

User Manual

Xeta9 Ethernet Bridge

Revision A: June 2015

Ethernet Firmware: 2.07.5661 and above

Models: Xeta9-E, Xeta9x9-E, Xeta9x-E (Emancipator+), Xeta9-INS



XETAUWAVE

C U S T O M R F S O L U T I O N S

Revision History

Rev	Date	Description	Prepared	Checked
00	2014-06-17	Release Version	TS, AR, SM	
A	2015-06-30	Release Version 2.0	GLB	RC/AR/TS

Quick Start Information

DC Power should be **10 – 30VDC**

The default IP address of all XetaWave Radios is **192.168.0.3**

[Click Here](#) to jump to the **Quick Start Guide**.

Navigating this Document

This Manual has been written with extensive use of Hyperlinks to assist when navigating electronically with a PDF Reader such as [Adobe Reader](#).

We also know some you work remotely and may wish to view the manual on a smartphone or tablet. So, we've added these download links for the Mobile Version of **Adobe Reader** since some PDF Apps don't recognize internal hyperlinks used for document navigation.



Feedback?

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Abbreviations

AES	Advanced Encryption Standard
ANSI	American National Standards Institute
ARP	Address Resolution Protocol
ASCII	American Standard Code for Information Interchange
BER	Bit Error Rate
CFR	Code of Federal Regulations (FCC)
CTS	Clear To Send
DC	Direct Current
DCD	Data Carrier Detect (RS232)
DI	Digital Input
DSR	Data Set Ready (RS232)
DTR	Data Terminal Ready (RS232)
DTS	Digital Transmission Systems
EIA	Electronic Industries Alliance
EIRP	Equivalent Isotropic Radiated Power
ERP	Effective Radiated Power
FCC	Federal Communications Commission
FHSS	Frequency Hopping Spread Spectrum
FSK	Frequency Shift Keying
GND	Ground
GPS	Global Positioning System
GUI	Graphical User Interface
HSRP	Hot Standby Router Protocol
HTTP	Hyper Text Transfer Protocol
IC	Industry Canada
ICMP	Internet Control Message Protocol
IP	Internet Protocol
ISM	Industrial, Scientific & Medical license free band; 902-928MHz in the USA.
INS	Intelligent Network Synchronizer
IO	Input Output
IP	Internet Protocol
KML	Keyhole Markup Language; XML based file format used in Google Earth
KMZ	Keyhole Markup language Zipped; a compressed version of a KML
LAN	Local Area Network
LED	Light Emitting Diode
LLC	Limited Liability Company

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Abbreviations continued...

MAC	Media Access Control
MAS	Multiple Address Systems licensed band
MMS	Multi-Master Sync
MPE	Minimum Permissible Exposure (limit)
MPED	Minimum Permissible Exposure Distance
MSK	Minimum Shift Keying
MSMP	Multi-Speed Multi-Point
OSHA	Occupational Safety and Health Administration
PA	Power Amplifier
PC	Personal Computer
PDF	Portable Document Format
POE	Power Over Ethernet; 802.3.af and 802.3at
PPS	Pulse Per Second
PSK	Phase Shift Keying (Binary, Quadrature, 8, 16)
PTMP	Point to Multipoint
PTP	Point to Point
QAM	Quadrature Amplitude Modulation
RF	Radio Frequency
RSS	Radio Standards Specification (IC)
RTS	Request To Send
RTU	Remote Terminal Unit
RSSI	Received Signal Strength Indicator
RXD	Received Data
SCADA	Supervisory Control and Data Acquisition
SNR	Signal to Noise Ratio (Margin)
TIA	Telecommunications Industry Association
TCP	Transmission Control Protocol
TXD	Transmitted Data
UDP	User Datagram Protocol
UI	User Interface
UL	UL is an American worldwide safety consulting and certification company
URL	Uniform Resource Locator
VLAN	Virtual Local Area Network
VSRP	Virtual Switch Redundancy Protocol
VSWR	Voltage Standing Wave Ratio

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Warranty

XetaWave LLC warrants your XetaWave Wireless Ethernet Radio against defects in materials and manufacturing for a period of **three** years from the date of purchase. In the event of a product failure due to materials or workmanship, XetaWave will, at its discretion, repair or replace the product.

In no event will XetaWave LLC, its suppliers or its licensors, be liable for any damages arising from the use of or the inability to use this product. This includes business interruption, loss of business information, or other loss which may arise from the use of this product. XetaWave LLC Wireless Ethernet Radios should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. XetaWave LLC accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the XetaWave Wireless Ethernet Radio, or for the failure of such Radio to transmit or receive such data.

Warranty policy may not apply:

- 1) If product repair, adjustments, or parts replacements is required due to accident, neglect or unusual physical, electrical or electromagnetic stress.
- 2) If product is used outside of XetaWave specifications.
- 3) If product has been modified, repaired or altered by Customer unless XetaWave specifically authorized such alterations in each instance in writing.

Caution

Opening an Enclosed XetaWave Radio will void the warranty.

The warranty period begins from the date of shipment and is defined per the standard warranty policy stated above.

Information in this document is subject to change without notice. The information contained in this document is proprietary and confidential to XetaWave LLC. This manual is for use by purchasers and other authorized users of the XetaWave Wireless Ethernet Radio only.

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FCC & IC Notifications

This device complies with Title 47 CFR § Parts 1, 15, 101 of the FCC code along with Industry Canada: RSS-102, Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands) and Safety Code 6 of Health Canada. Specifically, 47CFR § 1.1310, Table 1, Limits for General Population/Uncontrolled Exposure and RSS-102, Radio Frequency (RF) Exposure Compliance of Radio Communication Apparatus (All Frequency Bands) Table 4.2 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment).

Operation is subject to the following two conditions:

- 1) This device must not cause harmful interference and
- 2) This device must accept any interference received, including interference that may cause undesired operation.

This device must be operated as supplied by XetaWave LLC. Any changes or modifications made to the device without the express written approval of XetaWave LLC may void the user's authority to operate the device, pose violations and liabilities.

This device complies with Industry Canada license-exempt RSS standard(s). 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.

Caution


The model number XETA9 has a maximum transmitted output power of 4000 mW when used in the 928-960MHz band and 1000mW when used in the 902-928MHz band. The transmit antenna shall be kept at least 65.56 cm from physical space where humans may exist. Additional details may be found in the RF Exposure Calculations at the end of this section.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Title 47 CFR § Part 15 and ICES-003. These limits are designed to provide reasonable protection against harmful energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 1) Reorient or relocate the devices and/or antennas.
- 2) Increase the separation between the equipment and the receiver.
- 3) Connect the equipment to an outlet on a circuit different from that to which the receiver is connected.
- 4) Consult the dealer or an experienced RF/Radio/Electronics professional for help.

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Note: Whenever any XetaWave LLC module is placed inside an enclosure, a label must be placed on the outside of that enclosure which includes the module's FCC ID and IC ID.

 <p>FCC ID: PEJ-938224-MSD9 IC ID: 11169A-XETA9 MODEL #: Xeta9m-T SERIAL #: 123456 INPUT VOLTAGE: 4.5 – 5.0 VDC</p> <p>This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, (2) this device must accept any interference received, including interference that may cause undesired operation.</p> <p>Made in the USA by Xetawave, LLC Louisville, CO 80027 (303) 447-2745 www.xetawave.com</p>	<p>WARNING</p> <p>These radio systems shall be installed by a professional installer familiar with the applicable rules. Installation of all antennas shall be performed in a manner that will provide the MPED from the direction of maximum radiation, to any user or member of the public and consistent with the settings in the applicable antenna installation compliance section below.</p>
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Exposure Compliance

FCC ID: PEJ-93829283-XETA9

IC ID: 11169A-XETA9

It is the responsibility of the licensee or user to guarantee compliance with the appropriate MPE regulations when operating this device in a way other than described herein. The installer of this equipment must ensure the antenna is located or oriented such that it does not emit an RF field in excess guidelines as posted in the Canadian RSS-102/Safety Code 6 of Health Canada, 47 CFR Bulletin 65/47CFR § 1.1310 of the Federal Communications Commission, or the Council of European Union as appropriate.

The XetaWave XETA9 uses a low power radio frequency transmitter. The concentrated energy from an antenna may also pose a health hazard in the near field. People should not be near the antenna when the radio link is operating as general practice and maintain a safe distance as calculated below.

Note: The FCC and Industry Canada do not use the same RF power density level for their limits, and also express their limits in different units. The US/FCC/OSHA/ANSI use milliwatts per square centimeter (mW/cm²) and Industry Canada uses Watts per square meter (W/m²).

$$W / m^2 = 10(mW / cm^2)$$

The limits for Industry Canada are calculated from equation: $0.02619 f^{0.6834}$ taken from [RSS 102, Issue 5, Table 4](#); 915MHz has an exposure limit of 2.77 W/m², or 0.277 mW/cm²

The following calculations are based off the MPE (Maximum Permissible Exposure) requirements as outlined by the FCC and IC.

The MPED (Maximum Permissible Exposure) distance has been calculated from both the FCC MPE limit of 0.6 mW/cm² and also the MPE limit for Industry Canada above; 0.277 mW/cm².

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The table provides safe distance for several power levels and antennas besides the worst case for convenience. To calculate safe distance:

$$MPED = \sqrt{\frac{(ConductedPower(mW))(DutyCycle)(AntennaGain)}{(4\pi)(ExposureLimit(mW/cm^2))}} \quad \text{eq.2}$$

Where MPED is Maximum Permissible Exposure Distance or **safe distance**. All quantities are calculated in linear or numeric quantities.

The exposure limit, MPED, and conducted power units must be consistent, mW and cm for this case.

Duty cycle is set using payload sizes for master and slave.

The highest ISM duty cycle, 93%, that can be set is 1600 transmit and 64 receive using a modulation of 57 kbps MSK.

The highest MAS duty cycle, 94%, that can be set is 1600 transmit and 64 receive using a modulation of 10 kbps MSK.

Payload settings are set in the radio Network Configuration Menu. If the radio is a Master then the Master packet size is set to 1600 and slave packet size is set to 64. All radios in the link must have the same master and slave settings.

At power up and with no data transmitting, the radios will transmit a beacon with a duty cycle of 6 to 10% depending upon modulation setting.

Table of MPE Safe Distance vs. Antenna Gain and Power Output Setting							
Power Setting (mW) ^A	Duty Cycle (linear)	Antenna Gain (dBi)	Antenna Gain (linear)	FCC MPE Limit (mW/cm ²)	FCC Safe Distance (cm)	IC MPE Limit (W/m ²) ^B	IC Safe Distance (cm)
4000 (MAS)	0.94	6	3.98	0.6	44.55	2.77	65.56
4000 (MAS)	0.94	3	2.00	0.6	31.58	2.77	46.48
1000 (ISM)	0.93	6	3.98	0.6	22.15	2.77	32.61
1000 (ISM)	0.93	3	2.00	0.6	15.70	2.77	23.12
100 (ISM)	0.93	6	3.98	0.6	7.01	2.77	10.31
100 (ISM)	0.93	3	2.00	0.6	4.97	2.77	7.31
10 (ISM)	0.93	6	3.98	0.6	2.22	2.77	3.26
10 (ISM)	0.93	3	2.00	0.6	1.57	2.77	2.31
The higher the antenna gain, the greater the minimum required MPE safe distance.							
^A The worst case is 4000 mW with 6 dBi gain antenna and safe distance of 65.56cm.							
^B The limits for Industry Canada provide shorter safe distances due to larger MPE limit.							

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Antenna Installation

US/FCC antenna compliance

Since professional installation is required, standard RF connectors are used. Adapters or custom coaxial cables may be required to connect the radio output connector to the desired antenna.

Any antenna from a reputable manufacturer with desired frequency range, gain, beam pattern (coverage) and an input surge impedance of approximately 50 ohms can be used provided the requirements of [Title 47 CFR Part 15.247 \(a\), \(b\) and \(c\)](#) are met, i.e.

- **Maximum conducted power of 1W / 30 dBm** delivered to the antenna.
- **Maximum EIRP of 4W / 36 dBm.**

XetaWave has successfully tested the Xeta9 with the following [antennas](#):

- **Rubber Duck (Test) Antenna.** Laird Technologies EXR-902-TN 896-960 MHz, Unity Gain (0dBd/2.15dBi), 1/2 Wavelength, Portable, TNC (M). The maximum power setting for a 2.15 dBi antenna is 1000 mW, even if directly connected to the Radio.
- **Omni-Directional Antenna.** 8dBi Omni-Directional Vertical Antenna, Laird Technologies p/n FG9026. The Radio power must be reduced to satisfy 47 CFR Part 15.247 (a), (b) and (c) for antenna gain greater than 6 dBi*
- **Directional Antenna.** 11 dBi Directional, Yagi vertical antenna, Larson p/n YA5900W. The Radio power must be reduced to satisfy 47 CFR Part 15.247 (a), (b) and (c) for antenna gain greater than 6 dBi*.

If the antenna gain is greater than 6 dBi, the power setting shall be reduced by the amount the antenna gain exceeds 6 dBi. The coaxial transmission system loss also factors into the EIRP calculation.

$$\begin{array}{ccccccc} \text{EIRP} & = & \text{Transmit} & - & \text{Transmission} & + & \text{Antenna} \\ (\text{dBm}) & & \text{Power (dBm)} & & \text{System Losses (dB)} & & \text{Gain (dBi)} \end{array} \quad 9$$

Rearranging for Transmit Power to meet the maximum EIRP of 36dBm;

$$\begin{array}{ccccccc} \text{Transmit} & = & \text{EIRP} & - & \text{Antenna} & + & \text{Transmission} \\ \text{Power (dBm)} & & (\text{dBm}) & & \text{Gain (dBi)} & & \text{System Losses (dB)} \end{array}$$

For example, to calculate the **maximum transmit power** required to radiate an 11dBi Yagi at the maximum 36dBm / 4W EIRP with 3dB of transmission system loss;

$$\text{Maximum Transmit Power (dBm)} = 36 \text{ dBm} - 11 \text{ dBi} + 3 \text{ dB} = \mathbf{28 \text{ dBm} / 630 \text{ mW}}$$

dBm can be converted to **mW** using this [online calculator](#).

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Industry Canada antenna compliance

Under Industry Canada regulations, this Radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential Radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropic radiated power (EIRP) is not more than necessary for successful communication.

This Radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

The installer of this Radio equipment must ensure the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website.

The following antennas are approved for Canadian use as detailed below.

Type	Gain (dBi)	Antenna	Manuf.	Part Number	Impedance Input (Ω)
Radio connected, omni-directional	3	Rubber Duck (unity gain vertical)	Laird	EXR-902-TN	50
Base station, omni-directional	5.1	Tubular vertical	Commscope	DB583-Y	50
Base station, omni-directional	11.1	Tubular vertical	Commscope	DB589-Y	50
Base station directional	11	Yagi	Larsen	YA5900W	50
Base station directional	12	Yagi	Wavelink	PRO890-12	50
Base station directional	11.1	Yagi	Laird	YB8966	50
Base station, omni-directional	8.5	Tubular vertical	Wavelink	PRO902-8	50
Base station, omni-directional	5	Tubular vertical	Wavelink	PRO902-5	50
Base station, omni-directional	5	Tubular vertical	Laird	FG9023	50
Base station, omni-directional	8	Tubular vertical	Laird	FG9026	50

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UL Notifications

The Xeta9-E, Xeta9x9-E and Xeta9x (Emancipator+) are suitable for use in Class I, Division 2, Groups A, B, C and D OR **non-hazardous locations only**.

WARNING - EXPLOSION HAZARD

- Do not disconnect equipment unless power has been removed or the area is known to be non-hazardous.
- Substitution of components may impair suitability for Class I, Division 2.

The maximum operating temperature of the devices while subjected to the surrounding air temperature test at 85°C is in accordance with the temperature class of the table below:

Model	T-code
Xeta9x9-E, Xeta9-E, Xeta9x3-E, Xeta1-E, Xeta1x1-E, Xeta2-E, Xeta2x1-E, Xeta2x2-E, Xeta3-E, Xeta3x1-E, Xeta3x2-E, Xeta3x3-E, Xeta4-E, Xeta4x1-E, Xeta4x2-E, Xeta4x3-E, Xeta4x4-E, Xeta9-E, Xeta9x1-E, Xeta9x2-E, Xeta9x4-E.	T3C
Xeta9m-R, Xeta9m-T, Xeta9-SB, Xeta9m-R4V, Xeta9m-T4V	T4A
Xeta3m-R, Xeta1m-R, Xeta1m-T, Xeta2m-R, Xeta2m-T, Xeta3m-T, Xeta4m-T, Xeta4m-R	T5

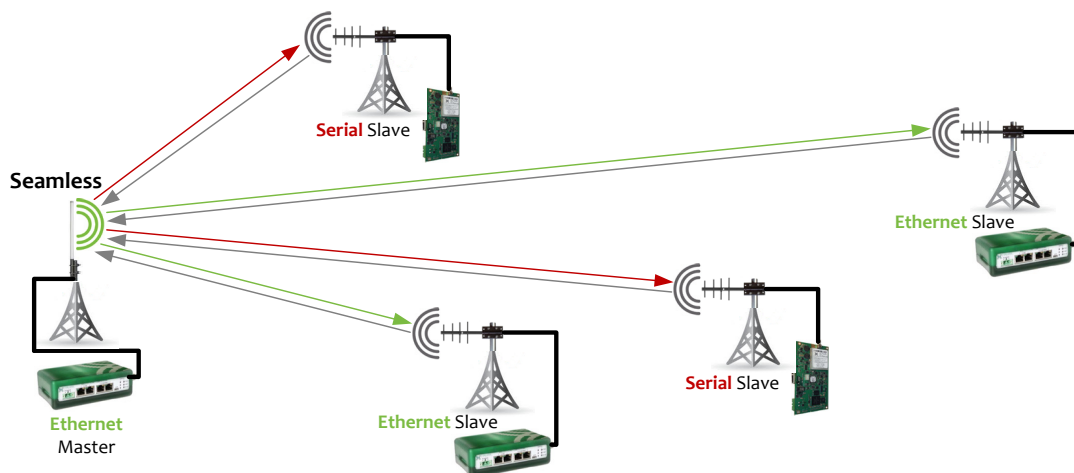
During the test, to maintain the unit within the temperature class listed above the transmit and receive duty cycles must be set per the directions and table below. TX packet size must be **less than or equal to** the value shown. Rx packet size must be **greater than or equal to** the value shown.

Model Number	Tx Packet Size <=	Rx Packet Size >=	Approximate Duty Cycle (%)
Xeta9-E, 4 Watts	100	64	53.5
Xeta9-E, 1 Watt	1024	1024	91.0
Xeta9m-R, 1 Watt MAS	250	64	39.0
Xeta9m-R, 1 Watt ISM	150	64	39.0
Xeta9m-R4V, 1 Watt	600	64	83.8
Xeta9m-T4V, 1 Watt	600	64	83.8
Xeta9m-T, 1 Watt MAS	250	64	62.4
Xeta9m-T, 1 Watt ISM	150	64	39.0
Xeta9x9-E			
Radio 1, 4 Watts	100	64	53.5
Radio 2, 1 Watt	1024	64	91.0
Xeta9x9-E			
Radio 1, 1 Watt	1024	64	91.0
Radio 2, 1 Watt	1024	64	91.0

Product Features Overview

Seamless Serial

Seamless is a technology in XetaWave Ethernet radios that creates multiple Serial networks within one Ethernet network, so that Serial and Ethernet Slaves can talk to an Ethernet Master.



A Seamless network refers to a virtual [Serial](#) network that exists within an Ethernet network.

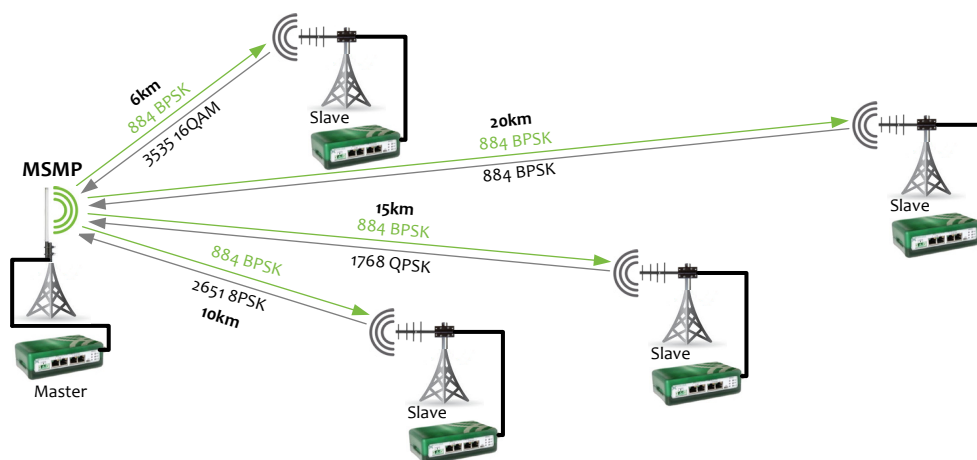
Seamless makes the following possible in a single wireless network:

- Local or remote terminal server connection to Ethernet Master Radio communicates with multiple Serial Slave Radios; simultaneously communicates with Ethernet Slave Radios.
- Local Serial port connection to Ethernet Master Radio communicates with multiple Serial Slave Radios; simultaneously communicates with Ethernet Slave Radios.
- Local or remote terminal server connection at Ethernet Master Radio communicates with one group of Serial Slave Radios while local Serial connection at Ethernet Master Radio communicates with a second group of Serial Slave Radios; simultaneously communicates with Ethernet Slave Radios.
- Two separate local or remote terminal server connections at Ethernet Master Radio communicate with two separate groups of Serial Slave Radios; simultaneously communicates with Ethernet Slave Radios.
- Two separate local Serial port connections at Ethernet Master Radio communicate with two separate groups of Serial Slave Radios; simultaneously communicates with Ethernet Slave Radios.

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MultiSpeed MultiPoint™ (MSMP)

When configured as part of a XetaWave PTMP network, the Radios in the network are not required to communicate at the same data-rate. This enables remote Slave Radios that are closer to the Master or in a better RF environment to communicate at faster data-rates than remotes that are further away or in high-noise areas.



Since transmissions from the Master Radio in a PTMP network must be received by all remotes irrespective of distance or RF conditions, the Master Radio is limited to a single data-rate. Remote Slave Radios must also be configured with the data-rate the Master will use to communicate.

Remote Slave Radios in a PTMP MSMP network independently and dynamically select the optimal data-rate. The list of data-rates is selected by checking the corresponding check-boxes on the remote Radio.

Data-rates which remote Slave Radios may use to communicate must also be defined on the Master Radio, therefore the configuration should match between the Master Radio and each of the remote Slave Radios.

Multi-Master Sync (MMS)

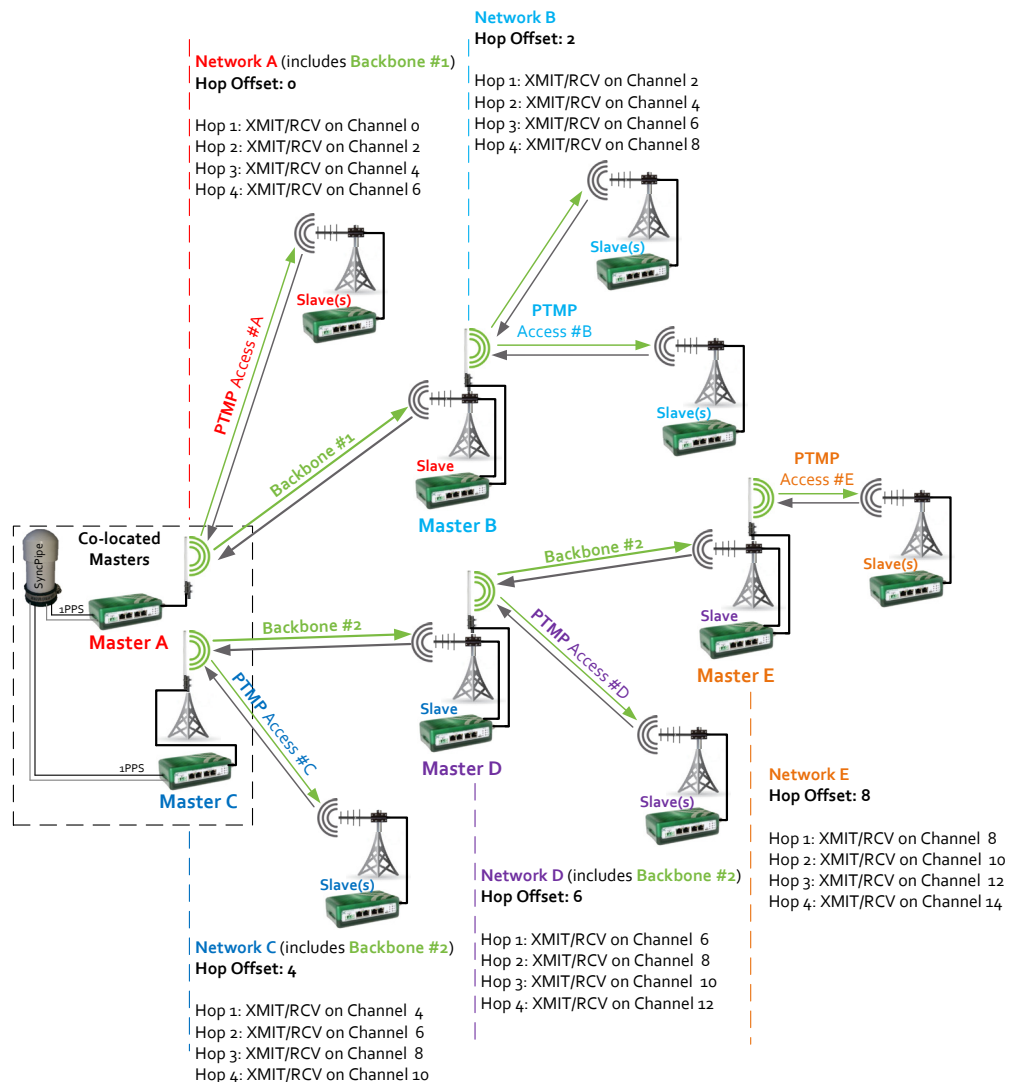
It is common practice in large Ethernet SCADA communication systems to install multiple overlapping wireless networks to mitigate poor performance and prioritize traffic for different traffic types and mixed protocols.

Wireless Ethernet networks with many remote devices can experience low throughput and long latency. Dividing large wireless networks into many smaller networks can increase throughput and reduce latency; PTP backhaul links for high throughput and PTMP access links to interface various end devices. Different traffic types can cause low priority data to block high priority data. Separating networks for each application in a single area establishes guaranteed capacity for each traffic type.

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For example SCADA polling, video surveillance and internet access can each have individual networks with the same or overlapping geographical coverage.

Installing multiple Radios at the same location or in the same geographical area must be done carefully to prevent interference.



XetaWave Radios have a technology to prevent problems related to multiple Radios installed at the same location; Multi-Master Sync or MMS.

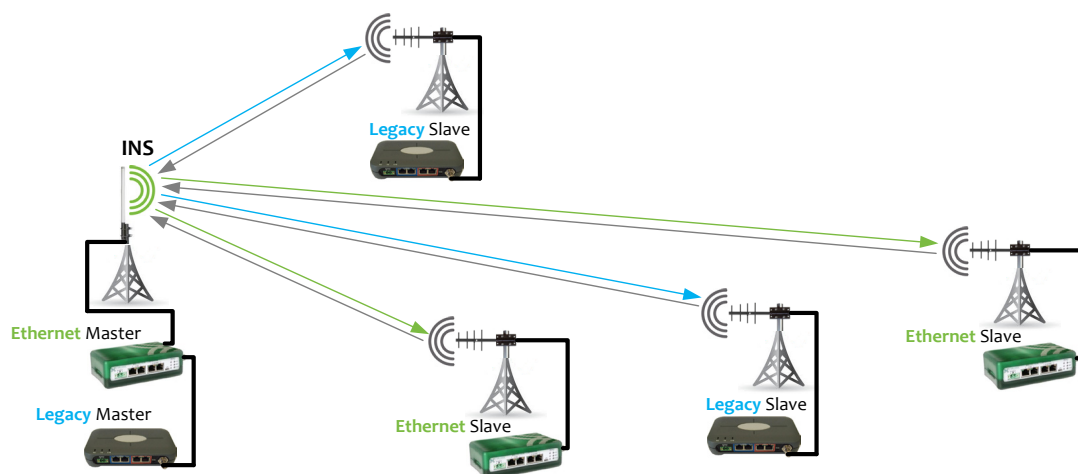
MMS synchronizes the Radios in overlapping networks to transmit and receive at the same time, but on different frequencies as shown in the following hop sequence.

For every hop in the sequence, each radio sub-network ; 1x Master + connected Slaves will transmit & receive on a unique frequency over the same time duration, therefore eliminating self-interference.

User Manual; Xeta9 Ethernet Bridge

INS (Xeta9-INS Only)

The Intelligent Network Synchronizer (INS) is a combination of software and hardware that allows users to overlay a higher performing XetaWave network on top of an existing legacy radio system.



One key function of the software is to detect the legacy radio timing; this is essential for the XetaWave Master to transmit on a different frequency at the same time and with the same duration as the legacy Master.

The INS hardware allows users to maintain only 1 antenna at the Master site, while amplifying signals from weak slave radios for the benefit of overlapping the legacy and XetaWave networks.

The INS system is composed of an Ethernet board, a 900MHz Xeta9m-T radio module and an INS module.

The INS module contains RF circuitry with 3 RF ports; an antenna port, a legacy port and a XetaWave port. The INS module has 2 operational states; Receive or Transmit.

Receive works by amplifying received signals from the antenna port and splitting the amplified signal to legacy port and XetaWave port.

Transmit works by combining signals from legacy and XetaWave ports and outputting the combined signal to the antenna port. **There is a 3dB signal loss in transmit.**

The INS module notifies the XetaWave radio of the transmit state of the legacy radio.

The INS module switches between Receive and Transmit according to the input signal TX_ON. When TX_ON is high or if the legacy radio transmits, the INS module enters Transmit. When TX_ON is low and the legacy radio is not transmitting, the INS module is receiving.

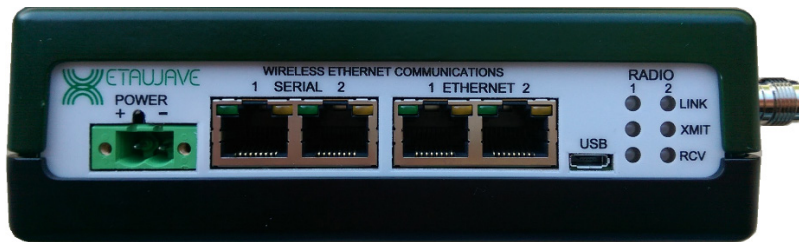
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Mechanical Design

Enclosed (Xeta9-E, Xeta9x9-E, Xeta9-INS)

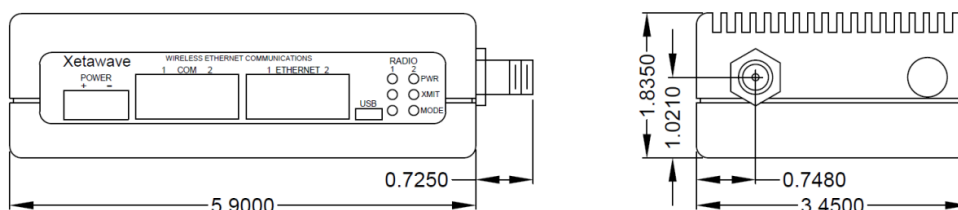
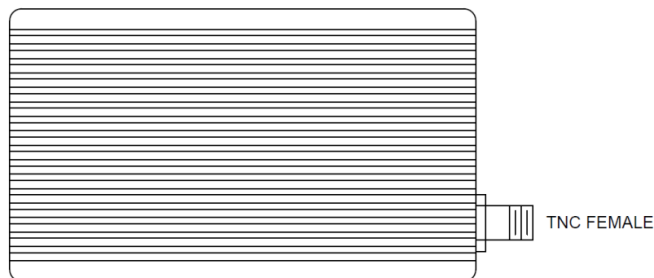
XetaWave enclosed Ethernet Wireless Radios all have the same design with front access to communication ports, side access to RF connections and I/O connections. The radio may or may not be DIN rail mounted. The top of the radio enclosure is a heat sink needed for high-power dual-radio applications – the finned heat sink surface should be kept clear of any materials. Stacking radios on top of each other is not recommended as a gap should always be maintained between radios to aid with heat dissipation.

The front of the radio includes (from left to right) the 10-32VDC power connector, the two Serial RJ45 COM port connectors, the two RJ45 Ethernet port connectors, a USB connector for future power use, and two sets of indicator lights for up to two radio modules. The left side of the radio may have I/O connectivity as an option.



Depending on Xeta9 model, the right side of the enclosure will have either one or two female TNC connectors...

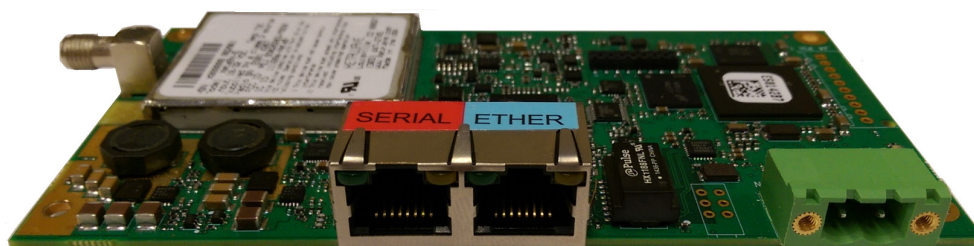
- 1 x TNC; **Xeta9-E** has 1 x internal RF module.
- 2 x TNC; **Xeta9x9-E** has 2 x internal independently configured RF modules.
- 2 x TNC; **Xeta9-INS** has 1 x internal RF module and 1 x internal INS module.



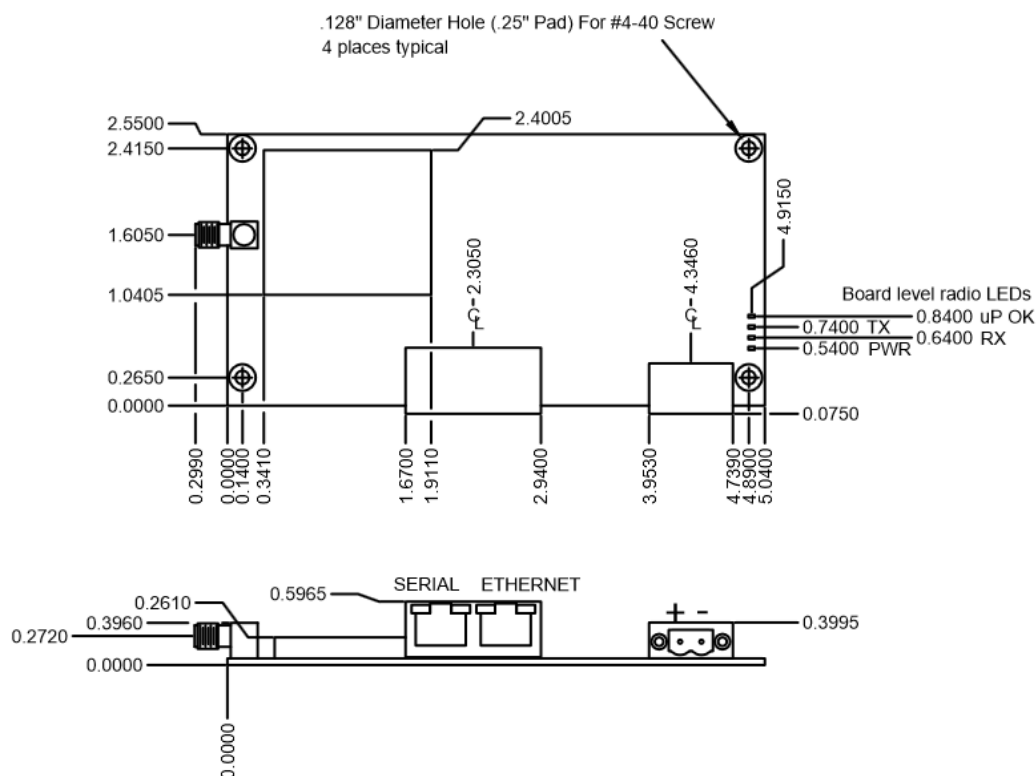
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Board Level Emancipator+ (Xeta9x-E)

The XetaWave Emancipator+ (Xeta9x-E) radio has one Serial RJ45 COM port connector, one RJ45 Ethernet port connector, side access to a SMA RF connector and the same 10-32VDC power connector as all other XetaWave products.



↑ Serial Port ↑ Ethernet Port + ↑ -
10-32 VDC



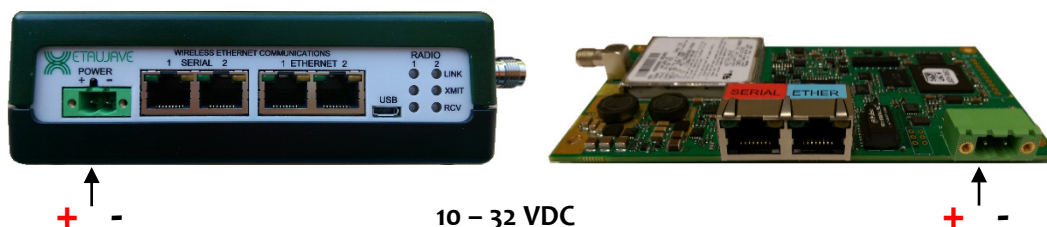
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Interface Cabling

DC Power

XetaWave recommends using a power source capable of 8W peak / 4W sustained.

The 10 – 32 VDC Power Connector is a Phoenix Contact MSTB 2-Pin plug used on all XetaWave Products. The Positive terminal is on the left and the Negative terminal is on the right. All XetaWave Radios have reverse polarity protection to 32VDC.

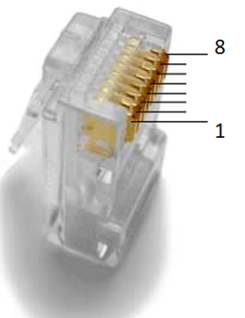


Caution

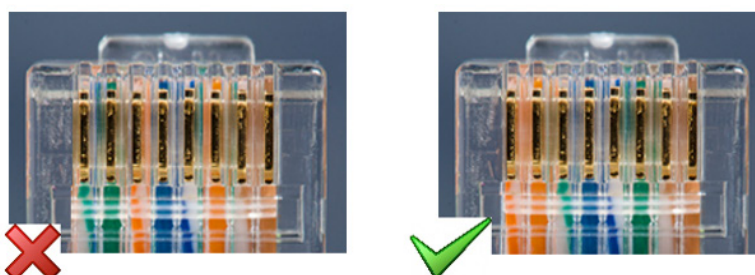
Use of 802.3af PoE / 802.3at PoE+ with existing XetaWave products is NOT advised.
PoE capabilities are on the product roadmap, but not currently implemented.

TIA/EIA 568 Wiring Standard

The T568 Standard defines the pin-out and wire pairing for the termination of RJ-45 connectors in two standard configurations; T568A and **T568B**.

8P8C RJ45 Plug	RJ45 Pin #	T568A Wire Color	Pair #	T568B Wire Color	Pair #
	1	Green	3	Orange	2
	2	Green	3	Orange	2
	3	Orange	2	Green	3
	4	Blue	1	Blue	1
	5	Blue	1	Blue	1
	6	Orange	2	Green	3
	7	Red	4	Red	4
	8	Red	4	Red	4

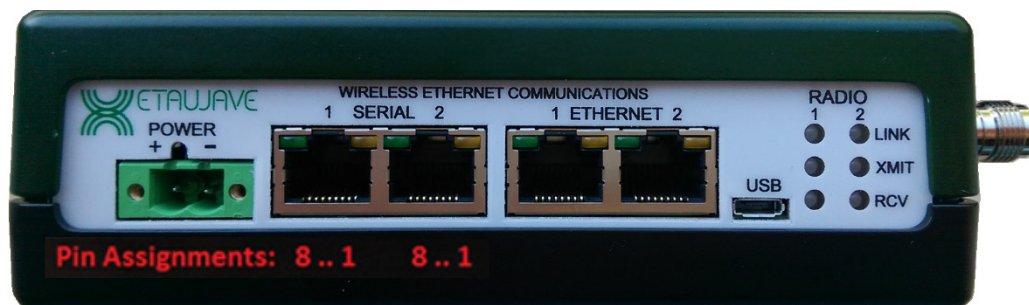
This manual assumes the use of the **T568B** Wiring Standard for **Serial** RJ45 connectors.



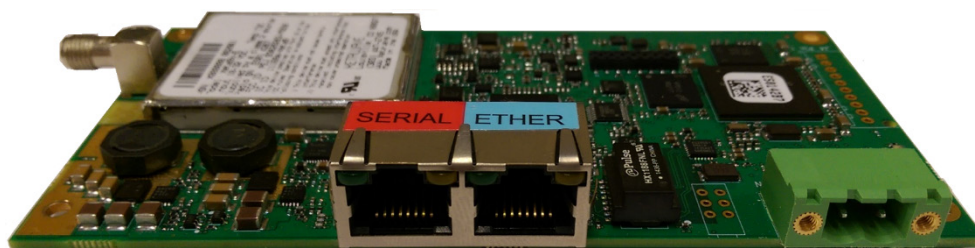
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RJ45 Serial Port Pin Assignments

All XetaWave Radios have the RJ45 locking tab facing upwards, which means the pin numbering of the [Serial RJ45 Ports](#) is reversed from right to left:



Reminder, the Xeta9x-E (Emancipator+) board level Radio has 1 x Serial RJ45 Port:



Pin Assignments: 8 .. 1

Connections for RS232

XetaWave uses the [EIA/TIA-561](#) standard for RS 232 signals on the Serial RJ45 Port. With the serial port on the XetaWave Radio configured as RS 232, the following table applies:

Serial RJ45 Pin #	RS 232 Signal Pinout EIA/TIA-561	T568B Wire Color	Connect to these lines on Serial End Device
1	Data Set Ready (DSR)	White/Orange	Data Terminal Ready (DTR)
2	Data Carrier Detect (DCD)	Orange	DSR/DTR line
3	Data Terminal Ready (DTR)	White/Green	Data Set Ready (DSR)
4	Signal Ground* (GND)	Blue	Signal Ground* (GND)
5	Receive Data* (RXD)	White/Blue	Transmit Data* (TXD)
6	Transmit Data* (TXD)	Green	Receive Data* (RXD)
7	Clear to Send (CTS)	White/Brown	Request To Send (RTS)
8	Request To Send (RTS)	Brown	Clear to Send (CTS)

* **TXD, RXD and GND** are required as a bare minimum for interfacing most serial end devices to the XetaWave Ethernet Bridge.

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Connections for 4-Wire RS-422 / RS-485

When the Serial port on the XetaWave Radio is configured to 4-wire RS-422 or RS-485, the following table applies:

Serial RJ45 Pin #	RS 422/485 Signal Pinout	T568B Wire Color	Connect to these lines on Serial End Device
1		White/Orange	
2		Orange	
3		White/Green	
4	Signal Ground (GND)	Blue	Signal Ground (GND)
5	Receive + (A)	White/Blue	Transmit + (Y)
6	Transmit + (Y)	Green	Receive + (A)
7	Transmit – (Z)	White/Brown	Receive – (B)
8	Receive – (B)	Brown	Transmit – (Z)

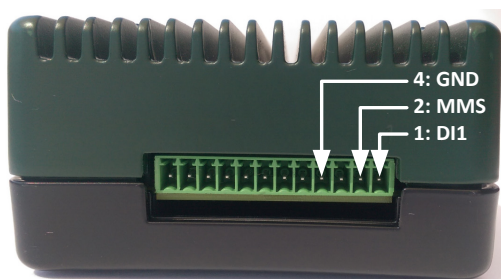
Connections for 2-Wire RS 485

When the Serial port on the XetaWave Radio is configured to 2-wire RS-485, the following table applies:

Serial RJ45 Pin #	RS 422/485 Signal Pinout	T568B Wire Color	Connect to these lines on Serial End Device
1		White/Orange	
2		Orange	
3		White/Green	
4	Signal Ground (GND)	Blue	Signal Ground (GND)
5	Bus+ (short to Pin6)	White/Blue	Bus+
6	Bus+ (short to Pin5)	Green	
7	Bus– (short to Pin8)	White/Brown	Bus–
8	Bus– (short to Pin7)	Brown	

IO Connections (Xeta9–E, Xeta9x9–E, Xeta9–INS)

On the standard range of Xeta9-E Radios, the following IO pins are implemented.



IO Pin #	Signal Pinout
1	DI-1 : See IO Section for details
2	MMS: See MMS Section for details
4	Ground

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Status LEDs

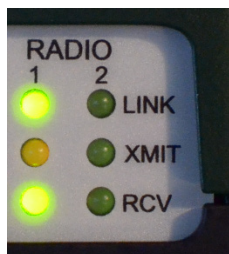
Enclosed Radios Xeta9-E, Xeta9x9-E, Xeta9-INS

Enclosed Ethernet Radios have **LINK***, **XMIT*** and **RCV*** LEDs on the front panel; Radio 1 for the Xeta9-E, Radio 2 for the Xeta9-INS and both for the Xeta9x9-E.



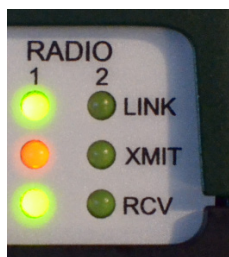
The **LINK** LED shows radio power and link state.

- A **red** LINK LED indicates that the radio has power but is **not** linked (a Point to Multipoint **Master** radio always shows a **green** LINK LED. All other radio configurations show a **red** LINK LED upon power up until the radio link is established).
- A **green** LINK LED indicates that the radio has power and is linked.
- When the link is established the LINK LED turns **green**.
- If the link is dropped, then the LINK LED returns to **red**.



The **XMIT** LED flashes **red** every time the radio transmits data.

The **RCV** LED flashes **green** when the radio is receiving and decoding an RF packet.

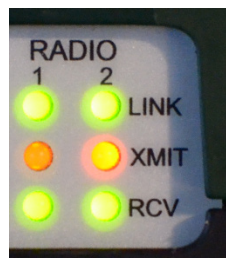


*Because of the high speed of the embedded microprocessor and communications, all status LEDs can turn on and off very quickly. In some cases the LEDs turn on and off so quickly that the LEDs appear to be on but dimly lit. This behaviour indicates that events are happening in very quick succession. A good example is the XMIT LED changing intensity from dim **red** to bright **red** to **off**. This indicates many small packets in quick succession (dim **red**), followed by many large packets with almost continuous transmissions (bright **red**), then no transmissions (**off**).*



*** Depending on the specific model and age of the radio, the front panel LED's may be referred to differently...**

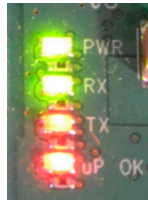
- **LINK** may also be referred to as **PWR**
- **XMIT** may also be referred to as **TX**
- **RCV** may also be referred to as **MODE** or **RX**



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Board Level Radio Xeta9x-E (Emancipator+)

The Xeta9x-E (Emancipator+) has all the LEDs that the enclosed Ethernet Radios have, but are presented in a different order and are referred to as follows:



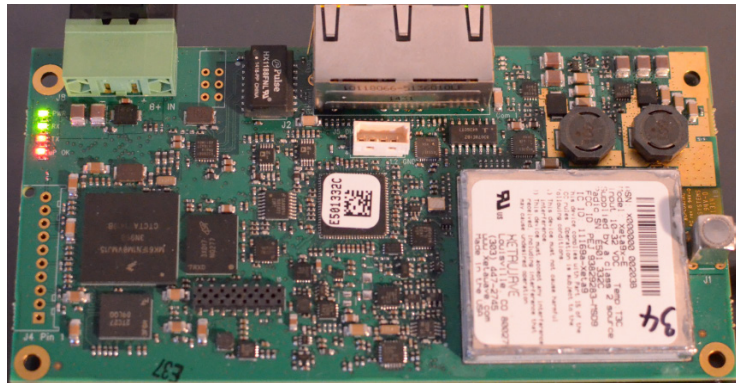
PWR = **LINK**

RX = **RCV**

TX = **XMIT**

The Xeta9x-E has an extra LED: **uP OK**, which indicates that the microprocessor is running.

Status LED's are located next to the DC power connector:



Using the Status LED's for Diagnostics

LINK/PWR - Master: **green** at all times. Slave: **green** indicates the link is up, **red** indicates the link is down.

Intermittent flickering **red** indicates a mismatch in RF Transmission Settings between Master and Slave and the likelihood that traffic is not moving. Verify Master and Slave RF Transmission Settings to ensure Frequency and MMS parameters match.

XMIT/TX - Lights up **red** when transmitting data; bright for large packets with almost continuous transmission; dim for small packets in quick succession; off for not transmitting at all.

RCV/RX - Lights up **green** when receiving data; bright for large packets with almost continuous reception; dim for small packets in quick succession; off for not receiving at all.

If the RCV/RX LED is excessively flickering on a live network that's passing data, the link may be marginal; Check the Radio Diagnostics page for signal and noise levels.

Note: Increasing the Beacon Period on the Master slows down the RCV/RX LED blinking rate on the Slave when the link is idle; i.e. not passing traffic.

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Web Interface Overview

XetaWave Wireless Ethernet Radios can be quickly configured using a web-based User Interface (UI) by entering the Radio IP address into the URL box of a web-browser. The PC/Laptop must have an IP address on the same subnet as the XetaWave Ethernet Radio in order to communicate.

XetaWave recommends the use of Google Chrome or Mozilla Firefox to access the UI. Internet Explorer is not recommended. Due to slightly different behaviour among web-browsers, it may occasionally be necessary to manually refresh a page or click on the link on the left navigation bar to reload a page. This is completely normal.

While XetaWave Radios are capable of multi-megabit data rates, web administration pages have been developed to support functional access over slow-speed links.

Default IP

The factory **default IP address** of all XetaWave Radios is **192.168.0.3**.

Accessing the Web Interface

The IP address of the Radio can be changed by the user at any time, so if the IP address of the unit is not known, the serial COM1 interface can be used to either discover the IP address, or to reset the unit back to the factory setting of 192.168.0.3.

- 1) Connect a terminal emulator such as Terra Term, PuTTY or Hyerterminal to a serial port on your PC/Laptop and set to 115200 8N1.
- 2) Connect the PC/Laptop serial port to COM1 of the Enclosed Radio or COM of the board level Emancipator.
- 3) Cycle the power to the Radio and watch the terminal window. The current IP address should be displayed on the screen. You can then press Ctrl + R to interrupt the boot sequence and then restore factory settings” by pressing 1, followed by “Y” to confirm.

```
Serial number: E5.01.33.2C
Software version: 2.07.5252
Device name: XetaWave

IPv4 address = 192.168.0.3
MAC address = 70-f1-e5-01-33-2c
Subnet mask = 255.255.255.0
Default gateway = 192.168.0.1
DNS server = 0.0.0.0

VLAN configuration:
Management VLAN = 1
Ethernet 1 Native VLAN = 1
Ethernet 2 Native VLAN = 1

Ctrl + R to interrupt terminal server startup
....
1 : Restore factory settings
2 : Restore default Management VLAN and default Native VLANs
.....1
Please confirm: Restore factory settings? (y/N) ..y
Factory parameters restored. Resetting...
```

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Main Menu

Device Name	XetaWave
Device ID	6000
IP Address	192.168.0.1
Ethernet Firmware	2.07.5661
Radio 1	Name: Ethernet Master ID: 6000, Point-to-multipoint, Master Firmware: 1.36.5612
Radio 2	Checking...
MAC Address	70-f1-e5-01-20-68
Serial Number	E5.01.20.68

Save Device Name

Validate
Settings

Device Name – user-definable name to permit easier user identification with the device. When ‘Save Device Name’ is clicked, the new value is saved in the internal flash for use after the next reset or power up.

Device ID – the Device ID is used to uniquely identify radio nodes in a XetaWave RF network. For enclosed radios this value displays the Device ID configured for the first installed RF module; Radio 1. For board level Emancipator+ this value displays the only Device ID that can be configured.

IP Address – displays the IP address configured on the “Network Settings” page.

Ethernet Firmware – displays the current Ethernet firmware version.

Radio 1 – displays Device ID, Network Type, Mode and current Radio firmware version of RF Module #1. When the web interface is accessed immediately after a power-cycle or reboot the Radio firmware values will display “checking...” for up to 15 seconds while configuration information is being read from installed RF modules.

Radio 2 – if a second RF module is installed, information about RF Module #2 is displayed here otherwise this value will display “Not Present”.

MAC Address – Enclosed Radio; this is the MAC Address of the Ethernet carrier board and not the RF Module(s). Board level Emancipator+; this is the MAC Address of the Radio. MAC addresses are set at the factory and cannot be changed.

Serial Number – this unique identifier is the same as the right most four bytes of the device’s MAC address. Enclosed Radio; this the Serial Number of the Ethernet carrier board. The RF Module serial numbers are located on the RF Transmission settings page. Board level Emancipator+; this is the Serial Number of the Radio.

Validate Settings – this button appears whenever changes requiring validation are pending. In order to prevent a user from inadvertently locking themselves out of a Radio, several connectivity-related changes require validation within a user specified time-limit. If changes are not validated within the specified time-limit the Radio assumes connectivity with the user has been lost and will revert back to its previous configuration.

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Network Settings

This is where to configure the IP Address, Subnet Mask, Default Gateway, VLANs and Port Speed/Duplex.

It is critical these values are set correctly and compatible with other Radios or devices on the network.

Due to the risk of losing connectivity with the Radio after changing IP address and VLAN settings, a validation safeguard is built in that requires the user to validate changes before they are permanently stored in memory.

Warning

You have requested to save critical network parameter changes (IP addresses, radio disable, etc.) which could render the device unreachable if unsuitable.

Please verify that this is your intention.

Saving of new critical settings causes an immediate reset and must be validated within a period of 5 minutes, otherwise the original settings will be returned. If you continue with the modification, please re-establish a connection afterwards using the new settings and validate in the LAN interface configuration side.

[Cancel - Go to menu page](#)

5 min. validation period [CONTINUE WITH SAVE](#)

If choosing a validation period from the drop down, you'll need to hit [Validate Settings](#) on the Main Menu page to confirm the changes and program them into memory.

Network Settings	
MAC Address	<input type="text" value="70-f1-e5-01-20-68"/>
IP Address	<input type="text" value="192.168.0.1"/>
Subnet Mask	<input type="text" value="255.255.255.0"/>
Default Gateway	<input type="text" value="192.168.0.1"/>
Management VLAN	<input type="text" value="1"/>
Bridging Options	<input type="checkbox"/> Promiscuous mode

VLAN Membership and Tagging				
	Ethernet 1	Ethernet 2	Radio 1	Radio 2
Speed / Duplex	<input type="text" value="Auto"/>	<input type="text" value="Auto"/>	N/A	N/A
Native VLAN	<input type="text" value="1"/>	<input type="text" value="1"/>	N/A	N/A
Port Tagging	<input type="text" value="NONE"/>	<input type="text" value="NONE"/>	N/A	N/A
Allowed VLANs	<input type="text" value="NATIVE"/>	<input type="text" value="NATIVE"/>	<input type="text" value="ALL"/>	<input type="text" value="ALL"/>
Allowed List	<input type="text" value="1"/> <div style="border: 1px solid #ccc; height: 100px; width: 100%;"></div> <div style="display: flex; justify-content: space-between;"> Remove Clear </div> <div style="display: flex; justify-content: space-between;"> Add </div>	<input type="text" value="1"/> <div style="border: 1px solid #ccc; height: 100px; width: 100%;"></div> <div style="display: flex; justify-content: space-between;"> Remove Clear </div> <div style="display: flex; justify-content: space-between;"> Add </div>	<input type="text" value="1"/> <div style="border: 1px solid #ccc; height: 100px; width: 100%;"></div> <div style="display: flex; justify-content: space-between;"> Remove Clear </div> <div style="display: flex; justify-content: space-between;"> Add </div>	<input type="text" value="1"/> <div style="border: 1px solid #ccc; height: 100px; width: 100%;"></div> <div style="display: flex; justify-content: space-between;"> Remove Clear </div> <div style="display: flex; justify-content: space-between;"> Add </div>
Submit				

*Saving of new settings causes an immediate reset and must be validated; otherwise the original settings will be returned. This ensures that new settings do not render a device unreachable.

[Help](#)
[Go back to menu page](#)

MAC address – Enclosed Radio; this is the MAC Address of the Ethernet carrier board and not the RF Module(s). Board level Emancipator+; this is the MAC Address of the Radio. MAC addresses are set at the factory and cannot be changed.

IP address – IPV4 address used to communicate with or connect to the XetaWave Radio. The address specified is used to access the web-based User Interface, and establish communications with serial devices through the Radio's built-in terminal server capabilities.

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Network Settings	
MAC Address	70-f1-e5-01-20-68
IP Address	192.168.0.1
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.1
Management VLAN	1
Bridging Options	<input type="checkbox"/> Promiscuous mode

VLAN Membership and Tagging				
	Ethernet 1	Ethernet 2	Radio 1	Radio 2
Speed / Duplex	Auto	Auto	N/A	N/A
Native VLAN	1	1	N/A	N/A
Port Tagging	NONE	NONE	N/A	N/A
Allowed VLANs	NATIVE	NATIVE	ALL	ALL
Allowed List	<div>1</div> <div>Remove Clear Add</div>	<div>1</div> <div>Remove Clear Add</div>	<div>1</div> <div>Remove Clear Add</div>	<div>1</div> <div>Remove Clear Add</div>
Submit				

**Saving of new settings causes an immediate reset and must be validated; otherwise the original settings will be returned. This ensures that new settings do not render a device unreachable.*

[Help](#)
[Go back to menu page](#)

Subnet Mask – mask applied to the IPV4 address to identify the network segment containing the Radio and when forwarding traffic to the default gateway is required.

Default Gateway – if a default gateway is configured, the Radio will periodically attempt to resolve the MAC address of the default gateway via ARP. Once the MAC address of the default-gateway is acquired, the Radio will periodically re-ARP for the gateway to ensure connectivity is maintained in the event the default-gateway is moved due to a redundancy protocol such as HSRP or VRRP.

Management VLAN – internally, XetaWave Radios have a virtual Ethernet port to accept traffic destined for the Radio's IP address. The VLAN specified here is the one associated with this internal virtual Ethernet port. In order to access the Radio's IP address, inbound traffic must enter the Radio on the same VLAN as the Radio's internal virtual Ethernet port. **The default setting is 1.**

Bridging Options – Promiscuous Mode allows the Radio to indiscriminately pass traffic that may be present on an Ethernet cable that is not typically relayed by an Ethernet switch. This mode is normally used for packet sniffing and network connectivity diagnosis.

Ethernet speed – speeds of 10 Mbps, 100 Mbps or auto-negotiation (speed and duplex) can be set.

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VLAN Membership & Tagging

XetaWave Ethernet Radios function as 5-port Enterprise Ethernet switches by implementing 802.1q VLANs and trunks. The five ports that participate in the Ethernet switching process are:

Port / Interface	Description
Ethernet 1	Physical Ethernet interface which can function as an access port, an 802.1q trunk, or both.
Ethernet 2	Physical Ethernet interface which can function as an access port, an 802.1q trunk, or both.
Radio 1	Wireless interface which functions as an 802.1q trunk.
Radio 2	Wireless interface which functions as an 802.1q trunk.
Management	Virtual Ethernet interface internal to the Radio which functions as an access-port.

VLAN Membership and Tagging

	Ethernet 1	Ethernet 2	Radio 1	Radio 2
Speed / Duplex	Auto ▼	Auto ▼	N/A	N/A
Native VLAN	1	1	N/A	N/A
Port Tagging	NONE ▼	NONE ▼	N/A	N/A
Allowed VLANs	NATIVE ▼	NATIVE ▼	ALL ▼	ALL ▼
Allowed List	<div>1</div> <div>Remove Clear Add</div>	<div>1</div> <div>Remove Clear Add</div>	<div>1</div> <div>Remove Clear Add</div>	<div>1</div> <div>Remove Clear Add</div>
Submit				

Native VLAN – this is the primary VLAN ID associated with a physical Ethernet port. By convention, untagged Ethernet frames entering the Radio via a physical Ethernet port are assigned to the native VLAN specified for that port. Any untagged frames leaving an Ethernet port are also associated with the port’s native VLAN. **The default setting is 1.**

Port Tagging – this value controls the VLAN tagging behaviour for an Ethernet port. **The default setting is NONE.**

- When set to “NONE” an Ethernet port does not add VLAN tags to any frame leaving the port and only untagged frames are allowed to enter the Radio. (One exception to this rule: tagged frames belonging to the native VLAN are accepted by the Radio). All packets entering and leaving the Radio are associated with the native VLAN.

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VLAN Membership and Tagging

	Ethernet 1	Ethernet 2	Radio 1	Radio 2
Speed / Duplex	Auto	Auto	N/A	N/A
Native VLAN	1	1	N/A	N/A
Port Tagging	NONE	NONE	N/A	N/A
Allowed VLANs	NATIVE	NATIVE	ALL	ALL
Allowed List	1	1	1	1
	Remove Clear Add	Remove Clear Add	Remove Clear Add	Remove Clear Add
	Submit			

Port Tagging continued...

- When set to “EXCLUDE NATIVE” the port acts as a VLAN trunk and will tag all frames leaving the port except those belonging to the native VLAN. Traffic entering the port can be tagged or untagged with all untagged frames automatically being associated with a port’s native VLAN.
- When set to “ALL” the port acts as a VLAN trunk and will tag all frames leaving the port including those belonging to the native VLAN. Traffic entering the port must be tagged. Any untagged frames entering a port are dropped.

Allowed VLANs – this value defines which VLANs are allowed to enter or leave an Ethernet port or Radio interface. **The default setting for Ethernet ports is NATIVE. The default setting for Radio interfaces is ALL.**

- When set to “NATIVE” an Ethernet port will only allow frames associated with its native VLAN to enter or leave the radio. It is not possible to set a radio interface to “NATIVE”.
- When set to “ALL” an Ethernet port or Radio interface will allow any valid frame to enter or leave the Radio.
- When set to “LIST” an Ethernet port or Radio interface will only allow those VLANs specifically identified in the “Allowed List” to enter or leave the Radio. This feature can be used to associate VLANs to a specific Radio interface and segment traffic over the wireless network if necessary.

Allowed List– this list is used in combination when the “Allowed VLANs” is set to “LIST” to specifically identify which VLANs can enter or leave the Radio over a physical Ethernet port or Radio interface. The maximum number of VLANs that can be specified across all ports and interfaces is 12.

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RF Modules

This page graphically displays the current status of each of the installed Radio Modules along with the current two-radio configuration, if applicable.

Radio Power State

Radio 1 (ON)

Radio 2 (OFF)

Enabled ☒
Enabled ☐

Two Radio Configuration

☒ Independent Modules
☐ Full Duplex

[Help](#)
[Go back to menu page](#)

Toggle Power to a RF Module

Click a Radio button to **toggle** power to a Radio. A Radio that is powered off will be automatically powered back on after a 2 minute interval to prevent being inadvertently disconnected from the Radio.

Disable Power to a RF Module

To **disable** a Radio module, uncheck the “Enabled” checkbox and press the “Save Enable/Disable” button. You will be prompted to select a validation period.

Warning

You have requested to save critical network parameter changes (IP addresses, radio disable, etc.) which could render the device unreachable if unsuitable.

Please verify that this is your intention.

Saving of new critical settings causes an immediate reset and must be validated within a period of 5 minutes, otherwise the original settings will be returned. If you continue with the modification, please re-establish a connection afterwards using the new settings and validate in the LAN interface configuration side.

5 min. validation period ▼

CONTINUE WITH SAVE

Caution

If an RF module is disabled it will remain powered off even through reboots and power-cycles until it is manually enabled on this page again. If you are accessing the web-based UI through a Radio Module and choose to disable that module (without selecting a validation period), you can be locked out of the Radio until such a time that the setting is reversed by physically connecting to the Radio and re-enabling the Radio Module.

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Two Radio Configuration (Xeta9x9-E only)

Independent Modules allows flexible installation with either 2 x Masters, or 1 x Slave and 1 x Master to create a “Back-to-Back Repeater” in one enclosed Radio; each Radio Module is independently configured from the RF Transmission Settings page.

Full Duplex is a special mode which allows 2 x Xeta9x9-E’s to communicate as a full duplex radio system. Choosing this mode changes the RF Transmission Settings page, with certain features greyed out due to being disabled.

- Radio#2 is not available in the drop down for independent configuration.
- RF Band is locked as MAS requiring fixed frequencies and FCC licenses.
- Network Type is locked as “Full Duplex”.
- Multi Speed Multi Point (MSMP) is disabled.
- Dynamic Payload is disabled.
- Multi Master Sync (MMS) is disabled.
- Master Transmit Rate is disabled.

Radio 1 ID: 200 (Slave)

Reload List

Delete List

RF Band	<input type="radio"/> ISM <input checked="" type="radio"/> MAS	Description	
	<div>ISM</div> <div>MHz</div> <div>Band Start 902.0000 MHz Stop 928.0000 MHz</div> <div>Exclude Lower 0 MHz Upper 0 MHz</div> <div>ISM Power 100 mW</div> <div>Hop Pattern 1</div>	<div>MAS</div> <div>MHz</div> <div>Xmit Freq 944.12500 MHz</div> <div>Recv Freq 945.12500 MHz</div> <div>MAS Power 5000 mW</div>	
Slave Transmit Rates	<input type="radio"/> 57 kbps MSK <input type="radio"/> 114 kbps MSK <input type="radio"/> 153 kbps MSK <input type="radio"/> 229 kbps MSK <input type="radio"/> 663 kbps 2FSK <input type="radio"/> 884 kbps BPSK <input type="radio"/> 1768 kbps QPSK <input type="radio"/> 2651 kbps 8PSK <input type="radio"/> 3535 kbps 16QAM <input type="radio"/> 3535 kbps 16PSK	<input type="radio"/> 10 kbps MSK <input type="radio"/> 19 kbps 4FSK 12.5kHz <input type="radio"/> 23 kbps QPSK <input type="radio"/> 34 kbps 8PSK <input type="radio"/> 39 kbps 4FSK 25kHz <input checked="" type="radio"/> 45 kbps 16QAM <input type="radio"/> 57 kbps 32QAM	
Master Transmit Rate	114 kbps MSK	(multispeed multipoint)	10 kbps MSK
Max Payload Bytes	Master 256	Slave 256	Dynamic Off
Beacon Period	1		MMS
Network Address	100	Network Radius 20 km	MMS Hop Offset 0
Upstream Device ID	100		Master Repeat 3
Downstream Device ID	300		Slave Retries 240
Network Type	Full Duplex	Mode Slave	Slave Attn Limit 100
Device ID	200		
Protocol	Ethernet		

Serial Number: E501069B

Firmware Version: 1.36.5612

Modify Radio Settings

Refresh All

Refresh Single

Scan

Diag Threshold -80 dBm

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RF Transmission Settings

The upper portion of the RF Transmission page defines the frequencies and modulation used by the Radio and the lower portion defines the networking parameters and how the Radio works inside a network.

Radio 1 ID: 6000 (Master) Ethernet Master		Reload List	Delete List
RF Band: <input checked="" type="radio"/> ISM <input type="radio"/> MAS		Description: Ethernet Master	
Band Start: 902.0000 MHz Stop: 928.0000 MHz Exclude Lower: 0 MHz Upper: 0 MHz ISM Power: 100 mW Hop Pattern: 1		Xmit Freq: 952.00000 MHz Recv Freq: 953.00000 MHz MAS Power: 100 mW	
Slave Transmit Rates: <div> <input type="checkbox"/> 57 kbps MSK <input type="checkbox"/> 114 kbps MSK <input type="checkbox"/> 19 kbps 4FSK 12.5kHz <input type="checkbox"/> 23 kbps QPSK <input type="checkbox"/> 34 kbps 8PSK <input type="checkbox"/> 39 kbps 4FSK 25kHz <input type="checkbox"/> 45 kbps 16QAM <input type="checkbox"/> 57 kbps 32QAM </div>		<input checked="" type="checkbox"/> 10 kbps MSK	
Master Transmit Rate: 884 kbps BPSK (multispeed multipoint)		MMS: 10 kbps MSK	
Max Payload Bytes: Master 256 Slave 256 Dynamic Off		MMS Hop Offset: 0	
Beacon Period: 1		Master Repeat: 3	
Network Address: 6000 Network Radius: 24 km		Slave Retries: 10 Slave Attn Limit: 100	
Upstream Device ID: 100			
Downstream Device ID: 1000			
Network Type: Point to Multipoint Mode: Master			
Device ID: 6000			
Protocol: Ethernet			
		Serial Number: E5011D2C Firmware Version: 1.36.5612	
		Modify Radio Settings Refresh All Refresh Single Scan	
		Diag Threshold: -80 dBm	

RF Band

The **RF Band** allows the Radio to operate in the...

- ISM band (902-928MHz)
- MAS band (928-960MHz).

RF Band ☒ ISM ☐ MAS

Once the band is set, the specific frequencies used must be defined.

- For ISM, a range of frequencies is used and the Radio may hop between RF channels within the range.
- For MAS, specific frequencies are used for transmit and receive and the Radio maintains those frequencies at all times.

Caution

MAS is a licensed band requiring an appropriate FCC license to remain in compliance.

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MAS Band (928–960 MHz)

MAS requires both the **Master Xmit Freq** and **Master Recv Freq** to be manually entered. The frequencies should correspond to the frequencies issued on the FCC license.

MAS

Xmit Freq	<input type="text" value="944.12500"/>	MHz
Recv Freq	<input type="text" value="945.12500"/>	MHz

ISM Band (902–928 MHz)

Use of **ISM** requires **Band Start** and **Stop** frequencies which are limited to 902 – 928 MHz.

ISM

Band Start	<input type="text" value="902.0000"/>	MHz	Stop	<input type="text" value="928.0000"/>	MHz
------------	---------------------------------------	-----	------	---------------------------------------	-----

The frequencies in use within the ISM band may be reduced by adjusting these settings to clip off the band extremities.

Additionally, a range of frequencies within the band may be excluded using the **Exclude Lower** and **Exclude Upper** settings to remove the desired frequencies.

Exclude Lower	<input type="text" value="0"/>	MHz	Upper	<input type="text" value="0"/>	MHz
---------------	--------------------------------	-----	-------	--------------------------------	-----

Care must be taken to ensure enough frequencies are available for the Radio to hop within the required regulations.

In particular, under FHSS rules (less than 663 Kbps) the Radio must have enough frequency bandwidth as required under FCC rules;

1. For FHSS systems operating in the 902-928 MHz band, if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least **50** hopping frequencies. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.
2. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least **25** hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.
3. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
4. Under DTS rules (greater than or equal to 663kbps) there is **no limit** on the minimum bandwidth for the Radio as it may operate on one frequency, therefore the lower and upper edge of the band may be reduced if the full 902 to 928MHz ISM range is not required.

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ISM Channels

The number of ISM channels varies with each modulation ¹.

The following sections provide channel frequencies, spacing, bandwidth and minimum channel requirements.

Hop Tables

The Radio generates hop tables automatically based upon the modulation and frequency range in use.

The following is true for the complete 902-928 MHz ISM Band;

- 57 MSK 171 channels with 76.45 kHz bandwidth ².
- 114 MSK 165 channels with 154.29 kHz bandwidth.
- 153 MSK 123 channels with 207.11 kHz bandwidth.
- 229 MSK 82 channels with 309.97 kHz bandwidth.
- 663 2FSK 26 channels with 900 kHz bandwidth.
- 884 BPSK 20 channels with 1.2 MHz bandwidth.
- 1768 QPSK 20 channels with 1.2 MHz bandwidth.
- 2651 8PSK 20 channels with 1.2 MHz bandwidth.
- 3535 16QAM ¹ 20 channels with 1.2 MHz bandwidth.
- 3535 16PSK ¹ 20 channels with 1.2 MHz bandwidth.

¹ Xeta9x-E “Emancipator+” supports modulations up to and including 2651 8PSK.

² 57 MSK uses the lower ISM band (902–915 MHz) even when **Band Stop** is set to **928 MHz**.

Additionally, using the **Exclude MHz** settings to exclude 902 – 915 MHz has no effect and the Radio will continue to use the lower half of the ISM Band.

To force the Radio to use the upper ISM Band (915 – 928 MHz), set Band Start to 915 MHz and Band Stop to 928 MHz.

The Radio will then use the upper half of the ISM Band maintaining 166 channels with 76.45 kHz channel bandwidth.

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57 MSK (FHSS) – 171 channels with 76.45 kHz channel spacing / bandwidth ¹.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	902.288225	44	905.575575	87	908.862925	130	912.150275
2	902.364675	45	905.652025	88	908.939375	131	912.226725
3	902.441125	46	905.728475	89	909.015825	132	912.303175
4	902.517575	47	905.804925	90	909.092275	133	912.379625
5	902.594025	48	905.881375	91	909.168725	134	912.456075
6	902.670475	49	905.957825	92	909.245175	135	912.532525
7	902.746925	50	906.034275	93	909.321625	136	912.608975
8	902.823375	51	906.110725	94	909.398075	137	912.685425
9	902.899825	52	906.187175	95	909.474525	138	912.761875
10	902.976275	53	906.263625	96	909.550975	139	912.838325
11	903.052725	54	906.340075	97	909.627425	140	912.914775
12	903.129175	55	906.416525	98	909.703875	141	912.991225
13	903.205625	56	906.492975	99	909.780325	142	913.067675
14	903.282075	57	906.569425	100	909.856775	143	913.144125
15	903.358525	58	906.645875	101	909.933225	144	913.220575
16	903.434975	59	906.722325	102	910.009675	145	913.297025
17	903.511425	60	906.798775	103	910.086125	146	913.373475
18	903.587875	61	906.875225	104	910.162575	147	913.449925
19	903.664325	62	906.951675	105	910.239025	148	913.526375
20	903.740775	63	907.028125	106	910.315475	149	913.602825
21	903.817225	64	907.104575	107	910.391925	150	913.679275
22	903.893675	65	907.181025	108	910.468375	151	913.755725
23	903.970125	66	907.257475	109	910.544825	152	913.832175
24	904.046575	67	907.333925	110	910.621275	153	913.908625
25	904.123025	68	907.410375	111	910.697725	154	913.985075
26	904.199475	69	907.486825	112	910.774175	155	914.061525
27	904.275925	70	907.563275	113	910.850625	156	914.137975
28	904.352375	71	907.639725	114	910.927075	157	914.214425
29	904.428825	72	907.716175	115	911.003525	158	914.290875
30	904.505275	73	907.792625	116	911.079975	159	914.367325
31	904.581725	74	907.869075	117	911.156425	160	914.443775
32	904.658175	75	907.945525	118	911.232875	161	914.520225
33	904.734625	76	908.021975	119	911.309325	162	914.596675
34	904.811075	77	908.098425	120	911.385775	163	914.673125
35	904.887525	78	908.174875	121	911.462225	164	914.749575
36	904.963975	79	908.251325	122	911.538675	165	914.826025
37	905.040425	80	908.327775	123	911.615125	166	914.902475
38	905.116875	81	908.404225	124	911.691575	167	914.978925
39	905.193325	82	908.480675	125	911.768025	168	915.055375
40	905.269775	83	908.557125	126	911.844475	169	915.131825
41	905.346225	84	908.633575	127	911.920925	170	915.208275
42	905.422675	85	908.710025	128	911.997375	171	915.284725
43	905.499125	86	908.786475	129	912.073825		

FHSS requires a minimum of 50 channels to be in use at any given time.

¹ 57 MSK uses the lower half of the ISM band (902 – 915 MHz) even when **Band Stop** is set to 928 MHz.

Additionally, using the **Exclude MHz** settings to exclude 902 – 915 MHz has no effect and the Radio will continue to use the lower half of the ISM Band – see next page.

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Forcing 57 MSK to use Upper ISM Band (915 – 928 MHz)

To force the Radio to use the upper half of the ISM Band, set **Band Start** to **915** MHz and leave **Band Stop** at **928** MHz.

The Radio will then use the upper half of the ISM Band maintaining **166 channels** with 76.45 kHz bandwidth;

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	915.038225	43	918.249125	85	921.460025	127	924.670925
2	915.114675	44	918.325575	86	921.536475	128	924.747375
3	915.191125	45	918.402025	87	921.612925	129	924.823825
4	915.267575	46	918.478475	88	921.689375	130	924.900275
5	915.344025	47	918.554925	89	921.765825	131	924.976725
6	915.420475	48	918.631375	90	921.842275	132	925.053175
7	915.496925	49	918.707825	91	921.918725	133	925.129625
8	915.573375	50	918.784275	92	921.995175	134	925.206075
9	915.649825	51	918.860725	93	922.071625	135	925.282525
10	915.726275	52	918.937175	94	922.148075	136	925.358975
11	915.802725	53	919.013625	95	922.224525	137	925.435425
12	915.879175	54	919.090075	96	922.300975	138	925.511875
13	915.955625	55	919.166525	97	922.377425	139	925.588325
14	916.032075	56	919.242975	98	922.453875	140	925.664775
15	916.108525	57	919.319425	99	922.530325	141	925.741225
16	916.184975	58	919.395875	100	922.606775	142	925.817675
17	916.261425	59	919.472325	101	922.683225	143	925.894125
18	916.337875	60	919.548775	102	922.759675	144	925.970575
19	916.414325	61	919.625225	103	922.836125	145	926.047025
20	916.490775	62	919.701675	104	922.912575	146	926.123475
21	916.567225	63	919.778125	105	922.989025	147	926.199925
22	916.643675	64	919.854575	106	923.065475	148	926.276375
23	916.720125	65	919.931025	107	923.141925	149	926.352825
24	916.796575	66	920.007475	108	923.218375	150	926.429275
25	916.873025	67	920.083925	109	923.294825	151	926.505725
26	916.949475	68	920.160375	110	923.371275	152	926.582175
27	917.025925	69	920.236825	111	923.447725	153	926.658625
28	917.102375	70	920.313275	112	923.524175	154	926.735075
29	917.178825	71	920.389725	113	923.600625	155	926.811525
30	917.255275	72	920.466175	114	923.677075	156	926.887975
31	917.331725	73	920.542625	115	923.753525	157	926.964425
32	917.408175	74	920.619075	116	923.829975	158	927.040875
33	917.484625	75	920.695525	117	923.906425	159	927.117325
34	917.561075	76	920.771975	118	923.982875	160	927.193775
35	917.637525	77	920.848425	119	924.059325	161	927.270225
36	917.713975	78	920.924875	120	924.135775	162	927.346675
37	917.790425	79	921.001325	121	924.212225	163	927.423125
38	917.866875	80	921.077775	122	924.288675	164	927.499575
39	917.943325	81	921.154225	123	924.365125	165	927.576025
40	918.019775	82	921.230675	124	924.441575	166	927.652475
41	918.096225	83	921.307125	125	924.518025		
42	918.172675	84	921.383575	126	924.594475		

FHSS; FCC requires a minimum of 50 channels to be in use at any given time.

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114 MSK (FHSS) – 165 channels with 154.29 kHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	902.327145	43	908.807325	84	915.133215	125	915.133215
2	902.481435	44	908.961615	85	915.287505	126	915.287505
3	902.635725	45	909.115905	86	915.441795	127	915.441795
4	902.790015	46	909.270195	87	915.596085	128	915.596085
5	902.944305	47	909.424485	88	915.750375	129	915.750375
6	903.098595	48	909.578775	89	915.904665	130	915.904665
7	903.252885	49	909.733065	90	916.058955	131	916.058955
8	903.407175	50	909.887355	91	916.213245	132	916.213245
9	903.561465	51	910.041645	92	916.367535	133	916.367535
10	903.715755	52	910.195935	93	916.521825	134	916.521825
11	903.870045	53	910.350225	94	916.676115	135	916.676115
12	904.024335	54	910.504515	95	916.830405	136	916.830405
13	904.178625	55	910.658805	96	916.984695	137	916.984695
14	904.332915	56	910.813095	97	917.138985	138	917.138985
15	904.487205	57	910.967385	98	917.293275	139	917.293275
16	904.641495	58	911.121675	99	917.447565	140	917.447565
17	904.795785	59	911.275965	100	917.601855	141	917.601855
18	904.950075	60	911.430255	101	917.756145	142	917.756145
19	905.104365	61	911.584545	102	917.910435	143	917.910435
20	905.258655	62	911.738835	103	918.064725	144	918.064725
21	905.412945	63	911.893125	104	918.219015	145	918.219015
22	905.567235	64	912.047415	105	918.373305	146	918.373305
23	905.721525	65	912.201705	106	918.527595	147	918.527595
24	905.875815	66	912.355995	107	918.681885	148	918.681885
25	906.030105	67	912.510285	108	918.836175	149	918.836175
26	906.184395	68	912.664575	109	918.990465	150	918.990465
27	906.338685	69	912.818865	110	919.144755	151	919.144755
28	906.492975	70	912.973155	111	919.299045	152	919.299045
29	906.647265	71	913.127445	112	919.453335	153	919.453335
30	906.801555	72	913.281735	113	919.607625	154	919.607625
31	906.955845	73	913.436025	114	919.761915	155	919.761915
32	907.110135	74	913.590315	115	919.916205	156	919.916205
33	907.264425	75	913.744605	116	920.070495	157	920.070495
34	907.418715	76	913.898895	117	920.224785	158	920.224785
35	907.573005	77	914.053185	118	920.379075	159	920.379075
36	907.727295	78	914.207475	119	920.533365	160	920.533365
37	907.881585	79	914.361765	120	920.687655	161	920.687655
38	908.035875	80	914.516055	121	920.841945	162	920.841945
39	908.190165	81	914.670345	122	920.996235	163	920.996235
40	908.344455	82	914.824635	123	921.150525	164	921.150525
41	908.498745	83	914.978925	124	921.304815	165	921.304815
42	908.653035						

FHSS; FCC requires a minimum of 50 channels to be in use at any given time.

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153 MSK (FHSS) – 123 channels with 207.11 kHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	902.353555	32	908.773965	63	915.194375	94	921.614785
2	902.560665	33	908.981075	64	915.401485	95	921.821895
3	902.767775	34	909.188185	65	915.608595	96	922.029005
4	902.974885	35	909.395295	66	915.815705	97	922.236115
5	903.181995	36	909.602405	67	916.022815	98	922.443225
6	903.389105	37	909.809515	68	916.229925	99	922.650335
7	903.596215	38	910.016625	69	916.437035	100	922.857445
8	903.803325	39	910.223735	70	916.644145	101	923.064555
9	904.010435	40	910.430845	71	916.851255	102	923.271665
10	904.217545	41	910.637955	72	917.058365	103	923.478775
11	904.424655	42	910.845065	73	917.265475	104	923.685885
12	904.631765	43	911.052175	74	917.472585	105	923.892995
13	904.838875	44	911.259285	75	917.679695	106	924.100105
14	905.045985	45	911.466395	76	917.886805	107	924.307215
15	905.253095	46	911.673505	77	918.093915	108	924.514325
16	905.460205	47	911.880615	78	918.301025	109	924.721435
17	905.667315	48	912.087725	79	918.508135	110	924.928545
18	905.874425	49	912.294835	80	918.715245	111	925.135655
19	906.081535	50	912.501945	81	918.922355	112	925.342765
20	906.288645	51	912.709055	82	919.129465	113	925.549875
21	906.495755	52	912.916165	83	919.336575	114	925.756985
22	906.702865	53	913.123275	84	919.543685	115	925.964095
23	906.909975	54	913.330385	85	919.750795	116	926.171205
24	907.117085	55	913.537495	86	919.957905	117	926.378315
25	907.324195	56	913.744605	87	920.165015	118	926.585425
26	907.531305	57	913.951715	88	920.372125	119	926.792535
27	907.738415	58	914.158825	89	920.579235	120	926.999645
28	907.945525	59	914.365935	90	920.786345	121	927.206755
29	908.152635	60	914.573045	91	920.993455	122	927.413865
30	908.359745	61	914.780155	92	921.200565	123	927.620975
31	908.566855	62	914.987265	93	921.407675		

FHSS; FCC requires a minimum of 50 channels to be in use at any given time.

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229 MSK (FHSS) – 82 channels with 309.97 kHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	902.404985	22	908.914355	43	915.423725	64	921.933095
2	902.714955	23	909.224325	44	915.733695	65	922.243065
3	903.024925	24	909.534295	45	916.043665	66	922.553035
4	903.334895	25	909.844265	46	916.353635	67	922.863005
5	903.644865	26	910.154235	47	916.663605	68	923.172975
6	903.954835	27	910.464205	48	916.973575	69	923.482945
7	904.264805	28	910.774175	49	917.283545	70	923.792915
8	904.574775	29	911.084145	50	917.593515	71	924.102885
9	904.884745	30	911.394115	51	917.903485	72	924.412855
10	905.194715	31	911.704085	52	918.213455	73	924.722825
11	905.504685	32	912.014055	53	918.523425	74	925.032795
12	905.814655	33	912.324025	54	918.833395	75	925.342765
13	906.124625	34	912.633995	55	919.143365	76	925.652735
14	906.434595	35	912.943965	56	919.453335	77	925.962705
15	906.744565	36	913.253935	57	919.763305	78	926.272675
16	907.054535	37	913.563905	58	920.073275	79	926.582645
17	907.364505	38	913.873875	59	920.383245	80	926.892615
18	907.674475	39	914.183845	60	920.693215	81	927.202585
19	907.984445	40	914.493815	61	921.003185	82	927.512555
20	908.294415	41	914.803785	62	921.313155		
21	908.604385	42	915.113755	63	921.623125		

FHSS; FCC requires a minimum of 50 channels to be in use at any given time.

663 2FSK (DTS) – 26 channels with 900 kHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	903.350000	8	909.650000	15	915.950000	22	922.250000
2	904.250000	9	910.550000	16	916.850000	23	923.150000
3	905.150000	10	911.450000	17	917.750000	24	924.050000
4	906.050000	11	912.350000	18	918.650000	25	924.950000
5	906.950000	12	913.250000	19	919.550000	26	925.850000
6	907.850000	13	914.150000	20	920.450000		
7	908.750000	14	915.050000	21	921.350000		

DTS has no restrictions on the minimum number of channels.

884 BPSK (DTS) – 20 channels with 1.2 MHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	903.500000	6	909.500000	11	915.500000	16	921.500000
2	904.700000	7	910.700000	12	916.700000	17	922.700000
3	905.900000	8	911.900000	13	917.900000	18	923.900000
4	907.100000	9	913.100000	14	919.100000	19	925.100000
5	908.300000	10	914.300000	15	920.300000	20	926.300000

DTS has no restrictions on the minimum number of channels.

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1768 QPSK (DTS) – 20 channels with 1.2 MHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	903.500000	6	909.500000	11	915.500000	16	921.500000
2	904.700000	7	910.700000	12	916.700000	17	922.700000
3	905.900000	8	911.900000	13	917.900000	18	923.900000
4	907.100000	9	913.100000	14	919.100000	19	925.100000
5	908.300000	10	914.300000	15	920.300000	20	926.300000

DTS has no restrictions on the minimum number of channels.

2651 8PSK (DTS) – 20 channels with 1.2 MHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	903.500000	6	909.500000	11	915.500000	16	921.500000
2	904.700000	7	910.700000	12	916.700000	17	922.700000
3	905.900000	8	911.900000	13	917.900000	18	923.900000
4	907.100000	9	913.100000	14	919.100000	19	925.100000
5	908.300000	10	914.300000	15	920.300000	20	926.300000

DTS has no restrictions on the minimum number of channels.

3535 16QAM (DTS) – 20 channels and 1.2 MHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	903.500000	6	909.500000	11	915.500000	16	921.500000
2	904.700000	7	910.700000	12	916.700000	17	922.700000
3	905.900000	8	911.900000	13	917.900000	18	923.900000
4	907.100000	9	913.100000	14	919.100000	19	925.100000
5	908.300000	10	914.300000	15	920.300000	20	926.300000

DTS has no restrictions on the minimum number of channels.

3535 16PSK (DTS) – 20 channels with 1.2 MHz channel spacing / bandwidth.

Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)	Ch	Freq (MHz)
1	903.500000	6	909.500000	11	915.500000	16	921.500000
2	904.700000	7	910.700000	12	916.700000	17	922.700000
3	905.900000	8	911.900000	13	917.900000	18	923.900000
4	907.100000	9	913.100000	14	919.100000	19	925.100000
5	908.300000	10	914.300000	15	920.300000	20	926.300000

DTS has no restrictions on the minimum number of channels.

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Transmit Power, RSSI, Sensitivity & SNR

Transmit Power

The power levels of the ISM and MAS bands are set in milli-Watts (mW).

ISM Power mW 10 - 1000 mW (10 – 30 dBm)

MAS Power mW 10 - 4000 mW (10 – 36 dBm; depending upon license)

mW can be converted to dBm using this [online calculator](#).

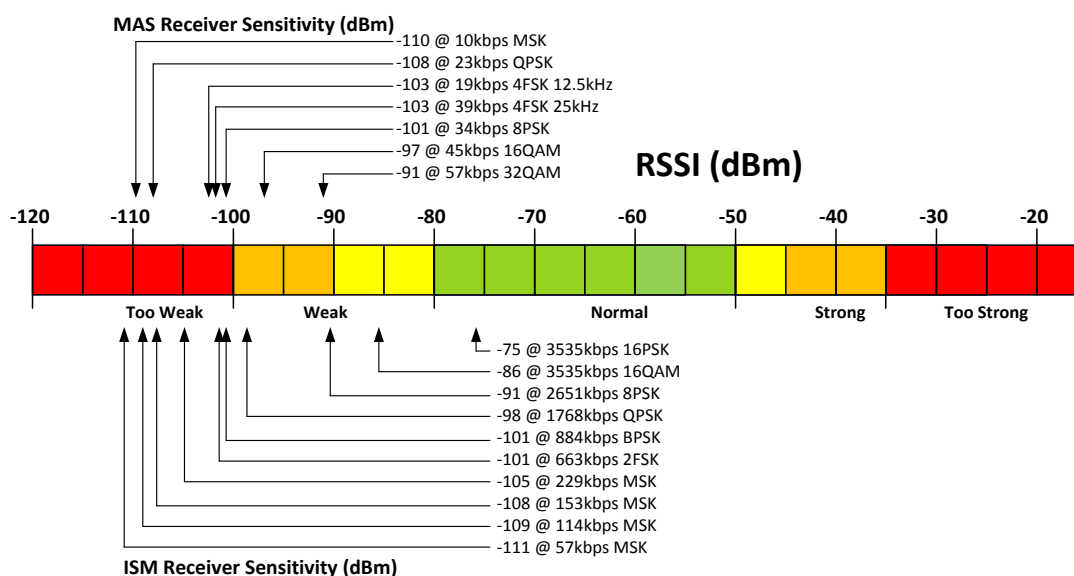
Caution

RF performance is often more problematic at higher RSSI levels as illustrated below. Transmit Power should be tuned to provide enough margin (SNR) on the receiving Radio; please refer to [Minimum SNR per Modulation](#) for recommended minimum SNR's.

When lab/bench testing with the optional odBi test antenna it is recommended to install a 20dB coaxial attenuator and adjust the transmit power to 50-100 mW.

RSSI

With high sensitivity and complex modulations it is important to consider the input level (RSSI) of the receiving radio to ensure that it's not too low and not too high.



RSSI above -50dBm should be [tuned](#).

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Sensitivity & Minimum SNR per Modulation

ISM			MAS			
Modulation	Sensitivity (dBm)	Min SNR (dB)	Modulation	Ch Size (kHz)	Sensitivity (dBm)	Min SNR (dB)
57 MSK ¹	-111	9.5	10 MSK	12.5	-114	14
114 MSK ¹	-109	8.5	19.2 4FSK	12.5	-106	22
153 MSK ¹	-108	8.5	23 QPSK	12.5	-108	20
229 MSK ¹	-105	9.5	34 8PSK	12.5	-101	27
663 2FSK ¹	-101	8.5	45 16QAM	12.5	-97	31
884 BPSK ¹	-101	6.5	57 32QAM	12.5	-91	37
1768 QPSK ¹	-98	10.5	20 MSK	25	-111	14
2651 8PSK ¹	-91	17.5	38.4 4FSK	25	-103	22
3535 16QAM	-86	22.5	46 QPSK	25	-105	20
3535 16PSK	-75	33.5	68 8PSK	25	-98	27
¹ Xeta9x-E “Emancipator +”; ISM only.			90 16QAM	25	-94	31
			114 32QAM	25	-88	37
			40 MSK	50	-107	15
			76.8 4FSK	50	-100	22
			94 QPSK	50	-102	20
			136 8PSK	50	-95	27
			180 16QAM	50	-91	31
			90 16QAM	50	-85	37

- The quoted sensitivity levels are based on a BER of 10⁻⁴.
- The minimum recommended SNR's, per modulation.

Hop Pattern

FHSS (less than 633kbps); the **Hop Pattern** should be set to 1, which creates a pseudo random hopping sequence through the available channels.

DTS (633kbps and above); the **Hop Pattern** may be set from 0 to 9. A Hop Pattern of 0 can only be used with DTS modulations because it fixes the frequency to a single channel. A **Hop Pattern** of 2-9 is a uniform step through the defined channels as follows:

2: Every other available channel

3: Every 3rd available channel

4: Every 4th available channel

5: Every 5th available channel

And so on.

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Transmit Rates

Slave Transmit Rates	<input type="checkbox"/> 57 kbps MSK	<input checked="" type="checkbox"/> 114 kbps MSK	<input type="checkbox"/> 10 kbps MSK
	<input type="checkbox"/> 153 kbps MSK	<input type="checkbox"/> 229 kbps MSK	<input type="checkbox"/> 19 kbps 4FSK 12.5kHz
	<input type="checkbox"/> 663 kbps 2FSK	<input type="checkbox"/> 884 kbps BPSK	<input type="checkbox"/> 23 kbps QPSK
	<input type="checkbox"/> 1768 kbps QPSK	<input type="checkbox"/> 2651 kbps 8PSK	<input type="checkbox"/> 34 kbps 8PSK
	<input type="checkbox"/> 3535 kbps 16QAM	<input type="checkbox"/> 3535 kbps 16PSK	<input type="checkbox"/> 39 kbps 4FSK 25kHz
			<input checked="" type="checkbox"/> 45 kbps 16QAM
			<input type="checkbox"/> 57 kbps 32QAM
Master Transmit Rate	114 kbps MSK ▼ (multispeed multipoint)		10 kbps MSK ▼

ISM Master Transmit Rate

In a PTP network the **ISM Master Transmit Rate** works in the same way as the ISM Slave Transmit Rates and will adjust speed based on signal quality.

In a PTMP network the **ISM Master Transmit Rate** is **fixed to a single modulation**; the one limiting factor in a PTMP network is that all remote Slave Radios must be able to receive the Master, therefore the Master must transmit at a rate suitable for the furthest remote Slave to receive.

ISM Master Transmit Rate selection also depends on the amount of data that needs to be moved from the Master Radio to the Slave Radio(s) and end device(s). In SCADA applications where small poll requests are sent from Master to Slave, the Master Transmit Rate can be set to a slower modulation.

ISM Slave Transmit Rates

The **ISM Slave Transmit Rates** may be set with multiple selections known as [Multi-Speed Multi-Point \(MSMP\)](#). The Radio will start operation at the lowest speed and, if successful, will increase to the next selected speed, so the Radio dynamically changes the data rate based upon signal quality measurements.

The advantage of this is to allow Radios that have a good RF connection to maintain a high-speed link to the master while Radios on the same network that have a poor RF connection can maintain a link at a slower data rate without penalizing the “good link” Radios.

XetaWave recommends selecting a max of FOUR consecutive Slave Transmit Rates.

The available modulations range from the FHSS modes of 57 kbps – 229 kbps to the DTS modes of 663 kbps – 3535 kbps. The primary difference between the modes is the bandwidth of the signal and the required strength of signal received at the Radio.

As a general rule, when the data rate increases, the sensitivity of the Radio decreases and therefore the required signal strength at the receiving Radio must increase to maintain the appropriate margin – see [Transmit Power, RSSI, Sensitivity & SNR](#) section.

The **MAS Receive Modes** are based upon the bandwidth of the permitted license. Either 12.5 kHz or 25.0 kHz bandwidth modulations are supported.

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Max Payload Bytes

Max Payload Bytes Master Slave Dynamic

Max Payload Bytes for Master and Slave range from **64** to **1600** Bytes. These settings are also referred to as “packet sizes”. To achieve high user data rates, larger packets and higher modulation levels are required. In one slot time, there are fixed delays that are not a function of packet size or data rate, so as more data is sent in a packet per slot time, the utilization increases.

In noisy RF environments, small packets with faster, more complex modulation will help the Radio get on and off a channel as quickly as possible to help mitigate bit error and packet loss.

If a targeted data rate is desired, there are multiple options of packet size and modulation that will result with a similar data rate. The choice of shorter packets with more complex modulation or longer packets with simpler modulation will be determined by the noise level in the environment.

ISM – Minimum Packet Sizes with Multi-Speed Multi-Point

The following table charts the smallest “Max Payload Bytes” setting when using multiple ISM Slave Transmit Rates.

			Fastest Modulation									
			MSK				2FSK	BPSK	QPSK	8PSK	16QAM	16PSK
			Kbps	57	114	153	229	663	884	1768	2561	3535
Slowest Modulation	MSK	57	64	162	227	356	1093	1469				
		114		64	97	162	530	718	1459			
		153			64	113	389	530	1084			
		229				64	275	378	780	1182	1583	1583
	2FSK	663					64	97	217	337	458	458
	BPSK	884						64	152	240	328	328
	QPSK	1768							64	108	152	152
	8PSK	2651								64	94	94
	16QAM	3535									64	64
	16PSK	3535									64	64

1. Find the fastest desired modulation at the top of the chart.
2. Find the slowest desired modulation on the left hand side of the chart.
3. The box where the column and the row meet is the smallest packet size that must be used for both Master and Slave Max Payload Bytes to get a good RF connection.
4. Multiple modulations can be enabled as long as the smallest packet size corresponds to the value where the fastest and slowest modulations meet.

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MAS – Minimum Packet Sizes with Multi-Speed Multi-Point

The following table charts the smallest “Max Payload Bytes” setting when using multiple MAS Slave Transmit Rates.

			Fastest Modulation						
			MSK	4KFS	QPSK	8PSK	4FSK	16QAM	32QAM
		Kbps	10	19	23	34	39	45	57
Slowest Modulation	MSK	10	64	143	152	240	327	328	416
	4FSK	19		64	69	116	171	162	209
	QPSK	23			64	108	162	152	196
	8PSK	34				64	106	94	128
	4FSK	39					64	94	68
	16QAM	45						64	87
	32QAM	57							64

1. Find the fastest desired modulation at the top of the chart.
2. Find the slowest desired modulation on the left hand side of the chart.
3. The box where the column and the row meet is the smallest packet size that must be used for both Master and Slave Max Payload Bytes to get a good RF connection.
4. Multiple modulations can be enabled as long as the smallest packet size corresponds to the value where the fastest and slowest modulations meet.

Examples

Example 1: ISM

Fastest Modulation: 884Kbps (BPSK), Slowest Modulation 229Kbps (MSK).

Smallest packet size must be 378 Bytes or larger.

Example 2: ISM

Modulations enabled: 2651 Kbps (8PSK), 884 Kbps (BPSK), 663 Kbps (2FSK).

The smallest packet size must be 337 Bytes or larger.

Example 3: MAS

57Kbps (32QAM), Slowest Modulation 23Kbps (QPSK).

The smallest packet size must be 196 Bytes or larger.

Example 4: ISM

Fastest Modulation 2651 Kbps (8PSK), Slowest Modulation 153 Kbps (MSK).

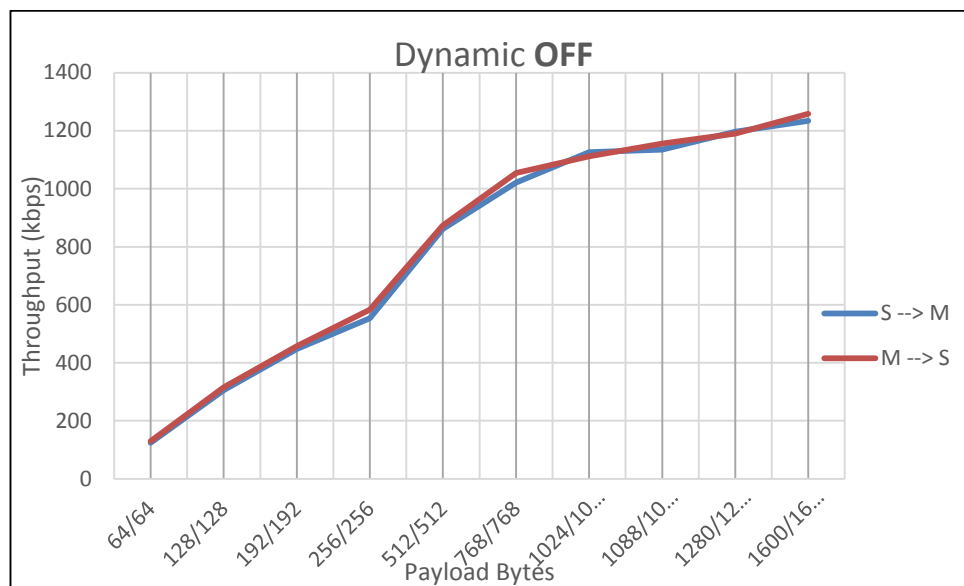
This combination of modulation modes will not work effectively.

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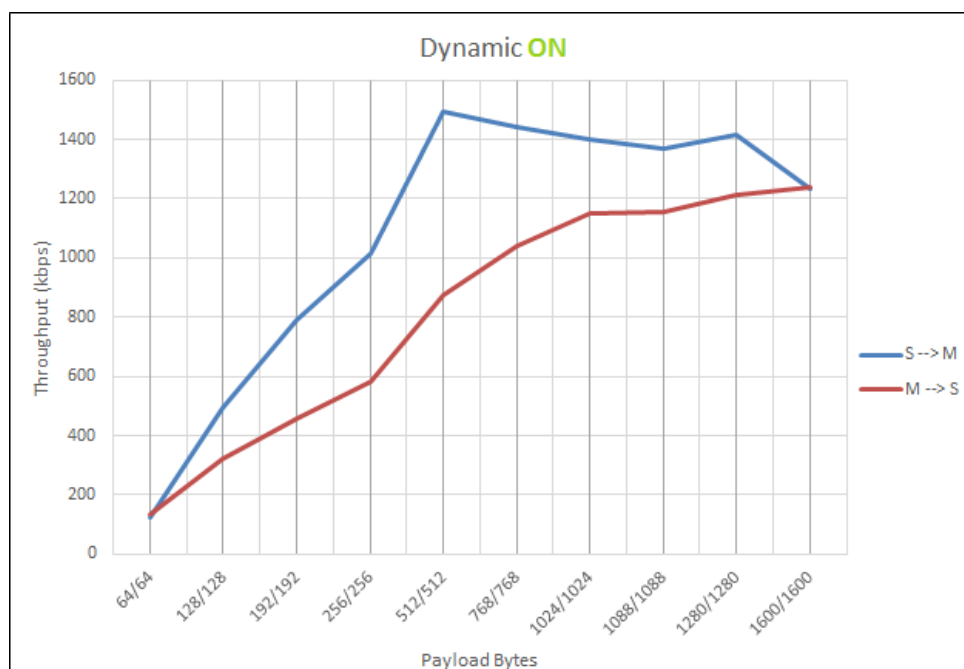
Dynamic Payload

Dynamic

Dynamic Payload is a feature that allocates the unused portion of the Master's timeslot to the Slave's timeslot to increase throughput from Slave → Master.



3535kbps 16QAM [FBench](#) throughput test results.



All Radios in the network must have the same setting. MMS is not compatible. Confirm the “Beacon Rate” is set to **1**, “MMS” setting is **none**, “MMS Hop Offset” is set to **zero** and the “Master Repeat setting” is set to **3**.

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Master Specific Settings

The following settings are specific to the Master Radio only.

Beacon Period

Beacon Period

Beacon Period sets the number of transmission slots the Master Radio may skip if it has nothing to transmit/acknowledge.

When set to zero, every slot that the Master can transmit will be used to send the header information and/or payload.

When set to 1, if there is no data to send after a successful transmit and if there is no Slave remote data to acknowledge, the Master will not transmit for that time slot and will resume transmitting the second time slot.

This feature helps to reduce the amount of RF noise in an environment when there is no benefit of the transmission.

The default setting is 1 and the recommended maximum setting is 15.

As the Beacon Period is increased, several things happen...

- The XMIT LED on the Master and the RCV LED on the Slave start to blink. The higher the Beacon Period the slower the blinking.
- Traffic on the link slows down; a basic ping test at various settings shows increased turnaround time as the Beacon Period is increased.
- With slower modulations, if the Beacon Period is increased too much the link will go down.

Master Repeat

Master Repeat

Master Repeat sets the maximum number of times the Master will repeat a transmit packet in the absence of an acknowledgement from the remote unit.

This is applicable only for a Point-to-Multi-Point network.

If set to 3 the master will repeat a packet up to three times unless the remote unit acknowledges receipt at which time the master will move to the next packet.

The default setting is 3.

Main
Network Settings
RF Modules
RF Transmission Settings
Serial Communications
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LAN Statistics
Radio Statistics
Terminal Server Statistics

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Slave Specific Settings

The following settings are specific to a Slave Radio only.

Slave Retries

Slave Retries

Slave Retries sets the maximum number of times the Slave will repeat a transmit packet in the absence of an acknowledgement from the Master.

If set to 10 the Slave will repeat a packet up to ten times unless the Master acknowledges receipt, at which time the Slave will move to the next packet.

When it reaches the limit without acknowledgement from the Master, the Slave will wait before attempting to send the data again, providing the **Slave Attn Limit** setting is greater than 1.

The default (and minimum) setting is 10 and the maximum is 254.

Slave Attn Limit

Slave Attn Limit

Slave Attn Limit sets the attention limit of the Slave before it drops the packet and stops transmitting.

Incrementing this setting by 1 increases the number of times the Slave will run through the **Slave Retries** sequence.

The default (and minimum) setting is 1 and the maximum is 254.

*Example; When set to **Slave Retries** of 10 and a **Slave Attn Limit** of 5, the Slave will run through 10 x Slave Retry sequences, five different times, for a total of 50 retries (54 in reality) before dropping the packet.*

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Network Parameters

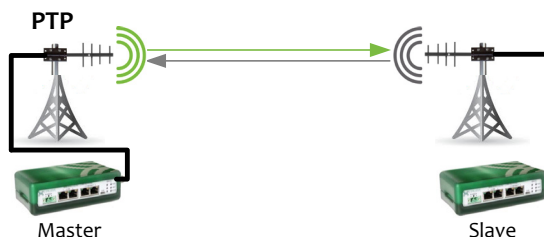
Network Type

Network Type

Network Type defines the network topology; **Point to Point** or **Point to Multi-Point**.

Point to Point (PTP)

A **PTP** network consists of two radios, a Master and a Slave that can only communicate with each other. The Master sends a beacon message to the Slave, which then responds.

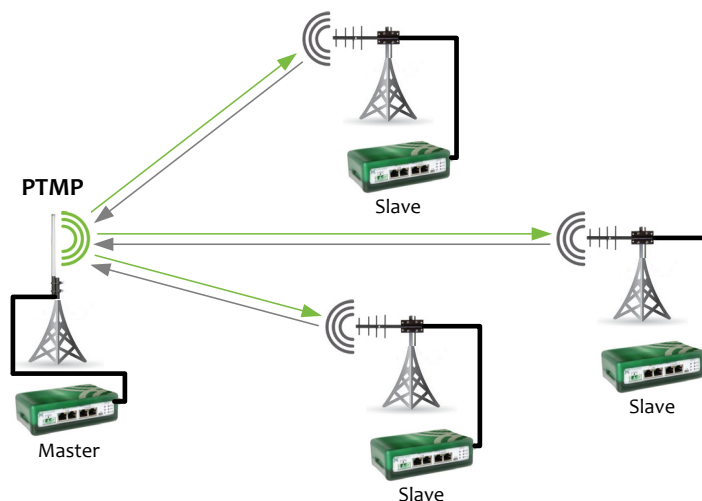


Data may be transferred in either direction. Data transfer speeds can be manipulated using the [Max Payload Bytes](#) and [Dynamic Payload](#) settings.

When set to PTP with multiple Slave Transmit Rates selected, both radios will be fixed to the highest Slave Transmit Rate. The Master Transmit Rate will also be fixed to the same speed/modulation. Refer to the [How to set up a PTP Link](#) section for configuration information.

Point to Multi-Point (PTMP)

A Point to Multi-Point network consists of one Master and many Slaves. The Master sends a beacon message to the Slaves, which then respond.



Data may be transferred in either direction. Data transfer speeds can be manipulated using the [Max Payload Bytes](#) and [Dynamic Payload](#) settings. Refer to the [How to set up a PTMP Network](#) section for configuration information.

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Network Address

Network Address

Network Address is a unique identifier that defines a group of communicating radios.

The Network Address can range from 1 to 65535.

Network Radius

Network Radius

Network Radius is the physical line-of-sight distance between two radios. It can be configured in Miles (miles) or Kilometers (km) and has an effect on transmission timing.

- Setting the Network Radius larger than the actual link is acceptable.
- Setting the Network Radius smaller than the actual link may cause the radios to stop operating.
- Network Radius must be identical in ALL radios within a network;
 - o PTP network; set the Network Radius in both radios as the link distance.
 - o PTMP network; set the Network Radius in ALL radios to the longest link in the network.
 - o MMS¹ network; set the Network Radius in ALL radios to longest link within the entire network.

¹ MMS networks contain several PTP / PTMP networks and therefore multiple Master radios that require precise timing to eliminate the possibility of self-induced interference.

Device ID

Device ID

Device ID is a unique number that identifies the radio on the RF network. Each radio on a network, as defined by the [Network Address](#), is required to have a unique ID in a similar way to IP addresses on an Ethernet network.

The Device ID settings allows for configuration of data paths throughout the network.

The Device ID is also an integral part of troubleshooting with the [RF Ping](#) utility.

The Device ID can range from 1 to 65534 and may be reused on different networks.

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Upstream Device ID

Upstream Device ID

For both PTP and PTMP networks, the **Upstream Device ID** on the Slave Radio should be the Device ID of the Master Radio that the Slave is required to communicate with.

The **Upstream Device ID** field is non-applicable on a Master Radio and can be set to the Master's Device ID.

The Upstream Device ID can range from 1 to 65534.

Downstream Device ID

Downstream Device ID

For PTP networks only, the **Downstream Device ID** should be the Device ID of the Slave radio that the Master is required to communicate with.

The **Downstream Device ID** field is non-applicable on a Slave Radio and can be set to the Slave's Device ID.

The Downstream Device ID can range from 1 to 65534.

Mode

Mode

Mode defines the radio's role in the network;

- **Master;** initiates contact/communication with Slave radios.
- **Slave;** waits for a Master radio to initiate communication.

Repeaters can be added to a network using a Xeta9x9-E, which contains 2 x 900MHz independently configured Radio Modules; 1 x Slave and 1 x Master creating a single enclosure back-to-back Repeater.

Protocol

Protocol

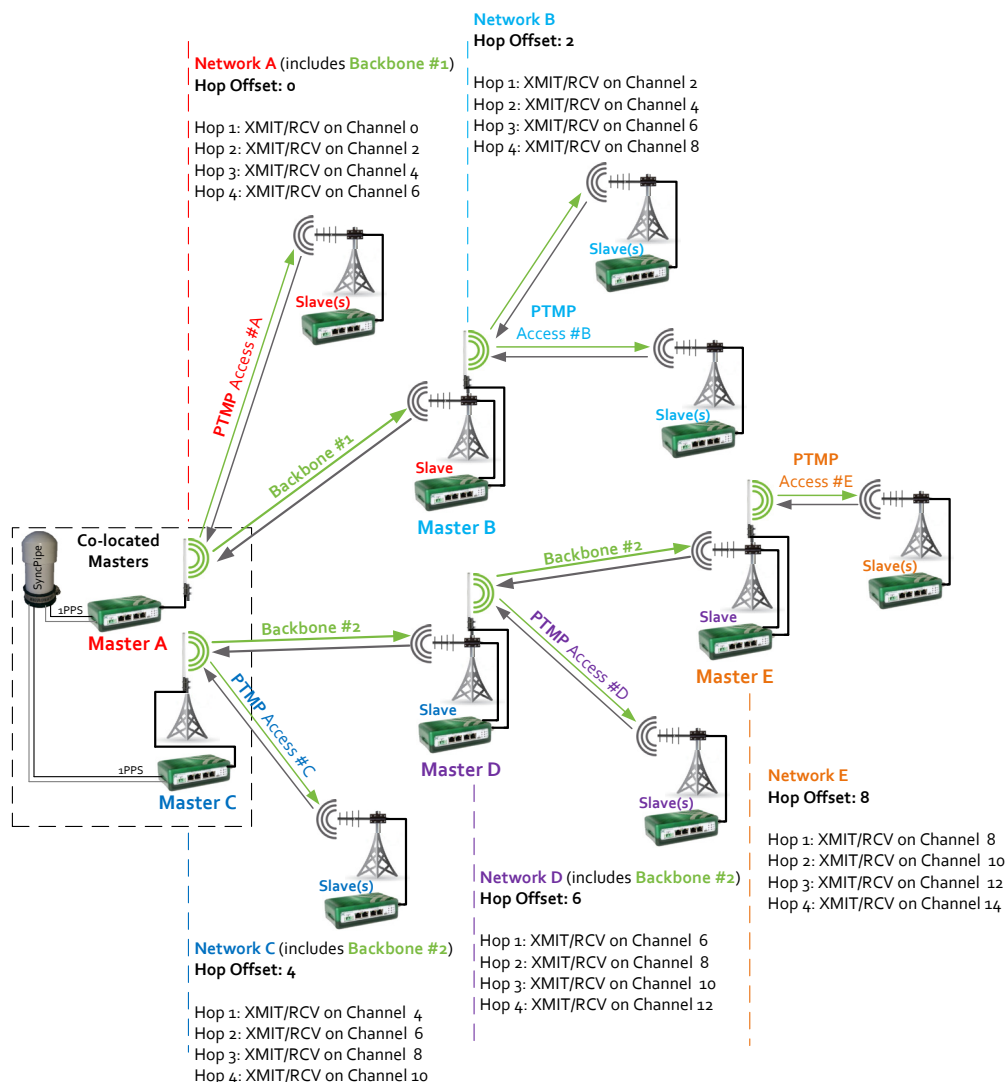
Protocol options are **Ethernet** and **Serial**, which are set based upon the type of data being carried on the network. Due to the larger size of Ethernet frames, additional RF overhead is needed to maintain the frame size. The Serial data is passed as it is received with no assumed framing. Refer to [How to Convert an Ethernet Radio to Serial](#) for more information on the Serial Protocol.

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Multi-Master Sync (MMS)

MMS is a timing feature that allows multiple Master radios in co-located networks and/or interconnected sub-networks to synchronize transmit and receive times to prevent self-interference.



Dividing the 902-928 MHz ISM Band is not required since each Master in the network is timed to precisely and simultaneously transmit using different frequency channels. The respective Slaves respond to their Masters on the same frequency channels before the entire system hops and the process continues.

Caution

MMS should be configured with FHSS modulations 57 MSK, 114 MSK, 153 MSK & 229 MSK OR DTS modulations 884 BPSK, 1768 QPSK, 2651 8PSK, 3535 16QAM and 3535 16PSK. It is not recommended to mix FHSS and DTS modulations.

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Whether FHSS or DTS modulations are used, the following radio settings that affect transmission timing must be the SAME in ALL radios within all sub-networks in the system;

- Frequency Band and Excluded Frequencies
- Hop Pattern (2 is recommended for MMS)
- Master Transmit Rate
- Slave Transmit Rate(s)
- Max Payload Bytes
- Network Type; PTP **or** PTMP
- Network Radius
- Protocol; Ethernet **or** Serial

MMS may operate in one of three modes;

1. **Generate**; the system Master internally “generates” the 1Hz timing signal for all other radios in the network(s).
2. **External**; a 1PPS “external” trigger signal from a GPS receiver is used to synchronize the 1Hz timing signal for all other radios in the network(s). See [IO Connections](#) for wiring info.
3. **INS**; the system is calibrated on the Xeta9-INS Master which requires a [special installation process](#). The **INS period** and **INS width parameters** are then programmed into the Slave Radios after the INS MMS setting has been selected.

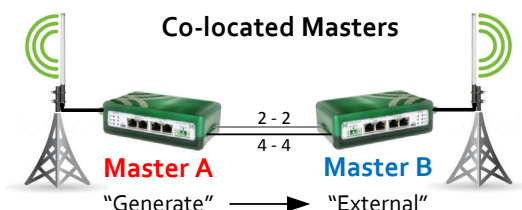
Master Specific Settings

Generate

MMS

When the Master radio is set to Generate, it will internally generate a 1Hz timing signal that can be used in two ways;

1. For timing downstream radios in any number of interconnected sub-networks.
2. For timing a co-located Master (and any number of interconnected sub-networks downstream of that Master).



If co-locating Masters connect Pin2 – Pin2 and Pin4 – Pin4 so that one Master will “generate” the timing signal and the other will receive it on the MMS Pins of the External IO connector.

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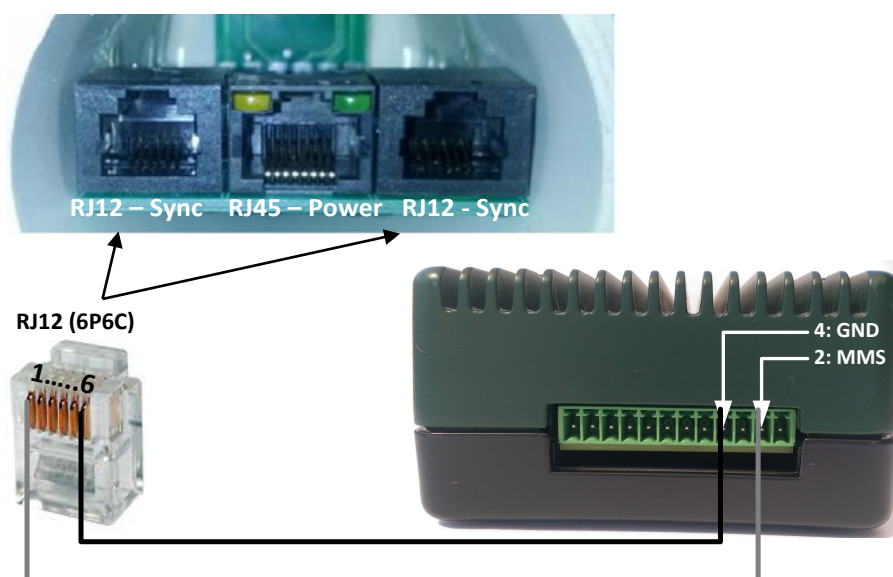
External

MMS External

Use of a 1PPS (one pulse-per-second) external trigger for MMS requires a GPS receiver capable of providing a 1PPS signal to the IO connector on the side of the radio.

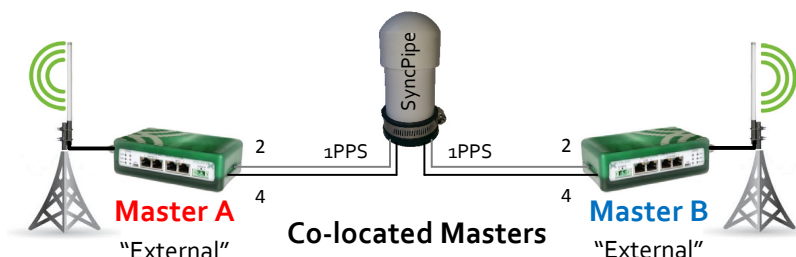
XetaWave has experience with the [SyncPipe Deluxe](#) from PacketFlux Technologies, which is also used in this manner for Cambium synchronization.

Either of the **RJ12 – Sync** ports can be used, with cable pinouts and wiring as follows;



RJ12 Pin #	Signal Pinout	Connect to MMS Pin #
1	1PPS GPS Sync	2
2 - 4	Not connected	-
6	Ground	4

With 2 x Sync Ports the SyncPipe can be used to precisely trigger two co-located Masters;



If using a GPS device with a single 1PPS port, it's possible to "daisy chain" the radios together Pin2 – Pin2 and Pin4 – Pin4 so that both radios are triggered simultaneously.

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Slave Specific Settings

When using MMS the Slave radio should always be set to **Generate**, irrespective of the Master's MMS setting.

Xeta9x9-E Specific Settings

When using MMS with a Xeta9x9-E Repeater, the Slave radio that connects to an upstream Master should be set to **Generate** and the Master that has downstream Slaves connected should be set to **External**; *the Xeta9x9-E has internal MMS circuitry between Radio Modules that propagates the timing signal.*

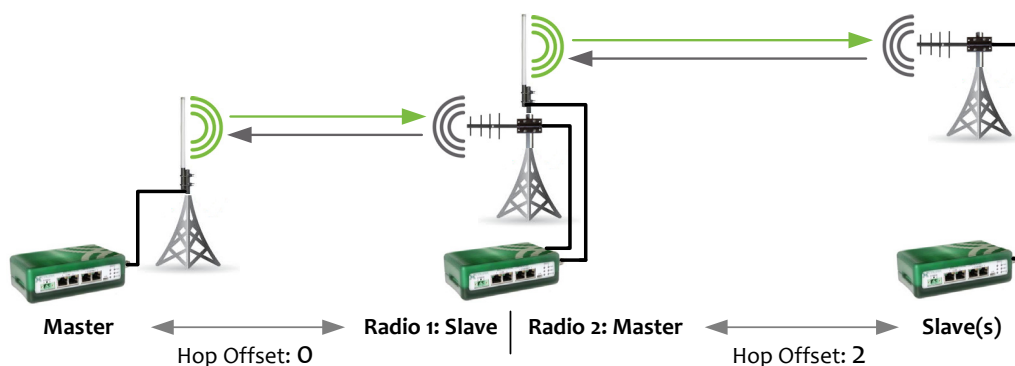
MMS Hop Offset

MMS Hop Offset

MMS Hop Offset is a crucial setting for MMS to operate effectively; it is this parameter that permits the frequency/channel separation between the radios in the MMS Network.

The MMS Hop Offset should be set so that each of the sub-networks operate on a different channel in the hop table. For example, if there are 20 channels in the hop table (DTS: 884 BPSK upwards), setting the first radio to "0" and the second radio to "2" results in the radios transmitting on channels 1 and 3 for the first slot, then 3 and 5 for the second slot, 5 and 7 for the third slot, 7 and 9 for the fourth slot, 9 and 11 for the fifth slot etc.

The MMS Hop Offset should match between each Master and their connected Slaves.



Please refer to the [How to set up MMS](#) section for more information on setting up MMS.

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Repeats & Retries

Master Repeat

Master Repeat sets the maximum number of times the Master will repeat a transmit packet in the absence of an acknowledgement from the remote unit.

This is applicable only for a Point-to-Multi-Point network.

Therefore, if set to 3 the Master will repeat a packet transmission up to three times unless the remote unit acknowledges receipt at which time the Master will move on to the next packet.

Slave Retries

Slave Retries sets the maximum number of times the Slave will repeat a transmit packet in the absence of an acknowledgement from the Master.

If set to 10 the Slave will repeat a packet up to ten times unless the Master acknowledges receipt, at which time the Slave will move on to the next packet.

The default setting is **10** and the maximum is **254**.

When it reaches the limit without acknowledgement from the Master, the Slave will wait before attempting to send the data again, providing the **Slave Attn Limit** setting is greater than 1.

Slave Attn Limit

Slave Attn Limit sets the attention limit of the Slave before it drops the packet and stops transmitting.

Incrementing this setting by 1 increases the number of times the Slave will run through the **Slave Retries** sequence.

Example; When set to **Slave Retries** of **10** and a **Slave Attn Limit** of **5**, the Slave will run through 10 x Slave Retry sequences, five different times, for a total of 50 retries (54 in reality) before dropping the packet.

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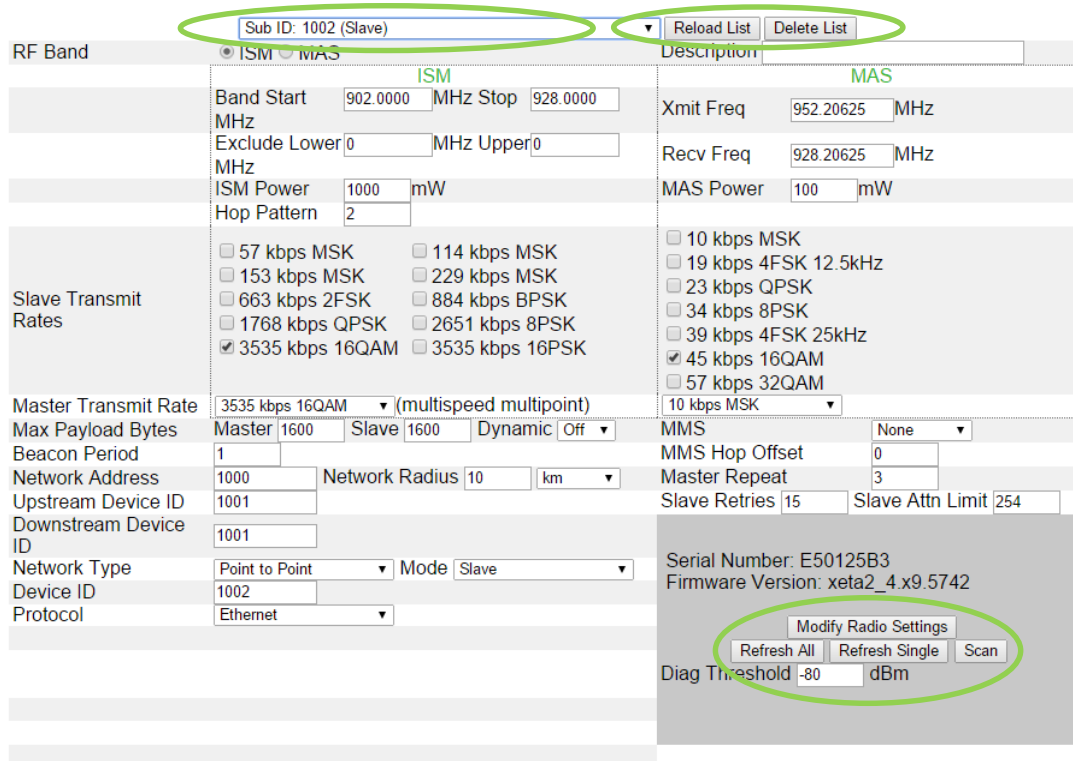
Diagnostic Threshold

The **Diagnostic Threshold** is the level at which the user wishes to detect noise. The radio will report 100% in the **% Avail** column on the [Radio Statistics](#) page until it detects noise above the **Diagnostic Threshold**. The default setting is **-80dBm**.

% Avail indicates the % of the time the radio went to transmit on the specified frequency and the noise measured in the channel was below the **Diagnostic Threshold**.

Page Controls

XetaWave Ethernet Bridge



Sub ID: 1002 (Slave) ▼ Reload List Delete List

RF Band: ISM MAS Description

Band Start: 902.0000 MHz Stop: 928.0000 MHz Xmit Freq: 952.20625 MHz

Exclude Lower: 0 MHz Upper: 0 MHz Recv Freq: 928.20625 MHz

ISM Power: 1000 mW MAS Power: 100 mW

Hop Pattern: 2

Slave Transmit Rates:

- ☐ 57 kbps MSK ☐ 114 kbps MSK
- ☐ 153 kbps MSK ☐ 229 kbps MSK
- ☐ 663 kbps 2FSK ☐ 884 kbps BPSK
- ☐ 1768 kbps QPSK ☐ 2651 kbps 8PSK
- ☒ 3535 kbps 16QAM ☐ 3535 kbps 16PSK

Master Transmit Rate: 3535 kbps 16QAM (multispeed multipoint) 10 kbps MSK

Max Payload Bytes: Master 1600 Slave 1600 Dynamic Off

Beacon Period: 1 MMS: None

Network Address: 1000 Network Radius: 10 km MMS Hop Offset: 0

Upstream Device ID: 1001 Master Repeat: 3

Downstream Device ID: 1001 Slave Retries: 15 Slave Attn Limit: 254

Network Type: Point to Point Mode: Slave

Device ID: 1002

Protocol: Ethernet

Serial Number: E50125B3

Firmware Version: xeta2_4.x9.5742

Modify Radio Settings

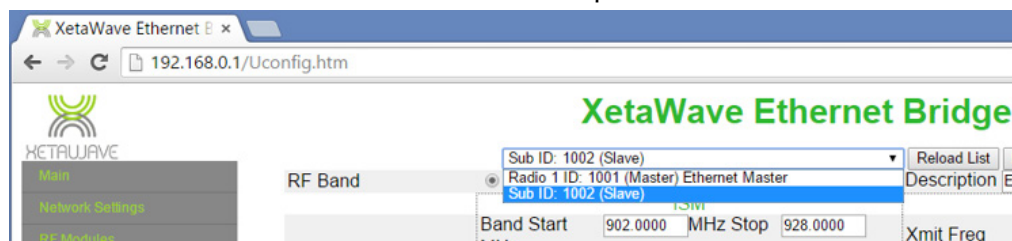
Refresh All Refresh Single Scan

Diag Threshold: -80 dBm

Sub-Radio Drop-Down List

In a PTMP Network it is not always necessary to navigate to the remote Slave radios to change RF Transmission Settings.

Once the network is up and running, the Master will pull the remote Slave radio settings and make them accessible in the Sub-Radio Drop-Down List.



XetaWave Ethernet Bridge

Sub ID: 1002 (Slave) ▼ Radio 1 ID: 1001 (Master) Ethernet Master Description E

Sub ID: 1002 (Slave)

RF Band: ISM MAS

Band Start: 902.0000 MHz Stop: 928.0000 MHz Xmit Freq:

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Refresh All

Refresh All pulls ALL settings from ALL available radios; **Reload List** when prompted to populate the settings into the UI.

Refresh Single

Refresh Single pulls settings from the radio selected in the drop down only; **Reload List** when prompted to populate the settings into the UI.

Scan

Scan will scan for new radios that are connected to the Master and add them to the list. Reload List when prompted to populate the settings into the UI.

Reload List

Reload List simply reloads the settings into the UI.

Delete List

Delete List removes all sub-radios from the drop down list.

Modify Radio Settings

Modify Radio Settings copies changed settings into the radio and resets the radio to the new configuration.

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Serial Communications

The upper portion of the Serial Communications page defines the Terminal Configuration for the Serial Ports and Radio Modules.

The number of Serial Ports and Radio Modules depends on the XetaWave product; the Xeta9x-E (Emancipator +) has 1 x Serial Port and 1 x Radio; the Xeta9-E and Xeta9-INS have 2 x Serial Ports and 1 x Radio; the Xeta9x9-E has 2 x Serial Ports and 2 x Radios.

Terminal Server Configuration			
Port	Terminal Server	Terminal Client	Other
Serial 1	<input checked="" type="checkbox"/> Enable terminal server 4320 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4320 TCP port number 192.168.0.4 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)
Serial 2	<input checked="" type="checkbox"/> Enable terminal server 4321 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4321 TCP port number 192.168.0.5 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)
Radio 1	<input checked="" type="checkbox"/> Enable terminal server 4323 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4323 TCP port number 192.168.0.7 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)
Radio 2	<input checked="" type="checkbox"/> Enable terminal server 4322 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4322 TCP port number 192.168.0.6 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)
Seamless A	<input type="checkbox"/> Enable terminal server 4324 TCP port number 120 Idle timeout (seconds)	Seamless network <input type="checkbox"/> Radio 1 <input type="checkbox"/> Radio 2 <input type="checkbox"/> Serial 1 <input type="checkbox"/> Serial 2 4324 Group number	
Seamless B	<input type="checkbox"/> Enable terminal server 4325 TCP port number 120 Idle timeout (seconds)	Seamless network <input type="checkbox"/> Radio 1 <input type="checkbox"/> Radio 2 <input type="checkbox"/> Serial 1 <input type="checkbox"/> Serial 2 4325 Group number	

Local Serial Ports									
Port	Binding	Interface	Baud Rate	Data	Parity	Stop	Flow Control	Line Delays	
Serial 1	<input checked="" type="radio"/> TS/TC/Seamless	<input checked="" type="radio"/> RS232	115200	<input checked="" type="radio"/> 8 bits	<input checked="" type="radio"/> Even	<input checked="" type="radio"/> 1	<input checked="" type="radio"/> RTS/CTS	Turn on	40 bits
	<input type="radio"/> Radio 1	<input type="radio"/> RS422		<input type="radio"/> 7 bits	<input type="radio"/> Odd	<input type="radio"/> 1.5	<input type="radio"/> XON/XOFF	Turn off	10 bits
	<input type="radio"/> Radio 2	<input type="radio"/> RS485			<input type="radio"/> None	<input type="radio"/> 2	<input type="radio"/> NONE		
Serial 2	<input checked="" type="radio"/> TS/TC/Seamless	<input checked="" type="radio"/> RS232	115200	<input checked="" type="radio"/> 8 bits	<input checked="" type="radio"/> Even	<input checked="" type="radio"/> 1	<input checked="" type="radio"/> RTS/CTS	Turn on	40 bits
	<input type="radio"/> Radio 1	<input type="radio"/> RS422		<input type="radio"/> 7 bits	<input type="radio"/> Odd	<input type="radio"/> 1.5	<input type="radio"/> XON/XOFF	Turn off	10 bits
	<input type="radio"/> Radio 2	<input type="radio"/> RS485			<input type="radio"/> None	<input type="radio"/> 2	<input type="radio"/> NONE		

Save Changes

The lower portion of the Serial Communications page defines the Serial Port Binding, Interface, Baud Rate, Data Bits, Parity, Stop Bits, Flow Control and RS485 Line Delays.

Please refer to [RJ45 Serial Port Pin Assignments](#) for cabling info.

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Terminal Server

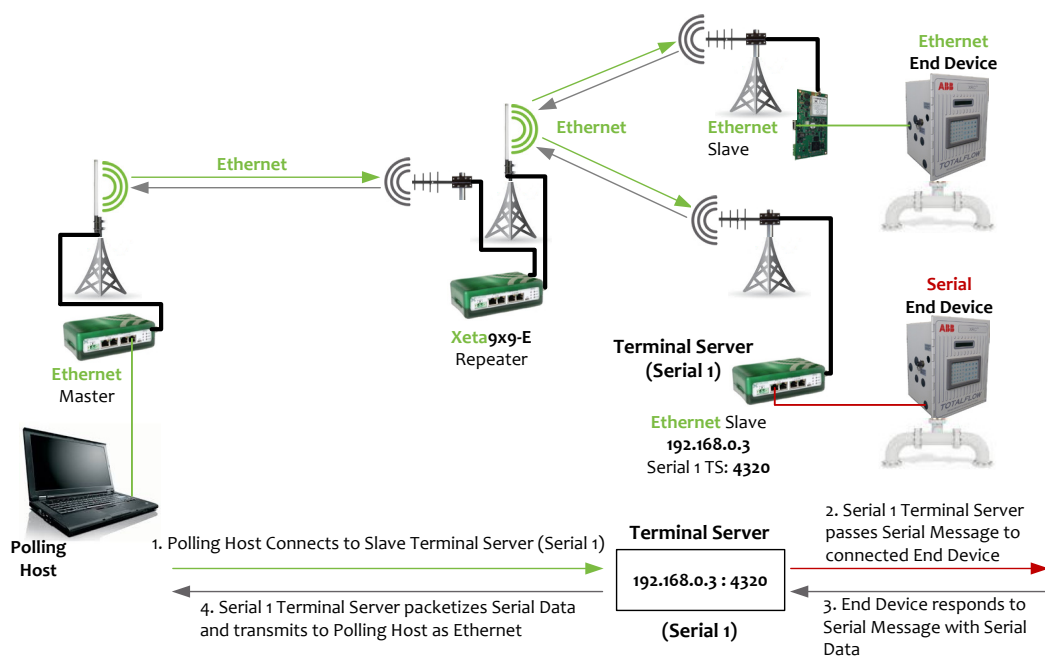
Serial Port

Port	Terminal Server	Terminal Client	Other
Serial 1	<input checked="" type="checkbox"/> Enable terminal server <input type="text" value="4320"/> TCP port number <input type="text" value="120"/> Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client <input type="text" value="4320"/> TCP port number <input type="text" value="192.168.0.4"/> IP address <input type="text" value="120"/> Idle timeout (seconds)	Trigger thresholds <input type="text" value="1024"/> Buffer input (bytes) <input type="text" value="2"/> Idle time (characters)

The Serial Port(s) are set to Terminal Server with a 1024 Byte buffer size and 2 character idle time, by default.

When set to Terminal Server, the user defined TCP port number is monitored for incoming TCP connections. If the Terminal Server observes traffic on that TCP port it creates a session to open the Serial Port and pass the data to the connected device(s) using the selected **Interface** definition.

The session will end if the host that initiated the session terminates it, or if the **Idle Timeout** is reached without any traffic present on the TCP port.



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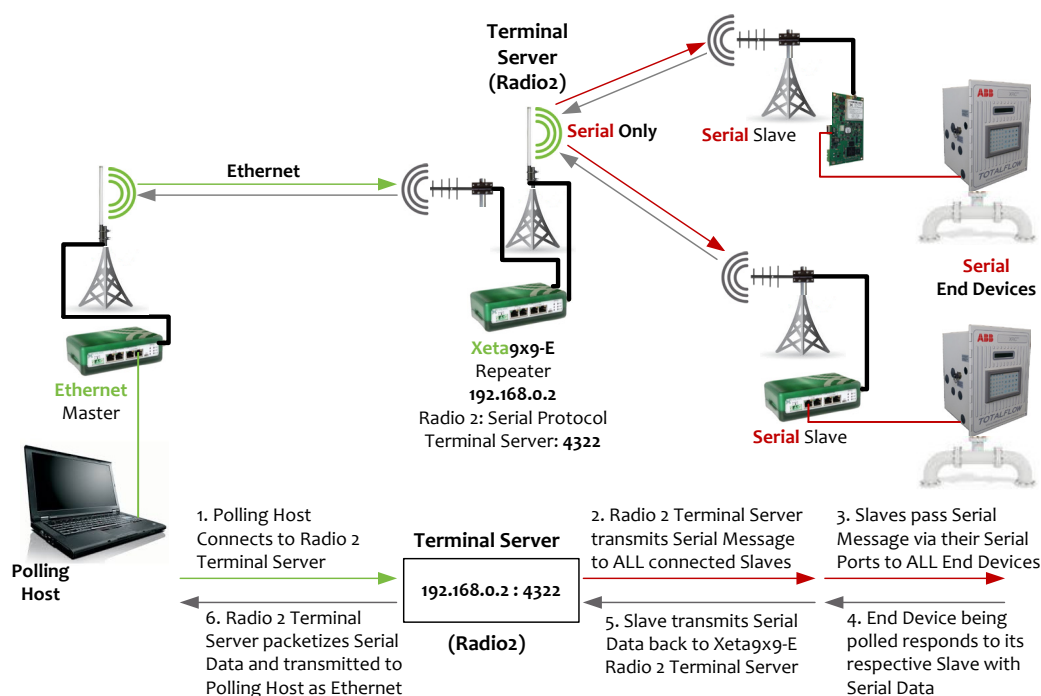
Radio

Port	Terminal Server	Terminal Client	Other
Radio 1	<input checked="" type="checkbox"/> Enable terminal server 4323 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4323 TCP port number 192.168.0.7 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)

The Radio(s) are also set to Terminal Server by default, but use of the Radio Terminal Servers requires the [RF Protocol](#) be set to **Serial**.

When set to the Serial RF Protocol, the radio module will only communicate with Serial remote Slaves such as the Xeta9x-SB (Emancipator -) or Ethernet radios that have been [re-configured to use the Serial Protocol](#).

The session will end if the host that initiated the session terminates it, or if the **Idle Timeout** is reached without any traffic present on the TCP port.



Caution

When changing the RF Protocol to Serial, remote Slave radios configured for the Ethernet RF Protocol will appear to be linked; i.e. the LINK/PWR and RCV/RX LED's will be green and the XMIT/TX LED will periodically flash red, however, it will not be possible to connect to these radios from an Ethernet perspective; i.e. you won't be able to ping the radio or access the User Interface from across the link.

Refer to [Seamless](#) if your network consists of both Ethernet and Serial Slave radios.

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Terminal Client

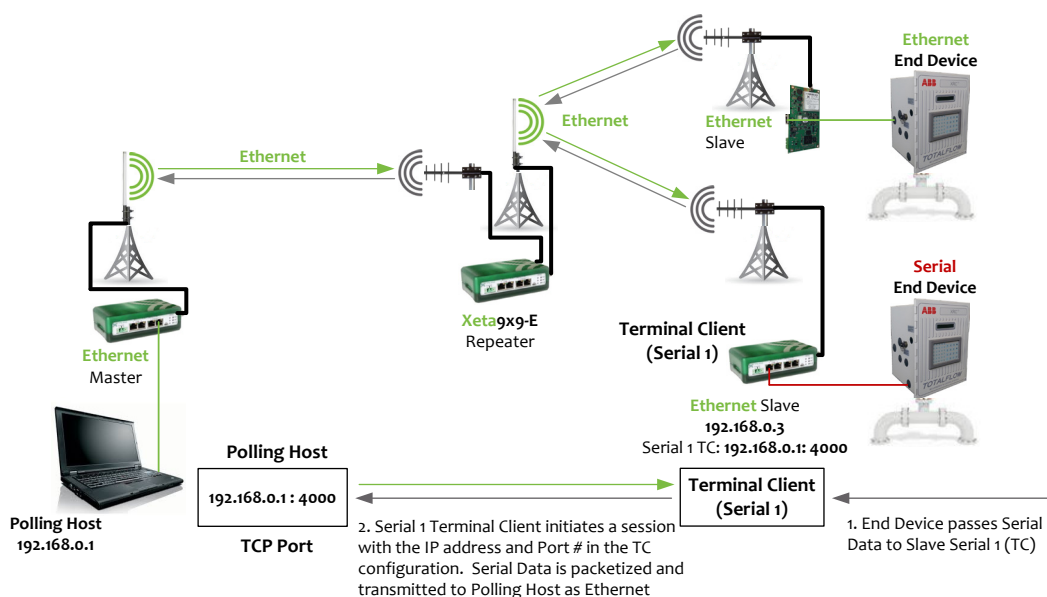
Serial Port

Port	Terminal Server	Terminal Client	Other
Serial 1	<input type="checkbox"/> Enable terminal server <input type="text" value="4320"/> TCP port number <input type="text" value="120"/> Idle timeout (seconds)	<input checked="" type="checkbox"/> Enable terminal client <input type="text" value="4320"/> TCP port number <input type="text" value="192.168.0.4"/> IP address <input type="text" value="120"/> Idle timeout (seconds)	Trigger thresholds <input type="text" value="1024"/> Buffer input (bytes) <input type="text" value="4"/> Idle time (characters)

The Serial Ports may also be set to Terminal Client where activity on the interface initiates a session to the Terminal Server specified by the **IP address** and **TCP port number** in the configuration.

Data arriving on the Serial Port will be sent to the destination IP address and TCP port.

Buffer size can remain at the default of 1024Bytes with a 4 character idle time.



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Radio

Port	Terminal Server	Terminal Client	Other
Radio 1	<input type="checkbox"/> Enable terminal server <input type="text" value="4323"/> TCP port number <input type="text" value="120"/> Idle timeout (seconds)	<input checked="" type="checkbox"/> Enable terminal client <input type="text" value="4323"/> TCP port number <input type="text" value="192.168.0.7"/> IP address <input type="text" value="120"/> Idle timeout (seconds)	Trigger thresholds <input type="text" value="1024"/> Buffer input (bytes) <input type="text" value="2"/> Idle time (characters)

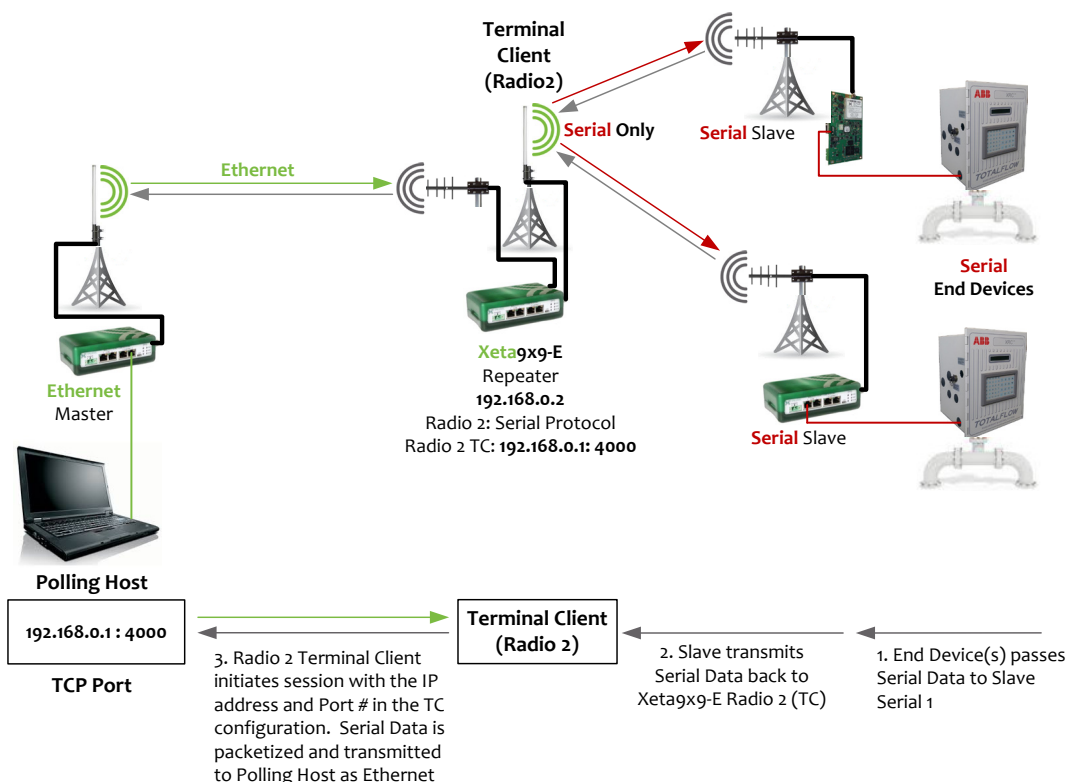
The Radio Module(s) may also be set to Terminal Client where data received by the radio initiates a session to the Terminal Server specified by the **IP address** and **TCP port number** in the configuration.

The Radio Terminal Client requires the [RF Protocol](#) be set to **Serial**.

When set to the Serial RF Protocol, the radio module will only communicate with Serial remote Slaves such as the Xeta9x-SB (Emancipator -) or Ethernet radios that have been [re-configured to use the Serial Protocol](#).

Data received by the radio will be sent to the destination IP address and TCP port.

The **Idle Timeout** terminates the session in the event that the destination stops responding.



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Seamless

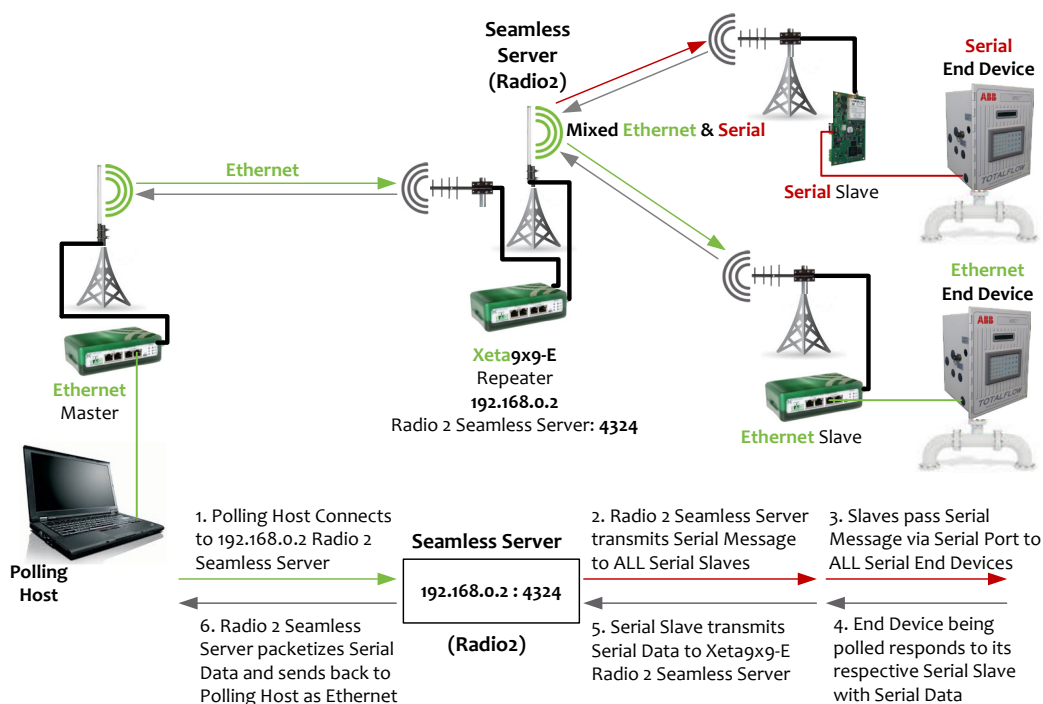
Seamless A ☒ Enable terminal server
 TCP port number
 Idle timeout (seconds)

Seamless network
☒ Radio 1
☐ Radio 2
☐ Serial 1
☐ Serial 2
 Group number

Seamless allows Ethernet and Serial Slaves to talk to the same Master/Repeater Master. Ethernet Slaves communicate via Ethernet Protocol and remain fully addressable. The Seamless Server on the Master/Repeater Master is configured similar to the Radio Terminal Server except for these differences; the RF Protocol can remain Ethernet and all installed radio modules and available serial ports can be incorporated into the Seamless group.

Serial Seamless Slaves are required to have the Seamless Group Number entered into their configuration under **9 : Serial Group**.

The session will end if the host that initiated the session terminates it, or if the **Idle Timeout** is reached without any traffic present on the TCP port.



Ethernet Slaves remain fully functional and addressable since they remain on an Ethernet network

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Trigger Thresholds

Trigger Thresholds should normally be left at 1024 bytes and 2 character idle time.

The thresholds determine when to send data to the radio to be transmitted on the RF link. If the **Buffer Input** is filled by the serial data, then the data is sent to the radio, however, if an idle time is detected before the buffer is full, then only that portion of the buffer is sent to the radio for immediate transmission.

Serial Port Binding

Local Serial Ports										
Port	Binding	Interface	Baud Rate	Data	Parity	Stop	Flow Control	Line Delays		
Serial 1	<input checked="" type="radio"/> TS/TC/Seamless	<input checked="" type="radio"/> RS232	115200	<input checked="" type="radio"/> 8 bits	<input type="radio"/> Even	<input checked="" type="radio"/> 1	<input type="radio"/> RTS/CTS	Turn on	40	bits
	<input type="radio"/> Radio 1	<input type="radio"/> RS422		<input type="radio"/> 7 bits	<input type="radio"/> Odd	<input type="radio"/> 1.5	<input type="radio"/> XON/XOFF	Turn off	10	bits
	<input type="radio"/> Radio 2	<input type="radio"/> RS485			<input checked="" type="radio"/> None	<input type="radio"/> 2	<input checked="" type="radio"/> NONE			
Serial 2	<input checked="" type="radio"/> TS/TC/Seamless	<input checked="" type="radio"/> RS232	115200	<input checked="" type="radio"/> 8 bits	<input type="radio"/> Even	<input checked="" type="radio"/> 1	<input type="radio"/> RTS/CTS	Turn on	40	bits
	<input type="radio"/> Radio 1	<input type="radio"/> RS422		<input type="radio"/> 7 bits	<input type="radio"/> Odd	<input type="radio"/> 1.5	<input type="radio"/> XON/XOFF	Turn off	10	bits
	<input type="radio"/> Radio 2	<input type="radio"/> RS485			<input checked="" type="radio"/> None	<input type="radio"/> 2	<input checked="" type="radio"/> NONE			

By default, the local serial port(s) are connected, or **bound**, internally to two of the radio's four terminal servers. This is indicated in the **Binding** column of the local serial port settings as TS/TC/Seamless. This enables TCP/IP connections to terminate on the Xeta9-E for serial communications through the local serial ports as well as the installed RF modules if their RF Protocol is set to **Serial**.

However, the built-in terminal servers do not allow serial communications between local serial ports and the installed RF modules.

If serial data communications are required between the local serial ports and installed RF modules, the port's binding setting can be changed.

Binding the Serial Port and RF Module requires the [RF Protocol](#) be set to **Serial**.

For example, setting the binding for the Serial 1 port to "Radio1" will connect the serial port directly to the radio. The radio will prompt for a restart after this change before taking affect. Once the binding change is applied, the terminal servers for both the local serial port and the installed RF module involved will be disabled.

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AES Encryption

Enable AES: ☐

Key

Enter as hexadecimal, dashes can be used between four byte blocks

Example: FFFFFFFF-FFFFFFF-FFFFFFF-FFFFFFF-FFFFFFF-FFFFFFF-FFFFFFF-FFFFFFF

To enable AES-256 Encryption check the **Enable AES** box on **ALL** radios in the network.

Entering a Key is optional. The radios will communicate with just **AES Encryption** checked; no Key.

If desired, the 256 bit Key should be entered in hex (4 bits per character) as a 64 character string. Dashes may be used, but will be ignored.

The key must be the **same** on **ALL** radios in the network.

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I/O

The I/O connector on the side of the radio (excluding Xeta9x-E “Emancipator +”) may be used to monitor a signal level for change and send an IP message to a Syslog server.

Currently one Digital Input is configurable; DI1. Please refer to [IO Connections](#) section for pinouts.

Level Change Alerts; DI1

The action can be set to either send a message when the DI1 level changes from low to high or high to low.

Level Change Alerts

Alert Dest IP

Alert Dest Port

On DI1 level low send

On DI1 level high send

Test Message

A **high** state constitutes voltage above a **0.5VDC** threshold. A **low state** is **0VDC**.

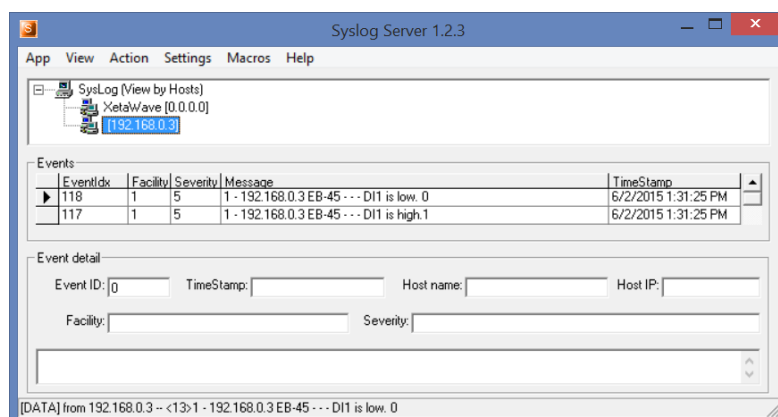
The **Alert Dest IP** and **Alert Dest TCP Port** represent the IP address and port # where the message will be sent when a change of state occurs.

On DI1 level low will send a message when the level becomes low; 0VDC.

On DI1 level high will send a message when the level becomes high. >0.5VDC.

The message can be a one-time only message, or can repeat every hour while the state is high (or low).

The operation can be tested using the **High** and **Low** buttons to ensure communication back to the Syslog server.



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Modbus

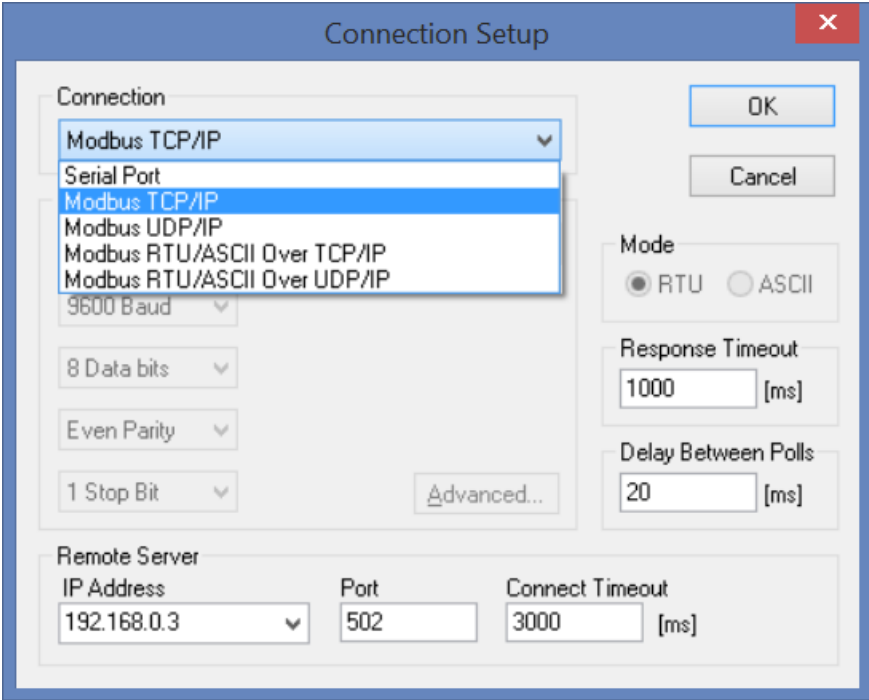
DC Input Voltage, Radio Temperature and Radio Uptime can all be monitored with a Scada host. There are two Modbus TCP Servers with default Port numbers **502** and **503**.

Modbus

TCP Server 1	TCP Server 2
Enabled <input checked="" type="checkbox"/>	Enabled <input checked="" type="checkbox"/>
TCP Port <input type="text" value="502"/>	TCP Port <input type="text" value="503"/>
Default 502	Default 503

[Modbus Register Maps](#)

The radio communicates using the **Modbus TCP/IP*** connection protocol.



The image shows a 'Connection Setup' dialog box. It has a 'Connection' section with a dropdown menu currently showing 'Modbus TCP/IP'. Below this are fields for 'Serial Port', '9600 Baud', '8 Data bits', 'Even Parity', and '1 Stop Bit'. There is an 'Advanced...' button. To the right, there are 'OK' and 'Cancel' buttons, and a 'Mode' section with radio buttons for 'RTU' (selected) and 'ASCII'. Below that are 'Response Timeout' (1000 [ms]) and 'Delay Between Polls' (20 [ms]) fields. At the bottom, there is a 'Remote Server' section with fields for 'IP Address' (192.168.0.3), 'Port' (502), and 'Connect Timeout' (3000 [ms]).

The **IP Address** and **Port** should match the setting in the radio. Timeouts can be set accordingly.

**Modbus RTU/ASCII over TCP/IP will not communicate to the radio.*

Slave ID

The Modbus Slave ID cannot be changed in the radio. Every radio has a Slave ID of **1**.

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Modbus Register Map

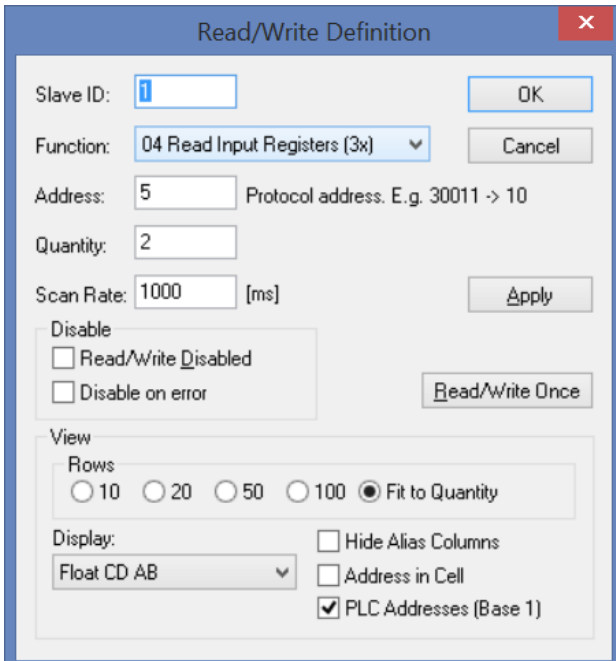
The Modbus Register Map shows the available Modbus Registers.

Modbus register maps

Simple register map						
Type	Register	Channel	Description	R/W	Default	Note
Input UInt32	0		Uptime LSW	RO		Seconds
Input UInt32	1		Uptime MSW	RO		Seconds
Input Float	2		Uptime LSW	RO		Days
Input Float	3		Uptime MSW	RO		Days
Input Float	4		Voltage LSW	RO		
Input Float	5		Voltage MSW	RO		
Input Float	6		Temperature LSW	RO		
Input Float	7		Temperature MSW	RO		

Monitor DC Input Voltage

The following settings should be used to read the DC Input Voltage from Register 5.



Read/Write Definition

Slave ID: OK Cancel

Function: Cancel

Address: Protocol address. E.g. 30011 -> 10

Quantity:

Scan Rate: [ms] Apply

Disable

☐ Read/Write Disabled

☐ Disable on error

Read/Write Once

View

Rows

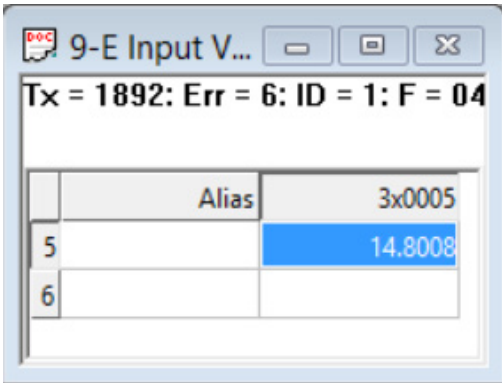
☐ 10 ☐ 20 ☐ 50 ☐ 100 ☒ Fit to Quantity

Display:

Hide Alias Columns

☐ Address in Cell

☒ PLC Addresses (Base 1)



9-E Input V...

Tx = 1892: Err = 6: ID = 1: F = 04

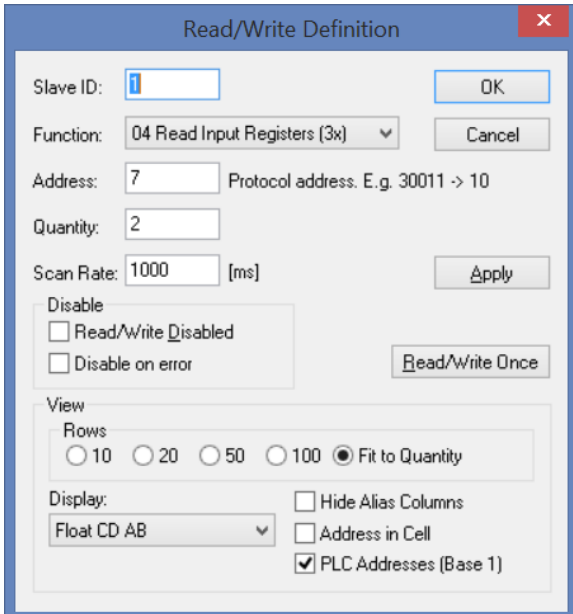
	Alias	3x0005
5		14.8008
6		

DC Input Voltage is reported in VDC.

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Monitor Radio Temperature

The following settings should be used to read the Radio Temperature from Register 7.



Read/Write Definition

Slave ID: OK Cancel

Function: 04 Read Input Registers (3x) Apply

Address: Protocol address. E.g. 30011 -> 10

Quantity: Apply

Scan Rate: [ms]

Disable

☐ Read/Write Disabled

☐ Disable on error

Read/Write Once

View

Rows

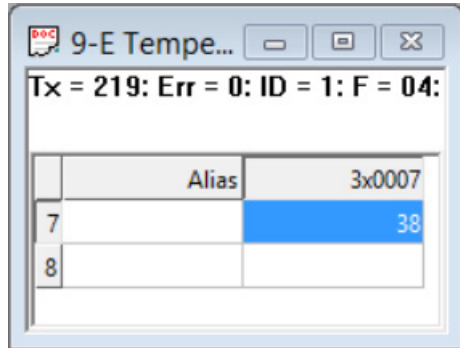
☐ 10 ☐ 20 ☐ 50 ☐ 100 ☒ Fit to Quantity

Display:

☐ Hide Alias Columns

☐ Address in Cell

☒ PLC Addresses (Base 1)



9-E Tempe...

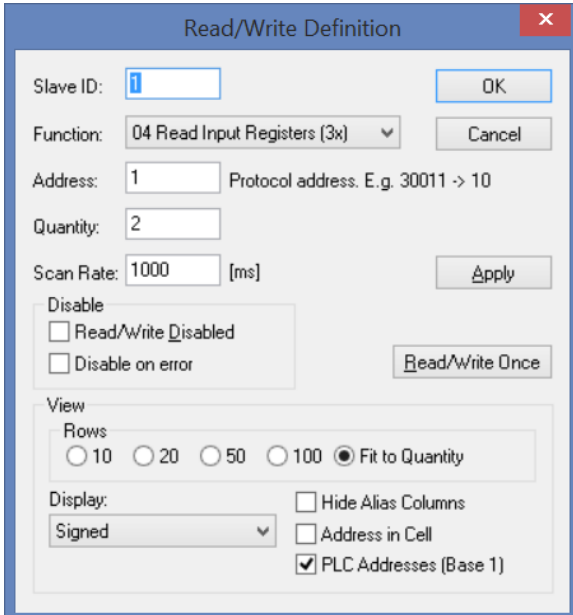
Tx = 219: Err = 0: ID = 1: F = 04:

	Alias	3x0007
7		38
8		

Radio Temperature is reported in deg C.

Monitor Radio Uptime

The following settings should be used to read the Radio Temperature from Register 1.



Read/Write Definition

Slave ID: OK Cancel

Function: 04 Read Input Registers (3x) Apply

Address: Protocol address. E.g. 30011 -> 10

Quantity: Apply

Scan Rate: [ms]

Disable

☐ Read/Write Disabled

☐ Disable on error

Read/Write Once

View

Rows

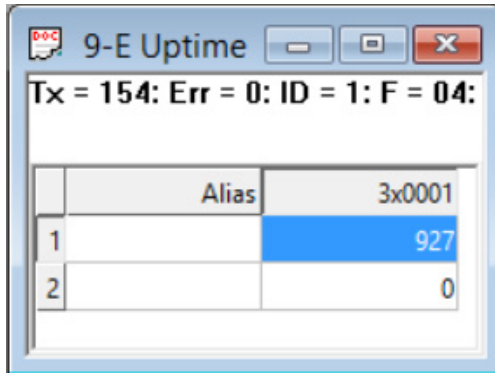
☐ 10 ☐ 20 ☐ 50 ☐ 100 ☒ Fit to Quantity

Display:

☐ Hide Alias Columns

☐ Address in Cell

☒ PLC Addresses (Base 1)



9-E Uptime

Tx = 154: Err = 0: ID = 1: F = 04:

	Alias	3x0001
1		927
2		0

Uptime is reported in Seconds and resets whenever the DC Input Power drops out.

Caution

Uptime is not RF Link uptime.

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System

Administration

The default username is: **ADMIN**

The default password is: **ADMIN**

Here you can change your user name and password and modify security settings

Modify your user name if desired
Verify your present password (Needed for changes and commands on this page)
Enter a new password (A new password must be entered to modify user name)
Confirm your new password (Must be identical to new password)

<input type="checkbox"/> HTTP server authentication	Enable login on to web server
Trusted IP address	<input type="text" value="0.0.0.0"/> Set non-zero to allow maintenance only from a trusted address

☒ No action
☐ Modify and save user name/password
☐ Modify and save security settings
☐ Restore factory settings
☐ Reset/Reboot device

Desired Action

Actions on this page are only accepted if the present password has also been entered correctly!!

Operating
Running time

The HTTP server can be configured to require basic authentication, requiring a **Username** and **Password** when a new connection is established.

A **Trusted IP Address** may be set to allow access only from that IP address.

Changes to Username and/or Password are saved by setting the desired action to **Modify and save user name/password** and clicking on **Perform desired action**.

Changes to the Trusted IP Address are saved by setting the desired action to **Modify and save security settings** and clicking on **Perform desired action**.

Restore factory settings returns the device to default settings.

*Note: This also provokes a reset of the device. If the factory settings cause the network parameters to be modified the radio will automatically start a three minute validation period. During this period it will be necessary to establish a connection to the radio using 'factory settings' and validate them before the default values become permanent. This is again to ensure that there is no danger of losing contact with a remote device. The default device IP address is: **192.168.0.3**.*

Reset/Reboot simply reboots the device.

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Firmware Upgrade

XetaWave 900MHz Ethernet firmware is loaded as a single **.bin** file, but contains two components;

- **Ethernet Code** that is loaded onto the Ethernet carrier board of enclosed radios such as the Xeta9-E and the Ethernet portion of the board level Emancipator+.
- **Radio Code** that is loaded onto the Radio module of enclosed radios and the Radio portion of the board level Emancipator+.

Upgrade Individual Radio

Firmware can be upgraded by loading the appropriate **.bin** file into the radio.

Upload and program new software to the XetaWave Ethernet Bridge:

No file chosen

Choose File to select the new firmware file.

Upload new software to load the new firmware file into the radio.

The radio will load the new Ethernet code and then the new Radio code. A reboot will occur during this process but the radio will maintain the same RF Transmission Settings.

Note: Once the firmware has been updated, the previous version will not be available.

Upgrade Serial Sub-network

In a [Seamless Serial](#) Network the Ethernet Master can be used to upgrade the Radio Code of any connected Serial Slaves.

Upgrade serial sub network radio firmware:

- ☐ Upgrade serial sub network
☐ Upgrade radio (Device ID)

Through: ☐ Radio 1 ☒ Radio 2

The entire Serial subnetwork can be upgraded all at once. Alternatively, individual radios can be targeted for upgrade by entering the **Device ID** (and in the case of a Xeta9x9-E) selecting the radio the Serial Slave is connected to.

The **Upgrade** button will then upgrade the chosen Serial Slave(s) in the sub network.

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Help Page

The radios contain a **Help Page** that will be expanded with future firmware releases.

The help page is intended for use with the browser's search function. Press Ctrl-F and type the setting name you want to find. The browser will highlight the setting name as it appears below. Press Enter to skip quickly through the occurrences of the setting name.

Main Page

The main page presents a summary of the device's configuration and status. User can validate settings changes if there is a pending validation, and modify Device Name.

Device Name

Device name is a string stored on the Ethernet interface to quickly identify the device.

Default

Blank

Options

This can be set to a string with 16 characters. Commas not allowed.

Device ID

Device ID is the Device ID of the first radio module powered up. If there are 2 radios in the product, the Device ID of the second radio module is ignored.

IP Address

IP Address currently set on the device. IP Address can be changed on the Network Settings page.

Default

192.168.0.3

Ethernet Firmware

Ethernet Firmware is the software version currently running on the Ethernet processor.

Radio, Radio 1, Radio 2

This presents a summary of the integrated radio information including Radio Name, Device ID, Network Type, Mode, and Radio Status. For enclosed radios with more than 1 embedded radio module all radios that are powered up will be shown.

MAC Address

MAC Address is the Ethernet hardware address of the device.

RF Transmission Settings Page

The RF Transmission Settings contains all radio configurations.

Slave Transmit Rates

Slave Transmit Rates set the allowable modulations for Slave radios to transmit to the Master radio. Slave Transmit Rates must be set the same in all radios on the network. **Note:** MSK modulations offer superior performance in sensitivity, selectivity and speed. MSK modulations are highly encouraged for FHSS; FSK modulations are discouraged.

Default

884 kbps BPSK

Options

- 57 kbps MSK, FHSS, 120 kHz bandwidth
- 114 kbps MSK, FHSS, 120 kHz bandwidth
- 153 kbps MSK, FHSS, 210 kHz bandwidth
- 228 kbps MSK, FHSS, 310 kHz bandwidth
- 663 kbps 2FSK, DTS, 900 kHz bandwidth
- 884 kbps BPSK, DTS, 1.2 MHz bandwidth
- 1768 kbps QPSK, DTS, 1.2 MHz bandwidth
- 2651 kbps 8PSK, DTS, 1.2 MHz bandwidth
- 3535 kbps 16QAM, DTS, 1.2 MHz bandwidth (9-E only)
- 3535 kbps 16PSK, DTS, 1.2 MHz bandwidth (9-E only)

Dynamic Payload

Dynamic payloads can provide improved performance on ISM and DTS networks, but the setting is not backward-compatible with older firmware. MMS is not compatible. All radios in the network must have the same setting. Confirm that the "Beacon Rate" is set to 1, that the "MMS" setting is None, "MMS Hop Offset" is set to 0, and the "Master Repeat setting" is set to 3.

I/O Page

The I/O page contains configuration for Syslog messages and Modbus TCP.

Modbus

[Modbus Register Maps](#)

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Utilities

RF Ping

The **RF Ping** Utility enables the direct testing of connectivity and link quality between a Master and a remote Slave radio and can be initiated from either side of the link.

RF Ping

☒ Radio 1 ☐ Radio 2
 (Device ID)

TimeStamp	Remote Signal	Remote Noise	Local Signal	Local Noise
48995	-73	-109	-78	-110
48996	-89	-108	-71	-104
48998	-81	-110	-86	-112
48999	-74	-108	-77	-106

Enter the **Device ID** for the radio on the opposing end of the link and press the **Start** button.

Note: when using this utility on a Xeta9x9-E it is necessary to select which Radio module to use for the test.

Once the test is initiated the radio will attempt four “pings” at the RF protocol level. These are not the same pings as ICMP; they are strictly at Radio Level.

Each successful ping will report signal and noise information for both the local and far side of the link.

The RF Ping Utility provides users with a diagnostic tool that can be used to:

- Verify that a remote/slave radio can be heard by the master radio.
- Verify a specific slave is connected to the master and able to communicate.
- Obtain link performace information at the master for a specific link.

Diagnostics

LAN Statistics

LAN Statistics is split into **two** tables, both offering diagnostic information relating to Ethernet functionality;

- For the board level Emancipator+ Radio, the diagnostic information relates to the single physical Ethernet port and Ethernet module of the board, including the in-built interface to the Radio module.
- For enclosed Radios, such as the Xeta9-E, the diagnostic information relates to both physical Ethernet ports and also the port connected to the installed Radio Module.

The **Radio Bridging** table lists diagnostic information relating to the interface with the Radio Module;

Radio 1 bridging		Radio 2 bridging	
Bad Syncs Rx	0	Bad Syncs Rx	0
Bad Headers Rx	0	Bad Headers Rx	0
Bad Data Rx	1	Bad Data Rx	0
Frag dropped	2	Frag dropped	0
Tx dropped	5272	Tx dropped	0
Good Headers Rx	253233	Good Headers Rx	0
Good Data Rx	242573	Good Data Rx	0
Frams	253233	Frams	0
Consumed	44848	Consumed	0
Tx bridged	291282	Tx bridged	0

Bad Syncs Rx indicates the 2Byte Sync portion of the Frame Wrapper* is corrupt or invalid.

Bad Headers Rx indicates the 24Byte Header portion of the Frame Wrapper* is corrupted or invalid.

Bad Data Rx indicates the data portion of the Frame Wrapper, i.e. the entire Ethernet packet is corrupted or invalid.

Frag Dropped indicates the complete loss of a fragmented Ethernet packet. If the Ethernet packet is too large to move on one hop, such as when using smaller “Max Payload Bytes”, the Radio will fragment the packet and send each fragment individually. The receiving Radio will reassemble the entire packet during post-demodulation processing; if one fragment doesn’t make it, the remaining fragments held in memory are dropped and the counter increments by 1. The buffer could also be full and therefore timing out.

Tx Dropped indicates a full Radio buffer and so the Ethernet board throws it away.

* The Frame Wrapper is the radio overhead that encapsulates the Ethernet packet, either as a single MTU, or fragmented into multiple smaller Ethernet packets.

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Radio 1 bridging		Radio 2 bridging	
Bad Syncs Rx	0	Bad Syncs Rx	0
Bad Headers Rx	0	Bad Headers Rx	0
Bad Data Rx	3	Bad Data Rx	0
Frag dropped	0	Frag dropped	0
Tx dropped	0	Tx dropped	0
Good Headers Rx	160015	Good Headers Rx	0
Good Data Rx	156161	Good Data Rx	0
Frams	160015	Frams	0
Consumed	8059	Consumed	0
Tx bridged	244213	Tx bridged	0

Good Headers Rx indicates the 24Byte Header portion of the Frame Wrapper has been successfully decoded.

Good Data Rx indicates the data portion of the Frame Wrapper has been successfully decoded.

Frams indicates fragmented packets.

Consumed represents the Ethernet Frames addressed to this device that have been successfully decoded.

Tx Bridged indicates Ethernet frames that have been sent to the Radio.

The **IP Frame and ARP Statistics** table lists diagnostic information relating to the Ethernet interface and ARP.

The table is split into **RX**, **TX** and the **ARP cache/table**.

IP frame / ARP statistics							
RX	Number of frames	TX	Number of frames	ARP entries in cache		IF	VLAN
Total RX frames	104702	Total TX frames	57325	192.168.0.250	4c-5e-0c-65-65-dd	Radio 2	1
Overruns	0	ARP frames	534	192.168.0.253	b8-2a-72-cd-6d-1c	Switch	1
Frames to us		ICMP frames	0	--	--	--	--
ARP frames	534	UDP frames	0	--	--	--	--
ICMP frames	3	TCP frames	56791	--	--	--	--
UDP frames	3243						
TCP frames	100100						
Broadcast frames							
ARP frames	822			Reset frame stats		Delete ARP entries	
ICMP frames	0						
UDP frames	0						
TCP frames	0	Other events	0				

RX

Total RX Frames represents the total amount of Ethernet frames received, from both the Ethernet switch ports and also the installed Radio Module(s).

Overruns indicates the capacity of the interface has been exceeded; the frame that is currently being received is dropped and the Overrun counter incremented.

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IP frame / ARP statistics

RX	Number of frames	TX	Number of frames	ARP entries in cache		IF	VLAN
Total RX frames	104702	Total TX frames	57325	192.168.0.250	4c-5e-0c-65-65-dd	Radio 2	1
Overruns	0	ARP frames	534	192.168.0.253	b8-2a-72-cd-6d-1c	Switch	1
Frames to us		ICMP frames	0	--	--	--	--
ARP frames	534	UDP frames	0	--	--	--	--
ICMP frames	3	TCP frames	56791	--	--	--	--
UDP frames	3243						
TCP frames	100100						
Broadcast frames							
ARP frames	822			Reset frame stats		Delete ARP entries	
ICMP frames	0						
UDP frames	0						
TCP frames	0	Other events	0				

RX – Frames to Us

This section displays diagnostics information relating to Ethernet traffic addressed to the Radio.

ARP Frames represents the total quantity of [Address Resolution Protocol](#) frames sent to the Radio.

ICMP Frames represents the total quantity of [Internet Control Message Protocol](#) frames sent to the Radio.

UDP Frames represents the total quantity of [User Datagram Protocol](#) frames sent to the Radio. *Note: UDP is a connectionless protocol that **does not** guarantee data delivery or packet sequence.*

TCP Frames represents the total quantity of [User Datagram Protocol](#) frames sent to the Radio. *Note: UDP is a connectionless protocol that **does not** guarantee data delivery or packet sequence.*

RX – Broadcast Frames

This section represents [Broadcast Traffic](#) that the Radio forwards on, either through the installed Radio Module or the Ethernet port(s).

TX – Frames Transmitted

This section displays diagnostics information relating to the transmission of Ethernet traffic through the Radio Module.

ARP Cache

The ARP cache or table as it's also referred to shows the connected devices by IP and [MAC](#) Addresses, what Interface they can be reached from and what VLAN they belong to.

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Radio Statistics

Radio Statistics contains information about the current RF Environment.

Radio Temp: 36 PA Temp: 34
Bytes Tx: 4649824 Bytes Rx: 6240007
Xmit Rate: 3 kbps Recv Rate: 3.7 kbps
Input Volt: 2676
Cur Success: 99

Freq	Noise			Signal			Fwd_Pwr	Rev_Pwr	% Avail	PA Current
	Max	Min	Avg	Max	Min	Avg				
903500000	-93	-117	-108	-64	-72	-67	992	46	100	550
904700000	-79	-116	-107	-64	-72	-67	1003	49	100	610
905900000	-82	-118	-108	-64	-71	-67	996	53	100	660
907100000	-79	-113	-105	-64	-71	-67	1007	49	100	610
908300000	-91	-115	-108	-64	-71	-66	1003	52	100	670
909500000	-79	-114	-106	-64	-71	-67	1007	48	100	570
910700000	-92	-115	-106	-63	-71	-67	996	50	100	630
911900000	-79	-116	-107	-64	-71	-66	996	53	100	660
913100000	-91	-118	-107	-64	-70	-67	996	44	100	570
914300000	-79	-114	-105	-64	-71	-67	992	50	100	620
915500000	-79	-115	-107	-64	-71	-67	992	46	100	550
916700000	-79	-115	-108	-64	-71	-67	996	49	100	610
917900000	-82	-116	-107	-65	-72	-68	992	51	100	660
919100000	-79	-116	-107	-64	-72	-68	1003	48	100	570
920300000	-87	-116	-108	-65	-73	-69	996	49	100	630
921500000	-79	-116	-108	-64	-73	-69	996	46	100	550
922700000	-80	-115	-108	-66	-74	-69	996	50	100	610
923900000	-79	-116	-108	-64	-74	-70	996	51	100	660
925100000	-79	-117	-107	-66	-80	-70	992	46	100	570
926300000	-79	-117	-109	-64	-77	-70	992	50	100	630

Radio / PA Temp shows the current temperature the Radio & Power Amplifier (deg C)

Bytes Tx is the amount of Bytes transmitted by the Radio.

Bytes Rx is the amount of Bytes received by the Radio.

Xmit and **Recv** rates are the instantaneous rates of how fast data is moving.

Input Volt is the supply voltage in mV that the radio is currently receiving, which differs between products.

Cur Success is the current communications success rate.

The **Freq** column specifies the channel frequency. Refer to [Hop Tables](#) for channel frequencies per modulation.

When assessing **Noise**, look at “Average” as opposed to “Max”. ISM Noise levels vary depending on how many radio systems are in the vicinity and how their hopping pattern and timing parameters are configured.

Remember, ISM is **License Free** which makes it a popular choice for nearly everyone. Most systems use hopping technology to coexist in the same spectrum. That being said, noise can become an issue in high traffic areas with multiple overlaid systems.

Sampling the noise floor at various locations on a prospective network is something that XetaWave recommends as part of the link design process. The more the system designer knows about the RF environment, the better engineered the system can be.

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Caution

Installing radio systems without sampling the noise floor can, in some cases, lead to unexpected performance. XetaWave recommends sampling the noise floor or at least making an allowance for a higher than expected noise floor in the link budget.

When assessing **Signal** look at the “Average” as opposed to “Max”. Consult the [RSSI](#) scale to ensure the Signal isn’t too weak or too strong; see [how to tune RSSI](#).

Fwd-Pwr is the output transmit power of the radio and should reflect the transmit power setting in RF Transmission Settings.

*Note: Slave **Transmit Power** will only change if connected to a Master and passing data.*

Rev-Pwr is the reflected power coming back into the radio from the transmission system and should be $\leq 10\%$ of **Fwd-Pwr**.

Caution

High Rev-Pwr indicates elevated [VSWR](#), which could mean damaged coax or water in a connector. Coaxial cables, connectors, antennas and then the radio should be checked (in that order).

% Avail indicates the % of the time the radio went to transmit on the specified frequency and the noise measured was below the [Diagnostic Threshold](#).

PA Current is the current being drawn by the Power Amplifier.

Page Controls

Poll

Poll updates the current Radio Statistics diagnostic snapshot.

Reset

Reset clears the current Radio Statistics History

Auto Refresh ☐ 30 Seconds allows selection of a predetermined update interval.

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Terminal Server Statistics

Terminal Server Statistics informs the user who is connected to each of the built in Terminal Servers. Remember, Serial Ports, Radio modules and Seamless are all defined as Terminal Servers;

Terminal Server	Remote Connection
Local/S1	192.168.0.250:64674
Local/S2	
Radio 1	
Radio 2	
Seamless A	192.168.0.129:64705
Seamless B	

The Remote Connection represents the IP address and Port # of the remote device that's connected; on a flat network this could be the polling host. On a routed network this would be the upstream router interface.

There are several parameters logged for each of the built in Terminal Servers;

	Local/S1	Local/S2	Radio 1	Radio 2	Seamless A	Seamless B
Received Serial Frames	0	0	0	0	0	0
Received Serial Bytes	0	0	0	0	0	0
Transmitted TCP Frames	0	0	0	0	0	0
Transmitted TCP Bytes	0	0	0	0	0	0
Received TCP Frames	129	0	0	0	42	0
Tx TCP Frames Dropped	0	0	0	0	0	0
Transmitted Serial Bytes	145	0	0	0	59	0
Server Connections	1	0	0	0	2	0
Client Connections	0	0	0	0	0	0

Received Serial Frames are frames of serial data no larger than the buffer size configured in [Serial Communications](#).

Received Serial Bytes indicates the amount of data received on the physical serial port.

Transmitted TCP Frames indicates how many TCP frames have been successfully transmitted from the Ethernet side of the Terminal Server. The TCP Frames contain the packetized serial data received on the Serial port of the Terminal Server.

Transmitted TCP Bytes indicates how much TCP data has been successfully transmitted on the Ethernet side of the Terminal Server.

Received TCP Frames indicates how many TCP frames have been successfully received on the Ethernet side of the Terminal Server.

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	Local/S1	Local/S2	Radio 1	Radio 2	Seamless A	Seamless B
Received Serial Frames	0	0	0	0	0	0
Received Serial Bytes	0	0	0	0	0	0
Transmitted TCP Frames	0	0	0	0	0	0
Transmitted TCP Bytes	0	0	0	0	0	0
Received TCP Frames	129	0	0	0	42	0
Tx TCP Frames Dropped	0	0	0	0	0	0
Transmitted Serial Bytes	145	0	0	0	59	0
Server Connections	1	0	0	0	2	0
Client Connections	0	0	0	0	0	0

Tx TCP Frames Dropped indicates how many TCP frames have been dropped on the Ethernet side of the Terminal Server and may indicate an issue with the RF link.

Transmitted Serial Bytes indicates how much serial data has left the Serial port.

Server Connections indicates the number of connections to the interface when configured as Terminal Server.

Client Connections indicates the number of connections to the interface when configured as Terminal Client.

Page Controls

Refresh

Refresh loads the current metrics into the UI.

Reset

Reset restores all metrics back to zero.

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Quick Start Guide

Accessing the Radio

The default IP address of all XetaWave Ethernet Radios is **192.168.0.3**.

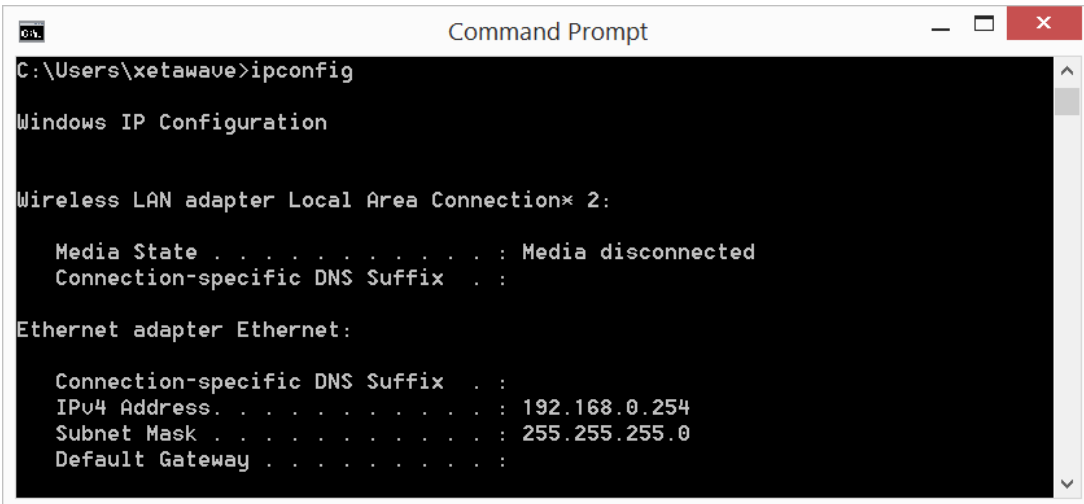
1. Connect a standard Ethernet cable into an Ethernet port on the Radio.
2. Connect the other end to the LAN port on your PC.
3. Open the web browser of your preference and type the address **192.168.0.3** into the URL box to connect to the User Interface.

If it does not come up, there are two common issues.

1. Computer is on a different subnet.
2. The radios IP address has been changed.

To troubleshoot these issues open a Command Prompt Window and type **ipconfig**.

This will give you the IP address of your computer, which should be in the same subnet (**192.168.0.X**) as the Radio in order to communicate with the Radio;



```
C:\Users\xetawave>ipconfig

Windows IP Configuration

Wireless LAN adapter Local Area Connection* 2:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Ethernet adapter Ethernet:

    Connection-specific DNS Suffix  . :
    IPV4 Address. . . . . : 192.168.0.254
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . :
```

The Computer and the Radio should have **unique** IP addresses.

Note: If using a routed network, confirm that the port on your managed switch / router is configured to the right subnet.

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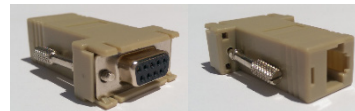
Obtaining an Unknown IP Address

If your Computer is on the same subnet as the default Radio IP address and communications cannot be established, it's possible the IP address of the Radio has changed. This is a common situation with previously used radios.

Note: it's good practice to apply some light colored electrical tape to the underside of the radio to track any IP address changes with a marker. You never know when you'll appreciate the time saved when needing to set up a radio in a rush!

To obtain the IP address you will need...

- [Serial to USB Cable](#)
- Standard CAT5 Ethernet cable
- Xetawave DB-9 to RJ45 adapter



Connect the **Serial to USB cable** to the **Computer** and install the drivers per the manufacturer instructions (unless the Operating System recognizes the device).

Note the **COM port** number allocated to the device by the Operating System.

Connect the **RJ45 to DB9** adapter to the **DB9 Serial port** on the **Serial to USB cable**.

Plug the **CAT5 Ethernet cable** into the **RJ45 to DB9** adapter.

Plug the **Cat5 Ethernet cable** into **COM 1 / SERIAL 1** of the Radio (**COM / SERIAL** on the board level Emancipator +).

Caution

XetaWave Radios use RJ45 connectors for both Serial & Ethernet ports. This means it's possible to plug an Ethernet cable into the Serial port and vice versa.

Please take care when connecting cables so that you don't have to waste time troubleshooting!

Open a [Terminal Emulator](#) of your choice, such as Tera Term or PuTTY and connect to the **COM port** assigned to the **Serial to USB cable**.

Set the baud rate to 115200 8N1

Cycle power to the Radio

The IP address should be displayed

```
Serial number: E5.01.33.2C
Software version: 2.07.5661.1.36.5791
Device name: XetaWave

IPv4 address = 192.168.0.4
MAC address = 70-f1-e5-01-33-2c
Subnet mask = 255.255.255.0
Default gateway = 0.0.0.0
DNS server = 0.0.0.0

VLAN configuration:
Management VLAN = 1
Ethernet 1 Native VLAN = 1
Ethernet 2 Native VLAN = 1

Ctrl + R to interrupt terminal server startup
.....
Starting terminal server mode...
```

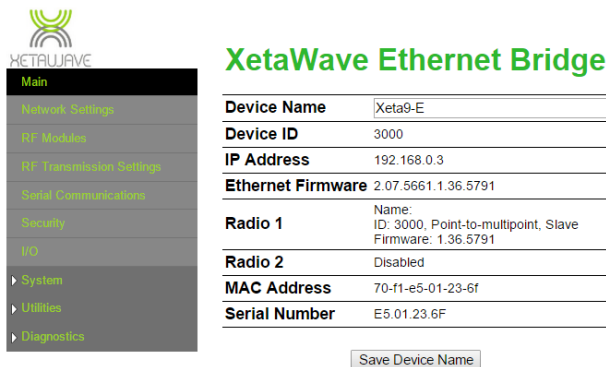
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Restoring the Default IP Address

You can also reset the radio to the default IP address using this method. Simply press Ctrl + R while the boot up is happening and follow the on screen instructions to do so.

User Interface and Configuration

Once you have access to the user interface on the web page the main page should pop up.

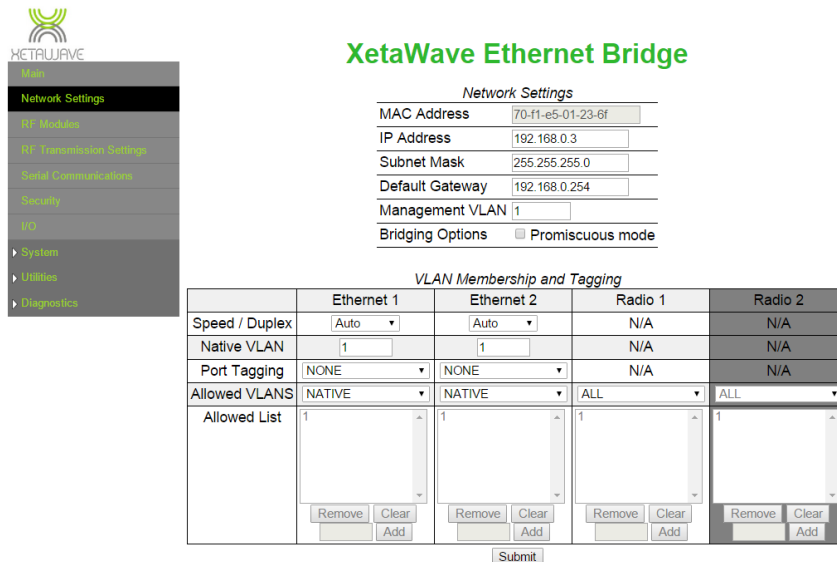


The screenshot shows the main configuration page of the XetaWave Ethernet Bridge. On the left is a sidebar menu with options: Main, Network Settings, RF Modules, RF Transmission Settings, Serial Communications, Security, I/O, System, Utilities, and Diagnostics. The main content area displays device information:

Device Name	Xeta9-E
Device ID	3000
IP Address	192.168.0.3
Ethernet Firmware	2.07.5661.1.36.5791
Radio 1	Name: ID: 3000, Point-to-multipoint, Slave Firmware: 1.36.5791
Radio 2	Disabled
MAC Address	70-f1-e5-01-23-6f
Serial Number	E5.01.23.6F

At the bottom right, there is a 'Save Device Name' button.

From this page navigate to the **Network Settings** page.



The screenshot shows the Network Settings page. The sidebar menu is the same as the main page, but 'Network Settings' is highlighted. The main content area is divided into two sections:

Network Settings

MAC Address	70-f1-e5-01-23-6f
IP Address	192.168.0.3
Subnet Mask	255.255.255.0
Default Gateway	192.168.0.254
Management VLAN	1
Bridging Options	<input type="checkbox"/> Promiscuous mode

VLAN Membership and Tagging

	Ethernet 1	Ethernet 2	Radio 1	Radio 2
Speed / Duplex	Auto	Auto	N/A	N/A
Native VLAN	1	1	N/A	N/A
Port Tagging	NONE	NONE	N/A	N/A
Allowed VLANs	NATIVE	NATIVE	ALL	ALL
Allowed List	1	1	1	1
	Remove Clear Add	Remove Clear Add	Remove Clear Add	Remove Clear Add

At the bottom center, there is a 'Submit' button.

**Saving of new settings causes an immediate reset and must be validated; otherwise the original settings will be returned.
This ensures that new settings do not render a device unreachable.*

On this page you can set the IP address of your choice, along with the default gateway. Make sure to click apply settings at the bottom of the page to make the changes permanent.

Note: If you change the IP address to a different subnet, make sure to change the IP address of the computer to match that subnet.

**Caution**

When changing certain settings of a Remote Slave via the Masters RF link it is always better to use the 'Validate Settings' option if prompted by the orange screen. This will ensure that if communication is lost, the Slave Radio will revert to the previously functioning configuration and communication will be restored.

RF Transmission Settings

The RF Transmission settings page is where you will configure the radio parameters, which define how the radios will communicate.

To configure a test link; enter the parameters highlighted in the screen shots below.

Master

Radio 1 ID: 1000 (Master) Reload List Delete List

RF Band ☒ ISM ☐ MAS

Description **MAS**

Band Start 902.0000 MHz Stop 928.0000 MHz
Exclude Lower 0 MHz Upper 0 MHz
ISM Power 10 mW
Hop Pattern 1

Master Tx Freq 952.20625 MHz
Slave Tx Freq 928.20625 MHz
MAS Power 100 mW

Slave Transmit Rates

<input type="checkbox"/> 57 kbps MSK	<input type="checkbox"/> 114 kbps MSK
<input type="checkbox"/> 153 kbps MSK	<input type="checkbox"/> 229 kbps MSK
<input type="checkbox"/> 663 kbps 2FSK	<input checked="" type="checkbox"/> 884 kbps BPSK
<input type="checkbox"/> 1768 kbps QPSK	<input type="checkbox"/> 2651 kbps 8PSK
<input type="checkbox"/> 3535 kbps 16QAM	<input type="checkbox"/> 3535 kbps 16PSK

Master Transmit Rate 884 kbps BPSK (multispeed multipoint)
Max Payload Bytes Master 1024 Slave 1024 Dynamic Off
Beacon Period 1
Network Address 1000 Network Radius 10 km
Upstream Device ID 1000
Downstream Device ID 1000
Network Type Point to Multipoint Mode Master
Device ID 1000
Protocol Ethernet

☒ 10 kbps MSK
☐ 19 kbps 4FSK 12.5kHz
☐ 23 kbps QPSK
☐ 34 kbps 8PSK
☐ 39 kbps 4FSK 25kHz
☐ 45 kbps 16QAM
☒ 57 kbps 32QAM
10 kbps MSK

MMS None
MMS Hop Offset 3
Master Repeat 2
Slave Retries 10 Slave Attn Limit 100

Serial Number: E50128E4
Firmware Version: 1.36.5791

Modify Radio Settings
Refresh All Refresh Single Scan
Diag Threshold -80 dBm

Click **Modify Radio Settings** after making your changes. If this button is not clicked the settings will not change, which can be confirmed with a page **Refresh**.

Slave

Local ID: 2000 (Slave) Reload List Delete List

Description

Band Start 902.0000 MHz Stop 928.0000 MHz
Exclude Lower 0 MHz Upper 0 MHz
Transmit Power 10 mW
Hop Pattern 1

Transmit Rates

<input type="checkbox"/> 57 kbps MSK	<input type="checkbox"/> 114 kbps MSK
<input type="checkbox"/> 153 kbps MSK	<input type="checkbox"/> 229 kbps MSK
<input type="checkbox"/> 663 kbps 2FSK	<input checked="" type="checkbox"/> 884 kbps BPSK
<input type="checkbox"/> 1768 kbps QPSK	<input type="checkbox"/> 2651 kbps 8PSK

Master Transmit Rate 884 kbps BPSK (multispeed multipoint)
Max Payload Bytes Master 1024 Slave 1024 Dynamic Off
Beacon Period 1
Network Address 1000 Network Radius 10 km
Upstream Device ID 1000
Downstream Device ID 2000
Network Type Point to Multipoint Mode Slave
Device ID 2000
Protocol Ethernet

MMS None
MMS Hop Offset 1
Master Repeat 2
Slave Retries 10 Slave Attn Limit 100

Serial Number: E501332C
Firmware Version: 1.36.5791

Modify Radio Settings
Refresh All Refresh Single Scan
Diag Threshold -80 dBm

Caution

When lab/bench testing with the optional odBi test antenna it is recommended to install a 20dB coaxial attenuator and adjust the transmit power to 50-100 mW. RSSI should be below -50dBm.

Using a paper clip instead of a proper antenna may damage the TNC connector, which may negatively impact performance when deployed.

XetaWave inspects the TNC connector during the RMA process. Improper use that causes subsequent damage is considered outside of warranty coverage.

Adjusting the RF Transmission Settings

Adjusting the Modulation

- Lower Modulations will have slower speeds, but offer better sensitivity. This equates to longer links with better ability to punch through clutter.
- Lower modulations also have smaller bandwidths which gives them higher noise immunity. This is because the narrow band has less chance of a bit becoming corrupted. One corrupted bit causes the whole packet to be thrown out.
- Higher Modulations will have faster speeds, but with lower sensitivities they will be restricted to shorter links.
- Higher modulations are more susceptible to noise as they have a larger bandwidth.

Adjusting the Packet Size

- Xetawave packet sizes can be set from 64 bytes to 1600 bytes.
- Smaller packet sizes will lead to lower throughput. This happens because each packet regardless of size has the same amount of overhead such as network address.
- Larger packet sizes will offer better throughput from lack of overhead.
- Larger packet sizes are more susceptible to noise. This happens due to the fact that they are modulated for a longer period of time which can result in corrupted bits.
- Dynamic allows the slave to use as much as 512 bytes of an unused master time slot. Dynamic does not work with multispeed or MMS. Ideal packet size settings are 512 and 512 when using dynamic. This can be seen on the graph below.

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Adjusting the Power

- Never use 1000mW with positive dB gain antennas in close proximity. This will cause dropped data, and can possibly damage the receiver.
- When doing indoor tests use 10mW, especially if there is no attenuation. If you have attenuation, tune the link to the proper receiver level mentioned below.
- RSSI levels should be between -60dB to -70dB.

Best Settings

For Speed and Throughput

16 QAM with 1600 byte packet sizes (Only if power levels are tuned; QAM is very sensitive to high RSSI levels.)

8PSK with 1600 byte packet sizes.

For Reliable Modulation with High Sensitivity and Speed

BPSK with 512 byte packet sizes.

Turn dynamic on to increase throughput.

For High Sensitivity with High Noise Immunity

114 MSK with 256 byte packet sizes.

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How To...

This section contains information on how to configure XetaWave Radios for different applications.

How to set up a PTMP Network

A [PTMP Network](#) consists of 1 x Master Radio and several Slave Radios.

Caution

XetaWave recommends limiting the number of Slave Radios in a PTMP Network to 50 per Master. This is to mitigate the system-wide impact that a lightning strike at a Master site would have; the fewer links connected, the lesser the overall impact.

Identical Radio Settings

The following RF Transmission Settings should be **identical** between the Master Radio and each of the Slave Radio's in order for communications to be established;

- **RF Band**; ISM (or MAS)
- **Band Start & Stop** Frequencies
- **Exclude Lower & Upper** Frequencies
- **Hop Pattern**
- **Slave Transmit Rates**; MSMP should be 4 x consecutive FHSS or DTS modulations
- **Master Transmit Rate**
- **Max Payload Bytes**; Master & Slave
- **Dynamic**; can be used unless Max Payload Bytes is 1600/1600 or MMS is active
- **Network Address**
- **Upstream Device ID**: On the Slaves, this should be the Master Radio Device ID. This field is non-applicable on a Master and can be set to the Master's Device ID.
- **Network Radius**
- **Network Type**; Point to MultiPoint
- **Protocol**
- **Hop Offset**; providing MMS is in use

Unique Radio Settings

The following RF Transmission Settings should be unique to each Radio;

- **Device ID**
- **Mode**; Master or Slave
- [MMS](#); Generate / External on the Master, Generate on the Slave

Note; remember that each Radio in the Network should also have a unique IP Address.

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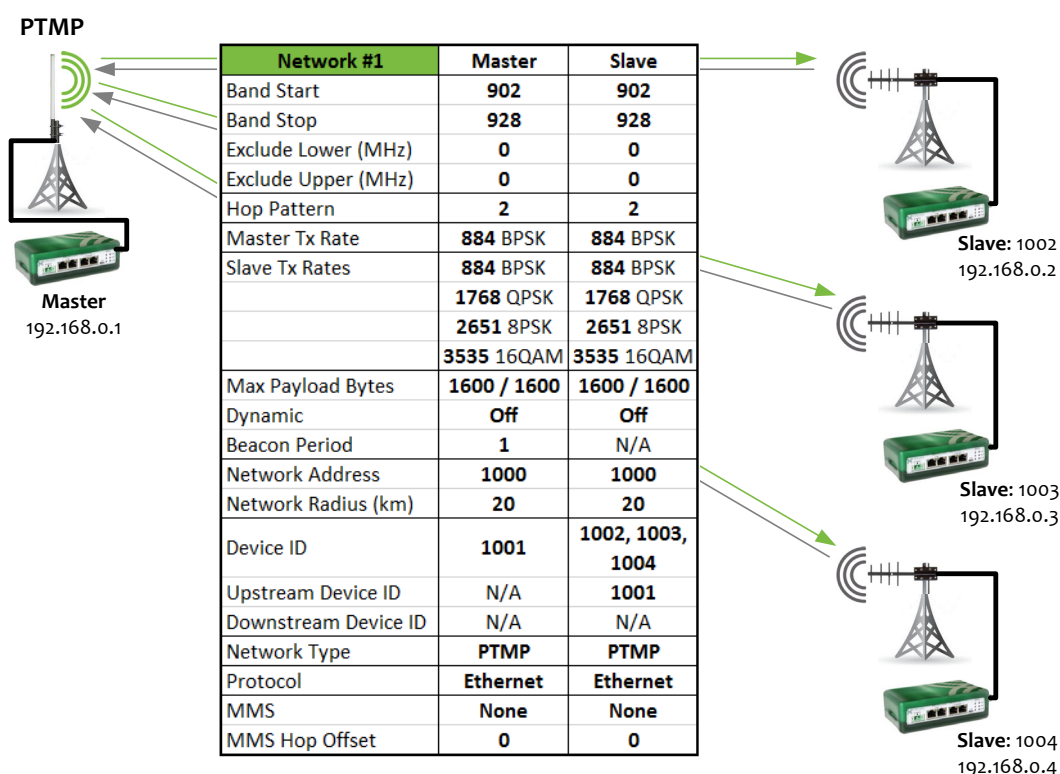
Non-Applicable Radio Settings

The following RF Transmission Settings are irrelevant in a PTMP Network;

- **Downstream Device ID**; this is a PTP setting.

PTMP ISM Test System

The following Network Diagram and Link Table illustrate the settings required for each radio to bench test a versatile higher performance PTMP network.



Transmit Power should be set so that RSSI levels are between -50dBm and -70dBm. For a bench test, this usually means setting the ISM Power to 10-50mW or adding some inline attenuators and adjusting the power accordingly.

The Master will talk to the Slaves at 884 BPSK, which has a sensitivity of -101dBm.

MSMP enabled (such as above) the Slaves will connect to the Master at the slowest selected speed for transmission of the first RF packet. As packets start to flow from Slave to Master, the Slave will ramp up the speed by stepping up in modulation to the next Slave Transmit Rate; providing link quality and signal levels allow.

Max Payload Bytes are set to the maximum 1600Bytes to provide throughput in both directions. Obviously, Slave → Master will see more throughput due to MSMP.

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How to set up a PTP Link

A [PTP link](#) provides more security over a PTMP link since the Downstream Device ID on the Master becomes active; this one setting eliminates all other Slave Radios from connecting to the Master irrespective of their RF Transmission Settings.

A PTP link offers a more connection oriented link where the Master is able to rebroadcast infinitely in the event that the Slave Radio doesn't acknowledge.

PTP links also offer different MultiSpeed performance where the radios will stay linked at the fastest possible modulation. The Master Transmit Rate takes on the fastest selected Slave Transmit Rate.

Identical Radio Settings

The following RF Transmission Settings should be **identical** between the Master and Slave Radio in order for communications to be established;

- **RF Band**; ISM (or MAS)
- **Band Start & Stop** Frequencies
- **Exclude Lower & Upper** Frequencies
- **Hop Pattern**
- **Slave Transmit Rates**; MSMP Slave Transmit Rates should be 4 x consecutive FHSS or DTS modulations
- **Master Transmit Rate**
- **Max Payload Bytes**; Master & Slave
- **Dynamic**; can be used unless Max Payload Bytes is 1600/1600 or MMS is active
- **Network Address**
- **Network Radius**
- **Network Type**; Point to Point
- **Protocol**
- **Hop Offset**; providing MMS is in use

Unique Radio Settings

The following RF Transmission Settings should be unique to each Radio;

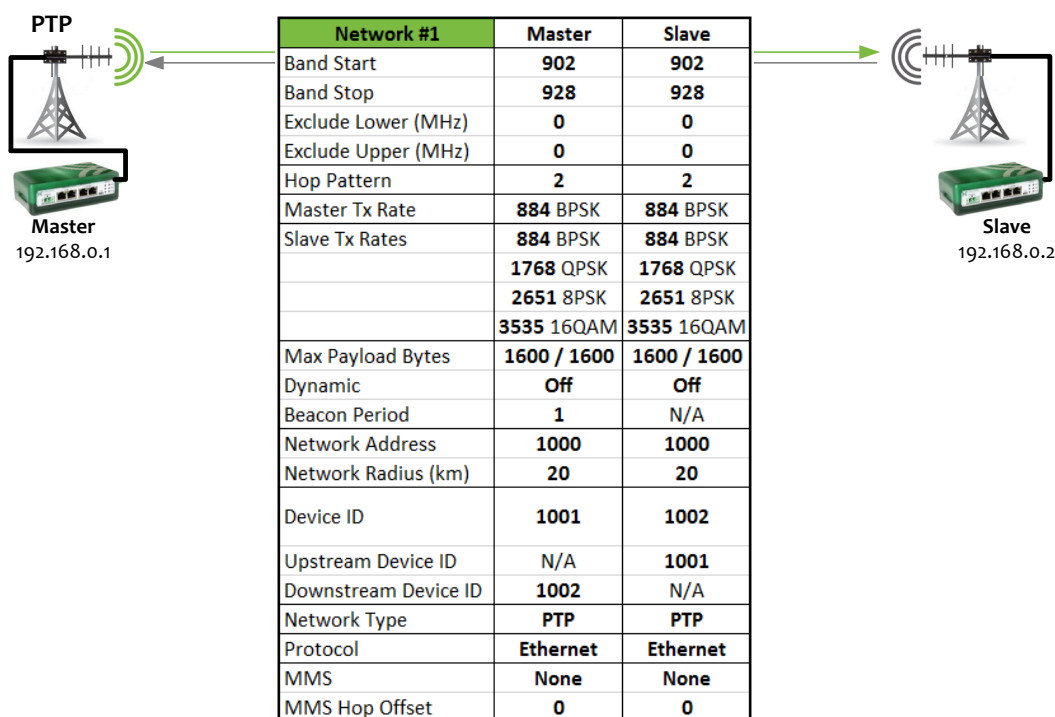
- **Device ID**
- **Mode**; Master or Slave
- **Upstream Device ID (Slave Only)**: this should be the Device ID of the Master. This field is non-applicable on a Master and can be set to the Master's Device ID.
- **Downstream Device ID (Master Only)**: this should be the Device ID of the Slave. This field is non-applicable on a Slave and can be set to the Slave's Device ID.
- **MMS**; Generate or External on the Master, Generate on the Slave

Note; remember that each Radio in the Network should also have a unique IP Address.

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PTP ISM Test System

The following Network Diagram and Link Table illustrate the settings required for each radio to bench test a versatile higher performance PTP network.



Transmit Power should be set so that RSSI levels are between -50dBm and -70dBm. For a bench test, this usually means setting the ISM Power to 10-50mW or adding some inline attenuators and adjusting the power accordingly.

The Master Transmit Rate is automatically set to the highest Slave Transmit Rate selected.

Both Radios will ramp up modulation to the **fastest** Slave Transmit Rate selected and remain at that speed as long as the signal levels and link quality allow.

If the RF environment, or RSSI levels do not allow the fastest selected modulation to be used, the Radio's will back down accordingly.

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How to convert an Ethernet Radio to Serial

How to convert an Ethernet Radio such as a Xeta9-E, Xeta9x9-E or Xeta9x-E (Emancipator +) to operate as a [Serial](#) only Radio.

Change RF Protocol from Ethernet to Serial

Protocol	Serial
Serial Framing	Serial
	Ethernet

Set the Serial Framing

Protocol	Serial
Serial Framing	Byte Mode
	Byte Mode
	Message Mode
	Seamless Byte
	Seamless Message

Byte Mode will transmit Serial Data from the buffer on **every** RF Transmission Slot, as Bytes.

Message Mode should be used if you are running Modbus or other message oriented Protocol. When set to Message Mode, the Radio waits for a pause in the Serial Data being received on the Serial Port from the End Device, i.e. the Radio waits for the End Device to finish communicating the message before transmitting the message as a whole. If the message cannot be transmitted as a whole, the Slave Radio will break it up between transmissions and the Master will reassemble upon demodulation.

Seamless Byte Mode is the same as Byte Mode but should only be used when talking to an Ethernet Master configured for Seamless. When selected you will be required to enter the Seamless Group ID.

Seamless Message Mode is the same as Message Mode but should only be used when talking to an Ethernet Master configured for Seamless. When selected you will be required to enter the Seamless Group ID.

Bind a Serial Port to the Radio

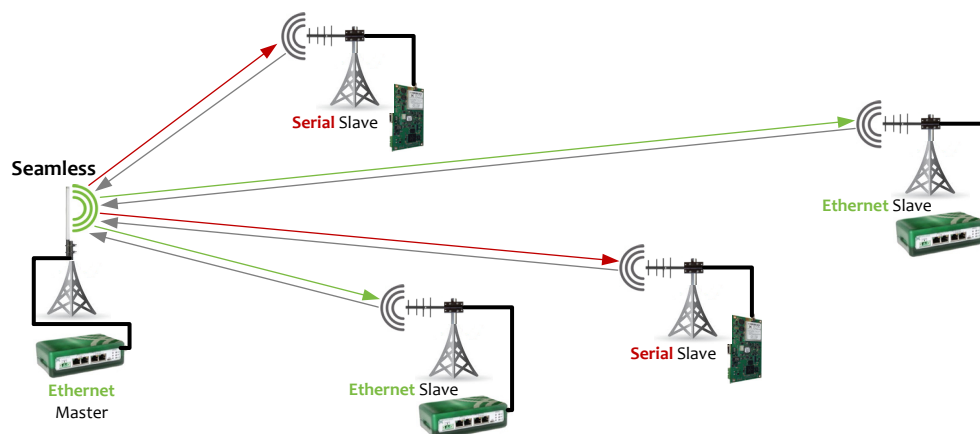
Port	Binding	Interface	Baud Rate	Data	Parity	Stop	Flow Control	Line Delays
Serial 1	<input checked="" type="radio"/> TS/TC/Seamless <input type="radio"/> Radio 1 <input type="radio"/> Radio 2	<input checked="" type="radio"/> RS232 <input type="radio"/> RS422 <input type="radio"/> RS485	115200	<input checked="" type="radio"/> 8 bits <input type="radio"/> 7 bits	<input type="radio"/> Even <input type="radio"/> Odd <input checked="" type="radio"/> None	<input checked="" type="radio"/> 1 <input type="radio"/> 1.5 <input type="radio"/> 2	<input type="radio"/> RTS/CTS <input type="radio"/> XON/XOFF <input checked="" type="radio"/> NONE	Turn on 40 bits Turn off 10 bits

The final part of converting an Ethernet Radio to Serial is to bind one of the Serial Ports to the Radio. This allows the Serial Data received on the Serial Port to be sent directly to the Radio and vice versa.

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How to set up a Seamless Serial Network

How to set up a mixture of Serial and Ethernet Slaves to communicate with an Ethernet Master.



Configure the Ethernet Master

Enclosed Radios have two Seamless Servers that can be independently configured. The board level Emancipator+ has only one Seamless Server.

The Master Radio should be set to the **Ethernet** Protocol because the Master will be communicating with Ethernet Slaves as well as Serial Slaves.

Protocol Ethernet

The Master should also be configured to allow the Ethernet Polling Host to connect via IP Address and Seamless Port number in the same way as a Terminal Server.

On the Serial Communications Page, the Seamless Server should be enabled and given a TCP Port Number such as the default 4324.

The Seamless Network should also be selected for the Radio Module where Seamless communications are required; for a Xeta9-E or Emancipator + this would be Radio 1. The Group number should match the TCP Port Number; 4324.

Seamless A <input checked="" type="checkbox"/> Enable terminal server		Seamless network	
<input type="text" value="4324"/>	TCP port number	<input checked="" type="checkbox"/> Radio 1	
<input type="text" value="120"/>	Idle timeout (seconds)	<input type="checkbox"/> Radio 2	
		<input type="checkbox"/> Serial 1	
		<input type="checkbox"/> Serial 2	
		<input type="text" value="4324"/>	Group number

The Serial Port Binding on the Ethernet Master should be set to TS/TC/Seamless.

Port	Binding	Interface	Baud Rate	Data	Parity	Stop	Flow Control	Line Delays
Serial 1	<input checked="" type="radio"/> TS/TC/Seamless	<input checked="" type="radio"/> RS232	115200	<input checked="" type="radio"/> 8 bits	<input type="radio"/> Even	<input checked="" type="radio"/> 1	<input type="radio"/> RTS/CTS	Turn on 40 bits
	<input type="radio"/> Radio 1	<input type="radio"/> RS422		<input type="radio"/> 7 bits	<input type="radio"/> Odd	<input type="radio"/> 1.5	<input type="radio"/> XON/XOFF	Turn off 10 bits
	<input type="radio"/> Radio 2	<input type="radio"/> RS485			<input checked="" type="radio"/> None	<input type="radio"/> 2	<input checked="" type="radio"/> NONE	

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Configure the Serial Slave

A Serial Slave that is required to connect to an Ethernet Master must be configured with the correct RF Transmission Settings to connect to the Master as previously mentioned in the [How to Set up a PTMP Network](#) section.

The only difference is the **Protocol** and **Serial Framing**, which should be set up to use either Seamless Byte or Seamless Message Mode. The Seamless Group ID number should also be entered.

For an Emancipator- (dedicated Serial Radio) the menu system is accessed from the Diagnostic Port using a Terminal Emulator such as TeraTerm, puTTY or Hyperterminal connected at 115200 8N1.

From the Operating Menu, enter the Configuration Menu “0”;

```

                                Operating Menu
Xeta9m-T rev 0, firmware 1.36.5251, SN E5012753
Mode: multipoint Slave (10002) to Master (1000)

Frequency      916700000 Hz
Xmit mode      8PSK 2651 kbps
Recv mode      8PSK 2651 kbps
Fwd power      0 mW
Rev power      0 mW
Supply         2676 mV
Amp temp       29 C
Board temp     30 C
Link state     up
RSSI           -62 dBm
Att level      1
Xmit rate      0.0 kbps
Recv rate      0.0 kbps
Cur success   0.00%
Avg success    42.24%
```

```

0 : Enter configuration menu
1 : Update radio status
2 : Reset all statistics
3 : Enable or disable automatic status updates
```

Enter selection:

From the Main Configuration Menu, enter the Serial Port Configuration Menu “0”;

```

                                Main Configuration Menu
Xeta9m-T rev 0, firmware 1.36.5251, SN E5012753
Mode: multipoint Slave (10002) to Master (1000)

0 : Serial port configuration menu
1 : RF and hopping menu
2 : Bit rate and modulation type menu
3 : Network menu
4 : Advanced menu
5 : Utilities menu
Esc: Return to previous menu
```

Enter selection: _

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From the Serial Port Configuration Menu, access the Seamless Group by typing “9”;

Serial Port Configuration Menu

```

0 : Data serial bit rate          921600 bps
1 : Data serial framing          8N1
2 : Data serial protocol         Raw
3 : Baud clock multiplier        0
4 : Data serial flow control     Enabled
5 : Serial message delay        30 bits
6 : Data serial interface        RS-232
7 : Delay after RS485 drivers on 40 bits
8 : Delay before RS485 drivers off 10 bits
9 : Seamless group               4324
Diagnostic serial bit rate       115200 bps
Esc: Return to previous menu

```

Enter selection:

Enter the Seamless Group ID and press **Enter**;

Seamless Group

This parameter specifies the group to which this radio belongs, for use when seamless serial protocol is enabled.

Current value = 4324

Enter new value (0 - 65535) or Esc to exit:

Press **Esc** to return to the Serial Port Configuration Menu.

From the Serial Port Configuration Menu, access Data Serial Protocol “2”;

Serial Port Configuration Menu

```

0 : Data serial bit rate          921600 bps
1 : Data serial framing          8N1
2 : Data serial protocol         Raw
3 : Baud clock multiplier        0
4 : Data serial flow control     Enabled
5 : Serial message delay        30 bits
6 : Data serial interface        RS-232
7 : Delay after RS485 drivers on 40 bits
8 : Delay before RS485 drivers off 10 bits
9 : Seamless group               4324
Diagnostic serial bit rate       115200 bps
Esc: Return to previous menu

```

Enter selection:

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Set the Data Serial Protocol to either **Seamless Serial Raw** (Seamless Byte Mode) or **Seamless Serial Message** (Seamless Message Mode);

Data Serial Protocol

This parameter specifies the protocol to use for serial port data.

- Raw serial protocol transmits all serial data received, with no framing.
- Ethernet frame protocol expects Ethernet frames with headers inserted by the Xetawave Ethernet card, and breaks them into fragments for transmission.
- Serial message protocol uses pauses in the serial data stream to detect and indicate message boundaries, improving performance of message-oriented protocols such as Modbus or DNP3.
- Seamless serial protocol allows serial slave radios to coexist in a network with Ethernet master and slave radios.

Current selection: Seamless raw

```

0 : Raw serial
1 : Ethernet frames
2 : Serial message
3 : Seamless serial raw
4 : Seamless serial message
Esc: Return to previous menu

```

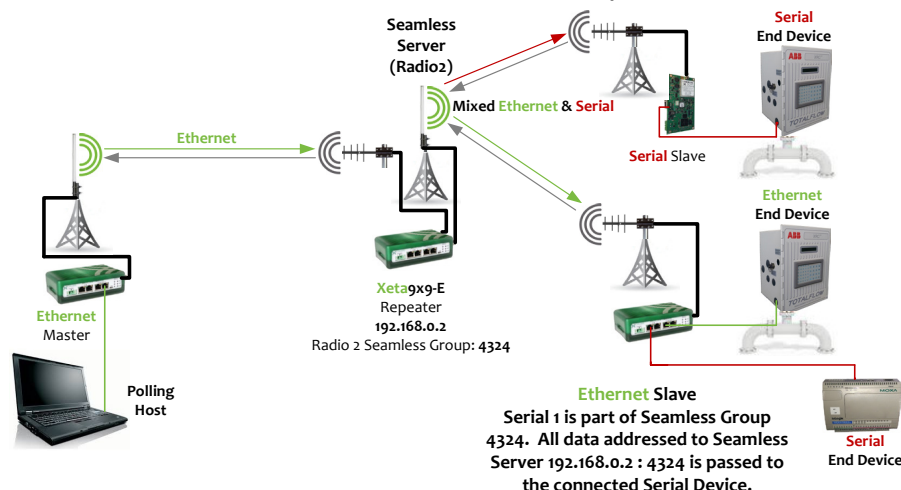
Enter selection:

Seamless Byte Mode will transmit Serial Data from the Slave's buffer on **every** RF Transmission Slot to the Ethernet Master Seamless Server.

Seamless Message Mode should be used if you are running Modbus or other message oriented Protocol. When set to Message Mode, the Radio waits for a pause in the Serial Data being received on the Serial Port from the End Device, i.e. the Radio waits for the End Device to finish communicating the message before transmitting the message as a whole. If the message cannot be transmitted as a whole, the Slave Radio will break it up between transmissions and the Master will reassemble upon demodulation.

Including Ethernet Radio Serial Ports within a Seamless Network

With a mixture of Ethernet and dedicated Serial Slaves, it's also possible to include the Serial Port of an Ethernet Slave into the Seamless Group.



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This allows the Polling Host to connect to the Seamless Server at the upstream Master/Repeater and poll the Serial Devices connected to both Serial and Ethernet Slaves. This has no effect on the addressability of Ethernet Slaves and any connected Ethernet End Devices.

To configure this feature on the Ethernet Slave, navigate to **Serial Communications** and;

- Ensure the Serial Port Terminal Server is disabled/deselected.
- Ensure the Seamless Server is disabled/deselected.
- Enable Radio & Serial 1 in the Seamless Network and enter the Seamless Group Number; *enabling the Serial Port allows data to pass from Radio to Serial Port, and enabling the Radio allows data to pass from Serial Port to Radio.*
- Set the Serial Port Binding to TS/TC/Seamless, set the Baud Rate and Save Changes.

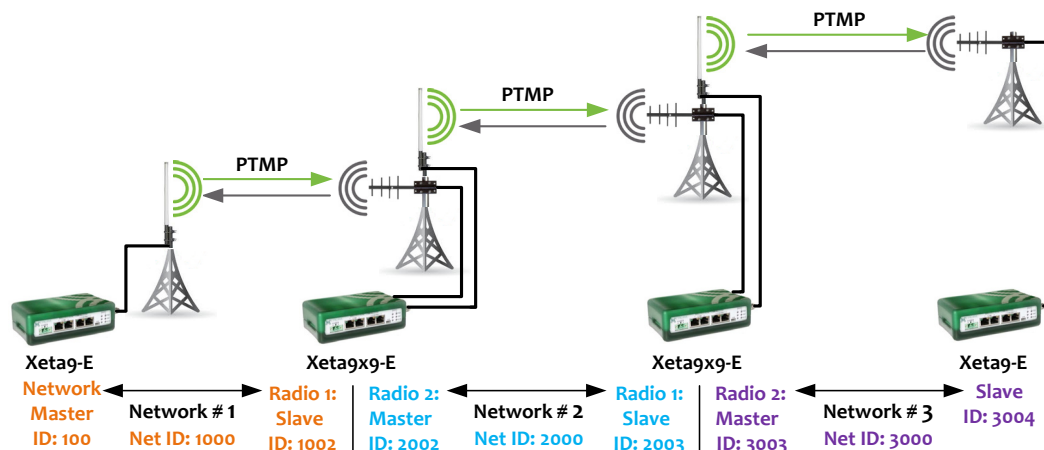
Terminal Server Configuration			
Port	Terminal Server	Terminal Client	Other
Serial 1	<input type="checkbox"/> Enable terminal server 4320 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4320 TCP port number 192.168.0.4 IP address 120 Idle timeout (seconds)	Trigger thresholds 512 Buffer input (bytes) 2 Idle time (characters)
Serial 2	<input checked="" type="checkbox"/> Enable terminal server 4321 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4321 TCP port number 192.168.0.5 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)
Radio	<input checked="" type="checkbox"/> Enable terminal server 4322 TCP port number 120 Idle timeout (seconds)	<input type="checkbox"/> Enable terminal client 4322 TCP port number 192.168.0.6 IP address 120 Idle timeout (seconds)	Trigger thresholds 1024 Buffer input (bytes) 2 Idle time (characters)
Seamless A	<input type="checkbox"/> Enable terminal server 4324 TCP port number 120 Idle timeout (seconds)	Seamless network <input checked="" type="checkbox"/> Radio <input checked="" type="checkbox"/> Serial 1 <input type="checkbox"/> Serial 2 4324 Group number	
Seamless B	<input type="checkbox"/> Enable terminal server 4325 TCP port number 120 Idle timeout (seconds)	Seamless network <input type="checkbox"/> Radio <input type="checkbox"/> Serial 1 <input type="checkbox"/> Serial 2 4325 Group number	

Local Serial Ports								
Port	Binding	Interface	Baud Rate	Data	Parity	Stop	Flow Control	Line Delays
Serial 1	<input checked="" type="radio"/> TS/TC/Seamless <input type="radio"/> Radio	<input checked="" type="radio"/> RS232 <input type="radio"/> RS422 <input type="radio"/> RS485	115200	<input checked="" type="radio"/> 8 bits <input type="radio"/> 7 bits	<input type="radio"/> Even <input type="radio"/> Odd <input checked="" type="radio"/> None	<input checked="" type="radio"/> 1 <input type="radio"/> 1.5 <input type="radio"/> 2	<input type="radio"/> RTS/CTS <input type="radio"/> XON/XOFF <input checked="" type="radio"/> NONE	Turn on 40 bits Turn off 10 bits
Serial 2	<input checked="" type="radio"/> TS/TC/Seamless <input type="radio"/> Radio	<input checked="" type="radio"/> RS232 <input type="radio"/> RS422 <input type="radio"/> RS485	115200	<input checked="" type="radio"/> 8 bits <input type="radio"/> 7 bits	<input type="radio"/> Even <input type="radio"/> Odd <input checked="" type="radio"/> None	<input checked="" type="radio"/> 1 <input type="radio"/> 1.5 <input type="radio"/> 2	<input type="radio"/> RTS/CTS <input type="radio"/> XON/XOFF <input checked="" type="radio"/> NONE	Turn on 40 bits Turn off 10 bits

User Manual; Xeta9 Ethernet Bridge

How to set up MMS

How to configure MMS in a PTMP system containing several Xeta9x9-E's; i.e. multiple Masters.



Remember, MMS is a timing feature that **requires the following parameters to be identical within ALL radios in the MMS Network**. This ensures that ALL radios in the network Transmit & Receive at precisely the same time, but on different frequencies/channels in the hop table;

- Frequency Band and Excluded Frequencies
- Hop Pattern (2 is recommended for MMS)
- Master Transmit Rate
- Slave Transmit Rate(s)
- Max Payload Bytes; Master **and** Slave
- Network Type*; PTP **or** PTMP.
- Network Radius
- Protocol; Ethernet **or** Serial

* Note: it's **not** possible to mix PTP links and PTMP Networks in a MMS configuration.

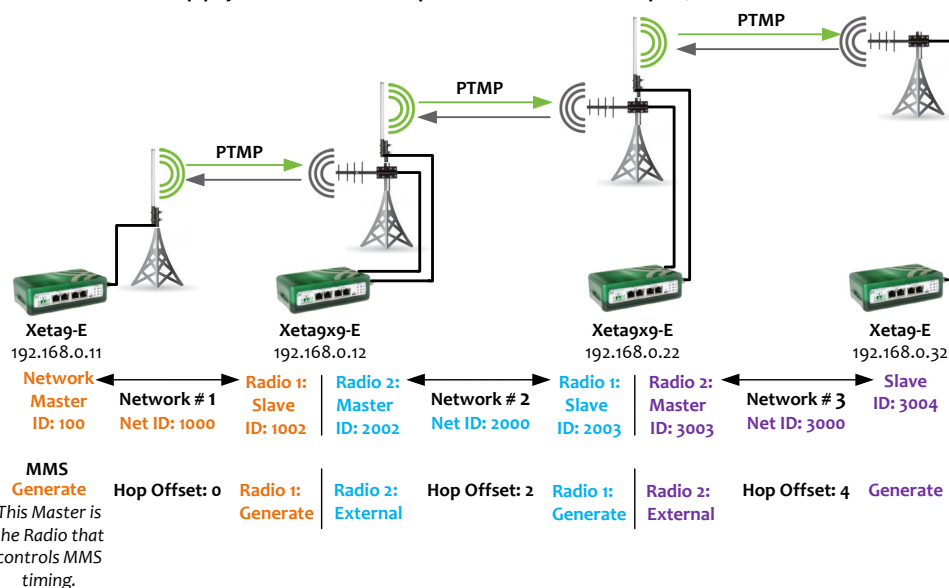
Timing can be triggered in three ways;

1. A timing signal can be generated by the Network Master and propagated across the RF links to other radios.
2. A 1PPS signal from a GPS receiver can be connected to the Network Master and propagated across the RF links.
3. A GPS receiver can be installed at every Master location to independently synchronize transmissions through multiple 1PPS sources.

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Configure the PTMP Network Segments

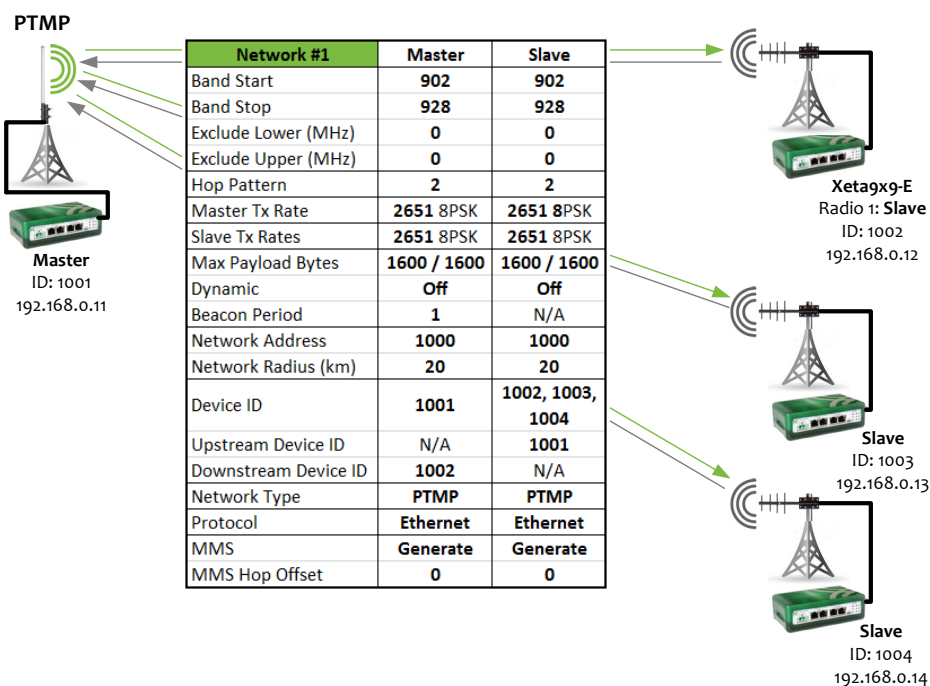
Configure all Radios in each [PTMP Network Segment](#) (1 x Master + multiple Slaves) with [identical](#) RF Transmission Settings. Give each Network Segment different Network ID's, Device ID's and apply a different Hop Offset. For example;



Network #1

The following Network Diagram and Link Table illustrate the settings required for each radio to set up the first Network Segment in the MMS System above.

Note: the Master is set to Generate, the Slaves are set to Generate and the Hop Offset is 0.

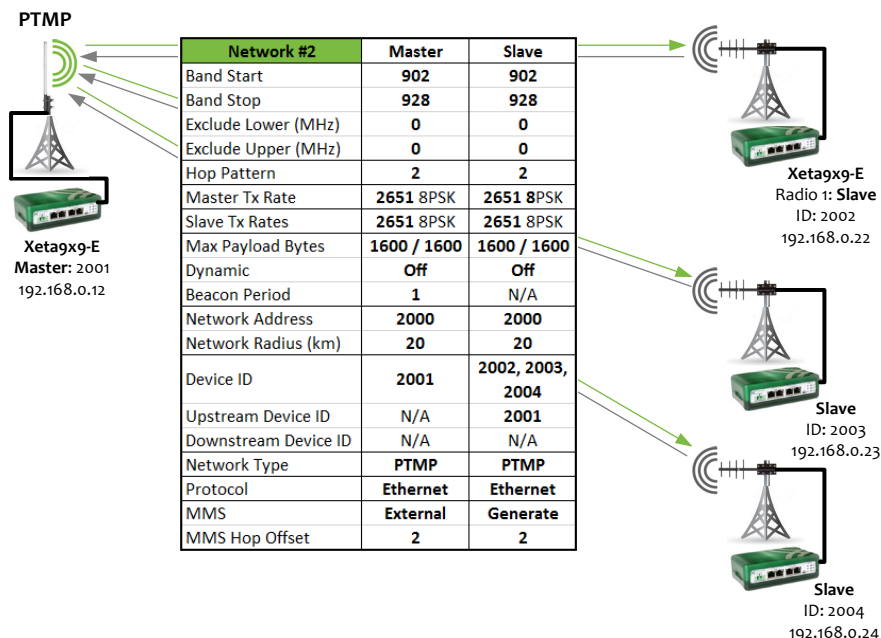


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Network #2

The following Network Diagram and Link Table illustrate the settings required for each radio to set up the second Network Segment in the MMS System.

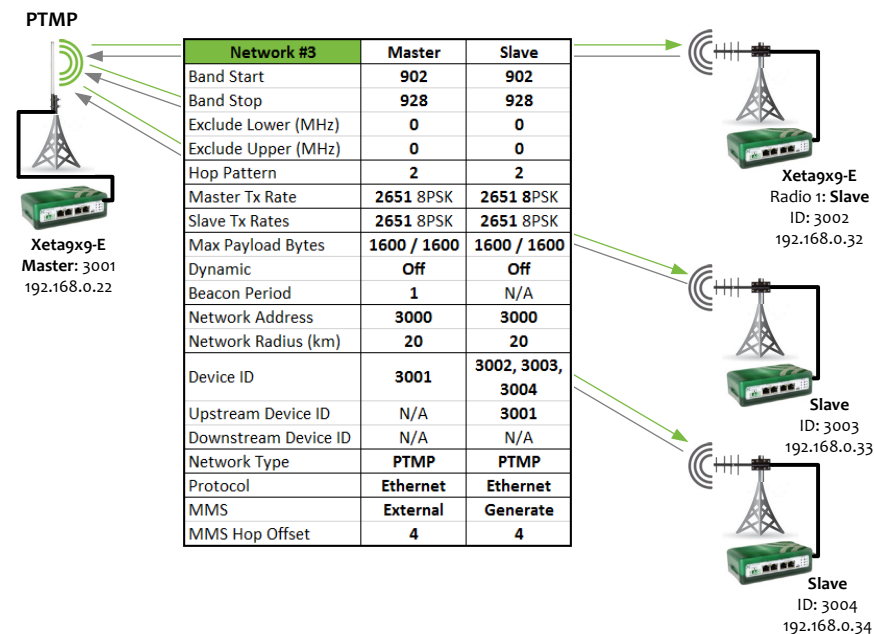
Note: the Master is set to External, the Slaves are set to Generate and the Hop Offset is 2.



Network #3

The following Network Diagram and Link Table illustrate the settings required for each radio to set up the third Network Segment in the MMS System.

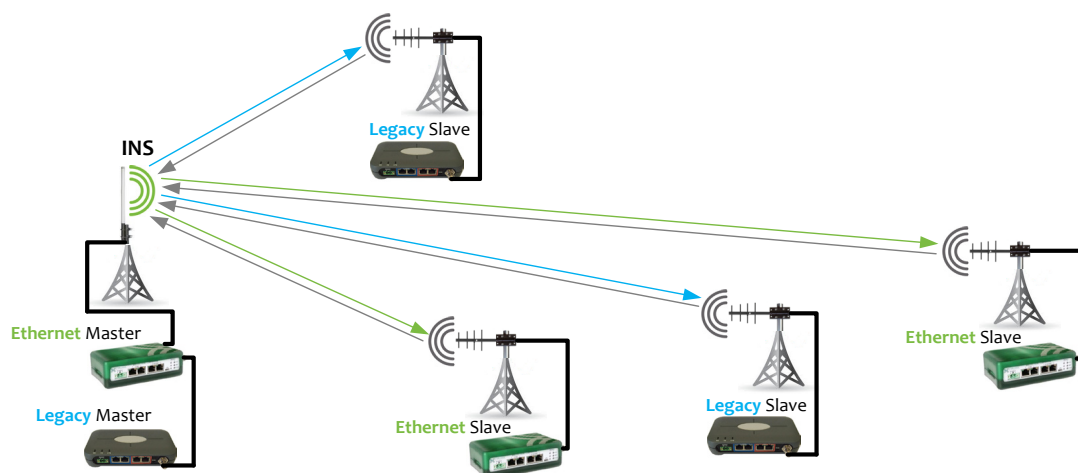
Note: the Master is set to External, the Slaves are set to Generate and the Hop Offset is 2.



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How to set up INS

How to correctly implement INS with the assistance of XetaWave Customer Support.

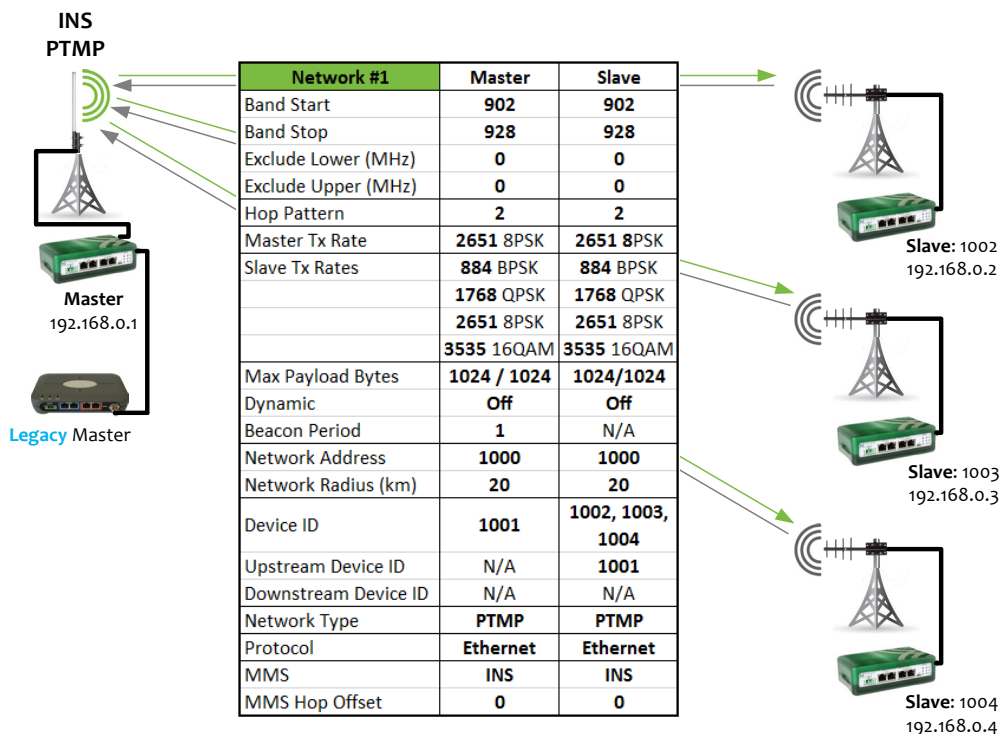


INS Calibration

Please engage support@xetawave.com for assistance with the calibration procedure as this requires special access to the INS Master Radio to obtain the correct period and width values.

Configure PTMP XetaWave Network

The XetaWave Radios that will be deployed into an INS system should first be configured for a PTMP Network.



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Configure Master for INS

Once the INS period and width values have been obtained, the process for activating INS on the Master is to select **INS** from the MMS drop down list and then enter the INS period and width in the INS fields as shown below.

Max Payload Bytes	Master 1600	Slave 1600	Dynamic Off	MMS	INS
Beacon Period	1			MMS Hop Offset	None
Network Address	1000	Network Radius 3	km	Master Repeat	External
Upstream Device ID	1001			Slave Retries 10	Generate
Downstream Device ID	1001				INS
Network Type	Point to Multipoint	Mode Master		Serial Number: E5011CAF	
Device ID	1001			Firmware Version: 1.37.6530	
Protocol	Ethernet			<input type="button" value="Modify Radio Settings"/> <input type="button" value="Refresh All"/> <input type="button" value="Refresh Single"/> <input type="button" value="Scan"/>	
				Diag Threshold -80 dBm	

INS Period	10972228	INS Width	5486114
------------	----------	-----------	---------

Configure Slaves for INS

Once the INS period and width values have been obtained, the process for activating INS on the Master is to select **INS** from the MMS drop down list and then enter the INS period and width in the INS fields as shown below.

Max Payload Bytes	Master 1600	Slave 1600	Dynamic Off	MMS	INS
Beacon Period	1			MMS Hop Offset	None
Network Address	1000	Network Radius 10	km	Master Repeat	External
Upstream Device ID	1001			Slave Retries 10	Generate
Downstream Device ID	1002				INS
Network Type	Point to Multipoint	Mode Slave		Serial Number: E50125B3	
Device ID	1002			Firmware Version: 1.37.6236	
Protocol	Ethernet			<input type="button" value="Modify Radio Settings"/> <input type="button" value="Refresh All"/> <input type="button" value="Refresh Single"/> <input type="button" value="Scan"/>	
				Diag Threshold -80 dBm	

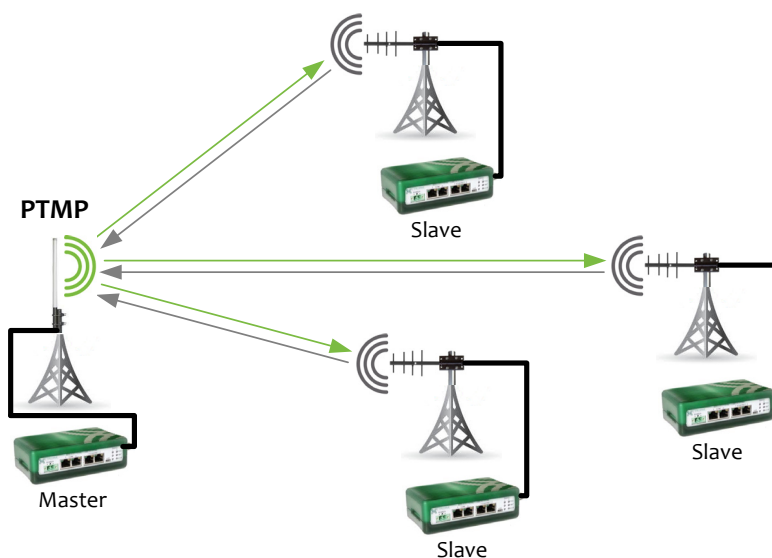
INS Period	10972228	INS Width	5486114
------------	----------	-----------	---------

User Manual; Xeta9 Ethernet Bridge

How to tune the RSSI

As previously discussed in this manual, RF is more problematic at higher [RSSI levels](#) so tuning of the system by strategically reducing transmit power may be necessary.

Links should be looked at individually; in a PTMP Network the Transmit Power of each and every remote Slave can be tuned individually. The Master's Transmit Power should be tuned to the furthest or weakest link.



At the Master location, use the RF Ping Tool to test each link by entering the Slave ID of each remote and clicking Ping. Record the Remote and Local Signal and Noise levels.

RF Ping

Radio 1

Radio 2

4000

(Device ID)

Start

TimeStamp	Remote Signal	Remote Noise	Local Signal	Local Noise
48995	-73	-109	-78	-110
48996	-89	-108	-71	-104
48998	-81	-110	-86	-112
48999	-74	-108	-77	-106

Note: If both the Master and Slave Radios have the same Tx power level, the gains in the system are the same and the link should be fairly well balanced; i.e. have near symmetrical RSSI.

Caution

Signal levels should meet the [Minimum SNR](#) for the fastest modulation you have selected, therefore Noise levels should be factored in to the tuning process.

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Tune the Longest Link First

For the longest/weakest link, reduce the Transmit Power of the Slave until the RSSI at the Master is sufficiently reduced to meet the Minimum SNR for the fastest modulation selected.

Use the RF Ping tool to check the RSSI levels as this provides specific measurements at both ends of each link and not a combined average.

Set the Masters Transmit Power level so that the Slave RSSI on the longest/weakest link meets the Minimum SNR for the fastest modulation selected.

Work Your Way Back

For all other Slave Radios reduce the Transmit Power until the RSSI at the Master is sufficiently reduced to meet the Minimum SNR for the fastest modulation selected.

Use the RF Ping tool to check the RSSI levels as this provides specific measurements at both ends of each link and not a combined average.

Once you have adjusted the Transmit Power on all the Slaves you have completed the tuning process.

Converting dBm to mW to dBm

Transmit Power is adjusted in mW and RSSI is reported in dBm.

For every required 3dB reduction in RSSI, the Transmit Power should be divided by 2.

Alternatively,

dBm can be converted to **mW** using this [online calculator](#).

And...

mW can be converted to **dBm** using this [online calculator](#).

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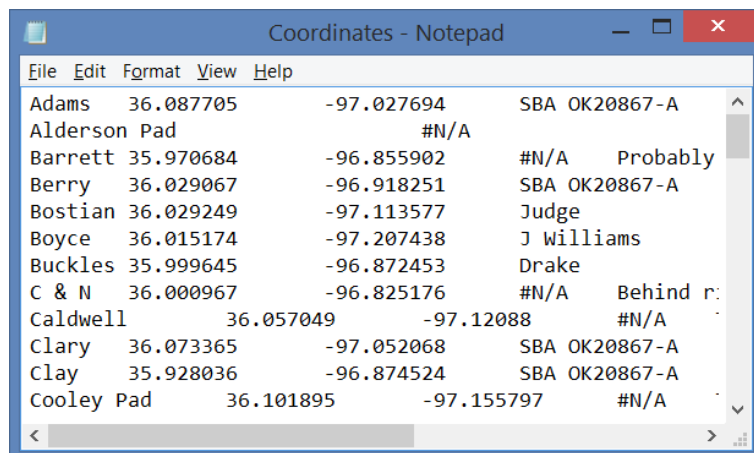
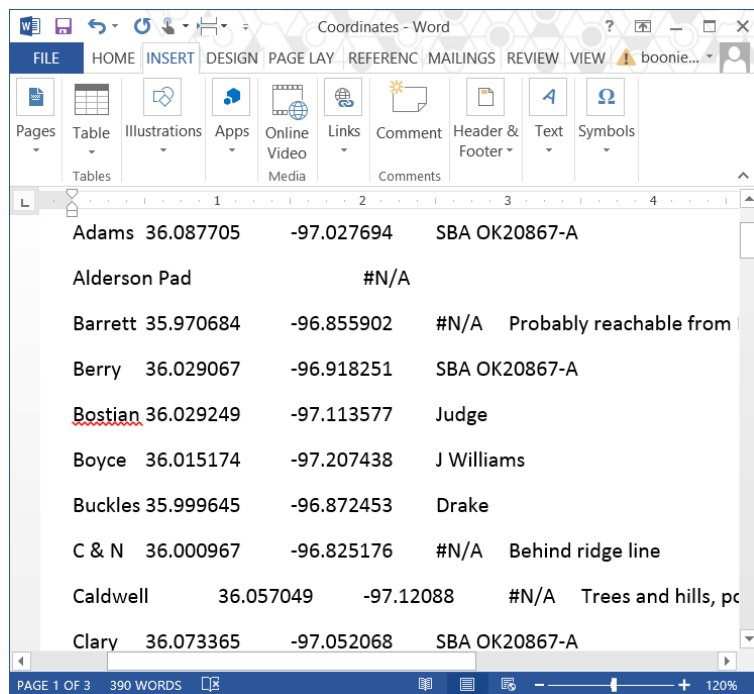
Import sites into Google Earth

This application note shows how to convert a set of site coordinates into a Google Earth KML file for input directly into Google Earth.

Convert Coordinates File to Excel

If the coordinates reside in a Word or Text file you'll need to import them into Excel.

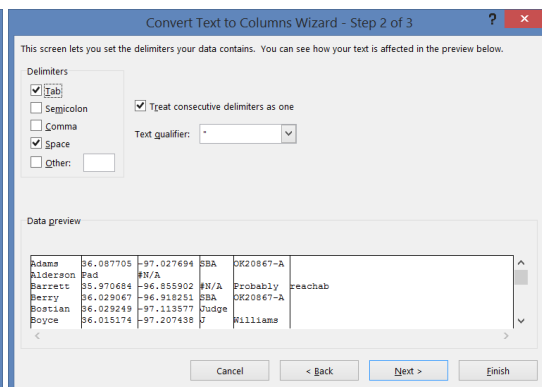
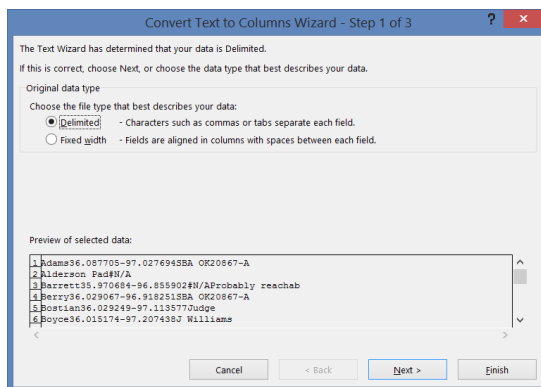
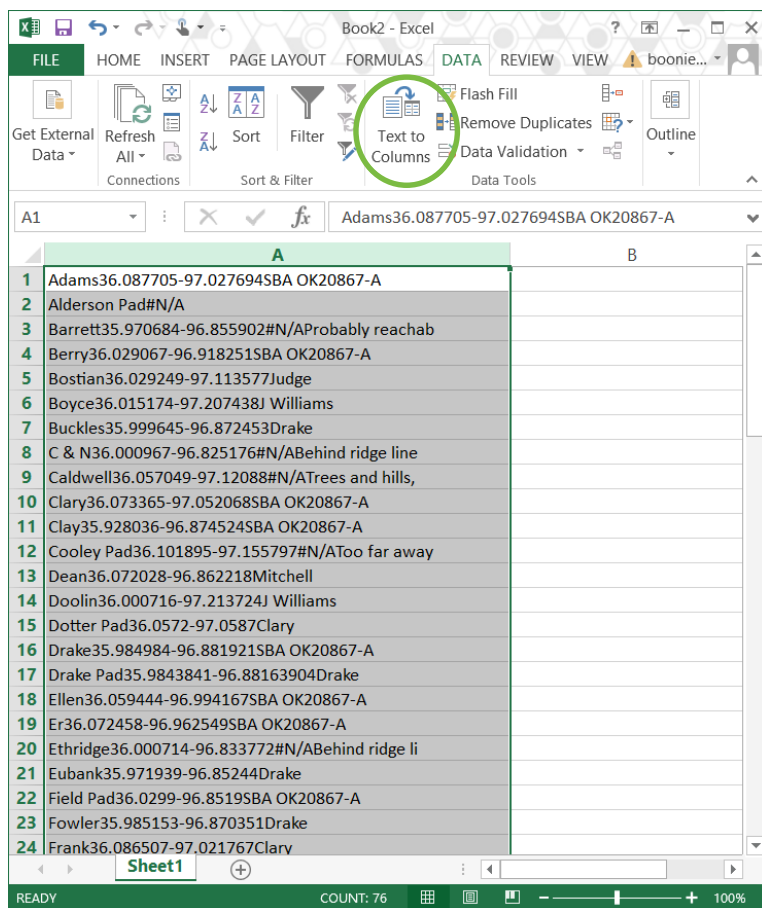
Copy the contents from the Word/Text file and paste into Excel, cell A1.



Alternatively, if importing a Text file you can use the 'Data\From Text' utility and delimit appropriately during the import process.

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Copying the data or not delimiting when importing a text file can leave all the data in Column A. Highlight Column A and use the 'Text to Columns' function on the Data tab to delimit the data and move into separate columns...

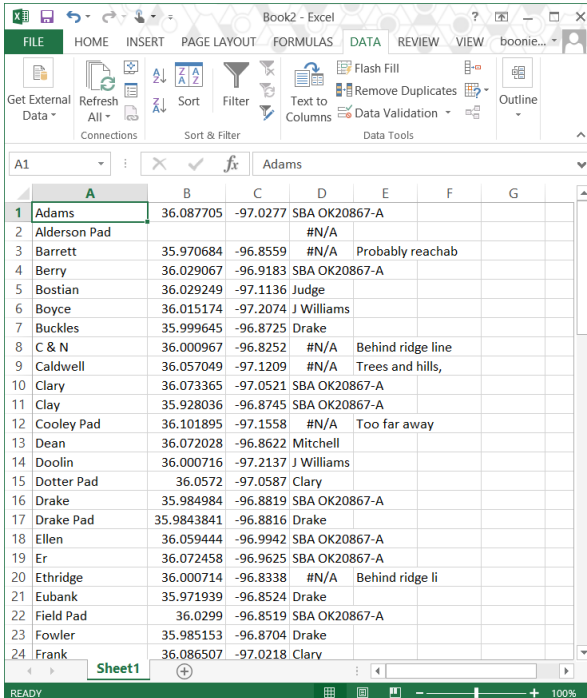


You may need to play with the delimiters to get this right since tab, semicolon, comma and space all have different effects on the data.

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Delimit and Sort Excel File

Once the data has been delimited correctly you should see the data populated in separate columns...



	A	B	C	D	E	F	G
1	Adams	36.087705	-97.0277	SBA OK20867-A			
2	Alderson Pad			#N/A			
3	Barrett	35.970684	-96.8559	#N/A	Probably reachab		
4	Berry	36.029067	-96.9183	SBA OK20867-A			
5	Bostian	36.029249	-97.1136	Judge			
6	Boyce	36.015174	-97.2074	J Williams			
7	Buckles	35.999645	-96.8725	Drake			
8	C & N	36.000967	-96.8252	#N/A	Behind ridge line		
9	Caldwell	36.057049	-97.1209	#N/A	Trees and hills,		
10	Clary	36.073365	-97.0521	SBA OK20867-A			
11	Clay	35.928036	-96.8745	SBA OK20867-A			
12	Cooley Pad	36.101895	-97.1558	#N/A	Too far away		
13	Dean	36.072028	-96.8622	Mitchell			
14	Doolin	36.000716	-97.2137	J Williams			
15	Dotter Pad	36.0572	-97.0587	Clary			
16	Drake	35.984984	-96.8819	SBA OK20867-A			
17	Drake Pad	35.9843841	-96.8816	Drake			
18	Ellen	36.059444	-96.9942	SBA OK20867-A			
19	Er	36.072458	-96.9625	SBA OK20867-A			
20	Ethridge	36.000714	-96.8338	#N/A	Behind ridge li		
21	Eubank	35.971939	-96.8524	Drake			
22	Field Pad	36.0299	-96.8519	SBA OK20867-A			
23	Fowler	35.985153	-96.8704	Drake			
24	Frank	36.086507	-97.0218	Clary			

The next step is to title and organize the columns into the following order (you can cut and paste the columns into the correct order)...

Latitude Longitude Name Description Icon

Latitude and **Longitude** can be represented as Decimal Degrees, Decimal Minutes or Decimal Seconds but must have either a negative sign for W or S hemispheres or the hemisphere specifier present.

Name should be the site name as this is what is displayed on Google Earth.

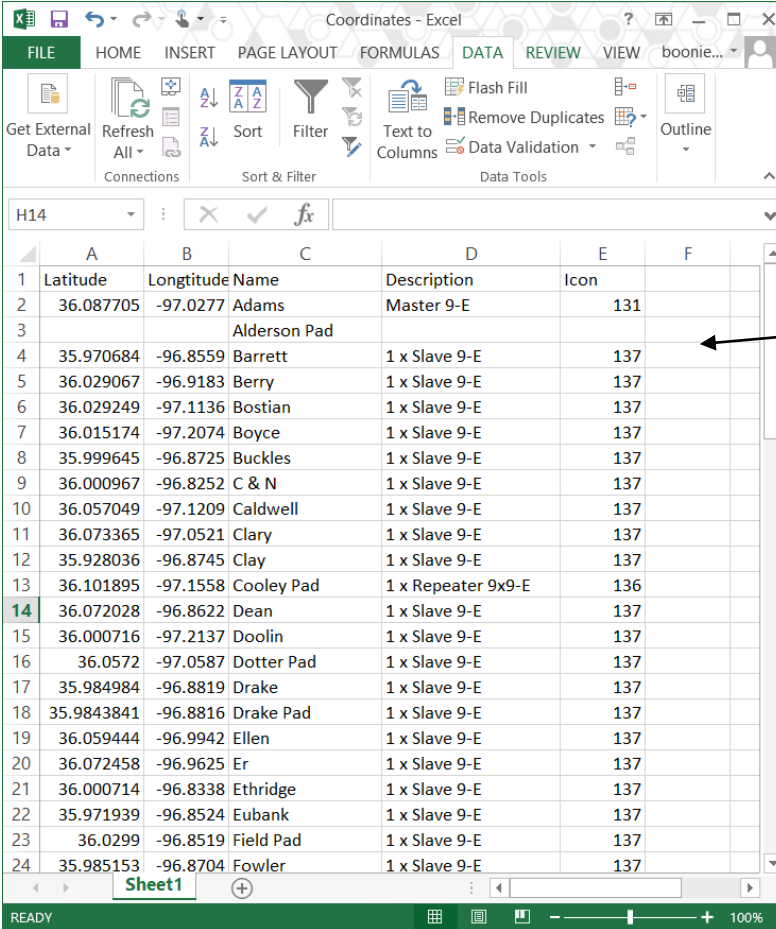
Description can be used to identify the site as a Master, Repeater or Slave and/or what equipment is located there. *Description can be left blank if this information is not known.*

Icon can be anything from [here](#), although it's recommended to use the following radio representations...



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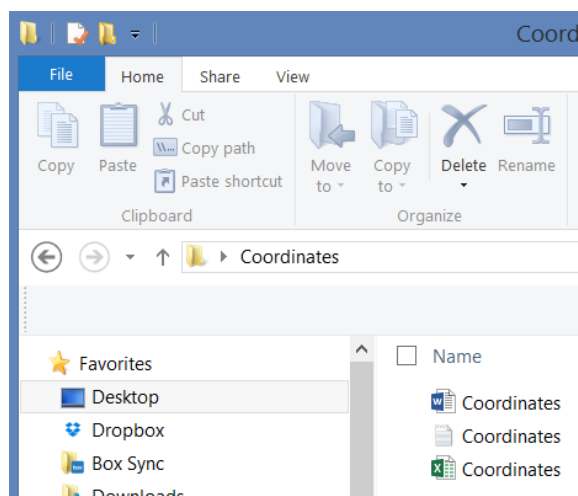
Once you have the information represented in this way it's time to remove any rows that don't have coordinates, save the Excel file and get ready to convert to a Google Earth KML.



	A	B	C	D	E	F
1	Latitude	Longitude	Name	Description	Icon	
2	36.087705	-97.0277	Adams	Master 9-E	131	
3			Alderson Pad			
4	35.970684	-96.8559	Barrett	1 x Slave 9-E	137	
5	36.029067	-96.9183	Berry	1 x Slave 9-E	137	
6	36.029249	-97.1136	Bostian	1 x Slave 9-E	137	
7	36.015174	-97.2074	Boyce	1 x Slave 9-E	137	
8	35.999645	-96.8725	Buckles	1 x Slave 9-E	137	
9	36.000967	-96.8252	C & N	1 x Slave 9-E	137	
10	36.057049	-97.1209	Caldwell	1 x Slave 9-E	137	
11	36.073365	-97.0521	Clary	1 x Slave 9-E	137	
12	35.928036	-96.8745	Clay	1 x Slave 9-E	137	
13	36.101895	-97.1558	Cooley Pad	1 x Repeater 9x9-E	136	
14	36.072028	-96.8622	Dean	1 x Slave 9-E	137	
15	36.000716	-97.2137	Doolin	1 x Slave 9-E	137	
16	36.0572	-97.0587	Dotter Pad	1 x Slave 9-E	137	
17	35.984984	-96.8819	Drake	1 x Slave 9-E	137	
18	35.9843841	-96.8816	Drake Pad	1 x Slave 9-E	137	
19	36.059444	-96.9942	Ellen	1 x Slave 9-E	137	
20	36.072458	-96.9625	Er	1 x Slave 9-E	137	
21	36.000714	-96.8338	Ethridge	1 x Slave 9-E	137	
22	35.971939	-96.8524	Eubank	1 x Slave 9-E	137	
23	36.0299	-96.8519	Field Pad	1 x Slave 9-E	137	
24	35.985153	-96.8704	Fowler	1 x Slave 9-E	137	

Remove rows that don't have coordinates.

Save the Excel file to a location of your choice...



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Convert to Google Earth KML

Open the following URL...

<https://www.earthpoint.us/ExcelToKml.aspx>

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Coordinate Grids

Polygon Area

Convert Coordinates

Batch Convert

USA Utilities

Township & Range

BLM Grid

Search By Description

Search By Lat Long

Alternate Grid

California Twp & Rng

California Grid

Search By Description

Search By Lat Long


Texas Land Survey

Abstract Grid

Search By Description

Search By Lat Long

Excel To KML - Display Excel files on Google Earth.

A user account is recommended for the features on this web page. 

Import a spreadsheet of lat/long coordinates to Google Earth. Pop-up balloons, icons, and paths are easily created from the spreadsheet data.

Latitude and Longitude are all that is needed to create a basic display on Google Earth. Add a Name, Description, and an [Icon](#) for a professional presentation.

Advanced features support [GPS tracks](#), [Time Sliders](#), and [Grid Coordinates](#).

To get started, read the [Quick Start](#) instructions or download the sample data [ExcelToKmlDemo.zip](#).

NEW: AppendDataColumnsToDescription accepts a list of column names.

Select an Excel file (xls,xlsx,xlsm,xlsb,txt, or csv)

[Browse...](#) No file selected.


[View on Google Earth](#)

[View File on Web Page, Check for errors](#)



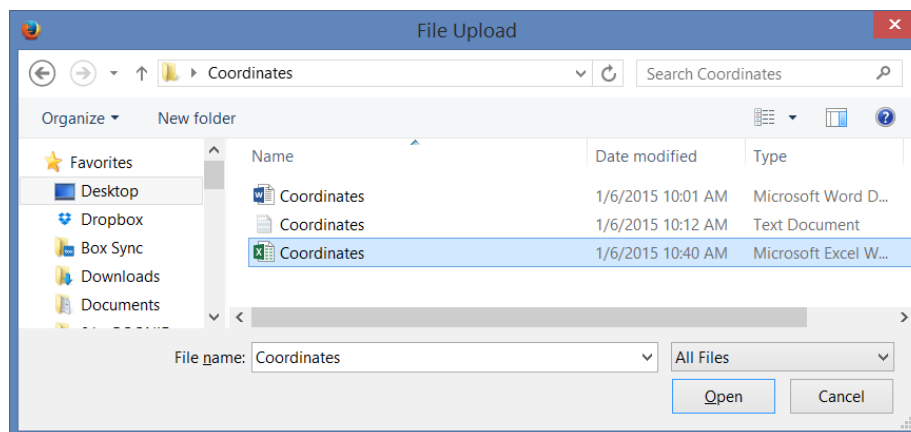
	A	B	C	D	E
1	Latitude	Longitude	Name	Description	Icon
2	43°36'34.86"N	116°12'23.30"W	BAM	Art museum	12
3	43 36 33.22	-116 12 18.40	Roses	Nice garden	111
4	43.608879028	-116.20320277	Zoo	Great visit	186

Sample points plotted onto Google Earth.

 Enhanced feature. [What is this?](#)

Free. User account is not needed.

Click 'Browse' and locate the coordinates file (although it says you can directly import a Text file this is normally problematic, which is why we convert to Excel first)...



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Next, click **View on Google Earth...**

Earth Point

Tools for Google Earth

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Worldwide Utilities

Excel To Google Earth

Coordinate Grids

Polygon Area

Convert Coordinates

Batch Convert

USA Utilities

Township & Range

BLM Grid

Search By Description

Search By Lat Long

Alternate Grid

California Twp & Rng

California Grid

Search By Description

Search By Lat Long


Texas Land Survey

Abstract Grid

Search By Description

Search By Lat Long

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A user account is recommended for the features on this web page. 

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NEW: AppendDataColumnsToDescription accepts a list of column names.

Select an Excel file (xls, xlsx, xlsx, xlsb, txt, or csv)

[Browse...](#) Coordinates.xlsx


View on Google Earth

[View File on Web Page, Check for errors](#)



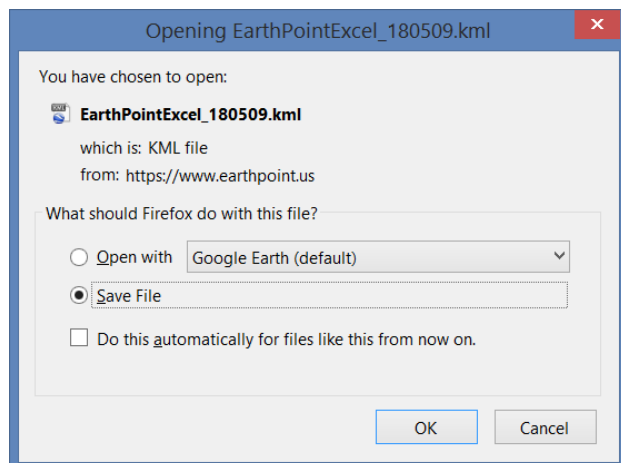
	A	B	C	D	E
1	Latitude	Longitude	Name	Description	Icon
2	43°36'34.86"N	116°12'23.30"W	BAM	Art museum	12
3	43 36 33.22	-116 12 18.40	Roses	Nice garden	111
4	43.608879028	-116.20320277	Zoo	Great visit	186

Sample points plotted onto Google Earth.

 Enhanced feature. [What is this?](#)

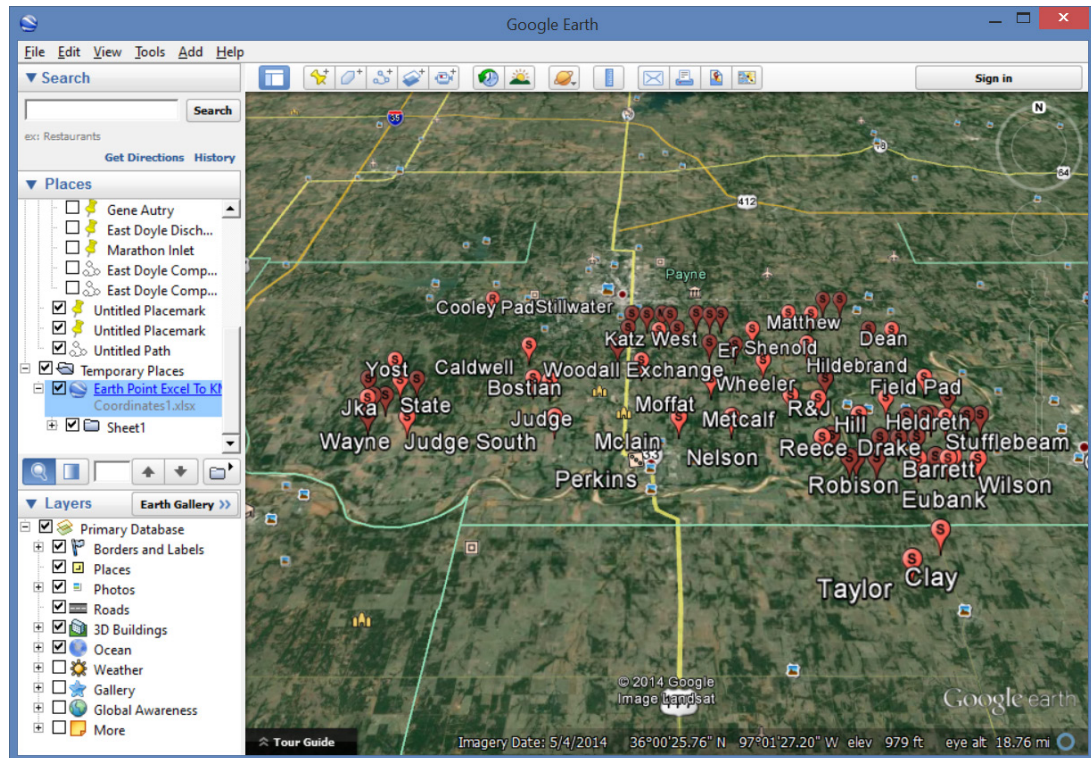
Free. User account is not needed.

Save the file to a location of your choice. You can then rename accordingly and email the file to whoever it may concern...



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Double click the KML file to load the sites into Google Earth...



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Gold Standard Networks

Gold standard networks are those that are installed predictably, perform well over time and recover from unexpected conditions quickly. Our experiences troubleshooting networks taught us to plan, install and troubleshoot networks with the considerations listed below. Follow these steps to build gold standard networks.

Planning

- Understand customer's application and required network throughput.
- Test radios on the bench with desired equipment before first deployment.
- Perform a path study for each link.
- Plan radio settings to achieve desired network throughput with consideration of expected signal strength, RF noise and overlapping networks.'
- Perform a [Site Survey](#) to sample in-band noise levels.
- Prepare equipment list that includes radios, radio accessories, cables, connectors, adapters, antennae, towers/poles, brackets, etc.

Installation

- Use compass to align antennae to magnetic azimuth.
- Properly torque all mechanical connections.
- Apply appropriate weatherproofing material to all exposed RF and electrical connections.
- Measure noise floor with final hardware installed (i.e. antennae, cable) using radio or spectrum analyzer.
- Compare actual received signal strength with expected signal strength from path study.
- Perform throughput test before leaving site.
- Confirm successful customer data test before leaving site.

Troubleshooting

- Obtain customer success/fail statistics.
- Capture radio settings (via screen shot or other).
- Capture radio statistics (via screen shot or other).
- Capture LAN statistics (via screen shot or other).
- Capture terminal server statistics (via screen shot or other).
- Perform noise measurement with radio and/or spectrum analyzer.
- Obtain diagnostic slot capture from master on problematic link.
- Sweep cable and antenna for loss with network analyzer (a.k.a site analyzer, cable and antenna tester).

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Pre-Deployment Tasks

Network Planning

XetaWave highly recommends the use of a Network Planning Tool during the link design process to provide some mathematical insight into expected performance.

There are various [Network Planning Tools](#) on the market, such as...

- [Pathloss](#)
- [Radio Mobile](#)

Caution

Failure to plan links can prevent maximizing link performance during deployment.

Transmission Systems

XetaWave recommends the use of a DC Grounded Transmission System featuring;

- DC Grounded [Antenna](#) from a reputable manufacturer with desired frequency range, gain, beam pattern (coverage) and an input surge impedance of 50 ohms.
- DC Block Surge Suppressor; Polyphaser [TSX-NFF](#) or [IS-B50LN-C2](#).

Losses within the Transmission System

The [decibel](#) is a logarithmic unit with the following net effects on signal loss; - **1dB** loss = **21%** signal loss

- **2dB** loss = **37%** signal loss
- **3dB** loss = **50%** signal loss
- **6dB** loss = **75%** signal loss
- **10dB** loss = **90%** signal loss

When modelling the transmission system in your planning software, such as Pathloss 5 or Radio Mobile, the insertion loss from the connectors & surge suppressor should be combined with the loss from any planned strain relief jumper cables in addition to the loss from the coaxial transmission line.

The following Cable Loss Calculators can be used to calculate the **Cable Loss** for the main transmission line.

- [Times Microwave Cable Loss Calculator](#)
Use the 'Cable Run Attenuation' value, since the connector losses are included in the table below.
- [Belden/Andrew Cable Loss Calculator](#)
Use the 'Matched Loss' value with SWR left at 1:1.

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Calculating Transmission System Loss

Refer to the table to obtain the **Connector & Jumper Loss** for the frequency you intend to use;

Connector & Jumper Losses						
Part	Description	Loss (dB)				
		200 MHz	300 MHz	450 MHz	900 MHz	2.4 GHz
1	TNC Connector (Male)	0.1	0.1	0.1	0.2	0.2
2	3ft/1m LMR240 Jumper	0.1	0.1	0.2	0.2	0.4
3	N-Type Connector (Male)	0.1	0.1	0.1	0.2	0.2
4	Surge Suppressor	<0.1	<0.1	<0.1	<0.1	<0.25
5	N-Type Connector (Male)	0.1	0.1	0.1	0.2	0.2
6	N-Type Connector (Male)	0.1	0.1	0.1	0.2	0.2
Total Loss		0.60	0.60	0.70	1.10	1.45

1. Use an online calculator to calculate the coaxial **Cable Loss** for the length and type of coax you intend to use;


[Times Microwave Cable Loss Calculator](#)

Use the 'Cable Run Attenuation' value, since the connector losses are included in the table below.

[Belden/Andrew Cable Loss Calculator](#)

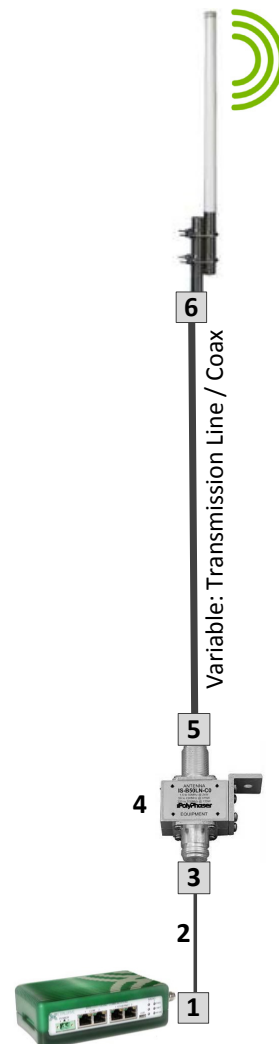
Use the 'Matched Loss' value with SWR left at 1:1.

2. Add the **Connector & Jumper Loss** from Step 1 to the **Cable Loss** from Step 2 to get the **Transmission System Loss**.
3. Enter the **Transmission System Loss** into the setup of your Network Planning Tool.

- For **Radio Mobile**, open Network Properties  and click on the **Systems** tab.

- Enter the **Transmission System Loss** into 'Line Loss (dB)'

Line loss (dB) (Cable+cavities+connectors)




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Path Study Request

XetaWave offers a path study service if planning assistance is required. Our **Path Study Request Form** can be downloaded from our [External Customer Download site](#).

Please contact Support@XetaWave.com to request access.

The **Customer Input** page requests customer & network information, desired speeds, intended antennas and any other comments / instructions / further information that can be provided.

XetaWave, LLC 258 South Taylor Ave Louisville, CO 80027 Tel: 303-447-2745 info@xetawave.com		Path Study Request Form 900MHz Rev03 - 2015-06-22		 XETAUWAVE	
Company Name:					
Address:					
Contact Name:					
Phone:					
Email:					
Installation Location:					
(City/County & State)					
Please select the modulations required by clicking the appropriate check boxes below					
ISM (License Free)			MAS (Licensed)		
<input type="checkbox"/> 3535 kbps 16PSK (-75dBm Sensitivity) <input type="checkbox"/> 3535 kbps 16QAM (-86dBm Sensitivity) <input type="checkbox"/> 2651 kbps 8PSK* (-91dBm Sensitivity) <input type="checkbox"/> 1768 kbps QPSK* (-98dBm Sensitivity) <input type="checkbox"/> 884 kbps BPSK* (-101dBm Sensitivity) <input type="checkbox"/> 663 kbps 2FSK* (-101dBm Sensitivity) <input type="checkbox"/> 229 kbps MSK* (-105dBm Sensitivity) <input type="checkbox"/> 153 kbps MSK* (-108dBm Sensitivity) <input type="checkbox"/> 114 kbps MSK* (-109dBm Sensitivity) <input type="checkbox"/> 57 kbps MSK* (-111dBm Sensitivity)			<u>200kHz Channels</u> <input type="checkbox"/> 884 kbps 32QAM (-??dBm Sensitivity) <input type="checkbox"/> 707 kbps 16QAM (-??dBm Sensitivity) <input type="checkbox"/> 530 kbps 8PSK (-??dBm Sensitivity) <input type="checkbox"/> 354 kbps QPSK (-??dBm Sensitivity) <input type="checkbox"/> 153 kbps MSK (-??dBm Sensitivity) <u>100kHz Channels</u> <input type="checkbox"/> 442 kbps 32QAM (-??dBm Sensitivity) <input type="checkbox"/> 354 kbps 16QAM (-??dBm Sensitivity) <input type="checkbox"/> 265 kbps 8PSK (-??dBm Sensitivity) <input type="checkbox"/> 177 kbps QPSK (-??dBm Sensitivity) <input type="checkbox"/> 76 kbps MSK (-??dBm Sensitivity) <u>50kHz Channels</u> <input type="checkbox"/> 227 kbps 32QAM (-??dBm Sensitivity) <input type="checkbox"/> 182 kbps 16QAM (-??dBm Sensitivity) <input type="checkbox"/> 136 kbps 8PSK (-??dBm Sensitivity) <input type="checkbox"/> 91 kbps QPSK (-??dBm Sensitivity) <input type="checkbox"/> 39 kbps MSK (-??dBm Sensitivity) <u>25kHz Channels</u> <input type="checkbox"/> 112 kbps 32QAM (-88dBm Sensitivity) <input type="checkbox"/> 90 kbps 16QAM (-94dBm Sensitivity) <input type="checkbox"/> 67 kbps 8PSK (-98dBm Sensitivity) <input type="checkbox"/> 45 kbps QPSK (-105dBm Sensitivity) <input type="checkbox"/> 39 kbps 4FSK (-103dBm Sensitivity) <input type="checkbox"/> 19 kbps MSK (-111dBm Sensitivity) <u>12.5 kHz Channels</u> <input type="checkbox"/> 57 kbps 32QAM (-91dBm Sens) <input type="checkbox"/> 45 kbps 16QAM (-97dBm Sensitivity) <input type="checkbox"/> 34 kbps 8PSK (-101dBm Sensitivity) <input type="checkbox"/> 23 kbps QPSK (-108dBm Sensitivity) <input type="checkbox"/> 19 kbps 4FSK (-106dBm Sensitivity) <input type="checkbox"/> 10 kbps MSK (-114dBm Sensitivity)		
* Xeta9x-E "Emancipator +"; ISM only to 2651 kbps 8PSK.					
Antenna Information					
Manufacturer	Model #	Gain (dBi)	Type		
			Omni (O)		
			Yagi (Y)		
			Sector (S)		
			Panel (P)		
Comments / Instructions / Further Information					

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Additionally, this is where the site information should be entered.

Note: Network Master in the top row should be the location of the network Gateway, where access to the network from the Enterprise system/Cloud occurs.

Please enter site information below					
Latitude & Longitude should be entered in one of the following WGS84 Geographical formats...					
1. Deg, Min, Decimal Sec; 39 58 05.71 N		105 07 09.00 W		Hemispheres should be identified as...	
39 58 05.71		-105 07 09.00		1. N, S, E, W	
2. Deg, Decimal Min; 39 58.09524 N		105 07.15002 W		or...	
39 58.09524		-105 07.15002		2. West and South should be negative.	
3. Decimal Deg; 39.968254 N		105.119167 W		Degree, Minute and Second symbols don't matter either way!	
39.968254		-105.119167			
Please note that coordinates in UTM Eastings and Northings cannot be used for Path Studies.					
Sites					
Latitude	Longitude	Antenna		Name	Role
		Height (ft)	Type (O, Y, S, P)		Master or M Repeater or R Slave or S
					Network Master

Note: the form has self-contained instructions to assist users.

Site Survey

A site survey involves using a spectrum analyzer or alternative spectrum tool to check in-band noise levels at the site.

XetaWave considers this an important step when building [Gold Standard Networks](#) since in-band noise levels can be factored into the Network Design.

Other aspects of a site survey include sweeping any existing installed coaxial transmission line, jumpers, surge suppressors and antennas for [Return Loss](#) or [VSWR](#).

Identifying possible causes of interference with co-located systems.