Competition: Dependable Network Flooding using Glossy with Channel-Hopping

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1 Abstract

We present a communication protocol for fast and reliable dissemination of events in short-range wireless networks. Our approach combines Glossy network flooding with a channel-hopping scheme to increase its robustness against external interference. We further describe our strategy to tackle the challenges of the test scenario and how to adapt the protocol for energy-efficient operation.

2 Flooding-based Event Dissemination

The main goal of our communication protocol is to report the status of the light bulb measured by the source node to the sink node as quickly as possible. We employ synchronized flooding using the Glossy protocol [2] implemented in Contiki with the source node as the originator of the flooding. The payload of each Glossy packet contains an ON/OFF bit indicating the observed status of the light bulb.

Glossy flooding is initiated by the source node and is based on the principle of synchronous packet transmissions to exploit constructive interference of simultaneous transmissions at the receiving nodes. Since Glossy eliminates random delays between packet reception and re-transmission of the packet in order to achieve synchronous transmissions, it provides network-wide packet dissemination with very low latencies. Glossy flooding can reach all nodes within a few milliseconds in the case of wireless networks consisting of a small number of hops. Therefore, it is an ideal candidate for data dissemination applications requiring low latencies.

3 Reliable End-to-End Packet Transmissions

During the competition phase, we expect strong radio interference on multiple channels of the IEEE 802.15.4 radio spectrum generated by an unknown number of JamLab [1] nodes placed in proximity to our sensor nodes. As packets will be forwarded simultaneously along different paths between the source and the sink node, Glossy is very reliable against jamming of single links, as packets will be forwarded along other paths that are not affected by interference. In order to improve the reliability in case of strong interference affecting multiple nodes, we periodically change the radio channels used for Glossy packets according to a randomized hopping sequence, which can be derived from the packet relay counter and the packet sequence number (see Figure 1).

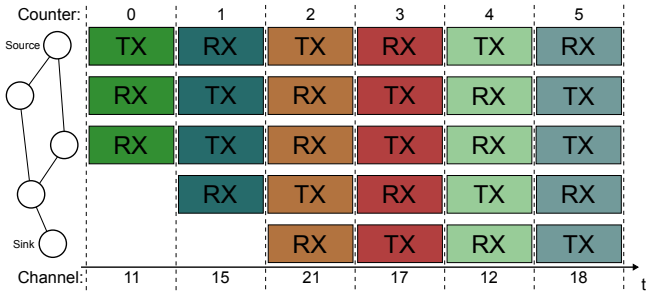

Figure 1. Example of Glossy-based flooding with channel-hopping: The IEEE 802.15.4 radio channel used for each communication slot is derived from the relay counter and the packet sequence number.

4 Energy-Efficient Wireless Communication

The CC2420 radio transceiver on the nodes can be put into idle mode between flooding phases to reduce the power consumption. However, nodes need to be synchronized in time so that the radio can be enabled again precisely at the start of the next flooding phase. The overall radio duty-cycle depends mainly on the network diameter, the number of packet repetitions for each flood, and the time interval between consecutive Glossy floods. On the other hand, the worst-case source-to-sink latency depends mainly on the time interval between floods and needs to be traded off against an increased power consumption when using shorter intervals. Therefore, we adapt the Glossy interval and the number of packet repetitions based on the available energy budget and reliability/latency requirements.

5 References

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