Next Generation Network – a PIONIER example

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Extended abstract

1. Introduction

One of the paradigms of the IT branch development at the beginning of the 21st century is *"ALL OPTICAL NETWORKS"*. Amongst the scientific society a new *"religion of fiber"* has formed. Researchers around the world build and own broadband optical networks connecting users in cities, regions and whole countries. Optical NRENS are being built in Poland, Switzerland and other countries. An American concept of "National Optical Facility" has been presented during Internet2 conference in Los Angeles, in October 2002.

This article describes the concept and stage by stage building process of national optical network, based on PIONIER (Polish Optical Internet - Advanced Applications, Services and Technologies for Information Society) programme. The paper starts with idea and topology of being-built optical network, worth so far 29 millions Euro. On this background the idea of intelligent optical network as well as the first, intermediate stage of its deployment are presented. The possibilities to use PIONIER network in order to improve international cooperation with closest European neighbors are presented in next section. Further part describes in detail the concepts of *e-Region* and *"Porta Optica"* programmes All these ideas allowed to propose a hypothetical next generation optical network for Europe – being the content of last section. This network should allow to satisfy the requirements of integrated, digital Europe, where cooperation between lingual and culturally distinct regions is historically motivated. The general idea of that network can be promptly described as *"ALL OPTICAL EUROPE FOR MOBILE EUROPEANS"*.

2. National backbone network for PIONIER programme - topology

The process of building the national backbone network for PIONIER programme has started in November 2001. So far 1300 km of fibers have been installed, including connections to Czech and German borders. Current investments (approx. 29 millions of EURO) allow to finalize deployment of approximately 2600 km of fibers by end of June 2003 while target network will reach 5500km of fibers with remaining parts being built in 2003-2004.

Optical fiber connections (16 fibers, including 4 NZDS fibers) are built in cooperation with telecom operators, from which "the right of way" has been acquired for: public roads, railway tracks, and power distribution lines. Fibers for research community are dedicated for

broadband long-haul transmission between 21 MAN centers, interregional transmission and regional transmission including all cities along the fiber path. The article describes the concept and realization examples.

3. Functional design of Intelligent Optical Network

This section describes the functional project and architecture of target Intelligent Optical Network. This multi-service network is based on DWDM technology with optical cross-connects and multi-lambda connectivity. A few separate networks including: multi-level network for commodity y Internet, dedicated networks for computational grid, education grid and administration have been defined. Individual infrastructures are designed for high reliability, by the means of using backup and protection scenarios. The commodity Internet network has a tier design, with highest level responsible for international, then interregional and finally regional connectivity. Levels are built basing on dedicated lambdas, and include associated nodes (PoPs).

The functional project has been consulted with major equipment vendors, including Alcatel, Ciena, Cisco, Juniper, Ericsson, IBM, Nortel, Lucent and Siemens. Each of companies offered their own deployment proposal. This project has been also proposed as an offer for offset investment negotiations, as a result of public tender for multi-purpose fighter plane for Polish Air Forces. If this offer is accepted, the estimated time of the deployment for target network is about 2 years.

4. Intermediate stage – 10GE multi-service network

During the intermediate stage, before the target network can be deployed, already existing fibers will be used for Internet connectivity. This will allow to give up existing channel lease from commercial operators, and to decrease cost with additional bandwidth increase. The intermediate stage of PIONIER network is based on 10 Gigabit Ethernet technology and DWDM transmission line equipment. As the network reaches the target shape, 10GE devices will be moved to dedicated channel, and line devices to regional networks. In result of the public tender, Extreme Networks Black Diamond switches with ADVA DWDM transmission equipment were chosen for deployment. The network will be fully operational from 30-06-2003. This section shows the network topology, configuration and functionality, as well as the process of acceptance testing.

5. International connectivity for PIONIER optical network

5.1. "E-region concept"

The PIONIER network was assumed to allow optical connectivity to neighboring NRENs. Currently two connections are being built: one reaches Germany in the town of Gubin, and other will finish in Cieszyn, at Czech border (the agreements with foreign operators as well as DFN and Cesnet have already been signed). There is also a chance to extend this link to Slovakia. This fact will create the base for E-region deployments, described in more detail in this section.

5.2. "Porta Optica"

It is planned to deploy fibers connecting eastern neighbors of Poland. Existence of such infrastructure will allow for creation of reliable, scalable optical connectivity between their NRENs and GEANT node in Poland, and enable better research cooperation, especially in grid areas. There is also possibility to apply E-region idea using that infrastructure. This project is called "*Porta Optica*" and it is described in this section. with the focus on real applications.

6. European Optical Network

The results presented in previous sections allow to start the discussion about European Optical Network. The section justifies the proposal of multi-lambda network with multi-level architecture. Such network is considered to be used for:

- intercontinental connectivity and global services (global computational grid, content grid, iTV grid etc.),
- international connectivity,
- bilateral connectivity,
- regional connectivity,

The network shall prove its usefulness by offering highly organized services in form of grid. The latter will require an effective mechanism provisioning static and dynamic connectivity with the bandwidth requirements reaching lambda level and more, while maintaining very high reliability.

This section presents possible architectures for deployment of European Optical Networks.