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Network for Sustainable Ultrascale Computing (NESUS)

WG 2: Programming models and runtimes

.

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FINAL ACTION MEETING
Madrid, March 15-16th 2018

WG2 goals presentation

□ Focus

- Promoting new sustainable programming and execution models in the context of rapidly changing underlying computing architecture.

□ Key objectives

- Scale handling (optimal usage of resources, faults)
- Improving programmability.
- Adaptation to rapidly changing underlying computing architecture
- Adaptations for data-centric programming models, **resilience, and energy-efficiency**

WG2 scientific contributions

- Simplification for programmers, higher level programming models, increased leverages for runtimes
 - Increase of programmability of heterogeneous systems
 - Increase the programmers insight with high level debugging tools
 - Simplification of network operations
 - Simplification of data management
 - Increase of reconfigurability of applications
 - Increase of awareness of sustainability for schedulers and runtime

In cooperation publications

□ Highlight:

- An application-level solution for the dynamic reconfiguration of MPI applications

□ A few numbers between 2014 and 2017

- Journals: 23 articles
- Conferences: 31 articles

□ Result directly from STSM

- 34 are related to WG2 (ie 50% of total)

WG deliverables

- Tutorial during Winter-Schools
 - Half tutorials are WG2 related
- White paper on sustainable programming models and run-times.
 - *Exascale machines require new programming paradigms and runtimes.*

Published in **Supercomputing Frontiers and Innovations**, with 13 authors from WG2
- Research papers on synergistic approaches for programming models and run-times.
 - More than 50, distributed along the Action duration

In-cooperation H2020 projects

- Most H2020 projects submitted have links with WG2
 - Most emblematic: **ASPIDE** (Exascale programming models for extreme data processing)
 - **REPHRASE** (Refactoring Parallel Heterogeneous Resource-Aware Applications) improves programming models to leverage heterogeneity
 - **LightKone** (Lightweight computation for networks at the edge) proposes a new programming paradigm along with its distributed runtime
 - **VINEYARD** (Versatile Integrated Accelerator-based Heterogeneous Datacenters) tackles the heterogeneity of resources using high level programming paradigm
 - **HPC4E** (High performance Computing for Energy) improves the programmability and performance for non computer scientists.

In-cooperation workshop organization

- Special Session on System Management for Energy Efficient Parallel Applications and Platforms. In PDP 2015
- First Workshop on Techniques and Applications for Sustainable Ultrascale Computing Systems, TASUS 2014. In EuroPar 2014.
- Twelfth International Workshop on Algorithms, Models and Tools for Parallel Computing on Heterogeneous Platforms (HeteroPar 2014). In EuroPar 2014.

Applications and benchmarks

- Large number of programming frameworks to change from classical paradigm
- Example: DuctTeip
 - Dependency-aware User-annotated Concurrent Tasks Ex
- Overall, in the tool repository 10 are related to WG2
 - Libraries
 - Compilation toolchain
 - Runtime support

Contributions to the Research Roadmap

- R2: Improve the programmability of complex systems
- R3: Break the wall between runtime and programming frameworks
- R4: Enabling behavioral sensitive runtime
- Contributions at the programming model level, at the runtime level, and at their interface

Summary

- Most existing researches are either at the level of programming models OR at the runtime one
 - The whole toolchain along with existing paradigms are to evolve to a new level for enabling Exascale !

- New H2020 projects are needed !

- Extreme challenges of programmability are needed !



Thank you!

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