

Disruptive Trends by Custom Compute Engines

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Computing is an extremely conservative science. After about a dozen of technology generations the dominant basic principles have mainly remained the same. Although von Neumann has not invented this mainstream form of computing, he and his co-authors have been in the mid' 40ies the first to clearly describe the strikingly simple machine paradigm which I would like to call the *von Neumann paradigm*. Other paradigms, like dataflow machines, reduction engines, or others, have never been commercially significant. Commercial breakthroughs mainly stem from the progress of semiconductor technology but have hardly affected the blinders limiting the scope of conference series like ISCA or MICRO, which remained almost 100% von-Neumann-based all the time. Dozens of expired supercomputing companies illustrate, how decades of searching for the universal massively parallel computer architecture finally failed. Von-Neumann-based parallel computing really succeeded only in some special application areas. Not only the area of embedded computing systems, but also PCs demonstrate, that more and more most silicon real estate is occupied by accelerators, prostheses needed by the aging von Neumann processor, now being a methusela after surviving so many technology generations.

The von Neumann paradigm is the driving force behind the success of software industry, by its simplicity helping to focus language design and compilation techniques to a usefully narrow design space, and, by helping to educate zillions of programmers. Prerequisite of this success is the fact, that its operational principles are RAM-based, yielding a seemingly almost unlimited flexibility. But we now have a RAM-based competitor: Reconfigurable Computing, where structure definition is RAM-based, instead of the instruction execution schedules as known from von Neumann principles. It turns out, that von Neumann does not support such soft hardware. This is the basis of an emerging disruptive trend which has (almost) all prerequisites to repeat the success story of the software industry: by a configware industry needing the support of a revolutionary new machine paradigm. However, the new trend is coming along with the challenge to overcome the incising limitations of the dominant "procedural-only" mind set of computing science in the von Neumann era.