

VSCADA: An Integrated Heterogeneous Testbed for Power System Utility Security Modeling and Simulation

Abstract—The economic operations of the United States is reliant on complex large-scale cyber-physical systems which include electric power grids, oil and gas systems, transportation systems, etc. To protect these systems and their control from security threats and to improve the robustness and resilience of these systems, are important goals. Since all these systems have Supervisory Control and Data Acquisition (SCADA) in their control centers, a number of testbeds have been developed at various laboratories. Usually on such testbeds, people are trained to operate and protect these critical systems. In this paper, we describe a distributed testbed that we developed for modeling and simulating SCADA applications and to carry out related security research. The testbed is a virtualized by integrating various heterogeneous simulation components. This testbed can be reconfigured to simulate the SCADA infrastructure of a power system, or a transportation system or any other systems, provided a back-end domain specific simulator for such systems are attached to it. In our previous papers, we have demonstrated how we integrated various kinds of system-level simulators based on the infrastructure being controlled or monitored. In this paper, we describe improvements over that by creating a scalable architecture capable of simulating larger infrastructures and by integrating communication models to simulate different network protocols. We also developed a series of middleware packages that integrates various simulation platforms into our testbed using the Python scripting language. To validate the usability of the testbed, we briefly describe how a power system SCADA case can be modeled and simulated in our testbed. The proposed testbed prototype has been implemented and utilized in a graduate-level class – Cyber Security of Critical Infrastructures. Various interesting case studies have been created by students in their final projects.