КОМПЬЮТЕРНЫЕ ТЕХНОЛОГИИ В ФИЗИКЕ

NETWORK AND COMPUTING INFRASTRUCTURE FOR SCIENTIFIC APPLICATIONS IN GEORGIA

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Status of network and computing infrastructure and available services for research and education community of Georgia are presented. Research and Educational Networking Association (GRENA) provides the following network services: Internet connectivity, network services, cyber security, technical support, etc. Computing resources used by the research teams are located at GRENA and major state universities. GE-01-GRENA site is included in European Grid infrastructure. Paper also contains information about programs of Learning Center as well as research and development projects in which GRENA is participating.

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INTRODUCTION

The e-infrastructure layers for research and education include: communication networks; Distributed Grid Computing, High Performance Computing (HPC) and scientific Clouds; scientific data–data management systems, data repositories, e-libraries, etc. All these layers are forming research environment enabling a shared access to unique or distributed scientific facilities (including data, instruments, computing, and networks). Taking into account European models, National Research and Education Network (NREN) and National Grid Initiative (NGI) have been established in Georgia [1]. They are actively participating in the regional and European projects, including initiatives focused on integration in the European e-infrastructures.

NETWORK AND COMPUTING FACILITIES

GRENA owns fiber-optic based network infrastructure connecting 45 research and education institutions of Georgia. The following services are provided to users:
- Internet connectivity:
— managed and guaranteed bandwidth (QoS);
— Virtual Private Network (VPN);
— network traffic monitoring and analyses (Nfsen, Nagios, Cacti).
- Network services:
— E-mail, Web-hosting, FTP;
— virtual servers;
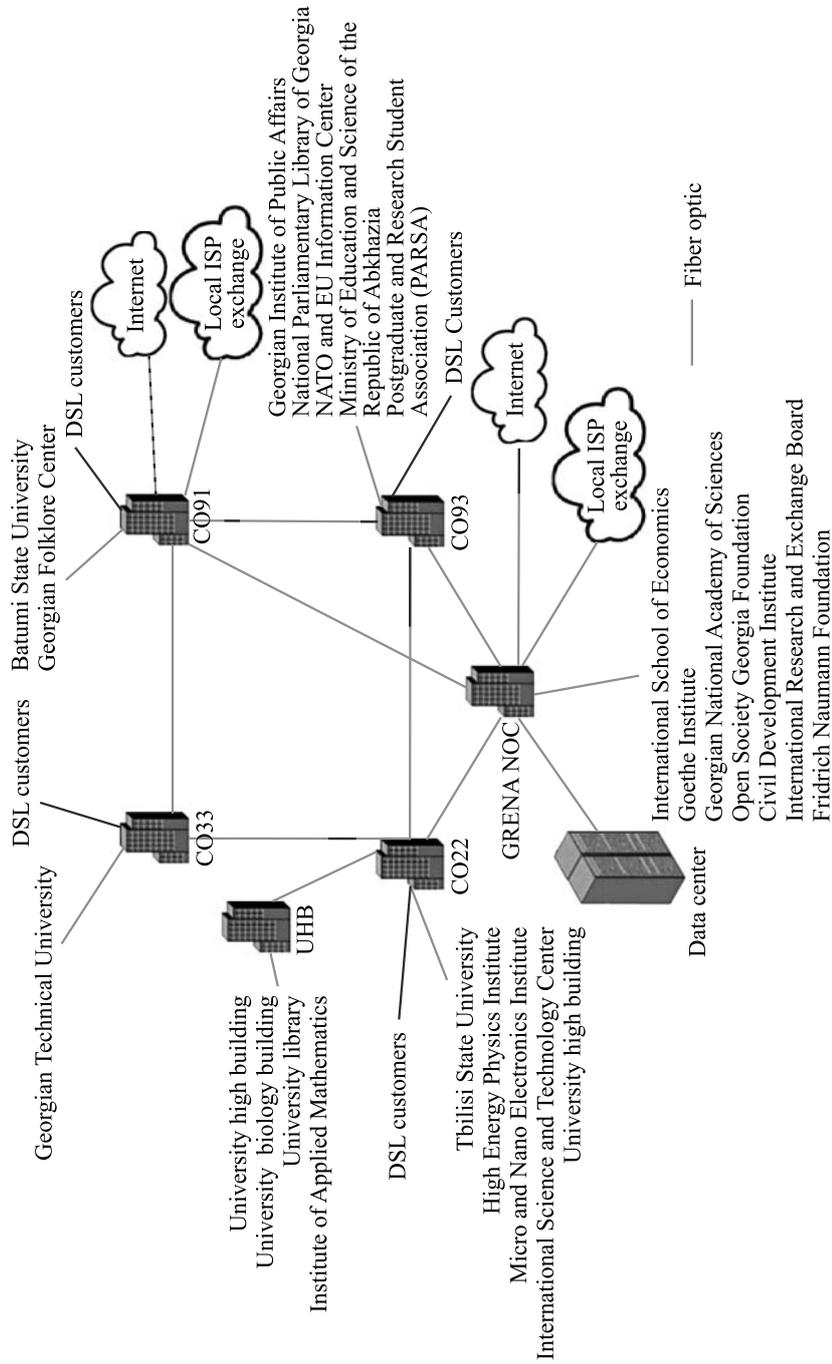
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Fig. 1. Schematic view of GRENA network

Internet

Local ISP exchange

DSL customers

Batumi State University
Georgian Folklore Center

CO91

Georgian Institute of Public Affairs
National Parliamentary Library of Georgia
NATO and EU Information Center
Ministry of Education and Science of the
Republic of Abkhazia
Postgraduate and Research Student
Association (PARSA)

DSL Customers

CO93

Internet

Local ISP exchange

GRENA NOC

International School of Economics
Goethe Institute
Georgian National Academy of Sciences
Open Society Georgia Foundation
Civil Development Institute
International Research and Exchange Board
Fridrich Naumann Foundation

Data center

DSL customers

Georgian Technical University

CO33

University high building
University biology building
University library
Institute of Applied Mathematics

UHB

CO22

DSL customers

Tbilisi State University
High Energy Physics Institute
Micro and Nano Electronics Institute
International Science and Technology Center
University high building

——— Fiber optic

— H.323 based videoconferences;

— e-learning system based on Moodle and Math-bridge.

• Network security:

— intrusion detection and prevention systems (Sophos UTM, Snort);

— computer Emergency Response Team — CERT-GE (member of Trusted Introducer TI);

— software licenses.

• Technical support — hot-line.

Schematic view of GRENA network infrastructure in Tbilisi is represented in Fig. 1.

GRENA is participating in GEANT projects. GEANT is European research and education network interconnecting European National Research and Education Networks. The GEANT project has grown during its iterations (GN1, GN2, GN3, GN3plus, and now GN4-1) to incorporate not only the award-winning 500 Gbps pan-European network but also a catalogue of advanced, user-focused services and a successful programme of innovation that is pushing the boundaries of networking technology to deliver real impact to over 50 million users [2].

The goal of the new European Union EaP Connect project is the integration of research and education networks from Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine into GEANT network. GEANT Limited is a coordinating partner. Project will provide large capacity increase and fulfill connectivity requirements of Eastern Partnership Countries. Project foresees implementation of GEANT network services (eduGAIN, eduroam, etc.) in EaP countries. In addition, access to scientific publications and databases will be provided. The total budget of the project is 13.7 MEUR. The funding scheme is the following: 95% of expenses will be covered by EU (DG NEAR) and 5% by six beneficiary NRENs. Project was approved in June 2015. At the initial stage, 1 Gbps connectivity to GEANT for GRENA network will be established in February 2016 with future upgrade up to 10 Gbps (Fig. 2).
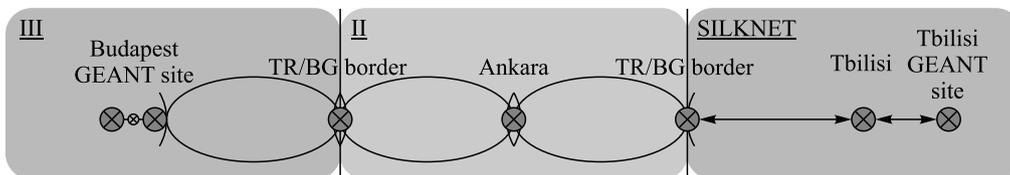

Fig. 2. GEANT connectivity scheme for GRENA network

Computing resources of GRENA are presented below:

Number of sites	Logical CPU	Storage capacity TB	Supported VOs	Digital certificates
2	272	35	6	CA

In cooperation with Tbilisi State University, Certification Authority (CA) was established. The average availability and reliability of the GE-01-GRENA Grid site is more than 99% (Fig. 3).

GRENA computing infrastructure is used in several scientific investigations and modeling:

— Advanced Research WRF (ARW) modeling system for weather research and forecasting for Georgia;

— investigation of highly mono-energetic low Z ion beams production at GeV energies with very small divergence angle using extremely high intensity laser beams;
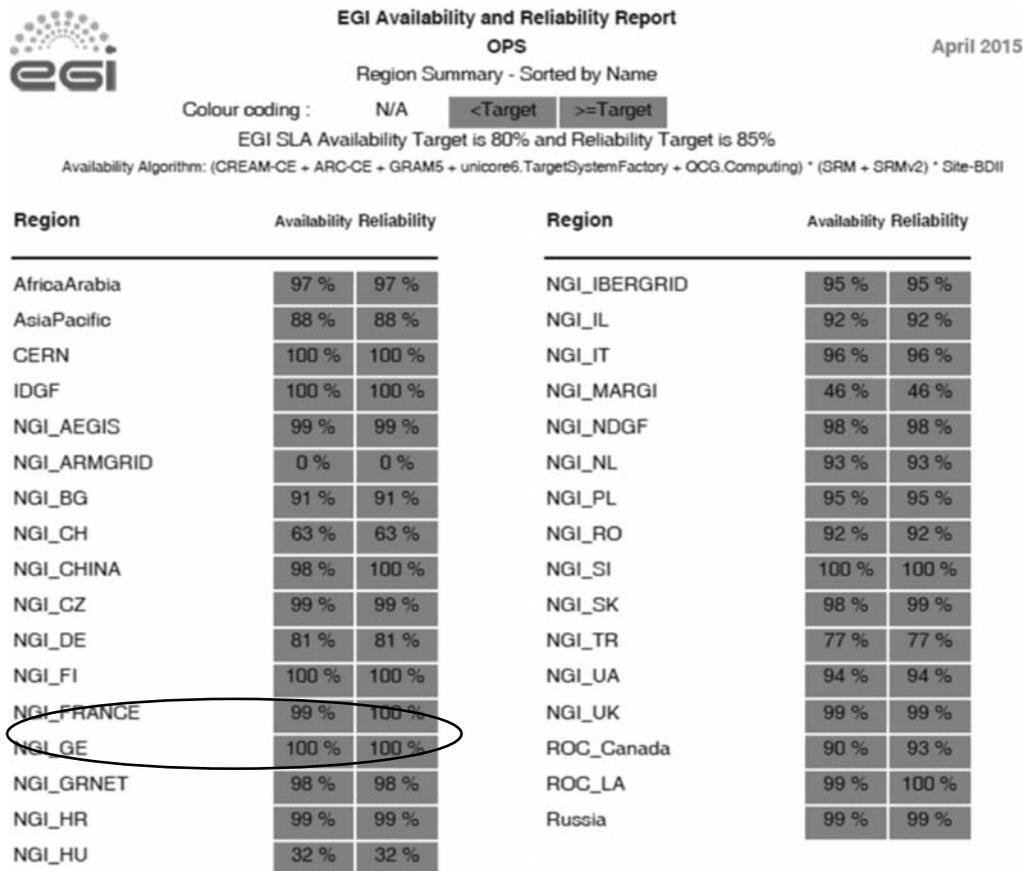
EGI Availability and Reliability Report
OPS
Region Summary - Sorted by Name
April 2015

Colour coding : N/A <Target >=Target
EGI SLA Availability Target is 80% and Reliability Target is 85%
Availability Algorithm: (CREAM-CE + ARC-CE + GRAM5 + unicore6.TargetSystemFactory + QCG.Computing) * (SRM + SRMv2) * Site-BDII

Region	Availability	Reliability	Region	Availability	Reliability
AfricaArabia	97 %	97 %	NGI_IBERGRID	95 %	95 %
AsiaPacific	88 %	88 %	NGI_IL	92 %	92 %
CERN	100 %	100 %	NGI_IT	96 %	96 %
IDGF	100 %	100 %	NGI_MARGI	46 %	46 %
NGI_AEGIS	99 %	99 %	NGI_NDGF	98 %	98 %
NGI_ARMGRID	0 %	0 %	NGI_NL	93 %	93 %
NGI_BG	91 %	91 %	NGI_PL	95 %	95 %
NGI_CH	63 %	63 %	NGI_RO	92 %	92 %
NGI_CHINA	98 %	100 %	NGI_SI	100 %	100 %
NGI_CZ	99 %	99 %	NGI_SK	98 %	99 %
NGI_DE	81 %	81 %	NGI_TR	77 %	77 %
NGI_FI	100 %	100 %	NGI_UA	94 %	94 %
NGI_FRANCE	99 %	100 %	NGI_UK	99 %	99 %
NGI_GE	100 %	100 %	ROC_Canada	90 %	93 %
NGI_GRNET	98 %	98 %	ROC_LA	99 %	100 %
NGI_HR	99 %	99 %	Russia	99 %	99 %
NGI_HU	32 %	32 %			

Fig. 3. Availability and reliability statistics

— quantum-chemical modeling of proton transfer in nitrogen containing biologically active compounds using Density Function Theory (mutation processes in DNA);

— high-resolution climate scenarios construction using Regional Climate Model. The RegCM v4.3 model was adopted for the South Caucasus region and executed for various time periods and boundary conditions on 20 Km grid;

— quantum-chemical description of influence of the R-groups on the formation of peptide bond;

— calculations of tumor cells concentration in the points taking into account proliferation migration and angiogenesis.

EDUCATION PROGRAM AND PROJECTS

GRENA Learning Center provides certified courses and vendor-based certification to students. Education program has the following directions:
— Cisco Networking Academy;
— Linux Professional Institute (LPI) Learning Center;
— Juniper Academy;

Fig. 4. http://elearning.grena.ge/

— Oracle Certified courses;

— Distance Learning Center;

— Pearson VUE Authorized Certification Center.

The e-Learning management system (LMS) of GRENA is based on Moodle platform (Fig. 4). In addition, Math-bridge system for teaching Mathematics is installed at GRENA and used by the students of Georgian universities.

GRENA has 15 years of successful experience in management and participation in international and local projects (Ministry of Education and Science of Georgia — 6 projects, European Commission — 15 projects, NATO Science for Peace and Security Programme — 14 projects, International Science & Technology Center — 2 projects, etc.). Currently GRENA is participating in implementation of several EU projects:

— FP7 — Bringing the EU-EECA cooperation and policy dialogue in ICT in the HORIZON 2020 era (EECA-2-HORIZON);

— TEMPUS Programme — Modernization of Mathematics curricula for Engineering and Natural Sciences studies in South Caucasian Universities by introducing modern educational technologies (MathGeAm);

— HORIZON 2020 — GN4-1 Research and Education Networking — GEANT (GN4-1);

— HORIZON 2020 — VRE for regional Interdisciplinary communities in South-East Europe and the Eastern Mediterranean (VI-SEEM);

— ENPI — EaP Connect.

CONCLUSIONS

GRENA provides network connectivity and services for research and education institutions of Georgia. In February 2016 connectivity to GEANT will be established with initial capacity of 1 Gbps. GRENA Grid and computation facilities are used in various scientific fields. Intensive education program is provided by GRENA Learning Center.

It should be noted that support from the Georgian Government, European Commission, and other donor organizations for the further development of e-infrastructure for education and science in Georgia is essential for the integration of scientific potential of Georgia into the European Research Area.

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2. http://www.geant.org/Projects/GEANT_Project_GN4-1/Pages/Home.aspx