OBANET (Optically Beam-formed Antennas for adaptive broadband fixed and mobile wireless access NETworks)

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Action line: IST 2000 - IV.5.2
Clusters: Adaptive Antennas

Main Objectives
OBANET project aims at studying, proposing, implementing and evaluating specific coverage area management strategies as well as their associated technologies for performance optimisation in broadband adaptive broadband wireless access networks in two scenarios: fixed and mobile broadband radio accesses in the 40 GHz band. Employing such frequency band make unfeasible DSP-based electronic beamformers (e.g. as employed in smart antennas for 3G mobile communications). Photonic beam-formed base-station antennas for broadband fixed and mobile wireless access networks are proposed in OBANET project. Optically beamformed base station antennas capabilities to address dynamically changes in the network features and resources (e.g. coverage areas and spectrum sharing in the sectored area) in order to overcome the service unavailability arising from man-made (e.g. provisional obstacles intercepting the radio link) and natural impairments (e.g. intensive rainfalls in some parts of the service areas) will be demonstrated. Coverage area management strategies and control/monitoring protocols for fixed and mobile radio accesses will be developed. High-performance optoelectronic devices and photonic integrated circuits composing the optical beamformers will be developed, using dense wavelength division multiplexing (DWDM) and photonic integrated circuit (PIC) technologies.

Technical approach
Three main technical aspects are addressed by OBANET project:

- SYSTEM ASPECTS: the specification of the overall network concept using optically beamformed base station antennas will be carried out. Coverage area management strategies and control/monitoring protocols for fixed and mobile radio accesses (to overcome natural and man-made performance degradation mechanisms, to optimise the spectrum sharing among cells in the service area, to optimise the network capacity by readily managing the coverage areas in different phases of network deployment, multiple access based on base station antenna beam division, etc) will be developed and a software evaluation platform will be implemented.

- TECHNOLOGY ASPECTS: a photonic integrated beamformer (PIB) for fixed and mobile access project scenarios will be developed, including high-performance packaging technologies and optoelectronic subsystems.

- EVALUATION PLATFORMS: two evaluation platforms will be built up. Discrete Beamformer (DB): using commercial-of-the-shelf technology. Different beamformer architectures for single and multiple antenna beams will be evaluated and resulting key parameters of application to the PIB fabrication will be derived. Photonic Integrated Beamformer (PIB): management strategies for the fixed and mobile access scenarios and specific application-oriented performance will be evaluated on the PIB prototype over the 40 GHz platform.

Key Issues
- Demonstration of a broadband wireless access network using optically beam-formed antennas,
incorporating adaptation capabilities to existing networks.

- Development of coverage area management protocols and algorithms. These protocols and algorithms can be of generic application to systems requiring distributed QoS management.
- Application of DWDM-techniques to beam forming networks
- Application of advanced Photonic Integration technology, as it is being developed for telecommunication applications, to RF beam forming networks.
- Merging of the both above-mentioned technologies: DWDM and Photonic Integrated Circuits.
- Improvement of RF optoelectronic interfaces between MMIC and optical discrete components to optimise the performance of optoelectronic devices for microwave applications.

Expected Impact

- Fixed and mobile operators will be able to provide more reliable services to customers by using base-station adaptation capabilities. The use of optical beam-forming techniques to provide telecom-market-oriented services will push the emergence of novel commercial applications of OBF networks. In addition, the combination of DWDM technologies, already employed in modern communication networks and photonic integrated circuits, will significantly reduce the production cost, which provides a scale advantage.

Expected Impact

OBANET project points to the major challenge of integrating photonic technologies with wireless technologies. OBANET will provide a significantly impact and push forward the research and development on several areas:

- **Optical beamforming.** By the demonstration of optically beamformed antennas operation in broadband fixed and mobile wireless access networks we will show that this technology is suitable to be implemented in real deployed networks for both scenarios with potential increase in performance, due to the special features of Photonic Technologies. Traditionally worldwide research and development on optical beamforming was conducted by military institutions. OBANET is moving the technological benefits of optical beamforming to the commercial field applications.

- **RF optoelectronic interfaces** The coupling efficiency between electrical and optical subsystems combined to form an optoelectronic device is of special importance in the case of analogue applications that require more stringent coupling conditions than the digital ones. A highly efficient technique will be studied in OBANET that will allow for the development of low-cost, high-density and highly-integrated mm-wave modules and its application to the interconnection of InP based optical components will be shown for the first time.

- **Photonic Integrated Circuits** Photonic Integrated Beamformers (PIB) are going to be developed in OBANET project using a combination of different advanced techniques: Photonic Integrated Circuits on InP that use circuits (switches, lasers, …) developed for mass-market DWDM applications (thus reducing the cost of the beamformer) and advanced interconnection techniques in order to increase the coupling efficiency. It is expected to make a significant advance in the efficient interfacing of PICs.

- **Wireless access networks management**: the coverage area management strategies and monitoring protocols defined in OBANET could be of application to advanced fixed and mobile wireless access networks. In addition, the OBANET partners are open to contribute to standardisation bodies dealing with issues related with the project, and therefore the expertise gained during the realisation of the project could also be reflected in those standardisation activities.

List of participants

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