

Run-time Reconfigurable RTOS for Reconfigurable Systems-on-Chip

Dissertation, Marcelo Götz

Abstract

Embedded systems are massively present in our lives and they are becoming omnipresent. This has demanded strong efforts in research for providing new solutions for the challenges faced in the design of such systems. For instance, the requirements of high computational performance and flexibility of the contemporary embedded systems are continuously increasing. A single architecture must be able to support, in certain cases, different kind of applications with different requirements which can start asynchronously and dynamically (changing environments). Reconfigurable computing seems to be a potential paradigm for these scenarios as it can provide flexibility and high computational performance for modern embedded systems. Of especial interest are those architectures where a microprocessor is tightly connected with a reconfigurable hardware (hybrid platform), constituting a so called reconfigurable System-on-Chip (RSoC). However, the complexity in designing such systems rises. Therefore, the usage of an Operating System (OS) is essential to provide the necessary abstraction of the computational resources in reconfigurable computing. Moreover, due to the intrinsic overhead caused by the reconfiguration activities and the potential sharing of computational resources the necessity for support provided by an OS is unquestionable. Nevertheless, embedded system platforms lack in computational resources. This fact requires a careful design of an OS for such a system, since it also consumes its resources. Along with the application tasks, the OS can profit from a RSoC based architecture by reconfiguring itself over this hybrid platform. Thereby, the OS can make use of the remaining resources that are not currently required by the application for its execution. Within this context, this work presents the design of proper methodologies, strategies, hardware and design support for a proper management of dynamic reconfiguration activities of a Real-Time Operating System (RTOS) running on a RSoC based platform. The intention thereby, is to promote the self-reconfiguration of the RTOS services on this hybrid platform, so that the computational resources of this execution platform are used in an efficient way.