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AN APPLICATION AWARE UTILITY BASED LIFETIME QUANTIFICATION FRAMEWORK FOR WIRELESS SENSOR NETWORKS

Abstract

Network lifetime is a novel performance metric that is used to evaluate networks comprised of nodes with irreplenishable energy sources. Wireless sensor networks (WSNs) are the primary examples of such networks. The network lifetime is a crucial performance metric since it indicates the amount of functionality obtained in return to the total investment including the sensor hardware, the deployment, and the administrative work. Unlike the legacy network performance metrics such as delay, throughput or jitter, the evaluation of network lifetime is not straightforward because of the application dependence involved. Application dependence is a recurring theme in the WSN domain that inhibits finding generalized solutions to the research problems, where the network lifetime quantification is no exception.

In this work, we devise a framework for incorporating the application dependence into the lifetime measurement process of the wireless sensor networks, thereafter via extensive experiments, demonstrate the significance of the lifetime metric itself in the quantification process for a variety of application scenarios including both scalar and video based wireless sensor networks. We show that the lifetime metrics that ignore application dependence fail in solving the network lifetime quantification problem in WSNs. Our proposed framework, weighted cumulative operational time (WCOT), combines two distinct mechanisms for realistic and application context aware network lifetime evaluation. Firstly, by introducing the utility function it enables the users of the network to inscribe their own application level requirements in a formal setting. This clarifies the inherent subjectivity due to the application dependence involved in the WSN network lifetime quantification problem by transforming it into a form that renders further computation possible. The utility function denotes the total cumulative utility (usefulness) offered by the collaboration of the sensor nodes. Secondly, instead of offeering a single cut-off threshold value for de_ning the point after which the network is assumed to be nonfunctional, WCOT framework makes use of the gradual change in the utility of the network and record how the network evolves over time in terms of functionality offered by keeping the weighted sum of the operational time. Unlike lifetime metrics that focus on a single threshold value, WCOT is able to differentiate network performances that di_er in how the network evolves till the utility drops to zero.

PUBLICATIONS

Journals

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