PROJECT PROFILE

# 2A103: Multiple input multiple output technologies for wireless access (MIMOWA)

**HIGH SPEED COMMUNICATIONS NETWORKS**

**Partners:**

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AWE Communications
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Runcom
STMicroelectronics
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**Project leader:**

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**Key project dates:**

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**Countries involved:**

Belgium
Germany
Israel
Spain
Turkey

**The MEDEA+ 2A103 MIMOWA project aims to simulate, implement and validate multiple input multiple output (MIMO) building blocks for different wireless interfaces in mobile and fixed applications. The focus will be on 3G, WiMAX and WiFi. These MIMO blocks will enable the European wireless semiconductor industry together with the infrastructure as well as the test and measurement industries to direct standardisation and roll out new wireless MIMO-enabled schemes. In the longer term, it will support sharing of MIMO building blocks, fostering integration, convergence and reuse for different standards. MIMOWA will enhance European knowledge of MIMO systems and strengthen global leadership in this key area.**

Consumers are increasingly choosing wireless networks on the basis of flexibility and mobility. They ask for advanced services such as mobile Internet, mobile TV, on-line gaming and video surveillance. Conventional network infrastructures do not guarantee the range and throughput that users require. Market forecasts show a gap between private hotspots with high data rates and carrier-owned public outdoor broadband wireless access systems with relatively long range but low data rates.

Future mobile multimedia applications in particular will require much higher data rates than today but the capacity of current wireless communications systems is by no means adequate. The multiple input multiple output (MIMO) approach is seen as a key technology for achieving the required data rates for the next generation of high speed WiFi, fixed and mobile WiMAX and 3G long term evolution (LTE) air interfaces.

So far, the benefits of MIMO have mainly been demonstrated in scientific studies and have not yet been developed in commercial applications. The main objective of the MEDEA+ 2A103 MIMOWA project is to overcome this gap.

MIMOWA aims to simulate, implement, validate and evaluate MIMO building blocks in terms of intellectual property (IP), silicon and field-programmable gate array content for use in a wide range of wireless interfaces. It will perform state-of-the-art analysis of MIMO benefits and describe design challenges. Other expected benefits include a reduction in development costs for networks and chips, lower cost for users, enriched academic knowledge and workforce skills as well as improved competitiveness.

## Reuse of blocks

The objective is to specify systems that can be implemented effectively with low complexity and best possible performance. Such systems have to be fully supported by the vast majority of mobile terminals. Reuse of MIMO building blocks across standards will lead to a significant decrease in development costs.

The MIMO gain has only been shown in the physical layer to date. However, this gain must be transferred to systems level. The objective of MIMOWA is the design of integrated physical layer/media access control

solutions. This will lead to adaptive systems which can switch between different operating modes, such as diversity and spatial multiplexing in a closed-loop MIMO system.

Furthermore, the MEDEA+ project will help advance the state of the art on MIMO multi-user communications by incorporating as much expertise as possible in point-to-point transmission. Spatial diversity has to be integrated with frequency, time and code diversity to enable proper dynamic resource allocation – key to advanced standards such as 'last mile' WiMAX wireless broadband. In the long term, full integration would enable evolving concepts of cognitive scheduling, which means flexible resource allocation adapted at any time to the conditions allowing for fully integrated quality of service.

## Overcoming rich scattering

MIMOWA will help with the design of appropriate techniques for the so-called rich-scattering environments characterised by severe interference, cell overlap and difficult call handover. Possible solutions in this area include sophisticated distributed aerial systems and multi-hop relaying.

Statistical channel models for 3G LTE, WiMAX and WiFi systems will be derived depending on the envisaged frequency bands, deployment scenarios and MIMO parameters – for instance, aerial numbers and spacing at transmitter and receiver – by using a highly accurate 3D ray-optical wave propagation model together with vector building data for urban and indoor environments. The impact of the MIMO channel on component complexity will be investigated by linking simulations with new advanced MIMO measurement techniques.

Advanced aerial technologies will be developed, such as small and highly efficient MIMO antennas for communications terminals or multi-layer cross-polarised micro-strips for low cost MIMO antennas in WiMAX applications.

## Facing up to competition

There is already considerable global competition in this area. However, MIMOWA is intended to enable chipmakers and both infrastructure and equipment manufacturers in Europe to develop a strong European base.

For example, in the WiFi arena, forecasts indicates an average annual growth rate in shipments of IEEE 802.11 products should be around 35% from 2005 to 2009. In the 3G LTE arena, universal mobile telecommunications system (UMTS) unit deliveries have gained significant speed. Although the first releases of the standard are not yet fully deployed, enhancements for packet services such as high-speed downlink packet access (HSDPA) and high-speed uplink packet access (HSUPA) are already being rolled out.

A forecast of the handset volume per release shows that expectations of true wireless Internet access will fuel these developments. Enhancements leading to even higher data rates are currently under discussion in 3GPP. However LTE is a revolution rather than just an evolution. It will be an orthogonal frequency-division multiplexing (OFDM)-based system solution.

From a terminal chipmaker point of view, support of this new system and others already existing will be a real challenge. The shift to OFDM offers a chance for Europe, since the main competitors in code-division multiple access (CDMA) have enhanced their expertise through a number of recent acquisitions.

## Meeting future needs

The wireless industry is constantly being asked to develop solutions that provide the required network capacity and throughput to close this gap. MIMO has already demonstrated its ability to enhance spectral efficiency and is expected to offer the largest return on investment among those future technologies currently under discussion. For that reason, MIMO will become a prevalent feature of wireless infrastructures across all air interfaces currently under consideration and across all geographic regions.

Several air interfaces are already being standardised. In addition to a potential convergence at air-interface level with OFDM or CDMA families, there is one common component across the various new and future air-interface candidates – use of MIMO technology. This makes MIMO one of the hot topics in the research community across Europe, the USA and Asia.

Adoption of multiple-aerial techniques in future wireless systems will ensure more efficient use of the spectrum, cut the cost of establishing new wireless networks, enhance the quality of service, and enable the realisation of reconfigurable, robust and transparent operation across multi-technology wireless networks. MIMOWA supports European efforts in the development of the components, knowledge and systems necessary, speeding future development of commercial products, and boosting European competitiveness and employment.

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