REPORT ON THE EXPANSION OF BALTICGRID INFRASTRUCTURE

Document Filename:	**BGII-DSA2-3-v1_2-IMCSUL-ReportOnExpansion.doc**
Activity:	SA2
Partner(s):	KTH, UIIP NASB
Lead Partner:	IMCS UL
Document classification:	**PUBLIC**

Abstract: During the BalticGrid project the necessary grid network infrastructure was built upon services provided by the National Research and Education Networks and pan-European GÉANT2 research network. By joining the BalticGrid-II project, Belarus partners and their respective networks have to become a part of this infrastructure.

Document review and moderation

	Name	Partner	Date	Signature
Released for moderation to				
Approved for delivery by				

Document Log

Version	Date	Summary of changes	Author
0.1	29/9/2008	Plan and structure of the deliverable	Katrina Sataki
1.0	20/10/2008	Text of the deliverable	Sergey Aneichik, Martins Libins, Katrina Sataki
1.1	22/10/2008	Minor updates	Sergey Aneichik, Bruno Martuzans
1.2	24/10/2008	Finalised version (released for internal review)	Liga Bardina, Baiba Kaskina, Katrina Sataki

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1. INTRODUCTION

1.1. PURPOSE

The purpose of this document is to give an overview of the inclusion of Belarus partners into BalticGrid network infrastructure. Implementation of Service Level Agreement in Belarus is discussed in the following sections. Demarcation points identified by the Service Level Agreement concluded between BalticGrid and Basnet are monitored along with network interfaces in order to ensure stability and reliability of network resources in Belarus.

1.2. APPLICATION AREA

This document is intended for partner's representatives in SA1 and SA2. The concluded SLA sets the requirements for the BalticGrid network monitoring system Gridimon.

1.3. REFERENCES

[1] http://www.geant 2.net/server/show/nav.00d007009	GÉANT2 network topology
[2] http://gridimon.balticgrid.org	BalticGrid-II Network monitoring portal

1.4. TERMINOLOGY

ACRONYMS	EXPLANATION
ALO	Administrative Level Objects
BASNET	Belarusian National Academic Network
CNCC	Central Network Coordination Centre
EENet	Estonian National Academic Network
GÉANT	European Academic Network
LITNET	Lithuanian National Academic Network
NREN	National Research and Education Network
SigmaNet	Latvian National Academic Network
SLA	Service Level Agreement

2. OVERVIEW ON THE STATUS OF THE BELARUS ACADEMIC NETWORK

2.1. BASNET – BELARUS ACADEMIC NETWORK

2.1.1. Historical background

The computer network of the National Academy of Sciences of Belarus — BASNET — is one of the first networks established in the Republic of Belarus for electronic data interchange between various research, academic, and educational establishments. We can single out three periods of its development.

Installation of the first network equipment at the Institute of Mathematics of the Academy in 1976 was the starting point of the initial period. At that time the computer network was built on large IBM 360-370 computers. The network protocol X.25, implemented in mini computers DEC PDP/11, was used to operate data transfer equipment, batch switching centers and terminal systems. A dedicated Minsk-Riga telex channel was employed to access global networks.

The second period of the network's development encompasses 1991-1993. During this period, using PAD-technology as the basis, the BASNET network was significantly modernized by the Institute of Engineering Cybernetics. BASNET connected 10 Institutes of the Academy and provided e-mail services, operating its own dedicated Minsk-Moscow channel.

The final period of the BASNET computer network's development started in 1994 with the establishment of the Information Technologies Center at the Academy of Sciences. Design, development, advancement, and exploitation of the Research and Information Computer Network and its informational resources in the Republic of Belarus became the main aspects of its activities. It resulted in a transition to modern computer and information technologies, employing high-capacity SPARC, COMPAQ, and DELL work stations, and CISCO network equipment.

In June 1995, leading foreign specialists participated in the NATO workshop on the Belarusian Unified Computer Network Development Strategy hosted by the Academy of Sciences. Representatives of practically all Republican ministries and leading foreign organizations participated in the meeting: DFN, German Telekom, World Bank, INTAS, SSC, USIA, USIC, NORDUNET, 3M, Eurasia Foundation, and NATO.

In 1997-1998 the Government of the Republic of Belarus decreed and allotted resources to build the Unified Research and Information Computer Network in Belarus. Since 1997 BASNET together with the Belarusian State University networks "BSUNet" and "NIKS" and Ministry of Education network "UNIBEL" have formed the Unified Research and Informational Computer Network (URICON) of the Republic of Belarus. Since May, 2007 BASNET is administrated by the United Institute of Informatics Problems of the National Academy of Sciences of Belarus (UIIP NASB). Computer networks BSUNet and NIKS are administrated by the Belarusian State University. UNIBEL is administrated by the Main Informational Analytical Center of the Ministry of Education.

Stages of BASNET development in the period of last 10 years: 1994-1998 — backbone fiber-optic network BASNET with the gateway to Internet; 1996-1999 — radio relay segment of academic network BASNET, BASNET network node on "Beltelecom", first stage of URICON; 2000 — satellite channel for the access of URICON to Internet, cross station of base URICON networks, Local Internet Registry status in RIPE NCC; 2001 — regional network nodes in Gomel, Vitebsk, Brest; 2002 — Radio-Ethernet segment of BASNET; 2003 — regional network nodes in Mogilev, Grodno; 2004 — connection of BASNET to GÉANT (34 Mbps), creation of the network infrastructure for the access to the supercomputer SKIF; 2005 — creation of the corporate library network of Republic of Belarus, creation of the telecommunication network of Belarusian Space System of the Remote Sensing of

Earth; 2006 — expansion of the access channel to GÉANT2 up to 155 Mbps; 2007 — creation of 2 new fiber-optic access nodes.

2.1.2. Current development

So far BASNET is the most advanced and dynamically developing research computer network in the Republic of Belarus. BASNET provides international connectivity to other Belarusian RENs and proposes various Internet services in all regional cities of Belarus — Brest, Gomel, Grodno, Mogilev, Vitebsk and capital — Minsk. Since May 2007 BASNET is administrated by the UIIP NASB, which is recognized as Belarusian NREN provider uniting research, cultural, educational and high-tech IT-institutions and IT-research laboratories in Belarus.

The United Institute of Informatics Problems of the National Academy of Sciences of Belarus (UIIP NASB) is the leading Belarusian institution for carrying out fundamental and applied research in the fields of information technology, computer science, applied mathematics, computer aided design and some other attached fields. The UIIP NASB staff (on 01.01.2008) is over 400 persons including 264 research workers: 17 scientists with DSc degree and 69 — with PhD degree. The UIIP priority research directions are the following: computer aided design (CAD/CAM/CAE); processing and recognition of signals, images and speech; operation research and discrete optimization; decision making in extreme situation; bio– and medical informatics, ergonomics; geoinformation systems; computer networks and telematics; input-output of video information; information security; supercomputers, grid and applications.

The UIIP NASB is the Belarusian coordinator and principal executor of three Russian-Belarusian joint supercomputer programs: SKIF (Development and creation of supercomputer family SKIF, 2000-2004); TRIADA (Development of applications based on SKIF supercomputers, 2005-2008) and SKIF-Grid (Development of Grid technologies and new generation of SKIF supercomputers, 2007-2010). The most important result of the SKIF program is the State Supercomputer Multi-Access Center with remote access to computing resources that was organized in the UIIP NASB. It includes the cluster supercomputers SKIF K-500 (128 Intel Xeon, storage – 0,8 TB) and SKIF K-1000 (576 AMD Opteron, storage – 9,5 TB).

Since 22 May 2008 UIIP NASB was admitted as a national member of TERENA. UIIP NASB also is a member of the European Center of Internet registration and has a status of the Local Internet Registry.

At the moment of writing this deliverable scientific computer network BASNET unites 46 research institutions of the National Academy of Sciences of Belarus and over 60 institutions and organizations of other Ministries – State Committee of Science and Technologies, Ministry of Agriculture, Ministry of Industry, State Committee of Chernobyl, Ministry of Health, Belarusian Attestation Committee, Fund of Fundamental Research etc.

The UIIP NASB uses its own equipment and metropolitan FO channels for BASNET and rents Beltelecom optics cable links only to Poland (155 Mbps, GÉANT node in Poznan) and to the regional BASNET nodes.

Main results in years 2004 – 2007:

- Creation of the network infrastructure for the access to the supercomputer "SKIF" resources.

- Creation of the corporate library network of Republic of Belarus.

- Creation of the telecommunication network of Belarusian Space System of the Remote Sensing of Earth.

- Creation of the telecommunication subsystem for the provision of the customers of Russia and Belarus with the space information.
- Designing of the project of BASNET modernization.

To fulfill the main aims of the BalticGrid-II project as the EGEE segment (#223807 of FP7-INFRASTRUCTURES-2007-2 Call) the UIIP NASB has a plan to achieve 1-10 Gbps connection to GÉANT and 1-2 Gbps connection to regional nodes in 2-3 years according to the national SKIF-Grid program and based on Porta Optica Study project results. At the end of 2007 the first tender of equipment purchase for BASNET modernization was held to ensure link speed no less than 10 Gbps in all these directions.

The first equipment delivery contract was executed at the beginning of December 2007 and modernization of interaction node of BASNET network with external networks for the means of traffic management with the speed up to 10 Gbps will be completed at the end of 2008.

2.1.3. BASNET topology

BASNET is based on 20 basic network nodes, 15 of which are connected by high-speed fiber-optic channels (about 40 km) transmitting data throughout the network with the speed of 100-1000 Mbps. BASNET provides full range of different services starting from dial-up and ADSL connections to wireless and leased line connections with various speeds. They provide e-mail, hosting, VPN, DNS services, depository and e-catalogue for Belarusian libraries.

Important aspect of functioning of BASNET is that network users are paying for the Internet access only. Network interaction with all organizations connected to scientific information computer network of the Republic of Belarus and BASNET network is ensured on free of charge basis and rate of data exchange is limited by the physical link speed only.

BASNET and UNIBEL lease links to the regional cities (currently up to 2Mbps). In the regional cities the services are organized mostly by leasing lines from PTT (see Fig. 1). The other R&D and Education networks are mainly serving for the Minsk region. They all have quite similar structures.
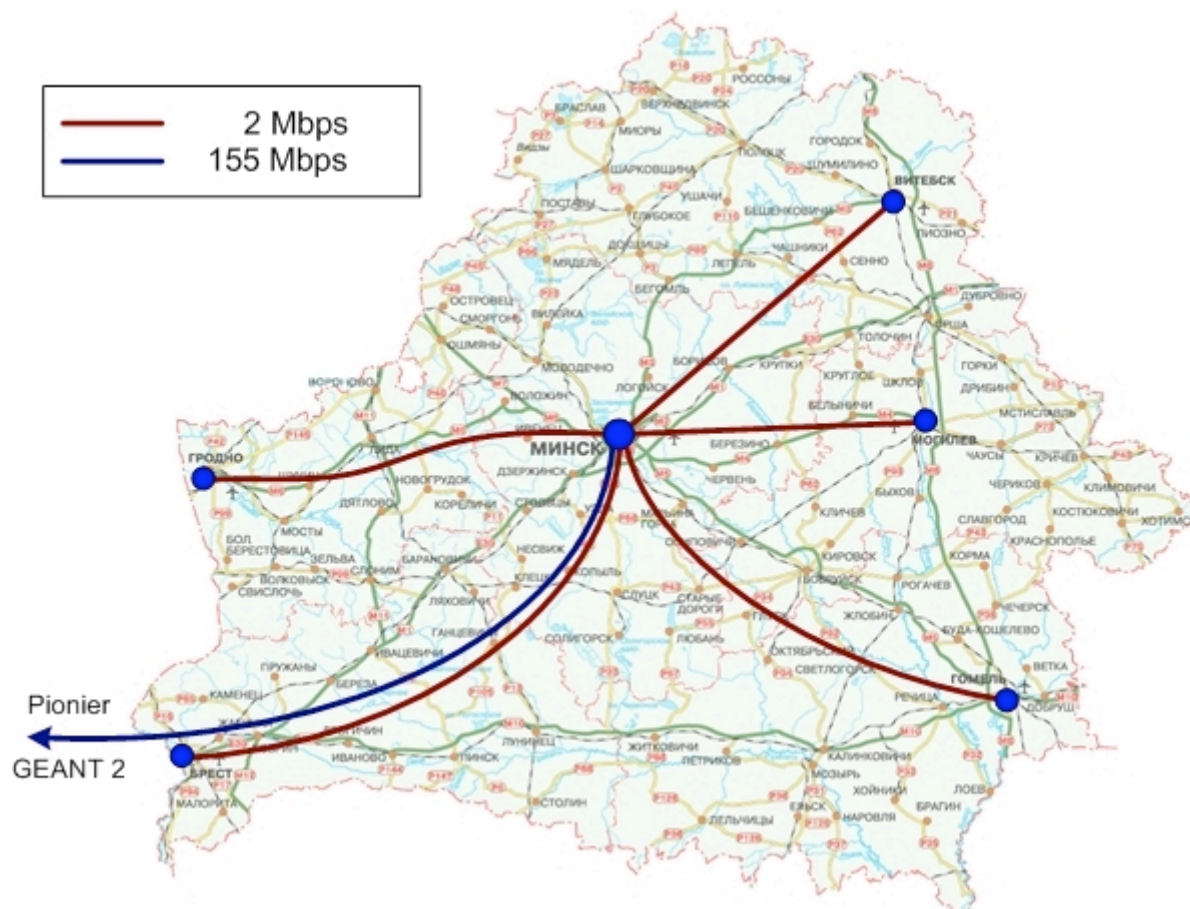
Fig. 1 Regional BASNET topology

2.2. INTERNATIONAL CONNECTIVITY

At the moment of writing this deliverable formally BASNET is not a member of GÉANT2 network (see Fig. 3).
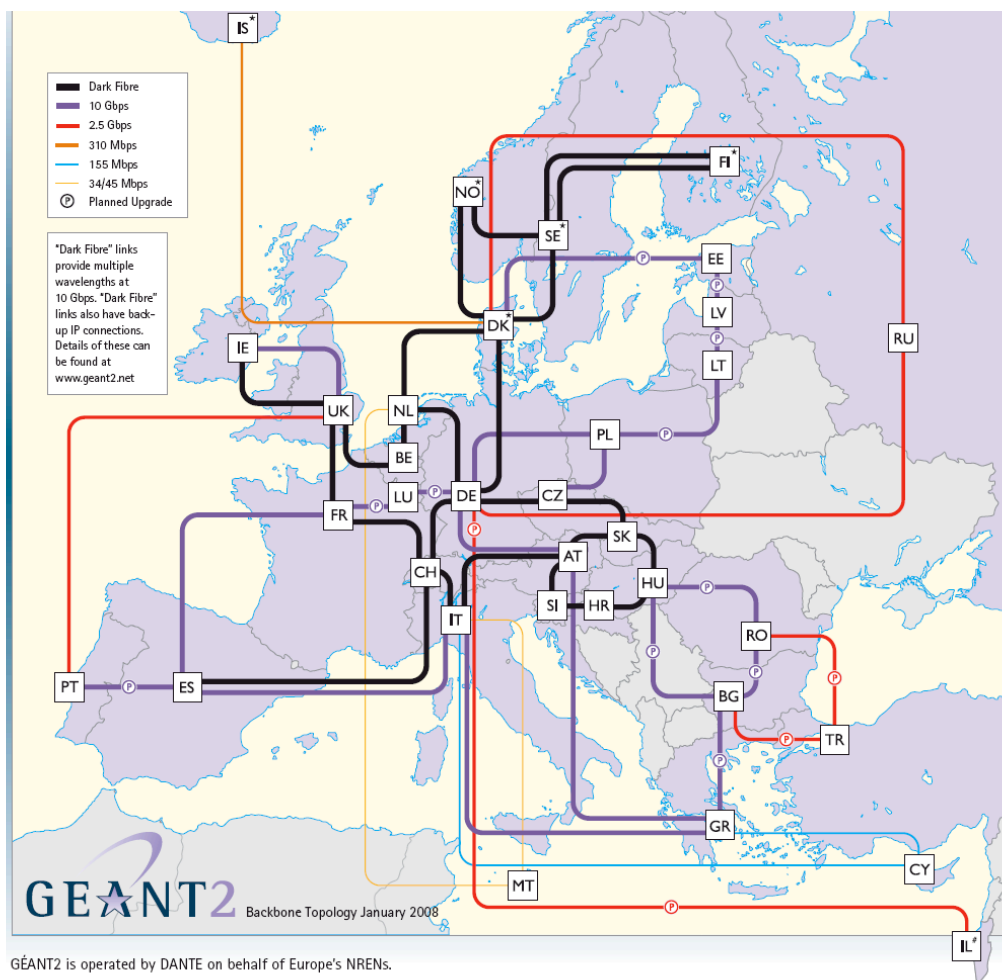
Fig. 3 GÉANT2 network topology

In the beginning of 2004 the Policy Committee (PC) of GÉANT kindly allowed Belarusian NREN BASNET to connect to GÉANT network through Polish NREN PIONIER. Link to PIONIER was officially established on 16 August 2004. Connection was organized through PIONIER node in Poznan Supercomputing and Networking Center (PSNC) through the channel rented at Polish PTT "TPSA" and PTT "Beltelecom" (Belarus) with the bandwidth of 34 Mbps.

In 2006 the leased channel bandwidth was increased to 155 Mbps over Polish PTT "Exatel". Transit connectivity between GÉANT and Belarusian NREN is guaranteed by the agreement with PSNC and GÉANT PC permission. Connection to GÉANT and PIONIER has allowed to increase the volume of the external traffic of the scientific-educational organizations of Belarus and has considerably increased quality of access to global computer networks as well as has opened new opportunities for the international cooperation in scientific and educational spheres.

Belarus NREN is an associated partner in GN-3 project proposal, which was submitted to the EC on 11 September 2008 and invited to the negotiations in October 2008. While the GN-3 project is not confirmed yet, Belarus NREN has negotiated prices for GEANT upgrade to 622 Mbps to Poznan for the year 2009.

2.3. AVAILABILITY OF NETWORK SERVICES

Daily statistics of utilisation of the channel BASNET-GÉANT2 can be seen in Fig. 5, but daily statistics of availability and response time of the channel BASNET-GÉANT2 in Fig. 7.
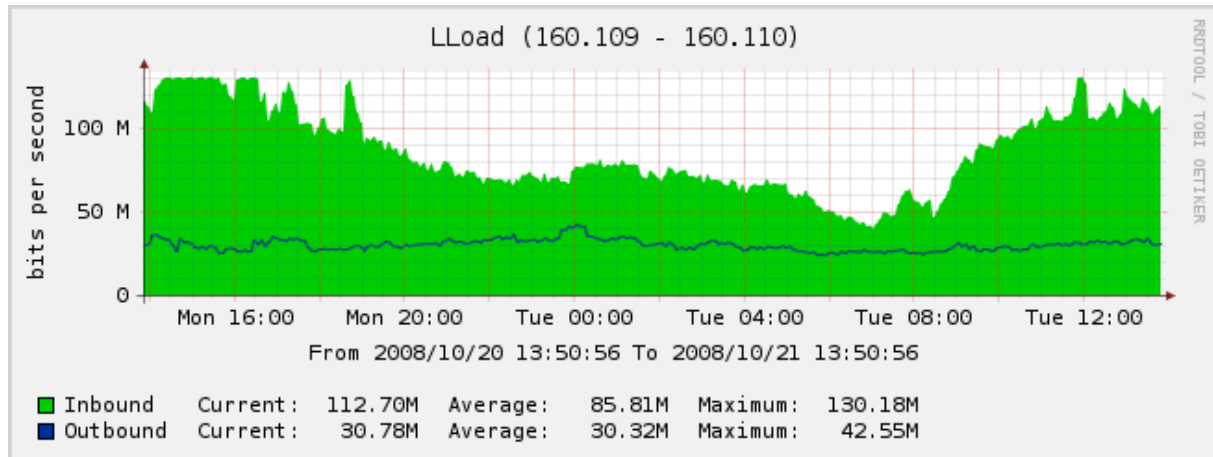

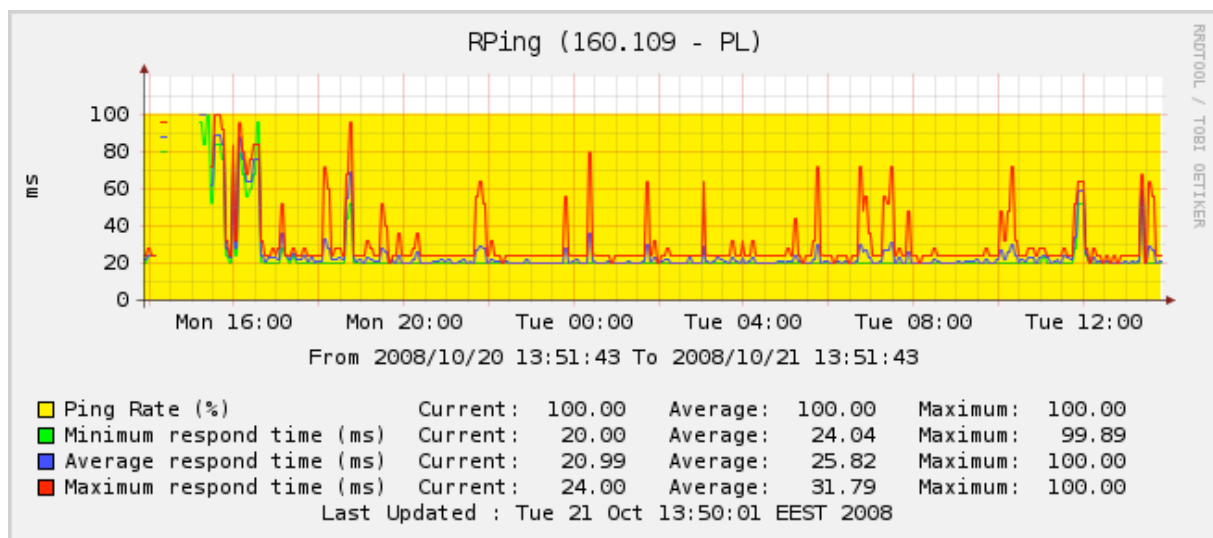**Fig. 5 Daily statistics of utilisation**

Fig. 7 Daily statistics of availability

It can be observed that the current bandwidth does not have enough capacity for future expansion. The awaited upgrade of the channel to 622Mbps will provide reserve for initial Grid users.

3. NETWORK REQUIREMENTS FOR BELARUS APPLICATIONS

Initial study of the requirements of applications run by scientists and researchers in Belarus does not show high demand for network throughput. Although there is a need to submit multiple jobs, there is no dependency between these jobs. Thus, network performance will not have high influence on the general output and results.

There is the following software used (or will be used) in Belarus:

- TINKER – molecular design.
- GROMACS, LAMMPS, AMBER, CHARMM – molecular dynamics.
- LS-DYNA – multi-physics simulation.
- ADAMS – motion simulations.
- ANSYS – engineering simulation.
- STARCD – multi-physics simulations.

Application name	Dataset size	Min. number of nodes	SEs communicate
TINKER	Up to 10 MB	1	low
GROMACS, LAMMPS, AMBER, CHARMM	Up to 100 MB	1	low
LS-DYNA	Up to 500 MB	1	high
ADAMS	Up to 200 MB	1	medium
ANSYS	Up to 100 MB	1	low
STARCD	Up to 100 MB	1	low

However, some applications under development (by local organizations) have indicated the requirement of up to 1Gbps bandwidth. This requirement is not well justified by other parameters like file size, data amount, real-time processing, etc.

Still, since network requirements and current technologies develop towards high-speed data transfer, it has to be noted that 1Gbps network requirement has to be taken into account.

4. DEMARCATION POINTS IN BELARUS AND THEIR CONNECTIVITY

There are the following demarcation points identified in Belarus:

1. Name of Demarcation point: **Access Node UIIP**
   Address, Floor, Room, Rack number: Akademicheskaya str. 1, floor 1, room 101, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 10 Gbps

2. Name of Demarcation point: **Access Node BNTU**
   Address, Floor, Room, Rack number: Akademicheskaya str. 1, floor 1, room 101, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

3. Name of Demarcation point: **Access Node BSUIR**
   Address, Floor, Room, Rack number: P.Brovki str. 17, floor 2, room 204, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

4. Name of Demarcation point: **Access Node Grodno**
   Address, Floor, Room, Rack number: Zaharova str. 55, floor 2, room Belpak, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

5. Name of Demarcation point: **Access Node Sosny (in planning)**
   Address, Floor, Room, Rack number: Marx str. 29, floor 1, room 107, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

5. CONCLUSION OF SERVICE LEVEL AGREEMENT

Service Level Agreement between BalticGrid-II and BASNET was prepared on the basis of the existing SLAs between BalticGrid and EENet, SigmaNet and LITNET.

The SLA consists of two parts:

1) General provisions – this part sets out the substantive clauses of the cooperation between BASNET and the BalticGrid-II project. These provisions also serve as guidelines to the interpretation of the specific provisions of the Agreement;

2) Specific provisions - technical service parameters which can be offered and/or ordered.

General provisions of the SLA contain Administrative Level Objects (ALO) that includes general information related to parties and the agreement itself:

- requisites of the Parties;

- purpose of the Agreement (includes the clause about the chosen SLA type);

- responsibilities of the parties: who is responsible for what, who are the contact persons, what are the expected reaction times of helpdesks etc.

- modification and termination of the Agreement.

This part serves as a legal basis of the cooperation.

Specific provisions of the SLA contain Service Level Objects (SLO), i.e., regarding of the SAL type chosen Specific provisions list the actual technical service parameters which can be offered and/or ordered.

Agreement has been signed by parties in 30 October 2008 during the first All-Hands Meeting held in Minsk. The text of the SLA is given in the Appendix A.

6. BALTICGRID MONITORING PORTAL UPDATES

Information on the network infrastructure and available monitoring data is collected on-line at http://gridimon.balticgrid.org. The first page shows geographical position of the Baltic countries and Belarus.
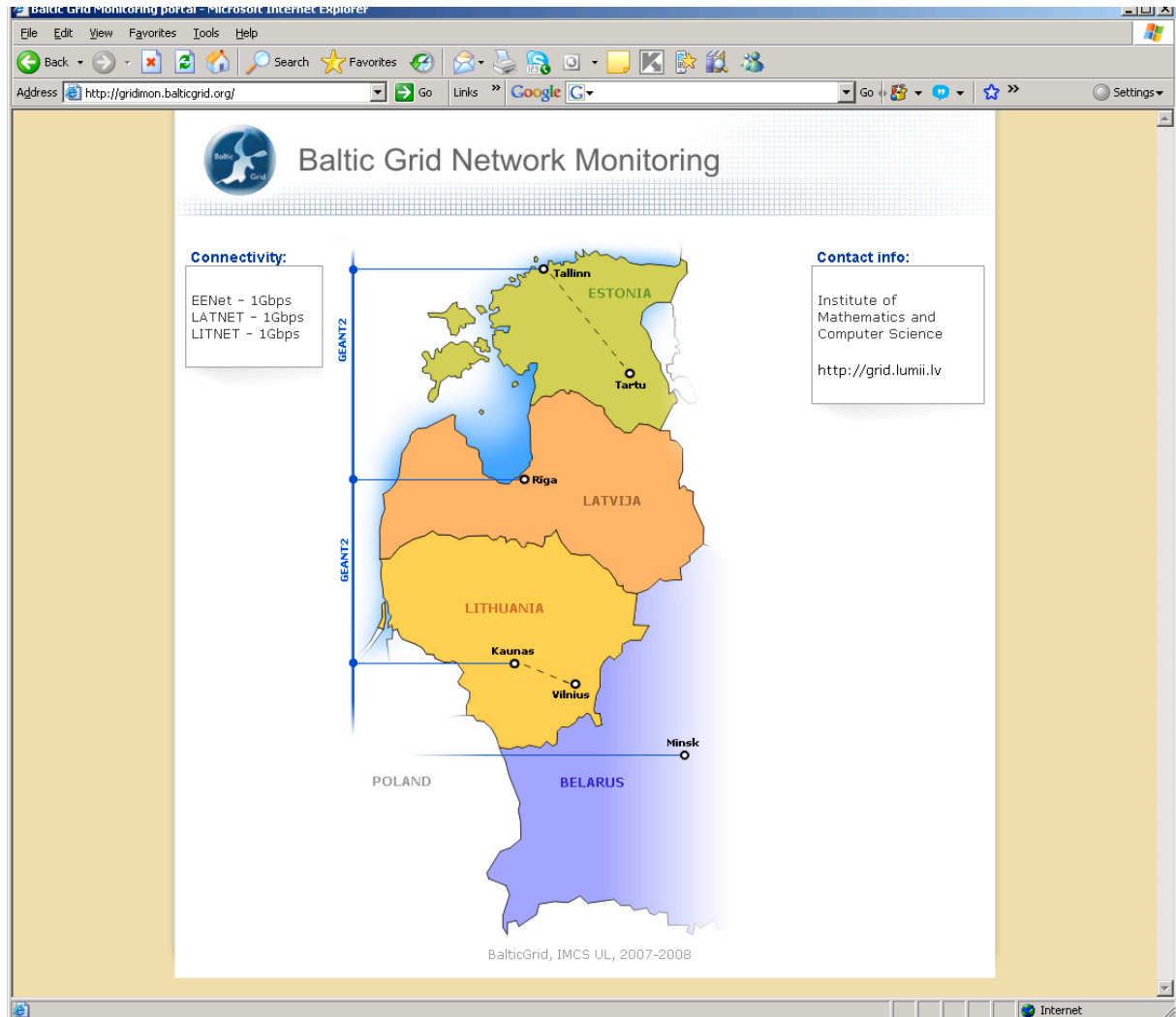

Fig. 9 Homepage of gridimon.balticgrid.org

By clicking on each country more detailed information on network topology is available. By adding Belarus to the BalticGrid infrastructure, detailed map of Belarusian Grid network has been developed.
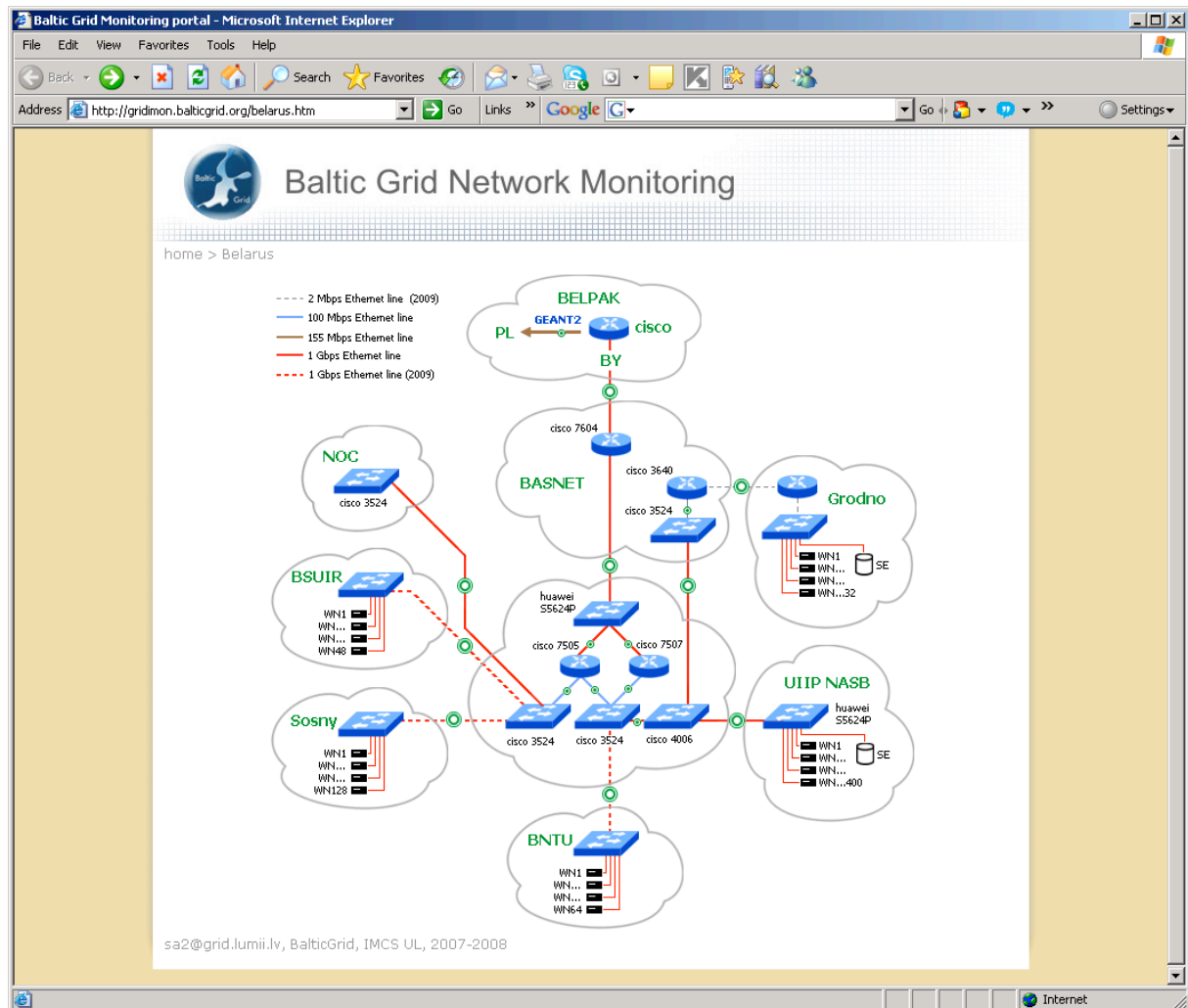
Fig. 10 Belarusian Grid network infrastructure view

By clicking on each link it is possible to view available graphical information.
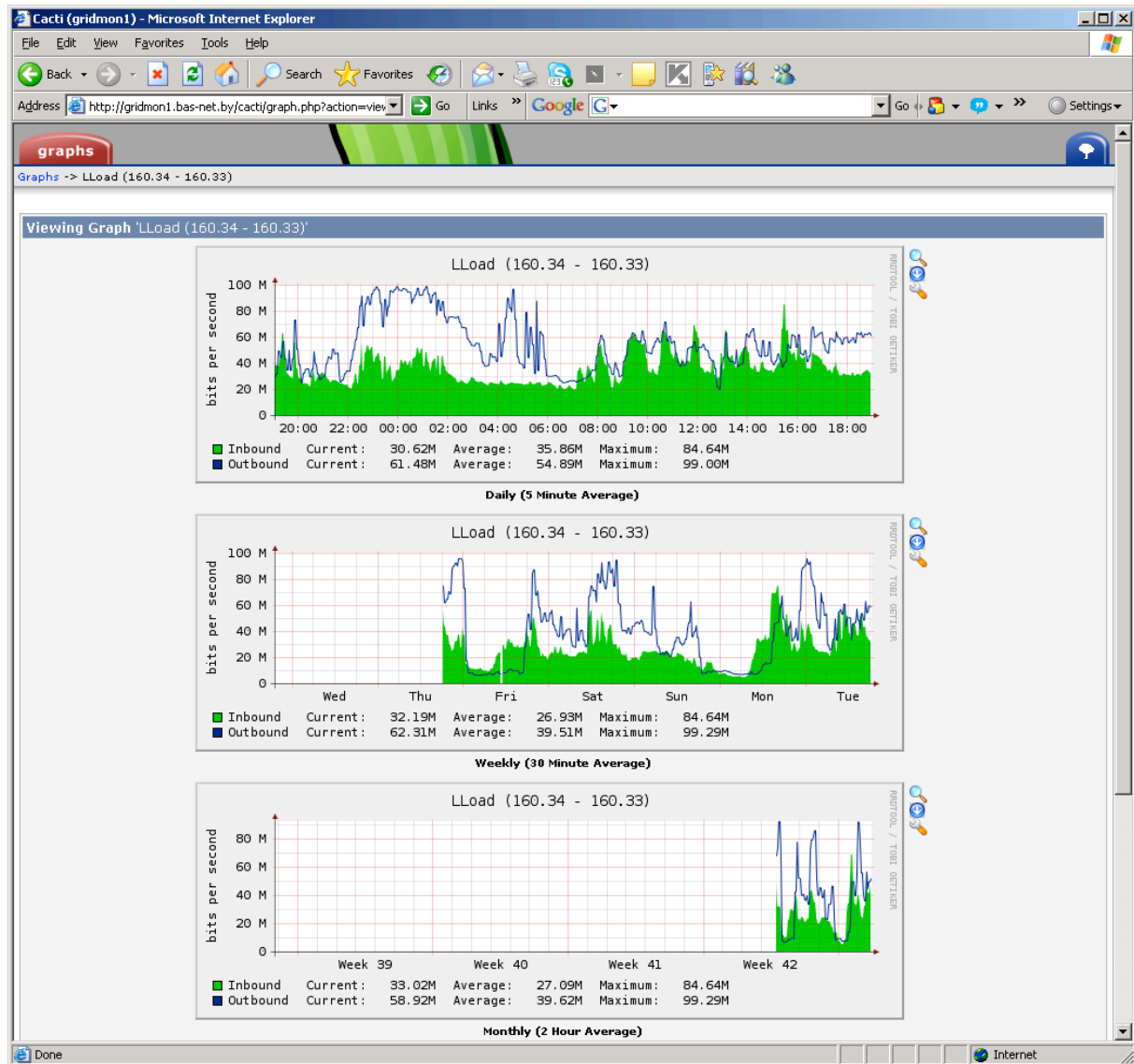
Fig. 11 rping data sample

Fig. 12 Traffic data sample

7. CONCLUSIONS

Grid network infrastructure of BASNET is successfully included into the infrastructure of BalticGrid-II.

Service Level Agreement between BalticGrid-II and BASNET has been signed. Belarusian Grid network diagram has been successfully added to the BalticGrid-II network monitoring portal at http://gridimon.balticgrid.org. It allows the monitoring of SLA adherence.

Future upgrades of the connection of Belarusian network to the European Academic Network GÉANT2 and participation of BASNET in the GN3 project in the status of associate member will ensure the future sustainability of the network and enough resources for academic and, particularly, Grid users.

APPENDIX A

SLA between BalticGrid-II and BASNET

SERVICE LEVEL AGREEMENT Nr. SA2-2008/10-01

GENERAL PROVISIONS

30 October 2008

BalticGrid-II

Full name	BalticGrid Consortium (FP7 project #223807)
Represented by	Åke Edlund
Position	BalticGrid Project Director, KTH PDC, 100 44 Stockholm, Sweden

and

NREN

Full name	United Institute of Informatics Problems
Represented by	Uladzimir Anishchanka
Position	Deputy Director

hereinafter referred to as Parties define the service level agreed to be provided by NREN to BalticGrid-II users.

ARTICLE 1- PURPOSE AND GOALS OF THE SLA

The purpose of this SLA is twofold. First, it is to establish a partnership between BalticGrid-II project and NREN in order to provide high quality services to BalticGrid-II users in the respective country. Second, to ensure that future development of resource demanding Grid applications within the BalticGrid-II project will not affect other academic users of the NREN. For the duration of the BalticGrid-II project the capacity requirement is projected to be 1Gbps for each BalticGrid-II resource centre (cluster).

The goals of this Agreement are as following:

- to express mutual understanding of the principles of cooperation between parties;

- to define responsibilities of each party;

- to set procedures for monitoring activities;

- to define network requirements;

- to establish problem reporting procedure and problem response procedures and time.

ARTICLE 2-DEFINITIONS

- Network requirements – collection of parameters that have to be implemented in order to guarantee successful operation of the applications within this network;

- Fair and Reasonable use – the use of the network that corresponds to the goals of the BalticGrid project, policies defined in this Agreement, netiquette, and acceptable practice in the respective country;

- ART-management – Quality of Service according to Amber, Rock and Timber levels;

- BalticGrid-II resource centres – a collection of nodes supported by an organisation in the BalticGrid-II;

- BalticGrid-II users – researchers that run their applications on the BalticGrid-II resource centres;

- NRR – Network Resources Request;

- Monitoring activities – activities performed by NREN and BalticGrid-II project participants that measure the actual status of the networking processes and their correspondence to the network requirements defined in this Agreement.

ARTICLE 3 - TERM OF AGREEMENT

The period for the agreement shall be effective from 1 February 2009 by 30 April 2010. Periodically, according to clauses in the ARTICLES 6 and 7, both Parties will review the benefits of continuing the SLA and take one of the following actions:

1. Terminate the SLA,

2. Modify the General provisions of the SLA, or

3. Modify the Specific Provisions of the SLA.

ARTICLE 4 – DUTIES AND RESPONSIBILITIES OF PARTIES

BALTICGRID: CHARACTERISTIC DUTIES AND RESPONSIBILITIES

1. Provides all necessary help to NREN in order to ensure service availability to BalticGrid-II users. Gives to NREN a full list of BalticGrid-II resource centres in the respective country.

2. Informs NREN about new resource centres within 3 (three) working days;

3. Responds to NREN information requests necessary for accomplishment of this Agreement in due time but not later than 5 (five) working days. Urgent requests (specified so by NREN) shall be answered as soon as possible but not later than in 2 (two) working days.

4. Ensures that BalticGrid-II resource centres make the necessary instalments and configuration of their clusters and local network..

5. BalticGrid-II contact persons:

   Administrative contact person: Guntis Barzdins, guntis.barzdins@sigmanet.lv

Technical contact person: Martins Libins, martins.libins@sigmanet.lv

NREN: CHARACTERISTIC DUTIES AND RESPONSIBILITIES

1. Ensures service availability and best possible network performance for the BalticGrid-II resource centres identified by BalticGrid-II and BalticGrid-II users.

2. Does not provide configuration and instalment of a local network for BalticGrid-II resource centres.

3. Is not responsible for the service availability in the local network of the organisation maintaining resource centre.

4. Responds to and resolves problems reported by BalticGrid-II Technical contact person by e-mail in due time:

   a. **Breakdown**: more than 90% BalticGrid users in the respective country are not able to use the infrastructure of NREN or are not able to connect to more than 50% of BalticGrid clusters in this country. Response time (high priority): 2 hours;

   b. **Broken international connection**: BalticGrid users/clusters in the respective country are not able to exchange data via international link. Response time (Medium priority): 4 hours;

   c. **Broken link**: BalticGrid users at the specific organisation are not able to use the infrastructure of NREN. Response time (Medium-Low priority): 8 hours.

5. NREN contact persons:

   Administrative contact person: Sergey Aneichik, aneichik@basnet.by

   Technical contact person: Oleg Moiseichuck, berroll@bas-net.by

DEMARCATION POINTS

1. Name of Demarcation point: **Access Node UIIP**
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   Planned capacity of the connection: 10 Gbps

2. Name of Demarcation point: **Access Node BNTU**
   Address, Floor, Room, Rack number: Akademicheskaya str. 1, floor 1, room 101, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

3. Name of Demarcation point: **Access Node BSUIR**
   Address, Floor, Room, Rack number: P.Brovki str. 17, floor 2, room 204, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

4. Name of Demarcation point: **Access Node Grodno**
   Address, Floor, Room, Rack number: Zaharova str. 55, floor 2, room Belpak, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

5. Name of Demarcation point: **Access Node Sosny (in planning)**
   Address, Floor, Room, Rack number: Marx str. 29, floor 1, room 107, rack 1
   Type of interface: Ethernet
   Planned capacity of the connection: 1 Gbps

ARTICLE 5 – MONITORING SLA ADHERENCE

Both NREN and BalticGrid-II monitor the compliance of actual network resources to the network requirements defined in the Specific provisions of this Agreement.
Results are collected and analysed on a monthly basis. Results might serve as a proof to the need to modify the SLA.

ARTICLE 6 – TERMINATION OF THE SLA

Either party may terminate this agreement provided that the terminating party first notifies the other party in writing of the exact nature of such decision giving the other party ten (10) days in which to cure the cause for such an action if it is caused by its actions. Agreement is considered terminated if other party does not reply or expresses an acceptance of the termination.

If a party which receives a termination notice from the other party does not agree to terminate the agreement, it notifies the other party and proposes amendments or modifications of the agreement or a new agreement.

If a consensus between parties is not reached in 2 (two) months, the agreement is considered to be terminated.

ARTICLE 7 – MODIFICATION OF THE SLA

Modification of the agreement might be initiated if NREN considers changing Specific provisions of the Agreement from ART-management to Over-provisioning.

Modification of the agreement is to be made if NREN does not meet network requirements defined in Specific provisions of the Agreement for Over-provisioning. In this case Specific provisions must be changed to ART-management.

Either party may invoke modification procedure by sending fully phrased amendment of a clause in writing to the other party. The party receiving a written proposal of modification, within 10 (ten) days accepts, alters or rejects modifications notifying the other party in written.

Modifications are in force when both parties sign an amendment to the Agreement.

ARTICLE 8 – DISPUTE RESOLUTION

All disputes arising under this Agreement shall be discussed the Parties within 30 working days after the issue has arisen or been identified.

If the dispute cannot be resolved within the said period, the Agreement shall be terminated or modified.

SPECIFIC PROVISIONS (Over-provisioning)   - **APPLICABLE**

1. Under this Agreement NREN will provide the following International connectivity to GEANT network:

- Packet loss: < 0.1%

- One-way delay between the BalticGrid-II resource centres is in the range of 20-50ms, but does not exceed 150 ms under any conditions.
- MTU of at least 1500 bytes all along the traffic path.
- Minimal jitter by avoiding extra routing/buffering hops on the path.
- Traffic load does not exceed 75% of available bandwidth for more than 10% a month.
- Available bandwidth should be increased so that traffic load does not exceed 50%.

2. In the case of non-compliance to the specified network requirements, NREN shall increase the capacity of their international connection or support ART-management.

SPECIFIC PROVISIONS (ART-management)   - **NOT APPLICABLE**

1. Under this Agreement NREN will provide Quality of Service management for the following levels:

- Amber.
    - Corresponds to GÈANT Premium IP.
    - Does not exceed 10% of total GÈANT connection capacity.
    - One-way delay does not exceed 100ms (distance delay + 50ms).
    - Jitter does not exceed 25ms.
    - No packet loss.
- Rock
    - Corresponds to GÈANT BE traffic class.
    - Traffic is rate-limited to Grid traffic + other GÈANT traffic < 85% of total GÈANT capacity.
    - One-way delay does not exceed 200ms.
    - Packet loss < 1%.
- Timber
    - Corresponds to LBE traffic in GÈANT.
    - Uses capacity unused by Amber and Rock traffic classes.
    - Might be rate-limited.
    - Packet loss: unspecified

2. The request for the specific level is to be submitted by BalticGrid-II not later that 3 (three) working days before the level has to be implemented.

3. NREN may propose to change the Specific provisions to Over-provisioning if monitoring results provide enough evidence.

BaltisGrid-II representative   NREN representative

_____   _____

Signature, Date   Signature, Date