Fully Converged Quintuple-Play Integrated Optical-Wireless Access Architectures

FIVER project proposes a novel integrated access next-generation network architecture for provision of quintuple-play service to the users' premises: wired and wireless Internet, wireless HDTV, home security, and digital TV. The FIVER architecture is completely integrated as the fiber-to-the-home, the in-home optical distribution network and the radio link are part of the same hybrid access network.

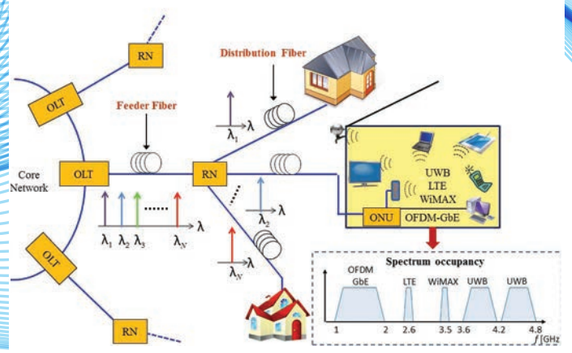

Fig. 1 Schematic diagram of the FIVER network proposed for the quintuple-play service provisioning.

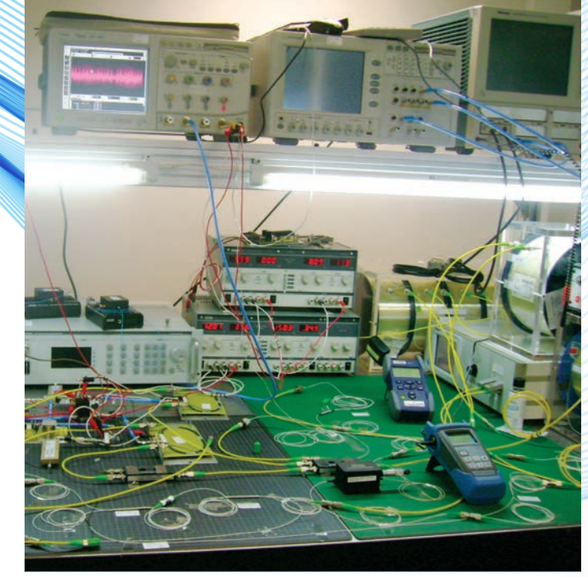

Fig. 2 Laboratory prototype of FIVER network developed by IT team.

Main Project Team

Adolfo Cartaxo	**Nm Av**
Tiago Alves	Nm Av
Filipe Carvalho	Nm Av
José Morgado	Nm Av

Funding Agencies

European Commission	415k€
Start Date	01-01-2012
Ending Date	01-12-2014

Indicators

Journal Papers	10
Conference Papers	12
Concluded PhD Theses	1
Concluded MSc Theses	4

Two Main Publications

Alves, T., Morant, M., Cartaxo, A., and Llorente, R., **"Performance comparison of OFDM-UWB radio signals distribution in long-reach PONs using Mach-Zehnder and linearized modulators,"** IEEE Journal on Selected Areas in Communications, Vol. 29, No. 6, PP. 1311-1320, June, 2011

Alves, T., Morant, M., Cartaxo, A., and Llorente, R., "**Transmission of OFDM wired-wireless quintuple-play services along WDM LR-PONs using centralized broadband impairment compensation,"** Optics Express, Vol. 20, No. 13, PP. 13748-13761, June, 2012.

PROJECT WEBPAGE URL

http://www.ict-fiver.eu

MOTIVATION / OBJECTIVE

In the recent years, a clear advance in the deployment of fibre-to-the-home (FTTH) optical access networks around the word has been experienced. FTTH access is a flexible, future-proof access technology that enables the provision of Gb/s bit-rate per user.

The fully-converged quintuple-play integrated optical-wireless access architectures (FIVER) project aims to extend beyond the advantages of the simple FTTH concept by integrating the optical distribution path with the final short/medium wireless link, into the same, complete end-to-end FTTH network architecture.

The integration of wireless and optical access networks in a single hybrid network has been identified as a powerful solution to address the dramatic demand increase for high data-rate wireless connectivity experienced along the last years. The full integration of the wireless and optical access networks can still be further exploited if the modulation formats of the signals used to transmit the wireless and wired services present similar features.

The FIVER project aimed at developing a novel integrated access next-generation network architecture reaching 100 km of optical fibre (indicated for long-reach passive optical networks, LR-PONs) employing only orthogonal frequency-division multiplexing (OFDM) signals. These OFDM signals are used for provisioning of the quintuple-play service to the users' premises: a custom OFDM-based signal for standard Gigabit Ethernet (GbE) (Internet and phone/voice data), a LTE signal (wireless connectivity), a WiMAX signal (wireless connectivity), two UWB signals (wireless HDTV) and DVB-T signals (digital TV).

CHALLENGES

The proposed FIVER architecture is completely integrated as the optical access FTTH, the in-home optical distribution network and the final radio link become part of the same hybrid access network. This permits a streamlined network architecture avoiding most of the conversion stages and proving cost, space and energy savings. The main challenges of this streamlined network architecture are (i) to ensure the coexistence of the bundle of OFDM signals along the optical fibre infrastructure with negligible inter-signal interference, and (ii) to develop a service-transparent centralized compensation approach enabling the compensation of the optical and radio transmission impairments for all the OFDM signals.

MAIN WORK DESCRIPTION

The contribution of IT to FIVER project was focused in providing adequate and optimized solutions for the photonic and wireless paths of the FIVER network architecture. IT was responsible for the analysis of the linearized electro-optic conversion techniques used in the FIVER architecture, and for the development, analysis and performance assessment of the linearized electro-optical conversion based on directly-modulated lasers. IT team implemented a laboratory network prototype that was used as a proof-of-concept of the photonic developments addressed by the FIVER project. IT team also contributed to the final open house project demonstration. This project demonstrator was helded by the Towercom's partner and allowed the integration of the FIVER network in the Towercom FTTH access network installed in Bratislava, Slovakia.

ACHIEVEMENTS

The optimum power distribution between the multi-format OFDM-based signals transmitted along the LR-PON was identified with the target of maximizing the performance of each OFDM signal. Two technical approaches, namely, linearized external modulation schemes and digital pre-distortion, were proposed as possible solutions for linearization of the electro-optic converters. The channel sounding performed by a set of out-of-band RF-pilots was proposed and demonstrated as a powerful centralized impairment compensation technique in OFDM-based LR-PONs supporting the quintuple-play service. Finally, the provisioning of the quintuple-play service in a multi-user environment served by a 100 km-long LR-PON employing the proposed centralized compensation approach was demonstrated in the laboratory prototype developed by IT.