# Case study: A microprocessor development in B*†

(Work in progress)

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Recently the correct development of systems involving both hardware and software has become an important issue. For such a development formal methods as well as tool support are needed. The *action system formalism* [2] has proved to be a useful formal method for developing systems where both hardware and software issues are concerned. This method, however, still lacks good tool support. Previous research has shown [7] that the *B Method* [1] and its supporting tools [5, 6] can be used as a mechanical tool for the action systems, due to the similar features of the action systems and the B Method. They are both state-based systems that support stepwise development of programs. Moreover, the B Method is an approach that has been used in many industrial projects and it offers proof-support for verifying the correctness of each step, as well as tools to manage and administrate the development task.

Until now the combination of action systems and the B Method has mostly been used for software development. However, we want to investigate if the B Method could provide mechanical tool support for systems involving also hardware. As a step towards this we present a case study showing a formal development of the *Caltech asynchronous microprocessor* [3] using the B Method and one of its associated tools Atelier B [6]. We follow the steps in an earlier development [3] where the action system formalism is used. In this development the microprocessor is decomposed into its functional components; the instruction memory, the program counter, the registers, the arithmetic logical unit, the data memory and the instruction execution unit. At each step a function is identified and the variables and code related to that function are gathered into a separate component. The steps are formally carried out within the *refinement calculus* [4]. Relying on the previous research results on refining action systems within the B Method [7] we perform the development steps of the microprocessor using the proof and development assistance of the tool Atelier B. Each step is proved using the automatic and interactive provers of the tool. With this case study we show how a mechanical tool can be used for the formal development of the Caltech microprocessor. Furthermore, we show that formal development of systems involving both hardware and software is a possible application area for the B Method and its tools.

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