

PROGRAMMING EXAMPLES

In this chapter we will demonstrate how to program the ESTeem Model 195Ep for each of the operating modes. For a detailed explanation of the modes, please refer to Chapter 1 of this manual. In the following examples we assume that the modems have been initially configured for IP Address, Net Mask, etc. and are ready for programming from the Model 195Ep's Web Configuration Manager's Setup Menu. The first example network in Figure 1 consist of two wired Ethernet networks (Large Plant LAN and Remote Building) that will be bridged together through a repeater site and have a direct backup pathway. This same wireless mesh canopy will provide wireless access to the single PLC on the forklift (Example 4).

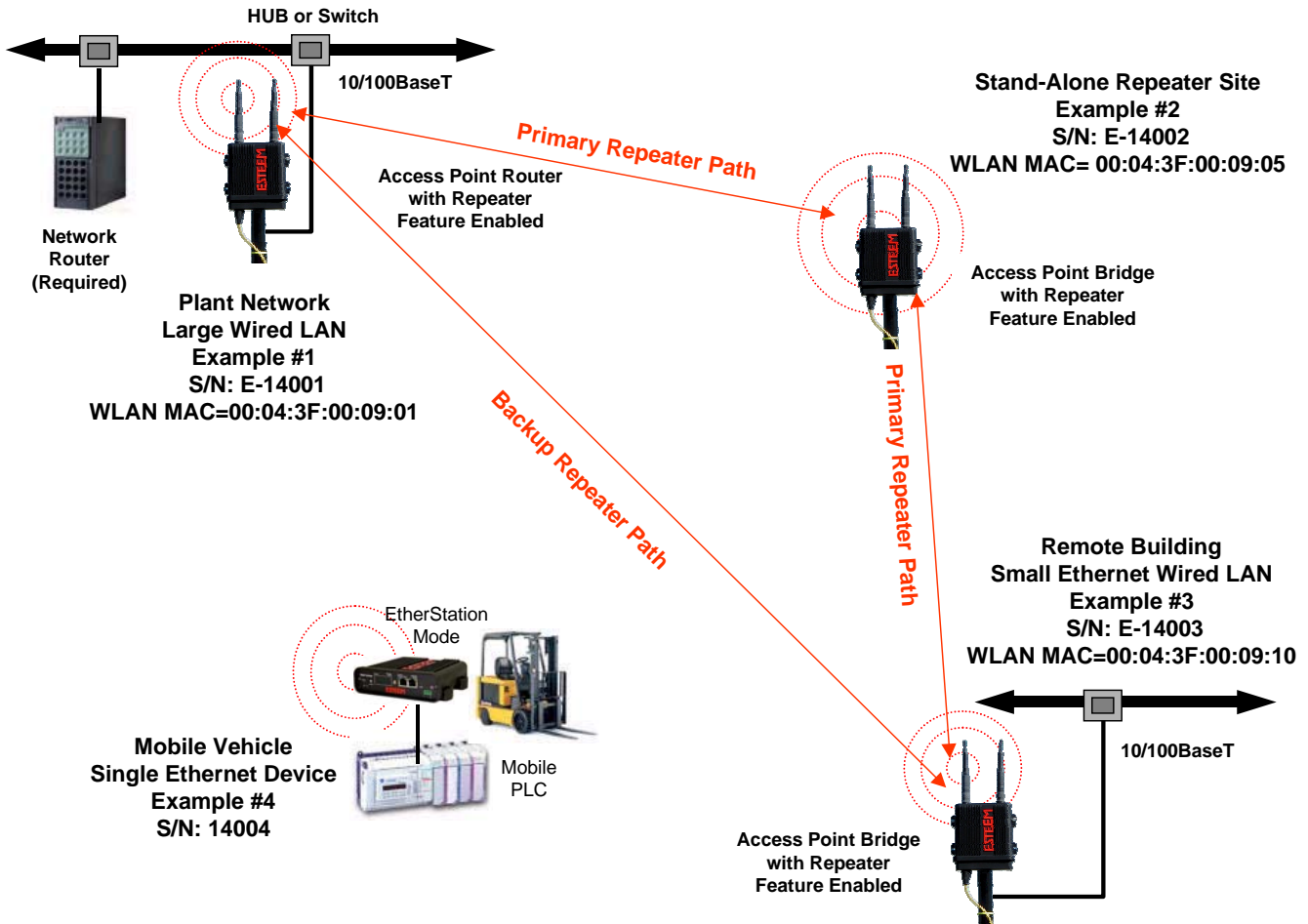


Figure 1: Programming Example #1 Diagram

The second example network in Figure 2 show how to configure the Model 195Ep if multiple Ethernet devices are connected to a single ESTeem Model 195Ep. A separate network address for the connected hardware is required and can be configured for fixed or dynamic IP (DHCP) addressing. The use of multiple network addresses will require that a network router be programmed for each of the remote devices. As we learned in Chapter 1 of this manual, the difference in the Station Router and the Station Masquerade Mode will depend upon the required availability of accessing the connected Ethernet devices to the 195Ep. The Station Router will allow devices on the Ethernet LAN to access these device and the Station Masquerade will not, very similar to a firewall.

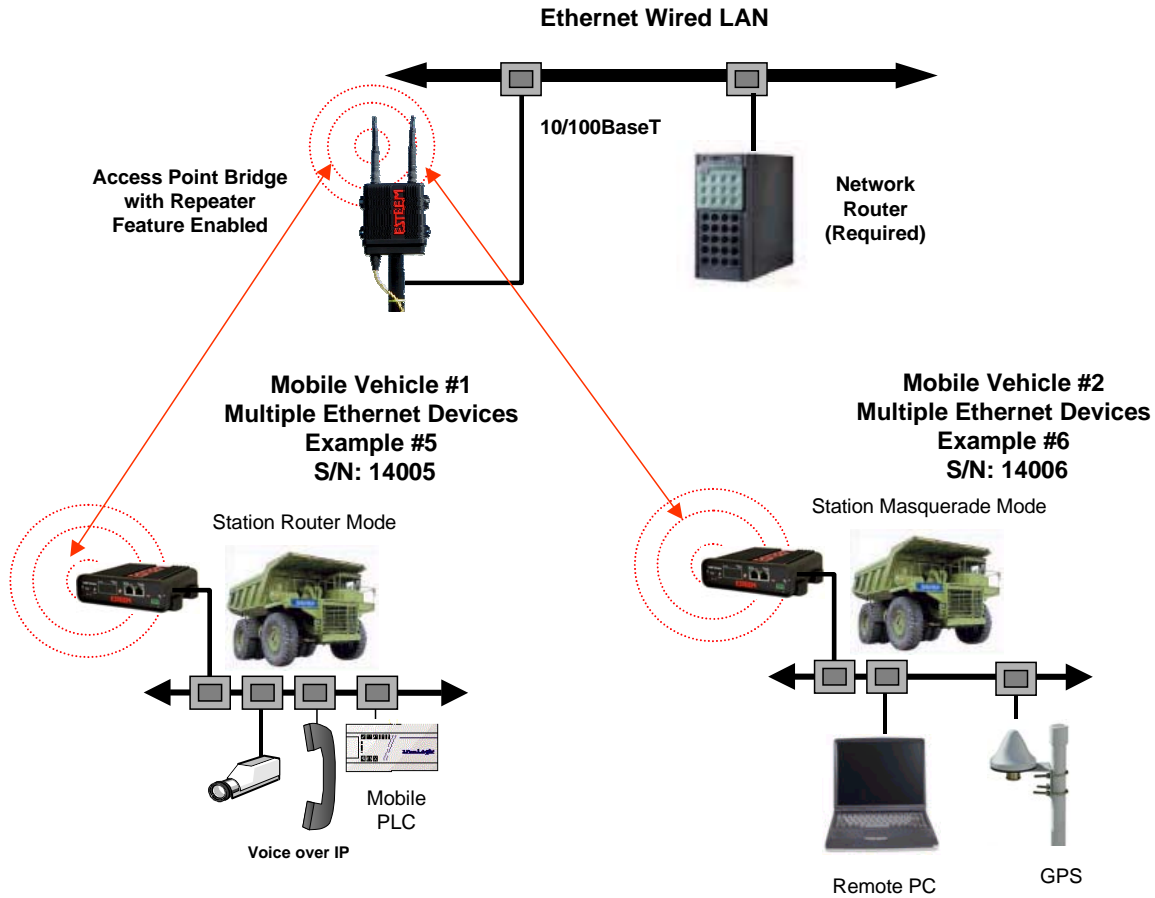


Figure 2: Programming Example #2 Diagram

Documentation

The first step when configuring your wireless system will be to document each Model 195Ep used in the network. The following is an example of the System Configuration Table (Chapter 2 – Starting Out) completed for the two example applications:

Modem_ID(Name) /Operating Mode	Serial Number	IP Address	Ethernet MAC	WLAN MAC
Plant Network AP_Router	E-14001	Ethernet 172.17.2.1 Wireless 172.16.2.1	00:04:3f:00:09:02	00:04:3f:00:09:01
Repeater AP_Bridge	E-14002	Bridge 172.16.2.5	00:04:3f:00:09:06	00:04:3f:00:09:05
Remote Building AP_Bridge	E-14003	Bridge 172.16.2.10	00:04:3f:00:09:11	00:04:3f:00:09:10
Forklift EtherStation	E-14004	N/A	00:04:3f:00:09:21	00:04:3f:00:09:20
Truck #1 Station Router	E-14005	Wireless 172.16.2.20 Ethernet 172.18.1.1	00:04:3f:00:09:26	00:04:3f:00:09:25
Truck #2 Station Masquerade	E-14006	Wireless 172.16.2.30 Ethernet 172.19.1.1	00:04:3f:00:09:31	00:04:3f:00:09:30

Table 1: Example System Configuration Table

Example 1 – Plant Network (Access Point Router with Repeater Enabled)

The ESTeem Model 195Ep configured as an Access Point Router will provide a separation between the larger Plant network and the Ethernet devices connected on the wireless network. This mode of operation is most often used when connecting the wireless system to a larger network to eliminate the Network broadcast traffic from entering the wireless system. If Ethernet devices on the Plant network want to access Ethernet devices on the wireless network, a network router is required to resolve the IP conflict created by having the wired and wireless networks on separate subnets.

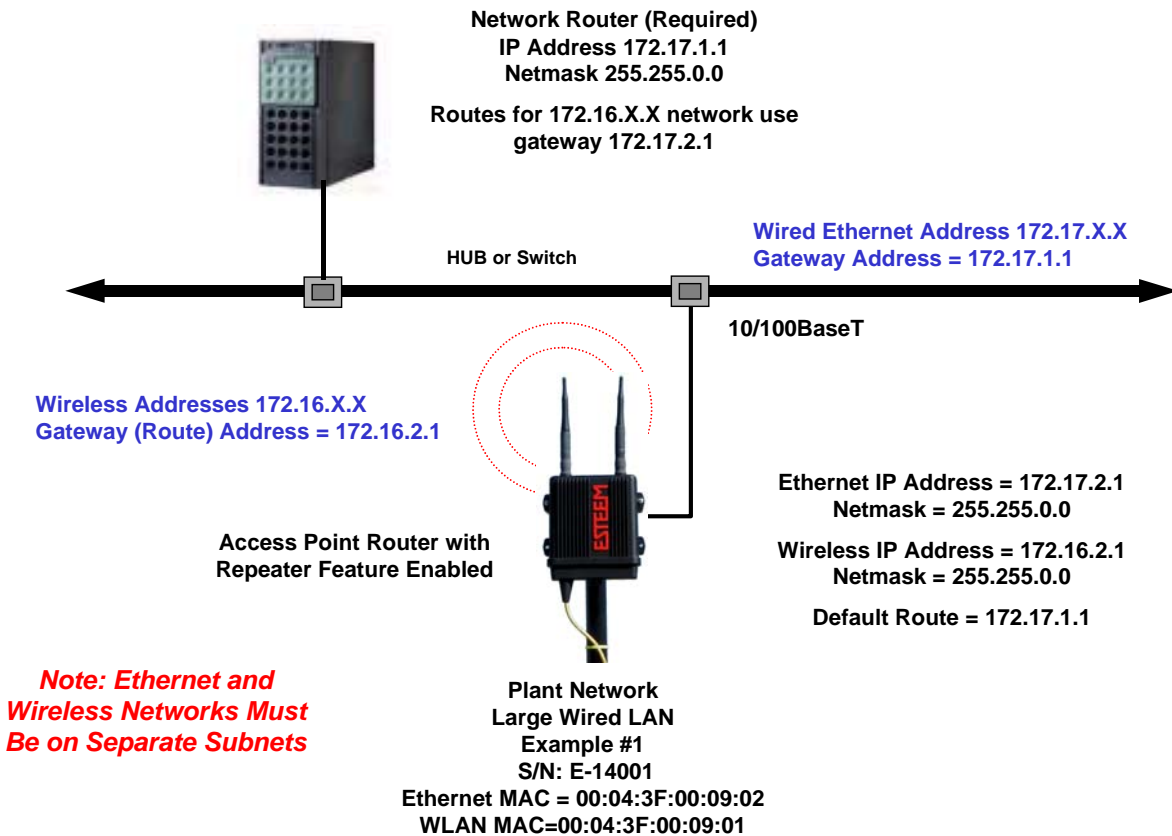


Figure 3: Access Point Router IP Addressing Example

1. Access the ESTeem Web page using your computer’s Web Browser as per instructions in Chapter 4. Select Setup from the menu items. From the Select Mode of Operation pull down box , select AP Router (Figure 4) and push the Next button below the pull down box.

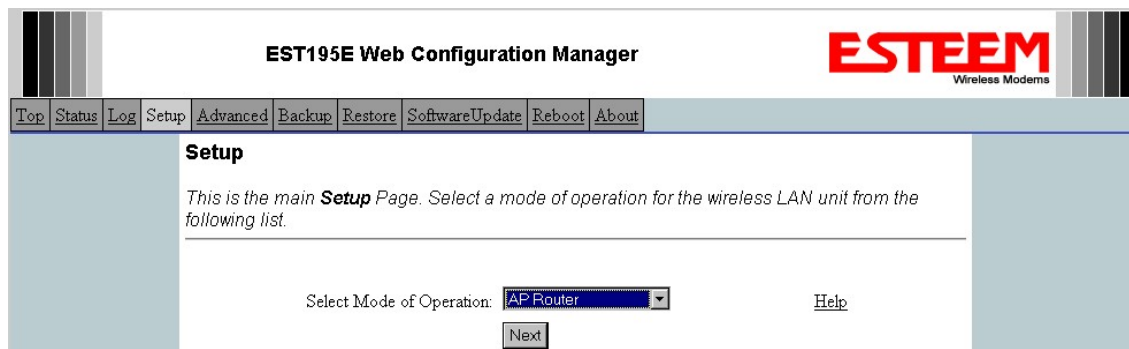


Figure 4: Access Point Router Setup Screen

Note: Throughout the Configuration Manager are Help Screens that can accessed for further information on each item.

2. Select if you want to use client or server Dynamic Host Configuration Protocol (DHCP) for the **Ethernet** device. If you want to enter a static IP address for the Model 195Ep, select Off and press the *Next* button. For our example, we have fixed IP addresses and will select Off. For more information on the operation and configuration of DHCP, please refer to Appendix C – Interface Ports. Reference Figure 5.

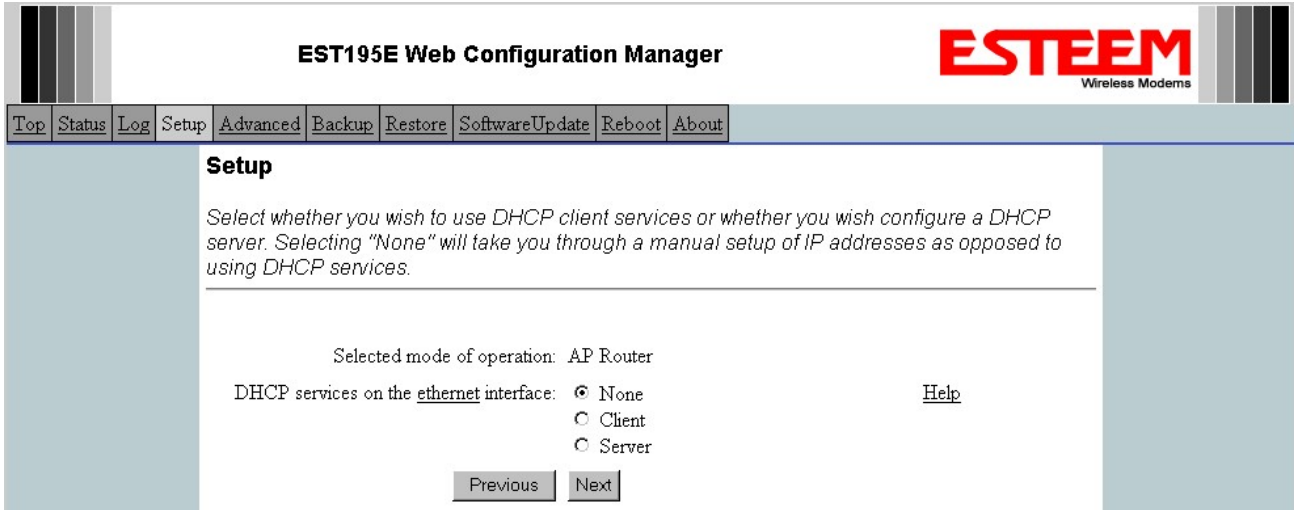


Figure 5: DHCP Ethernet Port

3. Refer to the site documentation (Table 1) and enter the IP Address and IP Netmask for the Model 195Ep on the **Ethernet** port. Reference Figure 6.

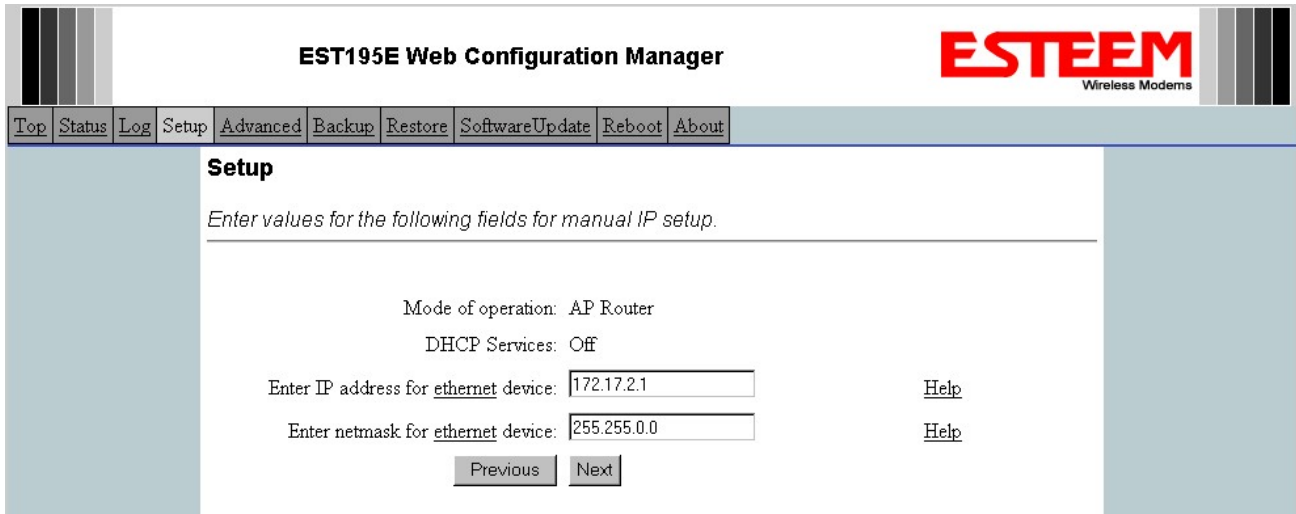


Figure 6: Ethernet IP Addressing

4. Select if you want to use client or server Dynamic Host Configuration Protocol (DHCP) for the **Wireless** device. If you want to enter a static IP address for the Model 195Ep, select Off and press the *Next* button. For our example, we have fixed IP addresses and will select Off. For more information on the operation and configuration of DHCP, please refer to Appendix C – Interface Ports. Reference Figure 7.

The screenshot shows the 'EST195E Web Configuration Manager' interface. At the top, there is a navigation menu with buttons for 'Top', 'Status', 'Log', 'Setup', 'Advanced', 'Backup', 'Restore', 'SoftwareUpdate', 'Reboot', and 'About'. The 'Setup' button is highlighted. The main content area is titled 'Setup' and contains the following text: 'Select whether you wish to use DHCP client services or whether you wish configure a DHCP server. Selecting "None" will take you through a manual setup of IP addresses as opposed to using DHCP services.' Below this, it states 'Selected mode of operation: AP Router' and 'DHCP services on the wireless bridge interface: None', ' Client', and ' Server'. There are 'Previous' and 'Next' buttons at the bottom, and a 'Help' link on the right.

Figure 7: DHCP Wireless Port

5. Refer to the site documentation (Table 1) and enter the IP Address and IP Netmask for the Model 195Ep on the **Wireless** port. Reference Figure 8.

The screenshot shows the 'EST195E Web Configuration Manager' interface. At the top, there is a navigation menu with buttons for 'Top', 'Status', 'Log', 'Setup', 'Advanced', 'Backup', 'Restore', 'SoftwareUpdate', 'Reboot', and 'About'. The 'Setup' button is highlighted. The main content area is titled 'Setup' and contains the following text: 'Enter values for the following fields for manual IP setup of the wireless bridging device.' Below this, it states 'Mode of operation: AP Router' and 'DHCP Services: Off'. There are two input fields: 'Enter IP address for wireless bridge device: 172.16.2.1' and 'Enter netmask for wireless bridge device: 255.255.0.0'. There are 'Previous' and 'Next' buttons at the bottom, and 'Help' links on the right.

Figure 8: Wireless IP Address

6. Enter the default route (Gateway) address for the network. This AP Router 195Ep will use the Network Router for address resolution (Figure 3). Enter the IP address for the Network Router and any DNS server information. If you are not connecting the Model 195Ep to the Internet, leave blank and press the *Next* button. Figure 9.

The screenshot shows the 'Setup' page of the ESTEEM Web Configuration Manager. The page title is 'EST195E Web Configuration Manager' and the ESTEEM logo is in the top right. A navigation menu includes 'Top', 'Status', 'Log', 'Setup', 'Advanced', 'Backup', 'Restore', 'SoftwareUpdate', 'Reboot', and 'About'. The 'Setup' section is active. Below the title, there is a sub-header 'Setup' and a descriptive text: 'Enter values for the following fields to set up the default route and DNS settings'. The form contains the following fields and options:

- Mode of operation: AP Router
- Enter default route IP address: [Help](#)
- Use DNS client services? Yes No [Help](#)
- Enter DNS domain: [Help](#)
- Enter primary DNS server IP address: [Help](#)
- Enter secondary DNS server IP address: [Help](#)

At the bottom of the form are 'Previous' and 'Next' buttons.

Figure 9: Wireless Security Level Settings

7. Select *Yes* if you will be using security for client access to your wireless network (recommended).

NOTE: The setting of this security level is ONLY for client access to the Model 195Ep. The security of the Bridge communication between the Model 195Ep's is separate and will be configured during the repeater configuration.

Enter the SSID for your network. The SSID is the unique identification for your wireless network and all 195Ep that share a wireless network MUST have the same SSID code. This identification code is case sensitive and must NOT contain spaces. Reference Figure 10.

The screenshot shows the 'Setup' page of the ESTEEM Web Configuration Manager. The page title is 'EST195E Web Configuration Manager' and the ESTEEM logo is in the top right. A navigation menu includes 'Top', 'Status', 'Log', 'Setup', 'Advanced', 'Backup', 'Restore', 'SoftwareUpdate', 'Reboot', and 'About'. The 'Setup' section is active. Below the title, there is a sub-header 'Setup' and a descriptive text: 'In the following fields, select whether you want wireless security features turned on and enter the service set identifier (SSID) that will be common to all wireless LAN devices.' The form contains the following fields and options:

- Selected mode of operation: AP Router
- Turn on wireless security features? Yes No [Help](#)
- Enter the SSID: [Help](#)

At the bottom of the form are 'Previous' and 'Next' buttons.

Figure 10: WEP Key Entry

8. Select the encryption level for the wireless client access to the network. For further information on the different levels of security, please refer to Appendix E – Security of this User’s Manual. If you would like to hide the SSID from broadcasting from the Access Point and would like to discard the broadcast probes select **Yes**. If Yes is selected the Model 195Ep will no longer send out periodic SSID radio beacons. The users of the network will have to know the SSID to enter the network and security is increased, but if you want the SSID to be broadcast to the network for easy identification then select **No**. In our example, we will be using mobile clients with 128 bit WEP. Reference Figure 11.

The screenshot shows the 'EST195E Web Configuration Manager' interface. At the top right is the ESTEEM logo with 'Wireless Modems' underneath. A navigation bar contains links: Top, Status, Log, Setup, Advanced, Backup, Restore, SoftwareUpdate, Reboot, and About. The 'Setup' section is active, displaying the title 'Setup' and the instruction: 'Enter/select values for the following fields to set up wireless security features.' Below this, there are two main configuration options: 'Select an encryption type:' with radio buttons for None, WEP 64-bit, WEP 128-bit (selected), WPA PSK, and WPA Enterprise; and 'Hide Beacon SSID and Discard Broadcast Probes?' with radio buttons for Yes and No (selected). Each option has a 'Help' link. At the bottom are 'Previous' and 'Next' buttons.

Figure 11: Security Selection

9. Enter the WEP key values for your application that will be used by all devices on the wireless network. Reference Figure 12.

The screenshot shows the 'EST195E Web Configuration Manager' interface. At the top right is the ESTEEM logo with 'Wireless Modems' underneath. A navigation bar contains links: Top, Status, Log, Setup, Advanced, Backup, Restore, SoftwareUpdate, Reboot, and About. The 'Setup' section is active, displaying the title 'Setup' and the instruction: 'Enter 13 hexadecimal bytes, separated by colons, for each of the following 128-bit WEP keys and select which key should be used as the default WEP key. These values are effective for all wireless LAN devices.' Below this, the encryption type is shown as '128-Bit WEP for ALL wireless LAN devices'. There are four input fields for 'Enter WEP Key 1' through 'Enter WEP Key 4', each with the label '(13 hex bytes):' and a text box containing the example value '11:22:33:44:55:66:77:88:99:00:aa:bb:cc'. A 'Help' link is next to the first field. At the bottom, there is a 'Select the default WEP key:' section with radio buttons for WEP Key 1 (selected), WEP Key 2, WEP Key 3, and WEP Key 4. A 'Help' link is next to this section. At the bottom are 'Previous' and 'Next' buttons.

Figure 12: WEP Key Input Screen

10. Enter the values for the Access Control List (ACL). This is a configurable MAC filter that can be set to allow or deny specific wireless MAC address to the network. This feature is further explained in Appendix E – Security. In our example we will not use the ACL. Reference Figure 13.

The screenshot shows the 'Setup' page of the EST195E Web Configuration Manager. The page title is 'EST195E Web Configuration Manager' with the ESTEEM Wireless Modems logo. A navigation bar includes links for Top, Status, Log, Setup, Advanced, Backup, Restore, SoftwareUpdate, Reboot, and About. The main content area is titled 'Setup' and contains the following text: 'Enter the appropriate values in the fields below for configuring MAC Address Authentication. If **allow_all** is selected, the MACs in the access control list are ignored.' Below this, it says 'Choose one of the following MAC address authentication modes:' followed by three radio button options: 'allow_all' (selected), 'allow only those client MACs in the list below', and 'deny only those client MACs in the list below'. A 'Help' link is next to the first option. There is an input field for 'Enter MAC address:' and an 'Add MAC to Access Control List' button. Below that is an 'Access Control List' list box, a 'Remove MAC' button, and a 'Remove ALL MACs' button. A note explains: 'To remove a MAC address from the access control list, select the MAC to remove and click the **Remove MAC** button. To remove all MAC addresses from the list, click the **Remove ALL MACs**.' At the bottom are 'Previous' and 'Next' buttons.

Figure 13: Access Control List Settings

11. Select the frequency channel of operation. All Access Points in the same Repeater Peer network need to be on the same radio frequency channel. See Appendix D – Radio Configuration for help in selecting the frequency channel. Reference Figure 14.

The screenshot shows the 'Setup' page of the EST195E Web Configuration Manager. The page title is 'EST195E Web Configuration Manager' with the ESTEEM Wireless Modems logo. A navigation bar includes links for Top, Status, Log, Setup, Advanced, Backup, Restore, SoftwareUpdate, Reboot, and About. The main content area is titled 'Setup' and contains the following text: 'Select the channel for the wireless LAN device to operate on. The first displayed number in the list is the channel, and the second is the channel frequency in MHz.' Below this is a 'Select a channel:' dropdown menu showing '6 (2437 MHz)'. A 'Help' link is next to the dropdown. At the bottom are 'Previous' and 'Next' buttons.

Figure 14: Radio Channel Selection

12. The Repeater Peer Table (Figure 15) identifies which Model 195Ep’s will bridge wireless Ethernet communication. Only other Access Point Repeaters need to be listed not the Model 195Ep’s in client modes. Multiple links to the same destination will provide a backup pathway (Mesh Network) if the primary pathway is lost. Looking at the system layout in Figure 1, both the repeater site and the direct link will be listed. Using the System Configuration Table (Table 1) as a guide, enter the Wireless (WLAN) MAC address for the 195Ep’s that will communicate with the Access Point Router (Example 1) starting with the primary repeater path through the stand-alone repeater.

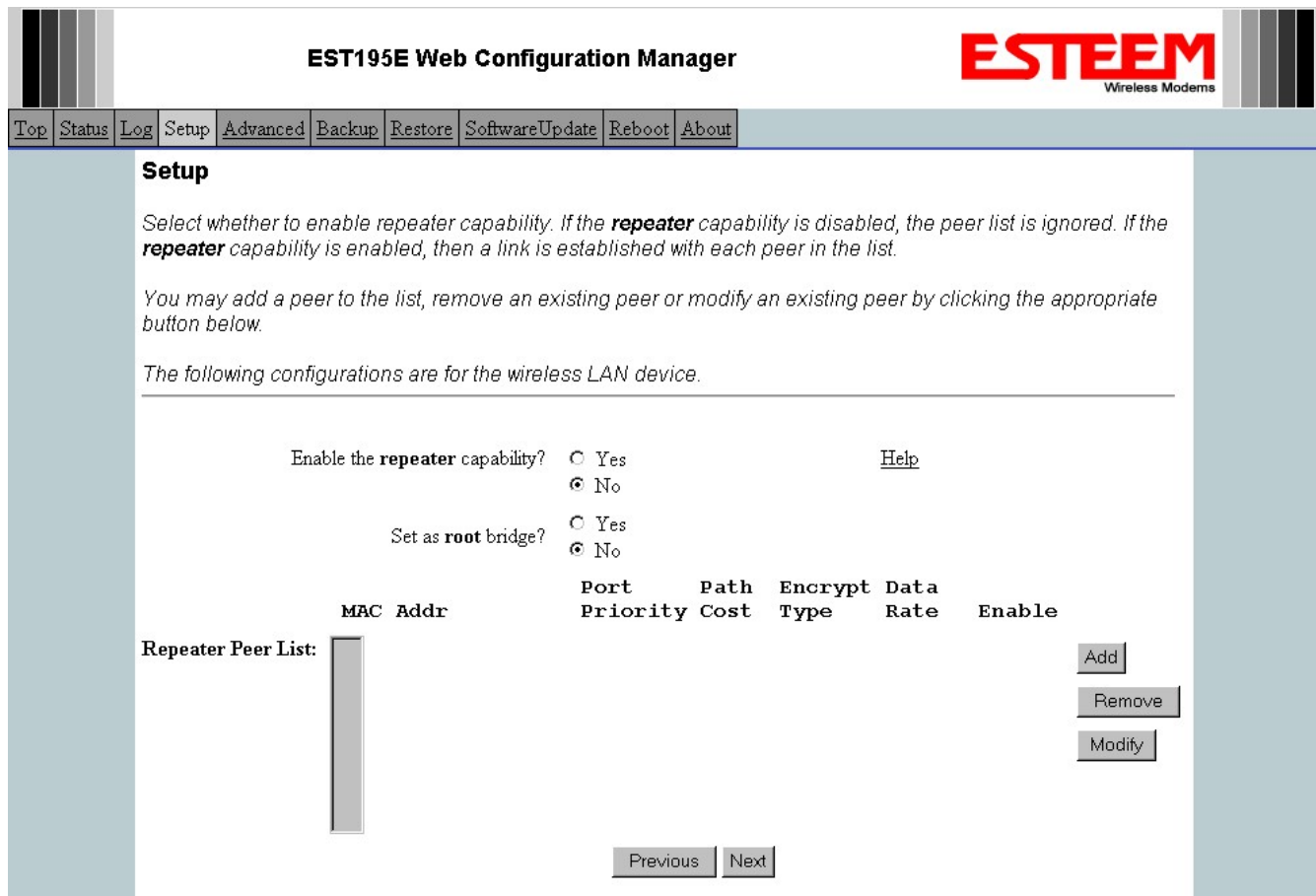


Figure 15: Blank Repeater Table

The communication link through repeater site is the best radio path from the Plant Network to the Remote Building and we want this link to be the primary repeater route. The 195Ep follows the same networking “rules” as any other Ethernet device and if we made no changes to the default path cost of 100 the lowest path cost would be directly to the Remote Building (Direct = 100, Repeater = 200 (100+100)). To configure the 195Ep to select the repeater as the primary radio path, the direct link’s path cost must be greater than the cost through the repeater link (any number greater than 200). We will set the path cost at 201 for the direct link, making the repeater link a lower path cost and thus the primary pathway. Press the *Add* button to enter the first repeater link to the Repeater Peer List and Figure 16 will be displayed.

Note: For a more complete description on configuring repeater routes, see Chapter 6 – Repeating Features.

First Repeater Link -

Enter the **Wireless (WLAN) MAC** address of the stand-alone repeater site and the path cost for this link will stay at the default value at 100. Select the level of Encryption for this communication link. The encryption levels for the repeater peer link must be the same on both sides, but is completely independent from the Encryption level for the client access to the network. For consistency in our example, we will also use 128-Bit WEP Encryption for the Repeater Peer link. Setting the link data rate to Dynamic will allow all data rates from 1 Mbps to 54 Mbps to be used. Verify the Repeater Link is set to Enable and press the *Create Repeater Peer Button*.

EST195E Web Configuration Manager

Top Status Log Setup **Advanced** Backup Restore SoftwareUpdate Reboot About

Setup - Add a Repeater Peer

To add a new repeater peer for the first wireless LAN interface, enter the MAC address, the port priority, the port cost, the key type, the key and the rate set and click the "Create Repeater Peer" button.

Enter the MAC address:

Enter the port path cost:

Select the encryption type: None
 WEP 64-bit
 WEP 128-bit
 TKIP

Enter the encryption key:

Select link data rate:
1 Mbps
2 Mbps
5.5 Mbps
6 Mbps
9 Mbps

Enable link: Enable
 Disable

Enter the 48-bit MAC address of the repeater peer.

Enter the bridge port path cost for this link. (1-65535)

Select the repeater link encryption method. Note: the encryption method and key setting must be the same on both repeater peers.

Enter the encryption key as a sequence of hexadecimal bytes (e.g. 0a:0b:1c:2d:3e). Key length: None=0 bytes, WEP64=5 bytes, WEP128=13bytes, TKIP=32 bytes.

Allow dynamic rate selection or select a specific data rate for this link to use. It is recommended, but not required, that the rate selections be the same on both peers.

Enable or disable the repeater peer link. Enable must be selected for the repeaters to communicate.

Figure 16: First (Primary) Repeater Link

Second Repeater Link (Direct Path) -

Press the Add button a second time (Figure15) and Figure 17 will be displayed. Enter the Wireless (WLAN) MAC address of the Remote Building and set the path cost for this link to a value of 201. Select the level of Encryption for this communication link. The encryption levels for the repeater peer link must be the same on both sides, but is completely independent from the Encryption level for the client access to the network. For consistency in our example, we will also use 128-Bit WEP Encryption for the Repeater Peer link. Setting the link data rate to Dynamic will allow all data rates from 1 Mbps to 54 Mbps to be used. Verify the Repeater Link is set to Enable and press the *Create Repeater Peer Button*.

EST195E Web Configuration Manager **ESTEEM**
Wireless Modems

Top | Status | Log | Setup | **Advanced** | Backup | Restore | Software Update | Reboot | About

Setup - Add a Repeater Peer

To add a new repeater peer for the first wireless LAN interface, enter the MAC address, the port priority, the port cost, the key type, the key and the rate set and click the "Create Repeater Peer" button.

Enter the MAC address: <input type="text" value="00:04:3f:00:09:10"/>	Enter the 48-bit MAC address of the repeater peer.
Enter the port path cost: <input type="text" value="201"/>	Enter the bridge port path cost for this link. (1-65535)
Select the encryption type: <input type="radio"/> None <input type="radio"/> WEP 64-bit <input checked="" type="radio"/> WEP 128-bit <input type="radio"/> TKIP	Select the repeater link encryption method. Note: the encryption method and key setting <u>must</u> be the same on <u>both</u> repeater peers.
Enter the encryption key: <input type="text" value="11:22:33:44:55:66:77:88:99"/>	Enter the encryption key as a sequence of hexadecimal bytes (e.g. 0a:0b:1c:2d:3e). Key length: None=0 bytes, WEP64=5 bytes, WEP128=13bytes, TKIP=32 bytes.
Select link data rate: <input type="text" value="Dynamic"/> <input type="text" value="1 Mbps"/> <input type="text" value="2 Mbps"/> <input type="text" value="5.5 Mbps"/> <input type="text" value="6 Mbps"/> <input type="text" value="9 Mbps"/>	Allow dynamic rate selection or select a specific data rate for this link to use. It is recommended, but not required, that the rate selections be the same on both peers.
Enable link: <input checked="" type="radio"/> Enable <input type="radio"/> Disable	Enable or disable the repeater peer link. Enable must be selected for the repeaters to communicate.

Figure 17: Second (Backup) Repeater Link

Figure 18 displays the complete repeater peer list with both repeater peer entries. Set Enable repeater capability to *Yes* and to both repeater paths. This Access Point Router 195Ep is also the primary data path for all Ethernet traffic on the network and will also need to be configured as the Root Bridge. Press the *Next* button to continue.

The screenshot shows the 'Setup' page in the ESTEEM Web Configuration Manager. It includes instructions on enabling repeater capability and a table of Repeater Peer List entries. The table has columns for MAC Addr, Port Priority, Path Cost, Encrypt Type, Data Rate, and Enable. Two entries are listed with MAC addresses 00:04:3f:00:09:05 and 00:04:3f:00:09:10, both with priority 128 and path cost 100 and 201 respectively. The 'Enable' column is set to 'true' for both. Navigation buttons for 'Previous' and 'Next' are visible at the bottom.

MAC Addr	Port Priority	Path Cost	Encrypt Type	Data Rate	Enable
00:04:3f:00:09:05	128	100	WEP128	Dynamic	true
00:04:3f:00:09:10	128	201	WEP128	Dynamic	true

Figure 18: Completed Repeater Peer List

13. Figure 19 will be displayed. If no further changes are necessary to the modem, you can commit the changes that will then be saved and the modem rebooted.

The screenshot shows the 'Commit Changes' page in the ESTEEM Web Configuration Manager. It includes instructions on committing changes and a row of navigation buttons: 'Previous', 'Commit Changes', 'Go To Advanced Setup', and 'Cancel'.

Figure 19: Commit Changes

Example 2 – Stand Alone Repeater (Access Point Bridge with Repeater Enabled)

Review the example diagram, Figure 1, and locate the 195Ep marked as Example #2. This ESTeem is being used by two other Model 195Ep's as a repeater but is not connected to an Ethernet network. This modem should be configured for Access Point Bridge mode.

1. Access the ESTeem Web page using your computer's Web Browser as per instructions in Chapter 4. Select Setup from the menu items. From the Select Mode of Operation pull down box, select AP Bridge (Figure 20) and push the *Next* button below the pull down box.

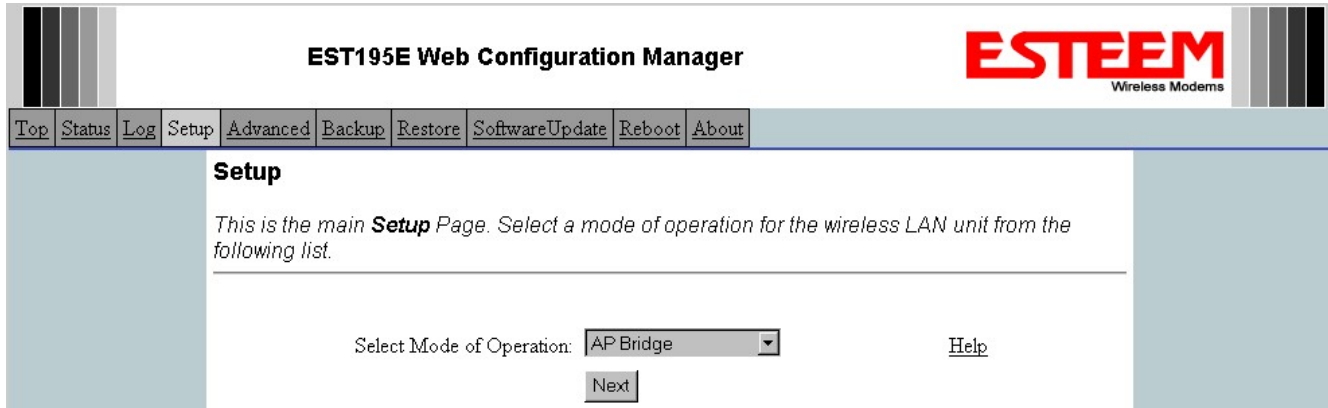


Figure 20: Access Point Bridge

2. Select if you want to use client or server Dynamic Host Configuration Protocol (DHCP) for the 195Ep. If you want to enter a static IP address for the Model 195Ep, select Off and press the Next button. For our example, we have fixed IP addresses and will select Off. Reference Figure 21.

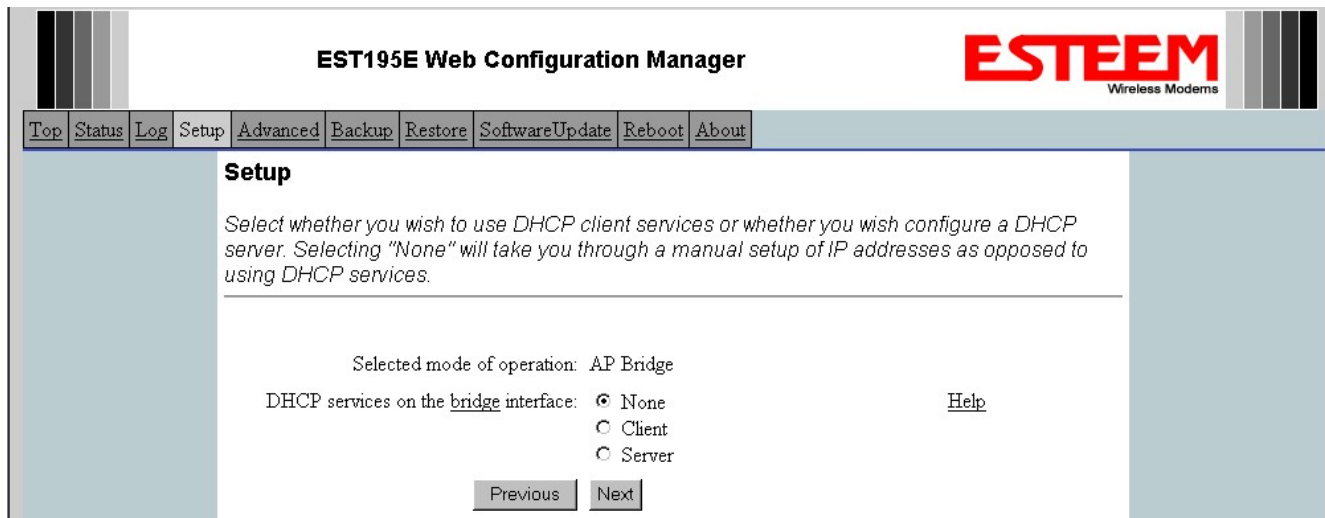


Figure 21: DHCP Configuration