU cores in 2009 and more than 1000 in 2010 to grid infrastructure. UIIP NASB has already set up Belarusian Grid Certification Authority and has obtained full accreditation from EUGridPMA for it. UIIP NASB operates the Network of the National Academy of Sciences of Belarus (BASNET) that is connected to the pan-European research network GEANT (at 622 Mbps). UIIP NASB runs central services for gLite sites in Belarus and governs the Operation Centre for UNICORE national grid segment.

The main tasks in Belarusian NGI operation should be:

- For operation of Grid topology using existing GOCDB from Central Europe ROC and testing customization for regional instance with GOCDB4. Create regional GOCDB with gLite and UNICORE middleware.
- Operation of NGI accounting repositories using APEL in parallel with own solutions until full migration.
- Operation of repositories storing monitoring and performance data and other related information. Running UNICORE monitoring system based on Nagios and Ganglia, as well as adaptation and extension it to gLite sites in Belarus.
• Operation of the Grid Core Central Services (BDII, LFC, WMS, LB and etc.) for Belarusian sites.

• Operation of the Grid Operations Portals (CIC) and deployment of NGI level national dashboard for gLite and UNICORE.

• For NGI e-Infrastructure Oversight 1st line support team has to be created and trained. For integration of NGI ticketing system solution supported by EGI will be adopted. Support team will provide monitoring of the incoming tickets.

• Operations Coordination will provide: Security and Incident Response, Rollout of middleware updates, Resource allocation in the NGI, Interoperation with national & regional grids.

Belarusian NGI is not yet a full member of EGI. In May 2010 Central Europe ROC will finish current activities and we need to create national GOCDB. 1st line support team should also to be created and trained.

UIIP NASB is the leader of Belarusian efforts in cloud computing within the BalticCloud and Northern Europe Cloud initiatives. The overall objective of these initiatives is to create a common effort on building competence in cloud computing technologies for scientific applications, involving both computation and data, and to understand what implications cloud technologies will or may have on respective e-Infrastructure for science.

At the beginning of 2009 UIIP NASB has launched the development of a billing system in order to monitor the employment of NGI resources. In future using of the National Grid will become a paid service and a global billing system will be the only way of accounting. The requirements for the billing system are the following:

• Recording of the actual time of computing resources usage in normalized units under SPEC2000.

• Ability to identify commercial software usage.

• Interaction with the system for different categories of users and providing relevant information.

• Various text and graphics reports about resources used by individual user, site, etc.

• Generating bills based on information above.

• All connections are secured with user and service certificates.

• E-mail notifications.

UIIP NASB has also developed an advanced custom Belarusian UNICORE distribution for Linux and Windows-based sites that is supplemented by detailed step-by-step manuals for users and administrators.

**Status of e-Infrastructure in Belarus**

UIIP NASB is the head organization for NGI development in Belarus and e-Infrastructure in Belarus has permanent funding in 2009-2010 from the national grid program. UIIP NASB has
signed EGI Letter of intention (LoI) and Memorandum of Understanding (MoU). Belarusian NGI is not yet a full member of EGI, but planning to join on full rights in future.

4.2. ESTONIA

Estonian Grid initiative was started in 2003 and its main objective is to introduce, initiate and promote Grid computing and Grid technologies in Estonia. EENet is appointed by the Ministry of Education and Research as a leading partner in the Estonian Grid initiative. EENet has signed the MoU for establishing of EGI by the Estonian NGI and is a member of EGI Council. Unfortunately there is no governmental funding for the Grid infrastructure management at Estonia.

The organizational structure and responsibilities are also in discussion with the Estonian Grid partners. Presumably there will be more middlewares and also Cloud technologies supported by the NGI to extend the computing infrastructure and to fulfil the requirements of new partners.

There are sufficient expertise and local installations for all of the essential Grid services to run the local Grid infrastructure at Estonia. There are currently resources from three Estonian NGI partner organizations integrated to Grid at Estonia. More computing and storage resources are available at the Estonian Grid partners organizations and people are working on extending the functionality of infrastructure (using other middlewares and Cloud technologies) to fulfil the requirements of the new sites and organizations.

The most critical issue for Grid infrastructure sustainability at Estonia is that there is a lack of sufficient financial support from the government. Currently Estonian NGI operations and support services management is funded from EC FP7 project BalticGrid-II and the project will end in April 2010. There are ongoing negotiations with the Estonian Ministry of Education and Research about finding additional funding for Estonian NGI management to provide sustainable infrastructure.

KBFI is currently leading the Cloud Computing developments at Estonia. EENet is going to put more effort to Cloud development during the next six months because it seems to be essential to involve more partners (i.e. business communities) for extending the NGIs operating range.

Flexible and accurate resource accounting system is very important for Estonian Grid partners. Current implementations of logging and accounting systems are not perfect and there should be put more effort to implement an easy, transparent and unambiguous system for Estonian NGI.

Status of e-Infrastructure in Estonia

EENet is appointed by the Ministry of Education and Research as a leading partner in the Estonian Grid initiative. EENet has signed the MoU for establishing of EGI by the Estonian NGI and is a member of EGI Council. There are ongoing negotiations with the Estonian Ministry of Education and Research about finding additional funding for Estonian NGI management to provide sustainable infrastructure.

4.3. LATVIA
In Latvia grid computing started in 2005 when Baltic States were invited to join grid community within the Baltic Grid Project. The Institute of Mathematics and Computer Science at the University of Latvia (IMCS-UL) and the Riga Technical University (RTU) were Latvian partners in the Project.

Ideas on National Grid Organisation in Latvia were raised already in 2006, but unfortunately were not supported and still there isn’t government recognized and financed NGI organisation in Latvia coordinating e-Infrastructure development in the country.

Since 2007 the Ministry of Education and Science nominated Inara Opmane, the executive director of the IMCS, to represent Latvia in the EGI. Latvia is supporting EGI and Inara Opmane on behalf of IMCS-UL signed MoU.

Until now there is no sustainable financial support from the government for NREN organisation in Latvia providing services to all academic organisations. IMCS-UL provides academic network services as LATNET since 1992 and as SigmaNet from 2008. SigmaNet represents Latvia as NREN in GEANT and TERENA. University of Latvia and the Riga Technical University have their own computer networks. Larger Latvian institutions deploy eduroam for authentication and authorization at participating institutions.

Grid computing clusters and storage elements in Latvia are provided by local resource centres at two universities – Riga Technical University and University of Latvia. IMCS-UL operates a local CA while certificates for BalticGrid are issued by EENet in Estonia. RTU provides central grid services for Latvian clusters in the Baltic Grid project - WMS, LFC, BDII, MYPROXY. Backup for central services is needed.

Currently Latvia grid clusters (IMCS-UL and RTU) contain 112 CPU and 2 TB storage. CPU number is insufficient and we hope to upgrade. IMCS-UL has in disposal also 0.5 PT storage facilities for specific applications. Resource monitoring of all Latvian sites are provided using Nagios and central SAM (service availability) and on rotation based resource and ticket watch among site administrators.

User support is provided in each resource centre separately via available mailing lists and web pages of local resource centres. Currently there is no local ticketing system in Latvia.

The program The information and communication technologies for the quality of education for the development of ICT applications in the education system for the period 2007-2013 was elaborated by the former Secretariat of the Special Assignments Minister for Electronic Government Affairs. The program presents the activities necessary for the modernisation of the education system infrastructure.

The latest strategy paper developed by the Ministry of Education and Science of the Republic of Latvia is the Guidelines for the development of science and technology 2009-2013. The
document was enacted by the Cabinet of Ministers in 25 August 2009. In the document it is planned to ensure the integration of Latvia’s science and research system into the European Research Area, by supporting participation in technological platforms and in other joint international activities, as well as by developing world level research infrastructures in Latvia.

In the strategy of the Ministry of Education and Science prioritization of directions of science is made, one of them being Informatics - that should comprise secure software, integrated systems and networks of information and communication, and electronic technologies.

The Ministry of Education and Science together with the Council of Science will elaborate the attitude to the support of Latvia’s participation in the research infrastructure projects defined by ESFRI (Latvia represented by Mrs Maija Bundule). E-infrastructures for language resources (CLARIN), bioinformatics, medicine and other are already in preparation.

Fragmentation of academic networks and lack of coordination of efforts leads to low efficiency and poor user support. Therefore the Latvian government has approved a plan to use European Regional Structural Fund project for upgrading academic ICT infrastructure. The project is planned to start in 2010 and will finance establishment of coordinated National Academic Network Infrastructure, high performance computing facilities, campus networks and data centres. Government supported legal Latvian NREN organisation and NGI also must be established to manage this newly created infrastructure and join EU e-Infrastructure on full rights. Besides already mentioned issues, this plan originally intended also creation of cross border links to Lithuanian and Estonian Academic Networks, but due to financial difficulties plans may change.

For the next 4 years Latvia will participate in GN3 and in that framework the GÉANT connectivity speed no doubt will be upgraded. Hopefully other services from GÉANT will be adopted in the country as well.

The most critical issues is that science is still far from being a priority in Latvia and therefore there have not been made a substantial financial investments into the development of e-Infrastructure. The level of the development of the national infrastructure is below the average level in the European Union.

While joining EGI there must be agreed tasks and responsibilities shared between EGI and Latvian NGI, as well as specific arrangements needed for integration. For example, the persons providing grid education and training in Latvia must be EGI certified.

Latvia also joined BalticCloud subproject. Participation in NEON (The Northern Europe Cloud Initiative) is planned. Both RTU and IMCSUL are planning to maintain and offer cloud resources.

**Status of e-Infrastructure in Latvia**

There isn’t government recognized and financed NGI organisation in Latvia. The Ministry of Education and Science nominated Inara Opmane, the executive director of the IMCS, to represent Latvia in the EGI. Latvia is supporting EGI and Inara Opmane on behalf of IMCS-UL signed MoU.

Latvian government has approved a plan to use European Regional Structural Fund project (2010 – 2013) for upgrading academic ICT infrastructure including NREN and grid facilities.
4.4. LITHUANIA

Grid workshop at Vilnius University organized by EGEE II, CrossGRID, SweGrid dissemination teams in October 2004. Information about grid projects were given. Three universities decided to launch grid testbed after this meeting. In December 2004 VU-VGTU-KUT established a grid testbed (48 CPU) based on ARC middleware (NorduGRID).

Lithuanian NGI (LitGRID) was established in July 2005 as the framework project funded by the Lithuanian Science and Studies Foundation with a budget 29 k€.

In October 2005 a Grid testbed (20 CPU) based on LCG v.2.6 has been launched and the same year BalticGrid project started with VU and ITPA as a project partners.

In 2006 LitGrid project was extended for 12 months with a budget 87k€. For the period 2007 - 2012 LitGrid has funding as a long term program of the Ministry of Science and Education.

Currently LitGRID operates 23 sites with 17 clusters and ~600 CPU, storage capacity ~10 TB. LitGrid unites 13 partners from most active Lithuanian universities, institutes and colleges. Grid activities are used and developed in 23 different research fields by almost 100 scientists and specialists. LitGrid has about 600 CPU’s and each year almost 1 million normalized CPU hours is used for different computations.

BalticGrid CA certificates are currently used in LitGrid for GRID authentication provided by 10 BalticGrid RAs in different geographical locations of Lithuania.

Medium term action plan for LitGrid contains:

- Establish LitGrid CA certified by EUGRIDPMA
- Increase the number of CPU available at LitGrid till 1000 until end of 2010
- Increase the available storage till 100 TB until end of 2010
- Increase the number of grid users by providing additional grid services (data grid) for new user communities (for example hospitals for storing/sharing medical data)
- Establish relations between Litgrid and business/industry

In a long term LitGrid has strategic plan to join EGI with LitGrid resources, to establish LitGrid user support center and dissemination centre, increase the number of CPU available at LitGrid up to 2000 and storage up to 500 TB until end of 2013.

Litgrid main VO's are balticgrid, gamess, litgrid. Central services WMS, VOMS, LFC are running on 3 sites (VU, VGTU, KTU). Monitoring of the availability, SAM test, etc. is based on EGEE Nagios. User accounting system is under development and user support is available based on RT system. RT administration is based on rotational principle between LitGrid partners. Periodical face to face meetings are organised between users and support staff.

Most critical issues to maintain the sustainability of e-Infrastructure in Lithuania:

- Political and financial support of Litgrid by Ministry of Science and Education,
- Sustainable support of gLite middleware by EGI,
• Local User support centre,
• Stable financial support for NREN from the Ministry of Science and Education.

Litgrid has started testing different cloud computing platforms (IaaS) with the aim to establish national cloud computing infrastructure LitCloud since early 2009. Three LitGrid partners (VU, VGTU, and KTU) are involved in this activity. Several open source IaaS platforms were tested and evaluated: Eucalyptus, OpenNebula, OpenQRM, Convirture on different hypervisors XEN, KVM. We see that cloud computing infrastructure is attractive infrastructure for new user communities with specific requirements and business communities as well. Small cloud infrastructure (total 15 CPU) is launched at three sites. Several images with Matlab, OpenFoam applications are available for users. LitCloud user guide is prepared and available on Litgrid website.

LitCloud activity is in close collaboration with the NEON (North Europe Cloud Infrastructure) project.

Special Interest Group (SIG) is created in order to help users to share data and computations. Gridcom – easier layer of GRID UI was created and is maintained for each active user.

Status of e-Infrastructure in Lithuania

Lithuanian NGI (LitGRID) was established in July 2005 as the framework project funded by the Lithuanian Science and Studies Foundation. LitGrid has funding as a long term program of the Ministry of Science and Education. Letter from the Ministry of Education and Science of Republic of Lithuania (from 13.10.2009) nominates the Lithuanian Grid program LitGrid as National Grid Initiative in the European Grid initiative. Vilnius University is nominated as authorized representative to act as a legal body for National Grid Initiative of Lithuania and to sign the Memorandum of Understanding. In a long term LitGrid has strategic plan to join EGI with LitGrid resources.

4.5. CONCLUSIONS BG-II

Partners of the BG-II project in their countries are working to develop a long term strategy for coherent e-Infrastructure development taking into account that e-Infrastructure in Baltic States and Belarus are in the different development stage compared to the rest of Europe.

European Commission has made a very clear strategic statement, calling all Member States to develop all elements of e-Infrastructures: Research and Education Networks, NGIs, scientific data infrastructures, supercomputing facilities, e-Science and it must become a guiding principle for Baltic State governments as well.

All BG-II partner countries do not have NGI organisations yet, but are planning to join EGI as eligible members. Letters of Intent (LoI) and Memorandums of Understanding (MoU) were signed by their representative organisations to join this organization in future.

The best NGI funding model would be permanent allocation from the state budget, but in reviewed cases a long term funding is provided in the framework of national programme or national project. Belarus has permanent state funding for the grid infrastructure. Long term national project financing option is used in Poland and Lithuania, but in Estonia and Latvia it is under negotiation and there is not available dedicated project financing yet.
NGI in Baltic States and Belarus and their status in EGI is presented in the Table.

<table>
<thead>
<tr>
<th>Country</th>
<th>NGI</th>
<th>LoI</th>
<th>MoU</th>
<th>Funding</th>
<th>Status in EGI Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estonia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Uncertain</td>
<td>Member</td>
</tr>
<tr>
<td>Latvia</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Uncertain</td>
<td>Member</td>
</tr>
<tr>
<td>Lithuania</td>
<td>Yes</td>
<td>Yes</td>
<td>Letter*</td>
<td>Project</td>
<td>Observer</td>
</tr>
<tr>
<td>Belarus</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Observer</td>
</tr>
</tbody>
</table>

* Letter from the Ministry of Education and Science of Republic of Lithuania (from 13.10.2009) nominates the Lithuanian Grid program LitGrid as National Grid Initiative in the European Grid initiative. Vilnius University is nominated as authorized representative to act as a legal body for National Grid Initiative of Lithuania and to sign the Memorandum of Understanding.

Technical operation aspects of e-Infrastructures in EGI are also very important and must be well elaborated. EGEE project in close cooperation with the EGI Design Study project is working on preparing transition to a sustainable operational model. MoU between EGEE and BG-II coordinates common actions to maintain stable operation of grid infrastructures and user support in Baltic States and Belarus in accordance with a new model.

Baltic States and Belarus are planning to join the NEON (North Europe Cloud Infrastructure) project and further develop BalticCloud infrastructure.
5. FINAL CONCLUSIONS

BG-II project aims to provide a sustainable and coordinated development of Grid infrastructure in the Baltic States and Belarus. This document represents long term strategy for coherent e-Infrastructure development in Baltic States and Belarus.

Partners of the BG-II project in their countries are working to develop a long term strategy for coherent e-Infrastructure development. Taking into account that e-Infrastructure in Baltic States and Belarus are in the different development stage compared to the rest of Europe it is important to analyse EU policies and best practice cases in other countries and projects.

European Commission has made a very clear strategic statement, calling all Member States to develop all elements of e-Infrastructures: Research and Education Networks, NGIs, scientific data infrastructures, supercomputing facilities, e-Science and it must become a guiding principle for Baltic State governments as well.

The White Papers, Roadmaps and Recommendations elaborated by e-IRG forum and assigned Task Forces are very valuable as guidance on the way to sustainable, properly functioning, user-friendly e-Infrastructure in Europe serving as a technological base for ERA.

In the EGI-DS project are developed guiding principles on NGI status to make it eligible for joining EGI. In SEE-GRID-SCI project even NGI cookbook is elaborated with detailed NGI setup guidelines.

There are several models for NGI organizations. In Poland NREN and NGI are separated, but in Croatia merged in one organization. Latin American experience supports one organisation model.

The best NGI funding model would be permanent allocation from the state budget, but in reviewed cases a long term funding is provided in the framework of national programme or national project. Belarus has permanent state funding for the grid infrastructure. Long term national project financing option is used in Poland and Lithuania, but in Estonia and Latvia it is under negotiation and there is not available dedicated project financing yet.

Technical operation aspects of e-Infrastructures in EGI are also very important and must be well elaborated. EGEE project in close cooperation with the EGI Design Study project is working on preparing transition to a sustainable operational model. MoU between EGEE and BG-II coordinates common actions to maintain stable operation of grid infrastructures and user support in Baltic States and Belarus in accordance with a new model.

Baltic States and Belarus are planning to join the NEON (North Europe Cloud Infrastructure) project and further develop BalticCloud infrastructure.

All BG-II partner countries do not have NGI organisations yet, but are planning to join EGI as eligible members and their representative organisations signed MoU to join this organization in future. Nevertheless in Estonia and Latvia (like as in Latin America) sustainable e-Infrastructure may be under risk, as usage and awareness on Grid computing is not so high as in other European countries and support to development of NGI and e-Infrastructure is not politically maintained.