Soft IP-Cores: RISC-V Processors and more

Doluwamu Taiwo Kuye[1]

Contents

[1] Doluwamu-taiwo.kuye@stud.hshl.de

Abstract:

1 Background

Hardcore processors dominated the world of IC design and system on-chip devices for a long time. A hardcore processor, typically fabricated on silicon at the transistor level, offered a dedicated and efficient solution; however, the emergence of difficulties like configurability, customization, and prototyping inefficiencies prompted a shift in the environment.

This resulted in the development of soft processors. Softcore processors have a critical advantage which is configurability. This means they can be tailored to specific application needs, optimising performance and power usage. This innovative flexibility addresses the limitations of fixed architectures in Hardcore processors and also provide added advantages like rapid prototyping. In the contemporary sphere of IC design, soft cores have become indispensable. They effectively navigate challenges and provide a dynamic solution to meet the ever-evolving demands of the field.

1.1 Significance of Soft IP-Cores in IC Design

The evolution of soft processors in integrated circuit (IC) design has been propelled by a dynamic interplay of challenges faced by hardware architects. Traditional ASIC designs grapple with intricacies such as power consumption, compactness, and signal integrity, demanding a departure from the rigidity of microprocessors. The accelerated obsolescence of microcontrollers further intensifies the need for adaptable solutions. Soft processors, emerging as a dynamic response, possess a transformative quality—their exceptional configurability.

The single most important benefit of soft processors is their unparalleled ability to be configured according to the specific requirements of diverse applications. This configurability not only addresses the constraints of ASIC design but also navigates the challenges posed by the rapid obsolescence of traditional microcontrollers. Soft processors become a canvas upon which designers can craft tailored solutions, optimizing performance, power consumption, and other critical parameters.

Moreover, soft processors seamlessly integrate with the rapid development cycle paradigm, particularly evident in the System-on-Programmable-Chip (SoPC) context. These processors, entirely describable using hardware description languages like VHDL or Verilog, play a pivotal role in expediting the development cycle. The integration with FPGA platforms introduces a novel dimension to IC design, allowing for dynamic configurability and adaptation to diverse applications.

In essence, soft processors are not merely a solution to specific ASIC design challenges or the transient lifespan of microcontrollers. They are, fundamentally, engines of rapid development, providing a versatile and dynamic platform for crafting reconfigurable systems. This chapter sets the stage for an in-depth exploration of soft processors, unveiling their advantages,

applications, and comparative insights. As we progress through subsequent sections, we will delve into the intricacies of soft processors, with a focus on their transformative impact in the landscape of modern IC design.

1.2 Objectives of the paper

2 Soft processor in IC Design

2.1 Softcores

2.2 Benefits of Soft cores

2.3 Comparison with Hard cores

3 RISC-V

The evolution of process architecture has been dominated in good parts by Complex Instruction Set Computing (CISC). While being a revolutionary development in bridging the gap between high-level language and computer architecture in its time, it now encounters challenges such as increased complexity, power consumption, and limitations in scalability. As technology progresses to the era of Industry 4.0, which is characterized by the integration of smart technologies and the demands of applications like the Internet of Things (IOT) and machine learning, these challenges have become more obvious and lead to some inefficiencies. This calls for a shift toward a more efficient and customizable architecture. In response to these evolving requirements, reduced instruction set computing (RISC) becomes an interesting and compelling alternative. RISC architecture, known for its simplicity, modularity, and performance advantages, addresses most of the shortcomings of CISC. In the wide landscape of RISC architectures, the open source and customizable nature of the RISC-V stand out. RISC-V embodies all the attributes of RISC architecture and also introduces an open standard that allows for collaboration and innovation. This paper explores the drawbacks of CISC in comparison to the innovative realm of RISC and tentatively explores RISC-V in the area of VLSI design. By delving into some specifics of RISC architecture, we aim to shed light on its potential to not only meet the demands of modern computing but also pave the way for a new era of open and collaborative processor design.

3.1 Importance in Soft processors

3.2 Key features of RISC-V

9 Declaration of Originality

I, Doluwamu Taiwo Kuye, herewith declare that I have composed the present paper and work by myself and without the use of any other than the cited sources and aids. Sentences or parts of sentences quoted literally are marked as such; other references with regard to the statement and scope are indicated by full details of the publications concerned. The paper and work in the same or similar form have not been submitted to any examination body and have not been published. This paper was not yet, even in part, used in another examination or as a course performance. I agree that my work may be checked by a plagiarism checker.

11/05/2023&Wuppertal - Doluwamu Taiwo Kuye

Bibliography