

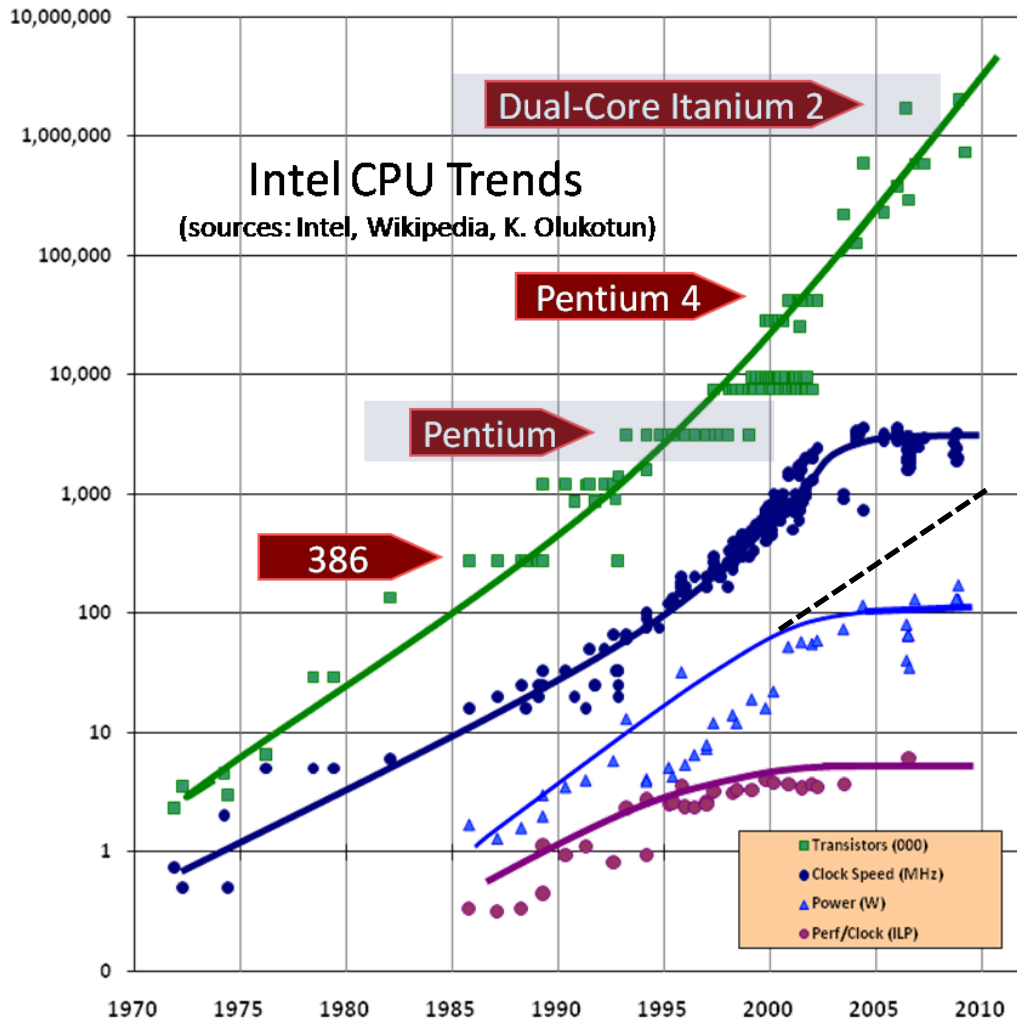


POWER: The New Metric

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🌿 It's Moore's Law's fault



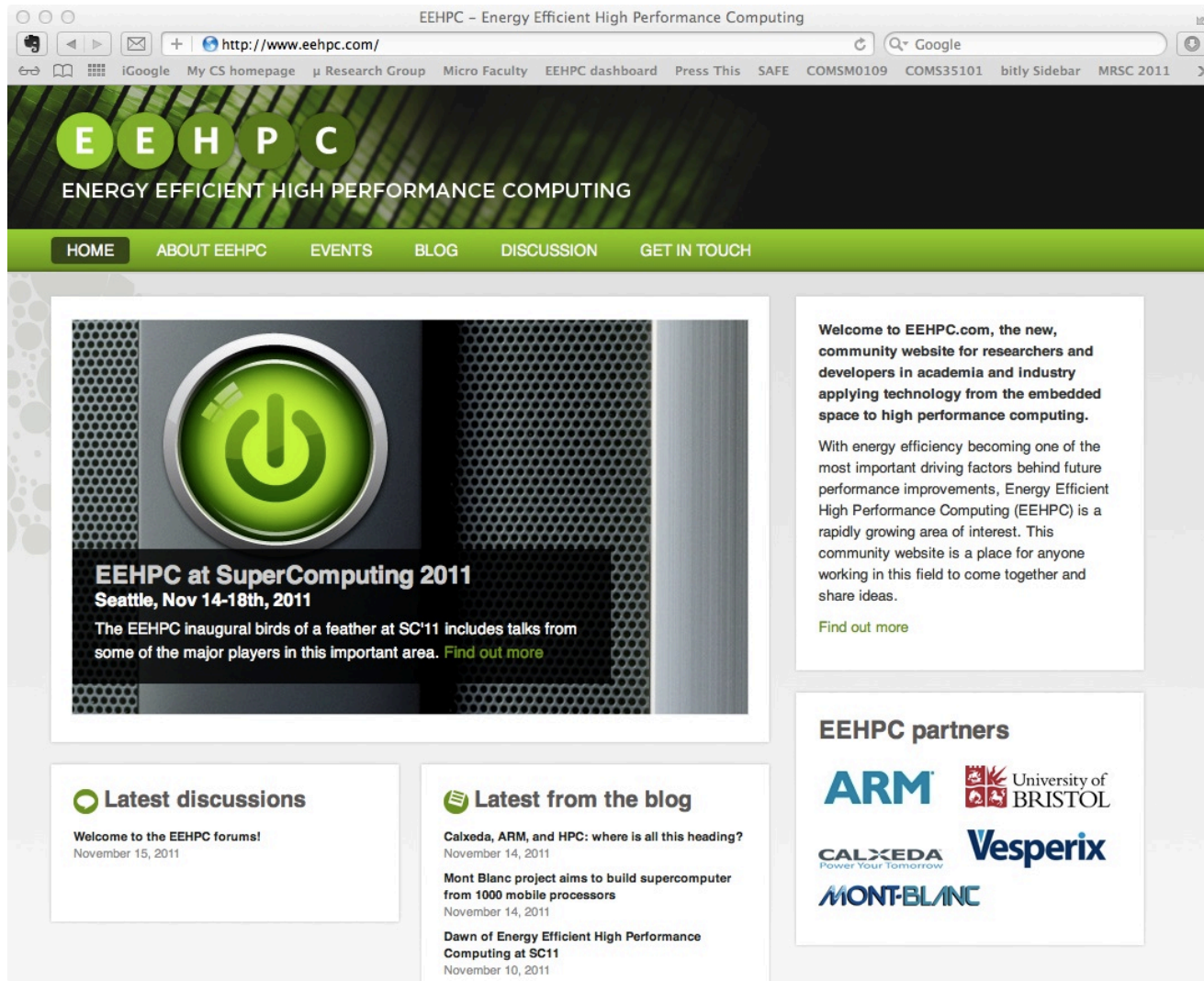
The real Moore's Law

The clock speed plateau

The power ceiling

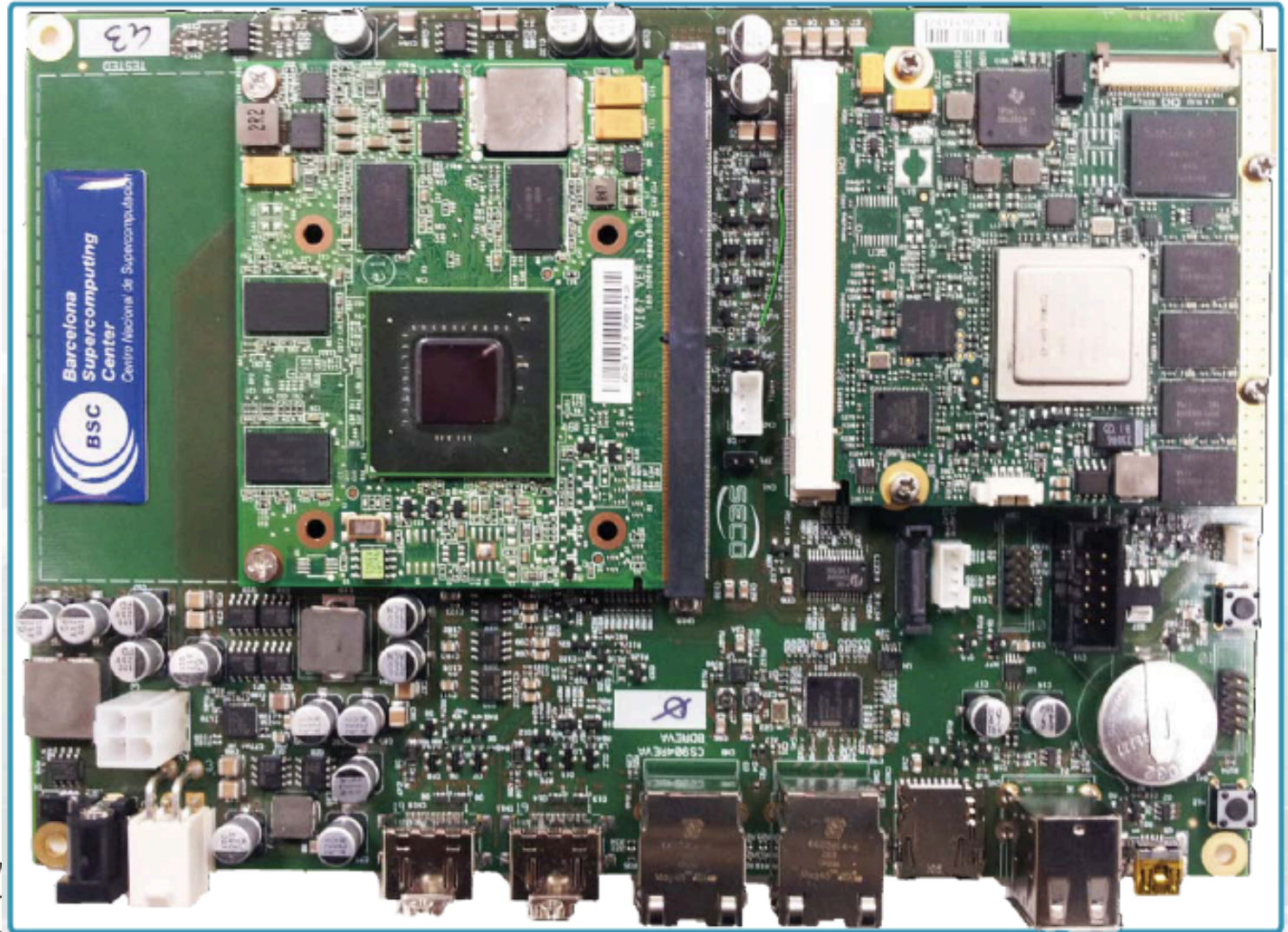
Instruction level parallelism limit

EEHPC.com launched at SC'11

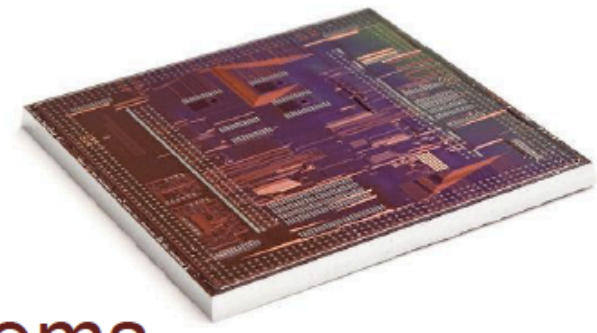
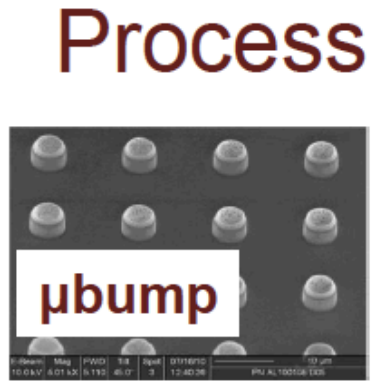
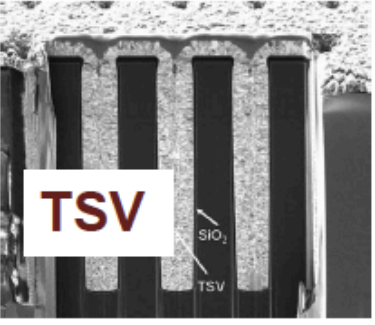
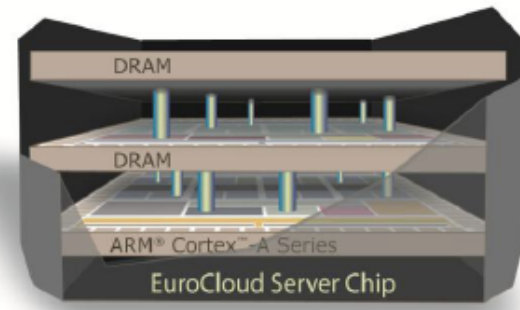


The screenshot shows the EEHPC.com website homepage. The browser address bar displays "http://www.eehpc.com/". The page features a green and black header with the EEHPC logo and the text "ENERGY EFFICIENT HIGH PERFORMANCE COMPUTING". A navigation menu includes links for HOME, ABOUT EEHPC, EVENTS, BLOG, DISCUSSION, and GET IN TOUCH. The main content area is divided into several sections:

- EEHPC at SuperComputing 2011**: A large graphic with a power button icon. Text: "Seattle, Nov 14-18th, 2011. The EEHPC inaugural birds of a feather at SC'11 includes talks from some of the major players in this important area. [Find out more](#)"
- Welcome to EEHPC.com**: A text box stating: "Welcome to EEHPC.com, the new, community website for researchers and developers in academia and industry applying technology from the embedded space to high performance computing. With energy efficiency becoming one of the most important driving factors behind future performance improvements, Energy Efficient High Performance Computing (EEHPC) is a rapidly growing area of interest. This community website is a place for anyone working in this field to come together and share ideas. [Find out more](#)"
- EEHPC partners**: A section displaying logos for ARM, University of BRISTOL, CALXEDA (Power Your Tomorrow), Vesperix, and MONT-BLANC.
- Latest discussions**: A section with the title "Welcome to the EEHPC forums!" dated November 15, 2011.
- Latest from the blog**: A section with two entries: "Calxeda, ARM, and HPC: where is all this heading?" dated November 14, 2011, and "Dawn of Energy Efficient High Performance Computing at SC11" dated November 10, 2011.

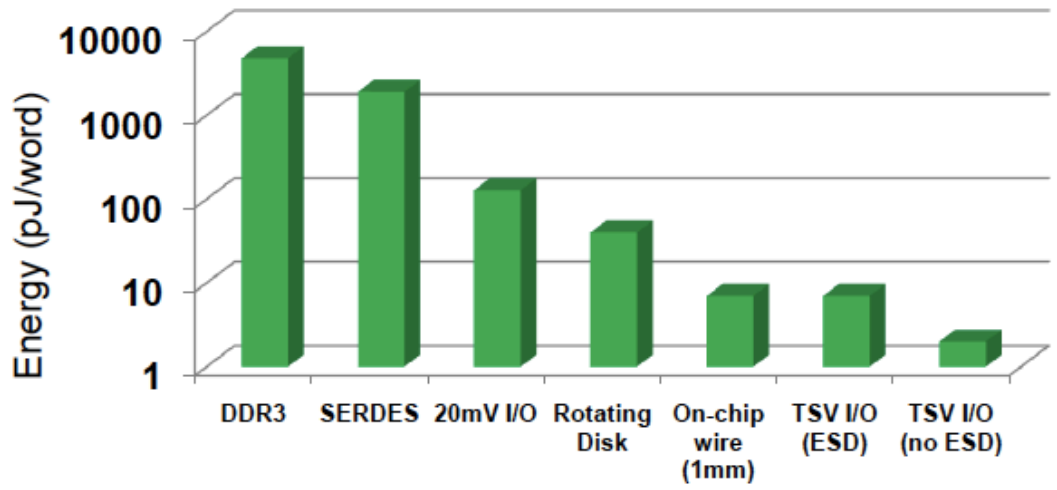


<http://www.eurocloudserver.com/>



Systems

Bandwidth — High TSV & μbump density
 >100GB/s of DRAM bandwidth, <25ns latency

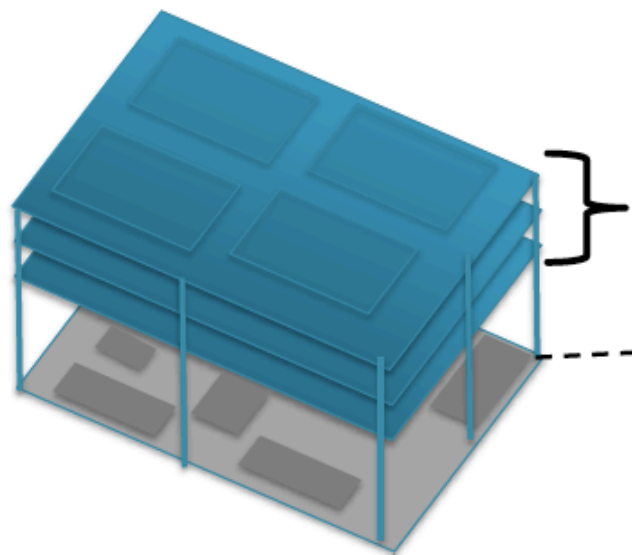


Power Density ,
 Thermal Management,
 Reliability

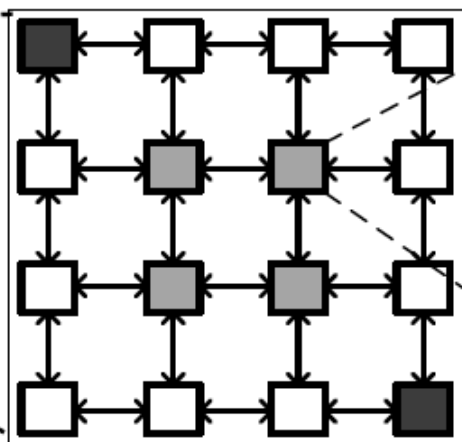
Design Tools , Methodology

Manufacturing, Test, Yield

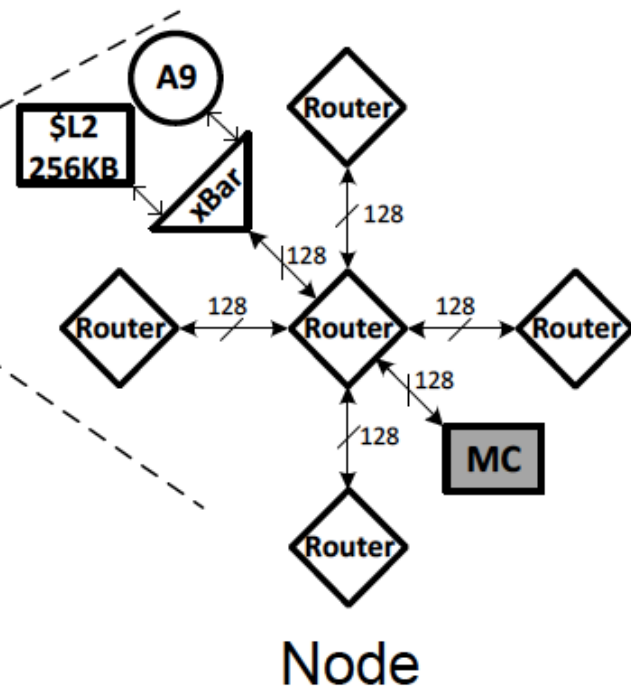
Standardization, Supply Chain



3D-stacked
DRAM cache



Logic die

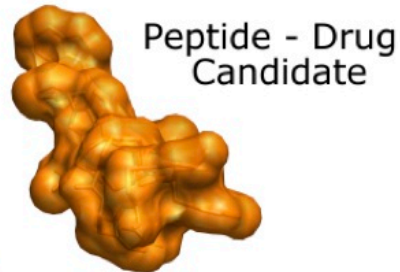


Node

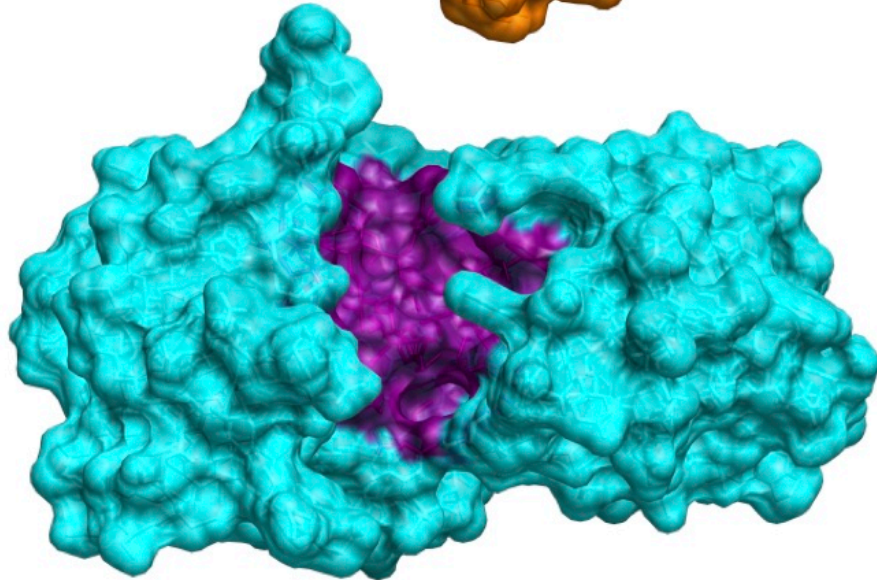
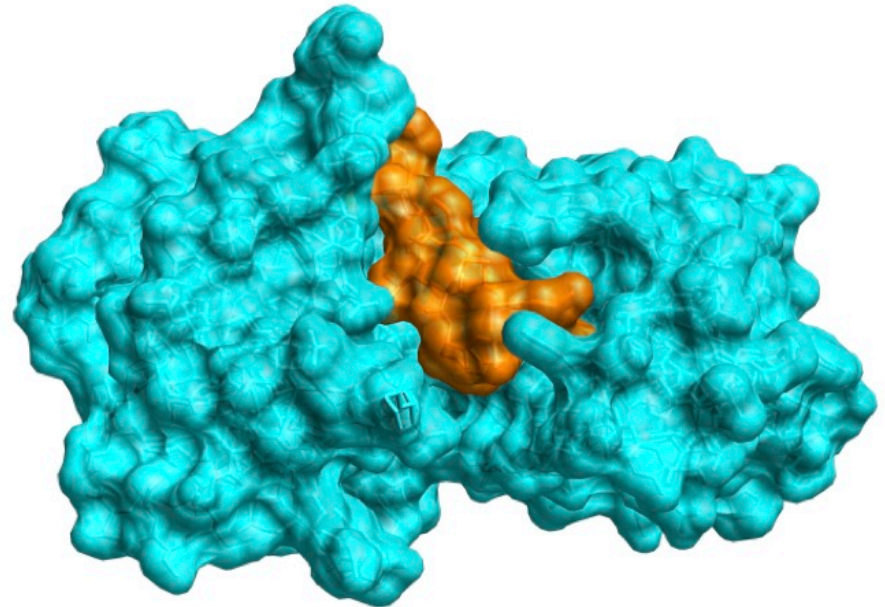
- 16 A9 ARM cores
- 4MB shared L2 cache
- 4x4 mesh interconnect
- 4 memory controllers with Wide I/O interface
- 4GB on-chip DRAM

BUDE:

Molecular docking with OpenCL



Predicted Successful Interaction

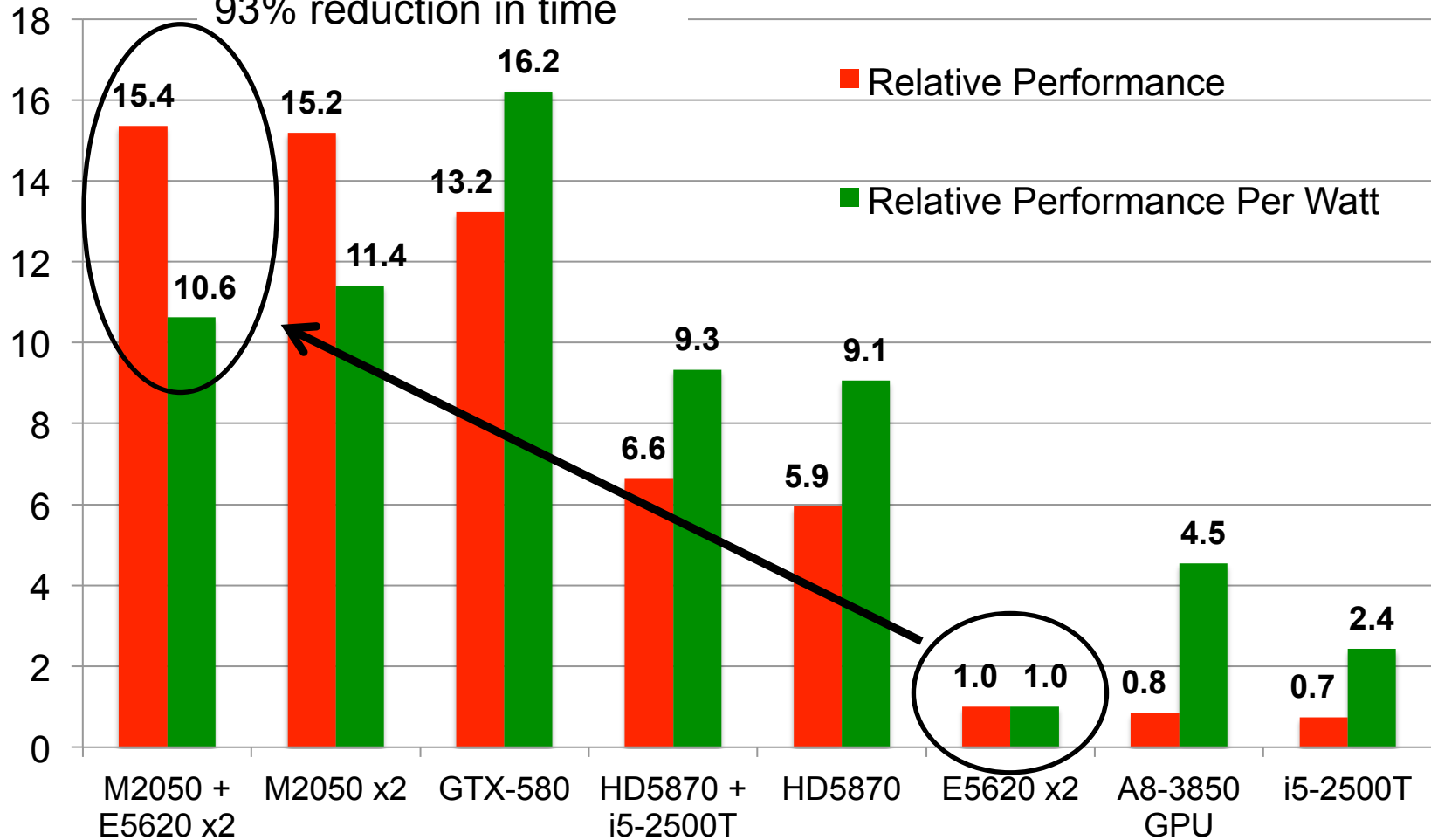


Enzyme - Drug Target

Proteins typically $O(1,000)$ atoms
Ligands typically $O(100)$ atoms

Relative energy and run-time

88% reduction in energy
93% reduction in time



Conclusions

- Power (energy efficiency) changing from being unimportant to being a limiting factor for large scale computing
- Is becoming a first order concern for hardware developers
- Likely to become a primary concern for software developers too