

The ESTeem 195Eg is now available with an optional factory installed serial port that can provide RS-232 communication between two or more serial devices using the wireless broadband link. The serial data is encapsulated and transferred as a standard Ethernet packet over an operating 195Eg wireless Ethernet system. The configuration for a serial 195Eg network will be the same as an Ethernet or a serial (RS-232) based communication network.

The serial interface option can be used to link two or more serial devices in a new or existing system. The serial data has very little impact on the network bandwidth and will allow for both Ethernet and serial applications simultaneously. A few possible applications would be installation of the 195Eg in an existing serial based network that was looking for future upgrade to an Ethernet based system. Another would be using the high-bandwidth Ethernet connections to provide a link to remote video hardware but also provide a serial link to the existing PLC in a SCADA type application.

SERIAL CONNECTIONS

The RJ-45 serial data port is the far-left port on face of the 195Eg (Figure 1). Using the ESTeem AA0621 interface cable, the 195Eg can be connected to a standard DTE-device (PC) with a male 9-pin Sub-D connector. The complete cable configuration is available in Appendix C – Interface Ports.

Second Ethernet Port

Installation of the serial option also includes installing a second 10/100 Base-T Ethernet interface. This second Ethernet port can be used to Bridge to the first Ethernet port (ETH_0) and the wireless link to work as a two-port HUB when configured in the AP Bridge mode. This second Ethernet port can also be configured as Router port between the wireless and the first Ethernet port in AP Router mode (Figure 2).

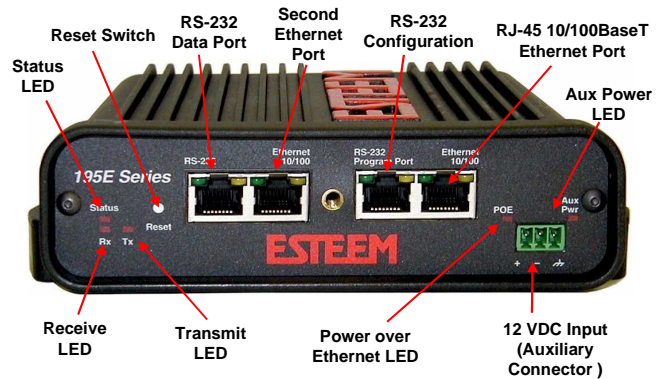


Figure 1: 195Eg Front Panel Overview

AP Bridge Mode

In the AP Bridge mode, both Ethernet ports (ETH_0 and ETH_1) and the wireless port (WLAN_0) are configured for a common subnet and share a common IP address.

AP Router Mode

In the AP Router mode, the two Ethernet ports (ETH_0 and ETH_1) will be on separate subnets. The primary Ethernet port (ETH_0) is configured for Subnet A. The secondary Ethernet port (ETH_1) is bridged to the Wireless port (WLAN_0), sharing an IP address and configured for Subnet B.

If desired, the secondary Ethernet Port (ETH_1) can be configured for a 3rd subnet (i.e. subnet C). This requires advanced configuration and routing tables specific to the particular networks.

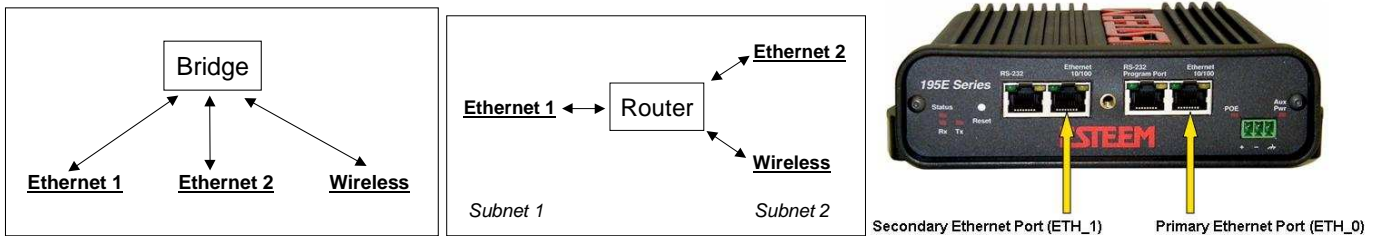


Figure 2: Bridge and Router Configuration for Ethernet Ports

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Setup

Select whether you want to enable the redirector for the external serial port device. If you choose to enable the redirector, then configure the remainder of the settings on the page.

Enable the serial data port? Yes No [Help](#)

Select the mode: Full Redirector Mode Terminal Server Mode [Help](#)

Select the baud rate: 2400 baud 4800 baud 9600 baud 19200 baud 38400 baud 57600 baud 115200 baud [Help](#)

Select the number of data bits: 7 8 [Help](#)

Select the number of stop bits: 1 2 [Help](#)

Select the parity: Even Odd None [Help](#)

Select the serial flow control: Hardware Software None [Help](#)

Enter the maximum bridge links for multicast packets (1-255): [Help](#)

Enter the destination IP address for the serial packets (multicast address for multipoint system): [Help](#)

Enter the serial IP port number (1024-64535): [Help](#)

Enter the maximum packet size in bytes (1-1024): [Help](#)

Enter the number of milliseconds (10-10000) of silence for packetization: [Help](#)

Select whether to use delimiter character 1: Yes No [Help](#)

Enter delimiter character 1 (00-ff hex): [Help](#)

Select whether to use delimiter character 2: Yes No [Help](#)

Enter delimiter character 2 (00-ff hex): [Help](#)

Enter whether the terminal server should read/generate modem control lines: Yes No [Help](#)

Figure 3: Serial Configuration Screen

SERIAL CONFIGURATION

Configuration of the serial port is completed during the standard setup of the 195Eg. After completion of the Repeater Peer configuration screen, the Serial Port Setup screen (Figure 3) will be displayed. Each section in the Serial Port Setup screen is described in detail with the following:

Enable the RS-232 Data Port

Enabling the serial data port allows the modem to send RS-232 data over the broadband wireless connection established with the ESTEem repeater peers. The modem can be configured in a point-to-point or point-to-multipoint system. Select Yes if you wish to enable the serial data port.

Mode of Operation

There are two distinct modes of operation for the serial port in the 195Eg. The Redirector mode will provide two-way serial communication between two or more serial devices, while the Terminal Server mode will allow serial communication to a specific remote site by connecting through telnet or SSH. Select one of the following modes of operation:

Full Redirector Mode - This mode allows bi-directional RS-232 data communication with another ESTeem. The RS-232 data transmission will appear transparent to the connected devices as if a serial cable is connected between the two ports. This mode will also be used in a multi-point serial network where all serial devices will need bi-directional communication (Figure 4).

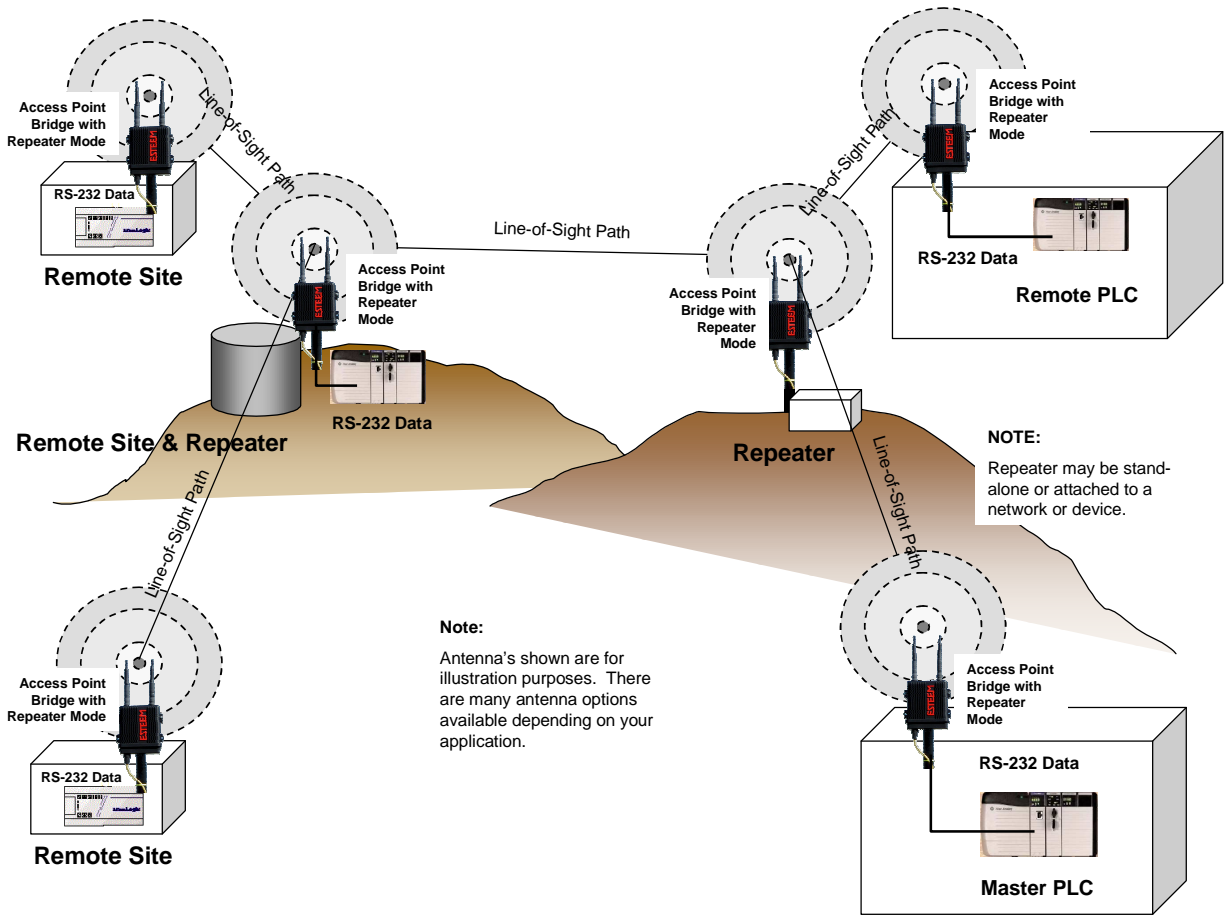


Figure 4: Serial Full Redirector Example

Terminal Server Mode - This mode of operation translates RS-232 serial data into a network-oriented terminal protocol, such as telnet or SSH. This mode would be selected if an interactive RS-232 session at remote locations is desired over the wireless Ethernet link (Figure 5).

Baud Rate

Select the data rate of the RS-232 connection to match your serial device.

Data Bits

Select the number of data bits on the RS-232 connection to match your serial device.

Stop Bits

Select the number of stop bits on the RS-232 connection to match your serial device.

Parity

Select the parity of the RS-232 connection to match your serial device.

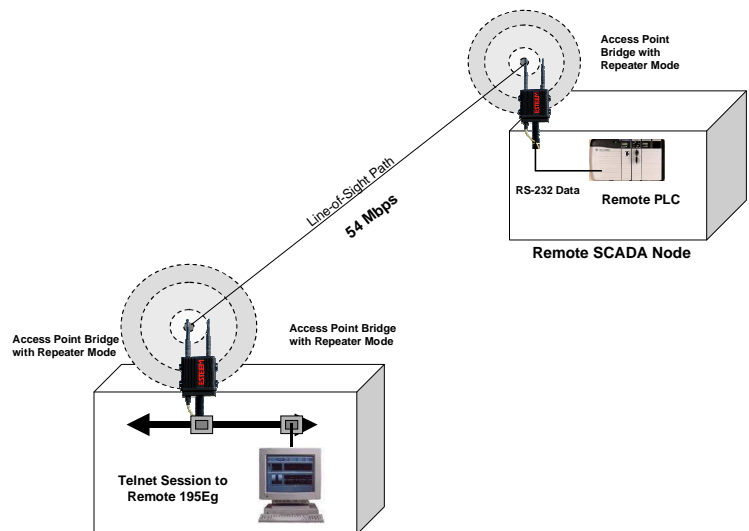


Figure 5: Terminal Server Example

Flow Control

Select the type of data flow control used on the RS-232 connection. The ESTeem can support Hardware flow control (RTS/CTS control lines) or Software Flow Control (XON/XOFF). Select None if no serial flow control is necessary.

Maximum Bridge Links for Multicast Packets

This value sets the maximum number of Ethernet bridge links that the multicast packets will be sent through when used in a multi-point system. A multi-point serial network uses multicast packets (UDP) to send the data to more than one remote ESTeem. You want to limit the number of network bridge links that these UDP packets will be passed through to make the network more efficient.

If you are using multiple ESTeem repeater links to send the serial data to remote locations, the value for the maximum bridge link needs to be increased to a number greater than the longest repeater chain. For example, if you are using four repeater (peer) links to send the serial data between two or more sites the number will need to be five (5) or greater (Figure 4).

Destination IP Address

The ESTeem configured for the correct destination IP and port number will send and receive the serial data from another modem. Set the destination IP address for the ESTeem where the serial data will be sent. If sending to more than one ESTeem (Multipoint) set to a multicast address (i.e 224.0.0.1).

Note: If you are using the ESTeem 195Eg in a multipoint application (multicast), you must have default Gateway configured in the ESTeem set to the IP address of the Root Bridge modem.

Serial IP Port Number

The ESTeem configured for the correct destination IP and port number will send and receive the serial data from another modem. Set the IP port numbers to match where the serial data will be sent. The serial data will not be sent if both the IP address and port number are not correct.

Maximum Packet Size

This number represents the maximum size of the serial data packet in bytes. If the number of bytes of data in the serial port buffer exceeds the maximum packet size before the timer or delimiter character is reached, the ESTeem will send forward the serial packet. For example, if the maximum packet size is set to a value of 100, when the serial port receives 100 bytes the data will be sent through the wireless connection.

Number of Milliseconds for Packetization

This number represents the time the ESTeem will hold data in the serial data buffer before sending to the remote ESTeem. This feature is generally used if the serial data does not have a consistent packet length or delimiter character. For example, if the number of milliseconds is set to a value of 10 the ESTeem will monitor the incoming serial data stream and any break in characters longer than 10 milliseconds will cause the data will be sent through the wireless connection.

Delimiter Characters

Enabling and specifying a delimiter character will transmit the data in the serial buffer when the delimiter character is recognized in the serial data stream. There are two unique delimiter characters that can be configured and enabled independently.

Terminal Server Control Lines

Enabling this feature will allow the ESTeem in the Terminal Server mode to read and generate modem control lines to the connected device.

To increase the wireless network's area of coverage for both indoor and outdoor applications, the ESTeem 195Eg utilizes a custom repeating feature that allows increased coverage areas without the added expense of hard cabling or adding an additional point to point radio link. With a conventional IEEE 802.11g or 802.11b Access Point (AP) network, all of the APs have to be interfaced to a common network either by hardwire, see Figure 1, or a separate, dedicated RF backbone. The Model 195Eg can create this RF backbone, bridge Ethernet networks connected to the wired Ethernet port and provide the wireless canopy for 802.11 clients simultaneously.

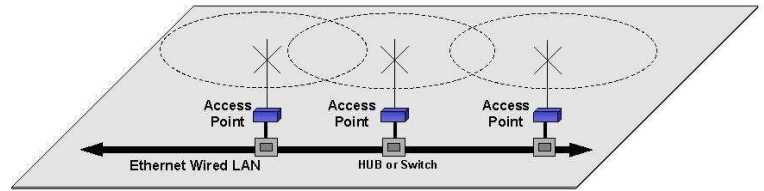


Figure 1: Conventional Access Point Diagram

When programmed in any of the three Access Point (AP) Repeater Modes, the Model 195Eg will create a wireless network with other Model 195Eg units in radio range that are programmed in the AP Repeater Peer table during setup. This feature adds the increased functionality of repeaters to the typical Ethernet Bridge configuration.

ESTEEM MESH NETWORK

One of the most powerful features of the AP Repeater Mode is the ability to input multiple communication routes and designate the priority for each of these routes to create a wireless Mesh network. The ESTeem Model 195Eg will automatically change communication routes in the network if a route has failed. The new route will be based upon the priority level set during configuration. This wireless Meshing technology allows the RF network to “self-heal” if any of the communication paths fail.

The routing priority is manually set during the configuration of the 195Eg. A manual path configuration is far superior to standard “self-discovery” networks, because you have direct control over the best RF paths and can easily identify any failed routes for easy troubleshooting. For example, Figure 2 shows a typical wireless Ethernet system used in the Water/Waste Water Industry. The problem with a standard “self-discovery” Mesh network is the selection of routes. Notice that the communication between the Water Plant (Site A) and Pump Site D has a marginal link, but it is the most direct route between the Ethernet devices.

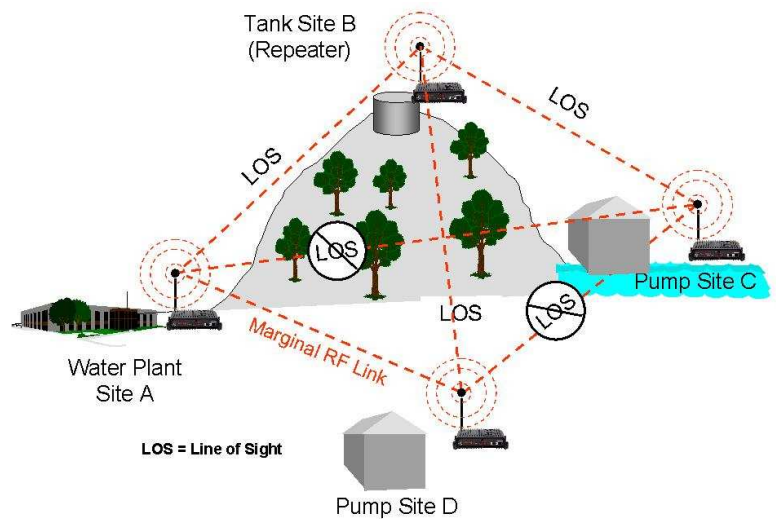


Figure 2: Small Mesh Network Diagram

This scenario poses the question, which path will the network select? The ESTeem Mesh Network takes out the guessing games by allowing the user to select and prioritize all communication routes in the system. In our example we would want the primary link to go through Tank B (Repeater) and use the direct link only if this primary link fails. The following sections will show how this completed.

Configuration

The configuration of the repeater paths is completed during setup of the Access Point modes. All three Access Point modes support repeating and Meshing features. Figure 3 shows an example repeater peer table from the setup menus. For an ESTeem 195Eg to communicate with another ESTeem 195Eg, *Yes* must be selected at the “Enable Repeater Capability.” Next, the Wireless LAN (WLAN) MAC address of each Model 195Eg that will have direct communications must be added to the Repeater Peer List.

Finally, *enabling the link* allows the corresponding 195Eg to be included in the communication routing. Mobile clients do not require input in the repeater peer table. If multiple Mesh routes are configured, you will also need to set the values for Priority and Path Costs (explained in Spanning Tree below). For multiple examples of repeater configurations, please refer to Chapter 5 of this user's manual.

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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 48-bit MAC address of the repeater peer.*

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

Select the encryption type: None WEP 64-bit WEP 128-bit TKIP *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: *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: *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: Enable Disable *Enable or disable the repeater peer link. Enable must be selected for the repeaters to communicate.*

Figure 3: Repeater Configuration Example

SPANNING TREE PROTOCOL (STP)

The ESTeem Model 195Eg uses standard Ethernet Spanning Tree Protocol (STP) to determine the radio routing structure of the wireless network. The primary purpose of STP is to make sure that "network loops" are not created. A network loop is having two communication paths to the same destination where the remote device would receive the same data multiple times. If there were no way to control the data flow, this data would be constantly passed around this loop causing a "packet storm" that would shut down the entire network. The Spanning Tree Protocol will block all these redundant links.

The STP operation begins by determining which Ethernet device on the network will be the Root Bridge. All Ethernet networks have a Root Bridge that is selected by the lowest MAC address. All path costs are evaluated against this Root Bridge device to determine routing and which paths will be blocked. On a wired Ethernet network, the location of the Root Bridge is not really important, but in a wireless network selection of the Root Bridge is critical to the wireless network routing. Let's use one of the Example network diagrams from Chapter 5 to continue the discussion (Figure 4).

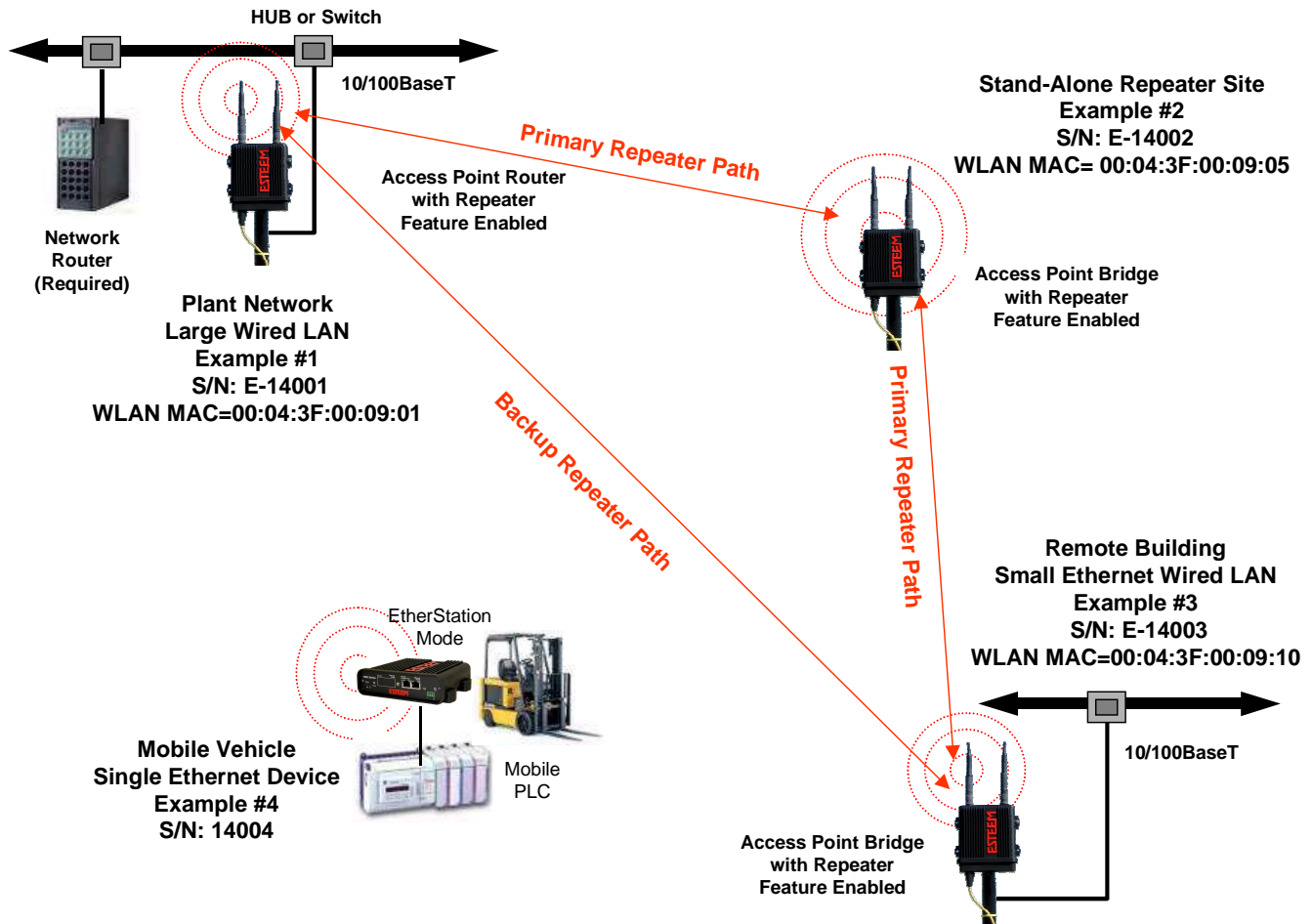


Figure 4: Programming Example #1 Diagram

The following sections describe the process of the STP in the ESTeem Model 195Eg as how it would happen in the above example.

Learning Phase - Once properly configured, each Model 195Eg will begin to search out the other Model 195Eg units in radio range that are programmed in the AP Repeater Peer table. All Model 195Eg's will calculate their routes to every Model 195Eg in the network based upon the lowest "path cost" to the Root Bridge. Path cost is the total cost of transmitting a packet through the wireless network to the Root Bridge. **Note:** *The Root Bridge in a network should be the Model 195Eg where the majority of the data flow is processed.* In every wireless network of two or more radios, the Root Bridge should be user defined. If not defined, the ESTeem 195Eg with the lowest MAC address will be designated as the Root Bridge.

In Figure 4, the Plant network (Example 1) is the most logical location for the Root Bridge based upon the amount of data flow. Setting this site as the root bridge is discussed below in Root Bridge.

Blocking and Forwarding Phase – To ensure you do not have a network loop situation due to redundant paths in your wireless network, the Model 195Eg will recognize and disable (block) one or more redundant links and provide back up links should the primary link fail. This establishes a wireless mesh network with a series of forwarding links, based upon the shortest path cost to the Root Bridge.

For example, looking at Figure 4, the Remote Building has two routes to the Root Bridge (Plant Network – Example #1); directly to the site and through the repeater. The direct link between the two sites is the shortest route (lowest Path Cost) and will be selected as the primary route unless overridden by manually changing the Path Cost in the configuration.

Path Cost

If more than one communication path to the Root Bridge is found, the 195Eg must determine which route to take based upon the lowest Path Cost. The default path cost to all links in the 195Eg network is 100. If the Path Costs are equal then the lowest MAC address will determine the priority route. In the ESTeem Mesh Network we want to directly control all data flow so do **not** want the routes to be automatically determined.

Looking again at our Example in Figure 4, if we made no changes to the default path cost of 100 (note values in Figure 3) the lowest path cost would be direct from the Remote Building to the Root Bridge (Plant Network).

Link Description	Number of Routes	Total Path Cost
Direct from Remote Building	1	100
Remote Build to Root Bridge Through Repeater	2	200

To configure the 195Eg to select the repeater as the primary radio path, set the path cost value for the direct link greater than 200 to make this the primary radio path. The lowest path cost will identify the highest priority. The Model 195Eg will use this routing, but also switch to direct communication if the repeater were to disappear.

Root Bridge

In any Access Point Repeater network consisting of more than two sites, one Model 195Eg should be designated as the Root Bridge. Only one Model 195Eg can be designated as the Root Bridge in a given network and should be located where the majority of the Ethernet data flow is processed. This site may be the Master location in a SCADA network or could be configured at a repeater site. Selection is important because all Model 195Eg's NOT configured as the Root Bridge will choose routing based upon the Path Cost to the Root Bridge. If you have any question as to which site in your AP Repeater application should be the Root Bridge, contact ESTeem Customer Support at 509-735-9092 or e-mail your application to support@esteem.com.

The Root Bridge will be selected in one of two ways: the Root Bridge can be manually set (recommended) during the configuration of the Repeater Peer table (Figure 3) **or** the Root Bridge designation will default to the lowest MAC address of all the Model 195Eg's in the network. The manual Root Bridge configuration is located in the "Advanced Settings" section.

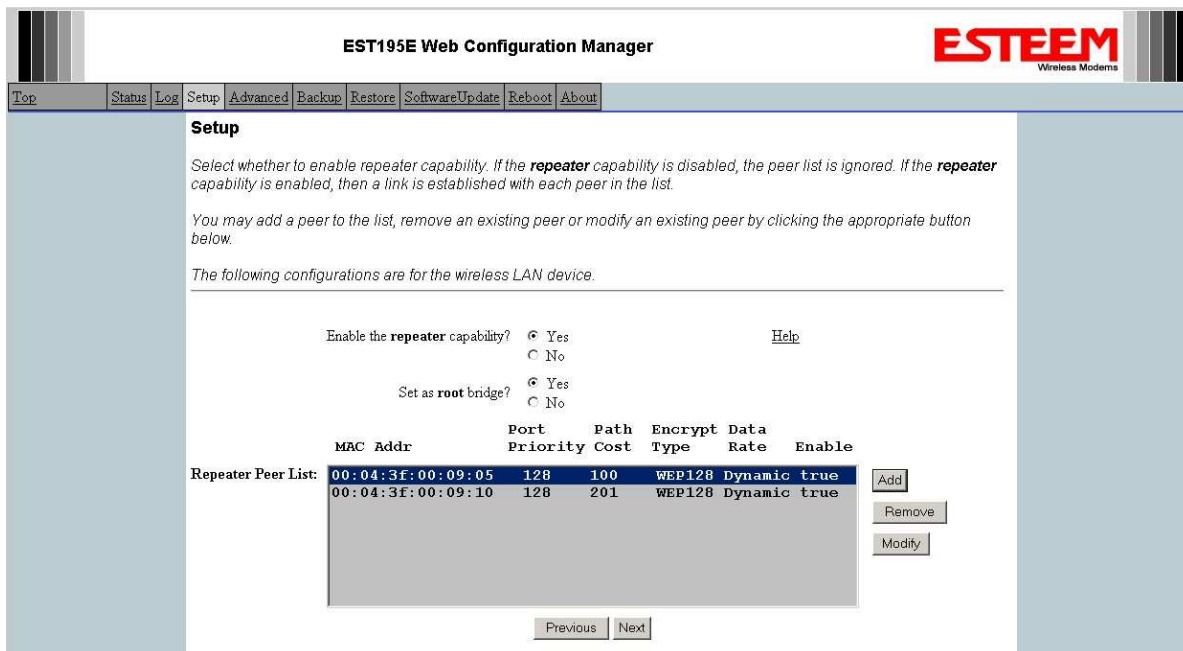


Figure 3: Repeater Configuration Example

Redundant Backup

The ESTeem Model 195Eg configured in Access Point Repeater mode will automatically function as a redundant backup if two Model 195Eg's are installed at the same location (Figure 7). If two Model 195Eg's are connected to the same HUB or Switch, one of the Model 195Eg's will be **Blocked** when the Spanning Tree Protocol is completed. The network will continue to use this route until any problem with the original Model 195Eg is detected and the second Model 195Eg will begin operation at that site.

Redundant Master Configuration – The configuration in Figure 7 will also provide a redundant backup for the Master Site (Root Bridge). Configure both Model 195Eg's as Root Bridges (see above) giving the primary Root Bridge a value of 1 and the secondary Root Bridge a value of 2.

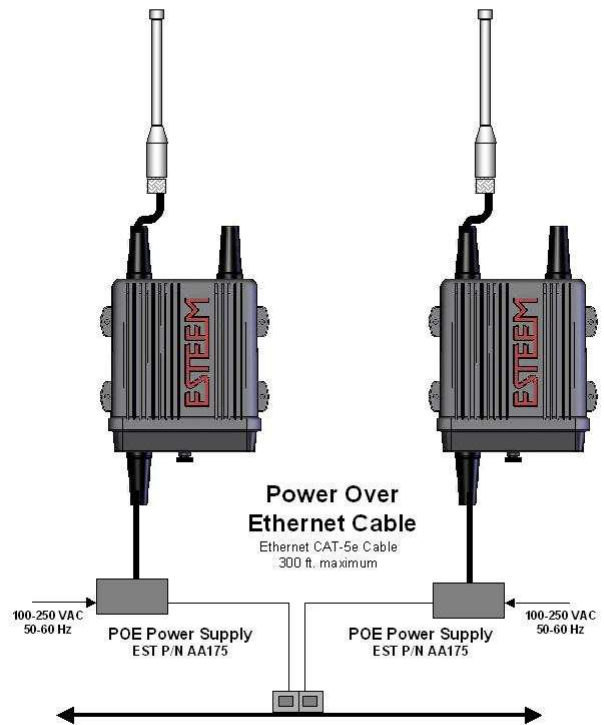


Figure 7: Redundant Backup Diagram