Impact of Weather on Smart Wireless networks

This document provides information on the impact of different weather events on Smart Wireless networks. We will explore the impact of rain, fog, snow and sandstorms.

Introduction

Emerson's Smart Wireless networks use the IEC 62591 *Wireless*HART® standard to transmit data from field devices through the gateway and into the control system. The wireless network operates using the 2.4 GHz frequency band. These networks were designed to use low power radios that operate up to ½ mile (800 meters). To cover larger areas Emerson's Smart Wireless networks use self-organizing mesh technology to send information from device to device by the best available routes to get the field device information to the gateway. This allows for multiple "hops" between the field device and gateway greatly increasing the area a Smart Wireless network can cover.

These networks were designed to be used in most environments around the world. In many places this means working in harsh environments and extreme weather. This white paper explores the impact that different weather may have on the Smart Wireless network and show that these devices will perform well in all but the most extreme weather.

Link Margin

In order to form a strong wireless network that will operate in an ever changing environment networks are designed with appropriate levels of link margin. Link Margin is the difference between the receiver's sensitivity and the actual received power measured in decibels (dB). When a Smart Wireless network is installed according to best practices link margin will be at least 10 dB. This means that a Smart Wireless network could experience up to 10 dB of attenuation and still have reliable communication at distances specified in the best practices. Many things can cause attenuation including changing weather events such as rain, fog, snow and sandstorms.

Rain

The closer the size of particles in the air, including rain drops, is to the wavelength of the wireless signal the more attenuation is caused. Networks using the 2.4 GHz frequency band have a wavelength of 4.9in (12.5cm). Rain drops have a size of between 0.02 to 0.33 in (0.05 to 0.8 cm). Empirical data shows that even during heavy rainstorms of 6 in/hr

(15.2 cm/hr), only minor attenuation of 0.05 db/mile (0.08 db/km) is seen on a 2.4 GHz wireless signal. Emerson's Smart Wireless networks are designed to have device to device lengths of up to ½ mile (800m) with link margins of 10 db. Because of this, rain will have no impact on reliability and distance of a properly planned and installed Smart Wireless network.

Fog

The size of water droplets in fog are significantly smaller than raindrops, ranging from 10 to 1000 times smaller. Because of this, the impact on 2.4 GHz systems is much less for fog than rain. Data shows that the attenuation of dense fog is in the range of 0.01 db/mile (0.016 db/km). This is well below the attenuation impact that will be noticeable in well designed Smart Wireless networks that are installed according to best practices.

Snow

Due to the larger size of snowflakes compared to rain drops, attenuation due to snow is generally higher than that of rain. However the value is still low compared to the link margin of Smart Wireless systems. A heavy snow fall can cause up to 0.1db/mile (0.16 db/km) attenuation of a 2.4 GHz system. This is still much lower than the link margin of a well designed Smart Wireless network so falling snow will not impact either reliability or distance.

Snow can also cover a wireless antenna, causing attenuation. Attenuation through snow is close to 1 db/ft (3 db/meter). Even with this level of attenuation you would need multiple feet of coverage at both the sending and receiving transmitter's antenna to impact reliability or distance of a well planned Smart Wireless network. The below picture is of a Smart Wireless device that is covered with snow and ice and still successfully sending its signal to the Smart Wireless Gateway.

Sandstorms

Sandstorms suspend solid particles in the air that are on average of 0.007in (0.02cm) in diameter. Because of this small size in comparison to the wavelength of 2.4GHz which is 4.9in (12.5cm), attenuation due to sandstorms is small. Data shows that the attenuation due to sandstorms is greater for higher frequency signals, around 0.12 db/mile (0.2db/km) for 20 GHz and less for lower frequencies such as 2.4 GHz. This attenuation is much less than the link margin of a well planned Smart Wireless network.

Summary

Smart Wireless networks have been designed to be used in harsh environments around the world, including challenging weather conditions. Emerson's Smart Wireless networks operate at 2.4 GHz which is only minimally impacted by weather events such as heavy rainfall, dense fog, snow and sandstorms. Smart Wireless networks planned according to best practices have more than enough link margin to remain operating at high levels of reliability and at distances specified in the best practices when these events occur. To ensure that your Smart Wireless network will operate correctly no matter what the weather make sure you install the network according to best practices which can be found in our document "IEC 62591 WirelessHART® Engineering Guide": http://www2.emersonprocess.com/siteadmincenter/PM%20Central%20Web%20Documents/EMR_WirelessHART_SysEngGuide.pdf

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