

# **Reader Report: AirPort Base Station Antennas**

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# FCC Caveat

[Note: We have not verified that the following procedure complies with any <u>F.C.C.</u> regulations, which we strongly advise checking before performing any such changes. -MacInTouch]

# Adding WaveLAN Extender

Date: Sat, 19 Feb 2000 23:19:50 -0800 Subject: Adding a WaveLAN Range Extender Antenna to Airport Base From: David L'Heureux

Dear MacInTouch,

I was inspired by MacInTouch reader's comments to add a WaveLAN Range Extender to my Airport Base Station. After completing this installation myself, I thought others might find my experiences and advise useful. I'm not a hardware engineer, so follow these at your own risk.

# **Tools I used**

- 1. Phillips screw driver (to open the case and unseat the interior "card cage assembly")
- 2. Dremel Tool (all hacks must own one of these...)
- 3. Pressurized can of air (to blow away the dust and plastic shavings from the Dremel Tool)

#### **General steps to follow**

- 1. Open the Airport base station housing by removing the three screws at the bottom of the enclosure. (Remember, you are now on your own as far as warranty goes, and I take no responsibility for your final results.)
- 2. Remove the three screws which hold the interior "card cage" to the top plastic housing.
- 3. Lift the interior "cage" enough to locate the WaveLAN card contained within the cage. You will not be able to completely lift the cage away from the plastic housing (read: don't try) since it has several wires attached to the base station plastics and hardware.
- 4. I would recommend now removing the WaveLAN card completely by sliding it out of the cage...
- 5. (Now the hard part) I then used my Dremel Tool with a steel "burr" like tip to notch out a rectangular area at the side of the upper housing of the base station. There is a black plastic ring/support which goes around the inside of the base station...using the Dremel Tool (or similar) you need to remove an area adjacent to where the WaveLAN card sits in the cage. This is necessary because the strain relief at the end of the antenna cable which connects to the WaveLAN card in the base station needs additional clearance to allow the cage to fit back

into the enclosure. Sounds kind of complicated, but it is fairly intuitive once you are inside...

- 6. At this point you will have a decent amount of plastic shavings inside the base station--use the aerosol can at this point to blast away the shavings from inside the base station. I would take particular care to inspect the connector pins inside the card cage to be sure they are free of debris.
- 7. Again with the Dremel Tool, make a small notch in the Airport plastics for the antenna cable to exit. See my photos below for an example of how you might want to do this...
- 8. Attach the antenna cable into the end of the WaveLAN card...the antenna comes with pretty clear instructions on how to do this. You have to remove a small cover on the end of the WaveLAN card to expose the antenna connector.
- Reinsert the WaveLAN card back into the cage...use care not to force it and/or bend any pins in the connector since the mechanical design of the slot it fits into isn't as refined as your PowerBook's PC Card slot.
- 10. Fish the antenna cable around the side of the base station to where you have cut your exit hole. (If you roughly follow my photos as to the placement of your exit hole, you don't have to fish the cable more than about 1-2".)
- 11. Screw the card cage back into place, and close the plastics and screw the base station back together.

#### Where I purchased the antenna

Insight.com Lucent WAVLan IEEE Indoor Range-Extender Antenna MFG's Part # 848072633 \$90.99

#### Pictures

Check out pictures at my iTools photo album

#### Results

Based on about 5 minutes of testing, it looks like the improvement is dramatic. I'm using the Farallon SkyLINE card with excellent results everywhere in my house (and outside, too!). Lucent's <u>WaveLAN pages</u> describe a 15%-50% improvement in signal strength with the Range Extender at one end of the connection.

If you have other questions, send me e-mail at: davidl at infoasis.com

Good luck!

#### **Extending the Airport's Range**

Date: Tue, 4 Apr 2000 Subject: Extending the Airport's range From: Doug Macmillan

#### Introduction

After reading MacInTouch about a reader who had disassembled an airport base station to find a Lucent PCMCIA Wavelan card with an antenna plug I decided to investigate a little further.

The first thing I found was that the Airport base station card functioned perfectly in the PCMCIA slot of Powerbook G3 400, making it very easy

to add external antennas. A local antenna specialist, after examining the connector said he could make an adaptor to an airport antenna cable, as the plugs would be difficult to obtain.

So I located two G4s and removed the antenna cables. These were sacrificed by cutting them in half so that a thicker coaxial cable adaptor could be connected. (warning - the voids the warranty on your cables) Replacment cables have apple part number 922-3905 and cost less than \$60 NZ.

The antennas work in two ways to boost the signal. Firstly they focus the radio frequency energy into a smaller area. Secondly, because of design, the antennas convert the electrical energy to the radio frequency more efficiently.

Because of the large numbers of combinations of antenna possible, not all permutations were tested. The plan was to gain an understanding of the functions and interactions of the different antenna systems.

Small flat plane antenna to iBook

The first antenna to be tested was the small patch antenna which was connected to the base station.



With an iBook walking down the street the range was approximately double before the signal dropped - about 100m. This antenna has a beam spread of 75 degrees horizontal and 65 degrees vertical. These figures simply mark the angles at which the signal strength drops to 50% as compared to the centre of the beam.

## Large flat plane antenna to iBook

Replacing this antenna with the large patch, increased the range by another 50 % to around 150m. The horizontal beam spread of this antenna is 65 degrees. The test iBook at this stage was using the standard built in antenna.

## Large flat plane antenna to iBook with Yagi Directional antenna

Now I decided to try the Yagi directional antenna connected in to the test iBook. This involved running the connector cable past the keyboard, which as a result would not close and sit flush. Closer examination revealed it might be possible to file a small cutout in the aluminium base of the keyboard. This again of course would void the warranty.

#### Directional antenna to iBook with Directional antenna

Due to geography the best line of site to the large patch antenna was 4.5 km away up a hill. So a 20 minute drive later I ended sitting up on the grass beside the road with an iBook on my lap and a meter long directional antenna in one hand attracting some very curious looks from passers by. Success. Logged straight in to my workplace's network and transferred an 8Mb file in under 60 seconds. Later results suggest that this combination of aerials might be good for up to 9 Km.

Extrapolating this, with 6 airports and 6 of these flat plane antennas mounted in a hexagonal shape, a radius of 360 degrees with a 4-9 km range could be possible with the receivers using the directional antenna.



This would need testing to determine if there would be limitations on the number of channels and interference from the other antenna broadcasting in a small area.

#### **Directional Antenna to Directional Antenna**

Now I wanted to see how far away I could be and still connect. From my home, I set up the Airport software base station on my iMac DV. Climbing onto the roof I connected, via a 2m extension cable, a Yagi directional antenna onto my TV aerial mounting pole.



I drove at first to a hill some 7 km away and tried to connect aiming the directional Yagi antenna through some trees to my home location. No signal. I moved 200m so that I was line of site. Connected and transferred the same 8Mb file in 60 seconds.

I drove a further 7 Km away and connected to my iMac DV without a problem. File transfer speed was down now to 2 minutes to transfer the 8 Mb file but still impressive given the distance of 14 km. I have not had the opportunity to test any greater range.

I have not yet tested the omnidirectional antenna, which gives a reasonable narrow 17 degree vertical beam width. A worthwhile study would be to test this antenna in combination with the Yagi Directional.

The small patch antenna is small and light enough to velcro onto the back of an iBook, but the connector cable would need to run past the keyboard. This could provide a useful increase in range to a roving iBook user - as long as the antenna was pointed back towards the base station.

## **Compliance issues**

In New Zealand, the document relating to radio frequency compliance is found at <u>www.moc.govt.nz/rsm/rfs29.pdf</u>. Output power must be less than 4000 mW. My understanding is that the New Zealand regulations are the same as the FCC (US) for the Airport cards, but you should check for compliance in your country.

The Airport card is rated at 15dBm or 30 mW (milliwatts). The Yagi directional antenna at 17 dB gain (amplification) raises this to 1500mw, well within the New Zealand Regulations. These figures were checked with the New Zealand authority responsible for permitting radio frequency devices.

In addition I spoke with a Lucent engineer in Australia who said that using the pair of Yagi directional antenna 17Km should be possible, and that with one installation they had done, they had managed 57Km between an island and the mainland while staying within FCC regulations.

There are some antenna, which will exceed the regulations, specifically antenna with 24 dB or more gain. These were not tested.

Detailed antenna information is available from <u>www.cushcraft.com/</u> <u>comm/pcscat.pdf</u>

Antenna	Amp. (dBi)	Horz. spr. (deg)	Vert. spr. (deg)	NZ \$ (no tax)	
Small patch	6	75	65	\$179	
OmniDirectional	9	360	17	\$490	
Large patch	12	65	25	\$435	
Yagi Directional	17	34	30	\$435	
Airport Adaptor (req. donor cable)				\$50	
Coax cable per meter				\$5	

Antennas	Tested
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As you can see there are many combinations possible. Prices shown here are in New Zealand Dollars as provided to me from Thomas Electronics, Dunedin, New Zealand. Halve the figures to get approximate US dollars.

Doug Macmillan



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