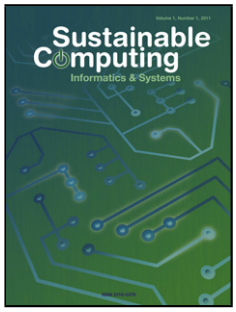

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Power-efficient Scheduling of Parallel Real-time Tasks on Performance Asymmetric Multicore Processors

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Highlights

- A novel EDF-based partitioned scheduling strategy for parallel tasks on single-ISA heterogeneous multi-core processor is proposed
- The application of the DVFS for the efficient power consumption under the proposed strategy is discussed
- Up to 23% energy is saved at the moderate system workload
- Proposed algorithm – parallelEDF – is compared with Equally Fit (EF) algorithm on 70 nm based performance asymmetric multicore processor
- The formal modeling of the proposed system using high-level petri-nets (HLPN), while these models are also verified using the Satisfiability Modulo Theory (SMT), and Z3 Solver.

Abstract

The use of computing devices has increased dramatically in recent time, which results in huge power consumption. This situation has made the power consumption a critical metric for evaluating the performance of a computing device. In this paper, we have addressed the real-time scheduling problem of parallel tasks on a performance asymmetric multicore processor with *m* cores with intent to reduce the power consumption. The proposed algorithm – parallelEDF – first divides the tasks into *m* segments and then executes these distributed tasks in earliest deadline first (EDF) fashion. Dynamic voltage and frequency scaling (DVFS) is also applied for power savings. We have evaluated the performance of the parallelEDF scheduling algorithm with Equally Fit (EF) algorithm on 70 nm based performance asymmetric multicore processor. The results reveal that up to 28% power can be saved at high system utilization level (about 80% system utilization). We have formally modeled the parallelEDF algorithm using high-level Petri nets (HLPN) while these models are also verified using the Satisfiability Modulo Theory (SMT), and Z3 Solver.

Keywords: Real-time Scheduling; Parallel Tasks; Power Consumption; DVFS; Performance Asymmetric Multicore Processor.

1. INTRODUCTION

Real-time tasks are constrained by timing requirements and required to be completed with-in associated deadlines. Any violation of these timing constraints can lead to a catastrophic result. Therefore for a real-time system, meeting task deadlines is as important as performing the task correctly [7]. Over the years, the complexity of real-time applications has increased hugely. To fulfill the requirements of such processing intensive applications much more processing power is required. Increasing the clock frequency of the processor is a solution but it suffers from high power consumption (as the performance is directly related to the clock frequency of the processor) [2].