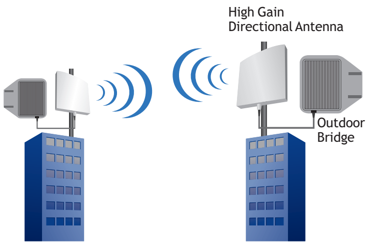
Building an Outdoor WLAN Network

This section will give you an overview on the basic concepts of building outdoor wireless networks. It provides the general guidelines on equipments, accessories and software features. However, since the variations on each installation site can influence the final result greatly; it is highly recommended to have experienced installers performing the actual design and installation.

Step 1: Knowing your need.

There are commonly three types of wireless outdoor applications

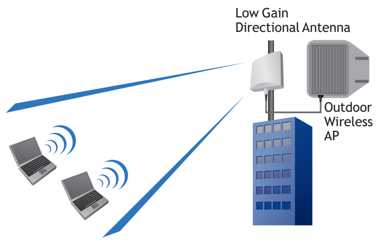
Connecting remote LANs Together



Point-to-Point

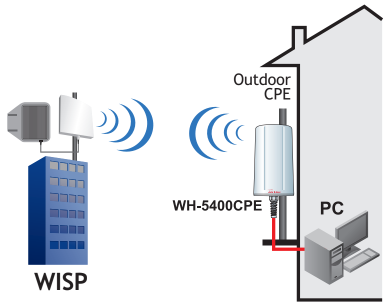
Connecting 2 remote office networks together

Provide Wireless Internet Services



Providing Internet service to outdoor clients

Receive Internet Service from WISP



Receiving wireless broadband service from WISP

Step 2: Choosing 2.4GHz or 5GHz

Please check with your local authority first about the legal outdoor WLAN frequencies in your country.

802.11b The 11Mbps WLAN standard that operates in the 2.4GHz using DSSS modulation. 2.4GHz frequency band is more crowded and more prone to interference. However, 2.4GHz can also deliver much further distance at the same output power comparing to 5Ghz device. If your distance requirement exceeds 10km or if you have to operate 2.4Ghz WLAN in a heavy interference area, we recommend using the 802.11b solution.

802.11g The 54Mbps WLAN standard that operates in the 2.4GHz using OFDM modulation. Although the 802.11g provides the ideal solution for indoor WLAN, there is one important feature to take notice for outdoor applications. If you want to reach more than 800 meter using the 54Mbps mode, please make sure your AP supports adjustable ACK Timeout function. 802.11g devices can also operate in the 802.11b mode.

802.11a The 54Mbps WLAN standard that operates in the 5GHz using OFDM modulation. The 5 GHz frequency band is not as crowded as the 2.4 GHz band. In addition, the 802.11a have 12 non-overlapping channels, comparing to 802.11b/g's 3 non-overlapping channels. However, the 5GHz device delivers far shorter distance at the same output power when comparing to 802.11g. But if higher gain antennas are used, the 802.11a can actually reach higher throughput at longer distance than 802.11g. It is recommended to use this solution if you require higher speed at distance greater than 10km.

Outdoor WLAN Standards

	Operating Frequency	Advantage	Disadvantage	Note
802.11b	2.4GHz	Better long distance stability, Less prone to interference than 802.11g	Only 11Mbps speed	
802.11g	2.4GHz	54Mbps speed at 2.4GHz band	More prone to interference. Less suitable for distance longer than 10km	Can also operate in 802.11b mode. ACK Timeout adjustment required for long distance.
802.11a	5GHz	54Mbps Speed at the quieter 5GHz band. Higher throughput at longer distance.	Shorter distance than 2.4Ghz at the same output power. 5Ghz frequency band restricted in more countries.	ACK Timeout adjustment required for long distance.

Step 3: Choosing the Right Antennas

A high Gain antenna does not actually increase the output power, but focusing available power at particular direction. For outdoor application, there are generally 2 types of antennas

Directional Antenna

Direction Antennas have limited angles of field in both horizontal and vertical direction. Because they do not have to cover 360 horizontal degrees like Omni antennas, directional antennas can have higher gain and wider vertical coverage. Directional antennas are available in Patch, Grid, or Yagee designs.

Omni Antenna

Outdoor omni antennas are also known as GP antennas. An outdoor omni antenna provides a near 360-degree horizontal coverage. However, the vertical coverage angles are typically much narrower than directional antennas. As a result, omni antennas are more suitable for environments that are roughly at the same height to each other. Omni antenna higher than 12dBi are not recommended due to their very narrow horizontal angle.

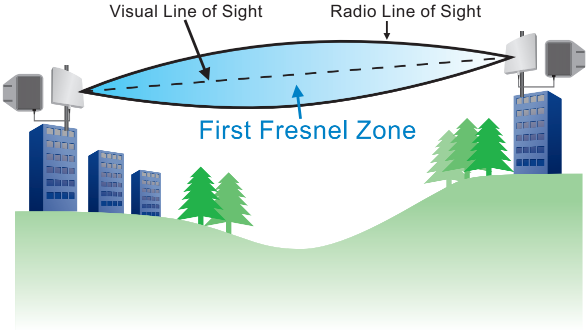
Antenna basic facts

Higher gain isn't always better:

If the distance between 2 stations is relatively short and an over-powering AP/antenna combination is used, it can induce severe performance lost due to Near-Field-Effect. In addition, higher gain also means narrower degree of field.

Wider Angle isn't always better:

An antenna with narrower degree is more difficult to align, but receive less noise from outside. This is particularly important for point-to-point installation. In an outdoor connection, 2 remotes sites not only have to be in the line-of-sight, but obstacles in the First Fresnel Zone can also reduce the performance. A wider angle of field increases the angle of the First Fresnel Zone.



GP antennas are not for Outdoor AP use:

A high gain GP antenna looks similar in appearance to indoor Dipole antennas. While it has a near 360-degree horizontal degree, the vertical coverage is usually 10 degree or less. Therefore, the idea to put a GP antenna on top of the building and the surrounding area will receive signal is false.

Step 4: Choosing the Right Cables

When a RF signal travel across an antenna cable, there is always a significant amount of cable loss. Therefore, the final output level of an outdoor AP/Bridge is influenced greatly by the length and quality of the antenna cables. Depending on your budget, a high quality cable is also significantly more expensive.

Cable Type	Cable Loss (dB/meter)
OEM RLA-10	0.22
Beldem H1000	0.22
Cavel RG-213	0.37
Belden H155	0.50
Times LMR-195	0.50
Andrew CN-195	0.50
OEM LX-195	0.65
OEM RG-58	1- 1.5

Step 5: Important Software Feature

TX Power Regulation

For countries that impose limit on WLAN output power, it might be necessary to reduce TX (transmit) power. The legal limit is measured as the output power at antenna end. Please check with your local authority about RF Power allowed in your country.

Output Power at Antenna End = (AP Output Power + Antenna Gain) - Cable Loss - Connector Loss -Lightening Protector Loss

ACK Timeout

When a packet is sent out from one wireless station to the other, it will waits for an Acknowledgement frame from the remote station. If the ACK is NOT received within that timeout period then the packet will be re-transmitted resulting in reduced throughput. If the ACK setting is too high then throughput will be lost due to waiting for the ACK Window to timeout on lost packets. By having the ability to adjust the ACK setting we can effectively optimize the throughput over long distance links. This is especially true for 802.11a and 802.11g networks.