

Editorial

Dear reader,

After 33 months of research work, OMEGA is now starting to reap the fruits, meaning: presenting tangible demonstrations of the home networking technologies the project has explored.

In previous issues, we already covered the Inter-MAC convergence layer as one of the main results. However, this is by far not the only remarkable result, OMEGA has produced.

Another important achievement on the way towards tomorrow's powerful and convenient home networks are the results on carrier-grade wireless local area networks, which Oliver Hofmann and Peter Caldera describe in their article.

At the ICT Event in Brussels, OMEGA successfully presented its results to an interested audience. See the short report in this issue.

Milon Gupta, editor

Project results & activities

OMEGA provides carrier-grade WLAN

Originally designed for data communication and networking, the applications for wireless local area networks (WLANs) are becoming more and more diverse. They have found their way into a lot of different environments, e.g. homes, enterprises, small offices, outdoor facilities, campuses, hospitals, cars, large vehicles and factories. New application fields include wireless content presentation on displays, distribution of HDTV, networking in the office, rapid sync-and-go file transfer, wireless mesh backhaul, telepresence, manufacturing floor automation, and cordless computing.

With the broader application field, the quality of service (QoS) requirements are becoming more diverse and more challenging. Demanding requirements are, for example, quasi error-free transmission and the support of a large range of data rates – from several kb/s up to several Gb/s.

The maximum packet loss rate has to be as small as 10^{-8} for transmission of uncompressed video. The maximum delay has to be as small as 10 ms for interactive gaming.

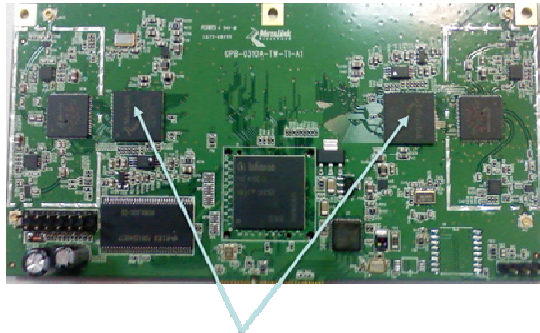
In order to prevail in the future market, WLAN systems have to:

- work reliably and enable high-quality audio/video streaming,
- be able to handle multicast IPTV streams,
- be easy to install and maintain,
- provide large coverage range, and
- be low cost and energy efficient.

OMEGA's WLAN demonstrator was made especially to exceed market expectations. Thanks to the fruitful research work within OMEGA, Lantiq – a leading supplier of broadband access and home networking technologies – was able to prototype a WLAN demonstrator which outperforms its competitors and lets OMEGA's vision of carrier-grade WLAN come true.

Fully compliant with IEEE 802.11n, OMEGA's WLAN demonstrator comprises a 3x3 MIMO system-on-chip (SoC) concurrently operating in the 2.4 GHz and 5 GHz bands. Supporting a maximum PHY data rate of 300 Mb/s per frequency band, a maximum TCP throughput of 175 Mb/s in single-band operation and up to 270 Mb/s in dual-band concurrent operation is achieved using Lantiq's GRX288 processor. The prototype is fully compliant with IEEE Std. 802.11n 2009 and passed Wi-Fi certification. Its main features leading to best-in-class results comprise:

- Transmit Beamforming (TxBF)
- Maximum likelihood decoder (MLD)
- Low density parity check (LDPC) codes
- Smart antenna selection
- Cognitive, content-aware rate and channel adaptation



2.4 GHz and 5 GHz

Fig. 1: OMEGA's WLAN demonstrator

With the help of Lantiq's TxBF algorithm, the signal-to-noise ratio (SNR) at the receiver can be increased by 3-6 dB. The TxBF technology is capable of intelligently providing ultra-high data rates directly to end user devices, regardless of whether the device is "beamforming ready" or not and without the need of calibration of the other station. Using the Lantiq beamforming technology helps manufacturers literally eliminate dead wireless spots for users at home.

By means of a MLD, the SNR at the receiver can be increased by 3-5 dB. The complexity of an exhaustive search over all possible symbols is very high and grows exponentially with the number of spatial streams and the constellation size. However, Lantiq's algorithm minimizes this complexity without compromising performance or delay.

In the field of forward error correction, LDPC codes prevail, due to their superior bit error rate performance at manageable complexity. In fact, LDPC codes can approach the Shannon limit to an arbitrary extent, depending on the block length. The use of LDPC codes in OMEGA's WLAN demonstrator can improve the receiver SNR up to 3 dB.

For video transmission without block errors, Lantiq has implemented a cognitive, content-aware rate and channel switching algorithm. Thus, it is possible to automatically change the channel without link drop or packet loss. This algorithm helps to quickly respond to channel degradation.

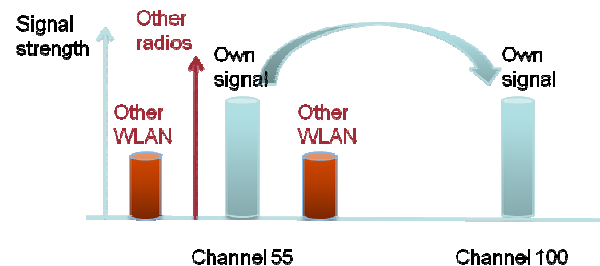


Fig. 2: Optimum channel selection: Automatic channel switching without link drop or packet loss

These advanced technologies and algorithms yield **a total SNR gain of about 8-10 dB**. Thus, the prototype has been demonstrated to deliver up to 300 % increased coverage range compared to existing 2x2 solutions with linear detectors, while maintaining links with a minimum or even zero packet error rate requirement.

The prototype also significantly enhances the streaming of HDTV via WLAN. Compared to existing solutions where only best effort streaming is available, the Lantiq solution enables a full wireless IP HDTV experience. This results in sustainable bit rates and elimination of pixel errors, allowing multiple simultaneous HD streams without packet loss. On reference systems, Lantiq demonstrated the transmission of four HD streams with 20 Mb/s simultaneously with maximum reach.

Furthermore, Lantiq's architecture intelligently off-loads the main processor by executing all real-time and processor-intensive operations on the "Thick MAC." Thus, the main processor load is reduced by a factor of 2. This results in higher throughput and more free performance on the SoC for other applications and services as well as superior energy and cost efficiency.

In a next step, the WLAN demonstrator will be integrated into the overall OMEGA platform. The whole system will be demonstrated at the 3rd OMEGA Open Event in February 2011.

Peter Caldera, Lantiq Austria
Oliver Hoffmann, Dortmund Univ. of Technology

Past events

MobiLight 2010

Barcelona, Spain, 10 – 12 May 2010

From 10 to 12 May 2010, the 2nd International ICST conference on mobile lightweight wireless systems took place in Barcelona, Spain. The technical programme included 12 technical symposia, 2 panels and 2 tutorials. Together with a comprehensive list of plenary talks, the conference attracted more than 150 attendees.

OMEGA partners organized a special session dedicated to advanced wireless technologies for a converged ultra-broadband home network. In this session, three papers from OMEGA partners and one external paper were presented.

Furthermore, OMEGA organized a tutorial on radio communications as external training seminar. This tutorial gave an insight into radio communications by building a bridge between the fundamentals and the recent advancements. After introducing the basics of transmission techniques and channel coding, the advances in WLAN standards were summarized. After an overview on principles of simulation and evaluation the tutorial closed with a presentation on recent and future developments of WiMedia.

[Conference website](#)

Oliver Hoffmann, Dortmund Univ. of Technology

Future Network & Mobile Summit 2010

Florence, Italy, 16 – 18 June 2010

The Future Networks and Mobile Summit is the new name of the ICT Mobile Summit, which was organised by the European Commission from 16 to 18 June 2010. In the context of convergence, this 19th edition addressed the challenges of building the Future Internet, based on mobile, wireless and fixed broadband communications infrastructures. The conference was chaired by Dr Roberto

Saracco, Director of the Future Centre of Telecom Italia. The OMEGA project contributed to the conference through paper presentations as well as a demonstration stand.



The OMEGA demonstration stand at the Summit

At the booth, videos of the demonstrations made at the 2nd OMEGA Open Event in February 2010 were presented. Additionally, a flash animation presented the user viewpoint and network behaviour of OMEGA networks. A software based demonstration also showed the possibility to make "greener" home networks by selecting the appropriate radio technology. The presence of numerous participants at the Summit was an opportunity for OMEGA to disseminate its technical achievements to a large audience.

[Conference website](#)

Jean-Philippe Javaudin, Orange Labs

OMEGA at the ICT Event

Brussels, 27 – 29 September 2010



At the ICT Event in Brussels, OMEGA demonstrated its results on convergent home networks, particularly its results on the inter-MAC convergence layer, to an interested audience.

OMEGA had set up an exhibition stand including a live demonstrator, which showed how a software implementation of inter-MAC enables seamless handover between different networks in the home, using the example of a high-definition video.



For more details see the description of the OMEGA stand on the [ICT Event website](#).

Upcoming events

OMEGA session at PIMRC in Istanbul

Wednesday, 29 September 2010, 11:00 - 12:30

At the 21st Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2010) in Istanbul, Turkey, OMEGA will hold a special session on Home Networks.

The session will be chaired by Ralf Jennen from RWTH Aachen University, Germany. In the session, OMEGA will present a paper on "Initial Techno-economic Results for OMEGA Home Gigabit Networks"

See the [PIMRC programme](#) for more details.

3rd OMEGA Open Event

Rennes, France, 23 – 24 February 2011

The 3rd Open Event will present the state-of-the-art on home networking technologies and make the participants familiar with OMEGA's concepts and technological solutions. At the event, OMEGA will demonstrate some of its final results.

The programme and registration will be available on the [Open Event page](#) in November.

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 three years from January 2008 to December 2010.

OMEGA will develop 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 20 European partners from industry and academia.