Cluster for Application and Technology Research in Europe on NanoElectronics

PROJECT RESULTS

CA116

How reduced interference and concurrent communication streams are set to benefit and drive the Internet of Things, gateway devices and mobile networks [CORTIF]

CORTIF ensures that radio spectrum can be used by multiple, concurrent applications without detrimental mutual interference and resulting performance degradation. Finding such a solution is significant when you consider some seven trillion wireless devices will be deployed by 2020. This project will benefit three key domains: professional mobile (with 5G networks); Internet of Things (less interference) and gateways (set-top boxes running multiple communications without interference). Crucially, this project also improved such metrics as throughput, radio frequency standardisation and power consumption.

Coexisting wireless networks suffer significant mutual interference with associated performance degradation. This interference takes the form of time and frequency collisions and becomes a critical problem in achieving reliable wireless communication. Furthermore, interference sources can also be found inside equipment. As end-users become increasingly familiar with mobile devices and heavy bandwidth applications, the available spectrum is becoming cluttered. In addition, coexistence of mobile services on adjacent bands is necessary to extend existing services. However, bandwidth-allocation cannot be guaranteed for extended wireless systems in the SIM bands; while there is pressure for higher data-rates and even greater reliability. In addition, there is the need to support billions of sensor devices which require ultra-low-power radio connections.

Ensuring concurrent use of radio spectrum without mutual interference

The CORTIF project's key response was to address the problem with multiple, concurrent applications operating in the radio spectrum without any detrimental mutual interference. This was applicable, both at the application level (same location), and technology level (same printed board). Project members were assigned tasks based on experience and expertise. Application experts (in mobile and set-top boxes) defined the system requirements and constraints; semiconductor suppliers developed the technical approaches; and integrators created and demonstrated working proof-of-concept level solutions highlighting the achievable improvement considering metrics such as throughput, radio frequency (RF) standardisation and power consumption.

The project delivered these key components:

- An ultra-selective active filter designed to enable the coexistence of a 2.5GHz EMEA LTE system. Proof of concept for a sub-GHz application was conducted and then ported on 40nm for 2.4 GHz operation;
- An anti-interference spectrum-sensing platform algorithm and software-defined radio (SDR) techniques;
- Design of an architecture based on a ↗Σ receiver. This architecture is highly flexible and covers a wide range (up to 6 GHz with a 65 nm CMOS technology);
- A hardware combiner prototype of integrated circuit techniques to remove interference in the analogue domain, considering radio impairment, like delay spread, phase shift and attenuation path;
- A wideband receiver with amplitude-domain filtering based on a nonlinear transfer function;
- The design and production of an antenna that operates in the 3G and 4G spectrum for home devices.

Simulation platforms were also developed and successfully validated for:

- Resource management strategies, such as power usage, bandwidth, and radiation;
- Using game theory for interference avoidance in a Bluetooth low-energy system;
- Coexistence between DVB-T2-Lite and LTE;
- Coexistence between LTE and LAN;
- Coexistence between Wi-Fi and Bluetooth low-energy;
- Digital cancellation of the professional mobile coexistence system, aimed at removing baseband interference in the narrowband received signal;
- Far-field radiation simulation environment for automotive integrated circuit products;
- Simulation models, coexistence methodology and measurements for RF physical layers (DVB-T/T2, LTE-U, WLAN 802.11bgn, ZigBee, Bluetooth);
- Modelling interference between sender/ receiver pairs.

Other project achievements include:

- A compact gateway which enables concurrent wireless systems, including 3G/4G networks and 802.11ac radios;
- Reliable communication for ISM 2.4 GHz for low-power, wireless devices in the healthcare domain;
- The development of a substrate extraction to handle wafer-flow (for EMC), and noise-coupling analysis (in automotive integrated-circuit applications).

Successful European collaboration

A good working environment produced effective project co-operation, creating trust among intellectual-property suppliers, integrated-circuit manufacturers and application owners. This was helpful in approaching coexistence techniques from different angles, but it also created a better understanding of coexistence constraints. In addition to its technical achievements, CORTIF also generated nine patents and 40 publications.

The impact of the work done by CORTIF is multifaceted and its goals cannot be met just though individual national research programmes, or projects developed by a single company. The scope of the project makes pan-European collaboration and the participation of 14 key European players from industry, research and academia in critical areas of CORTIF indispensable.

Impacting Europe and benefiting project partners

The three domains addressed by CORTIF will benefit from:

- Interference reduction between IoT devices;
- Set-top box capacity to run several wireless communications simultaneously in the same room with limited interference;
- Optimised spectrum usage for 5G emergence.

Expectations are also high for CORTIF's own industrial project partners, especially with:

- New IoT multi-standard devices expected to make a breakthrough;
- A new airline private mobile-radio secured against LTE-based broadband systems;
- A Bluetooth low-energy communication interface immune from the ISM band;
- Electronic design automation (EDA) tools expected to be deployed worldwide;
- A set-top box which supports seven concurrent wireless signals;
- A flexible radio test and characterization platform (FRaTaC), which optimises RF designs for operation in a busier RF spectrum;

Project achievements also had a wider impact, such as improving data-transfer reliability and signal range, which in turn strengthened European manufacturers' position in their market, and accelerated the business ramp-up of new wireless products. Furthermore, by supporting the coexistence of wireless communications through IoT, set-top boxes, TV tuners and professional mobile-radio (markets in which Europe leads), CORTIF consolidated Europe's position in these and other new wireless-service markets.

In addition, by proposing appropriate technical solutions for the coexistence of RF-spectrum sharing, European standardisation bodies will be more flexible in ruling on frequency allocations. It is also important to recognise Europe's competitive advantage: the complete development platform combining network control and drivers (as part of home automation) with increased security. Of course, CORTIF's coexistence techniques offer Europe a crucial advantage, especially over American semiconductor suppliers, its key competitors.

Looming on the horizon

However, there is more work on the horizon following CORTIF's achievements: wireless-communication coexistence will soon face new challenges for higher frequencies. With the emergence of 5G, for example, there will be the need to address coexistence in the millimetre wave bands, and between 5G communication and RF sensors in a confined space, such as in vehicles and airplanes.

PROJECT CONTRIBUTES TO

- Communication
- Energy efficiency
- Digital lifestyle
- Design technology

PARTNERS

BUT - Brno University of Technology
Airbus Defence and Space Systems
GS LDA
IMA - Institut mikroelektronickych aplikaci
IMEC
IMT - Institut Mines-Telecom
UPC - Universitat Politecnica de Catalun
IT - Instituto de Telecomunicações
NXP France
NXP Netherlands
Technicolor
Technolution
TUE - Technical University Eindhoven
XLIM

COUNTRIES INVOLVED

- France
- Portugal
- Czech Republic
- The Netherlands
- Spain

PROJECT LEADER

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KEY PROJECT DATES

01 July 2014 - 30 June 2017

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