

## Editorial

Dear reader,

The OMEGA project is officially closing at the end of March 2011. In the past three years, OMEGA has achieved remarkable results which promise to change home networking as we know it, for example via the standardisation of Inter-MAC. Another important result have been the technological advances in the area of smart wireless optics, which are explained in the article by Joachim Walewski and Dominic O'Brien on the occasion of the final demonstration in Rennes.

At the 3<sup>rd</sup> OMEGA Open Event in Rennes in February the project consortium demonstrated some major results and discussed with peers how to move on and exploit the OMEGA results beyond the lifetime of the project. The article by Adam Kapovits summarises some of the highlights of the project's final event.

I hope the information presented in this issue is of interest to you, and I would appreciate your feedback.

Milon Gupta, editor

## Project results & activities

### Smart wireless optics

At the final OMEGA Open Event in February 2011, the project presented its work on optical wireless indoor-communications to the public. The presentation encompassed a poster exhibition, guided tours of the final infrared- and visible-light-communication demonstrator, and the showing of a video about the aforementioned demonstrators in the innovation gardens of the host, Orange Labs.

### High-speed infrared demonstrator

One of the highlights of the event was the demonstration of a high-speed infrared (IRC) communications system. The system provides communications up to a range of 10 m at 280 Mbit/s between a base station and two user terminals. One terminal was used for video conferencing, showing bi-directional communications, and a 3D TV stream was sent to the other user terminal for display on a TV.

This is perhaps the most complete demonstration of an infrared system, involving work by the Universities of Oxford and Ilmenau, and industrial partners France Telecom and Apside. All elements of the system were designed and built by the partners as part of the OMEGA project.



*IRC base station (in centre of picture just below ceiling) communicating with terminal (above TV) for videoconferencing.*

### Visible-light-communication demonstrator

The visible-light-communication (VLC) demonstrator consists in essence of 16 high-power LED lamps that are mounted into the ceiling of the Orange-Labs show room. Four HD videos are continuously broadcasted by all the lamps. This is accomplished by aggregating the output of four video players into an Ethernet stream, and by modulating this data stream onto the electrical driving current fed to the LED lamps.



*Visible-light-communication: high-power LED lamps transmitting data, explained by Joachim Walewski from Siemens.*

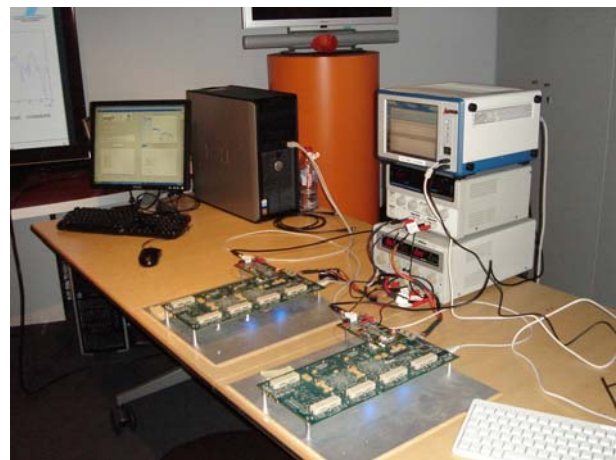
The line rate of the packet transmission is about 100 Mb/s, while the net data rate at the transport layer is about 80 Mb/s. The modulation rate of the LED is so high that the light outputted by the lamps appears quiescent to the rather slow human visual perception. This demonstrator was built from scratch, i.e. none of the system components, analogue and digital PHY nor MAC, did exist before the project commenced in January 2008.

Partners contributing to the technical work on wireless optics included, in alphabetical order, Apside, France Telecom, the Heinrich-Hertz Institute, Siemens AG, the University of Athens, the University of Illmenau, and the University of Oxford.

Joachim W. Walewski, Siemens AG, and  
Dominic O'Brien, University of Oxford

### Power Line Communication demonstrator

The Power Line Communication demonstrator was aimed to show high-rate communication up to 1 Gbps. It consisted of 2 FPGA based platforms (transceiver and receiver), a channel emulator reproducing real multipath power-line channels, and software pre- and post-processing to generate signals as well as display performance results.



*PLC demonstrator at OMEGA Open Event*

This demonstrator used an enlarged frequency band of 0 -100 MHz and an OFDM modulation with 4096 carriers, compared to 0-28 frequency range and 917 carriers for HomePlug AV standard based products. It fulfilled transmit power requirements and frequency notching capabilities as defined by EMC (electromagnetic compatibility) regulations.

This PLC demonstrator was designed with an industrial approach, being backward compatible with the HomePlug AV/IEEE 1901 standard, selecting analog components and developing signal processing algorithms that can be carried into future PLC chipset products.

Partners involved in OMEGA's PLC work included IETR, Orange Labs, SPiDCOM Technologies, Thyia and University of Udine.

Xavier Mongaboure, SPiDCOM Technologies

## Past events

### Final OMEGA Open Event in Rennes

The third and final OMEGA Open Event in Rennes, France, presented from 23rd to 24th February 2011 leading-edge technologies which will shape the future of home networking. About 100 international experts witnessed the final public demonstration of OMEGA's solutions, which will enable data transmission speeds up to one gigabit per second and the integration of heterogeneous communication technologies in the home.

The 3rd Open Event provided an outlook on the evolution of home networking technologies and made the participants familiar with OMEGA's concepts and technology solutions. In Rennes OMEGA demonstrated its main final results, and participants had the opportunity to get first-hand information about OMEGA's home networking solutions. The Open Event covered the following main topics: connectivity at home, including Radio, Power Line Communication (PLC) and Wireless Optics, as well as the Inter-MAC solution of OMEGA that facilitates the convergence.



*Professor Rüdiger Kays (left) from the University of Dortmund and Martial Bellec, technical manager of OMEGA from Orange Labs.*

## Demonstrations

The programme was very much focused on demonstrations and interaction with the audience. OMEGA ran two demonstrations – one showing the power of the proposed Inter-MAC solution through the seamless interoperation of various technologies (Power Line Communication, radio and wireless optics) and one having a specific focus on Wireless Optics.



*Xavier Mongaboure from Spidcom (right) explaining to interested participants OMEGA's results on power-line communications.*

The Inter-MAC demonstrator showed, how the Inter-MAC layer enables different use-case scenarios for home networking at gigabit speed. These scenarios included, among others, handover using the best available link, e.g. in case of accidentally broken links, as well as an increase of network capacity and reduced congestion. Radio handovers were also demonstrated using a laptop implementing the inter-MAC software developed in the project. Furthermore, OMEGA demonstrated a "follow-me" scenario among two TV sets, using the Inter-MAC layer and UPnP-based session mobility.



*Cyril Bezard from Technicolor explaining and demonstrating the operation of the Inter-MAC.*

OMEGA demonstrated two wireless optics solutions – one based, on infrared and one based on visible-light communication. The infrared demonstrator enables full-duplex communication at 256 Mbit/s in the entire living room, while the visible-light demonstrator enables a 100 Mbit/s broadcast via the ceiling lights – but also through appropriately equipped reading lights – in part of the living room. These demonstrators implemented the full OSI protocol stack, enabling the transmission of live video over wireless optics links.

The audience was able to experience important aspects, such as non-interference between the infrared, the visible-light, as well as radio-based demonstrators, seamless handover when moving a terminal from the area lit by the ceiling light to the proximity of the reading light. The fidelity of both technologies was demonstrated for home-centred use cases, broadcasting high-definition videos in parallel via the ceiling lighting and the infrared demonstrator.

The power-line communication (PLC) demonstrator aimed to show high-bitrate communication up to one Gbps in a PLC environment. The demonstrator emulated the PLC channel model as it was defined in OMEGA, including a PLC channel transfer function and several additive noises in the 0-100 MHz band.



*Audience attending a demonstration at the OrangeLabs showroom in Rennes.*

### Plenary sessions

The demonstrations were complemented with interactive plenary sessions. On the first day, OMEGA coordinator Jean-Philippe Javaudin from Orange Labs started with an overview of the project, before OMEGA's technical manager, Martial Bellec, also from Orange Labs, moderated a panel session on OMEGA's challenges and achievements. Topics discussed in the panel session included business aspects of home networking, radio technologies, power-line communication, wireless optics, and Inter-MAC. The panel participants were representatives of major industry players and research organisations from the OMEGA consortium.



*Panel discussion on the challenges and achievements of OMEGA (from left): Pierre Jaffré (Orange Labs), Vincenzo Suraci (University of Rome), Joachim Walewski (Siemens), Oliver Hoffmann (University of Dortmund), Dimitris Katsianis (University of Athens), Andrea Tonello (University of Udine)*

On the second day, Rolf Krämer from IHP moderated a panel session on next steps for Inter-MAC, in which the status and perspectives of Inter-MAC were discussed. Prof. Krämer first presented the inter-MAC implementation as shown in the demonstrations. This was followed by a presentation by Paul Houze, chairman of IEEE P1905.1 from Orange Labs, on the Inter-MAC standardisation in

IEEE P1905.1. In the ensuing panel session the participants, again representatives of major industry players and research organisations from the OMEGA consortium, discussed how the inter-MAC could be exploited by industry in the home networking eco-system.

### Tutorials

The programme was rounded off by two tutorials. In the first tutorial, Isabelle Siaud from Orange Labs talked about how to manage multiple radio interfaces in a point to point transmission. In the second tutorial, Stefan Nowak from the University of Dortmund explained the Inter-MAC layer and protocols in details.

Adam Kapovits, Eurescom

### About OMEGA

OMEGA is an Integrating Project in the ICT area funded by the European Commission under the Seventh Research Framework Programme (FP7). The project is running for 39 months from January 2008 to March 2011.

OMEGA has developed a user-friendly home area network capable of delivering high-bandwidth services and content at a transmission speed of one Gigabit per second. The interdisciplinary project consortium consists of 21 European partners from industry and academia.



The screenshot shows the OMEGA website homepage. At the top, there is a navigation bar with links for Home, About us, Publications, News, Events, and Contact. Below the navigation bar, the main content area is divided into three columns. The left column features a 'Home' section with a photo of a woman speaking at a podium and a caption 'Pictures from the 2nd OMEGA Open Event in Rennes, 2010'. The middle column contains the 'OMEGA' section, which includes a welcome message and a diagram of a home network. The diagram shows a 'Home Gateway' connected to a 'Mesh Radio' in the 'Office' and 'Lounge' areas, and a 'Bridge' in the 'Bedroom'. A legend indicates that 'ADSL - Asym Digital Subscri', 'FTTH - Fiber', and 'RL - Radio'. The right column contains an 'Events' section with a link to the '3rd OMEGA Open Event 2011' and a 'NEWS' section with links to 'OMEGA News - September 2010' and 'OMEGA News - March 2010'.