Home Gigabit Access

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SEVENTH FRAMEWORK PROGRAMME

Project scope

The OMEGA project has worked on defining a global standard for ultra-broadband home area networks. The new standard consists of a unified home network, which hides the heterogeneity of wired and wireless connections from the end user. Applications can benefit from the capabilities of all the combined technologies constituting the home network. Moreover, the OMEGA home network reaches transmission speeds of one gigabit per second (1 Gb/s) not only over robust Ethernet links, but also over power-line communications and wireless connections. Thus, OMEGA will enable home area networks to become as easy to use as electricity from the socket, putting an end to the coverage limitations as well as the wiring clutter in the home.

With OMEGA's gigabit home network, users can get easy access to high-bandwidth information and communication services such as telepresence, 3D gaming, enhanced interactivity, virtual reality, high-definition video, as well as e-health applications and services for the exchange of user-generated business or multimedia content.

Background

Home networks at gigabit speed are a pivotal technology for realising the EU's vision of the Future Internet. The demand for gigabit home networks is driven by emerging Future-Internet services running over new high-speed optical access networks and the rapidly growing number of communicating devices in the home.

Current home networks suffer from the fact that many devices are limited to gross transmission rates of 54 megabit per second, or require troublesome wiring to achieve higher rates. Thus, current home networks are at risk of becoming a bottleneck, when fed by high-speed optical access networks, which offer 100 megabit per second or more, both down- and upstream.

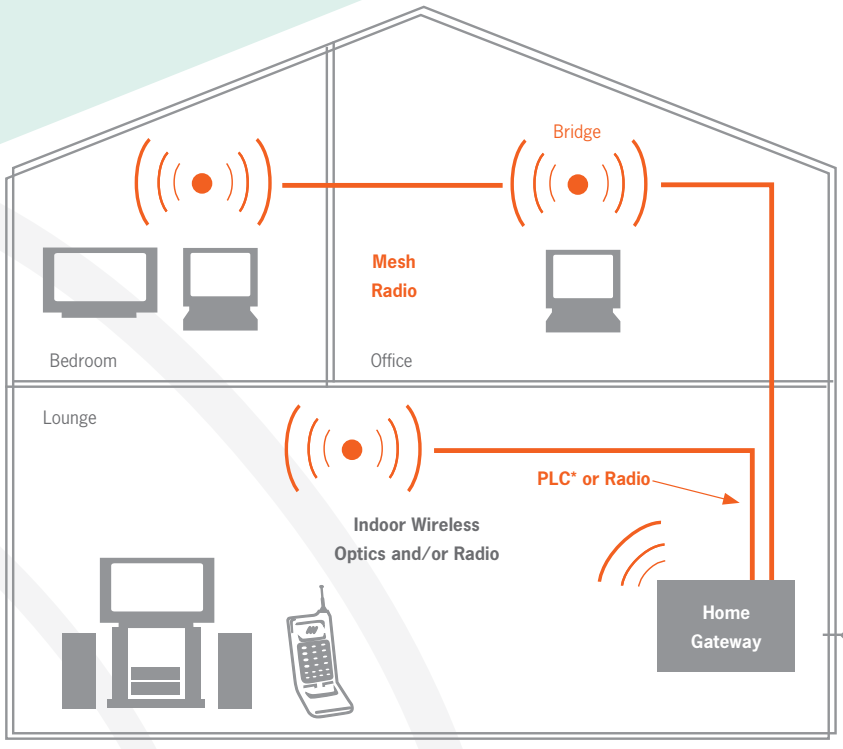
The Future Internet will offer extremely high bandwidth in core and access networks. Home-area networks play a key role in realising the benefits of this high bandwidth and making it tangible for the users by providing critical access to this infrastructure for end devices within the home. Extending access into the home and to individual devices is the only way to ensure the success of the Future Internet.

Future home area networks must enrich the lives of users, for example by enabling telepresence and interactive experiences through entertainment services. Furthermore, home networks should also support citizens in maintaining their independence as they age, for example by offering remote healthcare and by allowing them to communicate with their family to reduce any sense of isolation they may have. In short, users must have the ability to control their virtual as well as their physical environment via home networks.

Users will require such networks to be simple to install, without any new wiring, and easy enough to use so that information services running on the home-area network will be just another utility, like electricity, water, and gas.

The OMEGA project is centred on the needs of the user: gigabit radio frequency and optical links, combined with more robust local-area radio-frequency and visible-light communications provide wireless connectivity within the home and its surroundings. Combined with power-line communications, this provides a communications backbone in the home without the need for new wires.

A technology-independent MAC layer controls this network and provides services as well as connectivity to any number of devices the user wishes to connect in the home network in any room of a house or apartment. Furthermore, this so-called inter-MAC layer allows the service to follow the user from device to device.



ADSL – Asymmetric Digital Subscriber Line

FTTH – Fiber To The Home

RLL – Radio in the Local Loop

* Power-Line Communications

Technical approach

The goal of OMEGA was to build a transparent and seamless home network reaching a transmission speed of one Gb/s. Three main technologies that require no new wires in the home were being investigated and optimised, in order to provide coverage in all rooms.

Convergence and transparency

The OMEGA project pioneered a new method of convergence at the MAC layer called inter-MAC. This method was implemented and demonstrated in the project. It consists of a 2.5 OSI layer able to hide the heterogeneity of communication technologies, like, e.g., Wi-Fi and power line, which constitute the home network. The inter-MAC layer is capable of forming a unified network as well as integrating its heterogeneous wired and wireless links. Functions such as quality-of-service control, load sharing, and dynamic path selection are made possible in such unified networks. The performance and potential impact of an inter-MAC-enabled network were evaluated, showing positive results.

Continuity from the access network

Access-network continuity plays a key role in order to make services reach all devices in the home. In this context, OMEGA explored novel methods for managing the interconnection of the home area network (HAN) with various existing networks, as well as new approaches for achieving interoperability between different media renderers and proposed services.

Radio communications

Current and future services and contents in home networks put diverse demands on the underlying transmission technology. For reasons of efficiency, implementation effort and energy consumption, using one single technology to fulfil all the requirements to the desired extent is not expedient. In order to avoid inefficient and cumbersome solutions with coexistence problems, as experienced today, OMEGA integrated various appropriate radio devices into a converged heterogeneous radio network, which meets the customer's demands with respect to quality of service, reliability, throughput, ubiquity, and self-configuration. In addition to the crucial aspect of convergence at the radio layer, advanced PHY, MAC, and cross-layer mechanisms have been developed.

Moreover, a multi-Gb/s 60 GHz radio demonstrator and an enhanced implementation of Wi-Fi IEEE 802.11n have been developed in the OMEGA project.

Power-line communications

OMEGA investigated the increase of the current baseband bandwidth for power-line communications up to 100 MHz. Studying electromagnetic compatibility in this enlarged spectrum aided in inferring spectrally efficient modulation schemes, based on a multi-carrier approach, that best fit this wider communication bandwidth. As a consequence, this provides a foundation for new wide-bandwidth power-line communication transceivers that substantially increase the data rates available, as well as home coverage for consumer applications. An improved HomePlug AV demonstrator has been implemented in the project, and the feasibility of a a data rate of 1 Gb/s has been proven using advanced signal processing.

Optical wireless communications

The OMEGA project made substantial progress regarding optical wireless communications, both for infra-red (IR) and visible-light communication (VLC) systems, and did a proof of concept evaluation. A bidirectional IR demonstrator reaching a maximum of 1.25 Gbps was implemented as well as a wide room coverage with an area demonstration for up to 300 Mbps. In addition, a 100 Mbps video broadcast based on visible LED (VLC) on ceiling lighting was achieved. Moreover, a new MAC layer was developed for both IR and VLC.

Project impact

Advanced home-network standards

The OMEGA project has provided significant contributions to standardisation and will continue to contribute to standards especially in the fields of convergence layer, radio, power line, and wireless optics communications. The aim is to advance standards to a level that allows the seamless interconnection of all home devices within a gigabit home network.

New business opportunities

OMEGA demonstrated a proof-of-concept ultra-broadband home area network on the scale of one apartment and evaluated roll-out scenarios based on actual services. The remarkable capabilities of such a network will open up new business opportunities in the entire value chain, from manufacturers to network operators, service and content providers, up to the end users. The results of the project will enable the development of new advanced integrated services in the home.

Better inclusion of all citizens

Currently, home networks provide only benefits to ICT-savvy users, and even their benefits are still limited. The adoption of OMEGA's results will change this, giving all citizens, independently of their technical knowledge, the opportunity to access advanced information and communication services at home that will enrich their lives at gigabit speed. This will be particularly relevant for the growing number of elderly people, who will get easy access to services like, for instance, telemedicine and telepresence.

Partners

Orange Labs, France Telecom, France (Coordinator)

University of Roma, Italy

INSA-IETR, France

IHP Microelectronics, Germany

Lantiq, Germany

Thyia, Slovenia

Technicolor, France

ComNets, RWTH Aachen, Germany

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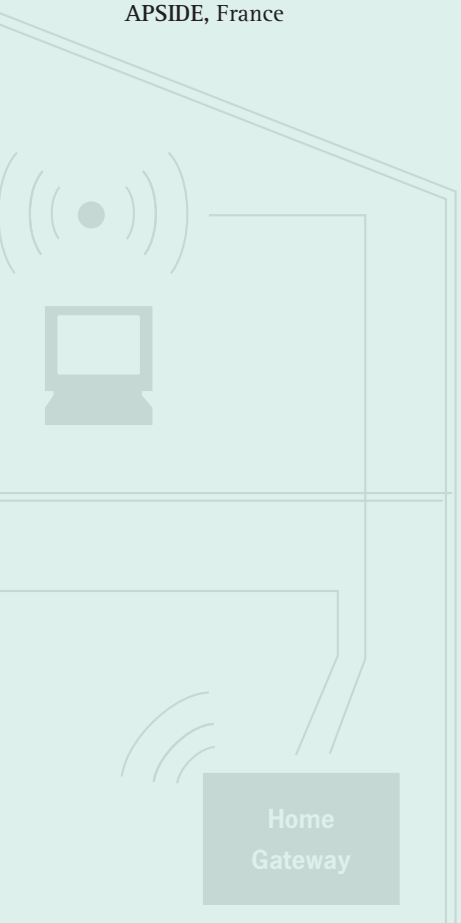

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About Omega

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's goal has been to 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 21 European partners from industry and academia.

Omega – Home Gigabit Access
Integrating Project, FP7-ICT
Project number: 213311
Start date: 1 January 2008
Duration: 39 months
Website: www.ict-omega.eu

Acknowledgement
OMEGA has received funding from the European Community's Seventh Research Framework Programme (FP7) under grant agreement number ICT-213311, which is reflected by the use of the European Community's FP7 logo in this flyer. The European Community has no responsibility for the content of this flyer.