

WDM-PON Field Trial at Energie AG

K. Grobe¹, S. Pachnicke², M. Roppelt², J.-P. Elbers¹

M. Fellhofer³, P. Neuber⁴, M. Dietrich⁴

{KGrobe, SPachnicke, MRoppelt, JElbers}@ADVAoptical.com

ADVA Optical Networking SE, ¹⁾ Fraunhoferstr. 9a, 82152 Martinsried,

²⁾ Märzenquelle 1-3, 98617 Meiningen

³⁾ Energie AG Oberösterreich Data GmbH, Böhmerwaldstr. 3, 4020 Linz

⁴⁾ ELCON Systemtechnik GmbH, Obere Hauptstr. 10,

09232 Hartmannsdorf

As part of, and funded by, the EU PIANO+ projects *TUCAN* and *IMPACT*, a field trial with a WDM-PON system started in early 2013 in the network of Energie AG Oberösterreich Data GmbH (EAG-D) near Allhaming in Upper Austria. The aim of the PIANO+ projects is the development of components and systems for next-generation ultra-broadband WDM-PON based on low-cost tunable lasers. For further information on these EU projects, please refer to www.pianoplus.eu/{IMPACT,TUCAN}.html.

EAG-D is a subsidiary of Energie AG Oberösterreich, a main utility in Upper Austria, and part of the Energie AG Group. The Energie AG Group acts as an infrastructure company (energy, water and waste management) in Austria and the neighboring CEE countries. EAG-D is a main fiber carrier in Upper Austria and provides connectivity services to public facilities, hospitals, Internet service providers, bank institutions, companies and schools. EAG-D now wants to extend their services to SMEs and residential customers.

The trial is also compliant with the current broadband strategies from state Austria and the federal state Upper Austria. Next steps plan the deployment of the *Breitband LAN* in Upper Austria. Aim is to provide symmetrical access with bandwidths ≥ 100 Mb/s, based on relevant LAN standards (Fast Ethernet, GbE). In this context, the EU plans for 30-Mb/s coverage until 2020 are regarded obsolete, since they are ~25 years behind LAN technology (FE was introduced in 1995). Fiber roll-out close to the customers is seen the only viable way forward. The roll-out should be funded on a per-connection basis for enterprises and residentials, and indirectly via backbone developments.

The field trial is conducted together with ELCON Systemtechnik GmbH and ADVA Optical Networking SE. ELCON Systemtechnik GmbH is a manufacturer of telecommunication products and networking components, with special respect to broadband access in rural and undeveloped areas. This covers copper, fiber and cable-TV infrastructure, and business and high-end residential customers. In the field trial, a CPE enabling full-duplex GbE access with 1 Gb/s is used.

The ELCON CPEs act as Optical Networking Units (ONU). The ONUs have slots (cages) for Small-Formfactor Pluggables (SFPs). In a first test phase, the SFPs contain reflective transmitters which are seeded, from the Optical Line Termination (OLT, i.e., the central-office head-end), with an EDFA noise source. This set-up was chosen to start tests early. In a second test phase, ONUs will be equipped with tunable laser technology. The ONUs communicate, via the shared PON infrastructure, with the OLT which is built by ADVA. The OLT contains a scalable Ethernet aggregation switch (which is also equipped with SFP transceiver slots) and the necessary means to connect to a BRAS and the PSTN. Further relevant system components include the WDM filter for the passive outside-plant. This filter is an athermalized cyclic AWG which can serve all downstream / upstream wavelengths on a single fiber.

The WDM-PON uses shared fiber and OLT infrastructure, and provides dedicated, high, symmetrical per-customer bandwidth on the WDM transmission links. Statistical multiplexing can be provided in a flexible and reconfigurable way, on demand, in the OLT Ethernet aggregation.

The test area in Allhaming was selected because it is served by EAG, still had relatively poor broadband coverage, and is rural, thus enabling a real field trial. Customers have been informed about the context with PIANO+. The trial system is field-deployed in early 2013, connecting 20 live customers.

The trial system has first been lab-tested extensively at ADVA and EAG-D labs. Error-free bidirectional transport of 1 Gb/s has been confirmed. Fiber-link budget is >12 dB. This translates to up to 30 km reach. ONU self-install and management / supervision capabilities have also been confirmed.

Relevant trial goals include the collection of operational experience with respect to WDM-PON, and also with respect to residential access.

Expectations of EAG-D included the compliance with national funding-agency requirements (scalable, high, symmetrical bandwidths), and cost efficiency with regard to both, CapEx and OpEx.

Re-using most parts of the OLT, the CPEs and the complete outside plant, the system will be upgraded to tunable-laser transmitters in the second trial phase. This upgrade enables passive reach up to 60 km and symmetrical data rates up to 10 Gb/s per wavelength, thus supporting future SMEs' needs. As part of this upgrade, autonomous ONU tuning will be shown.