ECOSCALE

Reconfigurable Computing and Runtime System for Future Exascale Systems

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Yannis Papaefstathiou

email: ygp@synelixis.com

Synelixis Solutions Ltd

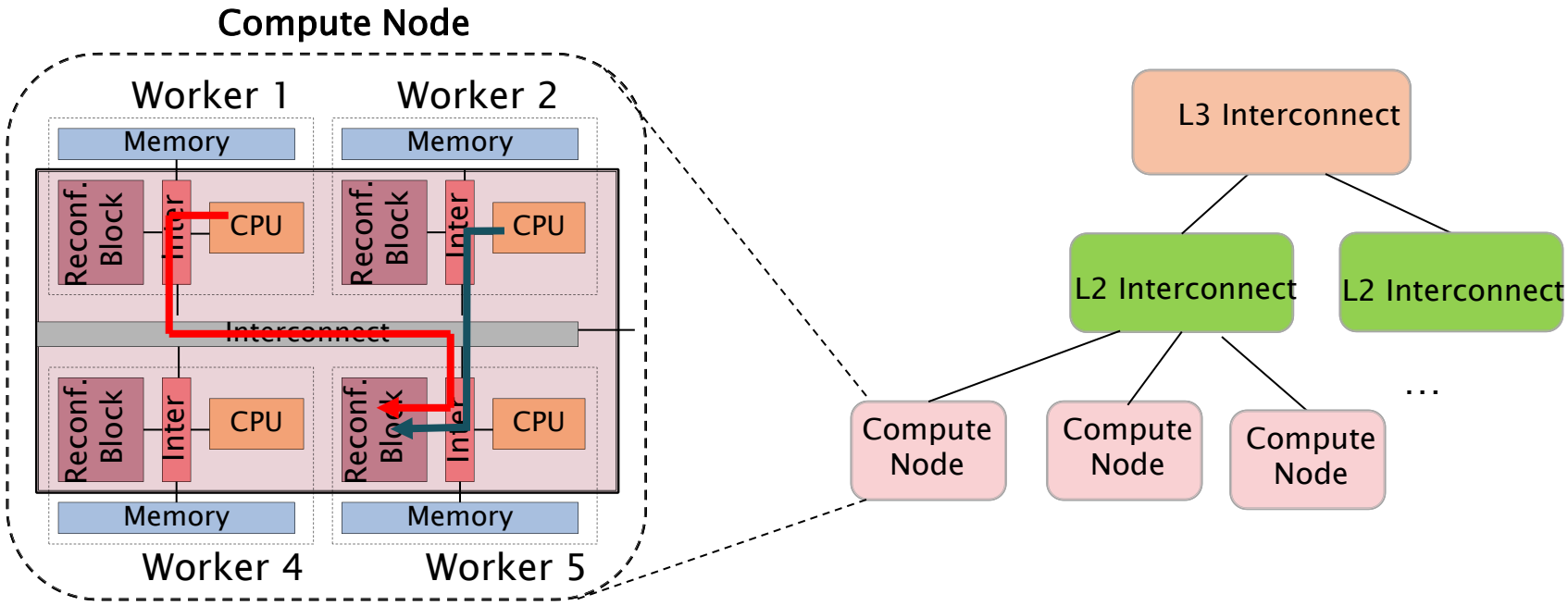
Outline

- Objectives
- Hardware
- Software (Programming)
- Relevance to EsD
- Conclusion

Objectives

- **Use MPI+OpenCL to utilize reconfigurable computing**
  - Get orders of magnitude more performance with conventional software development process
  - Get an order of magnitude higher energy efficiency by having dedicated hardware modules for power hungry tasks
  - Get orders of magnitude higher reliability in terms of MTTF since FPGAs can easily be reconfigured after deployment

How We Will do it ?



- Create a computing node incorporating FPGAs and high-end ARM cores tightly together
- Provide hooks to allow for the interconnection with vast storage efficiently (Through the ExaNest project)
- More complex Processing units will be seamlessly integrated (Through the ExaNode project)

Nice Hardware … what about Software

- The whole system will be programmed by "conventional" MPI and OpenCL
  - The programmer will not be aware of the FPGA's intricacies
  - Even the reconfiguration of the system will be done in a "zero latency" manner
- Most OpenCL kernels would be automatically translated into efficient hardware accelerators
- Certain optimized OpenCL kernels will be initially developed while a complete such repository is envisioned (through an EsD project?)

Relevance to EsD

- ECOSCALE can be the utilized within an EsD project in several manners:
  - Integrate the end reconfigurable platform with other homogeneous and/or heterogeneous large scale HPC system(s)
  - Port to the end platform novel HPC low-level software (e.g. intercommunication middleware, adapted OSs, tools for monitoring, debugging, performance analysis, security, QoS etc)
  - Optimize novel HPC applications for the ECOSCALE platform and/or create an ECOSCALE optimized library
  - Perform a design space exploration of ECOSCALE's main applications in other HPC systems
  - Open to any other suggestions !

Conclusion

- ECOSCALE provides an ecosystem comprising of a High Level programming environment coupled with a novel runtime environment running on top of a novel hardware environment
- ECOSCALE utilizes
  - Distributed Reconfigurable Logic
  - MPI+OpenCL programmability
  - Hidden runtime reconfiguration
  - ☝ So you get performance, power efficiency and resilience for free in terms of development time (almost ☺)
- ECOSCALE can (and should ?) be a part of an EsD project so as to be commercially exploited and allow highly demanding HPC applications to take advantage of its unique features

Euroexa is coming for more ☺