

Spectrum Monitoring and Surveillance

Anritsu MS2710XA Remote Spectrum Monitor Series

Protecting your investment with active interference mitigations

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Synopsis

Presentation: Spectrum Monitoring and Surveillance - Protecting your investment with active interference mitigations

Over the past few years, large investments have been allocated for frequency spectrum through government auctions. This auction process has been replicated in many parts of the world. To protect the investment value of this spectrum, it is imperative that operators provide quality service to their customers. With superior voice/data quality in the network comes increased demand for that service.

A key impediment to good network performance is the presence of interference. Sources of interference include illegal or unlicensed broadcasters, repeaters, DECT phones, jammers, wireless microphones and cable TV leakage. Interference can also come from other cellular networks, particularly along national borders where competing services are subject to different regulatory entities.

A spectrum monitoring system will facilitate the identification and removal of interference signals that reduce 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.

The Anritsu MS2710xA platform of spectrum monitors provides high performance real-time monitoring and IQ streaming of the radio spectrum. The Vision™ software platform works with Anritsu's spectrum monitoring hardware to automate the process of collecting measurement data, providing useful information about network health and use of the spectrum. Using multiple hardware probes covering a wide geographical area, Vision presents a comprehensive picture of spectral activity to assist users in monitoring the spectrum for unusual activity.

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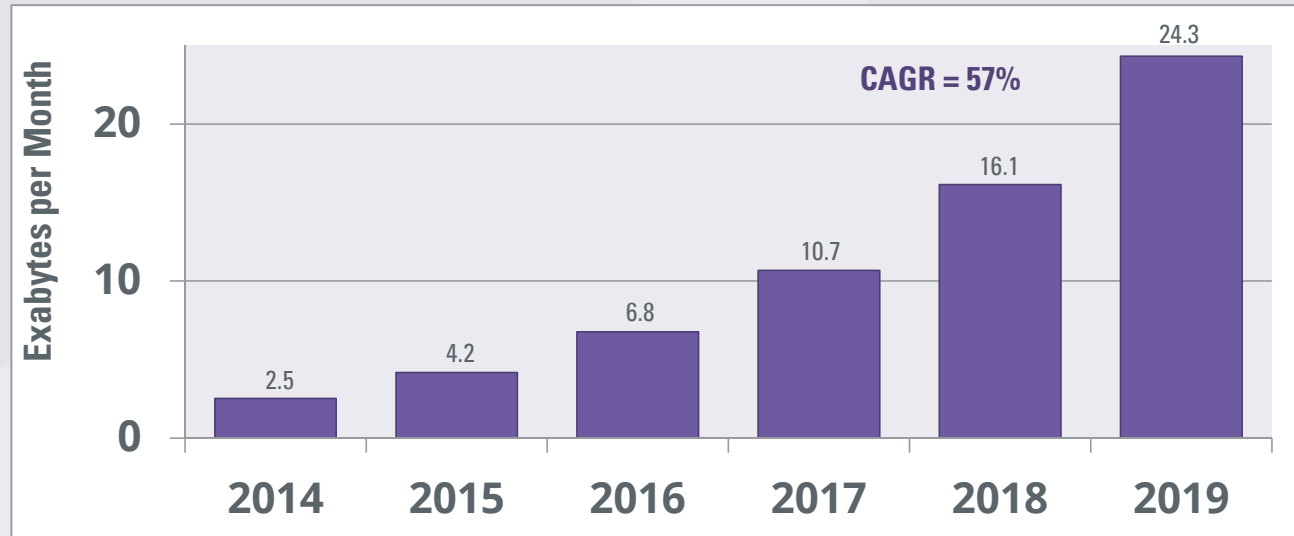


The Growing Importance of Spectrum Monitoring

DID YOU KNOW

6X
BY 2019

Global demand for wireless capacity will increase six-fold by 2019.



* Cisco VNI Global Mobile Data Traffic Forecast Update (Feb. 2015)

Why 24/7 Spectrum Monitoring Is Needed

- ➔ **Discover and facilitate removal of interference sources**
 - ▶ Interference may be intermittent, periodic, and frequency-agile
 - ▶ Need the ability to examine logged data
 - Patterns of unwanted signal activity
 - Characterize unwanted signal behavior
 - Locate the interference source
- ➔ **Characterize spectrum occupancy**
 - ▶ Determine usage rate for targeted frequency bands
 - ▶ Identify under-utilized spectrum for potential sharing or repurposing
- ➔ **Enforce compliance with government regulations**



Key Markets and Applications

Operators / Spectrum Users

- Coverage measurements and interference mitigation
 - Cellular service providers
 - Public safety radio
 - Positive train control
 - Wireless backhaul
 - Satellite communications
 - Television and radio Broadcasters

FCC / NTIA / EU Regulators / ITU-R

- Policy making and enforcement
- Illegal / unlicensed radio or TV broadcasts
- Spectrum occupancy and utilization

Security and Defense Agencies

- Espionage / Counter-espionage
- Signals intelligence
- Security at military facilities, national borders, utilities, airports and other sensitive sites
- Illicit broadcasts from jails/prisons

Cellular Operators - Spectrum Assurance

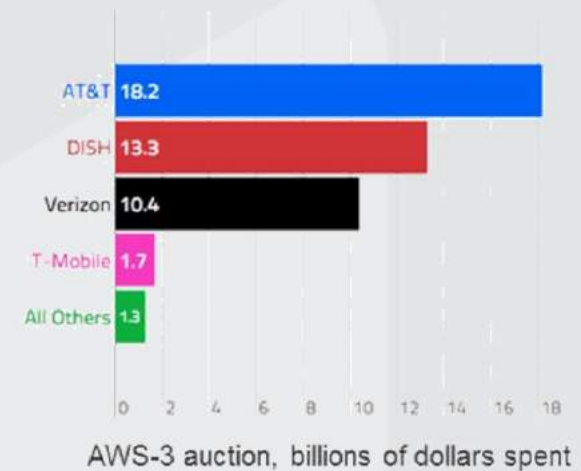
➔ In recent AWS-3 auctions for 65 MHz of spectrum, \$44.9 billion was raised

➔ Previous worldwide auctions sample

- ▶ Germany - \$98 billion USD
- ▶ India - \$13 billion USD
- ▶ UK - \$50 billion USD

➔ Interference mitigation is a top priority for optimizing network performance

FCC AWS-3 Auction



Stadium and Event Monitoring

➔ Spectrum Occupancy

- ▶ Scan several hundred frequencies to search for unoccupied frequency bands

➔ Interference

- ▶ Although communication problems may not be caused by other signals, interference must be ruled out

➔ Music Events

- ▶ Detect and create alarm in case of interference situations



Defense / Security

➔ Monitoring of Critical Infrastructure

- ▶ Embassies, Power Plants, Political Summits
- ▶ the fight against terrorism, organized crime,

➔ Compatible with many agency specific software

- ▶ Generate IQ data on demand via GUI
- ▶ Streaming or block transfer of IQ data
- ▶ process IQ data into e.g. Matlab

➔ Important features

- ▶ Save On Event
- ▶ Interference “Pre-Trigger” Capability
- ▶ Dynamic Scan of broad frequency bands
 - Use multiple antennas to scan frequency ranges sequentially
 - Stand alone capability via battery pack



Embassies



COMINT post

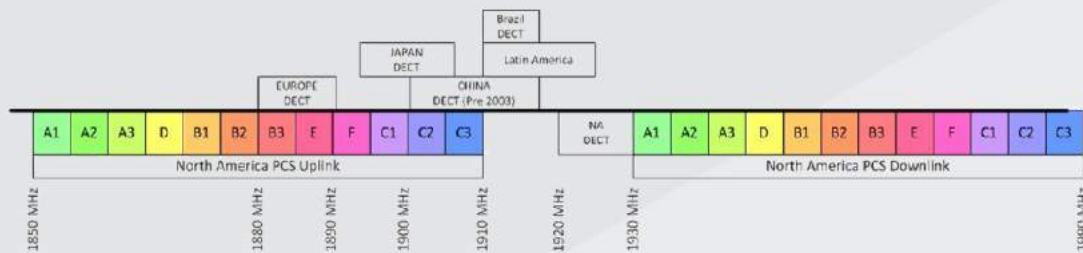
Critical Infrastructure Monitoring

➔ Border Patrol

- ▶ National boundaries often experience interference from operators from adjacent countries

➔ Sea- and Airports

- ▶ Ships arriving often use various frequencies that interfere with cellular signals
- ▶ DECT phones are a major problem
- ▶ illegal UAV (drones) with CATVs



MS27103A



BTS Rack Mount System

Satellite Operators

- ➔ **Monitor spectrum to insure area free of interference**
 - ▶ **Satellite operators may have to pay a penalty if customer service is jeopardized**
 - **Signal drop due to rain and snow fields**
 - **illegal transponder use**
 - **GSM re-broadcast or similar**
- ➔ **Key features needed**
 - ▶ **See multiple probes in parallel**
 - ▶ **Set spectrum masks for each frequency band**
 - ▶ **Utilize save-on-event**
 - ▶ **Generate reports**



- ➔ **Satellite farms are used for the following:**
 - ▶ **TV/Radio/Broadcast stations**
 - ▶ **Corporate networks, internet backbone**
 - ▶ **Maritime, In-flight applications**
 - ▶ **Mobile communications**

Government Regulators

➔ Regulators monitor

- ▶ Unlicensed use of spectrum
- ▶ Interference from adjacent frequency bands
- ▶ Spectrum occupancy

➔ Illegal Transmissions

- ▶ Prisons / jails,
- ▶ military facilities,
- ▶ borders, sensitive installations

➔ ComSystem band monitoring

➔ Law Enforcement

- ▶ Police, Special Forces, Military, Customs Force e.t.c.



MS27102A mounted on pole monitors airport frequencies for unwanted signals

Performance – Insight – Reliability - Scalability

➔ Revolutionary solutions for remote spectrum monitoring

- ▶ Generates greater return on multi-billion dollar spectrum investments
- ▶ Maximizes network capacity to meet customer demand
- ▶ Automates method of surveillance, interference detection and policy enforcement
- ▶ Designed to remain operational under adverse conditions in remote locations
- ▶ Delivers greater flexibilities and cost efficiencies to network management



MS2710xA Remote Spectrum Monitors

A family of platforms to meet your needs



MS27101A
Half Rack x 1U
Single Input



MS27103A
Full Rack x 2U
12 or 24 Input Ports



MS27102A
IP67 Outdoor Rated
1 or 2 Input Ports



OEM
PCB Only

The MS27101A Remote Spectrum Monitor

- ➔ Small footprint and low-profile
- ➔ Suitable for indoor or protected operating environments
 - ▶ Mount in vehicle for mobile spectrum monitoring
 - ▶ Carry in rucksack
- ➔ Ideal for spectrum occupancy measurements requiring max. POI
 - ▶ High-density deployments with multiple units operating in parallel
 - ▶ Dedicated signal monitoring hardware for each RF input
- ➔ Operates from DC or AC power



Rack Layout

The MS27102A Remote Spectrum Monitor

- ➔ **IP67 rated for outdoor use**
 - ▶ No dust ingress
 - ▶ Waterproof to one meter
- ➔ **Brackets available for mounting on wall or pole**
- ➔ **Two RF inputs available**
 - ▶ Multiple antennas for wider frequency coverage
 - ▶ Directional/angular diversity
 - ▶ Spatial diversity
- ➔ **Requires Ethernet connection and DC power**



The MS27102A is designed to maximize network capacity and is ideal for outdoor monitoring applications under harsh conditions

MS27103A Remote Spectrum Monitor

- ➔ Suitable for indoor/protected operating environments
- ➔ 12 or 24 RF inputs available
- ➔ Ideal for long term monitoring of numerous receive feeds
 - ▶ Multi-sector Base Transceiver Station (BTS) with multiple carriers per sector
 - ▶ Distributed Antenna System (DAS)
 - ▶ SatCom downstream monitoring
- ➔ Operates from DC or AC power

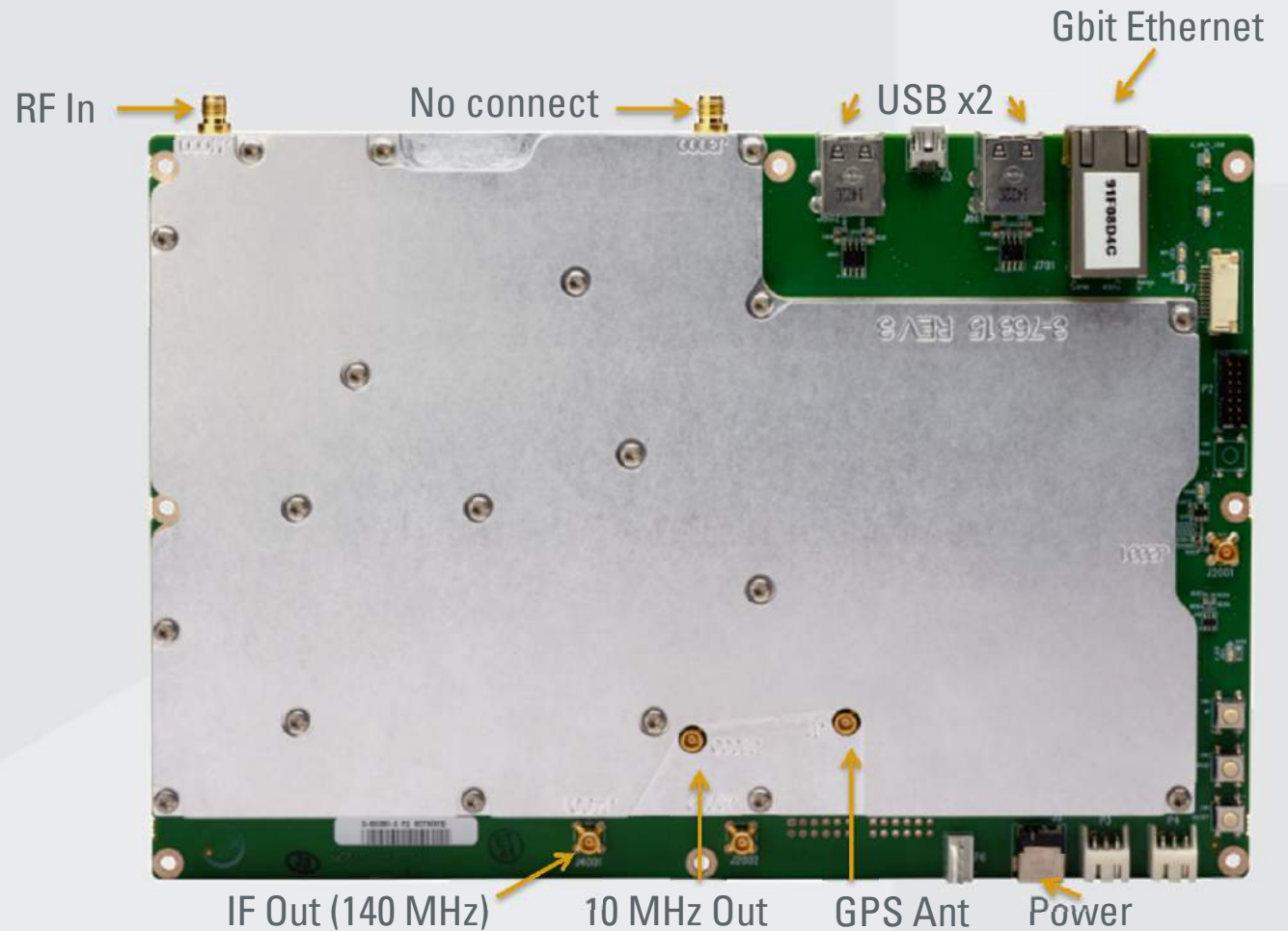


The MS27103A is ideal for cellular operators and DAS systems to ensure a high level of network performance



OEM Printed Circuit Board

- ➔ Very small form factor
- ➔ Ideal for System Integrators and Value Add Resellers

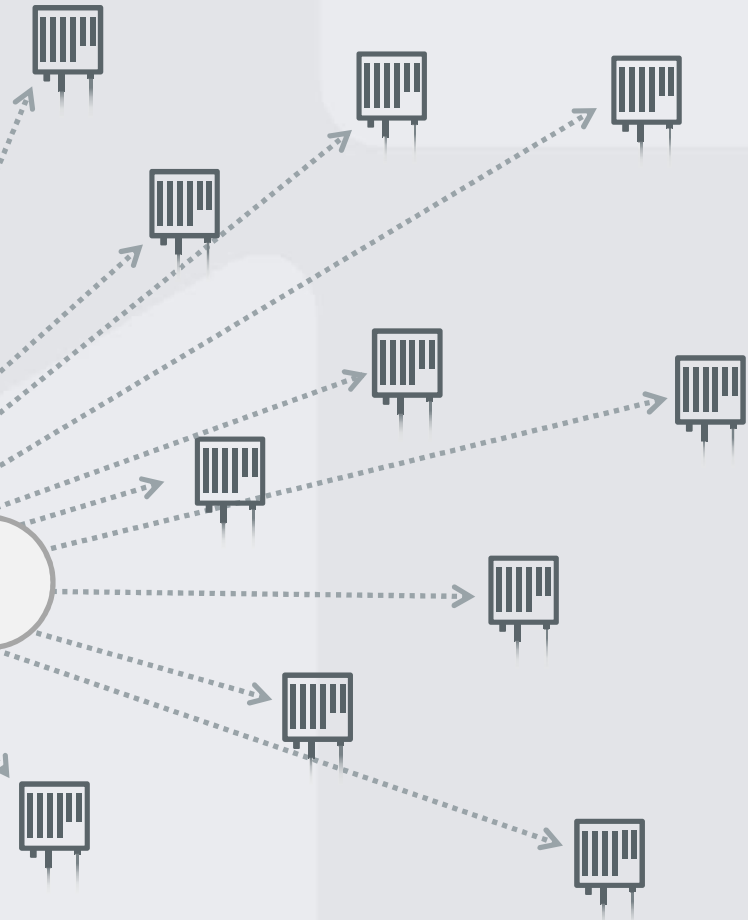


MS2710xA Performance Highlights

- ➔ 9 kHz to 6 GHz frequency coverage
- ➔ Fast sweep speed
 - ▶ Up to 24 GHz/sec
- ➔ High dynamic range
 - ▶ > 106 dB dynamic range
 - ▶ -155 dBm/Hz DANL w/ preamplifier on
 - ▶ +10 dBm Third Order Intercept (TOI)
- ➔ Excellent spectral purity
 - ▶ < -70 dBc input-related spurious
 - ▶ -88 dBm residual spurious
 - ▶ -100 dBc/Hz phase noise @ 10 kHz
- ➔ 20 MHz instantaneous FFT bandwidth
- ➔ IQ capture in block mode and streaming
- ➔ AM/FM/SSB Demodulation
- ➔ Integrated preamplifier
- ➔ Integrated GPS receiver
- ➔ Gigabit Ethernet for high speed communications

MS2710xA Operating Modes

- ➔ Interactive Spectrum Analysis via IP and GUI
- ➔ Individual control via SCPI programming
- ➔ Anritsu VISION, BLACK BIRD and MAGPIE software packages

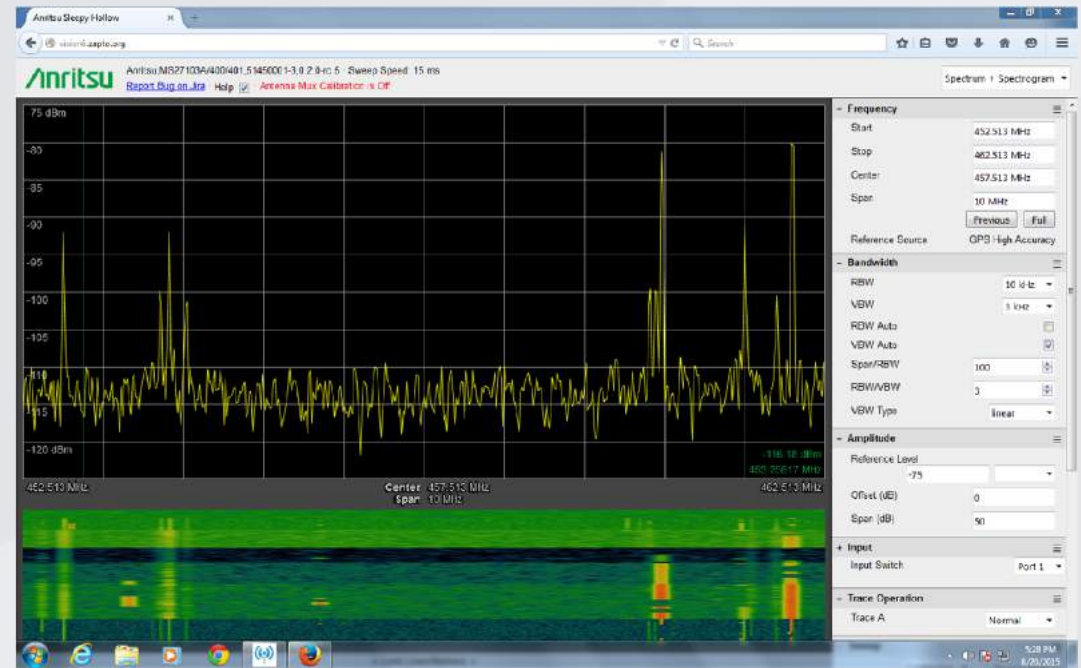


Connect from Anywhere. Anytime.

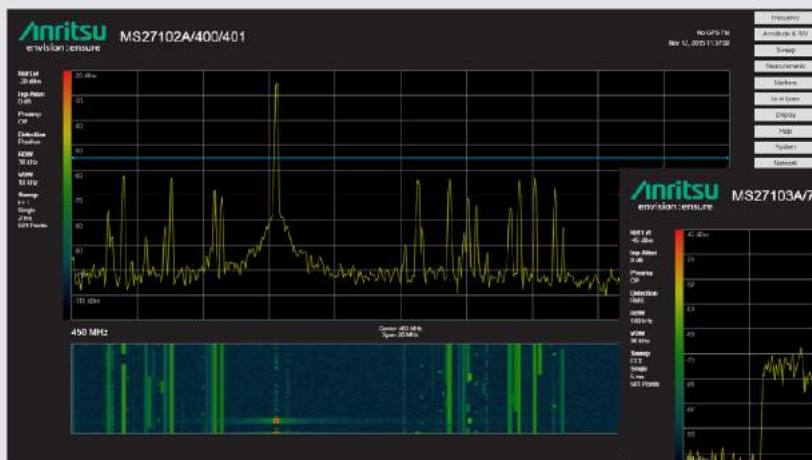


View, control and measure using computer, tablet or smart phone

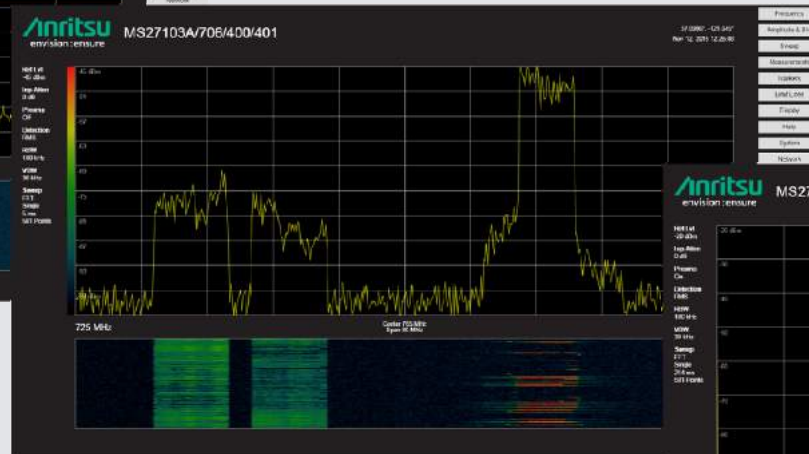
Every MS2710xA includes an embedded web server and Gigabit Ethernet for fast responsiveness



Remote Spectrum Analysis



Monitor for level threshold violations



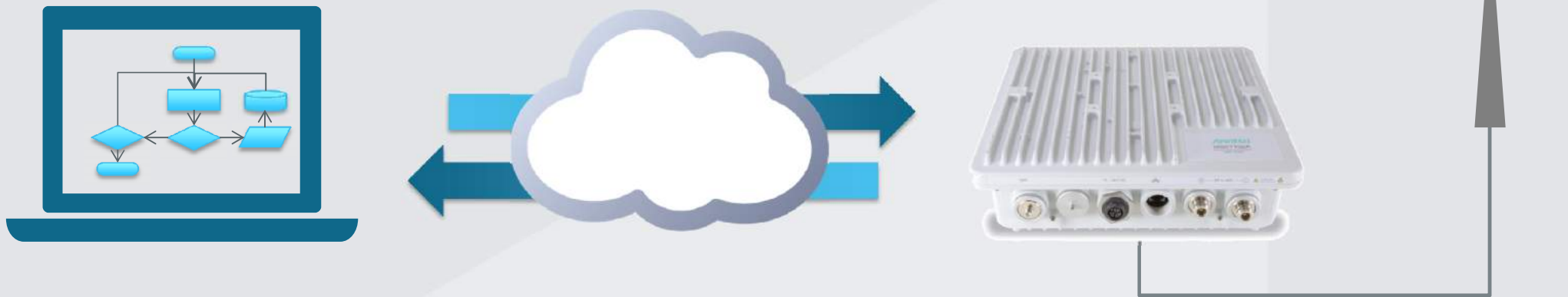
Spectrogram reveals signal changes over time



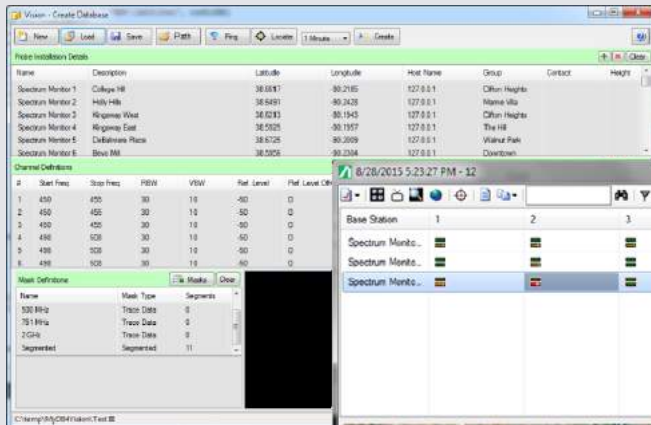
Noise Floor w/ RBW = 100 kHz, Preamp On

Do Your Own Thing – remote control via SCPI

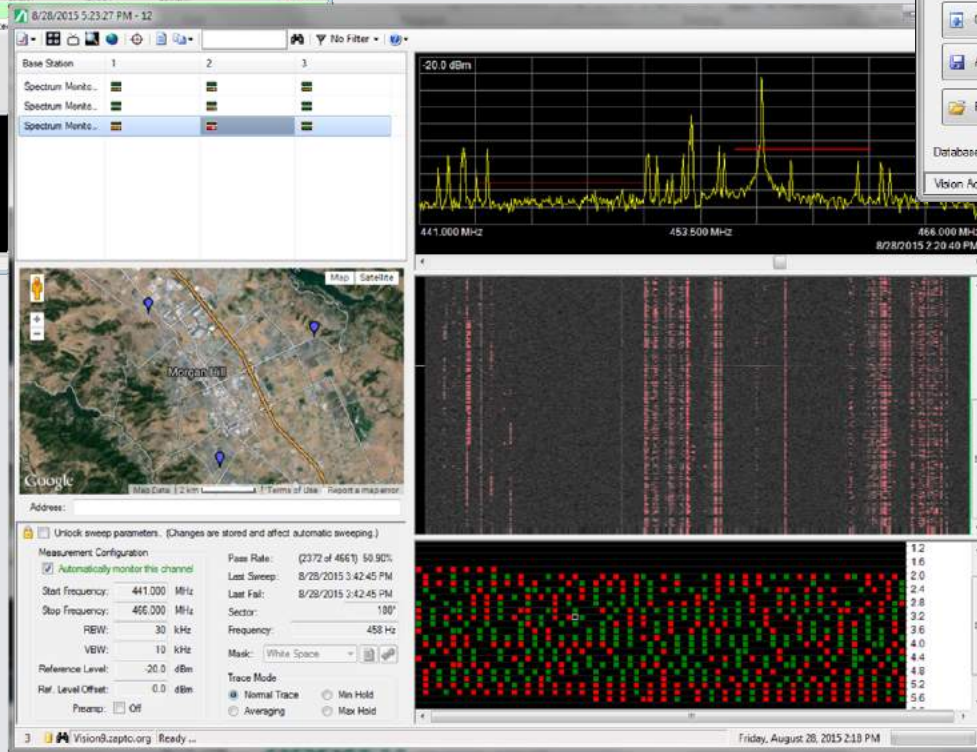
- ➔ Connect from anywhere via Gigabit Ethernet
- ➔ Control spectrum analyzer and retrieve traces, measurement results and digitized I/Q data from MS2710xA via SCPI commands
- ➔ Execute proprietary and/or confidential signal monitoring and processing applications



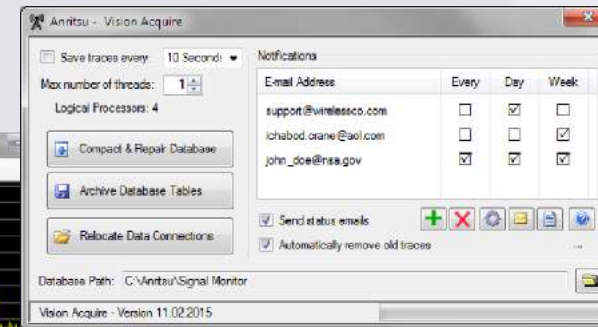
MX280001A VISION Software – Built for Big Data



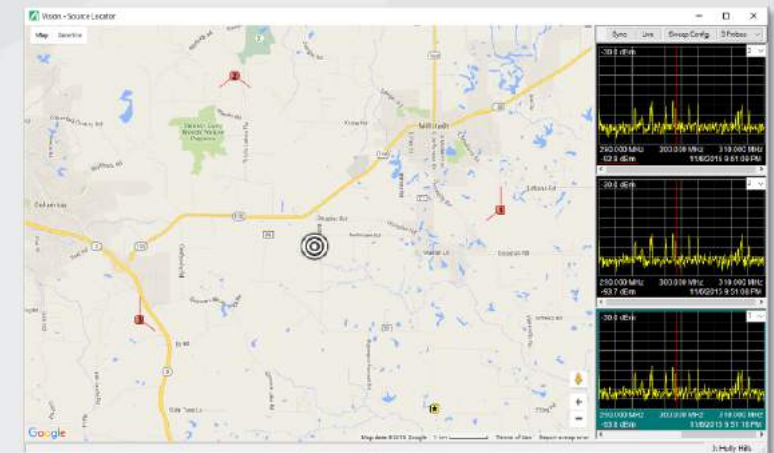
Vision Database Creator



Vision Monitor

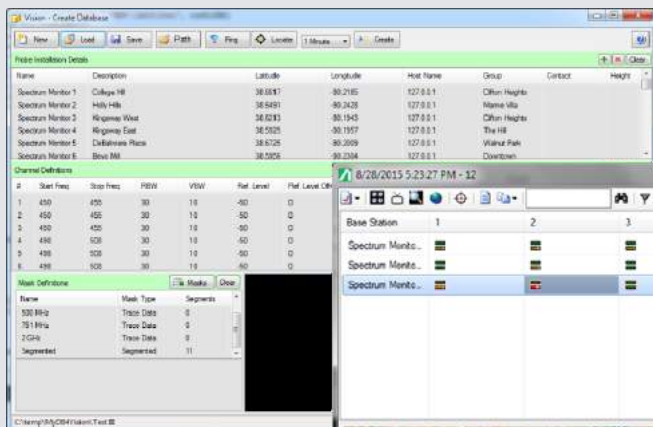


Vision Acquire

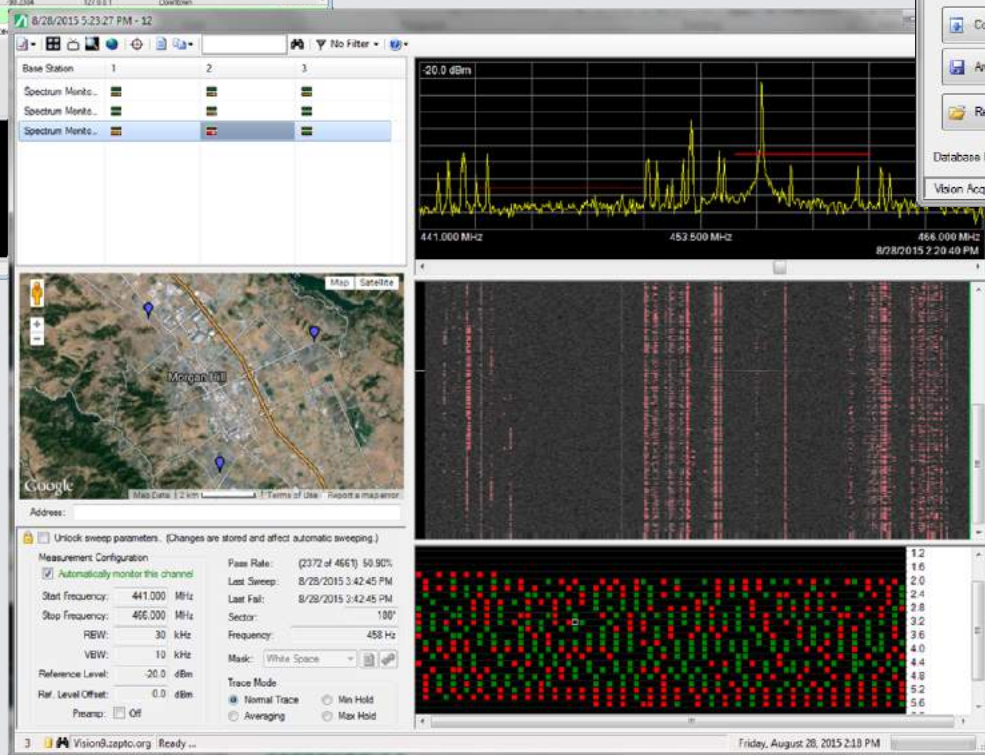


Vision Locate

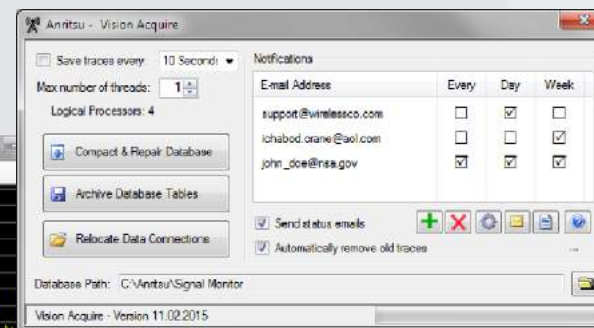
MX280001A VISION Software – Command and Control



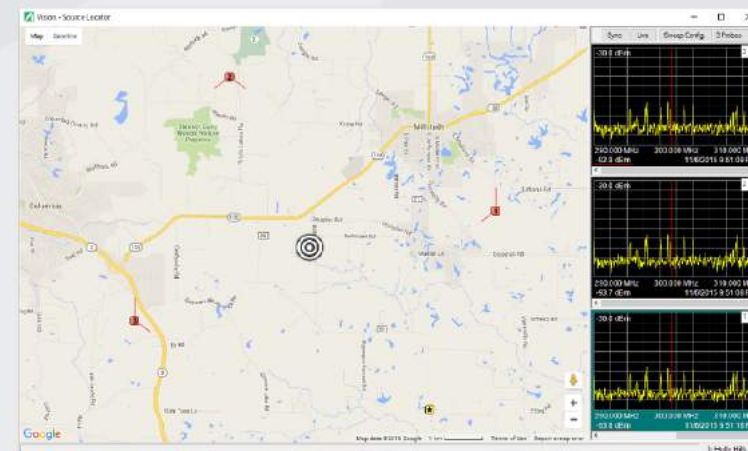
Vision Database Creator



Vision Monitor



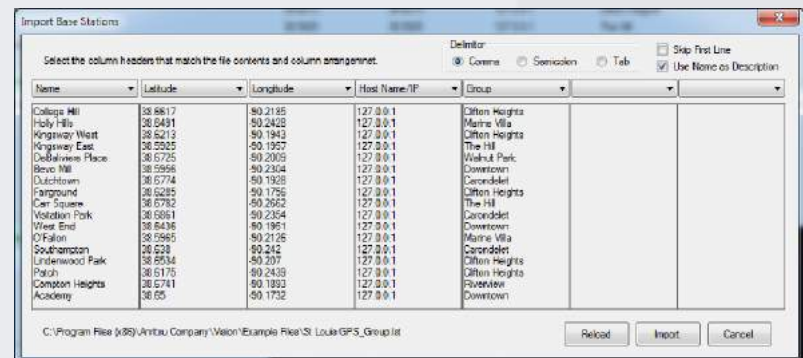
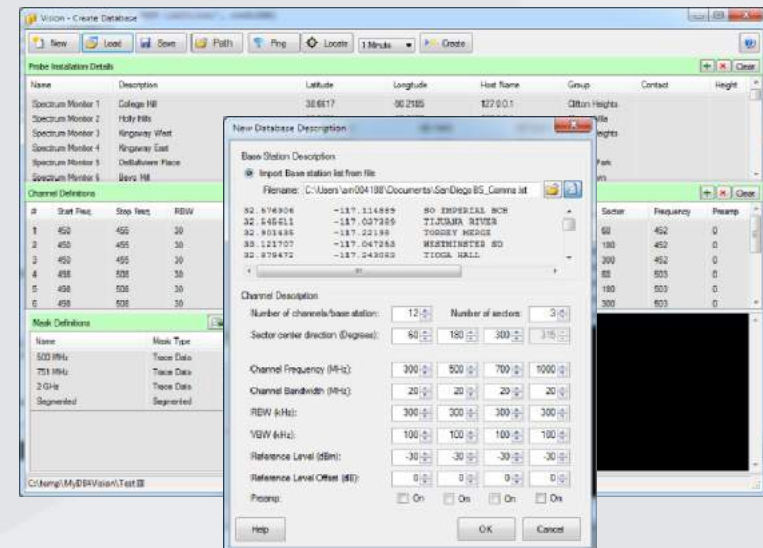
Vision Acquire



Vision Locate

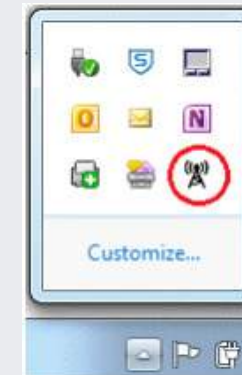
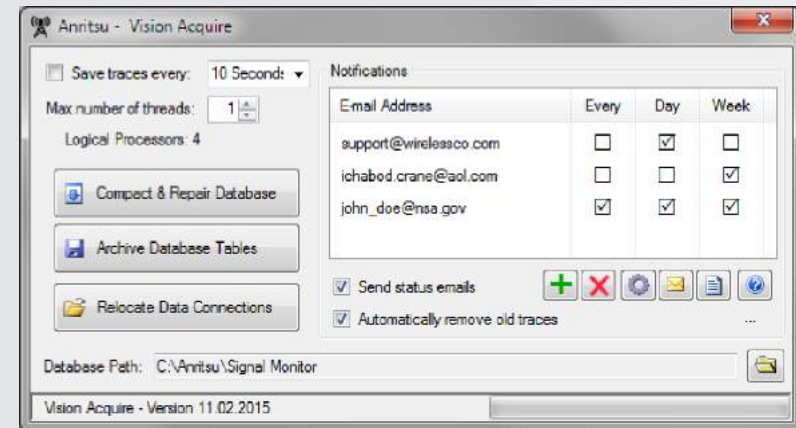
VISION Database Creator

- ➔ **Creates empty database tables**
 - ▶ Base station information
 - ▶ Scanning parameters
 - ▶ Limit lines
 - ▶ Trace history
- ➔ **Import/export functions save time and eliminate data entry errors**
 - ▶ Base station information
 - ▶ Limit lines
- ➔ **Designed to quickly get the system up and running**



VISION Acquire

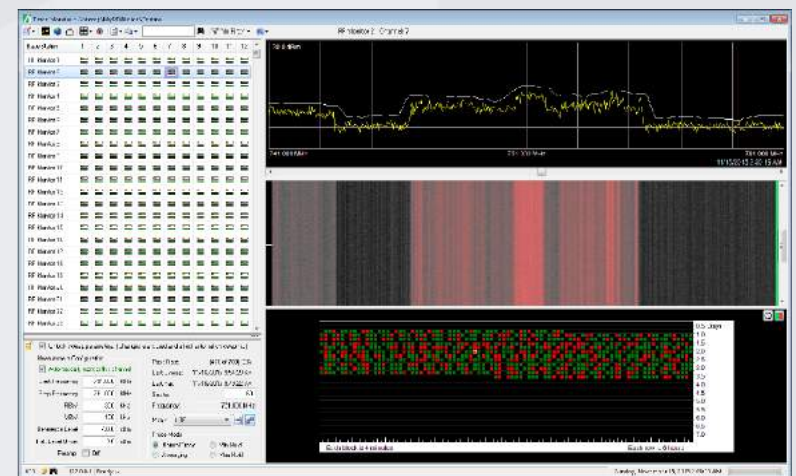
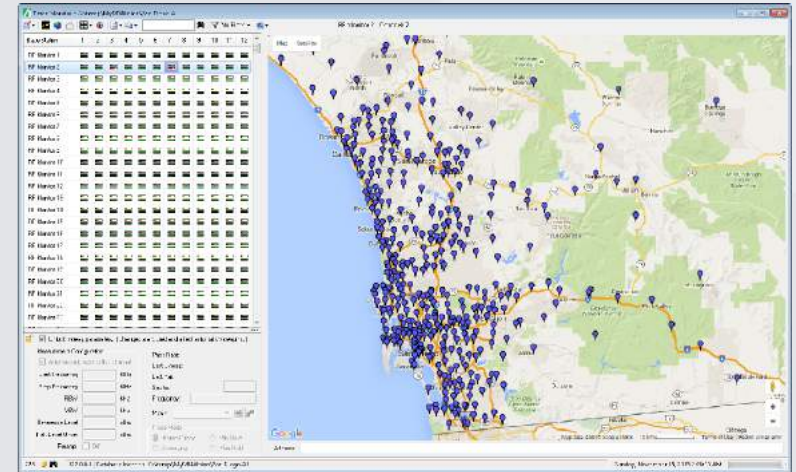
- ➔ Small program that runs silently on the database server
- ➔ Communicates with remote probes
- ➔ Acquires trace data and stores it in database
- ➔ Removes stale trace data
- ➔ Includes functions for maintaining the database
- ➔ Sends periodic reports to selected recipients



Vision Acquire stays in System Tray

VISION Monitor

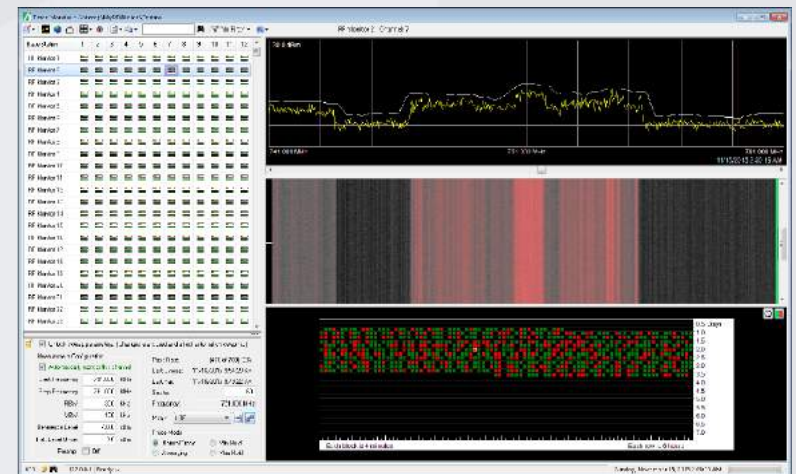
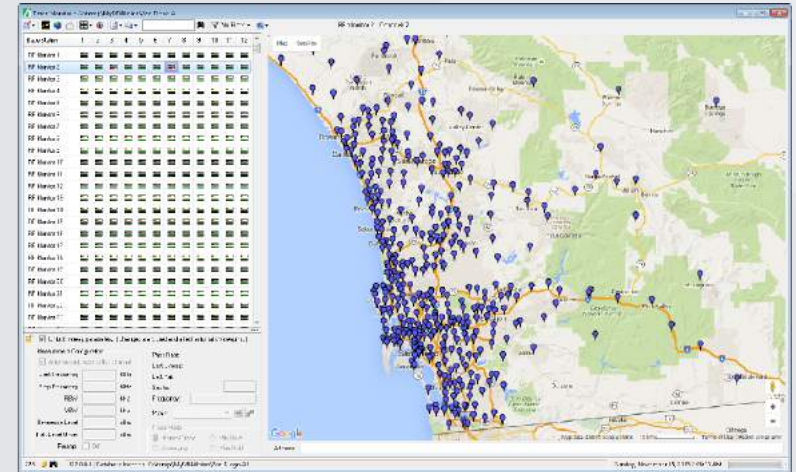
- ➔ 24/7 consolidated spectrum monitoring
- ➔ Independent acquisition settings for each channel of each probe
 - ▶ Frequency range, RBW, VBW
 - ▶ Reference level, preamplifier
 - ▶ Trace mode
 - ▶ Pass/Fail limit mask
- ➔ Alarm/Notification upon mask violation
- ➔ 30 day+ trace history database for each channel



VISION Monitor

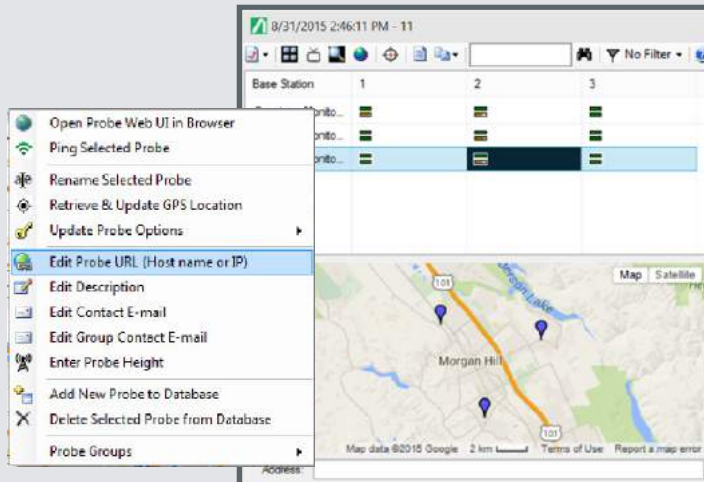
➔ Powerful data analysis tools

- ▶ Replay traces from any desired set of probes
- ▶ Identify patterns of interference
 - What bands are affected? How often? Fixed or mobile?
- ▶ Estimate location of interference operating
 - PDOA or
 - TDOA
- ▶ Generate reports

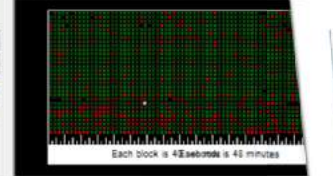
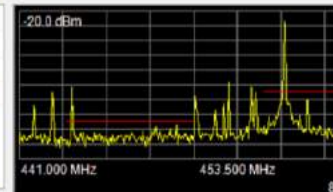


VISION Monitor Functions

Edit probe information and scan settings

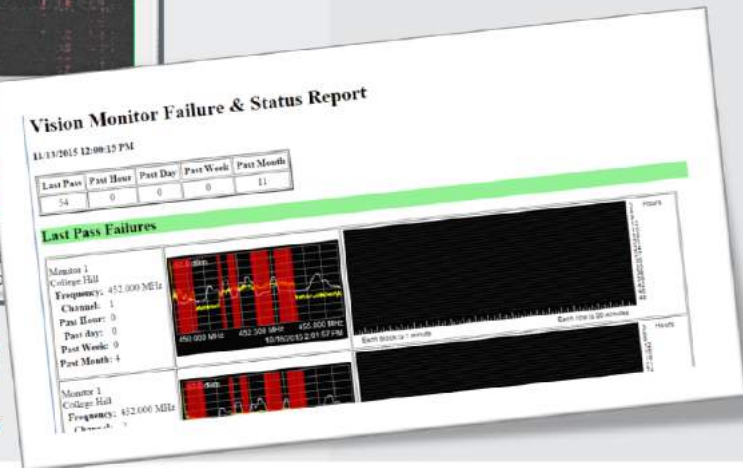


Edit limit lines and apply retroactively to historical trace data



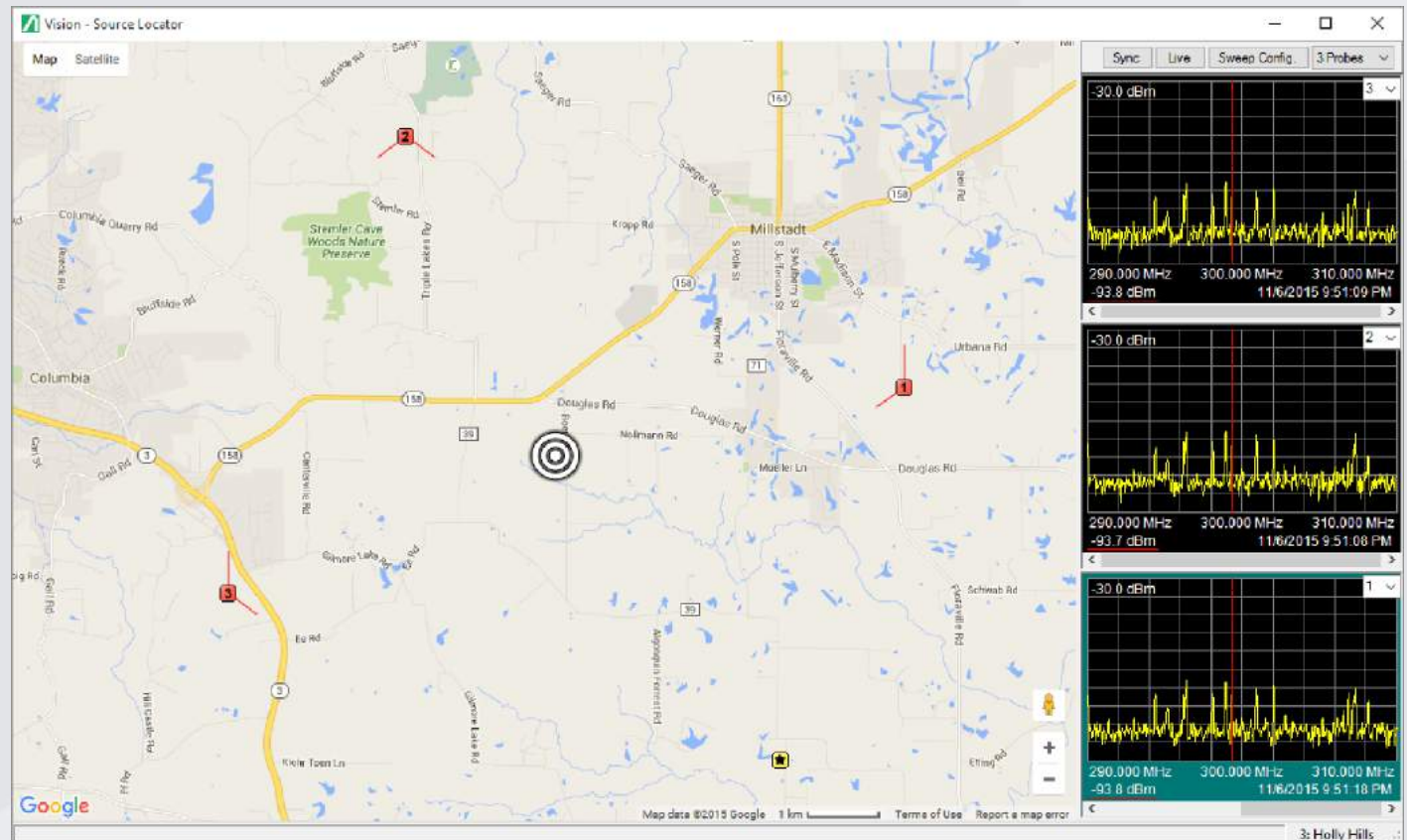
View synchronized historical or live data from numerous probes

Generate pass/fail reports



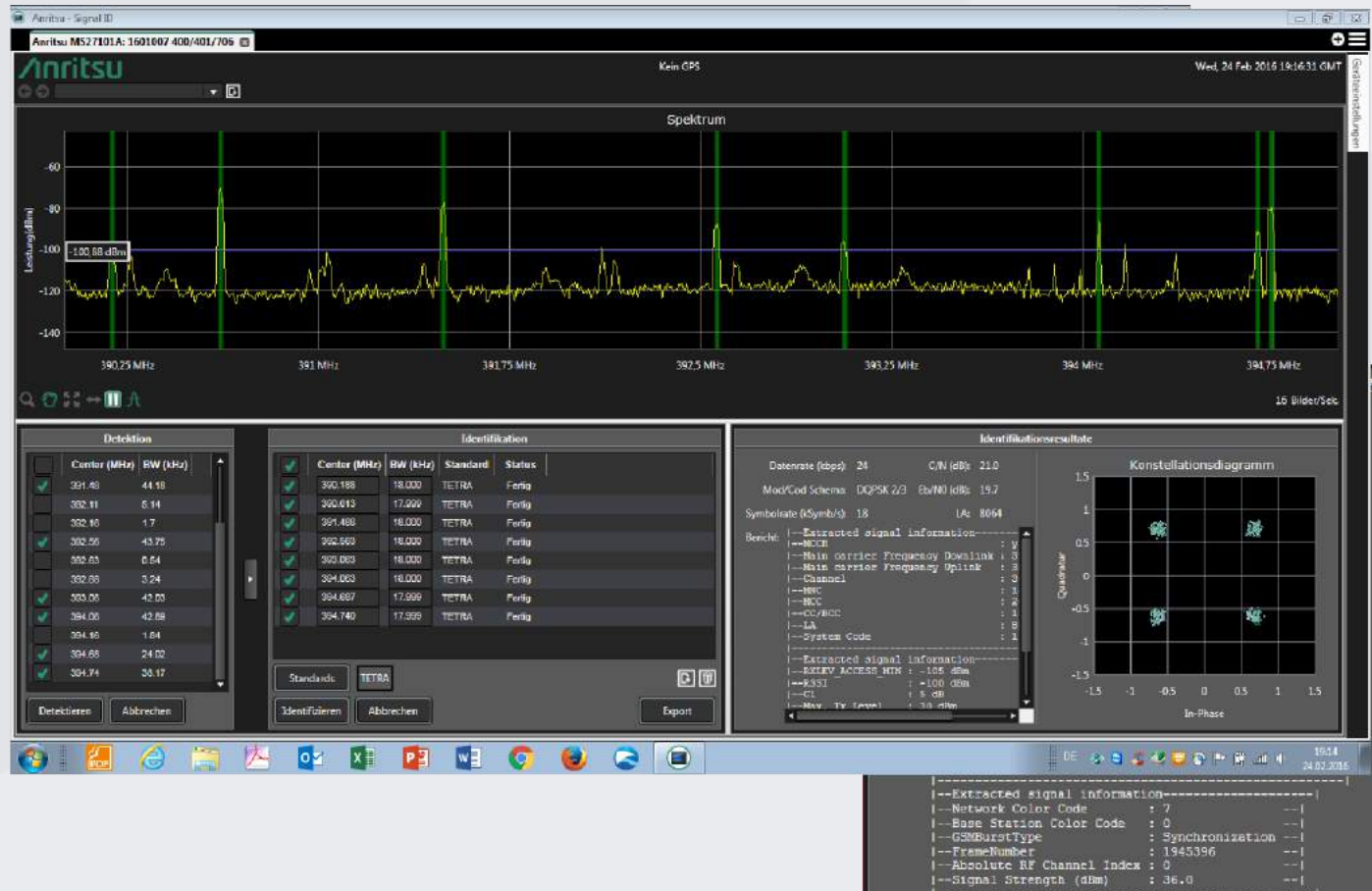
VISION Locate

- ➔ Launched via Vision Monitor
- ➔ At least three probes must be able to “see” the target signal
- ➔ Emitter geolocation
 - ▶ PDOA or
 - ▶ TDOA



BLACK BIRD

- ➔ Control several probes in parallel
- ➔ Fully automated scan and demodulation capabilities
- ➔ Record and replay
- ➔ Automated alarming



MAGPIE

➔ Fully automated scan and demodulation capabilities

- ▶ Carrier frequency, Baud Rate, SNR, ModCod scheme and Symbol rate ...
- ▶ DVB-S(2)(x),
- ▶ IESS,
- ▶ DVB-RCS,
- ▶ DVB-CID

➔ Record and replay

➔ Automated alarming

➔ Carrier-Under-Carrier detection



The Anritsu logo is centered on a light gray rectangular background. The word "Anritsu" is written in a bold, green, sans-serif font. Below it, the tagline "envision : ensure" is written in a smaller, gray, sans-serif font. The colon in the tagline is slightly larger than the other characters. In the bottom-left corner of the overall image, there is a small, light gray, rounded triangular shape pointing towards the center.

Anritsu
envision : ensure