



RoEduNet International Conference - Networking in Education and Research

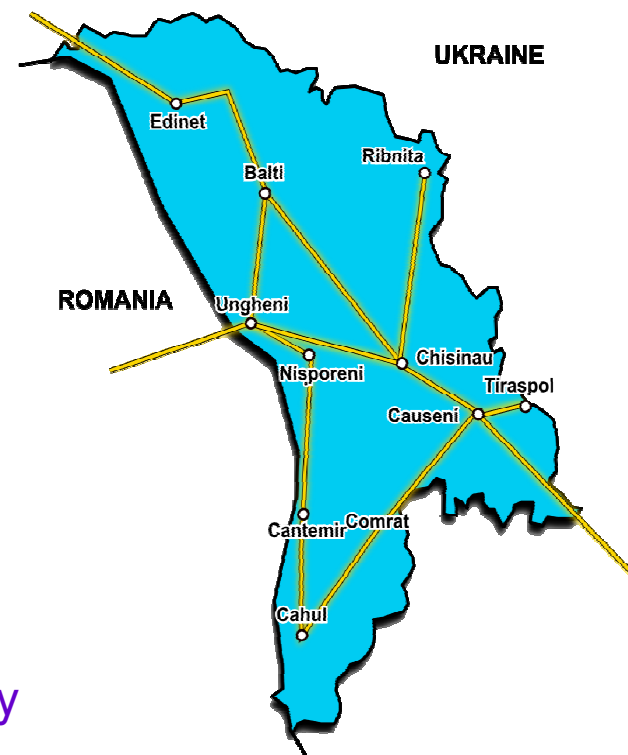



CBF Solution Implementation for Linking NREN of Moldova to GEANT

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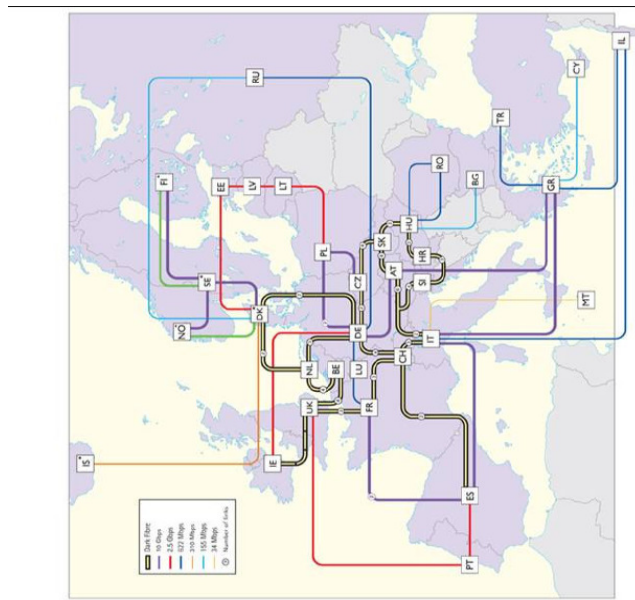


ELECTRONIC INFRASTRUCTURE

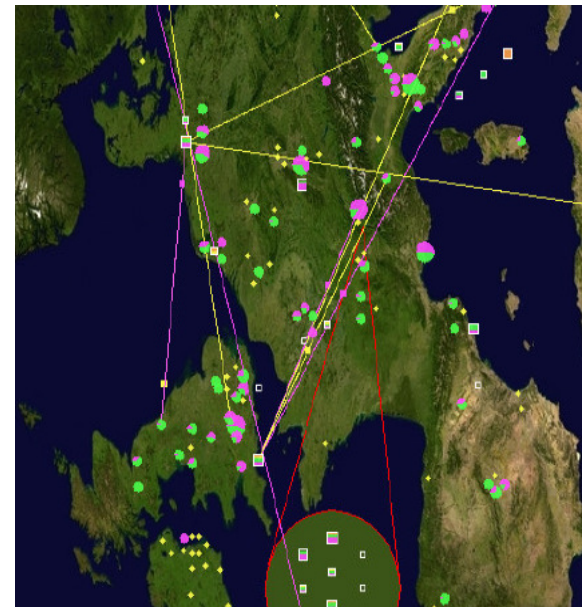
Enabling large-scale innovative research through collaboration of distributed teams of scientist across the European Research Area (ERA) paves the way towards a long-term vision of a *sustainable, transparent and ubiquitous* **electronic infrastructure (eInfrastructure)** open to a wide range of scientific user communities, providing the development of Information Society in Europe.

e-Infrastructures well established

Core leading initiatives, complemented by a range of satellite complementary projects that increase the impact and add value to the ensemble:



GEANT



EGI



Research & Educational networking in Europe

- Since 1993 European Commission started development of common Pan-European networking infrastructure with the aim to unite all research and educational institutions.
- R&E network development passed several stages. Now Trans-European infrastructure is named GEANT2 and has become one of the most developed Internet segment in the world.
- The fundamental principle of common R&E infrastructure building in Europe lay on development of National Research and Educational Networks (NREN).
- GEANT Network uses common approach – it joins one NREN from every country and these NRENs ensures interrelation and provides access of national R&E institutions to GEANT resources.



Diversity of R&E networking in Europe

- At present access to GEANT is organized not only directly through NRENs, but via existing and developing regional initiatives and networks that are supported by EC, and by regional and national authorities:
- NorduNet - unites all Scandinavian countries and represents them in GEANT Consortium;
- EUMEDCONNECT - a project of regional network creation that unites NRENs from Mediterranean Countries;
- TEIN2 (Trans - Asia Information Network) – a project for connection of 10 NRENs in Asia - Pacific region to GEANT;
- ALICE – huge initiative devoted to connection of 19 Latin-American NRENs to common GEANT infrastructure;
- SEEREN / SEE-LIGHT - EC founded regional R&E networking initiatives that have aim to provide access to GEANT network for South - Eastern European Countries;
- Porta Optica Study project;
- Black Sea Initiative (BSI) - the project focused on creation of regional network that will unite all countries of Black Sea Basin.




Extension of GEANT to the East

Various solutions for extension of GEANT to the East were developed. Very roughly, the topology of the East European part of the global Trans-European Academic network can be pictured as multiple ring and arc structure. Some of these rings and arcs, that arise more or less naturally, are:

- **Baltic ring:** a ring around Baltic Sea. The beginnings of this ring go back to the start of the Internet in Baltic countries when the first connection of Latvia went from Riga to Tallinn and further to Helsinki and Stockholm. The ideas to create a geometrical fiber ring around Baltic Sea were expressed frequently, though till today it is not done yet.
- **Central arc:** Poland–Belarus and further to the industrial cities of Russia, then to St. Petersburg and back into Scandinavia.
- **Southern arc:** Poland–Ukraine–Moldova–Romania and further through Ukraine to the industrial cities of the Central Russia then to Moscow and further to cities of Ural and other regions of Russia.
- **Caucasus arc:** Ukraine–Georgia–Armenia–Azerbaijan–Turkey, etc. and then to the Far East in cooperation with Silk Highway and other projects.

Black Sea Initiative





Advancing the Information Society in East and South-East Europe

In the past 5 years a number of targeted initiatives funded by the European Commission programs have contributed to ameliorating the state of eInfrastructures in the Eastern Europe and in SEE region:

- **SEEREN**
- **SEE-LIGHT**
- **SEE-GRID, SEE-GRID2 and SEE-GRID-SCI projects**
- **Porta Optica Study project**

The aims of these initiatives are:

- **to provide wide access** to modern infrastructures and services,
- **to activate** new user communities and
- **to enable** collaborative research activities.

RENAM network general information

RENAM network provides connectivity to:

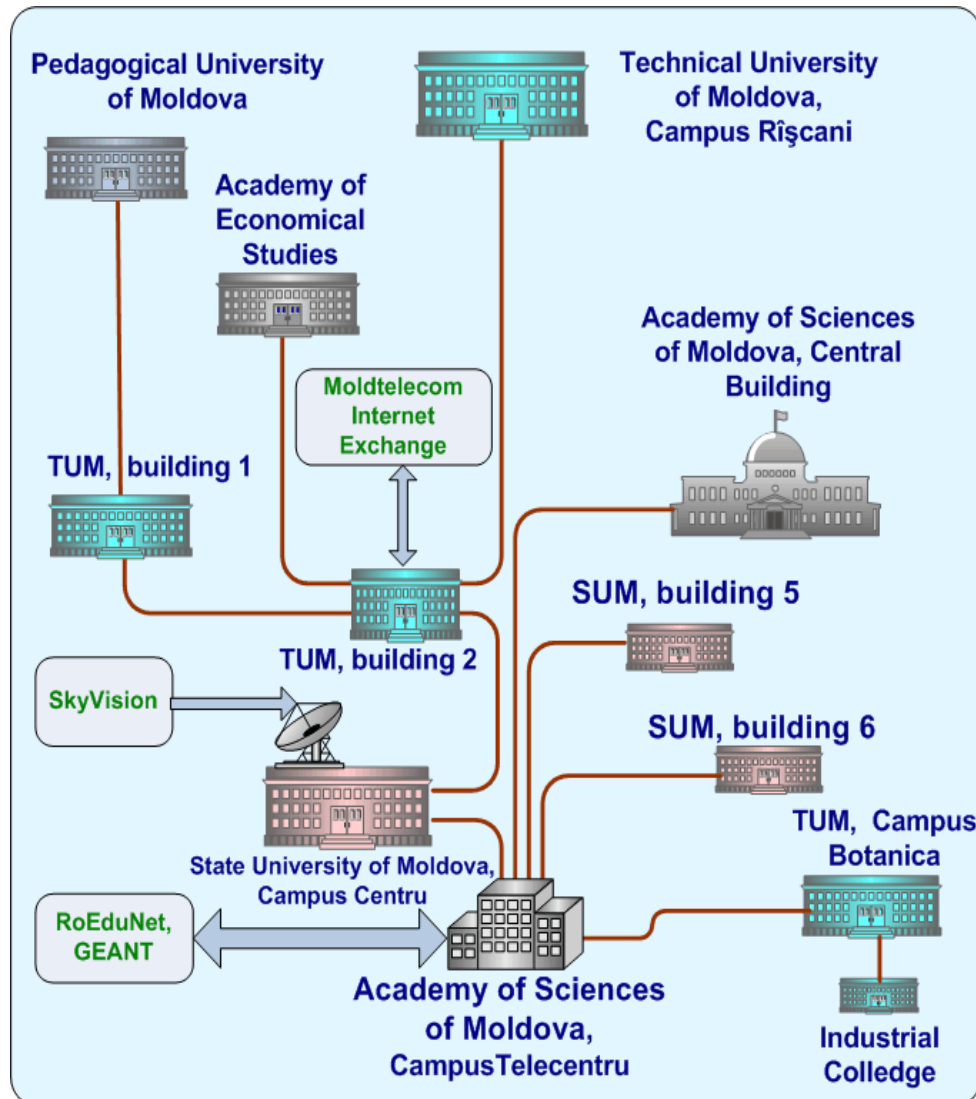
- about 5000 scientists and professors,
- 1000 Ph.D. students and
- more than 80 000 university and colleges students.

Now RENAM networking infrastructure join:

- 22 research institutes,
- 9 universities and
- 5 colleges.

RENAM infrastructure provides connectivity to the universities and organizations placed in Chisinau and other localities of Moldova.

The network node was realized in Balti State University, which joins also four technical colleges from Balti City.



RENAM external channels capacity extension roadmap

- **2001-2003.** RENAM-RoEduNet networks direct link and gateway construction. 4 Mbps. NATO grant NIG978385
- **2005-2006.** Increasing traffic capacity of the radio-relay channel Chişinău – Iaşi up to 16 Mbps and negotiation of leasing additional 16 Mbps bandwidth of the existing radio-relay channel Chişinău – Iaşi
- **2005-2007.** Organization of supplementary channel for Internet access by StarNet ISP and providing additional permanent traffic and backup facilities for RENAM network: 4M bps (backup 8 Mbps) – **2005**; 4 Mbps (backup 10 Mbps) – **2006**; 8 Mbps (backup 16 Mbps) - **2007**
- **2005.** Assuring 100 Mbps optical connection to the “Internet Exchange Point” of “Moldtelecom” S.A.
- **2007.** Increasing IX access capacity up to 1 Gbps
- **2006, November.** Widening bandwidth of the radio-relay channel Chişinău – Iaşi over **32Mbps**
- Elaboration and promotion of international projects for upgrading RENAM-GEANT via RoEduNet connection by using radio-relay channel facility and new fiber optics link Chişinău-Iaşi construction:
 - **1st stage – extension of the radio-relay channel up to 155 Mbps (2007);**
 - **2nd stage – extension of the radio-relay channel up to 2x155 Mbps (11.2008);**
 - **3rd stage – transition from radio-relay technology to usage of optical channel and upgrading its capacity up 1 Gbps (10.2009);**
 - **4th stage – transition to 10 Gbps optical channel operation.**



RENAM – RoEduNet – GEANT cooperation

In 2006 RENAM and RoEduNet signed the Agreement that fixes stages, terms of realization and traffic to GEANT exchange parameters:

- The parties stipulated that they ensure that the direct Dark fiber connection will operate at data transmission not less than 1 Gbps. Full 1 Gbps capacity will be used for information exchange between RoEduNet and RENAM internal networking segments;
- Access for all RoEduNet and RENAM users to the local IX points in Bucharest, Iasi and Chisinau will be provided at the communication speed not less than 100 Mbps;
- RoEduNet ensures the following traffic exchange capacity for access to resources of the Trans-European network GEANT II for RENAM network users:
 - **64 Mbps** – from 01.01.2007
 - **155 Mbps** – from 01.07.2007
 - **1 Gbps** – from 01.07.2008
 - **10 Gbps** – from 01.01.2010



RENAM – RoEduNet - GEANT fiber connection

Support of regional cross-border fiber infrastructure development for research and education:

- ❑ **EC FP6 Porta Optica Study project - DISTRIBUTED OPTICAL GATEWAY TO EASTERN EUROPE**
- ❑ **BLACK SEA INITIATIVE**
- ❑ **NATO project - NEW RENAM-ROEDUNET GATEWAY BASED ON CWDM TECHNOLOGIES IMPLEMENTATION**
- ❑ **EC FP7 SEE-GRID-SCI project – SA1 activity, task SA1.3 - Network Resource Provision**



CBF Project objectives

In order to improve RENAM-GEANT connectivity and to overcome radio-relay-based limited capacity a new project proposal “**RENAM – RoEduNet Fiber Optic Link Construction**” directed on construction of Fiber-Optics (FO) connection between two NRENs was elaborated and proposed in 2006 for consideration and negotiation to NATO Science Committee and to European Commission.

Two main strategic goals of the projects consists in:

- Improve the efficiency of direct link between research and educational institutions of Moldova and Romania countries
- Improve integration of Moldovan Academic network with Trans-European network GEANT through RoEduNet.

This way becomes possible to consolidate and wider the information exchange between the international and the Moldovan scientific communities using FO communication bridge that had initially 2x1 Gbps capacity and in 2010 it was upgraded up to 10 Gbps.



Integrated CBF connection implementation project

For optical link creation it was necessary to attract appropriate funding sources. An integrated proposal for the DF connection practical implementation was elaborated that presumed utilization of various sources of funding:

- European Commission contributed through FP7 project focused on GRID infrastructure development in SEE region;
- For necessary optical communication equipment procurement was elaborated by RENAM and RoEduNet and submitted to NATO Committee on Science for Peace and Security joint project entitled “New RENAM-RoEduNet gateway based on xWDM technologies”;
- Expenses of fiber cable installation on the territory of Moldova were partly covered by local partner organization StarNet Ltd.
- Significant contribution to the optical link construction on the territory of Romania was provided by RoEduNet and Romanian NREN partner organization – Romanian Railways.
- Additional funding contribution for purchasing of the necessary communication equipment was provided by RENAM and also by StarNet Ltd. Company.



CBF link construction workprogramme

The basic workprogramme of the integrated project comprised the following list of Work Packages:

- WP1 – construction of DF line:
 - Elaboration of technical specifications for fiber cable installation approved by the national authorities, including design of the optical cable trace and works on top geodesy;
 - Optical cable and spares purchasing and delivering to the mounting places;
 - Works on cable installation, welding and testing.
- WP2 – installation, adjusting and putting in operation of optical data transmission equipment:
 - Optical communication equipment necessary for organization of data transmission using optical lambdas selection, ordering, mounting, adjustment, testing and its functioning optimization;
- WP 3 – routing and data flows distribution equipment installation and putting in operation:
 - Specification, procurement, installation, adjustment, testing and putting in productive operation of new high performance routing and switching communication equipment for traffic distribution among users in RENAM network;
- WP4 – construction of last mile DF lines in Chisinau and Iasi:
 - Last mile fiber optics cable lines construction projects elaboration and obtaining of official allowance from local authorities;

RENAM-RoEduNet Fiber Optic Channel Construction: channel topology detailed map

The measured geographical distance between two connected nodes is 160 km





Selection of the prospect communication technology

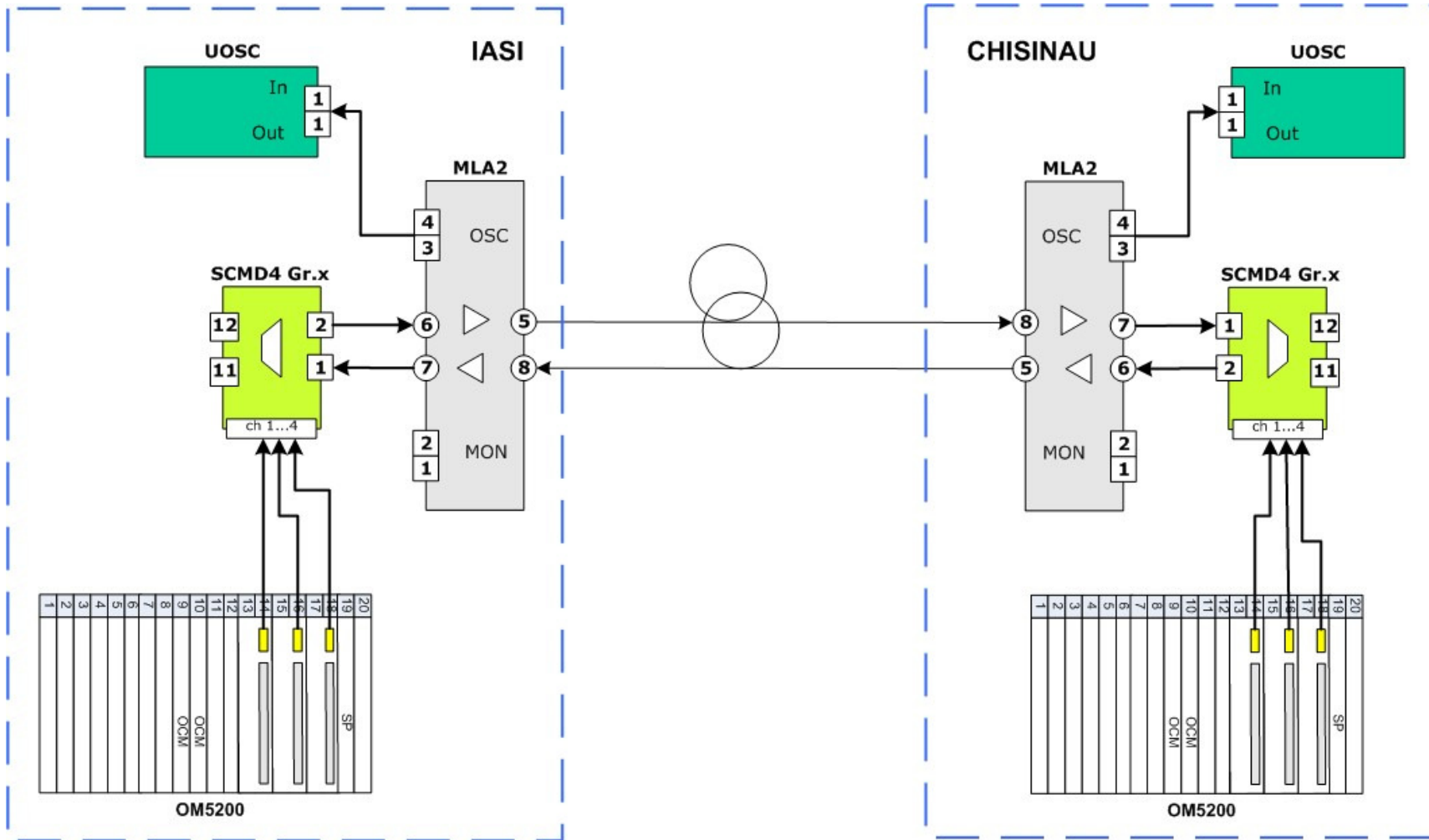
- Initial proposition was that technology has to be economically effective, scalable and flexible and has a long-time life circle;
- Selected technical realization has to ensure necessary level of compatibility– it has to be simply and fully operationally integrated in the existing fiber infrastructure:
 - Various Gbit Ethernet scalable technologies;
 - Implementation of various Lambda - waves splitting optical technologies for intensive usage of cable physical resources.



Analyzed technical solutions

- Offers from the following optical equipment suppliers were considered:
 - Cisco Coarse Wavelength-Division Multiplexing (CWDM) technique with Gigabit Interface Converter (GBIC)/Small Form-Factor Pluggable (SFP) modules;
 - Technical solution proposed by “Meriton Network” Company;
 - Technical solution elaborated and proposed by ADVA AG Optical Networking Company;
 - The offer that was elaborated and proposed by Felix Telecom based on Nortel Company equipment solutions.

Felix Telecom proposed optical solution

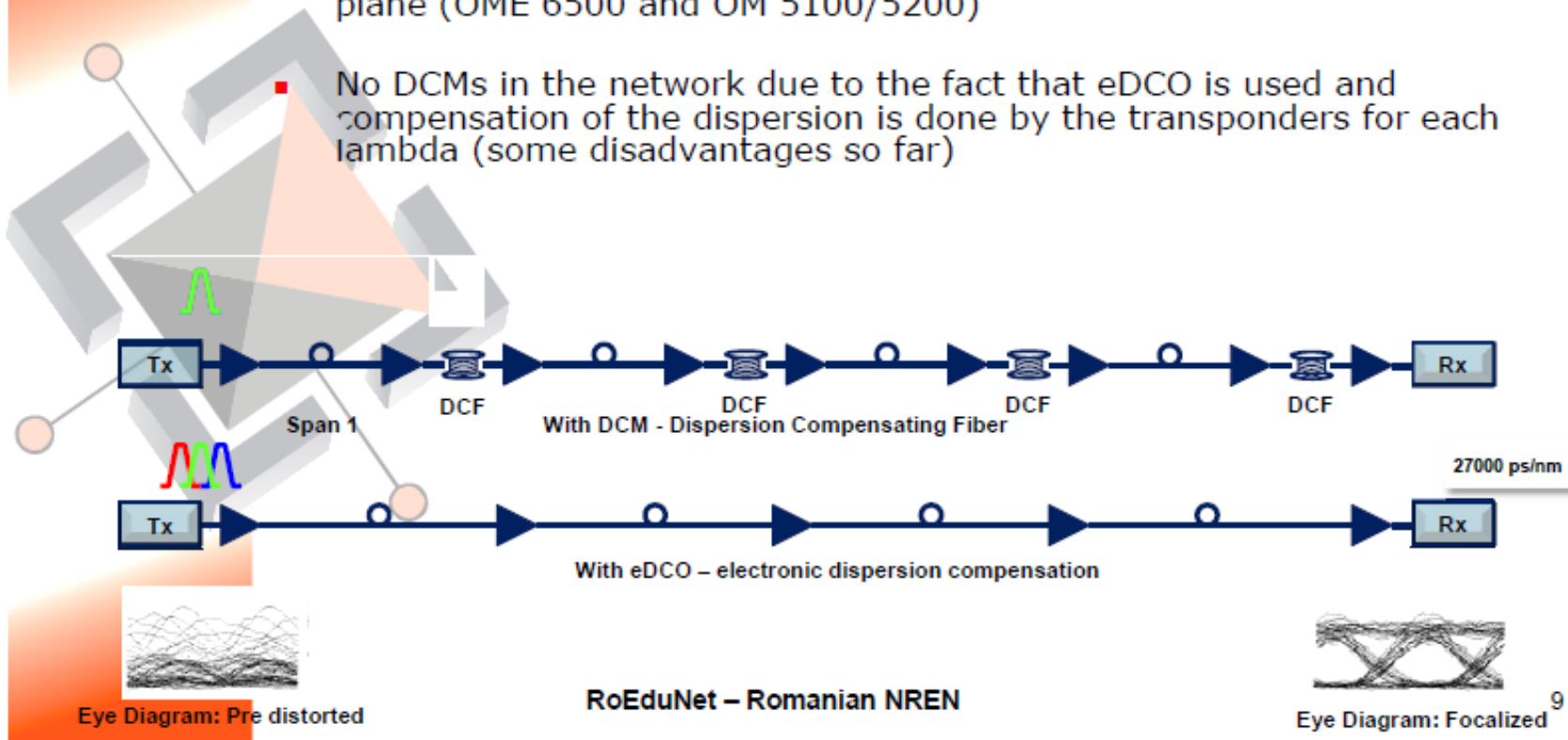


DWDM LINK – PHYSICAL CONNECTIVITY



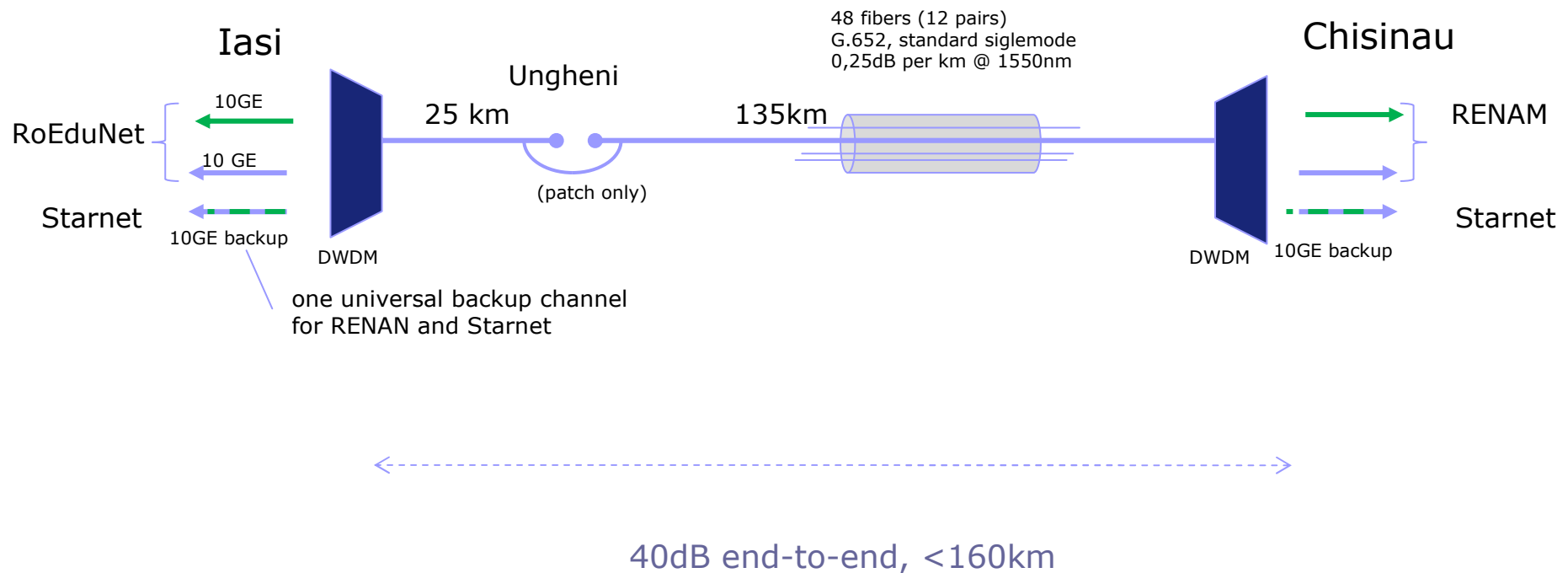
RoEduNet2 - Most Important Features

- ROADM – Reconfigurable Optical Add and Drop Multiplexers with 5 directions for all sites with three or more fibers directions
- No RAMAN amplifiers: good OSNR and good safety for operators
- No regeneration for any lambda (the longest lambda is about 1000 km, 1600 km supported by equipments)
- Separate optical plane (CPL – Common Photonic Layer) and service plane (OME 6500 and OM 5100/5200)
- No DCMs in the network due to the fact that eDCO is used and compensation of the dispersion is done by the transponders for each lambda (some disadvantages so far)



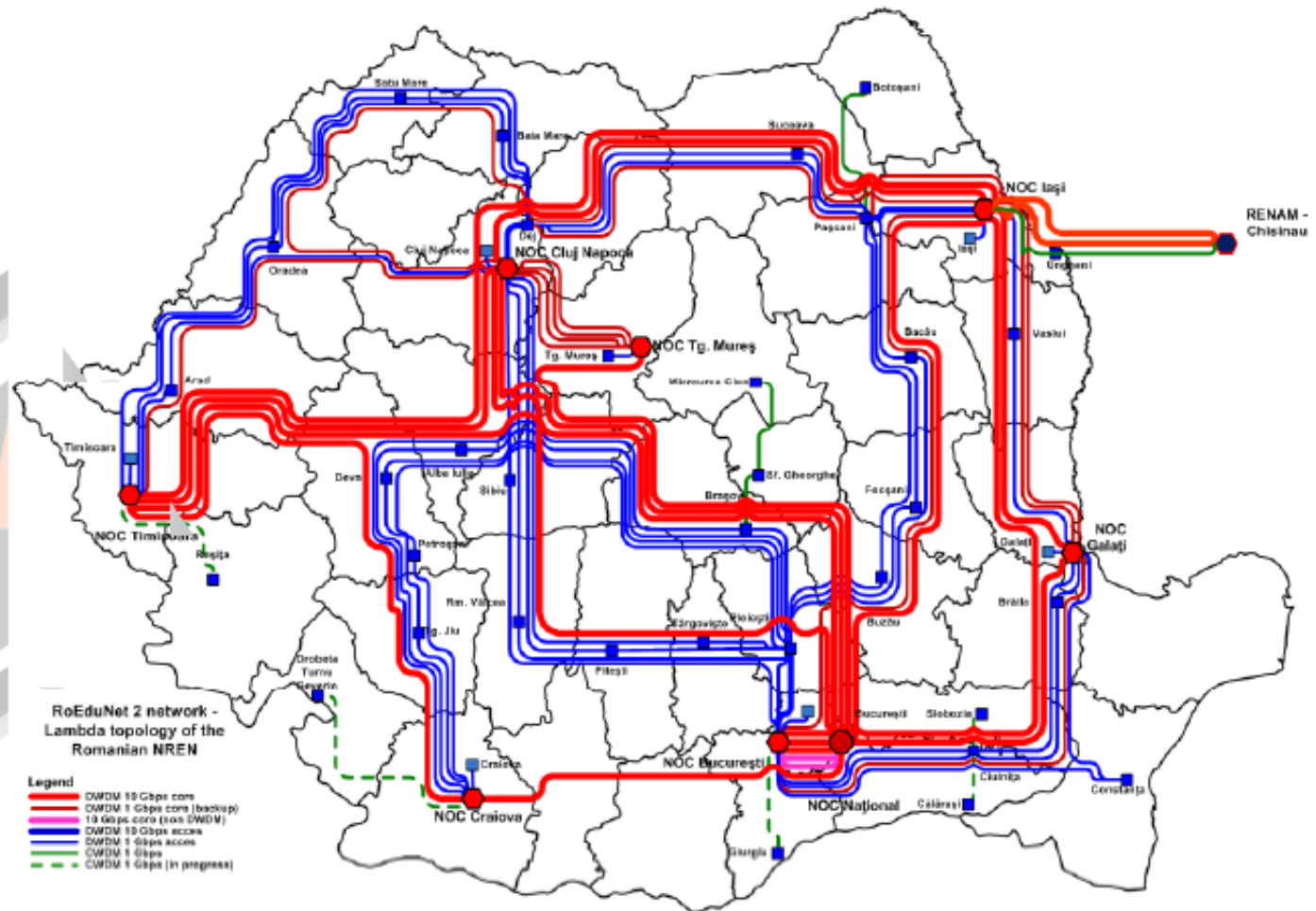
DWDM channel main elements

RENAM-RoEduNet 2 x 10GE + 1 x 10GE-Reserve

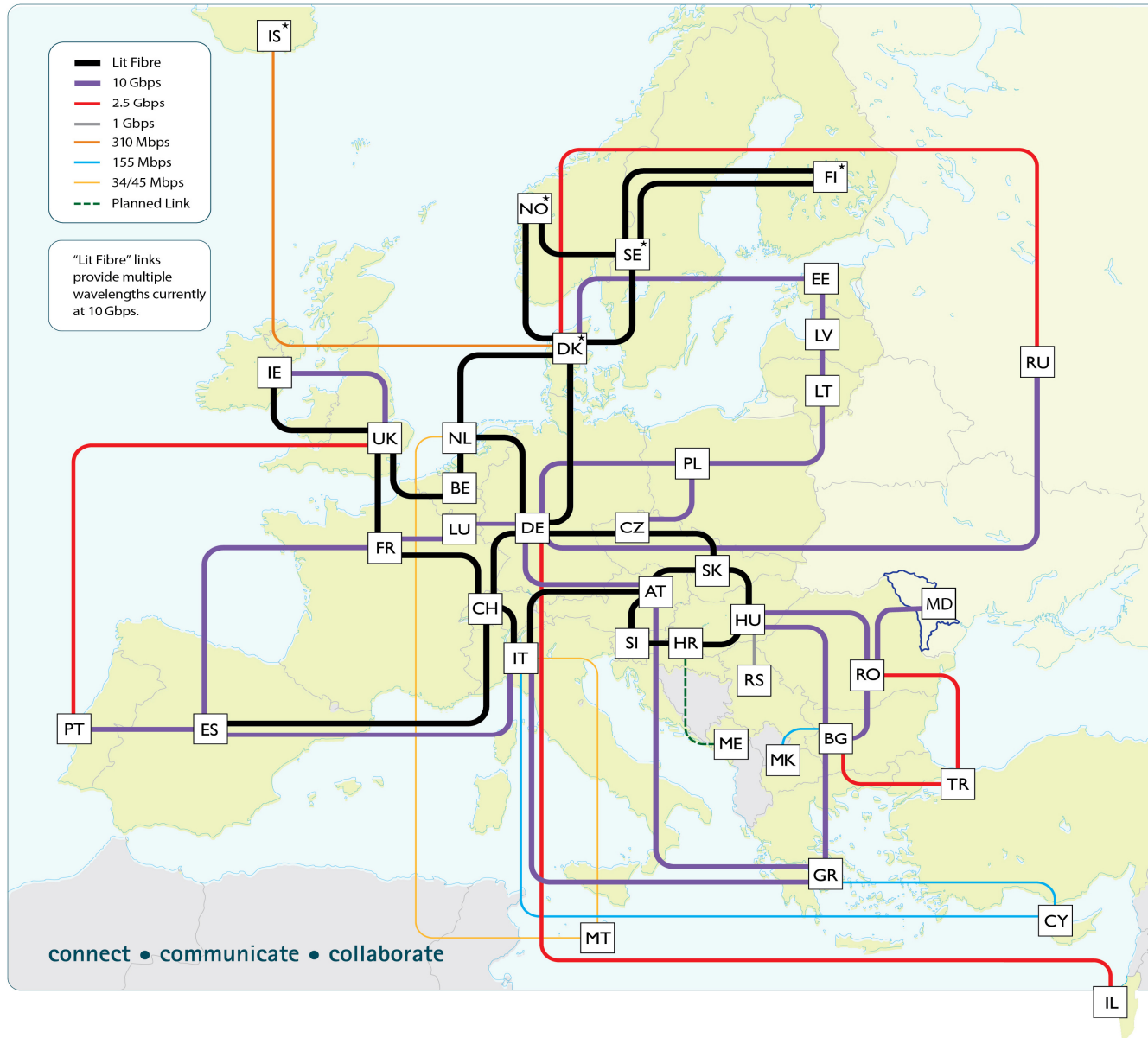




RoEduNet2 Services – Installed Circuits including RENAM



Integration to GEANT via RENAM-RoEduNet- connection





Thank you very much!

Questions ?

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Moldova - www.renam.md**

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