

Hardware/Software Task Machine

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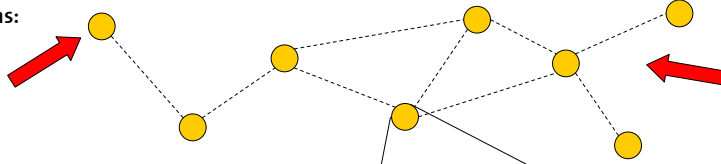


Eidgenössische Technische Hochschule Zürich
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Problem Statement and Motivation

Streaming Applications:

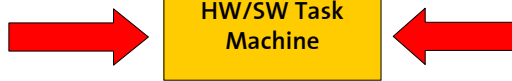
- DSP
- Crypto
- Communication



Flexibility:

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

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



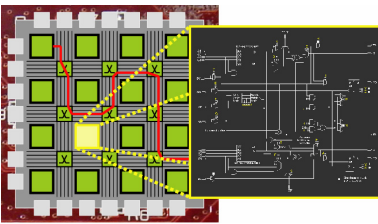
How to gain flexibility?

Solution

New Opportunities

Reconfigurable Hardware:

Predominant device: FPGA



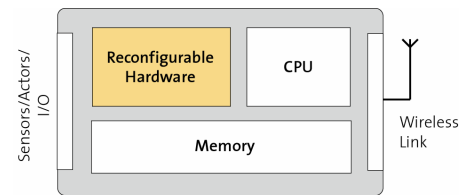
New Opportunity - Dynamic Task-based Reconfiguration:

- dynamically change hardware during operation.
- similar to software tasks.

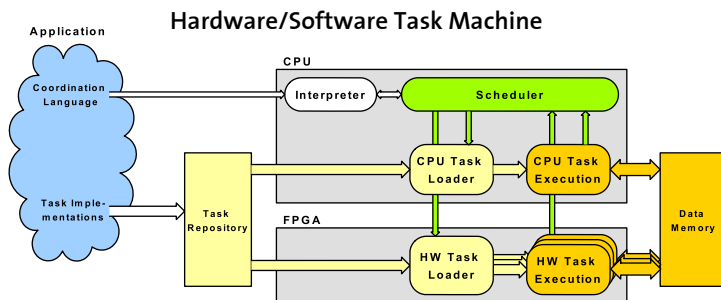
Problem/Challenge:

- Device dependency
- HW - Run-Time Environment

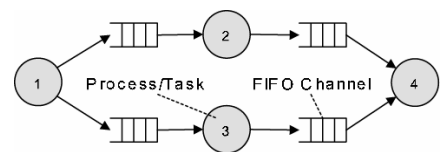
Target Architecture



System Architecture



Coordination Language



Data-Flow Process Network

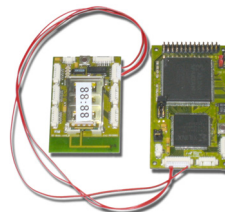
Prototypes

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

M. Dyer, M. Platzner, L. Thiele: *Efficient Execution of Process Networks on a Reconfigurable Hardware Virtual Machine*, IEEE Symposium on Field-Programmable Custom Computing Machines (FCCM), April, 2004.

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