

How to let cooperate the Neumann-world with reconfigurable world

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Abstract

The todays computers are much more powerful than their predecessors in the heroic age of information technology. They comprise several CPU cores and large working memory with high clock frequency and lots of additional controllers which perform many complicated functions for example I/O functions, storage management, direct memory access for peripherals, etc. There are much more intelligent devices within a computer than John von Neumann could have imagine in the 40's. But the basic architecture of the system is still the same: the CPU is the most intelligent device and it has to transact all of important operations and decisions. Other controllers which operate properly on non-Neumann principles get only secondary and less important functions. However, these days lots of devices are available which can implement many necessary judgments which are implemented in software by the operating system. Unfortunately this method is computationally expensive.

In this paper we describe a few possibilities how a single- or a multi-core CPU can be supported by using reconfigurable devices, typically FPGAs. We show more special cases when a Neumann type architecture is extended by non-Neumann controllers which support the CPU by handling semaphores, software interrupts, in short, implement that functions in hardware which are implemented nowadays in software by the operating system. This method works for the traditionally hardware controlled processes (for example serial communication, direct memory access, interrupts, etc.) perfectly for a long while. By this way, hardware tasks will be created which will replace the computationally expensive software operations. There are already systems which demonstrate how hardware and software tasks can work together. Not least, these implementations result in computationally highly effective and deterministic systems. This is a significant benefit, especially in case of real-time operation systems.

Keywords: reconfigurable, Neumann, FPGA