TIGER 2

Together IP, GMPLS and Ethernet Reconsidered

Project objectives

TIGER2 is the continuation and enrichment of the Celtic TIGER1 project, which defined an integrated network architecture, combining tightly and efficiently IP, GMPLS and Ethernet technologies in metropolitan, carrier-class environments. TIGER2 addresses a wider scope: in addition to the metropolitan networks, the project investigates the core network area and studies how to apply and adapt the principles of the TIGER solution to the backbone network requirements, considering the deployment of WSON / DWDM transport networks. In order to provide a consistent end-to-end approach, the interconnection and inter-working issues at the boundary between the metropolitan area and the core area need to be investigated. Therefore, TIGER2 covers both multi-domain/inter-domain and multi-layer studies.

Network Operators also share a keen interest in integrated solutions providing an enhanced manageability and efficient network operations, while relieving human operators from tedious unproductive tasks. Thus, TIGER2 investigates network management architectures (including both management and control techniques) to push a cognitive and more autonomous network-operating framework (self-management aspects).

Project Website

Additional information on the CELTIC TIGER2 project can be found on the project web site
http://projects.celtic-initiative.org/tiger2/

Contacts

TIGER2 Project Coordinator
Laurent Ciavaglia - Alcatel-Lucent – Laurent.Ciavaglia@alcatel-lucent.com

Ethernet over WDM Inter-Domain Demonstration
Véronique Piperaud – Marben Products – Veronique.Piperaud@marben-products.com
Mitrasingh Chetlall – Marben Products – Mitrasingh.chetlall@marben-products.com
Rémi Theillaud – Marben Products - remi.theillaud@marben-products.com
Ramon Casellas – CTTC – ramon.casellas@cttc.es
Ricardo Martínez – CTTC – ricardo.martinez@cttc.es
Raül Muñoz – CTTC – raul.munoz@cttc.es

Hitless Maintenance Demonstration
Samir Ghamri-Doudane – Alcatel-Lucent – Samir.Ghamri-Doudane@alcatel-lucent.com
Laurent Ciavaglia - Alcatel-Lucent – Laurent.Ciavaglia@alcatel-lucent.com

Inter-Domain Demonstration with Adaptation of Ethernet over WDM

Context

The purpose of the demonstration is to show the metropolitan and core segments of the TIGER2 generic reference model (cf. below), considering multi-domain / inter-domain and Ethernet and WDM lambda switching capabilities (LSC) issues.

In addition, a foreseen evolution of this experiment will be presented in the second demonstration; it consists in automating the maintenance process of such network services and devices.

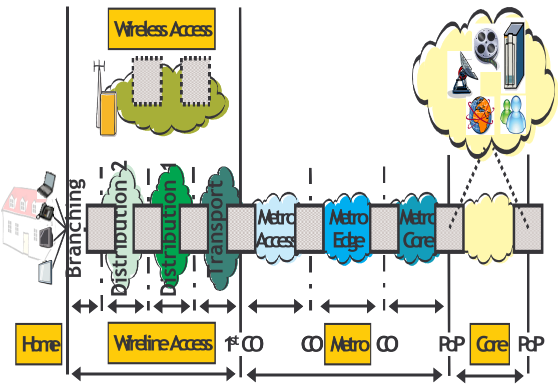

Figure 1: Generic reference model for the TIGER-2 project

Innovation

The demonstration interconnects two testbeds:

- The ADRENALINE (All-optical Dynamic REliable Network hAndLINg IP/Ethernet Gigabit traffic with QoS) testbed ® is a GMPLS-based Wavelength Switched Optical Network (WSON) developed at CTTC laboratories.

Each optical node is equipped with an Optical Connection Controller (OCC) for implementing a distributed GMPLS-based control plane, in order to manage automatic provisioning and survivability of lightpaths (with PCE-based path computation, RSVP-TE signaling protocol for wavelength reservation, and OSPF-TE routing protocol for topology and optical resource dissemination).

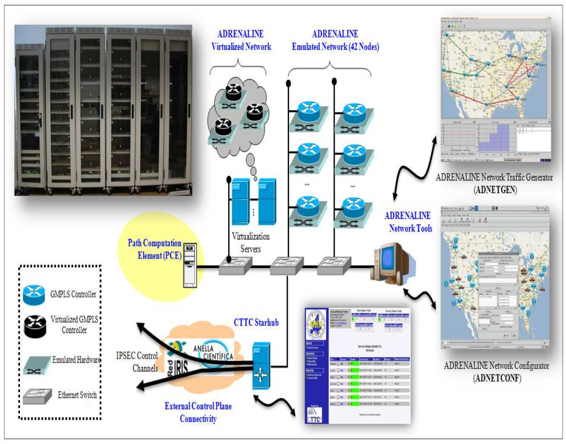

Figure 2: ADRENALINE Testbed® Virtualized and Emulated Network

- The MARBEN GMPLS network emulator, which emulates a network of nodes running a GMPLS compliant control plane. Furthermore, each emulated node hosts a transport plane emulation module to keep track of the allocation and release of transport plane resources (cf. Figure 3).

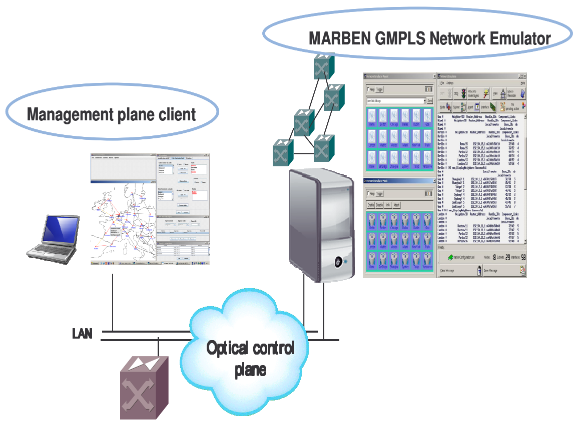

Figure 3: MARBEN GMPLS Emulator

The topology for the demonstration is shown in Figure 4. It is comprised of 2 distinct networks: The Marben Ethernet network (7 nodes) and the CTTC WSON network (14 nodes). The Marben network hosts two edge nodes (192.168.7.209 and 192.168.7.225) having external links to the CTTC network, the latter integrating PCE-based Routing and Wavelength Assignment (RWA).

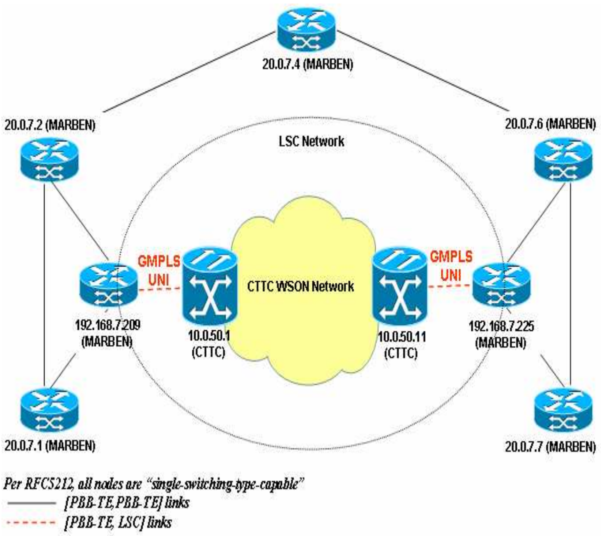

Figure 4: Network topology

Scenario

In the proposed scenario, Hierarchical LSPs will be set up between Ethernet (PBB-TE) capable MARBEN nodes. These LSPs pass through the CTTC network containing LSC capable nodes.

This is achieved in a two step procedure:

1. A first GMPLS LSC Label Switched Path (LSP) is setup between the two edge MARBEN nodes across CTTC wavelength switched optical network (WSON) Network. One Marben edge node requests an optical lightpath via a GMPLS UNI-like interface to the other edge Marben node The goal here is to dynamically establish an optical connection, referred to as a *Forwarding Adjacency* (FA) between the edge MARBEN nodes, which would serve as transport link to "tunnel" connections from the PBB-TE network, i.e. the FA is seen as a TE link from the upper Ethernet layer. To start advertising this FA TE-Link, after the WSON provisions the end-to-end lightpath in the optical domain, the edge MARBEN nodes must exchange some information associated to the FA TE-Link, like link identifiers. Such information is piggy-backed during the signaling of the LSC LSP (called the FA LSP). In particular, from a RSVP-TE perspective, this implies that the ingress node sends a Path message with the LSP Tunnel Interface ID (LTII) object containing the FA TE-Link information of the ingress node destined for the egress node. Upon reception of this message on the egress side, the corresponding egress FA TE-Link information destined to the ingress node is generated according to a preset policy and sent in a LTII object transferred back to the ingress within a Reservation message, followed by the corresponding RSVP Confirmation message.

2. Subsequently, LSPs can be setup between nodes in the MARBEN Ethernet network taking benefit of that previously created FA TE- link. In this demonstration, we will set up a LSP from ingress node 20.0.7.1 to egress node 20.0.7.7 with a "1+1 Unidirectional protection" such that one LSP passes through the CTTC LSC network using a FA TE-Link and the other stays in the MARBEN Ethernet network.

Benefit

This demonstration highlights the following main features:

- State of Art in GMPLS control of optical Networks: OSNR-aware WSON with PCE-based RWA with g.694 label encoding and regenerator control.

- Multi-Layer aspect: for the first time the optical layer and the Ethernet layer are controlled by a unified GMPLS control plane along with wavelength selection as per the latest IETF works.

- Multi-domain aspect: the scenario covers two different domains, not only from a Traffic Engineering point of view, but also distinct administrative domains handling "Backward Recursive Path Computation" (BRPC) and "per segment" Path Computation methods.

Hitless Maintenance Demonstration

Context

Maintenance operations are frequent tasks in telecommunication networks, and cover a large panel of hardware and software interventions. Although necessary, these operations result, most of the time, in partial or complete service interruption, which is detrimental to the end user and to the network operator.

Additionally, network-wide maintenance activities can rapidly become a complex task preempting precious human skills and time. They are error-prone as well, and one of the main causes of network downtime. As a result, the maintenance process is a major generator of costs, and constitutes a relevant example of the increasing complexity in operating today's networks.

Challenge

The objective is to relieve human operators from tedious maintenance tasks, to minimize service disruptions, and hence to drive down the costs. This is part of the Opex challenge that is pushing towards the introduction of trusted autonomic processes within network operations.

Technically speaking, the challenge is to provide network operators with a solution for the automation and optimized orchestration of maintenance operations, with minimal impact on the network.

Innovation

Providing relevant management tools

This includes the implementation of management interfaces and communication platforms that allow operators to publish maintenance targets, to enforce high level objectives and then to track progress reports. These tools aim clearly at keeping the operator within the control loop of its network.

Empowering the network

This is the heart of autonomic paradigms. In the context of hitless maintenance, it comprises:

- The design of dependency models and the derivation of the technical constraints that shall drive the planning of maintenance actions.
- The design and implementation of distributed constraint-based planning algorithms.

Embedding the intelligence

This is mainly about protocol definition/ extension for inter-node communications and coordination towards the optimal orchestration of maintenance actions.

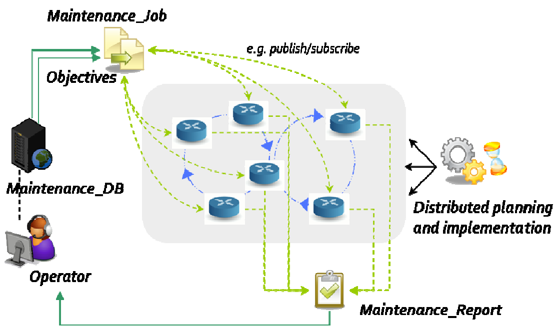

Figure 1: Hitless maintenance process

Scenario

The demonstration shows a first application of our platform; it addresses the maintenance of control plane features with a focus on the optimal orchestration of OSPF (routing function) graceful restarts.

In addition to the specific dependency model, the distributed agents for constraint-based planning and the management interfaces, an emulator of the control plane graceful restart mechanisms has been implemented.

The demonstration relies on two graphical user interfaces: (1) the dashboard that is used to publish maintenance jobs, enforce objectives and check reports; and (2) the emulator GUI that shows live what is really happening within the network (distributed coordination, decisions and actions).

Benefit

Provide autonomic tools to relieve operators from tedious maintenance tasks, so they can focus on the creation of value-added services.