



# **e-Infrastructures for Research and Education in Eastern Partnership Countries**

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# e-Infrastructure

**e-Infrastructures for research and education includes**

- **high-bandwidth networks**
- **distributed computing Grid, High Performance Computing (HPC) and scientific Cloud resources**
- **respective data repositories**

**All these facilities are forming new research environment enabling shared access to unique or distributed scientific facilities (including data, instruments, computing and networks).**



# GÉANT network

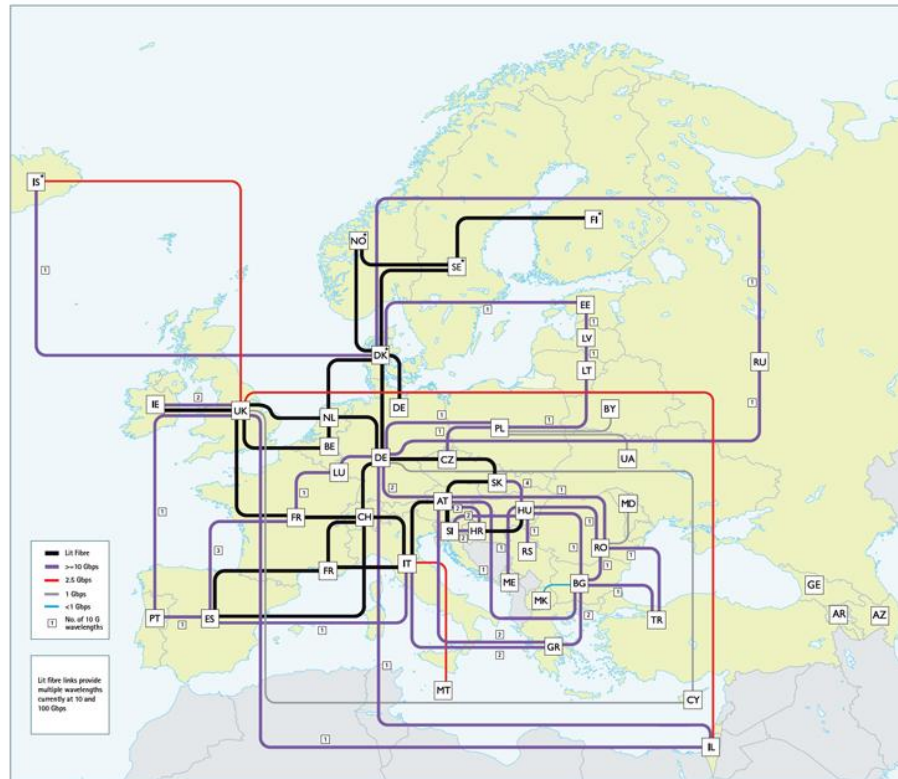


**GÉANT is a pan-European research and education network that interconnects Europe's National Research and Education Networks (NRENs).**

**Current GÉANT project GN3plus is a collaboration between 41 partners: 38 European NRENs, DANTE, TERENA and NORDUnet (representing Norway, Sweden, Finland, Denmark and Iceland). In total, the project represents 43 NRENs including Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.**

**GÉANT provides a high-bandwidth, first-class network infrastructure and services connecting over 50 million users at 10,000 institutions across Europe.**

The pan-European research and education network that interconnects Europe's National Research and Education Networks (NRENs). Together we connect over 50 million users at 10,000 institutions across Europe.



Backbone topology as at August 2013. GÉANT is operated by DANTE on behalf of Europe's NRENs.



\*Connections between these countries are part of NORDUNET (the Nordic regional network)

# Involved organizations:

<b>Armenia</b>	<b>ASNET-AM</b>	<a href="http://www.asnet.am">www.asnet.am</a>	<b>ARENA</b>	<a href="http://www.arena.am">www.arena.am</a>
<b>Azerbaijan</b>	<b>AzRENA</b>	<a href="http://www.azrena.org">www.azrena.org</a>	<b>AzScience Net</b>	<a href="http://www.azscience.net.az">www.azscience.net.az</a>
<b>Belarus</b>	<b>BASNET</b>	<a href="http://www.bas-net.by">www.bas-net.by</a>		
<b>Georgia</b>	<b>GRENA</b>	<a href="http://www.grena.ge">www.grena.ge</a>		
<b>Moldova</b>	<b>RENAM</b>	<a href="http://www.renam.md">www.renam.md</a>		
<b>Ukraine</b>	<b>URAN</b>	<a href="http://www.uran.ua">www.uran.ua</a>	<b>UARNET</b>	<a href="http://www.uar.net">www.uar.net</a>

# Network

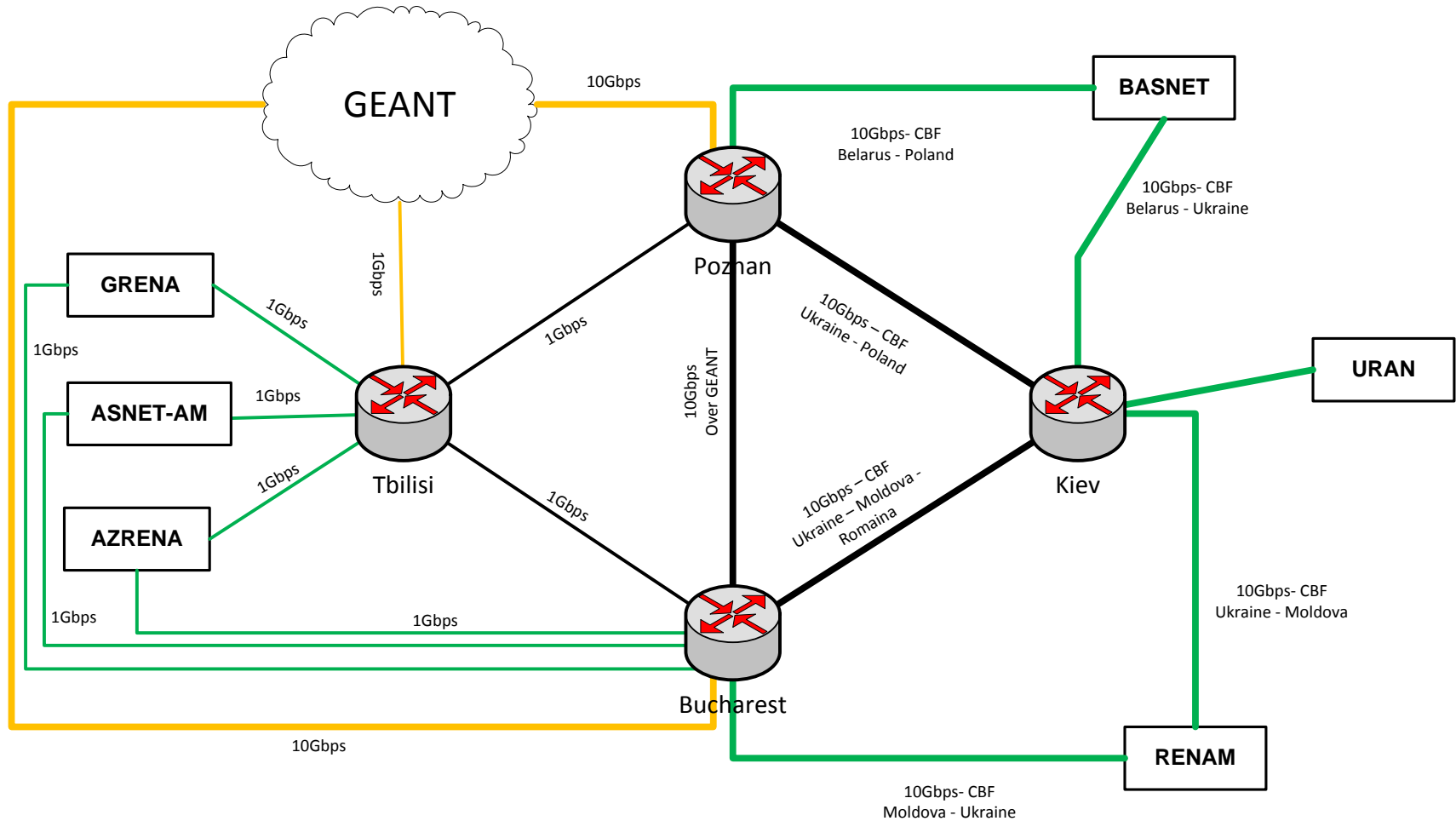
([www.terena.org/activities/compendium](http://www.terena.org/activities/compendium))

	Number of User Organizations	Universities + Research Institutes	International Connectivity Mbps	Backbone Capacity Gbps	Eduroam	Digital Certificate
Armenia ASNET-AM	48	37	45 GÉANT (09.13) + 200	1	yes	CA
Azerbaijan AzRENA, AzScience Net	49	45	45 GÉANT (09.13) + 150	1	yes	
Belarus BASNET	99	69	1000 GÉANT PIONIER	10	yes	CA
Georgia GRENA	45	18	200	1		RA
Moldova RENAM	64	43	10000 GÉANT RoEduNet	1	yes	CA
Ukraine URAN	169	103	500 GÉANT PIONIER +6000	10		CA

# Network summary

- **About half of students, lecturers and researchers are served by NRENs.**
- **Connectivity for Belarus, Moldova and Ukraine are better than for Armenia, Azerbaijan and Georgia due to the support from PIONIER (Poland) and RoEduNet (Romania).**
- **Fraction of scientific traffic is still low compare to the demand on commodity Internet for EaP countries.**
- **Costs for clear channel needed for GÉANT connectivity are several times more expensive compare to commodity Internet, especially in South Caucasus countries.**
- **Backbone capacity upgrade to 10 Gbps is required for Armenia, Azerbaijan, Georgia and Moldova.**
- **Eduroam service has been established in all EaP countries except Georgia and Ukraine, however percentage of institutional participation still very low.**

# Option for full regional network (GN3plus concept note)





# Full regional network

## Advantages:

- **Fulfills the connectivity and capacity requirements of NRENs.**
- **Provides large capacity increase to South Caucasus countries.**
- **Provides backup connection to all EaP country NRENs.**
- **Traffic between NRENs in Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine doesn't go through GÉANT and instead goes over the dedicated network.**

**Estimated cost over 3 years is about 13 MEUR. Funding scheme: 80% EC and 20% participating countries.**

**At the first stage most probably only part of this network will be realized.**

**Implementation of connectivity and federated services available at GÉANT network, also access to digital scientific publications.**

# European Grid Initiative:

## Integrated Sustainable Pan-European Infrastructure for Researchers in Europe (EGI-InSPIRE)

The goal of EGI-InSPIRE project is to establish a sustainable European Grid infrastructure and provide European scientists and their international partners with a sustainable, reliable e-Infrastructure that can support their needs for large-scale data analysis and simulations. 51 national and international institutions from Europe and Asia Pacific region are partners of the project, among them organizations from Armenia, Belarus, Georgia and Moldova.



# Grid resources ([gstat.egi.eu](http://gstat.egi.eu))

	<b>Total Number of Sites</b>	<b>Number of Sites EGI</b>	<b>Physical CPU EGI</b>	<b>Logical CPU EGI</b>	<b>Storage Capacity EGI, TB</b>	<b>Supported VOs EGI</b>
<b>Armenia</b>	<b>7</b>	<b>2</b>	<b>24</b>	<b>96</b>	<b>11</b>	<b>4</b>
<b>Azerbaijan</b>	<b>1</b>					
<b>Belarus</b>	<b>1</b>	<b>1</b>	<b>7</b>	<b>42</b>		<b>2</b>
<b>Georgia</b>	<b>2</b>	<b>1</b>	<b>10</b>	<b>80</b>	<b>1.8</b>	<b>5</b>
<b>Moldova</b>	<b>3</b>	<b>2</b>	<b>12</b>	<b>24</b>	<b>2.4</b>	<b>7</b>
<b>Ukraine</b>	<b>41</b>	<b>10</b>	<b>938</b>	<b>2372</b>	<b>455</b>	<b>45</b>

# Grid summary

- **All EaP countries are involved in Grid activities by providing computational resources to users.**
- **Only Azerbaijan resources is not included in the European Grid Infrastructure.**
- **Significant part of research computations is performed on local clusters not included in EGI.**
- **Computational and storage resources provided to EGI is not large except Ukraine.**
- **In total 62 Virtual Organizations (VO) are supported at 16 EGI sites.**
- **Armenia, Belarus, Moldova and Ukraine support CERN related VOs (ALICE, ATLAS, CMS, LHCb).**



# HPC and Cloud



**HP-SEE**  
High-Performance Computing Infrastructure  
for South East Europe's Research Communities



- **EaP countries are involved in HPC activities.**
- **In the framework of HP-SEE and partly PRACE projects research teams from the region have access to the HPC infrastructure and trainings.**
- **Several applications from EaP countries are running on European HPC centers.**
- **Work on research and education Clouds are in development stage (e.g. BSEC gEclipseGrid project).**

# Research teams (“Power Users”)

- **Armenia:** particle physics, life sciences, computational chemistry, earth and climate, astronomy and cosmology, computational engineering, etc.
- **Azerbaijan:** high energy physics CERN ATLAS experiment, photoelectronics.
- **Belarus:** remote sensing of the Earth system, modeling of Belarusian industries, image processing and automated diagnostic screening for medical and research institutions, agriculture, forest and water resources, ecology, etc.
- **Georgia:** weather research and forecasting, plasma physics, life sciences, computational chemistry, particle physics, seismology.

# Research teams (“Power Users”)

- **Moldova:** weather forecast, climate monitoring, climate change modeling; medical image acquisition, storing, processing and visualization; computational physics; nanotechnology, nano-materials and nanoelectronic discrete devices modeling and computer aided designing of semiconductor devices; economical processes modeling based on games theory algorithms.
- **Ukraine:** high energy physics, astrophysics and astronomy; life sciences, in particular, molecular and cellular biology, modeling of neural systems; medical applications (medical databases, processing of medical images and data); earth sciences, environment, seismology, climatology, predictions of the catastrophic natural phenomena; solid and soft matter physics, property and structure at atomic and molecular level; materials science, nanotechnologies, creation of materials with the desired properties.

# Conclusions

**During last few years important development of e-Infrastructure in Eastern Partnership countries has been made, however there is still significant gap between the developed European countries and region.**

**Support from Governments and European Commission for the farther development of e-Infrastructure in the region is essential for the integration of scientific potential of these countries in European Research Area, such as European Research Infrastructures with global impact.**



# Acknowledgments

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**Thank you for attention!**

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