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Poster

Routing Aware DSME Networks

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Abstract

Deterministic Synchronous Multichannel Extension (DSME) is a prominent MAC behavior of IEEE 802.15.4e can avail deterministic service using its multi-superframe structure. RPL is a routing protocol for wireless networks with low power consumption and generally susceptible to packet loss. A combination of these two protocols can integrate real-time QoS demanding and large-scale IoT networks. In this paper, we propose an architecture to integrate routing with DSME. We also show a simulation result by which we improve reliability by 40 % using routing.

Routing Aware DSME Networks

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Abstract
Deterministic Synchronous Multichannel Extension (DSME) is a prominent MAC behavior of IEEE 802.15.4e can avail deterministic service using its multisuperframe structure. RPL is a routing protocol for wireless networks with low power consumption and generally susceptible to packet loss. A combination of these two protocols can integrate real-time QoS demanding and large-scale IoT networks. In this paper, we propose an architecture to integrate routing with DSME. We also show a simulation result by which we improve reliability by 40 % using routing.

Author Keywords. DSME, RPL, IEEE 802.15.4e

1. Introduction

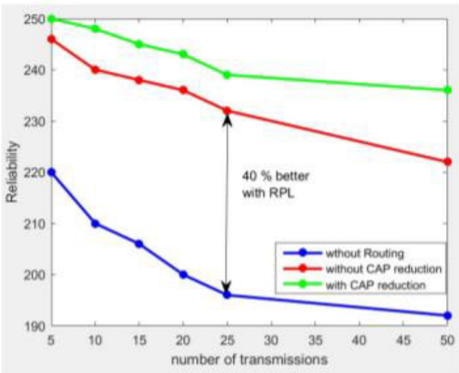
The IEEE 802.15.4e standard provides time critical support for IoT applications by introducing new MAC behaviors like TSCH, DSME and LLDN [1]. Among these MAC behaviors, DSME - Deterministic Synchronous Muti-channel Extension is a very versatile MAC behavior. Like the classic IEEE 802.15.4, it can alternate between CSMA/CA and Guaranteed Timeslots (GTS) to support both best effort and time-critical communications. Despite its many enhanced features, the standard does not specify any network layer for QoS centric routing purposes. Although it can support mesh topology, no intuition is given regarding the right mechanism that can dynamically setup the necessary service. Integrating a distributed routing protocol like RPL over DSME "helps achieving increased scalability (via routing), while providing robustness to cope with network changes". The main contribution in this paper are as follows: 1. We introduce an architecture that can support RPL over the existing DSME networks. 2. We use simulations to learn the advantages of RPL over the DSME in-terms of reliability

2. Network Architecture

The DSME network provides deterministic communication using its beacon enabled mode. This beacon enabled mode is supported by multisuperframes that comprises stacks of superframes. Every superframe comprises of a Contention Access Period (CAP) in which the nodes contend to access the channel and a Contention Free Period (CFP) in which the nodes send the data using Guaranteed timeslots (GTSs). There is an Enhanced Beacon (EB) helps in the overall synchronization of the network. RPL is a routing protocol that integrates technologies like IEEE 802.15.4 and IPv6 protocols. It supports both mesh as well as hierarchical topologies and is specifically designed to support networks that are prone to high exposed packet losses and limited resources in terms of computation and energy. RPL is based on hierarchical Directed Acyclic graphs (DAGs) in which a node can associate itself with many parent nodes. The destination nodes of an RPL is called a sink and the nodes through which a route is provided to internet are called gateways. RPL organizes these nodes as Destination-Oriented DAGs (DODAGs). In an RPL, every router in the system identifies and associates with a parent. This association is done based on an Objective Function (OF). OF can be based on quality determining parameters like LQI (Link Quality Indicator) and RSSI (Received Signal Strength Indicator). OF helps in providing an optimal routing path using metrics like latency or power efficiency. In case of a GTS allocation, the allocation request is sent to the parent node through the RPL network. A concrete example of our architecture is as follows: • A dedicated beacon broadcast for synchronization between every superframe for every superframe duration. • A dedicated beacon broadcast for synchronization every multi superframe. • A Enhanced Beacon common for all coordinators in the network carrying the broadcast + unicast packets for RPL signaling (DIO, DIS, DAO. In accordance with the standard, the Enhanced Beacon payload can be a variable and it carries the RPL information. • Dedicated unicast signal from the slave node to the parent node followed by N unicast signals from the coordinator to the slave nodes.

3. Preliminary results and Future scope

We simulated the reliability over a network of 25 nodes with static concentric mobility type in OpenDSME [2]. We introduce a constant interference range to emulate a real-time wireless network over 16 channels. Without having routing established for the network layer, it was noted that the reliability of the network depletes steadily with the increase in the number of nodes. We repeated the same experiment with the same network configuration but with generic routing employed in the network layer. We were able to observe that the reliability does not deplete steadily and almost shows 40% betterment results.



Reliability with generic routing

Our Simulation of RPL provides us an insight that routing over a dynamically evolving DSME networks can improve its reliability manifold. There is much research to be done in designing efficient algorithms that can stringently schedule the RPL routes to provide larger QoS

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References

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