

# Vision MX280001A Software



## Introduction

Spectrum monitoring systems facilitate the identification and removal of interference signals that degrade network capacity. 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 also serves 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 spectrum monitors surrounding a prison facility looking for illegal transmissions.

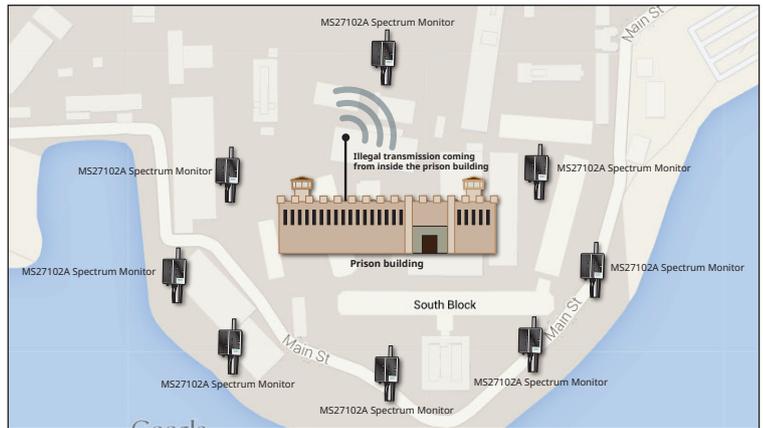


Figure 1: Monitoring for illegal transmissions from prison facility

## Vision MX280001A Software Overview

The Vision MX280001A software platform works with Anritsu’s spectrum monitoring hardware to automate the process of collecting measurement data, as well as providing useful information about network health and use of the spectrum. Using multiple hardware probes covering a wide geographical area, Vision software presents a comprehensive picture of spectral activity to assist users in monitoring the spectrum for unusual activity. Figure 2 shows a typical signal monitoring system with Anritsu Remote Spectrum Monitor MS27102A positioned for maximum coverage.

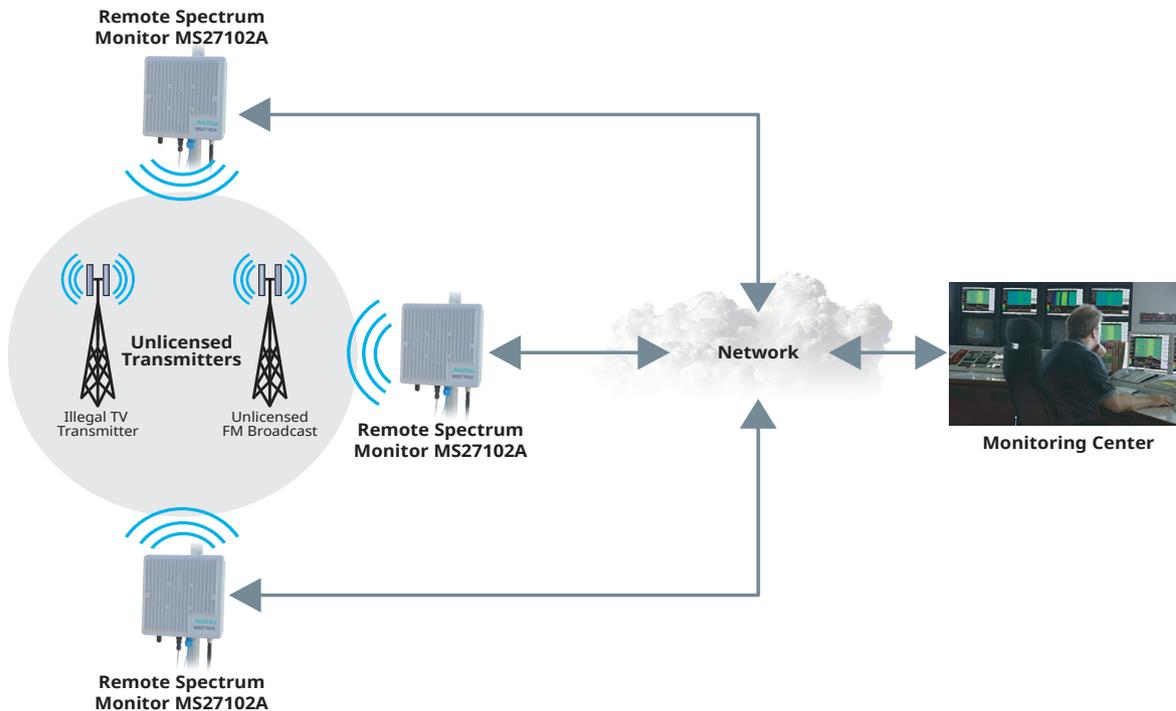


Figure 2: Spectrum monitoring system

Vision software facilitates a variety of applications used for spectrum monitoring systems. One important application includes determining the presence of interferers in a network that can degrade communication services. Cellular operators in particular are vulnerable to such interference that manifests itself in slower data rates and dropped calls. In most cases, network performance is compromised on the uplink frequency bands (communication from the mobile unit to the base station). However, network quality of service can also be impacted by interference on the downlink channels. This type of interference can be prevalent at the cell periphery where the power levels of the interference signals approximate those transmitted by the base station itself.

Another important application for Vision software is the detection of illegal or unlicensed broadcast signals. Illegal broadcasters may set up AM/FM, cellular, or other types of transmissions that must be identified and ultimately located. By using spectrum monitors, unlicensed broadcasts can be tracked, processed, and stored in a database for further examination and potential use in legal proceedings. See Figures 3 and 4 for important spectrum monitoring applications.

### Other applications include the following:

- Inform spectrum policy – accumulate historical spectrum data to determine percent time of occupancy
- Monitor jails/prisons for unauthorized transmissions
- Monitor borders, airports, nuclear facilities, and other sensitive areas
- Railroads – monitor spectrum for potential interference of positive train control (PTC) signals
- Satellite reception interference detection
- Interference monitoring at large venues such as stadiums, malls, etc.
- White space monitoring
- Indoor monitoring (board rooms, embassies, and other sensitive facilities). See Figure 5.



Figure 3: Stadium monitoring



Figure 4: Airport frequency monitoring



Figure 5: Indoor transmissions detection

## Vision Software – How it Works

Vision software is an optional program that runs on a PC using the Windows® operating system (Windows 7 or 10). This software provides control and automation capabilities when used with Anritsu’s Remote Spectrum Monitor hardware. Vision software is composed of two components, Vision Monitor and Vision Locate, responsible for monitoring and geo-locating interference signals (respectively). Additionally, a high-speed port scanner is available for rapidly switching between spectrum monitor RF In ports and scanning individual frequency channels. The high-speed port scanner also enables the user to view multiple traces on a display monitor with rapid refresh rates. Each performs a wide range of spectrum monitoring and control applications designed to mitigate interference problems and detect unusual signal activity.

## Vision Monitor

The Vision Monitor program is the visible user interface for monitoring remote spectrum activity. It provides a listing of all hardware monitors in the system along with a graphic overview of system health. A screenshot of the main user interface for Vision Monitor is shown in Figure 6.

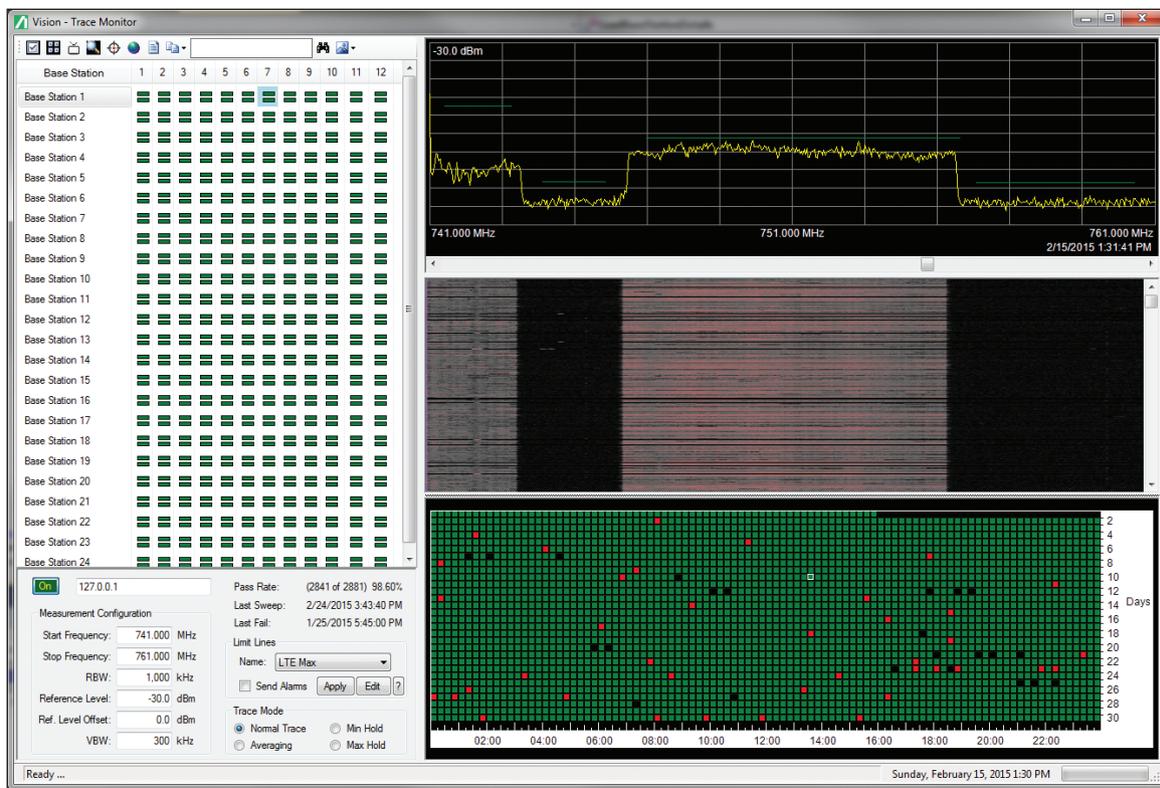


Figure 6: Vision Monitor screen

Shown here is a listing of the deployed monitors, with the ability to view both “real-time” and historic measurement trace and spectrogram data.

Vision Monitor performs a wide range of spectrum monitoring duties including:

- Measurement acquisition
- Data storage
- Threshold setting/alarm generation
- Reporting

Users can set up the Vision Monitor program to take automatic measurements for all spectrum monitors. The measurements are in turn uploaded into a database for further review. The database is updated with new data while old information is periodically purged according to user settings. Functions are also available for archiving, copying, and compressing the database. See Figure 7 for illustration.

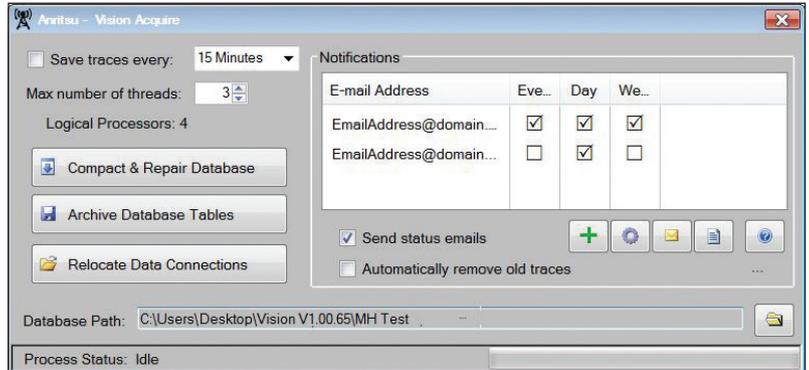


Figure 7: Vision Monitor measurement and database control

With Vision Monitor, users can set up limit lines for triggering alarms, view spectrum history, and change measurement parameters of individual or groups of spectrum monitor probes. The program makes heavy use of intuitive graphics to indicate the presence of interference or other signals of interest. Additionally, searches both in real time and over history can be made to indicate patterns of interference. In some cases, interference may only occur at certain times of the day or certain days of the week. It is important to be able to capture the signal, identify the pattern, and subsequently hunt for the signal location at the appropriate times. In addition to trace data, spectrograms can be viewed to indicate changes in frequency over time for suspicious signals.

For each remote monitor, Vision Monitor is capable of collecting data from as many as 24 input RF ports. This can be ideal for cellular systems with multiple sectors and multiple frequencies per sector. Figure 8 shows a screen shot of the user interface with multiple monitors overlaid on a map. Both GoogleMaps and OpenStreet Map are available. Using this map, alarm threshold violations can be easily seen with color changes on the probe indicating a frequency threshold violation at that site. If needed, automated email alerts can be sent to any email address provided. These alerts can be emailed in real time or sent as summary reports on a daily or weekly basis. These reports are a great tool for provide a snap shot of the network's health and provide time-stamped indications of when a suspicious signal might be present.

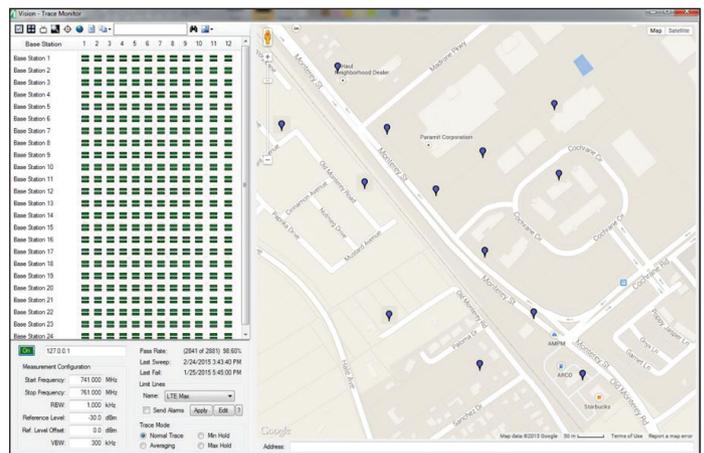


Figure 8: Monitor positions overlaid on map

### Vision Locate

Vision Locate is an optional program used with Vision Monitor. Once an interferer or suspected illegal signal is identified, a geo-location algorithm is employed to fix the approximate position of the signal. This enables the user to narrow down the signal location, minimizing the time and expense for pin-pointing its position. A sample map is shown in Figure 9 showing the suspected interference position using Power of Arrival (POA). In this window, the probe locations are indicated by the red squares. The interference position is identified by the concentric circles.

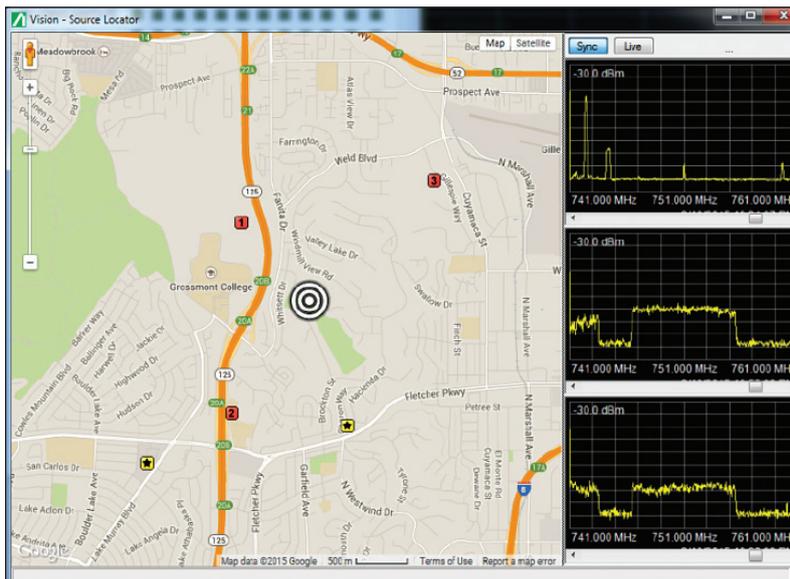


Figure 9. Geo-location of signal on map overlay

For interference that may have occurred in the past, users can also use historical data for positioning the signal of interest when POA geo-location is used. A search can be done for alarm violations that occurred at any of the spectrum monitor probes in the network. Using three probes in the vicinity, the interference position can be geo-located.

Three types of geo-positioning algorithms can be used to locate signals of interest. The POA algorithm is used to position the interference signal when low bandwidth or non-modulated transmission are to be located. A second positioning technique is available called Time Difference of Arrival (TDOA). TDOA uses the time that a given signal arrives at each receiver. Based on the time differences measured, a calculation is made for the interference position. In general, TDOA offers superior results to POA; however, TDOA cannot be used for CW and other types of non-modulated signals. For each of these types of measurements, POA and TDOA, three or more probes must be in the vicinity to detect the signal of interest in order to correctly triangulate the position.

A third type of geo-positioning available is Angle of Arrival (AoA). AoA provides bearing information for the position of a transmitted signal. One advantage of AoA over TDOA/POA is that only one location is needed in order to perform geo-location. Both TDOA and POA required three positions situation in a triangle format. However, AoA only provides bearing information, ie the signal of interest that lies somewhere along a trajectory line from the position of the AoA monitor to the interference signal's position. Directional antennas are used by the AoA algorithm to computer bearing lines. Power is automatically measured at each antenna port where calculations are made based on received signal strength.

## High-Speed Port Scanner (Option 407)

The High-Speed Port Scanner scans multiple RF In ports and multiple frequency channels measured with Anritsu Remote Spectrum Monitors. Although the High-Speed Port Scanner works well in scanning individual frequency channels on a given RF In port, this option is uniquely capable of quickly scanning multiple RF inputs on Anritsu's line of remote spectrum monitoring products. The Remote Spectrum Monitor MS27103A (either the standard 12-port or optional 24-port RF In version) in particular is the perfect match for the High-Speed Port Scanner where measurement speed is critical. The High-Speed Port Scanner can also be used with the Remote Spectrum Monitor MS27102A (2-port option) and the Remote Spectrum Monitor MS27100A when equipped with the 4-port switch accessory.

A key feature of the option is its multi-trace viewer (see Figure 10). A large number of traces can be viewed simultaneously in a single display. The number of traces that can be viewed is limited only by the size and resolution of the display monitor used.

Refresh rates for scanning 12 RF IN ports are typically less than one second.

When scanning multiple spectrum monitor units, a multi-threading process is used. This keeps the display refresh rates under one second even when multiple spectrum monitors are used. However, rates seen are dependent on sweep settings (RBW/VBW) in the unit and the network used. A slow network for transmitting the measurements back to the monitor could delay refresh rates in the display.

For the traces shown in the display monitor, marker and delta-marker functions are available for the spectrum traces. Each trace display also allows limit lines to be used to indicate alarm situations. Both Upper Limit and Lower Limit lines are available. Lower Limit line are applicable for detecting the absence of signals in a given channel bandwidth. When an alarm situation is present, the trace on the monitor is colored red.

To assist users in identifying individual spectrum plots, host names and descriptions can be used. Additionally, individual parameter settings (RBW/VBW, Ref Level, use of preamplifier, etc.) can be selected.



Figure 10. High-Speed Port Scanner multi-trace display

Other features included with the High-Speed Port Scanner are listed below (Figure 11).

- **Save-on-Event** – users have the option to continuously save all measurements or only the measurements when limit line violations occur
- **Save Measurements to Spreadsheet** – all measurement data can be saved in spreadsheet format (CSV) using either comma, semi-colon, or tab delimiter formats
- **GPS Location** – a selection is available to save GPS date/time/position coordinates as measurements are scanned. This feature is particularly helpful when measurements are taken in a mobile environment.
- **Save Sweep Traces** in an output file
- **Scan on System Startup** – an option exists to begin saving immediately when a PC/laptop is connected to a powered Anritsu Remote Spectrum Monitor
- **Re-use Configuration Parameters** – the last configuration file (channel/port settings, measurement parameters) can be automatically loaded when the application is started
- **Set Individual File Sizes** – set the maximum file size to be used for measurement storage before a new file is created
- **Memory Storage Settings** – set the minimum free space allowed before old files are deleted to make room for new measurements
- **Statistics** – show numbers of threshold violations, measurement count, and pass rates
- **Channel Power** – display channel power on screen

Note that both Channel Power and Occupied Bandwidth are automatically saved in a CSV file.

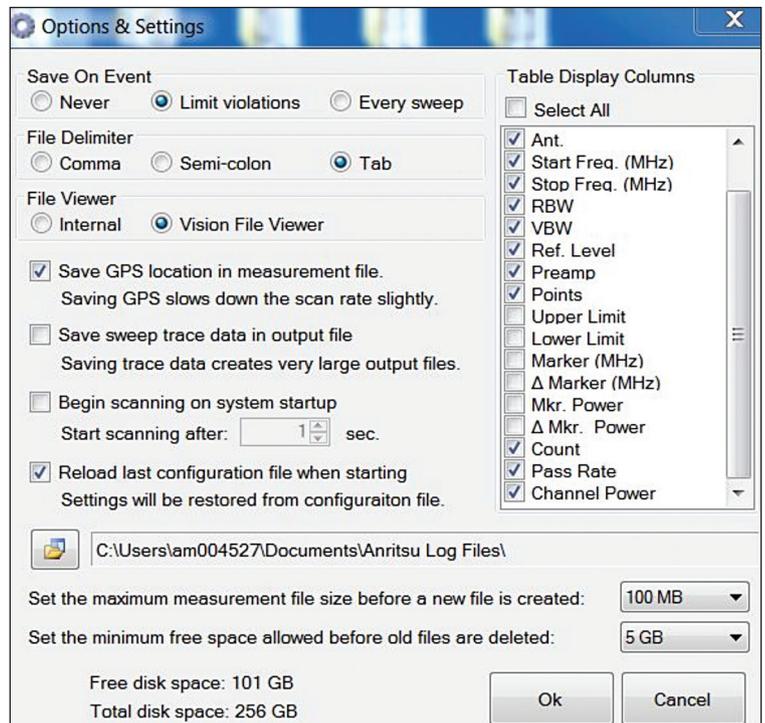


Figure 11. Options and Settings Windows

## File Viewer

The File Viewer is a free utility included with the Vision software download. As part of the Vision installation, the 'FileViewer.exe' program is placed in the Vision software's installation directory. Spectrum channel measurements saved as part of the High-Speed Port Scanner option can be viewed with the File Viewer. See Figure 12 for the File Viewer display.

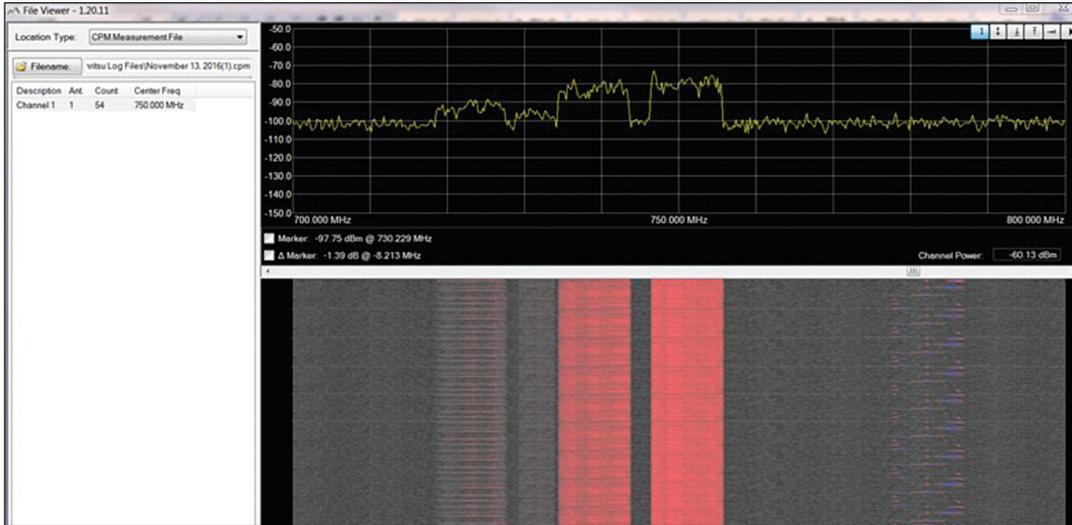


Figure 12. File Viewer Utility

A spectrogram is available to display measurements as a function of frequency and time. Channel Power for each trace is displayed at the bottom right-hand corner of the trace display.

Files saved either on a remote PC/laptop, in the spectrum monitor's flash memory, or on a USB stick attached to the monitor can easily be retrieved and displayed on the viewer. In addition, the following display features are available to the user.

- **Marker and Delta-Marker** functions
- **MAX or MIN Hold** for all traces accumulated
- **Average Trace Display** – averages over all traces accumulated and display one average
- **All Trace Display** – shows all traces taken during a set period for a selected channel
- **Video Playback** – automatic playback of traces with start, stop, slower, faster, play from beginning and play from current time position features

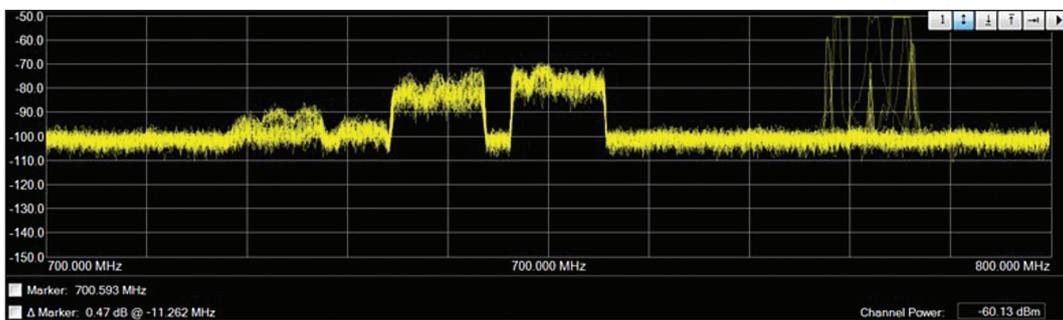


Figure 13. Trace Viewer display of all traces measured.  
*Notice intermittent signals on the right-hand side of trace.*

## Customer Upgrades

Customers wanting to upgrade their Vision software with the High-Speed Port Scanner must load firmware version V2016.11.2 or higher. The High-Speed Port Scanner is freely downloadable from the Anritsu website. However, it will only work with Anritsu spectrum monitors where a purchase of the Scanner option has been made.

## 3D Spectrogram

Used with the File Viewer available for viewing .RSM or .CSM measurement files, the 3D spectrogram enables user to view measurements as a function of both time and frequency. Figure 14 below shows an example of the 3D spectrogram display.

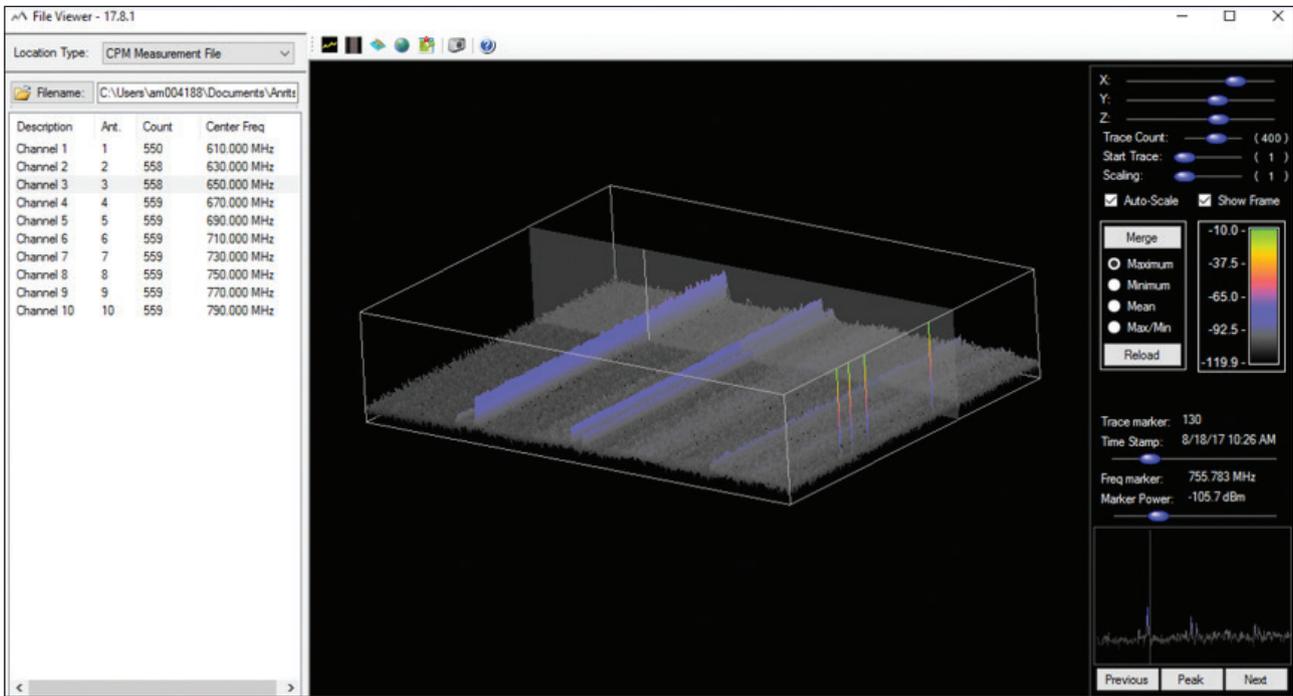


Figure 14. File Viewer 3D spectrogram

## Spectrum Occupancy (Option 485, Prerequisite Option 400)

Given the exponentially increasing cost of spectrum, government regulators are interested in measuring various frequency channels to determine how much a given spectrum is utilized. Underutilized frequencies could then be repurposed for other applications. An additional application for spectrum occupancy measurements is cognitive radio. Using various cognitive radio algorithms, multiple applications can be multiplexed in time for a given range of spectrum.

Anritsu's spectrum occupancy implementation allows users to set power threshold levels to determine whether a given frequency channel is to be considered occupied. In this way, noise and very low-level signals can be eliminated from the analysis. Occupancy reports can also be generated for all frequency bands measured. Figure 15 shows an example of an occupancy measurement in the FM radio band.

Signal Broadcast Identification (Requires Option 400)

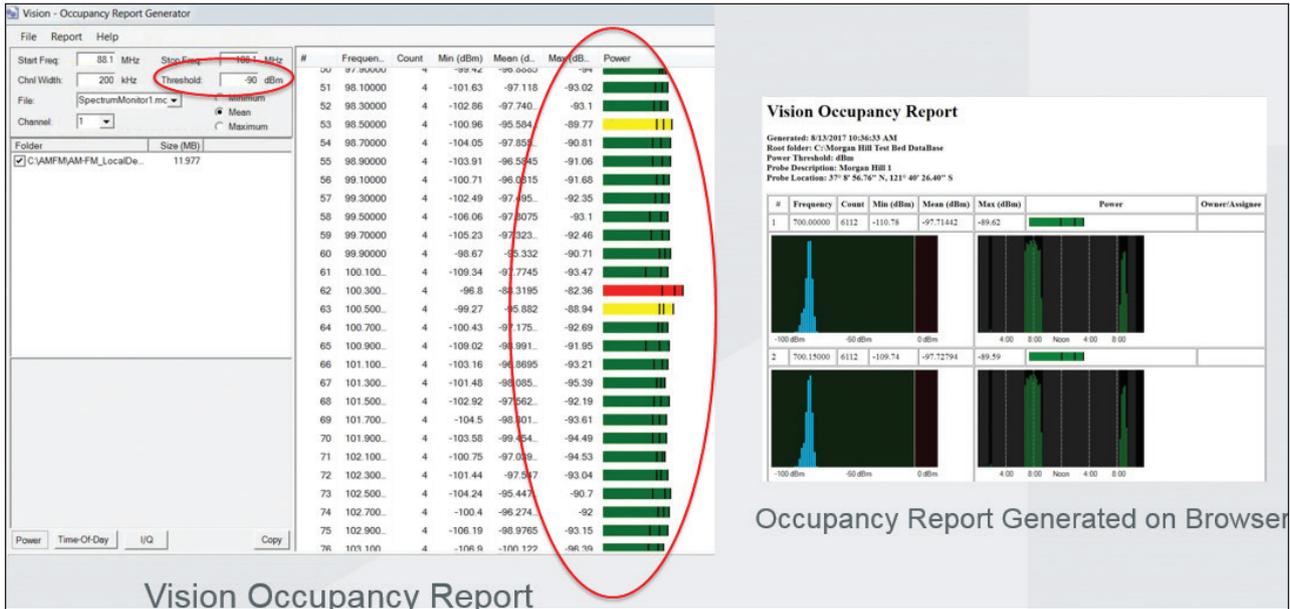


Figure 15. Spectrum occupancy display (requires Option 400)

When hunting interference signals, it can be helpful to have real-time information for what type of signal is authorized to be in a given channel. Regulators monitoring their frequency bands also want to view what signals are present and whether the transmissions fall within the bandwidth allocated to a particular vendor.

Anritsu’s Signal Broadcast Identification feature is designed to meet these needs. Using publically available data, users can import this information so that it is readily available once the spectrum is viewed. Whatever information that is available from the government regulator (or other agency involved with broadcast licensing) can be used. Broadcast information generally supplied include:

- Identity of broadcaster
- GPS coordinates of broadcaster’s transmitter position
- Frequency band in which a broadcaster is allowed to transmit
- Power level authorized for the transmission
- Type of signal broadcast (commercial radio, public safety, cellular, etc)

It should be noted that not all country’s regulators supply this information and the types of information provided on the authorized broadcaster may vary. See Figure 16 for an example illustration of the broadcast identification feature.

Signal Broadcast Identification (Requires Option 400)

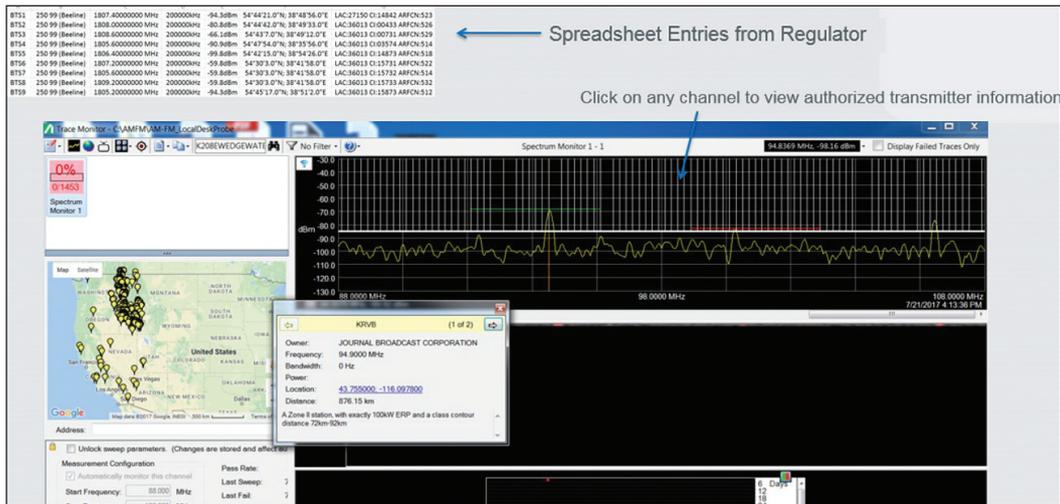


Figure 16. Signal Broadcaster Identification

Broadcaster information can be imported into Vision Monitor (option 400) via a spreadsheet (CSV format) and overlaid on the trace display. Additionally, users can plot the positions of all the transmitters on a map. Users can simply ‘mouse-over’ an icon on the map to see a pop-up window showing all information available on that transmitter.

In addition to broadcaster information supplied by the regulator, users may want to plot and identify other positions. For example, a cellular operator may want to identify the positions and frequencies of all their BTS transceiver equipment. This information is often considered proprietary and would be used only within the operator’s system. Interference hunters working for the operator could use this information to know their proximity to BTS equipment to prevent over-powering their receivers.

AM/FM Demodulation (Option 479)

AM/FM is offered as a stand-alone option, which can be downloaded with the Vision software installation package available on Anritsu’s website. The AM/FM option provides analysis information included AM modulation quality and FM deviation metrics.

The AM/FM demodulation option enables the user to remotely capture AM/FM signals and listen to the signals via their PA/laptop. The AM/FM signals can also be saved as WAV or MP3 files to be played at a later time (Figure 17).

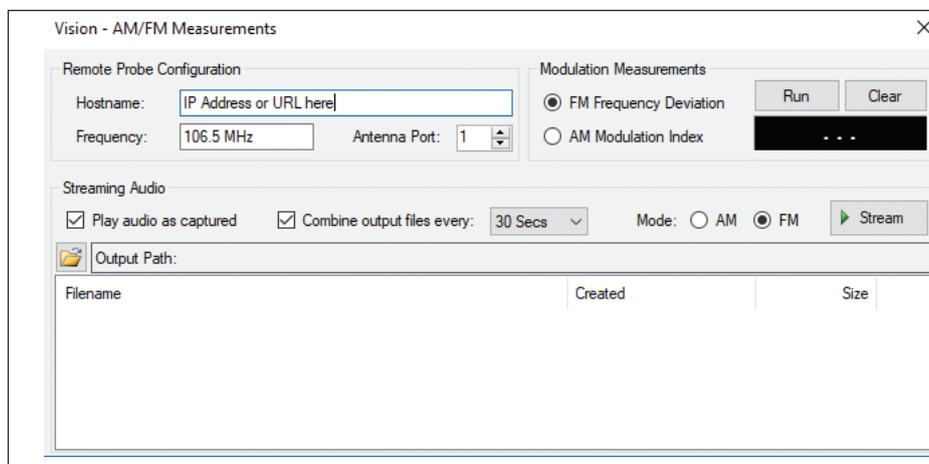


Figure 17. AM/FM display for measurements and streaming

## Signal Broadcast Identification (Requires Option 400)

FM deviation graphs can also be shown (Figure 18). The graphs are available via the Remote Spectrum Monitor/Vision API only and are not included in the stand-alone application. The AM/FM demodulation option is offered only in API format for system integrators and other customers. Typical specifications for AM and FM measurements are shown here:

- FM Deviation (Up to 75 KHz, 5% Accuracy), Input Level > -90 dBm
- AM Modulation (0 to 100% Depth, 5% Accuracy), Input Level > -90 dBm

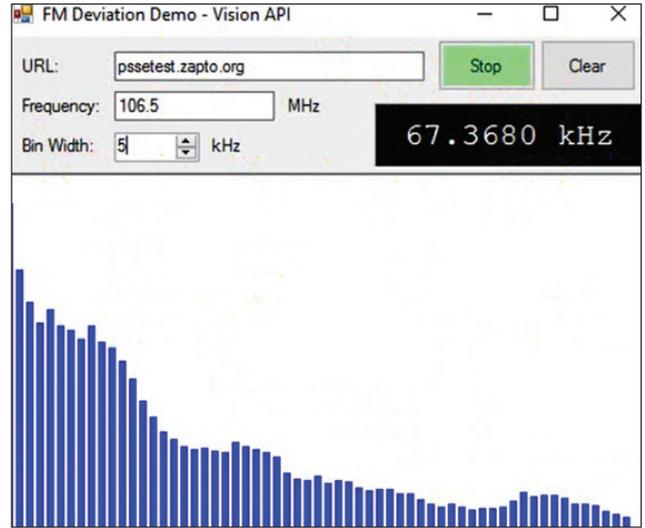


Figure 18. FM Deviation Measurement Display (graph available only through the API)

## Coverage Mapping (Option 486, Prerequisite Option 407)

The coverage mapping option (Figure 19) provides wireless service providers, public safety users, land mobile radio operators, and government regulators with the ability to map signal information over any given outdoor geographic area. The coverage mapping tool is offered with the following features:

- Ability to scan over multiple frequency channels
- Measurements can be taken based on RSSI, Channel Power, or Occupied Bandwidth
- Google Maps and OpenStreetMap are supported
- The color scale used for mapping can be changed to match the dynamic range of signals measured
- Measurements can be imported into Google Earth for further display and analysis

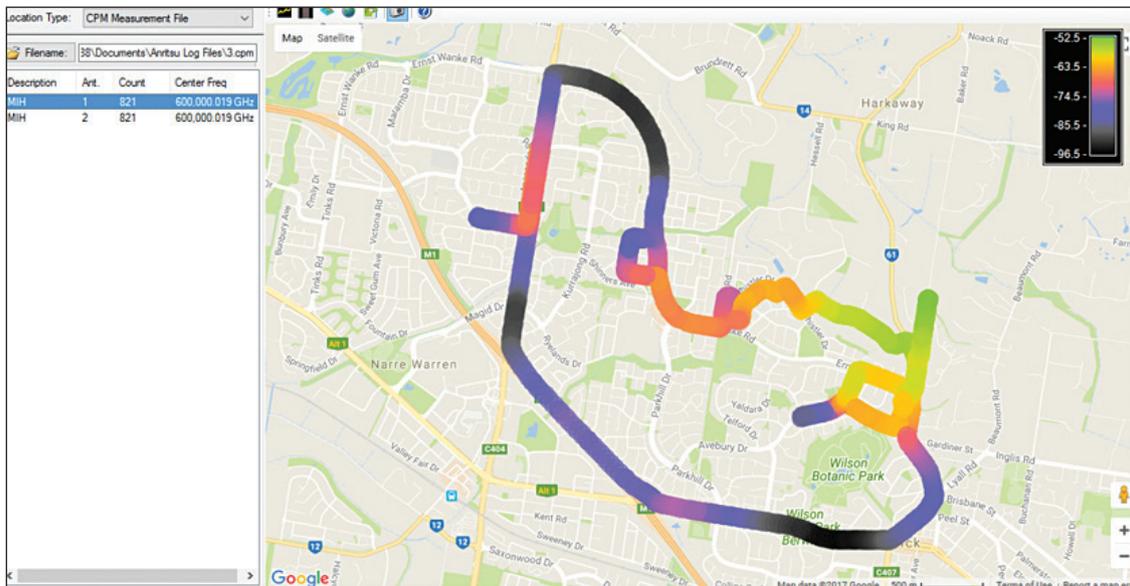


Figure 19. Coverage mapping display (Option 486)

## Remote Spectrum Monitoring Hardware

Anritsu offers several spectrum monitoring systems designed for both indoor and outdoor environments. The Remote Spectrum Monitor MS27101A (half-rack unit, Figure 27) is ideal for indoor use where space is at a premium. The Remote Spectrum Monitor MS27102A monitor (Figure 28) is an outdoor IP67-rated probe that can be positioned on towers, rooftops, or poles. It is ideally used to monitor for both interference and unusual signal activity. The Remote Spectrum Monitor MS27103A (Figures 29 and 30), which maintains 12 or optionally 24 RF inputs, is designed specifically for cellular systems or in applications requiring multiple RF inputs. The solution is also ideal for monitoring for interference in DAS environments. Finally, the Remote Spectrum Monitor MS27100A (Figure 31) is our OEM model, offered to customers interested in private labelling. All platforms are designed for stability, sweep speed and low spurious signals.



Figure 27. Remote Spectrum Monitor MS27101A (half-rack)



Figure 28. Remote Spectrum Monitor MS27102A



Figure 29. Remote Spectrum Monitor MS27103A (multi-port)



Figure 30. Remote Spectrum Monitor MS27103A (24-Port RF Input option shown)



Figure 31. Remote Spectrum Monitor MS27100A OEM Model

### Key Features for Remote Spectrum Monitor Platform:

- 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 ensure 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 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

### MS2090A Field Master Pro

In addition to the Remote Spectrum Monitors listed above, Vision Monitor (option 400) and the Vision High-Speed Port Scanner (option 407) is also available on the MS2090A spectrum analyzer.

Key Features for the MS2090A Field Master Pro:

- 9 kHz to 9/14/20/26.5/32/43.5/54 GHz
- DANL: -164 dBm (with preamp)
- TOI: +20 dBm (typical)
- Analysis bandwidth: 100 MHz
- Amp range: DANL to +30 dBm
- Phase noise at 1 GHz: -110 dBc/Hz @ 100 kHz offset (typical)
- Demodulation: 5GNR, RF, and modulation quality plus SSB signal analysis
- Resolution bandwidth (RBW): 1 Hz to 10 MHz
- RTSA bandwidth: 22, 55, 110 MHz (option dependent)
- Amplitude accuracy: < 14 GHz  $\pm$  1.3 dB ( $\pm$  0.5 dB, typical)
- Zero span with 60 ns minimum span



## Summary

In order to minimize expense while preserving network integrity, a highly automated process is required. Vision software provides an efficient user-friendly method for monitoring frequencies and alerting the user when unusual signal activity is present. By identifying patterns of interference, recording spectrum history, and geo-locating the position of target signals, Vision software is the perfect solution for your interference mitigation needs.

## Ordering Information

The Vision software application can be downloaded from the Anritsu website. In order to use Vision, an Anritsu spectrum monitor must be purchased and enabled with the option. Note that in order to use Vision Locate for geo-location, Vision Monitor must also be purchased.

MS27100A-0400	Vision Monitor enabled on MS27100A
MS27100A-0401	Vision Locate enabled on MS27100A (Requires Option 400)
MS27100A-0407	High-Speed Port Scanner enabled on MS27100A
MS27100A-0479	AM/FM Demodulation
MS27100A-0485	Spectrum Occupancy (Requires Option 400)
MS27100A-0486	Coverage Mapping (Requires Option 407)
MS27101A-0400	Vision Monitor enabled on MS27101A
MS27101A-0401	Vision Locate enabled on MS27101A (Requires Option 400)
MS27101A-0407	High-Speed Port Scanner enabled on MS27101A
MS27101A-0479	AM/FM Demodulation
MS27101A-0485	Spectrum Occupancy (Requires Option 400)
MS27101A-0486	Coverage Mapping (Requires Option 407)
MS27102A-0400	Vision Monitor enabled on MS27102A
MS27102A-0401	Vision Locate enabled on MS27102A (Requires Option 400)
MS27102A-0407	High-Speed Port Scanner enabled on MS27102A
MS27102A-0479	AM/FM Demodulation
MS27102A-0485	Spectrum Occupancy (Requires Option 400)
MS27102A-0486	Coverage Mapping (Requires Option 407)
MS27103A-0400	Vision Monitor enabled on MS27103A
MS27103A-0401	Vision Located enabled on MS27103A (Requires Option 400)
MS27103A-0407	High-Speed Port Scanner enabled on MS27103A
MS27103A-0479	AM/FM Demodulation

MS27103A-0485	Spectrum Occupancy (Requires Option 400)
MS27103A-0486	Coverage Mapping (Requires Option 407)
MS2090A-0400	Vision Monitor enabled on MS2090A
MS2090A-0407	High-Speed Port Scanner enabled on MS2090A

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