PROJECT RESULT

High speed communications systems

MEDEA+

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AI06: Integrated Network Copper Access (INCA)

Building a powerful European presence in the global DSL market

Faster access to Internet makes it possible to provide many new services, and brings new markets that in turn drive up the demand for high-speed access. Broadband connections are increasingly provided using high-speed digital subscriber line (DSL) technology, which exploits the existing public switched telephone network. The market is strong, with over 32 million ADSL subscribers worldwide. The MEDEA+ A106 INCA project has developed new physical layer components and systems for advanced DSL systems, and generic reusable systems and chipsets for ADSL, as well as contributing to the VDSL standard.

Asymmetric digital subscriber line (ADSL) and very high bit-rate DSL (VDSL) fall within the generic technology of xDSL, which provides digital connections over existing copper local loop telephone connections between exchange and customer premises. ADSL provides domestic broadband Internet connections, enabling downloads to customers' homes at up to 2 Mb/s. VDSL can provide connections up to 52 Mb/s over short distances, and proportionately lower rates as the distance between exchange and customer premises increases.

Strong argument for DSL

There is a strong economic argument for xDSL. A huge investment has been made over many decades to build the copper-based local loop access network; xDSL provides the means of exploiting this resource for the delivery of innovative digital services.

However, copper wires are prone to interference and losses; using them for high-speed data transfer poses a significant engineering challenge. The MEDEA+ A106 INCA project developed and integrated high performance ADSL and VDSL systems, based on advanced digital signal processing, system-on-chip (SoC) methodologies and silicon technologies.

There has been much debate about VDSL standardisation, with a choice between discrete multi-tone (DMT) and single carrier modulation (SCM). DMT has long been supported by the VDSL Alliance, representing over 40 telecom and semiconductor companies, and including members from the INCA consortium. In May 2003, VDSL Olympics tested both solutions; DMT came out ahead. As a consequence, both the ANSI/T1E1 and IEEE802.3ah standardisation committees selected DMT as the unique line code for VDSL. This was a major victory as DMT was the solution developed and promoted by the MEDEA+ A106 INCA project.

Four-part structure

INCA consisted of four separate work packages, each with clearly focused aims and outcomes:

- **Work package 1** developed an SoC design methodology. It starts from a high-level description of the system and continually refines it until a full definition of hardware and software components is produced. Such a methodology is essential for systems as complex as an ADSL or VDSL SoC.
- **Work package 2** focused on the transport of multimedia services over xDSL. The challenge was to develop an all-digital xDSL system, while at the same time

ensuring the customer would still have basic telephony service during power cuts. A range of services was considered, including the IEEE 802.3a Ethernet in the first mile (EFM) service that provides Ethernet within the local access network.

- **Work package 3** developed techniques for digital signal processing. At the heart of xDSL technologies is the fast Fourier transform (FFT) – the mathematical procedure that generates and decodes the composite DMT signal. ADSL uses DMT modulation to produce a signal that has good compatibility with the transmission characteristics of the local loop. This work package also treated error-correcting codes for enhanced ADSL and VDSL, and techniques for preventing interference with radio signals, especially from nearby radio transmitters. Moreover, INCA developed signal repeaters and regenerators to extend the VDSL service area.
- **Work package 4** developed building blocks to integrate the chipset design and application platform into a coherent whole. Demonstrator platforms were developed for a range of service, including high-speed interactive Internet, e-commerce and video-on-demand.

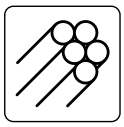
Promoting DSL markets

INCA came about as a natural extension of the earlier MEDEA A114 xDSL modems project, which also worked on DMT. The underlying aim of the two-year INCA project was to expand the market for ADSL and VDSL, promote VDSL at standardisation committees, and develop the underlying component technologies. Major emphasis was on developing chip architectures that offer flexibility, scalability, reconfigurability and intellectual property (IP) reuse. This was seen as essential to allow the development of a wide choice of xDSL modem products to suit customers from large businesses to individual consumers.

The consortium came together because the partners realised it would reduce the overall development time to commercialise advanced DSL systems. Co-operation has been very successful, taking the form of several clusters of collaboration rather than a single approach.

Consortium members had a range of complementary skills and competencies, with each partner focusing on its particular niche. For example, major global chipmaker STMicroelectronics is targeting the market for DSL chipsets for both exchange and customer premises equipment. Systems supplier Alcatel is producing equipment such as DSL access multiplexers that provide multiple connections both in the exchange and in remote cabinets. Consumer electronics manufacturer Thomson is targeting the market with DSL modems for consumer premises; it holds a 20% market share for DSL. France Telecom is already introducing a raft of broadband Internet services using INCA DSL technologies. Design and development support overall was provided by research centres and academic institutions specialising in the telecommunications area.

INCA partners certainly have a lot to show for their collaboration. They designed and demonstrated chipsets for ADSL and VDSL, and produced integrated DSL platforms. Partners have published more than 30 scientific and academic papers, and the standing of the European DSL suppliers is now ranked amongst the top three worldwide. However, huge R&D investments must continue to maintain this position and address fresh challenges such as the development of new DSL standards.



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Partners

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Ecole Normale Supérieure de Cachan
France Telecom R&D
Integrated Systems Development
Lund Institute of Technology (LTH)
STMicroelectronics
Telecommunication Research Centre Vienna (FTW)
Telia Research
Thomson Multimedia
TIMA Laboratory

Project leader

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Key project dates

Start: January 2001
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Countries involved

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Belgium
France
Greece
Italy
Sweden

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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.