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Simulation-based practical verification of Home Network Services and Systems

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Abstract

With the popularization of the internet, manufacturers and content providers have come to provide home network services not only to PCs but also various devices. These services become possible from an advancement of home network and increased connectivity of home appliances.

In future, these services will be advanced, and various services will be provided such as services optimized for context, services that can make prediction based on history or stored data, or systems that can utilize multiple services and town information.

When we verify these large-scale targets, an experimental or simulation-based approach is usually preferred. But experimental approach has problems such as a scale of the experiment, the durations of the experiment and a lack of exhaustiveness. On the other hand, simulation has problems such as lack of modeling accuracy of complex home networks.

In this paper, we propose a practical simulator that can simulate tens of thousands of houses, and then evaluate the simulator against real data and show two verification examples. The simulator considers the following five elements: house, home appliance, environment, electric power and human activity. It enables the simulation interactions between these elements, provides API for the exchange of information with the real world and generates high accuracy results by using real-time execution. Moreover it supports the repetitive execution with different parameters by using statistics or patterns.

As examples of practical verifications, we verify the accuracy of the environment element of the proposed simulator by comparing real data collected in iHouse with simulated data. We confirmed that the simulator produces high accuracy results. As a second example, we evaluate the efficiency of a new HEMS by using the simulator, and then discuss about the reduction of the energy consumption. We also attempt to predict the activities of a family from the energy consumption.

The proposed simulator realizes the verification of large-scale home network services and systems. Furthermore, it builds a simulation base for the verification of social systems.

Key Words: home network, large-scale simulation, practical verification, cyber physical systems, ubiquitous computing