The LambdaCat Open Testbed Facility: An Innovation Facility to Test Multi-layer Devices on a Real Environment

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Abstract. This paper describes the LambdaCat experimental infrastructure, which provides an open facility to test and validate research, experimental, and pre-production equiment and sevices aligned with Future Internet technologies. The LambdaCat validation platform is composed by three transparent and colourless ROADM-based nodes, which are deployed in the Barcelona metropolitan area. The experimental infrastructure is virtualized in order to offer logical isolated substrates to enable simultaneous disruptive research experiments in productive environments without interfering to parallel research users. An IaaS (Infrastructure as a Service) model is adopted to be aligned with the user infrastructure needs. The implemented services allow end users to test new telecommunications equipment and services. The experimental services are accessible at different network layers (L1, L2 & L3) to test new technologies and protocols, from core to access networks.

Keywords: Future Internet Testbed, Optical Open Infraestructure.

1 Introduction

Internet traffic is constantly growing and network applications require more restrictive connection parameters to transmit properly their data. Thus, to allow an optimized way to test new devices and applications aligned with the Future Internet, open collaborative environments should be deployed, driving R&D&i to a Public and Private Partnerships (PPP) model.

Moreover, many organizations can not afford the deployment of their own testbeds. Therefore, most devices, applications and services are tested in environments far of a real production context. These impacts negatively on the robustness of novel network devices and sevices. Thus, offering an open testbed to the R+D+i sector in Catalonia increases the developments quality, which also impacts positively on the emergence of future technologies.

T. Magedanz et al. (Eds.): TridentCom 2010, LNICST 46, pp. 564–569, 2011.

In this paper, we present the architecture and topology of LambdaCat experimental infrastructure, describing the devices that compose the experimental facility.

Secondly, the different services offered within LambdaCat optical open testbed are described. This section contextualizes the experimental services at the different network layers.

Thirdly, three research and innovation projects experiences that have been developed using LambdaCat experimental services are listed.

Finally, the paper describes the main goals and innovation keys of the LambdaCat open testbed facility. The section tries to contextualize R+D+i impact into public and private organizations, focusing on the benefits of collaborative environments.

2 Architecture and Topology

The LambdaCat open testbed is composed by three optical reconfigurable 2.5/10G ROADM-based nodes, with add and drop capabilities. The three nodes are deployed in the Barcelona metropolitan area establishing a multi-wavelength fibre ring. The points of presence (PoP) of the optical testbed are strategically placed on industrial and academic locations. The main research centres, technical universities and industrial clusters in Catalonia are connected to LambdaCat facility to use, test and offer their experimental services. Additionally, to demonstrate services and applications, the LamdaCat testbed offers a pool of distributed virtual machines. Thus, the platform can be configured to perform ad hoc multivendor tests at different network layers.

To complement the experimental connectivity services, LambdaCat facility offers monitoring services to analyze the performance of the devices and services under test. Moreover, HD media content 10G services are offered, as well as an extension to access to a 4k demonstration laboratory to test advanced media services. Finally, LambdaCat open testbed has two more interesting research extensions: a FTTH industrial extension and a GRID/cloud computing extension.

2.1 Network Structure

The network structure is composed by three open optical nodes, which are accessible at different OSI layers. It means that the network devices, services and protocols can be tested at different layers depending on the user needs and devices under test.

The three ROADMs have 2.5/10G connections on bidirectional fibres to implement redundancy and resiliency. The following illustration shows the LambadaCat testbed structure.

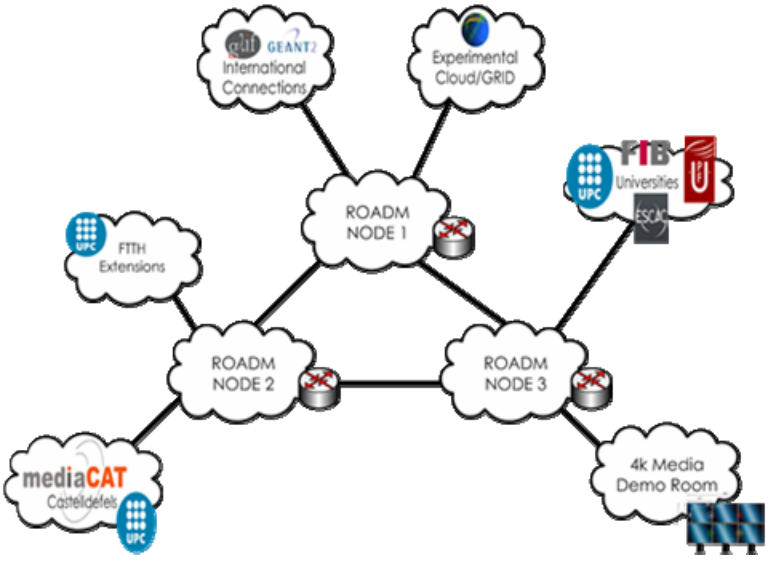

Fig. 1. LambdaCat extensions

Also, in each Point of Presence, a L2 switch, a L3 switch and a virtual machine server is located. These devices allow to the users to test devices, protocols and services.

The LambdaCat open testbed provides extensions to test technologies on more heterogeneous environments. These experimental extensions are described below.

2.2 Network Nodes

Each LambdaCat Point of Presence is composed by heterogeneous network equipment. Each node hosts multiple network equipment, from the optical to the service and application layer.

First, a ROADM is used to offer 2.5 and 10G connectivity at optical layer between LambdaCat PoPs. The ROADMs allow to the users to add and drop lambdas at each node. Second, each ROADM is connected to a layer 2 with the aim of offering different ports to access and test layer 1 and layer 2 services. Third, layer 2 switches are connected to a layer 3 switch to offer IP connectivity to test devices, protocols and services.

Finally, each layer-3 switch is connected to virtual machines servers to offer parallel instances to testing applications and services at higher OSI layers.

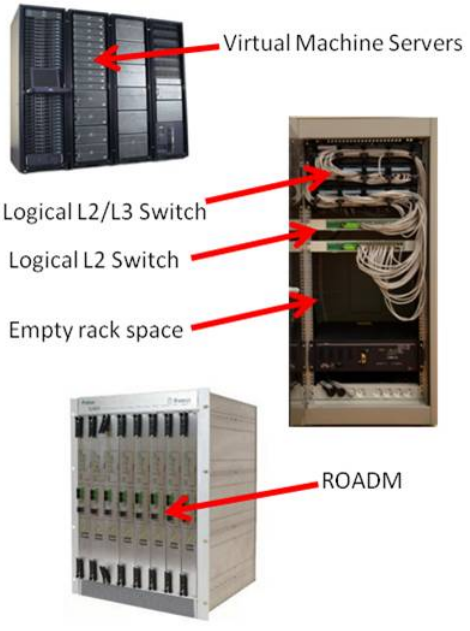

Fig. 2. PoP Topology

2.3 Network Extensions

Currently, LambdaCat open testbed has two FTTH extensions. The facility has connectivity to a FTHH laboratory placed in the Technical University of Catalonia in Castelldefels. This laboratory is aimed to provision experimental FTTH services to the university research community to research and develop new technologies and protocols.

Also, the LambdaCat open testbed provides another FTTH extension to test industrial and residential solutions in production environments. This FTTH extension offers two different platforms to test FTTH active and passive technologies, having connected a GPON OLT and an EPON one.

One of the LambdaCat PoPs is connected to a very high definition demo laboratory to offer 4k experimental media transmission services.

The LambdaCat facility has two international 10G connections, to offer international experimental services. These international connections will allow to connect the LanmbdaCat facility at other research locations and testbeds.

3 Experimental Services

In this section are described the different services offered for the different OSI layers. Each PoP has enough empty rack space to host simultaneous testing equipment. All the equipment that composes each PoP is virtualized to offer logical instances to the users and support parallel disruptive testings and experiments between them.

Applying IaaS techniques, the users are allowed to configure themselves their dedicated network resources without the intervention of a network manager.

Also, the LambadaCat experimental facility is connected to MediaCAT platform, where multiple media experimental services are offered. Currently, the MediaCAT media services are working in production environments, transmitting 2.5G and 10G streams with high definition media content between Barcelona and Castelldefels.

Over the LambdaCat testbed there are also monitoring and performance services to allow the users to analyze the behaviour of the technology that they are testing.

3.1 Layer 1 (L1) Services

LambdaCat experimental layer 1 services offer connections of 2.5 and 10G with add and drop capabilities on each optical reconfigurable ROADM node. The three ROADMs nodes are the outcomes from the Spanish R+D+i project DREAMS (PROFIT/CIDEM 2007) and an e-Infrastructure Catalan research project PAIS (InfoRegió 2009).

L1 experimental services are capable of establishing lightpaths between two or more network edges. This is done by using a network management tool, ARGIA [1]. ARGIA applies virtualization techniques to implement intelligency, flexibility and dynamic connections to the physical network. To test L1 equipment, the users will locate physically their devices on one of the PoP.

3.2 Layer 2 (L2) Services

To test L2 devices, the LambdaCat facility offers experimental connectivity services and empty port space in each PoP of the metropolitan ring. Thus, the experimental services allow to the users to manage their own connection.

3.3 Layer 3 (L3) Services

L3 services are characterized by offering IP connectivity streams between two or more network destinations. the LambdaCat experimental facility is capable of deliverying an IP network to the final users. This service allows configuring their own IP networks to the end users so they can configure their own IP network according to their test requirements.

3.4 Grid and Cloud Computing Services

The LambdaCat experimental grid computing services are mainly the outcome of PHOSPHORUS FP6-Project [2].

To offer cloud computing experimental services, the hosted servers on each node have eyeOS (Cloud computing operative service) installed and have access to the experimental cloud computing services.

End users can access these services through a remote connection to the LambadaCat experimental facility or by connecting or installing directly their developments on the experimental infrastructure.

3.5 Media Services

The LambdaCat open testbed is connected to the MediaCAT media platform, where users can access experimental media services through a connection to the facility. The platform is connected to a 4k visualization room to experiment with very high definition 4k media content services.

4 First Experimental Activities

LambdaCat open testbed facility has been used to test several R&D&i projects. In this section, four interesting research experiences are explained.

First, LambdaCat L1 connectivity services have been used to develop, deploy and debug the ARGIA management network tool. At present, ARGIA is used to manage the LambdaCat testbed, virtualizing L1 devices to offer dedicated experimental networks to the users.

The DREAMS project has used LambdaCat to develop and deploy the three ROADMs that nowadays compose the LambdaCat testbed.

Finally, the LamdaCat facility was used to deploy a GPON and an EPON OLT on UPC Castelldefels to test FTTH high-quality voice and novel business services.

5 Conclusions

LambdaCat experimental facility is aimed to offer an open experimental platform to improve the quality of network developments in Catalonia. This open experimental environment should promote and enhance public-private partnership of organizaions inside and outside Catalonia.

The LambadaCat experimental facility presents an ideal environment to researh on Future Internet technologies, architectures, protocols and services. One of the main innovation keys of LambdaCat is the capability of the end users to reconfigure their assigned resources according to their testing and research needs.

References

1. Argia, `http://www.inocybe.ca/frontpage/home`
2. Ferrao, L., et al.: Advance and Immediate Reservations of Virtualized Network Resources. In: Proceedings on Terena meeting (2008)