Wireless Sensor Networks

Assignment 2

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October 7, 2024

1 Problem

IEEE 802.15.4 uses ISM band 2.4 GHz radio frequencies (from channel 11 to channel 26) to transmit sensor data. These frequency are also used by other radio technologies, such as WiFi, Bluetooth, and others. To setup a WSN, it is an important step to select a channel with minimum interference. A practical approach is to leverage channel sensing to identify the channel interference status by measuring the noise/interference signal strength.

The following steps should be completed using a sensor node:

1. Write a program to measure the noise/interference signal strength of different channels (from channel 11 to channel 26).
   - To learn how to set up a given channel.
   - To measure RSSI of the noise/interference at different channels. You should decide how long to measure the RSSI value and how to deal with the measures in each channel. Please refer to the datasheet CC2420 about how to convert the RSSI register value to the RSSI value in dBm [1].
2. Compare noise/interference status at different channels and select the best channel. The Fig. 1 shows the 16 channels of 802.15.4 coexist with the channels of Bluetooth Low Energy and the Channels of WiFi.

2 Results

To test the implementation, I run the code with $N = 10$ samples and $t = 0.1$s. The output is shown in listing 1. In this particular experiment, channel 22 is selected as the best with an average RSSI of -84 dBm.

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Radio initialization successful
Reading RSSI values on channel 11
-93, -92, -92, -93, -93, -93, -93, -94, -94, -93, Channel: 11, Average RSSI: -93
Reading RSSI values on channel 12
-95, -95, -95, -95, -86, -95, -92, -95, -95, -93, Channel: 12, Average RSSI: -93
Reading RSSI values on channel 13
-92, -92, -92, -82, -90, -81, -92, -92, -92, -92, Channel: 13, Average RSSI: -89
Reading RSSI values on channel 14
-94, -95, -69, -93, -94, -94, -75, -94, -94, -94, Channel: 14, Average RSSI: -89
Reading RSSI values on channel 15
-94, -94, -40, -94, -94, -94, -94, -94, -70, -84, Channel: 15, Average RSSI: -85
Reading RSSI values on channel 16
-89, -97, -98, -96, -97, -97, -95, -86, -96, -97, Channel: 16, Average RSSI: -94
Reading RSSI values on channel 17
-92, -92, -92, -92, -93, -85, -92, -93, -91, -89, Channel: 17, Average RSSI: -91
Reading RSSI values on channel 18
-94, -95, -94, -95, -95, -89, -94, -91, -93, -95, Channel: 18, Average RSSI: -93
Reading RSSI values on channel 19
-88, -89, -90, -90, -89, -90, -90, -89, -90, -89, Channel: 19, Average RSSI: -89
Reading RSSI values on channel 20
-96, -95, -95, -95, -97, -96, -94, -96, -95, -95, Channel: 20, Average RSSI: -95
Reading RSSI values on channel 21
-89, -89, -89, -89, -89, -89, -84, -89, -89, -89, Channel: 21, Average RSSI: -88
Reading RSSI values on channel 22
-89, -88, -89, -51, -77, -90, -89, -89, -89, -89, Channel: 22, Average RSSI: -84
Reading RSSI values on channel 23
-87, -86, -87, -87, -86, -83, -87, -87, -87, -87, Channel: 23, Average RSSI: -86
Reading RSSI values on channel 24
-95, -96, -89, -95, -96, -96, -96, -89, -96, -83, Channel: 24, Average RSSI: -93
Reading RSSI values on channel 25
-91, -91, -92, -89, -90, -86, -92, -92, -89, -92, Channel: 25, Average RSSI: -90
Reading RSSI values on channel 26
-89, -90, -89, -90, -88, -89, -90, -89, -88, -86, Channel: 26, Average RSSI: -88

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Best Channel: 22, Best RSSI: -84
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Listing 1: Results

3 Discussion

The approach considered in this assignment is rather simple but shows a basic example of utilising channel sensing to select the best channel. However, in a real setting, this implementation might not be the best.

The current implementation computes a simple average of RSSI values over a fixed number of samples (N). This approach can be improved by using a weighted average, where more recent values are given higher weights to quickly adapt to environmental changes. An Exponential Mov-

ing Average (EMA) could be applied, which adjusts more dynamically to fluctuations in signal strength.

While RSSI is a useful indicator of signal strength, it might not provide a complete picture of the channel quality. A strong RSSI value could still be associated with poor performance due to high noise or interference and so, by incorporating Signal-to-Noise Ratio (SNR) as a metric, instead of relying solely on RSSI, one could improve the channel selection process.