Title

Hallway placement of access points affecting coverage & roaming

Brief

It is common for access points to be deployed in hallways/corridors for reasons such as:

- Easier installation without business interruption
- Easier access for maintenance
- Sterile/contamination reservations for healthcare settings
- User concerns regarding emissions
- Security of device in student dwellings

However, this is not a good practise and often leads to either coverage or roaming issues, or both.

The coverage issue stems from the use of vendor auto-management features such as RRM/ARM. Hallways provide very low levels of attenuation and often access points can have direct line-of-sight (LoS) to each other. As tools like RRM rely on the data shared by access points about their RF neighbours this leads to a false understanding of the environment. The result is the RRM solution instructs the AP's to transmit at very low powers to the point that coverage does not make it into all areas required due to attenuating obstacles the RRM solution is not aware of.

The roaming issue typically occurs because of the excessive coverage in the hallways. As there is nothing to attenuate the signal as it propagates up and down hallways an AP's signal is often satisfactory far beyond the neighbouring cells. This results in the clients remaining "stuck" to a very distant AP when there are closer better options, and when the user finally turns a corner or enters a room which introduces attenuating obstacles the signal from the associated AP drops to zero and forces a disruptive roam.

In the following section I demonstrate both these issues as encountered during a validation of an existing WLAN deployment.

Diagnosis

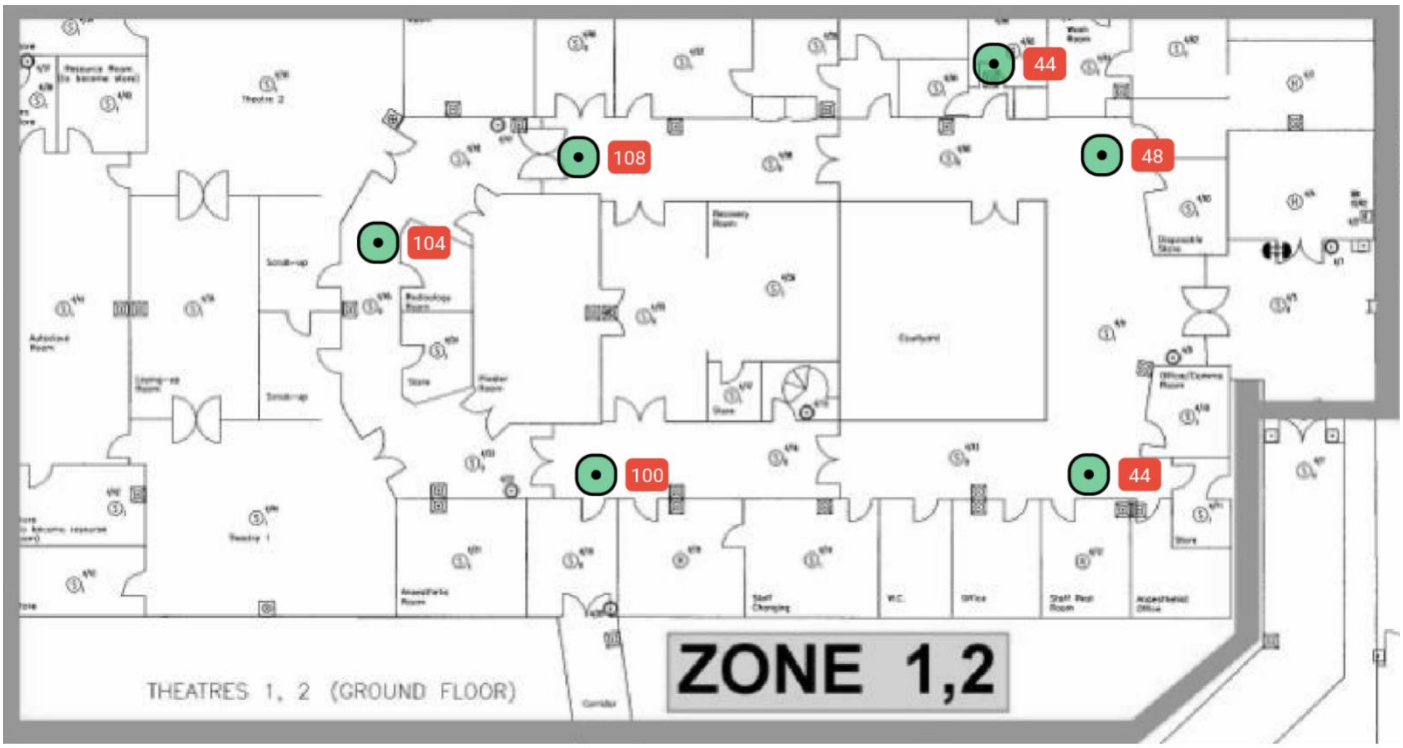

Figure 1 - floorplan and AP placement

Figure 1 shows the floorplan of part of a healthcare surgical complex.

- All hallway doors remain latched open except in the event of a fire.
- Almost all other doors closed for privacy and contamination purposes.
- 5 out of 6 AP in this part of the complex were installed in the hallways.
- 2 out of 6 AP's have LoS to 1 other AP.
- 2 out of 6 AP's have LoS to 2 other AP's.
- The voice client being deployed was to use 5GHz only so 2.4GHz data was not collected.
- The channel plan was limited to 36-48 & 100-112 to improve voice roaming.

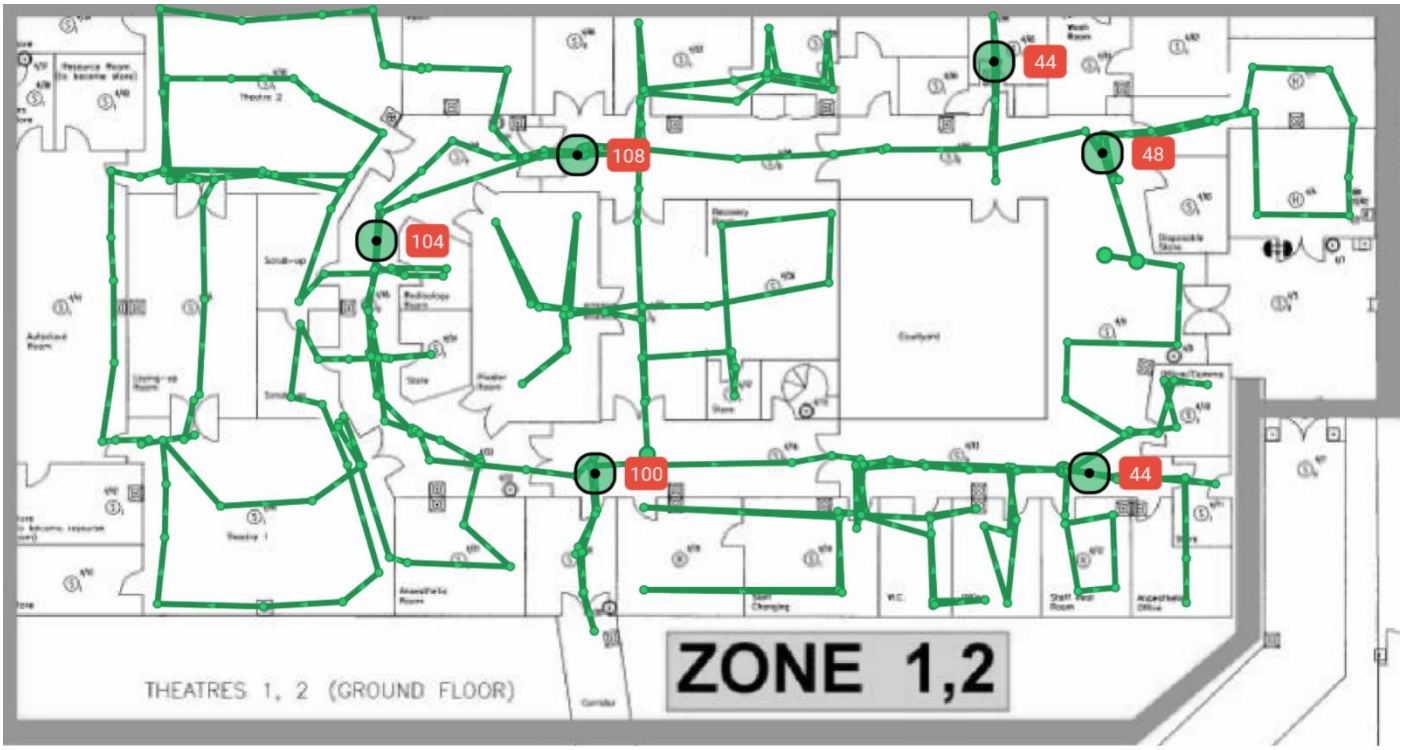

Figure 2 - survey path

Figure 2 shows the survey path followed.

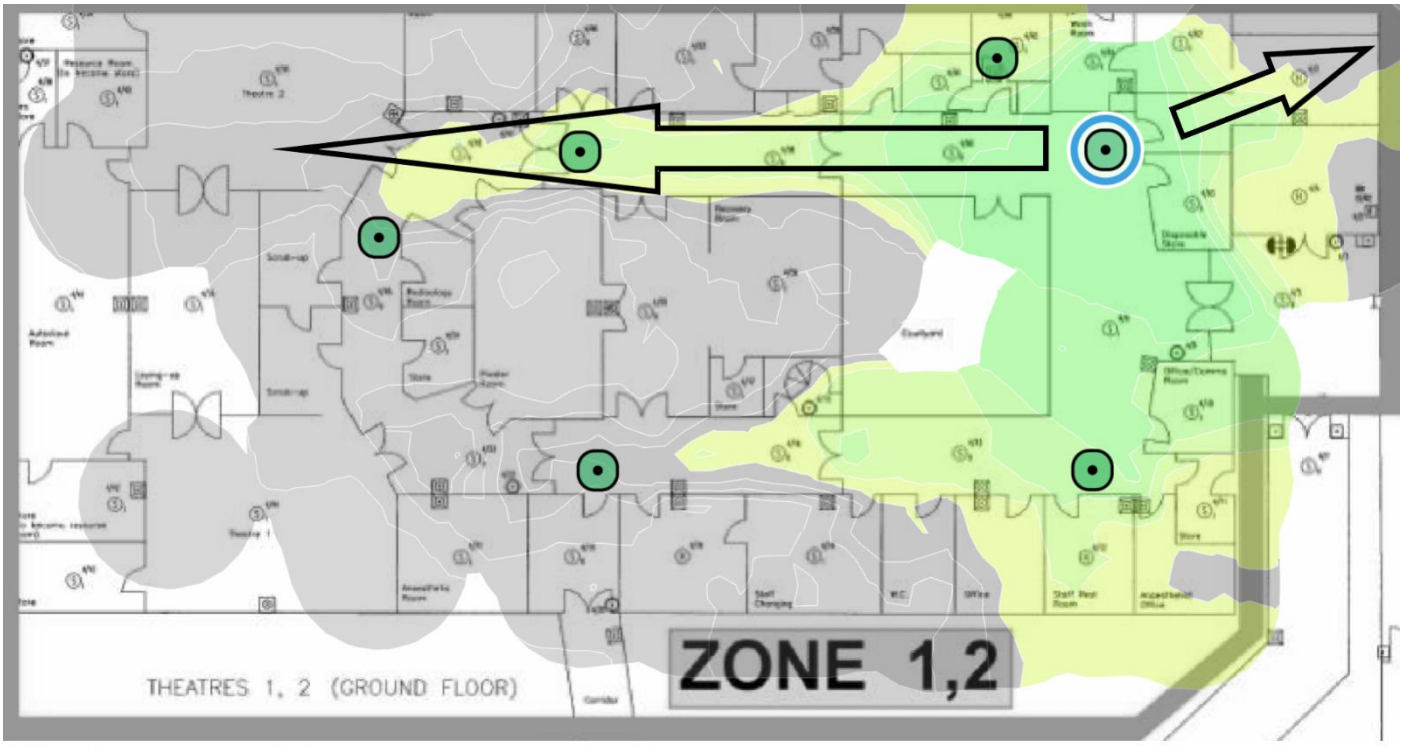

Figure 3 - coverage example 1

Figure 3 demonstrates how the signal from one of the hallway AP's propagates all the way down the hallway yet does not provide sufficient coverage in the offices directly to the right of it. This is based on a coverage scale/slider of -65dBm for voice.

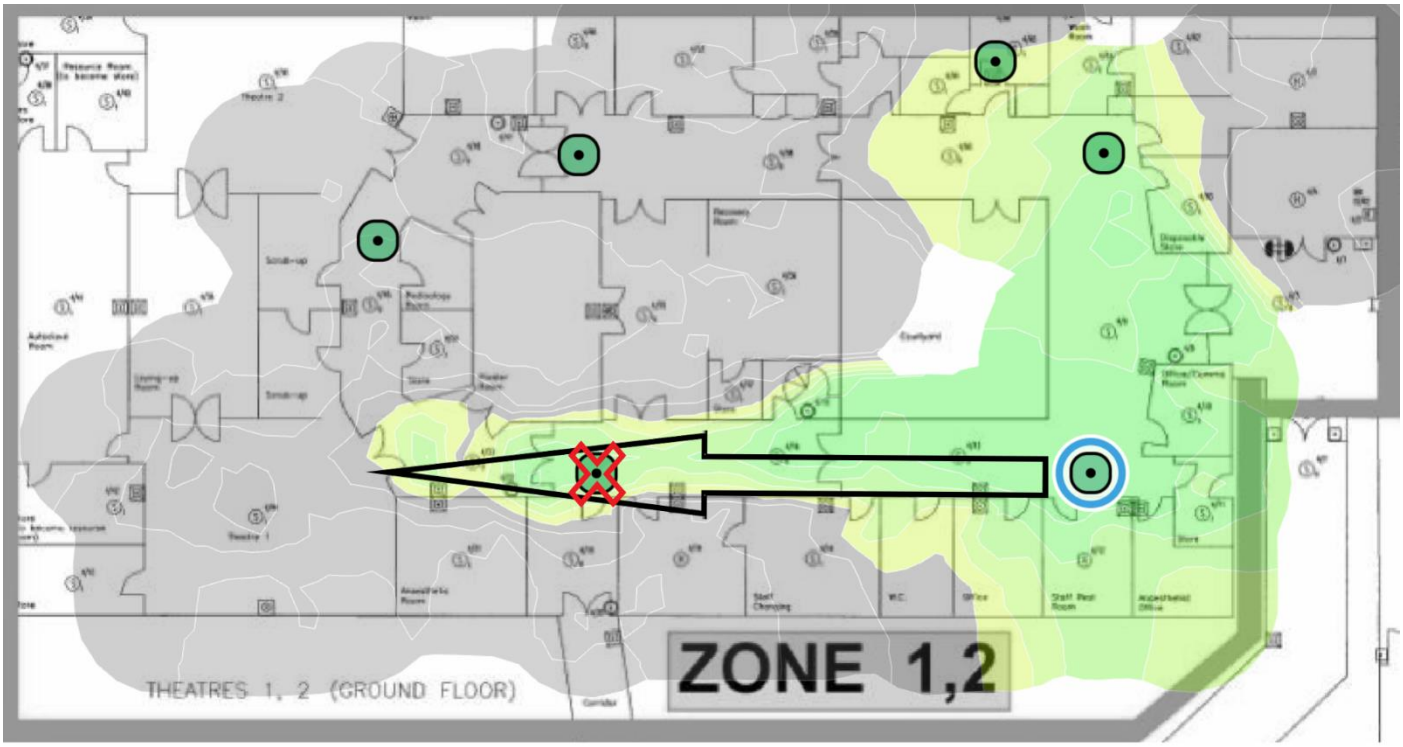

Figure 4.1 - roaming coverage example 1

Figure 4.1 shows the propagation down the hallway of another AP. The coverage extends well beyond the next AP, crossed out to demonstrate that a client would likely pass this AP by without attempting to roam to it. Notice where the AP's acceptable coverage (-65dBm) stops, as the hallway begins to turn a corner and LoS ends.

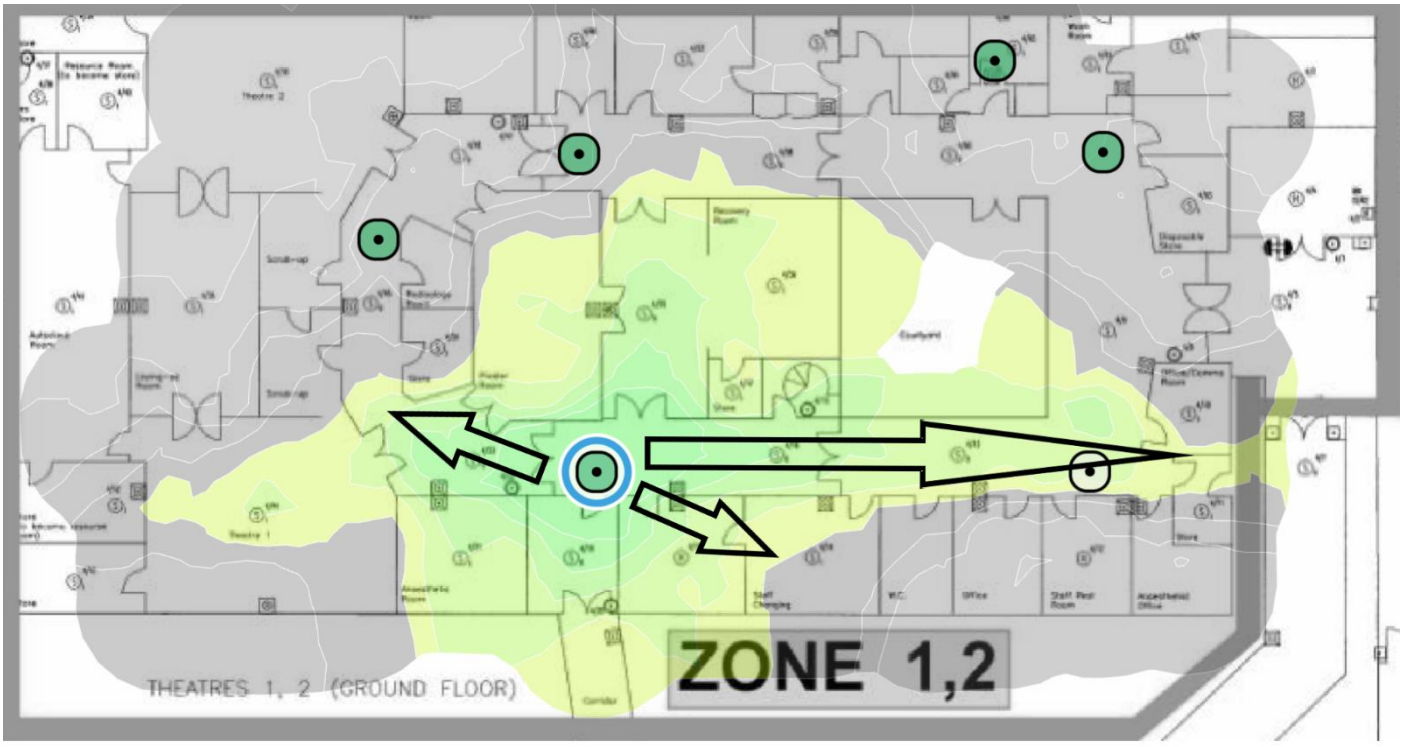

Figure 4.2 - roaming coverage example 2

Figure 4.2 shows several things.

- The coverage to the right provides a good overlap with the neighbour AP to facilitate good left-to-right roaming.
- However, if you compare the length of that coverage arrow with the one below it propagating into the surrounding rooms it demonstrates a vast cell asymmetry.
- The arrow left shows very little propagation as the hallway turns & walls introduce attenuation, and provides barely any additional coverage compared to the AP in Figure 4.1, despite being much closer to the turn.

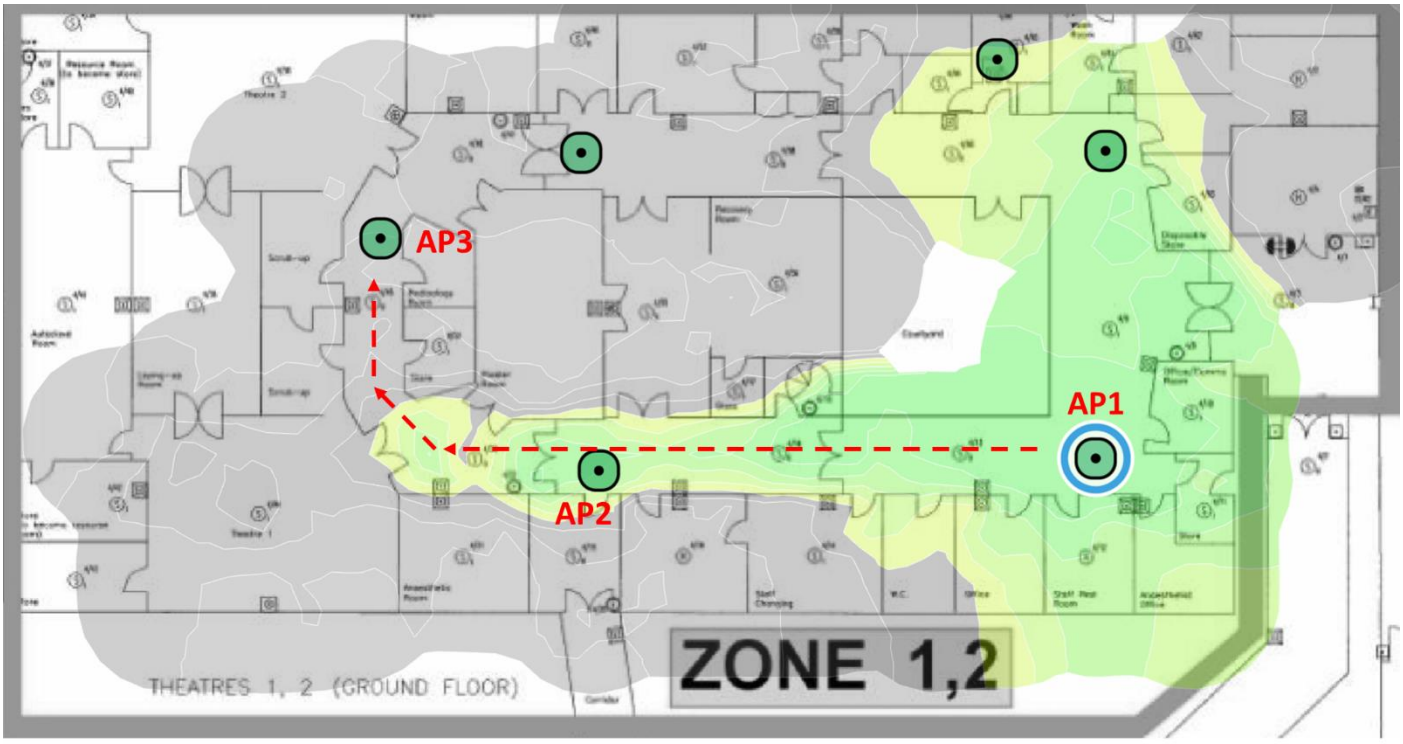

Figure 4.3 - roaming path

In Figure 4.3 we can see a potential roam path of a user moving around the complex. The client is likely associated with AP1 all the way to the turn because of the disproportionate hallway propagation. When AP1 signal drops suddenly on the turn the roam will be interruptive to a voice conversation.

In the worst-case scenario the client will have learnt about AP2 during the path and roam to this AP. As we have seen from Figures 4.1 and 4.2 this AP barely provides any extra coverage and the client will soon be in an "emergency" roam again.

Best case scenario is that the client finds and roams to AP3 so that it is entering a cell of coverage rather than leaving one.

In addition to the cell overlap issue if the WLAN is using Fast Transition Over-the-DS then this will likely fail as the client will not be able to initiate the roam via AP1 and therefore have to perform full Dot1X authentication again, costing an unacceptable amount of time.

Summary

The best practise and ideal solution is not to place AP's in hallways. AP's should be installed around the floorplan where they typically don't have line-of-sight of each other and attenuating obstacles are catered for, giving even signal propagation and cell coverage.

If this is not possible for any of the reasons mentioned earlier (or another reason) then minimum transmit power limits should be set on the auto-management feature so that cell sizes are sufficient to provide coverage into all areas of the floorplan. However, this will create more co-channel interference/contention reducing the efficiency of the cells, and still suffer from hallway roaming issues as clients will remain connected far from the associated AP.

Directional or Semi-Directional antennas can also be used to shape the coverage from the hallway AP's to improve the situation further.

Note: as the voice client vendor (not WLAN vendor or integrator) my remit was to identify why voice was performing poorly in this environment, which I achieved. It was not my jurisdiction to resolve the design or AP placement, for contractual reasons. I hope this essay has demonstrated my troubleshooting abilities and design understanding regardless.