



**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación

BoF 15: Embedded Technologies for Supercomputers

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Disclaimer

- I first gave this presentation as a BSC employee, and coordinator of the Mont-Blanc project. I am currently an employee of NVIDIA corp.
- I do not speak for any of them, there is no commitment expressed or implied by this presentation
 - I hardly speak for myself, and I reserve the right to change my mind at any time, without prior notice or warning
- This presentation is provided AS IS, with no warranty expressed or implied, that it will fit any purpose ...

The problem ... and the opportunity

- Nobody really knows how to build a sustainable EFLOPS supercomputer



POWER



SPACE



COST

- Consensus about it being revolutionary, not evolutionary
- Everyone starts from square zero, hence equal opportunities

Is this about Intel vs. ARM?

- It's really **NOT** about Intel vs. ARM
 - SandyBridge vs. Cortex-A15 vs. Haswell vs. Cortex-A57 vs. ...
- It's not even about Intel vs. NVIDIA, vs. AMD, ...
 - Kepler vs. Phi vs. FireStream vs. Mali vs. PowerVR ...
- After all, it's the same CMOS technology
 - With Intel usually on step ahead of the rest
- Performance vs. Power are just design choices
 - Tradeoff single-thread performance vs. throughput vs. cost vs. ...
- The advantage is in **integration** and **customization**
 - Traditional HPC: One size fits all
 - Embedded systems: Customized System-on-chip



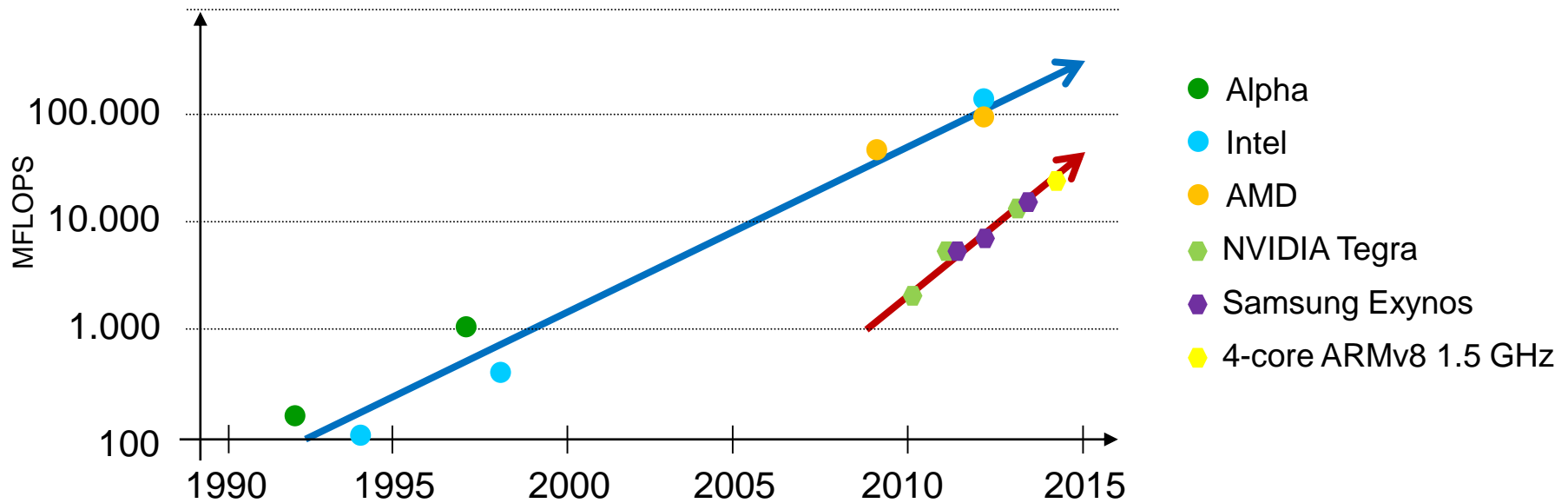
A new business model for HPC

- Many IP providers
 - CPU: ARM, MIPS, Power, ...
 - GPU: Mali, PowerVR, Kepler, ...
 - Network: Ethernet, Extoll, Nvlink (?)
 - I/O: PCIe, USB, ...
 - ...
- Many semiconductor providers
 - Nvidia, Samsung, Apple, Qualcomm, TI, ST, ...
- Many system integrators
 - Lenovo, HP, Dell, Supermicro, Bull, Eurotech, T-Platforms, ...

Benefits of the Embedded SoC model

- Separate the processor IP from the silicon integrator
 - Increased competition is good for the customer
- Enable customization of the SoC for the target application
 - Increased integration + specialization increase performance and energy efficiency

The killer mobile processors™

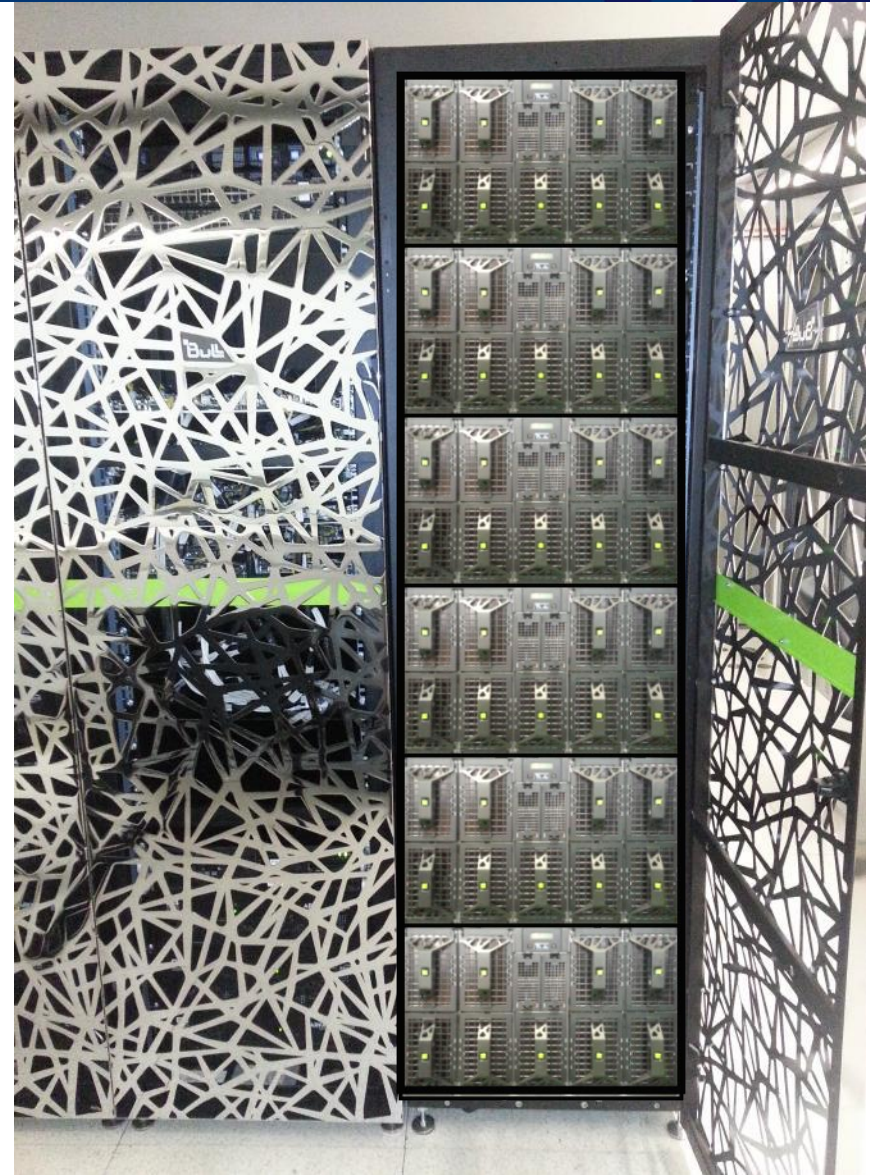


- History may be about to repeat itself ...
 - Mobile processor are not faster ...
 - ... but they are significantly cheaper
- Need 10 smartphones to achieve the performance of 1 High Performance CPU
 - Leverage the embedded GPU accelerator

1 Rack of the Mont-Blanc prototype

- 6 BullX chassis
- 54 Compute blades
- 810 Compute cards
 - 1.620 ARM Cortex-A15
 - 810 Mali-T604
 - 3.2 TB of DRAM
 - 52 TB of Flash

- 26 TFLOPS
- 18 KWatt



Conclusions

- Need sustainable EFLOPS technology
 - Limited power + space + cost
- Embedded industry has the potential to create a new class of sustainable computer
 - Faster, cheaper, more efficient
- The Mont-Blanc project has built the first such prototype system
 - Get ready for the change ... before it happens