Introduction of Armenian-Georgian Grid Infrastructures

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ABSTRACT
The grid infrastructure [1] is recognized today in Europe and worldwide, together with the high bandwidth networking, as one of the basic components of the e-Infrastructure of research and education. In order to ensure that the South Caucasus region would not stay behind in this important area, the deployment of appropriate Grid infrastructures are in process which will be accessible, at the same quality level, for all scientists and researchers independently of the physical locations of their institutes. The article introduces the Grid activities and networking infrastructures in Armenia and Georgia.

Keywords
Grid, Cluster, ArmNGI, GeoNGI, e-Infrastructures.

1. INTRODUCTION
Increasing demands of the advanced scientific research can be fulfilled only by exploiting the existing computation resources in a more efficient way, by means of on-the-fly coupling and dynamic on-demand allocation of resources. The grid infrastructure is recognized today in Europe and worldwide, together with the high bandwidth networking, as one of the basic components of the e-Infrastructure of research and education. Grid technology [2] aims to provide a solution for this problem. International Grid computing projects [3] and infrastructures are typically organized in multi-national ways, building on resources offered by several organizations and countries.

In addition to multi-national Grid infrastructures, Armenia and Georgia operate their own national Grid infrastructures (NGI) to support science and industry within national borders. These infrastructures have the benefit of better satisfying the needs of local, regional and national user communities. Particularly, in 2004, in the Institute for Informatics and Automation Problems of the National Academy of Sciences of Armenia (IIAP NAS RA) [4] the first high Performance computing cluster [5-6] in the South Caucasus region had been developed, which consists of 128 Xeon 3.06GHz (64 nodes) processors. In that period, the cluster was in the fifth place of the Top50 supercomputers in the New Independent State countries [7] by the 523.4GFlops performance. The article introduces the National Grid infrastructures in Armenia and Georgia, as well as Armenian-Georgian Grid segment.

2. Grid ACTIVITIES
Armenia and Georgia are participating in the EU FP7 Project South East European eInfrastructure for regional eScience (SEE GRID SCI) [8]. The South-East European eInfrastructure initiatives are committed to ensuring equal participation of the less-resourced countries of the region in European trends. SEE GRID SCI leverages the SEE eInfrastructure to enable new scientific collaborations among user communities. SEE GRID SCI stimulates widespread eInfrastructure uptake by new user groups extending over the region, fostering collaboration and providing advanced capabilities to more researchers, with an emphasis on strategic groups in seismology, meteorology and environmental protection.

The A-1606 Project entitled “Development of Armenian-Georgian Grid Infrastructure and applications in the fields of high energy physics, astrophysics and quantum physics” funded by International Science Technology Center (ISTC) [9] allows Armenian and Georgian communities to update existing Grid infrastructures in their countries and to deploy Armenian-Georgian Grid segment for the successful realization of regional tasks.

The Armenian leading research and educational institutions also involve in the ISTC Project A-1451 entitled “Development of Scientific Computing Grid on the Base of Armcluster for South Caucasus Region” [10].

Lately all interested units of Armenia (Presidium of the National Academy of Sciences, Ministry of Education and Science, State Engineering University of Armenia, Yerevan State University, Yerevan Physics Institute, Institute for Informatics and Automation Problems of the National Academy of Sciences, Armenian e-Science Foundation) [11] and Georgia (Georgian Research and Educational Networking Association, Georgian E.Kharadze National Astrophysical Observatory, Ivane Javakhishvili Tbilisi State University) have been established in order to deploy and operate sustainable national grid infrastructures.

The European Grid Initiative (EGI) [12] has the goal to provide a Europe-wide, sustainable Grid infrastructure that goes beyond the scope of traditionally funded Grid projects. This initiative foresees that each member country has only one Grid contact point organized as a National Grid Initiative, with the mandate to represent the scientific and Grid community of a country. Armenia and Georgia are participated in the policy board of EGI.

3. NETWORK INFRASTRUCTURES
The National Grid infrastructures based on network infrastructures operated by Academic Scientific Network of

Armenia (ASNET-AM) [13] and Georgian Research and Educational Networking Association (GRENA) [14].
GRENA was founded in 1999 with the purpose of joining efforts of organizations working in the computer networking field. The founders of GRENA are the Georgian National Academy of Sciences, five major state universities and Open Society-Georgia Foundation. Currently GRENA is providing information technology services (including Internet) to more than 140 research and educational institutions (see fig. 1) in four major cities of Georgia: Tbilisi, Kutaisi, Batumi and Telavi using different technology (fiber optic, DSL and wireless).

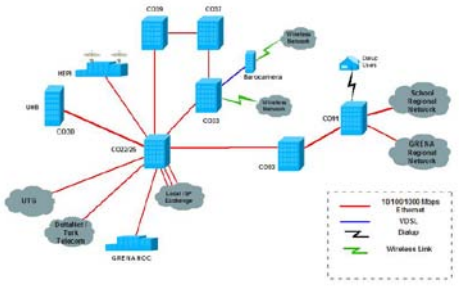

Fig. 1 Schematic view of GRENA Network in Tbilisi

ASNET-AM was created in 1994 by the Institute for Informatics and Automation Problems of the National Academy of Sciences of the Republic of Armenia (IIAP NAS RA). The ASNET-AM currently unifies academic, scientific, research, educational, cultural and other organizations, which are engaged in scientific and educational activity. The ASNET-AM infrastructure includes more than 50 organizations in 5 cities of Armenia, interconnected by wireless and wired (fiber-optics/copper) connections (see fig 2).

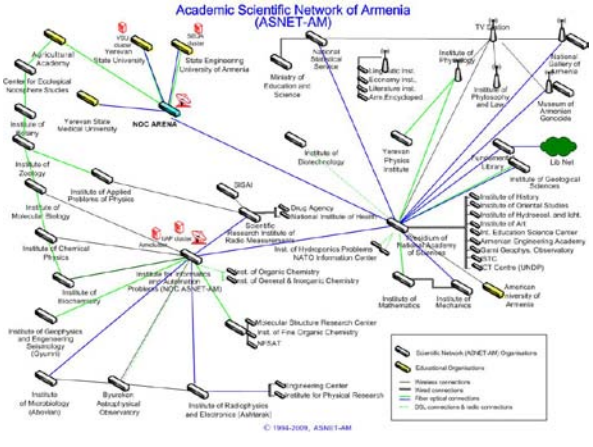

Fig. 2: Schematic view of ASNET-AM

In April 2009 the new fiber optic channels to the South Caucasus countries was established to GEANT according to the European Commission Black Sea Interconnection project [15].

4. GRID INFRASTRUCTURES

IIAP NAS RA (State Target Program funded by Armenian Government) and GRENA operate, support and manage a production quality Grid infrastructures that make computing, storage and informational resources accessible to users. The infrastructures also act as interface between national resource owners and major international projects. The infrastructures do this through human networking, by offering joint operations support, and by providing key middleware components for creating a virtual storage and computation entity leveraging national entities.
Different user communities and Virtual Organisations (VOs) are provided with access to facilities at many clusters in Armenia and Georgia and at other collaborating sites in a consistent way, according to agreed access management policies and service level agreements. The activity leverages existing national and international Grid initiatives. Currently, the grid infrastructures support 3 regional VOs of South East European Grid (seismology, meteorology, environmental protection). The Armenian "armgrid.grid.am" infrastructure VO [14] is used for Armenian user communities. The deployment of Georgian infrastructure VO is in process.
Computational recourses of Armenian NGI consist of five clusters located in Yerevan and Ashtarak cities presented in the table 1.

Site Location	Cores
IIAP NAS RA	176
Yerevan State University	48
State Engineering University of Armenia	48
Institute for Radiophysics and Electronics	48
Total	320

TABLE 1: Computation Resources

Armenia and Georgia participates in SEE GRID SCI Grid eInfrastructure with the AM-01-IIAP-NAS-RA and GE-01-GRENA sites [16]. The Grid sites are based on gLite middleware. After prototyping phases in 2004 and 2005, convergence with the LCG-2 distribution was reached in May 2006 when gLite 3.0 was released and became the official middleware of the EGEE project. The other computational resources (clusters) available in the Armenian NGI use OSCAR Toolkit [17] that has a rich set of pre-packaged applications and utilities which means you can get up and running without laboriously installing and configuring complex cluster administration and communication packages. The deployment of the common infrastructure based on gLite middleware is in process.
Two clusters in the Tbilisi State University and Yerevan Physics Institute will be deployed soon within the ISTC A-1606 Project.
All computing nodes and core services nodes of national grid infrastructures are interconnected by Gigabit Ethernet network. The Armcluster (largest cluster in the South Cacucsus) uses Myrinet [18] high bandwidth network for calculations.
MyProxy and VOMS core services are provided by Armenian NGI. The MyProxy server is intended to store medium length proxy certificates, typically valid for one week. A user can store a proxy certificate on the MyProxy server, and remove it at will. The deployment of National Workload Management Systems are in process that will comprise a set of Grid middleware components responsible for the distribution and management of tasks across Grid resources, in such a way that applications are conveniently, efficiently and effectively executed.
Ganglia [19] package is used to monitor the local computational resources, which is a scalable distributed monitoring system for high-performance computing systems such as clusters and Grids. It is based on a hierarchical design targeted at federations of clusters. It leverages widely used technologies such as XML for data representation, XDR for compact, portable data transport, and RRDtool for data storage and visualization. The Gstat and and BBmSAM [20] are used as centralised monitoring service, which monitor the worldwide Grid Information Systems.

In terms of storage resources, NGIs provide about 2TB of disk space to supported VOs. Through the Disk Pool Manager interface, these storage elements are accessible as a unified disk spaces, allowing seamless usage by the end users.

5. GRID APPLICATIONS

The most important direction of NGIs is the production use of the Grid infrastructures by a large number of diverse applications. These applications require, in particular, that the Grid middleware scales with a growing infrastructure, performs faster, and provides additional high-level services. NGIs will involve a number of strategic multi-disciplinary regional scientific communities / virtual organizations in various fields of science and thus further stimulate the use and expansion of the existing infrastructure and its services, and capitalize on the existing infrastructure human network to further strengthen scientific collaboration and cooperation among participating communities.

It is important to mention that potential Grid users and main research and scientific organizations in Armenia and Georgia are actively participating in large international collaborations. For an example in the field of High Energy Physics the scientists involve in several experiments, such as H1, HERMES at DESY (Germany); at TJLab and SLAC (USA), ANKE at COSY-Jülich (Germany), ATLAS, ALICE, CMS at LHC CERN (Switzerland).

At the mean time various applications have been developed by using Grid infrastructures, such as in the fields of quantum physics, astrophysics, molecular dynamics, 3D periodic artificial microwave structures, IT infrastructure library performance, quantum 3D reactive scattering in the 3-body system, identification and recognition of objects from video images by using digital signal and image processing methods, two-dimensional cellular automata, decision-making and nonlinear boundary parallel algorithms. Modeling and high performance calculations in these areas allow next-generation scientific study requiring intensive computation and analysis of shared large-scaled databases, by widely distributed scientific communities.

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