

Section 5 chapter 4

SPECIFICATION FOR VHF UHF & 900MHz LICENSED NARROWBAND FIXED WIRELESS IP/SERIAL DATA SYSTEM Remote and Redundant Base Station

4.0 WIRELESS MODEM GENERAL REQUIREMENTS

Integrated wireless modem hardware shall be supplied which complies with applicable FCC requirements for 12.5 kHz, 25 kHz. The radio and modem must be internally integrated.

- i. The radio modem shall be manufactured to RoHS standards
- ii. The radio will have the capability to be programmed for multiple frequency channels and switched to other channels under program control.
- iii. Wireless modem will be equipped with both an Ethernet port and serial data connectors. The wireless modem should be capable of receiving data from either the Ethernet port or the serial data connector, or all connections simultaneously.
- iv. The Ethernet port shall be capable of configuration as an IP Bridge, IP gateway, or an IP router.
- v. AES 128-bit data encryption, password protection, and both data and IP header compression shall be provided with the wireless modem as standard product features.
- vi. The RF data rate of the wireless modem will be 32 @ 25 kHz; 16.9 kbps @ 12.5 kHz and 8 kbps @ 6.25 kHz (user selectable). Frequency tolerance shall be +/- 1.0 ppm.
- vii. Serial Ports: The wireless modem will be equipped with 2 RS-232, DE-9F serial ports that support communications at 300 – 19200 bps. At least one port shall support RTS/CTS control signal operation.
- viii. Ethernet Port: RJ-45 10 BaseT, auto-MDIX
- ix. The radio modem shall provide transparent serial data-to-Internet terminal server operation, eliminating the need for any external hardware or modifications.
- x. Radio shall have front panel Indicators: LAN Link, LAN Activity, Tx/Rx, Status, and power.

4.1 WIRELESS MODEM OPERATION

- a. The wireless modem shall operate as a Base, Master or Remote utilizing IP routing capabilities within the modem software and within the customer

required frequency band.

- b. Routing mode must support Neighbor Discovery for the purpose of detecting the most efficient route between units. Neighbor discovery shall be automatic for small system shall require operator interaction on large system. Manual configuration will be available for user specific setups. When adding a new site, existing sites shall automatically update their database listings.
- c. The radio modem will have multiple frequency channels available, allowing a switch to these preprogrammed channels under programmed control.
- d. Separate data ports must be provided for both application data and on-line, non-intrusive diagnostic monitoring as well as IP-capable access through assigned IP ports. All ports shall be operable simultaneously.
- e. The wireless modem shall have the capability to operate as an IP router repeater (store and forward) for sites that are "over the horizon". This repeater feature shall be configurable in an on-demand basis by web browser interaction. The IP bridge configuration will allow repeater communications in a relay point mode to avoid data collisions.
- f. The wireless modem shall be fully compatible in operation with a remote site wireless modem and provide an access point, back-to-back repeater capability with operation in either bridge or router mode.

4.2 Radio Transmitter Requirements:

- i. Input Power: 10 to 30 VDC, 90 watts max.
- ii. RF Output Power: 1-10 watt and must be adjustable between 1 to 10 watts.
- iii. Frequency: VHF or UHF or 900MHz licensed bands.

4.3 Radio Receiver Requirements

Input Frequency: VHF or UHF or 900MHz licensed bands

4.4 Supported Protocols:

The wireless modem will support the following protocols:

- Ethernet IEEE 802.3
- ICMP
- IGMP
- TCP
- UDP
- Dynamic Routing (RIP version 2)
- IPSec and other transport protocols encapsulated within IP
- IP Fragmentation
- ARP (Address Resolution Protocol)
- IP directed broadcast

- IP limited broadcast
- IP multicast relay
- DHCP Client and Server
- NAT (Network Address Translation)

4.5 Remote Configuration

The unit will provide the capability to program the parameters of the wireless modem from anywhere on the wireless network, or an internal LAN network with access to the wireless network.

Access to the internal web server of a wireless modem unit will be controlled by a username and password to restrict unwanted access to information contained on the wireless modem's internal web server.

Diagnostics: The wireless modem shall be capable of passing both on-line, non-intrusive system diagnostic information, as well as off-line diagnostic information with loop-back testing. Diagnostics reported shall include:

- Receive signal strength in dBm at local and remote ends of link
- Internal Temperature
- Power supply voltage
- Forward and reflected RF power
- Packet Error Rate (PER)

Diagnostics shall include the capability to acquire usage analysis from both the local unit and a specified or series of specified remote units.

The diagnostics information shall be available via an Ethernet connection and a defined IP port number or as a local output from one of the user defined serial ports.

4.6 Physical Requirements:

- a. Temperature range: -30 to +60 Celsius. An optional fan shall prevent or minimize the transmitter power output back off by keeping the unit cooler providing improved performance in a 100% duty cycle, high ambient temperature environment.
- b. Humidity range: 0 to 95% relative humidity at 40 °C, non-condensing.
- c. Design: The radio design shall make use of surface mount PC board components.

4.7 Radio Modem Specifications :

- a. Frequency Band : 136 to 174 MH or 400 to 500 MHz (900MHZ also included)
- b. Radio modem should have both interface : Ethernet : 10 /100 Base T and RS232 both on same radio .
- c. Through put should be 32 kbps on Ethernet and 19.2 Kbps on RS232 .
- d. Frequency Stability : 1 PPM

- Radio Modem should have inbuilt On-line , RF network diagnostic and should provide necessary MIB files for third part network management softwares : SNMP / Web Interface etc.
- Radio Modem should have Off line diagnostics to monitor the RF network when system is offline .
- Radio Modem should be able to program for Bridge or Router Mode . Routing mode must support Neighbor Discovery for the purpose of detecting the most efficient route between units. Neighbor discovery shall be automatic for small system shall require operator interaction on large system. Manual configuration will be available for user specific setups. When adding a new site, existing sites shall automatically update their database listings.
- It should have built in store and forward feature .
- Radio Modem should support : most of the industries Ethernet protocols.
- Radio modem : Should be Simplex/Half Duplex .
- Radio modem should be able to operate in Star or Mesh Topology .
- Same radio modem should work as a Master , Repeater and Remote .
- RF Power Output should be 10 / 25 watt .
- Modulation Type: 2 FSK , 4 FSK
- Supply Voltage : 10 to 30 VDC
- RF Connector : TNC
- Radio Modem should have built in 128 bit AES Encryption for Data Security . password protection, and both data and IP header compression
- Radio modem should be able to program over the air .
- Duty cycle : 100 %
- The radio modem shall be manufactured to RoHS standards
- The radio will have the capability to be programmed for multiple frequency channels and switched to other channels under program control.
- Wireless modem will be equipped with both an Ethernet port and serial data connectors. The wireless modem should be capable of receiving data from either the Ethernet port or the serial data connector, or all connections simultaneously.
- Radio Modem should support IEC 101 and IEC 104 protocols
- Radio Modem should have built in Dynamic routing feature .
- Radio shall have front panel Indicators: LAN Link, LAN Activity, Tx/Rx, Status, and power.
- Bit error rate should be : $1 * 10^{-6}$ at -111 dBm
- Radio modem should support both RTS/CTS and DOX mode at RS232 port .
- RX to TX attack time : less than or equal to 3 to 4 msec.
- Temperature range: -30 to +60 Celsius.
- Suitable antennas with atleast 7.5 dBi gain should be used (Omni / Yagi) Antennas should be designed with DC grounded .
- Suitable Low loss coaxial cable should be used (LMR/CNT- 400 / 600)
- Suitable Multi Strike capability Lightning Protection Units should be used
- Power supply to the radio should have a facility of battery charging with auto changeover facility in case of power failure .
- Supplier has to get required frequency allocation .
- Supplier will supply required Towers . Tower should be self supported and galvanized and should be designed for present location weather conditions . Supplier should quote for Suitable 3/6/9/12 /15 / 18 /21/24/27/30 MTR Mast /towers . Based on Radio survey the appropriate tower height will be selected .
- Supplier has to carry out the detailed radio survey and should submit radio survey report.

4.8 Detailed Technical Specifications

These specifications are typical and subject to change without notice.

GENERAL	UHF	VHF		
Frequency Range (MHz)	406.125-470 MHz, 450-511.975 MHz	136 – 174 MHz		
Frequency Stability	1.0 ppm	1.0 ppm		
Modes of Operation	Simplex, Half-Duplex			
Channel Bandwidth	6.25 kHz; 12.5 kHz; 25 kHz			
Frequency Increment	1.25 kHz			
Power Source	10-30 VDC, Negative GND			
RF Impedance	50 Ω			
Operating Temperature	-30° to + 60° C			
Storage Temperature	-40° to + 85° C, 95% non-condensing RH			
Operating Humidity	5% to 95% non-condensing RH			
Rx Current Drain at 25°C		DC Input 10V	DC Input 20V	DC Input 30V
		520 mA (max) 450 mA (typ)	270 mA (max) 240 mA (typ)	190 mA (max) 170 mA (typ)
Tx Current Drain at 25°C	Power Out	DC Input 10V	DC Input 20V	DC Input 30V
	40 dBm (10W)	5.8 A (max) 3.6 A (typ)	2.5 A (max) 1.8 A (typ)	1.6 A (max) 1.2 A (typ)
	30 dBm (1W)	1.6 A (max) 1.2 A (typ)	0.8 A (max) 0.6 A (typ)	0.6 A (max) 0.4 A (typ)
Cold start	20 seconds			
Nominal Dimensions	5.50" W x 2.125" H x 4.25" D (13.97 x 5.40 x 10.8 cm)			
Shipping Weight	2.4 lbs. (1.1 Kg)			
Mounting Options	Mounting plate/pattern & DIN Rail			
Fan Output	5VDC, 400mA max.			

TRANSMITTER	UHF	VHF
Tx Frequencies	406.125-470 MHz, 450-511.975 MHz	136-174 MHz
Carrier Output Power	1-10W Adjustable	
Duty Cycle	100% (Power Foldback Allowed for High Temperatures)	
Radiated Spurious Emissions	Per FCC/Regulatory	
Conducted Spurious Emissions	<-65 dBc	
Transmitter Stability into VSWR:	> 10:1 (Power Foldback Allowed)	
RX to TX Time	< 2ms	
Channel Switching Time	< 15 ms (Band-End to Band-End)	

RECEIVER	UHF		VHF
RX Frequencies	406.125-470 MHz, 450-511.975 MHz		136-174 MHz
	25 kHz Channel	12.5 KHz Channel	6.25 kHz Channel
Data Sensitivity @ 10 ⁻⁶ Bit Error Rate (BER) (Maximum)	-111 dBm @ 16kb/s -103 dBm @ 32kb/s	-114 dBm @ 8kb/s -106 dBm @ 16kb/s	-112 dBm @ 4kb/s -103 dBm @ 8kb/s
Data Sensitivity @ 10 ⁻⁶ Bit Error Rate (BER) (Typical)	-114 dBm @ 16kb/s -106 dBm @ 32kb/s	-116 dBm @ 8kb/s -109 dBm @ 16kb/s	-115 dBm @ 4kb/s -106 dBm @ 8kb/s
Adjacent Channel Rejection	> 75 dB	> 60 dB	> 45 dB
Spurious Response Rejection	> 75 dB		
Intermodulation Rejection	> 75 dB		
TX to RX Time	< 1ms		
Channel Switching Time	< 15ms (Band-End to Band-End)		
Receive Input Power	17 dBm (50mW) max.		

MODEM/LOGIC	25 kHz Channel	12.5 KHz Channel	6.25 kHz Channel
Data Rate (Selectable)	16 kbps, 32 kbps	8 kbps, 16 kbps	4 kbps, 8 kbps
Modulation Type	2FSK, 4FSK		
Addressing	IP		

SETUP and COM Port	
Interface	EIA-232F DCE
Data Rate	Setup Port: 300 – 19,200 bps (Default: 19.2 Kbps) Com Port: 300 – 115,200 bps (Default: 9.6 Kbps)

Display	
5 Tri-color status LEDs	Power, Status, Activity, Link, Rx/Tx

Connectors		
Antenna Connector	TNC female (Tx/Rx)	
Serial Setup Port	DE-9F	
Serial Terminal Server	DE-9F	
Ethernet RJ-45	10 BaseT auto-MDIX	
Power - I/O	Power Header	Power Plug
	DRL p/n 415-7108-113 (Weidmüller p/n 1615550000) 4 Pin, 3.5mm, Power Header	DRL p/n 897-5008-010 (Weidmüller p/n 1639260000) 4 Pin, 3.5mm, Power Plug Cable: 60 inches Connections: Fan Output, Ground, Power, Enable

Diagnostics	
Message elements	Temperature, Voltage, Local RSSI, Remote RSSI, Forward Power, Reverse Power, Packet Error Rate

FCC / IC / UL Certifications			
	FCC	IC (DOC)	UL
136 – 174 MHz	NP4-5018500	773B-5018500	Pending
406.1 - 512 MHz	NP4-5048300	773B-5048300	Pending

4.9 OMNIDIRECTIONAL ANTENNA(S) FOR HOST or MASTER STATION WIRELESS MODEM

Omni-directional antennas for Host or Master Station Wireless Modems must meet the following requirements:

- Frequency Range: 406-470 or 450-512 MHz band
- Gain: Per user system requirements and system design
- SWR: Less than 1.5:1
- Surge and impulse protection: Direct ground protection
- Connector: 18-inch flexible extension TNC with neoprene housing

4.10 TRANSMISSION CABLE & MISCELLANEOUS FOR WIRELESS MODEM

Vendor shall provide transmission cable of the low-loss foam-dielectric type to connect the master station radio antenna port to the antenna.

Vendor shall provide a three-foot section of 'super-flex' transmission cable at the master wireless modem antenna port. Provide standard TNC connectors for connection to a continuous piece of cable extending to the antenna.

Vendor shall provide weatherproof transmission cable suitable for direct environmental exposure. Use 'O' ring seals on connectors.

Vendor provided materials shall utilize appropriate bulkhead RF transmission cable surge and impulse suppression devices at cable entrances, Polyphaser® or equivalent.

Vendor shall include specifications on cable hangers and ground kits, as required in the particular installation.

All installations are to be performed by a professional installer.

4.11 DIRECTIONAL ANTENNA FOR REMOTE STATION WIRELESS MODEM

The Directional Antenna for Remote Stations must meet the following requirements:

- Frequency Range: Appropriate to frequency of operation
- Gain: Per user system requirements and system design
- Surge and impulse Protection: Direct ground protection
- Front-to-Back Ratio: 20 dB, minimum
- Connector: 18 inch flexible extension TNC with neoprene housing to appropriate connector type of antenna cable
- Mounting Hardware: Weatherproof clamp suitable for direct mount to 2 inch, schedule 40 steel pipe
- Antenna Hardware Kits: items should be supplied from the equipment provider in a complete, easy-to-use kit providing all the necessary items to properly connect the wireless modem to the antenna and field install the antenna assembly.
- The contractor (professional installer) shall provide all masts, lightning suppressors, and any other apparatus required to assemble a complete, operable, and reliable fixed wireless data system.

4.12 SPARE PARTS

The vendor shall provide a complete itemized list of radio system spare parts including pricing.

4.13 TEST EQUIPMENT

The vendor shall provide a complete list of all test equipment, extender boards, and interface equipment for maintenance and diagnostic testing.

4.14 BASE STATION OVERVIEW

4.14.1 Ethernet Redundant Base Station Overview

The Ethernet Redundant Base Station shall have two Ethernet radios with identical RF and Ethernet MAC addresses, a controller board, an RF power sensor, and an RF antenna relay inside the 19 inch rack mount chassis. The Ethernet Redundant Base Station shall give the user access to two Ethernet Ports, the Setup Port and the Com Port of the active Ethernet base station. Both external Ethernet connections shall be connected internally with an embedded Ethernet switch the radios. The Ethernet, Setup and Com Ports shall be routed automatically by the controller board to whichever Ethernet is currently in use. It shall have two separate power supplies. Each power supply shall be able to power the entire base station. The Ethernet Redundant Base Station radios shall be identical to the remote radio.

4.14.2 Ethernet Failure Detection

The controller board shall have a microprocessor that shall continually monitor the status of the active Ethernet radio via an Ethernet connection. The controller board shall measure the transmit power of the Ethernet when it is sending data. The controller board also shall have the ability to send out a ping to a remote unit when necessary to verify if the active Ethernet is still capable of transmitting and receiving data.

4.14.3 Monitor the Base Station with Ethernet Connection

The base station shall be able to establish a telnet connection to the Ethernet radio currently in use. IP address, user name and password must be used

The following are the minimum parameters that shall be monitored.

- Diagnostic Forward Power
- Diagnostic Reverse Power
- Radio Temperature
- Foldback Status
- Error Status Message
- Externally Measured Forward Power
- Externally Measured Reverse Power

4.14.4 Monitor Receive and Transmit Data / Send Pings

The Ethernet Base shall be able to monitor the number of received and transmitted packets that go to/from the Ethernet radio. If there are no new received packets or if there are no new transmitted packets for a set period of time (Inactivity Time) the controller board shall generate its own traffic to verify the Ethernet is working correctly.

4.14.5 When a Failure Is Detected

When a failure is detected, and the base station is set to Automatic Mode, the first radio shall be powered off and the backup radio shall be powered on. The backup Ethernet radio boot up shall not be more than 25 seconds before being able to send and receive data. All ports shall be function with the backup Ethernet radio.

When an error is detected, the red Error LED on the base station's front panel shall turn on indicating which radio (Radio A or Radio B) the fault was detected with. The controller's Diagnostic web page shall report an error message showing which fault occurred. If the alarm is enabled, the buzzer shall sound two short chirps every 5 seconds indicating there is a failure. If enabled, the relays on the Alarm Port shall switch indicating an error has been detected.

Since both the Ethernets in the base station have identical Ethernet and RF MAC addresses, when the radios are switched neither the Local Area Network nor any remote Ethernets shall notice that the Base Station has switched to the backup Ethernet.

4.14.6 Ethernet Radio Setup for a Redundant System

In a redundant Ethernet system both Radio A and Radio B shall be setup identically.

4.14.6.1 Bridge Mode Setup:

The two Ethernet radios shall have identical Ethernet IP addresses.

4.14.6.2 Router Mode Setup:

The two radios shall have identical Ethernet IP and RF IP addresses. The two radios shall

have identical neighbor tables. When a new remote units shall be added to a field, both the current radio and the backup radio shall update their neighbor tables.

4.14.7 BASE STATION WEB MANAGEMENT

Status monitoring shall be possible from any browser-equipped computer, either locally or remotely. A password-protected shall be used.

Both the configuration parameters and operating firmware shall be possible to updated remotely, even over the RF network itself, using the webpages..

4.1.14.8 Navigating the Network Management System

The Web Interface shall be subdivided in two frames: the left frame shall allow the user to navigate the main menu, while the right main frame shall display the selected page.

4.14.9 Main Menu

Base Station's homepage shall allow the user access to Controller Settings, Radio Settings, Diagnostics, Routing Table, System Monitor Settings/Statistics, User Port and Firmware Updates. User shall be able to do as a minimum the following functions:

- Cancel operation
- Save
- Refresh
- Rest unit

