SoCrates - A Scalable Multiprocessor System On Chip

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Abstract

This document is the result of a Master Thesis in Computer Engineering, describing the analysis, specification and implementation of the first prototype of Socrates, a configurable, scalable and predictable platform for System-on-chip Multiprocessor system for real-time applications. The design time of System-on-a-Chip (SoC) is today rapidly increasing due to high complexity and lack of efficient tools for development and verification. By combining all the functions into one chip the system becomes smaller, faster, and less power consuming but increasing the complexity. To decrease the time-to-market SoCs are entirely or partially build with IP-components. Thanks to SoC, a whole new domain of products, like small hand held devices, has emerged. The concept has been around a few years now, but there are still challenges that needs to be resolved. There is a lack of standards for enabling fast mix and match of cores from different vendors. Further needs are new design methods, tools, and verification techniques. SoC solutions needs special kind of CPUs that consumes less power, is cheaper, smaller, but still has high-performance requirements. To fulfill all these demands, they are getting more and more complex as the number of transistors are rapidly growing which has led to the emerging of multiprocessors systems-on-a-chip. Our initial question is to investigate if it is possible to build these complex multiprocessors systems on a single FPGA and if these solutions can lead to shorter time-to-market. The consumer demands for cheaper and smaller products makes FPGA solutions interesting. Our approach is to have multiple processing nodes containing processing unit, memory and a network interface all together connected on a shared bus. A central in-house developed hardware real-time unit handles scheduling and synchronization. We have designed and implemented a MSoC that fits on a single FPGA in only 40 days, which has to our supervisors knowledge not been accomplished before. Our experience is that a tightly coupled group can produce fast results since information, new ideas and bug reports propagates immediately.

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