MODERN E - INFRASTRUCTURE FOR SCIENCE AND EDUCATION IN MOLDOVA, BASED ON THE RENAM-GEANT PLATFORM

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The article is devoted to the analysis of approaches and solutions for the development and use of the electronic infrastructure for offering services to science and education in the Republic of Moldova. In the paper are considering the trends in the development of e-Infrastructure and services in the national Research and Educational network RENAM, which provides effective information support for various scientific and educational processes. The prospects of creating new optical CBF (Cross Border Fibers) links and other components of the electronic platform RENAM-GEANT development with support of EaPConnect project funded by UE are described. The strategy of development of modern regional e-Infrastructure resources and the provision of services that are focused on satisfying requirements of scientific and educational communities in the countries included in the European EaP program are considered.

Keywords: IT infrastructure, information systems, electronic resources and services.

1. Introduction

Recently a huge part of societal activities, including research and education, began moving in digital space and is supporting by the Internet technologies. Therefore, the evolution of the digital infrastructure for science and education is inextricably linked with the progress of the Internet technologies development. The formation of modern ideas about the role and extension of functions of Internet technologies occurred in the early 2000s when new mass practices of interaction between people with the help of new information and communication technologies (ICT) became predominant. This contributes to the development of a digital environment that favors the acquisition of new knowledge, increasing the level of science and education, enhancing transition to a new model of digital economy.

An important development of electronic infrastructure in the Eastern Partnership (EaP) countries has been achieved over the past few years [1], but there is still a significant gap between the developed Western Europe countries and the Eastern Partnership region. Hence support from National Governments and EU for the further development of e-Infrastructure in the region is essential for the integration of scientific potential of these countries in the European Research Area. That is why since 2015 EaP countries are participating in the regional initiative named EaPConnect [2] that is supported by European Commission in a form of co-funded project and is intending to fill the existing gap.

E-Infrastructure offers a new generation of integrated resources and services based on ICT, and is widely regarded as a key tool for scientific and social development. A modern network infrastructure is one of the basic components of e-Infrastructure supporting the requirements of e-Science and e-Education. However, the insufficient development of NREN from the Eastern Partnership countries is an obstacle for their integration with Pan-European academic network GÉANT.

GÉANT network is the common platform uniting all national research and educational networks (NREN) in Europe [3]. This platform was created on the basis of cooperation between 43 partners. GÉANT and NRENs represent a high-speed world class networking infrastructure that connects thousands of educational and research institutions in Europe and offers tens of millions of users, from students and teachers to scientists and researchers, network and specific services for accessing, exchanging and managing data seamlessly on the continent, regardless of their location. This infrastructure now is supporting also mobile applications and users.

Over the past several years the dependence of research and education on access to high-speed networking infrastructures, to large-scale computing and other e-Infrastructures' services is rapidly increasing. At the Eastern Partnership e-Infrastructure event, organised by GÉANT Association and held in Chisinau, Moldova, on 11-12 December 2012, a Joint Declaration supporting development of ICT-based e-infrastructures for research and education in the Eastern Partnership region was signed. This Declaration was used for elaboration of Concept Note that contains an assessment of the needs of research and educational institutions in the six countries that belong to the Eastern Partnership region and investigates their requirements of connectivity to GÉANT network.

2. EaPConnect project: goals and prospects for RENAM e-Infrastructure development

The overall goal of the EaPConnect project is to provide the integration of research and educational communities of the Eastern Partnership countries with their EU counterparts by developing high-speed connectivity, fostering the deployment of new services, and providing opportunities for scientists, students and researchers from the region to publish their results and freely access scientific publications and research data collections. Nationally, Eastern Partnership countries have to reach the level of EU countries in the area of e-infrastructure and usage of informational and computational services by the research and academic communities. In the EaP region modern technologies are especially important for e-learning and the provision of digital information services [4, 5]. Universities, research institutes, libraries and cultural centers should participate in activities for the digitization of information, as well as promote new technologies for the development of access to

digitized information. Access to digital libraries, e-services for support of cultural heritage and e-learning resources is one of the highest priorities for regional R&E communities.

The NRENs of Eastern Partnership countries, in conjunction with GÉANT Association, play an important role in terms of providing the underlying data communications infrastructure for education and research as well as offer and develop of specific ICT services for R&E [2, 4-6]. GÉANT Association together with EaP regional NRENs with assistance of the NRENs of Romania and Poland studied the options of regional network integration to GEANT and elaborated solutions that were proposed as recommendations to the European Commission for launching a new regional e-Infrastructure project - EaPConnect. The new project focuses on improving connectivity of the region to the GÉANT network. The main goal of the project is to ensure that each NREN from EaP countries has at least one direct connection to GEANT and a backup connection through another NREN.

The new project presumes development of existing and creation new connections for Moldova. The general scheme for connecting RENAM to the GÉANT network as a part of the EaPconnect project presented in Figure 1.

Figure 1. MD-RO topology scheme

Located geographically in the Southeast Europe, Moldova can use two options of the optical telecommunication infrastructure development based on CBF connections to Romania implementation. The both options will use available internal optical infrastructures in Moldova and Romania and comply with EaPConnect project concept [2, 5]:

1. Chisinau (MD) - Iasi (RO): developing of the optical connection that is physically exists (RENAM ownership) and is operating jointly by RENAM and RoEduNet. This connection can (and should) be developed (taking in account that this link is operating since 2009) by upgrading installed optical equipment using EaPConnect project funds. This solution based on upgrading of the existing DWDM equipment;

2. Chisinau (MD) - Bucharest (RO) by creating new optical link Cahul (MD) - Galati (RO). We have examined possible options and have started negotiations of construction of the optical segments for fiber installation Chisinau – Cahul – Djurgulești. There are several operators that have and can offer existing optical resources for cover Djurgulești (MD) – Galati (RO) span. RoEduNet has its own optical infrastructure for providing connectivity Galati - Bucharest.

The availability of cross-border connectivity in Eastern European countries provides a basis for re-enforcing the existing infrastructure, offering more bandwidth and path diversity. This shall result in a sustainable, scalable infrastructure enabling international access and national infrastructure development. Expected results of the project include:

- The infrastructure procured by the EaPConnect project will serve for many years after the end of the project (sustainability);

- This created infrastructure, owned and managed by the NRENs may be re-used for both international connectivity as well as national NREN development (creating new Points of Presence and connecting new customers);
- Dark fibre infrastructure will be equipped with highly cost effective communication facilities (like 10Gbit/s transmission) and its capacity can be further improved at incremental cost, when necessary (scalability).

Now there is no cross-border links between NRENs of Ukraine and Moldova. One of the priorities of the project is to develop cross-border communication between NREN of Moldova and the both neighboring countries Romania and Ukraine in order to improve existing communication infrastructure and use it to support backup connection. The logical structure of implementation of connections between Moldova and Romania within the framework of the EaPConnect project is presented in Figure 2.

The final version of the proposed architecture presumes that the relations between Moldova-Ukraine-GEANT can be developed on the base of general and specific technical solutions that coordinated with URAN (NREN of Ukraine). The developed topology and possible technical solutions of the connections implementation proposed for reviewing and approval by the EaPConnect project Advisory Board and the technical staff of GEANT.

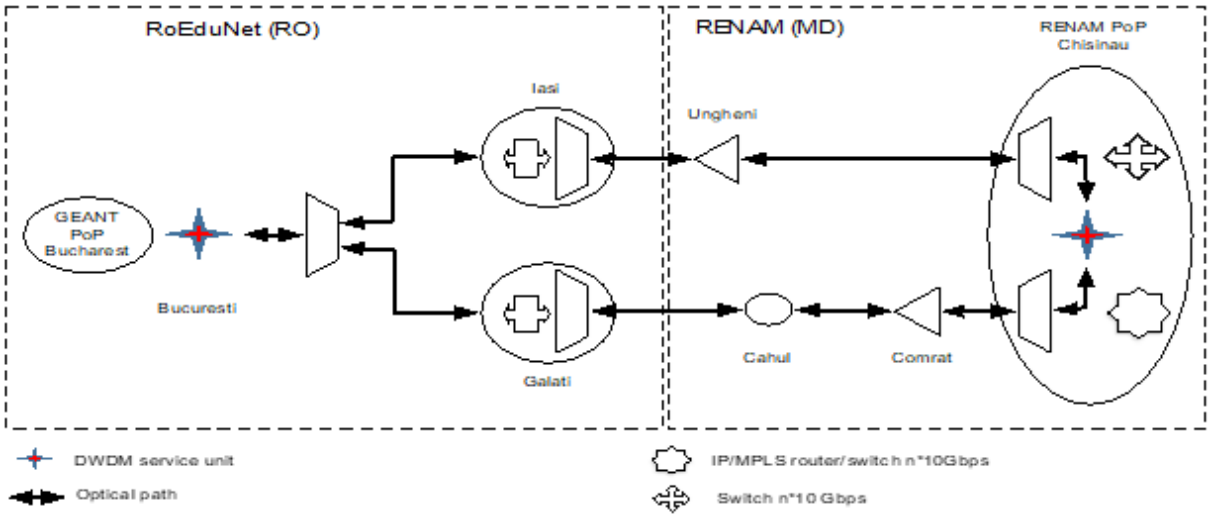

Figure 2. Logical structure of MD – RO connections implementation as a part of EaP network

3. Main services and resources delivered over RENAM e-Infrastructure

RENAM as a NREN of Moldova is a member of GEANT Consortium and all services developed and operated by GEANT community are accessible for national R&E, cultural and medical institutions via RENAM networking infrastructure. Among these services the following can be mentioned as the most important for users' community of Moldova [5, 6]:

- World-wide secured access to academic networks and global internet through the GEANT network infrastructure;
- Provision of high-speed dedicated connections between national and international institutions;
- Interconnection of main national research and educational institutions: ASM, UTM, ASEM, USM, UPSC, USMF "N. Testimiţianu", USEM, State University in Cahul, AMTAP and others;
- Support by Computer Security Incident Response Team (CSIRT);
- EDUROAM (education WiFi roaming) - secured WiFi network access service over the world (see – www.eduroam.org);
- EDUGAIN – Federated Identity Management service that is using global inter-federation mechanism (as it shown in Figure 3) that is uniting National identity federations.

- GCS (Digital Certificate Service) - access service to DigiCert digital certificates via GCS (GEANT Certificates Service). The service includes issuing personal certificates (email signature, documents, access, etc.), server certificates (SSL, EV SSL, Grid etc.) and some other on users request;
- GTS (GEANT testbed service) - access to virtualized resources for testing information systems and new communication protocols. GÉANT Testbeds Service (GTS) provides dynamically created, fully isolated, production-grade, packet testbeds as a service for the research and education community worldwide.

RENAM is developing its own Cloud-based computing infrastructure and providing access to various Cloud services. RENAM cloud infrastructure offering the following basic services: mail (Zimbra), Help Desk (GLPI), Wiki (BlueSpice MediaWiki), Video conference (Big Blue Button), LDAP (OpenLdap), OwnCloud, Eduroam (Radius server), network monitoring tools (Zabbix), etc.

Through RENAM users can get access to Cloud computing resources of the world-class cloud infrastructures (Amazon, Microsoft, CloudSigma, etc.). Access to these resources is offering via long term GEANT Framework Contract. For gaining access to various cloud resources is using federated access supported by EDUGAIN.

5. Acknowledgement

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6. Conclusion

Described results of works on the development and widening usage of the modern electronic infrastructure for science and education RENAM in the Republic of Moldova. The development of new external connections is considered as important outcome of the implementation of the UE funded EaPConnect project in Moldova. The main activities within EaPConnect project are dealt with creation of new cross-border links between Moldova and neighboring countries Romania and Ukraine in order to improve connectivity with the Pan-European network GEANT.

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