National Experimental Platform for Hybrid and Embedded Systems Technology (NEPHEST)

Statement of Work

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Statement of Work for NEPHEST

The objective of the NEPHEST project, jointly funded between DARPA/ITO and NSF/CISE, is the development of a National Experimental Platform for Hybrid and Embedded Systems Technology. The Institute for Software-Integrated Systems (ISIS) at Vanderbilt University is working on both the theoretical foundations and practical computational tools to support the modeling, analysis, and synthesis of large-scale, complex embedded systems. In these systems physics and information processing is tightly integrated, and the challenge is to form a unified framework, which facilitates composability in the design process. Hybrid modeling and analysis techniques provide powerful tools for understanding embedded systems, but the full potential of hybrid techniques has not been fully realized yet. Furthermore, real component-based modeling tools, techniques, open frameworks, and experimental platforms are not yet prevalent. ISIS's goal is to address these issues in the framework of the NEPHEST project.

In the ISIS subcontract to the NEPHEST effort, ISIS shall provide assistance and support to the statement of work outlined in the NEPHEST proposal as follows.

T-1: ISIS shall assist in surveying the state-of-the-art in hybrid and embedded system technology. The focus will be the review of state-of-the-art embedded software system development processes, including integrated analysis and synthesis methods, and application-specific solutions. ISIS shall review the industrial practices, commercially available tools, and standardization efforts. *Deliverable*: Relevant portions of the state-of-the-art report on hybrid and embedded systems technology.

T-2: In cooperation with UC Berkeley, ISIS shall define the core technology for the component-based design of embedded systems. While UCB is focusing on the physical implementation of a prototype component integration framework, ISIS shall build a high-level, model-based configuration interface for system integration. In this effort, ISIS shall use research products developed under previous funding, specifically metaprogrammable modeling tools. The modeling environment will allow the rapid prototyping of new concepts for embedded systems modeling, analysis, and synthesis, and experimentation with them. *Deliverable*: a modeling environment that allows the rapid definition of visual domain specific languages for modeling and development, and the configuration of large-scale experiments for hybrid and embedded systems research.

T-3: ISIS shall develop the architectural design for a component-oriented, web-based, open tool integration framework that facilitates semantic interoperability among design tools for embedded systems. The framework will be reusable for a wide variety of tools, including modeling, analysis, and synthesis tools. The framework will allow design tool integration with across the Internet: the tools integrated will be remotely accessed and configured according to the needs of the engineering workflow. *Deliverable*: the design document for and the prototype implementation of a reusable open tool integration framework, focusing on embedded system design. ISIS will conduct an experiment with actual embedded system development tools to demonstrate the functionality.

T-4: ISIS shall contribute to the development of challenge problem concepts and scenarios by compiling a list of interesting use cases. ISIS shall utilize its industrial contacts from the aerospace and other communities, through the Model-Integrated Computing Alliance, as well as its academic peers. ISIS shall cooperate with UCB and U Penn in actually developing a challenge problem implementation in the proposed NEPHEST experimental environment. *Deliverable*: A list of relevant challenge problems, and the prototype experimental platform, created in cooperation with UCB and U Penn.

T-5: In cooperation with UCB, ISIS shall develop a web-based repository for components, tools, verification results, and documents. While UCB will be responsible for the web-based front-end, ISIS shall focus on the database and integration issues, with emphasis on version control, scalability, storage of executable components, and support for web-based composition of embedded software. The repository will be developed in concert with the open tool integration framework described under T-3. *Deliverable*: A prototype design and its implementation that can serve as the backbone for the national repository.

T-6: ISIS shall evaluate the feasibility of NEPHEST in collaboration with other team members. ISIS shall develop metrics and success criteria and provide input to the implementation plan. *Deliverable*: Relevant sections of the evaluation and implementation plan.