

TangiTek CleanSignal™ Technology for Monopole Antennas

Objectives

1. To quantify the signal gain when the **CleanSignal™** antenna enhancement is used with monopole antennas in an uncontrolled “real world” noisy urban environment.
2. To quantify the behavior of low level background interference when the **CleanSignal™** antenna enhancement is used with monopole antennas. Based on previous results, we expected the interference level to decrease.
3. Based on previous results, we anticipate a 1 to 3 dB gain in SNR. We have observed a 1 to 9 dB gain in RSSI in Wi-Fi applications. In general, a 3 dB gain signifies a 2x improvement in antenna performance.



Testing Conditions

1. The testing environment was very sensitive to small changes in location, orientation, the time that the test was run, and the use of different hardware parts (antennas, antenna cables, cable length, Wi-Fi adapters, etc.). Different units of the same model part could easily generate different results.
2. The testing environment and the test results were particularly sensitive to the Wi-Fi adapter used. Adapters can have signal amplifiers and can serve as weak antennas themselves.
3. Due to the above considerations, testing with two antenna/cable/adaptor systems simultaneously produced erratic and non-reproducible results.
4. More consistent results were obtained when testing with the same hardware configuration, swapping the **CleanSignal™** antenna enhancement while running. This means that time varies for each test run and, thus, the amount of interference in the Wi-Fi spectrum varies. We tried to minimize this variation by continuously alternating between a stock (off-the-shelf) antenna and the same antenna with the **CleanSignal™** enhancement, using periods of approximately 10 minutes for each. Results reported here are taken from the tests with a single hardware configuration, alternating the **CleanSignal™** enhancement.
5. The **CleanSignal™** antenna enhancement included a ground plane enhancement that was constructed as part of the antenna input lead.

Results

1. The **CleanSignal™** antenna enhancement improved *the RSSI of the strongest signal*, generated by the closest source (a router about 20 feet from antenna with direct line of sight). The **CleanSignal™** antenna enhancement gave an average improvement of about 1.5 dB for the strongest signal (average = 1.44, std.dev = 0.7 with PCI adapter, average = 1.46, std.dev = 1.1 with USB adapter).
2. The effect of the **CleanSignal™** enhancement on weak signals showed no significant change (average = -0.1, std.dev = 0.3 with PCI adapter, average = 0.0, stddev = 0.6 with USB adapter).
3. The effect of the **CleanSignal™** enhancement on mid-range signals was inconclusive. Three routers (mixtest, mixtest2, and Gnosis) were positioned 30–50 feet from the antenna. The signal strengths for these SSIDs were typically in the range -70 to -50 dB with the PCI Wi-Fi adapter and -60 to -40 with the USB adapter. Their signal strengths were more erratic throughout the tests. In some cases, the signals suddenly dropped or increased by approximately 10 dB in the middle of a test. The cause of these sudden shifts was not known. In other cases the signals were so low that they were included with weak signals. For SSIDs that remained in the general range for mid-level signals, the **CleanSignal™** antenna enhancement gave an average improvement of about 0.8 dB.
4. The **CleanSignal™** enhancement modified the form factor of the monopole antenna by adding an additional component under the antenna, serving as a ground-plane. No such additional component was used for the stock antenna.

Conclusions

The **CleanSignal™** antenna enhancement gave an average improvement of about 1.5 dB during W-Fi testing using monopole antennas.

The following figure shows the results of a representative test run, swapping from Stock to CleanSignal™ to Stock to CleanSignal™.

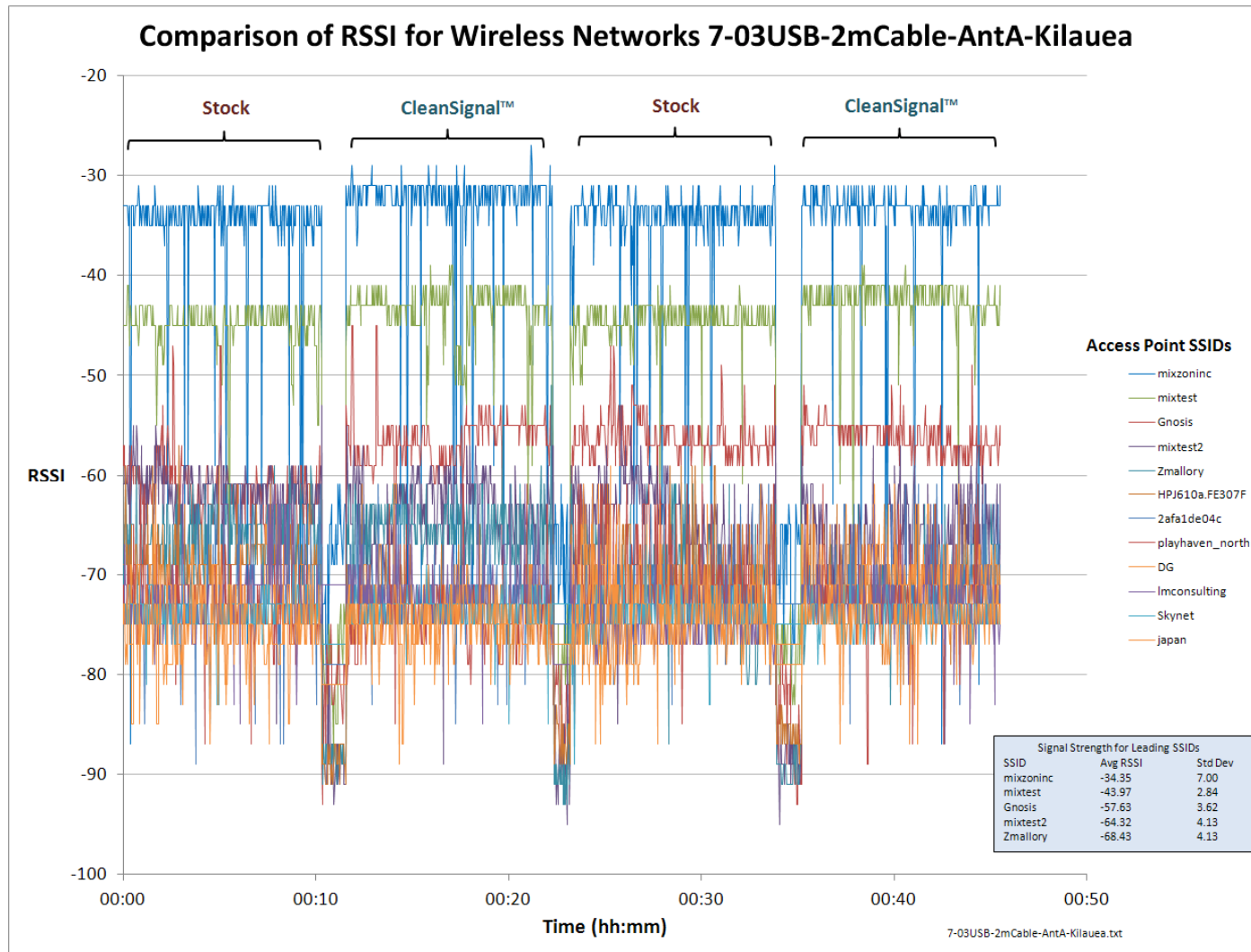


Figure 1 Comparison of Wi-Fi signal strength (RSSI) of a monopole antenna with and without CleanSignal™ enhancement.

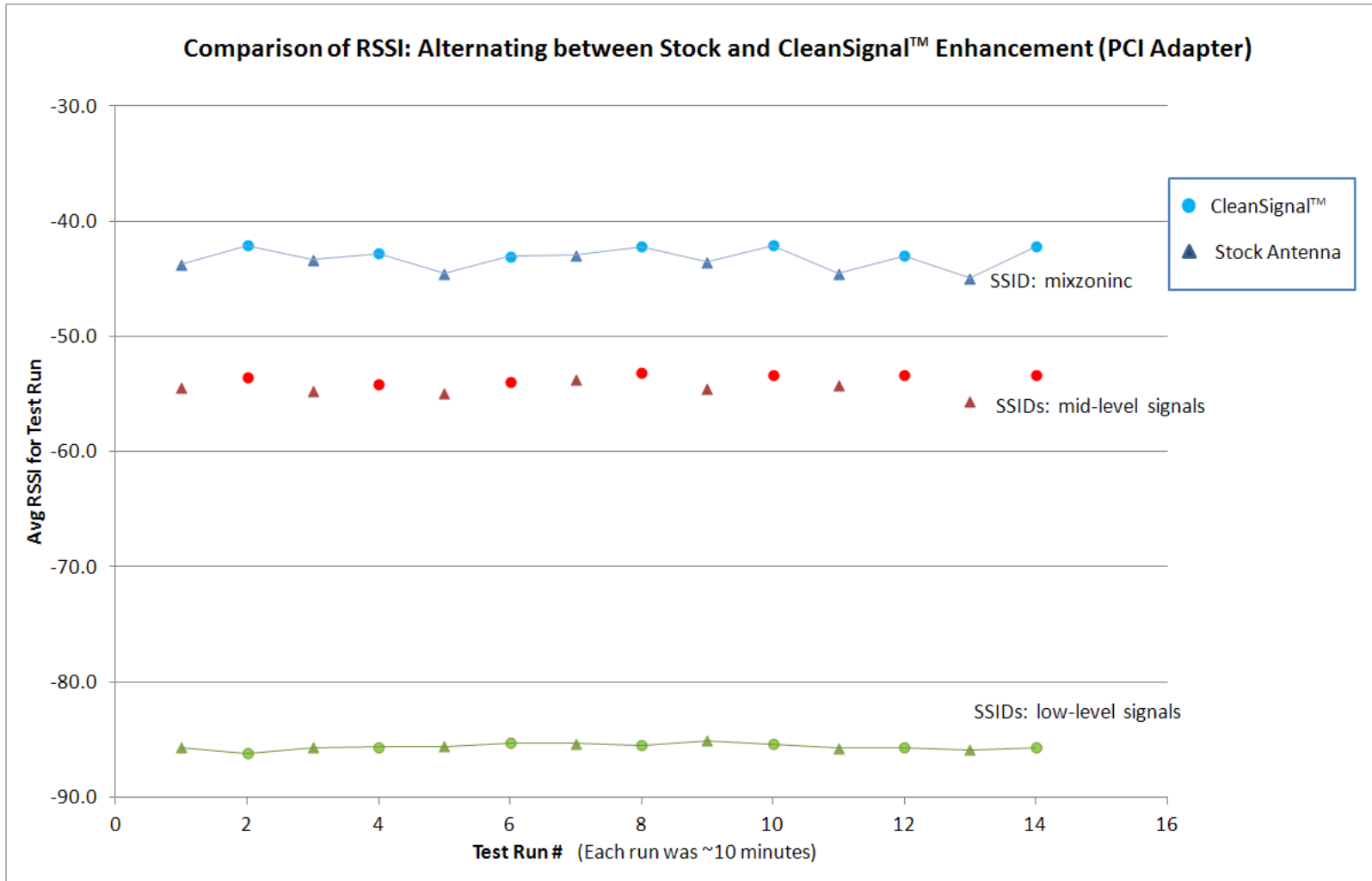


Figure 2 Comparison of Average Wi-Fi signal strength (RSSI) of a monopole antenna with and without CleanSignal™ enhancement across test runs.

System Configurations Used for Test

The following components were used from 9/27/2011 to 10/4/2011 for testing with the same hardware configuration, swapping the **CleanSignal™** antenna enhancement while running.

Component	Description
USB Wireless Adapter	Hawking Technology Hi-Gain Wireless-150N USB Network Adapter with Range Amplifier (HAWNU1) MAC 00:0E:3B:33:0E:03
PCI Wireless Adapter	Cisco-Linksys Wireless-N PCI Adapter with Dual-Band (WMP600N)
CleanSignal™ antenna enhancement	Mounted with gold-plated nut and washer
Antenna	3 dBi external antenna, labeled antenna "A"
Antenna cable	2 meters in length
PC	Dell Dimension DXO051 Intel® Core™2 Quad CPU Q6600 @2.40 GHz 3.40 GHz, 3.25 GB RAM Windows XP Professional, Version 2002, SP3
Wireless Monitoring and logging software application	WirelessMon version 4.0, PassMark Software Sampling rate: 3.0 sec, 10 ms delay Max signal: -10dB, Min signal: -90 dB

Prior to settling on the above configuration, the following components were varied in the tests.

Component	Description
USB Wireless Adapter	Hawking Technology Hi-Gain Wireless-150N USB Network Adapter with Range Amplifier (HAWNU1) MAC xx:xx:xx:xx:xx:A5 MAC xx:xx:xx:xx:xx:A7 Used with 5-foot USB cables
CleanSignal™ antenna enhancement	Likely there were instances when it was mounted without good contact.
Antenna	3 dBi external antenna, “A” and “B”
Antenna cable	0.25, 2, and 3 meters in length
PCs	Intel® Pentium M @1.10 GHz 1.24 GB RAM Windows XP Tablet PC Edition 2005, Version 2002, SP3 Dell ATG (Klondike) Intel® Core™2 CPU T7600 @2.33 GHz 3.25 GB RAM Windows XP Professional, Version 2002, SP3
Wireless Monitoring and logging software application	Network Stumbler version 0.40

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