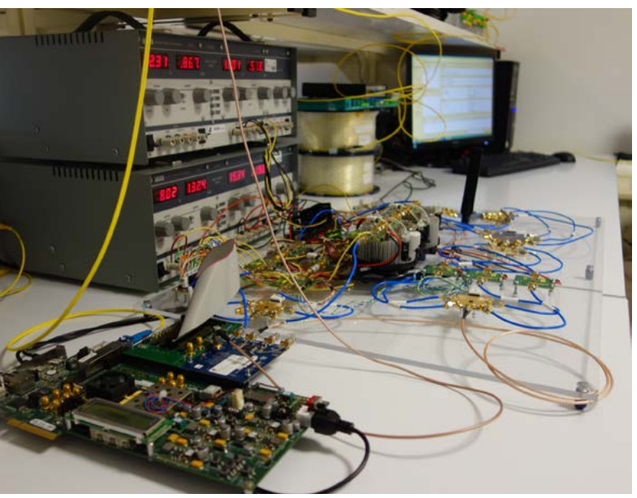
Next Generation Cloud Radio Access Networks

Flexicell was the first project that successfully demonstrated a Cloud Radio Access Network (C-RAN) for fourth and fifth generation (4G/5G) mobile eras, with a 25 km fronthaul implemented over a GPON infrastructure, to connect the software defined distributed radio heads (antennas) with the central digital processing unit. The demonstrator shows the interoperability with commercial user mobile terminals and applications and includes low latency and resource efficient digital radio compression modules to double the fronthaul traffic capacity.



PROJECT WEBPAGE URL
https://www.it.pt/Projects/Index/2112

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Funding Agencies

ANI (QREN)	**225,000€**

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Indicators

Conference Papers	6
Concluded MSc	2

Two Main Publications

G. Anjos, D. Riscado, J. Santos, A. S. R. Oliveira, P. Monteiro, N. V. Silva, P. Jesus, **Implementation and Evaluation of a Low Latency and Resource Efficient Compression Method for Digital Radio Transport of OFDM Signals**, 4th International Workshop on Emerging Technologies for 5G Wireless Cellular Networks - IEEE GLOBECOM 2015, San Diego, CA, USA, December, 2015

P. Monteiro, S. Julião, R. B. Nunes, D. Viana, P. Jesus, N. Silva, A. S. R. Oliveira, **High Spectral Efficient and Flexible Multicarrier D-RoF Modem using up to 1024-QAM Modulation Format,** ECOC 2015 – 41st European Conference on Optical Communication, Valencia, September, 2015

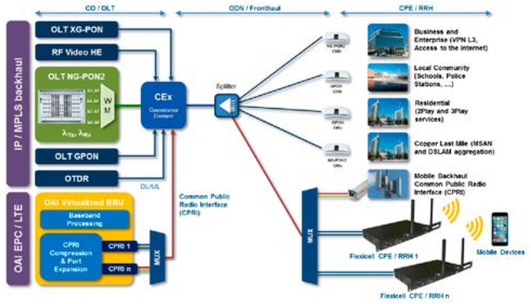

Fig. 1 Deployment scenario of the Flexicell project in the scope of Radio Access Network converged with a Passive Optical Network infrastructure.

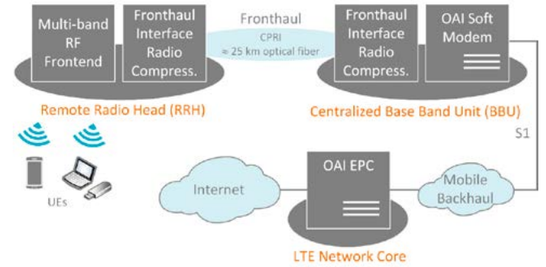

Fig. 2 Architecture of the Flexicell lab. demonstrator, including the interoperability and connectivity with user terminals.

GENERAL MOTIVATION AND OBJECTIVES

The convergence of fixed transport networks, based on high-speed optical infrastructures and broadband spectrally efficient wireless components has been identified as a key enabler of future access networks. The next generation of wireless systems (5G) should fulfil several goals, among which: provision of true broadband wireless access and enhanced system capacity, when compared with current third (3G) and fourth (4G) generation networks.

A traditional cellular network is built with many stand-alone base stations (BSs), each one covering a cell and processing and transmitting its own signal to and from the mobile terminals. The issues regarding the growing complexity of BSs, the need for cooling, the increasing number of BSs for improved coverage and the difficulties in the acquisition of sites has led to some rethinking of the cellular concept, whose main trends are currently converging to Cloud Radio Access Network (C-RAN). C-RAN has been defined in several different ways, but essentially designates a network architecture where several distributed Remote Radio Heads (RRHs) with reduced complexity are linked to a central or Base Band Unit (BBU) at which joint radio signal processing is performed. The connection between the RRHs and the BBU is established through a high capacity network link, named fronthaul, typically supported by an optical infrastructure. The ideas of distributed base stations were successfully demonstrated for the first time in a European FP7 project technical lead by Instituto de Telecomunicações / Universidade de Aveiro (IT/UA).

CHALLENGE

Besides the C-RAN advantages, further network optimizations can be promoted with the efficient use of existing metro and access networks to support the mobile backhaul and fronthaul network segments. The Flexicell project faced the challenge of joining the concepts of small cell, Cloud RAN, Software Defined Radio and infrastructure sharing in an integrated and unified architecture of a complete 4G/5G mobile network.

WORK DESCRIPTION AND ACHIEVEMENTS

In the scope of the Flexicell project, a complete C-RAN testbed for next generation mobile networks was developed and successfully demonstrated with a 25 km length fronthaul. The most important aspects of the Flexicell project, shown in Figure 1, are:

- Utilization of Passive Optical Networks (PONs) as the physical infrastructure for the fronthaul, in coexistence with triple-play services (voice, video, and data), avoiding dedicated and expensive links and simplifying the deployment of small cells for improved coverage and spectral efficiency.
- Compression of the fronthaul traffic data between the BBU and the RRH to increase almost 50% of fronthaul traffic capacity in PON systems with negligible performance degradation.
- Upgradability to future PON technologies (e.g. NG-PON2) that will support larger fronthaul bandwidths for next generation mobile networks with wider channels and bit rates.
- Adoption of software defined radio approaches from the BBU to the RRH, leading to an access infrastructure that is agnostic and upgradable to future network standards.
- Baseband processing and core network virtualization for more flexible deployment, management and upgradability, as well as improved load balancing at BBU nodes for better energy and resource efficiency.
- Interoperability of the developed mobile network infrastructure with commercial mobile terminals (e.g. smartphones and 4G modems/dongles) allowing the communication with any equipment or terminal connected to the same network or anywhere in the internet, for demonstrating real end user applications (e.g. mobile internet access, voice and video calls) and evaluate overall system performance and introduce optimizations.

The Flexicell project was developed in the framework of a collaborative research of IT-Aveiro/UA and Altice Labs.