

Intel® PRO/Wireless 2011/2011B LAN

Configuring Access Point Bridging and Repeating (WLAP
Mode)

Product Model

Intel® PRO/Wireless 2011/2011B LAN Adapter product models:

WEAP2011NA
WEAP2011EU
WEAP2011JP
WEAP2011AR
WEAP2011SG
WEAP2011KR
WEAP2011EO
WEAP2011BAK
WEAP2011BRW
WEAP2011BJP

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About This Document

Conventions

Keystrokes are indicated as follows:

ENTER	identifies a key.
FUNC, CTRL, C	identifies a key sequence. Press and release each key in turn.
Press A+B	press the indicated keys simultaneously.
Hold A+B	press and hold the indicated keys while performing or waiting for another function. Used in combination with another keystroke.

Typeface conventions used include.

<angles>	indicates mandatory parameters in syntax.
[brackets]	for command line, indicates available parameters; in configuration files, brackets act as separators for options.
GUI Screen text	indicates the name of a control in a GUI-based application.
<i>Italics</i>	indicates the first use of a term, book title, variable or menu title.
Bold	indicates important user information, license provisions or warranty conditions.
Screen dialog	indicates screen dialog and user input options, and the exact syntax of items.
Screen text	indicates text and data displayed in an application screen on a computer monitor.
Terminal text	indicates text shown in a radio terminal LCD screen.
<u>URL</u>	indicates a Uniform Resource Locator, such as a Web page address.

About This Document

This document uses the following for certain conditions or information:



indicates tips or special requirements.



indicates conditions that can cause equipment damage or data loss.



indicates a potentially dangerous condition or procedure that only Intel® PRO/Wireless 2011/
2011B LAN-trained personnel should attempt to correct or perform.

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Chapter 1. Introduction

This document describes how to set up an Intel® PRO/Wireless 2011/2011B LAN Access Point. For the Intel® PRO/Wireless 2011B LAN Access Point, the firmware is version 3.x. For the Intel® PRO/Wireless 2011 LAN Access Point, the firmware is version 2.5x.

The features in the access point firmware allow network communication between access points. You can use access points to extend radio coverage of a single Ethernet network or to bridge two Ethernet networks.

A wireless network consists of a root *Wireless Access Point* (WLAP) and one or more designated WLAPs. The root access point is typically connected to the Ethernet network; although, this is not a requirement. The network in Figure 1-1 uses two access points operating in the wireless mode to extend radio coverage. The solid line in the figure represents an Ethernet network.

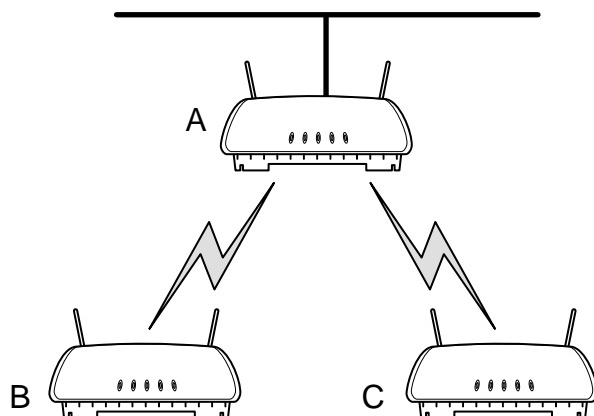


Figure 1-1: Extending Network Radio Coverage Using Wireless Access Points

Access points maintain their wireless connections through the radio broadcasting of probe, beacon, and *Bridge Protocol Data Unit* (BPDU) messages. Probe and beacon messages are part of the 802.11 protocol. BPDU messages are part of the Spanning Tree Protocol.

At the start of a wireless connection, access points send out probe requests and probe responses to gather operating status of other access points. Designated WLAPs also send out probes if they lose the beacon message from the root access point. The beacon messages are broadcast by the access points to keep the network synchronized. It contains information such as the access point's *Extended Service Set Identifier* (ESS ID) and MAC address. The ESS ID is also called the Network Name or SSID.

There are two types of BPDU messages. One type is a configuration BPDU. At the start of the wireless connection, the configuration BPDU messages determine the network configuration for the root access point and designated WLAPs. The other type of BPDU is the WLAP-Alive. These messages keep track of access points operating in the wireless network.

The procedures and examples in this document are for Intel® PRO/Wireless 2011 and 2011B LAN Access Points with firmware version 2.5x or higher. Additional information on access points is available in the Intel® PRO/Wireless 2011/2011B LAN Point Product Reference Guides available on the Intel support web site at www.support.Intel.com.

1.1 Basic Settings for Access Points

For a wireless *Access Point* (AP) operation, make sure that all access points have:

- The same ESS ID (Net ID) on the Access Point Installation screen. An example screen is

shown in Figure 1-2. The ESS ID is sometimes referred to as a SSID or Network Name.

- The WLAP Mode set to **Enabled**. This setting is on the RF Configuration screen. An example screen is shown in Figure 1-3.
- The same settings for the Rate Control and Short RF Preamble. These settings are on the RF Configuration screen. An example is shown in Figure 1-3. Rates set to **Required** are those at which all access points in the network must be capable of operating. **Optional** rates are those at which access points may operate if they are capable. This is to accommodate other manufacturers' access points that operate only at the 1- and 2-Mbps rates. For example, if all rates are set to **Required**, older access points that operate at only 1 and 2 Mbps would not associate. If only the 1- and 2-Mbps rates (or only the 1-Mbps rate) are set to **Required**, the older access points would associate. Intel recommends setting rates 1 and 2 Mbps to **Required** and 5.5 and 11 Mbps to **Optional** as shown in the example screen of Figure 1-3.
- The same setting for the *Wired Equivalent Privacy* (WEP) and WEP Algorithm. These settings are on the RF Configuration screen. An example is shown in Figure 1-3.

After making these settings, save them by pressing the **F1** key. Reset the access point.

```

Access Point A
                Access Point Installation

.Country Config-[CR]  United States
Unit Name          Access Point A
IP Address         157.235.55.199
                .Additional Gateways
                0.0.0.0
.Gateway IP Address 0.0.0.0
                0.0.0.0
                0.0.0.0
.Subnet Mask       255.255.255.0
                0.0.0.0
.DNS IP Address   0.0.0.0
                0.0.0.0
                0.0.0.0
.Net_ID (ESS)     Warehouse 1
                .Additional DNS
.Antenna Selection Full Diversity
                0.0.0.0
.DHCP/BOOTP      Disabled
                0.0.0.0

OK-[CR]          Save-[F1]          Save All APs-[F2]          Cancel-[ESC]
(Most parameters take effect only after being saved and AP is reset)
Identifies this Wireless LAN (1-32 characters)

```

Figure 1-2: Setting the ESS ID (Network Name/SSID)

1.2 Recommended Settings for Root Access Point

On the root access point, pay attention to the following settings on the RF Configuration screen, as shown on Figure 1-3:

- WLAP Priority
- WLAP Manual BSS ID

WLAP Priority

Set the root access point's WLAP Priority setting to a lower number such as 7000 hex. The default value for the WLAP Priority setting is 8000 hex, and it has a range from 0000 through FFFF hex.

Changing the WLAP Priority to a lower number ensures that the access point is recognized as the root access point. A WLAP ID is created for each access point from a concatenation of its WLAP Priority number and its MAC address. The priority number becomes the most-significant portion of the WLAP ID. The access point with the lowest WLAP ID becomes the root access point.

After the wireless network is running, observe the WLAP ID from the WLAP RF Statistics screen. Display this screen by pressing **F3** from the RF Statistics screen.

WLAP Manual BSS ID

Intel recommends that you set the WLAP Manual BSS ID to its own MAC address. An example is shown in Figure 1-3. This causes the access point to go directly to the Functional state and therefore reduces the time required to begin the wireless connection. The Functional state is described in section 3.3.1: *Functional State*.

```

Access Point A
                RF Configuration

.DTIM Interval      10          WLAP Mode          Enabled
.BC/MC Q Max       10
.Max Retries (d)   15          WLAP Priority       7000 hex
.Max Retries (v)   5          WLAP Manual BSS ID 00:A0:F8:93:C5:B5
.Multicast Mask (d) 09000E00 hex
.Multicast Mask (v) 01005E00 hex
.Beacon Interval   100 K-us    WLAP Hello Time    20
.Accept Broadcast ESSID Disabled
.MU Inactivity Timeout 60 min.  WLAP Max Age       100
.Rate Control
 11 Mb/s           Optional   WLAP Forward Delay 5
 5.5 Mb/s          Optional
 2 Mb/s            Required
 1 Mb/s            Required   WLAP MU Table Aging Time 240 min.
.RTS Threshold     2347 bytes
Extended Range     0 mi.
.Short RF Preamble Disabled
Tx Power Control   Full

OK-[CR]          Save-[F1]          Save All APs-[F2]          Cancel-[ESC]
Use the space bar to enable/disable/set link required WLAP operation.

```

Figure 1-3: Example Settings for the Root Access Point

Chapter 2. Extending a Network's Radio Coverage

This section covers examples for extending the radio coverage of a single Ethernet network with one-hop and two-hop wireless AP operations. The term “hop” refers to the direct communications link between two nodes of a network. With regard to wireless AP operations, the number of hops refers to the number of direct links through which a message passes between the root access point and a particular designated WLAP. Examples of one-hop and two-hop operations are shown in Figure 2-1 and Figure 2-2.

The basic settings for the access points are covered in the previous sections. In the following network diagram examples, the root access point is labeled A, and the two designated WLAPs are labeled B and C. For reference, the MAC addresses are included in the diagrams and example screens.

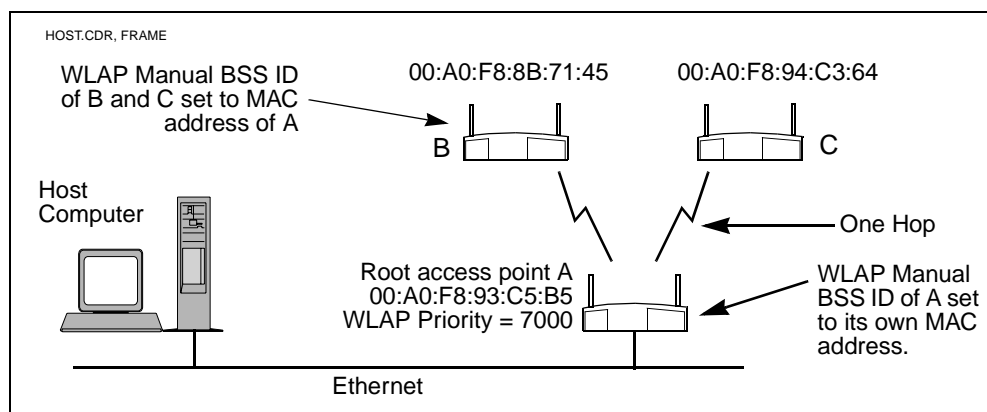


Figure 2-1: Wireless AP Network with One Hop

2.1 One-Hop Wireless Network Example

The example in Figure 2-1 extends a network's radio coverage with one hop between the root access point A and the two designated WLAPs B and C.

To configure the one-hop network, set the WLAP Manual BSS ID on the root access point to its own MAC address. In addition, set the WLAP Manual BSS ID on access point B and C to the MAC address of access point A. The RF Configuration screen for the root access point A is shown in Figure 2-3.

2.2 Two-Hop Wireless Network Example

The example in Figure 2-2 extends a network's radio coverage with two hops. In this network, there is one hop between the root access point A and designated WLAP B, then another hop between WLAP B and the other designated WLAP C.

To configure a two-hop network, set the WLAP Manual BSS ID on access point C to the MAC address of access point B and the WLAP Manual BSS ID on B to the MAC address of the root access point A. The Manual BSS ID for the root access point A is set to its own MAC address. The RF Configuration screen in Figure 2-3 shows the WLAP Manual BSS ID setting for access point C. The RF Configuration screens for the other two access points are the same except the WLAP Manual BSS IDs would be set to 00:A0:F8:93:C5:B5 and the WLAP Priority for access point A would be set to 7000.

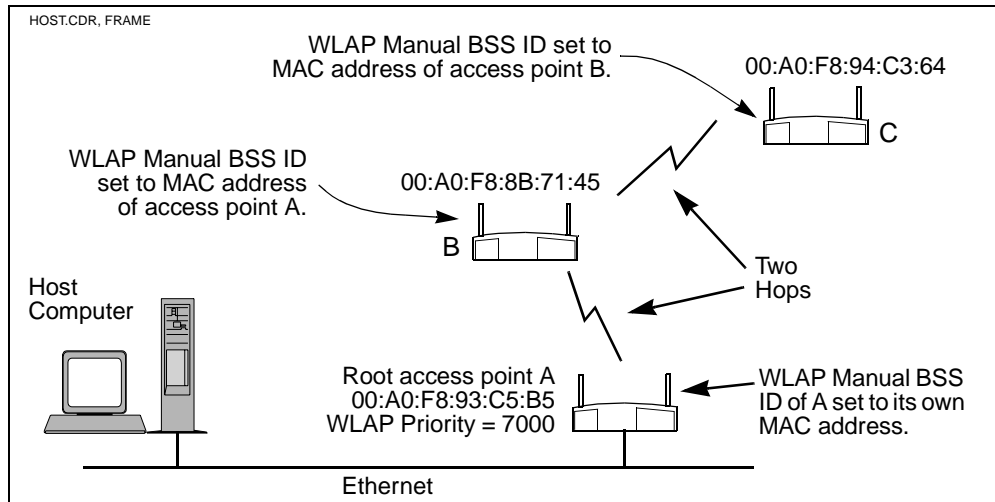


Figure 2-2: Wireless AP Network with Two Hops

```

Access Point C
                                RF Configuration
.DTIM Interval                  10           WLAP Mode                      Enabled
.BC/MC Q Max                   10
.Max Retries (d)               15           WLAP Priority                   8000 hex
.Max Retries (v)              5           WLAP Manual BSS ID 00:A0:F8:8B:71:45
.Multicast Mask (d) 09000E00 hex
.Multicast Mask (v) 01005E00 hex
.Beacon Interval               100 K-us      WLAP Hello Time                20
.Accept Broadcast ESSID Disabled
.MU Inactivity Timeout        60 min.    WLAP Max Age                  100
.WLAP Forward Delay           5
.WLAP MU Table Aging Time    240 min.
.Rate Control
 11 Mb/s                      Optional
 5.5 Mb/s                     Optional
 2 Mb/s                       Required
 1 Mb/s                       Required
.RTS Threshold                 2347 bytes
.Extended Range                0 mi.
.Short RF Preamble            Disabled
.Tx Power Control              Full

OK-[CR]      Save-[F1]      Save All APs-[F2]      Cancel-[ESC]
Enter the desired WLAP MAC addr, with which this AP is going to associate.
    
```

Figure 2-3: WLAP Manual BSS ID on Access Point C in 2-Hop Network

Chapter 3. Verifying Wireless AP Operations

You can verify wireless AP operations by looking at the following screens:

- WLAP RF Statistics
- Known Access Points

3.1 Viewing the WLAP RF Statistics Screen

Verify the wireless AP operations by viewing the WLAP RF Statistics screen. To view this screen, select **Show RF Statistics** from the access point's Main Menu, then press **Enter**. This displays the RF Statistics screen.

From the RF Statistics screen, press **F3**. This displays the WLAP RF Statistics screen. An example is shown in Figure 3-1.

During a wireless AP operation, associated access points are listed on the WLAP RF Statistics screen. The example screen in Figure 3-1 shows that two designated WLAPs have made wireless links with the root access point. This screen is for the one-hop network example in Figure 3-1. Notice that the two MAC addresses are listed under the "WLAP If Mac Addr" heading and two FWD states are listed under the "If State" heading. The term FWD indicates the forwarding of data to the associated access point.

For a two-hop network, the statistics in the WLAP RF Statistics screen is shown in Figure 3-2. The WLAP RF Statistics screen for the root access point lists only one designated WLAP in the FWD state. However, the WLAP B lists both of the other two access points in the FWD state.

Other possible "If" states on the WLAP RF Statistics screen are:

If State	Definition
DIS	Wireless interface is disabled
LIS	Access point is listening for configuration information
LRN	Access point is learning the configuration information
FWD	Access point is forwarding data
BLK	Access point is blocking data

Table 3-1: If States

As an access point starts to associate in the wireless AP mode, the state changes from DIS to LIS to LRN and then finally to FWD indicating association is successful.

Also note that in the example WLAP RF Statistics screens in Figure 3-1 and Figure 3-2, the Current State entry is Functional, which means that the access point is ready for other access points to associate with it. However, Functional does not necessarily mean that it has made a wireless AP connection. Additional information is covered in the section titled *3.3.1: Functional State*.

```

Access Point A

                                WLAP RF Statistics

Current # WLAP  Itf  2                                Root Interface      0
Current State  Functional                                Root Priority       7000 hex
Priority       7000 hex                                Root MAC Addr      00:A0:F8:93:C5:B5
Root Path Cost                                Root Path Cost      0

----- Wireless AP Interface Table -----

Itf      WLAP Itf      Itf  Path      Designated      Designated
ID       MAC Addr     State Cost      Root ID         Cost           WLAP ID        Itf ID

8001 00:A0:F8:8B:71:45 FWD  1  700000a0f893C5B5  0  700000a0f893C5B5  8001
8002 00:A0:F8:94:C3:64 FWD  1  700000a0f893C5B5  0  700000a0f893C5B5  8002
8003 00:00:00:00:00:00 DIS  1  700000a0f893C5B5  0  700000a0f893C5B5  8003
8004 00:00:00:00:00:00 DIS  1  700000a0f893C5B5  0  700000a0f893C5B5  8004

Refresh-[F1]  Timed-[F2]                                Previous-[F4]  Exit-[ESC]

```

Figure 3-1: RF Statistics from Root Access Point in One-Hop Network

```

Access Point B

                                WLAP RF Statistics

Current # WLAP  Itf  2                                Root Interface      1
Current State  Functional                                Root Priority       7000 hex
Priority       8000 hex                                Root MAC Addr      00:A0:F8:93:C5:B5
Root Path Cost                                Root Path Cost      1

----- Wireless AP Interface Table -----

Itf      WLAP Itf      Itf  Path      Designated      Designated
ID       MAC Addr     State Cost      Root ID         Cost           WLAP ID        Itf ID

8001 00:A0:F8:93:C5:B5 FWD  1  700000a0f893C5B5  0  700000a0f893C5B5  8001
8002 00:A0:F8:94:C3:64 FWD  1  700000a0f893C5B5  1  800000a0f88b7145  8002
8003 00:00:00:00:00:00 DIS  1  800000a0f88b7145  0  800000a0f88b7145  8003
8004 00:00:00:00:00:00 DIS  1  800000a0f88b7145  0  800000a0f88b7145  8004

Refresh-[F1]  Timed-[F2]                                Previous-[F4]  Exit-[ESC]

```

Figure 3-2: RF Statistics from Access Point B in Two-Hop Network

3.2 Viewing the Known Access Points Screen

The Known Access Points screen lists all access points that are linked together either through a wireless connection or through a wired connection. You can use the Known Access Points screen to determine the number of access points in a wireless AP network; however, keep in mind that the screen also lists access points that are connected to the same Ethernet as the root access point but may not be part of the wireless AP operation.

Figure 3-3 is an example of a Known Access Points screen listing the root access point and the two designated WLAPs. This example screen includes another access point connected to the same Ethernet as the root access point but not in the wireless AP network.

Access Point A		Known Access Points							
MAC Address	IP Address	Net_ID:	CH	HST	HSQ	MUS	KBIOS	FW_Ver	Away
00:A0:F8:93:C5:B5	157.235.55.199	3	-	-	0	0	0	02.51-11	
00:A0:F8:8B:71:45	157.235.55.60	1	-	-	0	0	0	02.51-11	
00:A0:F8:94:C3:64	157.235.55.198	11	-	-	0	0	0	02.51-11	
00:A0:F8:94:C2:04	157.235.55.53	1	-	-	0	0	0	02.51-11	

Echo-[F1] Delete-[F2] Next-[F3] Previous-[F4] Switch Exit-[ESC]

Figure 3-3: Known Access Points Showing WLAPs Plus Other

With this screen displayed, you can run an echo test, which performs a PING operation between the current access point and any of the listed radio-or wired-linked access points. To do this, you use the **Tab** key to highlight the access point you wish to PING. Then press **F1**, followed by the **Enter** key to start the echo test.

3.3 Observing the Access Point's LED Indicators

The access point's LED indicators and their basic functions are shown in Figure 3-4.

As an access point proceeds through the various states of a wireless AP operation, the LEDs provide certain status indications. The Intel® PRO/Wireless 2011/2011B LAN Product Reference Guides describe how the LED indicators are displayed during the several wireless AP operating states from Initializing through Functional.

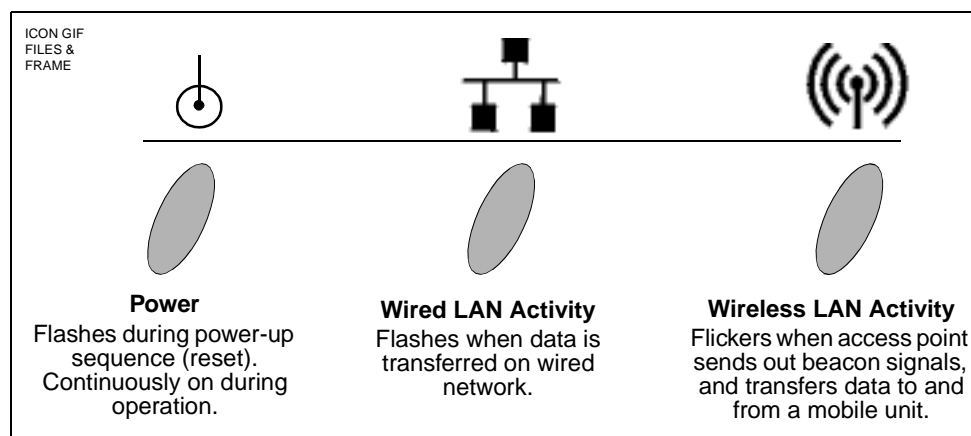


Figure 3-4: Access Point LED Indicators and Functions

During normal operation, it may be difficult to observe the LED indicator status because the states exists for only a very short time. During an abnormal operation, the access point may remain in a particular state permanently or for a significant length of time. In this situation, you can easily determine abnormal operation from the status of the LED indicators.

The following subsections cover two of the wireless AP states that you can easily determine by observing the LED indicators. These two states are: Functional and Send Probe. One of these states is displayed as the Current State entry on the WLAP RF Statistics screen.

Example screens showing the Current State as “Functional” are shown in Figure 3-1 and Figure 3-2. An example screen showing the Current State as “Send Probe” is shown in Figure 3-5.

```

Access Point A

                                WLAP RF Statistics

Current # WLAP  Itf  0                                Root Interface      0
Current State  Send Probe                                Root Priority       8000 hex
Priority       8000 hex                                Root MAC Addr      00:A0:F8:93:C5:B5
                                Root Path Cost     0

----- Wireless AP Interface Table -----

Itf      WLAP Itf      Itf  Path      Designated      Designated
ID       MAC Addr     State Cost      Root ID        Cost           WLAP ID        Itf ID
8001 00:00:00:00:00:00 DIS  1  800000a0f893c5b5  0  800000a0f893c5b5  8001
8002 00:00:00:00:00:00 DIS  1  800000a0f893c5b5  0  800000a0f893c5b5  8002
8003 00:00:00:00:00:00 DIS  1  800000a0f893c5b5  0  800000a0f893c5b5  8003
8004 00:00:00:00:00:00 DIS  1  800000a0f893c5b5  0  800000a0f893c5b5  8004

Refresh-[F1]  Timed-[F2]                                Previous-[F4]  Exit-[ESC]

```

Figure 3-5: Access Point in the Send Probe State

3.3.1 Functional State

The Functional state means that the access point is ready for mobile units or other access points to associate with it. In this state, the LED indicators display as follows:

Indicator	Activity
Power	Remains on
Wired LAN Activity	Flashes if activity occurs
Wireless LAN Activity	Flickers rapidly

Table 3-2: LED Indicators - Functional State

When the access point is in the Functional state, it may or may not have successfully made a wireless AP connection. You can determine if a wireless AP connection has occurred by viewing the WLAP RF Statistic screen. If this screen lists one or more access points as being in the FWD state in the Itf State column, then the current access point has made a wireless AP connection. For examples of screens showing the FWD state, refer to Figure 3-1 and Figure 3-2.

3.3.2 Send Probe State

Under certain conditions, an access point may remain in the Send Probe state (Figure 3-5) rather than continue on to the Functional state. In this state, the LED indicators display as follows:

Indicator	Activity
Power	Remains on
Wired LAN Activity	Remains off
Wireless LAN Activity	Blinks slowly (once per second)

Table 3-3: LED Indicators - Send Probe State

This occurs when an access point is configured to run in a wireless AP operation but is not associating with any other access points. The access point remains in the Send Probe state under one of the following conditions:

- a. The access point's WLAP Mode is set to **Enabled** and its WLAP Manual BSS ID is set to the MAC address of another access point.
- b. The access point's WLAP Mode is set to **Link Required**, it has no Ethernet connection, and its WLAP Manual BSS ID is set to either the zero default or another access point's MAC address.

The LED indicators continue to display the Send Probe status until association with another access point occurs, at which time the access point goes to the Functional state.

Preferred MAC Address. For condition a, if the WLAP Manual BSS ID is set to a "preferred" MAC address, the access point remains in the Send Probe state for approximately 30 seconds and then goes to the Functional state. To enter a preferred MAC address, change the first two numbers of the MAC address from 00 to 01; for example, 01:A0:F8:93:C6:E4. This is sometimes referred to as turning on the broadcast bit.

No MAC Address. For condition a, if the WLAP Manual BSS ID is set to the zero default value, the access point remains in the Send Probe state for approximately 30 seconds and then goes to the Functional state.

Ethernet Connection. For condition b, the Ethernet connection must be restored before the access point can associate and go to the Functional state.

Chapter 4. Using the Link Required Option

As shown in Figure 4-1, Link Required is one of the options for the WLAP Mode entry on the RF Configuration screen. This option allows an access point to create a wireless link in the event it loses its Ethernet connection.

Link Required can also be used to allow WLAPs to roam to another root access point if the original root access point loses its Ethernet connection.

Network examples using the Link Required option are covered in the following subsections.

```

Access Point A
                RF Configuration

.DTIM Interval      10
.BC/MC Q Max       10
.Max Retries (d)   15
.Max Retries (v)   5
.Multicast Mask (d) 09000E00 hex
.Multicast Mask (v) 01005E00 hex
.Beacon Interval   100 K-us
.Accept Broadcast ESSID Disabled
.MU Inactivity Timeout 60 min.
.Rate Control
  11 Mb/s          Optional
  5.5 Mb/s         Optional
  2 Mb/s           Required
  1 Mb/s           Required
.RTS Threshold     2347 bytes
Extended Range     0 mi.

                WLAP Mode      Link Required
.WLAP Priority      8000 hex
.WLAP Manual BSS ID 00:00:00:00:00:00
.WLAP Hello Time   20
.WLAP Max Age      100
.WLAP Forward Delay 5
.WLAP MU Table Aging Time 240 min.
.WEP (Privacy)     Disabled
.WEP Algorithm      40 bit shared key
.Encryption Key ID  1
.Encryption Key Maintenance
.Short RF Preamble  Disabled
.Tx Power Control   Full

OK-[CR]      Save-[F1]      Save All APs-[F2]      Cancel-[ESC]
Use the space bar to enable/disable/set link required WLAP operation.

```

Figure 4-1: Setting the WLAP Mode to Link Required

4.1 Link Required for Maintaining Ethernet Link

As previously mentioned, the Link Required option allows an access point to operate as a WLAP if it loses its Ethernet connection.

An example network is shown in Figure 4-2. In this example, when access point B loses its Ethernet connection, it resets then makes a wireless link to the Ethernet through access point A.

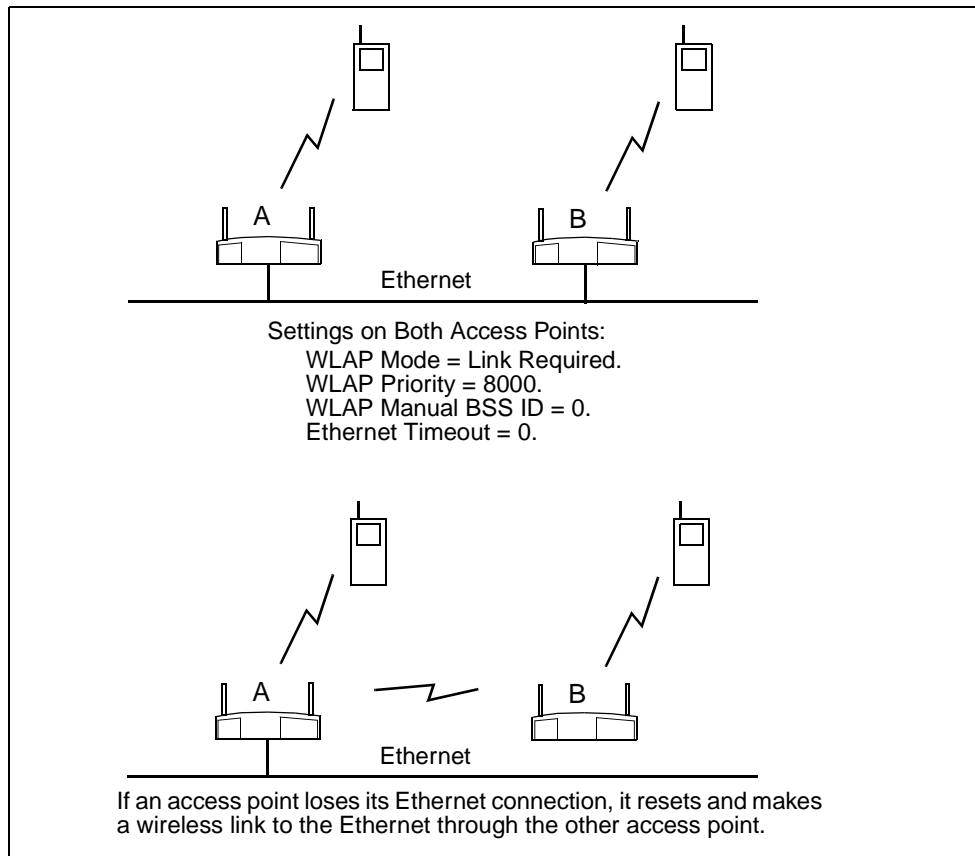


Figure 4-2: Link Required Operation for Maintaining Ethernet Link

By viewing the WLAP RF Statistics screen, you can determine whether or not a wireless link exists between access points. In the example network in Figure 4-2, no wireless link exists between the access points as long as they are both connected to the Ethernet. For this condition, the WLAP RF Statistics screen (Figure 4-3) shows the Current State as Functional, the Itf State as DIS (disabled), and the WLAP Itf MAC Addr as zero.

If one of the access points in the network in Figure 4-2 loses its Ethernet connection, it resets and initiates a wireless connection with the other access point. When the process of making the wireless link is completed, the WLAP RF Statistics screen (Figure 4-4) shows the Itf State as FWD (forward) and the WLAP Itf MAC Addr as the MAC address of the other access point.

```

Access Point A
                                WLAP RF Statistics

Current # WLAP  Itf  0
                                Root Interface      0
                                Root Priority      8000 hex
Current State  Functional
Priority       8000 hex
                                Root MAC Addr    00:A0:F8:93:C5:B5
                                Root Path Cost    0

----- Wireless AP Interface Table -----

Itf      WLAP Itf      Itf  Path      Designated      Designated
ID       MAC Addr   State Cost    Root ID        Cost           WLAP ID        Itf ID

8001 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8001
8002 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8002
8003 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8003
8004 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8004

Refresh-[F1]  Timed-[F2]
                                Previous-[F4]  Exit-[ESC]

```

Figure 4-3: No Wireless Link With Proper Ethernet Connections

```

Access Point A
                                WLAP RF Statistics

Current # WLAP  Itf  1
                                Root Interface      1
                                Root Priority      8000 hex
Current State  Functional
Priority       8000 hex
                                Root MAC Addr    00:A0:F8:8B:71:45
                                Root Path Cost    1

----- Wireless AP Interface Table -----

Itf      WLAP Itf      Itf  Path      Designated      Designated
ID       MAC Addr   State Cost    Root ID        Cost           WLAP ID        Itf ID

8001 00:A0:F8:8B:71:45 FWD  1 800000a0f88b7145 0 800000a0f88b7145 8001
8002 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8002
8003 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8003
8004 00:00:00:00:00:00 DIS  1 800000a0f893C5B5 0 800000a0f893C5B5 8004

Refresh-[F1]  Timed-[F2]
                                Previous-[F4]  Exit-[ESC]

```

Figure 4-4: Wireless Link After Loss of Ethernet Connection

4.2 Link Required for Backing Up Root Access Point

This section shows how to use the Link Required option so that designated WLAPs can roam to another root access point if the original one loses its Ethernet connection. In Figure 4-5, access points B and C are initially the designated WLAPs for root access point A. When access point A's Ethernet connection is broken, access points B and C reset then to roam to access point D. Furthermore, if access point D loses its Ethernet connection and access point A's Ethernet connection is restored, WLAPs B and C roams back to access point A.

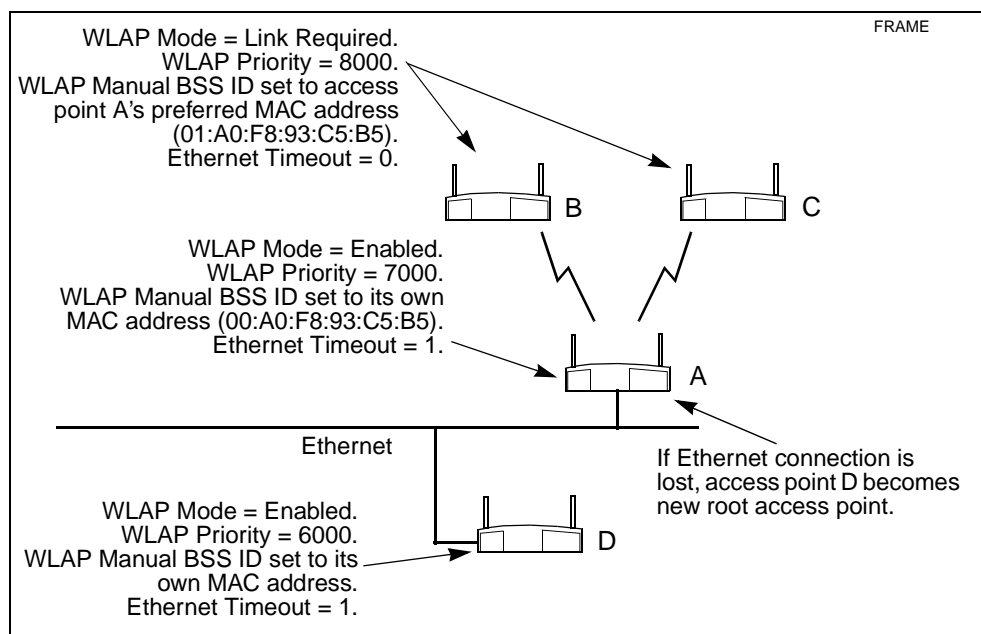


Figure 4-5: Network with Backup Root Access Point

Access point settings for the example in Figure 4-5 are described as follows:

Basic Settings. Make the settings previously described in 1.1: *Basic Settings for Access Points*.

WLAP Mode on RF Configuration Screen. On designated WLAPs B and C, set the WLAP Mode to Link Required. This causes the WLAPs to search for another access point with an Ethernet connection in the event the root access point loses its Ethernet connection. WLAP Mode for access points A and D is set to Enabled.

WLAP Priority on RF Configuration Screen. On access point A, make sure its WLAP Priority is set to a lower number (e.g., 7000) than the two WLAPs. On access point D, make sure its WLAP Priority is set to a lower number (e.g., 6000) than the other access points. The lower priority number ensures that access point D is recognized as the new root access point in the event access point A loses its Ethernet connection.

WLAP Manual BSS ID on RF Configuration Screen. On designated WLAPs B and C, set the WLAP Manual BSS ID to the “preferred” MAC address of the root access point A. To enter a preferred MAC address, change the first two numbers of the MAC address from 00 to 01; for example, 01:A0:F8:8D:25:F2. Using a preferred MAC address not only causes WLAPs B and C to associate with the root access point A, it also allows them to roam to another access point if the Ethernet connection to access point A is lost.

Ethernet Timeout on System Configuration Screen. Set the Ethernet Timeout to 1 on the two access points connected to the Ethernet (access points A and D). On WLAPs B and C, set the Ethernet Timeout to the default value of 0. With its Timeout set to 1, access point A detects a broken Ethernet connection and turns off its radio to allow the designated WLAPs B and C to search for another access point (e.g., access point D). Likewise, if access point D becomes the root, it would perform in the same way if it loses its Ethernet connection. An example System Configuration screen is shown in Figure 4-6.

Channel Setting. For wireless AP operations, it is not necessary to make any changes to the Channel setting. Designated WLAPs normally adopt the channel number of the root access point instead of using their own channel numbers specified on the System Configuration screen. To view the adopted channel number, refer to the System Summary screen.

```

Access Point A
                System Configuration
Channel          3
Auto Channel Select Disabled
.Ethernet Timeout 1
.Telnet Logins   Enabled
.Encryption Admin Any
.Agent Ad Interval 0
.S24 Mobile IP   Disabled
.Mobile-Home MD5 key *****
.Web Server      Enabled
Configure Kerberos-[F3]
System Password Admin-[F4]
  OK-[CR]      Save-[F1]      Save All APs-[F2]      Cancel-[ESC]
Sftwr detect(30-255 secs), 2,3,4 WLAP detect, 1 hardware detect, 0 disable

```

Figure 4-6: Setting the Ethernet Timeout to 1

Chapter 5. Bridging Two Ethernet Networks

As mentioned previously, you can use the wireless AP bridging feature to obtain a wireless connection between two Ethernet networks. An example of this is shown in Figure 5-1.

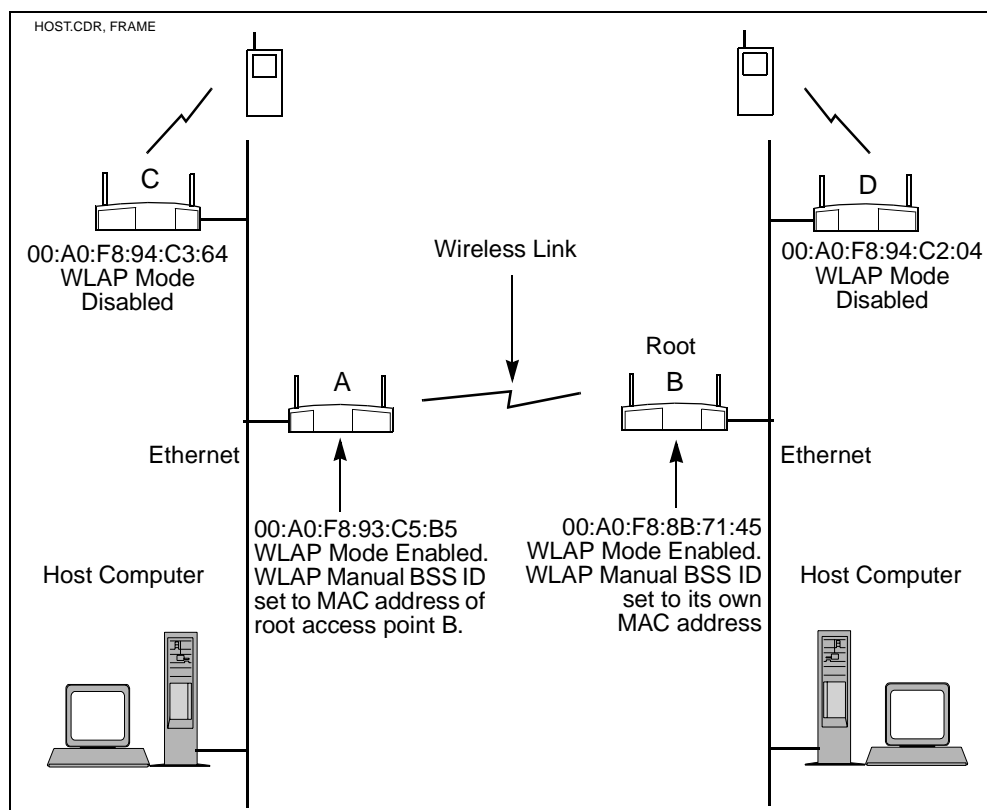


Figure 5-1: Bridging Two Ethernet Networks with Wireless AP

In the example, access points A and B have their WLAP Mode set to **Enabled** and provide the link between the two Ethernet networks. The WLAP Manual BSS ID for access point A is set to the MAC address of root access point B. The WLAP Manual BSS ID for root access point B is set to its own MAC address. Access point B is the root access point because its MAC address (00:A0:F8:8B:71:45) is lower than that of access point A (00:A0:F8:93:C5:B5). The WLAP Priority for these access points is set to the default value, 8000.

Also, in the example, all access points have their Ethernet Timeout set to the default value of zero, and access points C and D have their WLAP Mode disabled.

5.1 Verifying the Bridging Operation

As in the other wireless AP configurations, you can verify the network bridging operating by viewing the WLAP RF Statistics screen and the Known Access Points screen.

To determine which access points are operating in the wireless AP mode, view the WLAP RF Statistics screen. The example screen in Figure 5-2 shows access point A with a Current State of Functional and the forwarding of data (FWD) to the MAC address of access point B. Likewise, the screen viewed on access point B would show the forwarding of data to access point A. This verifies the wireless link between the two Ethernet networks in the example of Figure 5-1.

Because the other two access points C and D have their WLAP Mode disabled, their WLAP RF Statistics screen shows the Current State as Disabled and the Itf State as DIS (disabled).

```

Access Point A
                                WLAP RF Statistics

Current # WLAP Itf 1
                                Root Interface 1
Current State Functional      Root Priority 8000 hex
Priority      8000 hex          Root MAC Addr 00:A0:F8:8B:71:45
                                Root Path Cost 1

----- Wireless AP Interface Table -----

Itf      WLAP Itf      Itf Path      Designated      Designated
ID       MAC Addr     State Cost      Root ID        Cost           WLAP ID        Itf ID
8001 00:A0:F8:8B:71:45 FWD 1 800000a0f88b7145 0 800000a0f88b7145 8001
8002 00:00:00:00:00:00 DIS 1 800000a0f893C5B5 0 800000a0f893C5B5 8002
8003 00:00:00:00:00:00 DIS 1 800000a0f893C5B5 0 800000a0f893C5B5 8003
8004 00:00:00:00:00:00 DIS 1 800000a0f893C5B5 0 800000a0f893C5B5 8004

Refresh-[F1] Timed-[F2] Previous-[F4] Exit-[ESC]

```

Figure 5-2: Verifying Wireless AP for Bridging Networks

From any of the access points, you can view the Known Access Points screen to verify that all access points are linked together through the wired and wireless connections. With a successful bridging operation, the screen lists all access points on both Ethernet networks. Figure 5-3 is an example screen showing all four access points in the network of Figure 5-1.

```

Access Point D
                                Known Access Points

MAC Address      IP Address      Net_ID:      Warehouse 1      CH HST HSQ MUS KBIOS FW_Ver      Away
00:A0:F8:94:C2:04 157.235.55.53 1 - - 0 0 02.51-11
00:A0:F8:93:C5:B5 157.235.55.199 3 - - 1 0 02.51-11
00:A0:F8:8B:71:45 157.235.55.60 1 - - 0 0 02.51-11
00:A0:F8:94:C3:64 157.235.55.198 11 - - 0 0 02.51-11

Echo-[F1] Delete-[F2] Next-[F3] Previous-[F4] Switch Exit-[ESC]

```

Figure 5-3: Viewing the Access Points in Bridged Networks

5.2 Using the Ethernet Timeout Settings 2 & 3

Ethernet Timeout settings 2 and 3 on System Configuration screen are used in special network configurations such as the one shown in Figure 5-4. In this network, if access point A loses its Ethernet connection, mobile units are able to roam from access point D to access point H.

The following subsections describe the access point settings and sequence of events for the special network.

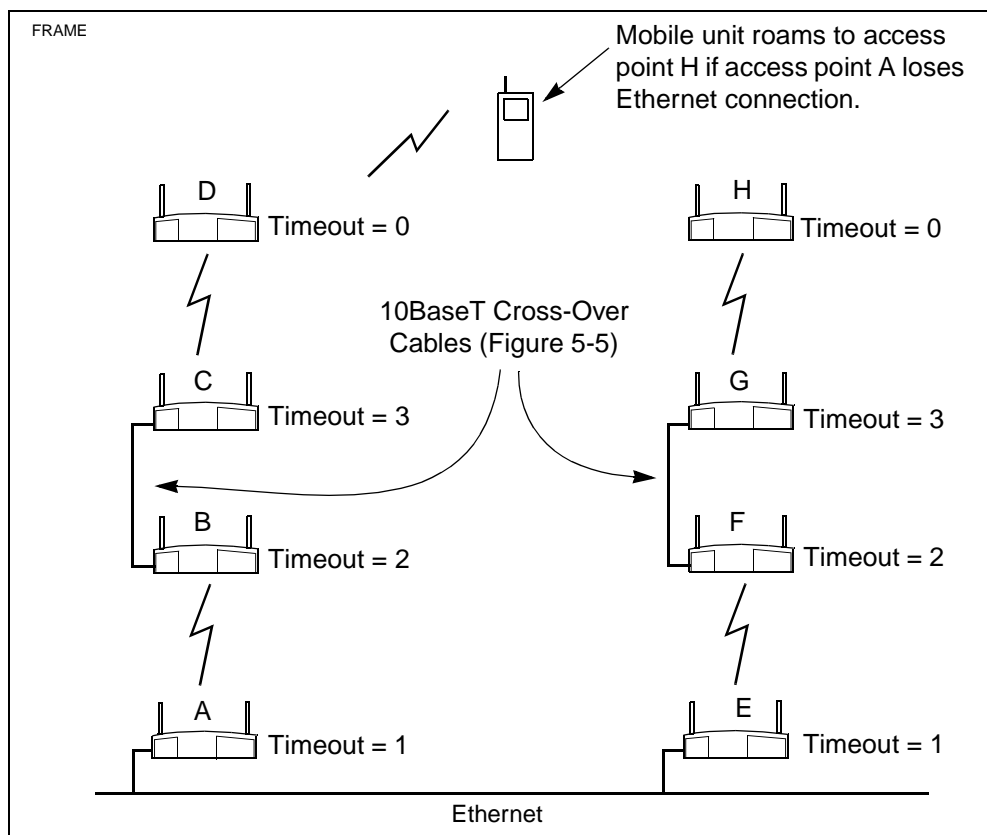


Figure 5-4: Special Network Using Timeout Settings 2 & 3

5.2.1 Ethernet Timeouts and Access Point Settings

This section describes the Ethernet Timeout settings and other access point settings for the special network in Figure 5-4. Ethernet Timeout settings, seen on the System Configuration screen, include:

Setting	Description
Timeout = 0	Ethernet Timeout function is disabled.
Timeout = 1	Access point detects a broken Ethernet connection and then turns off its radio. The Wireless LAN Activity indicator turns off. When the Ethernet connection is restored, the radio is turned on again.
Timeout = 2	Access point sends WLAP-Alive BPDUs on the Ethernet line as well as over wireless network. This allows other access points on the same Ethernet line to detect its presence.

Timeout = 3	Access point monitors WLAP-Alive BPDU messages on the Ethernet line as well as over the wireless network. If the BPDU message is missing on the Ethernet line, the access point turns off its radio and flashes its Ethernet Activity indicator approximately once every second. The BPDU is considered missing after a certain time determined by the setting of the WLAP Hello Time on the RF Configuration screen. The default is 20 seconds. When the Ethernet connection is restored, the access point turns on its radio and stops flashing the LED indicator.
Timeout = 4	Access point monitors WLAP-Alive BPDU messages on the Ethernet line as well as over the wireless network. If the BPDU message is missing on the Ethernet line, the access point resets. An example network using this setting is described in 5.3: <i>Using the Ethernet Timeout Setting 4.</i>

Table 5-1: Ethernet Timeout Settings

The wiring diagram for an Ethernet 10BaseT cross-over cable is shown in Figure 5-5.

The following are the settings for the access points in the special network of Figure 5-4. All access points have the WLAP Mode set to **Enabled**.

- Access Point A. Timeout = 1
Priority = 7000
WLAP Manual BSS ID = its own MAC address
- Access Point B. Timeout = 2
Priority = 8000 (default)
WLAP Manual BSS ID = MAC address of access point A
- Access Point C. Timeout = 3
Priority = 8000 (default)
WLAP Manual BSS ID = its own MAC address
- Access Point D. Timeout = 0
Priority = 9000
WLAP Manual BSS ID = MAC address of access point C
- Access Point E. Timeout = 1
Priority = 7000
WLAP Manual BSS ID = its own MAC address
- Access Point F. Timeout = 2
Priority = 8000 (default)
WLAP Manual BSS ID = MAC address of access point E
- Access Point G. Timeout = 3
Priority = 8000 (default)
WLAP Manual BSS ID = its own MAC address
- Access Point H. Timeout = 0
Priority = 9000
WLAP Manual BSS ID = MAC address of access point G

5.2.2 Sequence of Events in Special Network

In the example network in Figure 5-4, the following events occur if access point A loses its Ethernet connection:

- Access point A loses its Ethernet connection then turns off its radio.
- Access point B loses the beacon message from access point A, but it keeps probing access point A (Send Probe state).
- Access Point B then stops sending the WLAP-Alive-BPDU message on the cross-over Ethernet cable.
- Access Point C loses the WLAP-Alive-BPDU message then turns off its radio. The Ethernet Activity LED indicator flashes approximately once every second until the Ethernet connection is restored. With a lost Ethernet connection, the WLAP RF Statistics screen displays the Current State as “WLAP Lost on Ethernet” and the Wireless Interface (Itf) State as data blocked (BLK). An example screen is shown in Figure 5-6.
- Access Point D loses the beacon message from access point C, but keeps probing access point C (Send Probe state).
- Mobile unit loses beacon message from access point D, then roams to access point H.

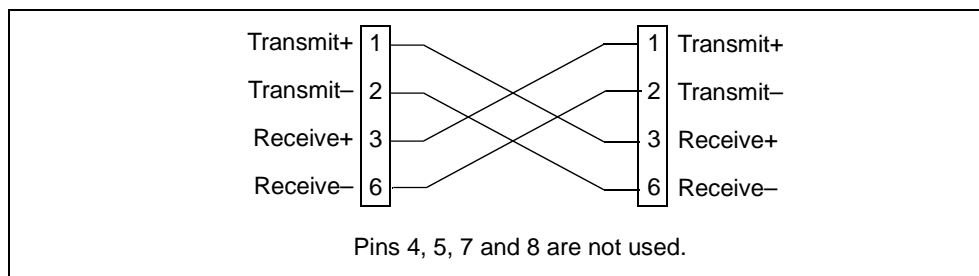


Figure 5-5: Wiring Connections of Cross-Over 10BaseT Cable

```

Access Point C
                                WLAP RF Statistics
Current # WLAP  Itf  1
                                Root Interface      0
                                Root Priority      8000 hex
Current State  WLAP Lost on Ethernet  Root MAC Addr  00:A0:F8:94:C3:64
Priority       8000 hex              Root Path Cost  0

----- Wireless AP Interface Table -----
Itf      WLAP Itf      Itf  Path      Designated      Designated
ID       MAC Addr  State  Cost  Root ID    Cost           WLAP ID        Itf ID
8001 00:A0:F8:94:C2:04  BLK   1  800000a0f894c364  0  800000a0f894c364  8001
8002 00:00:00:00:00:00  DIS   1  800000a0f894c364  0  800000a0f894c364  8002
8003 00:00:00:00:00:00  DIS   1  800000a0f894c364  0  800000a0f894c364  8003
8004 00:00:00:00:00:00  DIS   1  800000a0f894c364  0  800000a0f894c364  8004

Refresh-[F1]  Timed-[F2]              Previous-[F4]  Exit-[ESC]

```

Figure 5-6: States of Access Point C with Timeout 3 & Lost Ethernet

5.3 Using the Ethernet Timeout Setting 4

Ethernet Timeout setting 4 on System Configuration screen is used in special network configurations such as the one shown in Figure 5-7. In this network, the Timeout setting 4 allows access point B to detect a missing WLAP-Alive BPDU message if the Ethernet connection is lost between the two network hubs. When this occurs, access point B resets and makes a wireless connection with access point A. If the Ethernet connection is restored, access point B resets and the wireless connection is terminated.

As shown in Figure 5-7, Ethernet Timeout is set to 2 for access point A and to 4 for access point B. Both access points have the WLAP Mode set to Enabled, WLAP Priority set to 8000 (default), and WLAP Manual BSS ID set to zero (default).

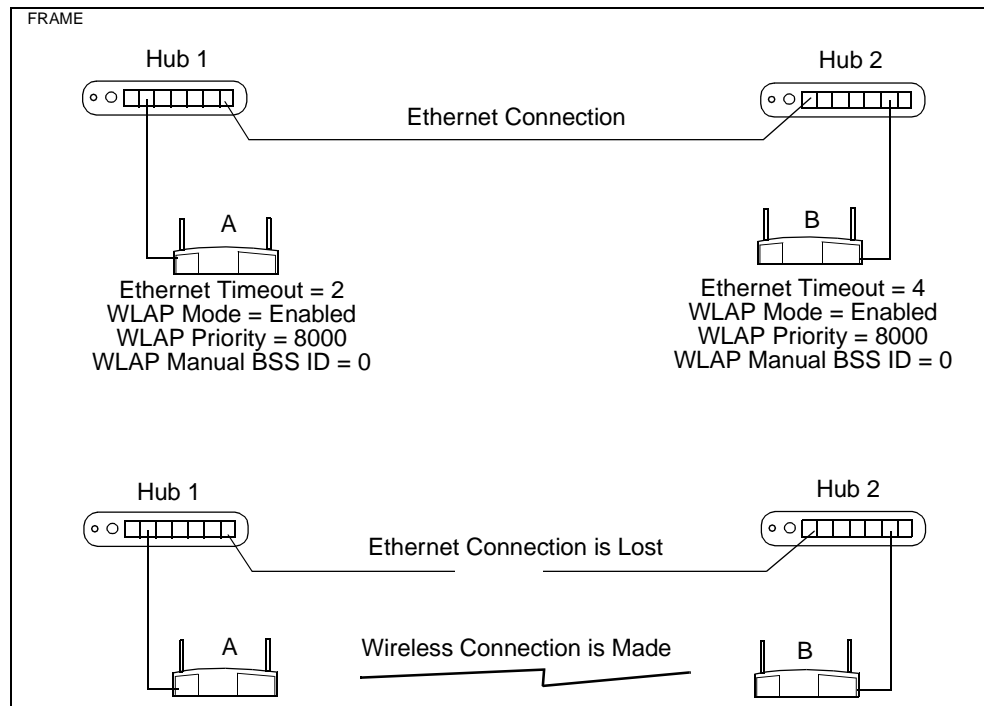


Figure 5-7: Special Network Using Ethernet Timeout 4

Chapter 6. RF Link Test

The RF Link Test is a site survey tool primarily for testing RF transmissions between access points used for bridging Ethernet networks. It can also be used for checking RF paths to mobile units.



Note

The RF Link Test is only available with an Intel PRO/Wireless 2011 LAN Access Point that has been upgraded with the latest firmware. To obtain the latest firmware, go to the Intel support website.

The example in Figure 6-1 shows two access points providing a wireless bridge between buildings. The RF Link Test tests the quality of the wireless link so that you can position the directional antennas for optimum signal transmission. This operation is covered later in 6.6: *Using RF Link Test to Align Directional Antennas*.

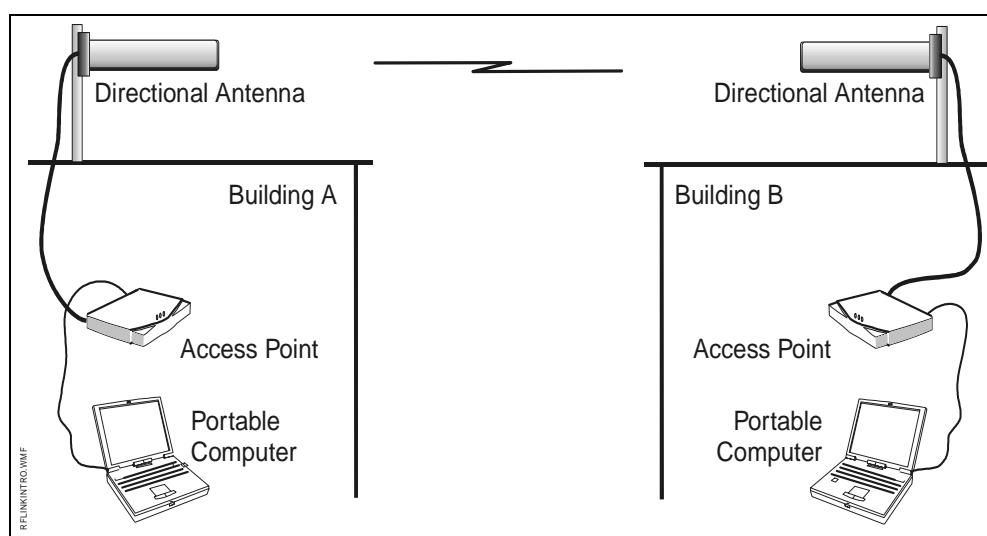


Figure 6-1: Example of Using RF Link Test for Antenna Positioning

6.1 Basic Setup for the RF Link Test

The basic setup for running the RF Link Test is shown in Figure 6-2. It consists of two access points communicating through a wireless access point link with one access point connected to a computer through a serial connection. The RF Link Test displays a special screen called Connection Quality Test that displays a bar graph showing the signal strength received from the remote access point.



Note

The computer may also connect to the local access point through a Telnet connection. This is covered in section 6.4.1: *Running the RF Link Test with Telnet*.

6.2 The Connection Quality Test Screen

During the RF Link Test, the local access point sends *Wireless Network Maintenance Protocol* (WNMP) packets once every second, and the signal quality of each reply is displayed on the Connection Quality Test screen. An example is shown in Figure 6-2.

Descriptions of the items displayed on the Connection Quality Test screen are listed in Table 6-1.

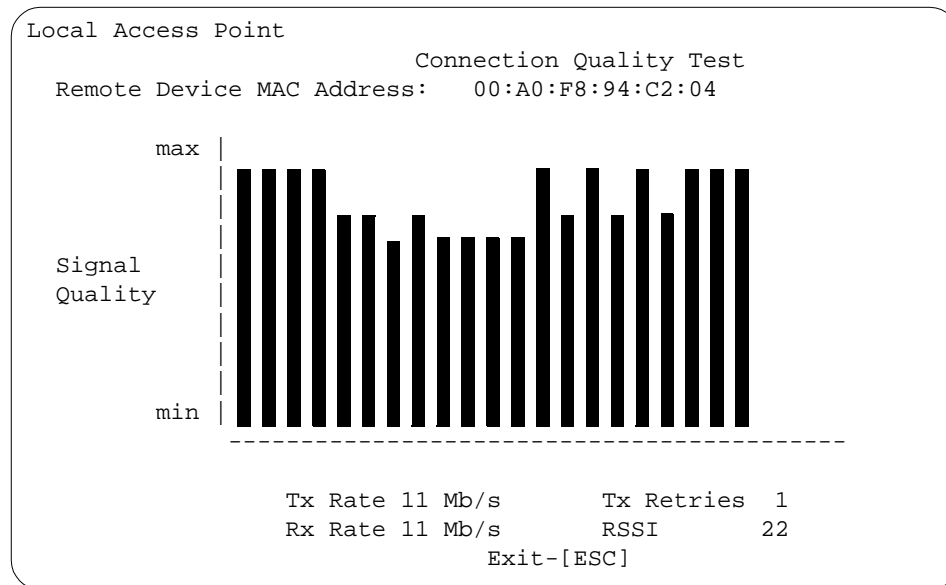


Figure 6-2: Example of Connection Quality Test Screen

Item	Definition
Remote Device MAC Address	MAC address of the remote access point that has a wireless access point link to the local access point.
Signal Quality	Displayed as vertical bars. Each bar is the signal quality, or strength, of each reply received from the remote access point. The higher the bar, the better the signal quality.
Tx Rate	Shows the transmitted data rate of the local access point in <i>Megabits per second</i> Mbps. One of four rates may be displayed: 11, 5.5, 2, or 1 Mbps.
Rx Rate	Received data rate from remote access point in Mbps. One of four rates may be displayed: 11, 5.5, 2, or 1 Mbps.
Tx Retries	Number of times packets are retransmitted from the local access point.
RSSI	<i>Received Signal Strength Indicator</i> . Indicates the current signal strength of the signal received from the remote access point. The maximum RSSI value for this test is 31; although, the RSSI scale during normal operation goes up to 255.

Table 6-1: Definitions of Connection Quality Test Screen

6.2.1 Low and Zero RSSI Readings

For RSSI values less than 3, the Connection Quality Test screen displays underscores (_) instead of bars. In addition, the screen displays the letter X to indicate that a reply is not being received from the remote access point within the one-second interval. In this case, RSSI is zero. If the letter X is continuously displayed, the access points may be either out of radio range or their wireless access point link is broken. For information on verifying the wireless access point operation, refer to 6.3: *Preparing for the RF Link Test*. Figure 6-3 is an example of a screen showing the X's and underscores.

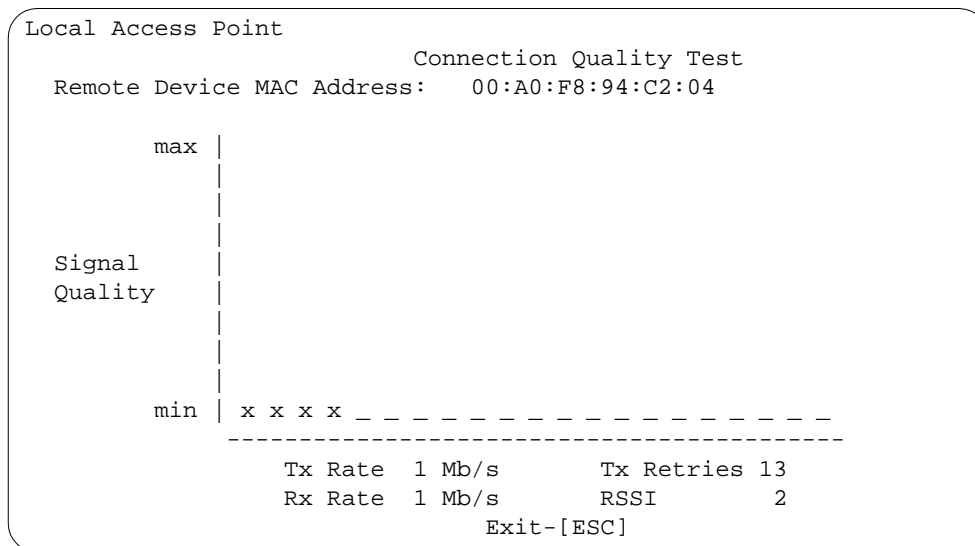


Figure 6-3: Connection Quality Test Screen Showing Low RSSI

6.3 Preparing for the RF Link Test

Before attempting to run the RF Link Test, make sure the two access points are configured as shown in 6.1: *Basic Setup for the RF Link Test*. Also make sure that they are communicating with each other through a wireless connection. Verify the wireless access point operation by looking at the access point's WLAP RF Statistics screen. To do this, press **F3** on the RF Statistics screen. With the WLAP RF Statistics screen displayed, verify that the Current State is Functional and the Itf State is being forwarded (FWD) to the MAC address of the remote access point. An example of the WLAP RF Statistics screen is shown in Figure 6-4.

```

Local Access Point
                                WLAP RF Statistics

Current # WLAP Itf 1                Root Interface      0
Current State Functional           Root Priority       7000 hex
Priority          7000 hex          Root MAC Addr      00:A0:F8:93:C5:B5
                                Root Path Cost     0

----- Wireless AP Interface Table -----
Itf   WLAP Itf   Itf   Path   Designated   Designated
ID    MAC Addr  State Cost  Root ID    Cost    WLAP ID    Itf ID
8001 00:A0:F8:94:C2:04 FWD   1   700000a0f893C5B5 0   700000a0f893C5B5 8001
8002 00:00:00:00:00:00 DIS   1   700000a0f893C5B5 0   700000a0f893C5B5 8002
8003 00:00:00:00:00:00 DIS   1   700000a0f893C5B5 0   700000a0f893C5B5 8003
8004 00:00:00:00:00:00 DIS   1   700000a0f893C5B5 0   700000a0f893C5B5 8004

Refresh-[F1]   Timed-[F2]                Previous-[F4]   Exit-[ESC]

```

Figure 6-4: Verifying the Wireless AP Operation

6.4 Running the RF Link Test

To run the RF Link Test:

1. Set up the two access points as described in the previous section.
2. From the access point Main menu, select **Show RF Statistics**.

3. With the RF Statistics screen displayed, press **F4**. This displays the Connection Quality Test screen, as shown in Figure 6-5.

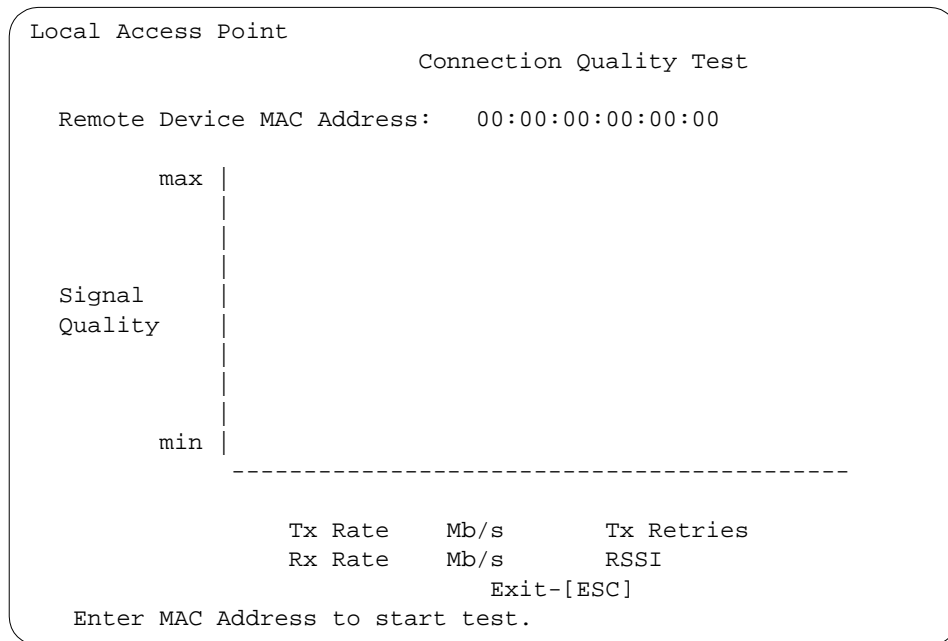


Figure 6-5: Connection Quality Screen Before Start of Test

4. Enter the MAC address of the remote access point.
5. Press **Enter** to highlight the MAC address, then press **Enter** again to start the RF Link Test. During the test, vertical bars scroll across the Connection Quality Test screen. As a new bar is displayed, its signal strength number is displayed as the RSSI number at the bottom of the screen. The higher the bar, the higher the RSSI number. Maximum signal strength is an RSSI number of 31. An example screen showing the maximum signal strength is shown in Figure 6-6.
6. To stop the RF Link Test, press the **Esc** key. This returns you to the Main Menu.

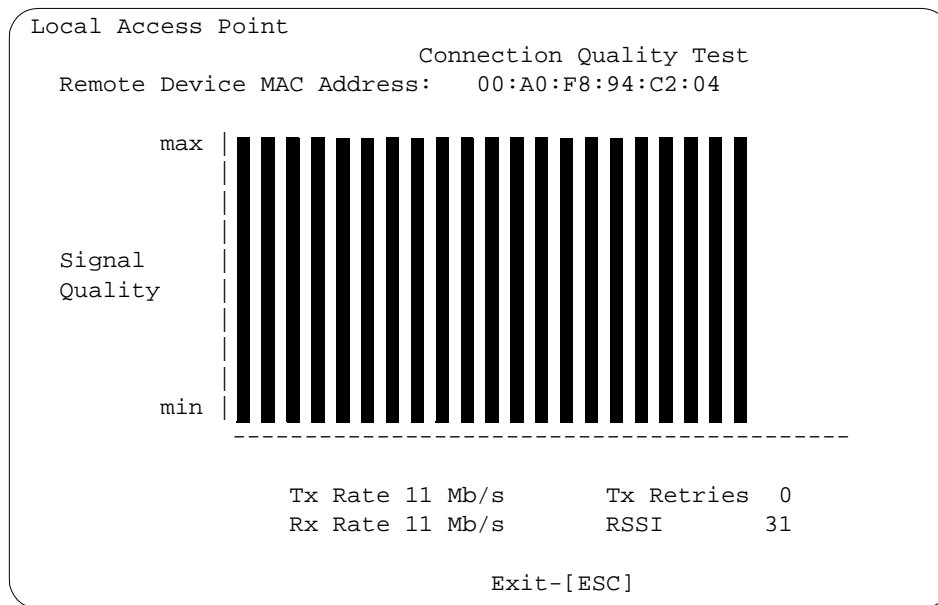


Figure 6-6: Test Screen Showing Maximum Quality of 31



Some settings on the RF Configuration screen may also affect the RF Link Test. These settings are described in 6.6.2: *Procedure for Aligning Directional Antennas*.

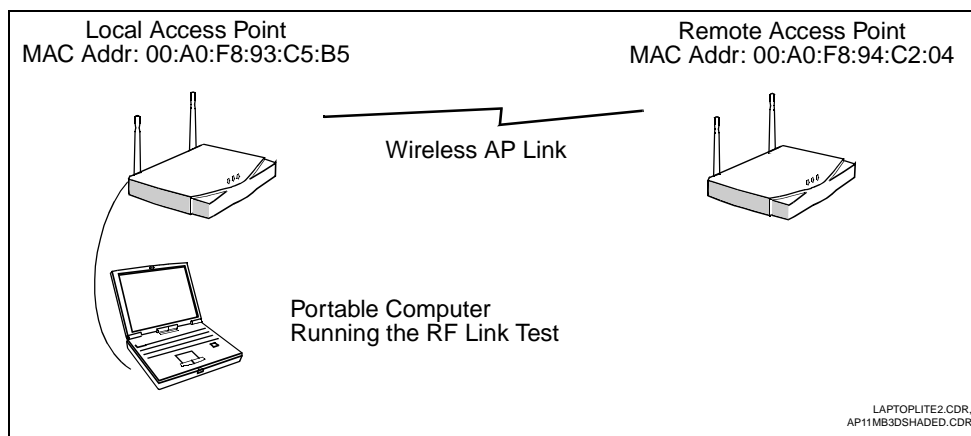


Figure 6-7: Basic Setup for RF Link Test

6.4.1 Running the RF Link Test with Telnet

For access point networks that are already installed, it may be more appropriate to run the RF Link Test using a Telnet connection. In this case, you must connect the local access point and computer running the RF Link Test to the same Ethernet network.

Make sure the **Telnet Logins** option is enabled on the local access point's System Configuration screen. In addition, make sure that the IP address and subnet mask of the computer are appropriate for the network and access point.

An example Telnet setup is shown in Figure 6-8, and the associated RF Link Test screen shown in Figure 6-9.

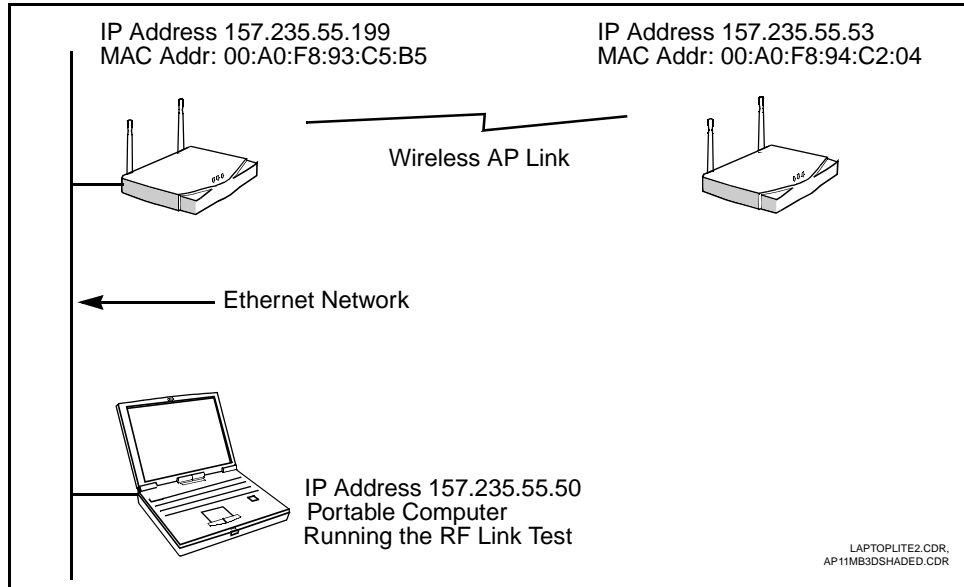


Figure 6-8: Running RF Link Test with Telnet Connection

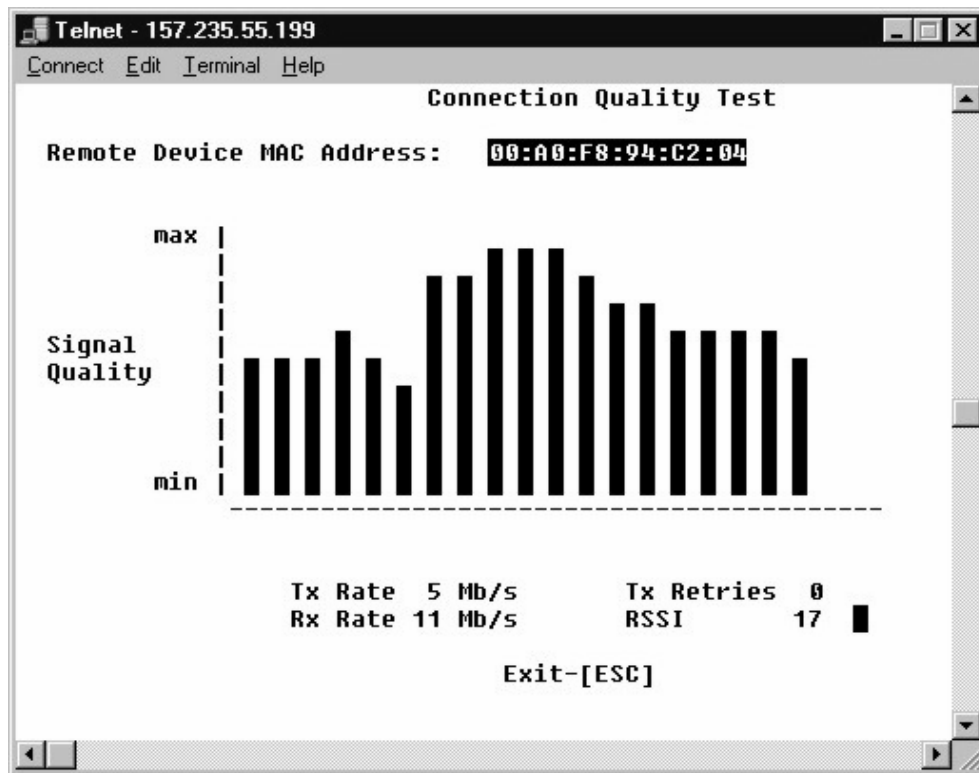


Figure 6-9: Test Screen Example Using the Telnet Connection

6.5 Using RF Link Test with Mobile Units

The RF Link Test may also be used to test the RF transmission paths to mobile units. In this case, the access point does not have to be operating in the wireless access point mode. The only requirements are that the mobile units have the same ESS ID as the access point and that they support the WNMP.

Figure 6-10 shows an access point associating with mobile units. In this example, you can use the RF Link Test to check the wireless path of a remote printer linked to a network through a client bridge.

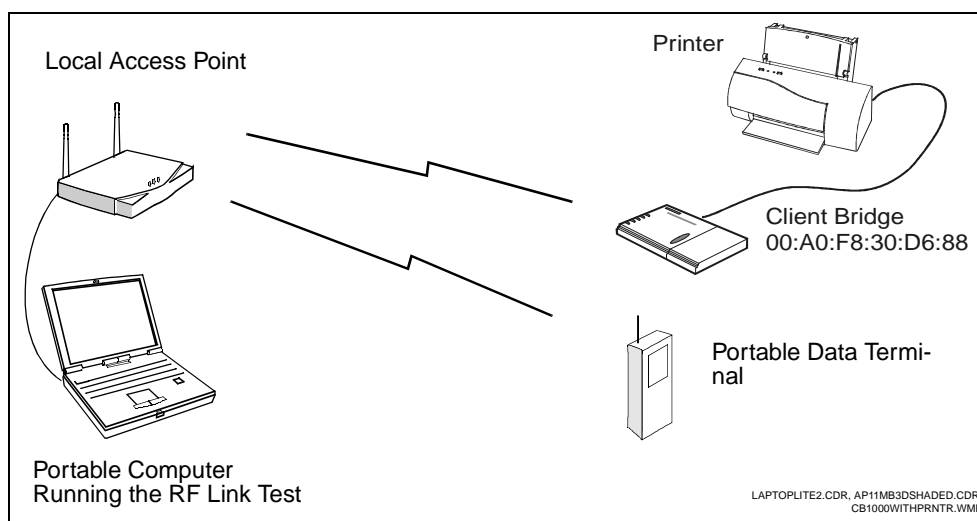


Figure 6-10: Access Point Associating with Mobile Units

Before running the RF Link Test with a particular mobile unit, make sure the access point is associating with the unit by viewing the access point's Mobile Units screen. This screen is shown in the example of Figure 6-11. To do this, select **Show Mobile Units** from the Main menu. Once association is verified, run the RF Link Test by entering the mobile unit's MAC address in the Connection Quality Test screen (Figure 6-6) as previously described.

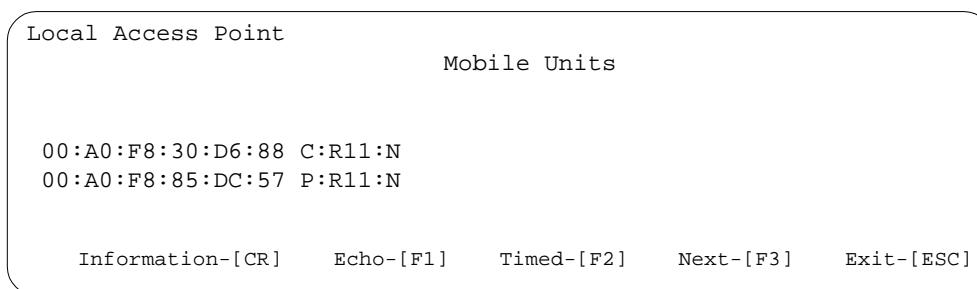


Figure 6-11: Verifying Association of Mobile Units

6.6 Using RF Link Test to Align Directional Antennas

The RF Link Test is useful for aligning directional antennas connected to access points that are used for bridging separate Ethernet networks located one-quarter mile or more from each other. An example setup for this type of operation is shown in Figure 6-12.

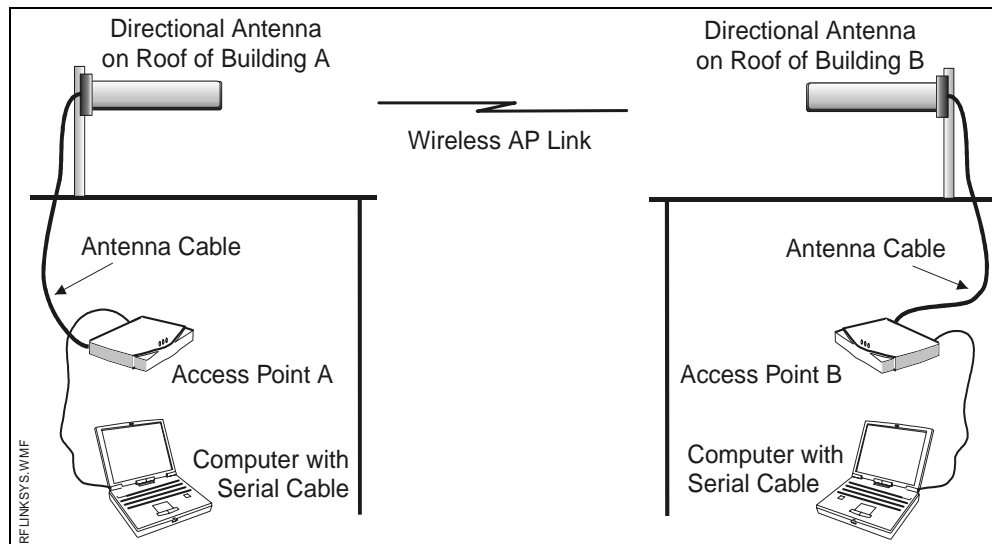


Figure 6-12: Example Setup for Using RF Link Test to Align Antennas

The alignment procedure is to point the antennas toward each other so that the RF Link Test for each access point shows the maximum RSSI reading. The antenna positioning is further refined by reducing the access point's radio power, while maintaining the maximum RSSI reading.



Note

Some access points support the radio power control feature; others do not support this feature.

This procedure is covered in the following subsections.

6.6.1 Setting Up for the Antenna Alignment Procedure

Follow these steps to set up the bridging access points. An example setup diagram is shown in Figure 6-12.

1. Install the directional antennas so that nothing obstructs the line of sight between them. For best results, mount each antenna on a pole on an elevated location such as the roof of a building. An example of a directional antenna is shown in Figure 6-13.
2. Connect the antenna cable to the access point's Antenna 1 connector, sometimes referred to as the Primary connector. As shown in Figure 6-14, this is the connector on the right as you face the rear of the access point.



Note

If the standard antenna cable is not long enough, use a special low-loss antenna cable. The low-loss antenna cable is custom made for a particular installation. It usually connects to the access point through an adapter cable. Length of the low-loss cable may be up to 60 feet. Only site survey or cable specialists should make custom antenna cables of this type.

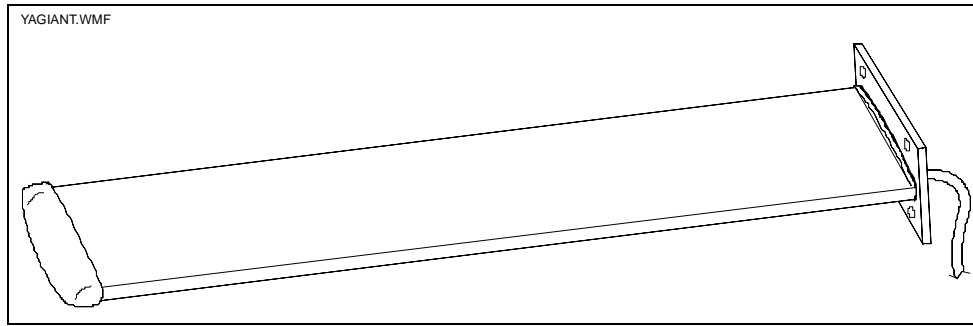


Figure 6-13: Exampel of a Directional Antenna

3. Connect the access point to a computer through a serial cable and turn on the access point. The DC power connector is shown in Figure 6-14.
4. With the Access Point Installation screen displayed on the computer, set the Antenna Selection option to **Primary Only**. Press **F1** to save the setting, then reset the access point.

Refer to the next subsection for the antenna alignment procedure.

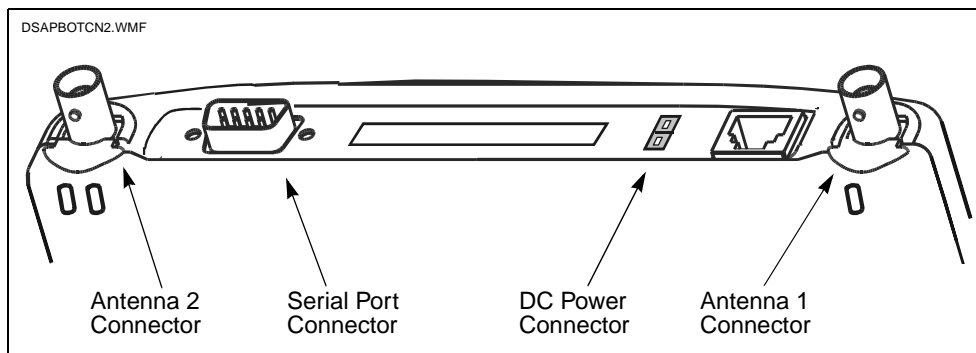


Figure 6-14: Access Point Connectors

6.6.2 Procedure for Aligning Directional Antennas

After setting up the equipment, follow these steps for aligning directional antennas connected to the bridging access points. At each location, a technician performs the procedure. Align one antenna first, and then align the other. As the technicians position the antenna and run the RF Link Test, they need to communicate with each other using two-way radios or cell phones. Other equipment you may need is covered in 6.6.3: *Additional Suggestions on Antenna Alignment*.

1. Attempt to point the antennas toward each other so that the access points communicate with each other through a wireless access point operation. Information on verifying the wireless access point operation is covered in 6.3: *Preparing for the RF Link Test*.
2. Make sure the Rate Control on the RF Configurations screen is set to **Required** for all four rates (Figure 6-15). This is recommended for access points that are performing a bridging function.
3. If antennas are over a mile apart, set the **Extended Range** on the RF Configuration screen to the appropriate distance setting. Type in the closest whole number in miles that matches the distance between antennas. This setting allows for the timing delays for distances over 1 mile.

The maximum setting is 50 miles. The example screen in Figure 6-15 shows a setting of two miles.



Note

The Extended Range setting is only available with an Intel PRO/Wireless 2011 LAN Access Point that has been upgraded with the latest firmware. To obtain the latest firmware, go to the Intel support website.

4. Make sure the radio in each access point is set to full power. You can verify this by viewing the **Tx Power Control** setting on the RF Configuration screen (Figure 6-15).



Note

After changing screen settings, remember to Press **F1**. Then, reset the access point.

5. Run the RF Link Test. If the access point's RSSI reading is 31 (maximum), set the Tx Power Control to 30 mW by pressing the space bar. This setting is supported by some radios only. If both access points show an RSSI reading of 31, they should both have their radio power reduced at the same time. After changing the power settings, remember to save the setting by pressing **F1** and then resetting the access point.
6. If the RSSI reading is less than 31, bring it up to maximum by slowly positioning one of the antennas left and right then up and down. Because the positioning of one antenna affects the RSSI readings at both locations, both technicians must monitor the RSSI readings. If required, repeat the positioning process for the other antenna.
7. With the RSSI reading at 31, repeat Step 5 while reducing the **Tx Power Control** setting as low as possible. The remaining settings are: 15 mW, 5 mW and 1 mW.
8. When the antenna alignment at both locations is complete, restore the **Tx Power Control** setting to **Full** (100 mW).
9. With full radio power restored, run the RF Link Test again to verify the maximum RSSI reading. Capture the Connection Quality Test screen to document your site survey activity. Do

this by holding down the **Ctrl** key and pressing the **Print Screen** key. Paste the captured screen into a word-processor program.

```

Local Access Point
                                RF Configuration

.DTIM Interval                10                WLAP Mode                Enabled
.BC/MC Q Max                  10
.Max Retries (d)              15                WLAP Priority             7000 hex
.Max Retries (v)              5                WLAP Manual BSS ID      00:00:00:00:00:00
.Multicast Mask (d) 09000E00 hex
.Multicast Mask (v) 01005E00 hex
.Beacon Interval              100 K-us          WLAP Hello Time          20
.Accept Broadcast ESSID       Disabled        WLAP Max Age             100
.MU Inactivity Timeout        60 min.       WLAP Forward Delay       5
.Rate Control
  11 Mb/s                     Required      WLAP MU Table Aging Time 240 min.
  5.5 Mb/s                    Required
  2 Mb/s                      Required
  1 Mb/s                      Required
.RTS Threshold                 2347 bytes   .Shared Key              Disabled
Extended Range                 2 mi.        .Key Width                40 bit
                                .Encryption Key ID       1
                                Encryption Key Maintenance
                                .Short RF Preamble       Disabled
                                Tx Power Control         Full

OK-[CR]      Save-[F1]      Save All APs-[F2]      Cancel-[ESC]
Transmit power affects coverage area. (These values are approximate.)

```

Figure 6-15: Example Settings for Aligning Antennas

6.6.3 Additional Suggestions on Antenna Alignment

If you are unable to make the access points operate with each other in the wireless access point mode, the problem is most likely that the narrow coverage areas of the directional antennas are not overlapping (Figure 6-16).

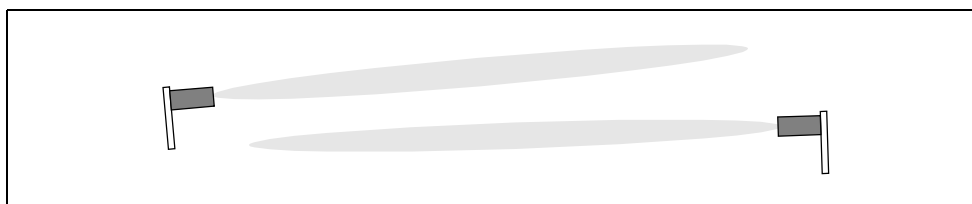


Figure 6-16: No Overlapping of Coverage with Directional Antennas

Omni-Directional Antenna

If the distance between the access points is not too great, it may help to use an omni-directional antenna temporarily on one access point to get the wireless access point operation started (Figure 6-17).



Note

Because of its limited range, the omni-directional antenna does not work over long distances.



Figure 6-17: Overlapping of Coverage with Omni-Directional Antenna

Other Equipment

In addition to two-way radios or cell phones, you may need the following equipment for aligning the antennas:

- Binoculars for viewing the antenna at the remote site.
- Compass to determine the direction of the remote antenna. You usually need a compass when the remote site is not visible from the local site. You should use the compass in conjunction with a topographic map that shows relative positions and elevations of the area. Remember to use a compass only in areas away from metal objects or structures.

You can use *Global Positioning System* (GPS) tools to pinpoint locations of the two antenna sites. GPS tools are especially useful when sites are not within visible range. They can be used in conjunction with a compass. GPS tools consist of portable devices as well as mapping software that runs in computers.

Chapter 7. Regulatory Compliance Information

For U.S. and international regulatory compliance information for the Intel® PRO/Wireless 2011/2011B LAN, see the Regulatory Specifications posted on the Intel customer support website at <http://support.intel.com>.

Important Regulatory Compliance Instructions

If your country is listed on the regulatory labels included with the Intel® PRO/Wireless 2011/2011B LAN hardware, remove the label for your country and attach it to the bottom of the device in the space provided. Failure to apply the label for the appropriate country constitutes a breach of law.

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