WHITE PAPER

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THE WI-FI PERFORMANCE COMPANY

10 Steps to Optimize Wi-Fi Performance

In the white paper entitled, **10 Factors Affecting Wi-Fi Performance,** we saw that there are many factors affecting Wi-Fi performance in an enterprise. This article provides a systematic plan for optimizing Wi-Fi performance that 7signal has found to prove out time over time.

1. Understand the Baseline

When faced with poor Wi-Fi performance, it is tempting to start making changes without really understanding what is going on. This is dangerous. First, take an inventory of the physical design – what APs are being used, where are they placed, what is the antenna design and purpose? This information will be handy as you make changes to improve performance. Then, take 3-5 days to baseline the performance of the network, preferably with a system capable of providing network performance from the clients' perspective. It is important to trend the performance over time, and see the peaks and valleys of throughput, packet loss, latency and jitter. Ultimately, improving the valleys when the network is heavily utilized will result in a better Wi-Fi experience for everyone. Taking data at night, when the network is "empty," can also be extremely valuable – if an empty network cannot provide good performance, then a busy network never will.

2. Perform Careful Channel Planning

The channel plan, or lack thereof, can wreck the best physical design. The first goal should be try to use the entire spectrum available – both 5 GHz and 2.4 GHz. This allows more users to utilize the network capacity. At 2.4 GHz, it is best to stick to non-overlapping channels (1, 6 and 11 in North America) and make sure adjacent APs are on different channels. It is important to think three dimensionally, and make sure adjacent APs on the floors above and below are also on a non-overlapping grid. Many WLAN vendors have automated the channel assignment process. They should not be trusted blindly and it is a good practice to check what they are doing and not flapping the channels – this causes a high amount of disconnects and users will not like that.

At 5 GHz, you don't have to worry about using overlapping channels, but as you plan for optimization, you will want channels assigned in such a way that HT40 channels fit if they are used. Also, it is a good practice to have bonded channels always on the same side.

3. Minimize Utilization

Air time is a valuable resource, and you want to try to reduce unnecessary management and control traffic. One way is to reduce the number of SSIDs to 3-4 per AP. Every SSID means a beacon is being sent several times a second – we have seen empty networks look full with all the beaconing. It also makes sense to change the beaconing rate from the default 100 ms to 300 ms. This still supports adequate roaming for the average person, although some older VoIP equipment still requires the 100 ms beacon rate.

Another way to decrease air time utilization is narrowing the range that the APs use for data rates – you probably don't need the highest data rates, and they may cause unnecessary retransmissions due to the higher signal to noise ratio needed at the client to accurately receive the packet. Similarly, you want to disable the lowest data rates on the APs as well, since these rates result in lengthy transit time. The tradeoff here is coverage, so you need to look at AP and Client data rates retransmissions analytics – ideally you want to be operating in that magic quadrant where data rates are reasonably high and retransmissions are low.

Last, (or in some cases first), look to see how much 802.11b is being used, and whether it is necessary. Most computers and mobile devices should not need .11b, but some legacy equipment (medical devices, ticketing machines, VoIP phones) may still need it. If you do not have to support .11b, disable it on the APs, and free up the airwaves. Remember to also try to remove any .11b clients as well since they are still sending out .11b probe requests.

4. Adjust Power Levels

For given physical AP locations, AP power levels have an optimum point. Higher power causes increases air utilization in the surroundings, lower means lacking coverage.

The automatic transmit power control algorithms used by many vendors tend to move the AP power levels to the lower end of the range in order to avoid interfering with neighboring APs. Try setting the minimum power level higher than the default, and the maximum power level lower than the default. One thing to remember at the high end is that the highest data rates don't use the highest power level, so you really want to use a power level that supports all data rates.

Use the results of active and passive test to verify that performance metrics improve both when the network is lightly and heavily loaded. Also, make the transmit power for 5GHz 3-5dB higher than 2.4GHz. 5GHz signals have higher path loss so they don't provide the same level of coverage for the same power, and you want to steer 5 GHz capable devices to attach at 5GHz rather than 2.4GHz.

5. Reduce Non-Wi-Fi Interference

After performing steps 1 to 4, you may need to still look for areas in the network that are subject to a high amount of non-Wi-Fi interference, particularly in the 2.4GHz band. Remember, Wi-Fi should and will work in the presence of interference, so it is generally a non-productive use of time to focus on non-Wi-Fi interference until you are sure you looked at the Wi-Fi parameters in your network. It helps to correlate active tests with interference – did you get poor throughput and delay at the same time you see a spike in interference? Using the orientation and directionality of sensors can help pinpoint the location of the interference. There may be steps that can be taken to address non-Wi-Fi interference – adjusting Bluetooth power levels on keyboards, for example, or physically moving a microwave oven or access point, to reduce the effect of the interference. Always remember to look at the results of active tests when you make these changes – if the changes are helping, it will show up in the active tests results. If you have mobile network base station antennas near to access points, they may overload the Wi-Fi receiver and degrade performance.

6. Disable Highest Data Rates

The highest data rates / MCS values on the access points are the most sensitive to noise, and it does no good transmitting as fast as possible if it just causes a lot of retransmissions. For voice, one technique often used is to run SSIDs only in .11g and .11a mode (and not .11n), since voice packets are short and don't benefit so much from higher .11n speeds – leave the .11n for data transmissions. Also use packet fragmentation – the probability of successful transmissions will go up in noisy environments.

7. Prioritize and Balance Traffic

If you are running in a multi-media environment, take advantage of QoS classes with WMM (wireless multimedia extensions) –voice, video, best effort, background. Separate SSIDs for each traffic type may also make sense, but no more than 3-4 SSIDs. If it looks like one AP is overly busy while its neighbor is not, adjust the power levels to encourage more balanced connections. Take advantage of the load balancing, band steering and admission control features that are specific to the WLAN manufacturer.

8. Ensure LAN/WAN Capacity

Don't forget to check the LAN / WAN performance – the Wi-Fi may be working fine, but there may be a bottleneck in the switch/router network. The best way to test this is by measuring the same set of metrics (throughput, loss, delay, jitter) over the air and over the wire from the same device / sensor. Often times the last mile connection to the facility is the bottleneck, particularly if all packets get switched off-site. If there is a lot of intra-building or intra campus traffic, you should take advantage of the WLAN local switching capabilities to avoid clogging up the last mile connection.

9. Improve Client Operation

You may go through all the steps above and measure remarkable improvement in many areas, but a set of clients or a single client may still be having issues. If the client is some type of special device or machine, like a mobile cart, make sure the antenna is not near metal and has the space to operate properly. Upgrade the Wi-Fi driver and adjust the power level. You may also want to set the roaming aggressiveness to medium or low.

10. Change the Physical Environment

The last step is to actually make physical changes to the network – moving APs, adding APs, changing antennas, particularly if after the above logical changes the performance metrics show that there are coverage or congestion issues in certain areas. Quite often we see people add or upgrade APs in a hope and pray strategy without realizing they can make dramatic improvements in network performance without them; moreover, adding or upgrading APs quite often does not improve anything and can even make things worse.

While there is not one simple magic bullet, every network can be improved. However, it is important to remember that what may work in one area may not necessarily be best for another area. That is why a methodology based on active tests and passive measurements is critical to make informed decisions and achieve the desired results.