Tutorial Two

System-Level Design of Embedded Media Systems

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Abstract

This tutorial reports on system-level design practices in Philips. First we present the design problems encountered in the development of embedded media systems for the consumer market. The characteristics and requirements of the consumer electronics domain are presented. We focus on high performance video applications and the demands that these applications put on architectures of embedded media systems.

Several high performance embedded systems architectures are illustrated. This includes an in depth discussion of high performance programmable components, in which the TriMedia VLIW cores are taken as an example. We further discuss system-on-a-chip (SoC) architectures that incorporate such cores. We address the aspect of heterogeneous SoC architectures that incorporate components in the range from programmable processors to function-specific hardware engines. For such architectures trade-offs can be made with respect to flexibility, performance, and cost to implement an optimal solution. This process involves hardware/software co-design with evaluation of different points in the architecture design space. A key aspect of SoCs is the communication architecture by means of which the different components communicate. We discuss the key issues in the design of such communication architectures. SoC architectures need to include a software stack and related programming paradigm to allow them to be programmed efficiently. We present the key issues that need to be addressed by an SoC software stack and illustrate this with an example.

The design of advanced SoCs and related software is a formidable task. A recent trend in this respect is platform-based design. Platform-based design aims to support the development of advanced SoCs by providing an architecture template, or platform, for the design of such SoCs. Platform-based design aims to facilitate reuse of hardware and software components and supports the rapid development of derivative designs. It thereby enables cost-effective design of a family of products under stringent time-to-market constraints. We present the essential ingredients of platform-based design and illustrate these with real-life examples.

Advanced design technology is required to tackle the design problems in the design of embedded media systems. We present a number of key principles for quantitative and explorative design and discuss several levels of abstraction at which designs can be modeled and evaluated. We further elaborate on the development and application of design technology based on a number of design cases. These cases

include the development of a TriMedia 64-bit VLIW CPU and heterogeneous multi-processor architectures for media processing.

The tutorial includes relevant references to related work in the field of embedded media systems and related design technology. The tutorial concludes with a summary that identifies a number of key lessons learned.

Pieter van der Wolf *was born May 20, 1961, in Gouda, The Netherlands. He obtained both an MSc degree (1986) and a PhD degree (1993) in Electrical Engineering from Delft University of Technology, The Netherlands. His PhD research concerned the definition and implementation of CAD Framework technology. After obtaining his PhD degree he became an assistant professor at Delft University of Technology. In 1996 he joined Philips Electronics, to become Senior Scientist at Philips Research Laboratories in Eindhoven, The Netherlands. He is active in the field of embedded systems architectures, with a focus on design technology. His research interests include system-level design methodologies, embedded systems architectures, and embedded processors.*

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