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## **Deliverable D.1.2v3 (update): NREN Status and Development Plans**

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**Authors:** Peter Bogatencov, Yashar Hajiyev, Oksana Kubichka, Ramaz Kvavadze, Bruno Martuzans, Igor Mkrtumyan, Liina Pärnamäe, Milosz Przywecki, Raimundas Tuminauskas, Gajane Valchevskaia,

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Project:	Porta Optica Study
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Document Code:	POS-03-002

# Table of Contents

0	Executive Summary	iv
1	Introduction	1
2	Gathering Information - The Questionnaire	2
3	Questionnaire Results	4
3.1	NREN Status: Type, Funding Scheme, Management	4
3.2	Relation to Other Research and Educational Networks	9
3.3	NREN Infrastructure: Nodes, Equipment and Connectivity Types	11
3.4	Current and Potential Suppliers, Relation to Local Telecom Companies	14
3.5	Development Plan	17
3.6	Users	20
4	Conclusions	23
	Appendix A REN Questionnaire .....	24
	Appendix B Maps of the NREN Infrastructure .....	27

## 0 Executive Summary

This document, “NREN Status and Development Plans”, describes the working environment of target country NRENs in the Porta Optica Study, their status, type, funding scheme and management, infrastructure, nodes/equipment and connectivity types. The deliverable also provides information about the NREN current suppliers, relation to other research networks and fiber providers in the country. The proper knowledge about these facts is the key to future infrastructure development process.

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

# 1 Introduction

The ultimate goal of Porta Optica Study is to study the feasibility of building regional and interregional networks based on dark fiber infrastructures in Eastern Europe, with their interconnection to GÉANT2.

In order to achieve the goal set in the Porta Optica Study project proposal, it is one of the objectives of the study to identify the NRENs, their operating environment, existing and potential customers and their ability to cooperate in European Research. This activity will provide a clear vision of the targeted NRENs with the focus on not only the well-recognized NRENs, but also on local RENs that may be included in the dark-fiber study. Although the Porta Optica Study participants are usually National Research and Educational Networks, sometimes the complex networking situation in target countries did require some more careful investigation.

The aim of this activity was to gather information about the current state of NRENs including their fiber optic segments. Based on the information gathered in the deliverables of WP1, Porta Optica Study will produce a series of case studies, aiming to produce guidelines for further fiber network development in the Baltic States, Eastern European countries and Southern Caucasus region.

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

## **2 Gathering Information - The Questionnaire**

In order to achieve unbiased results, a uniform Questionnaire was constructed and sent to all Porta Optica Study beneficiary partners:

<b>Country</b>	<b>NREN</b>
Armenia	ARENA
	ASNET
Azerbaijan	AzRENA
	AzNET
Belarus	BYNET
Estonia	EENet
Georgia	GRENA
Latvia	LATNET
Lithuania	LITNET
Moldova	RENAM
Ukraine	URAN
	UARNet/NASU

The Questionnaire included sections about the basic information on both National Research and Educational Networks (NRENs) and (in case there were any) other Research and Educational Networks (RENs) in the country. See the questionnaire in Appendix 1

The Questionnaire consisted of several different topics to better understand the structure of RENs.

- Country
- Name of the REN
- Name of the parent organisation, if existing

- Type of the institution of the REN (separate legal entity of its own; part of a larger organisation; other)
- Funding (the percentage of income from national government, from users, clients, from other sources)
- Management (short description of REN management structure, management scheme)
- Relation to other RENs (if existing) in the country (cooperation agreements, traffic agreements, agreements on pricing of services, other relations)
- Infrastructure (REN main infrastructure - bandwidth and type of channels, ownership of channels; a map of the infrastructure - backbone between cities and inter-city fibers)
- Current and potential suppliers, relation to other local telecom companies (whether REN rents/leases fibers from telecom companies, REN purchases other services from telecom companies and/or has joint projects with telecom companies, owns fibers itself)
- Development plans (partners were asked to provide a short description (max 500 words) of the development plans of the REN)
- Types and number of institutions permanently connected via REN
- Other useful information
- Contact data of the REN

The questionnaire was sent to the project target countries on March 21st. The first answers were received already on March 22nd, the last replies came on April 5th.

This document contains updated information which was prepared in May 2007.

In order to get a better overview of the results of the questionnaire, the responses were divided into smaller thematic groups which allow clearer comparison of the respondent institutions. . In case of Belarus there are plans to establish new NREN – BYNET as an Association of RENs, which will include major RENs: BASNET (research) and UNIBEL (education). Thus, some data is incomplete (e.g. it is not possible to define complete funding scheme at this point).

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

## 3 Questionnaire Results

### 3.1 NREN Status: Type, Funding Scheme, Management

NRENs were asked to provide the most basic details about their organisation. For completing project goals successfully, it was vital to understand the inner structure, legal status and sources of income of the institutions in question.

The answers to the questionnaire revealed that the organisational structure of the NRENs may vary much from country to country. Most of the project beneficiary partners are separate legal entities of their own, others are part of some larger organisation (usually the academy of sciences or some university).

Also the funding schemes of the networks were of great difference. While some NRENs acquire the largest part of their income from national governments budget (eg EENet up to 98.8% of its income), others receive no subsidies from their respective governments. Most of the institutions also receive payments from EC or NATO funds). The situation can be observed in the table below.

UARNet is operating network owned by NASU (National Academy of Sciences of Ukraine)<sup>1</sup>.

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<sup>1</sup> URAN distinguishes the enterprise UARNet and a corporative network of Ukrainian Academy of Science (NASU) and treats UARNet as one of a number of commercial ISP

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

REN	Name of the parent organisation	Form of organisation	Funding			Management
			From National Government	From users, clients	From other sources	
ARENA	National Academy of Sciences of Armenia	Foundation acting as a satellite Internet access provider under Virtual Silk Highway (SILK) Project. Armenian RENs are a non-formal association of academic and research institutions, universities, libraries and other non-profit foundations. The organizations representing Armenian RENs get financial support mostly from International Donor Organizations.	10%	0%	90% (OSI, NATO, UNDP, ISTC, Eurasia Foundation, CRDF)	ARENA is governed by a board including representatives of National Academy of Sciences, major state universities, OSI and UNDP. Technical solutions are prepared by Technical Groups of each of organizations representing REN.
ASNET	National Academy of Sciences of Armenia	Armenian RENs are a non-formal association of academic and research institutions, universities, libraries and other non-profit foundations.	10%	0%	90%	ASNET is governed by the National Academy of Sciences
AzRENA	The National Academy, Research Institutes and Universities	Public association of universities and research institutes of National Academy of Science	50%	47%	3%	AzRENA is governed by board including representatives of the founders.
AzNET	Ministry of Communication and Information Technology, UNDP, OSI-AF, AzRENA	Not a separate legal entity and also not part of a larger organisation	5%	1%	94% (UNDP; OSI-Az; AzRENA )	AzNET is governed by a steering committee, which includes representatives from project founding organizations: UNDP, OSI-AF, AzRENA and

						Azeri Government. Project staff with respect of founding organizations points of view prepares technical solutions.
BYNet (financial plan is attached <sup>2</sup> ),	Administration of Park of High Technologies	Association of UNIBEL (educational network), BASNet, network of State Committee "Voenprom", network of the Ministry of Industry,....	37%	53%	10% (International NATO NIGs)	The governing body of Administration of Park of High Technologies
EENet	EENet is a public institution operating under the administration of the Estonian Ministry of Education and Research	Separate legal entity of its own	71.2%	0.3%	28.5% (eg. EU Framework Program projects)	EENet Director is appointed by the Estonian Ministry of Education and Research. The structural units of EENet are the Network Department, the Services Department and the Customer Service Department. The Supervisory Board of EENet is appointed by the Minister of Education and Research and it determines the strategy

<sup>2</sup> ) Governmental support for the Park of High Tech. Today the proposed networking infrastructure budget just for the first building on the territory of the Park is about 500 000 USD.

2) There are 3 NATO infrastructure grants allocated for:

- a) CISCO Academy creation,
- b) Teleconferencing provision.

c) Secure NOC organization (250000 EUR) oriented onto Park of High Tech as project host institution. The budget was approved by NATO already.

3) National and International investments into buildings and infrastructure development of Park. It is not easy to identify (to separate) the networking cost from the total, as the total infrastructure investment cost is over 300 Mio US Dollars for 2007-2009. An estimation is that there will be enough money to create advanced networking infrastructure with high-speed data exchange.

4) Park will lead a number of National initiatives like e-hospital development (estimated costs is 1,5 mio USD). The project is in preparation with ITU (International Telecommunication Union) as sponsoring organization.

5) Finally Park together with Ministry of Education are developing the UNIBEL network -- ICT-infrastructure conception and the budget. It will be over 5 Mio USD for 2008-2009 and oriented to link educational institutions and schools to GEANT2.

Funding goes to the Administration of Park of High Technologies as this is the legal body which e.g., can get equipment from abroad.

Till Association BYNet is organized the financial support will be allocated for this governmental institution - Administration of Park of High Technologies ([www.park.by](http://www.park.by)).

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

						and development directions of EENet.
GRENA	No parent organisation	Separate legal entity of its own	0%	50%	50% (NATO, OSGF and OSI grants)	GRENA is managed by the GRENA Board which consists of representatives of the founding organisations and appoints GRENA Executive Director.
LATNET	Institute of Mathematics and Computer Science, University of Latvia	Part of a larger organisation	35%	27%	38%	The LATNET academic network is a separate department of the Institute of Mathematics and Computer sciences. The department is responsible for its financial income and outcome, and has its own bank account.
LITNET	Ministry of Education and Science of the Republic of Lithuania	LITNET is an association of academic research and other non-profit organizations.	85%	0%	15% (EC financing mainly including financing from ERDF )	The highest governing body of LITNET is LITNET Board whose structure and regulations are confirmed by the Ministry of Science and Education in Lithuania. LITNET Board coordinates the development and management of the network. Technical solutions are prepared by LITNET Technical Experts and presented to the LITNET board for final approval. LITNET consists of

						participating organizations, that not only connect to LITNET but provide connectivity to others are defined as regional centres (RC's).
RENAM	No parent organisation	Separate legal entity of its own	18%	61%	31% (International grants)	RENAM Association is governed by the Council of RENAM Association, which consists of heads of scientific and educational institutions, representatives of Ministries, the Academy of Sciences and makes strategy decisions on RENAM network and information systems development directions, assessing and approving RENAM development plans.
URAN	Association of users of URAN	Separate legal entity of its own	0%	70%	30% (NATO Network Infrastructure Grants)	URAN is governed by its Association of Users General Assembly, which elects Board to manage the work of URAN network.
UARNet/ NASU	National Academy of Sciences	Separate legal entity of its own	5%	95%	0%	State Enterprise

**Table 1:** NREN Status: type, funding scheme, management

### 3.2 Relation to Other Research and Educational Networks

The respondents were asked to indicate whether there were any other research and educational networks in their countries and to specify the relationship of the NRENs to these other networks.

Most of the partners responded that there were no other research networks in the country. LATNET noted that only extended campus LANs existed in Latvia. In Belarus there is number of research and educational networks. In Armenia and Azerbaijan there are several national research and educational networks and also many research and educational networks.

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

REN	Are there other RENs in the country?	There are with other RENs:			
		Cooperation agreements	Traffic agreements	Agreements on pricing services	Other relations
ARENA	Yes (ISOC//LIBnet/UNIn et)	Yes	Yes	No	ARENA and ASNET are cooperating in providing their clients alternative satellite connection. ARENA is connecting major Armenia universities.
ASNET	Yes (ISOC//LIBnet/UNIn et)	Yes	Yes	No	ASNET is mainly a research network that unifies Academic, Scientific, Research, Educational, Cultural and other organizations, which are engaged in scientific and educational activity . ASNET and ARENA together are representing Armenia educational and research network
AzRENA	Yes	Yes (AzRENA is one of founders of AzNET)	Yes (AzRENA and AzNET tightly collaborate on traffic management issues)	No	AzRENA is one of the founders and contributors to AzNET project.
AzNET	Yes	Yes (AzNET has cooperation agreement with AzRENA)	Yes (AzNET and AZRENA tightly collaborate on traffic management)	No	AzNET is one of the founders and contributors to support and development its own training facilities, resources

			t issues)		development systems and network infrastructure.
BYNET	Yes. Ministry of Health, 3 networks of the Ministry of education -BSU Network, UNIBEL, and NIKS, CESN_e, Ministry of Industry, State Committee "Voenprom"	Yes (between RENs)	Yes (between RENs)	Yes (between RENs)	
EENet	No	-	-	-	-
GRENA	No	-	-	-	-
LATNET	No (There are only extended campus LANs for example, LANET, DPUnet, etc.)	-	-	-	-
LITNET	No	-	-	-	-
RENAM	No	-	-	-	-
URAN	Yes (UARNet/NASU)	No	No	No	-
UARNet/NASU	Yes (URAN)	No	No	No	-

**Table 2: Relation to Other Research and Education Networks**

### 3.3 NREN Infrastructure: Nodes, Equipment and Connectivity Types

The project beneficiary partners were asked to provide a short description about the infrastructure of the NREN, possibly also with intercity connections. They were also asked to provide maps in \*jpg or \*gif format to illustrate the connectivity scheme of the RENs. The maps are included in Appendix 2.

The information gathered gives an overview of the present condition and status of the technological possibilities of the RENs and can be used later in Work Packages 2 and 3, when constructing the fiber optic development plan of Eastern Europe.

<b>REN</b>	<b>Infrastructure</b>
ARENA	ARENA foundation provides a satellite Internet access under Virtual Silk Highway (SILK) Project. Foundation member organizations are linked to the ARENA operating centre by various type of connections (mainly fiber – 10/100 Mbps).
ASNET	ASNET-AM backbone consists of 7 main network communication nodes in 4 cities of Armenia which are interconnected by fiber-optics and wireless links. Each node connects the nearby Scientific, Research, Educational and Cultural Organisations.
AzRENA	AzRENA connects 15 educational and 40 academic research institutes in 4 cities. AzRENA has about 5Mbps backbone connectivity in total, 2Mbps of which comes from "Silk Way" and 3 Mbps is supplied by Trans-Caucasian backbone operator AzerSat (Delta Telecom). The AzRENA network connects to Internet in symmetrical regime through two NOCs (Network Operations Center), central one is placed in the central building of the Academy, the backup is in the Presidium of Academy' building. Universities and academic institutes in Baku are connected with NOCs operational center by fiber optic and physical lines and Radio-Internet. In academy town the research institutes and nearest universities have Internet connectivity via AzRENA's own fiber-optic network. Several other universities have Internet through AzRENA's radio-modems. To provide Internet to most distant universities and institutes AzRENA uses leased lines from BakTelecom (Baku Telephone Network Production Association) in Baku and lines from the incumbent operator AzTelecom for delivering Internet to universities and research institutes in different cites.
AzNET	AzNET delivers Internet connectivity to 50 schools, 8 Universities, NGO's, libraries and universities over the ADSL, SHDSL equipment installed in more than 15 PSTNs of Baku, Ganja, Mingechevir, Siyazan, Hacigabul. AzNET also supports about 143 organizations with different kind of IT services, which include training, on-site technology support, web design and hosting, dialup. AzNET network connects to Internet in symmetrical. Universities, schools, NGOs and libraries located in Baku, Ganja, Mingechevir, Hacigabul and Siyazan are connected by cooper last mile solutions (telephony lines, leased lines) to nearest PSTNs, then via POPs mounted at PSTN by fiber-optic lines to NOC. Totally 8 Mbps Internet connectivity coming from Virtual Silk Highway (2 Mbps) and Delta Telecom (6 Mbps) delivered to NOC by means of Gigabit Ethernet Backbone. Last mile solutions realised by AzNET are based on ADSL and SHDSL technology. Minimal connectivity speed of served organisations is 64 Kbps. The served organizations in other cities via local PSTNs are connected to AzTelecom infrastructure via E1 channels.
BASNET network of the National Academy of Sciences of Belarus	Since Belarussian project partners are creators and leaders of BASNet network it's infrastructure and description are presented below. In Minsk (capital of Belarus ) there are 13 BASNET nodes. One is located in Beltelecom to organize link from BASNET to GÉANT2 via fiber-optic channels. Other BASNET nodes in Minsk are located in key institutes of the National Academy to link over 100 R&D and educational institutions. Three of nodes utilize radio links and all others FO links. To each regional city 2Mbps links are used that rented from Beltelecom. This allowed to organize BASNET regional nodes. The core of the Minsk backbone is FDDI-ring of 100 Mbps bandwidth. Some institutes are located at the ring and other (so called periphery-institutions) are connected by radial

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

REN	Infrastructure
	<p>fiber optics segments utilizing Fast Ethernet and Ethernet protocols, that provide high speed data exchange (100 Mbps) between local networks of the National Academy organizations. In order to provide high speed connection for organizations located in Academy Campuses (at Kuprevich St. and "Sosny" settlement) the technologies of wireless connection including radio-Ethernet and microwave channels are used. Within Academy Campuses these organizations are interconnected by high speed fiber channels.</p> <p>Since August 2004, access to the international R&amp;D networks is organized by fiber optics link to the Pan European Research Network GÉANT2 according to the agreements with the PSNC of the Polish Academy of Sciences.</p> <p>The NRENs of Poland (PIONIER) and Research network in Belarus are temporary linked by renting FO channels from "Beltelecom" (Belarussian PTT) and Exatel (on Polish side). The existing equipment provides up to 155 Mbps bandwidth.</p>
EENet	<p>EENet maintains a GÉANT2 Network PoP in Tallinn (Estonian capital) with the international connection of 1Gbps.</p> <p>Inside Estonia EENet operates a backbone network that connects 16 PoP-s in 12 towns. In each town one PoP is located in the premises of telco (mainly in Elion Enterprises Ltd. whose owner is AS Eesti Telekom, but in some cases also in other telco premises); the equipment of those PoP-s belongs to EENet.</p> <p>In addition there are 3 dark-fiber connected PoP-s in Tallinn, all located in research or educational institutions, and one in Tartu, in the premises of EENet office.</p> <p>Tallinn and Tartu are connected with dark fiber, leased from Televõrgu AS. On that fiber Allied Telesyn CWDM solution is used to provide 4x1Gbps full-duplex links.</p> <p>Other towns are connected to Tallinn or Tartu PoP with managed bandwidth Fast-Ethernet services by different telcos at speeds 4-20 Mbps.</p> <p>The network equipment of EENet consists of Cisco Catalyst switches, Cisco 7200VXR and Juniper routers.</p> <p>EENet network is interconnected with Estonian commercial ISP-s in two interconnection points in Tallinn.</p>
GRENA	<p>In Tbilisi (the capital of Georgia) infrastructure consists of DF owned by GRENA about 30 km and running at gigabit Ethernet technology. The regional country-wide network infrastructure is based on 2 Mbps E1 channels that are rented in the DF links owned by company Railway Telecom of Georgia.</p>
LATNET	<p>LATNET maintains the PoP of the GÉANT2 network and has international connection to it with the bandwidth 1Gbps (since 19 March 2007). The connections with main towns of Latvia are established by the leased optical lines with bandwidth up to 100 Mbs. The last mile connections are arranged by the radio link connections, UDSL, leased lines and other types of connections.</p>
LITNET	<p>Intercity connectivity:</p> <p>During 2005 LITNET has acquired optical fiber link from Kaunas University of Technology (KTU) to Institute of Mathematics and Informatics (IMI) in Vilnius. Second dark fiber link from KTU to Klaipeda University became operational in 2006. Optical fiber links from Klaipeda to Siauliai and from Siauliai to Panevezys will become operational in 2007-2008</p> <p>Currently LITNET intercity backbone consists of 1 Gbps links between major RC's (10Gbps between KTU and IMI).. Other 20 intercity links use managed bandwidth fast Ethernet services at speeds 4-50 Mbps.</p> <p>Currently Ethernet channels are provided by "Lietuvos Telekomas". Dark fiber was purchased from "Lietuvos Telekomas" and UAB "Skaidula".</p>

REN	Infrastructure
	<p>Most of higher education organizations are connected to LITNET by dark fiber. LITNET organizations own necessary DF links in major cities including developed DF infrastructures in Kaunas, Vilnius, and Klaipeda, Panevezys, Siauliai and Kedainiai.</p>
RENAM	<p>Most RENAM users are connected to the NREN by using miscellaneous types of connections including telephone operator leased lines (usually using xDSL technology), radio links, Ethernet/Fast Ethernet, Gigabit Ethernet, xDSL lines built by NREN itself, dial-up, Wi-Fi.</p> <p>In Chisinau (the capital of Moldova) metropolitan backbone RENAM has its own dark fiber infrastructure of total length approximately 20 km and shares about 6 km of fibers belonging to State telecommunication enterprise - the Center of Special Communications (CTS).</p> <p>There are no fiber links from Chisinau to peripheral cities and up to the present there are no plans on how to build effective connections on the territory of the Republic.</p> <p>International connections are currently realized using Radio-relay facilities offered by State Enterprise "Radiocomunicatii" that provides link between Chisinau and Iasi (Romania) RoEduNet node. Via RoEduNet, a partner NREN and member of GN2 Consortia, RENAM obtains access to GÉANT2 infrastructure. This link capacity is 16 Mbps at present and plans to be upgraded up to 34 Mbps in 2006</p> <p>A RENAM back-up channel is rented from local ISPs. At present RENAM is cooperating with "StarNet" Ltd.</p> <p>Very important for the network operation is local pairing with all ISPs in Moldova via IX point that is operating in Chisinau by "Moldtelecom" S.A. This link capacity is 100Mbps.</p> <p>Intercity channels:</p> <ul style="list-style-type: none"> <li>Chisinau – Balti – Radio-relay (SE "Radiocomunicatii") - 8Mbps</li> <li>Chisinau - Cahul – 128 kbps data transfer facility provided by "Moldtelecom" S.A</li> </ul>
URAN	<p>Intercity channels lease: Datagroup Ltd.(Kiev-Odessa, Kiev-Vinnitsa, Ethernet, 15 Mbps Kiev-Simferopol, Kiev-Kharkov, Kiev-Poltava, Ethernet, 10 Mbps, Simferopol-Sevastopol (YapikNet, 15 Mbps)</p> <p>Inside city channels: copper pairs - leased from JSC Ukrtelecom, optic fibers - URAN owned</p> <p>Inland connectivities (Internet exchange points):</p> <ul style="list-style-type: none"> <li>Kiev (UA-IX, 85% of Ukrainian traffic) - 100M</li> <li>Odessa (OdEX, 8% of Ukrainian traffic) - 100M</li> </ul> <p>External connectivity</p> <ul style="list-style-type: none"> <li>via Datagroup Ltd. and via State enterprise UARNet (both 100M)</li> </ul>
UARNet/NASU	<p>Own DWDM system (owned by NASU), international links: leased STM4 and GigabitEthernet (STM16 from July), national links based on own DWDM system (owned by NASU) and leased capacity (STM1) from UMC and Kyivstar</p>

**Table 3: NREN Infrastructure: Nodes, Equipment and Connectivity Types**

### 3.4 Current and Potential Suppliers, Relation to Local Telecom Companies

In order to plan the future fiber network, it was essential for the project to know the exact relationship between the project partners and the local telecom companies of the respective countries.

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

The questionnaire showed that all project participants had some kind of relationship with their local telecommunication providers. Most RENs rented or leased fibers from telecom companies (except GRENA and URAN) and purchased other services from them (except BASNET). All participating NRENs themselves owned fibers.

<b>REN</b>	<b>REN rents/leases fibers from telecom companies</b>	<b>REN purchases other services from telecom companies</b>	<b>REN has joint projects with telecom companies</b>	<b>REN itself owns fibers</b>
ARENA	No	No	No	No
ASNET	Armentel, Arminco	Armentel, Arminco	No	Yes
AzRENA	Yes (in Baku the FO lines from BakTelecom In other university towns from Aztelecom)	No (the city channels leased from BakTelecom, Intercity channels leased from Aztelecom and backbone connectivity over optic fibers from – AzerSAT are taken on the free of charge terms)	Yes ( AzNET project together with the Ministry of Communication and Information Technology)	Yes
AzNET	Yes (all local country-wide communication facilities are provided on free of charge base from Ministry of Communication & IT)	6 Mbps of Internet channel from Delta Telecom. AzTeleCom PU provides intercity communication data channels.	No	Yes
UNIBel BSU Network BASNET Network of the Ministry of Industry	Beltelecom	No	No	Yes
EENet	Televõrgu Ltd, Elion Enterprises Ltd	Elion Enterprises Ltd, Televõrgu Ltd	No	Yes
GRENA	No	Leasing E1 channels for regional connectivity from Railway Telecom of Georgia.	No	Yes

<b>REN</b>	<b>REN rents/leases fibers from telecom companies</b>	<b>REN purchases other services from telecom companies</b>	<b>REN has joint projects with telecom companies</b>	<b>REN itself owns fibers</b>
		Obtaining Right of Way for DF, renting space for PoPs at COs, renting copper pairs for ADSL connectivity in Tbilisi from United Telecom of Georgia		
LATNET	Lattelekom, Optron, Latvenergo (Electrical company), Latvijas Dzelzceļš (Railway company)	Lattelekom, ELISA	No	Yes
LITNET	AB "Lietuvos Telekomas"	"AB" Lietuvos Telekomas", AB "Lietuvos Energija", UAB "Bite GSM" Leased lines and broadband infrastructure at 4 - 1000 Mbps	Only short MAN lines	Yes
RENAM	Conform the Accord of Collaboration with State Enterprise "The Center of Special Telecommunications" (CTS) RENAM has approximately 6 Km of DF lines in Chisinau "StarNet" Ltd. – is providing connections for 2 RENAM nodes – conform the contract conditions	"Moldtelecom" S.A – leasing copper telephone lines for connecting end user's nodes and ensuring back-up facilities for RENAM nodes interconnection. "StarNet" Ltd. ; External backup channel and utilization a part of their private fiber infrastructure in Chisinau; "Radiocomunicatii Romania" - S.A. using radio-relay link facilities REN purchases other services from telecom companies for providing connection to	1. SE "Radiocomunicatii Moldova" – installation radio-relay facility for building the link Chisinau – the boarder with Romania; Creation of radio-relay link Chisinau-Balti; 2. CTS – the joint project of development of fiber infrastructure in Chisinau.	Yes

REN	REN rents/leases fibers from telecom companies	REN purchases other services from telecom companies	REN has joint projects with telecom companies	REN itself owns fibers
		RoEduNet on the territory of Romania		
URAN	No	Intercity channels lease: copper pairs – leased from JSC Ukrtelecom	Datagroup Ltd ETT	Yes (MANs)
UARNet/NASU	Yes (Kyivstar, UMC, Druzhba)	No	No	Yes

**Table 4: Current and potential suppliers, relation to local telecom companies**

### 3.5 Development Plan

Project beneficiary partners were asked to send a short description (max 500 words) of their development plans and also provide an URL to the official development plan, if existing. The question was answered by all participants and the development plan descriptions were received.

Unfortunately not many NRENs have their development plans published on their respective web-sites or elsewhere. The URL-s were received from EENet, LITNET (both only in the native language) and from RENAM.

The development plan descriptions revealed that all NRENs have understood the necessity of building dark fiber infrastructure which means for the NREN freedom, sustainability and predictive costs. Dark-fiber based NRENs have the flexibility of network design and technology choice.

The answers also affirmed the fact that for the NRENs which are not members of the pan-European research network GÉANT2, joining is a matter of very high priority.

REN	Short description (max 500 words) of the development plans of the REN:
ARENA	Development strategies for Armenian research and education network are: 1. Development of the Inter-University fiber network; 2. Connecting all Universities to the satellite communication channel providing Internet connection independent from the local Telecom. It will permit to activate research in all higher education institution and involve them in better collaboration.
ASNET	Development strategies for Armenian research and education network are: 1. Development of the Yerevan City 10Gb fiber backbone project;

REN	Short description (max 500 words) of the development plans of the REN:
	<p>2. Establishment of the NREN CERT;      3. Development of the POS-Armenia project      The major goal is to connect Armenian REN to the pan-European research network – GÉANT2 by 2009. These tasks will be achieved through the following:      Increasing transmission capacities for international channels: Armenian REN needs to be connected to GÉANT2 with 155 Mb channel.      Building all-Armenia backbone that will be a natural expansion of the Yerevan city backbone connecting Armenian research centers in other cities to Yerevan.</p>
AzRENA	<p>1. In the framework of EU TACIS South Caucasus regional program e-Caucasus and in the frame of joint project with Indiana University USA creation National Center of Distance Education (DE) in Baku State University (BSU), and scaling up the experience on DE to other Azerbaijan universities in capital and in cities.      2. The creation of the all necessary on-line resources and facilities to speed up implementation of e-learning technologies in the local higher education system.      3. Launch web-based thematically specialized courses on distance learning in different universities.      4. Founding in BSU the faculty of professional development program focused on DE design and implementation.      5. Expand with the Ministry of Communication and Information Technologies, UNDP, Open Society Institute the network and free broadband (0,6 Mbps-2 Mbps) to all universities and research institutes located in other cities of Azerbaijan. Increase the number of connected institutions to 25 (universities) and 45 (research institutes).      6. Broaden high-speed access connectivity to the backbone by covering the maximum of the country's territory, and using technology appropriate to each location. To set fiber-optic connection from each big university to nearest PSTN..</p>
AzNET	<p>Expand the current connectivity technology and different kind of project services among most potential clients groups of project targeted IT communities.</p> <p>1. Expansion of AzNET's DF backbone in Baku, Ganja, Sumgayit, Mingachevir and Sheki cities.      2. Cooperation with AzDataCom Project and utilization of regional data channels.      3. Increase of international connectivity bandwidth by using Virtual Silk Highway project and local fiber optic ISP channel from Delta Telecom.      4. Establishment of CERT.</p>
BYNET	<p>1. Implement dark fiber technology; to create link between BYNET (Park of High Technologies) and PIONIER; to establish 1-10Gbps link between Polish and Belarus and to get link to GÉANT2 up to 622Mbps in 2007-8.      2. Increase bandwidth between Minsk and regional cities up to 34Mbps.      3. Develop FO infrastructure to allow Belarussian R&amp;D community to participate in European projects (CERN, telescopes, GRID).      4. Introduce CERT in 2006-7 according to the NATO NIG project.      5. Connect institutions of the Park of High Technologies (over 10000 specialists) by high speed FO channels in 2007.      6. Connect all National and Republican libraries located in Minsk and in all regional cities (development of the corporative National Libraries Network) in 2007.      7. Connect all regional Universities in 2006-7.      8. Become TERENA member in 2007 to participate in their working groups.      9. Become full GÉANT2 2 member in 2008.</p>

REN	<b>Short description (max 500 words) of the development plans of the REN:</b>
	10. Establish information flow from leading informational centres to Belarussian libraries. 11. Organize bandwidth on demand to provide execution of various telematic applications, e.g., e-education, telemedicine, e-trade, e-libraries.
EENet	1. Maximise the capacity of magistral lines according to the resources allocated from the state budget. 2. Build dubbing fiber-optic channels for Tallinn-Tartu magistral backbone. 3. Increase the connection to GÉANT2 network to 2.5 Gbps by the end of by the end of 2007. 4. Promote the creation of intercity fibres. 5. Maintain Grid Central Services for Estonian and Baltic grid users and create the necessary computing resources for the Estonian science.
GRENA	1. Expansion of GRENA fiber optic backbone in Tbilisi by covering new parts of the city. 2. Renting additional channel for regional connectivity from Railway Telecom of Georgia. 3. Increase of international connectivity bandwidth by using fiber optic channels to Turk-Telecom, Railway Telecom of Georgia and satellite channel to NATO virtual Silk Highway project
LATNET	The main activities of LATNET development plan are the following 1. Build the connections of academic users to the panEuropean academic network GÉANT2 via services of telecom operators. 2. Build the connections of academic users to the panEuropean academic network GÉANT2 by installing own dark fiber connections. 3. Build the next generation national research and education network based on own dark fiber connections of end user campuses. 4. Installation of standardized communication infrastructure in the research centers and higher education institutions. 5. Creation of the next generation service center for the academic and research community
LITNET	Development strategies for Lithuanian research and education network LITNET are provided in the LITNET-2 development plan for 2005-2009. The main tasks of LITNET-2 programme are: 1. Developing the networking infrastructure of LITNET; 2. Ensuring quality management of the data transmission services; 3. Implementing new security measures; 4. Testing and implementing new technologies; 5. Further development of educational institutions network (schools). Technical capabilities and employed technologies of LITNET networking infrastructure should approach capabilities and technologies of the pan-European research network – GÉANT2 by 2009. These tasks will be achieved through materialization of the following actions: 6. Increasing transmission capacities for international channels: After the beginning of GÉANT2 project, LITNET be connected using two channels to two different European countries. Capacity of these channels should reach 10Gbps by the end of 2008. Connection to the commodity Internet will be at least 2 Gbps. There is a plan to install 1-10 Gbps dark fiber based connectivity to Poland in cooperation with Polish academic network during 2008. This connectivity may be used by GÉANT2 or its successor.

REN	Short description (max 500 words) of the development plans of the REN:
	<p>7. Developing system of intercity communications:      Intercity communications will be developed by increasing channel capacities and expanding network – establishing regional centres in all municipalities in order to connect educational institutions. It is also planned to continue improvement of network topology, development of Internet connections and ensure data communication with Lithuanian Internet service providers. Network availability should be increased by creation of peripheral rings.      By the end of 2008 capacity of the main ring should reach 10Gbps for IP transmission and additional 1-10Gbps channels for projects like Baltic GRID or LitGRID; peripheral rings will be based on 1Gbps leased channels or transmission over dark fiber.      LITNET is planning to base further network deployment on the lease/purchase/IRU of dark fibers and wave division multiplexing transmission technologies.  <a href="http://www.litnet.lt/index.php?option=com_content&amp;task=view&amp;id=31&amp;Itemid=55">http://www.litnet.lt/index.php?option=com_content&amp;task=view&amp;id=31&amp;Itemid=55</a> (only in Lithuanian)</p>
RENAM	<ol style="list-style-type: none"> <li>1. Upgrade existing radio-relay link up to 34 Mbps in 2006</li> <li>2. Upgrade existing radio-relay link up to 155 Mbps in 2007</li> </ol> <p>These solutions require supplementary monthly payment for data transfer bandwidth to the State Enterprise "Radiocomunicatii";</p> <ol style="list-style-type: none"> <li>3. A new proposal for constructing dark fiber link between Chisinau and Iasi was elaborated and submitted to NATO Science Committee. The proposed technical solution is based on Coarse Wavelength-Division Multiplexing (CWDM) equipment utilization with basic capacity N * 1 Gbps.</li> <li>4. New radio-relay links implementation for connecting universities centres in Cahul and Comrat cities (in 2007-8)</li> </ol> <p><a href="http://www.renam.md/r_a.html">http://www.renam.md/r_a.html</a></p>
URAN	<p>Deployment of fiber-optic MAN segments in Kiev, Kharkov, Dnipropetrovsk, Zaporizhia, Donetsk, Lugansk, Poltava, Vinnitsa, probably also Lviv. (100 km of fibers)</p>
UARNet/NASU	<p>Build 10 GE route via south of Ukraine</p>

**Table 5: Development plan of RENs**

### 3.6 Users

Finally, the project partners were asked to indicate their current users (permanent Internet connectivity). Although Porta Optica Study is more focused on the institutions which engage themselves in research and international cooperation, it is still useful to be aware of all the other users of NRENs to be able to predict the needs of the research and educational communities in the future.

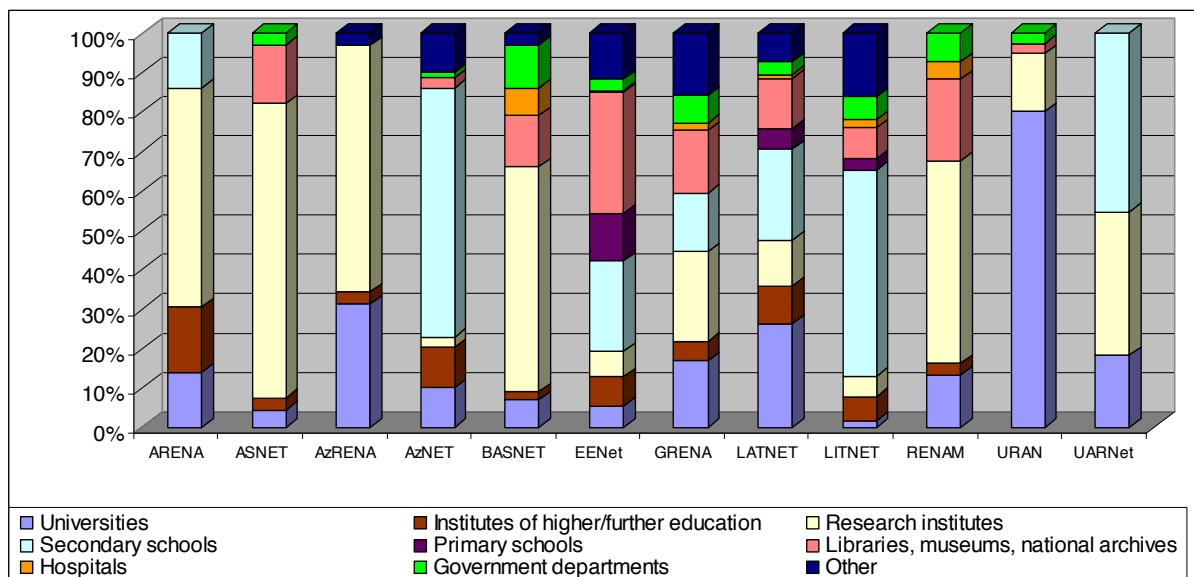
The NRENs connect mostly universities, institutions of higher/further education and research institutes. Many NRENs also connect libraries, museums and national archives. Very few provide services for primary schools and hospitals.

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

Besides the institutions shown in the Users table below, some NRENs also provide services to theatres, publishing houses, foundations and other institutions active in the field of culture and research.

REN	Universities	Institutes of higher /further education	Research Institutes	Secondary schools	Primary schools	Libraries, museums, national archives	Hospitals	Government departments	Other	Total number of institutions
ARENA	5	6	20	5	-	-	-	-	-	<b>36</b>
ASNET	3	2	50	-	-	10	-	2	-	<b>67</b>
AzRENA	20	2	40	-	-	-	-	-	2	<b>64</b>
AzNET	8	8	2	50	-	2	-	1	8	<b>79</b>
BASNET	7	2	57	-	-	13	7	11	3	<b>100</b>
EENet	15	21	18	64	34	86	1	8	33	<b>280</b>
GRENA	17	5	23	15	-	16	2	7	16	<b>101</b>
LATNET	25	9	11	22	5	12	1	3	7	<b>95</b>
LITNET	20	74	62	629	34	95	25	70	194	<b>1203</b>
RENAM	9	2	35	-	-	14	3	5	-	<b>68</b>
URAN	60	-	11	0	-	2	-	2	-	<b>75</b>
UARNet	40	-	80	100	-	-	-	-	-	<b>220</b>
<b>Sum</b>	<b>229</b>	<b>131</b>	<b>409</b>	<b>885</b>	<b>73</b>	<b>250</b>	<b>39</b>	<b>109</b>	<b>263</b>	<b>2388</b>

**Table 6: Users of RENs infrastructure**

**Figure 1:** Structure of users of NRENs infrastructure

## 4 Conclusions

The deliverable was based on a uniform questionnaire sent to all project beneficiary partners with a primary goal of gathering information about current state of NRENs including their fiber optic segments.

The results of this work-package provide the base information for the WP3 studies on optical fiber infrastructure deployment.

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

## Appendix A REN Questionnaire

### Porta Optica Study project, A1.2

#### REN Questionnaire

1.	<b>Country</b>		
2.	<b>Name of the REN</b>		
3.	<b>Name of the parent organisation, if existing</b>		
4.	<b>Type of the institution of the REN</b>	Separate legal entity of its own Part of a larger organisation If yes, please give also the name of this organisation: Other type If <i>other type</i> , please describe:	yes/no yes/no yes/no
5.	<b>Funding</b>	Please estimate the sources of REN income: from national government from users, clients from other sources	Percentage % % %

		Please name these <i>other</i> sources:
6.	<b>Management</b>	Please describe the management scheme of the REN:
		<i>In a separate file</i> please add a scheme of the management of the REN
7.	<b>Are there other RENs in the country?</b>	<input type="checkbox"/> yes/no
8.	<b>In case the answer to the previous question was 'yes', then: Relation of the REN to other research networks in the country</b>	<p>There are with other RENs...</p> <p><input type="checkbox"/> cooperation agreement(s)</p> <p><input type="checkbox"/> traffic agreement(s)</p> <p><input type="checkbox"/> agreement(s) on pricing of services</p> <p><input type="checkbox"/> other relations</p>
		<i>Please name those other relations:</i>
9.	<b>Infrastructure</b>	Please describe the main infrastructure of the REN (bandwidth and type of channels, ownership of channels):
		<i>In a separate file(s) (*.jpg or *.gif file) please provide a map/maps of the infrastructure the REN is using - backbone between cities and inter-city fibers.</i>
10.	<b>Current and potential suppliers, relation to other local telecom companies</b>	<p><input type="checkbox"/> REN rents/leases fibers from telecom companies</p> <p><input type="checkbox"/> If yes, please name those companies:</p> <p><input type="checkbox"/> REN purchases other services from telecom companies</p> <p><input type="checkbox"/> List of those companies and services:</p> <p><input type="checkbox"/> REN has joint projects with telecom companies</p> <p><input type="checkbox"/> List of those companies and projects:</p>
		<input type="checkbox"/> yes/no
11.	<b>Development plans</b>	<p><input type="checkbox"/> REN itself owns fibers</p> <p><input type="checkbox"/> URL to the development plan of the REN:</p> <p><input type="checkbox"/> http://</p>
		<input type="checkbox"/> yes/no

		Please provide a short description (max 500 words) of the development plans of the REN:	
<b>12.</b>	<b>Types and number of institutions, permanently connected via REN</b>	<b>Type of institution</b>	<b>Number</b>
		universities	
		institutes of higher/further education	
		research institutes	
		secondary schools	
		primary schools	
		libraries, museums, national archives	
		hospitals	
		government departments	
		others	
Total number of institutions:			
If <i>others</i> , please describe:			
<b>13.</b>	<b>Any other comments that give a better picture of the REN</b>	website:	http://
		contact person:	
		e-mail address:	
		phone number:	

## Appendix B Maps of the NREN Infrastructure

In addition to the questionnaire, the NRENs were asked to send information about their infrastructure in \*jpg or \*gif files.

As the availability of fiber network information was not the same in the respondent countries, then the information (maps) received also varied much in content and construction as no other standards except the file format were set to them. Nevertheless the illustrative material will help to visualise the complexity of network development in the observed areas of the Baltic States, Eastern Europe and Southern Caucasus regions.

The infrastructure maps and fiber network schemes are attached below in the alphabetical order (by country name). Note that the maps are only illustrations and to gather a full overview of the NREN the pictures should be observed together with the infrastructure descriptions in Chapter 3 of the report.

The list of Figures:

- Figure 1: The infrastructure on LIBnet- one of the research and educational networks in Armenia.
- Figure 2: The infrastructure of Armenian NRENs
- Figure 3: The fiber network of Armenia
- Figure 4.1: The network map of AzNET infrastructure in Baku (Azerbaijan) city.
- Figure 4.2: The network map of AzNET infrastructure in Ganja (Azerbaijan) city.
- Figure 5: The infrastructure of AzRENA in Azerbaijan
- Figure 6: The map of BASNET fiber channels in Minsk (Belarus )
- Figure 7: The infractructure map of EENet (Estonia)
- Figure 8: The fiber network scheme of Georgia
- Figure 9: The network topology map of GRENA (Georgia)
- Figure 10: The connection scheme to GÉANT2 in Latvia
- Figure 11: The network connections scheme of LITNET (Lithuania)
- Figure 12: The map of LITNET singlemode cable in Kaunas (Lithuania)
- Figure 13: The general scheme of RENAM Network (Moldova)
- Figure 14: The topology map of RENAM (Moldova)
- Figure 15: The map of URAN network (Ukraine)
- Figure 16: The map of URAN network in Kharkov (Ukraine)

- Figure 17: The map of URAN network in Odessa (Ukraine)
- Figure 18: The map of URAN network in Zaporizhia (Ukraine)
- Figure 19: The map of URAN network in Sevastopol (Ukraine)
- Figure 20: The map of URAN network in Dnipropetrovsk (Ukraine)
- Figure 21: The map of URAN network in Donetsk (Ukraine)
- Figure 22: The map of URAN network in Kyiv (Ukraine)
- Figure 23: The map of URAN network in Poltava (Ukraine)
- Figure 24: The map of URAN network in Seimferopol (Ukraine)
- Figure 25: The map of UARNet network (Ukraine)

Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002

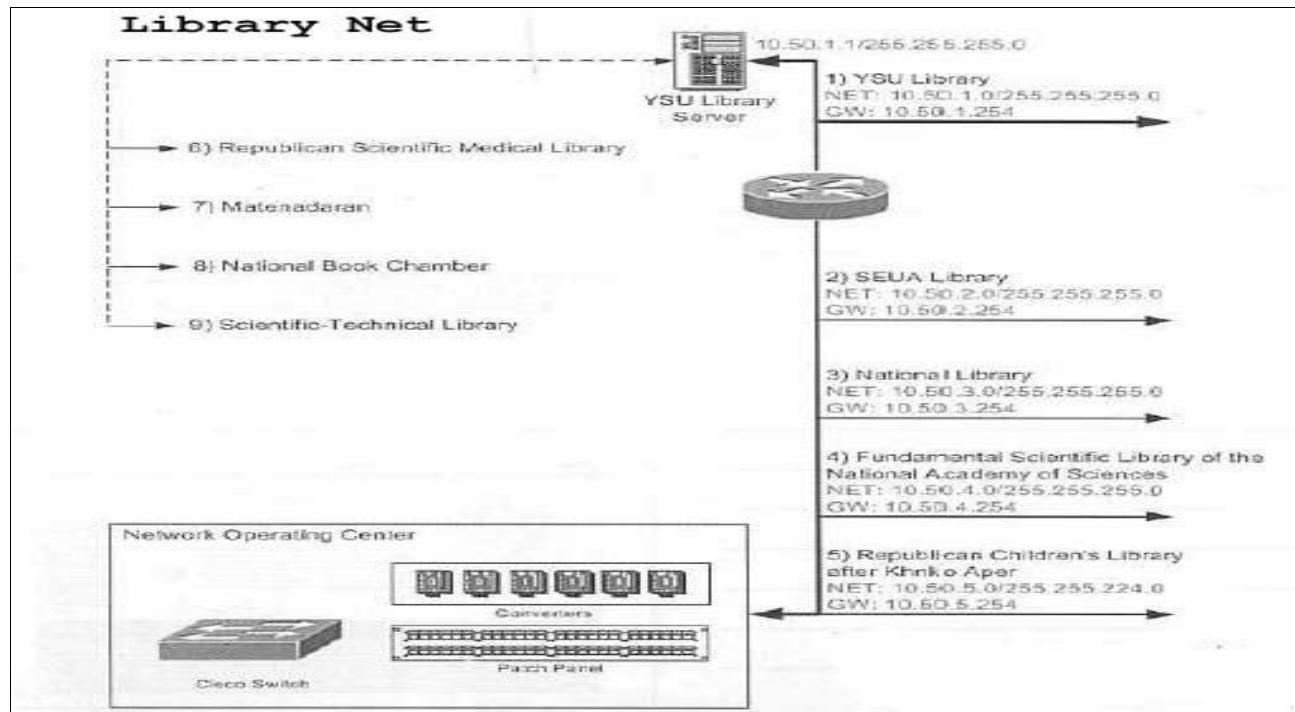


Figure 1: The infrastructure on LIBnet- one of the research and educational networks in Armenia.

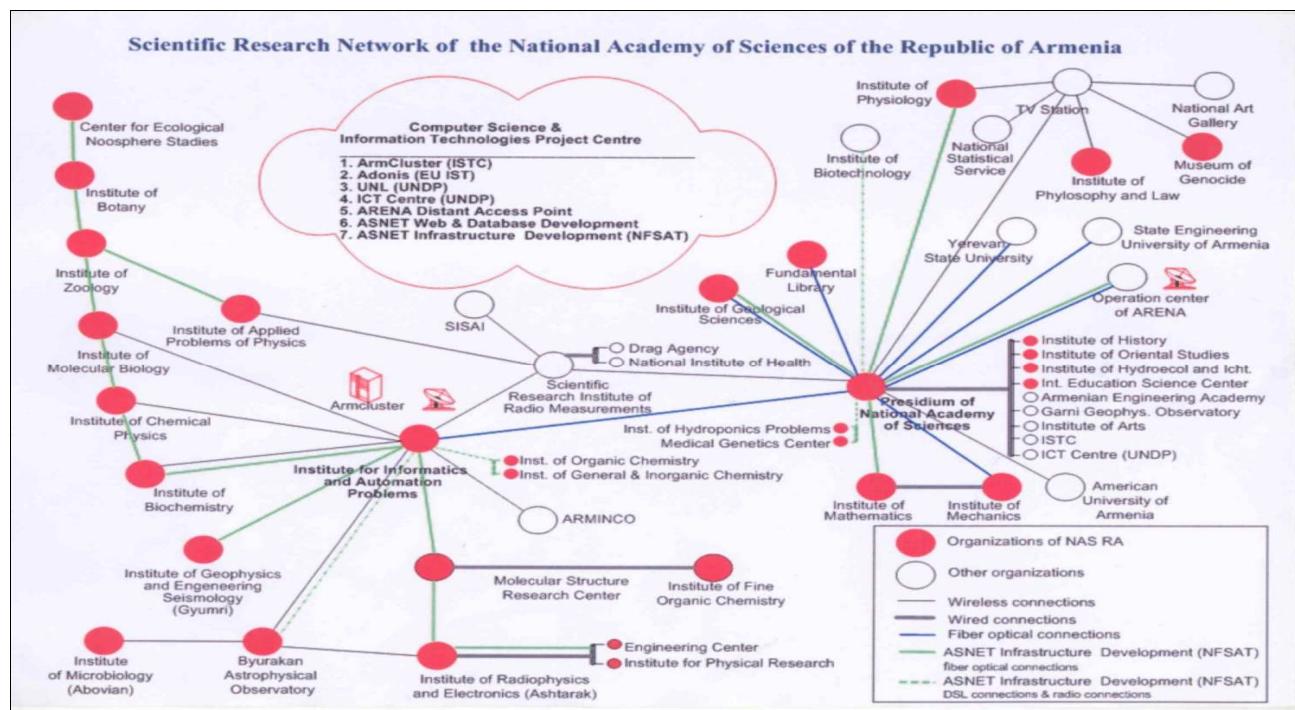
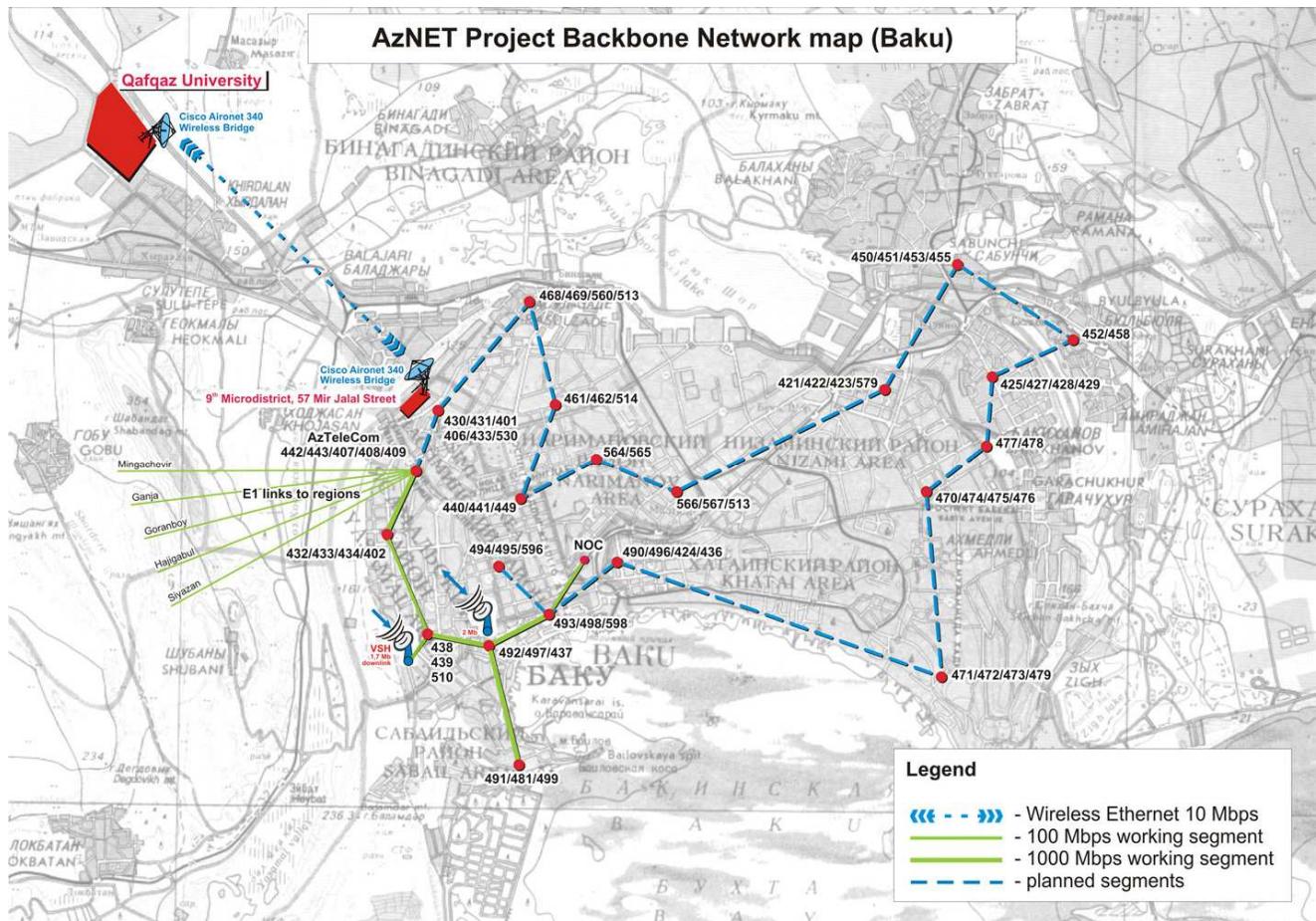


Figure 2: The infrastructure of Armenian NRENs

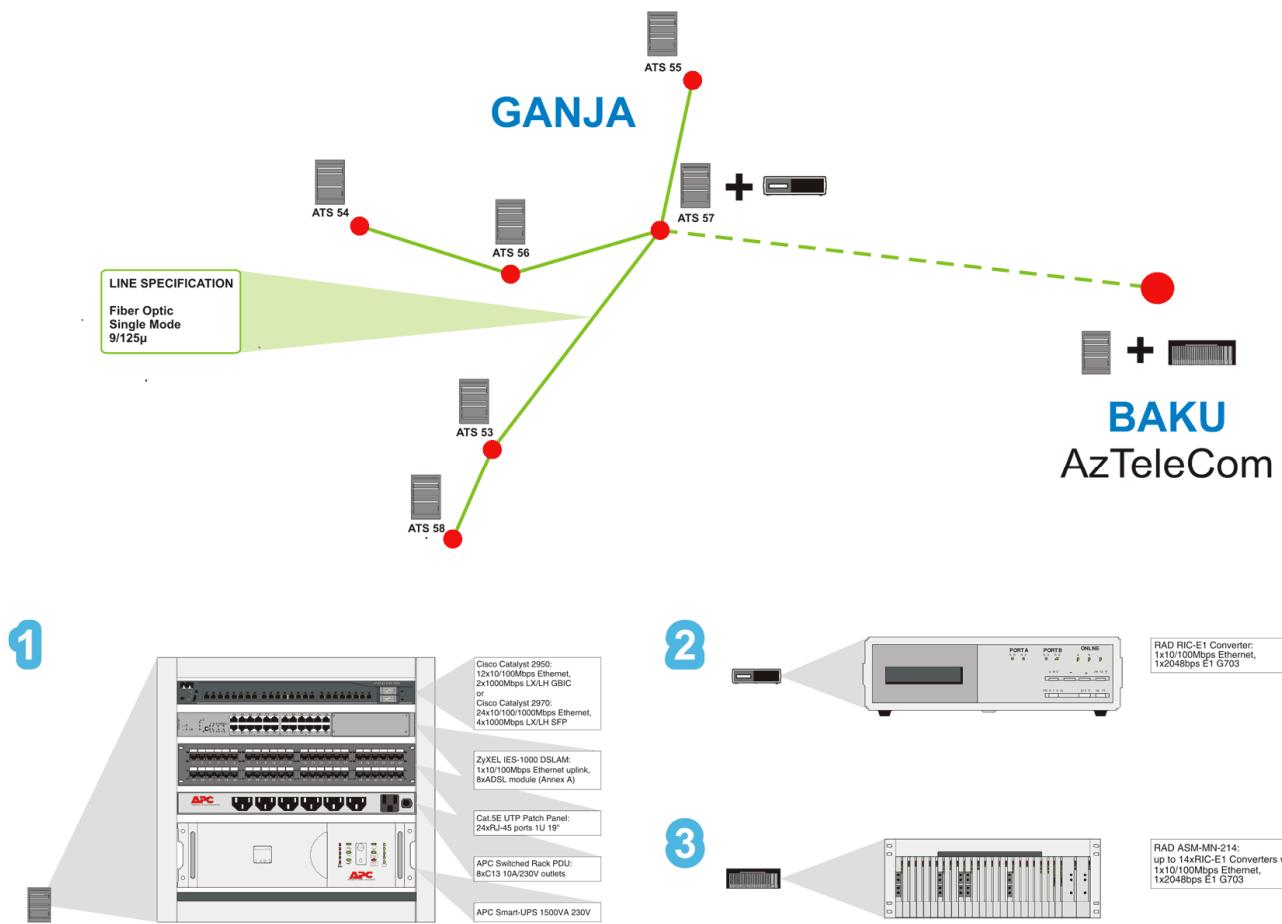
Project:	Porta Optica Study
Deliverable Number:	D1.2v3(update)
Date of Issue:	30.04.2006
EC Contract No.:	026617
Document Code:	POS-03-002



**Figure 3:** The fiber network of Armenia



**Figure 4.1:** The network map of AzNET infrastructure in Baku (Azerbaijan) city.



**Figure 4.2:** The network map of AzNET infrastructure in Ganja (Azerbaijan) city.

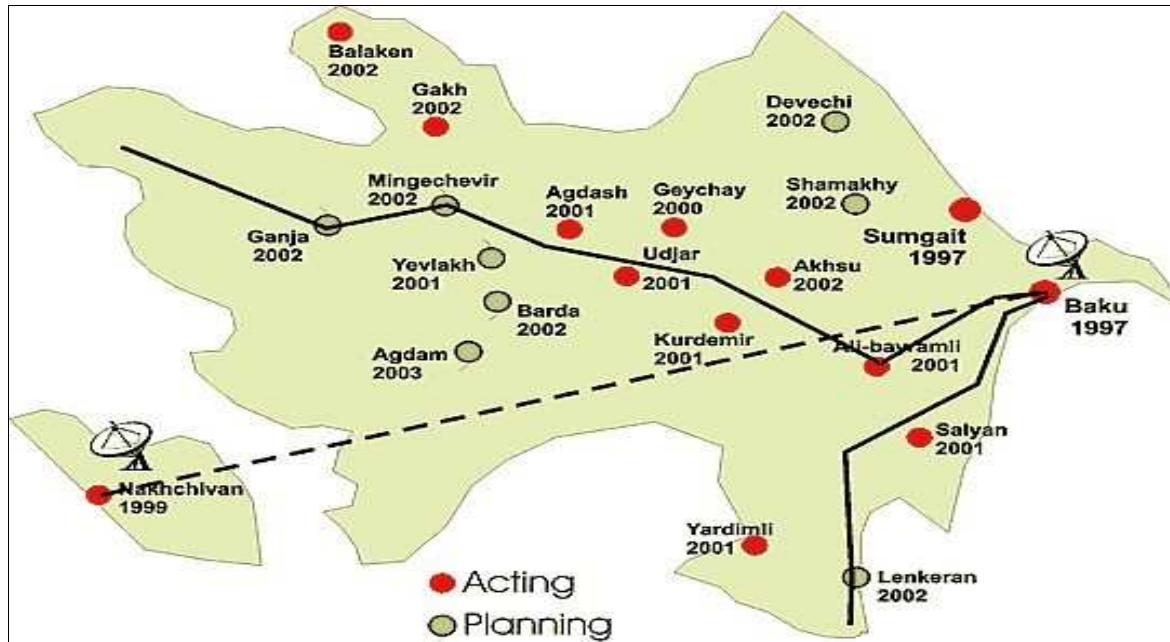


Figure 5: The infrastructure of AzRENA in Azerbaijan

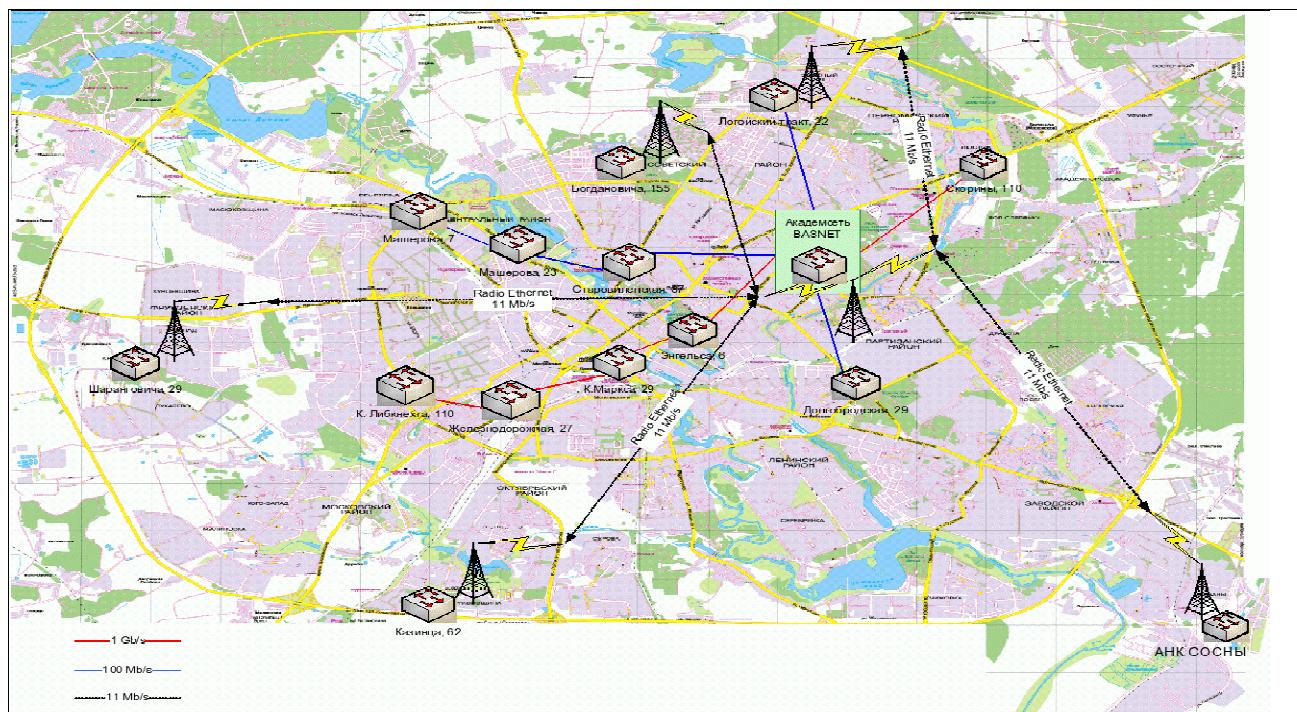


Figure 6: The map of BASNET fiber channels in Minsk (Belarus)



**Figure 7:** The infrastructure map of EENet (Estonia)



**Figure 8:** The fiber network scheme of Georgia

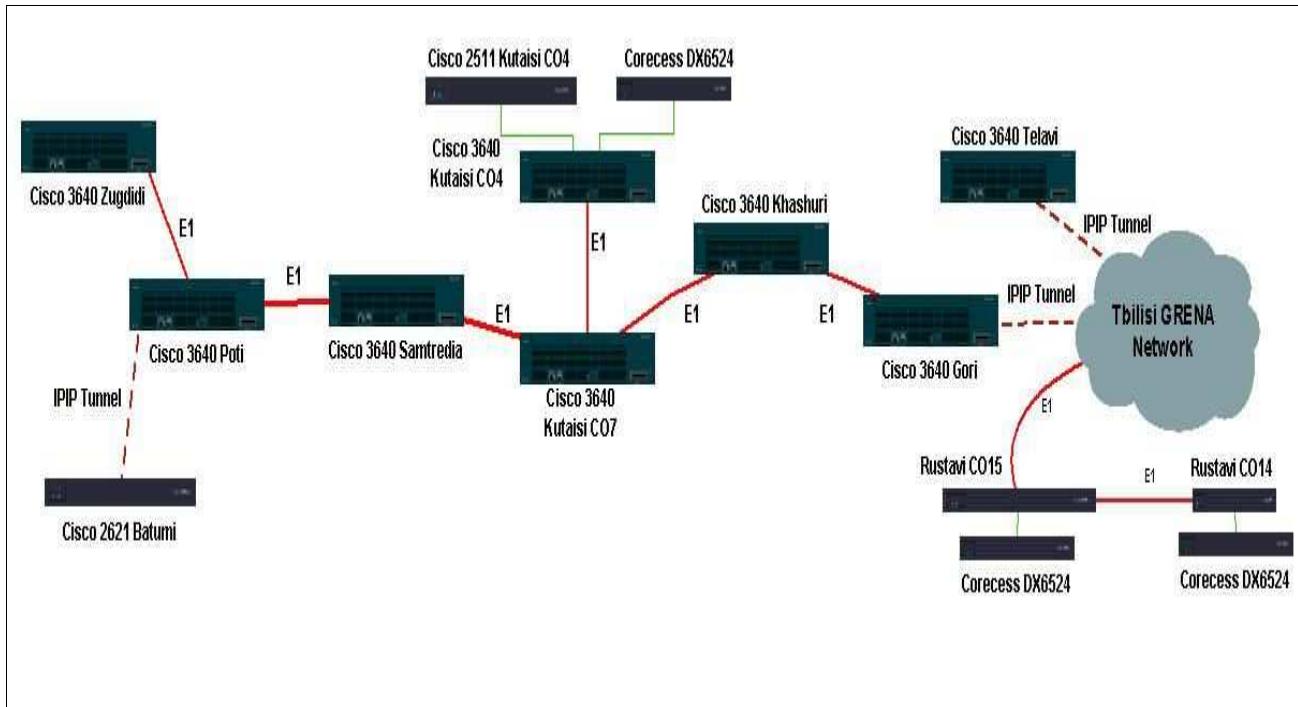


Figure 9: The network topology map of GRENA (Georgia)

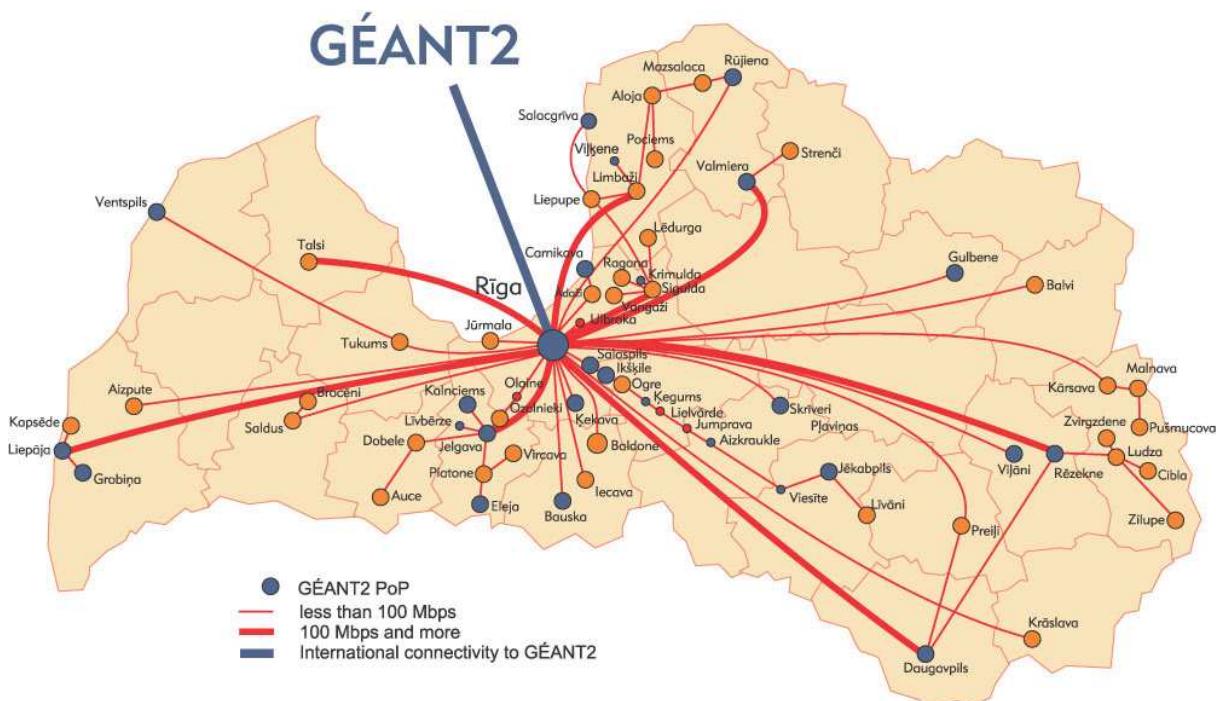


Figure 10: The connection scheme to GÉANT2 in Latvia

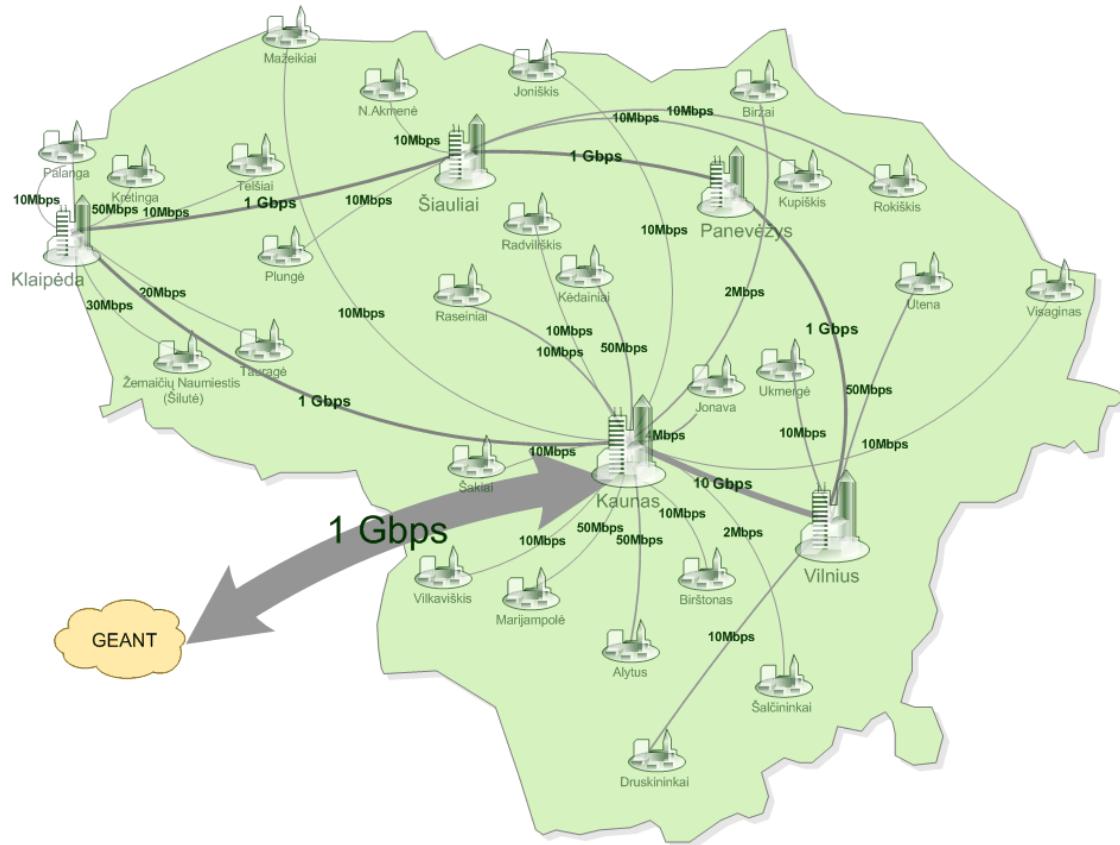


Figure 11: The network connections scheme of LITNET (Lithuania)

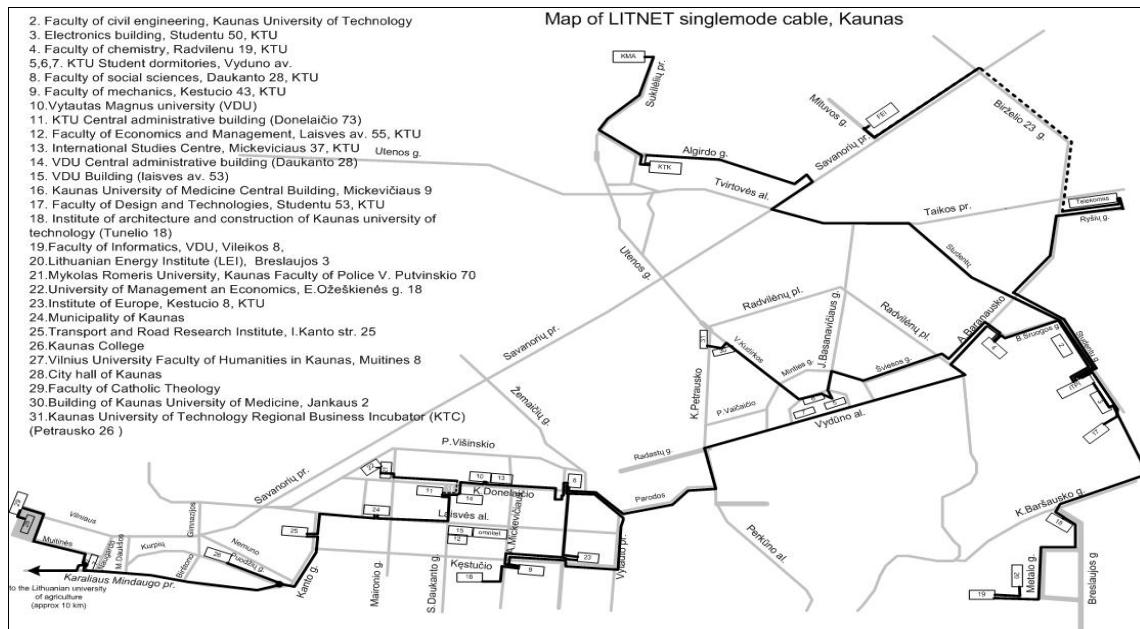
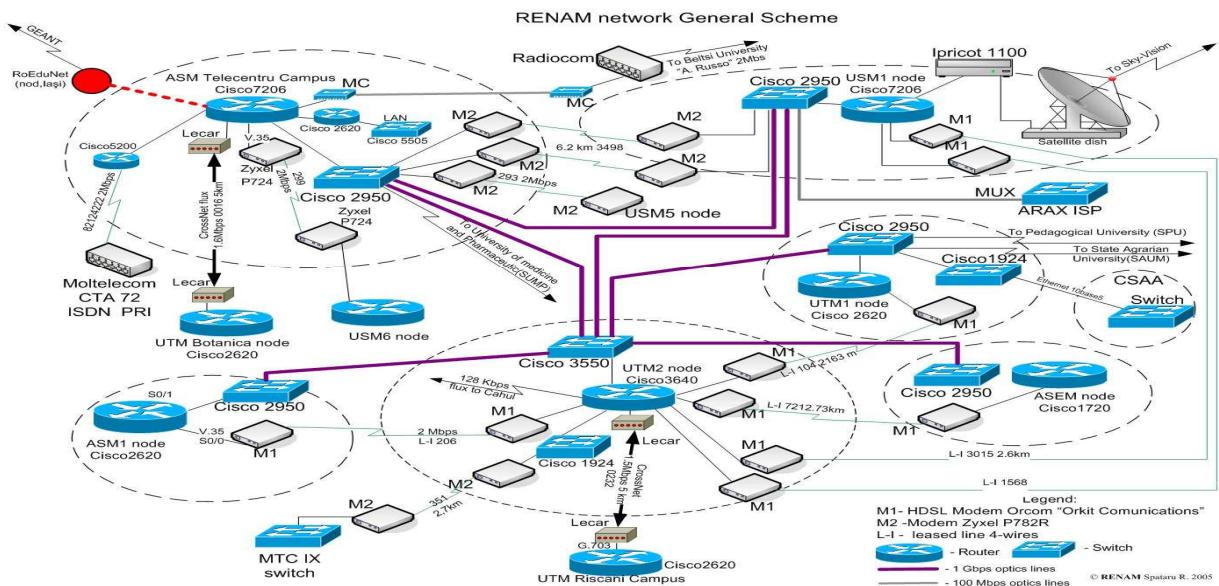
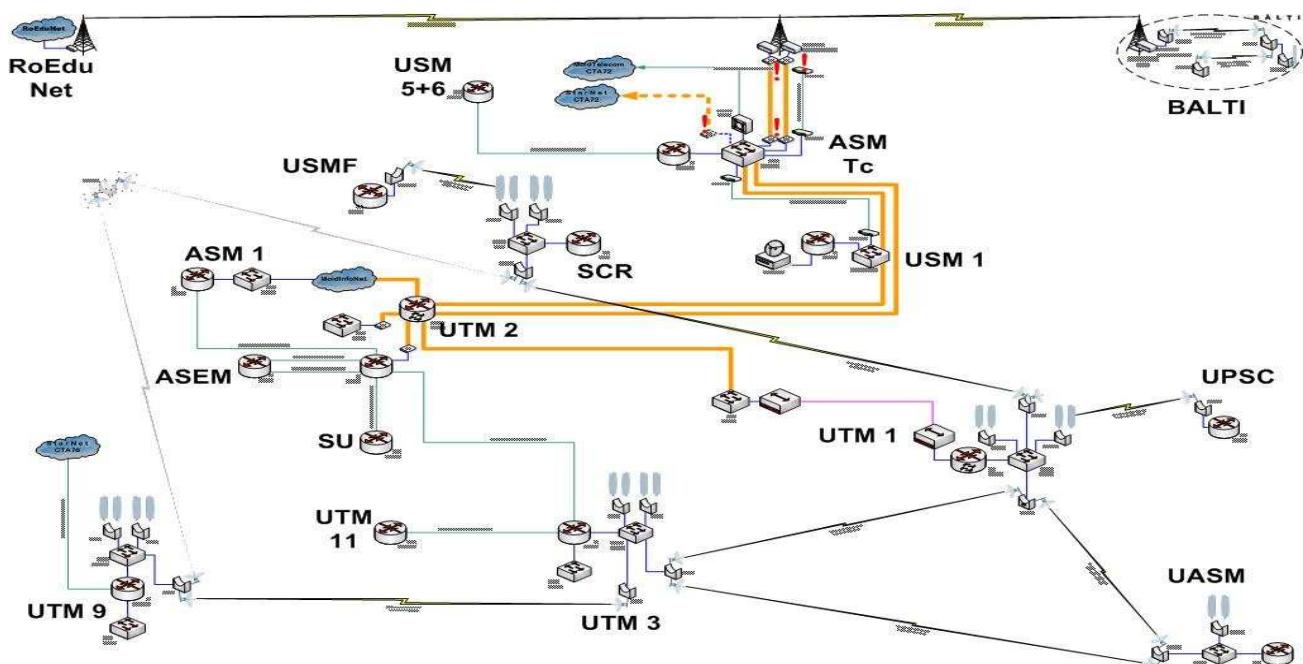


Figure 12: The map of LITNET singlemode cable in Kaunas (Lithuania)



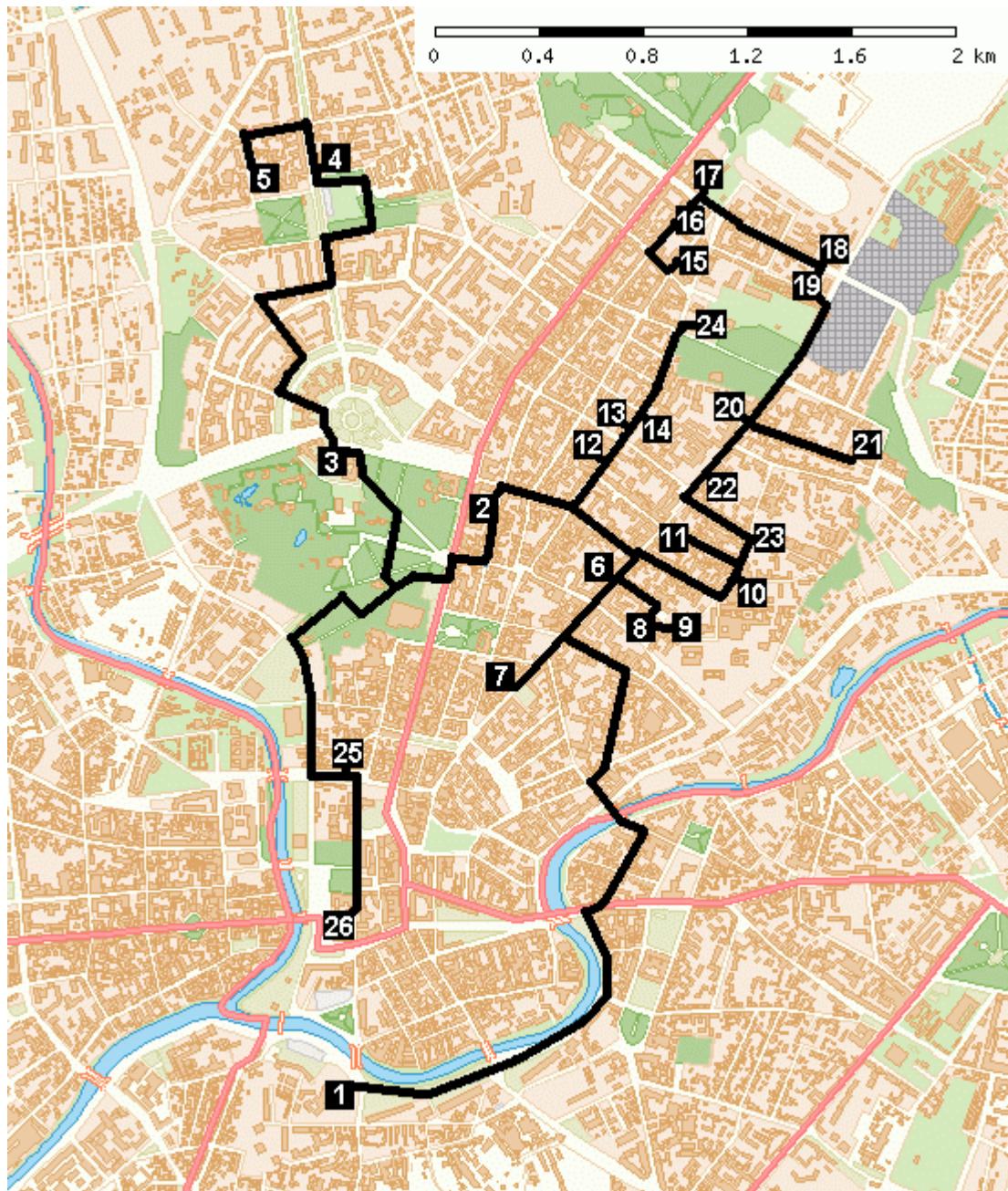
**Figure 13:** The general scheme of RENAM Network (Moldova)



**Figure 14:** The topology map of RENAM (Moldova)



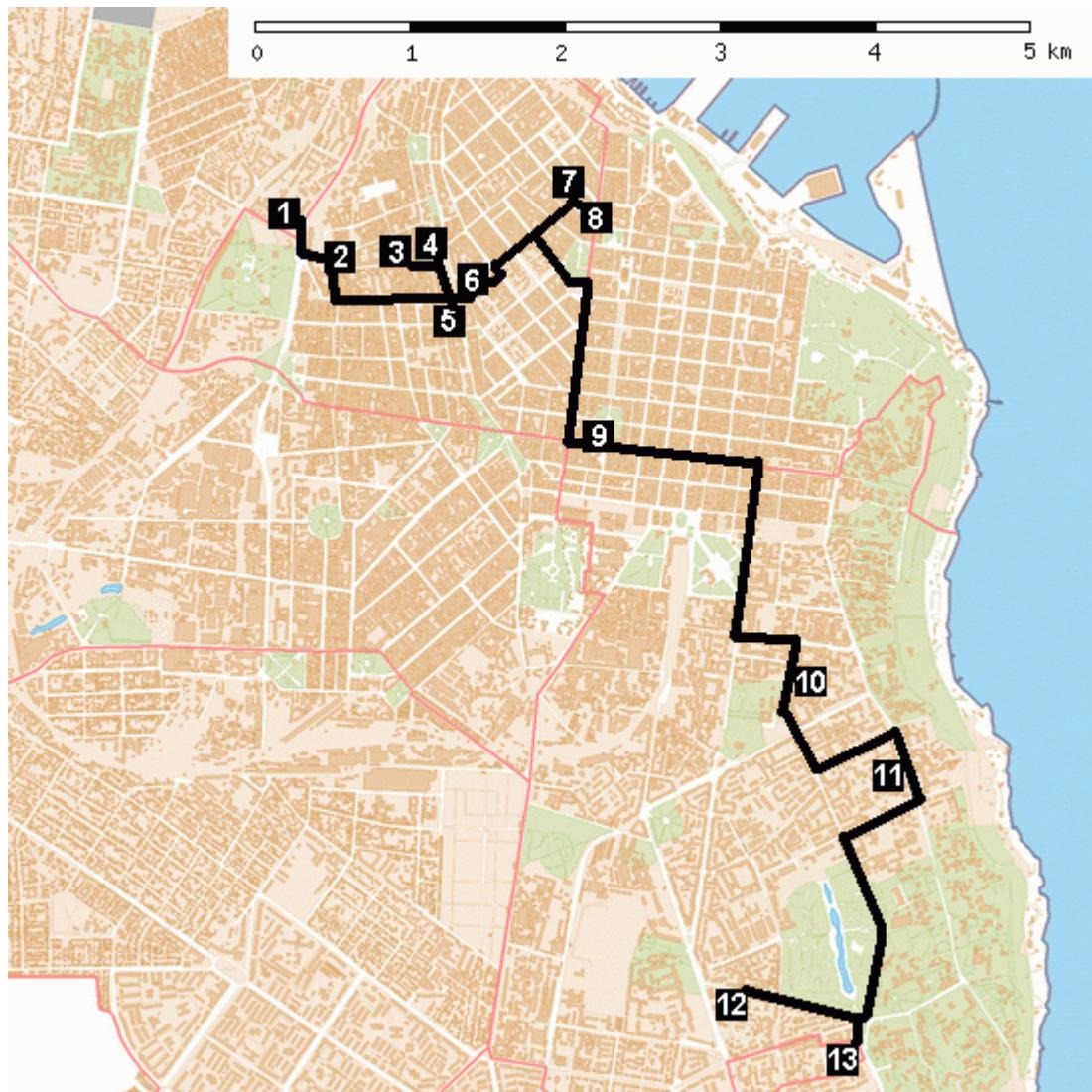
**Figure 15:** URAN network in Ukraine



**Figure 16:** The map of URAN network in Kharkov (Ukraine)

No	Name
1	Inter-city communication node: branch office ôUkrtelecomö, JSC., Netechenska wharf, 8
2	Inter-city communication node: State R&D Institute of Fundamental Chemistry (RDIFC), Myronosytska St., 2
3	Kharkiv National V.áKarazin University (KhNU), Svobody Sq., 4
4	Kharkiv National University of Radioelectronics (KhNURE), Lenina Ave., 14
5	Kharkiv National University of Economics (KhNUE) l' Lenina Ave., 9A
6	National Pharmaceutical University (NPhU), Pushkinska St., 53
7	NPhU, educational building - Pushkinska St., 27
8	Kharkiv State Academy of Design and Arts (KhADA), Chervonopraporna St., 11
9	KhADA, educational building, Chervonopraporna St., 8
10	National Technical University ôKharkiv Polytechnical Instituteö (NTU KhPI), Frunze St., 21
11	Academy of Legal Sciences of Ukraine, Olminskogo St., 2
12	Kharkiv National G.áSkovoroda Pedagogical University, Artema St., 29
13	Kharkiv National Automobile and Road University, Petrovskogo St., 25
14	Kharkiv National Technical University of Agriculture (KhNTUA), Artema St., 44
15	Academy of Civil Defense of MEU, Chernyshevskogo St., 94
16	KhNTUA, educational building, Myronosytska St., 92
17	NTU KhPI, Center for Foreign Nationals Preparing, Vesnina St., 5
18	NTU KhPI, educational building, Pushkinska St., 85
19	Institute of Experimental and Clinic Veterinary Medicine UAAS, Pushkinska St., 83
20	Inter-branch Institute of Vocational Education - Pushkinska St., 79
21	Kharkiv University of Liberal Arts ôPopular Ukrainian Academy, Lermontovska St., 27
22	S.áGrigoryev Institute of Medical Radiology of AMSU - Pushkinska St., 82
23	National Scientific Center ôKharkiv Physical and Technical Institute, Gudanova St., 13

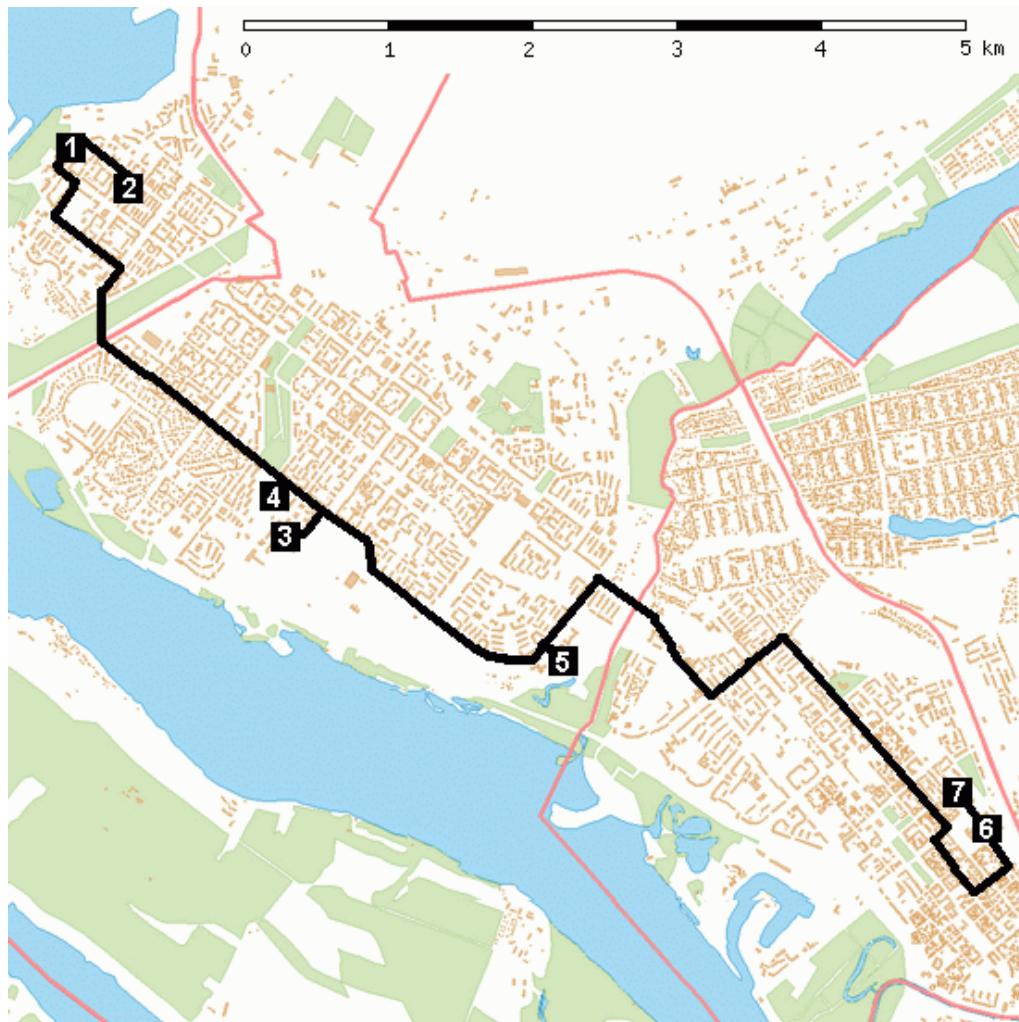
**Table 7.** Institutes connected to URAN network in Kharkov



**Figure 17:** The map of URAN network in Odessa (Ukraine)

No	Name
1	Inter-city communication node: branch office Datagroup, Ltd., Balkivska St., 42A
2	Odessa National Marine Academy, Didrihsona St., 8
3	Odessa State Academy of Building and Architecture, Didrihsona St., 4
4	Odessa State Marine University, Mechnikova St., 34
5	South Ukrainian State Pedagogical University І Staroportofrankovska St., 26
6	Odessa National A.áPopov Academy of Telecommunications, Kovalska St., 1
7	Odessa National I.áMechnikov University (ONU), Dvoryanska St., 2
8	Odessa State Academy of Refrigeration, Dvoryanska St., 1/3
9	Odessa Internet Traffic Exchange Point OdEx, Velyka Arnautska St., 72/74
10	Odessa National Polytechnic University (ONPU), Shevchenko Ave., 1
11	ONU, educational building, Frantsuzskiy Blvd., 26/28
12	Odessa National Law Academy, Pionerska St., 2
13	National Academy of State Administration (NASA), Odessa branch, Genuezska St., 22

**Table 8.** Institutes connected to URAN network in Odessa



**Figure 18:** The map of URAN network in Zaporizhia (Ukraine)

No	Name
1	Inter-city communication node: branch office ôDatagroupö, Ltd., Lenina St., 234
2	Zaporizhzhia State Engineering Academy, Lenina Ave., 226
3	Zaporizhzhia State Medical University (ZSMU) Mayakovskogo Ave., 26
4	ZSMU, hospital Stalevariv St., 34
5	ZSMU, hospital Peremohy Ave., 80
6	Zaporizhzhia National Technical University (ZNTU) Zhukovskogo St., 64
7	Zaporizhzhia National University (ZNU) - Zhukovskogo St., 66

**Table 9.** Institutes connected to URAN network in Zaporizhia



**Figure 19:** The map of URAN network in Sevastopol (Ukraine)

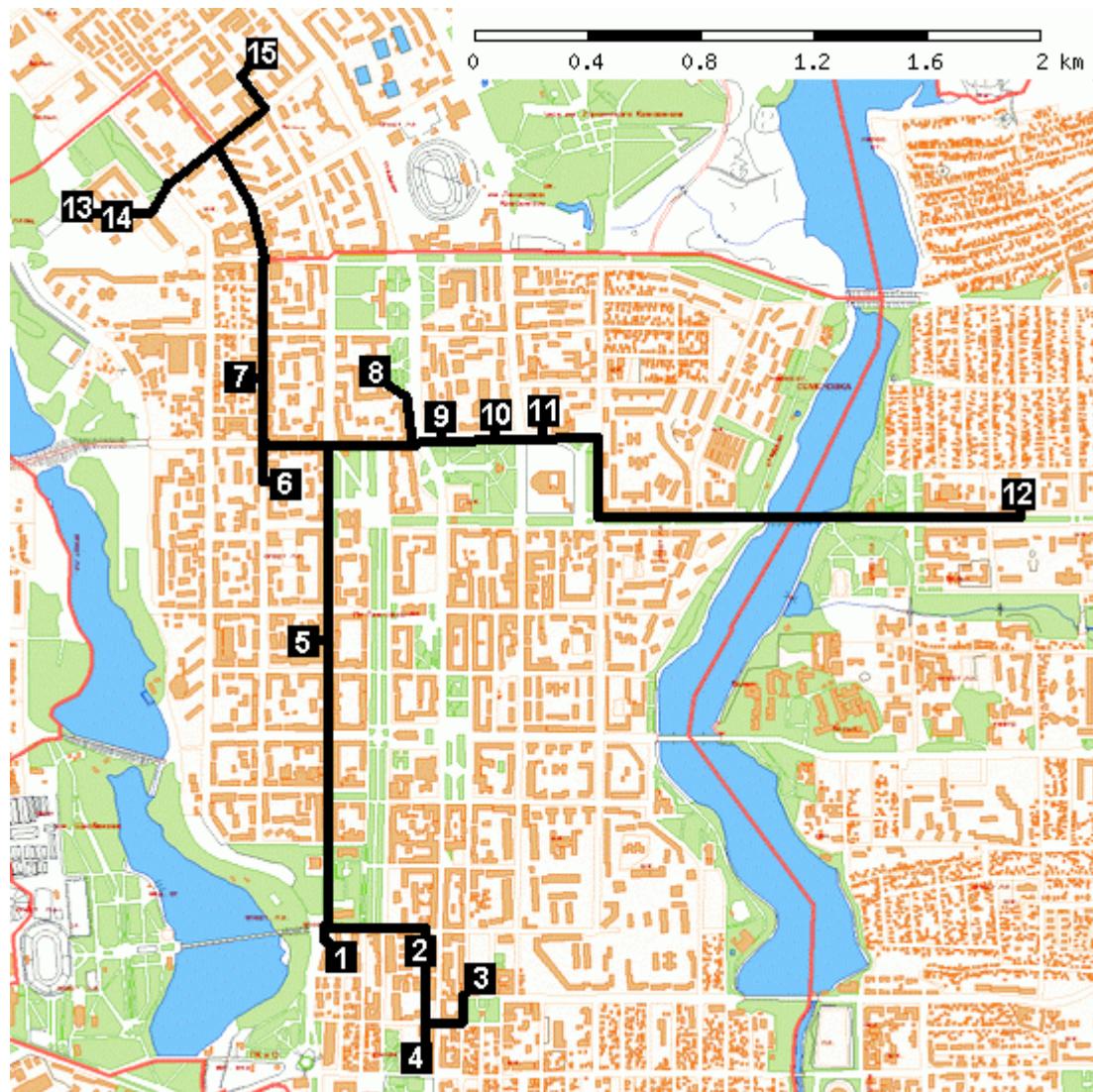
No	Name
1	Inter-city microwave communication node: technical premises of Yapik.Net, Ltd. l Vakulenchuka St., 29
2	Sevastopol National Technical University (SevNTU) l Striletska bay,
3	SevNTU, library - Striletska bay, students' hostels
4	SevNTU, hostels Striletska bay, students' hostels
5	SevNTU, educational building Gogolya St., 14
6	Central Children's Library Lenina St., 76
7	Institute Biology of Southern Seas of NASU (IBSS) Nahimova Ave., 2
8	Sevastopol Municipal University of Liberal Arts (SMULA) Kornilova Wharf, 2

No	Name
9	Marine Hydrophysical Institute of NASU (MHI) Kapitanska St., 2
10	MHI, laboratory building Katerna St., 47
11	Building College Pozharova St., 28A
12	SevNTU, Sevastopol Marine College Repina St., 3
13	SevNTU, educational building Gagarina Ave., 13
14	Sevastopol National University of Nuclear Energy and Industry Kurchatova St., 7

**Table 10.** Institutes connected to URAN network in Sevastopol**Figure 20:** The map of URAN network in Dnepropetrovsk (Ukraine)

No	Name
1	Inter-city communication node: branch office Datagroup, Ltd. Lyvarna St., 9
2	Dnipropetrovsk National Medical University (DNMU) Dzerzhinskogo St.,9
3	DNMU, educational building K.Marx Ave., 24
4	DNMU, educational building Zhovtneva Sq., 4
5	National Mining University (NMU) K.Marx Ave., 19
6	NMU, educational building K.Marx Ave., 21
7	NMU, educational building K.Marx Ave., 17
8	National Academy of State Administration (NASA), Dnipropetrovsk branch K.Tsetkin St., 9
9	NASA, Dnipropetrovsk branch, educational building Gogolya St., 29
10	Prydniprovsk State Academy of Building and Architecture (PSABA) Chernyshevskogo St., 24A
11	PSABA, Institute of Unbroken Professional Study Patorzhinskogo St., 11A
12	NMU, hostels Gagarina Ave., 57, 59,61
13	DNMU, Medical Institute of Popular Medicine Sevastopol St., 17

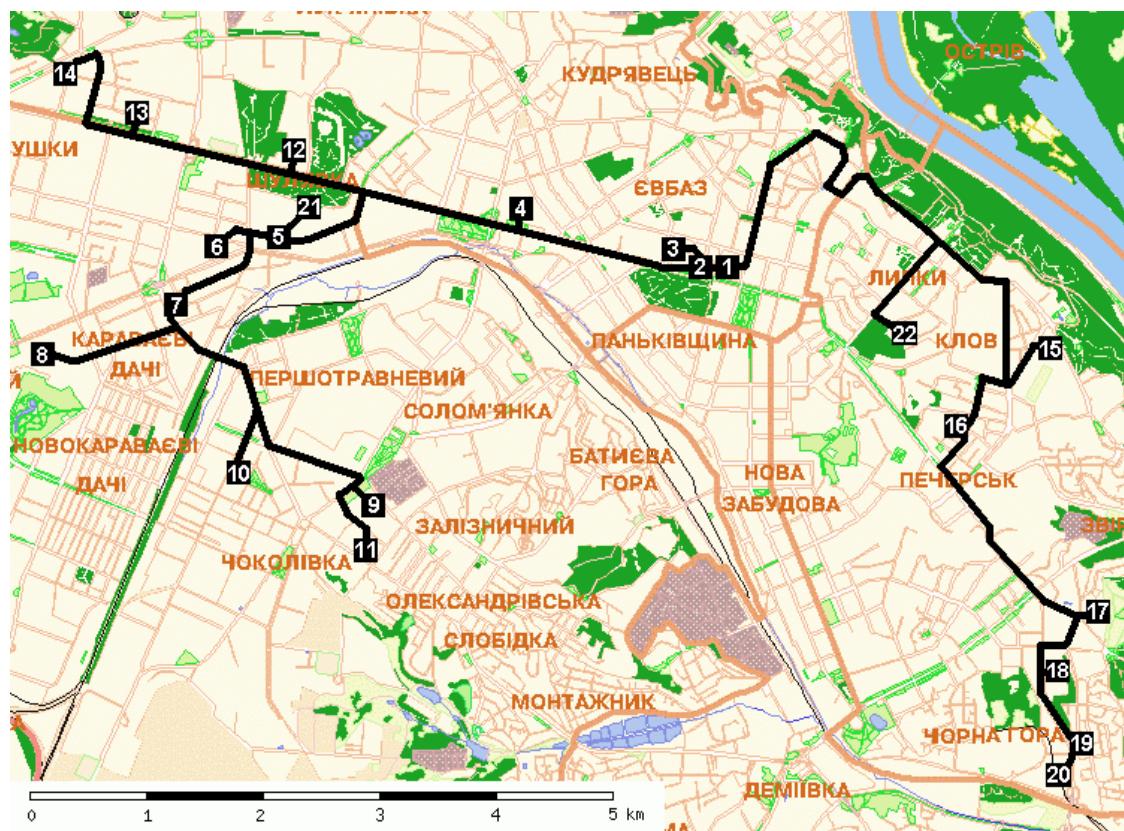
**Table 11.** Institutes connected to URAN network in Dnepropetrovsk



**Figure 21:** The map of URAN network in Donetsk (Ukraine)

No	Name
1	Inter-city communication node: branch office Datagroup, Ltd. Universitetska St., 7
2	Donetsk National Technical University (DonNTU) Artema St., 58
3	DonNTU, educational building Dzerzhinskogo Ave., 1
4	Donetsk State S.Prokofiev Musical Academy, Artema St., 44
5	Donetsk National University (DNU) Universitetska St., 24

No	Name
6	Donetsk State M.Tugan-Baranovsky Institute for Economics and Trading (DSIET) Schorsa St., 31
8	DNU, educational building Schorsa St., 46, building 10
9	DonNTU, educational building Artema St., 96
10	DonNTU, hostels Bogdan Kmelnitsky Ave., 100, Artema St., 131
11	DonNTU, Business Institute Bogdan Kmelnitsky Ave., 106
12	Donetsk State Institute of Administration Chelyuskintsev St., 163A
13	DSIET, educational building Shevchenko Ave., 30
14	Institute of Applied Mathematics and Mechanics of NASU R.Luxemburg St., 74
15	Institute of Mining Processes Physics of NASU; Donetsk O.Galkin Physical and Engineering Institute of NASU, L.Lytvinenko Institute of Physic and Organic Chemistry and Coal Fuel Chemistry of NASU, R.Luxemburg, 72
16	Institute of Industry Economics of NASU, Universitetska St., 77

**Table 12.** Institutes connected to URAN network in Donetsk**Figure 22:** The map of URAN network in Kiev (Ukraine)

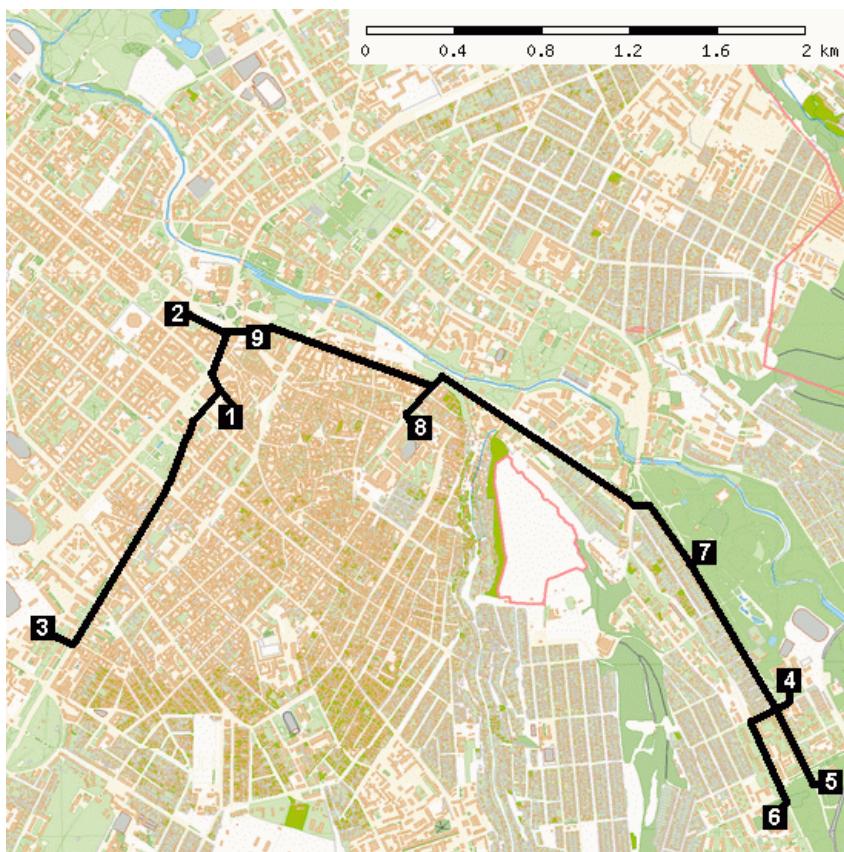
No	Name
1	Ministry of Science and Education of Ukraine, URAN Network Operation Center Shevchenka Blvd., 16
2	Ukrainian Traffic Exchange Point UA-IX Leontovicha St., 9
3	National M.Dragomanov Pedagogic University (NPU) Pirogova St., 9
4	Ministry of Science and Education of Ukraine Peremogy Ave., 10
5	National Technical University of Ukraine Kiev Polytechnical Institute (NTUU KPI) l' Peremohy Ave., 37
6	NTUU KPI, hostels l' Borschagivska St., Vyborgska St., Metalistiv St.
7	NTUU KPI, educational building Industrialny lane, 2
8	National Aviation University Komarova Ave. 1
9	Kiev National University of Building and Architecture (KNUBA) Povitrofotsky Ave. 31
10	KNUBA, hostel Volynska St., 9/21
11	NPU, educational building Osvity St., 4
12	A. Bogomolets National Medicine University Peremohy Ave., 34
13	Kiev National V.áHetman University of Economics Peremohy Ave., 54/1
14	National Academy of State Administration under the President of Ukraine E.Potje St., 20
15	National Transport University (NTU) Suvorova St., 1
16	Kiev National University of Technology and Design (KNUTD) Nemirovicha-Danchenko St., 2
17	Institute for Higher Education of Pedagogical Sciences Academy of Ukraine Bastionna St., 9
18	KNUTD, hostels Kikvidze St., 11b, 13b
19	KNUTD, hostels Kikvidze St., 33, 35
20	NTU, educational building Kikvidze St., 42

**Table 13.** Institutes connected to URAN network in Kiev

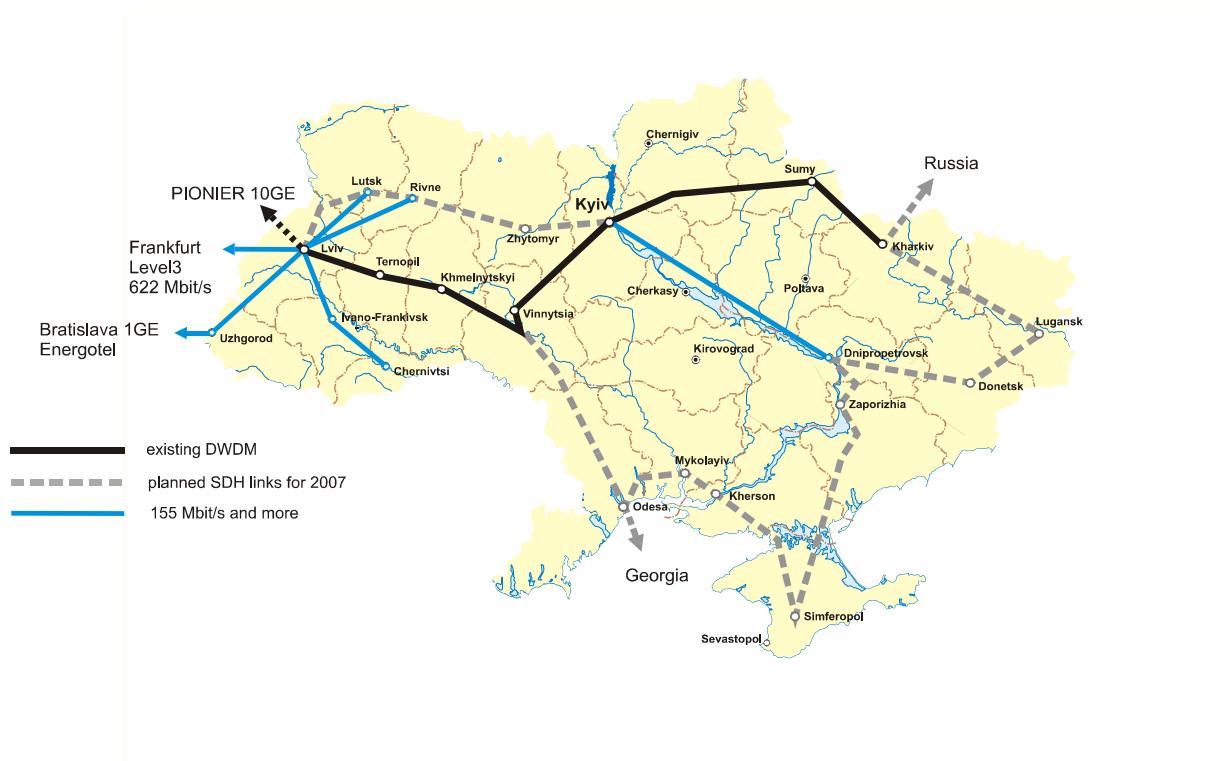


Figure 23: The map of URAN network in Poltava (Ukraine)

No	Name
1	Inter-city call-center: branch office "Ukrtelecom", JSC, room of exterior operators REO-2 – Zhovtneva St., 33
2	Poltava Military Institute of Telecommunications – Zinkivska St., 44
3	Poltava University of Consumer's Cooperation – Kovalya St., 3
4	Poltava State Agrarian Academy – Skovorody St., 1/3
5	Poltava State Pedagogical University – Ostrogradskogo, 2
6	Poltava National Yu. Kondratyuk Technical University (PNTU) – Pershotravnevy Ave., 24
7	Poltava State Law Academy - Pershotravnevy Ave., 14
8	Ukrainian Medical Stomatological Academy – Shevchenka St., 23
9	PNTU, Center of Post-Graduate Studies – Zhovtneva St., 42
10	International Scientific and Technical University, Poltava Business Institute – Sinna St., 7

**Table 14.** Institutes connected to URAN network in Poltava**Figure 24:** The map of URAN network in Simferopol (Ukraine)

No	Name
1	Inter-city communication node: branch office "Datagroup", Ltd. – Nekrasova St., 9
2	Ministry of Science and Education of AR Crimea – Radnarkomivsky Lane, 3
3	Crimean Engineering and Pedagogical University – Uchbovy Lane, 8
4	Tavria National V. Vernadsky (TNU) – Vernadsky Ave., 4
5	TNU, Republican Information and Exhibition Center – Vernadsky Ave., 20
6	TNU, hostels – Bespalova St., 45A
7	Crimean Scientific Center NASU – Vernadsky Ave., 2A
8	TNU, educational building – Studentska St., 10
9	TNU, educational building – Lenina St., 11

**Table 15.** Institutes connected to URAN network in Simferopol**Figure 25:** UARNet network