

This work establishes the HIRTE – a High Integrity Run-Time Environment for mission-critical telematics systems. Focusing on distributed, embedded application components, in the process, it introduces the domain of Electronic Toll Collection (ETC) to software architectures as a secondary result. Here, ETC serves as an archetype to refine and substantiate the requirements of reliability and economy, resulting in a set of design traits. These domain-specific characteristics reflect in the HIRTE design patterns, which, complemented by reference implementations in Ada, provide a framework for crucial embedded telematics software architectures. In this context, the Virtual Control Unit (VCU) – an extendable, lightweight virtual machine controlled by state automaton programs – represents a central concept. Additionally, the work yields tertiary artifacts for classification and risk evaluation of telematics systems, as well as original approaches to interoperability.

*Keywords:* telematics, telecommunications, embedded systems, Virtual Control Unit, self-contained state, smart cards, electronic toll collection, automotive, fault-awareness, high-integrity, mission-critical components, virtual machines, state automatons, Ada.