

XetaWave offers high performance software defined radios (SDR) that can replace Teledesign radios and provide significant improvements in performance. These radios can be serial only or they can be Ethernet radios with both Ethernet and serial interfaces. This application note describes replacing Teledesign radios with XetaWave serial radios. Included herein is a short overview of the radio types, point to multipoint and peer to peer networks, and a radio comparison.

### Teledesign Overview

Teledesign radios are simple serial radios offering the transmission and reception of data using GMSK modulation. More recent Teledesign radios, although none are in production today, covered the 100 and 400 MHz bands. These radios support RF data rates up to 19.2 kbps, store-and-forward repeating, transparent operating mode, and the optional packet (AirNet) mode.

**Transparent** – This peer to peer mode is available in all Teledesign radios. All radios within a network will receive a transmission from another radio if it is within LOS. Data that is received over the serial port will immediately be transmitted by the radio if force transmit over receive is enabled else the radio will transmit once receive is finished. Any protocol or message intelligence is left to the host application.

**Packet** – Known as AirNet, this optional mode can be configured for master-slave or CSMA. In packet mode, messages are broadcast so all radios within LOS will receive and send the data out their serial ports or messages can be addressed to one or more radios. When addressed, all radios within LOS will receive but only the radios with a matching address will send the data out their serial port.

**Master-Slave** – Used when the host application is designed so that only one node will ever attempt to transmit at a given time. An example of this type of system is a polled system with a base station that sequentially poles a number of remote nodes. *This mode does not support store-and-forward repeaters.*

**CSMA** – Used when there are multiple radios that could attempt to transmit simultaneously. In CSMA mode, the radios wait until the channel is idle and then attempt to transmit based on a random probability of transmission.

### XetaWave Overview

XetaWave currently offers serial radios that operate in the 100, 200, 400, and 900 MHz frequency bands. Other variants covering the 300, 700, 1300, 1400, and 2400 MHz frequency bands can quickly be made available. All radios are software defined (SDR) and support multiple MSK, PSK, and QAM modulations.

The XetaWave licensed band (100, 200, 400, 900, and 1400 MHz) radios support RF data rates from 10 kbps to 1 Mbps, depending on the frequency band. These radios support point to point, point to multipoint, full-duplex transmit, full-duplex receive, listen before talk, peer to peer, and enhanced

multipoint modes along with a store-and-forward repeater function. Optionally, the 100, 200, 400, and 900 MHz radios also support GE MDS x710 A and B modes.

The XetaWave unlicensed band (300, 900, 1300, and 2400 MHz) radios support RF data rates from 57 kbps to 4.4 Mbps. These radios support point to point, point to multipoint, listen before talk, and peer to peer modes along with a store-and-forward repeater function. The 900, 1300, and 2400 MHz radios also support an optional TDMA mode.

Although the XetaWave radios offer many more modes than the Teledesign radios, this document will focus on modes identical or similar to those supported by the Teledesign radio.

**Point to Multipoint** – A mode where multiple radios, called endpoints, are communicating with just one radio, called gateway. The endpoints do not communicate between themselves.

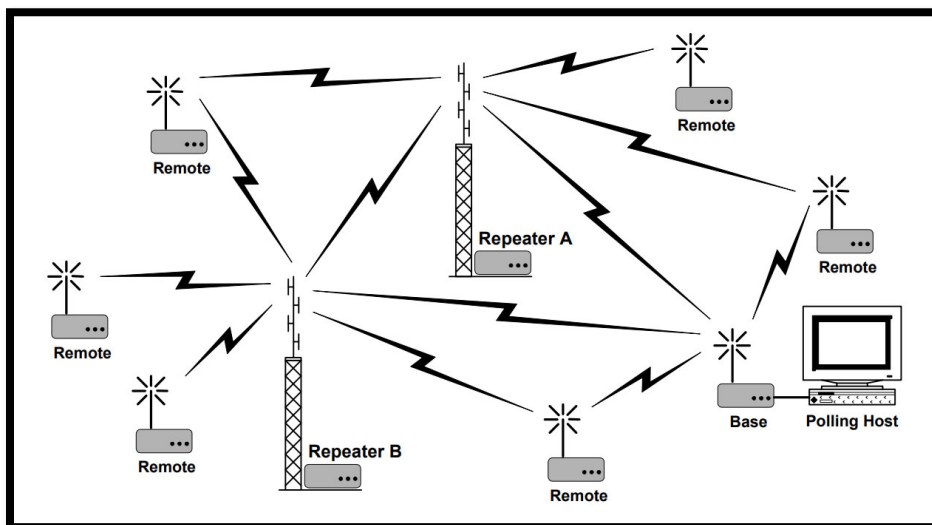
**Peer to Peer** – A mode where all radios within a network that are within LOS can communicate with each other. Prior to transmitting, a radio will make sure the channel is idle. If the channel is not idle, the radio uses a CSMA protocol to attempt to transmit based on a random probability of transmission.

**Listen Before Talk** – A point to multipoint mode in which the radio that wishes to transmit determines that the channel is idle before transmitting.

**Enhanced Multipoint** – A point to multipoint mode in licensed radios with some improvements in the overhead which results in an increase in throughput and a decrease in overall latency.

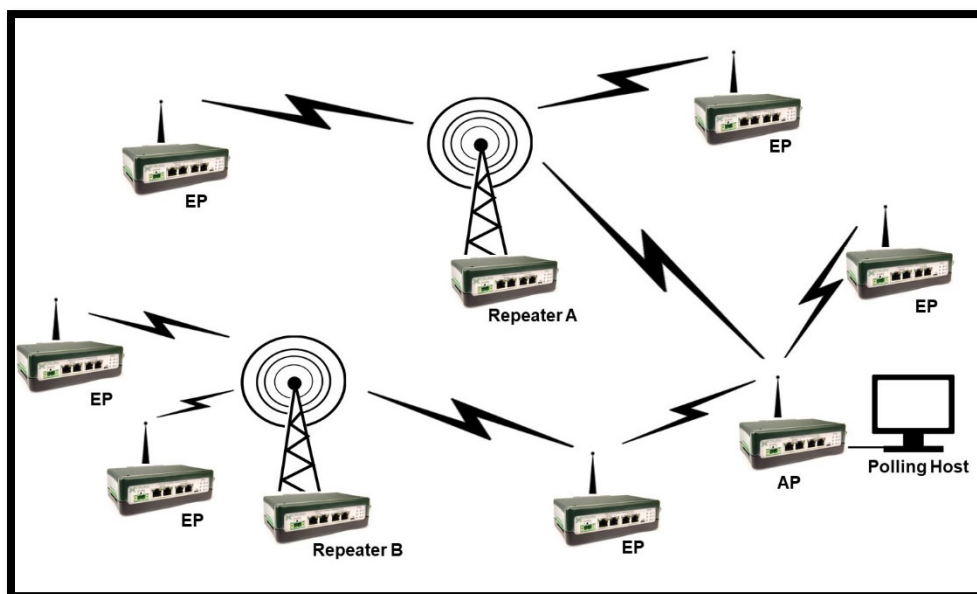
### Point to Multipoint (single hop repeater)

An architecture as illustrated below, whether operating with single, multiple, or no repeaters, in which a single polling host is initiating the transmission of request packets to devices connected to each remote and each device sends a response packet, is considered a point to multipoint network.



#### Dual Repeater Network using Teledesign Radios

The XetaWave point to multipoint or enhanced multipoint mode can be used for this type of network architecture as illustrated in the image below. The primary difference is that when using the Teledesign radio, a transmission from one radio like the base could be received multiple times by a remote radio and vice versa. With the XetaWave point to multipoint or enhanced multipoint mode, the remote radios are configured to communicate directly to a repeater or to an access point (base radio) so transmissions from one radio are only received once at another radio.



#### XetaWave Radios in Point to Multipoint or Enhanced Multipoint Mode with Single Hop Repeaters

This network architecture is supported by a licensed or unlicensed XetaWave serial only or Ethernet radio. The configuration of the radios is simple.

##### Common settings for all radios

- Configure the serial port (baud rate, framing, flow control, etc.)
- Configure the RF (max range, transmit output power, transmit/receive frequency or frequency hopping, forward error correction)
- Configure the RF bit rate and modulation
- Configure the network (type, address, and max payload size. Type should be set to point-to-multipoint or enhanced multipoint. If network uses repeaters, set this to yes)

##### Configure the gateway radio (master)

- Set the operating mode to master
- Set a unique ID for the radio (our device address)

#### Configure the endpoint radios (slaves)

- Set the operating mode to slave
- Set a unique ID for the radio (our device address)
- Set the upstream device address to the master or a repeater

#### Configure the repeater radios (slave repeater)

- Set the operating mode to slave/repeater
- Set a unique ID for the radio (our device address)
- Set the upstream device address to the master

### Point to Multipoint (multi hop repeater)

With licensed radios, there is typically an issue with daisy chaining repeaters. This is usually because the network is assigned one frequency or assigned an uplink frequency and a downlink frequency. If assigned a pair of frequencies, then the XetaWave radios can be configured to support multi hop repeaters. In this scenario, the uplink and downlink frequencies are swapped for every other repeater. So, if you have a network with one access point (AP) and three repeaters, the AP and repeater B will be configured with the same frequency pair while repeaters A and C will have their frequency pair swapped.

#### **XetaWave Radios in Point to Multipoint or Enhanced Multipoint Mode with Multi Hop Repeaters**

This network architecture is supported by a licensed XetaWave serial only or Ethernet radio. The configuration of the radios is simple.

#### Common settings for all radios

- Configure the serial port (baud rate, framing, flow control, etc.)
- Configure the RF (max range, transmit output power, forward error correction)
- Configure the RF bit rate and modulation
- Configure the network (type, address, and max payload size. Type should be set to point-to-multipoint or enhanced multipoint. If network uses repeaters, set this to yes)

#### Configure the gateway radio (master)

- Set the operating mode to master
- Set a unique ID for the radio (our device address)

#### Configure the endpoint radios (slaves)

- Set the operating mode to slave
- Set a unique ID for the radio (our device address)

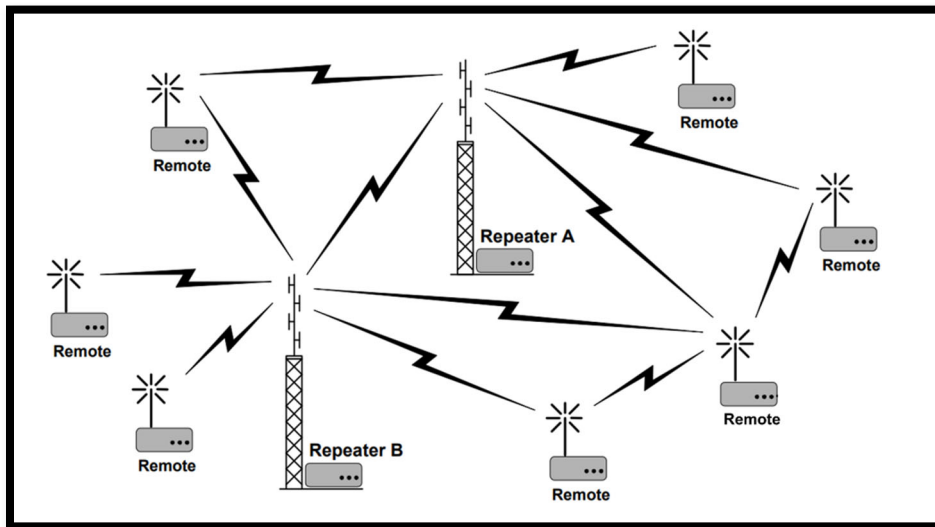
- Set the upstream device address to the master or a repeater

#### Configure the repeater radios (slave repeater)

- Set the operating mode to slave/repeater
- Set a unique ID for the radio (our device address)
- Set the upstream device address to the master

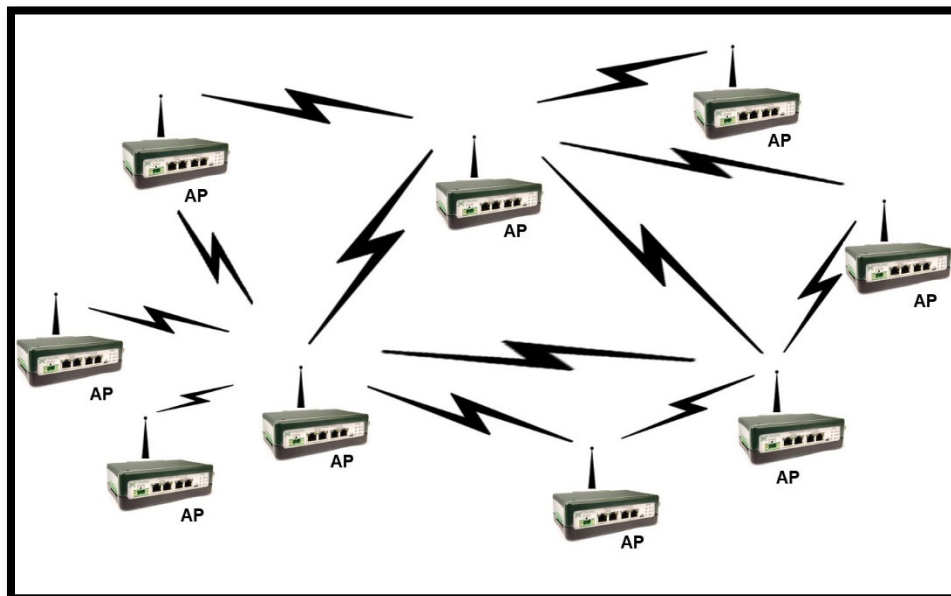
#### Peer to Peer

In a peer to peer networks, all radios in a network that are within line of sight of each other can communicate with each other. This is the fundamental operation of a Teledesign radio. The network architecture using Teledesign radios does not change from that shown in point to multipoint as can be seen in the illustration below.



#### Teledesign Transparent and Packet (AirNet) Architecture

To achieve the same network architecture where all radios within LOS of a transmitting radio will receive the transmission, the XetaWave peer to peer operating mode is used. In peer to peer, all radios basically assume the role of a master and have the same settings except for their unique radio ID. The network architecture with no repeaters is illustrated below.



### XetaWave Peer to Peer Architecture

This network architecture is supported by a licensed XetaWave serial only or Ethernet radio or an unlicensed serial only or Ethernet radio operating in single channel. The configuration of the XetaWave radios is simple.

#### Common settings for all radios

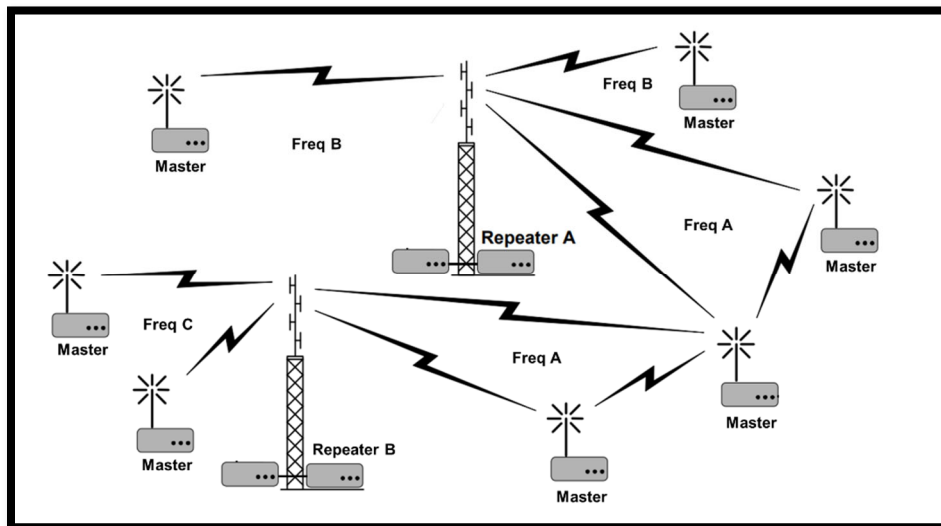
- Configure the serial port (baud rate, framing, flow control, etc.)
- Configure the RF (max range, transmit output power, transmit/receive frequency or frequency hopping, forward error correction)
- Configure the RF bit rate and modulation
- Configure the network (type, address, and max payload size. Type should be set to peer-to-peer)

#### Unique settings for all radios

- Set a unique ID for the radio (our device address)

The peer to peer mode of the XetaWave radio does not support a specific repeater function. It is strongly encouraged to use the point to multipoint or enhanced multipoint mode. If peer to peer is the required mode, then a couple of options, although not tested, would be to place two XetaWave radios at the repeater site(s) with their serial ports connected and

- (1) with the radios configured the same as all the other radios except for the unique radio ID, allow the CSMA algorithm of the radio to repeat the transmission determine when the channel is idle and then transmit. OR
- (2) divide the network into multiple networks operating on different frequencies as shown in the illustration below.



**XetaWave Peer to Peer with Back to Back Repeater**

### Radio Comparison

	<b>TELEDESIGN TS4000-05G</b>	<b>XETA WAVE XETA1-10MMNFA</b>
<b>FREQUENCY BAND</b>	136-162 or 150-174 MHz	136-174 MHz
<b>MODULATION</b>	GSMK	MSK, QPSK, 8PSK, 16QAM, 32QAM, 64QAM
<b>RF DATA RATE</b>	up to 19.2 kbps	up to 88 kbps
<b>CHANNEL BANDWIDTH</b>	12.5 kHz	12.5 & 25 kHz
<b>TRANSMIT OUTPUT POWER</b>	up to 5 Watts	up to 5 Watts
<b>OPERATING MODES</b>	Transparent & Optional AirNet	Point to Point, Point to Multipoint, Full Duplex Transmit, Full Duplex Receive, Peer to Peer, Enhanced Multipoint, optional TDMA & MDS x710
<b>INPUT VOLTAGE</b>	11 to 28 VDC	12 to 32 VDC
<b>DIMENSIONS</b>	6.5" x 3.1" x 1.8"	6.625" x 3.45" x 1.835"
<b>WEIGHT</b>	560 grams	700 grams

	<b>TELEDESIGN TS4000-05E</b>	<b>XETA WAVE XETA4-10MMNFC</b>
<b>FREQUENCY BAND</b>	406-440, 430-451, or 440-476 MHz	1406-430 & 450-470 MHz
<b>MODULATION</b>	GSMK	MSK, QPSK, 8PSK, 16QAM, 32QAM, 64QAM
<b>RF DATA RATE</b>	up to 19.2 kbps	up to 216 kbps
<b>CHANNEL BANDWIDTH</b>	12.5 kHz	6.25, 12.5, 25 & 50 kHz
<b>TRANSMIT OUTPUT POWER</b>	up to 5 Watts	up to 8 Watts
<b>OPERATING MODES</b>	Transparent & Optional AirNet	Point to Point, Point to Multipoint, Full Duplex Transmit, Full Duplex Receive, Peer to Peer, Enhanced Multipoint, optional TDMA & MDS x710
<b>INPUT VOLTAGE</b>	14 to 28 VDC	12 to 32 VDC
<b>DIMENSIONS</b>	6.5" x 3.1" x 1.8"	6.625" x 3.45" x 1.835"
<b>WEIGHT</b>	560 grams	700 grams

### Additional Serial Radios from XetaWave

	XETA2-10MMNFB	XETA9-10DMNFA
<b>FREQUENCY BAND</b>	217-222 MHz	902-928 (ISM) & 928-960 (MAS) MHz
<b>MODULATION</b>	MSK, QPSK, 8PSK, 16QAM, 32QAM	MSK, 4FSK, QPSK, BPSK, 8PSK, 16QAM, 32QAM, 64QAM
<b>RF DATA RATE</b>	up to 800 kbps	up to 4.4 Mbps
<b>CHANNEL BANDWIDTH</b>	12.5, 15, 25, 50, 250 & 500 kHz	12.5, 25, 50, 76, 154, 207, 310, 600, 900 & 1200 kHz
<b>TRANSMIT OUTPUT POWER</b>	up to 5 Watts	up to 1 Watt (ISM) & 3 Watts (MAS)
<b>OPERATING MODES</b>	Point to Point, Point to Multipoint, Full Duplex Transmit, Full Duplex Receive, Peer to Peer, Enhanced Multipoint, optional TDMA & MDS x710	Point to Point, Point to Multipoint, Full Duplex Transmit, Full Duplex Receive, Peer to Peer, Enhanced Multipoint, optional TDMA & MDS x710
<b>INPUT VOLTAGE</b>	10 to 32 VDC	10 to 32 VDC
<b>DIMENSIONS</b>	6.625" x 3.45" x 1.835"	6.625" x 3.45" x 1.835"
<b>WEIGHT</b>	700 grams	700 grams

If you are interested in a serial only radio supporting the frequency bands of 340-390 MHz, 450-470 MHz, 757-758 & 787-788 MHz, 896-901 & 935-940 MHz, 902-928 MHz, 1.35-1.39 GHz, 1.427-1.432 GHz, or 2.402-2.478 GHz, please email us at [sales@xetawave.com](mailto:sales@xetawave.com).

If you wish to introduce IP networking when you chose to replace your obsolete Teledesign radios, XetaWave offers a complete line of Ethernet radios. The Ethernet radios support all of the same operating modes as outlined for the serial only radio except for X710 and TDMA. Please visit our website at [www.xetawave.com](http://www.xetawave.com) or email us at [sales@xetawave.com](mailto:sales@xetawave.com).