MONT-BLANC

http://www.montblanc-project.eu

1st Year Progress
2nd Year plans

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SEVENTH FRAMEWORK PROGRAMME

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Mont-Blanc: Year 1 Highlights

- Architecture
  - Selection of the MPSoC
  - Definition of the Mont-Blanc architecture
- System software
  - HPC system software stack ported to ARM
  - OmpSs compiler support for FORTRAN
- Applications
  - Ported 11 full-scale applications to ARM multicore cluster
  - Extracted kernels for OmpSs evaluation

ARM MPSoC selection criteria (I)

- Quantitative metrics
  - Energy efficiency: GFLOPS / W
  - Absolute performance: GFLOPS
  - Cost efficiency: GFLOPS / $
  - Performance density: GFLOPS / cm^2 (or cm^3)
  - Memory bandwidth: Bytes / FLOP
  - Interconnect bandwidth: Bytes / FLOP
- Notes
  - These metrics do not depend on the MPSoC exclusively
  - Best performance and best efficiency may not be achieved at the same frequency

ARM MPSoC selection criteria (II)

- Must have features
  - ARM Cortex-A15
  - Embedded accelerator
    - 64-bit floating point
    - Programmable (OpenCL, CUDA, OpenMP, …)
  - 4 GB DRAM
    - Maximize per-node problem size
  - HPC compatible packaging
    - Package-on-Package (PoP) solutions not valid for HPC
  - Availability
    - Samples in Q1 2013, Mass production in Q2 2013
    - Direct support from vendor
  - Ethernet interface (1 GbE or +)
    - USB 3.0 to GbE bridge
  - Local storage interface
    - MMC or uSD

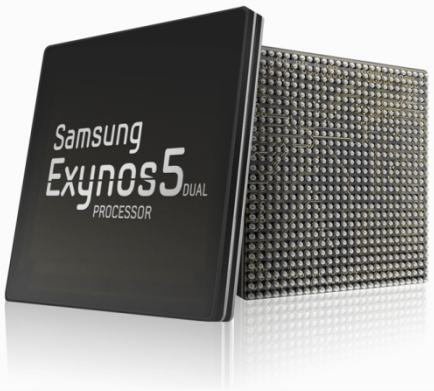
ARM MPSoC selection criteria (III)

- Nice to have features, but not required
  - Early evaluation / developer board
  - ECC protection on DRAM
  - Usability of DIMM format for DRAM
  - Advanced monitoring, control, and debug capabilities
  - Extended implication of the provider
    - Support for prototype development (hardware, firmware)
    - Support for use of the prototype (compiler, runtime)
    - Plans for ARMv8 MPSoC in the future
    - Great motivation and reactivity
- Clear message to be sent out
  - European provider, or European technologies
  - Technology from the mobile / consumer space used in HPC

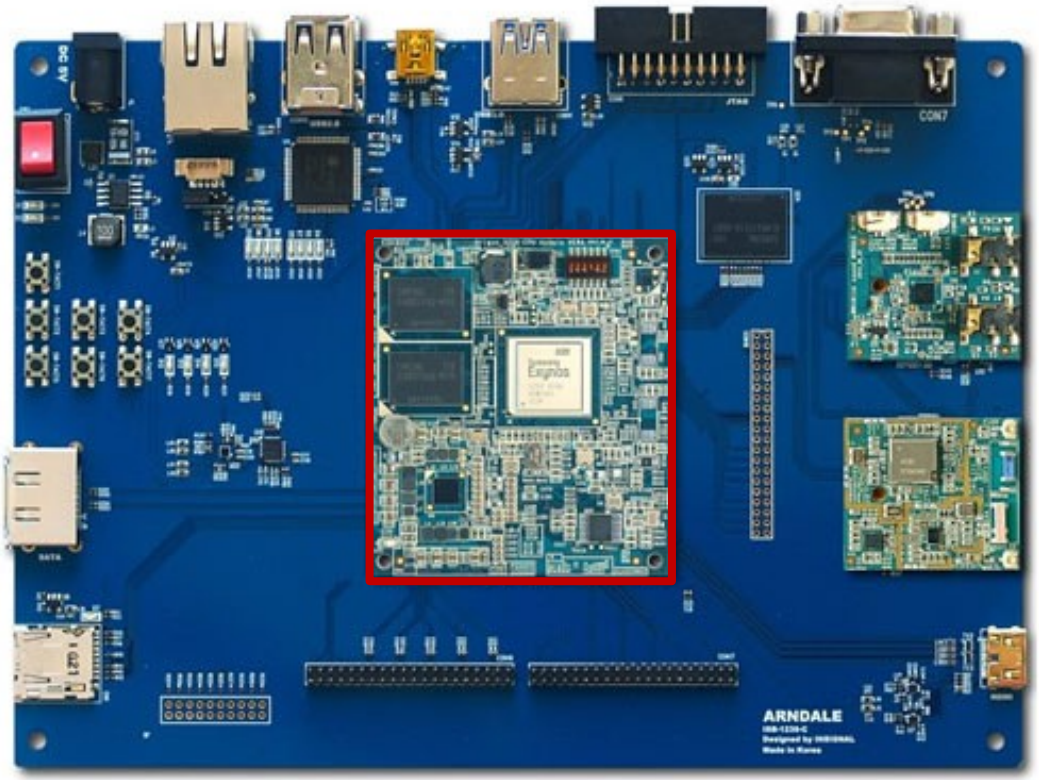
Samsung Exynos 5 Dual Superphone SoC

- 32nm HKMG
- Dual-core ARM Cortex-A15 @ 1.7 GHz
- Quad-core ARM Mali T604
  - OpenCL 1.1
- Dual-channel DDR3
- USB 3.0 to 1 GbE bridge

- **All in a low-power mobile socket**



Samsung Exynos 5 Arndale community board

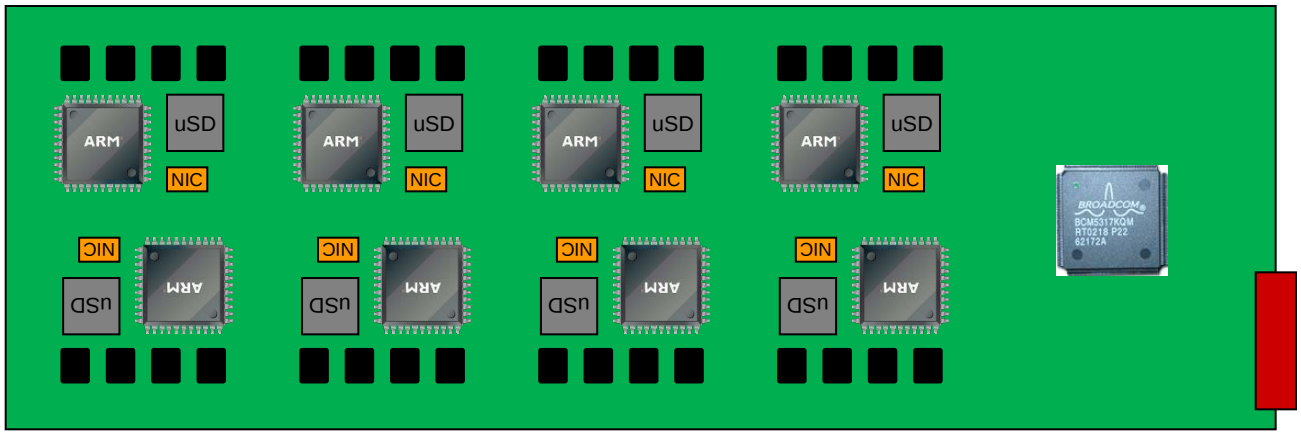


- Exynos 5 Dual SoC, full profile OpenCL
  - 2x ARM Cortex-A15, ARM Mali-T604, 2GB DDR3
- 100 Mbit Ethernet, NFC, GPS,HDMI, SATA 3, 9-axis sensor, …
- uSD, USB 3.0
- Available today, priced at $249

High density packaging architecture

- Standard BullX blade enclosure
- Multiple compute nodes per blade
  - Additional level of interconnect
    - On-blade switch with LBA

X86 + Nvidia cluster, Minotauro @ BSC, 1266 MFLOPS / Watt

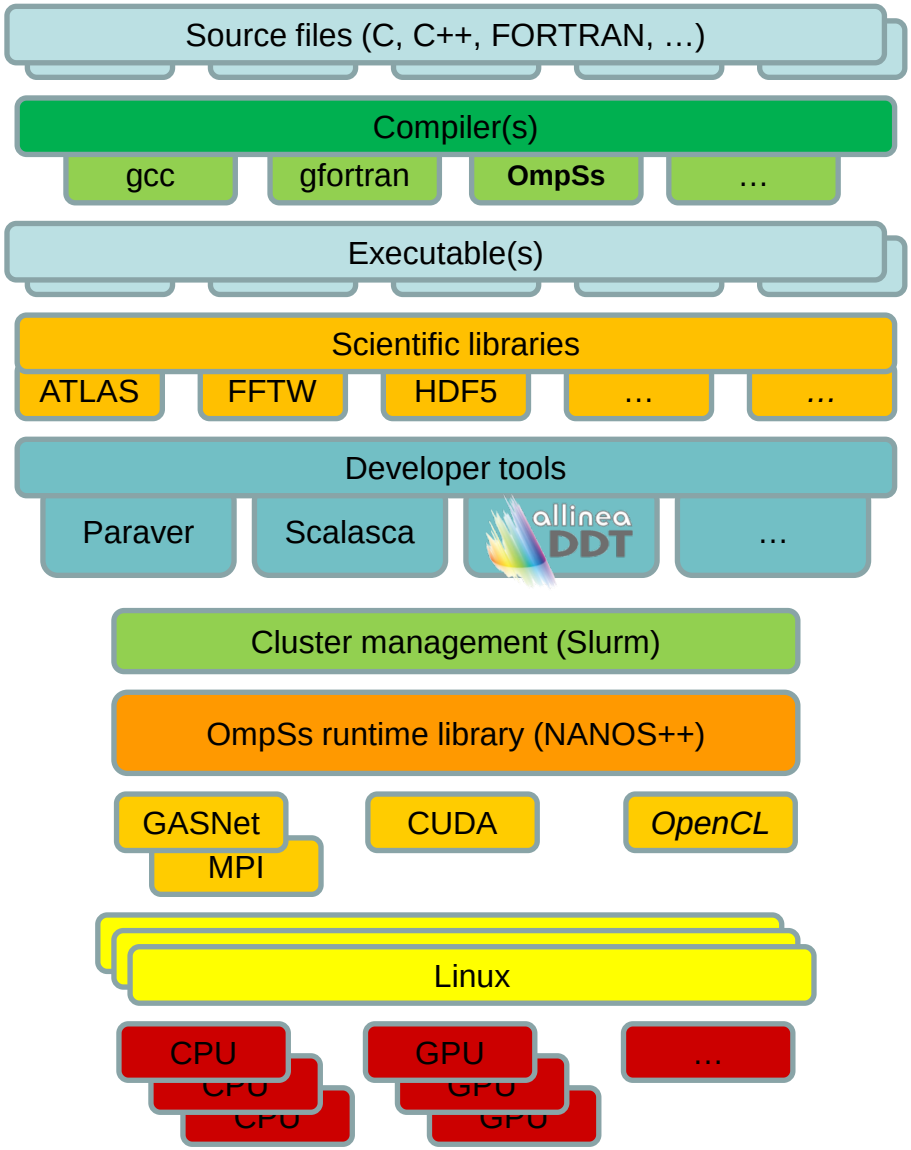


* Strawman design concept, not the actual Bull implementation

Challenges and Opportunities

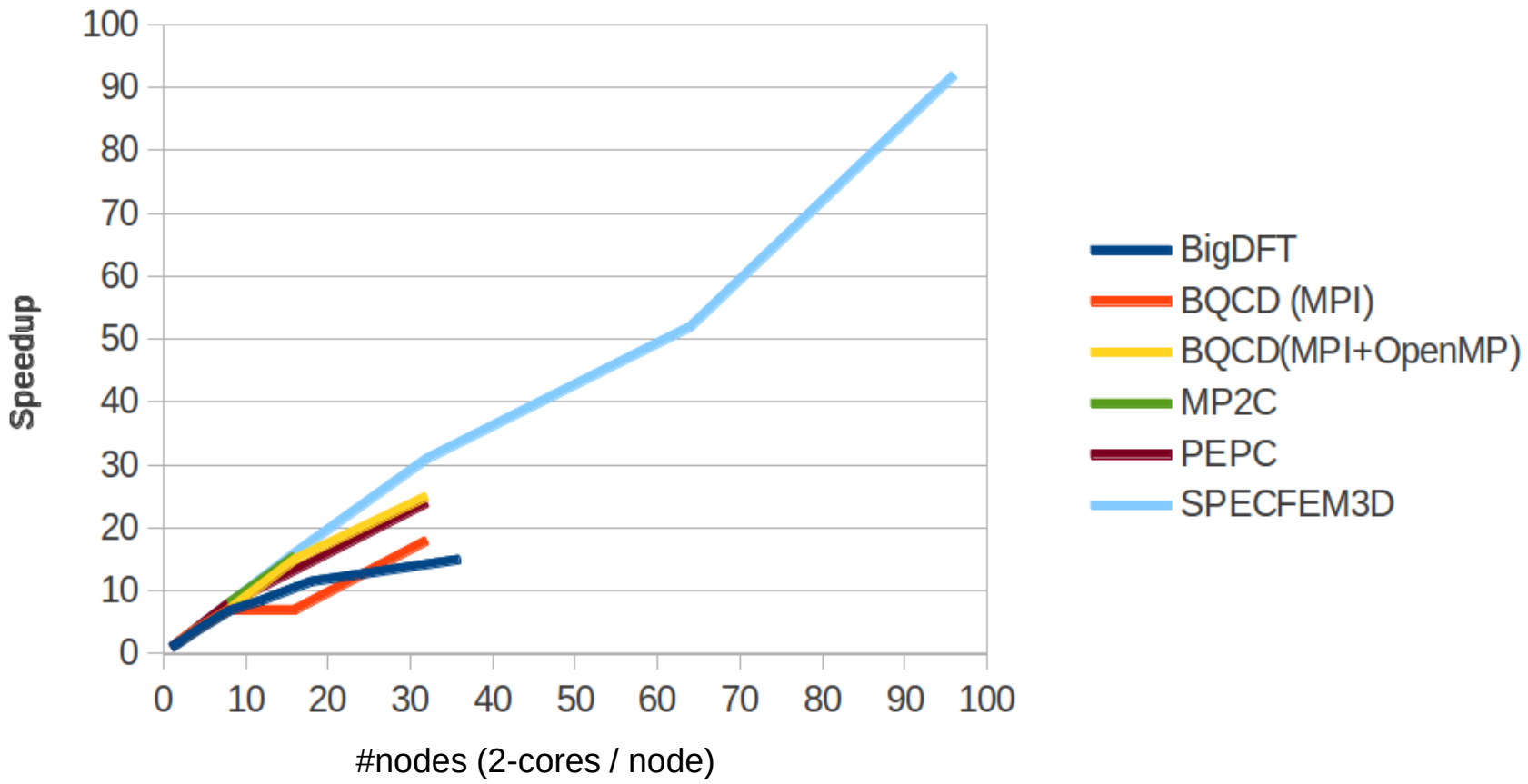
- Challenges
  - Low absolute performance
    - Requires strong scaling
  - High latency + low bandwidth interconnect
    - USB 3.0 to 1 GbE bridge
    - Overlap communication with computation
- Opportunities
  - Shared memory between CPU and GPU
- Exciting roadmap ahead
  - Exynos 5 Quad
    - 4x Performance improvement
    - Same mobile socket
  - ARMv8 CPU
    - ARM Cortex-A53 / A57
    - big.LITTLE
  - Vendors are listening …
    - GbE integration
    - ECC on DRAM
    - …

HPC System software stack on ARM



- Open source system software stack
  - Ubuntu Linux OS
  - GNU compilers
    - gcc, g++, gfortran
  - Scientific libraries
    - ATLAS, FFTW, HDF5,...
  - Slurm cluster management
- Runtime libraries
  - MPICH2, OpenMPI
  - **OmpSs toolchain**
- Performance analysis tools
  - Paraver, Scalasca
- Allinea DDT 3.1 debugger
  - Ported to ARM

Applications ported to ARM multicore cluster

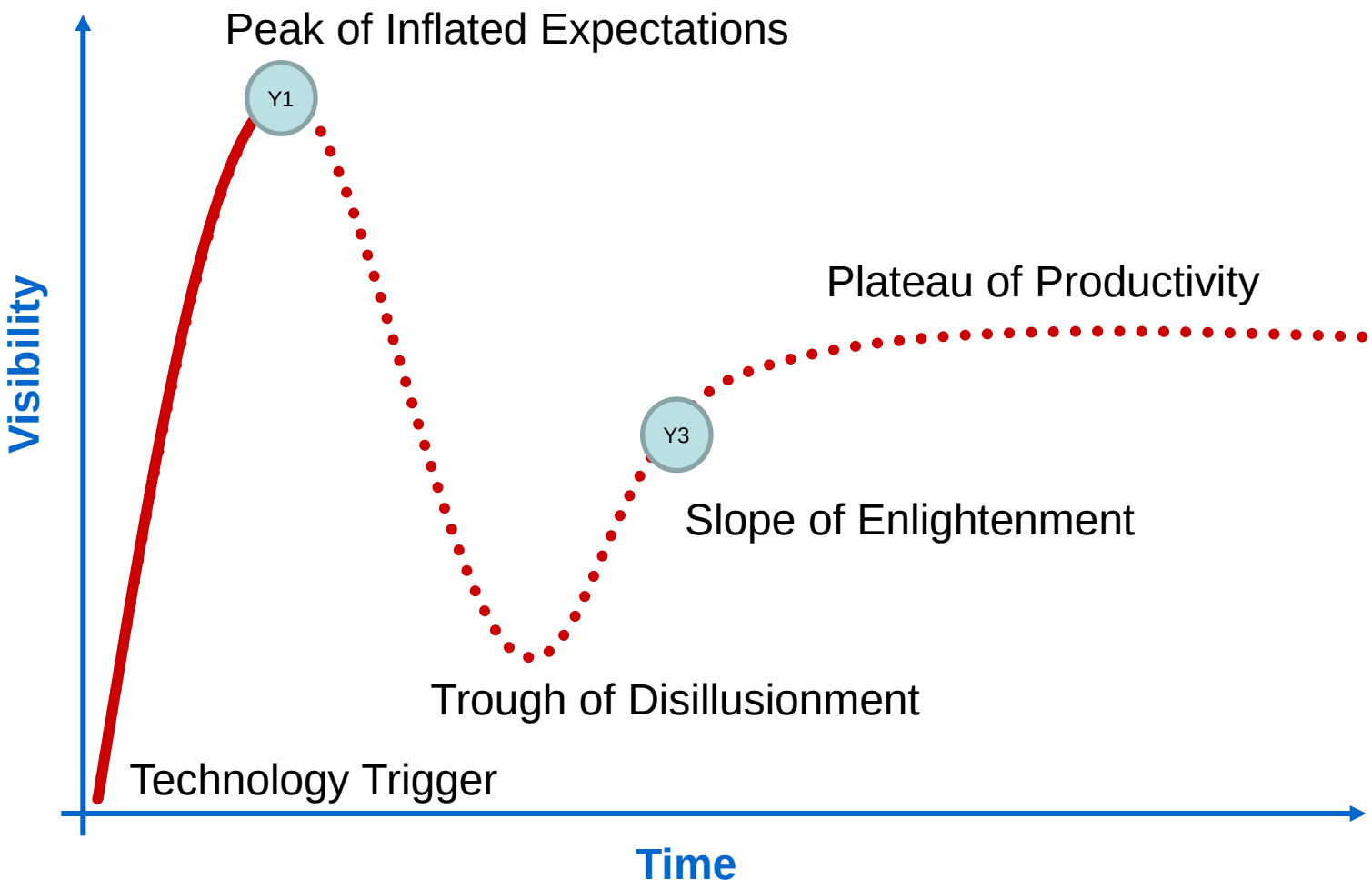


- Minimal porting effort, standard Linux environment
- Scalability issues detected due to MPI timeouts
  - MPI tuning in progress

Mont-Blanc: Year 2 Highlights

- Architecture
  - Development of the Mont-Blanc prototype
  - Research on next-generation Mont-Blanc system
- System software
  - Development of the OmpSs @ OpenCL runtime
  - Tuning of ARM Linux for HPC
- Applications
  - Porting of applications to OmpSs
    - Task partitioning

The hype curve



- We'll see how deep it gets on the way down ...

Conclusions

- Mont-Blanc architecture is shaping up
  - ARM multicore + integrated OpenCL accelerator
  - Ethernet NIC
  - High density packaging
- OmpSs programming model port to OpenCL
- Applications being ported to tasking model

- Stay tuned!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