Energy Efficient E-band Transceiver for the Backhaul of Future Networks

The energy-efficient and high-capacity microwave transceiver developed by E3Network will help to provide high-speed broadband access to everybody.

Main Objectives

Broadband and high-speed broadband access has a significant and positive impact on economic growth and employment growth. Therefore, in the Digital Agenda for Europe 2020, high-speed broadband is considered a crucial infrastructure for the 21st century by the European Commission. However, the backhauling infrastructure, which is responsible for connecting the core network to the small subnetworks at the edge of the entire hierarchical network, is becoming a bottleneck in the development of the network that will enable high-speed broadband access for everybody.

E3Network will design an energy-efficient and high-capacity transceiver for the backhaul infrastructure of future networks. It will work in the E-band, which enables highly focused “pencil beam” transmissions and huge bandwidth. The pencil-beam property facilitates a high degree of frequency reuse in the deployment of backhaul links and reduces European citizens’ exposure to electromagnetic fields. The transceiver will use modern digital multi-level modulations to achieve high spectral efficiency. This, together with the huge allocated bandwidth, will make capacities above 10 Gbps possible in these microwave links. The RF analogue front-end of the transceiver will be a highly integrated circuit using advanced SiGe BiCMOS technology, which enables energy and cost effectiveness.

Research will be driven by the end-user and industrial partners to ensure that it addresses the needs of future generations of mobile network infrastructure.

The resulting backhaul technology will strengthen the position of European industry in the field of network infrastructure technology. It will facilitate the transition to smaller and more energy efficient base stations, which are key for the novel network topologies needed in the future network infrastructures.
Technical Approach

E3Network is structured in 7 workpackages, two which are dedicated to project management and dissemination, standardisation and exploitation. The technical workpackages are:

WP1 (System Design Specification) studies the requirements for building an E-band transceiver for the future network.

WP2 (E-Band RF/Analogue Front-End Design) will develop the E-Band RF/Analogue Front-End. In this work package, an integrated circuit (IC) that fulfils the specifications generated in WP1 will be produced.

WP3 (Digital Base-band Design) will develop the digital base-band processor of the E3Network transceiver. A prototype that will follow the specifications produced in WP1 will be built within this workpackage.

WP4 (Transceiver System Integration and Validation) will be responsible for the integration of the IC generated in WP2, the digital base-band processor implemented in WP3, an antenna and a connector to the network.

WP5 (Network Integration and System Validation) will be responsible for testing the E3Network transceiver produced in WP4 within the network infrastructure.

Key Issues

E3Network will design and implement a high capacity E-band transceiver prototype. The figure shows a diagram of the E-band transceiver that E3Network will develop and how it fits into the future network's infrastructure. The transceiver prototype developed within the project (labelled E3Network transceiver in the figure) will consist of an antenna, a duplexer (DUP) to separate transmitted and received signals, a radio frequency/analogue front-end (RFAFE), a high performance digital base-band processor (DBBP) and a network interface (NETINT) able to provide a connection to standard network equipment.

- This transceiver will employ digital multi-level modulation methods. The use of these modulation techniques will enable higher spectral efficiency, which will provide the required backhaul capacity of future networks. The project will explore the different digital modulations using a mixed analogue-digital approach to balance the requirements for both the analogue RF front-end and the digital base-band processor.

- The RF/analogue front-end of the transceiver will be a highly integrated solution using SiGe BiCMOS technology. Such a highly integrated solution will enable better optimization of the transceiver in terms of performance, power consumption and cost. Furthermore, this integration will simplify the assembly process and improve the reliability of the resulting transceiver.

Expected Impact

The results of E3Network will have an impact on the landscape of mobile network infrastructures. The E-band transceiver will provide network operators with a backhauling technology that can meet the performance requirements of future generations of the European high-speed broadband and mobile network infrastructure.

The backhauling technology resulting from E3Network is optimum from the point of view of capital and operational expenditure. The proposed technology minimizes the civil work needed to provide backhaul to new cell sites. This will facilitate its deployment, allowing an increase in cell density in order to match the growing network traffic.

The microwave transceiver developed at E3Network will be a cost-effective, highly-integrated solution, which will translate into reduced power consumption. Additionally, the availability of the backhauling technology developed at E3Network will facilitate the transition to centralized base-band processing, resulting in smaller and more energy efficient base-stations. Therefore, E3Network will contribute to an increased economic and energy efficiency of access/transport infrastructures.

The results of E3Network will provide the European industries of the consortium with a new disruptive technology for network infrastructures. E3Network will offer new market opportunities for European industry in promising areas, strengthening Europe’s position in high capacity point-to-point microwave radio links.