Coexistence Solutions - HTPlus and ZumLink 900 Series Networks

1.1. Overview and Objective

This document provides FreeWave customers with a detailed understanding of how to migrate from the HTPlus Series to the ZumLink Series using a coexistence strategy.

> **Important!**: Migrating to ZumLink DOES NOT require you to "rip and replace" an HTPlus network, nor does it require the purchase of additional devices.

The Coexistence solution can be deployed without degrading the existing HTPlus network while enabling the superior performance of the new ZumLink 900 Series radios deployed on the network.

ZumLink is unique in its ability to coexist harmoniously because of these ZumBoost algorithms:

- Adaptive Spectrum Learning (ASL)
- Listen Before Talk (LBT)

LBT and ASL work together to maximize ZumLink throughput and minimize interference with other networks by sharing the RF space in a fair and balanced manner. Other radios drown out peers or require an additional piece of equipment. LBT and ASL are a part of the ZumLink RF protocol and do not need to be enabled or configured.

This document describes:

1.2. The ZumLink Advantage

Although FreeWave no longer provides the HTPlus Series of 900MHz industrial radios, existing HTPlus networks can be extended with the new ZumLink 900 Series radios. The ZumLink Series has comparable specifications to the HTPlus Series (shown in Figure 1) and employs several revolutionary enhancements including:

- ZumBoost (four performance enhancing algorithms can be used independently or together to 'boost' throughput in the most demanding RF environments.)
  - Packet Compression
  - Packet Aggregation
  - Forward Error Correction
  - Adaptive Spectrum Learning (ASL)
- IP Filtering with Net Mask technology
- Significantly higher throughput options
- ZumIQ Application Programmability and app-hosting at the edge

FreeWave's goal is to offer our Channel Partners and End-users the best RF technology available. The industry's highest throughput coupled with intelligent RF like ZumBoost and ZumIQ App Programmability set the new standard for Edge Computing.

Throughput	ZumLink	HTPlus Series
TCP Throughput Rate (kpbs)	63 @ 115.2 kbps	No
	147 @ 250 kbps	No
	318 @ 500 kbps	318 @ 614 kbps
	583 @ 1000 kbps	523 @ 867 kbps
	1,049 @ 4000 kbps	No
UDP Throughput Rate (kpbs)	89 @ 115.2 kbps	No
	189 @ 250 kbps	No
	395 @ 500 kbps	320 @ 614 kbps
	779 @ 1000 kbps	529 @ 867 kbps
	1,657 @ 4000 kbps	No

Note: With ZumBoost, ZumLink throughput can be drastically higher than HTPlus depending on data structure.

Figure 1: Comparison Chart - HTPlus vs ZumLink

1.3. Coexistence Defined

Coexistence is the ability to have two or more dissimilar RF networks to run side-by-side with minimal performance loss or degradation. Coexistence is required because HTPlus and ZumLink networks cannot communicate with each other over-the-air.

Although this Application Note is written for HTPlus and ZumLink networks, its methodology can be applied to other FreeWave and non-FreeWave radios as well.

Important!: The Coexistence solution **does NOT** require you to remove and replace HTPlus radios with ZumLink radios.
ZumLink's unique RF protocol, which includes Adaptive Spectrum Learning (ASL), makes this possible.

There are two Coexistence strategies illustrated in this document:

- Coexistence at a Gateway (on page 4)
  - This strategy focuses on extending a network at a gateway point by adding a ZumLink gateway and a few components to share the existing gateway antenna.
  - End points are deployed as usual.
  - See Figure 2 and Figure 3
- Coexistence Network Extension (on page 6)
  - This strategy focuses on extending a network from an end point.
  - This is similar to a "back-to-back repeater" approach where a second antenna is added and the units are connected via an Ethernet cable.
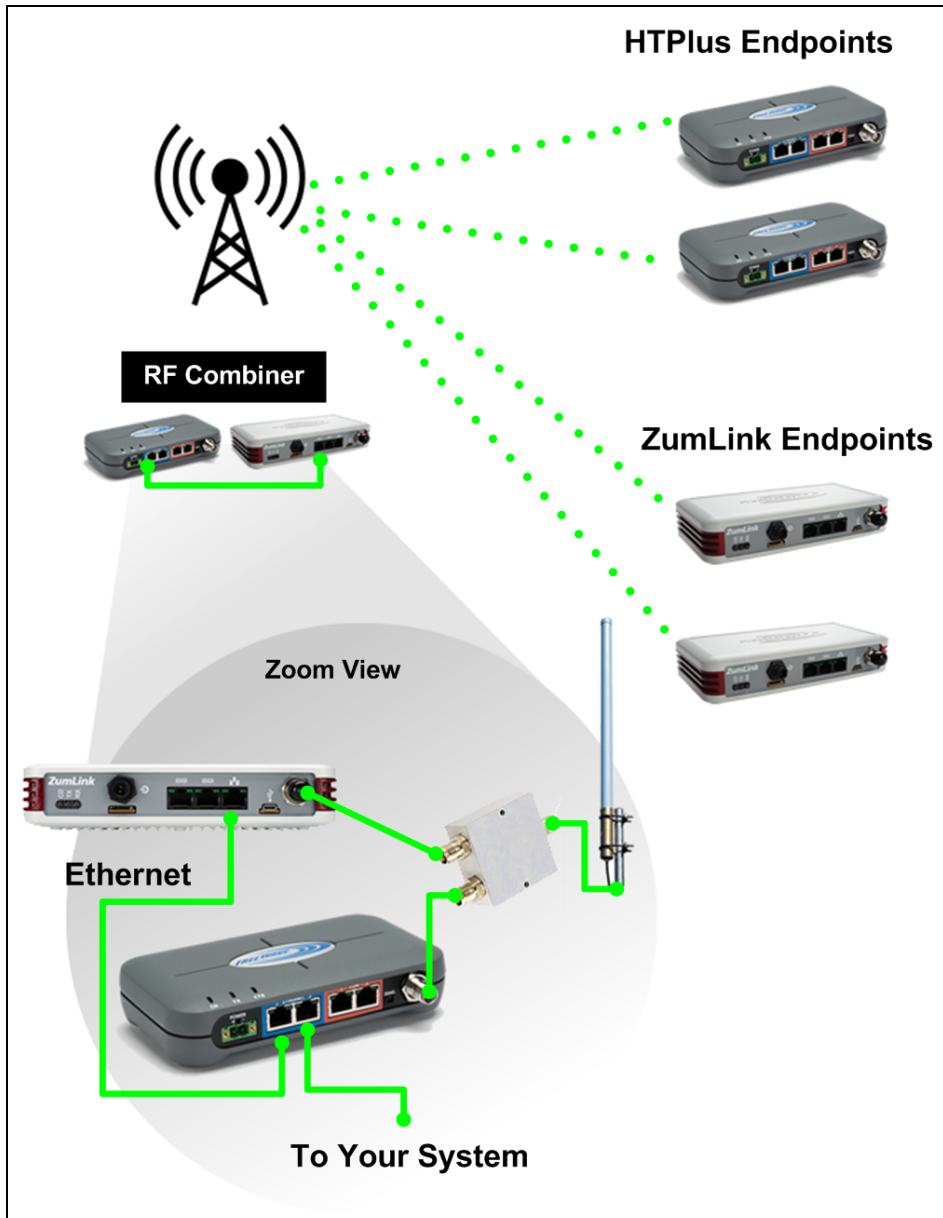 - See Figure 4

1.3.1. Coexistence at a Gateway

Figure 2: Coexistence at a Gateway

1.3.2. Coexistence at a Gateway with Part Numbers

> **Note**: See Ordering Information (on page 11) for additional information.
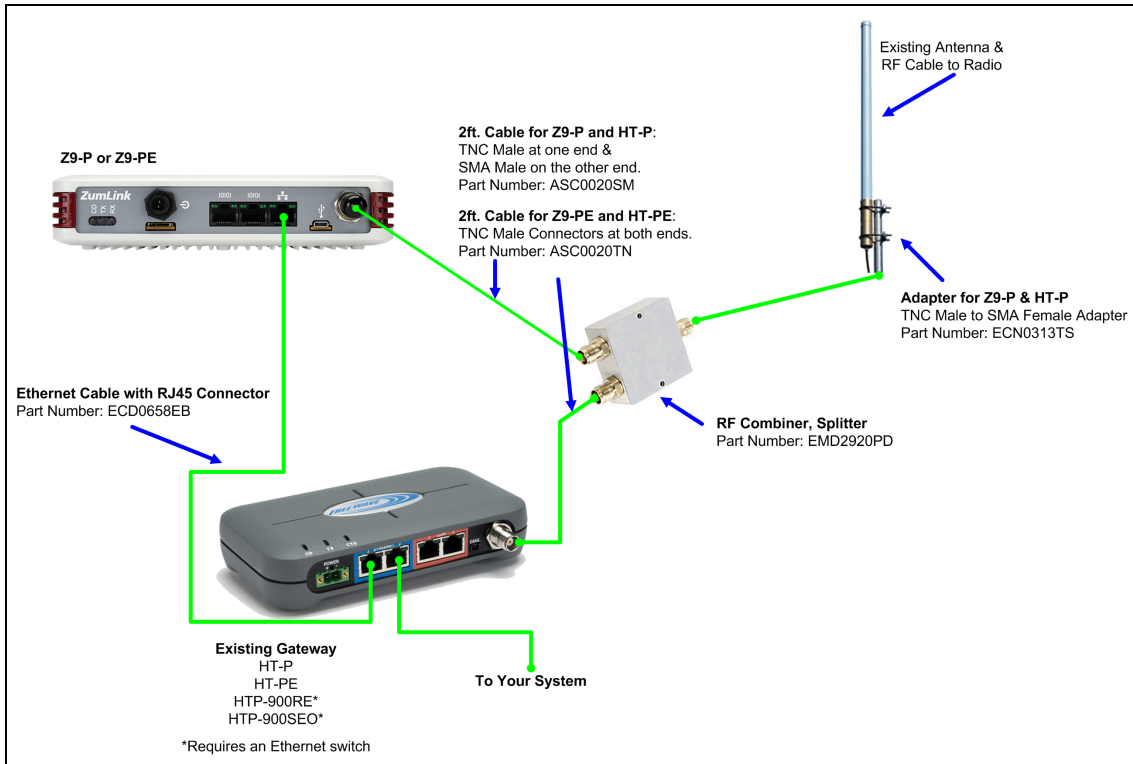

Z9-P or Z9-PE

2ft. Cable for Z9-P and HT-P:
TNC Male at one end &
SMA Male on the other end.
Part Number: ASC0020SM

2ft. Cable for Z9-PE and HT-PE:
TNC Male Connectors at both ends.
Part Number: ASC0020TN

Existing Antenna &
RF Cable to Radio

Adapter for Z9-P & HT-P
TNC Male to SMA Female Adapter
Part Number: ECN0313TS

Ethernet Cable with RJ45 Connector
Part Number: ECD0658EB

RF Combiner, Splitter
Part Number: EMD2920PD

Existing Gateway
HT-P
HT-PE
HTP-900RE*
HTP-900SEO*

To Your System

*Requires an Ethernet switch

Figure 3: Coexistence at a Gateway with Part Numbers

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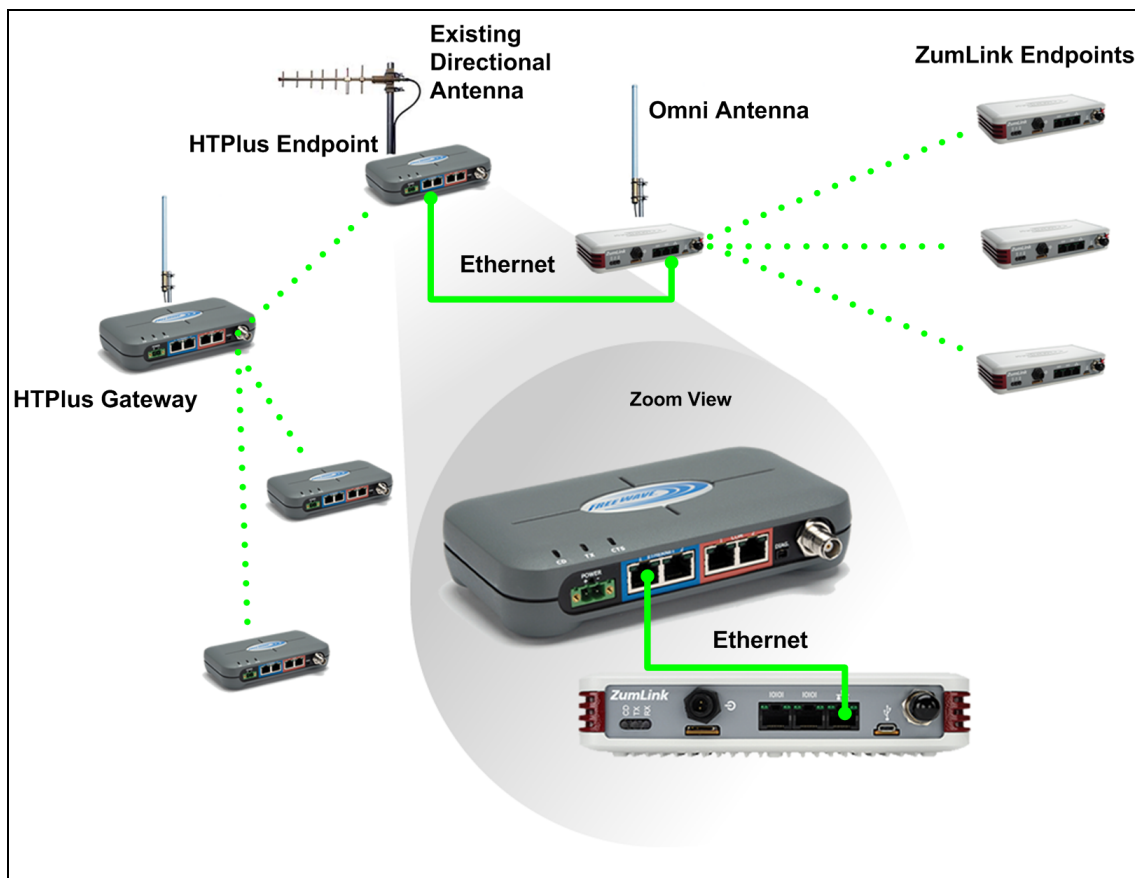
1.3.3. Coexistence Network Extension

Figure 4: Coexistence Network Extension

1.4. Coexistence Enhancement Strategies: Leverage Separation of RF for Each Network

Another approach that mitigates interference is to operate the two Gateways on different parts of the band. For the existing HTPlus network, Endpoints **do NOT** need to be configured. They follow the Gateway's configuration.
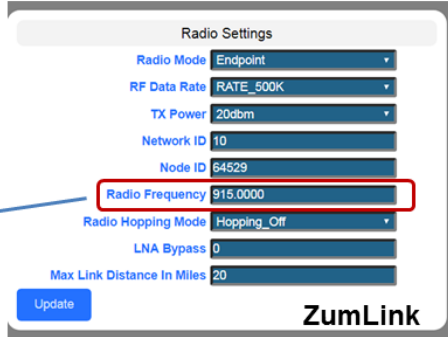
1.4.1. Single Channel Configuration

- ZumLink can be configured to use a single frequency for RF data rates 500K and above.
- The Frequency Zone containing the single channel can be disabled on the HTPlus network.
- See Figure 5

Figure 5: Single Channel Configuration

1.4.2. Split Band Configuration

- ZumLink can be configured to use a frequency mask to hop on half of the spectrum.
- The HTPlus network can be configured to hop on the other half of the spectrum.
- See Figure 6

Figure 6: Split Band Configuration

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1.5. ZumLink Details

ZumBoost

Coexistence leverages several of ZumBoost's four performance enhancing algorithms of the ZumLink 900 Series to minimize network link degradation.

Packet Compression

- Reduces the packet size to transmit fewer bits over the air.
- Encodes entire packet with compression algorithm to reduce the overhead associated with each transmission.
- Adjusts packet size to optimize throughput.
- RF Boost:
  - Squeezes more user data in less transmission time.
  - Reduces the transmission window, which lowers the probability of collisions.

Packet Aggregation

- Increases throughput by combining multiple packets into a single packet which minimizes the number of packets required for transmission.
- One transmit per packet can be replaced with one transmit per 20 packets when packets are combined into one packet.
- RF Boost:
  - Increases over-the-air throughput for small packets.
  - Improved SCADA data transmission.

Forward Error Correction

- Detects and fixes errors before sending them over the air, reducing the overhead associated with bad / dropped packets, retries, etc.

Adaptive Spectrum Learning

- Includes the **Listen Before Talk (LBT)** algorithm which increases throughput in noisy environments.
- **Adaptive Spectrum Learning (ASL)** learns which RF signals are part of the ZumLink network and which are not.

Additional Features to Aid Coexistence

Ethernet Switching

- The data coming from your system will only be transmitted through the Gateway radio that serves the destination IP address.

Netmask Filter Setting

- Significantly reduces congestion by preventing non-radio Ethernet traffic from entering the radio network, improving net performance.

1.6. FAQs

1. **Is there a decrease in network performance?**

   No.

2. **Is there a decrease in link range?**

   Negligible.

3. **What's the additional cost?**

   a. The complete Coexistence kit is under $100.

   b. A ZumLink Gateway can be covered by our rebate program.

4. **Does this mean I have to change the configuration on all of my existing radios?**

   a. No,
      Frequency Zones are disabled only on the existing Gateway.

   b. Just a few clicks and you are done.

5. **Do I need to change anything on my SCADA / PLC / RTU / System?**

   No.

6. **What if I have problems setting this up?**

   a. FreeWave Technical Support is available 24/7 for remote assistance.

   b. If your problem cannot be resolved remotely a FreeWave Systems Engineer (SE) may be deployed on site.

7. **Which FreeWave radios can be deployed in a Coexistence solution?**

   a. HTPlus Series

   b. FGR2-P Series

8. **Can I use the Coexistence solution with non-FreeWave radios?**

   Yes.

1.7. Ordering Information

1.7.1. Parts for Coexistence at a Gateway

Existing Product	New Product	Additional Replacement Equipment		
		FreeWave Part Number	**Qty**	**Description**
• HT-PE • HTP-900RE*	Z9-PE	EMD2920PD	1	RF Combiner, Splitter
		ASC0020TN	2	2ft. Cable, LMR240, TNC Male, TNC Male
		ECD0658EB	1	6ft. Ethernet Cable, RJ45 Connector

Note: *If the existing radio is an **HTP-900RE**, an Ethernet switch is also needed.

Existing Product	New Product	Additional Replacement Equipment		
		FreeWave Part Number	**Qty**	**Description**
• HT-P • HTP-900SEO*	Z9-P	EMD2920PD	1	RF Combiner, Splitter
		ASC0020SM	2	2ft. Cable, LMR240, TNC Male, SMA Male
		ECD0658EB	1	6ft. Ethernet Cable, RJ45 Connector
		ECN0313TS	1	Adapter, TNC Male to SMA Female

Note: *If the existing radio is a **HTP-900SEO**, an Ethernet switch is also needed.

1.7.2. Parts for Coexistence Network Extension

> **Important!**: This assumes that a new antenna is installed at both ends of the link.

> **Note**: Parts for the antenna and additional hardware, such as cables, are not listed.

Existing Product	New Product	Additional Replacement Equipment		
		FreeWavePart Number	**Qty**	**Description**
• HT-P • HT-PE • HTP-900RE* • HTP-900SEO*	• Z9-P • Z9-PE	ECD0658EB	1	6ft. Ethernet Cable, RJ45 Connector

> **Note**: *If the existing radio is an **HTP-900RE** or **HTP-900SEO**, an Ethernet switch is also needed.

1.7.3. Additional Accessories

These FreeWave accessories may be needed for network connection.

Additional Accessories		
FreeWave Part Number	**Qty**	**Description**
AOH4001HT	1	DIN rail kit for Z9-P
AOH4003SP	1	DIN rail kit for Z9-PE
ASC0002ZL	1	Power adapter cable for Z9-PE
ASC0030SM	2	3ft. Cable, LMR240, TNC Male, SMA Male
ASC0030TN	2	3ft. Cable, LMR240, TNC Male, TNC Male
ECN1234TN	1	Adapter, TNC Male to N-type Female
EMD1280UW	1	AC Power Supply for Z9-PE **Note**: The power adapter cable for Z9-PE is also needed. FreeWave Part Number: ASC0002ZL.
EMD1280UX	1	AC Power Supply for Z9-P

Learn More

For additional product information about the Z9-P / Z9-PE, visit http://support.freewave.com/.

For additional assistance, contact a local reseller, or contact FreeWave Technologies, Inc. at 303.381.9200 or 1.866.923.6168, or by email at moreinfo@freewave.com.

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The ZumLink complies with FCC Part 15 rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept any interference received, including interference that may cause undesired operation.

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