Runtime quality services assurance for Wireless sensor and actuator networks

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Abstract

Wireless sensor-actuator networks, or WSANs, greatly enhance the existing wireless sensor network by introducing powerful actuators. These actuators are expected to work with the sensor nodes and perform much richer application-specific actions. These generate dynamic traffic patterns in the network, which are dependent on the physical environment events being sensed but further aggravate the problem of quality assurance of the services provided by such systems. In this paper, we propose a novel approach for runtime quality services assurance for WSANs. The presented solution provides a complete picture of the system health with possibility to zoom in on the fault reasons of abnormal phenomena. Furthermore, it diagnoses network failures, detects application level failures, isolates affected areas of the network and pinpoints the causes of application malfunctioning without significant increase of power consumption. It meets these goals through combining two types of services: (1) Network diagnosis service that targets two failures that are likely to happen in WSAN deployments which are the node failure due to energy depletion, and the link failure due to poor connectivity with neighbors. (2) Application testing service which verifies the ability of the system to perform correctly its functionalities. Our approach is based on functional testing. Motivation for this type of test comes from considering the sensor as a black box component. Services are tested by feeding the nodes with test inputs and examining the outputs to compare them to the expected ones. Simulation results show that the presented solution is efficient both in terms of memory use and power consumption. It incurs a 4 %, on average, increase in power consumption (communication overhead) compared to using solely network diagnosis solutions.

Keywords: wireless sensor and actuator networks; fault tolerance; diagnosis, test.