Wi-Fi Range Extension: Endpoint

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Illustration 1: Versa WiFi USB Adapter II from C. Crane Co. with 5 dBi antenna attached

For many of us, it frequently seems that a reliable Internet connection is almost as important as our life blood. Usually, our network connection at work is fairly reliable, but our home office connection? Perhaps not so much. This is particularly true if we are relying on Wi-Fi[1,2]to hold our network together. Considering the barrage of advertising to which we are exposed, one would think that a Wi-Fi network was almost as easy to set up, and almost as reliable, as plugging in an Ethernet cable.

While Wi-Fi equipment has improved greatly in recent years and, in general, wireless networks are much easier to setup than they use to be, that doesn't guarantee their reliability. In part, this problem is actually due to the popularity of Wi-Fi networks. Basically, due to the limited number of Wi-Fi channels and the fact that the channels overlap, as more people set up home networks the likelihood that these networks will interfere with each other, effectively jamming your signal, goes up. There are other factors at work as well. Depending on whether you are using the a, b, g or n protocols, you will normally be working within a series of fixed no obstruction ranges, which are the ones typically printed on the boxes when you purchase a new Wi-Fi adapter or router. However, the frequencies used for Wi-Fi are easily blocked and reflected by typical home construction materials, let alone by the steel and concrete that many urban dwellers might encounter, which can greatly reduce their effective range. This can easily lead to a great deal of frustration when you aren't able to take your computer where you want with your 'mobile network.'

However, all is not lost, and you won't be reduced to going back and having CAT-5 cable run throughout your house. There are a number of ways to improve your wireless network connectivity. Some can be used to improve the connection to a single device, such as a laptop, while other approaches enhance your overall network coverage. In this column, we'll explore some of the approaches you can use to enhance the individual client connection, whether it is to connect to your router from a distant office in your home or to allow you to take your system outside, where you can do your Web browsing from a hammock. In a later column, we'll examine ways to enhance and expand your overall network coverage. Those really aggressive about improving their network connection are, of course, welcome to apply both sets of solutions.

Improving the network connectivity of an individual device basically comes down to improving the sensitivity of the wireless adapter on the device. There are several ways that one can go about doing this. Where existing hardware permits, you can improve the sensitivity of your adapter by replacing the adapter's antenna with a higher gain omnidirectional antenna. Where this is insufficient, you might replace the original antenna with a directional antenna or one with an active amplifier. If your adapter does not allow you to substitute antennas, such as many of those built into laptops, you may have to install an alternate Wi-Fi adapter. In the following sections, we'll examine a number of devices commercially available to improve the connectivity to your computer, as well as some of the strengths and weaknesses of these units and where they might be most appropriate.

Illustration 2: Directional 14 dBi Indoor/Outdoor 2.4 GHz WiFi Antenna from C. Crane Co.

The following tests were performed employing an Acer Aspire One netbook, Model NAV50 and a ViewSonic VOT-125, both with an internal IEEE 802.11 b/g/n wireless adapter, and an Actiontec MI242-WR Rev. F wireless router. The initial qualitative assessment was performed using the VOT-125 and the follow-up quantitative assessment with the Aspire One. While I was frequently able to detect my local Wi-Fi network via the internal Wi-Fi adapter in the VOT-125, I was unable to obtain a reliable connection to it.

The initial adapter installed for review was a Versa WiFi USB Adapter II ($29.95) provided by C. Crane Co.[3] This unit is an integrated USB adapter, similar in shape to many other USB based Wi-Fi adapters available and somewhat larger in size than most of the ones I've seen. The biggest visual difference is that at the opposite end from the USB connector is a RP-SMA[4,5] connector. This adapter comes with a 5 dBi[6] antenna and a CD containing the required drivers and other software.

The biggest potential drawback of this unit is that it only supports 802.11b/g and not 802.11n. If the rest of your network is 802.11g, this is pretty much a non-issue. My only other concern is the risk of mechanical damage. While the base unit only weighs an ounce, the weight of the antenna is basically riding on the end of that lever arm. If we swap out the existing antenna for those with higher gains, this risk will only get worse. On the other hand, a network doesn't do you any good if you can't connect to it. The takeaway is that you need to be particularly careful while using this unit to not snag it on anything and to avoid sharp movements while using it or else use a USB extension cable to separate the adapter from the PC to remove the stress from the USB connector. How much of an issue this torque might be will depend in part on the orientation of the USB ports on your system. If the ports are oriented vertically, there will be less stress on the adapter than if they are oriented horizontally. When oriented horizontally, there will be a significant difference between whether the port is positioned so that the unit is supported by your work surface or if it is suspended in the air.

Illustration 3: Super USB WiFi Antenna 3 from C. Crane Co.

Upon completing the installation of this unit, I was able to create a reliable connection to my local Wi-Fi network, though throughput still seemed slow. The next step in this process was to remove the 5 dBi antenna and replace it with the optional Hi Gain 7 dBi WiFi Antenna ($19.95) that C. Crane Co. had included for evaluation. This antenna did result in both improved reception and throughput.

Following this, I replaced the antenna on the unit with C. Crane's 14 dBi Indoor/Outdoor 2.4 GHz WiFi Antenna ($34.95). As this antenna is designed so that it can be used outdoors, it is equipped with a heavy-duty N-Female connector, instead of the RP-SMA connectors used on the other antennas. As such, and to allow it to easily be connected to the Versa adapter, a 10-foot co-axial Cable With N Male to RP-SMA Male adapter also was used. Unlike the previous antennas, which were omnidirectional, this unit is a directional antenna, with the preferred direction being perpendicular to the face of the unit.

On comparing the Versa adapter's performance with the directional antenna to that with the omnidirectional antennas, it did appear to enhance the transfer speed, but only when properly aligned. If you are trying to network two distant static locations together, this antenna might be a useful accessory, but because of its size, mounting requirements and aiming requirements, I doubt that it would prove useful for most mobile applications.

Following completion of the evaluation of the various antennas with the Versa adapter, I next installed C. Crane's Super USB WiFi Antenna 3 ($109.95). While the name might suggest that this is only an antenna, it is actually a full USB powered Wi-Fi adapter with an IP65[7,8] Ingress Protection Rating rating for indoor/outdoor use.

Some of the photos on the C. Crane Web site suggest that this is a huge unit, but it is really quite sleek in design. Weighing only 1.8 oz and with dimensions of 1.4" W x 10" L x 0.6" H, it is actually shorter and lighter than some of the optional Wi-Fi antennas available. It comes with a variety of mounting options, including a removable lanyard, suction cups, Velcro and cable ties, providing flexibility in terms of how permanent you want the installation and how mobile you plan to be in its use. As packaged, it comes with 15-foot split USB cable (second USB-A connector is to provide additional power in the event that your system doesn't source enough power through one connector), but a 30-foot cable is available for purchase.

To get to the operational specs, this unit supports the 802.11b/g/n standards, as well as the WEP 64/128, WPA, WPA2, WPA-PSK and 802.1x security protocols. It is an omnidirectional device with a stated range of up to one mile line of sight, assuming no obstructions. While I cannot confirm this one-mile range, due to the difficulty of finding a location locally with a one-mile clear sight line having a network, I can confirm that it greatly extended my effective network range. I was easily able to get at least 400 feet away from my wireless router before being disconnected, and that was with a considerable section of the path being through a hill! I have no doubt that this unit would easily provide connectivity within the typical house or yard. It's relatively small size and mounting options also make it very easy to pack for business trips where you are unsure of your networking options. It may well be overkill for many, as one of its primary marketing targets is for use in boats (which generally will have a clear line of sight), but I don't think this unit will let you down. As it is connected to the computer via a USB cable, you also don't have as much concern regarding potential mechanical damage as you might with the Versa adapter.

Table 1: While throughput values do not form a smooth curve, this is likely due to the large standard deviations observed with the limited data set. The significant difference between the values for the internal and the external adapters clearly indicates the value of upgrades to internal Wi-Fi systems in marginal network areas, even in the absence of hard quantitative numbers.

Observed Network Throughput		
Adapter/Antenna	**Average**	**Units**
Versa WiFi USB Adapter II/5 dBi antenna	4.94	Mbps
Versa WiFi USB Adapter II/Hi Gain 7 dBi WiFi Antenna	5.63	Mbps
Versa WiFi USB Adapter II/14 dBi Indoor/Outdoor 2.4 GHz WiFi Antenna	5.39	Mbps
Super USB WiFi Antenna 3	4.61	Mbps
Acer Aspire One integrated Wi-Fi adapter	89.0	Kbps

In addition to the qualitative evaluations above, I also attempted to perform some quantitative comparisons between the various adapter and antenna combinations, including the internal adapter of the Acer system, using the Iperf[9,10]network performance utility. For reasons that I'm still evaluating, the observed network throughput appeared to be more erratic than I was expecting. As such, averages for three trials occasionally were reversed from the trend I was expecting, but my suspicions are that most of this fluctuation were the result of factors such as fluctuations in the competing load on the network and interference from neighboring Wi-Fi networks. All of the configurations tested showed significant performance improvement over that provided by the Acer's internal Wi-Fi adapter/antenna combination.

If only one of your devices has a Wi-Fi network connectivity issue, I think that these devices from C. Crane could well resolve your issue. If you have an existing connection, but it is just marginal, you might want to try the Versa adapter with it's included antenna, upgrading to one of the alternate antennas if necessary. For more challenging networking situations or where you might require flexibility on the road, Crane's Super USB adapter is very appealing. If you are looking at a fairly fixed installation, you might want to investigate some of C. Crane's other antenna options as well. Replacement antennas are available from a number of other manufacturers too, just make sure that your antenna is removable and that the connectors match before you place your order.

When selecting an antenna or adapter, make sure that you are comparing apples with apples; a decibel gain figure without a reference means nothing. If you have connectivity issues with multiple devices, you might want to look into ways of expanding your overall network coverage, as opposed to replacing the network adapters on all of your systems. We'll investigate ways to do that in the next installment in this series.

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