245/945 Ethernet Modem Training

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Overview

- Modem Range
- Operation
- Configuration
- Radio Channels
- Meshing - Roaming
- Serial I/O
- Diagnostics
- Accessories

Applications

Transport

- Variable Speed signs
- Overhead Road condition signs
- Traffic Camera Monitoring

Mining

- Mine face failure detection
- Vehicle engine monitoring
- Stacker / Reclaimer operation
- Well head monitoring

Manufacturing

- Assembly line control
- Packaging line
- Unmanned cart control

Outside the square

- Control of props for movie production
- Operation of Mascots at special events
- Army Tank Target control

Mining

- Mining Redundancy

- PLC Connectivity for operations

Roaming / Moving Equipment

- Bomb Disposal Control

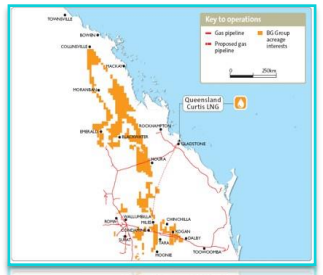
- Offshore Loading Control & Monitoring

Oil & Gas

- Floating Production & Storage Offloading

Coal Seam Gas Extraction

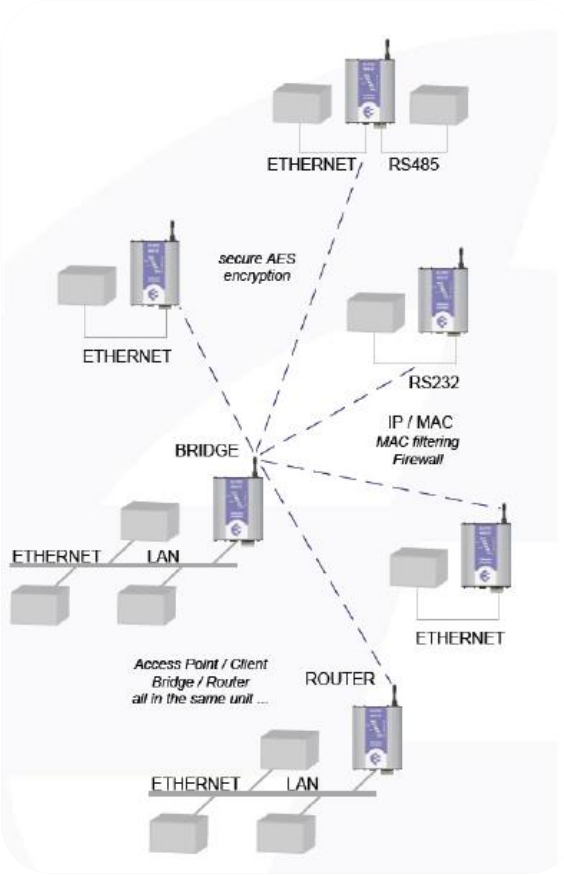


GAS WELLHEADS

Critical monitoring and control of Gas Well Head in Coal Seam Gas project in Queensland, Australia

- Automation “islands” of PLC, sensors, flowmeter, and communications
- Wireless Ethernet
- Low port count switches
- Backhaul via 3G / Monitoring



Wireless Ethernet




Features	Older narrow band 400/869/900Mhz	Wide Band 900Mhz	802.11 b/g 2.4GHz	802.11a 5GHz
Models	450/805/905U-E	945U-E	245U-E-G1	245U-E-A
Makeup	• Wireless Ethernet Modem • RJ45, RS232 & RS485 Connections • Access Point, Client, Bridge or Router • Modbus I/O Server • WDS Repeater functionality for all wide band & 802.11 radios • I/O Expansion capability with 115S Expansion I/O • High Radio TX Power, Excellent Sensitivity for industrial applications			

Wireless Ethernet

	450U-E	945U-E	245U-E-G	245U-E-A
Radio	400MHz Band	900MHz	2.4GHz	5GHz
Max Data Rate	19.2Kbps	54Mbps	54Mbps	54Mbps
Encryption	WPA	WEP,WPA1 & 2	WEP, WPA 1&2	WEP, WPA1&2
RS232 & RS485	√	√	√	√
Modbus I/O Server	√	√	√	√
WDS	√	√	√	√
AP / CL	√	√	√	√
Bridge / Router	√	√	√	√
TX Power	5W	630mW	400mW	400mW

Key Features

- Wireless Ethernet Modem
- 400MHz Fixed Frequency Band 5W Radio
- Up to 19.2Kbps Radio Data Rate*
- Excellent Receiver Sensitivity
- Suitable for long distance applications & noisy environments
- Long range 50km LOS

Wireless Ethernet

	905U-E	**945U-E**	245U-E-G	245U-E-A
Radio	900MHz FHSS	**900MHz**	2.4GHz	5GHz
Max Data Rate	200Kbps	**54Mbps**	54Mbps	54Mbps
Encryption	64bit, 128AES	**WEP,WPA1 & 2**	WEP, WPA 1&2	WEP, WPA1&2
RS232 & RS485	√	**√**	√	√
Modbus I/O Server	√	**√**	√	√
WDS		**√**	√	√
AP / CL	√	**√**	√	√
Bridge / Router	√	**√**	√	√
TX Power	1W	**630mW**	400mW	400mW

Key Features

- Wireless Ethernet Modem
- 900Mhz DSSS/OFDM 630mW Radio
- Up to 54Mbps Radio Data Rate
- WDS Meshing / Redundancy functionality
- Optional channel widths to overcome congested environments
- Suitable for high bandwidth applications & noisy environments
- Long range 9km

Wireless Ethernet

	945U-E	245U-E-G	245U-E-A
Radio	900MHz	**2.4GHz**	5GHz
Max Data Rate	54Mbps	**54Mbps**	54Mbps
Encryption	WEP,WPA1 & 2	**WEP, WPA 1&2**	WEP, WPA1&2
RS232 & RS485	√	**√**	√
Modbus I/O Server	√	**√**	√
WDS	√	**√**	√
AP / CL	√	**√**	√
Bridge / Router	√	**√**	√
TX Power	630mW	**400mW**	400mW

Key Features

- Wireless Ethernet Modem
- 2.4GHz, DSSS/OFDM 802.11b/g radio
- Up to 54Mbps Radio Data Rate
- Standard and optional channel widths to avoid congested environments
- WDS – Meshing / Redundancy functionality
- Add analog or discrete I/O with 115S Expansion
- Range 5+KM LOS

Wireless Ethernet

	945U-E	245U-E-G	245U-E-A
Radio	900MHz	2.4GHz	**5GHz**
Max Data Rate	54Mbps	54Mbps	**54Mbps**
Encryption	WEP,WPA1 & 2	WEP, WPA 1&2	**WEP, WPA1&2**
RS232 & RS485	√	√	**√**
Modbus I/O Server	√	√	**√**
WDS	√	√	**√**
AP / CL	√	√	**√**
Bridge / Router	√	√	**√**
TX Power	630mW	400mW	**400mW**

Key Features

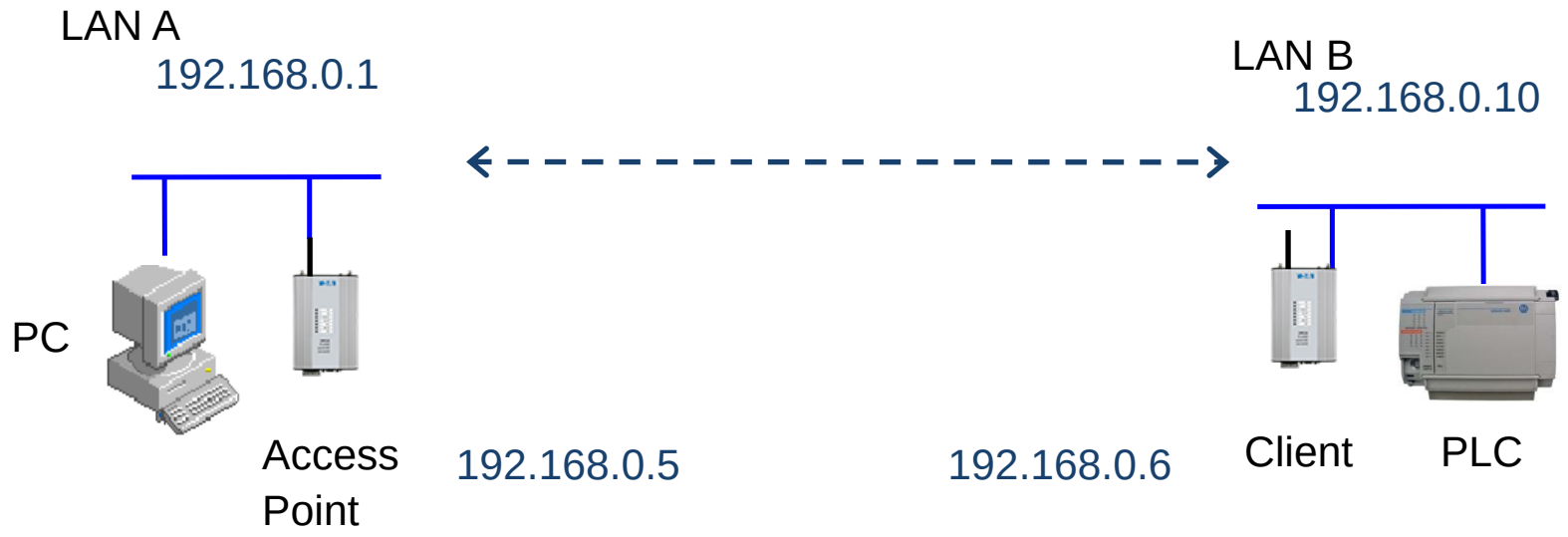
- Wireless Ethernet Modem
- 5GHz, OFDM 802.11a radio
- Up to 54Mbps Radio Data Rate
- Non overlapping radio channels for more separation
- WDS – Meshing / Redundancy functionality
- Add analog or discrete I/O with 115S Expansion
- Range 5+ KM LOS

Access Point - Client

- Access Point:
- Allows Connections from Remote Clients.
- Must have an Access Point in Wireless System to operate
- Typically referred to as the Master Radio
- Normally located at destination for Applications
- All Repeaters are configured as Access Points
- Access Points set the Radio Channel for System

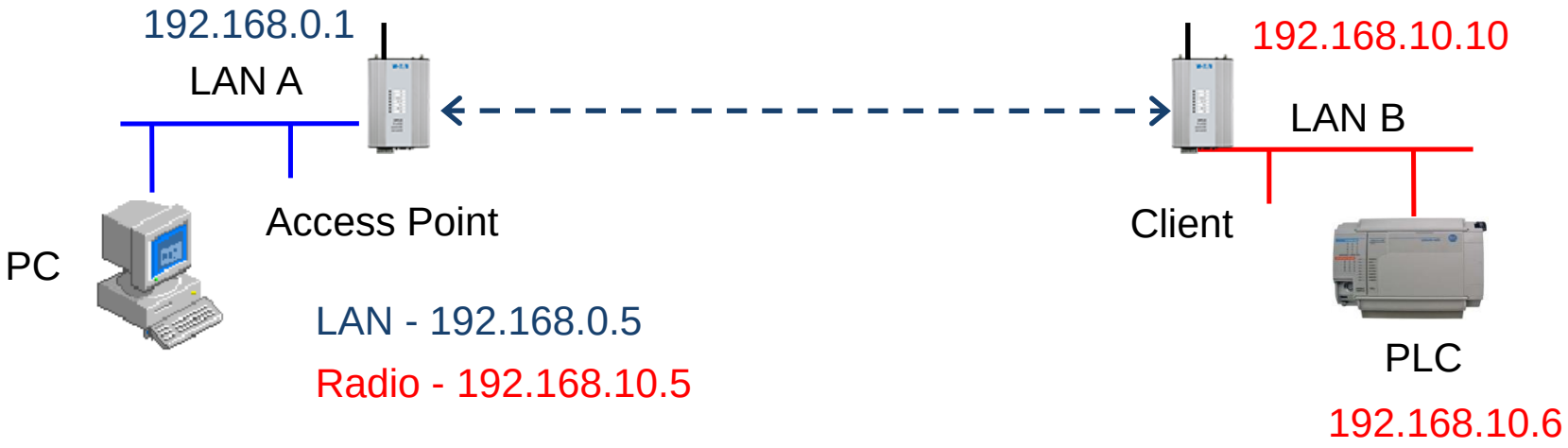
- Client:
- Clients can only connect to an Access Point.
- Clients scan for Access Points across all channels
- Clients can not communicate directly to another Client
- Typically referred to as the Slave Radio.
- Normally located at remote sites for Application
- Roaming (moving) equipment are typical Client devices

Bridge Network



- Bridge:
  - Extension of same network IP Addressing (LAN A &B)
  - IP Address same network range as LAN A & B
  - Most common network configuration (↑ 90%)
  - Simple configuration

Router Network



- Router:
  - Joining of different network IP ranges
  - Modem Wireless IP & Ethernet port IP Address different network range on Router radio
  - Less common network configuration (↓ 10%)
  - Advanced Configuration, understanding of networking required.

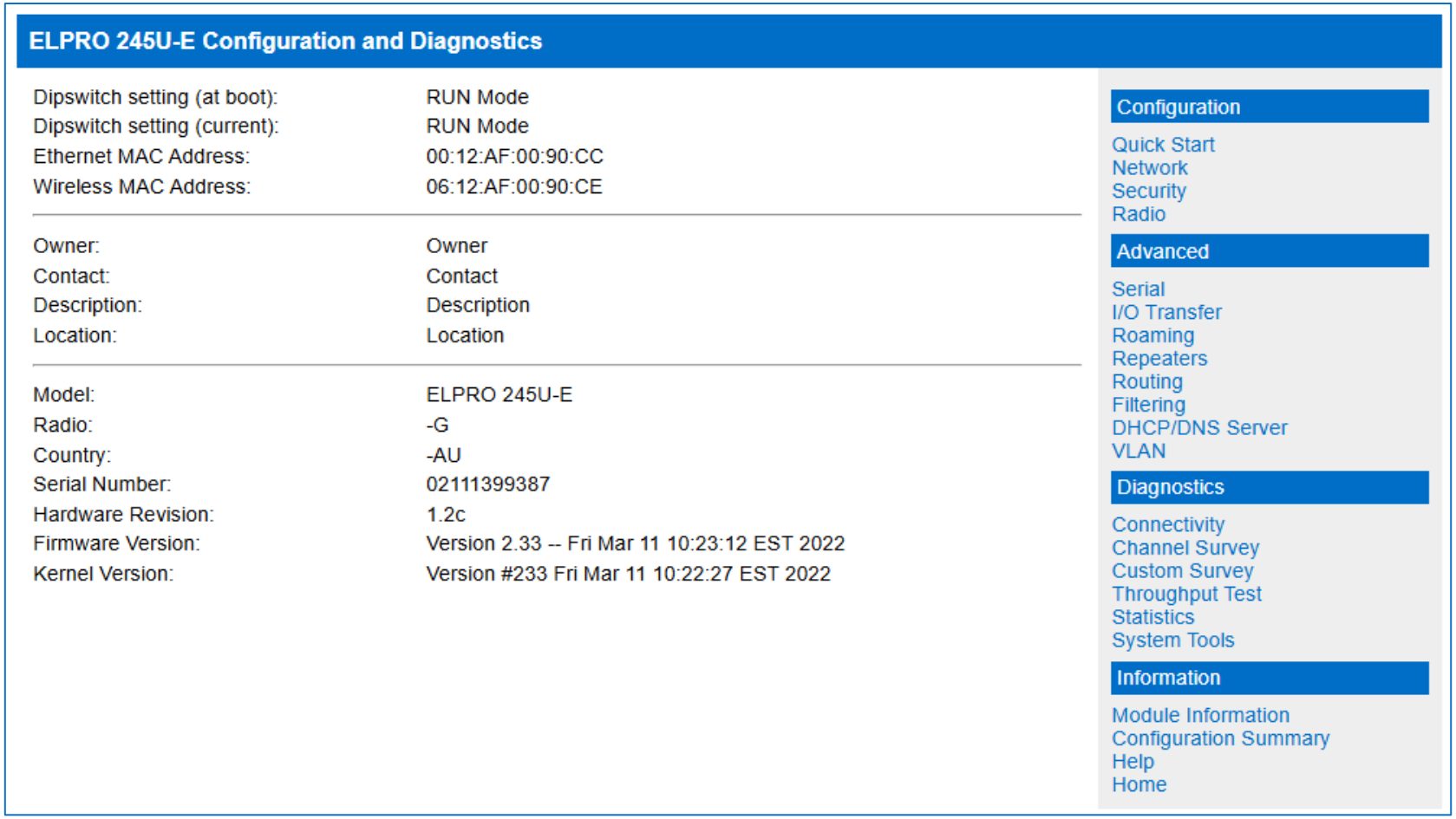
Connections

- Access Point
  - On start-up begins sending “Beacons” (Link messages) on set Channel or scan for quietest channel when set to Auto.
- Client
  - Scans for messages from AP and attempt to establish a link with the strongest radio signal
- Client Link Establishment
  - Checks Authentication (System address and Encryption)
  - Request a link (Association), Link LED
- AP
  - Link LED, Acts as a Master and control flow of messages

Loss of connection

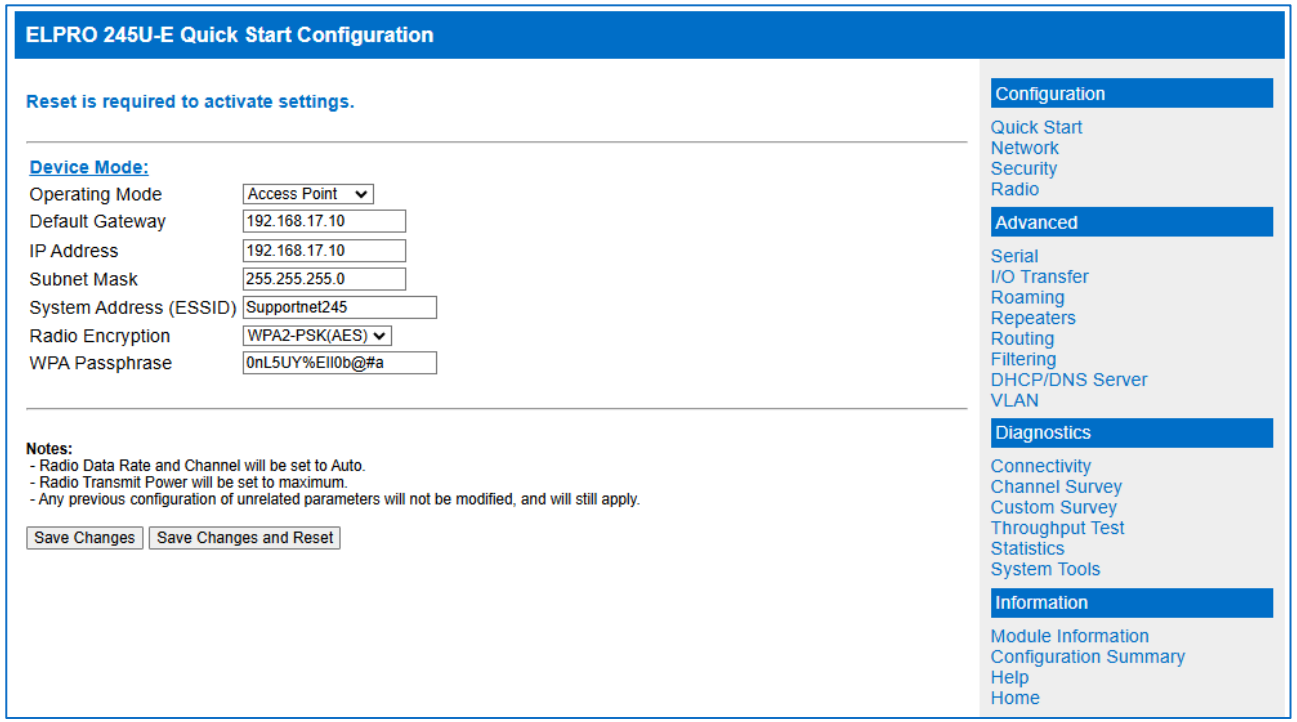
- Access Point
  - AP refreshes link after each message is received. If no comms has occurred from Client after 120sec, AP will send “link-check”, if no response will send De-authenticate and drop link.
- Client
  - Clients will drop the link if it can no longer receive beacons from AP. Time period is 10 beacon intervals.

Configuration



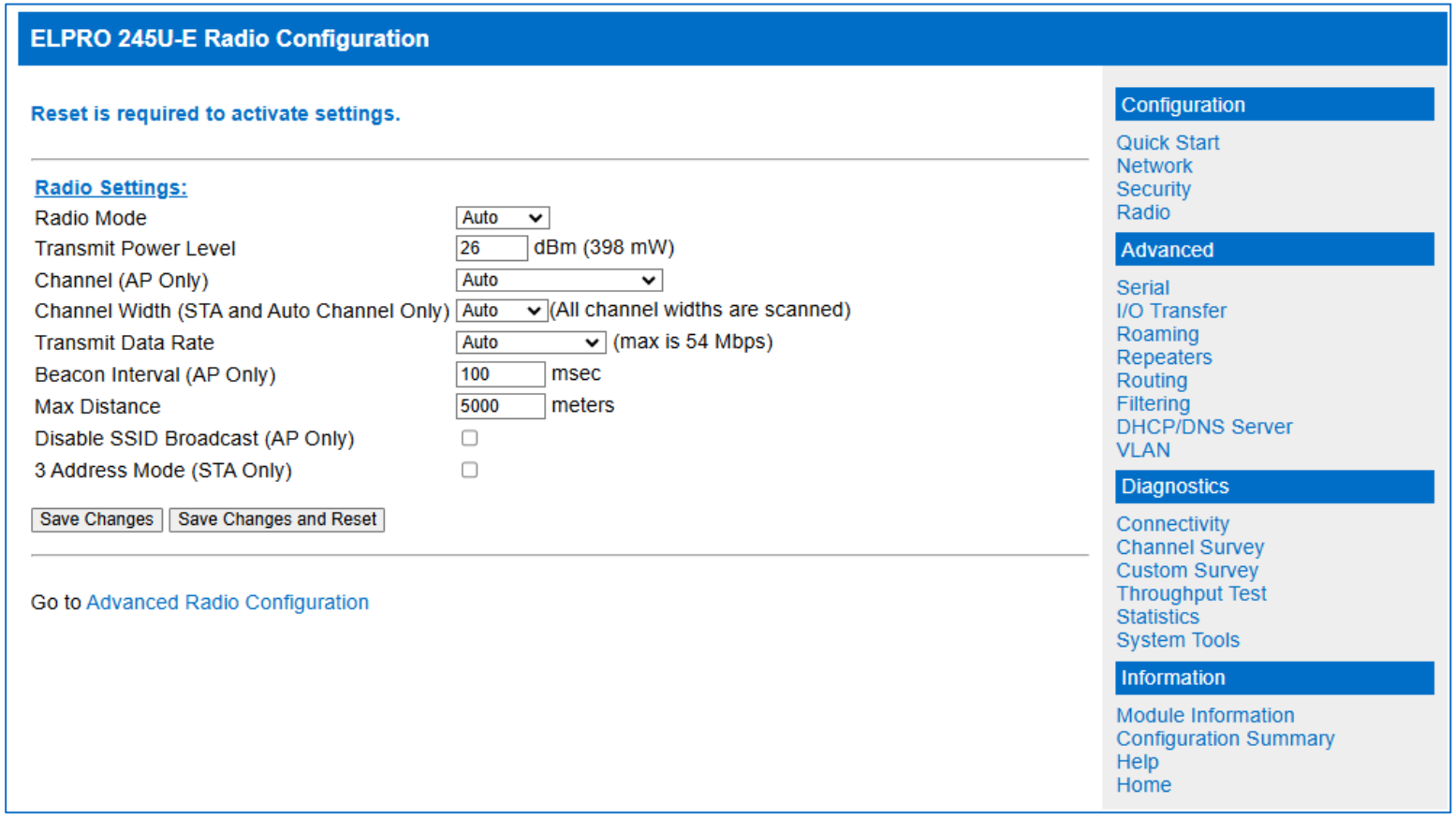
Quick Start

- Simple Configuration – Minimal input required
- Set 1 modem to be Access Point
- Remainder to be Clients
- System Address to be the same in all modems



Radio Page

- Allowing for additional parameters to be set to suit application

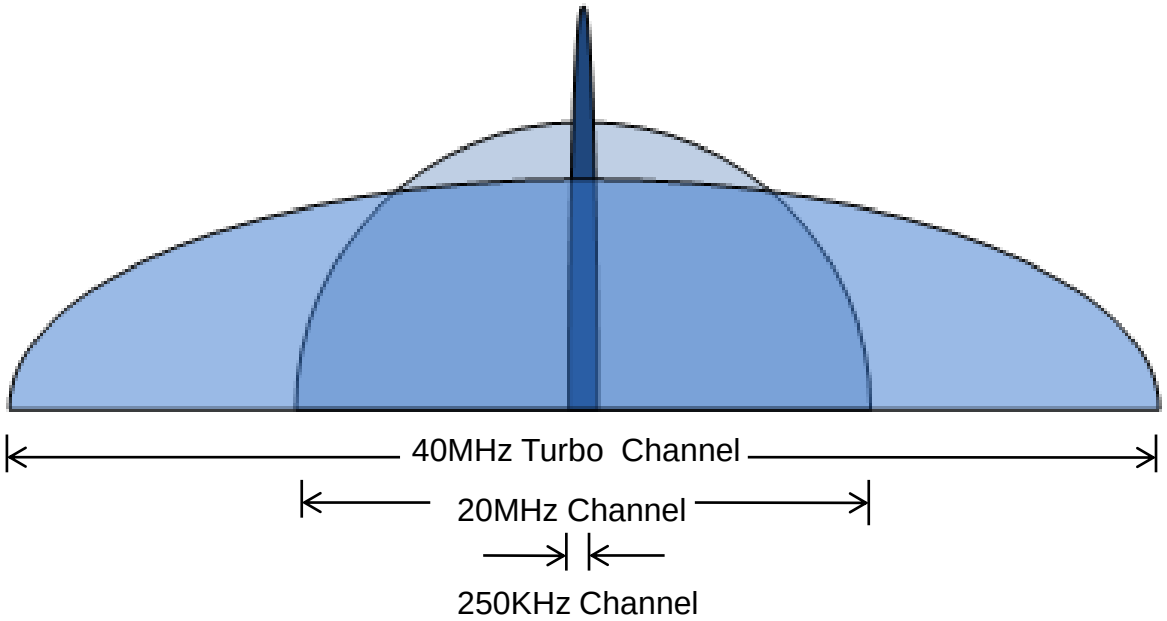


Radio Channels

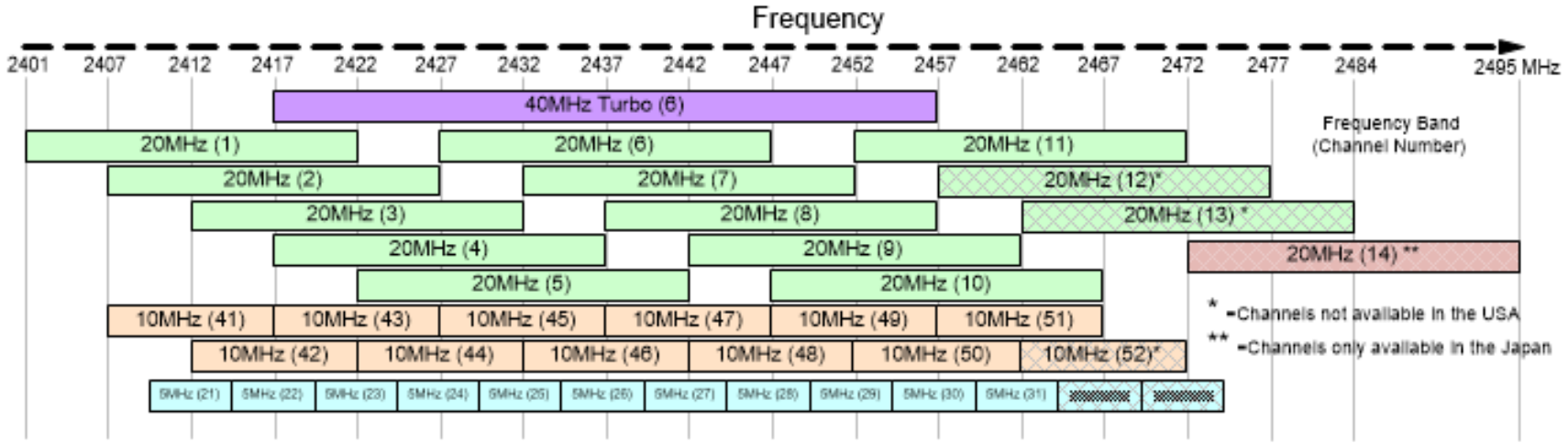
Comparison of radio channels between different Ethernet Modems.

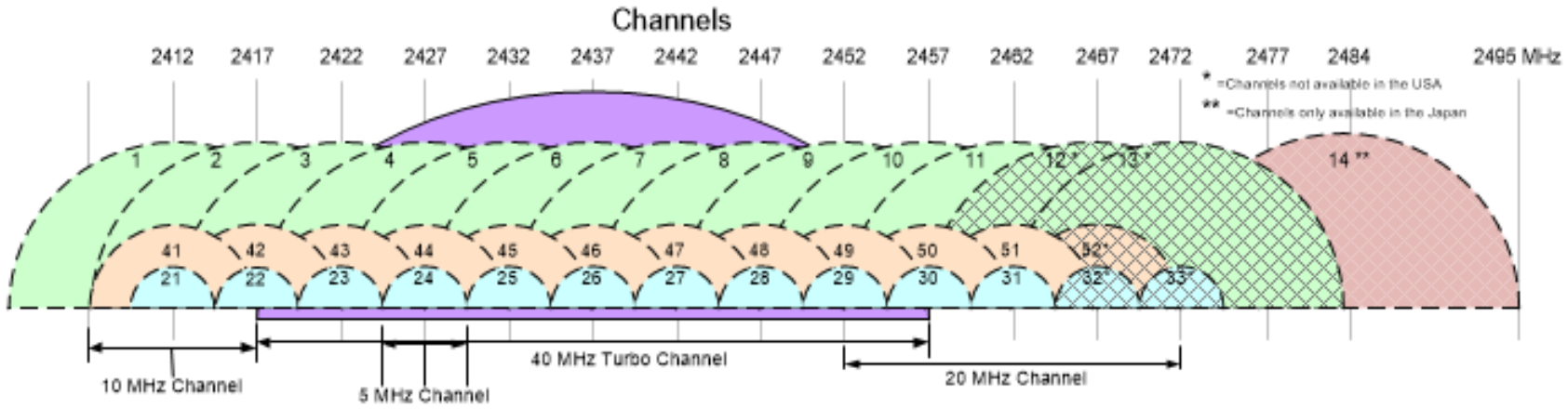
A wider channel will allow for more data to be transmitted

A narrow channel will give greater distance.



245U-E-G1 (2.4Ghz) Radio Channels





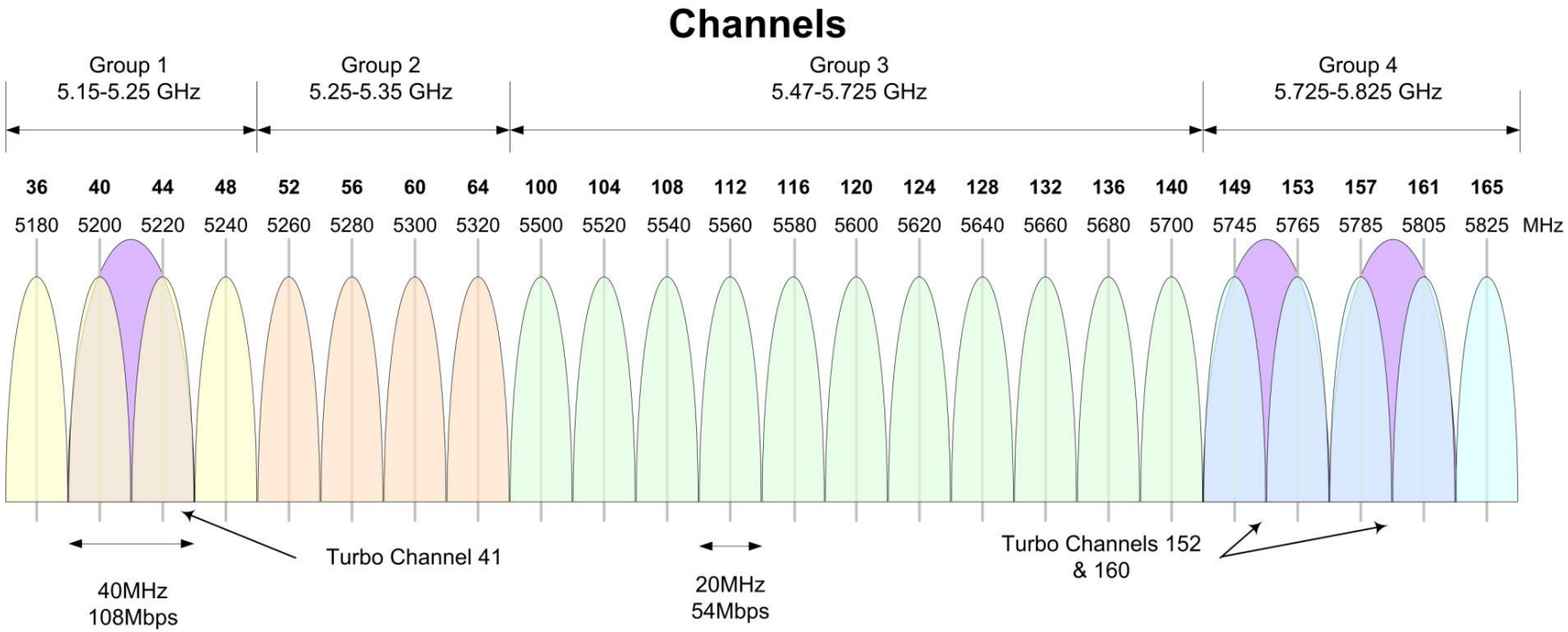
11 x 20MHz Channels

5MHz Spacing between Channels

1 x 40Mhz Turbo Channel

3 Non overlapping channels

245U-E-A (5hz) Radio Channels



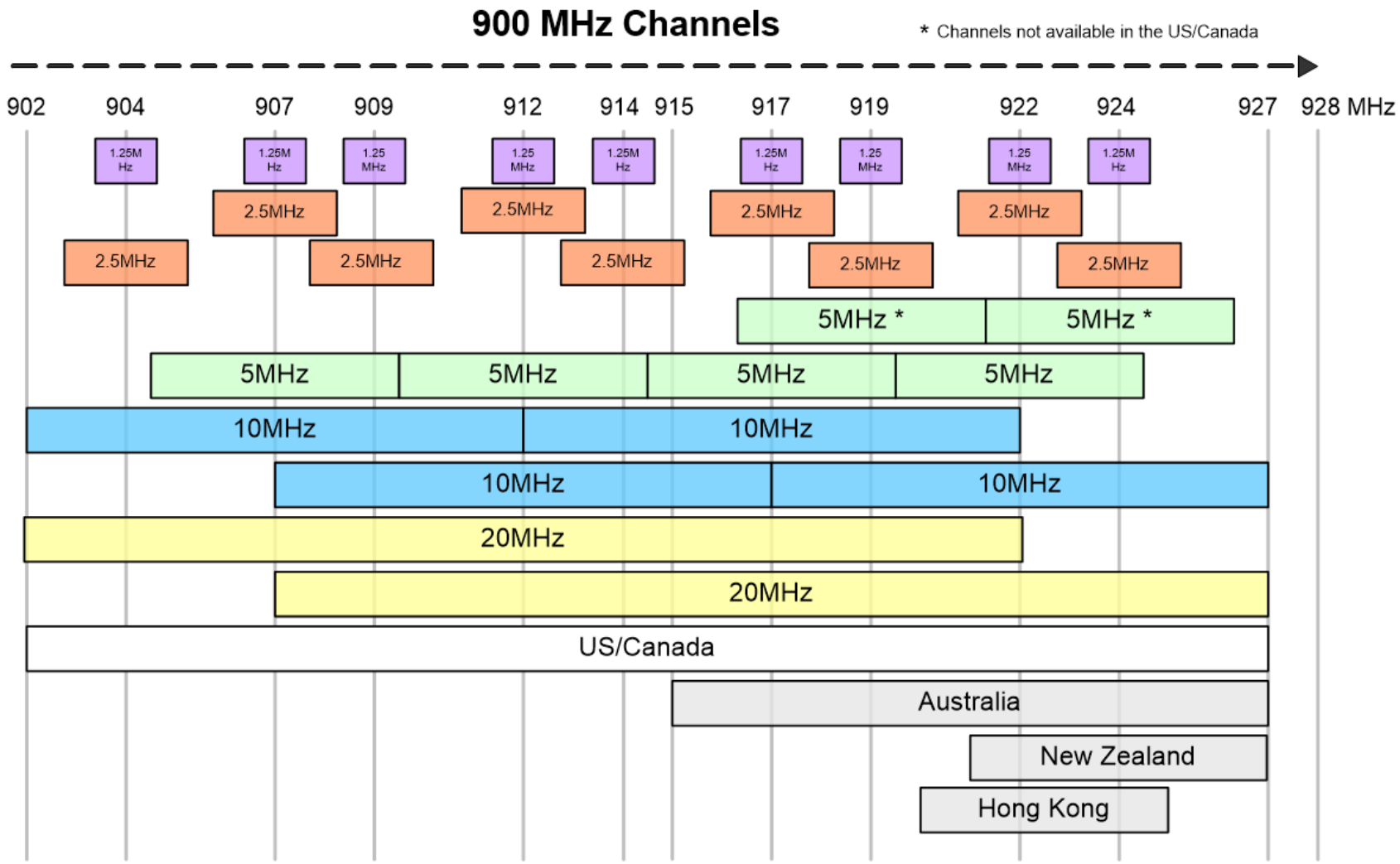
20MHz Spacing between Channels

3 x 40MHz Turbo Channels

All Non overlapping channels

4 Groups for different regions and power requirements

945U-E (900Mhz) Radio Channels



945U-E Radio

Data Rate (20MHz Channel)	Sensitivity	Data Rate (2.5MHz Channel)	Sensitivity	Max TX Power
1Mbps	-95dBm	125Kbps	-101dBm	28dBm
2Mbps	-93dBm	250Kbps	-99dBm	28dBm
5.5Mbps	-91dBm	687Kbps	-97dBm	28dBm
11Mbps	-90dBm	1.375Mbps	-96dBm	28dBm
6Mbps	-92dBm	750Kbps	-98dBm	28dBm
9Mbps	-91dBm	1.125Mbps	-97dBm	28dBm
12Mbps	-90dBm	1.5Mbps	-96dBm	28dBm
18Mbps	-88dBm	2.25Mbps	-94dBm	28dBm
24Mbps	-84dBm	3Mbps	-90dBm	28dBm
36Mbps	-81dBm	4.5Mbps	-87dBm	25dBm
48Mbps	-75dBm	6Mbps	-81dBm	23dBm
54Mbps	-72dBm	6.75Mbps	-78dBm	21dBm

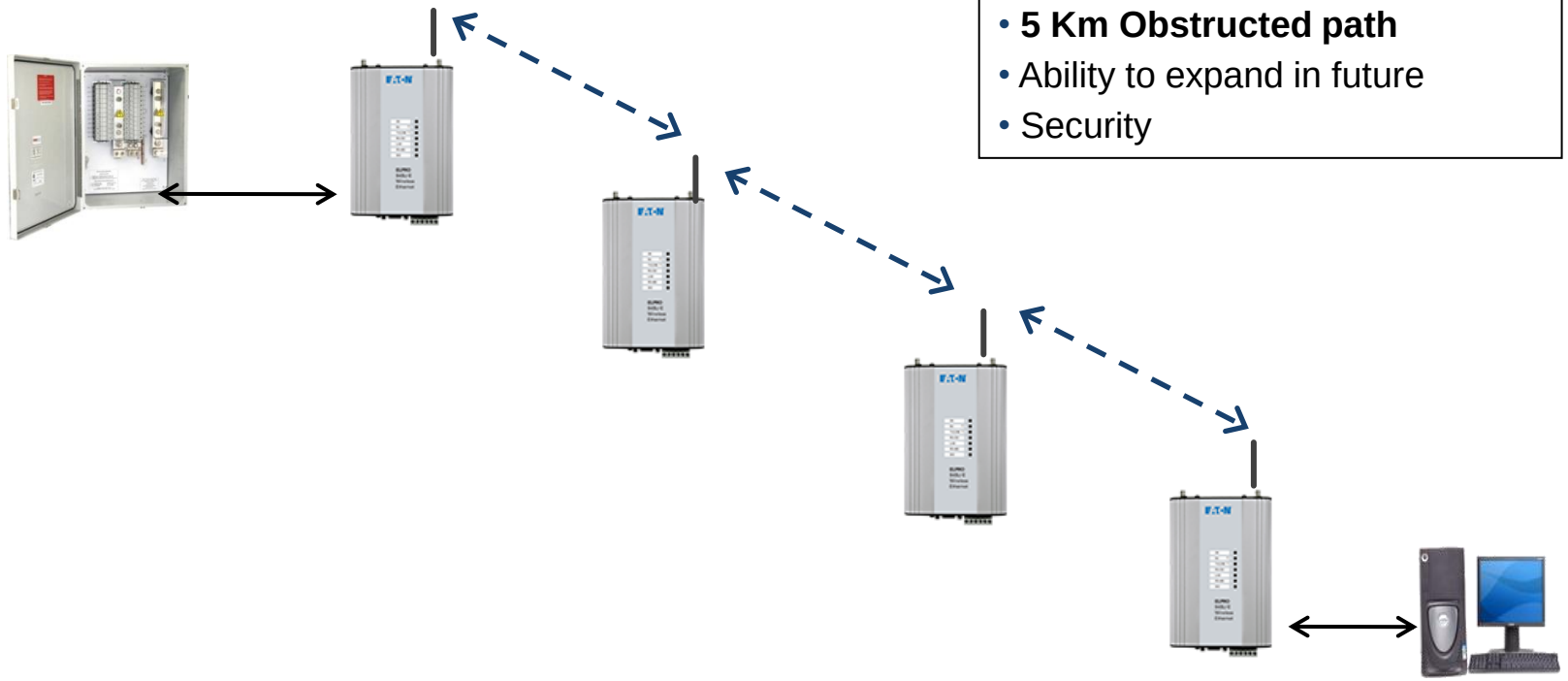
WDS - Wireless Distribution System

- Access Point (AP) to Access Point communications
- Primary use is to extend the range of the modems – Repeaters
- Meshing - If a path fails the system will heal itself to create another path.

Fixed Repeaters

Customer Requirements:

- Process Network Connectivity
- High throughput (Profinet)
- **5 Km Obstructed path**
- Ability to expand in future
- Security



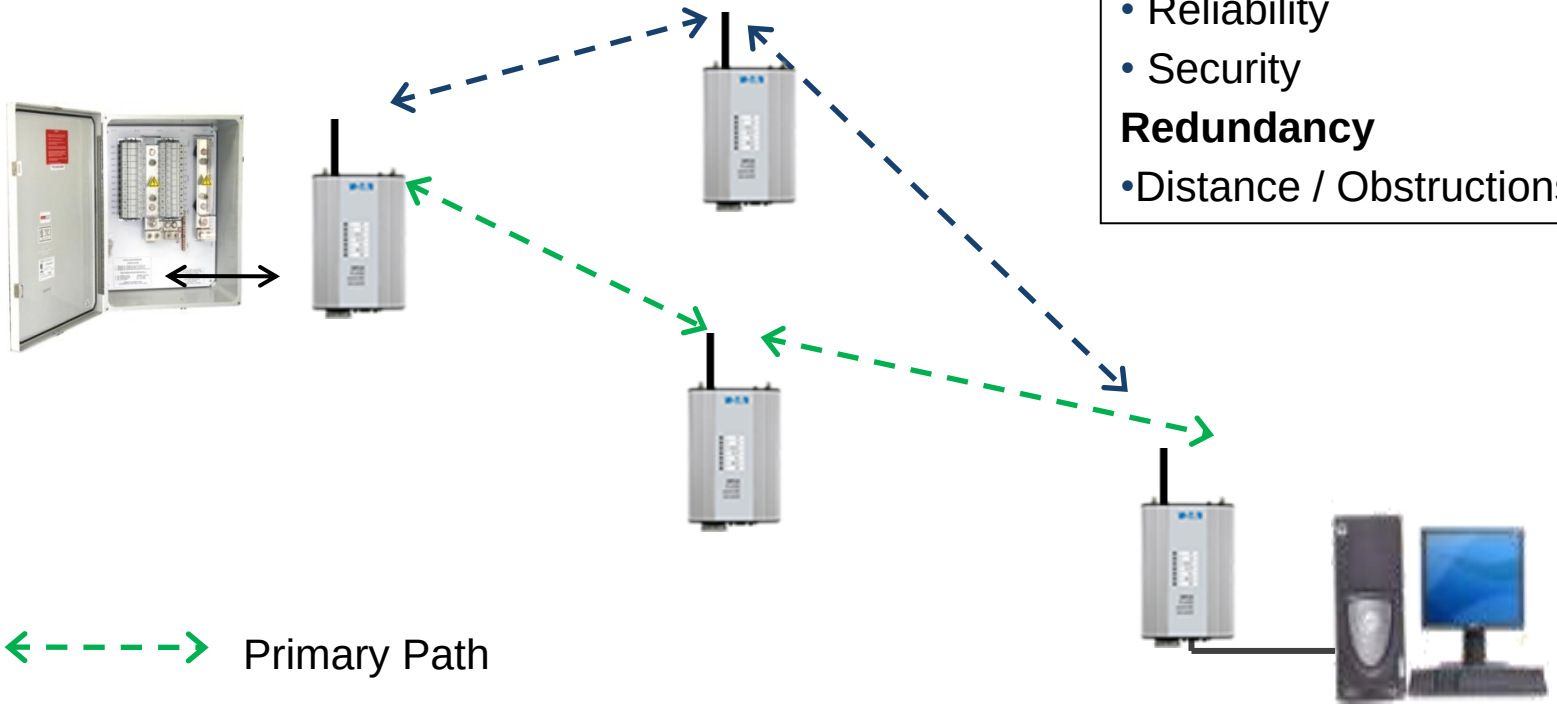
Redundancy

Customer Requirements:

- High data transmission rate
- Reliability
- Security

Redundancy

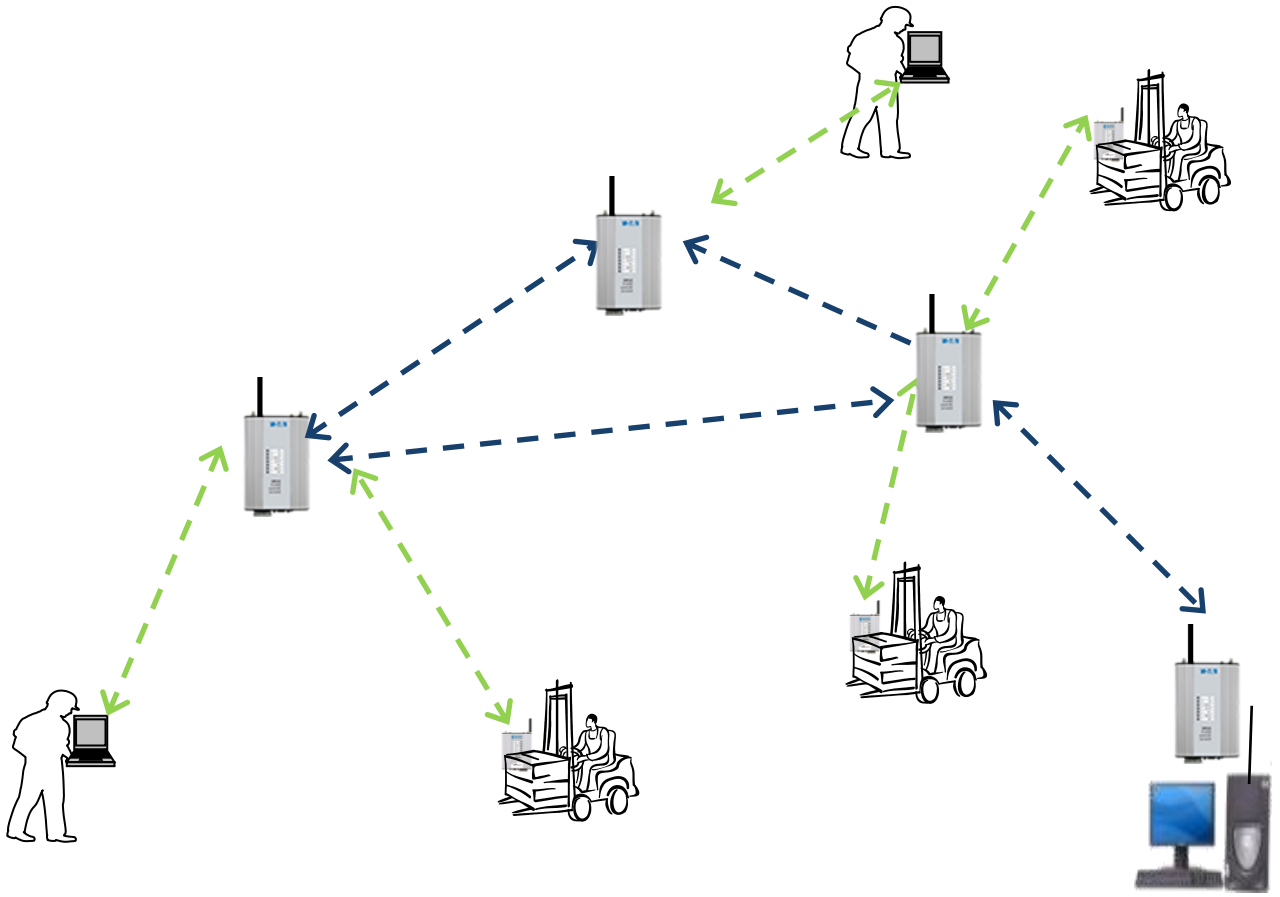
- Distance / Obstructions



Primary Path

Redundant Path

Meshing / Roaming



Customer Requirements:

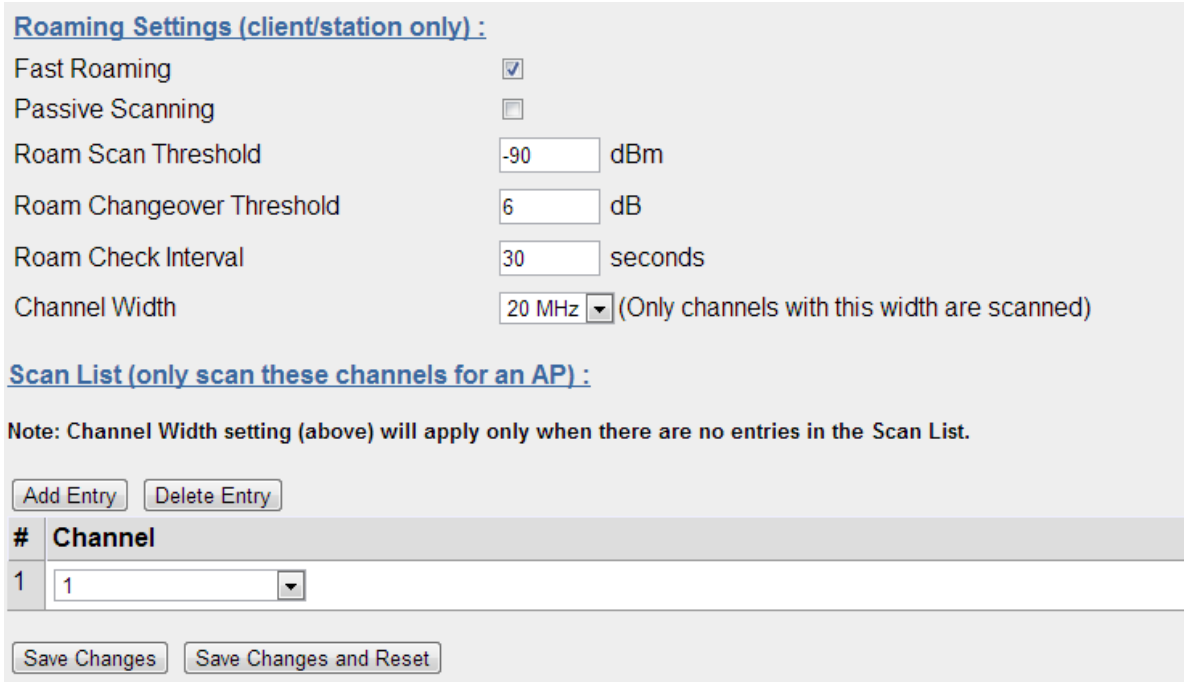
- High throughput
- Security
- Maintenance connectivity
- **Mesh**
- **Roaming vehicles**

Fixed Mesh

Roaming

Fast Roaming

- Applications with Moving Clients
- Portable Trolley’s
- Portable Pumps / Generators,
- Mine Vehicles
- Process Automation



VLAN

A VLAN lets you segregate a network into smaller parts without having to build parallel hardware systems.

V = Virtual.

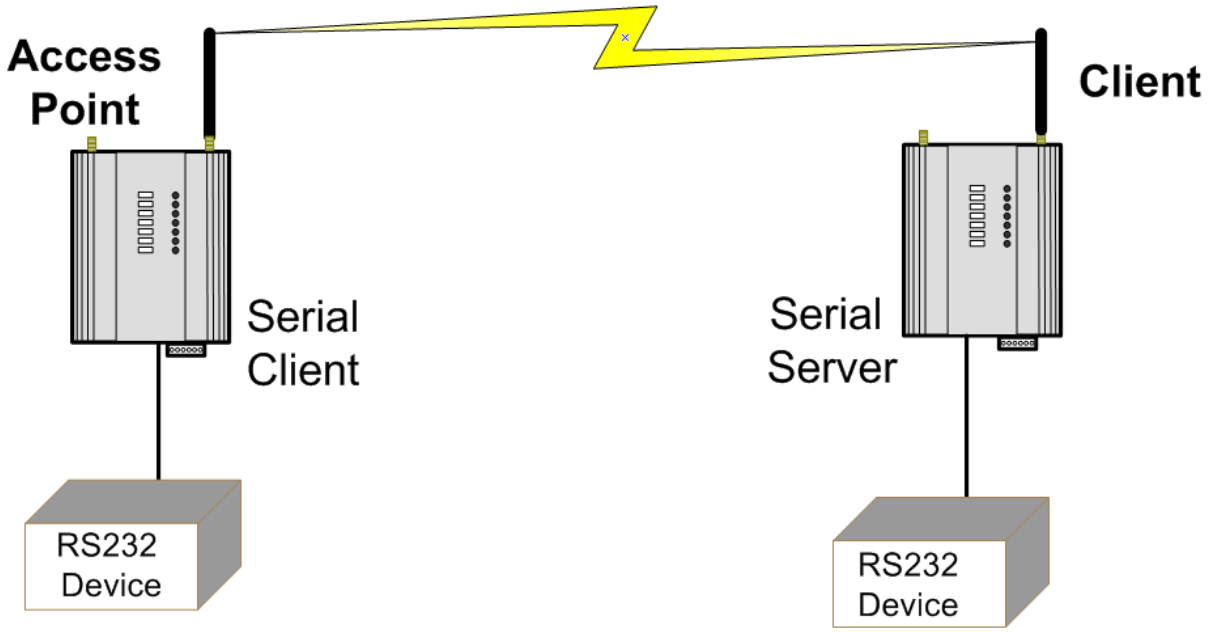
A VLAN will allow you to segment and divide your network up and set a series of rules or priorities

Serial Options

Serial Server & Client

- Serial server and Client give pass through serial communications (transparent) between modems.

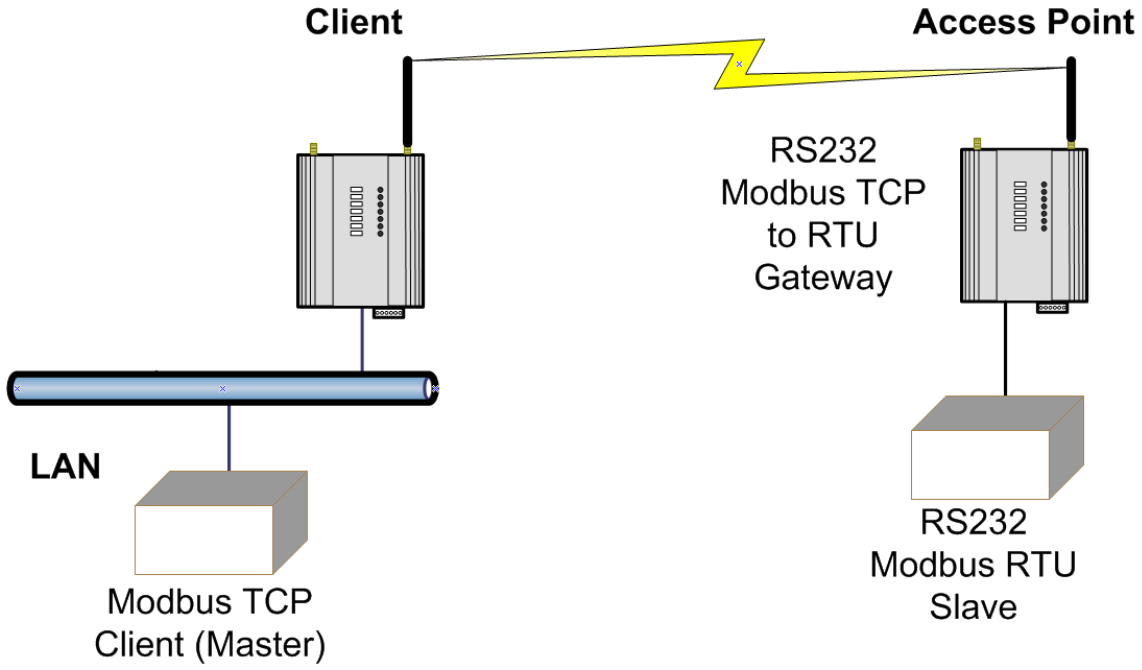
  e.g. RS232 input – RS232 output.



Serial Options

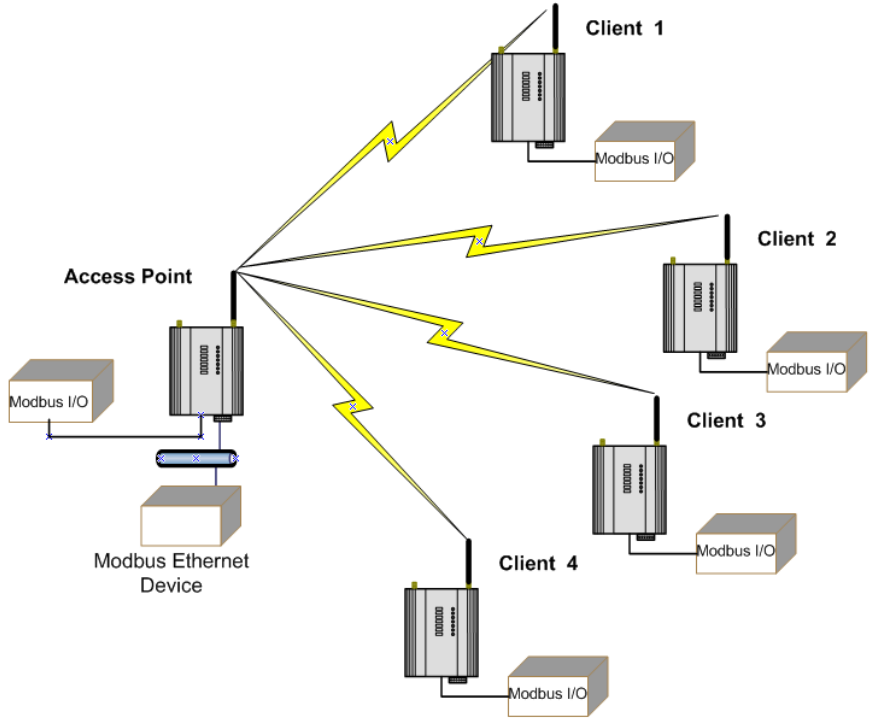
Modbus TCP/RTU conversion

- Internal TCP / RTU Conversion allowing legacy Serial Devices connect to Ethernet based network.



Modbus I/O Server

- Large I/O Consolidation
- 2 Way I/O (Transceiver)
- Point to Multipoint
- I/O to I/O or,
- I/O to SCADA/PLC/DCS etc
- Discrete, Analog, Pulsed, Voltage
- Operate other Ethernet Devices at same time



LED Indications

Green – Normal Operation

Green – Receive Good Signal Strength
Red – Weak Signal Strength

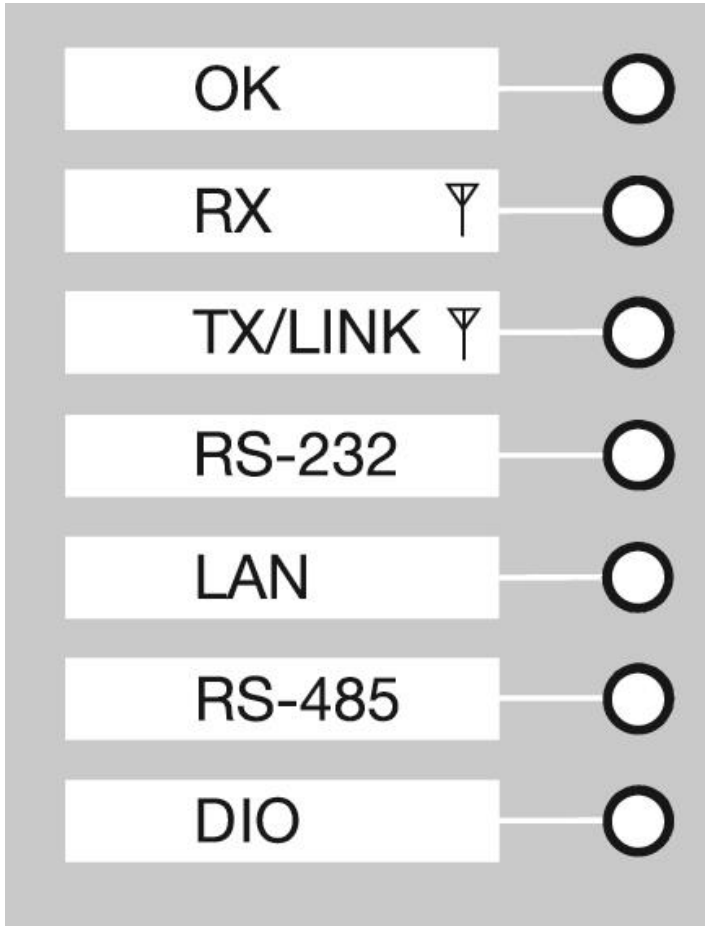
Green – Link to remote radios
Red – Radio Transmitting

Green – Data Sent from Serial Port
Red – Data Received on Serial Port

Amber – Ethernet Port link and data transfer when flashing

Green – Data Sent from Serial Port
Red – Data Received on Serial Port

Green – Used as an Input
Red – Used as an Output



Connectivity

ELPRO 245U-E Connectivity

Got Connectivity or Throughput problems? Diagnose using Channel Survey.

Connected Devices:

```
wi0:
=====
MAC ADDRESS        IP ADDRESS       AID CHAN    RATE RSSI BGND CAPS
06:12:af:00:9c:9e  192.168.17.11      1   41  12.00M  -78  -92 EPSs
```

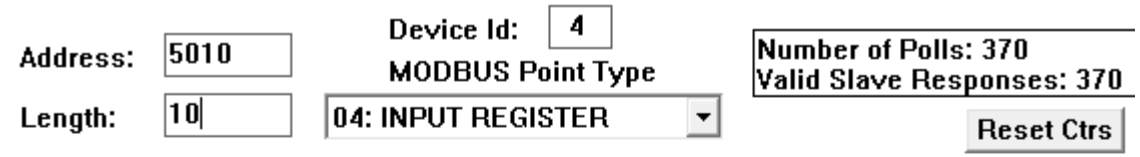
Each modem will display details of whom they are connected too.

Site Survey:

```
SSID            BSSID             CHAN    RATE  S:N      INT CAPS
TP-Link_0FA3    10:27:f5:ec:0f:a3    3  54.00M -85:-96  100 EPsR RSN WME
SupportNet      00:12:af:00:1a:2b    3  11.00M -90:-96  100 EP   WPA
ELPROTECH1      08:36:c9:1c:fe:e0    6  54.00M -59:-96  100 EPs  RSN WME ATH
Aquamonix       78:8a:20:84:e4:e8   11  54.00M -87:-101  100 EPSs RSN WPA WME ATH
SWStarlink      ea:48:6f:2a:d6:d0    1  54.00M -93:-101  100 EPSs RSN WME
                12:27:f5:ec:0f:a3    3  54.00M -85:-96  100 EPsR RSN WME
                ea:48:6f:4a:d6:d0    1  54.00M -91:-101  100 EPSs RSN WME
                ea:48:6f:6a:d6:d0    1  54.00M -95:-101  100 EPSs RSN WME
```

Client Radio’s will display a list of other Access Points that were in range prior to connecting to an Access Point.

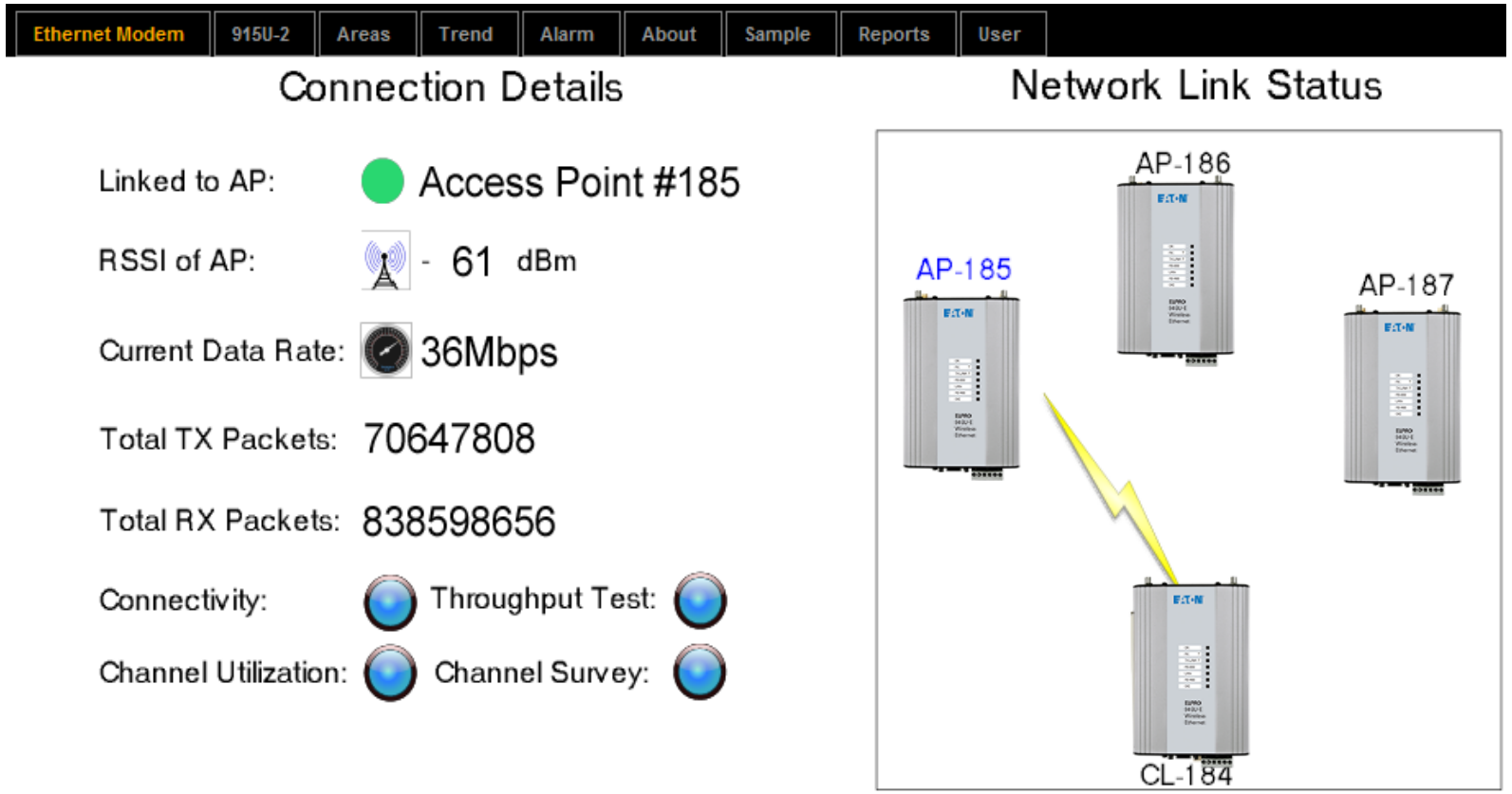
Network Diagnostics




```
35010: <65535>
35011: <00000>
35012: <00001>
35013: <00000>
35014: <00063>
35015: <11000>
35016: <01554>
35017: <44800>
35018: <37142>
35019: <00000>
```

Register	Module	Description
5000	Both	Total number Associated Stations
5001	Both	Current Radio Channel. See section 3.2 “Selecting a Channel” for channel details
5002	Both	Number Wireless Interfaces configured, includes Virtual Interfaces – wi1-wi10
5010	Both	Wireless Adaptor (wi0) - Link Status
5011	Both	Wireless Adaptor (wi0) - Link Status Inverted
5012	Both	Wireless Adaptor (wi0) - Number Associated Stations for this interface
5013	AP Only	Wireless Adaptor (wi0) - Points to the starting register of the AP's Station List. First interface (wi0) will always start at 5200 and dynamically enter data depending on the number of STA’s. Remaining interfaces (wi1-wi10) will be entered after wi0 data. Register 5023, 5033, etc will indicate starting location for each interface.
5014	STA Only	Wireless Adaptor (wi0) – RSSI & BGND of Rx message from AP e.g. Hex 5F5D = 5F for RSSI and 5D for BGND (Convert value from hex to dec and add a “-“ e.g. 5F = -95dB)
5015	STA Only	Wireless Adaptor (wi0) - Transmit Data Rate from the Access Point
5016	STA Only	Wireless Adaptor (wi0) - MAC Address of the Access Point
5020-5026	As per 5010-5016	As per registers 5010-5016 but for the next Wireless Adaptor (wi1)
5030-5036	As per 5010-5016	As per registers 5010-5016 but for the next Wireless Adaptor (wi2)
5040-5046	As per 5010-5016	As per registers 5010-5016 but for the next Wireless Adaptor (wi3)
……etc	As per 5010-5016	As per registers 5010-5016 but for the next Wireless Adaptor (wi10)
5200	AP Only	RSSI of the Client (STA)
5201	AP Only	Transmit Data Rate to Client (STA)
5202	AP Only	MAC address of Client (STA)
…..etc	AP Only	Dynamic list of STA's Refer to register 5023, 5033, etc for starting register of each wi interface
9999	Both	Reset module (enter FFFF to reset module)

Network Diagnostics



Example of using inbuilt diagnostic registers with SCADA program to monitor network connections

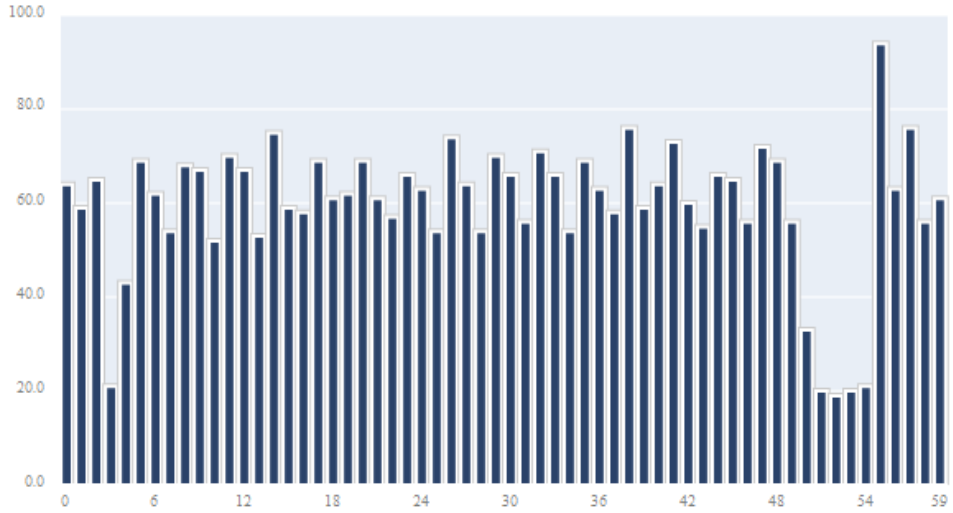
Throughput Testing

Theoretical throughputs by Channel and Data rate

Channel Width	Channel Data Rate	Actual Data Rate
40MHz	108Mbps	32Mbps
20MHz	54Mbps	25Mbps
10MHz	27Mbps	12Mbps
5MHz	13.5Mbps	6Mbps
2.5MHz	6.75Mbps	3Mbps
1.25MHz	3Mbps	1Mbps

Channel Utilization

Bar Graph of Percent Channel Utilization with 1 Second Intervals:

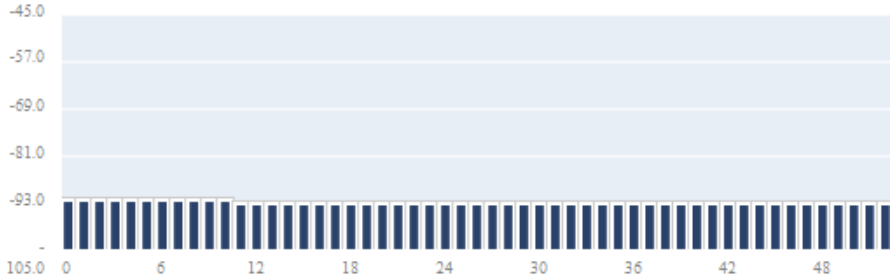


Average Channel Utilization for past 60 seconds = 59%

Channel Survey used to view the utilization of the specific channel.

Can also view Background Noise (interference)

Bar Graph of Noise Floor (dBm) with 1 second intervals:



Average Noise Floor for past 60 seconds = -92dBm

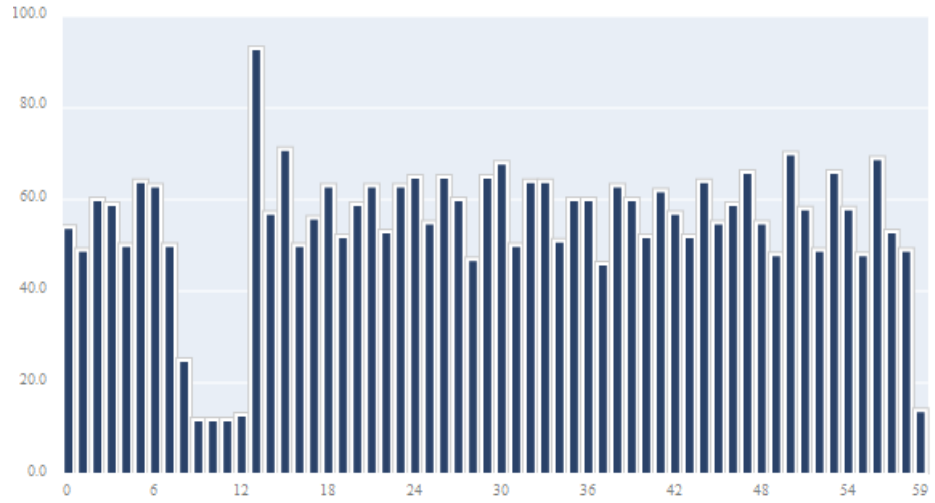
Custom Survey

Include the following data on Chart 1:

Percent Radio Tx	☑
Percent Radio Rx	☐
Percent Busy (due to CCA or Noise)	☑
Time Interval for Chart 1	Seconds

Following Chart shows for Actual Radio TX & Noise with Average of 54% of channel being busy over a 60 second period.

Chart 1 (Percent Tx + Percent Busy):



Average Utilization (Percent Tx + Percent Busy) for past 60 seconds = 54%

Custom Survey

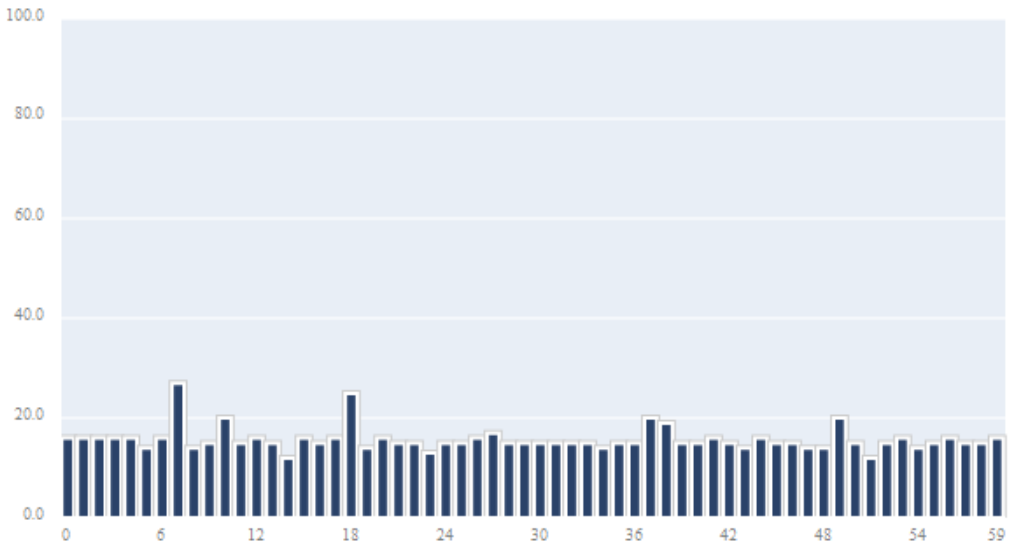
Include the following data on Chart 2:

Percent Radio Tx	☐
Percent Radio Rx	☑
Percent Busy (due to CCA or Noise)	☑
Time Interval for Chart 2	Seconds

Following Chart shows Percent busy on RX and Noise.

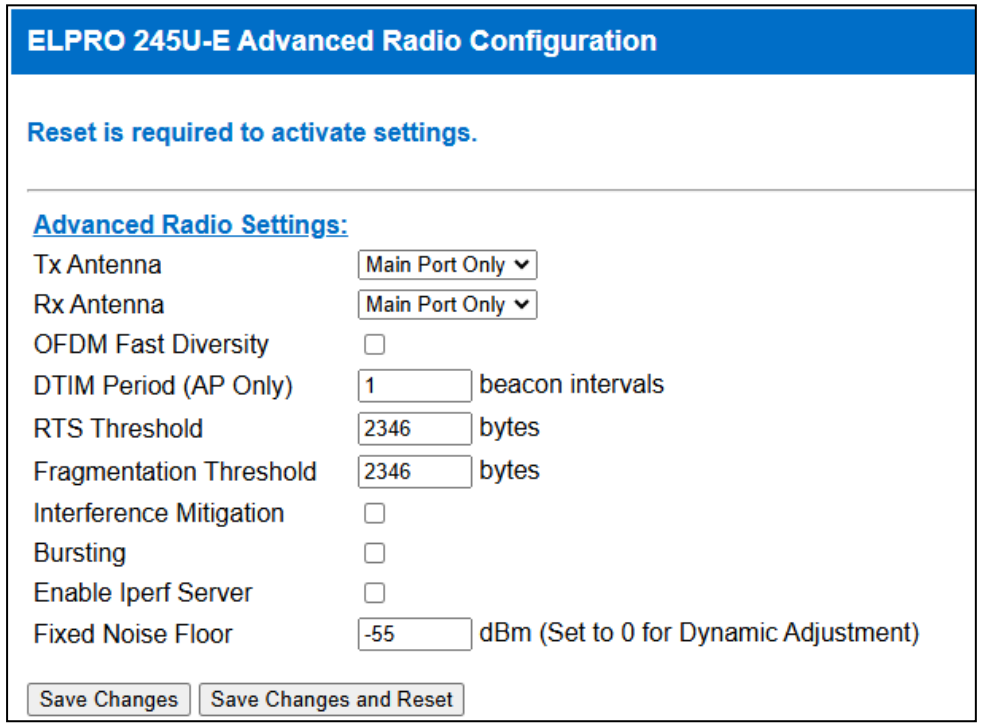
Indications are that there is no CCA noise and limited RX traffic for this modem

Chart 2 (Percent Rx + Percent Busy):



Average Utilization (Percent Rx + Percent Busy) for past 60 seconds = 16%

Fixed Noise Floor



By using a Fixed Noise Floor any Noise or background traffic/noise below this level will not be ignored.

Thank You.

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