Question 2: Spectral Scan

The ath9k supports spectral scans. This card is installed on Node6, thus all following commands are issued on that device if not stated otherwise.

Configuration

1. Show current configuration for the scan options:

   `tail -n +1 /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_*`

   Output:

   ```
   ==> /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_count <==
   8

   ==> /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_fft_period <==
   15

   ==> /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_period <==
   255

   ==> /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_scan0 <==

   ==> /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_scan_ctl <==
   disable
   ==> /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_short_repeat <==
   1
   ```

   Review of some parameters:

   - `spectral_count` : Nr of requested scans
   - `spectral_fft_period` : Period the PHY-Layer passed frames to the overlying MAC Layer. (fft_period+1) * 4uS

     In this case every 64 micro seconds

   - `spectral_short_repeat` defines the spectral scan mode.

     - 1 = 4usec scan mode
     - 0 = 204 usec scan mode

2. Configure wlan1 to make it able to scan

- Edit /etc/config/wireless

  ```
  config wifi-iface 'default_radio1'
      option device 'radio1'
      option network 'lan'
      option mode 'sta'
  ```

- Check that it scan:

  `iw dev wlan 1 scan | head -n 9` (just show first 9 lines to show if it worked)

  Output:

  ```
  BSS a8:54:b2:71:d3:8b(on wlan1)
          TSF: 956888621281 usec (11d, 01:48:08)
          freq: 2462
          beacon interval: 100 TUs
          capability: ESS (0x0421)
          signal: -21.00 dBm
          last seen: 2370 ms ago
          Information elements from Probe Response frame:
          SSID: LEDE
  ```

  Yes, it worked!

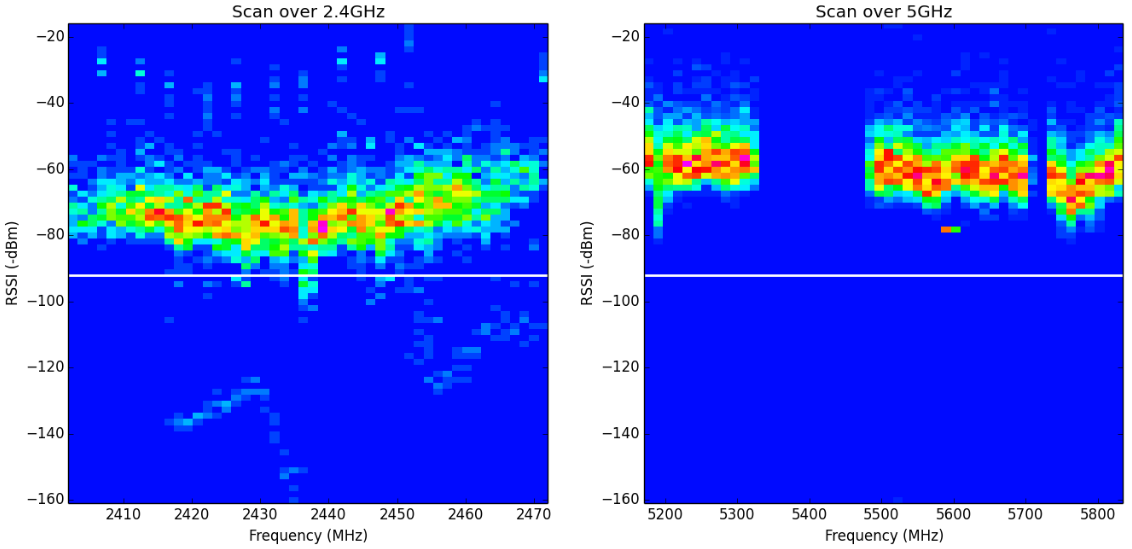
Run

1. Create shell script to run spectral scan

   `cat /root/hw05/spectral_scan`

   ```
   #! /bin/ash

   # switch on chanscan on phy1
   echo chanscan > /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_scan_ctl

   # perfom scan on wlan1 and drop output
   iw dev wlan1 scan > /dev/null 2>&1

   # save the output in /root/hw05/spectral_scan_wlan1.data
   cat /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_scan0 \
     > /root/hw05/spectral_scan_wlan1.data

   # disable spectral scan
   echo disable > /sys/kernel/debug/ieee80211/phy1/ath9k/spectral_scan_ctl
   ```

2. Run `spectral_analysis.py` script to produce the heatmap



The figure shows two heatmaps. One for each spectrum (2.4 and 5GHz) from a single scan. The y-axis are syncrhonized to make a better comparison. The white horizontal line represents the noise floor of the experiment which is -94 dBm. The hue of the color represents how many fft samples were registered in discrete range of x and y, where blue are fewer hits and red more frequent hits.

In the 2.4GHz spectrum most frames were detected within -60 dBm and ne the noise floor at -94 dBm across the whole spectrum. Below this there are only a couple of detections which might be some interfering noise because it spreads across multiple channels. In between -20 and -40 dBm there are some distinctive strong signals equally distributed. They occur not on the exactly on the channels center frequency which can be a hint of **OFDM** (Orthogonal Frequency Division Multiplexing) is being used here.

The 5GHz spectrum has most of its signals with the range of -40 - 80 dBm. Which is slightly stronger then the 2.4GHz spectrum. There is also less noise on that heatmap which is natural for these frequencies, since 5GHz waves have a shorter range and less devices send on that channels. Also there are two visible gaps of signals from 5350 to 5500 MHz and around 5700 Mhz. These frequencies could be used for new devices on the medium since they are is no staturation.