

... Interference

Introduction

This document describes various sources of interference that might affect the performance of ORINOCO wireless LAN systems. Whether they actually will interfere is primarily determined by the:

- The type of device and the frequency channel at which it radiates radio energy.
- The location of the device in relation to the signal paths of your ORiNOCO devices.

This document will help you identify potential sources of interference. If sources of interference do occur, the guidelines described in this document will help you to eliminate and/or minimize the negative effects of the interference on ORiNOCO wireless performance.

Types of Interference

There are two types of interference which may occur in the Industry, Scientific and Medical (ISM) band in which ORiNOCO operates:

- Narrow band interference
- Wide band interference

"Narrow" and "Wide" are relative measures, the reference is the 16 MHz bandwidth (at -30 dBm points in the spectrum) of the ORiNOCO system.

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 ORiNOCO system. Narrow band signals will not disrupt communication on a ORiNOCO system because they have a processing gain (10x) that will cause interference up to Signal to Interference Ratio of only 10 dB).

Most sources of interference described later in this document, will be narrow band in term of a ORiNOCO Direct Sequence Spread Spectrum (DSSS) system.

A DSSS receiver will receive energy over a range of frequencies corresponding to the spread bandwidth. The de-spreading performed by DSSS receivers collects energy from different frequency components and adds them constructively to recover the wanted information; this is known as processing gain.

A part of the receiver bandwidth may be occupied by a narrow band interference signal. The received narrow band signal will be "spread" by the DSSS receiver. The effective interference depends on the power ratio between the wanted signal and the interference signal and on the processing gain of the receiver.

However, with strong interference signals the receiver amplifier circuits may be overloaded by the interfering signal and subsequent signal processing has little effect.

Wide Band Interference

Wide band interference exceeds the receiver bandwidth of victim systems and makes data reception as well as interference avoidance difficult or impossible. The primary source of wide band interference consists of domestic microwave ovens that operate in the 2.4 GHz band. This energy is spread in time and frequency. The typical microwave oven operates at 50 pulses per second and typically sweeps through frequencies between 2400 and 2450 MHz although most of the energy is typically present at frequencies near 2450 MHz.

DSSS systems, because of their wide bandwidth, may have trouble to obtain a free piece of spectrum in conditions of heavy interference. When wide band interference cannot be avoided, DSSS receivers suffer degradation during the time that the microwave energy is present in its operating bandwidth. Given the pulsed operation of the microwave oven, one or more messages transmitted by a DSSS system may be affected and may have to be retransmitted.

Wide band interference of sufficient strength will jam the ORiNOCO system, however if the interfering device operates intermittently, the system will be able to complete some transmissions successfully; however the user will notice a performance degradation.

Potential Sources of Interference

Potential sources of interference for ORiNOCO networks may be one or more of the following devices:

- Microwave ovens
- Elevator motors
- Copier machines
- Theft protection equipment (retail)
- Cordless Telephones

When these interference sources are present in the wireless networking environment, consider one or more of the options listed below to eliminate or minimize the negative effects of interference:

- Move the interfering device away from the signal paths of your ORiNOCO devices.
- Investigate whether the interfering device allows for adjusting (re-tuning) the emitted radio signal.
- Reconfigure your ORiNOCO devices to select another frequency-channel.

When considering to adjust the frequency channel of your ORiNOCO devices, you will only need to change the frequency channel in the access points: In IEEE 802.11 infrastructure environments ORiNOCO stations will automatically adopt the channel of the WavePOINT-II devices. In ad-hoc workgroups, i.e. networks that do not include WavePOINT-II devices, this parameter must be modified on each individual workgroup participant.

In exceptional cases where re-locating devices and/or adjusting frequency channels does not resolve the negative effects of interference, you may need to (re-)consider a combination of wired and wireless LAN segments on the locations where the interference truly impact wireless performance.

Please Note: See also "If ORiNOCO is the Source of Interference" on page 6.

Microwave Ovens

Band:	2.4 GHz where the maximum radiation from the ovens occurs around 2450 MHz. The emitted radiation sweeps from 2400 to 2450 and remains stable for a short period at 2450 MHz.
Bandwidth:	May vary per product and manufacturer.
Power:	Not an intended transmitter.
	The radiation cycle of the oven is about 10 milliseconds. Interference occurs only while the oven is on. Product variation is such that no uniform levels of emission can be identified.
Environment:	Cafeterias and/or kitchens.

Expected effects:

ORiNOCO will achieve communication in most situations except if the oven is very close to a ORiNOCO station:

- **Hardly Affected** - ORiNOCO operating around 2480 MHz (ORiNOCO type C) are hardly affected because of the difference in frequency between the two systems. Noticeable effects only occur when the oven is within a few meters of a ORiNOCO (station).
- **Moderately Affected** - ORiNOCO operating around 2430 MHz (ORiNOCO type A and D) is less severely affected by ovens than ORiNOCO operating at 2460 MHz.
- **Strongly Affected** - ORiNOCO operating around 2460 MHz (ORiNOCO type B) is affected strongly if the distance from the receiving ORiNOCO to the oven is considerably less than the distance to the transmitting ORiNOCO. In general, a separation of 30 meters in open space between a ORiNOCO station and a oven will reduce the interference experienced by the ORiNOCO station to very low levels. Walls help to reduce interference: a solid brick wall allows the safe distance to be reduced to 10 meters.

Corrective Action

- Keep Microwave ovens away from any ORiNOCO station - 20 meters is sufficient but less can give acceptable results depending on local conditions such as operating frequency and walls.
- If you have interference, do not use an Microwave oven while your network is very busy and heavily loaded.

Theft Detection Devices

Band:	<ul style="list-style-type: none"> ▪ 915 MHz, possible range 902-928 MHz. ▪ 2.4 GHz, possible range 2.400 - 2.435 GHz. ▪ 2.4 GHz, possible range 2.465 - 2.4835 GHz.
Power:	:75 mW e.i.r.p.
Environment:	Retail.

The theft detection devices use a small part of the available ISM bandwidth. Often the theft detection device can be tuned (in 100 KHz steps) to determine which part of the band is used

Expected effects:

- **Hardly Affected** - When they operate in the same band, depending on the location of ORiNOCO antennas and the theft detection devices. You are advised to investigate whether tuning the radio channel of the theft detection device is possible or select another operating channel for your ORiNOCO system.
- **Not Affected** - When the theft protection system operates in the 915 MHz band the radio channels are so far apart that they do not interfere with one another. When the theft protection system operates in the 2.4 GHz band, ORiNOCO performance will neither be affected when the operating frequency of the system is adjusted, or you have reconfigured your ORiNOCO system to operate at another frequency channel.

Cordless Telephones

Cordless phones or cell-phones exist in various types and technologies. Subject to local radio regulations these devices often use dedicated radio channels:

- In Europe, cell-phones (also referred to as GSM phones) use the 915 MHz and/or 1800MHz band
- In the US cell-phones use the xxx MHz band

Another popular type of cordless phones are indoor wireless handsets for home-use.

- DECT technology phones use the xxxx MHz band
- Xxxx technology phones use the xxxxx MHz band

Expected effects:

- For Europe and other countries - the location of ORiNOCO antennas and the cordless handsets and base units will determine whether interference might occur and could be resolved. ORiNOCO systems might show a reduced performance capacity and the cordless phones can show reduced line quality and loss of connection.

Corrective Action:

Keep cordless telephones (especially the base units) away from any ORiNOCO station. A separation of 20 meters is sufficient but less can give acceptable results depending on local conditions such as operating frequency and walls.

(Un-)licensed Citizen band Radio Devices

(Un-)licensed Citizen band devices that are often used for personal communications from vehicles and or homes often use a dedicated radio band that is different from the ORiNOCO radio band.

As such these devices do not interfere with ORiNOCO wireless networks.

Other wireless equipment

Wireless is hot, but not only in networking or communications environments. In the home and professional market you will see a wide variety of other wireless devices such as:

- Remote controls for TV sets, VCRs, Garage doors or (light) switches.
- Wireless keyboards and mouse devices for your computer.
- Wireless audio headsets or speaker systems.

Many of these devices are based on either infrared or radio technology.

- Infrared systems will never interfere with ORiNOCO radio technology.
- Radio-based systems may interfere dependent on the type of radio technology and/or operating frequency applied.

Expected effects:

Whether interference is caused by such devices, can easily be determined running the WaveMANAGER/CLIENT radio diagnostics, and watch the behaviour of your ORiNOCO system while switching the suspect device(s) off and on again.

Corrective Action:

If interference does occur, you are advised to move the transmitting/receiving antennas of such devices away from the signal paths of your ORiNOCO system, or consult the user documentation that came with the suspect device to investigate whether the device allows for adjusting its operating frequency.

If ORiNOCO is the Source of Interference

ORiNOCO has been designed to operate in any type of physical environment using the license-free radio band assigned to wireless Industry, Scientific and Medical (ISM) applications.

Although the ISM band allows unlicensed usage of the band, local radio regulations as defined by national governments or institutions may restrict the use of this band to specific users only, or distinguish between "primary" and "secondary" users.

In the USA the Federal Communications Commission (FCC) has identified a number of primary users. In situations where ORiNOCO communications interfere with devices operated by primary users, the FCC regulations require the ORiNOCO user to stop the interference either by re-orienting the ORiNOCO antennas and/or equipment, or disable the ORiNOCO network.

A list of primary users in the USA is available from the FCC.