Title	
Author(s)	,
Citation	
Issue Date	2014-03
Type	Thesis or Dissertation
Text version	ETD
URL	http://hdl.handle.net/10119/12100
Rights	
Description	Supervisor: , ,

Japan Advanced Institute of Science and Technology

On Design and Validation of Application Specific Sensor Networks

Shingo Yasuda

School of Information Science,

Japan Advanced Institute of Science and Technology

March 24, 2014

Abstract

Information has been collected and shared since the dawn of history, and this is something that humans feel a strong desire to do. In the modern age, this has given rise to sensor networks that can collect various types of information. We proposed a sensor network system for automatically collecting various kinds of information. Such networks have generally involved wired collections of static sensors. Recently, however, there has been interest in movable wirelessly-connected sensors for applications such as vehicular networks and biological research on wild animals. For these kinds of applications, methods such as ad-hoc networking and delay/disruption/disconnection tolerant networking (DTN) have been proposed. In such networks, there is a large number of parameters that should be optimized during the design and verification stages. However, this is often not possible because the mobility of ad-hoc/DTN network nodes is usually uncontrollable and unknown. This makes it difficult to assess the effectiveness of a sensor network system.

Developers must therefore utilize not only simulation but also emulation using actual program code in targeted scale network environments. Thus, the importance of network testbeds for verifying such technologies and applications is growing. In addition, the scalability requirements for testbeds are increasing beyond those currently used because system updating is difficult for a sensor network in a ubiquitous environment. Since discrete spatiotemporal data are obtained from such sensor networks, mining schemes are also necessary in order to analyze the data and provide feedback for future systems. However, current experiment support tools for network testbeds are insufficient for achieving this.

The purpose of the present study was to design and validate application-specific sensor networks. The design parameters for the sensor network system are first considered in the logic verification stage. Next, parameters and techniques for verifying the sensor network on large-scale testbeds are described, together with the design of the testbed construction framework for network applications. The framework includes a failure recovery mechanism, and was evaluated using prototype software. The use of this framework and the associated software is expected to decrease the cost of software verification experiments for large-scale testbeds.

On the basis of the above considerations, a four-phase framework is proposed for the design and validation of application-specific sensor networks. In addition, this paper proposes techniques for the design of the logical validation phase based on some sample sensor networks. An emulator is then developed for a wide area wireless sensor network. The emulator can take into account the parameters used during the logic verification phase. Finally, techniques are described for mining the data obtained from such a sensor network. This paper describes the life cycle of sensor network development and verification on ubiquitous environment utilizing these proposed techniques and frameworks. This will allow the implementability and validity of future sensor networks to be evaluated, and thus enrich the information obtained from such networks, and satisfy the human desire for increased knowledge.

Key Words: Sensor networks, Wireless network emulation, Network system evaluation, Large-scale testbed, Design framework for wireless sensor network