PROJECT RESULT

High speed communications systems

MEDEA+

A107: System-on-chip application platform towards fourth generation radio (4G-RADIO)

Highly integrated approach developed for multimode wireless communications terminals

Integrated analogue and digital solutions have been developed for highly reconfigurable current and future multifunction and multistandard terminals in next generation wireless communications systems. The 4G-RADIO project developed new architectures, circuits and technologies, including advanced CMOS silicon-on-insulator (SOI) expertise, as well as demonstrating their transfer into semiconductor technology design. Results of the work are already appearing in submicron CMOS and advanced BiCMOS devices – boosting the global competitiveness of key European players in chipmaking and communications.

Wireless technologies play an increasing role in local and wide area communications. But a major barrier has been the range of different standards involved, served by single standard terminals. Market research now predicts an enormous growth in the market share for multimode 4G mobile handsets to over 40 percent by 2010, despite the major economic turndown at the start of the decade.

In 2001 and 2002, 2.5G systems such as general packet radio service (GPRS) or enhanced data rates for global evolution (EDGE) had begun operating but innovation in wireless communications practically stopped – stalling the rollout of third generation (3G) mobile systems in Europe.

GSM mobile phone handsets had reached an advanced level of integration using proven 0.25 to 0.35 µm bipolar CMOS (BiCMOS) technology. Triple-band capability was common despite a significant impact on the design and cost of the radio-frequency (RF) parts of the handset. GPRS was possible, but the extension to EDGE was physically more difficult.

Various different wireless local area network (WLAN) standards – such as IEEE 802.11a/b – offered broadband access, mainly for portable computers. However, digital video (DVB) and audio (DAB) broadcasting receivers were not capable of sharing the same radio resources as these terminals.

In short, the state of the art was at the point where low-cost products were available for single- or at most dual-mode devices but made relatively little reuse of components and had an extremely limited scope for reconfiguration. Therefore, a huge research and development effort was required, mainly in the area of terminal design, to make 4G systems a reality.

Multimode access

The MEDEA+ A107 4G-RADIO project focused on 4G systems with a terminal able to access systems working on all types of standards, such as 2G, 2.5G, 3G, 3G+, WLAN, DVB-T/H, DAB and GPS – representing a huge increase in multimode and multiband capability. The goal was development of highly integrated terminals using standard CMOS technologies for multimode transceivers/receivers at 2 to 5 GHz.

Development of reconfigurable architectures, circuits and building blocks and their transfer into advanced semiconductor technology design was the main challenge. Use of development libraries for RF and baseband circuits led to the realisation of highly integrated building blocks and circuits with high performance. In addition, advanced CMOS silicon-on-insulator (SOI) technology was developed and evaluated for other future applications.

But the MEDEA+ project was about more than just multimode capability; it also offered radical new technological solutions. Future terminals have to be capable of autonomous adaptation of all internal resources to deliver the right combination of air-interface functionality with minimum power consumption. Additionally, the terminal has to be reconfigurable under network command and/or by software download. As a mobile product, it also has to be attractive in terms of cost, size, weight and connection time.

Many advances

Important synergies were achieved by comparing different system architectures. All partners decided to use zero intermediate frequency down-conversion in receivers to cut power consumption and external component count. And frequency generation is performed using voltage-controlled oscillators (VCOs) with multiple digital bands for digital pre-tuning to cover the wide frequency range in multimode operation.

Project advances included:

* Building blocks already transferred into the world's first single chip 0.13 µm CMOS transceiver that includes baseband processor and RF transceiver offering low cost and high performance;
* New concepts and functional RF blocks to handle digital and analogue radio as well as positioning systems for next generation multistandard receivers in cars;
* Ultra low voltage (0.6V) low-current wideband RF building blocks and power-efficient linearisation techniques for long standby and talk times in 3G handsets;
* Microwave frequency transistor models for advanced CMOS SOI, including a 0.13 µm process, offering good RF behaviour and low power consumption;
* A high-speed signal processing chip for 4G reference systems offering high reconfigurability, for use in a variety of other test and measurement devices; and
* High performance core building blocks for multiband, multifunction operation in 3G/4G cellular phone and WLAN markets up to 5 GHz. These were demonstrated in a fully integrated WLAN transceiver and a wideband code division multiple access (W-CDMA) front end, and could lead to a major breakthrough against US and Japanese dominance.

Finally, a common demonstrator, based on Agilent´s 4G baseband platform for orthogonal frequency division multiplex (OFDM) and other recent test equipment developments, proved multimode functionality. This is not yet a single chip solution, but results of the evaluation showed the advantages and progress achieved.

Changing the landscape

Overall, intellectual property and silicon hardware generated by 4G-RADIO has not only influenced the business strategy of the main partners but also changed the terminal and receiver landscape. The first 4G terminals are now available to handle worldwide 2G mobile services, as well as 3G, while providing WLAN and Bluetooth connectivity, FM radio and even DVB reception.

All participants gained know how and competence in the worldwide field of wireless communications. Furthermore the main project partners, as key European players in the semiconductor and communications business, strengthened their competence, leadership and market positions.

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KEY PROJECT DATES:

Start: July 2001
End: August 2005

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