The Time-Predictable Multicore Processor T-CREST

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***Abstract*—For research on time-predictable multicore architectures, we need open-source prototypes. The T-CREST project provides an open-source multicore platform, hosted at GitHub. T-CREST consists of Patmos processor cores, the Argo network-on-chip, various shared on-chip memory configurations, memory controllers, an LLVM based compiler, and several worst-case execution time analysis tools.**

T-CREST is intended to explore the open research question on how to best design and implement time-predictable communication between processing cores. T-CREST includes currently three different network-on-chip designs, various forms of shared or owned scratchpad memories, and a time-predictable arbiter for shared external memory.

To best of our knowledge, T-CREST is the only fully open-source architecture for research on future real-time multicore architectures.

A real-time system needs to deliver results in time, before a given deadline. The environment with which the system interacts usually constrains the deadline. For example, a control loop operating at a specific frequency demands one computation per iteration. To guarantee that tasks deliver results in time, the worst-case execution time (WCET) needs to be analyzed statically.

This demonstration presents the T-CREST platform, a time-predictable multicore processor optimized for the WCET [2]. Figure 1 shows the T-CREST multicore processor. It consists of several processing cores named Patmos [3] connected to (1) the message passing networks-on-chip (NoC) Argo [1] and (2) to a time-division multiplexing memory arbiter to access shared on-chip memory and a shared memory controller to the external main memory. We optimized Patmos for reducing the WCET. A compiler that optimizes for the WCET and three WCET analysis tools: (1) the standard industrial WCET analysis tool aiT, (2) the research WCET analysis tool platin, and (3) a port of Heptane for Patmos support T-CREST.

T-CREST is prototyped in an FPGA. In this demonstration we will show multicore code executing in the FPGA. We will demonstrate how to write time-predictable code and how to perform WCET analysis of these programs.

T-CREST is fully open-source and available from GitHub. The GitHub page for Patmos contains build instructions for setting up T-CREST. To simplify this process we also provide an Ubuntu based virtual machine with all tools installed. From that setup the cheap Altera DE2-115 FPGA board can be used to explore a 9-core version of T-CREST. Following list contains the main links:

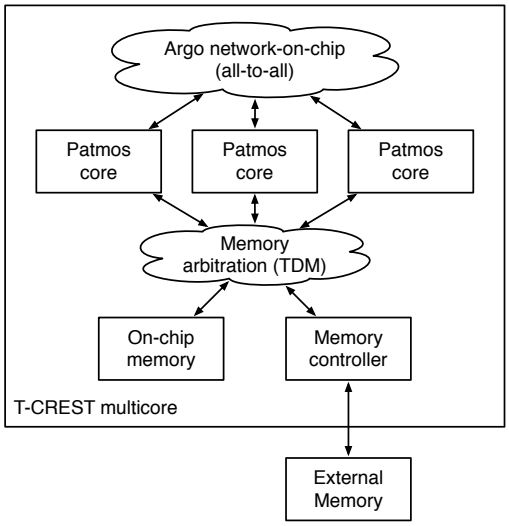

Fig. 1. The T-CREST multicore architecture with several processor cores connected to a network-on-chip and shared memories.

- https://github.com/t-crest
- https://github.com/t-crest/patmos
- http://patmos.compute.dtu.dk/

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References

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