MEDEA+

Leading the way to wider consumer choice

EUREKA

Advances in MEDEA+

Key advances in consumer electronics have been made in:

- Improving digital storage – from much greater memory for mobile phones to Blu Ray discs for high-definition film entertainment;
- Developing new audio- and video-compression technology that boosts the capacity of existing terrestrial and satellite distribution channels while opening up wider choice and new possibilities in home entertainment;
- Improving the quality and reducing the cost of large screen displays ready for high-definition TV (HDTV) in the home, while developing ever higher quality displays for mobile equipment;
- Home networking – both wired and wireless – that allows increasingly easy access to shared music, films, TV programmes and digital photographs;
- Ensuring security and digital rights management to enable greater quality in home and mobile entertainment while protecting the rights of the distributors and programme makers;
- Increasing the functionality of mobile devices – from simple phones to mobile TV, information and banking terminals or filming and distributing personal audiovisual material; and
- Widening the choice of in-car functionality, turning simple car radios into systems able to inform, entertain, communicate and guide drivers and passengers in safety and comfort.

Leading the way to wider consumer choice

We take increasingly for granted easy access to an ever wider range of entertainment and information resources wherever we are – at home, on the move or, perhaps more surreptitiously, in the office. Massive improvements in communications systems, major advances in storage and home networking, and enormous progress in display systems have been driven by the technological advances achieved in the MEDEA+ and preceding MEDEA programmes. These advances have opened up a much wider choice for the consumer as well as helping protect the rights of distributors and programme makers, making it possible for Europe to establish a highly competitive entertainment and information industry. And, despite a massive shift of consumer product manufacture to the Far East, Europe has been able to more than hold its own in the design and application of world-beating consumer electronics technologies.

The traditional consumer electronics market covers a wide range of equipment used for entertainment, communications and information access. It includes the complete gamut of everyday devices found in the home – personal computers (PCs), wired and wireless networks, broadband Internet access, large- and small-screen televisions, audio equipment and recording/playback devices – as well as the diversity of objects we take with us as we move around, including mobile phones, automotive infotainment equipment, portable media players and GPS navigation systems.

Worldwide markets for such consumer electronics equipment have grown tremendously over the past decade and this strong growth is set to continue over the next few years according to high-tech market research firm In-Stat. It forecasts that PCs will maintain their strong growth pattern with a compound annual growth rate of 9.7% until 2011, with growth being driven by increased sales in Africa, the Middle East, South America and Asia/Pacific regions. PC shipments will be driven by a continued transition from desktop to mobile units.

Key role for semiconductors

Key to much of the progress in consumer electronics has been the ability to reduce prices on a regular basis while providing an ever-wider range of functions. While much of this has come from improved efficiency due to shrinking chip structures and inevitably through globalisation by moving manufacture to areas where labour costs are lower, semiconductor design has played a major role.

However, progress in the semiconductor industry has come at a price. The cost of investing both in the research needed for innovations and the manufacturing facilities required for advanced microelectronics is now much higher than almost any individual company can afford. Increased co-operation and alliances, backed by public-private investment, has been essential to maintain the European microelectronics industry at the global forefront.

Successive EUREKA programmes – starting with the Joint European Submicron Silicon Initiative (JESSI) from 1989 to 1996, followed by MEDEA from 1997 to 2000, and now MEDEA+ finishing in 2008 – have made a major difference to the European consumer electronics industry. In particular, they have propelled the top European chipmakers into the global vanguard in application-specific integrated circuits (ASICs) and kept them there. This success has been achieved both through European technological ingenuity and by working with the world community to establish the standards necessary to enable equipment interoperability.

Increasing convergence

The consumer electronics industry has seen increasing convergence between PC and entertainment equipment. While nearly all households in most industrialised countries have at least one TV, less than three quarters own PCs. The remaining households see PCs as too complex or irrelevant. The availability of interactive services via the TV at little or no extra cost could provide the motivation for large-scale migration to the digital medium, offering all households a user-friendly and inexpensive route to participation in the Information Society.

Broadcast TV has long been a one-way flow of information and entertainment to the viewers. Now analogue terrestrial VHF/UHF television services are being phased out in the transition to digital broadcasting for enhanced signal quality and lower bandwidth. This digital changeover makes it possible to introduce interactive services – such as information feedback, Internet access, e-commerce, e-learning and polling – that currently need a phone-connected PC or set-top box.

However, this requires a return channel with high bandwidth and high reliability. Existing return paths based on wired or wireless telephony are costly, inconvenient, interrupt voice communications and are unable 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 mobile-phone networks can handle such volumes.

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) standards evolving in Europe since the mid 1990s. The approach is equally applicable to future generations of mobile phones and other portable devices.

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 of the IM4DTTV project, no silicon solutions were available for the RF section.

By the close of the 42-month project, a design for the baseband upstream core of the modem had been realised ready for silicon integration. The RF stage of the user terminal was also designed and fabricated. Completing the set of silicon-ready cores was an RF/baseband integrated downstream system-on-chip (SoC) device and external duplexer. These elements were demonstrated in combination for a presentation of tele-voting on a music programme.

Adding functionality

Increasing convergence between mobile communications and consumer multimedia applications meant Europe had to improve mobile audio, video and imaging equipment performance while reducing power consumption. Innovations were essential in circuit integration and display technology for emerging portable audio, video and imaging applications. This was necessary to consolidate global leadership in mobile phones and enable Europe to break into Asia.

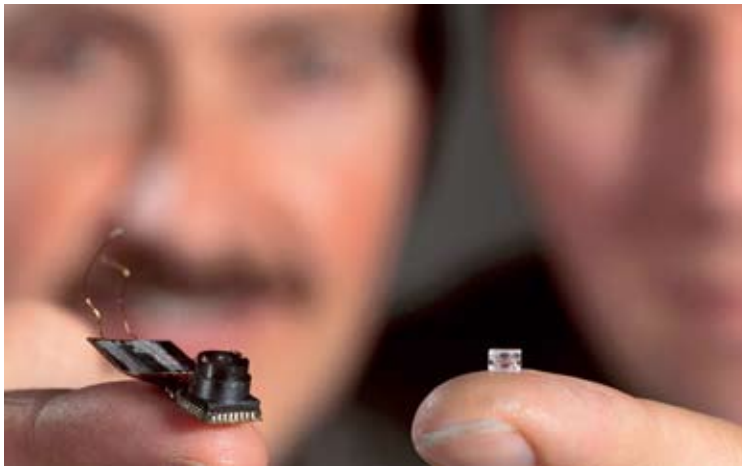
Until relatively recently, there had been no simple, low-cost solutions combining multimedia, digital rights management and connectivity. Each function was performed separately by stand-alone portable equipment. So there was a need for a cost-effective solution for handheld consumer systems combining all these features. This would enable development of innovative digital portable audio and video players, mobile and smart phones, digital cameras and camcorders, personal digital assistants, web terminals and equipment for e-shopping, e-banking, e-learning and medical care.

The MEDEA+ A207 Pocket MM project set out to define and develop a silicon application platform for nomadic multimedia equipment. Chipmakers and communications specialists collaborated with multimedia software and systems companies. The mix of multimedia and low power development technologies expertise available and good co-operation were particularly important to the project's success.

While the initial intention was to develop a generic software platform based on advanced processors, it was quickly realised that battery life was a key barrier. The final approach involved software and hardware with a strong development focus on multimedia hardware implementation to deliver high computing performance needing low power.

Another major difficulty was displays – the area of greatest cost and such displays mainly came from Japan. However, a display partner was found in Europe, offering low-power colour organic light-emitting diode (OLED) panel technology.

The outcome was a validated platform offering highly effective image, video and audio features with very low power consumption. Results are already being applied in audio, video and other mobile entertainment systems, chips with firmware for mobile multimedia applications, OLED displays for mobile applications and reconfigurable hardware for a range of uses.

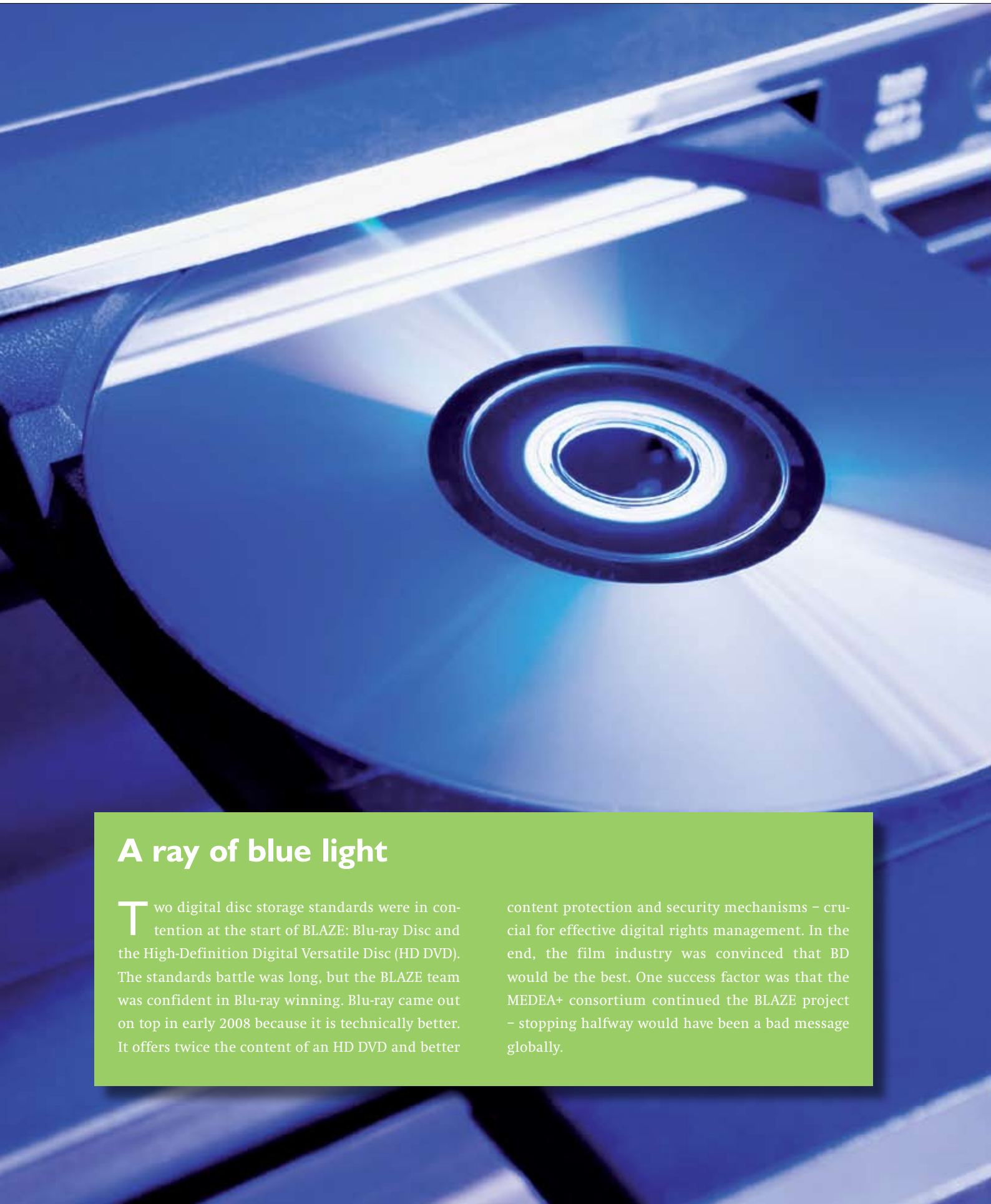


A major benefactor has been the mobile phone. Before Pocket MM, putting cameras in phones was practically unknown – now companies are already including two cameras. Worldwide shipments of camera-equipped phones are set to reach 860 million in 2009, when camera phones are expected to account for 89% of all mobile handsets shipped.

Mass storage essential

Mass data storage is a critical strategic issue in the evolution of both consumer and professional electronics equipment. The demand for such storage has exploded with multimedia PCs increasingly commonplace and digital video recorders fast displacing the old analogue videocassette recorders (VCRs).

The MEDEA+ A202 FUST project focused on developing SoC devices for mass storage applications, with an emphasis on common approaches for all types of storage devices. It laid the foundation for the development of advanced storage products by covering general architectures, intellectual property and prototype chips. It also resulted in new formats, common systems architectures and components for optical, magnetic and electronic storage media, together with prototype implementations of SoC devices.



A ray of blue light

Two digital disc storage standards were in contention at the start of BLAZE: Blu-ray Disc and the High-Definition Digital Versatile Disc (HD DVD). The standards battle was long, but the BLAZE team was confident in Blu-ray winning. Blu-ray came out on top in early 2008 because it is technically better. It offers twice the content of an HD DVD and better content protection and security mechanisms – crucial for effective digital rights management. In the end, the film industry was convinced that BD would be the best. One success factor was that the MEDEA+ consortium continued the BLAZE project – stopping halfway would have been a bad message globally.

FUST covered almost every aspect of mass storage need, including the hard disk drives (HDDs) now found at the heart of most mass-produced consumer digital video recording products. The MEDEA+ project covered many functionalities of the overall system, including source coding for compressing data streams, stream handling, file and disk-content management, copy protection, recording control and network communication with equipment such as camcorders, TVs and PCs. In addition, FUST completed the definition of the architecture for an SoC device for optical disc drives that support both DVD-RW and DVD+RW formats.

Source codecs provide the coding/compression functionality necessary for converting video signals into a format suitable for storage. Extensive viewer panel tests were carried out in FUST to gain a perceptual evaluation of various processing parameters. These tests enabled the setting of parameters to provide optimum image sharpness and keep visual coding artefacts to a minimum.

Work was also carried out on a software implementation of a codec for audio compression in both low-end consumer applications and hi-fi quality applications. And FUST completed the design of a memory controller chip for handling high-definition television (HDTV) data streams.

An important issue in mass-storage applications is copy protection. FUST therefore investigated digital watermarking, where copy-protection data is embedded into the video data stream. A generic solution for audio copy protection was also developed that was able to handle a variety of business models. The key to this generic solution was its portability across a variety of storage media.

Effective HD storage

The MEDEA+ 2A201 BLAZE project took this work on storage even further, developing a highly effective system that is now helping Europe to open up its lead in HDTV. It designed an overall architecture and developed single-chip solutions for an innovative HD storage system based on the Blu-ray Disc (BD) standard. This is providing a boost to the European chipmaking, consumer electronics and content distribution industries.

With large screen displays, particularly liquid crystal (LCD) and plasma, becoming increasingly affordable, the ability to store and playback high-definition content is essential to speed up deployment of HDTV. Europe had to develop the microelectronics and embedded firmware for such storage to be able to participate in the huge potential markets for disc recorders/players and personal computer drives.

Not only was a complete solution required to allow recording from broadcast and broadband video-on-demand (VOD) services as well as pre-recorded discs, but it was also essential to integrate effective digital rights management (DRM). Robust DRM is essential to make media content delivery profitable and ensure income for all the value-added service providers involved in service deployment.

Current DVD optical disc technologies rely on a red laser to read and write data, the next-generation BD optical disc format uses a shorter wavelength blue-violet laser. It was developed to enable recording, rewriting and playback of HD video, as well as storing large amounts of data. It offers more than five times the storage capacity of traditional DVDs, holding up to 25 GB on a single-layer disc and 50 GB on a dual-layer disc. This extra capacity combined with advanced video and audio codecs offers an unprecedented HD experience.

A key to BLAZE's success was development of a stable and robust common architecture initially and ensuring all subsequent developments kept to this. With Blu-ray now having won the standards battle – see BOX – fast commercialisation of project results is expected by all partners. Potential applications include displacing older less integrated solutions in HD set-top boxes, media centres and multimedia HDDs as well as high-end audio and BD players. And the scalable IP now available will be used for DVD decoders and set-top boxes for Asian and North American markets.

Fast-changing standards

Technology and standards have evolved very quickly in the area of mass storage, and the MEDEA+ FUST project helped in setting the pace. Work was carried out on Blu-Ray Disc optical recording technology, which offers five times the capacity of current DVD systems, as well as on red-laser recording for DVD+R/RW and micro-optical drives, copy protection using electronic watermarking, and video compression for professional camcorders. FUST solutions helped open up these standards to the mass market with its common architectures and SoC device designs.

A 3D view of life

Following on the success of BLAZE, the MEDEA+ 2A207 Triton project is now working on use of Blu-ray as a carrier for three-dimensional (3D) TV. The high capacity of Blu-ray discs will play a key role in storing the mass of data required. Triton is offering European technology companies the chance to take the first steps to 3DTV. It is bringing together the technology suppliers for a 3DTV content chain and distribution networks to speed evolution of public 3D displays into cost-effective home-based media players.

Triton is focusing on 3DTV and holographic storage. In the medium term, the intention is to create a set of innovation clusters in Europe that can effectively sustain and develop the interests of European companies and media by establishing innovative flagships products and business models in the first steps to full 3DTV solutions. These technology clusters can then interact to form the basis for commercial R&D to create a European movement in the core technologies for 3DTV and virtual reality for consumer and professional applications.

3DTV and the necessary storage technology for consumer and professional applications are a first essential step on the ladder to a long-term vision for a fully functional virtual environment. This vision may be practical in 2030 and beyond. However, for European companies to have a place in this future, they need to create strong business interests in the intermediate 3DTV applications. From these initial applications, steps can be taken to the final vision of a full multi-view holographic display in the home. Proposals for technical innovation to skip these intermediate steps are an excellent challenge for research teams but represent a great investment risk for the systems companies or the semiconductor industries.

Leading the way for 3DTV

Advanced 3DTV systems will be a driving force behind the next phase of consumer electronics ICs, probably led by gaming consoles. The European semiconductor industry must have the right technologies to compete with Asia to make 3D terminals. The '3DTV from Europe' group brings together major chipmakers and systems houses throughout Europe to give guidance to all 3DTV R&D activities in Europe and encourage joint standardisation proposals. It is already working with the MEDEA+ TRITON and iGLANCE projects to ensure complementarities and reuse of results. These projects will be only the first two steps in a longer trajectory towards full deployment of 3DTV from Europe. Many professional applications of 3DTV are foreseen – such as medical and health-care applications, 3D infrastructure, civil engineering, aerospace and transport, as well as military applications.

By focusing on the most direct applications of 3DTV, Triton expects to support the broadest interests of the European high technology regions for:

- 3DTV display technology for commercial and consumer applications;
- Standards for 3DTV in world markets;
- Demonstrating the economic impact of 3DTV in stimulating the semiconductor industry;
- Coupling developments in 3DTV and advanced audio technologies;
- Implementing holographic storage technology for professional imaging applications; and
- Demonstrating a business-to-business solution for 3DTV distribution for disc and broadcast networks.

Futuristic multiviewpoint

Triton is closely related to and complementary with the MEDEA+ 2A208 iGLANCE project. Triton is concentrating on the overall content delivery chain from end to end. This covers content capture, transmission, reception and display of a single 3D view. It has a business model that progresses from public displays to applications in hotels and for home cinema. The iGLANCE project is focusing on a futuristic vision of multiple views of a 3D scene and the additional requirements for 3DTV displays that fully support such an approach, with a focus on receivers only – a key element in the 3DTV delivery chain.

Work with HD displays indicate that it is possible to implement 3DTV for consumers at low cost by applying a lenticular lens – an array of magnifying lenses designed so that when viewed from slightly different angles, different images are magnified, producing an illusion of depth. In practice, such an array is applied as a transparent overlay to the TV screen, ensuring full brightness and colour of the image while providing separate images for the right and left eye that are combined by the brain, without the need for any special glasses.

Next-generation processing chips for HDTV receivers should therefore not only upgrade the existing generation of chips in terms of AV quality performance, but also prepare for the development of such a new innovative application. iGLANCE is therefore working on a TV chip design which innovates in the direction of 3DTV with multiple cameras serving so-called multi-view processing, enhanced with a user-controlled information channel allowing for more interactive manipulation of the content.

Both projects start from the vision of employing a texture and depth format for 3DTV systems. This format has been standardised in the MPEG 3DAV working group for a single view, but the multi-view 3DAV standard is still under construction. The two projects both have sufficient knowledge to propose jointly European extensions to the standard for the multi-view case and forms of interactivity.

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MEDEA+ ∑!2365 (2001 to 2008) was the industry-driven pan-European programme for advanced co-operative R&D in microelectronics. Its aim was to make Europe the global leader in systems innovation on silicon. Some 90 projects were labelled, covering challenges in microelectronics applications and enabling technologies, and involving 2500 scientists and engineers annually from 23 European countries. The more than 600 partners included major microelectronics manufacturers, systems houses, SMEs, universities and institutes.