Integrated end-2-end trials of an Ethernet based forced forwarding solution developed within MUSE

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Abstract

End-2-end tests and evaluations, as a proof of concept, are essential tools in the development of innovative telecommunication concepts and platforms. This paper describes an innovative approach towards the tests and evaluations of an Ethernet based forced forwarding solution for a multi-service and multi-provider access network. It describes the integrated lab and test bed environments and the results of the end-2-end evaluations and tests.

Introduction

The overall objective of the integrated project MUSE (MUlti-Service access Everywhere) is the research on and development of a future low cost, full service access and edge network, which enables the ubiquitous delivery of broadband services to every European citizen.

The high bandwidth access solutions developed within MUSE should have multi-service and multi-hosting capabilities, enable low investment cost and operational expenses and they should be easy to use and utilize for the end users.

One of the solutions developed within MUSE is an Ethernet based forced forwarding access network, that will be evaluated using the test approach described in this paper.

The carrier grade Ethernet access platform that is used in this lab and field trial evaluations has been developed at Ericsson in order to demonstrate and evaluate the solutions from MUSE. The platform is built upon an enhanced forced forwarding solution. [1]

Main features of this MUSE enhanced Ethernet forced forwarding test platform:

Multi-service and multi-operator capability

The access network can handle a large number of simultaneous access network and (application) service providers. Each of these can have access to all customers in the network. This means that the customers can chose from a large spectrum of different services, but also between similar services provided by different operators.

Distributed-edge

The edge node can be divided into several geographically separated physical units still maintaining a controlled environment for service provisioning. This is made possible by using virtual service agents that are distributed in the forwarding elements. See reference [2] for a more detailed description.

Scalable

In a BRAS type of network the maximum size of the network is determined by the capacity of the BRAS node. The multi-edge node in this Muse access network has no such limits. New forwarding elements can be added when necessary in order to increase the total capacity of the network. This can be done without affecting the traffic in the already installed network.

Innovative approach towards full-service end-to-end testing

Within MUSE we have put extensive efforts in defining a complete test suite for full-service end-to-end testing. This test suite describes ***what*** and ***how*** to test.

Tests will be done in two different environments. In the integrated lab environment at TNO all functional and performance tests will be carried out. Additional to that, the end user behavior and implications of use of real services will also be taken into account in the tests that will be performed in the Swedish broadband testbed environment facilitated by Acreo.

The purpose of full-service end-to-end testing goes far beyond just testing an access solution for offering broadband services to end-users. Knowledge of its capabilities and shortcomings, obtained by adequate tests, is vital for both operators and vendors. The MUSE tests and evaluations are a key factor in the project and will continuously generate feedback to the different work packages and task forces within MUSE to continuously improve the solutions developed within MUSE.

- For operators, it is a strategic asset to support their migration decisions. They face a constant need for innovating their way of offering broadband services to their customers, and a minor misjudgement in the capabilities of such a new solution may cause significant costs due to the large volumes being installed.
- For vendors, these tests are vital to improve/debug their solutions, and are instrumental for them to prove how adequate their solutions are.

The challenge is to make well-balanced judgements on a ***system as a whole***, and not of individual elements or sub-systems. This requires a holistic top-down view on the relevant capabilities and shortcomings of such a system under study. However, to enable balanced judgements, detailed expertise is required on ***all*** relevant properties to know *what* [3] and *how* [4] to analyse them by suitable tests.

This is a true challenge, due to the complexity of state-of-the-art access systems.

The test suite guides operators and vendors to the most relevant aspects of "triple play full-service, end-to-end testing" of access systems. This test suite addresses a wide range of properties related to quality of service (QoS), connectivity, security, system management, xDSL and fibre.

Test environments

Figure 1 below describes the TNO integrated test environment. The MUSE platform under test will be connected to one of the provider edge (PE) routers of the integrated lab environment. Via this PE router every service available in the integrated lab environment can be reached. Depending on what service(s) the customers are subscribed to the customer will get access to this specific service(s) by connecting a proper end user terminal (PC, set-top-box, VoIP phone, etc.). The Ethernet over xDSL platform will be used as a reference to the MUSE platform.

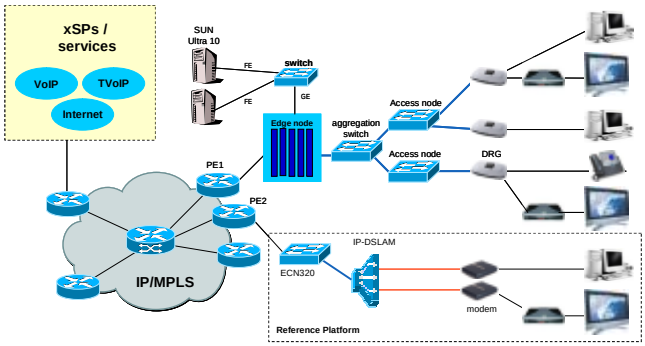

Figure 1: *Detailed overview of the MUSE lab trial test and evaluation set-up*

The Swedish broadband testbed, figure 2 below, operated by Acreo in close cooperation with two commercial access networks: Hudiksvall City Network and Sollentuna Energi Network will be used to evaluate the influence of end-user behavior on the access solution. Services are injected into the network either directly from the edge routers in Hudiksvall or Kista or via a larger service exchange point used by several service providers. The transmission link is a protected DWDM link with a current capacity of 10 Gbps. The access areas marked L2 in the figure are currently equipped with an Ericsson access solution that will be upgraded to the MUSE solution during the trials. Besides these areas with real end-users, end-user nodes can be set-up in the lab-environment. Other first-mile technologies as well as more metro oriented parts (e.g. VPNs via MPLS, GMPLS, DTM) can be used as reference or in interoperability experiments.

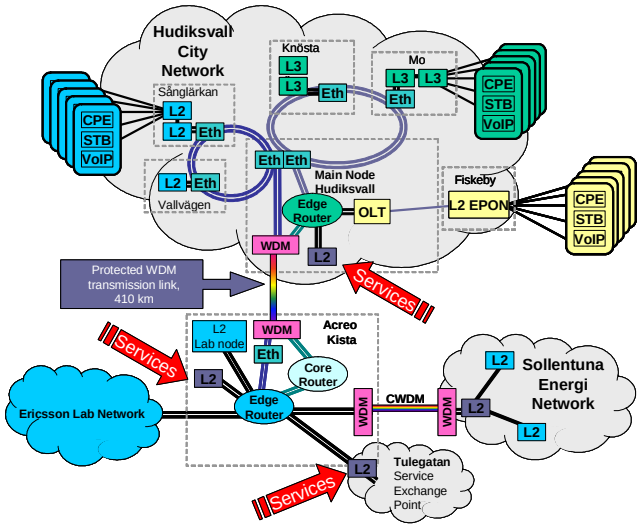

Figure 2: *Schematic illustration of the testbed*

Description of tests

During the tests as much as possible use will be made of the generic test methods and procedures developed within MUSE [3] [4]. Next to these specific tests will be developed dedicated to the MUSE Ethernet forced forwarding solution.

A test plan and planning is available which describes every test in detail, including:

- test objective(s)
- test configuration and environment
- test method
- the expected result(s)

Table 1 gives an overview of the topics of the general and specific tests to be performed.

Connectivity testing
service-binding set-up
filtering
scalability
multicasting
Quality of Service (QoS) testing
network quality: delay, jitter, packet loss
throughput
rate limiting
priority and queuing
Perceived QoS testing
perceived quality of voice
perceived quality of video
perceived quality of browsing, gaming (optional)
Network management testing
self-provisioning portal
accounting function
Security testing
spoofing
network security
authentication
management security

Table 1: *test plan*

Results

In May 2005 the MUSE test and evaluation set-up was successfully installed at TNO. Initial services as IP-TV and Internet access were thereby set-up and verified. A peer-to-peer video stream was also demonstrated via the platform.

In the meantime the broadband Internet connection between Acreo and TNO has also been tested. This test showed that a video stream of several Mbit/s can easily be streamed from Sweden to The Netherlands and visa versa. This Internet connection will be used during the tests and evaluations to test the MUSE Ethernet access systems at both sides simultaneously.

The integrated lab-trials and testbed evaluations will take place during the second half of 2005..Results from these evaluations will be reported at the conference.

Results of the specific tests on perceived quality of services (QoS) will be presented in a dedicated paper [5].

Conclusions

Both the lab-trial and test bed evaluations are integrated parts of the R&D process. We have started the lab-trial evaluation before the final solution is ready. This enables feedback from the evaluations to be used to improve the final solutions and not only used afterwards as verification that the requirements have been fulfilled.

Acknowledgements

This work is partially funded by the European Commission as part of the IST 6th framework integrated project MUSE.

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