



## Development of On-Chip Signal Processing for Audio/Video/User interfaces

### Executive Summary

The report identifies several major future trends in the applications of microelectronics for digital signal processing. The task given to the subcommittee of the MEDEA+ Scientific Committee was to report on the “Development of On-Chip Signal Processing for Audio/Video/User Interfaces”.

The sub-committee comprised experts from Fraunhofer Gesellschaft, TU Delft, IMEC, INPG-TIMA and IST-Lisbon, with additional contribution by industry experts.

In the process of writing the report, the scope was somewhat broadened to include other major developments, in particular application scenarios.

In order to identify major trends and to establish where future progress in IC technology for on-chip signal processing is required, the following procedure was followed:

- Identify the main trends in applications of very complex signal processing, including both important requirements for future systems and trends in applications.
- Identify a few “killer applications” which will not just make use of new enabling technologies (including silicon technologies and new algorithms), but will turn up as appliances that will then be sold in the order of many million highly complex devices.
- Derive research issues from the main trends and killer applications, including very important issues for future systems-on-a-chip.

The task was carried out not as a complete overview of the group’s vision of future technology, but to provide examples in particular in areas where European research, both basic research at university level and applied research, is already strong and where further strengthening would help to maintain or gain a world leading position in these application areas.

#### **1. A short overview of main trends is given below:**

- paradigm change towards peripheral control and ambient intelligence,
- large collection of 'intelligent devices' surrounding the user and interacting with him,
- exponential increase of demand for signal processing on the chip both between user and background network (video on demand) and between users (roaming),
- emphasis on a scaled 'Quality of Service',

- new importance of security and privacy protection while allowing easy access,
- emergence of 'personal networks',
- need for large wireless bandwidth,
- enormous increase of computational complexity of signal processing algorithms,
- emerging 'immersive experiences',
- seamless roaming access,
- need for support of 'context awareness',
- renewed importance of energy considerations,
- augmented reality.

**2. Overview of selected potential killer applications:**

- The Personal Information Centre or Wearable Digital Assistant,
- Surrounding multimedia and videophony,
- Ubiquitous communications.

**3. Overview of important research Issues:**

- Techniques for (broadband) wireless communications,
- User's access and interfacing,
- Next generation multimedia as truly immersive,
- Networking issues,
- Increase of 'true' intelligence,
- New types of distributed architectures,
- New design technology needs.

**4. Consequences for future systems on a chip:**

- Networks on a chip techniques will be needed,
- Real time operating systems to be intensively developed,
- Combination of heterogeneous signal processing resources,
- New dynamic and adaptive techniques for task management,
- Power-speed trade-offs.

**Major findings** were that Europe should:

- Take the lead in G4 by putting strong efforts into the open standardisation of its components. Support the implementation of new standards. In a lot of cases reference designs are needed for complex new standards (e.g. MPEG-4, MPEG-7, MPEG-21).
- Develop an energy-efficient platform for 'intelligent system design', consisting of embedded processors, modules for decision making, modules for pattern recognition, local networking devices and a variety of networking protocols.
- Start research efforts at higher system levels. Explore aggressively the new possibilities in the multimedia era: new types of transducers, interaction with the Internet, user's control, new services.
- Start searching in 'body area networking' and place extra emphasis on the development and system integration of devices surrounding the individual.