

# Grid in Armenia: Present Status and Perspectives

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# 1 Introduction

- **Past few years - intensive development of the Grid approaches to the collaborative use of distributed complex experimental facilities and instrumentation, high-volume databases and large scale computing resources.**
- **Large investments in the leading industrial countries → rapid evolvement of Grid technologies from R&D to practical applications in numerous international and national Virtual Organizations (VOs).**
- **Soviet science - tradition of active participation in the international collaborations. The e-Globalization tendency of the research stipulates development of the appropriate e-Infrastructures in FSU countries.**
- **We will present current status, problems and perspectives in introduction and dissemination of Grid technologies in Armenia.**
- **Our experience could help specialists from the other former soviet republics in the construction of their national Grids.**

## 2 Grid necessity in Armenia

- Several national research centres enter large international collaborations. Example – Yerevan Physics Institute (YerPhi) → ALICE, ATLAS, CMS experiments at LHC (CERN) → LCG → A local Grid node corresponding to a Tier 2 standards has to be deployed.
- Larger involvement of Armenian institutions in international collaborations (astrophysics, biology, seismology, health care...)
- Grid → Effective access to the remote resources and their processing across a heterogeneous environment embracing powerful computing and data storage nodes, small computer farms or even individual PCs → Very important for countries as Armenia → Allows integrating into properly designed VOs of small research labs, high-tech and industrial enterprises, educational, medical centres and other governmental and non-governmental organizations that possess high intellectual potential and need more computing resources.
- Giving national and international communities access to large diversity of data accumulated in this Armenia: high-energy and cosmic physics, Markarian Galaxies surveys, seismology, environment, medicine...

### 3 Armenian e-Science Foundation <http://www.escience.am/>

- **Non-profit, non-governmental institution established in 2002.**
- **Goals of ArmeSFo - introduction and dissemination of the e-Science technologies in Armenian scientific, educational and other organizations**
- **A modest but continuously stable support of the ArmeSFo activity is provided by:**
  - **Swiss “Fonds Kidagan”**
  - **Caloust Gulbenkian Foundation**
  - **“Link Ltd” software developing company (<http://www.link.am>)**
  - **“Lans Ltd” computer hardware vending company (<http://www.lans.am>)**
  - **“Web” Internet Service Provider (<http://www.web.am>).**

## 4 ArmeSFo Certification Authority <http://www.escience.am/ca/>

*First Armenian Certification Authority established in 2003*

- ArmeSFo CA is maintained by ArmeSFo as a courtesy service to Armenian Grid community
- ArmeSFo CA is managed by ArmeSFo team of YerPhI
- ArmeSFo CA issued certificates have a common fixed component:

*C=AM, O=ArmeSFo*

Distinguished Name of ArmeSFo CA root certificate:

*C=AM, O=ArmeSFo, CN=ArmeSFo CA*

- In 2003, ArmeSFo CA became the member of the European Data Grid CA group (EDG CA) and its successors, European Policy Management Authority group for Grid Authentication in e-Science (EUGridPMA) and LCG CA group



## 5 ArmGrid Project of ArmeSFo

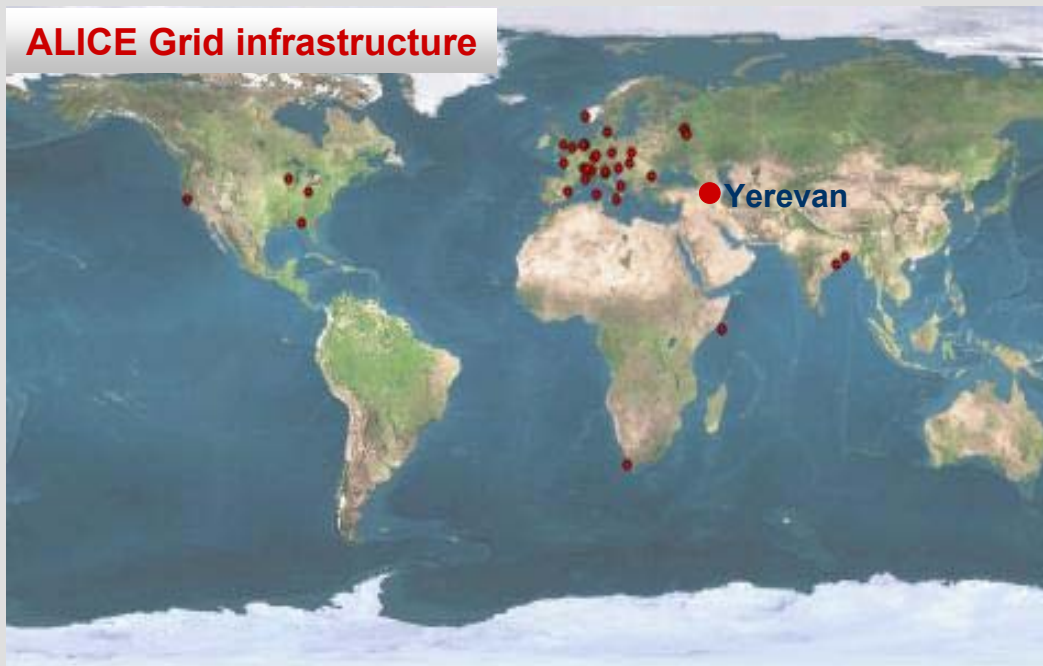
<http://www.grid.am/>

### Goals:

- Employment of the Grid technologies in Armenia
- Building Grid infrastructures in Armenia
- Involvement of the national specialists in the work on different aspects of Grids: ♦security and authentication, ♦middleware development, ♦interoperability and portability, ♦building application layers for national Grids
- **ArmGrid project is realized through active participation of the students from higher education institutions of Armenia**
- **Actually, the project members are involved in the development work for AliEn and EGEE International Grid projects**

## 6 First and unique Grid node in a vast geographical region

ALICE Grid infrastructure



- **2001:** First studies of Grid in Armenia by the team of **ArmGrid** project: The Globus middleware toolkits 1.1.4 and 2.0 have been installed and tested.
- **2002:** **AliEn** client package was installed and the group entered the **AliEn VO** of the **CERN ALICE** experiment.
- **A catastrophically low capacity of WAN in Armenia makes impossible a full-scale exploitation of the AliEn functionality by the physicists!**



## 7 Digital Divide in Armenia (WAN)

- **No State policy in this field. Moreover, the State is a shareholder of the “ArmenTel” operator, monopoly owner of all internal and external telecommunication lines of Armenia → Internet prices exceed the world ones by a factor of 10!**
- **Typical numbers of the Internet external connectivity of research and educational institutions are from a few Kbps to a few tens Kbps per institution.**
- **A slightly better situation in YerPhI. Since 1994, NATO and DESY have been paying a satellite connection which reaches actually 128/196 Kbps bandwidth.**
- **In 2003, NATO has launched so-called Silk Virtual Highway project of WAN channels for South Caucasian and Middle Asian FSU republics. A 500 Kbps/(a few Mbps) bandwidth is allocated to Armenia within that project. The bandwidth is shared by a number of research and educational Armenian organizations for their everyday needs.**
- **Current Armenian research international WAN bandwidth is too narrow and can not provide a full-scale work in the running international Grids.**

## 8 Digital Divide in Armenia (MAN)

- Thanks to the international funds (Soros Foundation, US NSF), a progress in the deployment of the national MAN is observed during the last years. Several scientific and education institutions have been connected by the underground and air fiber optics channels. After deployment of the modern I/O equipment, the national science and education MAN channel speed should reach a few hundred Mbps.
- The development of the science and higher education network in Armenia has been chaotic and sporadic until now and future progress is hardly possible without a National Program. Having a clear vision of such a program, ArmeSFo could elaborate its details in the cooperation with relevant governmental and non-governmental organizations

## 9 Development work can be carried out even with modest bandwidth and equipment

- The Grid is an entirely new field, and most of the work is now centred into the development of the software tools collectively known as middleware and application software
- To participate in the development and testing of these tools, even a very modest network and computing equipment is enough
- Small focussed groups can fully participate from their home location to an activity at the leading edge of computing science
- Participation in this activity alone will result in a build up of expertise for the involved groups, with a training and technology fall-out effect
- An illustrative example is the work of ArmeSFo/ArmGrid team from YerPhI on the development of the software for the Grid environment of the CERN ALICE experiment

## 10 The work on the AliEn toolkit development (1)



**AliEn**  
@GRID

- **ALICE experiment – typical next generation HEP collaboration involving ~1000 scientists from ~100 institutions** (<http://alice.web.cern.ch/Alice/AliceNew/>)

- **Large-scale simulations, heavily distributed processing and event storage, complex analysis of very large volume data (one event up to 2GB, 2 PB/year)**
- **ALICE offline group developed a dedicated Grid architecture called AliEn, ALICE Environment on the Grid** (<http://alien.cern.ch>). Based on the Open Source standard components (SOAP, Globus GSI, etc), AliEn framework is a lightweight, simplified but functionally equivalent alternative to full blown Grid
- **AliEn has been successfully tested in simulation period of ALICE. Several other HEP experiments as well as health-care Grid projects (EU MammoGRID, INFN GP-CALMA) are exploiting AliEn or some components of it.**
- **AliEn has been chosen by Middleware Reengineering and Integration (JRA1) team of European EGEE project for integration of leading Grids middleware.**

## 10 The work on the AliEn toolkit development (2)

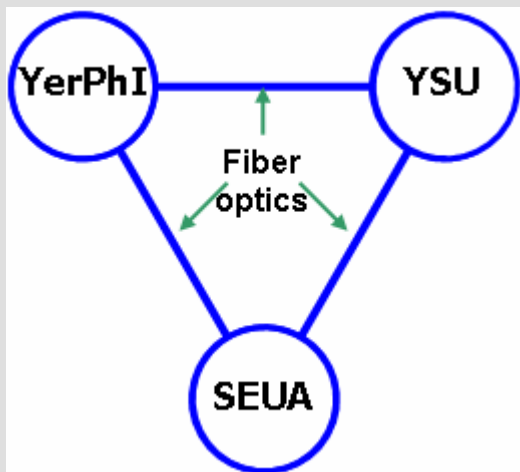


- The **ArmeSfo/ArmGrid** group from YerPhI, which includes students from State Engineering University of Armenia (SEUA) and Yerevan State University (YSU), is participating in the AliEn development work since the end of 2002

- After a short period of the work on the authentication aspects of AliEn, the group has been suggested to undertake the AliEn port to the Windows OS
- The necessity of the port:
  - 1. Access to AliEn to a large army of the Windows users*
  - 2. JRA1 team of EGEE has to provide robust middleware components, deployable on several platforms including Windows*
- The port of AliEn toolkit end-user/client part is successfully advancing. Its actual status will be presented at this Conference by Artem Harutyunyan
- The work of Armenian group will continue until having AliEn fully operational on Windows

## 11 Future steps. Building national Grids (1)

ArmeSFo considers important to proceed to the phase of its experience transfer to the Armenian institutions. The acquired knowledge and availability of a high-speed MAN make possible deployment of the national Grids which is foreseen to realize in two stages.



- **First stage: Educational Grid between YerPhI, SEUA and YSU**
- Specialists and students will get first hand experience of the whole Grid architecture and its functioning
- Testbeds will allow participants to acquire skills in the practical use of the Grid, to learn cooperative work within VOs
- The Educational Grid could be constructed on the basis of the AliEn Open Source software
- The functionality of the other Grids (LCG, EGEE, etc) could also be studied and tested within the Educational Grid

## 11 Future steps. Building national Grids (2)

- At the Second stage: The acquired knowledge will be offered to other Armenian scientific and educational institutions such as:
  - ◆ Byurakan Astrophysical Observatory,
  - ◆ Armenian Academy of Sciences,
  - ◆ Computing Science centres,
  - ◆ Earth science and Seismic centres
  
- In a farther perspective: Transferring knowledge to the non-scientific organizations (health-care centres, enterprises...). Integrating into national Grid infrastructures the organizations located in the remote regions of Armenia

## 12 Embedding regional States into common Grid environment (1)

- **Armenia, Azerbaijan, Georgia, Iran and Turkey constitute a complex world region with a diversity of the national mentalities, religions, traditions as well as economical, social and scientific development**
- **Deployment of a common e-Infrastructure would have a positive socio-political impact on this region. It would promote the dissemination of the modern information technologies, initiate the exchanges between the scientists and would finally serve to the improvement of the morale climate and relations amongst the populations of the region**
- **Taking into account that all these States are participating (to a different extent) in the LHC experiments, the creation of a common e-Environment could begin with the deployment of a regional HEP Grid infrastructure complying with Tier2 (or 1) standards of the LCG project**



## 12 Embedding regional States into common Grid environment (2)

Creation of a regional Grid infrastructure is very challenging task since its achievement requires a lot of coordination and technical skills

However, the goal is worth pursuing since it will help to reduce numerous scientific, technological, social and political Divides existing in this very large geographical region and will finally promote the involvement of this region in the international e-Globalization process

Meanwhile, the complexity of the task will require support and coordination by the international HEP community

However, due to the psychological problems, even this support and coordination could be not sufficient for the organization of the cooperative work of the regional specialists and non-ordinary approaches are needed

A decisive role can be played in this initiative by the generation of young scientists and students. We believe that this generation is not too burdened by the historical prejudices and it can take the responsibility of the construction of a collaboration climate in the region

## 13 Conclusion

- **ArmeSFo** is steadily advancing in the practical realization of its pioneering initiative of the e-Science introduction in Armenia
- The first, most important stage of getting professional understanding of the Grid technologies and overcoming the psychological difficulties, which arise naturally when dealing with such very innovative and complex technologies, seems being completed
- A compact and actively working team, which consists mainly of young specialists-students is created
- The team shows capacity to contribute fruitfully to the development of the leading edge technologies of the Grid

*Despite of numerous difficulties, we are fully confident in the final achievement of **ArmeSFo** goals!*

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