ArtistDesign Kickoff Meeting

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Transversal Activity Presentation

Design for Adaptivity

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Adaptivity

An embedded system is adaptive, if it can modify its behaviour and/or architecture to changes in requirements, objectives, and/or external conditions

- Increasingly important as the complexity and autonomy of embedded systems increase.

- Off-line:
  - To handle changes in system specifications , e.g., platform-based or product-line based production (e.g. adaptive components, reprogrammable hardware)

- On-line:
  - To dynamically respond to changing conditions and contexts
  - Improve performance and resource utilization

- Crosscutting:
  - Involves both software and hardware
  - Relevant for all thematic clusters

Adaptivity – What?

Some examples:

- – adaptive and flexible resource/QoS management

- – feedback-based scheduling

- – testing and verification of adaptive systems

- – adaptation of software components,

- – self-organizing systems

- – dynamic reconfiguration of FPGAs/MPSoCs

- – OS, MW, and language support for adaptation

- – ad hoc networking for sensor networks and MANETs

- – .....

- .....

Objectives

- Connect and integrate activities related to adaptivity within the thematic clusters

- Focus on on-line approaches

- Challenges:

  - Adaptivity in system modelling – how is adaptivity modelled

  - Efficient adaptation – how can adaptation mechanisms be made resource efficient

  - Frameworks for adaptivity – unified frameworks for adaptivity (negotiation, contracts, QoS)

  - Predictable and dependable adaptivity – what types of formal guarantees concerning predictability and dependability can be stated for an adaptive system

  - Robustness and adaptivity – the relationships between robust design techniques and adaptive design techniques

  - Adaptivity from an application's point of view – how should the adaptation mechanisms be exposed to the application developers (APIs etc)

  - Interface between software and hardware

Industrial Sectors

- All, but most focus on soft real-time sectors

  - Consumer electronics

  - Telecom

- However, also in what is normally considered as "hard" safety-critical systems there is a need for adaptivity

  - Don Winter, Boeing

    - "Need active resource management and dynamic scheduling"

    - "Need to handle during system execution things that were not considered at design-time"

Adaptivity – Who?

- Core Teams
  - Lund (Årzén)
  - SSSA (Buttazzo)
  - York (Burns)
  - ETHZ (Thiele)
  - Bologna (Benini)
  - IMEC (Mamagkakis)
  - TU Braunschweig (Ernst)
  - Aachen (Leupers)
  - KTH (Tenhunen)
  - MDH (Lisper)
  - TUKL (Fohler)
  - Verimag (Sifakis)

- AffiliatedTeams
  - UPC (Martí)
  - UPM (Alonso)
  - Catania (Lo Bello)
  - Ericsson (Eker)
  - Evidence (Gai)
  - CTU (Hanzalek)
  - NXP

Partner Interests

Core Partners:

– **Lund University** (Karl-Erik Årzén)
  - feedback-based scheduling

– **SSSA** (Giorgio Buttazzo)
  - adaptive scheduling

– **York** (Alan Burns)
  - flexible scheduling and resource usage,

– **ETHZ** (Lothar Thiele)
  - using control techniques, e.g., MPC, to adapt schedules and task allocation to changes in requirements, system state, and estimations.

– **Bologna** (Luca Benini)
  - dynamic adaptation of mode of operation (supply voltage, clock frequency, shutdown) for multi-core, multi-resource architectures in response to varying environmental conditions

Partner Interests

- **IMEC** (Stylianos Mamagkakis)

  - dynamic/adaptive management of hardware resources (processing elements, memory, communication interconnect) to meet dynamic resource requests from the software

- **Braunschweig** (Rolf Ernst)

  - design robustness to adaptations

- **RWTH Aachen** (Rainer Leupers)

  - adaptivity at the processor ISA/architecture level

- **MDH** (Björn Lisper)

  - parameterized WCET analysis

- **KTH** (Hannu Tenhunen)

  - hardware-based adaptation

Partner Interests

Affiliated Partners:

– **UPC** (Pau Martí)

  ● self-organizing and cooperative resource management

– **UPM** (Alejandro Alonso)

  ● adapting system behavior by modifying resource assignment

– **U Catania** (Lucia Lo Bello)

  ● adaptive scheduling

– **Ericsson** (Johan Eker)

  ● Flexible multimedia in mobile telecom.

Tools and Platforms

- Whatever that is relevant from the thematic clusters, including

  – SHARK RTOS

  – TrueTime simulator

  – RWTH Aachen's embedded processor customization tool chain

  – SWEET (Swedish Execution Time Analysis Tool)

Total Budget (4 years)

- Overall:
  - 297 500 € (6.61 % of ArtistDesign)

- Per core partner:
  - 21 250 €
  - 44.44% JPIA and 55.56% JPRA
  - Twice as much for the activity leader

- This may sound much, but for each partner this is a very, very small amount

- Example:
  - 2/3 personnel costs, 1/3 travel-related direct costs
  - 5 k€ / man month → 3 man months → 3 man weeks / year

Adaptivity – How?

- How should we work in this activity considering the very small amount of funding available?

- It is not possible to finance any new major collaborations using only ArtistDesign funds.

- ArtistDesign funds can only be used as an add-on to already existing funds for collaborations, e.g., through STREPs

- We need to identify which existing funded collaborations that the partners are involved in and build upon these.

  – Use the ArtistDesign funding to create connections among these and magnify it

Existing Collaborations

- ACTORS STREP

  – Partners: ULUND, SSSA, TUKL, Ericsson, Evidence

  – Topic: Adaptive reservation management in multimedia telecom

- REALITY STREP

  – Partners: IMEC, U Bol, STM

  – Topic: Adadptation in nano-scale technologies (post 45 nm-tech)

- MNEMEE STREP

  – Partners: IMEC, ICD (Dortmund)

  – Topic: Memory management

- ANDRAS

  – Partners: KTH, OFFIS

  – Reconfigurable hardware

- DYSCAS

  - Reconfig automotive

  - Volvo, KTH, D-C. Bosch

- Trader

  - Adaptivity and dependability for cons. Elect

  - IMEC, ESI, NXP,

- MOSART

  - NoC resource management

  - IMEC, KTH

- FRESCOR

  - 18 more months

Adaptivity – How?

- Lots of different approaches and interests

- We need to gather in a meeting/workshop where we

    - Discuss different approaches to adaptivity

    - Define taxonomy

    - Identify partner interactions

    - Do the real planning for the activity

- A suggestion

    - In Lund

    - May-(June) 2008, e.g., 13-14 May

    - 1.5 day workshop

- No summer schools etc before October 2008 due to Artist2

Plans for Year 1

- Activity Meeting in Spring

  – Define what we mean by adaptation and what the different partners work with

  – Taxonomy

  – Identify connections and collaborations

  – Further planning

  – Result: Report

- Spawn partner collaborations - examples:

  – Braunschweig, Aachen, Bologna: software support for multicore adaptivity

  – ETHZ, Bologna: adaptive power saving techniques in sensor nodes

  – Lund, SSSA, TUKL: control and adaptation

  – Lund, Bologna: control techniques for dynamic voltage and speed settings