RENAM NETWORK INFRASTRUCTURE FOR INNOVATION AND TECHNOLOGICAL TRANSFER SUPORT IN MOLDOVA

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1. Introduction

The necessity to support new directions in education, science and technology, to shift toward new perspective networking services, modern educational systems, new distance learning technologies and applications require the increment of capacity of internal and external communication links, communication equipment possibilities and introducing new communication technologies having high degree of Quality of Service (QoS) parameters. As a consequence, it will become possible to exploit new methods of information presentation, interaction with information resources and also many other modern networking technologies will be open for utilization.

Creation of common networking infrastructure for science and education in Moldova passed several stages. A very important step on above-mentioned road was made in 1999, when RENAM, a new joint Research and Education Networked Association of Moldova, was created under support of NATO scientific program and recommendations of European Commission. The analysis of current state and of the accumulated experience allowed to specialists of RENAM to elaborate and accept the program of the further development of the RENAM network infrastructure, which provides the following directions of activity:

1. Creation of own fiber optic media of transfer of the data for backbone development in Chisinau city;
2. Shifting of the basic highways of internodal links on new communication technologies – STM 155 Mbps, optic Gbit Ethernet and 5 GHz 22-54 Mbps wireless links;
3. Establishment of new high-speed communications with basic network and Internet Services Providers of Moldova;
4. Implementation of new channels of access to peripheral nodes in territory of the country having capacity of up to 2 Mbps and more;
5. Creation of experimental segments and gateways for introduction and deployment of IPv6 Internet technologies;
6. Elaboration and realization of new gateway interactions, including ground and satellite channels of external access to the Internet, gateways to scientific - educational networks of partners from Romania and Ukraine;
7. Expansion and transition to new technology of a gateway to access the Trans-European academic network GEANT (G2) through the scientific network of Romania - RoEduNet

The whole program of RENAM network development has been structured into a number of separate projects, which are intended to reach the above mentioned objectives. The main directions of activity presume significant modernization of external connections and reconstruction of current Chisinau MAN backbone (fig.1), which covers principal RENAM nodes:
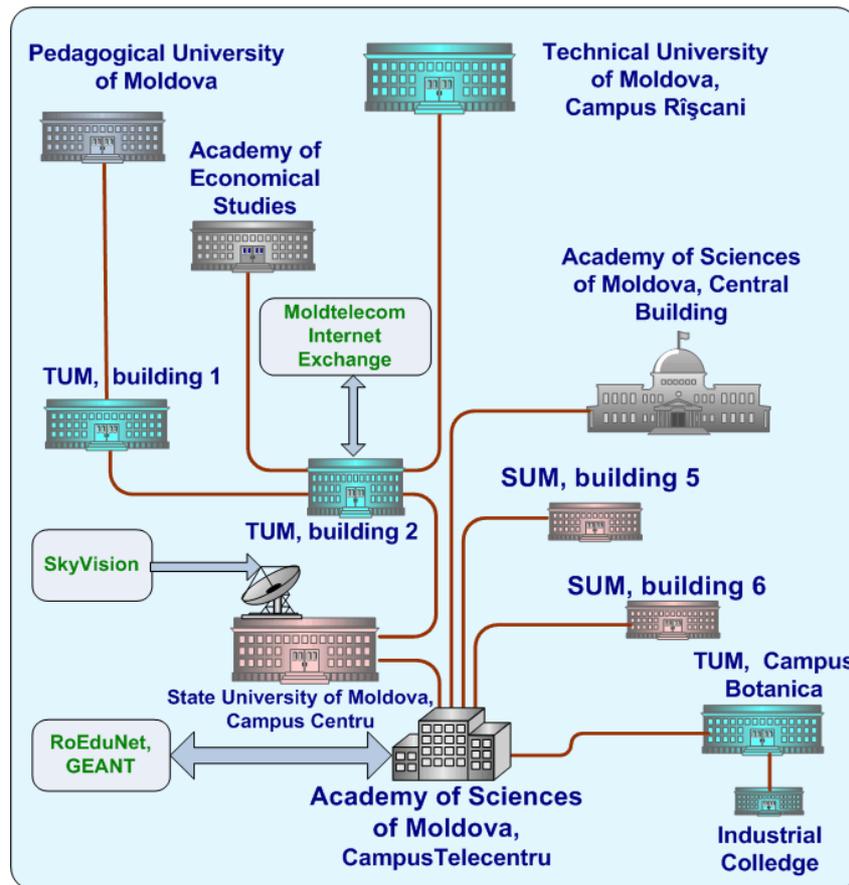
Figure 1. RENAM: Chisinau MAN backbone structure.

- ASM - Academy of Sciences of Moldova (http://www.asm.md),
- USM - State University of Moldova (http://www.usm.md),
- TUM - Technical University of Moldova (http://www.utm.md),
- AES - Academy of Economic Studies (http://www.ase.md),
- SPU - State Pedagogical University.

Next stage of RNAM development has the goal additionally to join resources of other institutions, including that located in peripheral centers, like:

- SMU - State Medical University,
- CMRSU - Cahul Moldova - Romanian State University,
- CCU - Comrat City University.

The external connectivity or RENAM has its aim to provide worldwide Internet access, ensure regional collaboration, creating horizontal connections for information exchange with local networks operators and increasing network readiness for research results dissemination and innovations transfer. A very important goal of regional networking activity is establishing direct connections with neighbor countries through their NRENs. Joint investigations and educational collaboration in two neighbour countries: Moldova and Romania - are actively developed. These real needs objectively impacted on elaboration and implementation of information exchange facilities for scientific-educational communities of both countries. That had presumed a necessity to launch and realize a project of integration of informational and communicational resources available within two neighbour networks - RENAM and RoEduNet. In years 2002-2003 there was proposed and implemented NATO

project "RENAM – RoEduNet Networks Direct link and Gateway Construction", which had following strategic purposes [1]:

- Establishing direct links between research and educational organizations of both countries and creation conditions for joint investigations and teaching activity promotion.
- Integration Moldovan academic community with European informational space.
- Improving facilities for scientific and educational content development in common language.

The created communication gateway is based on utilisation of existing radio-relay communication facility of State Enterprise "Radiocomunicatii Moldova". This gateway provided integration of joint RENAM and RoEduNet infrastructure into Trance-European Research and Educational network GEANT (fig.2).
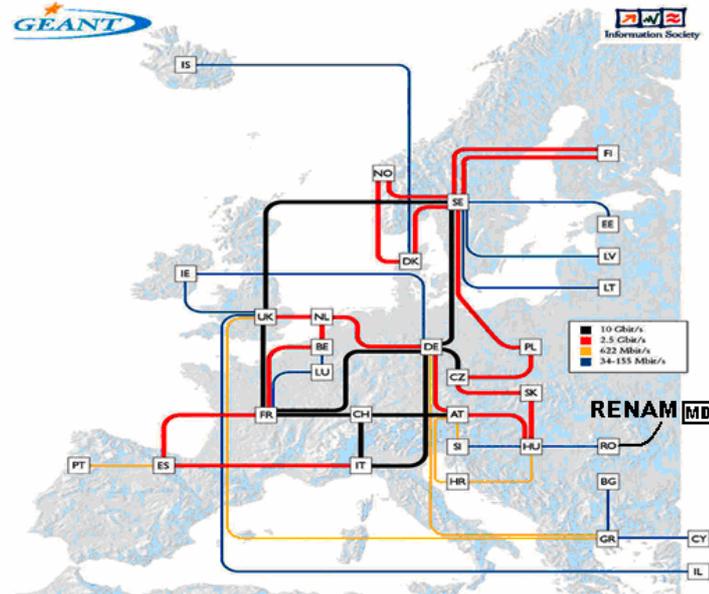

Figure 2. Integration of RENAM with GEANT Trans-European Research and Educational Network

As a result this project had significantly improved not only regional collaboration, but also offered capacitive access to global network. The achieved success of the project realisation permitted to create platform for new bridges to the Ukraine, Turkey, Russia, Caucasus and other regions.

At present existing link to Romania is overloaded and were proposed for implementation two new approaches to upgrade RENAM - RoEduNet – GEANT connectivity. The first way to improve the external connection consists in modernization of the created radio-relay facility. The proposed technical solution is based on utilization of new equipment and radio-relay tracts to cross the distance between Chisinau and Iasi (RoEduNet node in Romania) and can allow reaching up to 34 Mbps (initially) or even 56 Mbps by using microwave modems of new generation. Another direction deals with construction of the second link based on using resources of fibre connection Chisinau-Iasi. Fibre technology is very flexible for building up high-speed data transmission capacity. Implementation of both projects will ensure reliable and productive connection that mainly could satisfy current needs of research and educational community of Moldova.

In year 2003 a project of widening RENAM satellite Internet connection was realized, which was preemption of the previous NATO project CN NIG 972759. It allowed to upgrade RENAM satellite ground equipment and offer an external channel capacity of 4,5 Mbps with possibility to be increased up to 70 Mbps. This satellite connection improved interaction with North and South America networking segments.

RENAM plays important role in the local Internet segment development and its interconnection with Moldovan ISPs is permanently perfecting. This refers both to the local Internet Exchange Point link modernization and to back-up connection construction to "Moldtelecom" S.A. Internet access node.

Further improvement of the networking infrastructure and its transition to the new technological basis is an essential part of RENAM development programme. The creation of the own fibre optic communication medium is economically and technically grounded and the realization of the first stage of dark fibre connections topology persuaded the rightness of this approach [2].

Transferring principal arterial RENAM network connections on new technological base assumes two approaches. The central, mostly overloaded traffic exchange highways within Chisinau City is realized by means of fiber optic communication media and creation mainly Gbit Ethernet and rare STM technology fiber segments (fig.3).

During new projects elaboration in years 2002-2003 various fiber optics data transmission technologies were examined. Actual decision relies on wide market fiber technologies development investigation and as result understanding that Gbit Ethernet in many cases may be the most effective and flexible technology for IP based networks. An appropriate correction of the initial work program was done in 2003 and now two selected technologies - Gbit Ethernet and STM are practically implementing. For providing the most effective support of QoS it is suggested utilization of radial STM technology fiber segment that is based on one core switch within Chisinau backbone. Proposed Gbit Ethernet fiber segment covers 8 RENAM nodes and is based on de-facto industry standard Cisco Systems Inc. switches.

Figure 1. RENAM network connectivity schema.

Separated and far located RENAM backbone campuses presume to be connected by modern, enough rapid (up to 54 Mbps) radio links (fig. 4).

Figure 4. RENAM wireless backbone network schema

Implementing of radio communications capabilities to RENAM's infrastructure will permit to and will be oriented on solving the following tasks:

- Creation of backup radio links between RENAM PoP's thus increasing the overall reliability and readiness on the whole infrastructure;
- Covering as much as possible the whole territories of Chisinau and Baltsi cities;
- creation and distribution electronic distance learning and training courses for mobile users from and between Universities, colleges students, postgraduate students, pupils;
- providing information exchange, electronic publications and other scientific information availability for the most members of scientific-educational community, as well as almost all of schools situated in Chisinau and Balti who cannot be connected to RENAM infrastructure through fiber optic or copper media;
- effective access from virtually anywhere from Chisinau to scientific information resources;
- join projects realization, information projects support, establishing necessary contacts with industry and governmental organizations, which RENAM would be able to connect to its infrastructure by using new communication technologies.

The real data transfer rate within every Wi-Fi Point of Presence (PoP) is expected to be from 10 Mbps to 50 Mbps, and it is depended mainly on distance between PoPs and on the atmospheric conditions; while for mobile users connected to omni directional antennas, the real data transfer rate is planned to be not less than 1 Mbps and up to 10 Mbps; this speed can vary as the user will change his location.

The above basic technological solutions comprise main technical essence of current stage of RENAM network development program. Current direction of network development assumes the creation of new nodes linked by fiber optic in communication backbone based on dark fiber and utilization of Cisco Systems Inc. Gbit Ethernet equipment. This backbone technology with wireless connections supplement will be used for data exchange by all scientific and educational community entities that will provide optimal cost/throughput and highly reliable data transmission medium.

The program of national network infrastructure development is planned to become a backbone for all Universities, colleges, schools, scientific institutions in Moldova and to cover all the territory of the country. RENAM is open for all research and educational institutions, individual representatives of the scientific and educational community of Moldova, interested in usage and development of the networking and information resources. Main goals of second stage of RENAM project consists in providing networking infrastructure for national scientific and educational community, in creation of points of presence in new peripheral nodes of Moldova, where research and educational centres and organizations are located, in improvement of Internet connectivity based one current capacity increasing and creation new external links.

One of the main International strategic scopes of RENAM consists in joining or establishing mutual relationships with partner NRENs by means of significant improvement of Trance-European connectivity, provided by GEANT2 (G2) EU project.

Another essential task consists in creation of integrated information system content kernel, which must be under constant development and accumulation of new information blocks, such as innovations dissemination, distant education systems, computerized curricula database, applied databases in the spheres of terminology, linguistics, ethnography, folklore, etc.

References

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Аннотация

В работе приводится общая концепция и некоторые детали создания Научно-образовательной Сетевой Ассоциации Молдовы (RENAM), которая осуществляет сетевую поддержку Высшего Совета по Науке и Технологическому Развитию а также Агентства по Инновациям и Технологическому Трансферингу Академии Наук Молдовы. Выполнение текущих проектов RENAM откроет возможности улучшить качество и увеличить надежность внешних связей, будет гарантировать прозрачность сети RENAM и создаст основу для передачи инновационного контента при помощи мультимедийных средств, средств и инструментов дистанционного образования. Изложена краткая история и главные цели и направления строительства национальной научно-образовательной сетевой инфраструктуры.

Paper describes general concept and some details of foundation of Research and Educational Networking Association of Moldova (RENAM) that supports the Supreme Council on Science and Technological Development and the Innovation and Technological Transfer Agency of the academy of Sciences of Moldova. Implementation of RENAM current projects will open the possibility to improve and increase reliability of external connections, ensure transparency of RENAM network and creates a base for multimedia-supported innovation transfer, distant education services and tools. Brief history, main goals of national networking infrastructure for science and education construction, current state and planed directions of its future development are outlined.