Interference Hunting with the Field Master Pro™ MS2090A

Introduction

We live in a wireless world. The number and scope of wireless devices in our world continues to grow exponentially. This evolution of technology has brought many great advantages, from the convenience of wireless headphones, to the security of smart homes, and even to new, life-saving medical devices. But with increased traffic over the air comes increased complications in managing the traffic to avoid interference. Interference can cause lower data transfer rates, unreliability, and even full network failure, which can then lead to customer dissatisfaction, increased operations costs, and even safety hazards in certain situations. It’s important for any network manager or regulator to quickly identify sources of interference and remove them to ensure communications between people and devices function for their intended purposes.

Anritsu’s Field Master Pro™ MS2090A handheld spectrum analyzer is loaded with tools ideal for interference hunting and analysis. The 110 MHz of analysis bandwidth and real-time spectrum analysis (RTSA) software enable detection of pulsed signals as narrow as 5 ns. The interference finder audio tone enables signal location, and IQ capture and analysis tools enable signal identification. And that’s just the beginning. In conjunction with Anritsu’s other tools, like Mobile InterferenceHunter™ and the PIM Hunter™ probe, the Field Master Pro MS2090A is the ideal instrument for detecting and eliminating interference in any network.

Sources of Interference

In general, sources of interference can be put into one of two categories: intentional and unintentional. Intentional interference could be as nefarious as a radar jammer during warfare to as simple as a store owner jamming cell signals to keep employees off their phones. In the first example, the lives of soldiers or even civilians could be at risk if radar systems are unable to find and track objects in the air. The second example is not nearly as life-critical, but basic cell jammers are illegal and can cost operators millions of dollars if not found and eliminated quickly. Either way, the interference is specifically designed to disrupt important communications and has a real impact on the people and businesses involved.

Unintentional sources of interference are probably more common and are often more difficult to identify. There are a wide variety of things that can interfere with communication systems, so narrowing it down to the specific cause is not always straightforward. Some common causes of unintentional interference are:

- Low-quality electronics that transmit harmonics or radiate spurs into restricted frequency bands
- Legacy devices transmitting in newly restricted frequency bands
- Illegally imported products such as wireless home telephones or repeaters
- Radiation from long cable television runs when the cable insulation breaks down over time
- Poorly planned networks that illegally radiate across international boarders
- Loose nails and cables, sheet metal, rusty bolts, etc. that cause passive intermodulation (PIM)

Even low-quality lighting elements can transmit sporadic energy that can look like an unwanted RF signal. Finding and eliminating these sources of interference takes precision tools and trained users.
Stages of Interference Hunting

Typically, interference hunting follows all or some of three different stages:

1. Spectrum monitoring / clearing
2. Signal identification
3. Interference location finding

The remainder of this document will discuss each of these stages and how the Field Master Pro MS2090A can be valuable tool.

Spectrum Monitoring / Clearing

In the spectrum monitoring / clearing stage, network monitors are looking for any sort of sporadic or unknown signals within a defined band. This is often done when new applications are set to take over a frequency band (usually before transmitters are turned on) and ensure the spectrum is clear of intended signals to make unintended signals easier to track. For example, when T-Mobile in the US purchased rights to transmit 5G signals in the 600 MHz band, it was important to ensure the removal of legacy broadcast television signals that were previously occupying those frequencies.

When using a spectrum analyzer like the Field Master Pro MS2090A for spectrum clearing, the key enablers are noise floor and sweep or capture speed. The Field Master Pro MS2090A has best-in-class noise floor up to 54 GHz, and when combined with extremely fast capture speeds provides a deep look at spectrum even at low power. With real-time capabilities, the Field Master Pro MS2090A performs up to 512 million FFTs per second, which enables it to capture a signal as narrow as 2.06 µs at full amplitude with 100% probability – and even capture signals as narrow as 5 ns. The real-time density display on the screen ensures no signal is missed, even signals within signals. For example, a CW jammer signal hiding in a modulated LTE signal would still be visible on the density display, however it would be hidden in a typical spectrum analyzer display.

Example of RTSA ability to see signals within signals

The Field Master Pro MS2090A is also compatible with Anritsu’s Mobile InterferenceHunter (MIH) MX280007A software. With the MIH built-in spectrum clearing mode, users can drive through a defined geography and create a map of signal levels in the band of interest. Any regions where the RF power exceeds a predetermined limit will be marked on the map and can be investigated for sources of interference.
Signal identification

Once it has been determined that there is an interfering signal and the timing and frequency of the signal is known, it is often helpful to identify some of the signals characteristics. Answers to these questions can tell a network operator a lot about the interference and possibly help identify the source:

- Is the signal repetitive?
- Does it have patterns of common modulation schemes, such as bandwidth and shape?
- Is it random in amplitude, phase, and frequency?
- Does it coincide in time with any known occurrence in the nearby environment (e.g., a car driving by or machinery in use)?

For example, the behavior of interference caused by a fluorescent light will look very different from a nefarious radar jammer. The most complete method to determining the answers to these questions is to break the signal down into I and Q parts and analyze it sample by sample. The Field Master Pro MS2090A has IQ capture and streaming options that allow users to capture up to hours of IQ data (bandwidth/sample rate dependent). That data can then be transferred to a PC and analyzed with post processing software (like Matlab or Bird Technologies’ SpectroX) where users can replay the signal to look for patterns, map the I and Q in a constellation diagram to identify basic modulation schemes, or even demodulate the signal for full signal identification. These types of patterns or modulation schemes can provide experienced network monitors with clues to help identify the source of interference.

Here is an example of a source of possible interference from simple handheld speed radar device. This is a device that anyone can purchase online and use to test the speed of a baseball pitch or golf swing. It transmits signals at around 24 GHz, which in many countries is near where weather radar and new millimeter-wave 5G signals are expected to reside. Looking at this signal in the Field Master Pro MS2090A RTSA mode shows the frequency and bandwidth characteristics. The spectrogram is even helpful in showing the movements of the signal over time. But to get the full characteristics of the transmitter, the Field Master Pro MS2090A enables the capture of IQ data to examine the movement of the signal in extreme detail. Zooming in on the beginning and end of each chirp shows brief out-of-band sweeps that could interfere with adjacent signals.
Capturing IQ allows users to zoom into signals for greater insights
Interference Location Finding

Once it is certain that interference is present and analysis of the signal has given clues of its origin, the final challenge is locating the source and taking necessary steps to eliminate it. The Field Master Pro MS2090A has several powerful tools for finding interference.

The first is the built-in Interference Finder measurement (Option 0025), where users select a sweep span and bandwidth for integrated power measurements. Utilizing the fast sweep speed and FPGA processing of the advanced Field Master Pro MS2090A hardware, the user hears an audio tone relative in pitch to the measured power in the sweep. Utilizing a directional antenna, the user can follow the audio tone as it gets higher and higher in pitch until they locate the offending transmitter.

Field Master Pro MS2090A Interference Finder provides audio tones to track interference

The Field Master Pro MS2090A’s fast sweep speed also supports use with the Anritsu PIM Hunter probe (P/N 2000-1884-R). In cases where PIM is causing issues with signal integrity, this PIM probe can be connected to the Field Master Pro MS2090A and used to pinpoint the precise location of the PIM source. The analyzer is tuned to the frequency of the intermodulating PIM tone and the signal output increases dramatically as the probe tip gets closer to the source.
With the MIH interference hunting tool, users can also walk or drive across a geographic area where interference is suspected. In the case of driving, it uses Power of Arrival (POA) measurements made using an omni-directional antenna mounted on a vehicle and driven over the geographic area of interest to pinpoint source of interfering signals. The source of the interference is identified by applying proprietary algorithms to channel power data captured with geo-located positioning information during an area drive in a vehicle. It also features a multi-emitter function for hunting interference where multiple known signals may also be transmitting.

One unique feature of the Field Master Pro MS2090A and MIH pairing is the new measurement of power flux density. With a calibrated antenna and by selecting the Flux Power measurement in MIH, the Field Master Pro MS2090A returns units in dBm/m²/MHz (or the power flux density). This is becoming the standard measurement for operators measuring cross-border interference and reporting violations to national regulatory bodies to request action.

For more on the Field Master Pro and MIH, see the Spectrum Clearing and Geo-Locating Legacy Signals application note (P/N 11410-01154).

**Conclusion**

In the ever-expanding world of wireless, interference is going to be inevitable. To maintain the integrity of networks, owners will have to be able to quickly and accurately observe, identify, and hunt interference. The Field Master Pro MS2090A handheld spectrum analyzer has the most comprehensive and powerful set of interference hunting tools.