Hardware/Software Task Machine
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Problem Statement and Motivation

Streaming Applications:
• DSP
• Crypto
• Communication

How to execute high performance streaming applications efficiently in Communicating Embedded Systems?

Flexibility:
• Device dependency
• Deployment of new applications/algorithms/protocols
• Component-based application design

How to gain flexibility?

New Opportunities

Reconfigurable Hardware:
Predominant device: FPGA

New Opportunity - Dynamic Task-based Reconfiguration:
• dynamically change hardware during operation.
• similar to software tasks.

Problem/Challenge:
• Device dependency
• HW - Run-Time Environment

Target Architecture

System Architecture

Hardware/Software Task Machine

Coordination Language

Data-Flow Process Network

Prototypes

CPU: XScale on IPAQ h3900
• Windows CE .NET
• Tasks as dynamic loadable libraries
• Tasks are threads, using Win CE's scheduler together with the Task Machine's scheduler

FPGA: Custom FPGA Module
• Connected to IPAQs expansion slot as memory mapped I/O.
• Tasks as partial bitstreams
• CPLD as DMA Task Loader

BTnode rev2:
• low-power wireless sensor node
• Bluetooth radio module
• 8 MIPS microcontroller
• only Interpreter + Scheduler, no task execution on micro-controller
Custom FPGA Module:
• Connected via serial link
• Tasks are prefetched and stored on non-volatile memory

Publication

Completed Student Projects
P. Fercher: Mobiler FPGA mit Bluetooth Kommunikation, Diplomathesis, 2003
C. Metzger, D. Hirt: Embedded Machine, term project, 2004
R. Plessl: Embedded Machine on FPGA, Masterthesis, 2004
C. Lombriser, M. Andre: Embedded Task Machine mit BTnode und FPGA, term project, 2004