

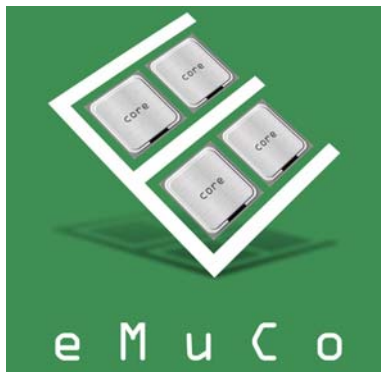
e M u C o

Embedded Multi-Core Processing for Mobile Communication Systems

The ICT-eMuCo project targets the system platform of future mobile devices based on multi-core architecture. This comprises the relevant controller elements as well as the operating system and application layers.

At A Glance: eMuCo

Embedded Multi-Core Processing for Mobile Communication Systems



Project Coordinator

Name: Attila Bilgic

Institution: Ruhr Universität Bochum

Email: Attila.Bilgic@is.ruhr-uni-bochum.de

Project website: www.emuco.eu

Partners:

ARM (United Kingdom)

GWT-TUD (Germany)

Infineon (Germany)

Ruhr Universität Bochum (Germany)

Telelogic (Sweden)

Technische Universität Dresden (Germany)

"Politehnica" University of Timisoara (Romania)

University of York (United Kingdom)

Duration: 24 months

Start: February, 2008

Total Cost: € 4.582.829,00

EC Contribution: € 2.900.000,00

Contract Number: INFSO-ICT-216378

KEYWORDS: multi-core, load balancer, virtualization, microkernel, parallel code generation

Main Objectives

Mobile communication has become the dominant branch in the communication business over the last decade and is still rapidly growing in the market. Mobile devices for standards like the Universal Mobile Telecommunication System (UMTS) and the future Long Term Evolution (LTE) incorporate multiple radio access technologies to enable the best quality of service in the current environment of the user. In addition, on one hand, it is expected that there will be an exponential growth in the usage of multimedia applications such as video streaming, video conferencing, complex graphics etc., rising the computational power demand, which can not be pursued further by accelerating the processor clock. On another hand, the coexistence of multiple software environments will be a must in order to offer all demanded services to the user.

Today's mobile communication systems usually contain multiple processing units, but individual units are typically dedicated to specific tasks rather than being general purpose, e.g. specifically for protocol stack handling. Other design approaches allocate special tasks to dedicated systems resulting in unnecessary hardware for situations other than high load.

The aim of eMuCo is to address the platform for future mobile convergent devices based on multicore architecture offering:

- Flexible system platform by a modular architecture.
- Seamless system platform allowing the coexistence of different radio access technologies and software environments on the same platform.
- Improvement of computational processing capacity of Applications
- Reduction of power consumption
- Scalability
- Real time handling of the system control signals and real time applications.

eMuCo will focus on Flexible System Platform for Future Mobile Convergent Devices.

Technical Approach

Addressing Multi-core systems for mobile devices

General purpose multi-core systems for mobile devices are an emerging technology with no (currently) known wide-spread use of any multi-core system.

A forerunner of these types of systems is the eMuCo approach. It proposes a multi-core hardware platform, which is effectively exploited by the combination of an *L4 micro-kernel*, a load balancer, virtualization techniques and Model-driven parallel code generation.

L4 microkernel is a minimal computer operating system kernel, which only provides a minimal set of kernel functionality and allows building user-level services by providing mechanisms such as address space management, thread handling, and inter-process communication (IPC).

The load balancer provides the necessary services to support multi-core such as allocation of task/thread on the multiple cores, priority management and thread monitoring.

Virtualization allows to run a broad set of existing applications in new environments by using virtual machines to run whole operating systems along with their applications.

Key Issues

Seamless integration of diverse software environments

The combination of the *L4 microkernel* together with a load balancer and virtualization techniques provides a spatial and temporal separation of the resources, allowing a seamless and secure integration of different software environments, such as applications running on different operating systems and different protocol stacks on the modem subsystem side.

Multiple cores will only provide more speed when used with multi-threaded software

The software has to be designed to take advantage of the available multi-core hardware architecture. Model-driven parallel code generation is a solution, which allows fast and

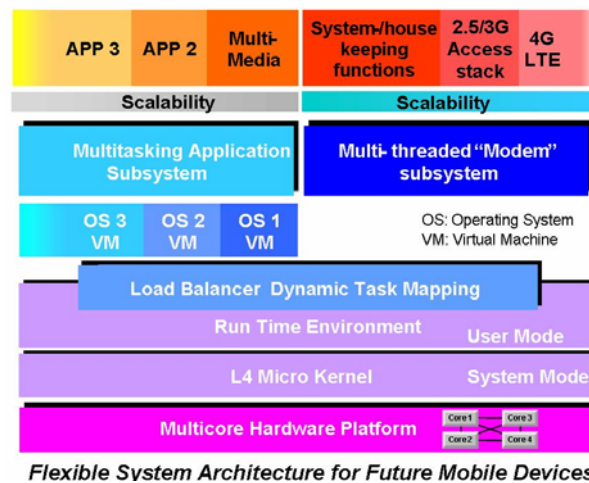
suitable software development to scalable parallel hardware architectures.

Concurrent and parallel execution of applications and control signals

Meeting deadlines of real-time transactions and shortening the response time of on-line transactions at the same time is critical in mobile communications as it directly influences the user experience. The eMuCo multicore hardware platform together with a load balancer provides a logical simultaneous processing on each core (concurrency) by a priority management and provides physical simultaneous processing (parallelism) by core allocation.

Scalability and flexibility thinking on the trends of the future mobile communication

The eMuCo approach allows scalability in three dimensions: On the application subsystem, on the modem subsystem and on the number of cores in the hardware platform. It gives the flexibility that the system architecture requires to serve the rapid changes on the mobile market.



Expected Impact

The mobile communication market is still one of the fastest growing markets in the area of consumer electronics; this applies especially for the mobile devices used in these networks. As of today two major European companies are active in this market, ARM as the worlds leading supplier of cores for mobile devices and Infineon as the world market leader for communication RF integrated circuits. And many other suppliers in Europe depend on this market either directly or as a supplier of the major market players.

The project will support Europe to gain:

- Sustained leadership in mobile communication
- Market leadership for embedded multi-core systems
- Leadership in software development tools for embedded multi-core systems
- Open source platform components for EU embedded systems