Technical Document - Best and Worst Channel Recommendation

Daniel Atkinson

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This technical document describes how the recommendation of best/worst channels is done in the site survey section of flashman.

Values of RSSI are negative, the higher they are the stronger the signal, that is to say -70 dBm is a weaker signal than -49 dBm. For that reason, it is not straightforward to develop a score for each channel (e.g.: multiplying the number of APs in a channel by the negative of the RSSI values will not do). Let S be the set of all 2.4GHz (5GHz) signals, one for each AP, where $S(i)$ is the i-th term of that set, $i = 1$ to n, where n is the number of APs scanned. Let W be the set of all 2.4GHz (5GHz) channel widths, such that $W(i)$ represents the width of the i-th AP scanned. Let C be the set of all the 2.4GHz (5GHz) channels, such that $C(i)$ represents the channel index of the i-th AP, with $i = 1$ to n. Therefore, $|S| = |W| = |C|$.

Channels in 2.4GHz can have widths of 20MHz and 40MHz, whereas channels in 5GHz can also have a width of 80MHz. Let channel of index k have a width of 20MHz, $k = 1$ to m, where m is the number of channels of 2.4GHz (5GHz). This channel can interfere with channels of index $k-2$ to $k+2$. If the channel of index k had a width of 40MHz it would affect channels indexed from $k-4$ to $k+4$. Analogously, with a width of 80MHz it would affect channels indexed from $k-8$ to $k+8$. The approach taken is to apply a transformation f on the values of RSSI of the 2.4GHz (5GHz) channels, such that

$$f(i) = 1 - \frac{S(i) - \max S}{\min S - \max S}, \tag{1}$$

where $\min S$ is the smallest value in the set S, $\max S$ is the largest value in the set S. Therefore, all transformations f map to the range $[0, 1]$.

To account for the diminishing interference in adjacent channels an inverse square root function, g, was used, together with a filter, to weigh the values of the transformed signals. Let r be the range function that defines the filter,

$$r(i) = \begin{cases} 2 & \text{if } W(i) = 20 \\ 4 & \text{if } W(i) = 40 \\ 8 & \text{if } W(i) = 80 \end{cases} \tag{2}$$

Weight function, g, is defined as followed:

$$g(i,j) = \begin{cases} \frac{1}{\sqrt{1+\frac{r(j)}{2}|C(j)-C(i)|}} & \text{if } C(i) \in [C(j)-r(j), C(j)+r(j)] \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

This way, when $C(i) = C(j)$, the weight equals one, and, independent of the width, the furthest channel that is still encompassed by the filter has weight $\frac{1}{3}$.

Now, we can define the final score for each channel, $T(k)$,

$$T(k) = \sum_{i=1}^{n} \sum_{j=1}^{n} I(i,k) * g(i,j) * f(j), \tag{4}$$

where I is an indicator function that has value one if $C(i) = k$ and zero otherwise. The best channel is $\min T$ while the worst is $\max T$.

There is one caveat: one must take into account the DFS channels, channels that are reserved for radar. In that case, the channels with indexes i and $i+1$ may not be adjacent and adjustments must be made.