FP7 Research Infrastructures

BSI

Black Sea Interconnection

Deliverable D3.2
Network Topology

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Abstract: This document describes the final networking topology, hardware specifications, routing and addressing plans. The information provided in this document will be used by technical personnel involved in the deployment and management of the BSI network.

The BSI Consortium consists of:

TUBITAK	Coordinating Contractor	Turkey
GRNET	Contractor	Greece
CEENET	Contractor	Austria
DANTE	Contractor	United Kingdom
GRENA	Contractor	Georgia
AZRENA	Contractor	Azerbaijan
NAS RA	Contractor	Armenia

Document Revision History

Date	**Issue**	**Author/Editor/Contributor**	**Summary of main changes**
February 1st, 2009	a	Yannis Mitsos,	First draft version
March 3rd, 2009	b	Yannis Mitsos, Ramaz Kvatadze, Amiraslan Aliyev, Arthur Petrosyan	**Input from partners**

Preface

The Black Sea Interconnection (BSI) project aims to achieve a high-speed network backbone among the NRENs of the South Caucasus countries (Georgia, Azerbaijan and Armenia) and enable connectivity to the pan-European GÉANT2 network. The BSI project intends to introduce new technologies and services to the Information Society in those countries and be an important leap towards the integration of those countries' scientific potential with the European Research Area. The project involves the development of strategies for interconnecting the existing infrastructures in the region, realization of the connections and supplying operational support for the established network. The project beneficiaries are TUBITAK, GRNET, CEENET, DANTE, GRENA, AZRENA and NAS RA.

The main objectives of the BSI project are:

1. Building a proper regional research and education network among South Caucasus and connecting it to GÉANT2.
2. Integration of South Caucasus scientific potential to Europe by successfully disseminating the infrastructure and promoting the ICT projects in South Caucasus countries.
3. Fostering collaboration between homogenous scientific communities by identifying the involved communities in the region and establishing mechanisms for knowledge transfer.

The BSI project has started its activities on March 2008 and is planned to be completed by the end of February 2010. BSI is coordinated by TUBITAK. The total budget of the project is *1 861 908* € and it is co-funded by the European Commission's Seventh Framework Programme for Research Infrastructures and National budgets of South Caucasian Countries.

The BSI consortium will achieve the following milestones:

Milestone number	Milestone name	Date	Status
M1	Kick-off meeting	M1	√
M2	Project management information system established	M1	√
M3	Promotional package available	M4	√
M4	NRENs requirements collected and analysed	M2	√
M5	Technical and operational requirements analysed	M3	√
M6	Tenders prepared	M3	√
M7	Suppliers selected	M4	√

M8	Connectivity and equipment contracts signed	M5	√
M9	Final BSI topology determined	M5	√
M10	Operation of the regional networking infrastructure offering access to BSI NRENs GÉANT2 access	M6	
M11	Management framework in place and stable network operation	M8	
M12	Services/tools selected	M10	
M13	Successful completion of first period project review	M12	
M14	Workshop/Conference Track in region organized	M20	
M15	Services/tools deployed	M20	
M16	Successful completion of project - final project review	M24	

The project will issue the following deliverables:

Del. no.	**Deliverable name**	**Nature**	**Dissemination Level**	**Date**	**Status**
D1.1	Project Management Information system	R	CO	M1	√
D1.2	Network Acceptable Use Policy	R	PU	M4	√
D2.1	Requirements capture and an analysis	R	PU	M1	√
D2.2	Networking topology options and implementation approaches	R	PU	M2	√
D3.1	Tender progress report	R	CO	M4/M5/M6	√
D3.2	Network topology	R	PU	M6	√
D4.1	Network implementation and equipments configuration	R	PU	M9	
D4.2	Operational procedures and management framework	R	PU	M10	
D4.3	Networking services and tools specifications	R	PU	M12	
D4.4	Deployment of essential network services and management tools	R	PU	M21	
D5.1	Web site, docs repository and mailing lists	R	PU	M1	
D5.2	BSI Promotional material	O	PU	M8	
D5.3	Stakeholders meetings in beneficiary	R	PU	M15	

	countries				
D5.4	Report on awareness and liaison activities	R	PU	M23	

***R** = Report , **O** = Other , **PU** = Public, **CO** = Confidential (only for members of the consortium incl. EC).*

References

[1] BSI Consortium, "D2.1 BSI Requirements Capture and an Analysis," April 2008.

[2]

Executive Summary

What is the focus of this deliverable?

The focus of this deliverable is to present the selected BSI networking topology, the hardware specifications, routing and addressing plans. It provides direct input for the specification of the acceptance tests and the 'network' configuration. The information provided in this document will be used by technical personnel involved in the deployment and management of the BSI network.

What is next in the process?

The evaluation committee has evaluated all offers and took measures to ensure their validity in terms of reliability, pricing and network topology. Based on this evaluation, the consortium is ready to award a contract after having received the European's Commission clearance.

What are the deliverable contents?

The deliverable is consisted of:

Introduction (BSI topology overview);

Physical topology (NREN topologies, equipment, PoP details);

Logical topology (NREN connected interfaces IP addresses, NREN autonomous systems, NREN address space).

Conclusions

To be completed

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1. Introduction

The BSI (Black Sea Interconnection) project intends on bridging the digital divide that exists between the South Caucasus countries and Europe by establishing a regional research and education network in the South Caucasus and connecting it to GÉANT2/3. The project involves the development of strategies for interconnecting the existing infrastructures in the region, realization of the connections and supplying operational support for the established network. The existence of interconnections between the South Caucasus countries and connection to GÉANT2 with reasonable capacities will enable introduction of new services to the region and will be an important step towards the integration of the scientific potential in the region with Europe.

The current backbone based on satellite connections offers only couples of Mbps connections among the National Research and Education Networks (NRENs). The BSI aims to supply a minimum of 34 Mbps connection for each NREN to the regional network backbone. The backbone model and the connection capacities for the beneficiary countries have been analyzed, evaluated and reported in Deliverable D2.1.

2. Physical network topology

Among the networking potentials that were anticipated and elaborated in the deliverable D2.1, the following one has been eventually reached as a result of the tender procedure. One of the NRENs will be directly connected via an E3 (34 Mbps) channel to GÉANT2. The other two NRENs will be connected to each other with a 34 Mbps link and they will share an STM-1 link to GEANT.

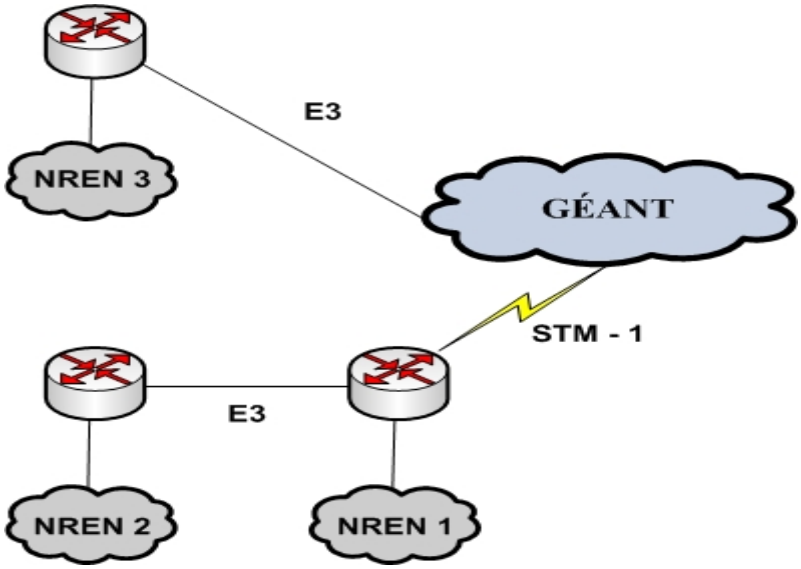

Figure 1 Resulting BSI Topology

The BSI tender resulted in the physical network topology shown on Figure 2.

The topology includes 3x34Mb connectivity from Armenia, Georgia and Azerbaijan correspondingly to the Sofia GEANT2 POP. With this option, the 3xE3 are aggregated in Novorossiysk into 1xSTM-1 and transmitted to Sofia.

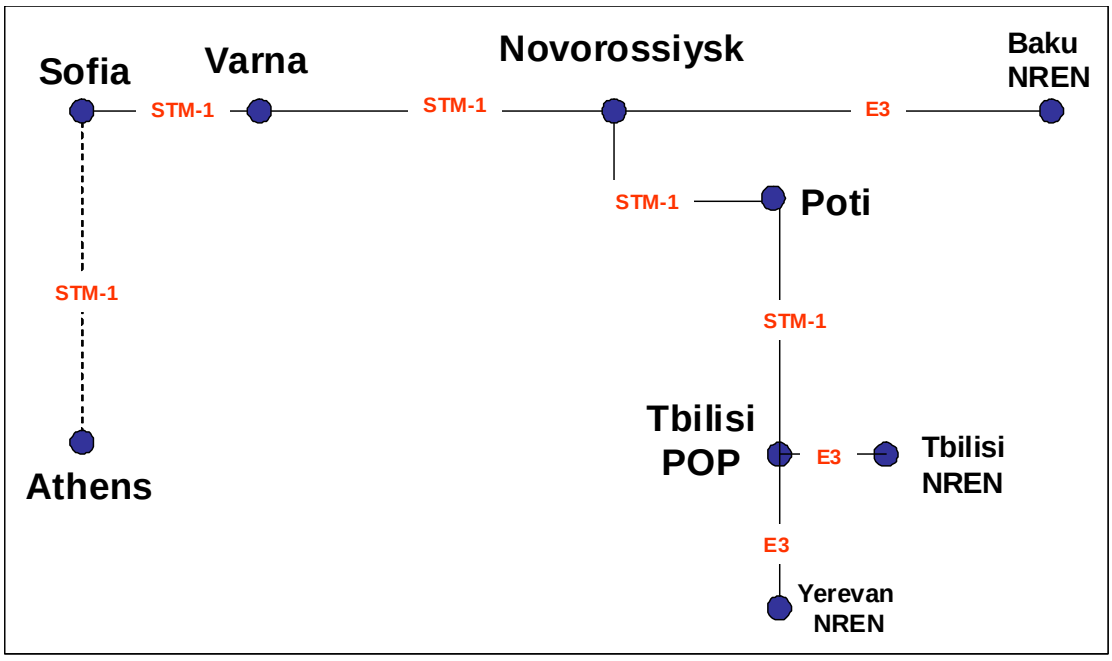

Figure 2**:** Bundle Offer 1: Aggregation in Novorossiysk, Termination to Sofia or Athens

3. BSI beneficiary NRENs topologies

This section describes the topologies of the BSI beneficiary NRENs.

3.1. Armenia (NAS/RA)

Armenian NREN is composed of two major scientific, research and education network topologies. One - Academic Scientific Network of Armenia (ASNET-AM) was created in 1994 by the Institute for Informatics and Automation Problems (IIAP) of the National Academy of Sciences of the Republic of Armenia (NAS RA). ASNET-AM curently unites Academic, Scientific, Research and other organizations, which are engaged in scientific activity. Another - Armenian Research and Educational Networking Association (ARENA) was founded in 2000. ARENA board members are: Yerevan State University,State Engineering University of Armenia, Yerevan State Medical University, Yerevan Physics Institute, National Academy of Sciences, Yerevan Institute of Automated Systems of Management, National Foundation of Science and Advanced Technologies, United Nations Development Program, Open Society Institute Assistance Foundation – Armenia.

Though they were historically developed separately and have their own internal infrastructure both ASNET-AM and ARENA networks are now united into a single network infrastructure as shown on the picture below. The interconnection types are: from leased lines and wireless connections to , own/leased optical fibers.

ASNET-AM infrastructure includes 52 scientific organizations interconnected by wireless and wired (fibre optical/copper) connections as shown on the picture below.

ARENA has recently created an University network by interconnecting 35 major universities of Armenia with fibre optical connections as shown on the picture below.

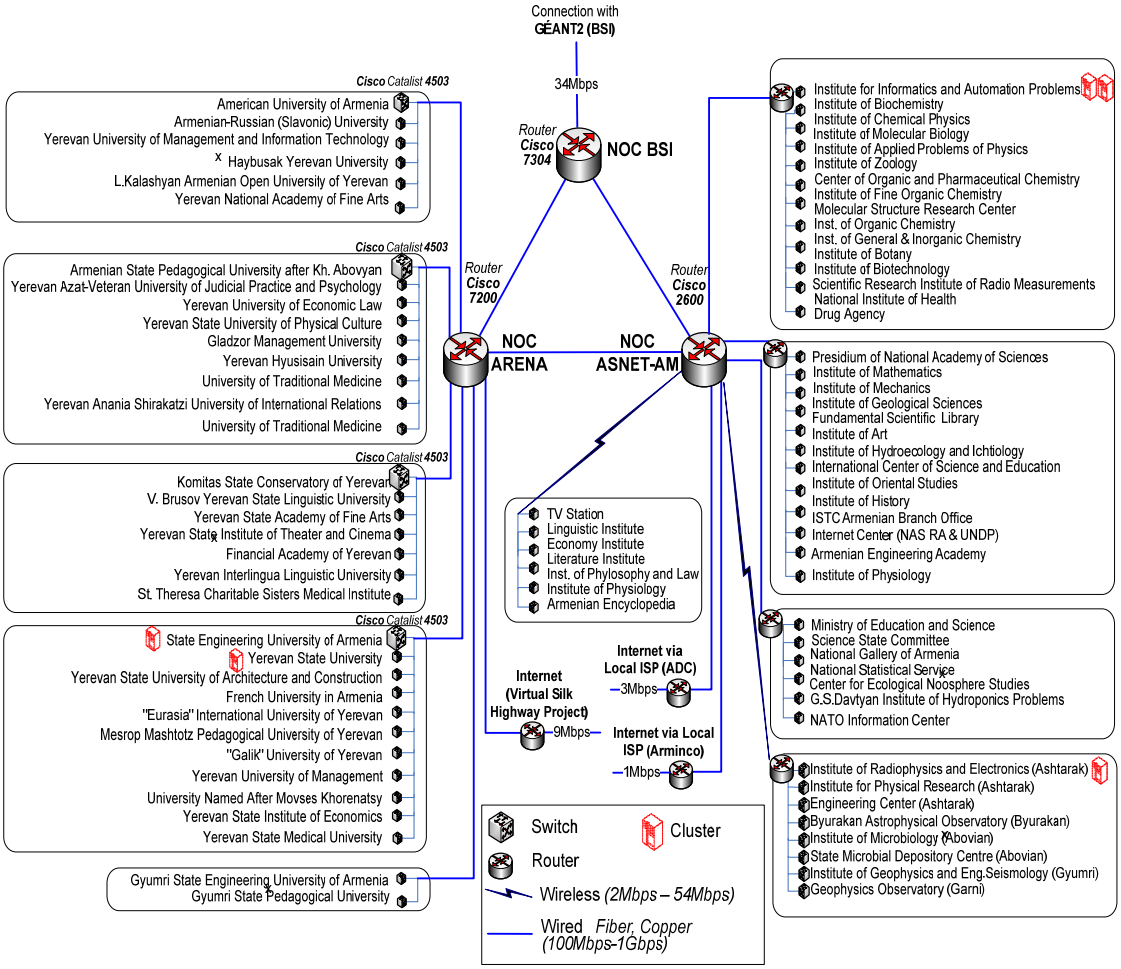

Figure 3 Schematic view of Arena Network

3.2. Azerbaijan (AzRENA)

Azerbaijan Research and Educational Networks Association (AzRENA) was established in August of 2000 by the leading institutes and universities on the basis of the National Academy of Sciences and Ministry of Education of Azerbaijan Republic. The Association is non-governmental organization and public for academic and education institutions.

Connection to Internet of AzRENA's education network is carried out via Local ISP and the project "Virtual Silk Highway".

The education and academic institutions of the city of Baku are connected with NOCs by means of the dedicated and physical lines and Wireless Access Points. Data transmission is carried out via local ISPs. This AzRENA network has been expanded within the project on the infrastructure enhancement and connection

to AzRENA backnone of Ganja and Nakhchivan being the regional members of the Association (NATO Grant No. NIG 976370).

AzRENA network connects about 15 education and research centers. At present time about 900 workstations serving 6000 users are connected to Internet via AzRENA. Technology of AzRENA infrastructure networking is flexible and mobile that allows fast developing of regional education and academic networks and integrating them in a general network in the cities and regions of Azerbaijan.

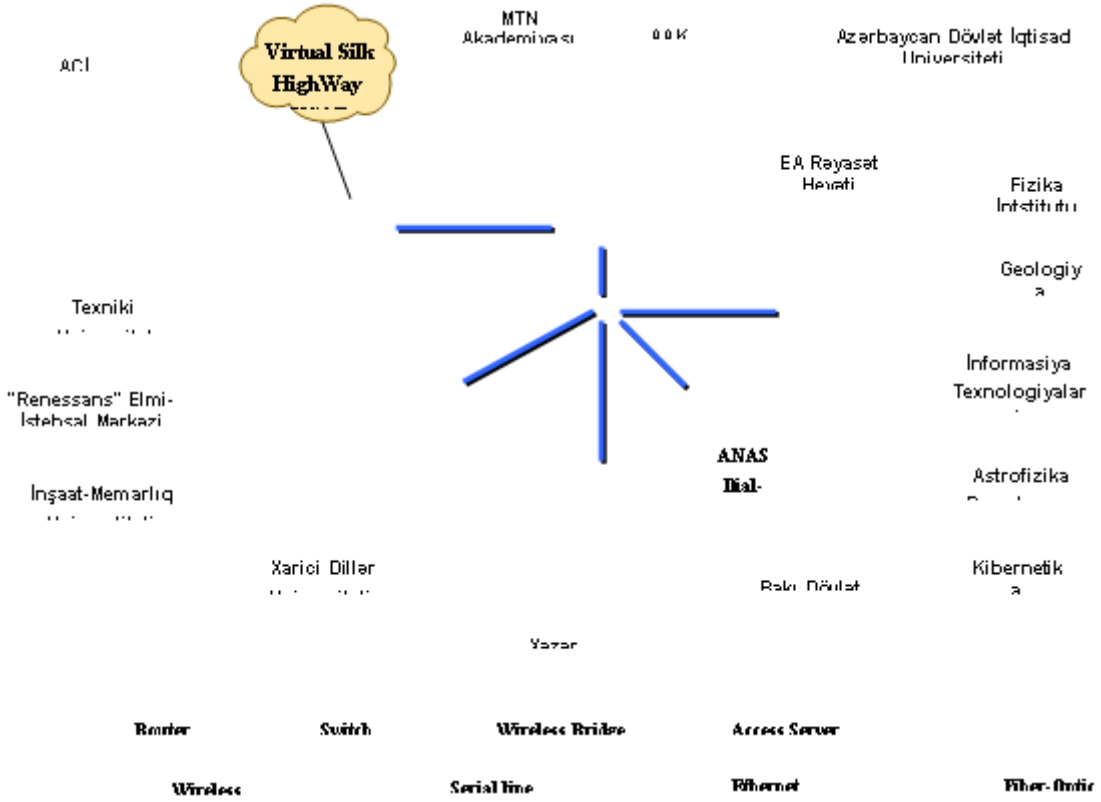

Figure 4 Schematic view of Azrena Network

3.3. Georgia (GRENA)

The existing infrastructure of the GRENA network is the following:

International connectivity: important step in the development of the GRENA network was made in 2002, when according to the NATO Virtual Silk Highway project (Silk project) GRENA received a new satellite station and established connectivity via DESY (Hamburg, Germany) to the Pan-European research network GEANT. Taking into account that fiber optic channels became available in the Caucasus and according to the decision of Silk Board on March 15, 2008 GRENA obtained 6Mbps fiber optic link to Internet via local connectivity provider Delta Net in the framework of Silk project. In addition from the own resources GRENA is purchasing 39Mbps bandwidth from the same company.

Metropolitan area network: During 2002-2008 years significant development and expansion of GRENA network in Tbilisi took place with the support of NATO

Networking Infrastructure grants. Fiber optic cable was installed between all Points of Presence (PoP) of GRENA network in Tbilisi CO22, CO30, CO33, CO37, CO39, CO91, CO93 and GRENA NOC. This completed creation of GRENA backbone ring in the center of Tbilisi and hence increased significantly reliability of the network. GRENA backbone was upgraded from initial 100Mbps to 1Gbps capacity. In parallel GRENA is supporting large educational institutions in the deployment of fiber optic connections. Currently 17 institutions are connected through fiber optic in Tbilisi and Kutaisi. Another important step in the development of network was implementation of ADSL services at all COs, where GRENA PoPs are present. Small and medium size research and educational institutions are connected to GRENA backbone at these PoPs via ADSL or VDSL. GRENA established local Internet exchange at CO22 with all major ISPs in Georgia. Estimations show that we are saving significant part (up-to 15%) of international bandwidth after establishing local exchange. The establishment of high bandwidth local exchange links also encourages the development of local content now available at high rates throughout the country.

GRENA is also operating wireless network in Tbilisi and Kutaisi for institutions located outside of the city center. Currently 4 institutions in Tbilisi and 1 university building in Kutaisi are connected via wireless connection. Wireless network is using bridges Aironet BR340 functioning at frequency 2.4 GHz.

GRENA Network Operation Center (NOC) located at the building of Open Society - Georgia Foundation. Currently besides administrative workstations based on PC architecture NOC includes server farm consisting 6 application servers (3 HP, 1 DELL and 2 Fujitsu-Siemens servers running Linux OS), which provide HTTP, FTP, DNS and e-mail services to the majority of GRENA customers as well as network monitoring and data backup service. In March 2007 for the Deer Leap Georgia project GRENA installed additional 5 servers (3 DELL and 2 HP servers, running Linux OS) for providing HTTP, FTP, e-mail services and web content filtering for the secondary schools. In September 2008 GRENA started establishment of first GRID site in Georgia according to the European Commission SEE-GRID-SCI project. This site consists of 6 Fujitsu-Siemens, 1 DELL servers and 1 PC all running Linux OS.

Regional Network: GRENA regional network connecting the largest cities of Georgia: Tbilisi, Kutaisi, Batumi and Telavi. The physical connectivity to Tbilisi is provided by the fiber optic 2-4Mbps channels in Kutaisi and Batumi and by the microwave 2Mbps link to Telavi. In Kutaisi, Batumi and Telavi Cisco 3640/2621 devices are used as access routers and universities and research institutes are connected via fiber optic, DSL or wireless. In addition for the Deer Leap Georgia project 10Mbps fiber optic link is used, which is connecting schools in 21 regional cities to the GRENA NOC via VPN.

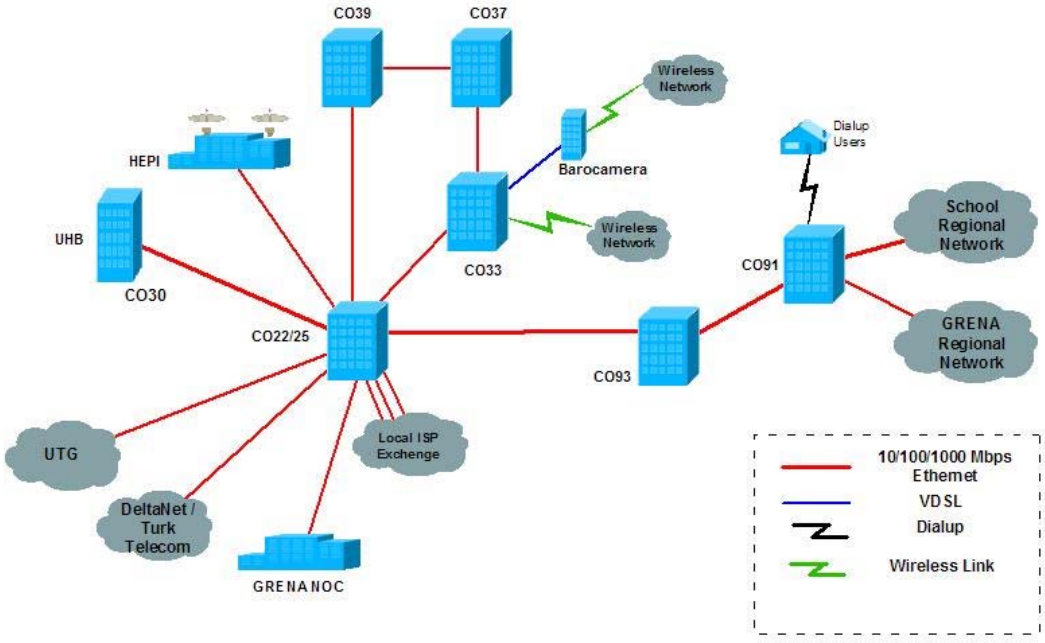

Figure 5 Schematic view of GRENA Network in Tbilisi

3.4. BSI NRENs PoP details

In the following sections contact details for BSI PoPs are summarized.

3.4.1. Armenia (.am)

Organisation name	National Academy of Sciences of Armenia
Address	24A, Marshall Baghramian ave. Building of Institute of Geological Sciences, Internet Center/Armenian Freenet Club (ARENA Foundation)
Telephone (at the above address)	-
Floor & room number	Server room
Rack or cabinet	-
Router slot	-
Zip code & city	Yerevan, 0019
Country	Republic of Armenia
Technical contact NAME	Arthur Petrosyan
Technical contact ADDRESS	24A, Marshall Baghramian ave., Yerevan, 0019, Republic of Armenia
Technical contact TELEPHONE	+374 10 526742
Technical contact FAX	+374 10 569281
Technical contact E-MAIL	arthur@sci.am

Table 1: BSI PoP in .AM details

3.4.2. Azerbaijan (.az)

Organisation name	Azerbaijan Research and Educational Networking Association
Address	Sharifzadekh 241
Telephone (at the above address)	-
Floor & room number	-
Rack or cabinet	-
Router slot	-
Zip code & city	AZ1012
Country	Azerbaijan
Technical contact NAME	Irshad Guliyev
Technical contact ADDRESS	9 F.Agayev street
Technical contact TELEPHONE	+99412 5101100 (ext 101)
Technical contact FAX	+99412 4975895
Technical contact E-MAIL	admin@azrena.org

Table 2: BSI PoP in .AZ details

3.4.3. Georgia (.ge)

Organisation name	Georgian Research and Educational Networking Association
Address	95 Tsinamdzgvrishvili str.
Telephone (at the above address)	-
Floor & room number	5 floor
Rack or cabinet	-
Router slot	-
Zip code & city	0112 Tbilisi
Country	Georgia
Technical contact NAME	Nick Elbakidze
Technical contact ADDRESS	10 Chovelidze St
Technical contact TELEPHONE	+995 93 355755
Technical contact FAX	+995 32 912952
Technical contact E-MAIL	nelbakidze@grena.ge

Table 3: BSI PoP in .GE details

3.5. Equipment

The following sections present the border routers which will be used by the BSI NRENs.

3.5.1. Armenia (.am)

```
bsi>sh ver
Cisco IOS Software, 7300 Software (C7300-P-M), Version 12.2(31)SB12, RELEASE SOF
TWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Fri 30-May-08 19:21 by pwade


ROM: System Bootstrap, Version 12.2(22r)S, RELEASE SOFTWARE (fc1)


 bsi uptime is 2 hours, 7 minutes
Uptime for this control processor is 2 hours, 7 minutes
System returned to ROM by power-on
System image file is "disk0:c7300-p-mz.122-31.SB12.bin"


cisco 7300 (NPEG100) processor (revision B) with 983040K/65536K bytes of memory.
Processor board ID SMQ1220N60X
SB-1 CPU at 800Mhz, Implementation 0x401, Rev 0.2, 512KB L2 Cache
4 slot midplane, Version 69.48


Last reset from power-on
3 Gigabit Ethernet interfaces
1 Serial interface
1021K bytes of non-volatile configuration memory.


126000K bytes of ATA compact flash in bootdisk (Sector size 512 bytes).
253008K bytes of ATA compact flash in disk0 (Sector size 512 bytes).
```

```
Standby route processor in slot 2 is up with 1048576K/65536K
bytes of memory.
Standby image version:
Cisco IOS Software, 7300 Software (C7300-P-M), Version
12.2(31)SB12, RELEASE SOF
TWARE (fc3)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Fri 30-May-08 19:21 by pwade

Configuration register is 0x2102
```

3.5.2. Azerbaijan (.az)

```
az7204>sh ver
Cisco Internetwork Operating System Software
IOS (tm) 7200 Software (C7200-JK9O3S-M), Version 12.3(12a),
RELEASE SOFTWARE (fc
2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Thu 13-Jan-05 22:22 by kellythw
Image text-base: 0x60008AF4, data-base: 0x62268000

ROM: System Bootstrap, Version 12.2(4r)B, RELEASE SOFTWARE (fc1)
BOOTLDR: 7200 Software (C7200-KBOOT-M), Version 12.1(8a)E, EARLY
DEPLOYMENT RELE
ASE SOFTWARE (fc1)

az7204 uptime is 43 weeks, 2 days, 6 hours, 25 minutes
System returned to ROM by power-on
System image file is "disk0:c7200-jk9o3s-mz.123-12a.bin"


This product contains cryptographic features and is subject to
United
States and local country laws governing import, export, transfer
and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use
encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this
product you
```

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agree to comply with applicable laws and regulations. If you are
unable
to comply with U.S. and local laws, return this product
immediately.

A summary of U.S. laws governing Cisco cryptographic products
may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending
email to
export@cisco.com.

cisco 7204VXR (NPE400) processor (revision A) with
229376K/32768K bytes of memor
y.
Processor board ID 26804642
R7000 CPU at 350MHz, Implementation 39, Rev 3.3, 256KB L2 Cache
4 slot VXR midplane, Version 2.6

Last reset from power-on
Bridging software.
X.25 software, Version 3.0.0.
SuperLAT software (copyright 1990 by Meridian Technology Corp).
TN3270 Emulation software.

PCI bus mb0_mb1 (Slots 0, 1, 3 and 5) has a capacity of 600
bandwidth points.
Current configuration on bus mb0_mb1 has a total of 400
bandwidth points.
This configuration is within the PCI bus capacity and is
supported.

PCI bus mb2 (Slots 2, 4, 6) has a capacity of 600 bandwidth
points.
Current configuration on bus mb2 has a total of 0 bandwidth
points
This configuration is within the PCI bus capacity and is
supported.

Please refer to the following document "Cisco 7200 Series Port
Adaptor Hardware Configuration Guidelines" on CCO
<www.cisco.com>,
for c7200 bandwidth points oversubscription/usage guidelines.


2 FastEthernet/IEEE 802.3 interface(s)
1 ATM interface(s)
125K bytes of non-volatile configuration memory.

46976K bytes of ATA PCMCIA card at slot 0 (Sector size 512
bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).
```

```
Configuration register is 0x102

az7204>
```

3.5.3. Georgia (.ge)

```
Border_CO91#sh ver
Cisco IOS Software, 7300 Software (C7300-A3JK91S-M), Version 12.2(33)SB3, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Sun 21-Dec-08 17:38 by prod_rel_team


ROM: System Bootstrap, Version 12.2(22r)S, RELEASE SOFTWARE (fc1)


 Border_CO91 uptime is 2 hours, 31 minutes
Uptime for this control processor is 2 hours, 31 minutes
System returned to ROM by reload at 00:32:56 UTC Sat Jul 1 2000
System image file is "disk0:c7300-a3jk91s-mz.122-33.SB3.bin"
Last reload type: Normal Reload
Last reload reason: Reload command




This product contains cryptographic features and is subject to United
States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this
```

```
product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

cisco 7300 (NPEG100) processor (revision B) with 983040K/65536K bytes of memory.
Processor board ID SMQ1220N63D
SB-1 CPU at 800Mhz, Implementation 0x401, Rev 0.2, 512KB L2 Cache
4 slot midplane, Version 69.48

Last reset from software reset or reload
3 Gigabit Ethernet interfaces
2 Serial interfaces
1 ATM interface
1021K bytes of non-volatile configuration memory.

126000K bytes of ATA compact flash in bootdisk (Sector size 512 bytes).
253008K bytes of ATA compact flash in disk0 (Sector size 512 bytes).

Standby route processor in slot 2 is up with 1048576K/65536K bytes of memory.
Standby image version:
Cisco IOS Software, 7300 Software (C7300-A3JK91S-M), Version 12.2(33)SB3, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Sun 21-Dec-08 17:38 by prod_rel_team
```

```
Configuration register is 0x2102
```

4. Logical network topology

The following sections give an overview of connected interface IP addresses, autonomous systems and advertised prefixes by BSI NRENs.

4.1. BSI NRENs connected interfaces IP addresses (endpoints)

The table hereafter lists the BSI NRENs connected interfaces (IPv4).

NREN	GEANT3 side	NREN side	Subnet address
.AM	62.40.125.165/30	62.40.125.166/30	62.40.125.164/30
.AZ	62.40.125.169/30	62.40.125.170/30	62.40.125.168/30
.GE	62.40.125.173/30	62.40.125.174/30	62.40.125.172/30

Table 4: BSI NRENs connected interfaces IP addresses and link endpoints

The table hereafter lists the BSI NRENs connected interfaces (IPv6).

NREN	GEANT3 side	NREN side	Subnet address
.AM	2001:0798:002C:10AA::13/126	2001:0798:002C:10AA::14/126	::12/126
.AZ	2001:0798:002C:10AA::17/126	2001:0798:002C:10AA::18/126	::16/126
.GE	2001:0798:002C:10AA::21/126	2001:0798:002C:10AA::22/126	::20/126

Table 5: BSI NRENs connected interfaces IP addresses and link endpoints

4.2. BSI NRENs autonomous systems and advertised IPv4/6 prefixes

This sections lists the BSI NRENs autonomous systems and advertised IPv4/6 prefixes

NREN	Autonomous System(s)	IPv4/6 prefix(es)
.AM	AS47623	93.187.160/21
.AZ	AS29630	82.194.8.0/22
.GE	AS20545	217.147.224.0/20

Table 6: BSI NRENs autonomous systems and IPv4/6 prefixes

4.3. BSI NRENs border routers eBGP sessions

The following sections provide details on the eBGP sessions between the border routers, participating in the BSI network.

4.3.1. Armenia (.am)

[this section will be updated as soon as the network is operational and the routers will be configured]

[Output of the "show bgp ipv4 unicast summary"]

4.3.2. Azerbaijan (.az)

[this section will be updated as soon as the network is operational and the routers will be configured]

[Output of the "show bgp ipv4 unicast summary"]

4.3.3. Georgia (.ge)

[this section will be updated as soon as the network is operational and the routers will be configured]

[Output of the "show bgp ipv4 unicast summary"]

5. BSI routing scheme

[this section will be updated as soon as the network is operational and the routers will be configured]

6. Conclusion

In this report (D3.2) we presented in detail the current topology of BSI connected networks, resulting from the international connectivity tender. The information provided in this document is used on everyday basis by technical personnel involved in the deployment and management of the BSI network.