LANTRONIX®

Application Note:

Antenna Solutions for the WiPort™

Lantronix, Inc.
15353 Barranca Parkway
Irvine, CA 92618
Tel: +1 (949) 453-3990

Part Number 920-927
Revision A July 2004

Contents

Recommended Antenna Solutions 3
Basic Types of Antennas 3
Performance Issues 5
Data Throughput 5
Site Survey 5

Recommended Antenna Solutions

A wide variety of 802.11b antennas are commercially available through numerous vendors. Virtually any of these antennas function with the Lantronix WiPort™ so long as the mating conductor is a 50 ohm RP-SMA adapter. When choosing an antenna, carefully consider the site requirements as each antenna has different performance characteristics. Lantronix has verified that the following antennas function with the WiPort:

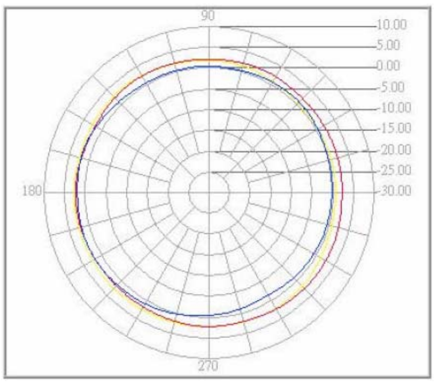
Manufacturer	Model	Type	Gain
Wanshih Electronic Co. Ltd (Taiwan)	WSS-001	Omni-directional “Rubber Duck”	2.15
Wanshih Electronic Co. Ltd (Taiwan)	WSS-002	Omni-directional “Rubber Duck”	2.15
Wanshih Electronic Co. Ltd (Taiwan)	WSS-003	Omni-directional “Rubber Duck”	2.15
Wanshih Electronic Co. Ltd (Taiwan)	WSS-005	Omni-directional “Rubber Duck”	2.15
Wanshih Electronic Co. Ltd (Taiwan)	WSS-007	Omni-directional “Rubber Duck”	5.0
Wanshih Electronic Co. Ltd (Taiwan)	WSS-008	Omni-directional “Rubber Duck”	2.7
Hyperlink Technologies	HG-2403RD-RSF	Omni-directional “Rubber Duck”	3.0
Hawking Technology	HA16SIP	Omni-Directional (with stand)	6.0
Hawking Technology	HA16SDP	Directional Patch Antenna	6.0
Hawking Technology	HAI15SC	Corner Reflector	15.0
WLANAntennas	2417AA	Yagi Flag	8.0

Basic Types of Antennas

There are two basic types of antennas most commonly used in 802.11b applications: omni-directional and directional (point-to-point). Omni-directional antennas are the easiest to use and the most common. As the name suggests, the omni-directional antenna does not require aiming. The electromagnetic energy from the antenna radiates in all directions but typically is strongest perpendicular to the body of the antenna. Omni-directional antennas are often used indoors and when the needed range is usually tens of meters.

Omni-Directional "rubber duck" antenna

The following figure depicts a typical omni-directional antenna radiation pattern (looking down along the axis of the antenna):



	Freq(MHz)	peak(dBi)	Angle(o)	Avg(dBi)
yellow	2400.00	2.85	134.85	1.98
red	2450.00	2.75	324.12	2.23
blue	2490.00	2.15	164.54	0.63

Directional antennas are generally used when the application requires a longer range. Unlike omni-directional antennas, directional antennas emit signals in a more focused and directional way. As a result, the directional antenna must be aimed at the target antenna. The advantages of directional antennas include increased range and the ability to be aimed through openings. Various directional antennas have different fields of radiation. This variation is dependent on the specific directional antenna selected.

One type of directional antenna is a patch antenna. The photo below is an example of a patch antenna:

Directional antennas often increase the range of a radio by as much as 50-100% in an open, non-obstructed area.

Performance Issues

Ensure the antenna is outside of any conductive enclosure. Electrically conducting surfaces reflect electromagnetic waves. The more open to the surrounding area the target antenna is, the better the performance of an antenna system. While the radio waves still penetrate walls, obstructions may affect the performance, and thus the range, of the unit. This is especially true of electrically conductive obstructions. Furthermore, because 802.11b uses the 2.4 GHz frequency to carry its information, the signal is susceptible to some attenuation as a result of passing through water. This is something to consider when expecting large groups of people (people are comprised of 60% water) to congregate directly between the sending and receiving antennas.

Another serious performance issue is electrical interference. Various types of electronic equipment emit a variety of interference that may affect the range of the unit. The only valid way to determine the range of the unit is through site testing.

Note that to work effectively, the sending antenna communicates with the receiving antenna or access point. For the WiPort to operate in infrastructure mode, it must communicate with the access point's antenna. The best way to assure this is an unobstructed path between and within range of the units. For the WiPort to operate in Ad Hoc mode, it must communicate with its target WiPort or other 802.11b Ad Hoc radio.

Data Throughput

With all 802.11b radios, as the distance between the sending and receiving units increases, or the electromagnetic obstruction of the path between the units increases, the data rate automatically drops to accommodate the environment. The data rate transitions from 11 Mbps to 5.5 Mbps to 2 Mbps to 1 Mbps as the signal strength decreases. For most applications, even 1 Mbps is sufficient.

Also, clients and access points share bandwidth, so the maximum simultaneous transmission rate between multiple clients and a single access point is reduced by the number of clients attempting to send data simultaneously.

Site Survey

The only valid way to determine the performance of a wireless system in a given environment is to perform a site survey. When planning a wireless installation, keep the following in mind:

- Different barriers affect the signals differently.
- Interference from other nearby equipment may change throughout the day as this equipment is turned on and off.
- Data throughput changes with changing environmental conditions.

The following is a list of typical barrier construction materials and the relative effect they may have on signal transmission:

RF Barrier	RF Barrier Severity	Examples
Air	Minimal	Air
Wood	Low	Partitions
Plaster	Low	Inner walls

RF Barrier	RF Barrier Severity	Examples
Synthetic material	Low	Partitions
Asbestos	Low	Ceilings
Glass	Low	Windows
Water	Medium	Damp wood, aquarium
Bricks	Medium	Inner and outer walls
Marble	Medium	Inner walls
Paper rolls	High	Paper on a roll
Concrete	High	Floors, outer walls
Bulletproof glass	High	Security booths
Metal	Very high	Desks, metal partitions, re-enforced concrete

While highly dependent on the actual environment, the typical range and data rate for an omni-directional antenna-equipped unit can be as high as those listed in the following table:

Data Rate	Range		
	Open Plan Building	Semi Open Office	Closed Office
11 Mbps	160 m (525 ft)	50 m (165 ft)	25 m (80 ft)
5.5 Mbps	270 m (855 ft)	70 m (230 ft)	35 m (115 ft)
2.0 Mbps	400 m (1300 ft)	90 m (300 ft)	40 m (130 ft)
1.0 Mbps	550 m (1750 ft)	115 m (375 ft)	50 m (165 ft)

Consider these to be maximum ranges. Proper planning includes relying on as little as half this range. Again, the only way to determine the actual range and data rate is to test the unit in the environment.