

A collage of images. At the top, a tin can is open, revealing a yellow circuit board with various components inside. Below the can, there are three robots: a red one on the left, a blue one in the middle, and a white one on the right. The background is a light blue gradient.

Tin cans have firmly established themselves as the medium of choice for shipping and storing a broad range of products. An important part of this success story is their simplicity. If an opening-tool is needed at all, it is the modest and universally compatible can-opener.

Computer systems have long been the antithesis of this. Even simple tasks called for specialist skills. Not so for embedded systems! Here, the computer is usually contained within the device it controls and reacts directly to relevant events. In the extreme, it blends in so well that nobody knows it's there – until they take a peek inside.



## Embedded system technologies

“Embedded, Everywhere” is the title of a research agenda published in 2001 by the National Academy of Sciences in the USA. This agenda highlighted the importance the scientific community attached to research in the field of embedded computers. Embedded intelligent devices are today, five years later, pervasive and estimated to be more numerous than people on earth. By 2010, at least three embedded computers will exist for every living person. That equals 16 billion machines, growing to 40 billion by 2020. The European Union is currently formulating a major initiative covering research into the next generation of embedded device technologies, which will focus on the interaction between embedded networks. ARTEMIS<sup>1)</sup>, as the program is called, rallies industries and academia to lead the development efforts, backed by funding from national governments and the EU. Asia is equally aware of the significance of embedded technologies for future economic growth and prosperity. Government-backed programs exist in Japan, Korea and China, each with its own flavor and emphasis. All these regional and national programs are driving towards the pervasive use of embedded devices in a multitude of applications across industries and large infrastructures, health and entertainment, fixed and mobile networks.

So what is this technology all about, and how do we, in ABB, use it? What challenges lie ahead? Where is the technology going? This issue of ABB Review focuses on exactly these questions, and finds answers in almost all areas of ABB’s research and development.

Embedded computers have been around for some decades already. Their tasks have been restricted primarily to autonomous applications and small networks involving limited interaction with humans. The term “embedded” refers to the nature of these tasks, which are mostly related to dedicated background functions that escape human awareness (as long as the tasks are performed correctly). For example, a modern car has well over 20 embedded computers taking care of systems for brakes, comfort, engine control etc. The next step foreseen for these embedded devices is their full membership of sensor-based networks as intelligent and communicative systems that are not only capable of exchanging information among themselves, but also between different networks. The exponential increase in complexity compared to our current level of capability defines a technology gap, which we now have to find ways of bridging,

hence the importance of initiatives like ARTEMIS in Europe and its counterparts in the USA and Asia.

Two guest-authors in this issue of ABB Review introduce the topic of embedded technologies to our readers. Dr. Kostas Glinos, of the European Commission, describes in the first article the importance the EU is attaching to this technology, and presents the ARTEMIS initiative in some detail. The second lead story is by Dr. Richard Zurawski, president of the ISA Group based in St Clara, California. He looks more carefully at the state of embedded hardware and software technologies and where the trends seem to be leading. A review of how ABB uses embedded systems in its own product portfolio completes the overview section.

Several applications of embedded systems are described next. This set of articles cover a wide range of products with enhanced customer benefits, which originate from the incorporation of embedded technologies already in the initial design-phase.

The next section is devoted to a broad spectrum of communication capabilities of embedded devices. Wireless communication and industrial Ethernet, fieldbus and power-line carrier are just a few examples that illustrate how ABB can support information exchange on different levels and over different media. The last two sections of this issue of ABB Review describe software and hardware implementations.

The breadth of technologies required to bring performance benefits to our customers is remarkable. Maintaining up-to-date knowledge in a number of rapidly changing fields as wide apart as low power applications to software generation and verification, from advanced signal processing to FPGA technologies is a great challenge for our global research and development teams. But then, tackling such challenges is why researchers love research in the first place.

Enjoy your reading

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### Footnote

<sup>1)</sup> ARTEMIS stands for Advanced Research & Technology for Embedded Intelligence and Systems