WiFiTester Initial Comments
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WiFiTester is a little after hours project which was started in 2021 to quantify and qualify wifi statistics, and see if small data collection devices could give a helpful picture into the issues raised by users. The premise is that WiFi signals vary over time, so whereas technician time only gives a snapshot of 5 minutes, 24 hours or more of data collection might give more insight.

The system is comprised of small cigarette pack sized Raspberry Pi 4's or matchbook sized Rock Pi S's. Both run Linux on ARM chips. The former support 802.11a/b/g/n on the 2.4 GHz and 5 GHz bands**,** whereas the latter support only 802.11 b/g/n on the 2.4 GHz band. Pandemic supply chains drove up the prices and drove down hardware availability.

The systems was essentially completed in the fall of 2021. Data was collected in November using the campus Aruba system, as well as test done offsite at friend's sites.

The tests were repeated in March, after a false start in Februrary where we got terrible results when we used the deprecated Aruba SSID and got results from remote buildings rather than the closest building – and Steve Borque helped diagnose that configuration error. But the bad results helped prove the data collection was valid in bad situations – just the wrong access points were being connected as a user error.

The gist of the results are as follows:

- 2.4 GHz and 5GHz results are night-and-day in all statistics except signal strength, which appears consistently low in all channels on campus.
- In all cases, 5Ghz gave vastly superior speeds and reliability.
- The 5 GHz (802.11a) band is uncluttered with nearby access points, because each AP uses different channels. While the UW signal strength appears low, there is little background noise to interfere so the signal to noise is always decent. Rogue 5GHz systems typically pick other unused channels because there are many to choose from.
- The 2.4 GHz (802.11b/g) band has much noise interference from nearby and distant APs and particularly more rogue APs (student phones or other user base stations) because there are only three distinctly usable frequencies (others overlap those three).
- In the 2.4 GHz bands, the signal to noise is often poor resulting in lower bandwidths than otherwise possible.
- Due to the channel crowding by multiple APs (often 5 or 10 APs), the client device often picks a less ideal AP from the ones available, one with less signal strength, leading to a negative Signal to Noise ratio, and results in terrible network performance – sometimes for days before giving up and finally switching to a better or closer AP.

- The AP advanced feature to hand-off doesn't appear to work (in these tests). Is it still disabled due to an Android bug?

- We consistently saw top speeds of about 55-60 Mbps on 5GHz, and typically top speeds of about 30 Mbps on 2.4 GHz doing uploads. Downloads were usually slower by about 40% on both bands and both types of devices. Hardware may have been a factor in this difference.

- Rogue APs are a common source of problems. The testers would suddenly get poor performance just as the rogue APs appeared on the graphs.

- Better antennas sometimes give worse results because the device can see more distant APs and unfortunately connect to them.

- TCP retransmit errors are common when signal strength or signal to noise are weak. This leads to devastating performance declines.

- If you have 802.11a/b/g capabilities, there is some likelihood you will connect to the worse 2.4 GHz bandwidth. IST tries to use timing features to encourage 5 GHz adoption, but it's really only a guess as to which you will use – at least on Linux.

- Having a dedicated 5 GHz SSID would guarantee 5 GHz capable devices would get faster and more reliable connections. But that has political ramifications due to our affiliation with eduroam

- Often signals and thus performance can be dramatically different just a few metres away. Run the tester close to where the user resides.

Takeaways

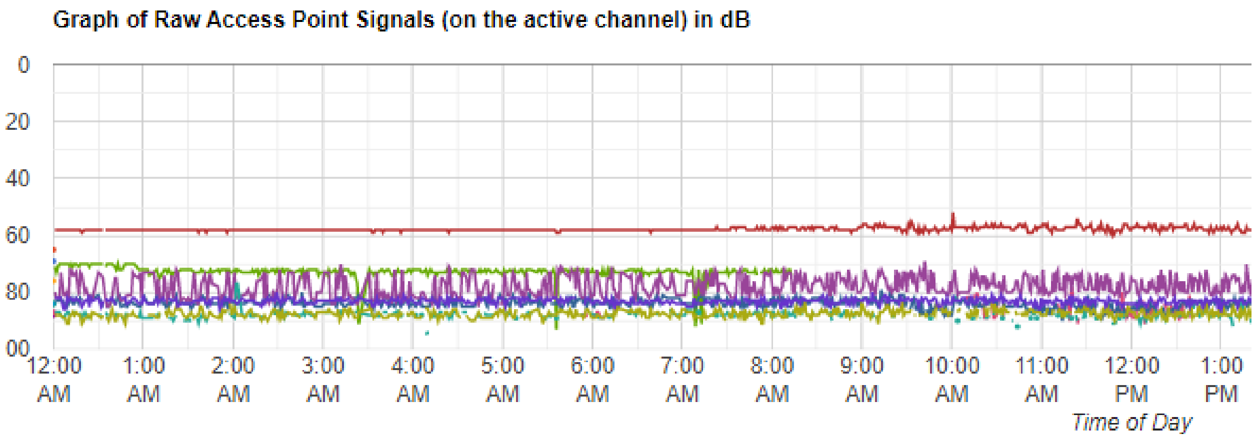
- Anything we can do to force 802.11a / 5 GHz conntions will vastly improve the user experience. Many Operating Systems do not let easily you choose a preference in bands.

- The little computers provide a reasonable view of the wifi and network. In the hands of an expert who can rule out other causes, they can provide clues to exact problems.

Detailed Look

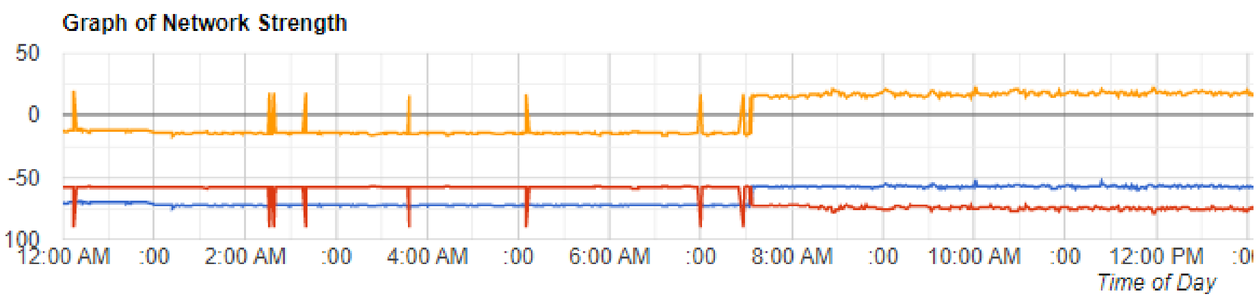
The following section shows some statistics for a typical situation both on 2.4 GHz and 5 GHz bands, The graphs are handled separately.

First, the 2.4 GHz 802.11b/g/n

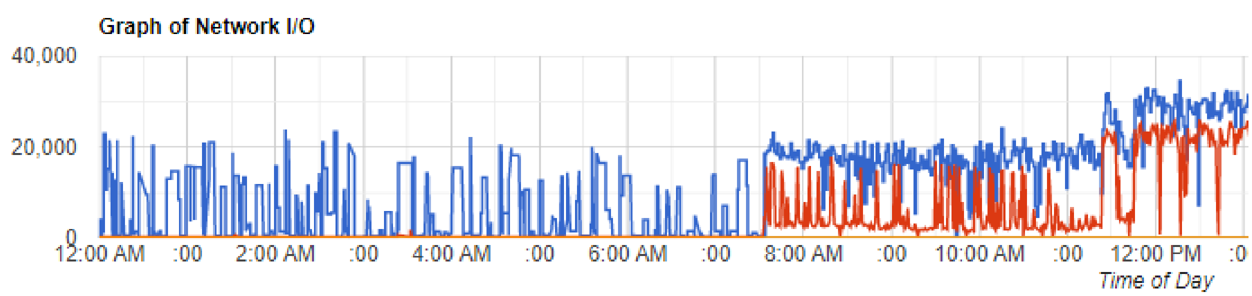


The closest physical access point is the top red line, at roughly -58 dB. However, for most of that morning the client associated with the second access point, shown in light green at about -68 dB. Other access points (UW and rogue) filled out the rest of that mess.

As a result of this bad association, from midnight until 7:30, the signal to noise ratio (S/N) (the orange line below) was about -13 dB. And once we switched, at 7:30, the S/N rose to about +13 dB.



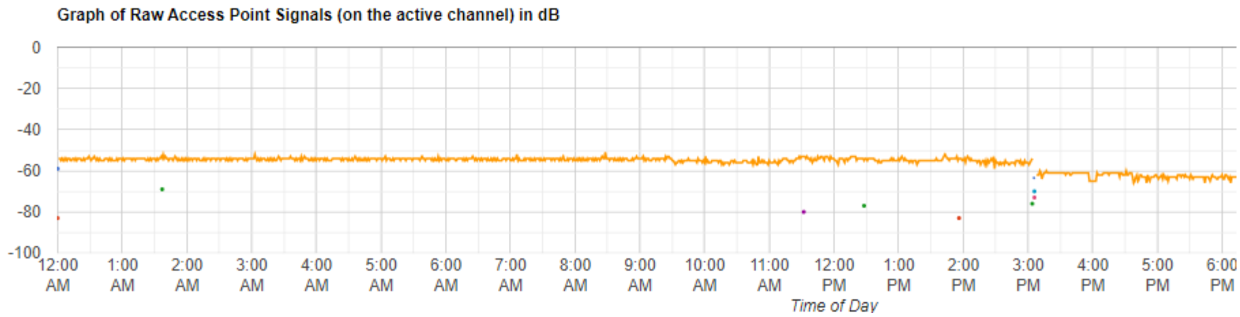
The upload and download speeds were affected greatly by the change in S/N due to that swithover. Downloads (red below) and uploads (blue) went from kilobytes per second to several megabytes per second.



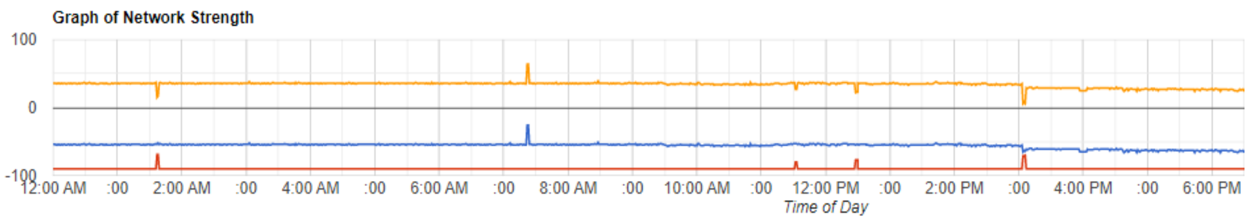
As a side note: it is believed the occasional cyclical zero numbers every few minutes are due to a hardware consideration, possibly an underpowered AC adaptor driving the RockPi. Replacement adaptors have been ordered. The peaks are good, but the valleys may be artificial.

Now looking at a 802.11a/b/g/n device in the same room, but without an external antenna. Only the closest access point is detected, other APs appear as occasional blips without much interference. This shows the benefit (at times) of having a worse antenna. At 3pm, the client switch from 2.4 GHz

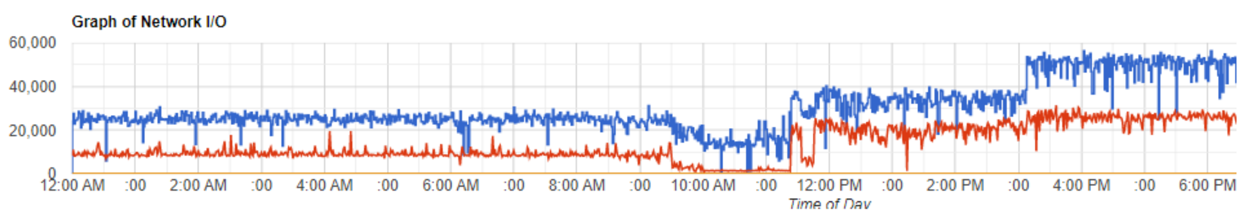
802.11b/g/n channel 6 to 5 GHz 802.11a channel 112, the signal was a bit weaker, but there is negligable background so the weaker signal is not a problem.



Accordingly, the detected signal to noise is good. The S/N drops a bit at 3pm, but not a lot.



However, the bandwidth jumps at the better 802.11a source to about 55 Mbps for uploads. Again, downloads are slower, possibly due to the Pi hardware.



In both tests shown, performance noticeably increased at 12 pm too. I don't know what external forces caused that improvement. This is not a complete diagnostic system, but it does give more insight than a mere user could typically offer.