# WiP Abstract: Platform for Designing and Managing Resilient and Extensible CPS


Subhav Pradhan, Abhishek Dubey, and Aniruddha Gokhale
EECS Dept, Vanderbilt University, Nashville, TN
{subhav.m.pradhan, abhishek.dubey, a.gokhale}@vanderbilt.edu

Martin Lehofer
Siemens Corporate Technology
Princeton, NJ
martin.lehofer@siemens.com


Extensible Cyber-Physical Systems (CPS) are loosely connected, multi-domain platforms that "virtualize" their resources to provide an open platform capable of hosting different cyber-physical applications. These cyber-physical platforms are extensible since resources and applications can be added or removed at any time. However, realizing such platform requires resolving challenges emanating from different properties[1]; for this paper, we focus on *resilience*. Resilience is important for extensible CPS to make sure that extensibility of a system doesn't result in failures and anomalies.

Since extensible CPS have dynamic resources and applications, resilience mechanism should be autonomous. To achieve this, we are currently working on a platform called CHARIOT (Cyber-pHysical Application aRchItecture with Objective-based reconfiguraTion)[2]. As shown in Figure 1, CHARIOT comprises design-time and runtime entities. CHARIOT-ML[1] is a modeling tool used at design-time. Applications are modeled as components with functionalities. Systems are modeled using goal-based system description, which allows them to have mission goals that can be satisfied by functionalities. This results in a generic description of system requirements, which is later used at runtime to provide autonomous resilience.

Runtime aspect of CHARIOT comprises a distributed infrastructure that implements a self-reconfiguration based autonomous resilience mechanism. This mechanism is implemented as a closed loop comprising (a) monitoring infrastructure, (b) a Satisfiability Modulo Theories (SMT) based resilience infrastructure that computes new configuration points[1] at runtime, and (c) application managers. It is important to note that any resilience mechanism provided should be predictable as CPS have strong timing requirements. Figure 2 presents preliminary result to show predictability of the Configuration Point Computation (CPC) algorithm used to compute new configuration points.

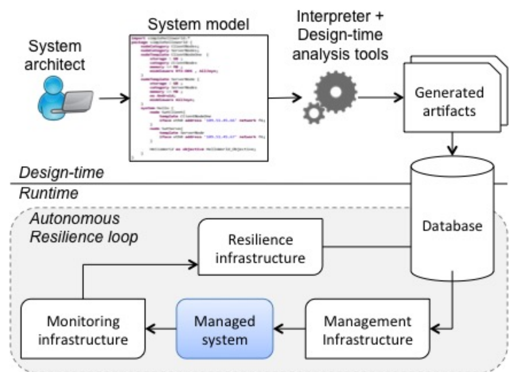


**Figure 1: CHARIOT overview.**

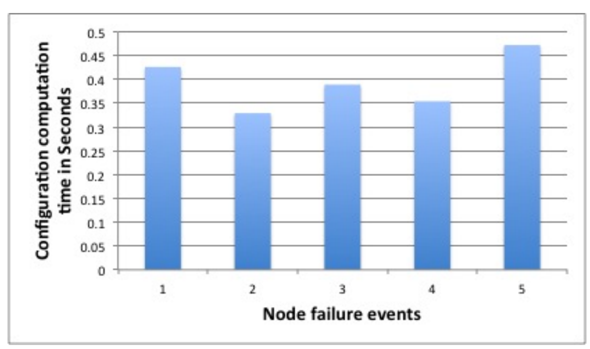


**Figure 2: Preliminary results showing time taken to compute new configuration point.**

[1]Subhav M Pradhan et al. "CHARIOT: A Domain Specific Language for Extensible Cyber-Physical Systems". In: *Proceedings of the 15th Workshop on Domain-Specific Modeling (To be published)*. ACM. 2015, pp. 9–16.


[2]This work is sponsored by a research grant from Siemens Corporate Technology.



978-1-5090-1772-0/16/$31.00 ©2016 IEEE