User's Guide

Microwave Data Systems Inc.

MDS Mercury 900™

Wireless IP/Ethernet Transceiver

Covering Firmware Release 1.x

MDS 05-4446A01, Rev. A
APRIL 2006

PRELIMINARY

industrial/wireless/performance

MDS

QUICK-START INSTRUCTIONS

INSTALLATION SUMMARY

Step 1 – Mount the Transceiver

Step 2 – Install the Antenna

Step 3 – Measure & Connect Primary Power (10.5–30 Vdc)

Step 4 – Review the transceiver's Configuration

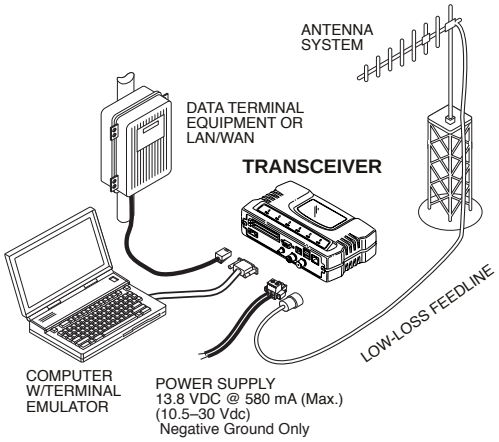
Device Mode—Access Point, or Remote (Default)
Network Name—Unique name for each radio network.
Required for Remotes to associate with Access Point.
IP Address—Must be a unique number to allow for IP access through the Ethernet Port.
NOTE: A unique IP address is essential to access the browser-based Management System.
RF Output Power—Adjust as necessary for regulatory compliance. (Default = 1 Watt /+30 dBm)
Password—Used for remote access and some Management System features. (Default = admin)

Step 5 – Connect the Data Equipment

Connect the data equipment to data port(s):

- LAN—10BaseT Ethernet-compatible equipment:
  Ethernet Hub (Straight-Through Cable); Ethernet Node (Crossover)
- COM1—Management System (Default); Serial (Alternate)

Step 6 – Check for Normal Operation



TYPICAL INSTALLATION

- Observe the transceiver LED status panel for the proper indications. In a normally operating system, the following LED indications will be seen within 30 seconds of power-up:
  PWR—Lights continuously LAN—On or blinks intermittently LINK— On or blinks intermittently (Remotes: if associated)
- Use PING command to test basic data link integrity between Access Point and Remotes.
- If the PING command is successful, connect the RTU/data equipment to the data port and verify normal operation.
- If the LINK LED on Remotes is not on after 20 to 30 seconds, the unit has failed to associate with the Access Point. It may be necessary to reposition or redirect the radio's antenna for better reception/signal strength.
- Check connected data equipment for normal operation

BASIC CONFIGURATION DEFAULTS

The Management System can be accessed through the COM1 Port using a terminal session on a PC. The basic items listed below, along with many other parameters & tools can be accessed through this method. HTTP, Telnet access, and changing some parameters are controlled by password.

ITEM	MGT SYSTEM MENU	DEFAULT	VALUES/RANGE
Device Mode	Network Configuration	Remote	• Remote • Access Point
Unit Password	Device Information	admin (lower case)	• 1–8 alphanumeric characters • Case-sensitive; can be mixed case
Network Name	Network Configuration	"Not Programmed"	• 1–16 alphanumeric characters • Case-sensitive; can be mixed case
IP Address	Network Configuration	192.168.1.1	Contact your Network Administrator
RF Output Power	Radio Configuration	+30 dBm (1.0 Watt)	20–30 dBm @ 50Ω (0.1–1.0 Watt)

Detailed instructions for setting transceiver parameters are contained in Section 3 of this manual.

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ISO 9001 Registration

Microwave Data Systems adheres to the internationally-accepted ISO 9001 quality system standard.

To our Customers

We appreciate your patronage. You are our business. We promise to serve and anticipate your needs. We will strive to give you solutions that are cost effective, innovative, reliable and of the highest quality possible. We promise to build a relationship that is forthright and ethical, one that builds confidence and trust.

Related Materials on the Internet Data sheets, frequently asked questions, case studies, application notes, firmware upgrades and other updated information is available on the MDS Web site at www.microwavedata.com.

About Microwave Data Systems Inc.

Almost two decades ago, MDS began building radios for business-critical applications. Since then, we ve installed nearly 100,000,000 radios in over 110 countries. To succeed, we overcame impassable terrain, brutal operating conditions and disparate, complex network configurations. We also became experts in wireless communication standards and system applications worldwide. The result of our efforts is that today, thousands of utilities around the world rely on MDS-based wireless networks to manage their most critical assets.

The majority of MDS radios deployed since 1985 are still installed and performing within our customers' wireless networks. That s because we design and manufacture our products in-house, according to ISO 9001 which allows us to control and meet stringent global quality standards.

Thanks to our durable products and comprehensive solutions, MDS is the wireless leader in industrial automation including oil and gas production and transportation, water/wastewater treatment, supply and transportation, electric transmission and distribution and many other utility applications. MDS is also at the forefront of wireless communications for private and public infrastructure and online transaction processing. Now is an exciting time for MDS and our customers as we look forward to further demonstrating our abilities in new and emerging markets.

As your wireless needs change you can continue to expect more from MDS. We'll always put the performance of your network above all. Visit us at www.microwavedata.com for more information.

OPERATIONAL & SAFETY NOTICES

RF Exposure

Professional installation required. The radio equipment described in this guide emits radio frequency energy. Although the power level is low, the concentrated energy from a directional antenna may pose a health hazard. Do not allow people to come closer than 23 cm (9 inches) to the antenna when the transmitter is operating in indoor or outdoor environments. More information on RF exposure is on the Internet at www.fcc.gov/oet/info/documents/bulletins.

CSA/us Notice

This product is pending approval for use in Class 1, Division 2, Groups A, B, C & D Hazardous Locations. Such locations are defined in Article 500 of the National Fire Protection Association (NFPA) publication *NFPA 70*, otherwise known as the National Electrical Code.

The transceiver has been recognized for use in these hazardous locations by the Canadian Standards Association (CSA) which also issues the US mark of approval (CSA/US). The CSA Certification is in accordance with CSA STD C22.2 No. 213-M1987.

CSA Conditions of Approval: The transceiver is not acceptable as a stand-alone unit for use in the hazardous locations described above. It must either be mounted within another piece of equipment which is certified for hazardous locations, or installed within guidelines, or conditions of approval, as set forth by the approving agencies. These conditions of approval are as follows:

The transceiver must be mounted within a separate enclosure which is suitable for the intended application.

The antenna feedline, DC power cable and interface cable must be routed through conduit in accordance with the National Electrical Code.

Installation, operation and maintenance of the transceiver should be in accordance with the transceiver's installation manual, and the National Electrical Code.

Tampering or replacement with non-factory components may adversely affect the safe use of the transceiver in hazardous locations, and may void the approval.

A power connector with screw-type retaining screws as supplied by MDS must be used.

WARNING

EXPLOSION HAZARD!

Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Refer to Articles 500 through 502 of the National Electrical Code (NFPA 70) for further information on hazardous locations and approved Division 2 wiring methods.

FCC Part 15 Notices

The transceiver series complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This device is specifically designed to be used under Section 15.247 of the FCC Rules and Regulations. Any unauthorized modification or changes to this device without the express approval of Microwave Data Systems may void the user s authority to operate this device. Furthermore, the Mercury Series is intended to be used only when installed in accordance with the instructions outlined in this manual. Failure to comply with these instructions may also void the user s authority to operate this device.

Part 15 rules also require that the Effective Isotropic Radiated Power (EIRP) from an MDS Mercury Series installation not exceed 36 dBm. Refer to *5.1.4 Antenna & Feedline Selection 140* on Page 137 for more information.

Industry Canada RSS Notices

Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To reduce potential radio interference to other users, the antenna type and its gain should be chosen so that the Equivalent Isotropic Radiated Power (EIRP) is not more than that permitted for successful communication.

This device as been designed to operate with the antennas listed below, and having a maximum gain of 12 dB. Antennas not included in this list or having a gain greater than 12 dB are strictly prohibited for use with this device. The required antenna impedance is 50 ohms. Refer to Table 5-3 on Page 147 for a list of antennas acceptable for use with this transceiver.

Manual Revision and Accuracy

This manual was prepared to cover a specific version of firmware code. Accordingly, some screens and features may differ from the actual unit you are working with. While every reasonable effort has been made to ensure the accuracy of this publication, product improvements may also result in minor differences between the manual and the product shipped to you. If you have additional questions or need an exact specification for a product, please contact our Customer Service Team using the information at the back of this guide. In addition, manual updates can often be found on the MDS Web site at www.microwavedata.com.

Environmental Information

The manufacture of this equipment has required the extraction and use of natural resources. Improper disposal may contaminate the environment and present a health risk due to hazardous substances contained within. To avoid dissemination of these substances into our environment, and to limit the demand on natural resources, we encourage you to use the appropriate recycling systems for disposal. These systems will reuse or recycle most of the materials found in this equipment in a sound way. Please contact MDS or your supplier for more information on the proper disposal of this equipment.

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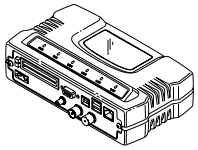


1.1 PRODUCT DESCRIPTION

The MDS Mercury 900™ transceiver provides an easy-to-install wireless local area network (WLAN) service with long range and secure operation. It supports both Ethernet *and* serial data interface options at over-the-air data speeds of up to 1.5 Mbps. The transceiver is ideally suited for demanding applications in mobile or fixed environments, where reliability and range are paramount.

The product is commonly used to convey text documents, graphics, email, video, voice over IP (VoIP), and a variety of other application data between mobile, fixed-point, and LAN-based entities.

Figure 1-1. The MDS Mercury 900™ Transceiver

Rugged Packaging

The transceiver is housed in a compact and rugged cast-aluminum case that need only be protected from direct exposure to the weather. This one enclosure contains all necessary components for radio operation and data communications. The only user-serviceable component inside the case is a fuse for the DC power input line.

Simple Installation

Most installations employ an omni-directional antenna at the Access Point (AP) location and mobile stations. Fixed Remote stations often employ a directional antenna aimed at the AP. Regardless of the type used, antennas are a vital part of the system and must be chosen and installed correctly. Refer to *INSTALLATION PLANNING* on Page 139 for guidance on choosing suitable antennas and installation sites.

For basic services, simply connect an antenna, connect your Ethernet LAN to the transceiver's LAN port, apply primary power, set a few operating parameters, and you are done. No license is required for operation in the U.S.A., Canada, and many other countries. Check requirements for your region before placing the transceiver in service.

Secure Operation

Data network security is a vital issue in today's wireless world. The Mercury Transceiver provides multiple tools to help you build a network that minimizes the risk of eavesdropping and unauthorized access. Some are inherent in the radio's operation, such as the use of 900 MHz spread-spectrum transmissions; others include data encryption, en-

abling/disabling remote access channels, and password protection.

Remember, security is not a one-step process that can simply be turned on and forgotten. It must be practiced and enforced at multiple levels, 24 hours-a-day and 7 days-a-week. See *"MDS CYBER SECURITY SUITE"* on Page 14 for more information about the transceiver's security tools.

Robust Radio Operation

The transceiver is designed for operation in the license-free 900 MHz Industrial, Scientific, and Medical (ISM) band. It can provide reliable communications at distances up to 25 miles (40 km) in fixed-site applications over favorable terrain, even in the presence of weak signals or interference.

Mobile range depends on many factors, including terrain, building density, antenna gain, and speed of travel. The unit is designed for successful application in a variety of mobile environments, and offers the best combination of range, speed and robustness available in an industrial wireless package today. By using multiple Access Points, a network can be created that provides consistent, reliable coverage over a large metropolitan area.

Flexible Services

Users with a mix of equipment having Ethernet and serial data interfaces can accommodate this equipment through the use of a Remote Dual Gateway. This flexibility allows the transceiver to provide services in data networks that are being migrated from legacy serial/EIA-232-based hardware to the faster and more easily interfaced Ethernet world.

Flexible Management

Configuration, commissioning, troubleshooting and other maintenance activities can be done locally or remotely. Four different modes of access are available: local RS-232 console, local or remote IP access (via Telnet or SSH), web browser (HTTP, HTTPS), and SNMP (v1/v2/v3).

The text-based interfaces (RS-232 console, Telnet, and SSH) are implemented in the form of easy-to-follow menus, and the terminal server configuration includes a wizard to help you set up the units correctly.

Transceiver Features

The transceiver's design makes the installation and configuration easy, while allowing for future changes.

- Long Range—Up to 25 miles (40 km) in line-of-sight conditions. Repeater stations may be used to extend the operational range. (Refer to Page 158 for more detailed information on range.)
- Industrial-Grade Product—Extended temperature range for trouble-free operation in extreme environments
- Robust Radio Communications—Designed to operate in dense, high-interference environments

- Robust Network Security—Prevents common attack schemes and hardware from gaining access or control of network. Common attack events logged and reported by alarms.
- High Speed—1.5 Mbps is over 100-times faster than 9.6 kbps radios.
- Plug-and-Play Connectivity—Ethernet bridge configuration option requires minimal setup
- Serial Ports—Gateway for serial-based equipment to IP/Ethernet networks with embedded terminal server. Site-to-site configurations are also possible.
- Single hardware package provides configuration as Access Point or Remote

1.1.1 Model Offerings

The transceiver comes in two primary models—Access Point and Remote. Three types of Remote Gateways are available—the Ethernet Bridge, the Serial Gateway, and the Dual Gateway supporting both IP/Ethernet and serial services. Table 1-1 summaries the different interface abilities for each type.

A unit can be configured in the field to operate as an Access Point or as a Remote with some restrictions. Only the Dual Gateway Remote units can be reconfigured as an Access Point. Ethernet Bridge and a Serial Gateway Remotes cannot be reconfigured as Access Point unless they are first upgraded to Dual Gateway type. This is accomplished with an “Authorization Key” purchased from the factory. Each one of these individual software keys is associated with the serial number of the corresponding unit.

Table 1-1. Transceiver Models and Data Interface Services

Model	Type	LAN[1]	COM1[1]
Access Point[3]	N/A	Yes	Yes
Remote…	Ethernet Bridge[2]	Yes	No
	Serial Gateway[2]	No	Yes
	Dual Gateway[3]	Yes	Yes

NOTES
1. Provides access to the embedded Management System on all units.
2. Can be upgraded to Dual Gateway with an Authorization Key.
3. Can be configured as an Access Point or Dual Gateway through the embedded Management System.

1.2 APPLICATIONS

The following sections provide illustrations of typical transceiver installations. This is meant as an overview only. It is recommended that a network manager be involved in all installation planning activities.

1.2.1 Wireless LAN

The wireless LAN is the most common application of the transceiver. It consists of a central control station (Access Point) and one or more associated Remote units, as shown in Figure 1-2 on Page 6. A LAN provides communications between a central WAN/LAN and remote Ethernet segments. The operation of the radio system is transparent to the computer equipment connected to the transceiver.

The Access Point is positioned at a location from which it can communicate with all of the Remote units in the system. Commonly, this is a high location on top of a building or communications tower. Messages are exchanged at the Ethernet level. This includes all types of IP traffic.

A Remote transceiver can only talk over-the-air to an Access Point unit (AP). Peer-to-peer communications between Remotes can only take place indirectly via the AP. In the same fashion, an AP can only talk over-the-air to associated Remote units. Exception: Two APs can communicate with each other “off-the-air” through their Ethernet connectors using a common LAN/WAN.

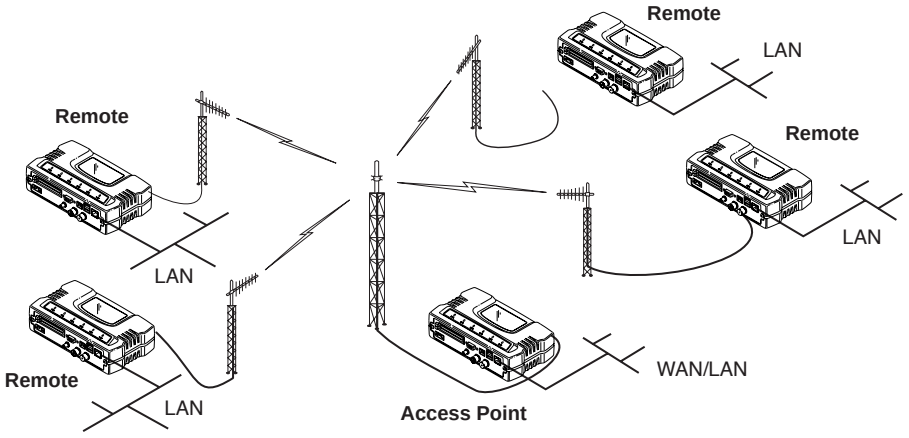


Figure 1-2. Typical Wireless LAN

1.2.2 Point-to-Point LAN Extension

A point-to-point configuration (Figure 1-3) is a simple arrangement consisting of an Access Point and a Remote unit. This provides a communications link for the transfer of data between two locations.

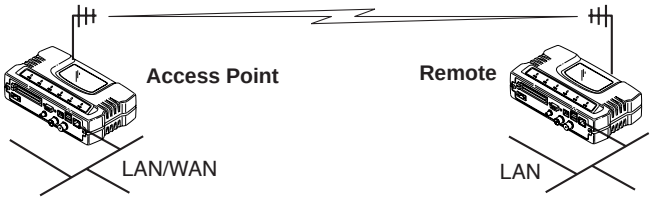


Figure 1-3. Typical Point-to-Point Link

1.2.3 Backhaul for Serial Radio Networks

One of the primary design features of the transceiver is to provide a path for serial devices to migrate to IP/Ethernet. Many radio networks in operation today still rely on serial networks at data rates of 9600 bps or less. These networks can use the transceiver as a means to continue using the serial service, while allowing the rest of the infrastructure to migrate to an IP format.

A Remote transceiver using one serial port for the data stream, and the other for network-wide diagnostics can support operational radio networks built with MDS serial-based radios, such as MDS x790/x710, MDS TransNET and others. In the case of radios using a single port for data and diagnostics, the capabilities are doubled. The data streams are delivered to an IP socket in an application, or in serial format using the Access Point.

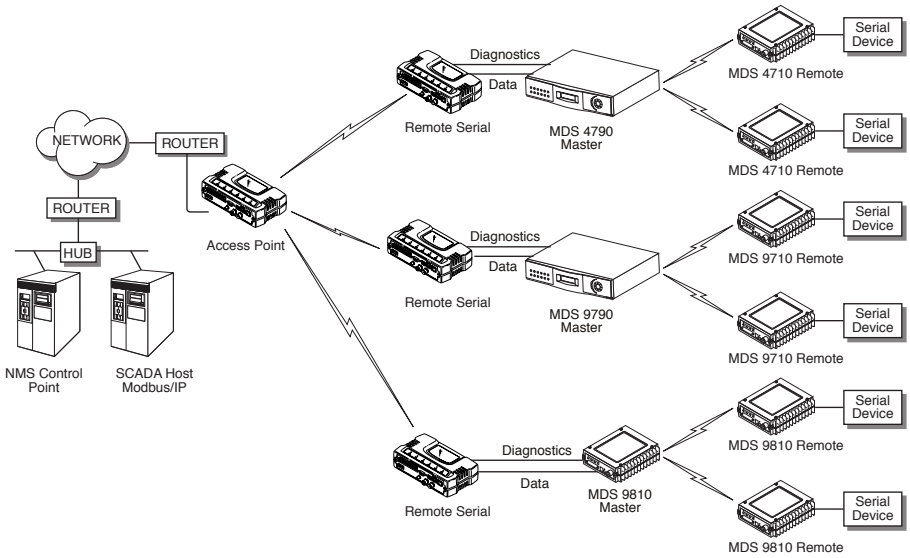


Figure 1-4. Backhaul Network

1.2.4 Multiple Protocols and/or Services

Prior to the introduction of EThernet/IP-based radios, two radios were often used to service two different types of devices (typically connected to different SCADA hosts). A Mercury radio provides this functionality using a single remote unit. Each of the two serial ports can be connected

via IP to different SCADA hosts, transporting different (or the same) protocols. Both data streams are completely independent and the transceiver provides seamless simultaneous operation as shown in Figure 1-5.

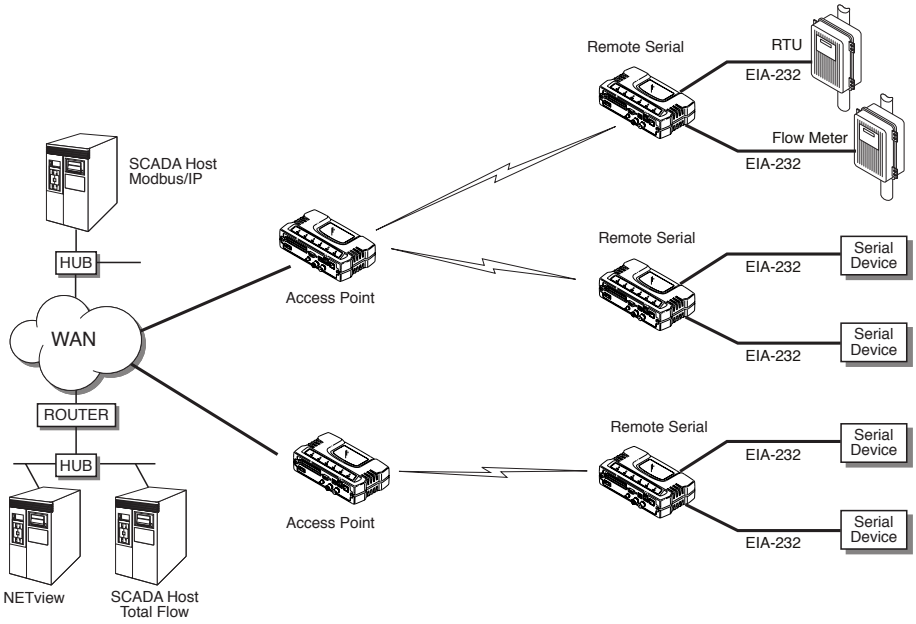


Figure 1-5. Multiple Protocol Network

By using a single radio, the cost of deployment is cut in half. Beyond requiring only one radio instead of two, the biggest cost reduction comes from using half of the required infrastructure at the remote site: one antenna, one feedline, one lightning protector and ancillary hardware. Other cost reductions come from the system as a whole, such as reduced management requirements. And above all, the potential for future applications that run over Ethernet and IP, such as video for remote surveillance.

1.2.5 Wireless LAN with Mixed Services

The transceiver is an excellent solution for a long-range industrial wireless LAN. It offers several advantages over commercial solutions—primarily improved performance over extended distances. The rugged construction of the radio and its extended temperature range make it an ideal solution even in harsh locations. In extreme environments, a simple NEMA enclosure is sufficient to house the unit.

The transceiver trades higher speed for longer range. Commercial 802.11a/b/g solutions are designed to provide service to relatively small areas such as offices, warehouses and homes. They provide high data rates but have limited range. The Mercury transmits at a higher power level, uses a different frequency band, has higher sensitivity, and a narrower channel to concentrate the radio energy and reach farther distances. It is designed for industrial operation from the ground up.

IP-based devices that may be used with the transceiver include a new breed of more powerful Remote Terminal Units (RTUs) and Programmable Logic Controllers (PLCs). These, as well as other devices, may be used in applications ranging from SCADA/telemetry monitoring, web-based video, security monitoring, and voice over IP. Figure 1-6 shows a typical wireless IP network.

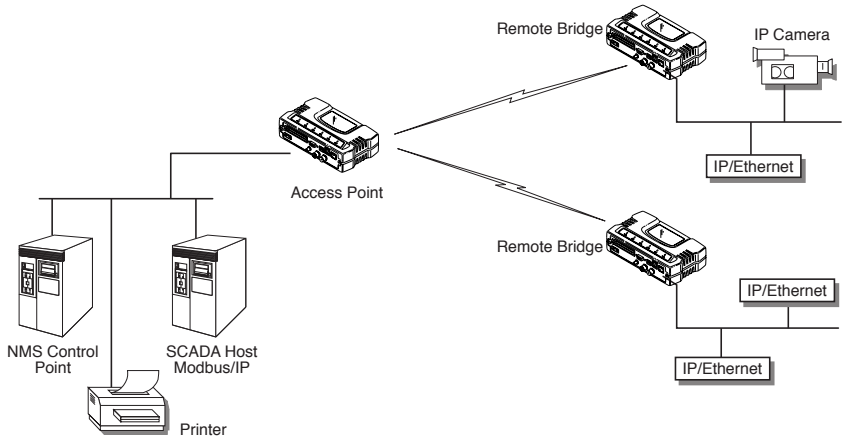


Figure 1-6. Extended-Range LAN with Mixed Applications

1.2.6 Upgrading Older Wireless Network with Serial Interfaces

Millions of wireless data products have been sold in the last two decades for licensed and license-free operation, many of them manufactured by Microwave Data Systems. There are several ways that these systems can benefit from incorporating Mercury equipment. The chief advantages are interface flexibility (serial and Ethernet in one unit), and higher data throughput. By taking advantage of its built-in serial and Ethernet interfaces, the transceiver is well suited to replace leased lines, dial-up lines, or existing MAS 900 MHz data transceivers.

Replacing Legacy Wireless Products

In most cases, legacy radio transceivers supporting serial-interface equipment can be replaced with Mercury transceivers. Legacy equipment can be connected to the transceiver through the COM1 port with a DB-25 to DB-9 cable wired for EIA-232 signaling. The COM1 port supports all standard EIA-232 signaling and acts as a data-terminal equipment device (DTE).

NOTE: Several previous MDS-brand products had non-standard signal lines on their interface connectors (for example, to control sleep functions and alarm lines). These special functions are not provided nor supported by the transceiver. Consult equipment manuals for complete pinout information.

Supplement legacy wireless network with IP services

The Mercury Dual Gateway model can support up to two serial devices and one Ethernet connection at the same time. The serial interface (COM1) operates in two different modes: Connectionless UDP and connection-orientated TCP.

In the UDP mode, the transceiver supports point-to-multipoint serial-port to serial-port connectivity. In the TCP mode, it supports point-to-point Ethernet/IP to serial port connectivity.

For further details on the transceiver's Serial Gateway interface modes, see *"CONFIGURING THE SERIAL INTERFACES"* on Page 62.

1.2.7 High-Speed Mobile Data

Mercury transceivers support high-speed data communications in a mobile environment. Remote radios roam between different Access Points, providing seamless transitions and continuous coverage. For additional information on configuring a mobile network, refer to *Mobile Data Configuration* on Page 59.

1.3 NETWORK DESIGN CONSIDERATIONS

1.3.1 Extending Network Coverage with Repeaters

What is a Repeater System?

A repeater works by re-transmitting data from outlying remote sites to the Access Point and vice-versa. It introduces some additional end-to-end transmission delay but provides longer-range connectivity.

In some geographical areas, obstacles can make communications difficult. These obstacles are commonly large buildings, hills, or dense foliage. These obstacles can often be overcome with a repeater station.

Option 1—Using two transceivers to form a repeater station (back-to-back repeater)

Although the range between fixed transceivers can be up to 40 km (25 miles) over favorable terrain, it is possible to extend the range considerably by connecting two units together at one site in a "back-to-back" fashion to form a repeater, as shown in Figure 1-7. This arrangement should be used whenever the objective is to utilize the maximum range between stations. In this case, using high-gain Yagi antennas at each location will provide more reliable communications than their counterparts—omnidirectional antennas.

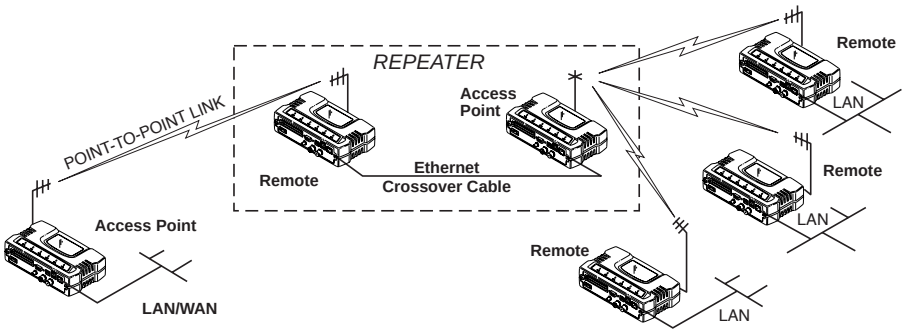


Figure 1-7. Typical LAN with a Repeater Link

Overview

Two transceivers may be connected "back-to-back" through the LAN Ports to form a repeater station. (The cable must be a "cross-over" Ethernet cable for this to work). This configuration is sometimes required in a network that includes a distant Remote that would otherwise be unable to communicate directly with the Access Point station due to distance or terrain.

The geographic location of a repeater station is especially important. A site must be chosen that allows good communication with *both* the Access Point and the outlying Remote site. This is often on top of a hill, building, or other elevated terrain from which both sites can be "seen" by the repeater station antennas. A detailed discussion on the effects of terrain is given in Section 5.1.2, *Site Selection* (beginning on Page 140).

The following paragraphs contain specific requirements for repeater systems.

Antennas

Two antennas are required at this type of repeater station—one for each radio. Measures must be taken to minimize the chance of interference between these antennas. One effective technique for limiting interference is to employ *vertical separation*. In this arrangement, assuming both are vertically polarized, one antenna is mounted *directly* over the other, separated by at least 10 feet (3 Meters). This takes advantage of the minimal radiation exhibited by most antennas directly above and below their driven elements.

Another interference reduction technique is to cross-polarize the repeater antennas. If one antenna is mounted for polarization in the vertical plane, and the other in the horizontal plane, an additional 20 dB of attenuation can be achieved. (Remember that the corresponding stations should use the same antenna orientation when cross-polarization is used.)

Network Name

The two radios that are wired together at the repeater site *must* have different network names. To set or view the network names, see *"STEP 3—CONNECT PC TO THE TRANSCEIVER"* on Page 22 for details.

Option 2—Using the AP as a Store-and-Forward Packet Repeater

A wireless network can be extended through the use of an alternate arrangement using the Access Point as a repeater to re-transmit the signals of all stations in the network. The repeater is a standard transceiver configured as an Access Point, and operating in Store and Forward mode. (See Figure 1-8.)

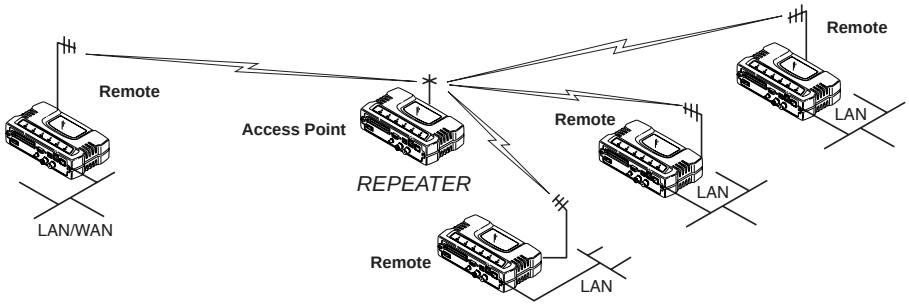


Figure 1-8. Typical network with store-and-forward repeater

As with the conventional repeater described in Option 1 above, the location of a store and forward repeater is also important. A site must be chosen that allows good communication with *both* the Access Point and the outlying Remote site. This can be on the top of a hill, building, or other elevated terrain from which all sites can be “seen” by the repeater station antenna. A detailed discussion on the effects of terrain is given in Section 5.1.2, *Site Selection* (beginning on Page 140)

1.3.2 Protected Network Operation using Multiple Access Points

Although MDS transceivers have a very robust design and have undergone intensive testing before being shipped, it is possible for isolated failures to occur. In mission-critical applications, down time can be virtually eliminated by using some, or all, of the following configurations:

In a point-to-multipoint scenario, the Access Point services multiple remotes. A problem in the Access Point will have an effect on all remotes, since none will have access to the network. When operation of the network does not tolerate any down time, it is possible to set up a protected configuration for the Access Point to greatly reduce the possibility of this occurrence.

Two or more Access Points can be configured with the same Network Name and kept active simultaneously, each with its own independent antenna. In this scenario, Remotes will associate with either one of the available Access Points. In case of a failure of one of the AP’s the Remotes will quickly associate with another of the remaining Access Points re-establishing connectivity to the end devices.

The Access Points are unaware of the existence of the other AP's. Because the hopping algorithm uses *both* the Network Name *and* the Wireless MAC address of the AP to generate the hopping pattern, multiple AP's can coexist—even if they use the same network name. The collocated AP's will be using different hopping patterns and frequencies the great majority of the time. Although some data collisions will occur, the wireless-MAC is built to tolerate and recover from such occurrences with minimal degradation.

1.3.3 Collocating Multiple Radio Networks

Many networks can operate in relatively close physical proximity to one another provided reasonable measures are taken to assure the radio signal of one Access Point is not directed at the antenna of the second Access Point**.**

The Network Name and the association process

The Network Name is the foundation for building individual radio networks. It is part of a beacon signal broadcast by the Access Point (AP) to any Remote units with the same Network Name. Remotes that join the network are referred to as being "associated" with the Access Point unit.

Multiple APs with the same Network Name should be used with care. Using the same Network Name in multiple APs may result in Remotes associating with undesired APs and preventing data exchange from occurring as planned.

The use of a different Network Name does not guarantee an interference-free system. It does however, assure that only data destined for a unique network is passed through to that network.

Co-Location for Multiple Networks

It may be desirable to co-locate Access Points at one location to take advantage of an excellent or premium location that can serve two independent networks. Each network should have unique Network Name and each AP unit's antenna should be provided as much vertical separation as is practical to minimize RFI.

NOTE: All transceivers are shipped with the Network Name set to "Not Programmed." The Network Name must be programmed in order to pass data and begin normal operations.

Can radio frequency interference (RFI) disrupt my wireless network?

When multiple radio networks operate in close physical proximity to other wireless networks, individual units may not operate reliably under weak signal conditions and may be influenced by strong radio signals in adjacent bands. This radio frequency interference cannot be predicted with certainty, and can only be determined by experimentation. If you need to co-locate two units, start by using the largest possible vertical

antenna separation between the two AP antennas on the same support structure. If that does not work, consult with your factory representative about other techniques for controlling radio frequency interference between the radios. (See *"A Word About Radio Interference"* on Page 145 for more details.)

1.4 MDS CYBER SECURITY SUITE

Today the operation and management of an enterprise is becoming increasing dependent on electronic information flow. An accompanying concern becomes the cyber security of the communication infrastructure and the security of the data itself.

The transceiver is capable of dealing with many common security issues. Table 1-2 profiles security risks and how the transceiver provides a solution for minimizing vulnerability.

Table 1-2. Security Risk Management

Security Vulnerability	MDS Cyber Security Solution
Unauthorized access to the backbone network through a foreign remote radio	• 802.1x RADIUS authentication • Approved Remotes List (local) Only those remotes included in the AP list will associate
"Rogue" AP, where a foreign AP takes control of some or all remote radios and thus remote devices	• 802.1x RADIUS authentication • Approved AP List A remote will only associate to those AP included in its local authorized list of AP
Dictionary attacks, where a hacker runs a program that sequentially tries to break a password.	• Failed-login lockdown After 3 tries, the transceiver ignores login requests for 5 minutes. Critical event reports (traps) are generated as well.
Denial of service, where Remote radios could be reconfigured with bad parameters bringing the network down.	•Remote login with SSH or HTTPS •Local console login •Disabled HTTP & Telnet to allow only local management services
Airsnort and other war-driving hackers in parking lots, etc.	•900 MHz operation is not interoperable with standard 802.11b wireless cards •The transceiver cannot be put in a promiscuous mode •Proprietary data framing
Eavesdropping, intercepting messages	•AES-128 encryption •RC4-128 encryption
Key cracking software	• Automatic Rotating Key algorithm

Table 1-2. Security Risk Management

Security Vulnerability	MDS Cyber Security Solution
Replaying messages	• Automatic Rotating Key algorithm
Unprotected access to configuration via SNMPv1	• Implement SNMPv3 secure operation
Intrusion detection	• Provides early warning via SNMP through critical event reports (unauthorized, logging attempts, etc.) • Unauthorized AP MAC address detected at Remote • Unauthorized Remote MAC address detected at AP • Login attempt limit exceeded (Accessed via: Telnet, HTTP, or local) • Successful login/logout (Accessed via: Telnet, HTTP, or local)

1.5 ACCESSORIES

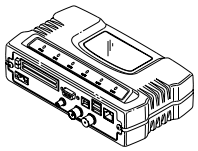
The transceiver can be used with one or more of the accessories listed in Table 1-3. Contact the factory for ordering details.

Table 1-3. Accessories

Accessory	Description	MDS Part No.
AC Power Adapter Kit	A small power supply module designed for continuous service. UL approved. Input: 120/220; Output: 13.8 Vdc @ 2.5 A	01-3682A02
Omni-Directional Antennas	Rugged antennas well suited for use at Access Point installations. Consult with your factory Sales Representative for details	Call factory
Yagi Antenna (Directional)	Rugged antennas well suited for use at Remote installations. Consult with your factory Sales Representative for details.	Call factory
GPS Receiving Antenna (Powered)	Attaches to GPS coaxial connector on front panel of the transceiver. One popular type is the Antenna Specialists K721GPS Amplified Antenna.	Call factory
TNC Male-to-N Female Adapter	One-piece RF adaptor plug.	97-1677A161
TNC Male-to-N Female Adapter Cable	Short length of coaxial cable used to connect the radio's TNC antenna connector to a Type N commonly used on large diameter coaxial cables.	97-1677A159 (3 ft./1m) 97-1677A160 (6 ft./1.8m)
Ethernet RJ-45 Crossover Cable (CAT5)	Cable assembly used to cross-connect the Ethernet ports of two transceivers used in a repeater configuration. (Cable length ≈ 3 ft./1M)	97-1870A21

Table 1-3. Accessories *(Continued)*

Accessory	Description	MDS Part No.
2-Pin Power Plug	Mates with power connector on transceiver. Screw terminals provided for wires, threaded locking screws to prevent accidental disconnect.	73-1194A39
Ethernet RJ-45 Straight-thru Cable (CAT5)	Cable assembly used to connect an Ethernet device to the transceiver. Both ends of the cable are wired identically. (Cable length ≈ 3 ft./1M)	97-1870A20
EIA-232 Shielded Data Cable	Shielded cable terminated with a DB-25 male connector on one end, and a DB-9 female on the other end. Two lengths available (see part numbers at right).	97-3035L06 (6 ft./1.8m) 97-3035L15 (15 ft./4.6m)
EIA-232 Shielded Data Cable	Shielded cable terminated with a DB-9 male connector on one end, and a DB-9 female on the other end, 6 ft./1.8m long.	97-1971A03
Fuse	Small, board-mounted fuse used to protect against over-current conditions.	29-1784A03
Flat-Surface Mounting Brackets & Screws	Brackets: 2″ x 3″ plates designed to be screwed onto the bottom of the unit for surface-mounting the radio.	82-1753-A01
	Screws: 6-32/1/4″ with locking adhesive. (Industry Standard MS 51957-26)	70-2620-A01
DIN Rail Mounting Bracket	Bracket used to mount the transceiver to standard 35 mm DIN rails commonly found in equipment cabinets and panels.	03-4022A02
COM1 Interface Adapter	DB-25(F) to DB-9(M) shielded cable assembly (6 ft./1.8 m) for connection of equipment or other EIA-232 serial devices previously connected to “legacy” units. (Consult factory for other lengths and variations.)	97-3035A06
Bandpass Filter	Antenna system filter that helps eliminate interference from nearby paging transmitters.	20-2822A02
Ethernet Surge Suppressor	Surge suppressor for protection of Ethernet port against lightning.	29-4018A01



2 TABLETOP EVALUATION AND TEST SETUP

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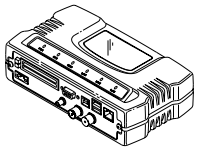


2.1 OVERVIEW

It is recommended that a “tabletop network” be set up to verify the basic operation of the transceivers. This allows experimenting with network designs, configurations or network equipment in a convenient location. This test can be performed with any number of radios.

When you are satisfied that the network is functioning properly in a benchtop setting, field installation can be performed. Complete information for field installation, including mounting dimensions and antenna selection, is provided in *INSTALLATION PLANNING* on Page 139

For the following evaluation, one of the transceivers in the network must be set to Access Point service (**Device Mode = Access Point**) for proper operation.

NOTE: It is important to use a “Network Name” that is different from any currently in use in your area during the testing period.

To simulate data traffic over the radio network, connect a PC or LAN to the Ethernet port of the Access Point and PING each *transceiver* several times.

2.2 STEP 1—INSTALL THE ANTENNA CABLING

Figure 2-1 is a drawing of the tabletop arrangement. Connect the antenna ports of each transceiver as shown. This provides stable radio communications between each unit and prevents interference to nearby electronic equipment.

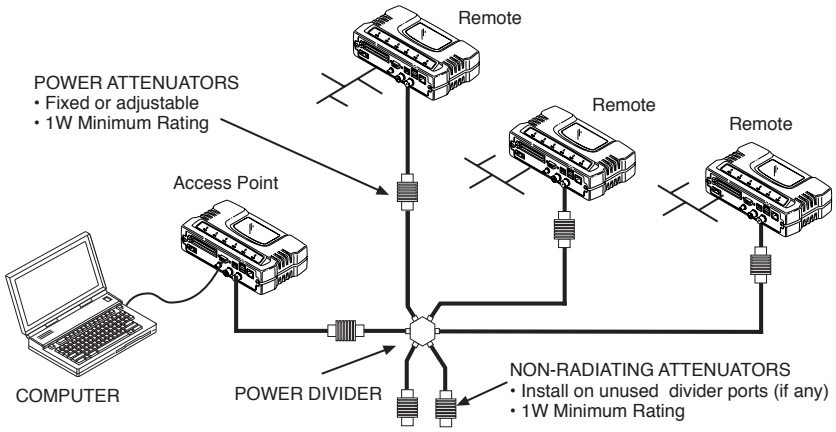


Figure 2-1. Typical setup for tabletop-testing of radios

NOTE: It is very important to use attenuation between all units in the test setup. The amount of attenuation required will depend on the number of units being tested and the desired signal strength (RSSI) at each transceiver during the test. In no case should a signal greater than –50 dBm be applied to any transceiver in the test setup. An RF power output level of +20 dBm is recommended from the transceivers. (See *"Radio Configuration Menu"* on Page 52.)

2.3 STEP 2—MEASURE & CONNECT THE PRIMARY POWER

The primary power at the transceiver's power connector must be within 10–30 Vdc and be capable of continuously providing 15 Watts (typical power consumptions are: 760 mA @ 10.5 Vdc, 580 mA @ 13.8 Vdc, and 267 mA @ 30 Vdc).

A Phoenix two-pole power connector with screw-terminals is provided with each unit. Strip the wire leads to 6 mm (0.25"). Be sure to observe proper polarity with the positive lead (+) on the left and negative (–) on the right.

NOTE: It will take about 45 seconds for the transceiver to power up and be ready for operation.

CAUTION
POSSIBLE EQUIPMENT DAMAGE

The transceiver must only be used with negative-ground power systems. Make sure the polarity of the power source is correct.

2.4 STEP 3—CONNECT PC TO THE TRANSCEIVER

Connect a PC's Ethernet port to the LAN port using an Ethernet cross-over cable. The LAN LED should light. Alternatively, you can use a serial cable to connect to the COM1 port. (Figure 2-2 on Page 25)

2.5 STEP 4—REVIEW TRANSCEIVER CONFIGURATION

2.5.1 Getting Started

Start by logging into the Access Point radio. This is done first because the Remotes are dependent on the AP's beacon signal to achieve an "associated" state.

NOTE: Transceivers are shipped from the factory set to the "**Remote**" mode unless they are marked differently.

Once the Access Point is up and running, move the computer connection to each of the Remote units, log-in at each unit, review their configuration, set their IP addresses and Network Name and wait for each to achieve an associated state.

With all units associated, you will be ready to connect and test your data services.

2.5.2 Procedure

The following is a summary of the configuration procedure that must be done on each unit in the system. Key parameters are shown on the Embedded Management System overview (Figure 3-1 on Page 32). A lists of parameters can found in two tables: Table 4-5 on Page 129 and Table 4-7 on Page 132. Detailed information on using the Management System can be found in *MS INTRODUCTION* on Page 31.

NOTE: The Management System supports the use of "configuration files" to aid in uniformly configuring multiple units. These are detailed in *Using Configuration Scripts* on Page 107.

2.5.3 Basic Configuration Defaults

Table 2-1 provides a selection of key operating parameters, their range, and default values. All of these are accessible through a terminal emulator connected to the COM1 serial port or through a Web browser connected to the LAN Port. (See Figure 5-1 on Page 139 for hookup.)

NOTE: Access to the transceiver's Management System and changes to some parameters, are controlled by password to maintain security.

Table 2-1. Basic Configuration Defaults

Item	Menu Location	Default	Values/Range
Device Mode[1]	Main Menu>> Network Configuration>> Device Mode	Marked on unit's ID label	• Access Point • Dual Remote • Serial Gateway • Ethernet Bridge
Network Name	Main Menu>> Network Configuration>> Network Name	"Not Programmed"	• 1–15 alphanumeric characters • Case-sensitive; can be mixed case
IP Address	Main Menu>> Network Configuration>> IP Address	192.168.1.1	Contact your network administrator
RF Output Power	Main Menu>> Radio Configuration>> RF Output Power	30 dBm (1.0 Watt)	20–30 dBm @ 50Ω (0.1–1.0 Watts)
Unit Password	Main Menu>> Device Information>> User Password	admin (lower case)	• 1–8 alphanumeric characters • Case-sensitive; can be mixed case

1. Ethernet Bridge and Serial Gateway will not be displayed if a superior mode is authorized for this unit.

A unique IP address and subnet are required to access the browser-based Management System either through the LAN port, or remotely over-the-air.

2.6 STEP 5—CONNECT LAN AND/OR SERIAL EQUIPMENT

Connect a local area network to the LAN port or a serial device to the COM1 (DCE) port. The LAN port will support any Ethernet-compatible equipment. This includes devices that use Internet Protocol (IP).

NOTE: If you configure COM1 for payload data service while you are plugged into it, you will not be able to access the built-in management system. Alternate methods for accessing the management system are: use Telnet or the web browser through the Ethernet port; use Telnet or the web browser over the air (remote management from another radio).

Figure 2-2 shows the interface connectors on the front panel of the transceiver.

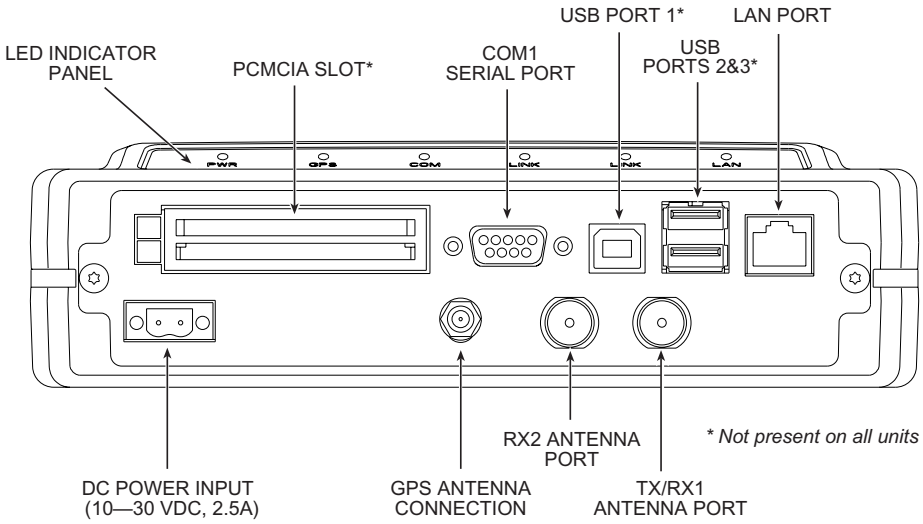


Figure 2-2. Transceiver Interface Connectors

- **LED INDICATOR PANEL**—Displays the basic operating status of the transceiver. Section 2.7 contains detailed information.
- **PCMCIA SLOT**— Connector slot that conforms to the standard established by the Personal Computer Memory Card International Association. Can be used for a wireless card or other PCMCIA device. *Not present on all units.*
- **COM1 SERIAL PORT**— DB-9 connector used for management of the transceiver via a connected PC. *MS INTRODUCTION* on Page 31 provides complete connection details.
- **USB PORT 1**—Universal Serial Bus connector conforming to the Type-B standard. *Not present on all units.*
- **USB PORTS 2 & 3**—Two Universal Serial Bus connectors conforming to the Type-A standard. *Not present on all units.*
- **LAN PORT**—Connection point for Ethernet Local Area Network.
- **PWR**— DC power connection for the transceiver. Power source must be 10–30 Vdc, negative ground, and capable of furnishing at least 10 watts.
- **GPS ANTENNA PORT**— Coaxial connector (SMA-type) for connection of a Global Positioning System receiving antenna. Compatible with powered GPS antennas.
- **RX2 ANTENNA PORT**— Coaxial connector (TNC-type) for attachment of a second receiving antenna used in space diversity arrangements.
- **TX/RX1 ANTENNA PORT**— Coaxial connector (TNC-type) for attachment of the main station antenna (transmit and receive).

2.7 STEP 6—CHECK FOR NORMAL OPERATION

Once the data equipment is connected, you are ready to check the transceiver for normal operation.

Observe the LEDs on the top cover for the proper indications. In a normally operating system, the following LED indications will be seen within 45seconds of start-up:

- PWR—Lit continuously
- LINK—On, or blinking intermittently to indicate traffic flow
- LAN—On, or blinking intermittently to indicate traffic flow

Figure 2-3 shows a close-up view of the transceiver's LED Indicator panel. Table 2-2 provides details on each LED function.

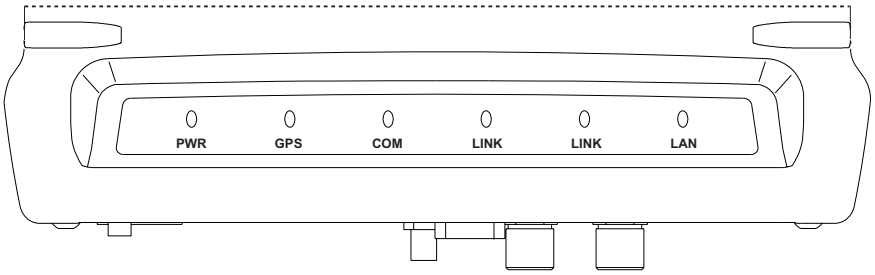


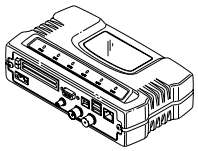
Figure 2-3. LED Indicator Panel

If the radio network seems to be operating properly based on observa-

Table 2-2. Transceiver LED Functions

LED Label	Activity	Indication
PWR	ON	Primary power (DC) present
	Blinking	Unit in “Alarmed” state
	OFF	Primary power (DC) absent
GPS	ON	Internal GPS receiver is synchronized with the satellite network.
	OFF	Internal GPS receiver is not synchronized with the satellite network.
COM (MGT System)	Blinking	Data TX/RX
	OFF	No data activity
LINK (Access Point)	ON	Default state
	Blinking	Data Tx/Rx
	OFF	Traffic exceeds the capacity of the radio network
LINK (Remote Gateway)	ON	Associated to AP
	Blinking	Data Tx/Rx
	OFF	Not associated with AP
LAN	ON	LAN detected
	Blinking	Data TX/RX
	OFF	LAN not detected, or excessive traffic present

tion of the unit’s LEDs, you can use the **PING** command to verify the link integrity with the Access Point. This command can also be used to point your browser to another Remote unit’s IP address in the same network.



3 EMBEDDED MANAGEMENT SYSTEM

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3.1 MS INTRODUCTION

The transceiver's embedded management system is accessible through various data interfaces. These include the COM1 (serial) port, LAN (Ethernet) port, and via SNMP. Essentially the same capabilities are available through any of these paths.

For support of SNMP software, a set of MIB files is available for download from the MDS Web site at **www.microwavedata.com**. A brief summary of SNMP commands can be found at *SNMP Agent Configuration* section on Page 50 of this manual.

The transceiver's Management System and its functions are divided into seven functional groups as listed below.

- Section 3.3, *BASIC DEVICE INFORMATION* (beginning on Page 40)
- Section 3.4, *CONFIGURING NETWORK PARAMETERS* (beginning on Page 44)
- Section 3.5, *RADIO CONFIGURATION* (beginning on Page 52)
- Section 3.6, *CONFIGURING THE SERIAL INTERFACES* (beginning on Page 62)
- Section 3.7, *CYBER SECURITY CONFIGURATION* (beginning on Page 78)
- Section 3.8, *PERFORMANCE VERIFICATION* (beginning on Page 85)
- Section 3.9, *MAINTENANCE* (beginning on Page 100)

Each of these sections has a focus that is reflected in its heading. The section you are now reading provides information on connecting to the Management System, how to navigate through it, how it is structured, and how to perform top-level configuration tasks. Figure 3-1 on the following page shows a top-level view of the Management System (MS).

3.1.1 Differences in the User Interfaces

There are slight differences in navigation among the user interfaces, but for the most part, the content is the same. You will notice a few differences in capabilities as the communications tool is driven by limitations of the access channel. Figure 3-2 and Figure 3-3 show examples of the Starting Information Screen as seen through a console terminal and a web-browser, respectively.

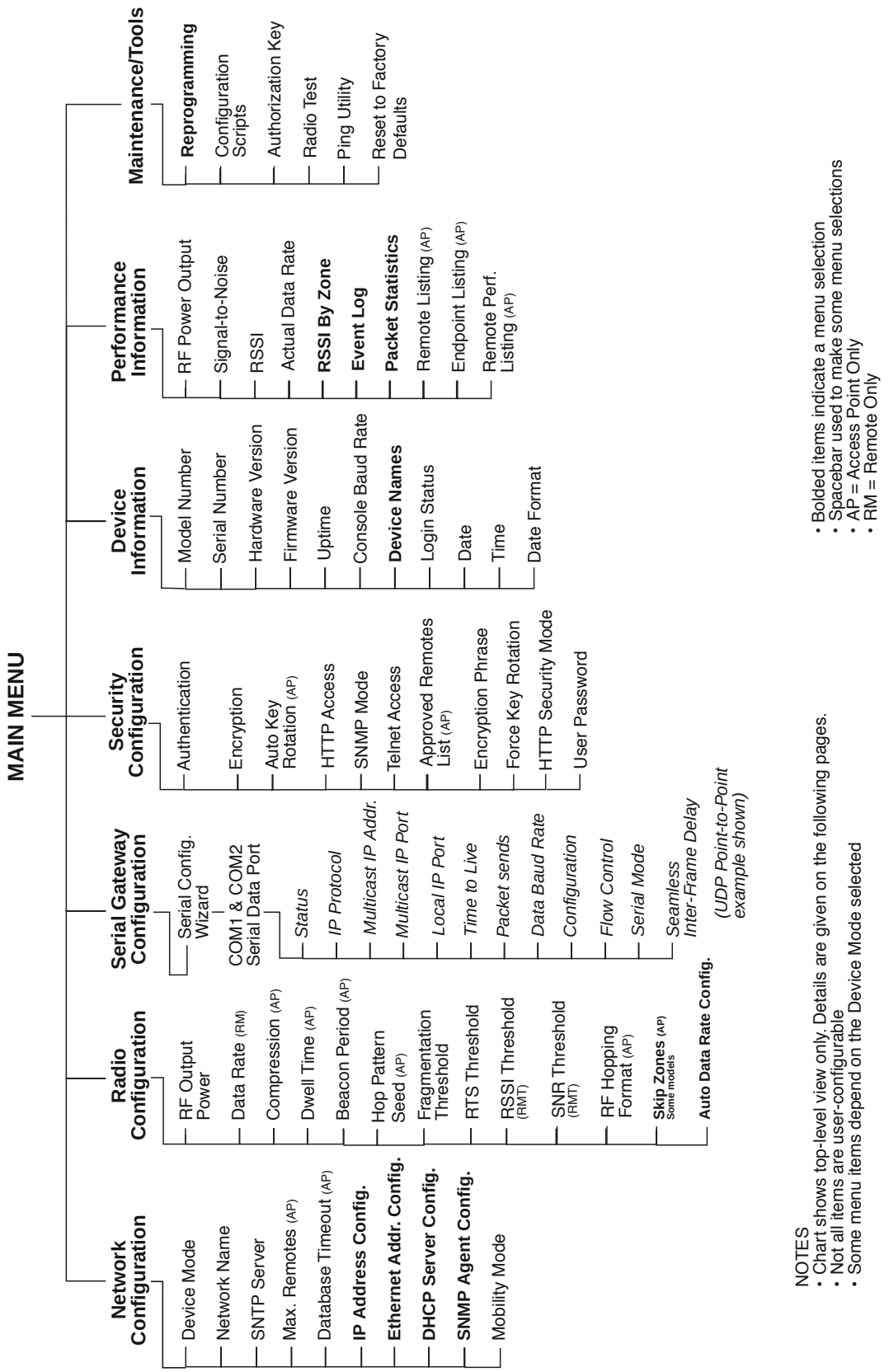

Figure 3-1. Embedded Management System—Top-level Flowchart

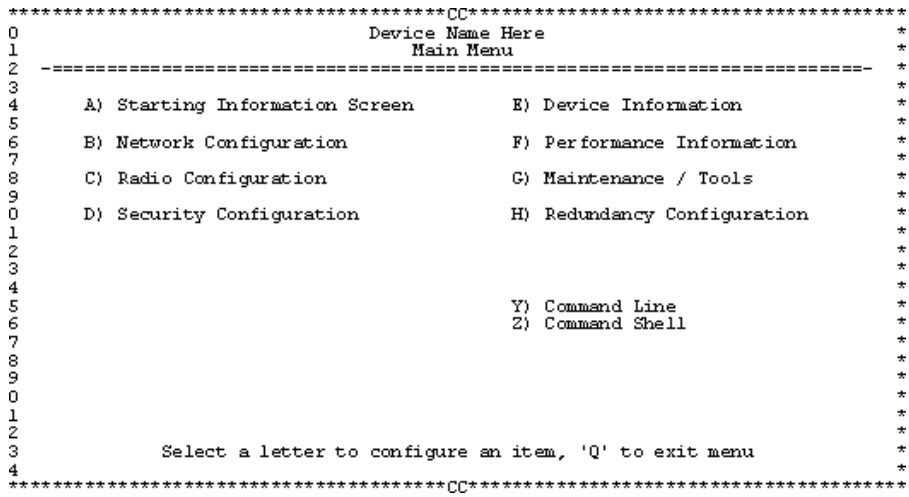

Figure 3-2. View of MS with a text-based program—
(Terminal Emulator shown—Telnet has similar menu structure)

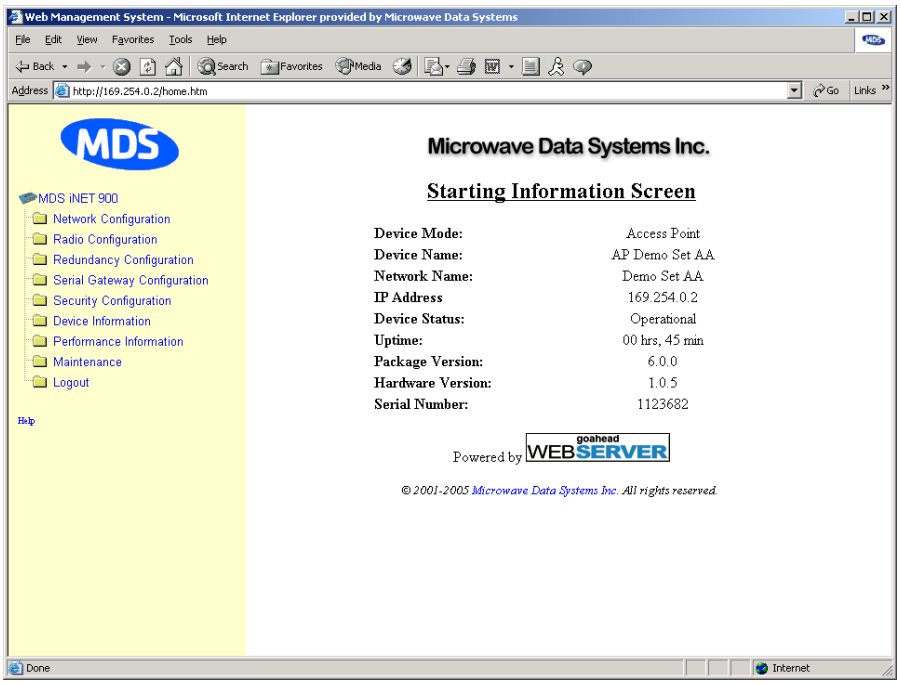

Figure 3-3. View of the MS with a Browser
(Selections at left provide links to the various menus)

3.2 ACCESSING THE MENU SYSTEM

The radio has no external controls. All configuration, diagnostics and control is performed electronically using a connected PC. This section explains how to connect a PC, log into the unit, and gain access to the built-in menu screens.

3.2.1 Methods of Control

The unit's configuration menus may be accessed in one of several ways:

- **Local Console**—*This is the primary method used for the examples in this manual*. Connect a PC directly to the COM 1 port using a serial communications cable and launch a terminal communications program such as HyperTerminal. This method provides text-based access to the unit's menu screens. Console control is a hardware-based technique, and is intended for local use only.
- **Telnet or SSH***—Connect a PC to the unit's LAN port, either directly or via a network, and launch a Telnet session. This method provides text-based access to the unit's menu screens in a manner similar to a Local Console session. Telnet sessions may be run locally or remotely through an IP connection.
- **Web Browser***—Connect a PC to the unit's LAN port, either directly or via a network, and launch a web browser session (*i.e.*, Internet Explorer, Netscape, etc.) This method provides a graphical representation of each screen, just as you would see when viewing an Internet website. The appearance of menu screens differs slightly from other methods of control, but the content and organization of screen items is similar. Web browser sessions may be run locally or remotely via the Internet.

* Telnet, SSH and Web Browser sessions require the use of a *straight-through* or *crossover* Ethernet cable, depending on the whether the PC-to-radio connection is made directly, or through a network. For direct connection, a **crossover** cable is required; For connection via a network, a **straight-through** type is needed.

Cable type can be identified as follows: Hold the two cable ends side-by-side and in the same plug orientation (*i.e.*, both locking tabs up or down). Now look at the individual wire colors on each plug. If the wires on both plugs are ordered in the same sequence from left to right, the cable is a straight-through type. If they are not in the same order, it *may* be a crossover cable, or it may be wired for some other application. Refer to *DATA INTERFACE CONNECTORS* on Page 153 for detailed pinout information.

3.2.2 PC Connection & Log In Procedures

The following steps describe how to access the radio's menu system. These steps require a PC to be connected to the unit's COM 1 or LAN port as shown in Figure 3-4.

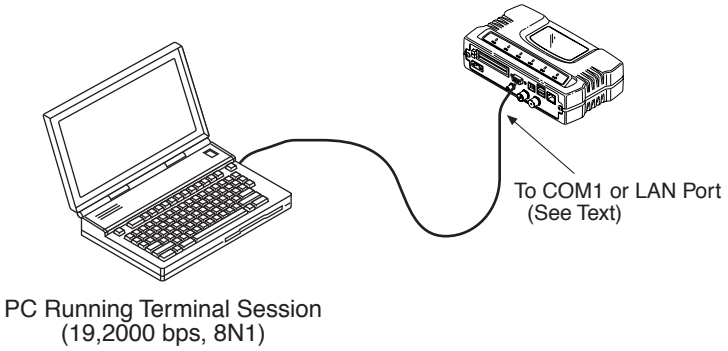

Figure 3-4. PC Configuration Setup

Starting a Local Console Session (Recommended for first-time log-in)

1. Connect a serial communications cable between the PC and the unit's COM 1 port. If necessary, a cable may be constructed for this purpose as shown in Figure 3-5.

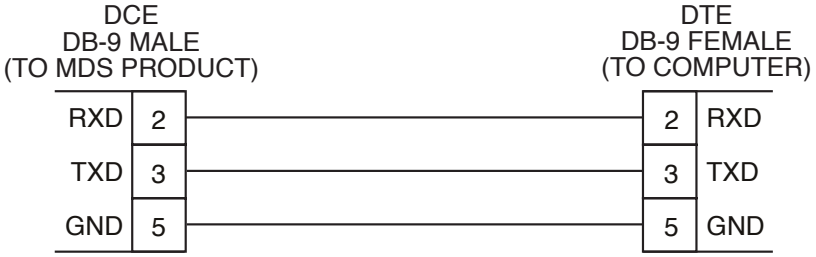

Figure 3-5. Serial Communications Cable (DB-9M to DB-9F)
(Maximum Recommended Cable Length 50 Feet/15 meters)

2. Launch a terminal emulation program such as HyperTerminal and configure the program with the following settings:
   - 19,200 bps data rate
   - 8 data bits, no parity
   - One stop bit, and no flow-control
   - Use ANSI or VT100 emulation.

TIP: The HyperTerminal communications program can be accessed on most PCs by selecting this menu sequence: **Start>>Programs>>Accessories>>Communications>>HyperTerminal.**

NOTE: Early versions of PuTTY may not operate when using SSH to connect to the transceiver. The latest version (beta 0.58 at the time of publication) does *not* work with the transceiver's internal server. However, the latest development snapshot does work properly. Both the latest released and the latest development snapshot can be downloaded from: **www.chiark.greenend.org.uk/~sgtatham/putty/.**

NOTE: If the unit is powered-up or rebooted while connected to a terminal, you will see a series of pages of text information relating to the booting of the unit's microcomputer. Wait for the log-in screen before proceeding.

3. Press the ENTER key to receive the **login:** prompt.

4. Enter the username (default username is **admin**). Press ENTER.

5. Enter your password (default password is **admin**). (For security, your password keystrokes do not appear on the screen.) Press ENTER.

NOTE: Passwords are case sensitive. Do not use punctuation mark characters. You may use up to eight alpha-numeric characters.

The unit responds with the Starting Information Screen (Figure 3-6). From here, you can review basic information about the unit or press **G** to proceed to the Main Menu.

```
****************************************CC****************************************
0                                MDS Mercury 900                                 *
1                          Starting Information Screen                          *
2  -=========================================================================-   *
3                                                                               *
4                          Device Mode        Remote                            *
5                                                                               *
6                          Device Name        Remote #3                         *
7                                                                               *
8                          Network Name       mds-wlan                          *
9                                                                               *
0                          IP Address         192.168.1.1                       *
1                                                                               *
2                       A) Device Status      Alarmed                           *
3                                                                               *
4                          Connection Status  Scanning                          *
5                                                                               *
6                          Uptime             2 days, 02 hours                  *
7                          Firmware Version   1.0.0                             *
8                          Hardware Version   1.0.0                             *
9                          Serial Number      1354242                           *
0                                                                               *
1                                                                               *
2                                                                               *
3             Select a letter to configure an item, 'Q' to exit menu            *
4                                                                               *
****************************************CC****************************************
```

Figure 3-6. Starting Information Screen—Local Console Session
(Telnet has similar menu structure)

Starting a Telnet Session

NOTE: This method requires that you know the IP address of the unit beforehand. If you do not know the address, use the Local Console method (above) and access the *Starting Information Screen*. The address is displayed on this screen.

1. Connect a PC to the unit's LAN port, either directly or via a network. If connecting directly, use an Ethernet *crossover* cable; if connecting via a network, use a *straight-through* cable. The LAN LED lights to indicate an active connection.

NOTE: When using Ethernet to access the unit, it may be necessary to change your computer's IP access to be compatible with the radio IP address. You can identify or verify the unit's IP address by using a Local Console session to communicate with the radio through its COM 1 Port and viewing the *Starting Information Screen*.

2. Start the Telnet program on your computer targeting the IP address of the unit to which you are connected. and press ENTER.

TIP: A Telnet session can be started on most PCs by selecting: **Start>>Programs>>Accessories>>Command Prompt**. At the command prompt window, type the word **telnet**, followed by the unit's IP address (*e.g.*, **telnet 10.1.1.168**). Press ENTER to receive the Telnet log in screen.

NOTE: Never connect multiple units to a network with the same IP address. Address conflicts will result in improper operation.

3. Enter your username (default username is **admin**). Press ENTER.

   Next, the **Password:** prompt appears. Enter your password (default password is **admin**). (For security, your password keystrokes will not appear on the screen.) Press ENTER.

   The unit responds with a Starting Information Screen (see Figure 3-6). From here, you can review basic information about the unit or press **G** to proceed to the Main Menu.

NOTE: Passwords are case sensitive. Do not use punctuation mark characters. You may use up to eight alpha-numeric characters.

Starting a Web Browser Session

NOTE: Web access requires that you know the IP address of the unit you are connecting to. If you do not know the address, start a Local Console session (see *Starting a Local Console Session (Recommended for first-time log-in)* on Page 35) and access the *Starting Information Screen*. The IP address is displayed on this screen.

1. Connect a PC to the unit's LAN port, either directly or via a network. If connecting directly, use an Ethernet *crossover* cable; if connecting via a network, use a *straight-through* cable. The LAN LED lights to indicate an active connection.

2. Launch a Web-browser session on your computer (*i.e.*, Internet Explorer, Netscape Navigator, etc.).

3. Type in the unit's IP address and press ENTER.

4. A log-in screen is displayed (Figure 3-7) where you enter a user name and password to access the unit's menu system. Note that the default entries are made in *lower case*. (Default User Name: **admin**; Default Password: **admin**)

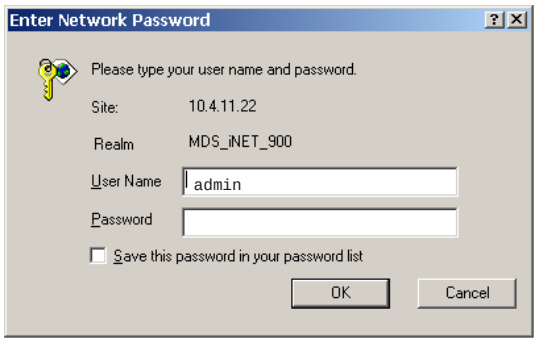

Figure 3-7. Log-in Screen when using a Web Browser

NOTE: Passwords are case sensitive. Do not use punctuation mark characters. You may use up to eight alpha-numeric characters.

5. Click **OK**. The unit responds with a startup menu screen similar to that shown in Figure 3-8. From here, you can review basic information about the unit or click on one of the menu items at the left side of the screen.

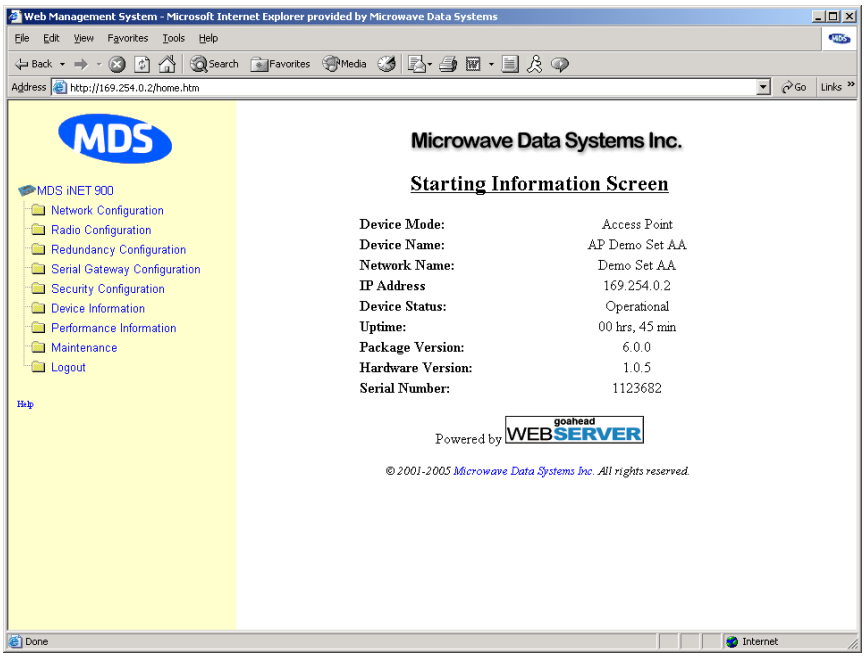

Figure 3-8. Starting Information Screen—Web Browser Example

3.2.3 Navigating the Menus

Via Terminal Telnet or SSH Sessions

Recommended for first-time log-in

Local Console Telnet and SSH sessions use multi-layered text menu systems that are nearly identical. To move further down a menu tree, you type the letter assigned to an item of interest. This takes you to an associated screen where settings may be viewed, or changed. In most cases, pressing the ESCAPE key moves the screen back one level in the menu tree.

In general, the top portion of menu screens show *read-only* information (with no user selection letter). The bottom portion of the screen contains parameters that can be selected for further information, alteration of values, or to navigate to other submenus.

When you arrive at a screen with user-controllable parameter fields, you select the menu item by pressing an associated letter on the keyboard. If there is a user definable value, the field will clear to the right of the menu item and you can type in the value you wish to use. Follow this action by pressing the ENTER key to save the changes. If you make a mistake or change your mind before pressing the ENTER key, simply press ESCAPE to restore the previous value.

In some cases, when you type a letter to select a parameter, you will see a prompt at the bottom of the screen that says **Choose an Option**. In these screens, press the keyboard's SPACEBAR to step through the available selections. When the desired option appears, press the ENTER key to choose that selection. In some cases, several parameters may be changed and then saved by a single keystroke. The ESCAPE key can be used to cancel the action and restore the previous values.

Logging Out Via Terminal Emulator or Telnet

From the Main Menu screen, press **Q** to quit and terminate the session.

Navigating via Web Browser

Navigating with a Web browser is straightforward with a framed "homepage." The primary navigation menu is permanently located on the left-hand side of this page. Simply click on a desired menu item to bring it to the forefront.

NOTE: To maintain security, it is best to log-out of the menu system entirely when you are done working with it. If you do not log out, the session automatically ends after 10 minutes of inactivity.

Logging Out Via Web Browser

Click on **Logout** in the left-hand frame of the browser window. The right-hand frame will change to a logout page. Follow the remaining instructions on this screen.

NOTE: In the menu descriptions that follow, parameter options/range, and any default values are displayed at the end of the text between square brackets. Note that the default setting is always shown after a semicolon: [**available settings or range; default setting**]

3.3 BASIC DEVICE INFORMATION

This section contains detailed menu screens and settings that you can use to specify the behavior of the unit.

3.3.1 Starting Information Screen

Once you have logged into the Management System, you will be presented with a screen that provides an overview of the transceiver and its current operating condition. It provides an array of vital information and operating conditions.

```
****************************************CC****************************************
0                                 MDS Mercury 900                                *
1                            Starting Information Screen                         *
2  -=====================================================================-       *
3                                                                                *
4                            Device Mode        Remote                           *
5                                                                                *
6                            Device Name        Remote #3                        *
7                                                                                *
8                            Network Name       mds-wlan                         *
9                                                                                *
0                            IP Address         192.168.1.1                      *
1                                                                                *
2                         A) Device Status      Alarmed                          *
3                                                                                *
4                            Connection Status  Scanning                         *
5                                                                                *
6                            Uptime             2 days, 02 hours                 *
7                            Firmware Version   1.0.0                            *
8                            Hardware Version   1.0.0                            *
9                            Serial Number      1354242                          *
0                                                                                *
1                                                                                *
2                                                                                *
3              Select a letter to configure an item, 'Q' to exit menu            *
4                                                                                *
****************************************CC****************************************
```

Figure 3-9. Starting Information Screen

- **Device Mode**—Current operating mode of the unit as it relates to the radio network.
- **Device Name**—This is a user-defined parameter that will appear in the heading of all pages.
  (To change it, see *Network Configuration Menu* on Page 44.)
- **Network Name**—The name of the radio network in which the unit is associated.
- **IP Address**—Unit's IP address [**192.168.1.1**]
- **Device Status**—Condition of the unit's association with an Access Point.

  At the Access Point:
  - *Alarmed*—A alarm event has been logged and not cleared.
  - *Operational*—Unit operating normally.

  At a Remote:

- *Scanning*—The unit is looking for an Access Point beacon signal.
- *Exp(ecting) Sync(hronization)*—The unit has found a valid beacon signal for its network.
- *Hop Sync*—The unit has changed its frequency hopping pattern to match that of the Access Point.
- *Associated* —This unit has successfully synchronized and associated with an Access Point.
- *Alarmed*—The unit is has detected one or more alarms that have not been cleared.

NOTE: If an alarm is present when this screen is displayed, an "A)" appears to the left of the **Device Status** field. Pressing the "A" key on your keyboard takes you directly to the "Current Alarms" screen.

- **Uptime**—Elapsed time since the transceiver was powered-up.
- **Firmware Version**—Version of firmware that is currently active in the unit.
- **Hardware Version**— Hardware version of the transceiver's printed circuit board.
- **Serial Number**—Make a record of this number. It must be provided to purchase Authorization Keys to upgrade unit capabilities. (See *"Authorization Keys Menu"* on Page 114.)

3.3.2 Main Menu

The next screen, the Main Menu, is the entryway to all user-controllable features. The transceiver's **Device Name** appears at the top of this and all other screens as a reminder of the unit that is currently being controlled

```
****************************************CC****************************************
0                                Device Name Here                                *
1                                    Main Menu                                   *
2  -=========================================================================-   *
3                                                                                *
4      A) Starting Information Screen         E) Device Information             *
5                                                                                *
6      B) Network Configuration               F) Performance Information        *
7                                                                                *
8      C) Radio Configuration                 G) Maintenance / Tools            *
9                                                                                *
0      D) Security Configuration              H) Redundancy Configuration       *
1                                                                                *
2                                                                                *
3                                                                                *
4                                                                                *
5                                             Y) Command Line                    *
6                                             Z) Command Shell                   *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3            Select a letter to configure an item, 'Q' to exit menu              *
4                                                                                *
****************************************CC****************************************
```

Figure 3-10. Main Menu

- **Starting Information Screen**—Select this item to return to the start-up screen. (See *"Starting Information Screen"* on Page 40)
- **Network Configuration**—Tools to configure the data network layer of the transceiver. (See *"Network Configuration Menu"* on Page 44)
- **Radio Configuration**—Tools to configure the wireless (radio) layer of the transceiver. (See *"Radio Configuration Menu"* on Page 52)
- **Serial Gateway Configuration**—Tools to configure the two serial ports. (See *"Serial Data Port Configuration Menu"* on Page 65)
- **Security Configuration**—Tools to configure the security services available with the transceiver's environment. (See *"MDS CYBER SECURITY SUITE"* on Page 14)
- **Device Information**—Top level user-specific and definable parameters, such as unit password. (See *"Device Information"* on Page 42)
- **Performance Information**—Tools to measure the radio and data layer's performance of the radio network. (See *"Performance Information Menu"* on Page 85)
- **Maintenance/Tools**—Tools to use configuration files, change firmware and use Authorization Keys to change major unit capabilities. (See *"Authorization Keys Menu"* on Page 114)

3.3.3 Configuring Basic Device Parameters

Device Information

Below is the menu/screen that displays basic administrative data on the unit to which you are connected. It also provides access to some user-specific parameters such as device names.

```
****************************************CC****************************************
0                              Device Name Here                                  *
1                             Device Information Menu                            *
2  -=========================================================================-   *
3                                                                                *
4                    Model             MDS Mercury 900                           *
5                                                                                *
6                    Serial Number     1354242                                   *
7                                                                                *
8                    Uptime            2 days, 02 hours                          *
9                                                                                *
0                                                                                *
1      A) Date        01 Jan 2005            D) Console Baud Rate  115200        *
2                                                                                *
3      B) Time        04:55                  E) UTC Time Offset    0 hrs         *
4                                                                                *
5      C) Date Format Generic                F) Device Names                     *
6                                                                                *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3             Select a letter to configure an item, 'Q' to exit menu             *
4                                                                                *
****************************************CC****************************************
```

Figure 3-11. Device Information Menu

- **Model Number** *(Display only)*
- **Serial Number** *(Display only)*

- **Hardware Version** *(Display only)*
- **Firmware Version** *(Display only)*—Current firmware installed and being used by the transceiver.
- **Uptime** *(Display only)*—Elapsed time since powering up.
- **Console Baud Rate**—Used to set/display data communications rate (in bits-per-second) between a connected console terminal and the radio. [**19200**]
- **Device Names Menu**—Fields used at user's discretion for general administrative purposes. The Device Name field is used by the transceiver as the "Realm" name for network security and in the MS screen headings. (See Figure 3-12 on Page 43)
- **Date**—Current date being used for the transceiver logs. User-settable. (Value lost with power failure if SNTP (Simple Network Time Protocol) server not accessible.)
- **Time**—Current time of day. User-setable.
  Setting: HH:MM:SS
  (Value lost with power failure if SNTP server not accessible.)
- **Date Format**—Select presentation format:
  - Generic = dd Mmm yyyy
  - European = dd-mm-yyyy
  - US = mm-dd-yyyy

Device Names Menu

```
****************************************CC****************************************
0                                Device Name Here                                *
1                                Device Names Menu                               *
2  -=====================================================================-       *
3                                                                                *
4      A) Device Name            My Device                                       *
5                                                                                *
6      B) Contact                TechServices                                    *
7                                                                                *
8      C) Location               On the hill top                                 *
9                                                                                *
0      D) Description            user-text-her                                   *
1                                                                                *
2                                                                                *
3                                                                                *
4                                                                                *
5                                                                                *
6                                                                                *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3             Select a letter to configure an item, 'Q' to exit menu             *
4                                                                                *
****************************************CC****************************************
```

Figure 3-12. Device Names Menu

- **Device Name**—Device Name, used by the transceiver as the "Realm" name for network login (web browser only) and menu headings.
- **Owner**—User defined; appears on this screen only.
- **Contact**—User defined; appears on this screen only.
- **Description**—User defined; appears on this screen only.
- **Location**—User defined; appears on this screen only.

3.4 CONFIGURING NETWORK PARAMETERS

3.4.1 Network Configuration Menu

The *Network Configuration Menu* is the home of three parameters that should be reviewed and changed as necessary before placing a transceiver in service—Device Mode, IP Address and Network Name. Screens for both the Access Point and Remote units are shown below.

```
****************************************CC****************************************
0                              Device Name Here                                 *
1                         Network Configuration Menu                            *
2  -=========================================================================-  *
3                                                                               *
4    A) IP Configuration                                                        *
5                                                                               *
6    B) Ethernet Port Config                                                    *
7                                                                               *
8    C) Bridge Configuration                                                    *
9                                                                               *
0    D) SNMP Agent Config                                                       *
1                                                                               *
2    E) SNTP Server Address  xxx.xxx.xxx.xxx                                    *
3                                                                               *
4    F) Integrated Wireless Config                                              *
5                                                                               *
6                                                                               *
7      Ethernet Address           00:c0:69:00:00:01                             *
8      Wireless Address           00:c0:69:00:00:02                             *
9                                                                               *
0                                                                               *
1                                                                               *
2                                                                               *
3            Select a letter to configure an item, 'Q' to exit menu             *
4                                                                               *
****************************************CC****************************************
```

Figure 3-13. Network Configuration Menu
From Access Point

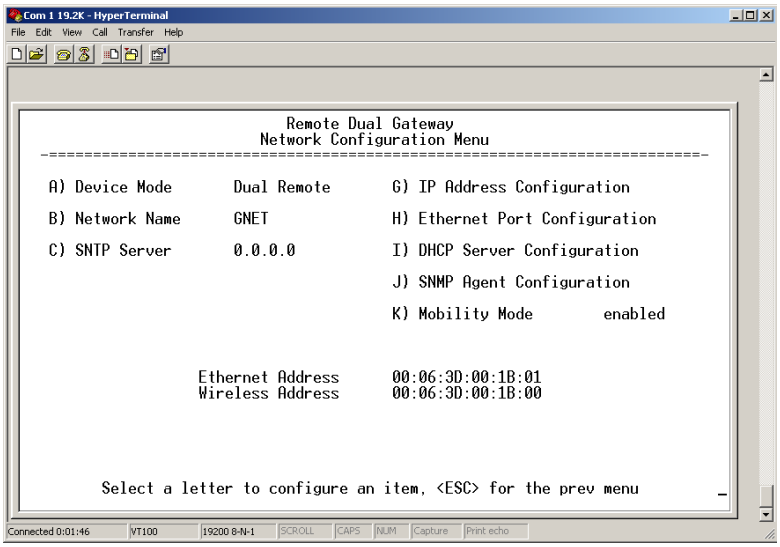

Figure 3-14. Network Configuration Menu
From Remote Unit

- **Device Mode** *(User Review Recommended)*—Either Access Point or a variation of a Remote. [**Remote**]
- **Network Name** *(User Review Required)*—Name of the radio network of which this unit will be a part. Essential for association of Remotes to the Access Point in the network. [**Not Programmed**]

TIP: For enhanced security, consider using misspelled words, a combination of letters and numbers, and a combination of upper and lower case letters. Also, the Network Name should be at least nine characters long. This helps protect against sophisticated hackers who may use a database of common words (for example, dictionary attacks) to determine the Network Name.

- **SNTP Server**—Address of SNTP server (RFC 2030) from which the transceiver will automatically get the time-of-day startup time. Without an SNTP server, the date and time must be manually set. An AP will try to get the time and date from the SNTP server only if an IP address is configured. It will continue to retry every minute until it succeeds.

  A remote will get the time and date from the SNTP server, if an IP address is configured. Otherwise it gets it from the AP at authentication time. The transceivers use UTC (Universal Time Constant) with a configurable time offset. [**0.0.0.0**]
- **IP Address Configuration** Presents a menu for configuring the local static IP address of the transceiver. Detailed explanations are provided in the section titled *IP Address Configuration Menu* on Page 46
- **Ethernet Port Configuration**—Presents a menu for defining the status of the Ethernet port (enabled or disabled), the Ethernet rate limit, link hardware watch (enabled/disabled), and the Ethernet link poll address. Detailed explanations of this menu are contained in *Ethernet Port Configuration Menu* on Page 47
- **DHCP Server Config(uration)**—Menu for configuration of DHCP services by the Access Point unit. DHCP provides “on-the-fly” IP address assignments to other LAN devices, including MDS Mercury 900 units. [**Disabled**]
- **SNMP Config Menu**—SNMP configuration parameters.
- **Mobility Mode**—Used to configure whether the transceiver is enabled or disabled for mobility operation. *Note that this selection may appear on both Access Point and Remote menus, but it only takes effect when set on Remotes.* Additional settings and information for mobility operation are contained in *Mobile Data Configuration* on Page 59. [**enabled, disabled; disabled**].
- **Maximum Remotes** *(AP Only)*—Number of Remotes permitted to be associated with (served by) this Access Point. [**50**]

- **Database Timeout** *(AP Only)*—This sets the database "age time" (*Remote Listing Menu (Access Points Only)* on Page 93) to determine when a remote is declared as unavailable. The timer may be set from 0 to 255 minutes and resets each time a message is received from a remote. [**0–255 minutes; 5 minutes**]
- **Database Logging** *(AP Only)*—Determines which types of devices will be reported as "added" or "deleted" from the AP's database (See Section 3.8.1, *Performance Information Menu* (beginning on Page 85). In the case of deletions, this information is triggered by a timer expiration as described in the item above. Available selections are: **Remote**, **All** (endpoints and remotes), or **Disabled**.
- **Ethernet Address** *(Display Only)*—Hardware address of this unit's Ethernet interface.
- **Wireless Address** *(Display Only)*—Hardware address of the unit's wireless interface.

3.4.2 IP Address Configuration Menu

The radios use a local IP address to support remote management and serial device services. The IP address of a radio can be set as a *static IP address* or as a *dynamic IP address*. When static IP addressing is used, the user must manually configure the IP address and other parameters. When dynamic addressing is used, the radio uses a DHCP Client process to obtain an IP address from a DHCP Server, along with other parameters such as a *net mask* and a *default gateway*.

```
****************************************CC****************************************
0                                Device Name Here                                 *
1                                IP Configuration Menu                            *
2  -=====================================================================-       *
3                                                                                 *
4      A) IP Configuration                                                        *
5                                                                                 *
6         IP Address Mode            Static                                      *
7                                                                                 *
8         IP Address                 192.168.1.1                                 *
9                                                                                 *
0         IP Netmask                 255.255.0.0                                 *
1                                                                                 *
2         IP Gateway                 0.0.0.0                                     *
3                                                                                 *
4                                                                                 *
5                                                                                 *
6                                                                                 *
7                                                                                 *
8                                                                                 *
9                                                                                 *
0                                                                                 *
1                                                                                 *
2                                                                                 *
3             Select a letter to configure an item, 'Q' to exit menu              *
4                                                                                 *
****************************************CC****************************************
```

Figure 3-15. IP Address Configuration Menu

CAUTION: Changes to any of the following parameters while communicating over the network (LAN or over-the-air) may cause a loss of communication with the unit being configured. Communication will need to be re-established using the new IP address.

- **IP Address Mode**—Defines the source of the IP address of this device. [**Static, Dynamic; Static**]
- **Dynamic Mode**—Enabling this option forces the transceiver (AP or Remote) to obtain an IP address from any DHCP server available on the LAN. Dynamic Mode is also known as *DHCP Client* mode. [**Disabled**]
- **Static IP Address** *(User Review Recommended)*—Essential for connectivity to the transceiver's MS via the LAN port and to send Ethernet data over the network. Enter any valid IP address that will be unique within the network. [**192.168.1.1**]
  This field is unnecessary if DHCP is enabled. [**255.255.0.0**]

  Static IP Netmask—The IPv4 local subnet mask. This field is unnecessary if DHCP is enabled. [**255.255.0.0**]
- **Static IP Gateway**—The IPv4 address of the network gateway device, typically a router. This field is unnecessary if DHCP is enabled. [**0.0.0.0**]

  The lower three lines of the screen show the actual addressing at the transceiver whether it was obtained from static configuration or from a DHCP server.

NOTE: Any change made to the above parameters results in the **Commit Changes** option appearing on screen. This allows all IP settings to be changed at the same time.

3.4.3 Ethernet Port Configuration Menu

The transceiver allows for special control of the Ethernet interface, to allow traffic awareness and availability of the backhaul network for redundancy purposes.

NOTE: The transceiver's network port supports 10BaseT and 100BaseT connections. Confirm that your hub/switch is capable of auto-switching data rates.

To prevent excessive Ethernet traffic from degrading performance, place the transceiver in a segment, or behind routers.

```
****************************************CC****************************************
0                                Device Name Here                                *
1                              Ethernet Port Config Menu                         *
2  -=====================================================================-       *
3                                                                                *
4      A) Ethernet Port Enable     enabled                                       *
5                                                                                *
6                                                                                *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3                                                                                *
4                                                                                *
5                                                                                *
6                                                                                *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3             Select a letter to configure an item, 'Q' to exit menu             *
4                                                                                *
****************************************CC****************************************
```

Figure 3-16. Ethernet Port Configuration Menu

- **Ethernet Port Status**—Allows enabling/disabling Ethernet traffic for security purposes. Setting it to **Follows Link Status** enables the port if there is a connection established with the AP, but disables it otherwise. [AP: **Enabled, Disabled; Enabled**]
  [Remote: **Always On, Follow Radio Link, Disabled; Always On**]
- **Ethernet Rate Limit**—The transceiver will send alarms (SNMP traps) when the rate reaches 50%, 75%, and 100% to help identify potential problems with traffic.
- **Ethernet Link (H/W) Watch** *(AP Only)*—Detects the lack of an Ethernet connection to the LAN port at the electrical level (link integrity). The current AP will broadcast a beacon signal indicating its "NOT AVAILABLE" status so Remotes that hear it do not try to associate to it. Once the Ethernet connection is restored, this beacon signal changes to "AVAILABLE" and Remotes are allowed to join in. [**Disabled**]
- **Ethernet Link Poll Address** *(AP Only)*—When an IP address is provided, the Access Point pings the remote IP device every 2 minutes to test the integrity of the backhaul link. If this link is not available, the AP will advertise its "NOT AVAILABLE" status in the beacon signal so Remotes do not try to associate to it. Once the IP address is reachable, this beacon signal changes to "AVAILABLE" and Remotes are allowed to join in. 0.0.0.0 disables this function. Any other valid IP address enables it. [**0.0.0.0**]

3.4.4 DHCP Server Configuration

A transceiver can provide automatic IP address assignments to other IP devices in the network by providing DHCP (Dynamic Host Configuration Protocol) services. This service eliminates setting individual device IP address on Remotes in the network, but it still requires thoughtful

planning of the IP address range. One drawback to network-wide automatic IP address assignments is that SNMP services may become inaccessible as they are dependent on fixed IP addresses.

The network can be comprised of radios with the DHCP-provided IP address enabled or with DHCP services disabled. In this way, you can accommodate locations for which a fixed IP address if desired.

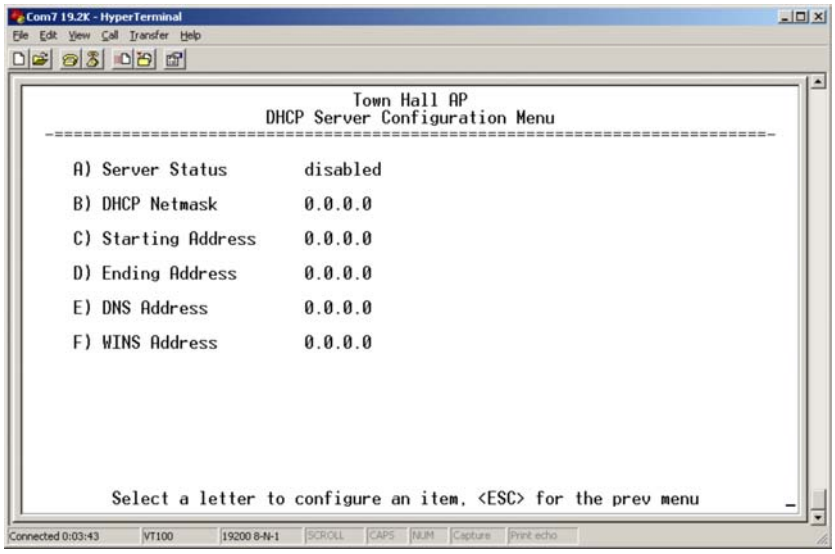

Figure 3-17. DHCP Server Configuration Menu

NOTE: There should be only one DHCP server active in a network. If more than one DHCP server exists, network devices may randomly get their IP address from different servers every time they request one.

NOTE: Combining DHCP and RADIUS device authentication may result in a non-working radio module if the DHCP server is located at a remote radio. The DHCP server should be placed at the AP location, if possible.

- **Server Status**—Enable/Disable responding to DHCP requests to assign an IP address. [**Disabled/Enabled; Disabled**]
- **DHCP Netmask**—IP netmask to be assigned along with the IP address in response to a DHCP request. [**0.0.0.0**]
- **Starting Address**—Lowest IP address of the range of addresses to be provided by this device. [**0.0.0.0**]
- **Ending Address**—Highest IP address in the range of addresses to be provided by this device. A maximum of 256 addresses is allowed in this range. [**0.0.0.0**]
- **DNS Address**—Domain Name Server address to be provided by this service.
- **WINS Address**—Windows Internet Naming Service server address to be provided by this service.

- **Restart DHCP Server**—Selecting this option forces the transceiver to start servicing DHCP requests using the Starting Address. Payload data will not be interrupted but may experience some delays as new addresses are distributed.

3.4.5 SNMP Agent Configuration

The transceiver contains over 100 custom SNMP-manageable objects as well as the IETF standard RFC1213 for protocol statistics, also known as MIB II. Off-the-shelf SNMP managers such as Castle Rock Computing *SNMPc*™ and Hewlett Packard HP *OpenView*™ may also be used to access the transceiver's SNMP Agent's MIB. The transceiver's SNMP agent supports SNMPv3.

The objects are broken up into nine MIB files for use with your SNMP manager. There are textual conventions, common files and specific files. This allows the flexibility to change areas of the MIB and not affect other existing installations or customers.

- **msdreg.mib**—MDS sub-tree registrations
- **mds_comm.mib**—MDS Common MIB definitions for objects and events which are common to the entire product family
- **mercury_reg.mib**—MDS sub-tree registrations
- **mercurytrv1.mib**—SNMPv1 enterprise-specific traps
- **mercurytrv2.mib**—SNMPv2 enterprise-specific traps
- **mercury_comm.mib**— MIB definitions for objects and events which are common to the entire Mercury Series
- **mercury_ap.mib**—MIB definitions for objects and events for an Access Point transceiver
- **mercury_sta.mib**—Definitions for objects and events for a Remote radio
- **mercury_sec.mib**—For security management of the radio system. SNMPv3 allows read/write operation. SNMPv1/2 allows only for read-only access.

NOTE: SNMP management requires that the proper IP address, network and gateway addresses are configured in each transceiver of the associated network.

In addition, some management systems may require the MIB files to be compiled in the order shown above.

```
****************************************CC****************************************
0                              Device Name Here                                  *
1                            SNMP Agent Config Menu                              *
2  -=========================================================================-   *
3                                                                                *
4      A) Read Community      ********                                           *
5                                                                                *
6      B) Write Community     ********                                           *
7                                                                                *
8      C) Trap Community      ********                                           *
9                                                                                *
0      D) V3 Auth Password    ********                                           *
1                                                                                *
2      E) V3 Priv Password    ********                                           *
3                                                                                *
4      F) SNMP Mode           disabled      J) Trap Manager #1    0.0.0.0        *
5                                                                                *
6      G) Trap Version        v1 traps      K) Trap Manager #2    0.0.0.0        *
7                                                                                *
8      H) Auth Trap Status    disabled      L) Trap Manager #3    0.0.0.0        *
9                                                                                *
0      I) V3 Password Mode    manager       M) Trap Manager #4    0.0.0.0        *
1                                                                                *
2                                                                                *
3            Select a letter to configure an item, 'Q' to exit menu              *
4                                                                                *
****************************************CC****************************************
```

Figure 3-18. SNMP Server Configuration Menu
From Access Point

This menu provides configuration and control of vital SNMP functions.

- **Read Community String**—SNMP community name with SNMPv1/SNMPv2c read access. This string can be up to 30 alpha-numeric characters.
- **Write Community String**—SNMP community name with SNMPv1/SNMPv2c write access. This string can be up to 30 alpha-numeric characters.
- **Trap Community String**—SNMP community name with SNMPv1/SNMPv2c trap access. This string can be up to 30 alpha-numeric characters.
- **V3 Authentication Password**—Authentication password stored in flash memory. This is used when the Agent is managing passwords locally (or initially for all cases on reboot). This is the SNMPv3 password used for Authentication (currently, only MD5 is supported). This string can be up to 30 alpha-numeric characters.
- **V3 Privacy Password** Privacy password stored in flash memory. Used when the SNMP Agent is managing passwords locally (or initially for all cases on reboot). This is the SNMPv3 password used for privacy (DES encryption). This string can be between 8 and 30 alpha-numeric characters.
- **SNMP Mode**—This specifies the mode of operation of the radio's SNMP Agent. The choices are: disabled, v1_only, v2_only, v3_only. v1-v2, and v1-v2-v3. If the mode is disabled, the Agent does not respond to any SNMP traffic. If the mode is v1_only, v2_only, or v3_only, the Agent responds only to that version of SNMP traffic. If the mode is v1-v2, or v1-v2-v3, the Agent responds to the specified version of SNMP traffic. [**v1-v2-v3**]

- **Trap Version**—This specifies what version of SNMP will be used to encode the outgoing traps. The choices are v1_traps, v2_traps, and v3_traps. When v3_traps are selected, v2-style traps are sent, but with a v3 header. [**v1 Traps, v2 Traps, v3 Traps**]
- **Auth Traps Status**—Indicates whether or not traps will be generated for login events to the transceiver. [**Disabled/Enabled; Disabled**]
- **SNMP V3 Passwords**—Determines whether v3 passwords are managed locally or via an SNMP Manager. The different behaviors of the Agent depending on the mode selected, are described in **SNMP Mode** above.
- **Trap Manager #1–#4**— Table of up to 4 locations on the network that traps are sent to. [**Any standard IP address**]

NOTE: The number in the upper right-hand corner of the screen is the SNMP Agent's SNMPv3 Engine ID. Some SNMP Managers may need to know this ID in order interface with the transceiver's SNMP Agent. The ID only appears on the screen when SNMP Mode is either v1-v2-v3 or v3_only.

3.5 RADIO CONFIGURATION

There are two primary data layers in the transceiver network—radio and data. Since the data layer is dependent on the radio layer working properly, configuration of the radio items should be reviewed and set before proceeding. This section explains the *Radio Configuration Menu*, (Figure 3-19 for AP, Figure 3-20 for Remote). The Configuration Menu is followed a secondary menu, the *Skip Zone Options*.

3.5.1 Radio Configuration Menu

```
****************************************CC****************************************
0                                Device Name Here                                *
1                               Radio Configuration Menu                         *
2  -=================================================================-           *
3                                                                                *
4     A) RF Output Power     30 dBm         H) RF Start Frequency 1 903000000 Hz *
5                                                                                *
6     B) Dwell Time          20 msec        I) RF End Frequency 1   927000000 Hz *
7                                                                                *
8     C) Beacon Interval     61 hops        J) RF Start Frequency 2 0 Hz         *
9                                                                                *
0     D) Default Modulation  QPSK 1/2 rate  K) RF End Frequency 2   0 Hz         *
1                                                                                *
2     E) Frag  Threshold     1000           L) RSSI Threshold       -110 dBm     *
3                                                                                *
4     F) Retries             0                                                   *
5                                                                                *
6     G) Repeats             0                                                   *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3            Select a letter to configure an item, 'Q' to exit menu              *
4                                                                                *
****************************************CC****************************************
```

Figure 3-19. Radio Configuration Menu From Access Point

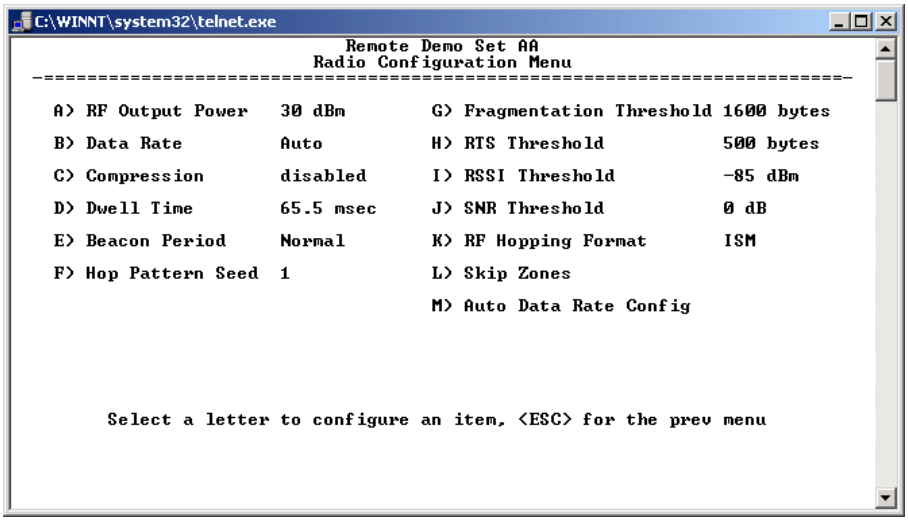

Figure 3-20. Radio Configuration Menu
From Remote Unit

- **RF Output Power** *(User Review Recommended)*—Sets/displays RF power output level. Displayed in dBm. Setting should reflect local regulatory limitations and losses in antenna transmission line. (See *"How Much Output Power Can be Used?"* on Page 144 for information on how to calculate this value.) [**20–30; 20**]
- **Data Rate** *(Remote Only. AP fixed is at 512/1 Mbps.)*—Shows the over-the-air data rate setting for the Remote radio. Remotes can operate at one of two data rates when communicating with an AP; 512 kbps or 1 Mbps. Higher speeds are possible with strong RF signal levels, typically stronger than –77 dBm RSSI including a 15 dB fade margin.

  When the data rate is set to **AUTO**, the remote radio is able to change speeds based on the signal quality criteria set in the Auto Data Rate submenu described later in this section (see Page 56). [**256, 512, AUTO; AUTO**]

- **Compression** *(AP Only)*—Enabling this option uses LZO compression algorithm for over-the-air data. Varying levels of data reduction are achieved depending on the nature of the information. Text files are typically the most compressible, whereas binary files are the least compressible. On average, a 30% increase in throughput can be achieved with compression enabled.
- **Dwell Time**—Duration (in milliseconds) of one hop on a particular frequency in the hopping pattern. (This field is only changeable on an Access Point. Remotes get their value from AP upon association.) [**8.2, 16.4, 32.8, 65.5, 131.1; 32.8**]

TIP: If a packet is being transmitted and the dwell time expires, the packet will be completed before hopping to the next frequency.

- **Beacon Period**—Amount of time between Beacon transmissions (in msec).

  Available Intervals: **Normal** (104 ms), **Fast** (52 ms), **Faster** (26 ms), **Slow** (508 ms), **Moderate** (208 ms). These values provide relatively quick association times where Fast is very fast (≈ 5 sec) and the other end, the largest recommended value, the 508 ms period is slow (≈ 60 sec). [**Normal, Fast, Faster, Slow, Moderate; Normal**]

  TIP: Increasing the Beacon Period will provide a *small improvement* in network data throughput. Shortening it decreases the time needed for Remotes to associate with the AP. A short beacon period is usually only a benefit when there are mobile Remotes in the network.

- **Hop Pattern Seed**—A user-selectable value to be added to the hop pattern formula. This is done in the unlikely event that identical hop patterns are used with two collocated or nearby networks. Changing the seed value will minimize the potential for RF-signal collisions in these situations. (This field is only changeable on an Access Point. Remotes read the AP's value upon association.) [**0 to 255; 1**]
- **Fragment Threshold**—Before transmitting over the air, if a packet exceeds this number of bytes, the transceiver sends the packet in multiple fragments that are reassembled before being delivered over the Ethernet interface at the receiving end. Only even numbers are acceptable entries for this parameter. Over-the-air data fragmentation is not supported on AP units. (See *"Network Performance Notes"* on Page 96 for additional information.) [**256–1600 bytes; 1600**]

  TIP: In an interference-free environment this value should be large to maximize throughput. If interference exists then the value should be set to smaller values. The smaller the packet the less chance of it being interfered with at the cost of slightly reduced throughput.

- **RTS Threshold**—Number of bytes for the over-the-air RTS/CTS handshake boundary. (See *"Network Performance Notes"* on Page 96.) [**0 to 1600 bytes; 500**]

NOTE: While the transceiver accepts RTS Threshold values below 100, the lowest value that works is 100.

TIP: Lower the **RTS Threshold** as the number of Remotes or overall over-the-air traffic increases. Using RTS/CTS is a trade-off, giving up some throughput in order to prevent collisions in a busy over-the-air network.

The **RTS Threshold** should be enabled and set with a value smaller than the **Fragmentation Threshold** described above. RTS forces the Remotes to request permission from the AP before sending a packet. The AP sends a CTS control packet to grant permission to one Remote. All other Remotes wait for the specified amount of time before transmitting.

- **RSSI Threshold (for alarm)**—Level (dBm) below which the received signal strength is deemed to have degraded, and a critical event (alarm) is generated and logged. Under these conditions, the PWR lamp flashes, and a trap is sent to the trap manager if SNMP is enabled and set properly. [**0 to -120; -90**]
- **SNR Threshold (for alarm)**—Value (dB) below which the signal-to-noise ratio is deemed to have degraded and a critical event is generated and logged. Under these conditions, the PWR lamp flashes, and a trap is sent to the trap manager if SNMP is enabled and set properly. [**0 to 40; Not Programmed**]
- **RF Hopping Format**—Operation must be compliant with country-specific restrictions for the frequency band used. This option must be specified when the order is placed and cannot be modified in the field by the user. The available formats are:
  - **ISM**: 902–928 MHz band
  - **GSM**: 915–928 MHz band
  - **SPLIT**: 902-907.5 and 915-928 MHz bands
  - **CHANNELS**: 902–928 MHz, selectable, from 1 to 80 channels.

NOTE: When using **CHANNELS** mode, all radios (AP and Remotes) must be set to use the same channels in order to establish a link. If this is not done, the radios will not connect.

NOTE: The transceiver operates only in the **CHANNELS** mode, with selectable channels from 1 to 75.

- **Channel Config**—Brings up a submenu (Figure 3-21) that displays.

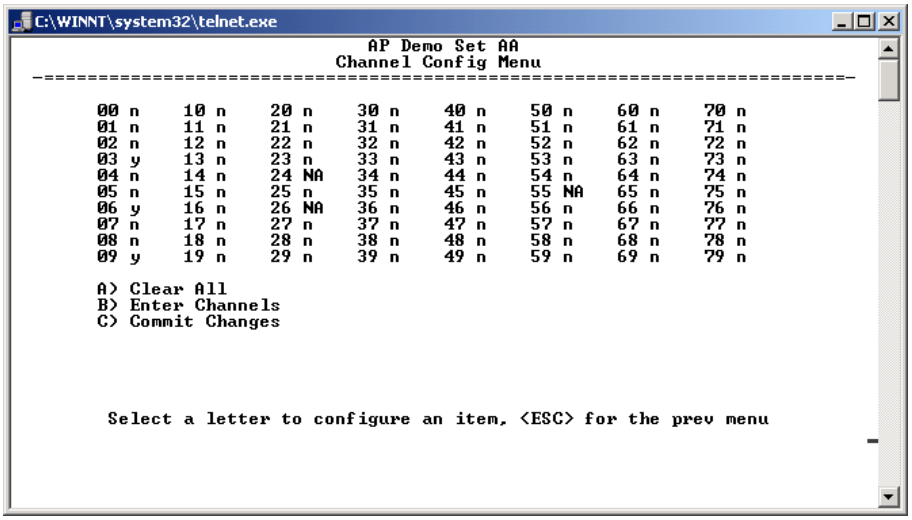

Figure 3-21. Channel Config Submenu
(In the default configuration, all channels are disabled)

Key to channel indicators:

n (no) = Radio channel is not used

y (yes) = Radio channel is used

NA (not available) = Radio channel is not available

- **Clear All**—This command clears all entries in the Channel Config Menu, resetting the available channels to “no usage.” Channels that are not available for use will appear with a notation of or **NA**. These channels are not available because of pre-existing conditions, and are not user-configurable.
- **Enter Channels**—This allows selection of the channels used for frequency hopping operation. *The selection of particular channels will result in an indication of* **y**. *Be aware that these channels do not become active until the* **Commit Changes** *selection is invoked.*
- **Commit Changes**—This re-boots the radio and loads the active channels into the frequency list for frequency hopping operation.

Radio Configuration Menu descriptions, continued...

- **Auto Data Rate Configuration**—This selection brings up a submenu as shown in Figure 3-22. For the settings in this submenu to have any effect, the Data Rate menu item(Page 53) must be set to **AUTO**.

The Auto Data Rate Configuration submenu is typically for use in environments where signal quality is variable, and you wish to maintain the highest possible over-the-air data rate as conditions change.

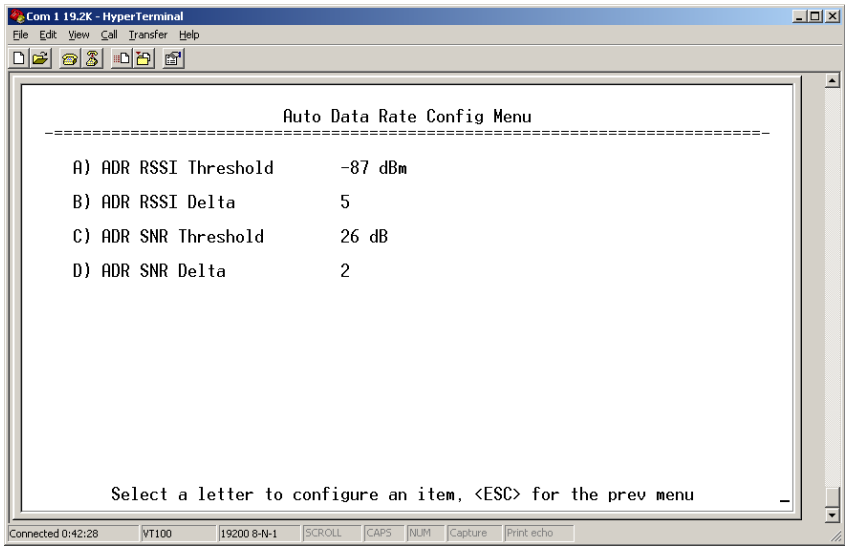

Figure 3-22. Auto Data Rate Submenu

NOTE: In the description below, “high speed” 1 Mbps operation. “Standard speed” refers to 512 kbps.

The Auto Data Rate Configuration submenu consists of two threshold settings, each accompanied by a “delta” (amount of change) setting. Using the example of Figure 3-22, assume the current RSSI is -87 dBm. An RSSI reduction of more than 5 dBm (more negative RSSI number) would cause a data rate change from high speed to standard speed. Once the data speed has changed to standard speed, an RSSI *increase* to the level of -82 dBm would be required for the radio to switch back to high speed. This provides an operational “window” or hysteresis range over which the data speed stays constant despite minor changes in signal strength.

The SNR (signal-to-noise ratio) threshold and delta operate in the same manner described above, with the exception that the units are expressed in relative dB instead of dBm. In the example of Figure 3-22, a drop of 2 dB from a level of 26 dB would result in a data rate change from high speed to standard speed. For the radio to return to high speed, the SNR would need to increase to 28 dB. (*See Glossary for definition of SNR.)*

RSSI or SNR figures alone mean little when determining signal quality. Both parameters must be considered to get a true understanding of signal quality. For example, a strong, but noisy signal would likely be less useful than a weak signal with low noise levels. Proper use of the threshold and delta settings will result in smoother, more reliable performance from your wireless link.

Figure 3-22 shows the default values for RSSI and SNR parameters but these may be changed to optimize performance in your environment. In properly designed systems, experience has shown that RSSI levels between -50 dBm and -90 dBm provide reliable operation, provided the signal-to-noise ratio is 17 dB or above. Tailoring the thresholds with these baseline values in mind, can provide improved performance in your system.

The selections on the Auto Data Rate menu are as follows:

- **ADR RSSI Threshold—**A specified received signal strength value, which, if exceeded by the range of the **RSSI Delta** setting, causes a data rate change in the transceiver. [**-50 to -100; -87 dBm**]
- **ADR RSSI Delta—**A user-specified *difference* from the **RSSI Threshold** figure which, if exceeded, causes a data rate change in the transceiver. [**0-10; 5**]
- **ADR SNR Threshold—**A user-specified signal-to-noise ratio, which, if exceeded by the range of the **SNR Delta** setting, causes a data rate change in the transceiver. [**10-30; 26**]
- **ADR SNR Delta—**A user-specified *difference* from the **SNR Threshold** figure which, if exceeded, causes a data rate change in the transceiver. [**0-10; 2**]

Radio Configuration Menu descriptions, continued...

- **Skip Zones** *(Does not apply to all models. Editable at AP Only.)*—This selection brings up a submenu (Figure 3-23) that displays the current utilization of zones. Each zone consists of eight RF channels. In some instances there may be a part of the spectrum used by another system, that results in “continuous” or “persistent” interference to your system. To alleviate this form of interference, the transceiver may be programmed to “block out” affected portions of the spectrum using the Skip Zones Menu.

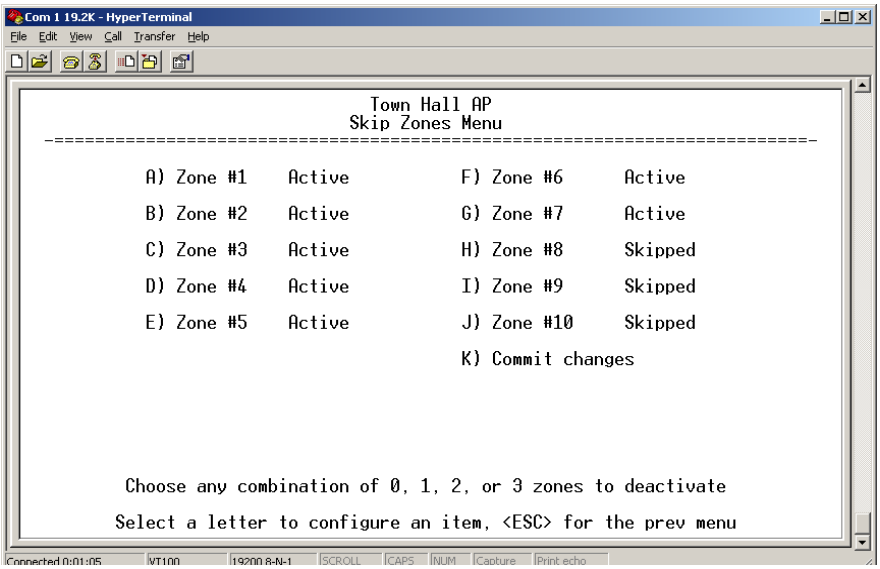

Figure 3-23. Skip Zone Options Submenu
("Commit changes" displayed only on Access Point radios)

Figure 3-23 displays the utilization of 10 zones, each having eight RF operating frequencies. Zones can be toggled between **Active** and **Skipped** at Access Point units by first keying in the letter of the zone to be changed, and then pressing the spacebar to toggle between the two options for each zone. Select the **Commit Changes** menu item to implement changes. These changes will be forwarded to all units in the network through the Access Point's beacon signal.

A maximum of three zones can be skipped and still be compliant with FCC regulations.

3.5.2 Mobile Data Configuration

Because a mobile environment is more demanding than fixed-site operation, additional considerations must be made at the time of configuration. These key points should be considered for all mobile installations:

- Use middleware—The use of middleware in the mobile laptops is highly recommended for better operation of a mobile data system. MDS provides middleware from one of the vendors available in the market. Contact your MDS representative for details.
- Plan your network coverage—Deploy Access Points so that they provide overlapping coverage to each other. Access Points must use the same network name to enable roaming
- Set the Remote radios to the lower operational speed (512 kbps) to optimize coverage
- Configure the Remote radios for mobile operation—Enable the

mobility function using the Remote radio's Network Configuration Menu (see Figure 3-24). Although a menu selection appears in the Access Point's Network Configuration menu, this setting cannot be changed. When you enable the Remote radio's Mobility Mode option, the radio scans for an alternate AP if the RSSI is at or below the RSSI threshold defined in the Radio Configuration screen (see Figure 3-25).

- Set the RSSI Threshold to -85 dBm—This level is typically used for mobile systems with good performance. Make sure there is overlapping coverage of more than one AP to provide a good user experience and continuous coverage.

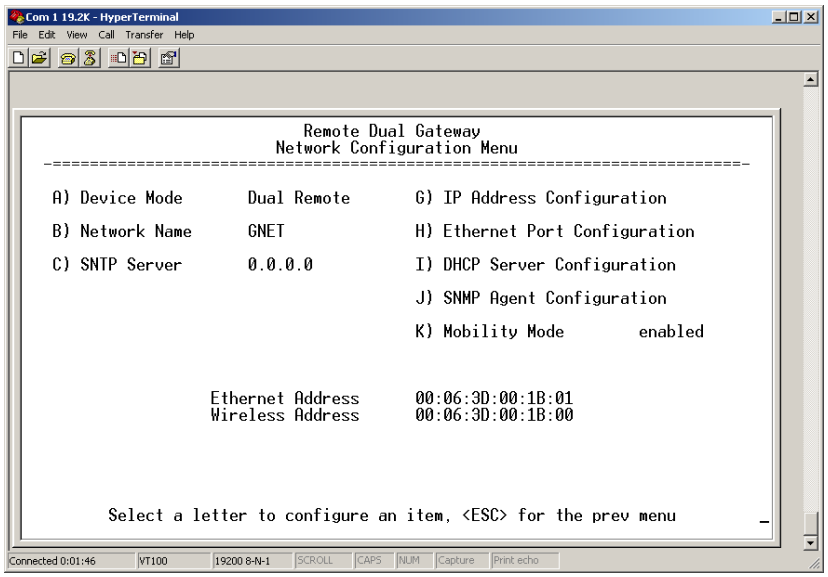

Figure 3-24. Enabling Mobility at Remote Radio

After association is lost with an AP, and scanning for an alternate AP is started, the former AP is placed on a "blacklist" for 10 seconds, to avoid linking back to the same AP. If no alternate AP is found, a link is eventually made to the same AP as before. This is why it is important to design a system with sufficient overlapping coverage by multiple APs.

```
****************************************CC****************************************
0                                Device Name Here                                *
1                              Radio Configuration Menu                          *
2  -=====================================================================-       *
3                                                                                *
4     A) RF Output Power     30 dBm         H) RF Start Frequency 1 903000000 Hz *
5                                                                                *
6     B) Dwell Time          20 msec        I) RF End Frequency 1   927000000 Hz *
7                                                                                *
8     C) Beacon Interval     61 hops        J) RF Start Frequency 2 0 Hz         *
9                                                                                *
0     D) Default Modulation  QPSK 1/2 rate  K) RF End Frequency 2   0 Hz         *
1                                                                                *
2     E) Frag  Threshold     1000           L) RSSI Threshold       -110 dBm     *
3                                                                                *
4     F) Retries             0                                                   *
5                                                                                *
6     G) Repeats             0                                                   *
7                                                                                *
8                                                                                *
9                                                                                *
0                                                                                *
1                                                                                *
2                                                                                *
3             Select a letter to configure an item, 'Q' to exit menu             *
4                                                                                *
****************************************CC****************************************
```

Figure 3-25. Radio Configuration Menu—Remote

Other parameter settings that should be reviewed for Mobility Mode:

- **Compression** [**AP; disabled**]—Disable radio compression. Data compression is best performed by the middleware running on the mobile laptop PC. Gains in efficiency are made because middleware compresses data at a higher stack level, and it aggregates multiple data frames and streams into a single packet. Compression at the radio level, although highly efficient, works at the individual packet level.
- **Dwell Time** [**Set to the minimum value**]—This setting controls the amount of time that the unit spends on each frequency between hops. Although overall throughput appears to decrease by this setting the effects of multipath fading are minimized through frequency diversity.
- **Beacon Period** [**Set to the fastest value**]—This parameter defines the interval at which the Access Point transmits a synchronization beacon to all remotes. A faster setting minimizes resynchronization times when remote radios roam between access points or in highly interrupted coverage areas (dense buildings, for example).
- **Fragmentation Threshold** [**remote; 256**]—Set to a small value. This parameter defines the size of the message packets transmitted over the wireless media. These fragments are reconstructed into the original packet before delivery to the external device at the remote end of the link. In a mobile environment with rapidly changing conditions, setting this value to a minimum value improves the probability of packets being sent complete on the first try.

- **RTS Threshold** [**AP; 0 -1600 bytes**]—Enable RTS flow at a small value. This setting is a wireless equivalent to RTS/CTS flow control in a wired communications circuit. This mechanism prevents packet collisions caused by the “Hidden Node” scenario, in which remotes can’t hear each other before transmitting. When this value is set below 100 or above 1500, it is effectively disabled.

3.6 CONFIGURING THE SERIAL INTERFACES

3.6.1 Overview

The transceiver includes an embedded serial device server that provides transparent encapsulation over IP. In this capacity, it acts as a gateway between serial and IP remote devices. Two common scenarios are PC applications using IP to talk to remote devices, and serial PC applications talking to remote serial devices over an IP network.

Note that the transceiver’s COM1 port is DCE. Therefore, if the equipment to be connected is also DCE, then a null-modem cable will need to be used.

Com1 Port–*Dual Purpose Capability*

The COM1 port is used as a local console connection point and to pass serial data with an external device. Setting the COM1 port status to **Enable** prevents access to the Management System (MS) through this port. However, the MS can still be accessed via the LAN port using Telnet or a web browser.

To restore the COM1 port to support Management System services, connect a terminal to the port, select the proper baud rate (19,200 is default), and enter an escape sequence (**+++**) to reset it to the console mode.

TCP vs. UDP

Both types of IP services are used by the transceiver embedded serial device server—TCP and UDP. TCP provides a connection-oriented link with end-to-end acknowledgment of data, but with some added overhead. UDP provides a connectionless best-effort delivery service with no acknowledgment.

Most polled protocols will be best served by UDP service as the protocol itself has built-in error recovery mechanisms. UDP provides the needed multidrop operation by means of multicast addressing.

On the other hand, TCP services are best suited for applications that do not have a recovery mechanism (error-correction) and must have the

guaranteed delivery that TCP provides despite the extra overhead. The IP-to-Serial example shows how to do this. (See *"IP-to-Serial Application Example"* on Page 72.)

Serial Encapsulation

Transparent encapsulation, or IP tunneling, provides a mechanism to encapsulate serial data into an IP envelope. Basically, all the bytes received through the serial port are put into the data portion of a TCP or UDP packet (TCP or UDP are user configurable options). In the same manner, all data bytes received in a TCP or UDP packet are output through the serial port.

When data is received by the radio through the serial port it is buffered until the packet is received completely. There are two events that signal an end-of-packet to the radio: a period of time since the last byte was received, or a number of bytes that exceed the buffer size. Both of these triggers are user configurable.

One radio can perform serial data encapsulation (IP-to-Serial) and talk to a PC. Two radios (or one radio and a terminal server) can be used together to provide a serial-to-serial channel.

TCP Client vs. TCP Server

On a TCP session there is a server side and a client side. The server is always waiting for requests from clients. The transceiver can be configured to act as either a server or a client.

The client mode attempts to establish a connection to a server (typically running on a PC) whenever it receives data on the serial port.

There is also a Client/Server mode where a connection is established in either the client or server modes. An incoming "keep alive" timer and outgoing counter

UDP Multicast

IP provides a mechanism to do a limited broadcast to a specific group of devices. This is known as "multicast addressing." Many IP routers, hubs and switches support this functionality.

Multicast addressing requires the use of a specific branch of IP addresses set apart by the Internet Assigned Numbers Authority (IANA) for this purpose.

UDP multicast is generally used to transport polling protocols typically used in SCADA applications where multiple remote devices will receive and process the same poll message.

As part of the Multicast implementation, the radio sends IGMP membership reports and IGMP queries, and responds to membership queries.

It defaults to V2 membership reports, but responds to both V1 and V2 queries.

You must configure the multicasted serial port as the target for the multicast data (for example, multipoint-to-multipoint mode, or point-to-multipoint mode where the inbound data is multicast). This restriction is because a host that only sends data to a multicast address (for example, point-to-multipoint mode where the radio acts as a point) will not join the group to receive multicast data because the host's inbound data is directed unicast data.

The serial-to-serial example which follows shows how to provide multicast services. (See *"Point-to-Multipoint Serial-to-Serial Application Example"* on Page 74.)

PPP

External devices can connect to the transceiver using PPP (Point-to-Point Protocol). The transceiver works as a server and assigns an IP address to the device that connects through this interface.

To gain access to the transceiver from a PC even if the network is down, a modem may be connected to one of the transceiver's COM ports that has been configured with PPP.

Data Buffering

Data buffering is always active regardless of the selected mode. When Seamless mode is selected, a buffer size of 256 bytes is used. When custom mode is selected, the size options are: 16. 32, 64, 128, and 256 bytes. The Inter-Frame Delay is settable in either Seamless or Custom modes.

Implementing Configuration Changes

There are several configuration parameters for the Serial Gateway found under the *Serial Configuration Menu* of the Management System. After making changes to the configuration, you must use the menu's "Commit Changes" to assert the changes.

If you are connecting EIA-232 serial devices to the transceiver, review these parameters carefully.

Serial Configuration Wizard

The Serial Configuration Wizard available through the **Serial Gateway Configuration Menu** is recommended for configuration of serial ports. The wizard uses a step-by-step process, will eliminate possible conflicting settings, and streamline complex configurations.

The wizard can be bypassed by selecting option **B) View Current Settings** and adjusting the individual settings of the appropriate parameter

3.6.2 Serial Data Port Configuration Menu

This menu assists you in setting the data parameters for the COM1 Serial Data Port. It utilizes a wizard program to simplify the steps involved in this task.

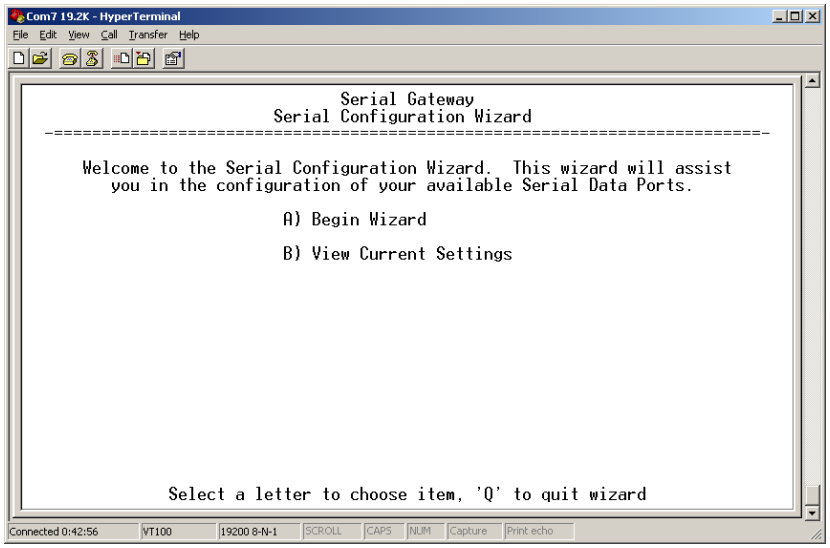

Figure 3-26. Serial Configuration Wizard

- **Begin Wizard**—Tool for configuration of serial ports using a step-by-step process.
- **View Current Settings**—Displays all settable options. Depending on the selected IP protocol.

3.6.3 Configuring for UDP Mode

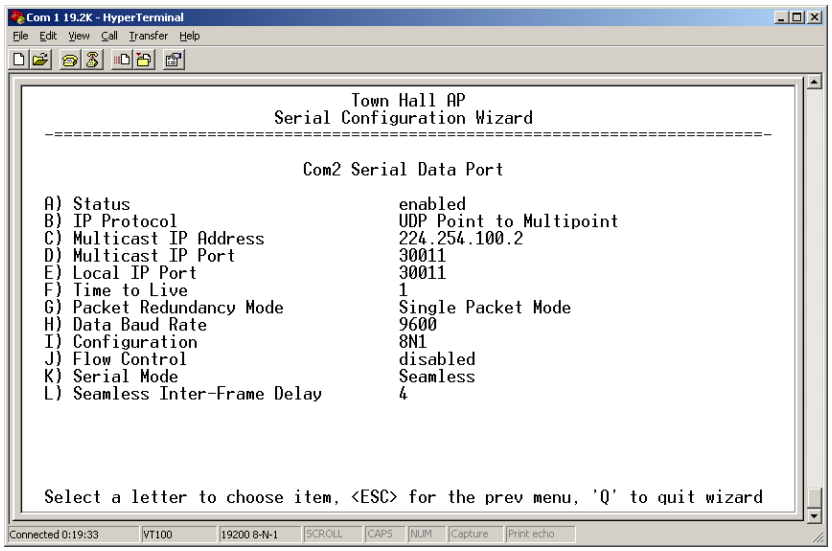

Figure 3-27. UDP Point-to-Multipoint Menu

UDP point-to-multipoint to send a copy of the same packet to multiple destinations, such as in a polling protocol.

- **Status**—Enable/Disable the serial data port.
- **IP Protocol**—Point to Multipoint [**TCP, UDP PPP; TCP**]. This is the type of IP port that will be offered by the transceiver's serial device server.
- **Multicast IP Address** (used instead of **Local IP Address** when using UDP Point-to-Multipoint.)— Must be configured with a valid Class D IP address (224.0.0.0–239.255.255.255). IP packets received with a matching destination address will be processed by this unit [**Any legal IP address; 0.0.0.0**].
- **Multicast IP Port** (used instead of **Local IP Port** when using UDP Point-to-Multipoint.)—This port number must match the number used by the application connecting to local TCP or UDP socket. [**1-64,000; 30010**]
- **Local IP Port**—Receive IP data from this source and pass it through to the connected serial device. The port number must be used by the application connecting to local TCP or UDP socket. [**Any valid IP port; 30010**]
- **Time to Live (TTL)**—An IP parameter defining the number of hops that the packet is allowed to traverse. Every router in the path will decrement this counter by one.
- **Packet Redundancy Mode**— For proper operation, all radios' Serial Packet Redundancy mode must match (Single Packet mode vs. Packet Repeat mode). This is because a transceiver, when in Packet Repeat mode, sends 12 extra characters (sequence numbers, etc.) to control the delivery of the repeated data. Misconfigurations can result in undesired operation.
- **Data Baud Rate**—Data rate (payload) for the COM port in bits-per-second. [**1,200–115,200; 19200**]
- **Configuration**—Formatting of data bytes. Data bits, parity and stop bits [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**].
- **Flow Control [Com1 port]**—RTS/CTS handshaking between the transceiver and the connected device. [**Enable, Disable; Disabled**]
- **Serial Mode**—When seamless mode is selected data bytes will be sent over the air as quickly as possible, but the receiver will buffer the data until enough bytes have arrived to cover worst-case gaps in transmission. The delay introduced by data buffering may range from 22 to 44 ms, but the radio will not create any gaps in the *output* data stream. This permits operation with protocols such as MODBUS™ that do not allow gaps in their data transmission. [**Seamless, Custom; Seamless**]

- **Seamless Inter-Frame Delay**— Number of characters that represent the end of a message (inter-character time-out). UDP packet sizes are delimited and sent out based on the Seamless Inter-Frame Delay only when receiving data through the serial port. MODBUS defines a “3.5-character” parameter. [**1–65,535; 4**]
- **Custom Data Buffer Size** (Custom Packet Mode only)—Maximum amount of characters, that the Remote end will buffer locally before starting to transmit data through the serial port. [**16, 32, 64, 128, 256; 32**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (Shown only after changes have been entered.)

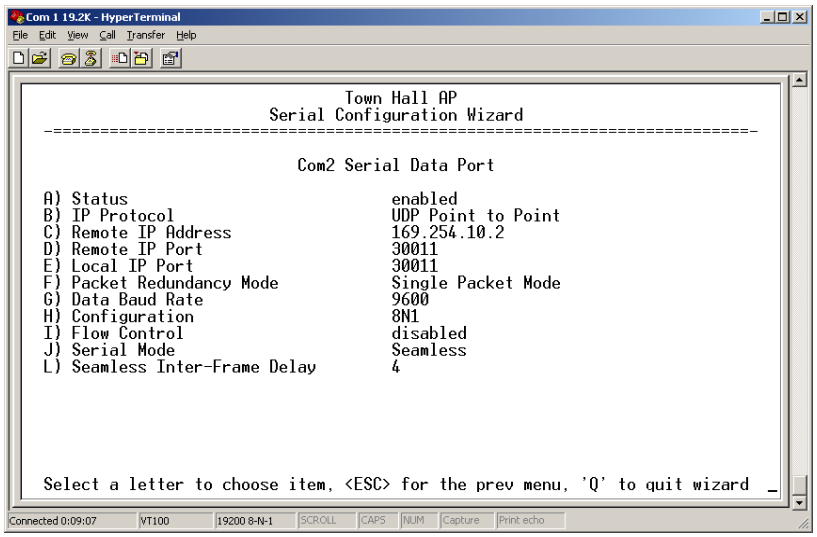

Figure 3-28. UDP Point-to-Point Menu

Use UDP point-to-point configuration to send information to a single device.

- **Status**—Enable/Disable the serial data port.
- **IP Protocol**—UDP Point-to-Point. This is the type of IP port that will be offered by the transceiver’s serial device server. [**TCP, UDP, PPP; TCP**]
- **Remote IP Address**—Data received through the serial port is sent to this IP address. To reach multiple Remotes in the network, use UDP Point-to-Multipoint. [**Any legal IP address; 0.0.0.0**]
- **Remote IP Port**—The destination IP port for data packets received through the serial port on the transceiver. [**1–64,000; 30010**]
- **Local IP Port**—Port number where data is received and passed through to the serial port. This port number must be used by the application connecting to this transceiver. [**1–64,000; 30010**]

- **Packet Redundancy Mode**— For proper operation, all radios' Serial Packet Redundancy mode must match (Single Packet mode vs. Packet Repeat mode). This is because a transceiver, when in Packet Repeat mode, sends 12 extra characters (sequence numbers, etc.) to control the delivery of the repeated data. Misconfigurations can result in undesired operation.
- **Data Baud Rate**—Data rate (payload) for the COM port in bits-per-second. [**1,200–115,200; 19200**]
- **Configuration**—Formatting of data bytes. Data bits, parity and stop bits [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**].
- **Flow Control** (COM1 port)—RTS/CTS handshaking between the transceiver and the connected device. [**Enable, Disable; Disabled**]
- **Serial Mode**— When seamless mode is selected, data bytes will be sent over the air as quickly as possible, but the receiver will buffer the data until enough bytes have arrived to cover worst case gaps in transmission. The delay introduced by data buffering may range from 22 to 44 ms, but the radio will not create any gaps in the output data stream. This mode of operation is required for protocols such as MODBUS™ that do not allow gaps in their data transmission. [**Seamless, Custom; Seamless**]
- **Seamless Inter-Frame Delay**— Number of characters that represent the end of a message (inter-character time-out). MODBUS defines a "3.5-character" parameter. [**1–65,535; 4**]
- **Custom Data Buffer Size** (Custom Packet Mode only)—Maximum amount of characters, that the Remote end will buffer locally before starting to transmit data through the serial port. [**16, 32, 64, 128, 256; 32**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (Shown only after changes have been entered.)

3.6.4 Configuring for TCP Mode

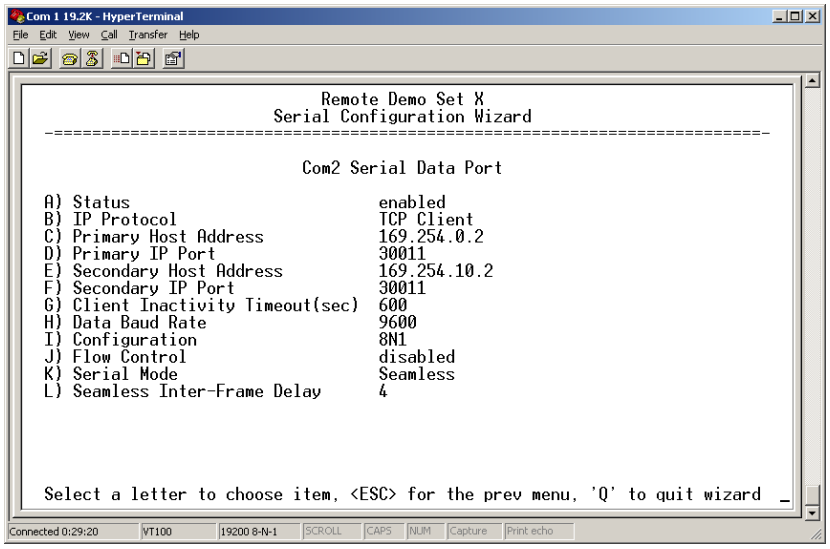

Figure 3-29. TCP Client Menu (Remote)

- **Status**—Enable/Disable the serial data port.
- **IP Protocol**—TCP Client. This is the type of IP port that will be offered by the transceiver's serial device server. [**TCP, UDP, PPP; TCP**]
- **Primary Host Address**—The IP address to be used as a destination for data received through the serial port.
  [**Any legal IP address; 0.0.0.0**]
- **Primary IP Port**—The destination IP port for data packets received through the serial port on the transceiver.
  [**Any valid IP port; 30010**]
- **Secondary Host Address**—The IP address to be used as a destination for data received through the serial port in case the primary host address is not available.
  [**Any legal IP address; 0.0.0.0**]
- **Secondary IP Port**—The destination IP port for data packets received through the serial port on the transceiver used along with the secondary host address above.
  [**Any valid IP port; 30010**]
- **Outgoing Connection's Inactivity Timeout**—Amount of time (in seconds) that they transceiver will wait for data before terminating the TCP session. [**0–600; 600**]
- **Data Baud Rate**—Data rate (payload) for the COM port in bits-per-second. [**1,200–115,200; 19200**]
- **Configuration**—Interface signaling parameters. Data bits, parity and stop bits
  [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**].
- **Flow Control [Com1 port]**—RTS/CTS handshaking between the transceiver and the connected device.
  [**Enable, Disable; Disabled**]

- **Serial Mode**— If data buffering is Enabled, the radio will operate in seamless mode. Data bytes will be sent over the air as quickly as possible, but the receiver will buffer the data until enough bytes have arrived to cover worst case gaps in transmission. The delay introduced by data buffering may range from 22 to 44 ms, but the radio will not create any gaps in the output data stream. This mode of operation is required for protocols such as MODBUS™ and some variants which do not allow gaps in their data transmission.
  [**Seamless, Custom; Seamless**]
- **Seamless Inter-Frame Delay**— Number of characters that represent the end of a message (inter-character time-out). MODBUS defines a “3.5-character” parameter.
  [**1–65,535; 4**]
- **Custom Data Buffer Size** (Custom Packet Mode only)—Maximum amount of characters, that the Remote end will buffer locally before starting to transmit data through the serial port.
  [**16, 32, 64, 128, 256; 32**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (Shown only after changes have been entered.)

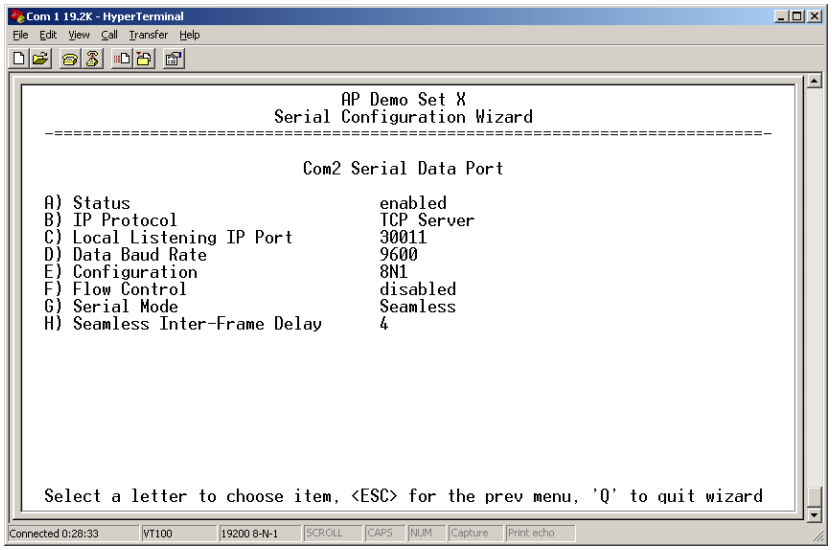

Figure 3-30. TCP Server Menu (AP)

- **Status**—Enable/Disable the serial data port.
- **IP Protocol**—TCP Server. This is the type of IP port that will be offered by the transceiver’s serial device server.
  [**TCP, UDP, PPP; TCP**]
- **Local Listening IP Port**—Receive IP data from this source and pass it through to the connected serial device. The port number must be used by the application connecting to local TCP or UDP socket.
  [**Any valid IP port; 30010**]

- **Data Baud Rate**—Data rate (payload) for the COM port in bits-per-second. [**1,200–115,200; 19200**]
- **Configuration**—Interface signaling parameters. Data bits, parity and stop bits
  [**7N1, 7E1, 7O1, 8N1, 8E1, 8O1, 8N1, 7N2, 7E2, 7O2, 8N2, 8E2, 8O2; 8N1**].
- **Flow Control** (COM1 port)—RTS/CTS handshaking between the transceiver and the connected device.
  [**Enable, Disable; Disabled**]
- **Serial Mode**— If data buffering is Enabled, the radio will operate in seamless mode. Data bytes will be sent over the air as quickly as possible, but the receiver will buffer the data until enough bytes have arrived to cover worst case gaps in transmission. The delay introduced by data buffering may range from 22 to 44 ms, but the radio will not create any gaps in the output data stream. This mode of operation is required for protocols such as MODBUS™ and some variants which do not allow gaps in their data transmission.
  [**Seamless, Custom; Seamless**]
- **Seamless Inter-Frame Delay**— Number of characters that represent the end of a message (inter-character time-out). MODBUS defines a “3.5-character” parameter. [**1–65,535; 4**]
- **Custom Data Buffer Size** (Custom Packet Mode only)—Maximum amount of characters, that the Remote end will buffer locally before starting to transmit data through the serial port.
  [**16, 32, 64, 128, 256; 32**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (Shown only after changes have been entered.)

3.6.5 Configuring for PPP Mode

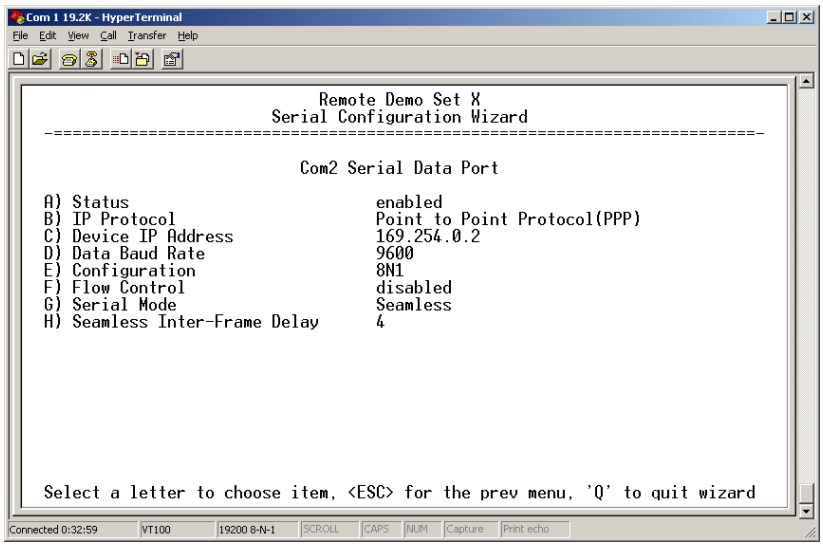

Figure 3-31. PPP Menu

- **Status**—Enable/Disable the serial data port.
- **IP Protocol**—PPP. This is the type of IP port that will be offered by the transceiver's serial device server. [**TCP, UDP, PPP; TCP**]
- **Device IP Address**—IP address that will be assigned to the dialing device once the connection is established. [**0.0.0.0**]
- **Data Baud**—The baud rate of the serial port of the transceiver to which the external device is connected.
  [**1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200; 19200**]
- **Configuration**—Byte format of the serial port
  [**7N1, 7E1, 701, 7N2, 7E2, 702, 8N1, 801, 8N2, 8E2, 802; 8N1**]
- **Flow Control** (COM1 port)—RTS/CTS handshaking between the transceiver and the connected device.
  [**Enable, Disable; Disabled**]
- **Serial Mode**—When seamless mode is selected, data bytes will be sent over the air as quickly as possible, but the receiver will buffer the data until enough bytes have arrived to cover worst case gaps in transmission. The delay introduced by data buffering may range from 22 to 44 ms, but the radio will not create any gaps in the output data stream. This mode of operation is required for protocols such as MODBUS™ that do not allow gaps in their data transmission. [**Seamless, Custom; Seamless**]
- **Seamless Inter-Frame Delay**— Number of characters that represent the end of a message (inter-character time-out). MODBUS defines a "3.5-character" parameter. [**1–65,535; 4**]
- **Custom Data Buffer Size** (Custom Packet Mode only)—Maximum amount of characters, that the Remote end will buffer locally before starting to transmit data through the serial port.
  [**16, 32, 64, 128, 256; 32**]
- **Commit Changes and Exit Wizard**—Save and execute changes made on this screen (Shown only after changes have been entered.)

A PPP session shows the following possible states:

- **Sending LCP Requests**—The PPP server is querying for any clients that need to connect.
- **Link Established**—A successful PPP connection has been negotiated and an IP address is assigned.
- **Port not Enabled**—The serial port is disabled.

3.6.6 IP-to-Serial Application Example

You have a choice to use UDP or TCP to establish communications. This will depend on the type of device you are communicating with at the other end of the IP network. In this example we will use TCP to illustrate its use.

In TCP mode, the transceiver remains in a passive mode offering a socket for connection. Once a request is received, data received at the serial port will be sent out through the IP socket and vice versa, until the

connection is closed, or the link is interrupted. In this mode, the transceiver behaves the same, whether it is an Access Point or a Remote. (See Figure 3-32 and Table 3-1)

NOTE: The TCP session has a timeout of 10 minutes (600 seconds). If inactive for that time, it will be closed. The transceiver will offer the port again for connection after this time expires.

Establishing a Connection

From the PC, establish a TCP connection to the IP address of the Remote transceiver and to the IP port as configured above (30010). A Telnet client application can be used to establish this connection. Data can now be sent between the PC and the RTU or other connected device.

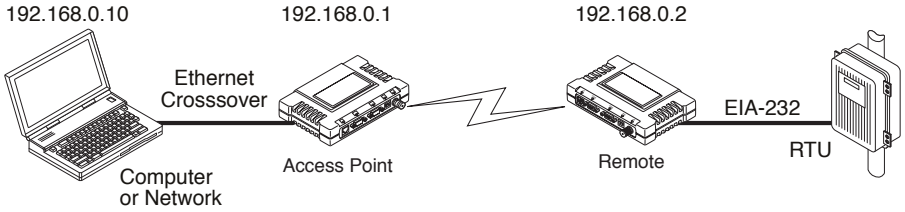

Figure 3-32. IP-to-Serial Application Diagram

Table 3-1. Serial Port Application Configuration
IP-to-Serial Connection

Transceiver Location	Menu Item	Setting
Access Point	None is required	None is required
Remote Unit	IP Address	192.168.0.2
	Status	Enabled
	IP Protocol	TCP
	Baud Rate	9,600 (Example)
	Flow Control	None
	Local IP Port	30011

3.6.7 Point-to-Point Serial-to-Serial Application Example

Once the transceivers are configured and the changes have been executed, they begin processing any data presented at the COM ports. Data presented at the Access Point's COM port will be packetized and sent via UDP to the Remote. Upon receiving the packet, the Remote strips the data out of the UDP packet and sends it out its COM port. Likewise, data presented at the Remote's COM port is packetized, sent to the Access Point, stripped, and sent out the Access Point's COM port. Note, this configuration does not use multicast addressing.

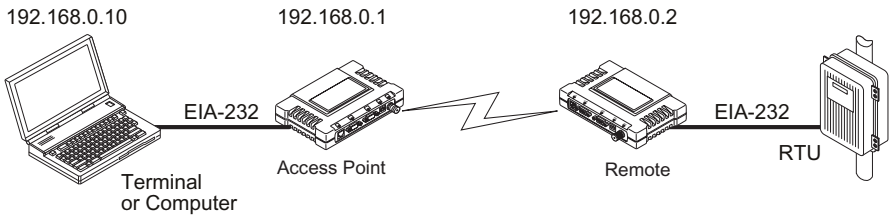

Figure 3-33. Point-to-Point Serial-to-Serial Application Diagram

Table 3-2. Serial Port Application Configuration

Transceiver Location	Menu Item	Setting
Access Point (COM1)	Status	Enabled
	Data Baud Rate	9,600 (Example)
	Flow Control	Hardware (Example)
	Serial Mode	Seamless
	SIFD	4
	IP Protocol	UDP
	Remote IP Address	192.168.0.2 (IP address of the Remote radio)
	Remote IP Port	30011
	Local IP Port	30011

3.6.8 Point-to-Multipoint Serial-to-Serial Application Example

The operation and data flow for this mode is very similar to Point-to-Point serial-to-serial application, except that it uses multicast addressing. The primary difference is that data presented at the Access Point's COM port will be packetized and sent via UDP to all of the Remotes. Upon receiving the packet all of the Remotes strip the data out of the UDP packet and send it out their COM port. Likewise, data presented at any of the Remotes' COM ports is packetized, sent to the Access Point, stripped, and sent out the Access Point's COM port (see Figure 3-34, Table 3-3, Figure 3-35, and Figure 3-36 on Page 76.

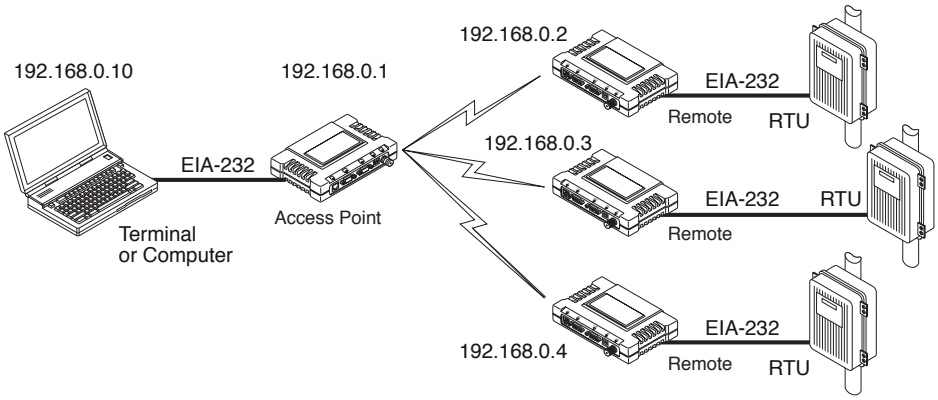

Figure 3-34. Point-to-Multipoint Serial-to-Serial Application Diagram

Table 3-3. Serial Port Application Configuration

Transceiver Location	Menu Item	Setting
Access Point (COM1)	Status	Enabled
	Baud Rate	9600 (Example)
	Serial Mode	Custom
	Flow Control	Disabled
	IP Protocol	UDP
	Remote IP Address	224.254.1.1— Multicast Address[1]
	Remote IP Port	30011
	Local IP Port	30011
Remote Units (COM1)	Enable	Enabled
	Baud Rate	2,400 (Example)
	Serial Mode	Custom
	Flow Control	Hardware (Example)
	IP Protocol	UDP
	Remote IP Address	192.168.0.1
	Remote IP Port	30011
	Local IP Port	30011
	Local Multicast Address[1]	224.254.1.1 — Multicast Address[1]

1. This address is an example only. Any Class D IP address (224.0.0.0–239.255.255.255) will work.

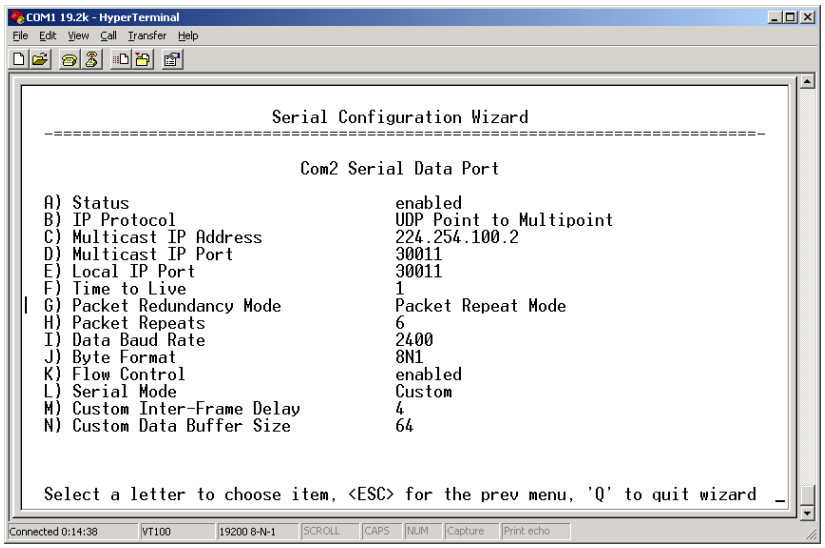

Figure 3-35. Access Point Serial Port Configuration

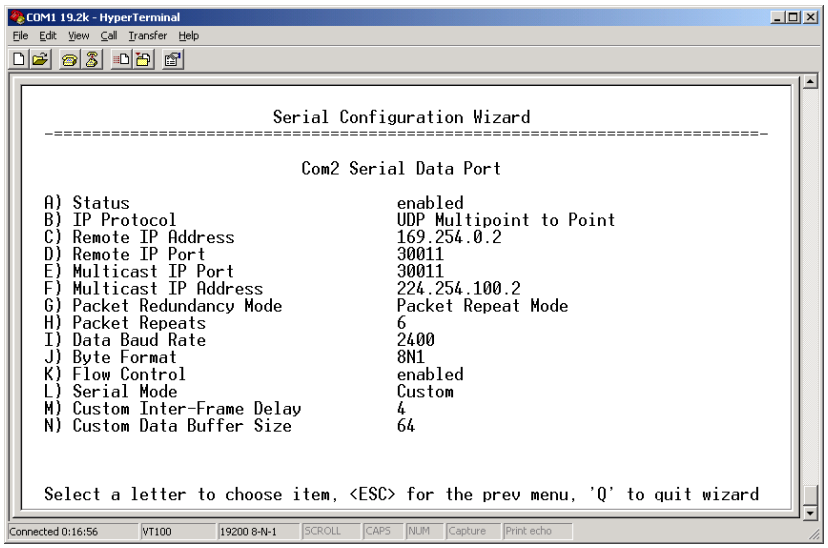

Figure 3-36. Remote Radio Serial Port Configuration

3.6.9 Mixed Modes

Note that in this example, the TCP mode does not involve the Access Point. Thus, the transceiver in a single network can run in *both* modes at the same time. In other words, some Remotes can be configured for TCP mode while others can be configured (along with the Access Point) for UDP mode.

In this configuration, the Host PC can use both data paths to reach the RTUs. This may be helpful when a mixed collection of RTUs is present where some RTUs can operate in a broadcast form while others cannot (see Figure 3-37 on Page 77 and Table 3-4 on Page 77).

Operation and Data Flow

- Communicate with RTU A by Telneting to Remote 1, port 30011.
- Communicate with RTU B by Telneting to Remote 2, port 30011.
- Communicate with RTUs C and D by sending and receiving data from the Access Point's COM port.
- All communication paths can be used simultaneously.

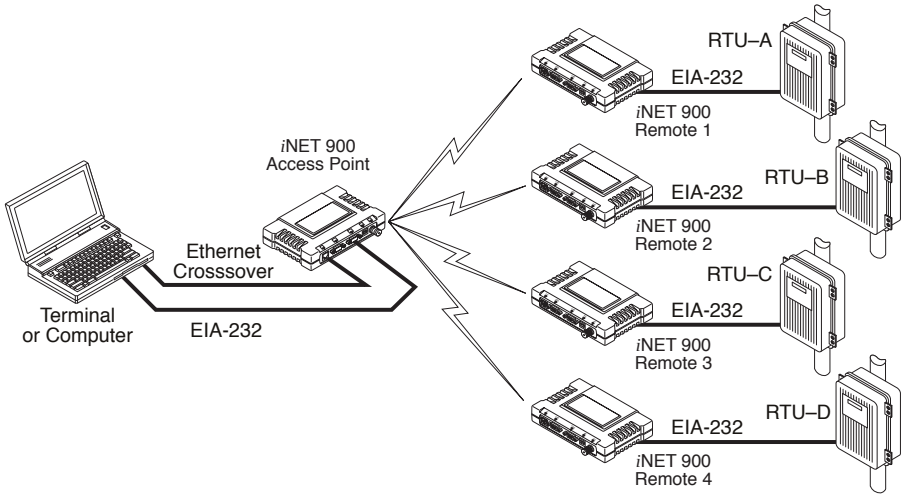

Figure 3-37. Mixed-Modes Application Diagram

Table 3-4. Serial Port Application Configuration

Transceiver Location	Menu Item	Setting
Access Point	Status	Enabled
	Baud Rate	9,600
	Flow Control	Disabled
	IP Protocol	UDP
	Send to Address	A multicast IP address such as 224.254.1.1
	Send to Port	30011
	Receive on Port	30011
	Receive on Address	0.0.0.0 (Not Used)
Remote Units (COM1)	Status	Enabled
	Baud Rate	2,400
	Flow Control	Disabled
	IP Protocol	TCP
	Receive on Port	30011

3.7 CYBER SECURITY CONFIGURATION

The cyber security features of the transceiver are grouped into three general areas: controlling access to the radio itself for configuration and management purpose (Device Security), controlling how and when radios communicate with each other, as well as how data traffic is handled (Wireless Security) and a special section dealing with authentication and authorization using a central server (RADIUS Configuration). Figure 3-37 shows the Security Configuration Menu, which is the entry point for these categories.

```
****************************************CC****************************************
0                              Device Name Here                                 *
1                           Security Configuration Menu                         *
2  -=========================================================================-  *
3                                                                               *
4      A) Device Security Configuration                                         *
5                                                                               *
6      B) Integrated Wireless Configuration                                     *
7                                                                               *
8      C) Manage Certificates                                                   *
9                                                                               *
0      D) RADIUS Configuration                                                  *
1                                                                               *
2                                                                               *
3                                                                               *
4                                                                               *
5                                                                               *
6                                                                               *
7                                                                               *
8                                                                               *
9                                                                               *
0                                                                               *
1                                                                               *
2                                                                               *
3            Select a letter to configure an item, 'Q' to exit menu             *
4                                                                               *
****************************************CC****************************************
```

Figure 3-37. Security Configuration Menu
(Access Point Version Shown)

3.7.1 Device Security

This group of features controls how the radios can be accessed either locally or remotely for configuration and management.

```
****************************************CC****************************************
0                              Device Name Here                                 *
1                        Device Security Configuration Menu                     *
2  -=========================================================================-  *
3                                                                               *
4      A) Telnet Access        enabled                                          *
5                                                                               *
6      B) SSH Access           enabled                                          *
7                                                                               *
8      C) HTTP Access          enabled                                          *
9                                                                               *
0      D) HTTP Security Mode   MD5 Digest                                       *
1                                                                               *
2      E) User Auth Method     Local                                            *
3                                                                               *
4      F) User Auth Fallback   None                                             *
5                                                                               *
6      G) User Passwords                                                        *
7                                                                               *
8                                                                               *
9                                                                               *
0                                                                               *
1                                                                               *
2                                                                               *
3            Select a letter to configure an item, 'Q' to exit menu             *
4                                                                               *
****************************************CC****************************************
```

Figure 3-38. Device Security Menu

- **User Auth Method**— Defines whether username and password is verified locally or via a central server. [**Local, RADIUS; Local**]
- **User Auth Fallback**— Defines the alternate authentication mode in case the authentication server is not available. [**Local, None; Local**]
- **User Password**—Local password for this unit. Used at log-in via COM1 Port, Telnet, SSH and Web browser. [**Up to 8 alphanumeric characters without spaces (case-sensitive); admin**]

TIP: For enhanced security, consider using misspelled words, a combination of letters and numbers, and a combination of upper and lower case letters. Also, the more characters used (up to eight), the more secure the password will be. These strategies help protect against sophisticated hackers who may use a database of common words (for example, dictionary attacks) to determine a password.

- **SNMP Mode**—This specifies the mode of operation of the radio's SNMP Agent. If the mode is disabled, the Agent does not respond to any SNMP traffic. If the mode is v1_only, v2_only, or v3_only, the Agent responds only to that version of SNMP traffic. If the mode is v1-v2, or v1-v2-v3, the Agent responds to the specified version of SNMP traffic. [**disabled, v1_only, v2_only, v3_only, v1-v2, v1-v2-v3; v1-v2-v3**]
- **Telnet Access**—Controls remote access through Telnet sessions on Port 23 [**Enabled, Disabled; Enabled**]
- **SSH Access**— Controls remote access through SSH (Secure Shell) sessions on Port 22 [**Enabled, Disabled; Enabled**]
- **HTTP Mode**— Controls remote access through HTTP sessions on Ports 80 and 443. Selecting **HTTPS** forces secure connections to Port 443. When **HTTP Mode** is disabled, access through HTTP or HTTPS is not allowed. [**Disabled, HTTP, HTTPS; HTTP**]

- **HTTP Auth Mode**—Selects the method of HTTP log-in authentication. This parameter functions only when **HTTP** is selected in the previous menu item. Although the **Basic Auth** mode requests a password, the actual password text is transmitted in the clear (unencrypted). [**Basic Auth, MD5 Digest; Basic Auth**]

3.7.2 Wireless Security

The features in the Wireless Security menu control the communication of data across the wireless link. The radios can be authenticated locally via a list of authorized radios, or remotely via a centralized RADIUS server. RADIUS is a centralized authentication mechanism based on standards.

```
****************************************CC****************************************
0                              Device Name Here                                 *
1                           Security Configuration Menu                         *
2  -=========================================================================-  *
3                                                                               *
4      A) Device Security Configuration                                         *
5                                                                               *
6      B) Integrated Wireless Configuration                                     *
7                                                                               *
8      C) Manage Certificates                                                   *
9                                                                               *
0      D) RADIUS Configuration                                                  *
1                                                                               *
2                                                                               *
3                                                                               *
4                                                                               *
5                                                                               *
6                                                                               *
7                                                                               *
8                                                                               *
9                                                                               *
0                                                                               *
1                                                                               *
2                                                                               *
3            Select a letter to configure an item, 'Q' to exit menu             *
4                                                                               *
****************************************CC****************************************
```

Figure 3-39. Wireless Security Menu

- **Device Auth Method**—Controls whether device authentication is executed locally, via a central server, or not at all. Selecting **Local** uses the Approved Remotes List described later in this manual. [**None, Local, RADIUS; None**]
- **Encryption**— When enabled, it forces the transceiver to use AES-128 encryption (RC4-128) on all over-the-air messages. This option requires the Encryption Phrase to be previously configured. Both the AP and the Remote radios must use the same encryption phrase. (Some units may not be authorized to use encryption. "See *"Authorization Keys Menu"* on Page 114" for additional details.) [**Enabled, Disabled; Disabled**]
- **Auto Key Rotation**—When enabled, it forces the transceiver to use the key rotation algorithm to generate a new encryption key after 500 kilobytes of information has been transmitted, or one hour has elapsed. [**Enabled, Disabled; Disabled**]
- **Approved Access Points/Remotes List** —Displays a menu to manage the list of other radios with which this unit will be permitted to communicate.

- **Encryption Phrase**—Phrase (text & numbers) that will be used by the encryption algorithm.
  [**8 to 29 alphanumeric characters; Blank**]
- **Force Key Rotation**— It triggers an immediate key rotation of the encryption keys before the internal counters do it automatically.

Local Authentication—Approved Remotes/Access Points List Submenu

Setting the **Device Auth Method** to **Local** forces the transceiver to check the *Approved AP List* before a radio link can be established. In the case of a Remote, the AP must be in the *Approved Access Points List* before it accepts the beacon as being valid. In the case of an AP, a Remote must be in the *Approved Remotes List* to be granted authorization. Before enabling this option, at least one entry must already exist in the *Approved AP/Remotes List*.

This menu is the same for both Access Points and Remotes and the names change to reflect their mode. Replace “Remotes” with Access Points” in the following description.

NOTE: The limit for Remotes (in an Access Point radio) is 255. The limit for Access Points (in a Remote radio) is 104.

```
****************************************CC****************************************
0                              Device Name Here                                 *
1                     Approved AP/Remote Configuration Menu                     *
2  -=========================================================================-  *
3                                                                               *
4      A) View Approved Devices                                                 *
5                                                                               *
6      B) Add Approved AP/Remote     0                                          *
7                                                                               *
8      C) Add Associated Remotes                                                *
9                                                                               *
0      D) Delete Approved AP/Remote  0                                          *
1                                                                               *
2      E) Delete All Devices                                                    *
3                                                                               *
4                                                                               *
5                                                                               *
6                                                                               *
7                                                                               *
8                                                                               *
9                                                                               *
0                                                                               *
1                                                                               *
2                                                                               *
3            Select a letter to configure an item, 'Q' to exit menu             *
4                                                                               *
****************************************CC****************************************
```

Figure 3-40. Approved Remotes List Menu

- **Add Remote**—Enter MAC address of Remote.
  [**Any valid 6-digit hexadecimal MAC address; 00:00:00:00:00:00**]
- **Delete Remote**—Enter MAC address of Remote. For security purposes, you may want to delete a stolen or deprovisioned radio from this list.

- **Add Associated Remotes**—Add all currently associated remotes to the approved remote list. Alternatively, you can enter each Remote MAC manually.
- **Delete All Remotes**—Remove (complete purge) of all Remotes from current list.
- **View Approved Remotes**—Simple listing of approved Remotes by MAC address, of radios authorized to join this AP. If a Remote is not in this list, it will not be able to associate with this AP.
- **Save Changes**—Saves all changes made during the session with this menu. Changes are implemented only if they are "saved" before exiting this menu.

3.7.3 RADIUS Authentication

This section covers the configuration needed for the radios to access the RADIUS server, which is used for Device Level Security and for Wireless Access Security. MDS does not provide the RADIUS server software.

Operation of Device Authentication

Device authentication forces the radio to authenticate before allowing user traffic to traverse the wireless network. When Device Security is configured to use RADIUS as the Authentication Method, Remote radios need three types of certificates: public (client), private, and root (Certificate Authority). These files are unique to each Remote radio and need to first be created at the server and then installed into each unit via TFTP. The certificate files must be in DER format.

Device authentication uses the serial number of each radio as the Common Name (CN) in its certificate and in its RADIUS identity field. Each Access Point *and* Remote radio must be identified/recognized by the RADIUS Server through the Common Name (Serial number) and IP address entries.

NOTE: Consult your RADIUS network administrator for assistance in configuration, or for help with other issues that may arise.

To activate device authentication, select **Device Auth Method** and set **RADIUS** as the active mode. The behavior of this setting differs depending on whether it is implemented on an Access Point or a Remote transceiver. An explanation of these behaviors is given below:

Access Point: When **Device Auth Method** is set to **RADIUS**, the AP disassociates all associated Remotes and waits for the RADIUS Server to Authenticate the Remotes before allowing data to be passed from them. When approval is received from the RADIUS Server, data from the Remote is allowed to pass.

Remote: When **Device Auth Method** is set to **RADIUS**, the Remote halts any data it is passing, and requests Authentication from the RADIUS Server. If accepted, data is allowed to be transmitted.

Operation of User Authentication

When user authentication is set to **Local** or **RADIUS**, you must enter a valid user name and password before being allowed to manage the radio. In **RADIUS** mode both of these fields may be up to 40 characters long. In **Local** mode the user name is **admin** and the password may be up to 8 characters long.

When set to **RADIUS**, *all* logins to the local configuration services are required to be authenticated via the RADIUS Server, including telnet and SSH (Secure Shell) sessions. Authentication must be accepted before access to the radio menu is granted.

3.7.4 RADIUS Configuration

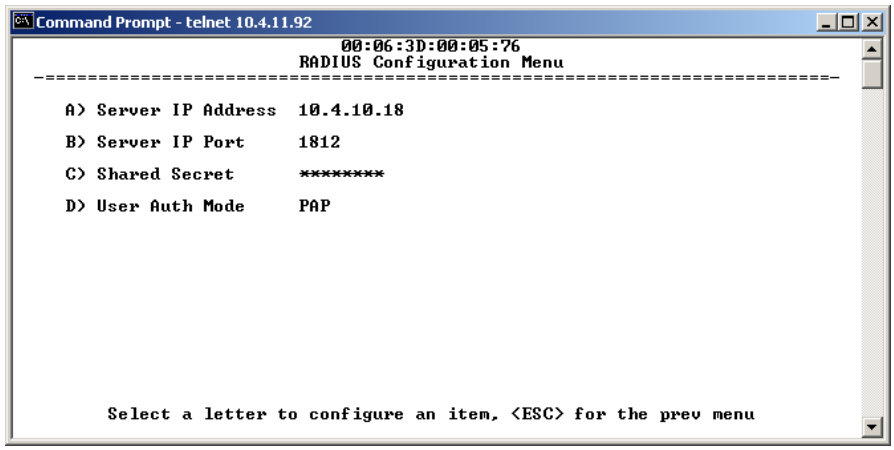

Figure 3-41. RADIUS Configuration Menu

- **Server IP Address**—Used to set/display address of the Server where the RADIUS application resides.
- **Server IP port**—1812 is the standard port for authentication (RFC 2865, June 2000) and should not be changed unless instructed to do so by an administrator.
- **Shared Secret**—User authentication and Device authentication require a common shared secret to complete a RADIUS transaction. This entry must match the string used to configure the appropriate files on the RADIUS Server.
- **User Auth Mode**—Should be set to PAP or CHAP depending on the configuration of the server.

NOTE: CHAP is the more secure mode when compared to PAP. PAP may display the login password in log files at the RADIUS Server. CHAP will encrypt the login password.

NOTE: The security password may not exceed 40 characters in length.

3.7.5 Certificate Management *(Remote transceivers only)*

Use Certificate generation software to generate certificate files and then install these files into each Remote unit via TFTP. The certificate files must be in DER format. The Common Name (CN) field in the public certificate file must match the serial number of the unit it will be installed in.

```
****************************************CC****************************************
0                                Device Name Here                                 *
1                              Manage Certificates Menu                           *
2  -=====================================================================-        *
3                                                                                 *
4          Certificate Transfer Mode   TFTP                                       *
5                                                                                 *
6      A) TFTP Host Address            0.0.0.0                                    *
7                                                                                 *
8      B) TFTP Timeout                 10 sec                                     *
9                                                                                 *
0      C) Private Key Password         ********                                   *
1                                                                                 *
2      D) Root CA Download Path        cacert.der                                 *
3                                                                                 *
4      E) Certificate Type             Root CA                                    *
5                                                                                 *
6      F) Retrieve Certificate                                                    *
7                                                                                 *
8                                                                                 *
9                                                                                 *
0                                                                                 *
1                                                                                 *
2                                                                                 *
3             Select a letter to configure an item, 'Q' to exit menu              *
4                                                                                 *
****************************************CC****************************************
```

Figure 3-42. Manage Certificates Menu

(NOTE: The appearance of this screen differs from the others because a different terminal program was used; Menu content is the same regardless of program.)

- **Server IP Address**—the IP address of the Server where the RADIUS application resides.
- **TFTP Timeout** should be set appropriately according to the layout of the network.

Three certificate files (Root, Client, and Private Key) must be present in *each* of the Remote radios. Use the commands described below to install these files into each Remote radio.

- **Certificate Filename**—Used to specify the filename of the certificate file residing on the TFTP server.
- **Certificate Type**—Selects one of the three file types mentioned above. [**Root Certificate, Client Certificate, Private Key Certificate; Root Certificate**]
- **Retrieve Certificate**—Initiates the retrieval of the certificate file from the storage location. A successful installation issues a **Complete** status message.

NOTE: It is *imperative* that the three certificate files are installed correctly into the Remote radio, in their respective file types. If they are not, it will render the Remote un-authenticated for data traffic. Consult your RADIUS network administrator if issues arise.

3.8 PERFORMANCE VERIFICATION

After the basic operation of the radio has been checked, you may wish to optimize the network's performance using some of the following suggestions. The effectiveness of these techniques will vary with the design of your system and the format of the data being sent.

There are two major areas for possible improvement—the radio and the data network. The following sections will provide you with a variety of items to check and on many occasions, ways to correct or improve their performance.

3.8.1 Performance Information Menu

This menu/screen is one of two primary sources of information on the radio layer and radio network performance.

```
****************************************CC****************************************
0                              Device Name Here                                 *
1                         Performance Information Menu                         *
2  -=========================================================================-  *
3                                                                               *
4      A) Event Log                                                             *
5                                                                               *
6      B) Packet Statistics                                                     *
7                                                                               *
8      C) Wireless Network Status                                               *
9                                                                               *
0      D) Internal Radio Status                                                 *
1                                                                               *
2                                                                               *
3                                                                               *
4                                                                               *
5                                                                               *
6                                                                               *
7                                                                               *
8                                                                               *
9                                                                               *
0                                                                               *
1                                                                               *
2                                                                               *
3            Select a letter to configure an item, 'Q' to exit menu             *
4                                                                               *
****************************************CC****************************************
```

Figure 3-43. Performance Information Menu
(AP Version Shown)

- **RF Output Power** *(Display only)*—Measured power output. (See *"How Much Output Power Can be Used?"* on Page 144)
- **Signal-to-Noise** *(Display only)*—Current running-average SNR value all active operating frequencies. (No value displayed on APs)
- **RSSI** *(Display only)*—Current running-average Received Signal Strength Indication for all active operating frequencies. (No value displayed on APs.)

- **Actual Data Rate** *(Display only)*—Over-the-air transmission rate (as opposed to selected data rate) for the remote being monitored. The fastest data rates can generally be achieved with stronger signal levels.
- **RSSI by Zone**—Received Signal Strength Indicator by Zone. (See *"RSSI by Zone Menu (Remotes Only)"* on Page 86)
- **Event Log**—Access the menu for managing the unit's log of operational activities.(See *"Authorization Key—Alter the unit's overall capabilities by enabling the built-in resources. (See "Authorization Keys Menu" on Page 116)"* on Page 101)
- **Packet Statistics**—Multiple radio and network operating statistics. (See *"Packet Statistics Menu"* on Page 90)
- **Wireless Network Status** *(Displayed only at Remotes)*—Current association state and MAC address of the Access Point. (See *"Wireless Network Status (Remotes Only)"* on Page 92)
- **Remote Listing** *(AP Display only)* —List of basic information for all Remote units currently associated with this Access Point. (See *"Remote Listing Menu (Access Points Only)"* on Page 93)
- **Endpoint Listing** *(AP Display only)*—List of units accessible by this AP through associated Remote ports. (See *"Endpoint Listing Menu (Access Points Only)"* on Page 94)
- **Remote Performance Listing** *(AP Display only)*—(See *"Remote Performance Listing Menu (Access Points Only)"* on Page 95)

RSSI by Zone Menu *(Remotes Only)*

This screen displays the strength of RF signals received from the currently associated Access Point.

Network integrity depends in large part on stable radio signal levels being received at each end of a data link. In general, signal levels stronger than –80 dBm will provide reliable communication that includes a 15 dB fade margin.

If you find there is a poor signal level on one zone, check the *Packet Statistics Menu* section on Page 90 and record the values. Then, set the questionable zone to "Skipped" in the Radio Configuration Menu (Page 52) and look for an improvement in the Packet Statistics error rates. If there is none, return the Zone to "Active."

RSSI measurements and Wireless Packet Statistics are based on multiple samples over a period of several seconds. The average of these measurements will be displayed by the Management System.