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NEWSLETTER

COMPLETE

COMMUNICATION PLATFORM FOR TENDERS OF NOVEL TRANSPORT NETWORKS

HIGHLIGTS

Newsletter No. 1

With the first COMPLETE newsletter project partners present the project vision and structure. ECI Telecomco- as a vendor and CESNET as a member of the NREN ecosystem highlight their future plans.

Vendors' corner: ECI

In the Vendors' section the first newsletter presents current vision, equipment and networking solutions proposed by the ECI company.

NREN's roadmaps—CESNET

In the first COMPLETE newsletter, CESNET as the project partner is presented and future directions descri-

Dear Readers,

With hereby newsletter we wish to present the COMPLETE project and the project consortium. COMPLETE is aimed at addressing the PCP/PPI (Pre-Commercial Procurement, Public Procurement of Innovation) in the area of optical networking technologies and infrastructures.

The project main concept is to create support and communications platform in the area of PPI/PCP procedures for Public and Government Institutions, Bodies, Organizations and Agencies. The platform will deliver information regarding latest and future solutions in the area of optical networking. The series of newsletters will present the latest information regarding the project, future roadmaps of vendors and information about the needs expressed by Procurers, i.e. operators of public networks.

Your sincerely,

Bartosz Belter, the project Coordinator

Your Partner for Growth

The Path to Software Defined Super-channel Optical Networking

Jonathan Homa, Director Solutions and Product Marketing, ECI Telecom

The shift to cloud-based hosted applications, video downloads, and the Internet of Things, is driving unrelenting growth of Internet and other telecommunications traffic. To get a sense of its magnitude, by 2018, global Internet traffic will be equivalent to the transfer of 200 million 1Gbyte files (each about the size of an encoded full-length movie) every single hour.

The underlying technology supporting these massive traffic flows is fiber optic networking, where current state-of-the-art commercial technology can transmit multiple 100Gbps optical signals on a single fiber. This is achieved using advanced digital signal processors that perform sophisticated encoding and coherent detection of a single carrier 100Gbps signal in a 50GHz wide optical channel. Yet even with such advances, there continues to be a push for faster rates and more efficient optical networking to satisfy the traffic beast.

The goal is to achieve a Transport Software Defined Networking (SDN) architecture that manages multiple layers of transport services over a network of high capacity super-channel optical links. This will provide operators with a programmable, elastic, network featuring reduced Capex and Opex, and rapid introduction of new services. This paper describes how to get there in five steps.

Step 1: Super-channels

To achieve faster transmission rates we must consider that we are running up against the Shannon Limit, which is the theoretical maximum information transfer rate of a channel for a particular noise level. The industry is overcoming this barrier using a technique called super-channel transmission. First, it uses ultra-dense encoding for one further push in the maximum transmission rate of a single optical carrier, doubling the capacity from 100Gbps to 200Gbps. This brings us right up against the limit for transmission over any meaningful geographic distance. Next, it combines multiple 200Gbps signal transmitters and receivers in an integrated module to create a super-channel transmission system. Initial systems will feature a 400Gbps super-channel that combines two 200Gbps signals. This is capable of all-optical transmission, without electrical regeneration, to about 1000Km. Future systems will combine five 200Gbps signals to create 1Tbps super-channel transmission.

Step 2: Flexible Spectrum

While super-channel transmission addresses how to increase rates, another challenge facing optical networks is maximizing fiber capacity. Historically, the usable fiber spectrum was sliced into fixed 50GHz channels to accommodate fixed wavelength lasers and multiplexers. This meant that a two-carrier 400Gbps super-channel would use two 50GHz channels, or 100GHz of spectrum. Today, an advanced technique called Nyquist-shaping allows transmission of 200Gbps signals in only 33GHz of spectrum. To take advantage of this and other advances in tunable technologies, the industry is moving to a flexible spectrum allocation scheme that supports arbitrary channel widths. Using flexible spectrum, a 400Gbps super-channel requires only 66GHz of spectrum, which provides a 33% increase in fiber capacity.

Step 3: Colorless, Directionless, Contentionless Routing

Now we must consider how to join multiple point-to-point links of super-channel signals using flexible spectrum channelization into multi-node ring and mesh networks. Two technologies used for this are state-of-the-art reconfigurable optical add/drop multiplexers (ROADMs) and programmable amplifiers. The ROADMs combine Colorless, Directionless and Contentionless (CDC) reconfigurability with an ability to support any flexible spectrum allocation scheme, to route individual wavelengths from fiber to fiber across multiple nodes, without conversion back into the electrical domain. The amplifiers ensure highest signal-to-noise ratio for the wide super-channels to obtain optimum transmission.

Step 4: Wavelength Switched Optical Network (WSON)

WSON is an initial industry architecture that leverages super-channel networking. Under WSON, nodes communicate with each other using GMPLS signaling to discover network topology and make automated wavelength routing decisions in the event of failures. One benefit is an ability to restore optical paths dynamically using existing facilities, to supplement and in some cases to replace automated protection switching that uses dedicated facilities. This reduces costs and enhances the ability to offer and support Service Level Agreements.

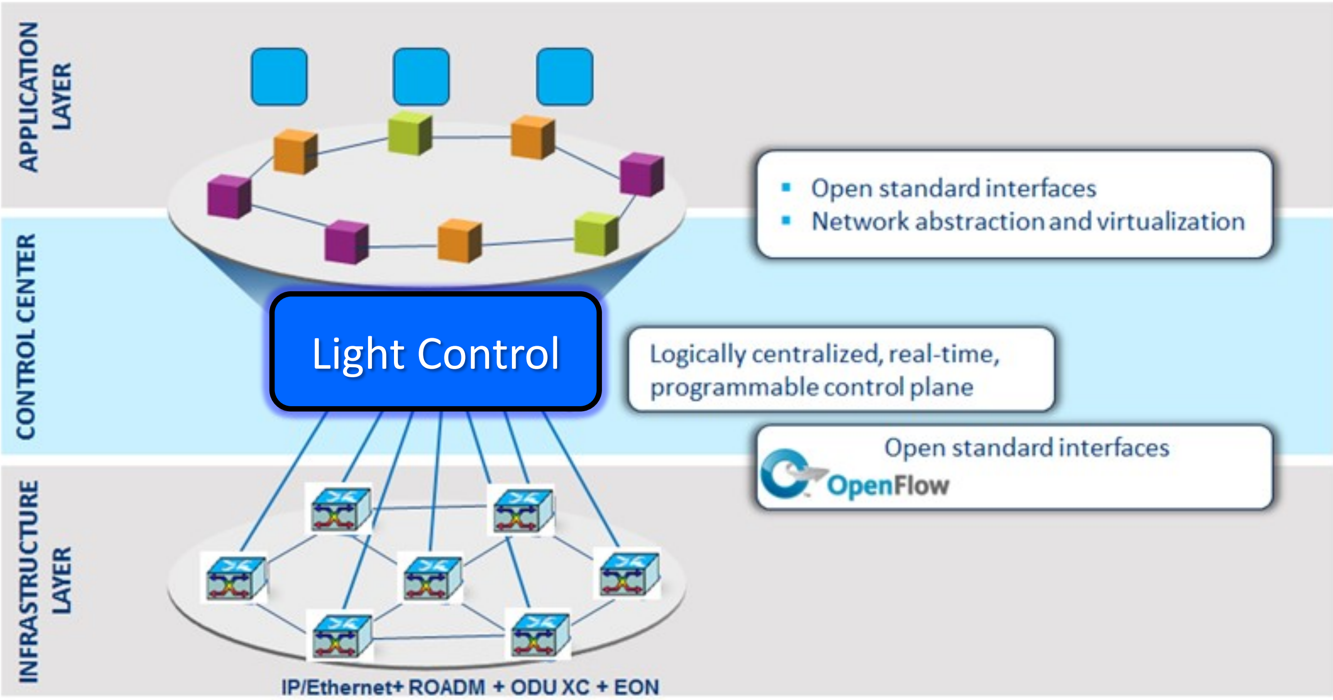

Figure 1: ECI SDN Framework

Step 5: Transport-SDN (Software Defined Networking)

The general industry trend is to an elastic SDN architecture that optimizes networks for traffic and operations. SDN networks are configurable dynamically across multiple service layers to meet traffic demands, and its centralized intelligence simplifies network operations and the flow of information to OSS.

The main SDN concept is that network control is programmable and decoupled from how network devices physically forward/route/direct traffic. This migration of control, formerly tightly bound in the individual network devices, into accessible computing devices, enables abstraction of the underlying infrastructure for applications and network services, which can treat the network as a logical or virtual entity. As a result, service providers gain unprecedented programmability, automation, and network control, enabling them to build highly scalable, elastic networks that readily adapt to changing business needs while simultaneously reducing both Capex and Opex investments in comparison to today's architecture.

The SDN-based solution includes a centralized and programmable multi-layer SDN Controller, open interfaces on the network elements, and value-added applications that run on top of the Controller. The Controller provides centralized, programmable, and dynamic service creation, using intelligent, customizable multi-layer algorithms. A Transport SDN Controller differentiates by being multi-layer and carrier-class designed for high-availability networks. Multi-layer means that its control plane operates on layers 1 through 3 – encompassing fixed and flexible optical grids, OTN, and Packet – for optimal end-to-end automatic service creation and near real-time service restoration. Under a Transport SDN framework, dynamic control of super-channel network reconfigurability will migrate from the network devices to the SDN Controller, which will coordinate this with reconfigurability of other network layers and services, for maximum network service responsiveness and survivability.

ECI Telecom is offering the Elastic Network. Through its rich portfolio of packet-optical transport systems, and SDN and network management platforms, ECI Telecom addresses all the steps identified in this document, to enable the deployment of a Software Defined Super-channel Network.

NRENs' roadmaps

CESNET (Czech Education and Scientific NETwork) was established in 1996 as an association comprising prominent representatives from the academic and university fields with the members from the Academy of Science of the Czech Republic. The main goals of CESNET are the following:

- Operation and development of the e-infrastructure for research, development and education, which includes a National Research and Education Network (NREN) Infrastructure, a Distributed Computing Infrastructure facility and a Distributed Storage Infrastructure with other infrastructures and applications necessary for the services of the Czech academic community (e.g. AAI, collaboration tools, computing cloud, CSIRT, monitoring tools, etc.).
- Research and development of advanced information and communication technologies and applications.
- Broadening of the public knowledge about the advanced networking topics.

CESNET R&D activities focuses on future network architectures, photonic services, testbeds, e-identity, security, monitoring tools, grid middleware, and cloud technologies. The services provided focus on keeping the e-infrastructure at the state-of-the-art level. CESNET has a range of research and development activities related to network technologies (e.g. integration of custom-built (by CESNET) monitoring tools to supervise the state of the managed infrastructure), grid computing, storage (PetaBytes of storage capacity) and better-than ultra HD real-time video transfers. Moreover, CESNET's dedicated research and experimental optical facility (dark fibre testbed) with remote access introduces great means to test new networking architectures. CESNET's researchers posses long-term experience with collaboration of large teams over long distances on a worldwide scale. The basic element of the E-infrastructure is a high-speed computer network CESNET2 which is a robust backbone infrastructure (n × 100 Gb/s) with high redundancy, reliability and flexibility. The core topology of the optical backbone network is based on leased optical fibres conforming to the ITU-T G.652 and G.655 standards.

CESNET needs are coming from demands of users communities. They can be divided into 4 general groups:

- Research focused (e.g. Academy of Sciences or Research and development units of commercial companies).
- Education focused (mainly represented by universities and other educational and academic institutions).
- Others (e.g. Hospitals, Government, Museums, Theaters, Libraries etc.).
- Research infrastructures (e.g. Extreme Laser Infrastructure (ELI).

The most demanding user group are researchers, who often requires high volume data transfers, computation power or advanced network technologies. Common interest of all research groups are collaborative tools. NREN users labeled under the title "Others" frequently have specific needs (e.g. Hospitals) high quality, high bandwidth demanding video transfers including low, fixed latency and remote instrument control. Special group of users are Research Infrastructures projects, which were created for the reason to uptake the research excellence in the specific area. It is clear, that the crucial underlying technology is ultrafast optical network infrastructure, which is scalable to comply with future user needs. Also, such technologies should be easily upgradeable to the next generation without major investments.

PARTNERS

CESNET grnet PCSS

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