Longevity Enhancement Technique on IEEE 802.15.4/ZigBee Sensor Network Using D-Policy M/G/1 Queuing Model

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Abstract

Wireless sensor networks are an emerging research domain for a wide range of potential applications. Their importance has been enforced by the delivery of IEEE 802.15.4/ZigBee Sensor Network (ZSN). Power consumption is an interesting challenge to prolong the operational lifetime of ZSN. ZigBee routers closer to the ZigBee coordinator (ZC) have a larger forwarding traffic burden and consume more energy than devices further away from the ZC. The whole operational lifetime of ZSN is deteriorated because of such an uneven node power consumption patterns, leading to what is known as an energy hole problem (EHP) around the ZC. In this article, we propose a novel power-saving scheme to alleviate the EHP based on the D-policy M/G/1 queuing model. With little management cost, the proposed queue-based powersaving technique can be applied to prolong the lifetime of sensor network economically and effectively. For the proposed queue-based model, mathematical framework on performance measures have been formulated. And also we analyze the average traffic load per node for tree-based ZSN. Focusing on ZigBee routers deployed at the innermost shell of ZSN, numerical and data simulation results validate that the proposed approach indeed provides a feasibly cost-effective approach for lifetime elongation of sensor networks.

Keyword：Wireless sensor networks