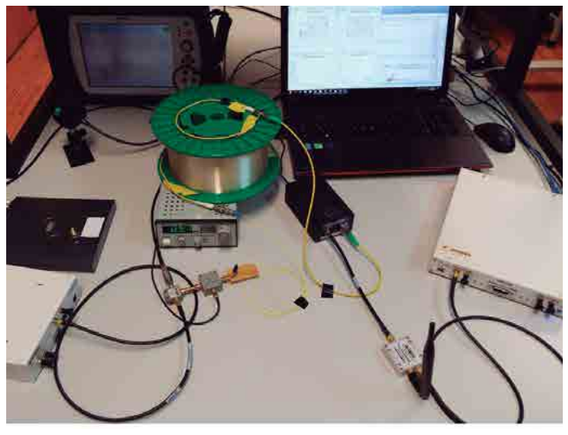
Hydra-RoF

Hybrid Dynamic Radio Access Supported by Radio Over Fiber

The Hydra-RoF project addresses heterogeneous scenarios where femtocells used to increase the capacity and coverage of a mobile operator coexists with an WiFi. Hydra-RoF considers scenarios supported by Distributed Antenna Systems (DAS) using Radio over Fiber (RoF) technology. Integration strategies for the different radio access technologies (RATs) and cooperation strategies are considered.



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Indicators	
Funding	33k €
Conference Papers	7
Book Chapter	1
Concluded MSc	3

Two Main Publications

P. Monteiro and A. Gameiro, "Convergence of Optical and Wireless Technologies for 5G" Book chapter in "Opportunities in 5G Networks: A Research and Development Perspective", CRC Press, ISBN: 9781498739542.

M. C. R. Medeiros, R. Costa, H. A. Silva, P. Laurêncio and P. P. Monteiro, "Cost effective Hybrid Dynamic Radio Access supported by Radio over Fiber," "2015 17th International Conference on Transparent Optical Networks (ICTON)", Budapest, 2015, pp. 1-4. (Invited)

PROJECT WEBPAGE URL

https://www.it.pt/Projects/Index/1942

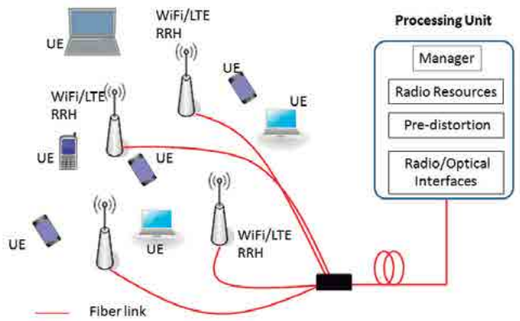

Fig. 1 Hydra-RoF concept.

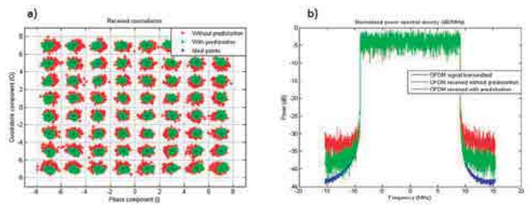

Fig. 2 LTE signal Orthogonal Division Multiplexed (OFDM) signal with 20 MHz bandwidth, 2028 subcarriers modulated with 64 QAM, after transmission over an optical link with and without pre-distortion. a) Constellation diagram showing 3% (EVM-Error Vector Magnitude) improvement with pre-distortion. b) 2048 total subcarriers, where 1201 are used for data transmission using 64QAM and the other 847 are used for guard, and a total bandwidth of 20 MHz. b) Power spectrum showing Adjacent Channel Rejection (ACR) improvement obtained with pre-distortion.

GENERAL MOTIVATION AND OBJECTIVES

The development of optical and wireless communications have taken generally independent paths. Sometimes they are seen as competitors, at least for the access segment of the network. Currently, the trend in broadband optical communications is to bring the fiber to the home (FTTH) or to the curb (FTTC), in what is more generally designated as Fiber-to-the-x (FTTx). The number of fibre to the home (FTTH) and fibre to the building (FTTB) subscribers in Europe increased by 23% over the first nine months of 2016, reaching nearly 44.3 million FTTH/B subscribers. Homes passed increased by 17%, reaching more than 148 million in EU391 at end-September 2016 . The huge investment required to roll-out a fiber-based Next Generation Access (NGA) network has led to some experts arguing that only a single next generation fiber access network to end users will be sustainable from an economic perspective in the future.

The Hydra-RoF project addresses heterogeneous scenarios where a femtocell is used to increase the capacity and coverage of a mobile operator and coexists with an WiFi network. Both, femtocell and WiFi networks, are connected to the operator's network through an IP broadband backhaul fiber connection, and are managed as a single identity. Such centralized heterogeneous scenario is supported by a Distributed Antenna System (DAS) using Radio over Fiber (RoF) technology as illustrated in Fig.1. When LTE and WiFi network coexist, both networks can take profit of their complementary characteristics, by using appropriate traffic offload strategies they can offer better quality services to their clients.

The Remote Radio Units (RRUs) are connected to an intelligent head-end node, Processing Unity located at a single point by means of a fiber network using RoF technology. Thanks to RoF technology, all electronic equipment and radio processing devices are centralized at the Processing Unity, thus leaving the architecture of the RRUs as simple as possible. The centralization at the PU enables a reduction of the maintenance cost and provides a centralized control of the network.

The Hydra-RoF architecture employs low cost optical components combined with digital pre-distortion and compensation techniques.

[1] The EU 39 includes Andorra, Austria, Belarus, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Latvia, Lithuania, Luxembourg, Malta, Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and United Kingdom.

CHALLENGE

To provide high performance and low cost integration strategies for the different radio access technologies (RATs) and based on these integration strategies develop efficient cooperation mechanisms between mobile and WiFi networks..

WORK DESCRIPTION AND ACHIEVEMENTS

Demonstration of centrally managed architectures employing low cost optical components combined with digital pre-distortion techniques.

- Implementation of digital pre-distortion and compensation techniques in commercially available software defined platforms.

- Demonstration of efficient link using low cost and low power consumption commercially available vertical-cavity surface-emitting laser (VCSEL) diodes emitting at 1550 nm directly modulated with WiFi and LTE signals.

- We have demonstrated, that extra propagation delays introduced by fiber links in a distributed WiFi network supported by RoF can be efficiently managed by the TCP transport protocol. For WiFi extended up 10 kilometers, throughput experienced by the wireless users is not significantly affected by distance. Therefore, fairness is achieved with this solution for a distributed network.