Analysis of IEEE 802.15.4 networks under various interference patterns

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Coexistence problem

As more and more devices need to share the same 2.4GHz ISM band, the problem of interference becomes highly relevant. One of the protocols that those WSNs make use of is the IEEE 802.15.4/ZigBee standard. This standard is sensitive to external interference like Wi-Fi.

In this work, we analyze the performance of a large ZigBee network under the effect of external interference. In particular, we compare the effects of different patterns of external interference, i.e., periodic and Poisson distributed traffic, on the ZigBee network performance.

Results

Simulations are performed using the OMNeT++ simulator. The network consists of 25 ZigBee nodes that each send 25 packets per second to one of the five central nodes that is closest to it. The total length of a packet is 20 bytes.

The external interference is simulated as a noise source that produces a strong interference signal for a chosen period of time, either according to a periodic or with a Poisson distributed pattern.

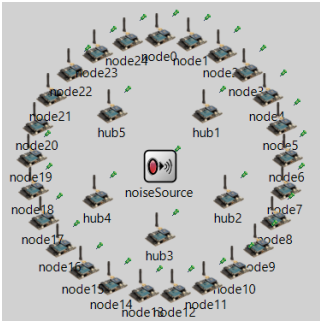

Figure 1: Network topology of 25 nodes, 5 hubs and a noise source.

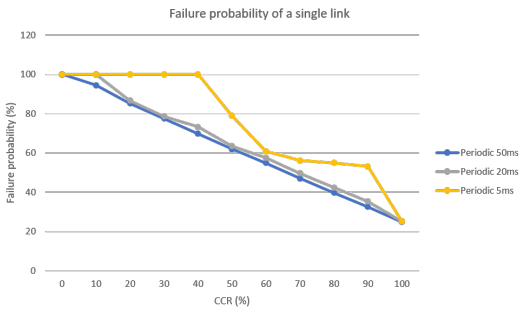

Figure 2: Comparison of different CCR periods for periodic interference.

A larger interference period for periodic interference will result in better total performance for the ZigBee network.

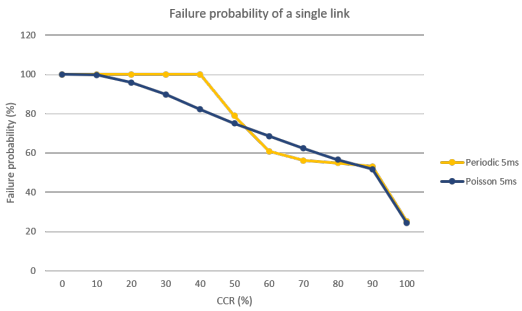

Figure 3: Comparison of periodic and Poisson interference for a CCR period of 5ms.

The comparison between a periodic and Poisson interference with a 5ms period interference signal shows some interesting results with a crossing of the two lines around 60%. This could be due to the random nature of the Poisson interference which is useful at lower clear channel rates.

Conclusions

We show that the type of external interference traffic, the typical mix of different frame types and their temporal characteristics, play significant role on the ZigBee network performance. For the same clear channel rate, the performance of the network can vary hugely, depending on the distribution of the interference.

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