

Worldwide Suppliers of High Grade Antennas for Wireless Networks...

## WiFi Installs Frequently Asked Questions Version 1.3

Thank you for downloading our WiFi FAQ guide, we constructed this guide in order to aid you choosing and selecting the best solution to your WiFi range issues or for setting up a between building or a point to point link. We update this guide as frequently as we can to ensure the data is as up-to-date and as relevant as possible.

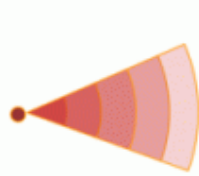
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### Antenna types...



#### Omni Directional

This type of antenna is designed to give a 360 degree pick up, its limiting factor is overall range.



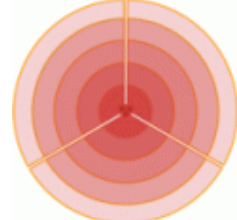
#### Directional – Narrow Beam

Directional (Narrow Beam) – These are generally used for Long range between buildings or between point links.



#### Directional – Wide Beam

Directional (Wide Beam) – Designed for shorter between Building links or multiple routers/WiFi card pick up.



#### Sector Antenna

Sector antennas have a 120 degree pick up and are commonly installed as a set of 3 to give 360 degree – ideal for professional hotspot making

### Antenna connection types...



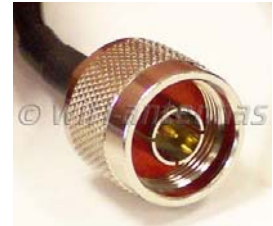
#### RP SMA Male

RP or R = Reverse Polarity  
Most common in WiFi Systems



#### SMA Male

Common in 2.4GHz CCTV Systems



#### N-Type Male



#### MC



#### MCX



#### MMCX

#### U-FL

PLEASE NOTE: Not all systems have removable antennas – Please check prior to ordering

**Cable Types...**



**RG316**

Approx loss per metre at 2.4GHz  
= 1.6dB

**No Picture  
Currently  
Available**

**RG174**

Approx loss per metre at 2.4GHz  
= 1.8dB



**RG58**

Approx loss per metre at 2.4GHz  
= 0.9dB

**No Picture  
Currently  
Available**

**CLF200**

Approx loss per metre at 2.4GHz  
= 0.5dB



**HDF400**

Approx loss per metre at  
2.4GHz= 0.25dB

## WiFi Range Extending...

Many Laptops are supplied with integrated WiFi network adaptors, this is convenient for most people but if you have low signal strength which drops the connection they can be a real problem. The normal procedure for increasing WiFi range is to relocate and install higher gain antennas. As most integrated WiFi in laptops don't have external antenna ports you are limited to what you can do to increase signal strength, consider the following options:

### 1. Use a USB or PCMCIA Wireless network adaptor with external antenna port and attach a high antenna...

You can install a new WiFi network adaptor onto your laptop which is fitted with an external antenna port to enable you be able to fit a high gain antenna and/or a power booster unit [ [More Details](#) ]

You will need to disable your internal network adaptor on the laptop to prevent hardware clashes. We stock the below external WiFi network adaptors:

USB (with RP SMA connection) - Link to USB Dongle – [ [More Details](#) ]

PCMCIA (with MC connection) - Link to PCMCIA Card – [ *Coming Soon!* ]

You may want to disable power saving on your USB ports to avoid the dongle going into sleep mode if not used also check the output power is set to full.

Now you have an external antenna port you can now attach a higher gain antenna, if possible we suggest you use a directional antenna for maximum range and pickup. See below for a couple of possible suggestions for antennas:

Directional - 6dB Patch link [ [More Details](#) ]

Omni-Directional - RP-SMA connection - [ 6dB Omni-Directional link ]

Omni-Directional - MC connection - [ Antenna base and 9dbi omni link ]

The disadvantage with this solution is that we will need to disconnect the antenna each time you pack away your laptop.

### 2. Set up a repeater access point...

Most new wifi access points can be configured as a repeater. The repeater can be installed in an area where it can pick up signal from the broadband access point and then redistribute the signal to reach further.

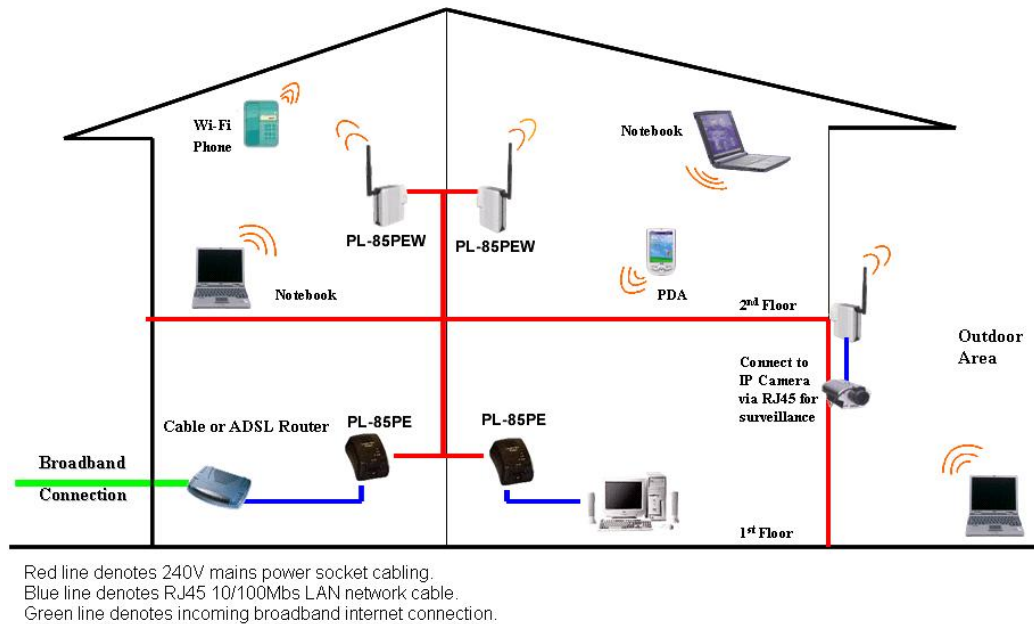


The advantage of this option you do not require any additional antennas on the laptop and can use the laptop in the wire free environment.

The disadvantage is each repeater halves the data transfer rate. Repeaters can be daisy chained if large buildings or areas are to be covered.

### 3. Homeplugs...

If you have a dead spot within your house/office, one option available to you is to install homeplugs.



The advantage with this system is that you can install as many WiFi Homeplugs as you wish and cover very large areas within the house and outbuildings providing they share the same electricity supply (see note below). This set up provides multiple wifi hot spots around your building or buildings so you can use your laptop to connect to the best signal wherever you are without fitting additional wifi devices; this is especially useful with PDA's and smart phones.

You need to ensure your router has a free Ethernet/LAN port available and a spare mains socket so that a Homeplug unit can be used. The homeplug uses the mains socket to power itself and to distribute the LAN data on to your building mains cabling. You can install a standard (85Mbps unit) next to the router and then use one or more Wifi Homeplug Adaptors in spare sockets around the house where you have dead spots.

More details can be found on these units by the links below:

85Mbps Homeplug - [ [Link](#) ]

85Mbps Homeplug with WiFi - [ [Link](#) ]

Please note: Homeplugs can only communicate when the electricity is being supplied from the same electricity meter and electrical phase (some buildings, generally industrial are supplied by 3 phase power). Units can be used on different ring mains.

Homeplugs cannot be used with surge protected sockets and maintain data speed better when not used on extension cables.

### 4. Power Boosters...

Due to power and physical space constraints of laptops, PDA's and smart phones the wifi signal tends to be weaker than their access point counterparts, to overcome this a booster can be used on the access point. Our range of power boosters not only increase the output power of your wifi access point but also, and in these applications most importantly, provide a received signal boost of +20dB or 10 times. Weak signals received at the wifi access point that were previously too weak to give a stable connection become reliable. Testimonials have reported increases between 20% and 40% in signal strength.

### 5. Check Power Settings and Channel Number...

Some laptops can adjust the output power of the internal WiFi access point. If available, this setting can be adjusted through the adapter's driver interface program, Try setting this to "maximum" or "100%" to ensure the strongest signal possible. Note that if a laptop is being run in a power saving mode, this setting may automatically be lowered and decrease the laptop's range and signal strength.

Another suggestion is to try changing the WiFi network channel, with a large number of WiFi devices and other systems using the 2.4GHz such as Video Senders, wireless CCTV, DECT phones, Bluetooth, microwave oven etc, interference is a real possibility. Changing the channel number can move your signal away from other interfering devices.

Channel	Lower Frequency	Central Frequency	Upper Frequency
1	2.401	2.412	2.423
2	2.404	2.417	2.428
3	2.411	2.422	2.433
4	2.416	2.427	2.438
5	2.421	2.432	2.443
6	2.426	2.437	2.448
7	2.431	2.442	2.453
8	2.436	2.447	2.458
9	2.441	2.452	2.463
10	2.446	2.457	2.468
11	2.451	2.462	2.473
12	2.456	2.467	2.478
13	2.461	2.472	2.483

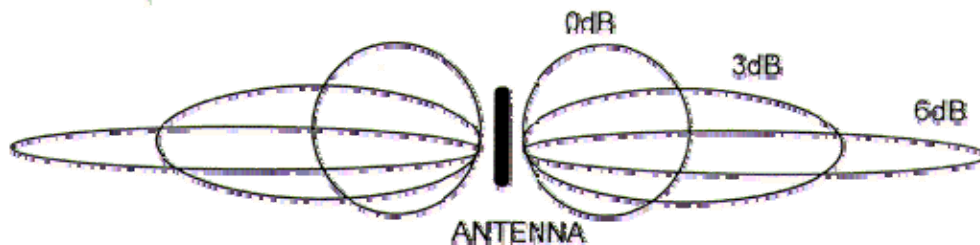
As the above table shows there are 13 channels available in Europe, 11 channels for America, these channels in a perfect world would always transmit at the centre frequencies, due to manufacturing and environmental variations these frequencies will vary between the lower and upper limits of the channel band.

If you find a nearby network on channel 6 to avoid any chance of interference from it you would choose from channel 1, 11, 12 or 13 because the upper and lower frequencies do not overlap with channel 6.

## Further Considerations...

### Antenna performance dBi...

The diagram below shows a side on view of how signals emanate from a omni-directional antenna, from above they appear circular



As you can see all a high gain antenna actually does is focus the signal into a narrower side emitted beam, in simple terms it can be thought of as a doughnut, the higher the gain the flatter the doughnut.

Choosing an antenna (especially omni-directional) is not always as simple as higher gain is better, it depends on how the signal you are trying to receive propagates. Within a building signals commonly bounce off objects and walls, this can be how they propagate up and down floors, not through the floor and ceiling as you might think. If you use a higher gain antenna this could mean you are focusing the signal away from the route it was previously taking so then no signal gets to where you want it but other areas not being used get a stronger signal..

### Polarisation...

Polarization is important when dealing with various antennas in a wireless network, it is best to maximise signal by not mixing polarizations. If a vertical and horizontal antenna is used together you generally consider the transfer loss to be -3dB (half).

Wireless network Omni-directional antennas are generally vertical polarization.

If you have control of how both antennas are positioned you can mount both on their side to change the polarization from vertical to horizontal, this has two benefits horizontal polarization travels better over long distances and the second has already been mentioned, any vertical polarised networks in the area are reduced from the background noise by -3dB.

### **Building construction...**

There are many variables in building construction which cause problems with wifi transmission;

Metal cladding,  
Metal framed,  
Foil backed insulation and plasterboard,  
Foil wall paper,  
Thick walls and bricks containing a high metal (iron) content  
Old lead paint, not used now but can be hidden under layers of later paint.  
Wire mesh safety glass,

We can estimate the level of loss caused by materials in buildings; some are shown in the table below;

<b>Material</b>	<b>Approximate loss</b>
Plasterboard, single layer	3dB
Glass wall with metal frame	6dB
Window	3dB
Wire mesh safety glass window	8dB
Cinder block wall	4dB
Steel reinforced concrete floors	Up to 20dB
Solid core wall	Up to 10dB
Brick wall	8dB
Concrete Wall	Up to 15dB

6dB is equal to cutting the free space (line of sight) range in half, 12dB is one quarter the range.

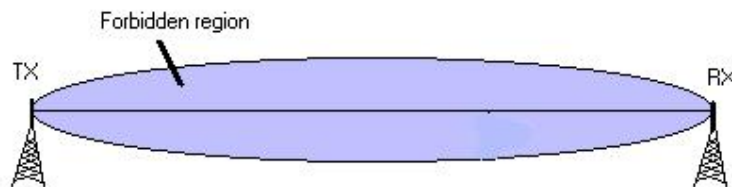
Metal cladding and foil backed insulation are a nightmare from a signal transmission point of view, they not only block the signal from leaving the room or building but they also cause signal reflection which can cause signal cancelling or the signal bounces around so long it becomes attenuated to the point of being too weak to be of use.

### **Other household and office items which cause attenuation are...**

Filing cabinets  
Desks, (especially when using wifi PCI cards where the PC is under the desk)  
Fish tanks  
Baths  
Water and heating pipe work  
And last but not least people, attenuation will be caused if you are using a laptop with a PCMCIA card on your lap or a PCI card in a PC which is under a desk you sit at.

### **Long range link, points of note...**

A tree in the line of sight can attenuate a wifi signal by 15dB; this is dependent on foliage and branch density. An interesting point to note is an effect called the Fresnel Ellipsoid which represents how the energy you are transmitting propagates from the antenna, it's not a line as you might expect but a bubble, if an object such as a tree is within that bubble the signal will be attenuated even if the line of sight is clear.



Fresnel Ellipsoid 2.4GHz simplified example; If you have a 300metre wifi link there should be no obstacles within 1.8m of either side of the antenna along the full length of the link.

Another effect to note is Propagation diffraction which calculates how well a signal will travel over an object such as a hill that it can't pass through



2.4GHz Propagation Diffraction simplified example;

If the top of a hill or building is 20metres higher than your antennas and is positioned directly at the mid point of a 300metre WiFi link the resulting loss is -32dB.

**Practical example...**

Free space loss is signal attenuation that would result if all absorbing, diffracting, obstructing, refracting, scattering, and reflecting influences were removed so as to have no effect on propagation. Free-space loss is primarily caused by beam spread, *i.e.*, the signal spread over long distances causes the signal to peter out in the same way a ripple fades away when a pebble is dropped in a pond.

Theoretical free space loss table;

Distance/Km	Gain Loss/dB (2.4GHz)	Gain Loss/dB (5GHz)
0.1	80.0	86.4
0.25	88.0	94.4
0.5	94.0	100.0
1.0	100.0	106.0
1.5	103.5	109.5
2	106.0	112.0
3	109.5	115.5
4	112.0	118.0
5	114.0	120.0
10	120.0	126.0
15	123.5	129.5
20	126.0	132.0

**Calculating Antenna requirements...**

To work out your antenna requirements you can apply your values to this calculation, for this example I make the following assumptions;

- transmit power; 100mW (+20dBm)
- 5metres extension, HDF400, cable loss; 0.25dB/metre =1.25dB
- connector loss; 0dB
- 10Kms between antennas with line of sight
- Receive sensitivity; -85dBm
- 802.11g 2.4GHz link

- 1) Transmit [dBm]: transmitter power [dBm] -cable loss [dB]+ antenna gain [dBi]
- 2) Propagation [dB]: Free space loss [dB]. (table above)
- 3) Receive [dBm]: antenna gain[dBi]- cable loss [dB]- receiver sensitivity [dBm]

Therefore;

- 1)  $20-1.25+24= +42.75\text{dBm}$
- 2) see free space loss table = -120

$$3) 24-1.25-(-85)= +107.75\text{dBm}$$

Finally;

Add results from 1), 2) and 3) then minus 25dB from the result.

25dB is an arbitrary figure which I consider a reasonable margin required to overcome today's heavy use of 2.4GHz raising the background levels plus the effects of adverse weather, rain, snow etc and still expect a reliable connection. This figure could be ignored if your link is located in a remote area or the occasional dropped connection doesn't worry you.

$$42.75+(-100)+107.75 = +30.5$$

$$30.5-25 = +5.5\text{dB}$$

Even with the 25dB safety margin the result leaves a further +5.5dB buffer, your connection will be very good, capable of sustaining high data rates. If you end up with a negative final value then your link is unlikely to work and you should consider firstly increasing the gain of the antenna, if you are using the highest gain antenna available then power boosters will be required at both ends.

### ***Power boosters...***

If I was then to add our 500mW 802.11g pen booster to the equation we can add;  
500mW is +27dBm

booster transmit power – access point transmit power

$$27-20 = +7\text{dBm}$$

Booster receive gain +20dB

You can now add 27dB (7+20) to the result of the previous calculation

$$+5.5+27 = +32.5$$

There is an argument to say you should not add the receive gain to the equation depending on what is causing your connection to fail. If the cause is noise in the 2.4GHz band then the booster will boost the noise and signal by +20dB therefore achieving nothing. If the cause is weak signal alone then the receive boost will help.

### ***PLEASE READ:***

This FAQ guide is provided as exactly that, a guide, real world installations vary wildly because all the variables are variable. So the upshot is you can estimate the feasibility of a wireless network but it is impossible to guarantee it, a certain amount of trial and error may be necessary.

Useful Links:

Website

Connector Chart

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