Product Brochure

envision : ensure

MS27102A

Remote Spectrum Monitor

Introduction

With the rapid expansion of wireless communications, the need for robust networks relatively free of interference continues to grow. Capacity will be degraded by the presence of illegal or unlicensed signals that interfere with needed transmissions. These signals can be periodic or present at different frequencies over time, making the discovery and removal of these sources of interference a significant challenge.

A spectrum monitoring system will facilitate the identification and removal of illegal or unlicensed interference signals. By monitoring spectrum on a continual basis, problem signals can be identified as they occur in real time. Patterns of unwanted signal activity can also be examined, providing an efficient way to characterize and locate the source of the interference problem.

In addition to interference detection, spectrum monitoring is also used to characterize spectrum occupancy. Government regulators and operators are often interested in determining the usage rate for various frequency bands. Monitoring these frequencies provides the information needed to optimize spectrum for maximum utilization. Spectrum can be re-purposed for other applications or multiplexed with other signals using cognitive radio techniques.

Spectrum monitoring can also serve to enforce compliance with government regulations. Police, fire fighters, air traffic control, military, and emergency services must all have access to communications free of impediments and distortion. Compliance with spectrum regulations is often enforced by spectrum monitoring. Figure 1 shows the Remote Spectrum Monitor MS27102A deployed to monitor Positive Train Control (PTC) frequencies. PTC is being deployed worldwide to provide automated signaling for train control. The Remote Spectrum Monitor MS27103A can also be used inside the train to insure wireless integrity.

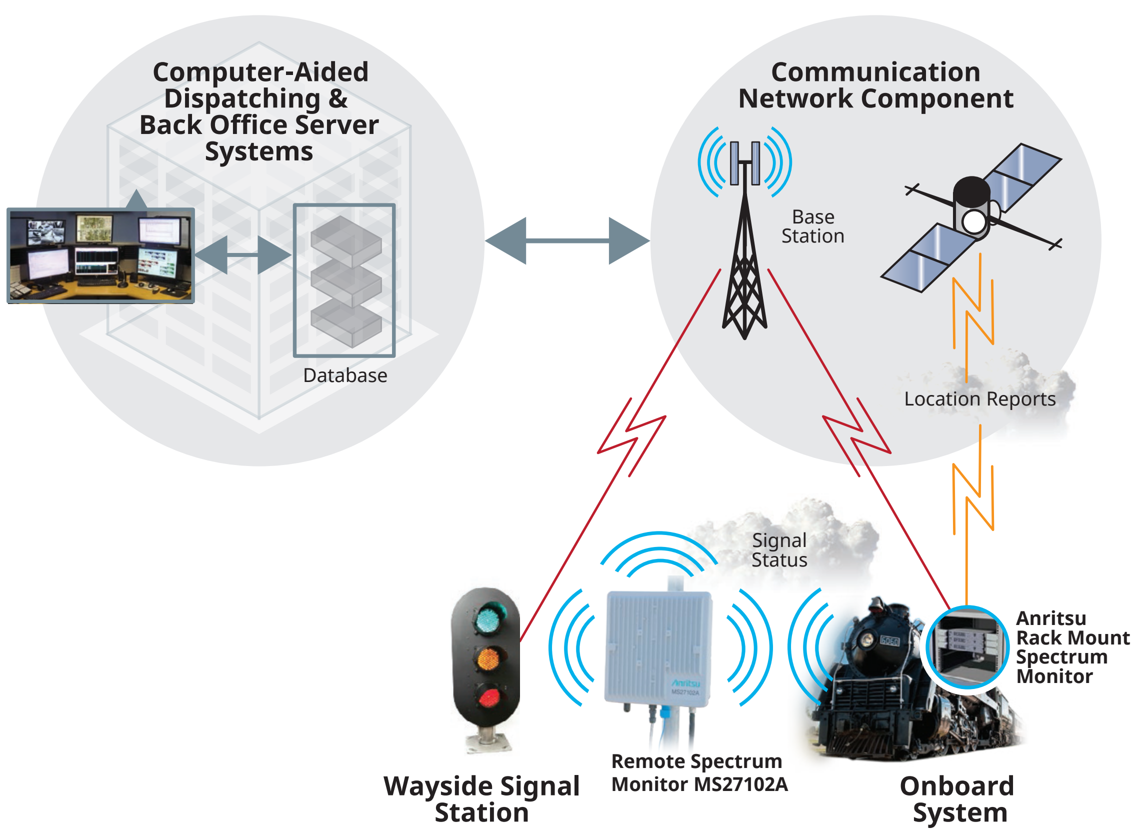

Figure 1. Spectrum Monitoring System Monitoring PTC Frequencies

Remote Spectrum Monitor MS27102A

Capable of sweeping at rates up to 24 GHz/s, the Remote Spectrum Monitor MS27102A allows capture of many types of signals. This includes periodic or transient transmissions as well as short "bursty" signals. Also featured is a high dynamic range, high sensitivity, and low spurious signals. This enables the Remote Spectrum Monitor MS27102A (shown here in figure 2) to reliably distinguish between low-level signals being observed and those signals generated by the monitor itself.

Figure 2. Remote Spectrum Monitor MS27102A Outdoor Spectrum Monitor (IP67)

Key Facts

- 9 kHz to 6 GHz
- Sweep speed up to 24 GHz/s
- Integrated web server to view, control and conduct measurements via a web browser (both Chrome and FireFox supported)
- Remote firmware update capable
- Watchdog timer to insure long-term stability for remotely deployed monitors
- IP67 rated for outdoor deployments
- Linux operating system
- Low spurious signals for accurate signal discovery
- 20 MHz instantaneous FFT bandwidth
- Low power consumption < 11 watts (input voltage 11 to 24 VDC)
- Integrated GPS receiver for monitoring location and for time synchronization applications
- Gigabit Ethernet available for high speed transmissions
- Interference analysis: spectrogram and signal strength
- Dynamic range: > 106 dB normalized to 1 Hz BW
- DANL: <–150 dBm referenced to 1 Hz BW, preamp On
- Phase noise: –99 dBc/Hz @ 10 kHz offset at 1 GHz
- IQ block mode and streaming with time stamping for TDOA applications
- Vision™ software optional for automated spectrum measurements, setting alarms and geo-locating signal sources

Designed For Remote Applications

With monitors potentially being deployed hundreds or thousands of kilometers from the control center, it is imperative that each probe remain operational under all types of conditions. The Remote Spectrum Monitor MS27102A is designed for robust field deployments, with capabilities for remote power cycling, automated system recovery protocols, and firmware updates "pushed" to the monitor remotely.

In the event of an application error or power fluctuation which causes an ongoing interruption in monitor communication, a re-boot policy is implemented to bring the remote probe back to its previous state. Under these conditions, the current firmware is automatically reloaded and online operation is restored. Instrument settings are also restored to their previous state.

A "Golden" firmware image is also placed on each unit in a secure location in memory. If for any reason the firmware in the unit becomes corrupted, a Golden Image is used to bring back full operation of the probe. This feature is particularly useful for remote firmware updates.

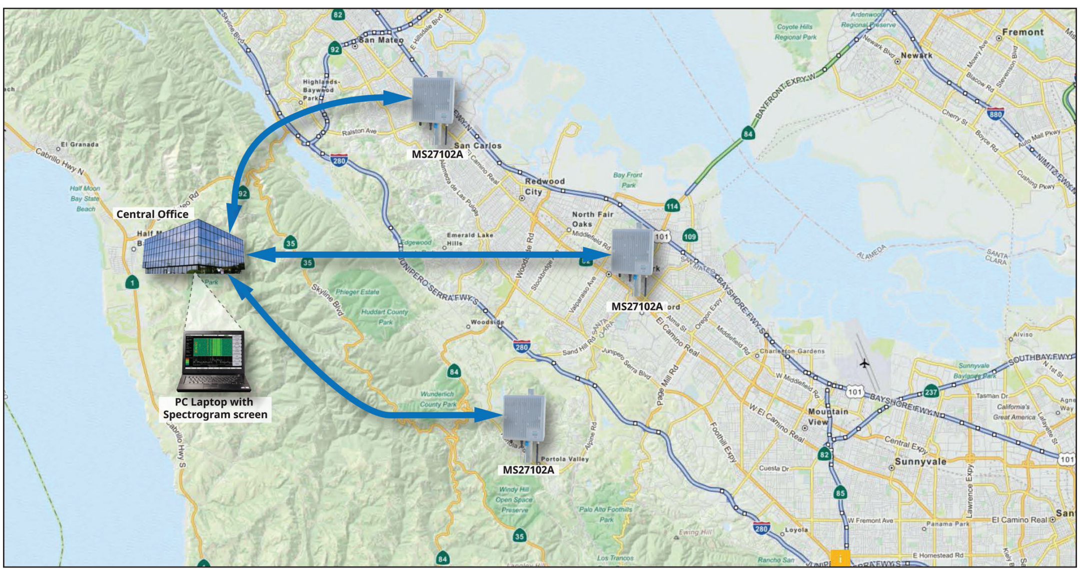

Figure 3. Remote Spectrum Monitor MS27102A Outdoor Spectrum Monitoring System

Remote Firmware Updates

There are several stages or "checks" performed when a new firmware package is downloaded remotely into the instrument. Once a new firmware image is downloaded to the monitor, various tests are performed to insure the code was properly transmitted without error (see figure 4). The code is then transferred into probe memory and installed. If a failure occurs during firmware acquisition or validation, the process is aborted and the failure status is returned to the user. If the firmware update is installed but does not operate correctly, the Golden Image automatically replaces the downloaded firmware to keep the remote monitor operational.

The Golden Image feature provides the user with assurance that the monitor stays in operation when changes are made to the code. Any bug fixes, updates, or user requested features can then be remotely sent to the spectrum monitor and safely incorporated.

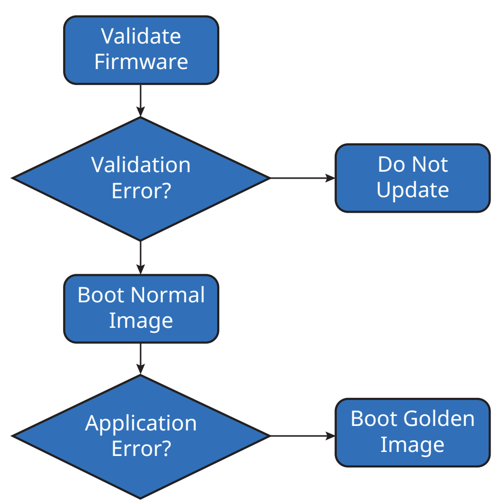

Figure 4. Firmware Update Policy

Integrated Web Server

The Remote Spectrum Monitor MS27102A features an integrated web server. Using an internet browser (Chrome and FireFox are supported), a user from anywhere in the world can log in to the spectrum monitor and control any of its features. This includes such parameters as frequency settings, resolution bandwidth/video bandwidth (RBW/VBW) control, reference level configuration, and many other settings relevant to the user's spectrum monitoring application. Trace data, spectrograms and other measurements can be viewed inside the browser window. A key advantage in using the web server is that it is platform agnostic. Any electronic device capable of rendering a browser will work with the web server. Users can utilize their PC/laptop, tablet, or even a smartphone to view the spectrum and change instrument settings. The Remote Spectrum Monitor MS27102A features Gbit Ethernet, allowing fast transfers of measurement data, and control information. Figure 5 shows the server application displayed on a smartphone.

See figure 6 below for the main user interface provided by the web server.

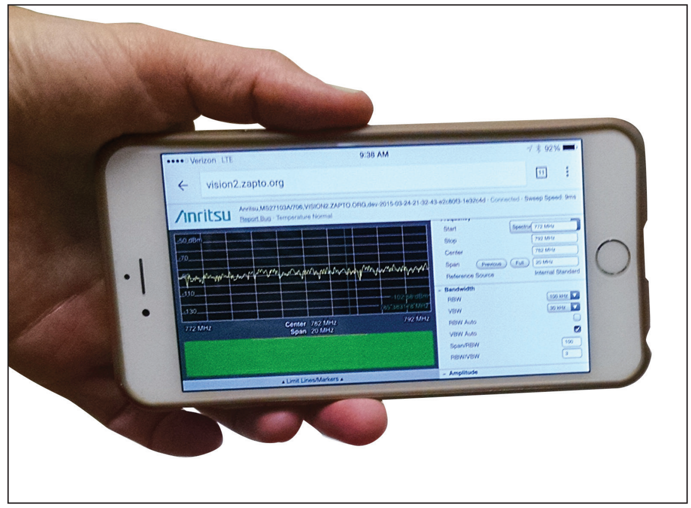

Figure 5. User Interface Displayed on Smartphone

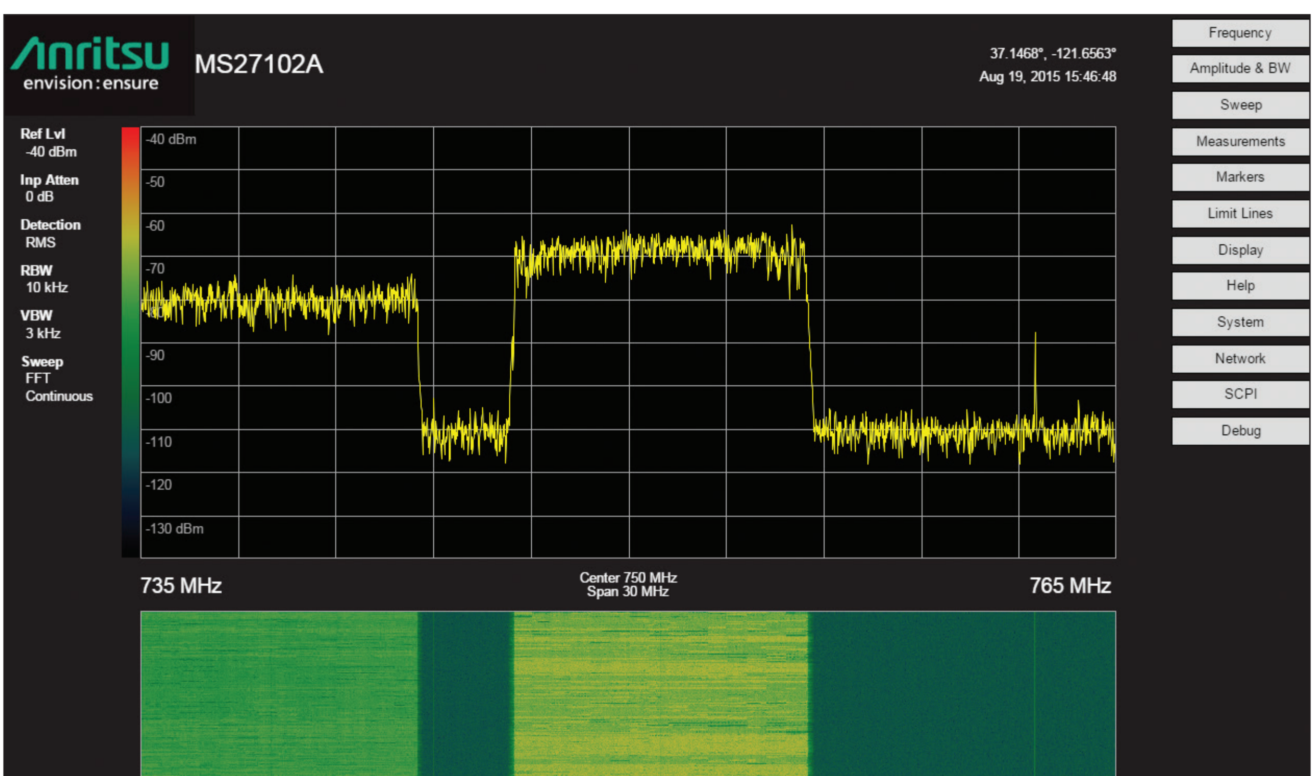

Figure 6. Screenshot of User Interface

Hardware

The Remote Spectrum Monitor MS27102A is rated to IP67 standards for outdoor deployment. It is dust tight (no ingress of dust) as well as water resistant. This involves testing the probe for immersion into as much as 1 meter of water for durations of up to 30 minutes. Each port on the unit is ruggedized and weatherized. Ports include power, RF Input, Gbit Ethernet, and GPS antenna. See figure 7 for port positioning. With an operating temperature range from –40 ºC to +55 ºC, a rugged weatherized case and splash proof design, the Remote Spectrum Monitor MS27102A works in the most extreme weather conditions with guaranteed performance anywhere and anytime.

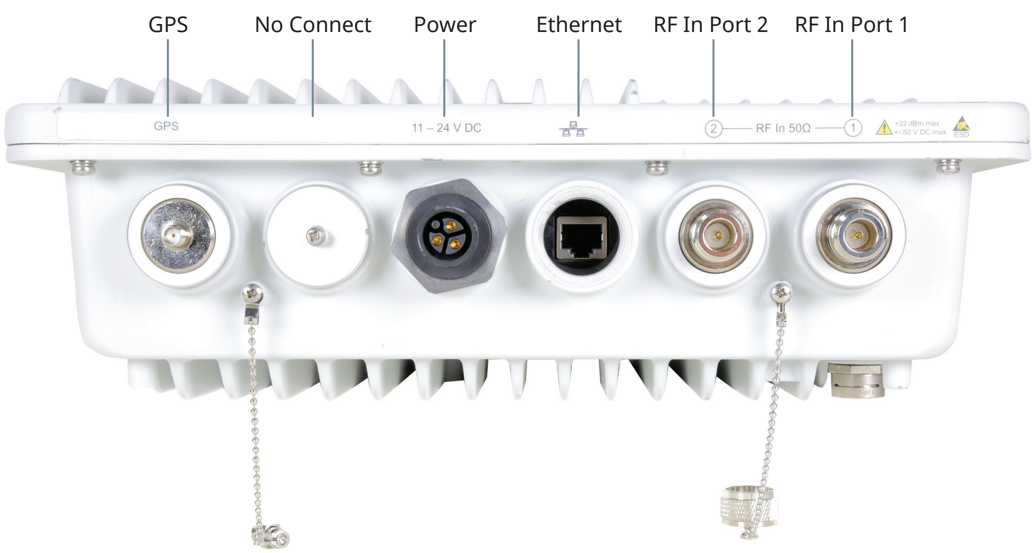

Figure 7. Port Locations on Remote Spectrum Monitor MS27102A (2-Port Option Shown)

The Remote Spectrum Monitor MS27102A comes with a mounting plate designed for field applications. With user supplied U-bolts or clamps, the mounting plate allows the monitor to be mounted on poles of varying diameters. Instructions for mounting your spectrum monitor can be found on the Anritsu website.

The probe uses power from a 11 VDC to 24 VDC source, typically consuming less than 11 Watts. The low power consumed facilitates the use of the spectrum monitor powered from solar cells.

Key Applications

- Radio surveillance and monitoring
- Detection of illegal or unlicensed transmitters, including AM/FM and cellular broadcasts
- Coverage measurements
- Spectrum occupancy and frequency band clearing
- Fast and efficient detection and elimination of interference sources
- Monitor jails/prisons for illegal broadcasts
- Security at military facilities, national borders, utilities, airports and other sensitive sites (see figure 8)
- Spectrum monitoring associated with lab RF testing
- Government regulators enforcing spectrum policies

Fig 8. Anritsu Remote Spectrum Monitor Positioned at Airport

Signals of Interest (SOI)

The wide variety of signals to be monitored fall into several categories. Each of these types of signals will be examined in some detail. These include:

- Intentional interference (including illegal or unlicensed broadcasts)
- Accidental interference
- Occupancy

Intentional Interference

Illegal AM/FM and video broadcasts are found in many parts of the world. These signals can be generated by pirated broadcast equipment or by using over-powered CB radios. Figure 9 shows a table listing interference complaints per year registered by the UK government communications regulator Ofcom. In this table, 'Critical service' refers to interference reports affecting life services communications.

Additionally, jammers are sometimes used for applications such as preventing students from cheating on tests, stopping employees from taking phone calls on company time or to prevent inmates from making illicit calls from prisons. Jammer signals can often leak out into the wider environment, interfering with other legitimate services. Mitigating these types of interference has become a high priority with government regulators.

YEAR	INTERFERENCE COMPLAINTS			
	Critical service		All other	
	London	Rest of UK	London	Rest of UK
1010	29	4	506	72
2011	35	0	424	69
2012	36	2	288	48
2013	21	5	179	93

Fig 9. Interference Complaints Published by Ofcom, Communications Regulator in the UK

Accidental Interference

A wide variety of accidental interference can be seen in the spectrum. A common problem is cable TV leakage. This type of leakage exists both from cable signals leaking into the outside environment as well as from external signals leaking into the cable system. This problem has been enhanced with the transmission of cable signals into frequency bands used by broadcasters and cellular operations (such as the 700 MHz LTE band).

Digital enhanced cordless telecommunications (DECT) phones also cause interference problems, particularly when people bring their wireless phones along when moving from one country to another. DECT frequencies vary in different countries, providing the potential for interference when transported. Figure 10 shows spectrum used in the US for certain cellular frequencies. DECT phones brought by travelers from other countries can often cause interference.

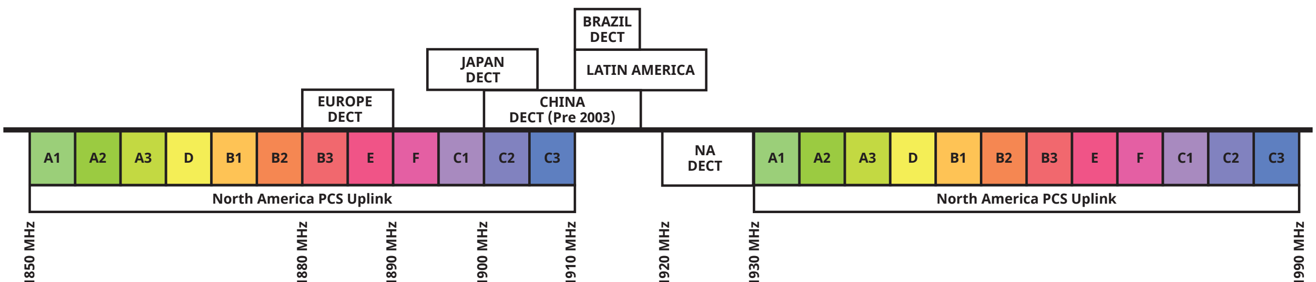

Figure 10. DECT Phones Improperly Used Can Cause Unintentional Interference

Other sources of interference include cellular signals (due to antenna tilt or azimuth errors), repeaters oscillating, wireless microphone problems, power equipment, and many others.

Occupancy

With the rapid demand for available spectrum from both public and private sectors, new ways are being investigated to allow more efficient use of various frequency bands. A lot of the spectrum is potentially underutilized, providing the opportunity to re-purpose existing spectrum with additional applications.

Spectrum occupancy measurements quantify the amount of usage of frequency bands over a given period of time (see figure 11). Remote spectrum probes are used to monitor a band of frequencies, recording spectral histories as a function of time.

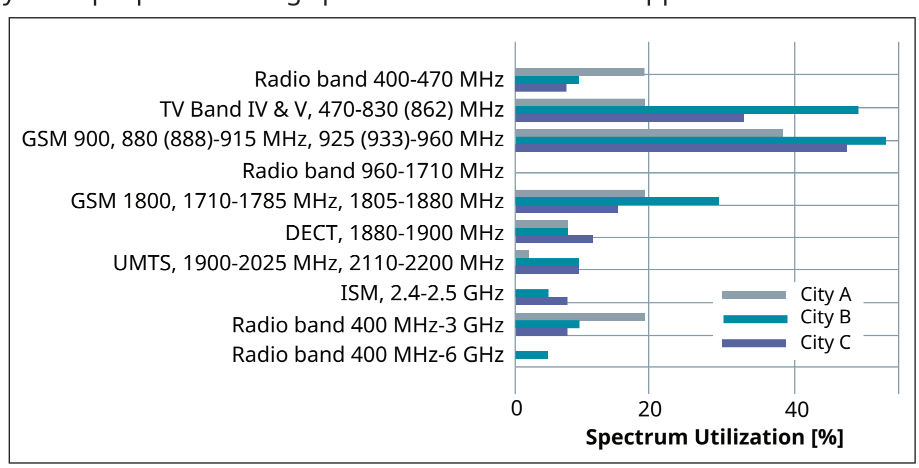

Figure 11. Spectrum Occupancy Measurement

Performance

The Remote Spectrum Monitor MS27102A is able to sweep the frequency spectrum at rates up to 24 GHz/s. This enables the user to capture intermittent or pulsed signals. Additionally, the spectrum monitor has an instantaneous FFT bandwidth of 20 MHz.

A typical use case for this feature is the real-time capture of the entire FM radio band (88 MHz to 108 MHz in most countries). The user can perform multiple FFT captures of FM signals, and storing the data for later playback and analysis. Unlicensed signals can then be identified using this information.

Multiple spectrum sensors can also be deployed to extend the RF monitoring capabilities and for geo-location of SOI. Using three or more probes, Anritsu's optional Vision software can be used to position an interferer signal or illegal broadcast. Additionally, IQ measurements are time stamped using the probe's GPS receiver. This enables the user to employ their own software using Time Distance of Arrival (TDOA) capabilities to find interferers, given each IQ measurement is precisely time stamped. See figure 12 for TDOA example.

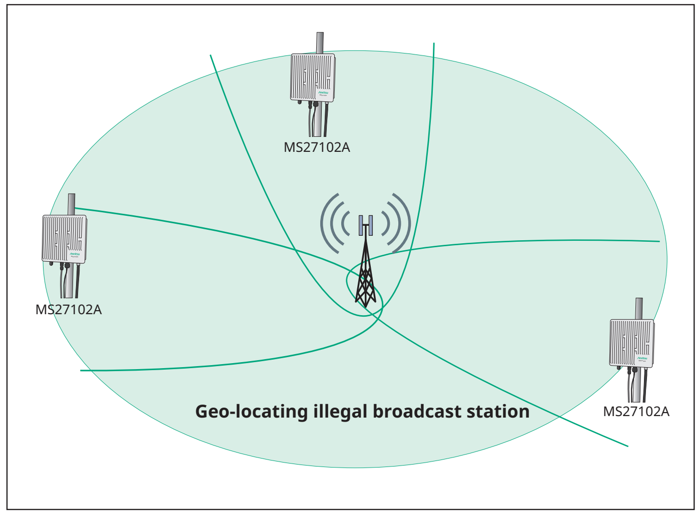

Figure 12. TDOA for Geo-Locating Interference Signal

Communications

Communications with the Remote Spectrum Monitor MS27102A are conducted via wired Ethernet. Each monitor is shipped with a pre-programmed static IP address. After making a connection with this IP address, users can then change the address to a different static IP. Alternatively, dynamic host configuration protocol (DHCP) or domain name system (DNS) may be used. See Anritsu's Ethernet Configuration Guide for details.

All commands and inquiries with the Remote Spectrum Monitor MS27102A are done using SCPI commands. Anritsu provides a user manual listing each SCPI command, a description of each command and the correct syntax for each command. Users may also download a text file containing SCPI commands to be executed in sequence on the probe.

Summary

The Remote Spectrum Monitor MS27102A is the ideal solution for unwanted signal detection. Using Anritsu's Vision software or your own applications, users can identify patterns of interference, record spectrum history, and geo-locate the sources of problem signals. Together with other Anritsu interference mitigation products, Anritsu provides the total solution to your interference mitigation needs.

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Specifications are subject to change without notice.

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