GE Medical Systems

Technical Publications

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Revision 0

GEMS WirelessLAN Pre-Installation Manual

Operating Documentation

For more information about the products in this guide, contact Proxim's inside sales group at (415) 960-1630, or send us a fax at (415) 960-1984.

Section	TITLE	PAGE

REVISION HISTORY

0 July, 1997 Final draft.

LIST OF EFFECTIVE PAGES

PAGE NUMBER	REVISION NUMBER	PAGE NUMBER	REVISION NUMBER	PAGE NUMBER	REVISION NUMBER
Cover	0	i to ii	0	1-1 to 1-12	0
Inside Cover	0				

SECTION 1
INTRODUCTION

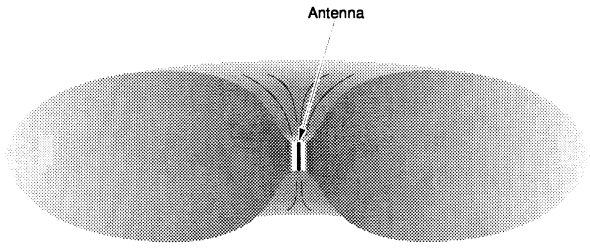
The WirelessLAN family of high speed, wireless bridges connects LANs in buildings with GEMS mobile products up to 1,000 ft. apart. WirelessLAN products are more affordable, install more quickly, and are easier to use than alternate solutions, such as laying cable or leasing a line from the telephone company.

This guide explains the major tasks required to complete a WirelessLAN bridge system installation. Most installations are simple and straightforward. After reading this guide, you will be able to identify any installation challenges associated with your site.

SECTION 2
WIRELESS BASICS

WirelessLAN products use radio waves to connect to a wired LAN. They operate at a frequency of 2.4 GHz using a transmission technique called spread spectrum frequency hopping. (Information about spread spectrum frequency hopping is given in the Wireless PCMCIA Adapter user's guide.) The transmitted radio waves travel in all directions and, at this frequency, will "bounce" off metal objects and pass through non-metallic objects before arriving at the receiver. The signal may make several bounces enroute to the receiving antenna.

The products used within a building have a small antenna that radiates low energy radio waves. Typically, the antennas will be pointing either straight up or straight down (termed vertical polarization). Transmission and reception work best when all the wireless components are vertically polarized. Radio signals radiate from the omnidirectional antennas in a three-dimensional circular pattern, as shown below.



Due to the antenna design, the radio waves propagate farther in the horizontal direction than they do in the vertical direction. Thus, within a building, WirelessLANs work best on a given floor; transmission is less effective between floors.

Signals at 2.4 GHz pass through most non-metallic objects. Nonetheless, building construction materials do effect radio transmissions, and may be classified by their impact on radio waves. Floor-to-ceiling structures made of dense material, such as masonry or metal, can be highly attenuating. These structures, such as firewalls, stairwells, elevator shafts, exterior walls, and bathrooms, can easily reduce signal strength by 60% or more. Computer rooms are sometimes specially shielded, and can create zones of low signal penetration. Other structures, such as book-cases, filing cabinets, interior walls, doors, and floor-to-ceiling partitions, have lesser impact, but the additive effect of multiple structures can reduce the signal strength to unacceptable levels.

Other factors can affect wireless transmissions. Devices that emit radio energy, such as microwave ovens and certain industrial equipment, can cause interference. The most likely source is microwave ovens, since they also operate in the 2.4 GHz range and, when in use, leak small amounts of radio energy.

All of these factors — penetration, reflection, absorption, and interference — act to affect LAN radio signals as they propagate through a building. Unless the WirelessLAN is properly designed, at some point signal strength will fall below acceptable levels and communications will be cut off or data will be lost. This manual will help you understand and measure how WirelessLAN signals propagate through your building. It will assist you in positioning the wireless components for full coverage of your facility.

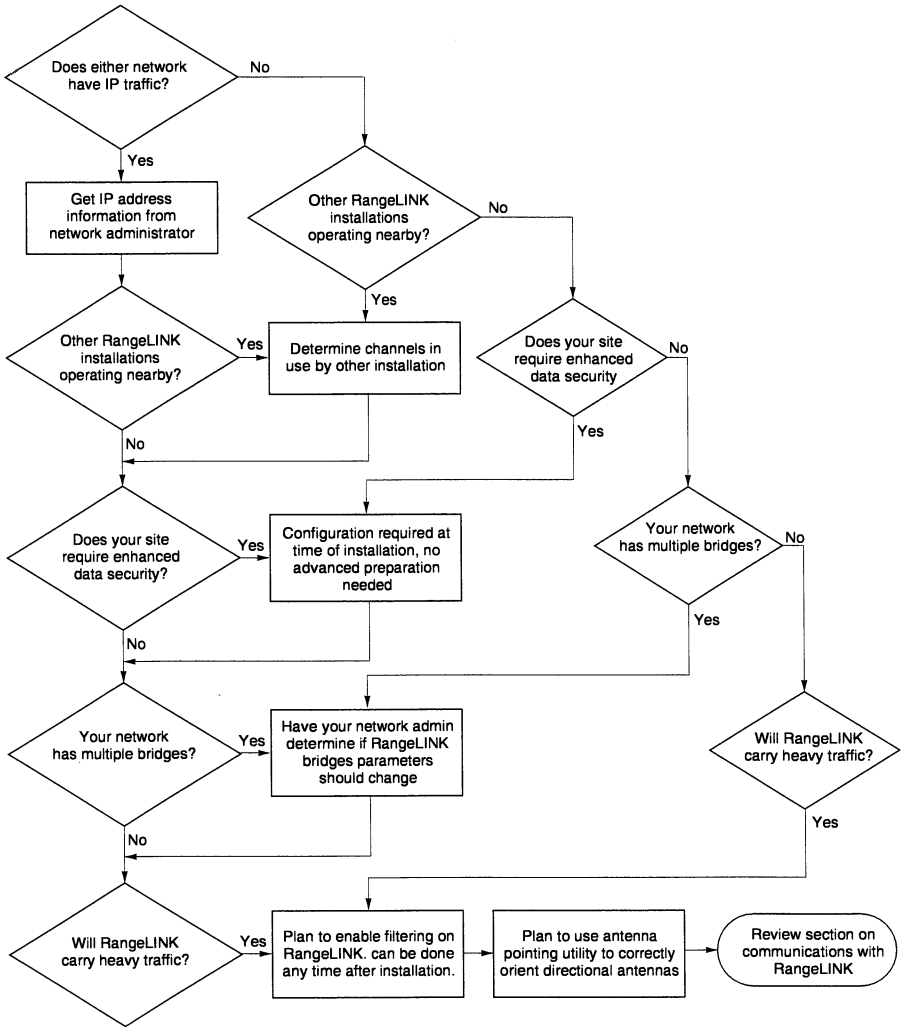
SECTION 3
WHO SHOULD READ THIS GUIDE

If you will install the antennas, WirelessLAN bridges, or configure WirelessLAN software, you should read this guide.

SECTION 4
INFORMATION YOU'LL NEED

Depending on the complexity of your network, you may need additional information and equipment during installation. This section helps you determine what you'll need. Review the following flowchart. Each rectangular block represents information you'll need. Additional detail for each block is available after the flowchart.

ILLUSTRATION 1
PRE-INSTALL PLANNING FLOWCHART



4-1 Easy Installation

If you can use the Easy Installation procedure, you're ready to begin installation of your WirelessLANs. Using the pre-configured software in the box, you will be up and running shortly after making antenna, network, and power connections.

4-2 Communicating with WirelessLAN

If the pre-install planning flowchart indicates that you need to establish communications with WirelessLAN, you'll need to use the management interface to configure your unit. Two options are available: directly via the serial port on the unit or over the ethernet network.

To use WirelessLAN's serial port, you'll need the following hardware at each site:

- DOS-based PC with an available serial port
- Female to female null modem RS-232 cable. This cable mates with WirelessLAN's serial port (a 9-pin male DB shell connector) and the serial connector on the DOS-based PC.

To establish an over-the-network connection, you'll need the following hardware at each site:

- DOS-based PC with an ethernet card
- Ethernet network connection to the PC and your WirelessLAN

4-3 IP Address Information

If you need IP address information, WirelessLAN requires the following items. Your network administrator should be able to give you this information.

- IP address for each WirelessLAN unit
- Subnet mask number
- Default gateway ID (required when traffic on a segment needs to cross a router)

4-4 Channels in Use by Other Installations

If you know of other WirelessLANs networks operating in the same geographical vicinity, determine which channels are already in use. During installation, you can select from 15 independent, full-bandwidth radio link channels.

If you can't determine if other Proxim networks are operating nearby, corrective measures can be taken during installation.

4-5 Enhanced Security

For improved data security, you may want to change the security code ID on all WirelessLAN units in operation on your network. There are 1,048,576 unique choices for the security ID. This is a simple procedure you can complete through the management interface at the time of installation.

4-6 Bridging Parameters

WirelessLAN meets the IEEE 802.1d Spanning Tree Protocol specification. This protocol was designed to handle cases in a complex bridged network (multiple bridges) where loops are created either unintentionally or to provide redundancy in the network. The bridges will configure themselves into a spanning tree topology removing any loops within the network. If you are administering a network with more than one bridge (WirelessLAN or otherwise), you will probably need to have some understanding of this protocol so that you can configure your bridges for optimum performance. Consult the WirelessLAN user's manual or your network administrator for more details.

4-7 Filtering

WirelessLAN supports a number of different bridge filter types. Filters are capable of controlling traffic forwarded from the ethernet segment to the wireless link. You may want to implement filtering to reduce unnecessary traffic across the link. The following filter types are available:

- Novell IPX Broadcast filters
- Protocol type filters
- ARP filters

If you don't know whether you need filtering, you can put your bridges into operation to assess actual traffic levels. Filters can be enabled at any time. Consult the WirelessLAN user's manual for more details.

4-8 Antenna Aiming Tool

The antenna aiming tool **requires** the use of WirelessLAN's serial port, since the units can't be on the ethernet network when measuring signal strength. See the section titled "Communicating with WirelessLAN" above for more details. You will need to use the antenna aiming tool under any of the following circumstances:

- You can't see one site from the other.
- Your range is close to the recommended maximum.
- You have ordered yagi antennas.

SECTION 5
PHYSICAL REQUIREMENTS

5-1 Power

WirelessLAN units at each site require AC power.

5-2 Network Connections

WirelessLAN units at each site require 1 ethernet connection. Use 10BaseT (WirelessLAN has an RJ-45 jack) or 10Base2 (WirelessLAN has a BNC jack) connections.

5-3 Antenna Cabling and Placement

Antenna placement can have a significant effect on your bridge performance.

SECTION 6
ANTENNAS, CABLES, & INSTALLATION

6-1 Sites and Performance

The surrounding terrain and landscape affect all radio signals. You've probably noticed that the signal from your car radio can fade if you drive behind hills or under bridges. WirelessLAN's performance degrades if the signal passes through obstructions such as tall buildings, dense trees, or hills. Radio towers and nearby high tension power lines can also reduce performance of your WirelessLAN. Since WirelessLANs operate from fixed locations, many of these site problems can be mitigated with careful antenna location and installation.

The patch antennas are directional, which means they must be aimed towards the other site. In some cases, you will not be able to clearly see the other site. Under those conditions, use the antenna aiming tool simultaneously at both locations.

6-2 Estimating Range

Making general statements about range can be misleading. The range you experience will depend greatly on your site, the surrounding terrain, and other factors such as buildings, weather, power lines, and antenna towers. Antenna cable length can also have a significant impact on the range you experience.

The following tables provide estimates of link quality, under the assumption that your sites have a clear line of sight between antennas. Link quality ratings include estimates of how varying conditions may affect the link. Varying conditions could include rain, fog, or even passing traffic (if your antenna mounts are low enough to be affected). For simplicity, these tables define conditions for 4 link quality categories:

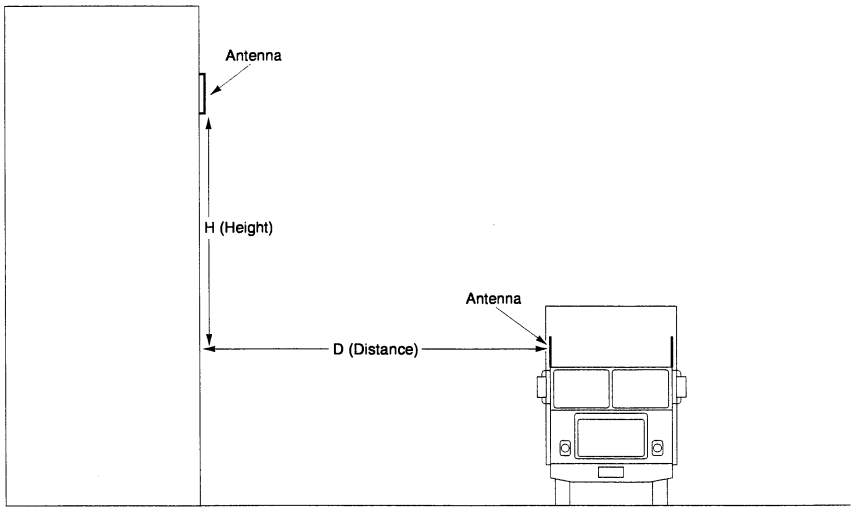
- **Excellent** — data link should provide full throughput rates under nearly all conditions. Service outages should be very rare. Occasional throughput degradation may occur in very heavy rains or other unusual conditions.
- **Good** — data link should provide full throughput rates in most conditions. Service outages should be very rare. Varying conditions will cause throughput degradation more often than with an excellent link.
- **Acceptable** — data link will provide full throughput rates in good conditions. Varying conditions will often cause the link to fall back to a lower throughput rate. While service outages shouldn't be common, they will occur.
- **Marginal** — data link will provide reduced throughput rates in most conditions. Varying conditions will often cause the link to fail. If you need very high link availability, you should consider a wired solution.

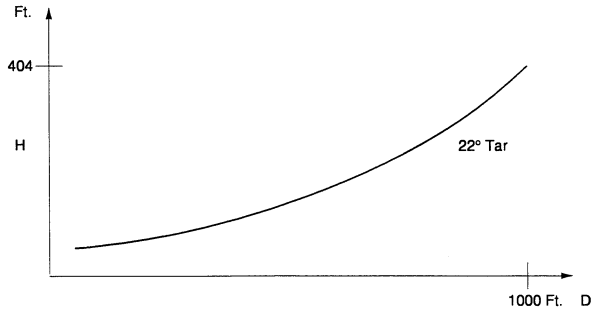
6-3 Antenna Mounting

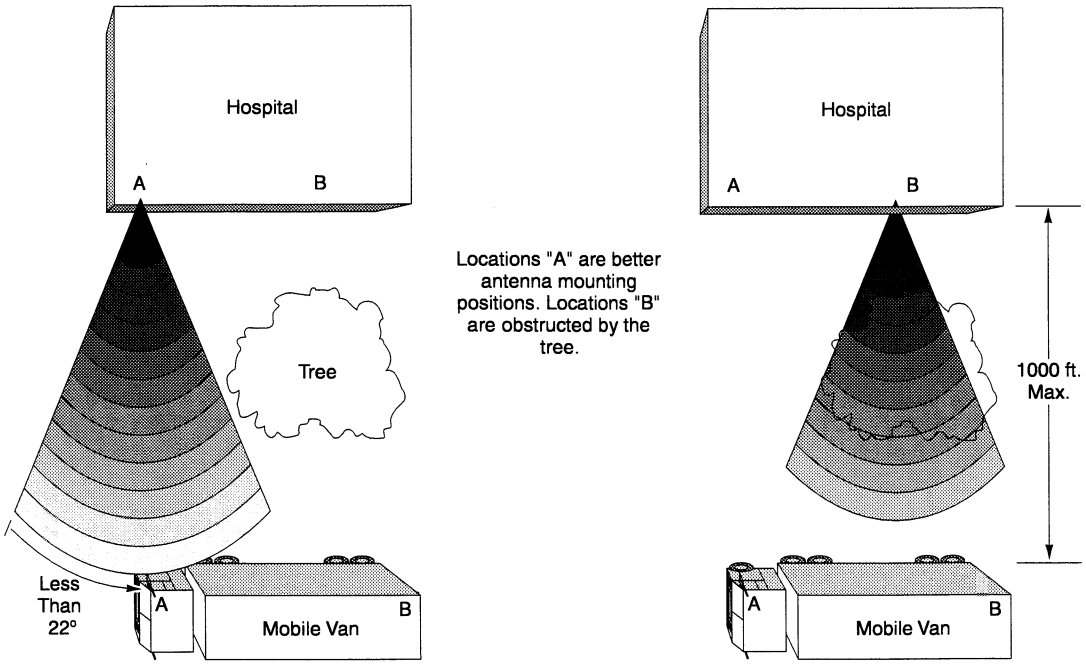
For best performance, always mount the data antennas on the exterior of the building. Consider the following factors related to antenna installation:

1. Pick antenna mounting locations to minimize obstacles (hills, buildings, trees, etc.) in the line of sight between antennas and maximize safety during installation and use (avoid installing antennas too close to power lines).
2. Pick antenna mounting locations on the building that line up best with the orientation of the mobile scanner antenna.
3. Pick an antenna mounting location that best suits the location of the WirelessLAN bridge within the interior of the building.

ILLUSTRATION 3
ANTENNA MOUNTING LOCATIONS







4. A clear line of sight for radio signals is larger than a clear visual line of sight. For example, consider this top-down view of 2 buildings with a large tree between them. Even though you may be able to see the other antenna through the tree, you don't have a clear line of sight path. For **very** short links (across the street), you may be able to achieve a good link through the tree. However, for longer links, consider placing antennas to minimize interference:
5. Measure the distance between the WirelessLAN unit and the antenna mounting location. Use this information to order the correct antenna cable length. For best performance, minimize the antenna cable length and install a longer ethernet cable. At WirelessLAN's frequencies, cabling has a significant impact on range.
6. GE Medical Systems does not provide antenna mounting hardware, such as masts, rooftop brackets, cable connection waterproofing tape, or guy wires. GEMS does provide antenna brackets that can be used with a mast.
7. Find out if there are any local regulations or permits for antenna installations.

6-4 Antenna Safety Standards

The following guidelines are safety recommendations for all amateur and general purpose communications antennas from the U.S. Consumer Product Safety Commission. For mast mounted antennas, be sure to review the antenna safety standards concerning grounding and mounting per National Electric Code.

6-4-1 You, Your Antenna, and Safety

Each year hundreds of people are killed, mutilated, or receive severe permanent injuries when attempting to install an antenna. In many of these cases, the victim was aware of the danger of electrocution, but did not take adequate steps to avoid the hazard.

For your safety, and to help you achieve a good installation, please **READ** and **FOLLOW** the safety precautions below: **THEY MAY SAVE YOUR LIFE!**

1. If you are installing an antenna for the first time, please, for your own safety as well as others, seek PROFESSIONAL ASSISTANCE. Consult your dealer. He can explain which mounting method to use for the size and type of antenna you are about to install.
2. Select your installation site with safety, as well as performance, in mind. **REMEMBER**: ELECTRIC POWER LINES AND PHONE LINES LOOK ALIKE. FOR YOUR SAFETY, ASSUME THAT ANY OVERHEAD LINES CAN KILL YOU.
3. Call your power company. Tell them your plans and ask them to come look at your proposed installation. This is a small inconvenience considering **YOUR LIFE IS AT STAKE.**
4. Plan your installation procedure carefully and completely before you begin. Successful raining of a mast or tower is largely a matter of coordination. Each person should be assigned to a specific task, and should know what to do and when to do it. One person should be designated as the "Boss" of the operations to call out instructions and watch for signs of trouble.
5. When installing the antenna, **REMEMBER: DO NOT** use a metal ladder. **DO NOT** work on a wet or windy day. **DO** dress properly — shoes with rubber soles and heels, rubber gloves, long sleeve shirt or jacket.
6. If the assembly starts to drop, get away from it and let it fall. Remember, the antenna, mast, cable, and metal guy wires are all conductors of electrical current. Even the slightest touch of any of these parts to a power line complete an electrical path through the antenna and the installer — **THAT'S YOU!**
7. If any part of the antenna system should come in contact with a power line — **DON'T TOUCH IT OR TRY TO REMOVE IT YOURSELF. CALL YOUR LOCAL POWER COMPANY.** They will remove it safely.

If an accident should occur with the power lines call for qualified emergency help immediately.

6-5 Aiming Directional Antennas

If your data link doesn't have a clear radio line of sight, or if you are operating near the maximum distance recommended for WirelessLAN installation, you'll need to carefully aim your directional antenna. Consider the following factors when aiming your antenna:

- Sometimes, acceptable WirelessLAN operation **is** possible when the antennas are not pointed directly at each other. While aiming is important, don't be concerned if your antennas are not perfectly aimed. The following diagrams illustrate the effect of mis-aligned directional antennas.

ILLUSTRATION 4
CORRECTLY ALIGNED ANTENNAS

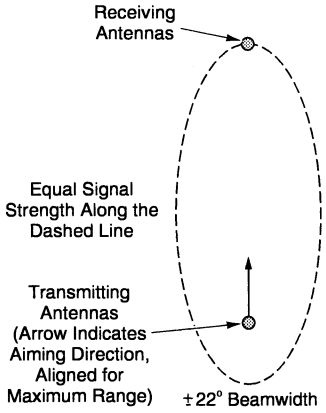
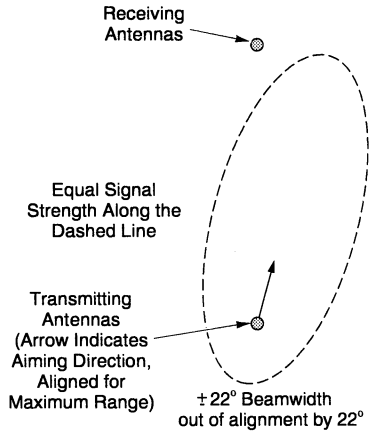


ILLUSTRATION 5
INCORRECTLY ALIGNED ANTENNAS



- Directional antennas are polarized. Polarization is indicated by the "UP" arrows on each antenna. Make sure both antennas are correctly oriented.
- Both sites should be prepared to run the aiming tool. See the discussion titled "4-2 Communicating with WirelessLAN" earlier in this document.
- Consider how you will communicate with the other site. You may want to have walkie-talkies, cellular phones, or standard extension phones available at the antenna mast.
- If you can't see the other site, setup will be much easier if you have a general direction for initial aiming. City maps, a compass, easy-to-spot landmarks, and binoculars or telescopes can be useful tools.
- Wind and weather can dislodge your antennas if they're not secured. Make sure to tighten all mounting hardware after aiming is complete.

SECTION 7
SPECIFICATIONS

TABLE 5
ANTENNA SPECIFICATIONS

Antenna	Sold with	Gain	Beamwidth Horiz.	Beamwidth Vert.	VSWR (max)	Size	Mast dia.	Termination
Patch	1520 2090	8.5 dB	±22°	±18°	2:1	8.09" X 6.59" X 0.85" 20.5 X 16.7 X 2.2 cm	1.75" 4.4 cm	12" (30.5 cm) cable with N-type female

TABLE 6
CABLE SPECIFICATIONS

Model	Impedance (ohms)	Length (ft/m)	Loss (dB)	Termination	Cable Diameter (in./cm)	Bend radius (in/cm)	Temp. (°C)
7712	50	20 (6.1)	1.3	N-male to N-male	0.405 (1)	1 (2.5)	-40° to 85°
7717	50	75 (22.8)	3.2	N-male to N-male	0.590 (1.5)	1.5 (3.8)	-40° to 85°