PROJECT RESULT

Integrated information/ communication/ entertainment terminals

MEDEA+

A203: Integrated modem for digital terrestrial TV (IM4DTTV)

Interactive TV is the digital future

Interactive digital terrestrial television will offer all households a user-friendly and inexpensive route to participation in the Information Society. As terrestrial off-air UHF/VHF is the dominant mode of television delivery in Europe, rather than cable or satellite, there is a need to ensure interactivity through this medium. The consortium in the MEDEA+ A203 IM4DTTV project has designed and tested a cost-effective integrated wireless modem that is not only capable of meeting this requirement, but is also equally applicable to future generations of mobile phones and other portable devices.

Historically, television has been a one-way flow of information and entertainment from the broadcaster to the viewers. It has become the dominant mass medium in most countries and has played a major role in shaping civil society. Analogue terrestrial VHF/UHF television has long predominated as the means of providing a low cost and widely available service to both urban and rural communities in developed countries.

Now, the TV industry is actively pursuing a transition from analogue to digital broadcasting to deliver enhanced signal quality and while using less transmission bandwidth. The changeover will permit the introduction of an appealing range of interactive services — such as information feedback, Internet access, e-commerce, e-learning and polling — that currently require the use of a phone-connected personal computer (PC) or set-top box.

Universal access

While more than 98% of households in the majority of industrialised countries have at least one TV set, at most only 65 to 70% will own and operate a PC. For the remaining households, PCs are seen as too complex or irrelevant to their needs. The availability of interactive services via TV at little or no added cost could provide the motivation for large-scale migration to the digital medium. It is thus an ideal means of bringing near-universal access to the Information Society.

For this to be possible, the terrestrial TV system must incorporate a return channel with high bandwidth and high reliability. Existing return paths based on wired or wireless telephony are unsuitable for reasons of cost, inconvenience of connection, interruption of voice communications and inability to cope with mass access. Real time tele-voting, for example, requires the gathering, processing and display of the results of millions of votes in a few seconds. Neither public service nor GSM networks can handle such volumes. The partners in the MEDEA+ A203 IM4DTTV project set out to solve the problem by developing a low-cost modem integrated in the TV for wireless return transmission. This is based on digital video broadcasting (DVB) norms evolving in Europe since the mid 1990s.

Strong European position

The European DVB group represents more than 200 companies. It has established a family of digital TV standards for terrestrial (DVB-T), cable (DVB-C), satellite (DVB-S) and microwave multipoint distribution system (DVB-MMDS) broadcasting. While the starting point was existing synchronous frequency division multiple access (SFDMA) technology, the group also embraced orthogonal frequency division

multiple access (OFDMA) to accommodate both small cell/high bit rate and larger cell/lower bit rate applications.

Almost all direct broadcast satellite (DBS) systems worldwide now use the DVB standard. DVB-T is also well on the way to becoming a *de facto* world standard. The DVB-RCT specification for a terrestrial return channel standard was drafted as part of this process.

DVB-RCT is not only a physical layer for interactive DVB-T but also the foundation of an asymmetric interactive system. The performance depends heavily on the quality of management performed by the software layers and executed by the medium access control (MAC) interface incorporated in the chip itself. A key asset is the ability to provide a flexible upstream channel bandwidth from a few tenths of kbit/s to several Mbit/s by reusing the UHF/VHF network infrastructure and spectrum for normal downstream DTV. The specific objectives of the MEDEA+ project were to test and validate DVB-RCT with a hardware platform covering equipment for both the user terminal and broadcast sides, and to evaluate the complexity of implementation.

Ready for the future

Digital terrestrial receivers are built around a radio frequency (RF) tuner and a digital demodulator. CMOS process evolution makes it possible to embed all the functions required to demodulate the intermediate frequency (IF) signal into a single chip, which then treats the baseband signal. Using this technology, very low cost demodulators can be built – but at the outset, no silicon solutions were available for the RF section.

By the close of the 42-month IM4DTTV project, a design for the baseband upstream core of the modem had been realised ready for silicon integration, although demonstration of the final prototype was only possible in the form of a field programmable gate array (FPGA) test rig. The RF stage of the user terminal was also designed and actually diffused on silicon using HCMOS-9 technology. Completing the set of silicon-ready cores was an RF/baseband integrated downstream system on chip (SoC) and external duplexer. These elements were assembled into a demonstrator platform comprising a set-top box with the relevant MAC plus RCT modulator, together with a complete base station capable of implementing all functions of the RCT demodulator. The combination was extensively tested by the partners, and ultimately demonstrated in September 2004 with a presentation of tele-voting on a music programme.

Although the roll-out of digital TV has been slower than first anticipated, IM4DTTV has successfully produced silicon-ready designs and prototype software ready for its introduction. In addition, the consortium has created a set of comments and change recommendations that will help to consolidate DVB-RCT as the standard for tomorrow's interactive broadcasting. Furthermore, the applied OFDMA technology is likely to prove a strong candidate in alternative systems, such as wireless metropolitan area network (MAN, IEEE 802.16) and fourth generation mobile phones.

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MEDEA+ focuses on enabling technologies for the Information Society and aims to make Europe a leader in system innovation on silicon for the e-economy.