Heterogeneous MPSoC Technology for Modern Cyber-physical Systems

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Abstract

The recently introduced 20nm CMOS technology node enabled implementation of a very complex multi-processor system on a single chip (MPSoC) that may involve hundreds processors, made possible much increased performance, and facilitated a further rapid progress in mobile and autonomous computing, global networking and wire-less communication. This, combined with progress in sensor and actuator technologies, created new important opportunities. Numerous new sorts of mobile and autonomous cyber-physical systems became technologically feasible and economically justified. Various systems performing monitoring, control, diagnostics, communication, visualization or combination of these tasks, and representing (parts of) different machines or devices, or even being wearable or implantable in human or animal bodies can serve as examples. A new wave of information technology revolution arrived that started to create much more coherent and fit to use modern cyber-physical systems. However, many of the new cyber-physical applications are complex and heterogeneous. They combine different kinds of signal and information processing involving algorithms with various characteristics. To adequately serve these applications, heterogeneous architectures should be exploited. Moreover, these applications usually require a guaranteed high performance, (ultra-)low energy consumption and adaptability. The combination of their high complexity with their stringent and partly contradictive requirements results in numerous serious development challenges, such as: ability to satisfy the stringent requirements, complex multi-objective system optimization, reduction of the system development time and costs without compromising of its quality, etc. To overcome these challenges sophisticated system and design technologies are needed. Predicting the current situation, several years ago the presenter of this keynote proposed the system and design paradigms that effectively address these challenges, namely the paradigms of: life-inspired systems and quality-driven model-based design. This presentation focuses on the heterogeneous MPSoC technology exploiting heterogeneous application-specific computation and communication resources involving: application-specific instruction-set processors (ASIPs) and HW accelerators, distributed parallel memories and hierarchical communication structures, and being a practical realization of the paradigm of life-inspired systems. After discussing the issues and challenges of the modern cyber-physical system design, the presentation introduces the heterogeneous MPSoC technology and explains the design of various parts of such heterogeneous MPSoC.