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INFORMATION AND COMMUNICATION

Information and communication technologies (ICT) have become a major driving force of innovation worldwide. Modern electronics and microsystems have entered our everyday life, from the Internet to business software, from satellite navigation to telemedicine.

ICT forms the technological basis for the information- and knowledge-based society, as well as for the steady stream of new multimedia and services offered in business (*E-business*, *E-commerce*), public administration (*E-government*), health care and private life.

The ICT sector, which encompasses electronics, including micro- and nanoelectronics, communication technology, telecommunications and IT services, generates on average 10% of gross domestic product in the OECD countries, and the trend is strongly upwards. As the key technology of an increasingly knowledge-oriented business environment, ICT additionally act as a growth accelerator for many other sectors, including mechanical engineering, automobile manufacture, automation, training and development, the services industry, medical technology, power engineering and logistics.

The intermeshing of technology is of central importance, involving production on the one hand (computers, electronic components, telecommunications, radio and TV equipment and I & C services on the other (software development, data processing and telecommunication services).

As big as the industry is, its life cycles are short. The time it takes before memory chips, video screens, mobile phones and software are superseded by better successor products reaching the market, is becoming shorter and shorter.

Microelectronics remains one of the most important technologies for the information and communication industry. The computer power and storage capacity of microprocessors have risen a thousand-fold over the past 15 years. Today, they are found in many everyday things such as automobiles, cell phones and domestic appliances, as well as in industrial plant and equipment. Mobile terminals are developing into multipurpose systems. Many systems, even miniaturised ones like sensors, can be equipped at low cost with their own computer power and storage capacity, so that they can process and communicate data themselves.

In just about every area of life, society is increasingly dependent on an efficient information and communication infrastructure. The boundaries between telecommunications and information technology will disappear, as they will between mobile, fixed-line and intra-company communication. Services and applications are moving increasingly into the foreground. At any location, at any time and from any mobile or stationary terminal, users can access the applications they require to complete tasks (always-on services). Networks and IT infrastructures will become invisible to the user. This vision will become reality though the Internet as the dominant network protocol.

More than 90% of processors are not installed in PCs, but work away in the background as embedded systems e. g. in anti-lock braking systems, machine controls, telephone equipment and medical devices. Embedded systems are an example of overarching interdisciplinary research and development. From the various applications for embedded systems, interfaces are created to a number of other scientific disciplines. Electronic systems (hardware components), communication technology (networking platforms) and microsystems (sensors, actuators) deserve particular mention.

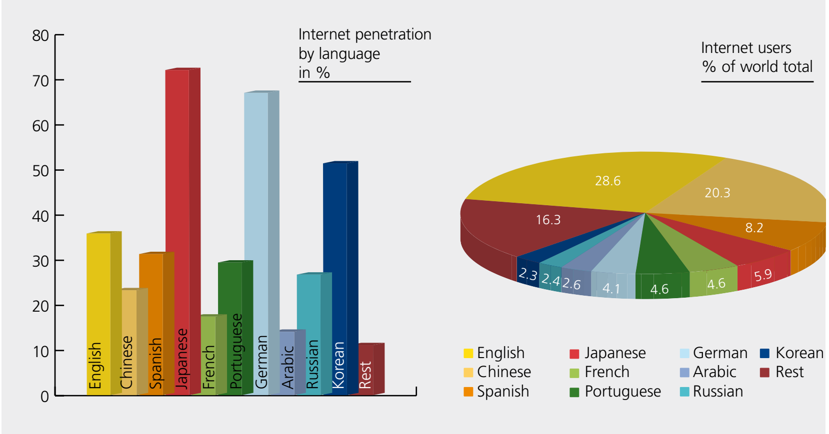
A paradigm shift has occurred in the development of *processor cores (CPUs)*. While processor clock speeds have risen constantly in the recent past, no further increase can viably be achieved above 4 GHz. The solution to the problem is provided by processors with more than one computational core, the multi-core CPUs, in which each core runs at comparatively low clock speeds. The downside is that this creates new challenges for the software needed to parallelise the programmes.

► **The topics**. Today's communication landscape is characterised by an increasing heterogeneity, particularly of access networks, as well as by the coalescence of fixed-line and mobile networks. Despite this heterogeneity and complexity, next-generation networks will have to allow an efficient, integrated, flexible and reliable overall system to evolve (convergence, virtualisation). What's more, networks should provide mechanisms which permit increasingly mobile users to use broadband multimedia services independently of the access network, securely and with the guarantee of privacy. Multimedia telephony, conferencing, interactive games, distributed services and IP telephony will additionally broaden the services already well established on the Internet.

Key focal points in the further development of *Internet technologies* include self-organising mechanisms for controlling dynamic network topologies and improved procedures which guarantee quality of service (individual service, web 2.0, Internet of Things). Worldwide communications and thus also globalisation are mainly driven by the Internet as a global network and by the continuous development of Internet technologies. Before Internet technologies were standardised, data communications were characterised by isolated solutions. At the end of 2008, more than 1.5 billion people were using the Internet.

Computer architecture creates the technical foundation for devices and systems to communicate with each other – by advancing the design of computers, particularly how they are organised, as well as their external and internal structures. Current areas of research include parallel computer architectures, configurable processors and distributed embedded systems.

An increasing part of system functionality is already implemented in *software*. Up to 80% of the R&D expenditure incurred in realising new communication systems is attributable to software development. Software engineers are particularly focusing on higher efficiency, quality and reliability. New mathematical models, data structures and algorithms further the exponential growth of computer power. Put together with improved hardware and increasingly accurate simulations, they achieve high precision, visualisation quality and speed. Work is being conducted increasingly on the modularisation of software architectures, in order to develop service-oriented systems (information management, service-oriented architecture SOA, open-source software and Java).



Internet usage. Left: Internet penetration by language. There is clearly a higher percentage of Internet penetration in small language areas – such as the German-speaking regions with just under 100 million inhabitants or the Japanese-speaking zones with approximately 128 million people – than in very large language areas such as the Chinese-speaking parts, which have a population of about 1.3 billion. Right: Tallying the number of speakers of the world´s languages is a complex task, particularly with the push in many countries to teach English in their public schools. In India and China a lot of users choose English as their Internet language. Source: internetworldstat

Despite the increase in computer speed, storage capacity and the logical design of computers, devices and robots with intelligence matching that of humans are still a long way off. *Artificial intelligence* is a subcategory of computer science which is somewhat difficult to define precisely. The interpretation of collected data in the context of the environment and the derivation of actions required, for instance, by an autonomous robot, presents a broad field with enormous research potential.

Many applications depend on computer-aided monitoring and assessment of the visual environment. The key is provided by automatic *image evaluation and interpretation*. New algorithms have the potential to remove all the manual effort involved in searching through or monitoring camera images, e. g. when looking for a particular subject in a photo collection or monitoring the movements of a suspicious person. ■