Proxim wireless

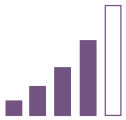
Performance Matters. Proxim Delivers.

How to Minimize **Radio Frequency Interference** in your Outdoor Wireless Network

With the influx of wireless based communications in unlicensed bands, the likelihood that one's wireless network gets interfered is higher than ever today. Much as we'd like to, interference in these bands can't be eliminated, however what can be done is "minimize the impact". This guide book walks you through some of the concepts and common causes of RFI (Radio Frequency Interference), as well as some best practices that will help you to minimize RFI and it's impact.

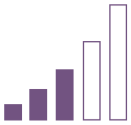
So, what is RFI and what is the impact?

Although the definitions of interference are myriad, from an RF perspective, interference is said to occur when unwanted or undesired signals occurs at or near the same frequency channel as the desired signal in the receiver system. Depending on the intensity of the interfering signal, networks can experience anything from slight performance degradation to something as severe as complete link disruption. The impact of interference can be broadly categorized into three levels.



Disturbance

Results in a slight drop in the effective throughput of the system.



Interruption

Users experience considerable drop in system throughputs, intermittently, typically in the order of a few seconds or minutes.

Disruption

A more severe form of interruption when users experience long periods (hours and sometimes even days) of downtime or total loss of communication.

Types and Sources of Interference

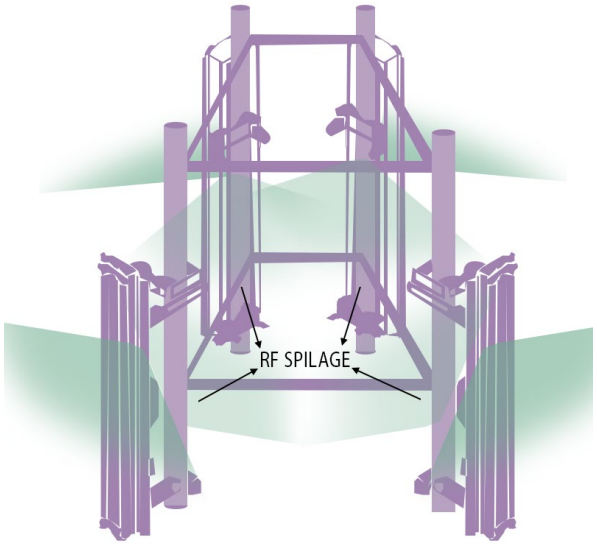
From an interference handling perspective, interference can be classified on the basis of the emanating source: it is either from within the network i.e. self interference or a result of a third party outside one's network i.e. external.

Interference can also be classified based on bandwidth and frequency, we will see that ahead.

Note

Self interference

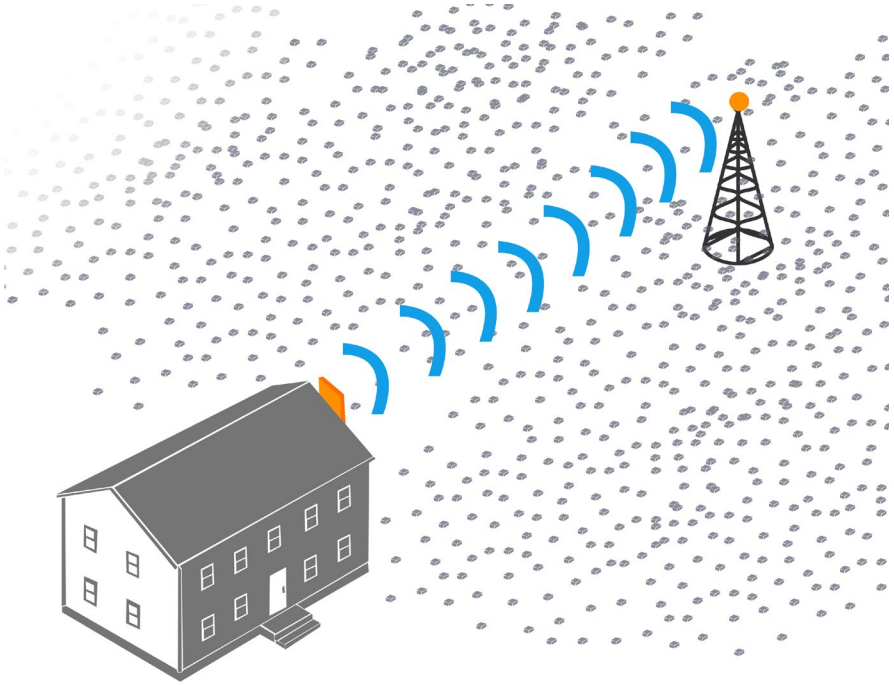
As the name suggests, it is the interference caused by radios within one's own network. Traditionally self interference has been solved by optimizing the placement of radios and designing of a network, however, very often in dense networks where radios are placed in close proximity, self interference increases leading to poor network performance and throughput.



Self interfernce caused due to side and backward RF spillage on collocated radios

External interference

Although the "by-products" are the same as self-interference, this type of interference is caused by sources outside one's influence and is consequently more difficult to overcome.



Types and Sources of Interference

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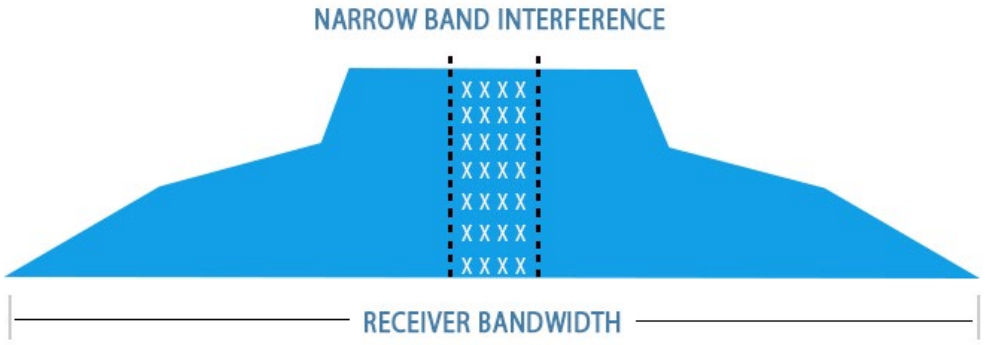
Bandwidth based interference

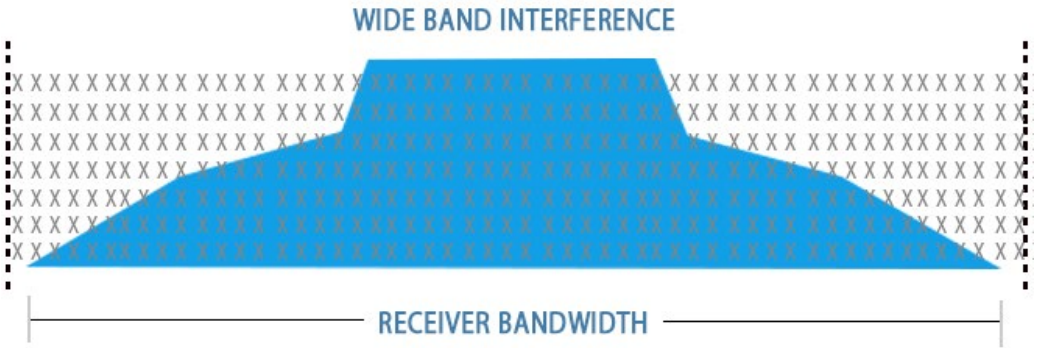
Narrow band interference

Narrow band signals contain high levels of radio energy in a frequency range that is smaller than the receiver bandwidth of the system.



Wide band interference

Wide band interference exceeds the receiver bandwidth of the victim systems and makes data reception as well as interference - avoidance difficult or impossible. Wide band interference of sufficient strength will jam the system, however if the interfering device operates intermittently, the system will be able to complete some transmissions successfully.



Types and Sources of Interference

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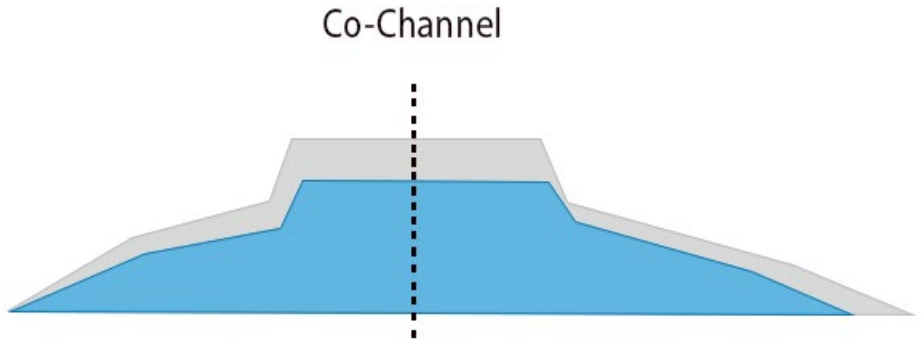
Frequency based interference

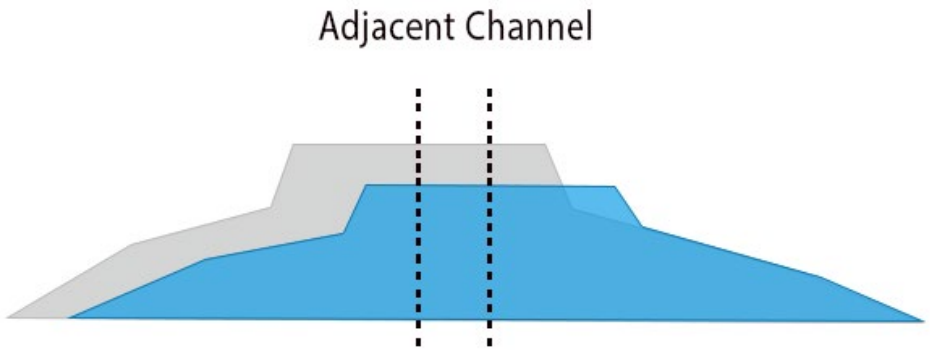
Co-channel interference

Is said to occur when two or more radio transmitters operate on the same frequency channel in close proximity.



Adjacent channel interference

This is defined as interference which occurs when two networks are operating on frequency channels that are right next to each other. Often times in these situations the excess energy that is produced outside the main signal "bleeds over" into the adjacent frequency channel.



Overcoming Interference - Fundamentals

To overcome interference the fundamental goal is to remove the energy entering your system from undesired sources, be your own or a third party. Combating interference while deploying a wireless system in unlicensed bands can be accomplished via a mix of intelligent RF best practices and features inherent in the products themselves.

Designing an optimal wireless network

Proper design and deployment are critical elements when it comes to avoiding potential interference. A good practice is to survey the antenna locations for potential interference prior to a deployment. Typically spectrum analyzers and antennas are used to determine if there are any interfering signals that might need to be "steered around".

Select the right antenna

Antennas come in a variety of sizes, shapes and performance with characteristics such as "gain" and "beam width". A good design should not only have the "right" antenna gain so as to minimize the RF energy spillage outside the intended area but also should have the right beam width. Antennas with excessively large or open beam widths increase the likelihood of RF interfering with a systems reception.

In radio parlance, gain refers to the ability of an antenna to increase the strength of the transmitted signal while beam width refers to the antenna's ability to focus on a specific aperture for transmitting and receiving signals.

Overcoming Interference - Fundamentals

Continued

Proper physical spacing

Although there is no fixed rule, it is recommended that there should be least 3 feet of both vertical and horizontal separation between antennas if possible. Interference issues generally show up when inadequately spaced out antennas sense RF energy from the side and back lobes of each other.

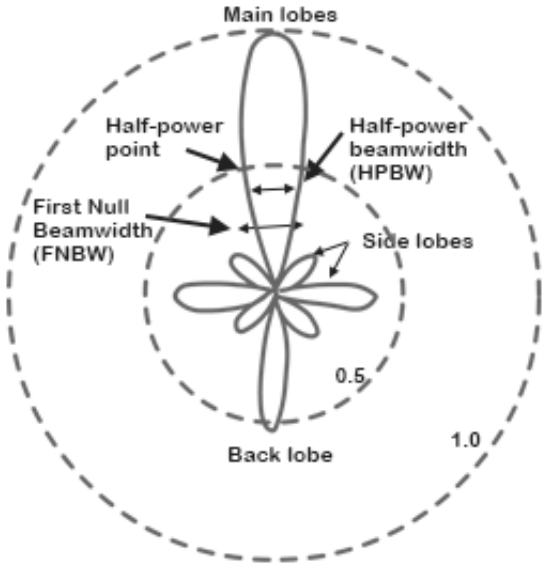
What are RF Lobes?

Main Lobe (major lobe, main beam) - Radiation lobe in the direction of maximum radiation.

Minor Lobe - Any radiation lobe other than the main lobe.

Side Lobe - A radiation lobe in any direction other than the direction (s) of intended radiation.

Back Lobe -The radiation lobe opposite to the main lobe.



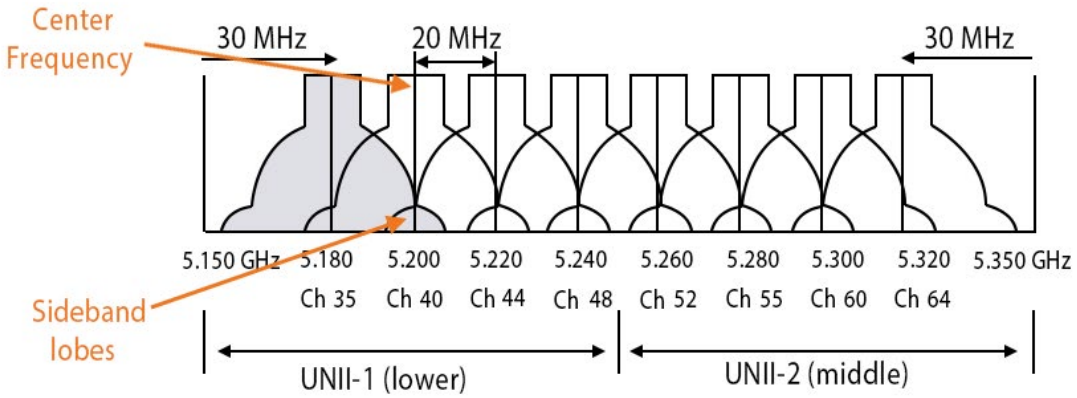
Overcoming Interference - Fundamentals

Continued

Proper channel spacing

When utilizing more than one channel, one should ensure that the multiple centre frequencies based on channel bandwidth are adequately spaced out so as to ensure that there is no overlap and no interference with one another.

For example theoretically in the 5 GHz range, there is roughly 20 MHz between each of the center frequencies, typically that should be enough channel separation, but sometimes engineers do observe that the sideband carrier frequencies extend much further causing two adjacent channels to overlap and interfere with one another. In cases such as these 40 MHz (two channel separations) between the centre frequencies might be necessary to stabilize the link. The other work around is to configure bandwidth of 5 MHz / 10 MHz although this does provide some relief in locating a clean adjacent channel but it should be noted that the through-puts will drop accordingly.



Overcoming Interference - Fundamentals

Continued

Interaction and Dialogue

Always remember, interference impacts both the "interfere" and the "interferer". An interfere's system encountering interference will be affected, but so does the interferer's system. In cases when surrounding networks interfere with one another, an effective neutralization technique is human dialogue. By engaging in a dialogue with other operators, to either reduce the transmission powers or "space out" the operating frequencies, network operators can come to a "mutual accommodation" and ensure lesser interference caused by each other's network.

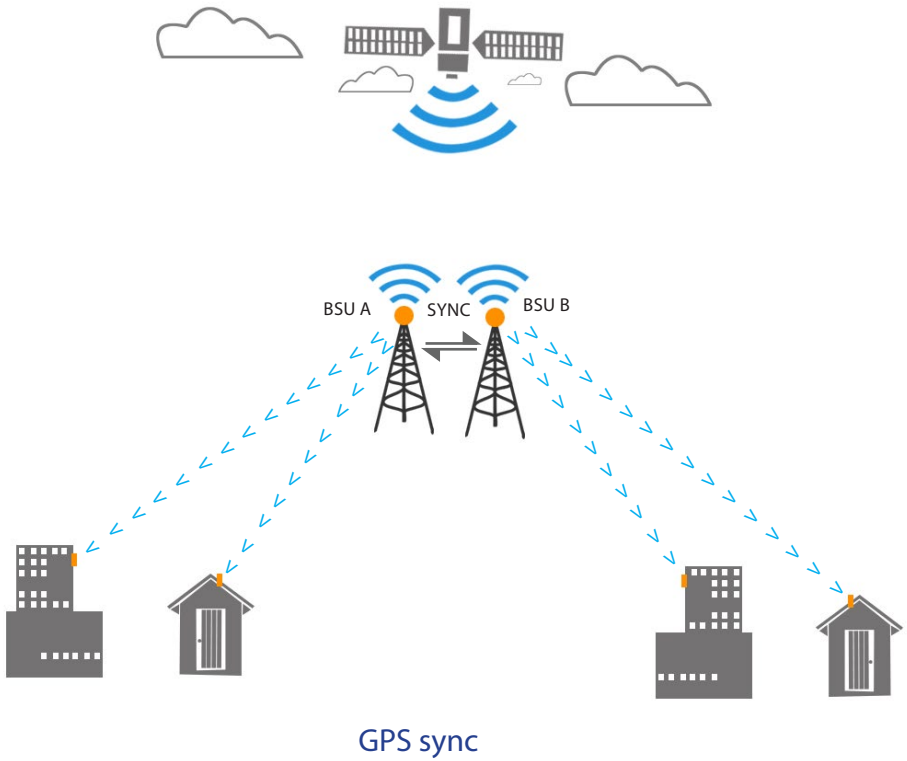
Tsunami® - Designed to help you overcome interference

While good practices can reduce the impact of interference, a well designed wireless solution provides an increased degree of tolerance to interference. Below are some of the key features that help Tsunami® users to overcome interference.

WORPsync

Tsunami radio now featured with advanced GPS sync technology

When it comes to addressing interference within a network i.e. self interference, the WORPsync feature is an invaluable tool which enables all base station units in a network to either transmit or receive at the exact same time. This way the WORPsync helps to significantly reduce self interference that typically happens when radio signals transmitted by one base station unit interfere with another neighboring base station unit in the receive mode. In the bargain, the WORPsync also increases spectral efficiency and allows channel reuse.



DCS / ACS

The Dynamic Channel Selection(DCS) feature is an adaptive tool that ensures a steady reliable link quality even in severe interference conditions. The DCS feature essentially enables Proxim radios to continuously detect interferences on the current operating channel and then seamlessly switch to other interference-free channels, thereby ensuring high up times and minimal performance degradation.

ATPC (Automatic Transmit Power Control)

ATPC (Automatic Transmit Power Control) is a feature that enables Proxim's point to point and point to multipoint radios to dynamically adjust their transmit power to an optimal level. This primarily helps to reduce the impact of self interference. While at the same time ensuring a good quality link.

Tsunami® - Designed to help you overcome interference

Continued

Noise Filtering

Tsunami® products have a feature called Satellite Density to help to achieve maximum bandwidth in a network. With this feature network engineers can adjust the receive sensitivity of a radio and improve the performance in environments with high noise level. A user can configure the Noise Filtering to: Disable Large, Medium, Small, Mini, or Micro. The Medium, Small, Mini, and Micro settings are appropriate for higher noise environments; whereas, Large is appropriate for a lower noise environment. Reducing the sensitivity of the device enables unwanted "noise" to be filtered out as it disappears under the threshold.

Frequency Agility

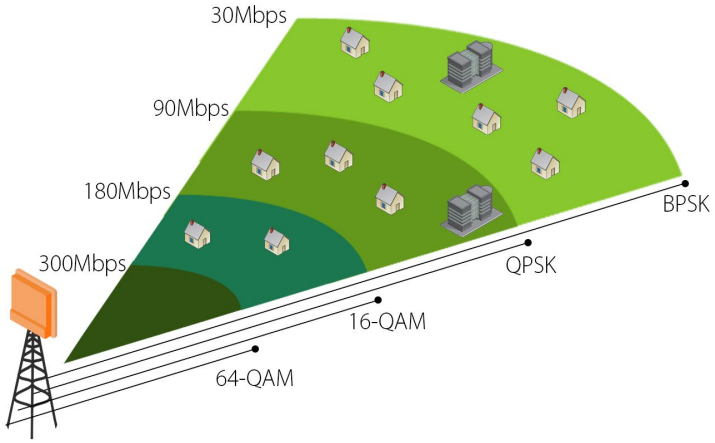
Proxim Tsunami® products typically support frequencies from 5GHz to 5.9GHz, allowing operation in any of the UNII unlicensed bands from a single product. If the predefined center frequencies are not desirable, a user can shift the center frequency to a new un-congested frequency.

Built In Spectrum Analyzer

The Spectrum Analyzer is a very useful tool to scan the surrounding spectrum and to help select a channel with least interference.

Dynamic Data Rate Selection

DDRS or dynamic data rate selection is a feature that continuously monitors the surrounding interference and adaptively adjusts the network to provide the best possible throughput. Without this feature many times a network will cease to operate as interference rises and will re-gain its link only when the noise has dropped back to original lower levels.



WORP®

Unlike many standard outdoor wireless systems, that have a distributed contention protocol, Proxim's proprietary WORP®(Wireless Outdoor Routing Protocol) is a centralized control function that allows subscriber units to transmit data only when permitted by the base station, reducing demand contention and packet collision and maximizing throughput.

Conclusion: The Tsunami® Advantage

The process of minimizing interference is a blend of both - RFI neutralization best practices and features inherent in the products; however another commonly overlooked aspect in a wireless solution is the reliability - the ability to consistently perform despite the most hostile conditions. Proxim's proprietary WORP® is one such technology that helps ensure Tsunami® radios to perform even in the most RF hostile conditions where other standard wireless technologies simply fail to perform. Know more about WORP® in the white paper: WORP® - Connecting the internet of things. You can also test drive any of our outdoor products for free via our Try Buy Program.

"We compared a lot of wireless solutions but none were as reliable as Proxim's. They perform well in spite of the extreme interference and severe nLoS conditions. I would strongly recommend Proxim."

– Daniel Miranda, IT Analyst, Serv Imagem.

About Us

Proxim Wireless Corporation (OTC Markets: PRXM) provides Wi-Fi®, Point-to-Point and Point-to-Multipoint 4G wireless network technologies for wireless internet, video surveillance and backhaul applications. Our ORiNOCO® and Tsunami® product lines are sold to service providers, governments and enterprises with over 2 million devices shipped to over 250,000 customers in over 65 countries worldwide. Proxim is ISO 9001-2008 certified. For more information, visit www.proxim.com. For investor relations information, e-mail ir@proxim.com or call +1 413-584-1425.