MUSE Demonstrator of High-Speed Distributed Access Solutions (Subproject D)

Evolving broadband services put pressure on existing Access infrastructures. Next generation Residential Gateways will manifest an increase in functionality for private networks as well as bandwidth. Intensive data exchange and video traffic will drive the need for high-speed distributed architectures, where content is stored and cached closer to the end user and the aggregation relieved.

Key Features

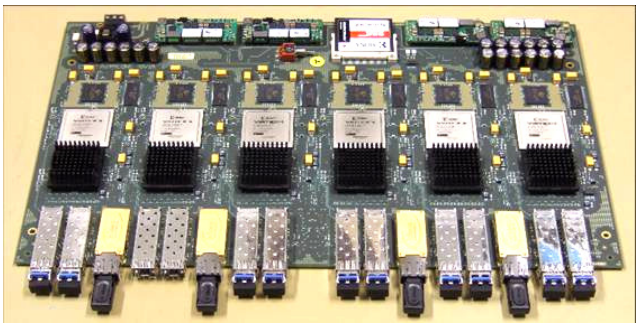
- High-speed Optical Ethernet access, combining the advantages of PON (Passive Optical Network) with those of Point-to-Point systems.
- An Optical Access Multiplexer with minimum footprint and power dissipation in the Central Office, connecting to standard Ethernet ONUs (Optical Network Unit).
- A multi-protocol distributed caching system that keeps the network load to a minimum without the need for providing resources.
- A Residential Gateway implementation for small computer platforms that exhibits the newest features from DSL-Forum (DSL – Digital Subscriber Line) and OSGi (Open Service Gateway initiative) standards.
- Prototypes and systems tested in various trials.

One of the subprojects in MUSE developed solutions that specifically addressed future high speed access networks. An explorative study resulted in the demonstration of alternative optical access mile solutions. A new residential gateway with an enhanced set of functions and operating at high speeds was prototyped. Novel architecture concept with a high level of distribution of functionality were studied and realised in a lab trial.

High Speed Optical Access

High-speed access technologies face two key challenges. First, obviously the investment costs including operational costs have to be acceptable. Especially housing and powering of networks can impose significant OPEX (Operational Expenditures). Secondly, access networks more and more need to accommodate demanding services such as IPTV (Internet Protocol Television) and VoD (Video on Demand). Networks need to address this load, preferably at the network edge if possible. The need for compact Access Multiplexers will remain one of the most important aspects of future access networks.

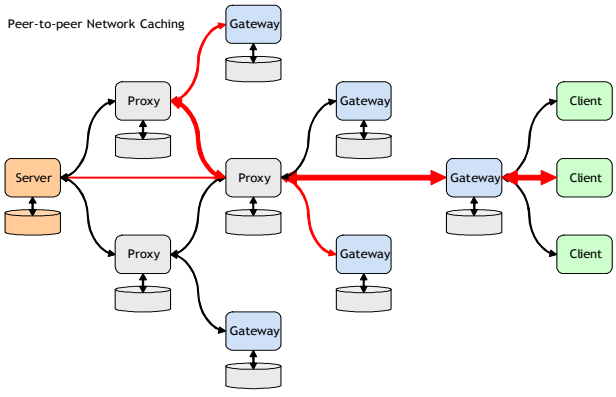
Not only for hybrid nodes, such as the mentioned DSLAM (DSL Access Multiplexer) and Radio Access Points, but also for high-speed fibre access networks the footprint, the power consumption and cost should be kept to a minimum. In the MUSE project, an Optical Access Multiplexer has been developed that meets these objectives by making optimal use of available components and transmission techniques. This Asymmetric PON (AsPON) solution does not require a complex MAC (Medium Access Control) algorithm: Standard Gigabyte Ethernet can be used both in the Access Node (AN) and the CPE (Customer Premises Equipment). Power and footprint can be kept to a minimum by using a single transmitter at the AN, and deploying a Parallel Optical Receiver Array (used in optical backbones).



A 48-port Optical MUX blade

Distributed Caching

High-speed access means high network loads. In order to avoid clogging of edge nodes and aggregation networks, caching is a proven method. A peer-to-peer caching system was devised that operates without the need for investments in server farms or external services.



Peer-to-peer caching.

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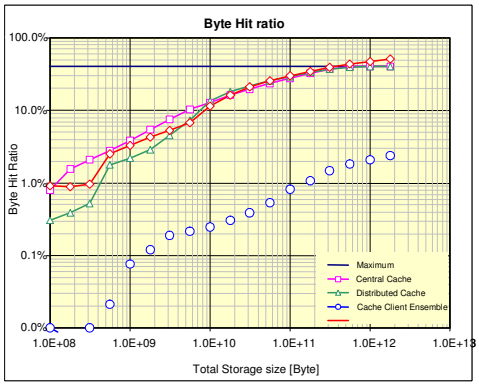
MUSE High-Speed Distributed Access Solutions

In the system, content localization is provided by a hierarchy of Tracking Nodes in the network. By making use of caching resources available in Residential Gateways or Access Points, a multi-Terabyte cache can be constructed that enables fast downloads for the end-user and significant load reductions for the network owner.



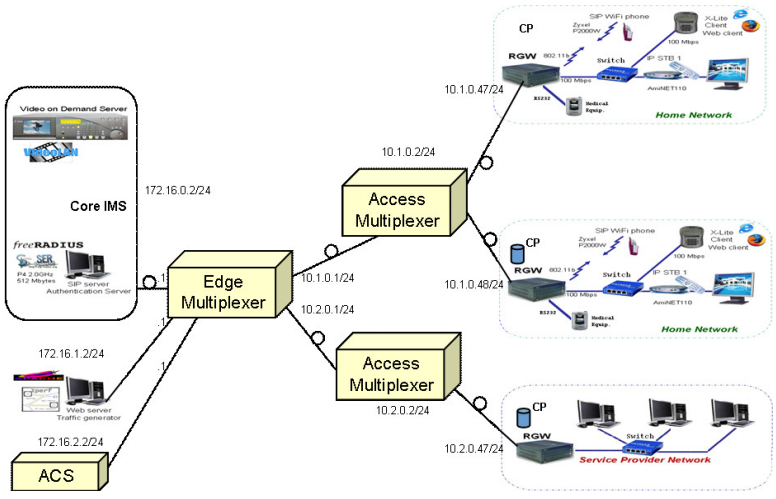
Network load reduction with peer-to-peer caching

The Residential Gateway

The RGW (Residential Gateway) is a key device because it is in between the customer and the access networks and must properly adapt all signalling and data protocols. For example, if the transport network provides a QoS (Quality of Service) mechanism, the RGW must forward that QoS in the downstream direction and provide such kind of mechanism in the upstream direction. This is necessary to provide a real end-to-end QoS for whatever kind of service.A software based prototype has been devised that can run on small processor platforms.

The device has the following features:

- Classification/VLAN (Virtual Local Area Network) tagging, using the 802.1pq specification to tag Ethernet frames in order to create VLANs and provide prioritization per flows.
- Policy/Shaping. Each flow can be configured, either manually or automatically, to reserve a certain amount of bandwidth.
- Dispatcher/Queue System. To accomplish the priority configuration, the RGW has a queue system to store frames that will be extracted by the scheduling block.
- Scheduling. Depending on the algorithm implemented, this block will extract frames from the proper queue at some configured rate (it depends on several parameters as the interface rate, the flow direction, etc.).
- Authentication based on 802.1X
- Hybrid NAT (Network Address Translation) traversal mechanism (ALG + STUN)
- TR-069 based Remote Management and OSGi Bundle Management. The Technical Report TR-069 protocol specifies a number of RPC (Remote Procedure Calls) for both the RGW and ACS (Auto Configuration Server). Via these RPC the ACS can for example manipulate a set of parameters in a MIB (Management Information Base), download files, reboot the device etc. The MIB can be extended by other specifications from the DSL forum, like TR-098 and can be tailored using vendor specific parameters.



Trials and demos

The devices and systems that were developed for the Distributed Access Solutions have been tested in various trials throughout the duration of the MUSE project. A concise demo is presented at the MUSE booth at Broadband Europe 2007. Project representatives will gladly show you around and answer any questions you may have.

MUSE is a European consortium of vendors, operators and universities, active from January 2004-March 2008. The aim is cooperation on research and development of future, low cost, multi-service access networks.

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More information on MUSE and the High-Speed Distributed Access Solutions can be found on the MUSE website

www.ist-muse.eu

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