Full Control Networks
Whitepaper

Network Troubleshooting Wireless Edition : Part 1

Why don't we turn all the Access Points to full power?

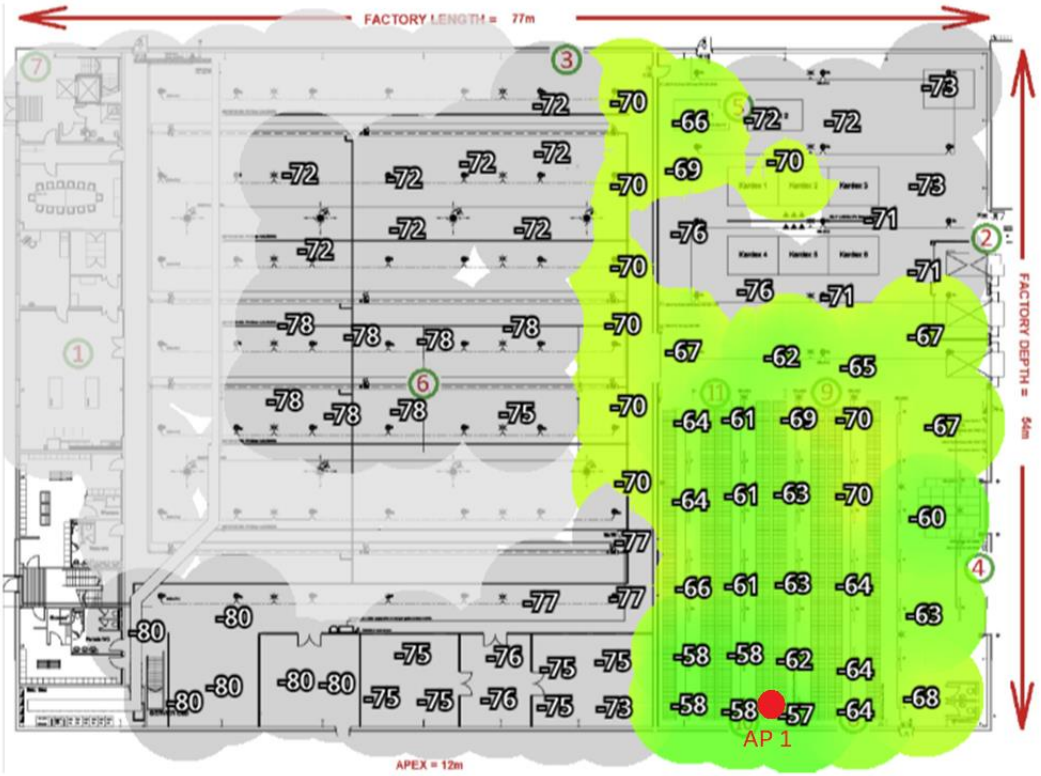
There are quite a few things in WiFi which seem confusing. And one of the ones at the top of the list is: Why can't we set every Access Point (AP) to full power, so they cover as much space as possible? You might be thinking more signal is better or perhaps considering the cost savings of using less APs? Unfortunately, it's not a good idea and this paper explores why in a bit more detail.

Introduction

Without going into the physics of it too much, when you power up an Access Point, it effectively produces two footprints:

- The footprint you want : the useable footprint – an area close to the AP with a strong signal
- The footprint you don't want : the weaker signal that propagates gradually out a long way from the AP

Let's look at an example. AP1 is installed in the bottom right of the image below.



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AP1 produces a useable footprint which covers around a ¼ of the floor space – this area is highlighted using green/yellow colour in the image above. The limit has been set at -70dBm, as client devices won't want to use signal that's weaker than that.

The footprint that doesn't meet the specification is highlighted using grey colour and we can see that this unusable signal degrades slowly and reaches across the whole factory.

With modern WiFi there are two issues at play here:

- Roaming
- Channel re-use

Roaming

Roaming is the term we use when a device moves from one Access Point to another. The first thing to say about roaming is that the rules in WiFi state *how* the roaming takes place, but not *when*. Devices can roam whenever they want, as it's a function of the drivers in the device itself.

The second thing is that devices don't really want to move, they are much happier staying connected to an AP for as long as they can, before roaming. It's one of the biggest misconceptions in wireless to think that your device is always connected to the strongest AP, wireless just doesn't work like that.

So, if you turn all your APs to full power, what is more likely to happen is your device will connect to the first AP, but then just ignore the next two or three APs you pass as you walk, as the signal from the first one is still deemed as good enough (even though it might be significantly weaker than the nearest AP). Eventually you reach the point where the device sees the need to roam.

The roaming process typically requires a wait of ~5 seconds after seeing the signal drop below its minimum requirement, before it will move to the next AP. This is a problem when APs are powered very high, signal does not attenuate quickly, meaning end devices can be on the edge of their minimum value for quite some time. As the signal fluctuates above and below the threshold, the 5 second timer keeps resetting. A device might start the roaming process and stop it several times until the signal stays below the minimum value for long enough to complete the move.

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Channel Re-use

The issue here is a basic transmission one.

When one AP transmits on a channel, all other APs using the same channel will stop and wait if they can hear the signal at -85dBm or stronger. This is because the APs can't tell which AP is using the channel, they just know the channel is in use, therefore they must all wait until the channel is free again.

This is made worse by the fact that the signal propagation for -85dBm can go a long way, as we saw in the survey above the whole floor plan is covered to this value.

So, in the example shown although only around a quarter of the footprint can actually use a channel, it's use of it will stop all other APs using that channel in the rest of the space. High powered APs are very inefficient users of the spectrum, stopping a far greater area from working than they actually service.

This is more significant when using wide channels (because you have less channels to play with, you need to repeat them more often). If you use 80MHz wide channels (4 channels bonded together) and your APs can hear any of the 4 overlapping channels at -85dBm (which could be up to 50-100 meters away), you effectively stop 4 channels from working each time one AP broadcasts. All APs on all those channels will have to stop and wait until it is clear to send. Making the channel reuse issue even worse.

This is one of the areas that WiFi6 is trying to address. You may hear the terms BSS Colouring or Spatial Reuse which are referencing this exact problem, and WiFi6E which is using more spectrum space, so more separate channels to pick from before we hit this reuse issue again.

Summary

If we look at the way some of the big manufacturers operate, their APs out of the box will run at 1/16th max power, which does mean you need to buy a lot more APs.

However, there are two good reasons for this:

- The roaming points are clearer for the clients to work out and they move quicker to the next AP
- The unwanted footprints are kept smaller meaning less issues when the channels need to be re-used

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