



# Programming models and operating systems

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# Agenda

- Cluster topics
- Cluster organization
- Goals
- Projects already started
  - Xavier Martorell
  - Dimitris Nikolopoulos
  - Bilha Mendelson
  - Theo Ungerer
  - Olivier Temam
  - Pedro Trancoso
  - Rainer Leupers
- Discussion
- Conclusion

# Cluster topics (1)

Cluster topics include the following:

## Parallel programming models

- Expressing different types of parallelism
  - Loop parallelism
  - Task parallelism
  - Streaming parallelism
- Novel programming paradigms
  - Transactional memory
- Mixed programming models

# Cluster topics (2)

## OS/Run Time systems

- Managing parallelism
  - Task off-loading
  - Task synchronization
  - Load balancing
  - Scheduling and allocation
  - Power optimization
  - Quality of Service / Real Time
- Support for new architectures: heterogeneous cores, reconfigurable cores
- Real-Time
  - Automotive and avionic systems
  - Hard/soft real time

But remember: *members drive the agenda*

# Contacts

Several people work for this cluster:

BSC

- Cluster leader: Mateo Valero
- Cluster coordinator:  Roberto Gioiosa
- Programming models coordinator: Xavi Martorell
- Operating System/Runtime coordinator: Nacho Navarro

all of us are willing to help you to get in touch and to coordinate the cluster. But..

In order to have a more comprehensive view, we would like to know who's working on your side. Please send us contacts names and interests, then we will...

# Getting in touch!

... build a community around this cluster:

Mailing lists:

The easy way to communicate with other people in the cluster.

Web resources:

Wiki / Drupal / Jommla! web site for collaborative documentation; sharing knowledge among people is the first step through successful collaborations

Meetings

2/3 meeting per year scheduled together with other HiPEAC2 events

# Cluster Organization

We need to be active inside HiPEAC2 in order to contribute to Europe's growth

## Yearly events:

E.g. MULTIPROG Workshop (this year in conjunction with the HiPEAC Conference):

- Many of you attended the workshop
- Several problems emerged during the presentations
- People are now aware of what is going on in Europe concerning programming Multi-core processors

## Tutorials:

There are several programming models already available in our cluster:

- Organize tutorials to train people how to use these programming models
- Promote and write applications that use this programming models

# Cluster Organization (2)

Mobility:

Promote internships, visiting and sabbaticals:

- Give the opportunity to people to work closely
- Increase the level of collaboration inter- and intra-cluster

Other meetings

2-3 Hub meetings per year

# Goals

There can be several goals inside the cluster. Besides the general goals of HiPEAC2 (publishing, promoting research, getting in touch, mobility, etc.), we have some specifically related to our cluster. Some examples are:

## Programming models

Climb down the Babel Tower

- There are now several programming models
- We can try to converge to a programming model and promote it as the HiPEAC2 programming model

## Operating Systems

Both Supercomputers and Embedded Multi-core systems need new OS/Runtime in order to address:

- Performance
- Heterogeneity and multiple address spaces
- Real Time constraints
- Power issues

# Goals (2)

The previous ones are only some of the problems we might want to address. We are the cluster, we should decide what to address and how to do it.

- The goal of this meeting is to make people aware of what is the current research in Europe
- Once this is clear, we need to define our goals and how to reach them

Collaboration (inter- and intra- cluster) is the main key to reach our goals

Applications

- Taken from other clusters and ours
- Find representative of several domains
- Programming these applications with our programming models
- Build a repository of HiPEAC2 benchmarks
- The Task Force on Applications will help us reaching our goals

# Relationship to other clusters

The Programming model and Operating systems cluster is related to:

- Architecture cluster / Interconnection networks
  - Explicit hardware support for PM constructs
  - Scheduling + allocation on heterogeneous architectures
- Reconfigurable cluster
  - Task execution on reconfigurable hardware
  - Scheduling / pre-fetching reconfiguration of hardware
- Compiler platform
  - Extend GCC to support Transactional Memory

# Projects already started (1)

## Programming models

- OpenMP, StarSS, (BSC/UPC)
- Transactional Memory (BSC, INRIA, DITEC UM, Univ. Edinburgh)
- CAPSULE (INRIA)
- Tagged procedure call (FORTH)
- Heterogeneous cores (NTNU)
- Hierarchically Tiled Array (UDC)
- Load/task distribution (Thales)

## Identifying and exploring parallelism

- Program analysis and optimizations (UPC, Ugent, Thales)

# Projects already started (2)

## Operating Systems/RunTime

- Scheduling (Hebrew University)
- Resource management (Univ. Edinburgh, Hebrew University)
- Runtime and OS evaluation tools for heterogeneous multicore environments (UPC/BSC, FORTH-ICS, IBM Research)

## Real Time

- MERASA (European FP7 project)
- ASMP-Linux (BSC, Univ. of Rome “Tor Vergata”)

# Thank you!

If you have any doubts, please don't hesitate to contact me at:

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