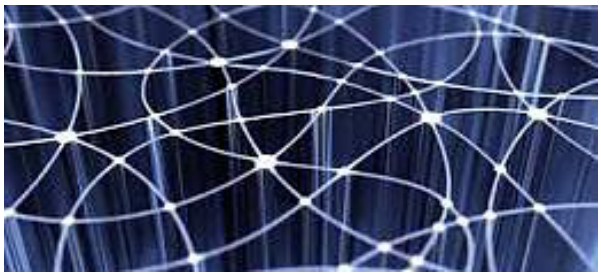

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Evaluation of High-Level Open-Source Tool-Flows for Rapid Prototyping of SDR Applications on Heterogeneous Platforms

Traditional radios have a fixed hardware-defined functionality and typically support only one radio standard. Though resulting in simple, easy-to-optimise designs, the fixed architecture is not sustainable given the rapidly changing landscape of radio protocols and the increasing demand for seamless access. Software-defined radios (SDRs) were coined two decades ago to meet these and other demands.A SDR is a flexible radio architecture where some or all of the physical layer functions that are traditionally realised using fixed hardware processors are implemented through user-modifiable software that runs on programmable chips. These chips include GPPs, DSPs and FPGAs. Although SDRs are generally applauded for their attractive potential, they remain a niche technology. It is virtually agreed that since SDR is an inherently complex domain, the high skills set required to build efficient SDRs is a prime reason why many communication systems designers are reluctant to adopt the technology. Currently, conventional SDR design methodologies such as the popular HDL-based approaches for FPGA firmware development do not provide mechanisms to effectively abstract the software and hardware complexity of designs for the average designer. Rather, these tools tend to force developers to work at a low-level of coding, often building up solutions from first principles, which can be a tedious and error prone process that may yield inefficient designs and poor productivity levels. There is therefore a need for easy-to-use and efficient high-level tools to simplify and accelerate SDR applications design. While there is high and varied activity in literature and industry to address this need, very little work has been done to survey the various existing approaches and evaluate their effectiveness. Where this has been done, focus has been limited to homogeneous target architectures and few open-source tools were considered. In this paper, we comprehensively evaluate potential open-source high-level tool-flows (Delite DSL framework, Migen, MyHDL and Ptolemy) for rapid prototyping of SDR applications on heterogeneous target platforms. The tools are evaluated against an ideal high-level SDR flow that we designed; particular strengths and lacks of each tool are discussed.

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