Technical Note - TN-61

Subject: Co-sited Transceivers

Description:

- Tx-Rx Isolation

This document addresses the problem of co-sited Transmitters and Receivers operating with less than ideal frequency separation, as can occur when a pair of opposite sense split frequency bases operate on a single community site.

The Problem

Provided that the attenuation is reasonable, and blocking is not dominant then the majority of the interference is generated by the broadband (white) Transmitter noise floor falling across the receivers IF bandwidth which causes the apparent noise floor of the receiver to rise.

As an example this broadband noise floor is around -115dbm/Hz from a few channels away from the carrier out to 20MHZ or so for a Trio E series product operating at 5 Watt power output.

Isolation Filters

In practice, the required isolation for successful operation of the receiver will be effected by Antenna separation augmented by a filter in the offending transmitter.

Where the offending transmitter is a full duplex product where the Rx and Tx ports are separate, the filter in the transmitter can be either a narrow notch at the affected receiver frequency, or a narrow bandpass filter at the offending transmitter frequency.

For a half duplex offending transmitter with a single antenna port the augmenting filter can only be a notch at the affected receiver frequency.

In all cases of Notch filters in the offending transmitter it must have very little attenuation and VSWR at its own Tx frequency, and in the case of half duplex it must also have little loss at its own local Rx frequency.

Antenna Isolation

For Yagi and co-linear antennas mounted with the driven elements aligned axially, and a few meters apart in free air with well screened coax an isolation of around 40dB should be easily achieved requiring an extra 30dB to be achieved by filters at the frequency separation. In all cases the isolation achieved by antenna placement must be measured by metering RSSI at the receiver, and if possible the antenna placement adjusted for lowest interference to minimize filter requirements. Note that the isolation will almost surely change with changes to any near field conducting objects (ie addition or removal of nearby antennas, cabling, bracing, metallic building materials etc).

Practical Example 1

Assuming - Broadband noise of offending Tx is known to be < -115dBm/Hz

and antenna separation known to exceed 35dB.

The power (Pn dBm) in the receiver bandwidth (Hz) can be calculated as follows

Pn = Tx noise power (dbm/Hz) + (10*log10(Rxbw in HZ))

for a 12.5kHz Receiver b/w = 8kHz - so for a Tx noise floor of -115dBm/Hz

Pn = -115dBm + 39dB = -76dBm

With an antenna isolation of 35dB an effective Rx noise floor of 111dBm will be present before a filter is added.

Practical Example 2 (measure interference noise level)

With the antennas in place and the receiver connected to a diagnostics PC or RSSI meter, and the offending transmitter operative - observe the RSSI level with the antennas adjusted to best separation.

In this case again we assume around -76dBm is measured.

Filter Selection

For a narrow band binary or 4 level GMSK radio-modem a noise level of 12 to 15 dB below the wanted signal is required for minimal degradation, and we will assume therefore the interfering noise level must be <-130dBm in the receiver.

In the cases above therefore the filter must provide > 19dB attenuation of the offending Transmitter at the affected Receivers frequency.

A suitable **bandpass** filter in a duplex offending transmitter in this case must have a **skirt attenuation** of >19dB at the separation frequency distance away from the peak response which will be at the transmitters frequency.

A suitable **Notch** filter for a duplex interfering radio transmitter must have a notch depth at the affected receiver frequency of > 19dB

AND a minimal attenuation or reflection loss at the offending Transmitters frequency (say < 1dB).

AND for a Simplex interfering radio the notch must also

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