

# From Embedded Systems to Cyber-Physical Systems: Does the Name Change Matter?"

Peter Marwedel  
TU Dortmund  
Germany

Information technology (IT) systems embedded into enclosing products are called “embedded systems”. Examples include information processing systems in transportation systems, telecommunication or automation. Recently, the term “cyber-physical system” has been proposed in the US. Reasons for proposing the new term include the need to represent complex information processing systems integrated with their physical environment and the need to distinguish such systems from simple microcontroller-based systems, which many people associate with the term “embedded system”. In this talk we will address the question:

*Does this new term represent a different class of systems?*

The new term emphasizes the link between IT and physics, and therefore between IT and time, space, and energy. The need to explicitly model time has some pivoting and frequently dominating consequences: physical time –frequently abstracted in computer science- needs to be re-introduced. In the talk, we will present some areas, in which such modelling of physical time has recently been focussed on. This focus requires a reconsideration of basic concepts in computer science. We will present an integration of timing analysis into an experimental compiler. Such integration potentially avoids long trial-and-error procedures for obtaining code meeting real-time requirements. We will also demonstrate how the familiar concept of caches is challenged by the timing properties of scratch-pad memories.

The link to physics also implies an increased focus on energy models for IT. Unfortunately, precise energy models for IT systems are lacking. The link to space leads to distributed computing and concurrency. This is a complex topic which will not be addressed in the talk, due to time constraints.

The talk will provide an answer to the question raised in its title. This answer will be based on the topics discussed in the talk, but will not be revealed here in order to provide an incentive to the audience.