

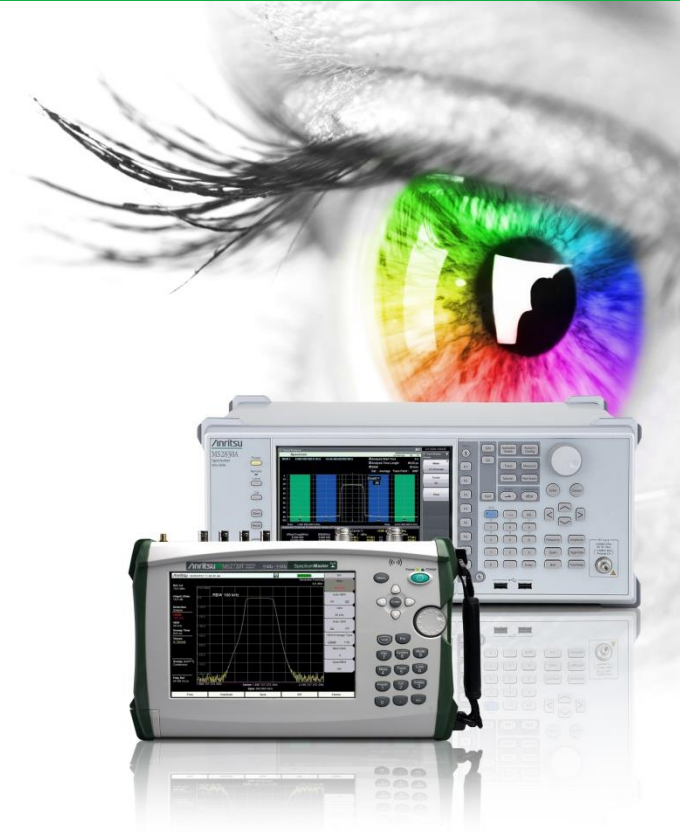
RF Interferences Hunting and Over the Air measurement



Ferdinand Gerhardes

EMEA Business Development Manager

April 2018



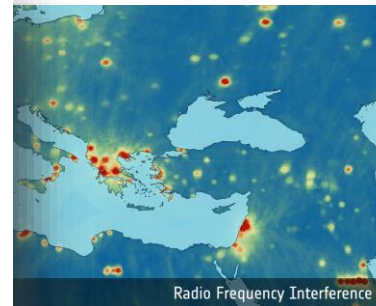
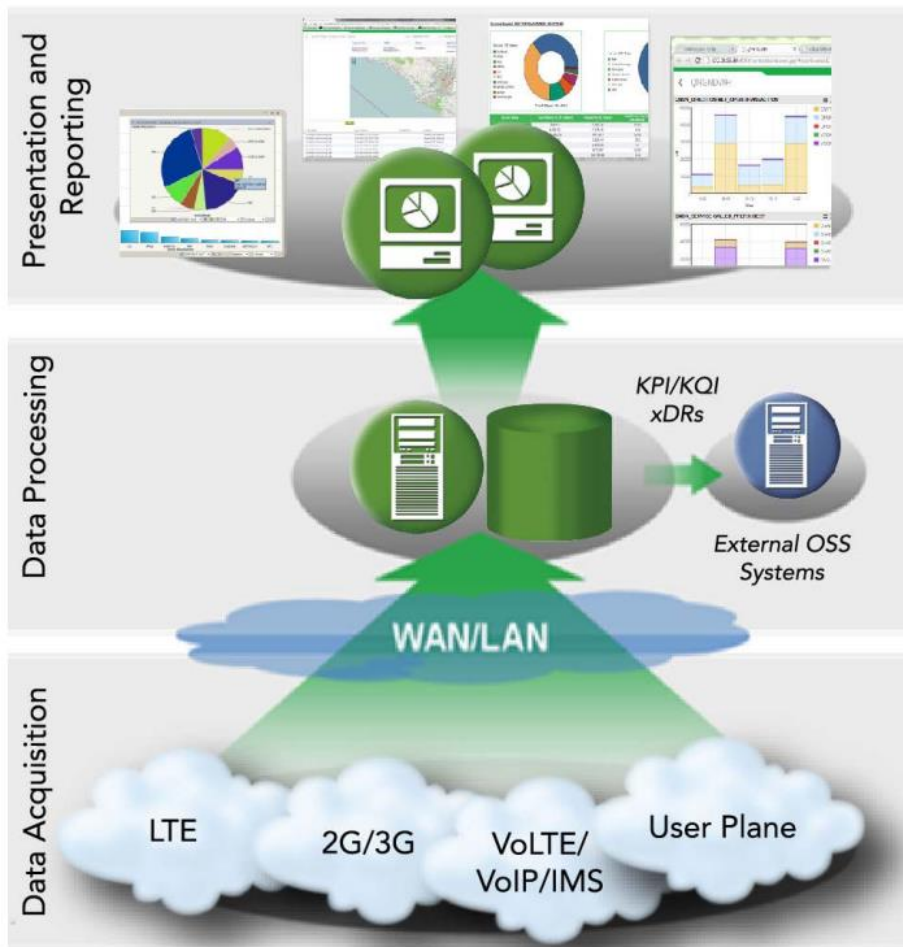
The Wireless Challenge

- ➔ **More transmitters**
 - ▶ spectrum is becoming more and more crowded.
- ➔ **More mobile devices**
 - ▶ stationary TRX are no longer the norm
- ➔ **New modulation types**
 - ▶ analog signals becoming less common than digital signals.
- ➔ **More complex modulation**
 - ▶ higher order modulation requires a better RF environment.
- ➔ **Spectrum refarming**
 - ▶ moving services to different frequencies requires spectrum clearing and involves different propagation and interference types.
- ➔ **Wireless connectivity**



The Wireless Challenge

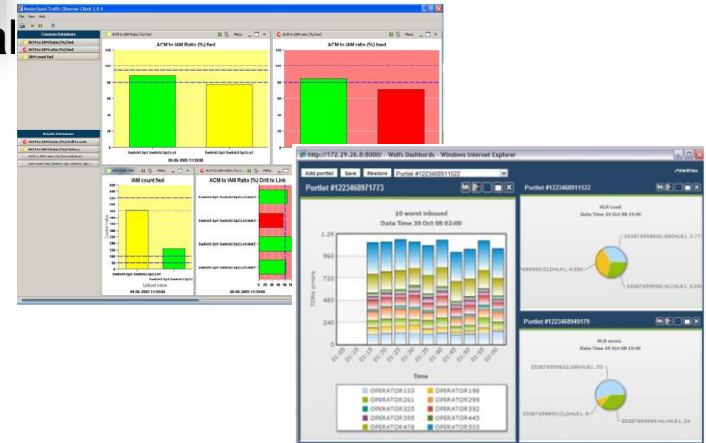
Indicators - or know that you have a problem



was placed in orbit in
 tic
 erence
 ng point



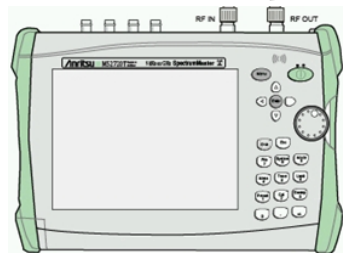
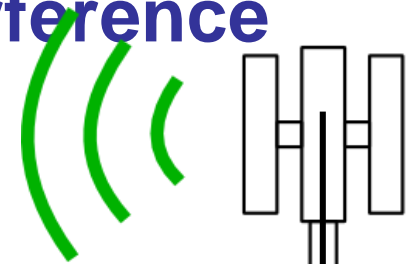
Dimensional
 coupled
 y



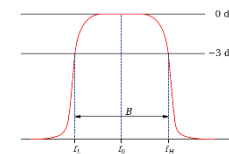
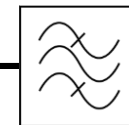
Spotting and characterization of Interference

What and how to look for?

- ➔ Check for interference at receiver
 - ▶ At the tower for Cellular or complaint area for Two Way or in the complaint area for Broadcast
 - ▶ Allow the RX pre-filter to eliminate the strong side emissions
 - ▶ Measure noise floor from a receive antenna
 - ⊕ Same receive pattern as the radio
 - ▶ Get a visual ID on the interfering signal
 - ⊕ Characterize signal so you will know it later



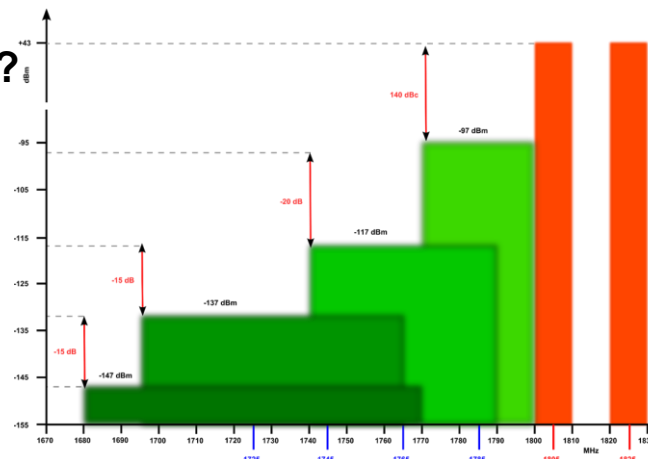
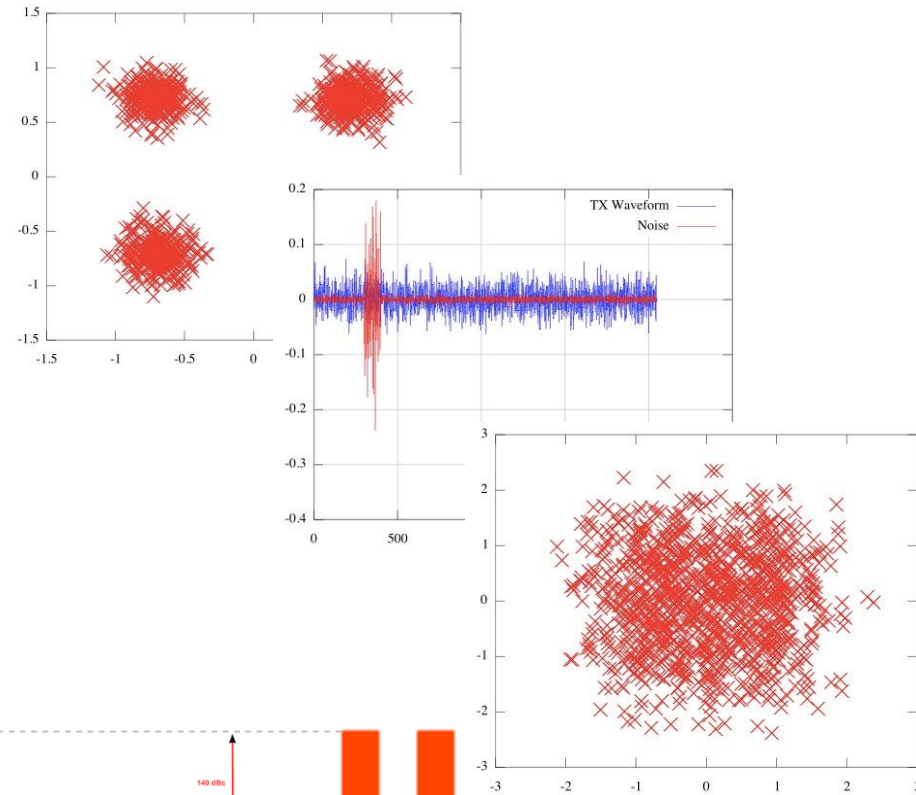
Receive filter
for out of band
signal suppression



Spotting and characterization of Interference

Interference Mechanisms

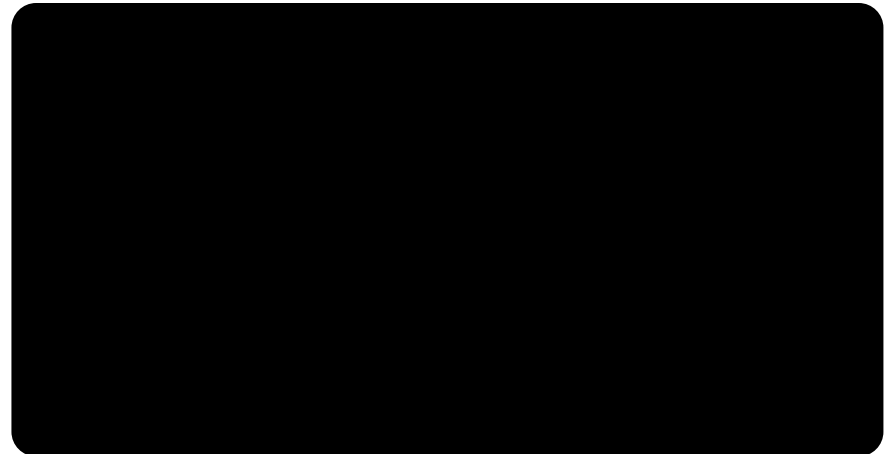
- ➔ A series of questions to be answered:
- ▶ Is it On-Channel interference?
 - ▶ Is it In-band interference?
 - ▶ Is it Impulse Noise?
 - ▶ Is it Harmonics?
 - ▶ Is it Passive Intermodulation?
 - ▶ Is it a Near-Far Problem?
 - ▶ Is it intentional?



Spotting and characterization of Interference

Interference Mechanisms

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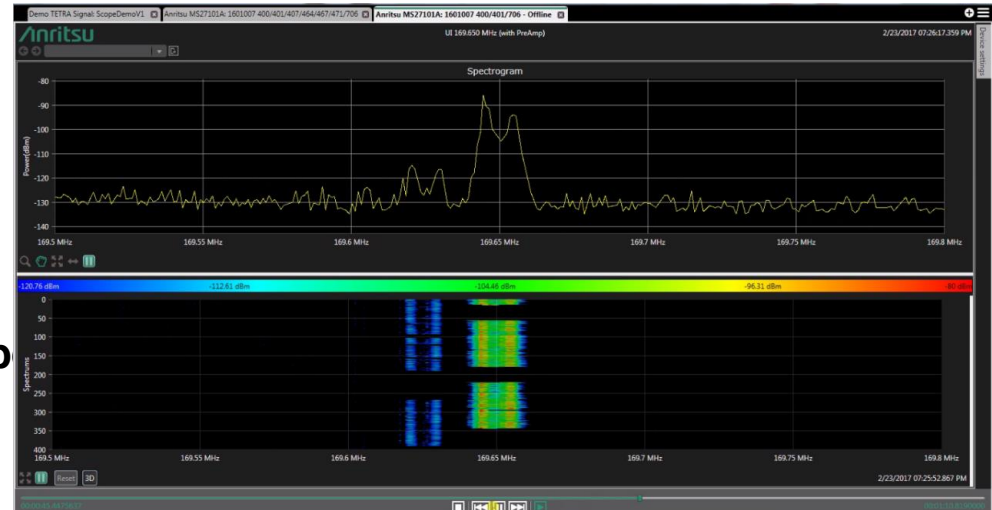


Spotting and characterization of Interference

Documentation of all measurable signal parameters

➔ Signal parameters

- ▶ Center Frequency
- ▶ Occupied Bandwidth
- ▶ Channel Power
- ▶ Transmission shape / envelop
- ▶ Time based characteristics
 - ⊕ Puls Duration (PD)
 - ⊕ Pulse Repetition Frequency (PRF)
- ▶ Location based parameters
 - ⊕ Time
 - ⊕ GPS location
- ▶ Weather conditions
- ▶ Propagation environment
 - ⊕ Rural
 - ⊕ Suburban
 - ⊕ Urban



➔ Signals may be linked to other signals

- ▶ Look for a trace that turns on and off
- ▶ Look for carriers that turn on and off when your interference turns on and off

**Automatic Spectrum
Monitoring
MS2710xA
VISION MX28001A
SpectraVision MX28010A**

Automatic Spectrum Monitoring

MS2710xA Remote Spectrum Monitors - A family of platforms to meet y



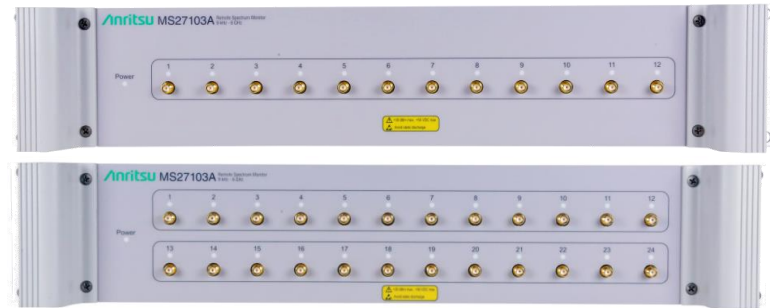
MS27101A

Half Rack x 1U Single
Input



MS27102A

IP67 Outdoor rated 1 or 2 input
ports



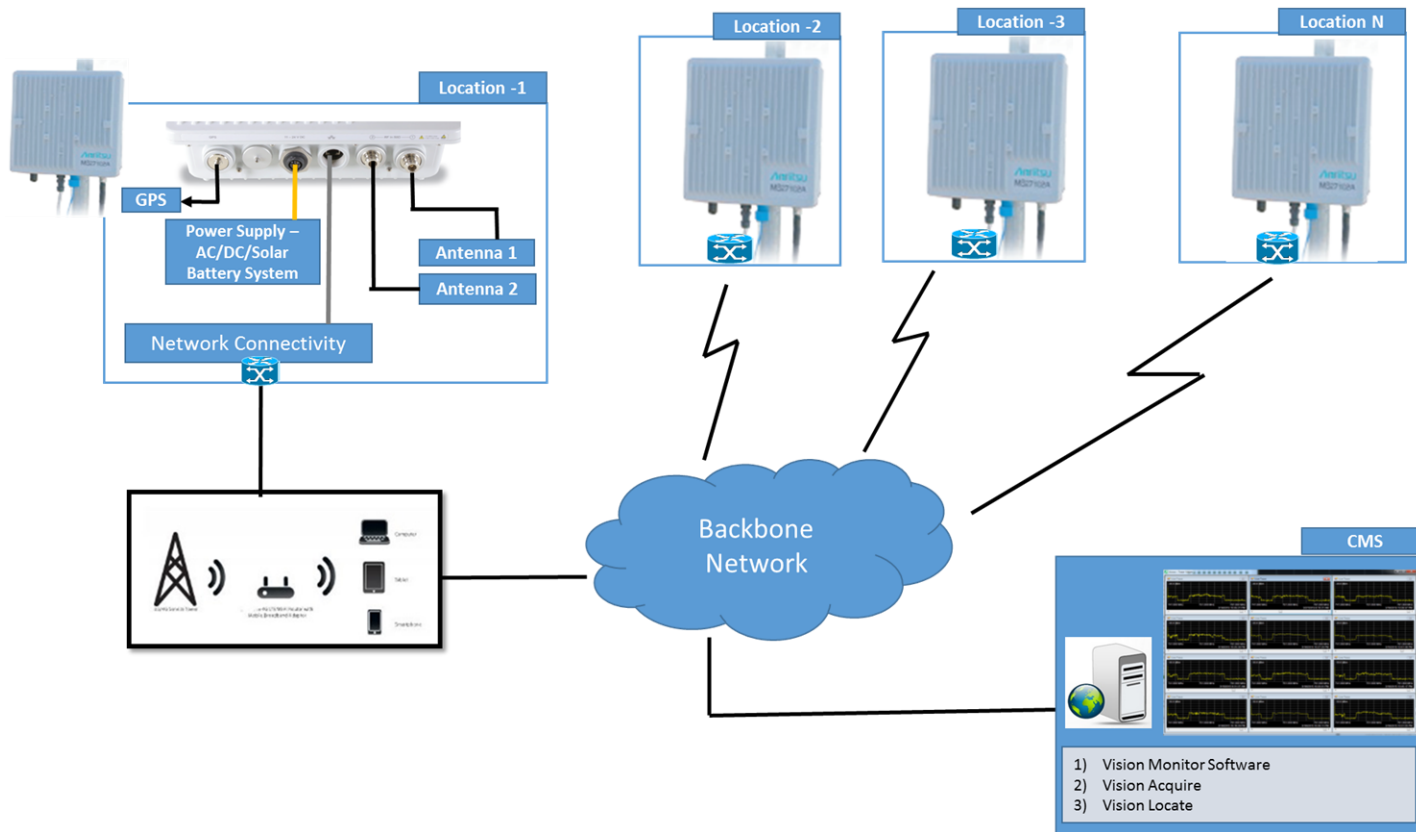
MS27103A Full Rack x 2U 12 / 24
input ports



MS27100A OEM PCA Only

Automatic Spectrum Monitoring

MS2710xA Operating Modes



Automatic Spectrum Monitoring

VISION Monitor Functions

Edit probe information and scan settings

8/31/2015 2:46:11 PM - 11

- Open Probe Web UI in Browser
- Ping Selected Probe
- Rename Selected Probe
- Retrieve & Update GPS Location
- Update Probe Options
- Edit Probe URL (Host name or IP)**
- Edit Description
- Edit Contact E-mail
- Edit Group Contact E-mail
- Enter Probe Height
- Add New Probe to Database
- Delete Selected Probe from Database

Base Station 1 2 3

Measurement Configuration

Start Frequency: 441 000 MHz

Stop Frequency: 466 000 MHz

RBW: 30 kHz

VBW: 10 kHz

Trace Level: -20.0 dBm

Preamp: Off

Pass Rate: (6014 of 8482) 70.90%

Last Sweep: 8/31/2015 2:38:42 PM

Last Fail: 8/31/2015 2:34:34 PM

Sector: 180°

Frequency: 458 Hz

Mask: Normal Trace Min Hold Averaging Max Hold

Address: Ready...

Unlock sweep parameters. (Changes are stored and affect automatic sweeping.)

Measurement Configuration

Automatically monitor this channel

Pass Rate: (6014 of 8482) 70.90%

Last Sweep: 8/31/2015 2:38:42 PM

Last Fail: 8/31/2015 2:34:34 PM

Sector: 180°

Frequency: 458 Hz

Mask: Normal Trace Min Hold Averaging Max Hold

Trace Level: -20.0 dBm

Preamp: Off

Address: Ready...

Each block is 4Esaecms is 45 minutes

Sunday, August 30, 2015 8:3

Edit limit lines and apply retroactively to historical trace data

Mask name Start Freq. (MHz) Stop Freq. (MHz) Amp. (dBm)

Segmented	741 000000	742 818200	-84.21
Segmented	742 818200	744 636400	-84.21
Trace Mask	744 636400	746 454600	-102.71
450 MHz	746 454600	748 272700	-79.17
500 MHz	748 272700	750 090900	-61.74
751 MHz	750 090900	751 909100	-84.95
2 GHz	751 909100	753 727300	-84.32
	753 727300	755 545500	-80.90
	755 545500	757 363600	-102.84
	757 363600	759 181800	-103.04
	759 181800	761 000000	-104.15

How to Edit Limit Lines

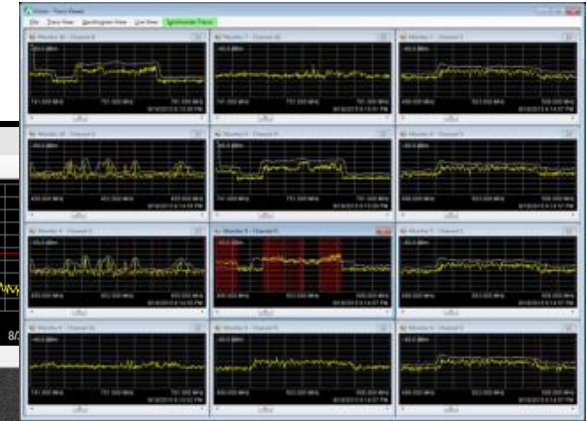
Select a limit line by clicking it on either the table or the graph.

You can drag a limit line with the mouse to reposition anywhere on the graph.

To adjust the alignment size hold down the Control key and use the mouse wheel.

For precise placement use the segment editor accessed from the toolbar.

For crude adjustments, the keyboard arrow keys are very useful.



View synchronized historical or live data from numerous probes

Generate pass/fail reports

Vision Monitor Failure & Status Report

11/13/2015 11:00:15 PM

Last Pass	Past Hour	Past Day	Past Week	Past Month
34	0	0	0	11

Last Pass Failures

Monitor	Channel	Frequency	Past Hour	Past Day	Past Week	Past Month
Monitor 1	College Hill	412 000 50Hz	0	0	0	4
Monitor 1	College Hill	412 000 50Hz	0	0	0	4

Automatic Spectrum Monitoring

VISION monitoring and multilateration – sensor deployment

The screenshot displays the Anritsu Trace Monitor interface. The main window shows a map of Munich, Germany, with several sensor deployment points marked by blue location pins and circled in red. The points are located at Schloss Nymphenburg, Special Airport Oberpfaffenhofen, and Pullacher Forst. The map includes labels for various districts such as ALLACH-UNTERMENZING, LAIM, HADERN, and SENDLING. The interface also features a left-hand panel with three status indicators showing 100% success rates for three different channels. Below the map, there is a detailed measurement configuration panel.

Measurement Configuration

- Start Frequency: 118.000 MHz
- Stop Frequency: 141.000 MHz
- RBW: 3 kHz
- VBW: 1 kHz
- Reference Level: -60.0 dBm
- Ref. Level Offset: 0.0 dBm
- Trace Points: 801
- Sweep Timeout: 10 sec.
- Preamp: FFT:

Pass Rate: (998 of 998) 100%

Last Sweep: 7/10/2016 8:04:46 PM

Last Fail: --

Sector: 0°

Frequency: 0 Hz

Mask: [None]

Trace Mode: Average

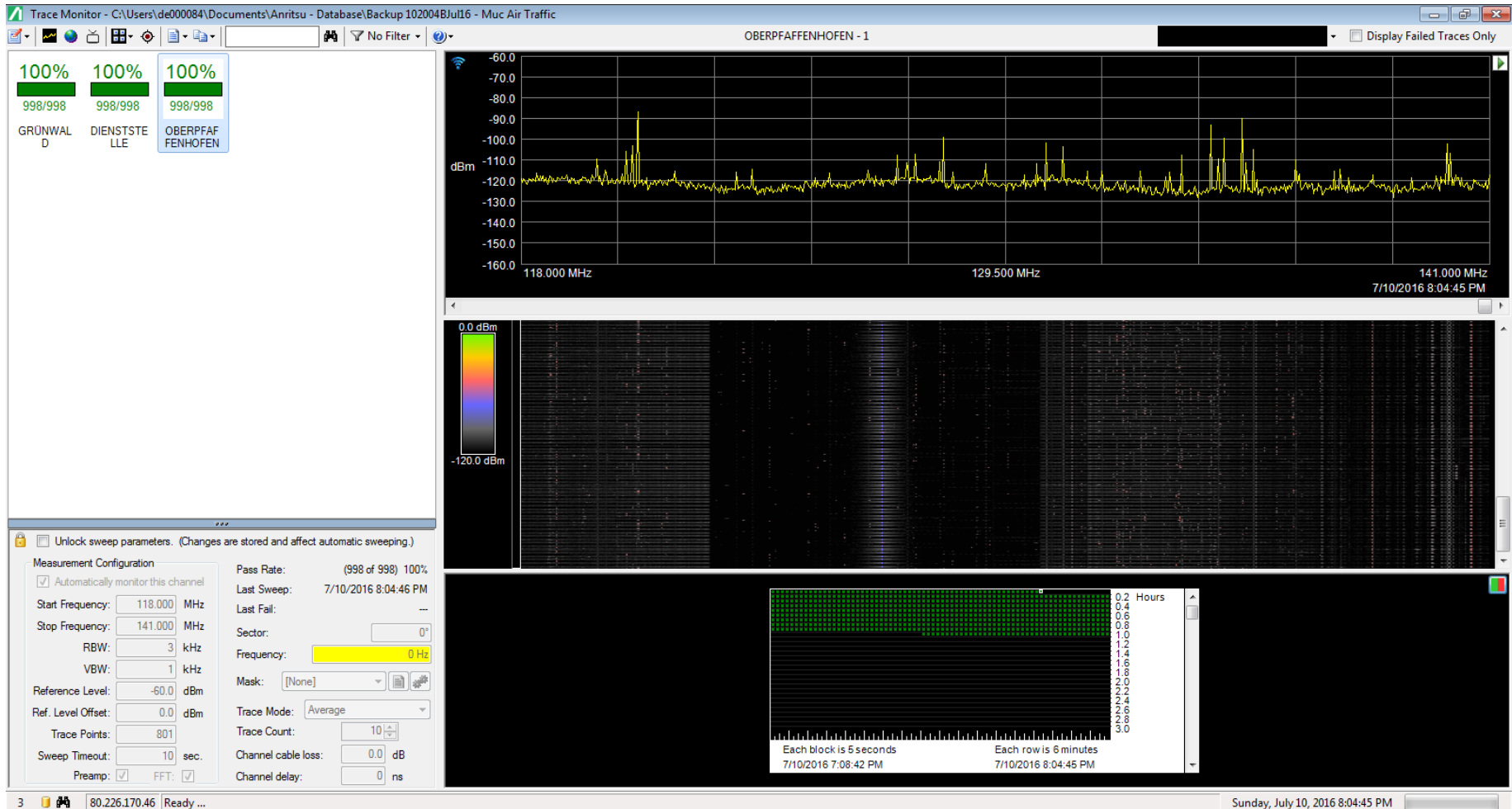
Trace Count: 10

Channel cable loss: 0.0 dB

Channel delay: 0 ns

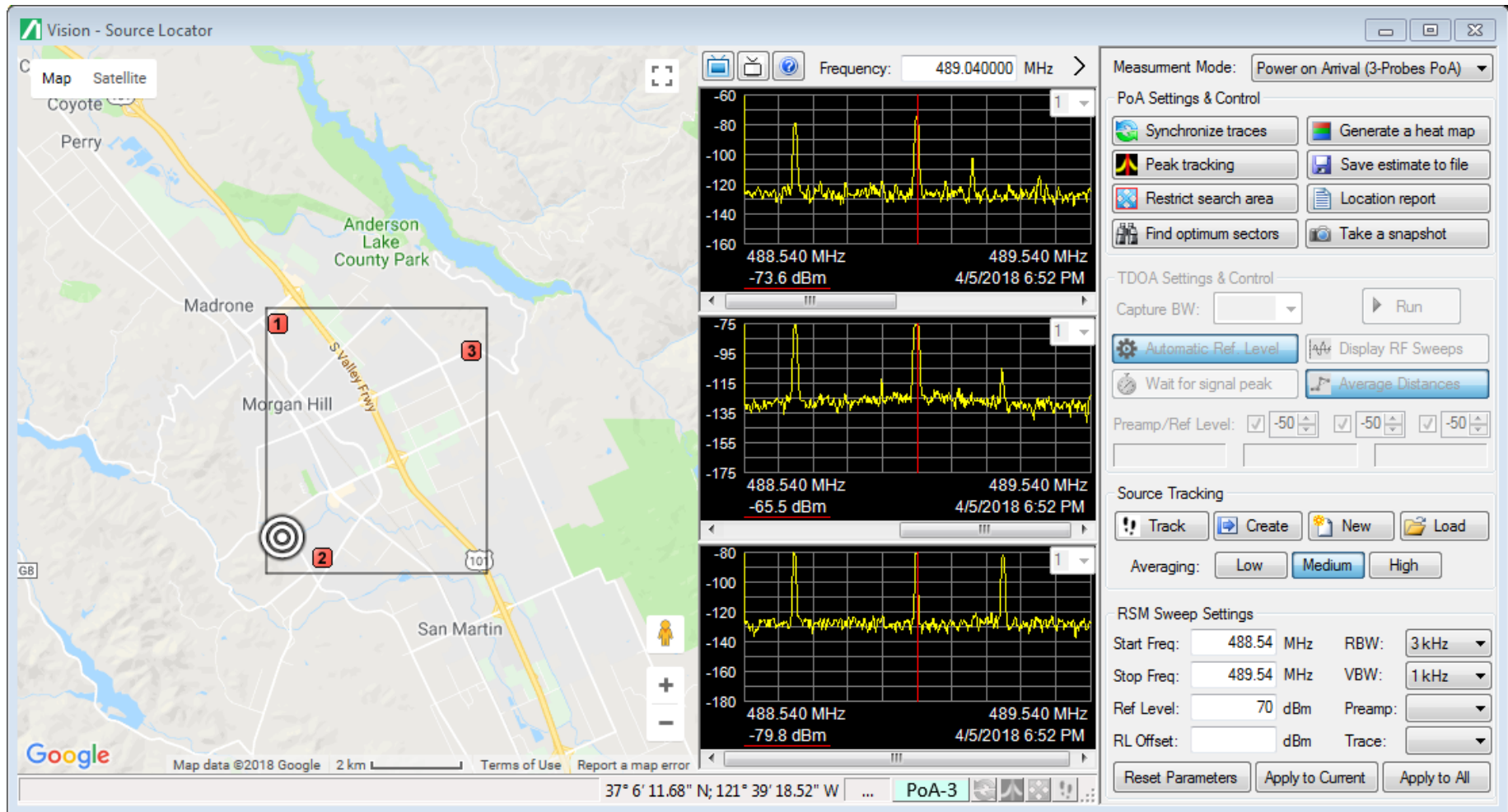
Automatic Spectrum Monitoring

VISION monitoring and multilateration - GUI



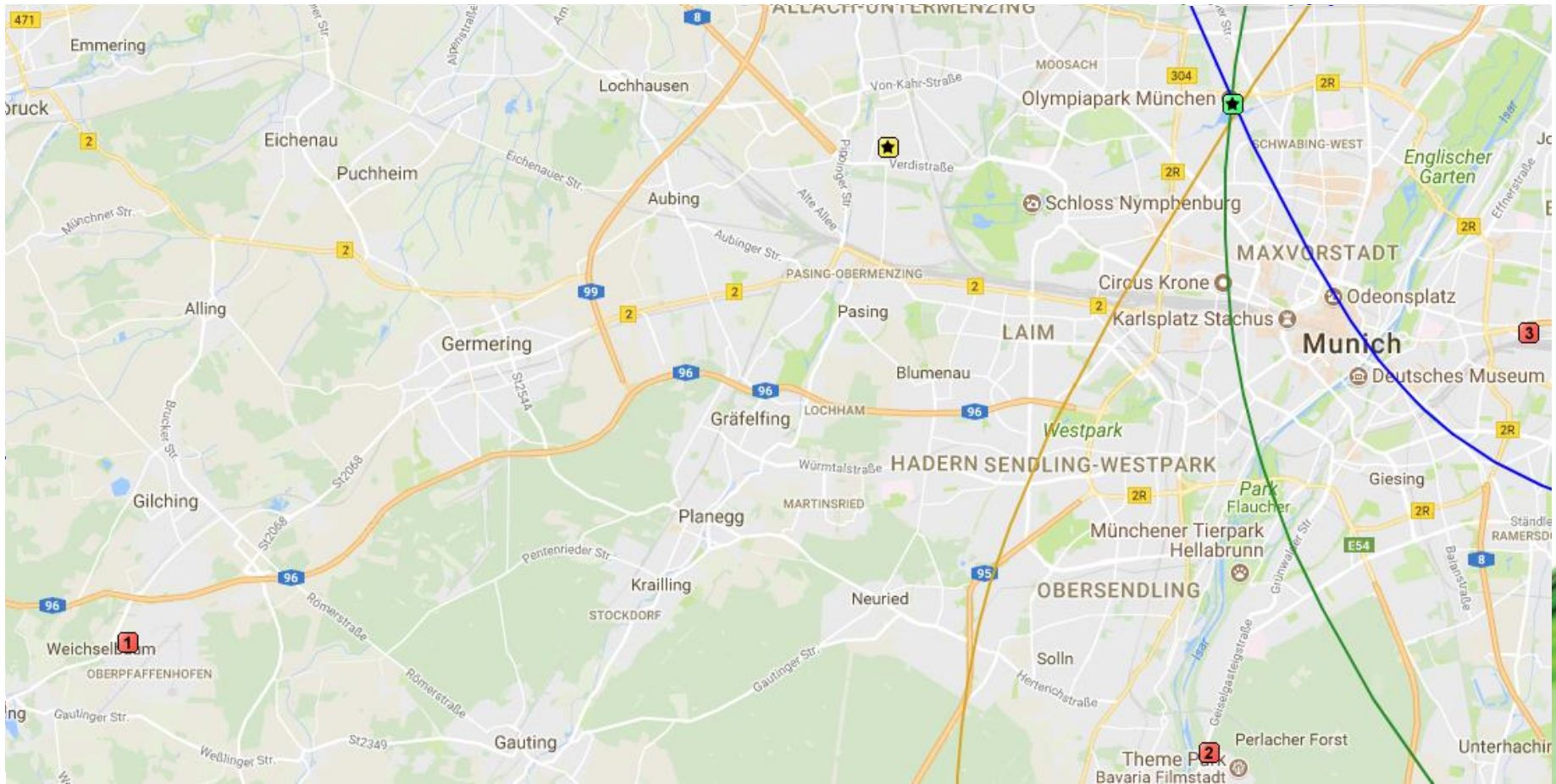
Automatic Spectrum Monitoring

VISION monitoring and multilateration – PDOA & TDOA GUI



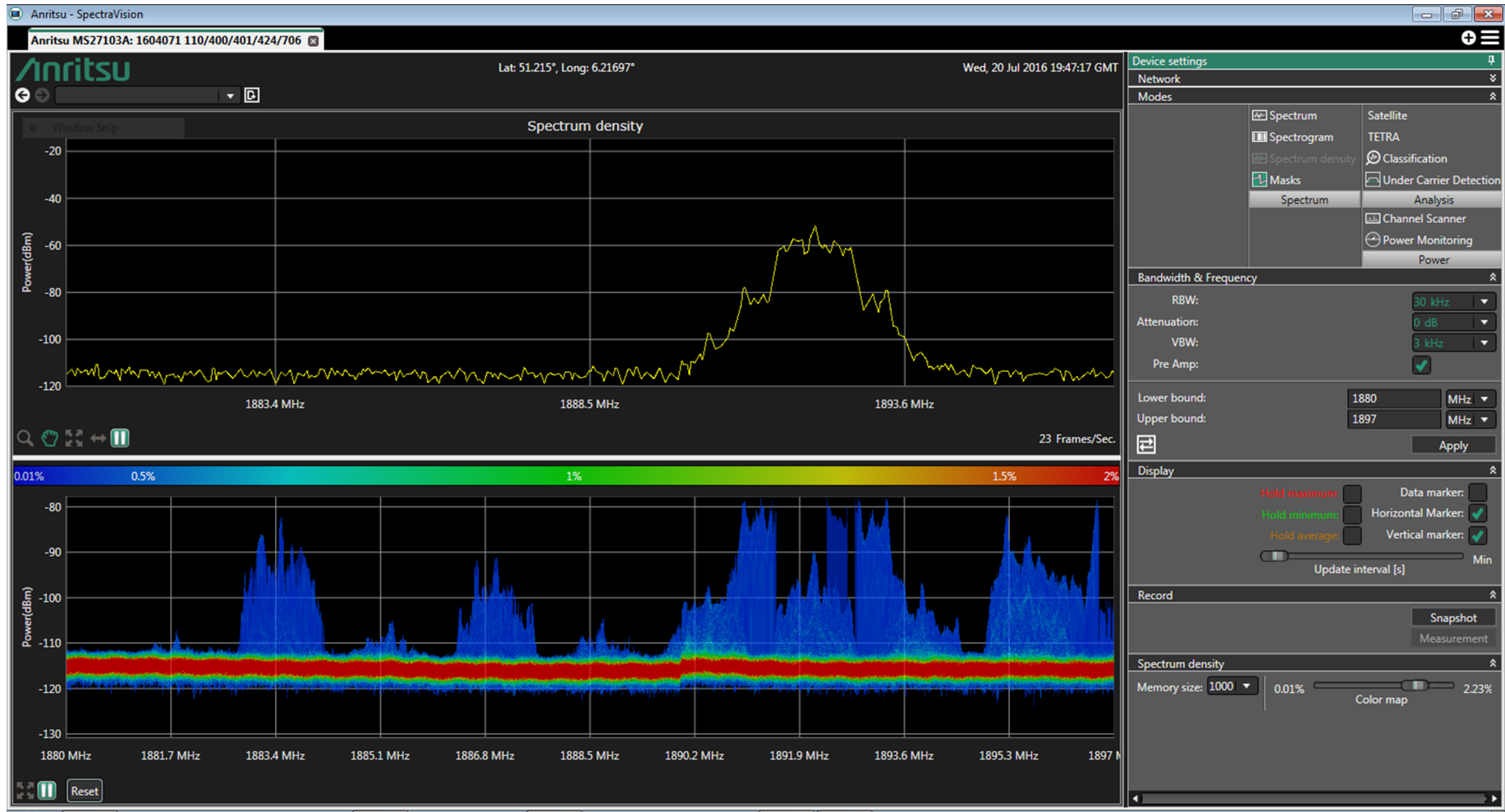
Automatic Spectrum Monitoring

VISION monitoring and multilateration – Typical TDOA result



Automatic Spectrum Monitoring

SpectraVision for simple monitoring but signal analysis



Automatic Spectrum Monitoring

SpectraVision for simple monitoring but significant



The 'Standards' dialog box is open, showing a list of communication standards. A red arrow points from the '16QAM' entry in the 'Identification Results' panel to the '16QAM' entry in this dialog box.

Standard
GSM
DECT
TETRA
WLAN 802.11a/g
WLAN 802.11b/g
DVB-S1
DVB-S2
IESS
BPSK
QPSK
8PSK
16APSK
32APSK
4QAM
8QAM
16QAM
32QAM
64QAM
Pi/4-DQPSK

Automatic broadband Interference Locating system

Mobile Interference Hunter

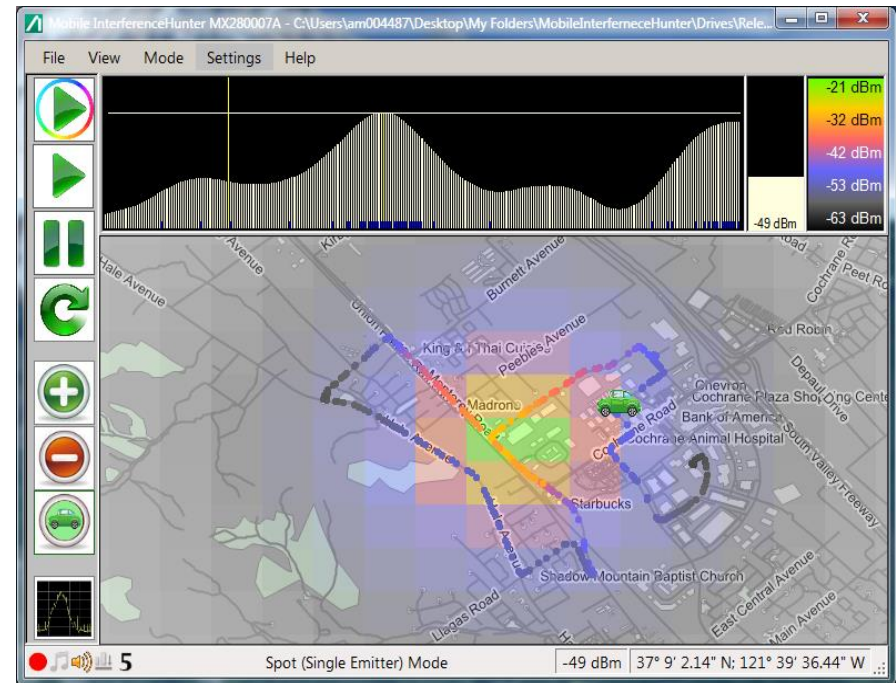
MX28007A

Automatic broadband direction finding system

MX28007A – classical interference hunting role

➔ Target application of Mobile InterferenceHunter™

- ▶ **Traditional Direction Finding**
 - ⊕ 10 geo-located bearings per hour?
- ▶ **Mobile InterferenceHunter**
 - ⊕ 100s of geo-located measurements per hour
 - ⊕ While driving...
 - ⊕ With patent pending driving direction guidance
 - ⊕ With optional RSM handoffs
 - ⊕ Works with pulsed or bursty signals



Automatic broadband direction finding system

MX28007A

➤ Single or multiple emitter detection mode

- ▶ make it easy to use for any type of emitter detection application
- ▶ e.g. multiple emitter mode is ideal for locating e.g. multiple cable TV interferers
- ▶ Multiple TRX operating the same RF

➤ A spectrum clearing mode using channel power measurements that map signals above a certain power threshold

➤ Key capabilities

- ▶ Guided area scan
- ▶ Post-capture analysis
- ▶ No special antenna requirement



Anritsu Handheld Spectrum Analyzer with GPS Option



Dash-mounted Windows® PC Tablet with MX28007A Software and 2000-1801-R mounting hardware



2000-1647-R
Broadband Magnet Mount Omnidirectional Antenna
700 MHz to 6 GHz with GPS Antenna in one housing
(recommended antenna for users operating in this frequency range)

Automatic broadband direction finding system

MX28007A

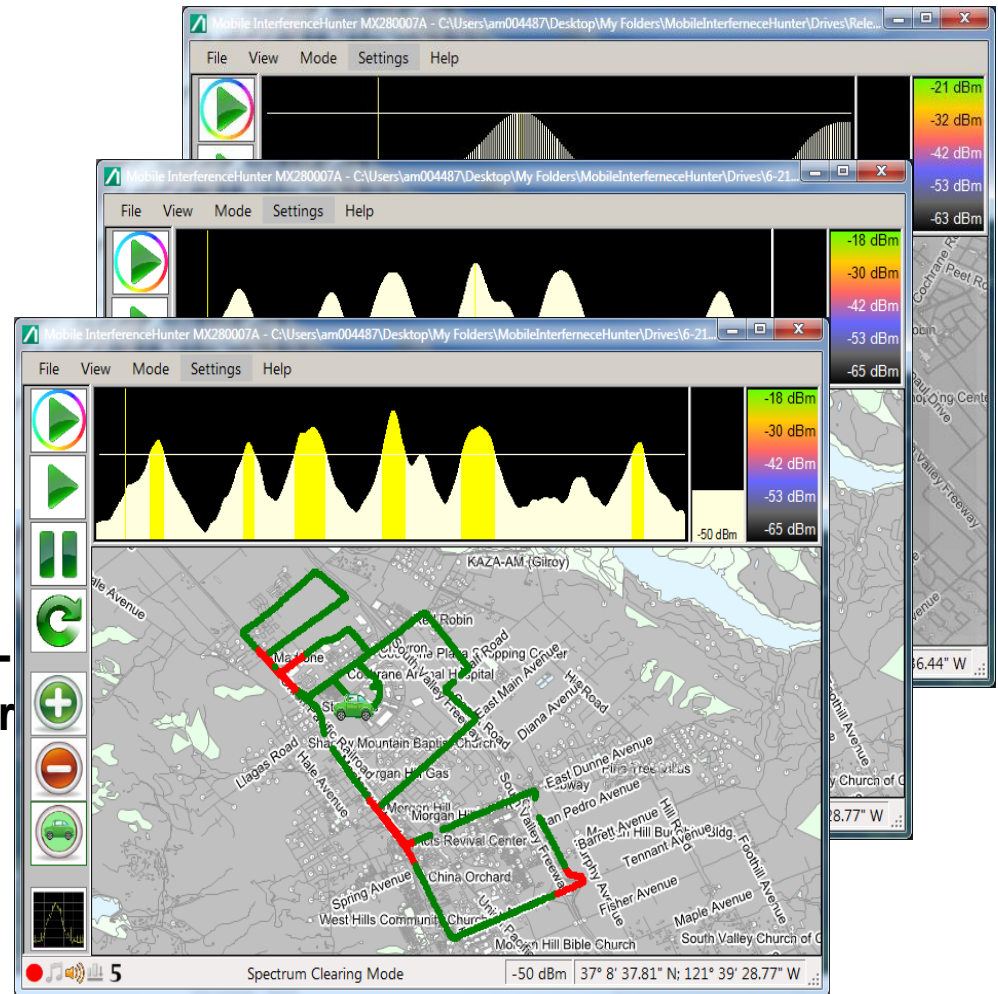
➤ Log files allow post-drive analysis

- ▶ Many parameters may be changed
- ▶ Allows expert assistance

➤ Single-Emitter

➤ Multi-Emitter

➤ Spectrum Cleaning



Automatic broadband direction finding system

MX28007A – Hunting CATV egress

➤ Poorly maintained cable networks tend to leak

- ▶ Squirrels and other rodents
- ▶ CATV theft
- ▶ Storm or traffic damage

➤ This leakage can:

- ▶ Be in LTE uplink bands
- ▶ Affect uplink quality
- ▶ Have multiple sources

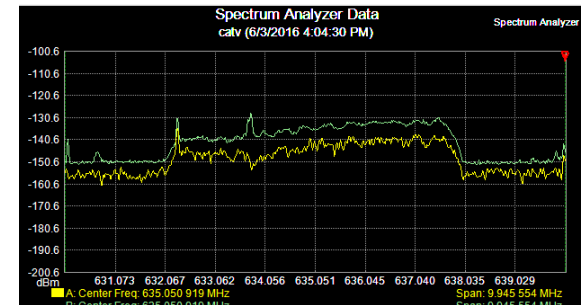
➤ The Problem

- ▶ Locating 100s of emitters
- ▶ By direction finding alone it's going to take a while

➤ Multi-Emitter mode

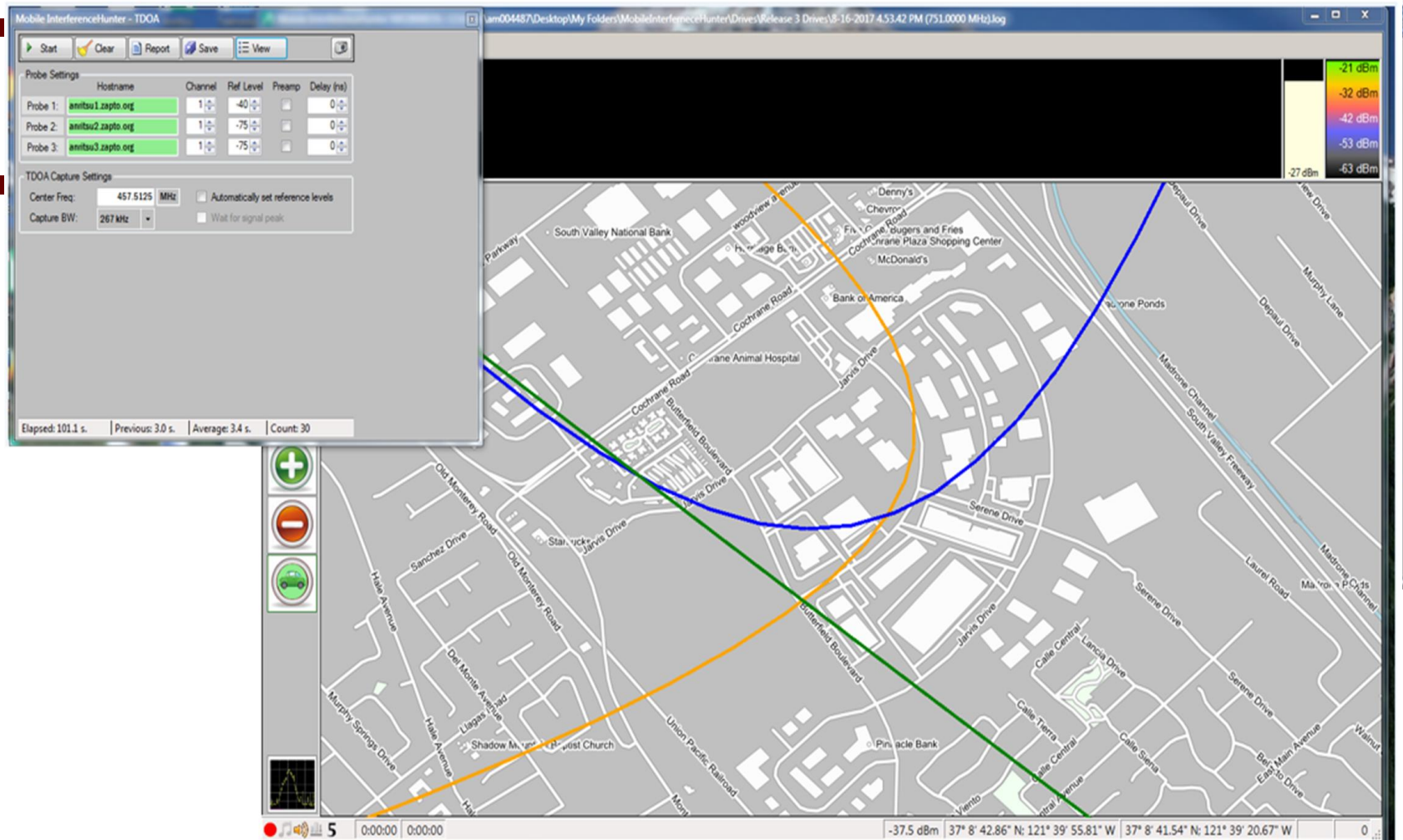
- ▶ Locates channel power peaks
- ▶ Shows power gradient
- ▶ Can ignore LTE uplink signals

Can get to the nearest curb



Automatic broadband direction finding system

MX28007A – aided by VISION multilateration results



Automatic broadband direction finding system

MX28007A Compatibility

➔ All current HH SPAs

▶ Required Options

- ⊕ GPS (Option 31)
- ⊕ Ethernet (Option 411)

▶ Burst Detect

- ⊕ Spectrum Master MS2720T
- ⊕ BTS Master MT8220T

➔ Also works with

- ▶ MS2760A, up to 110 GHz
- ▶ MS27101A, headless



Spectrum Master™
MS2760A



Remote Spectrum
Monitor MS27101A



VNA Master
MS2034B/35B



VNA Master
MS20236C/37C/38C



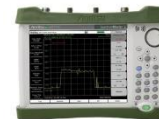
Spectrum Master™
MS2720T



Spectrum Master
MS2021B



Spectrum Master
MS2722C/23C/24C/25C/26C



Spectrum Master
MS2711E/12E/13E



BTS Master™
MT8220T



BTS Master
MT8221B/22B



Cell Master™
MT8212E/13E



Site Master™
S332E/62E



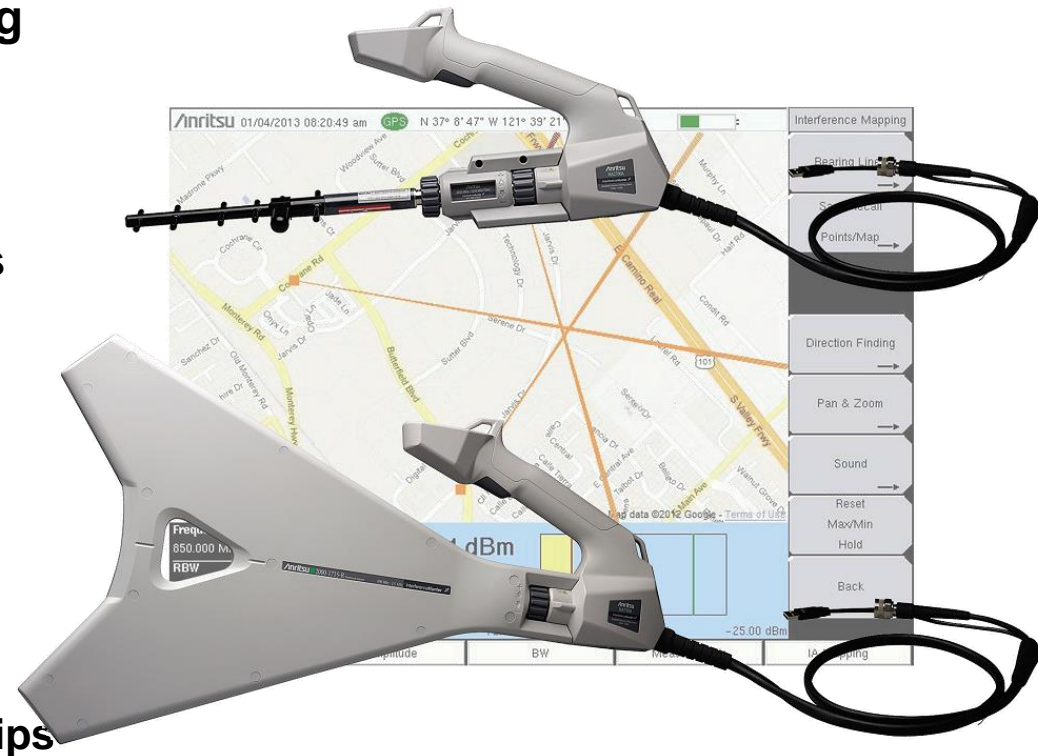
LMR Master™
S412E

**The last 100 m to the target
with
MS2700A**

Handheld Emitter Location

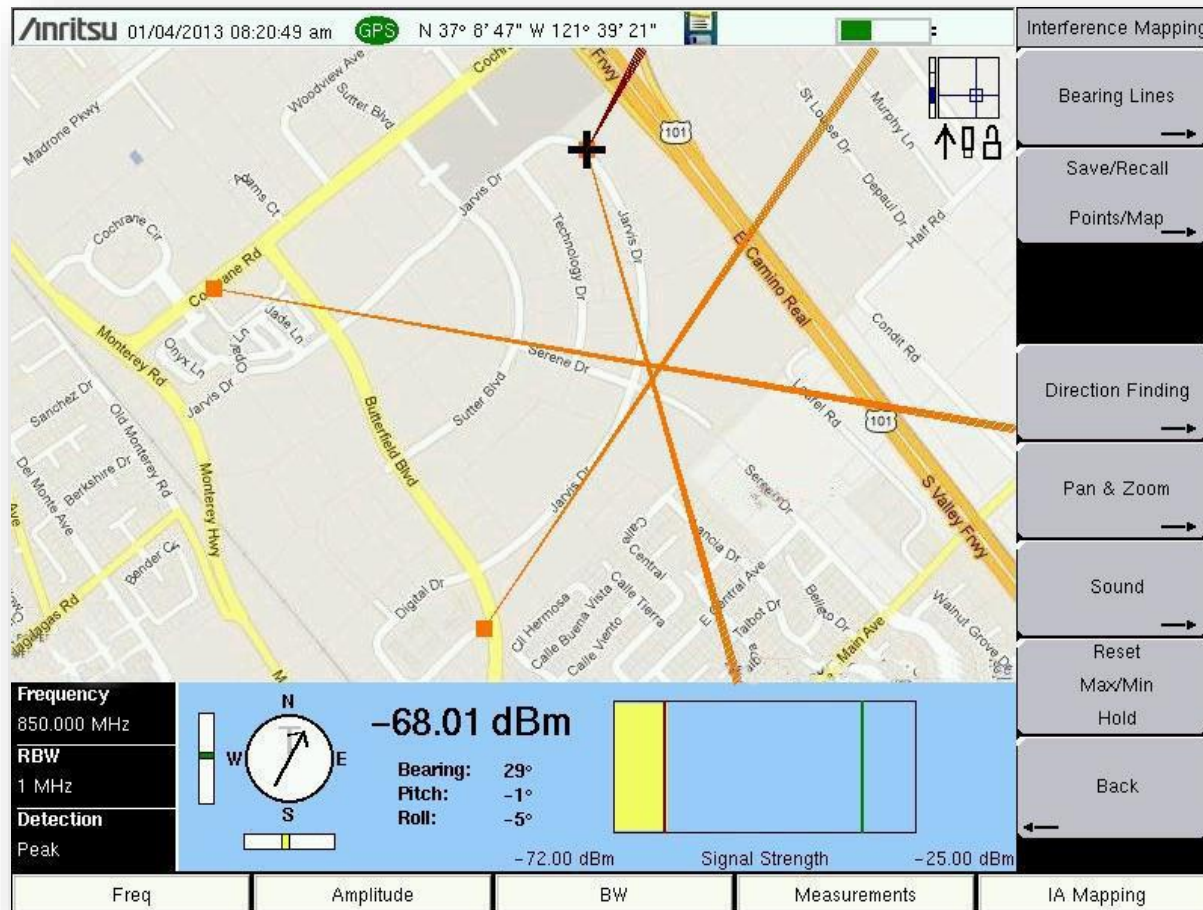
MA2700A

- ➔ **MA2700A for manual sniffing and taking bearings for locating purposes**
 - ▶ Built-in electronic compass
 - ▶ Built-in GPS receiver
 - ▶ Built-in preamplifier
 - ▶ Trigger for saving vectors
- ➔ **Easy no-tool attachment of antennas**
- ➔ **Ergonomic design**
 - ▶ Instrument in front of the hips
 - ▶ Antenna operation by one hand
- ➔ **Light weight**
- ➔ **Several available antennas**



MA2700A Handheld emitter localization

MS2700A – typical results





Word cloud containing various words for "Thank You" in multiple languages:

- Thank You
- Merci
- Gracias
- Thank
- Biyann
- Grazie
- Juspaxar
- Arigato
- Dankscheen
- bolzin
- Shukuria
- Tashakkur
- Mehrbanii
- Maako
- guzalmashita
- atuu
- Komapiisumida
- Fingki
- Yaqhanyalay
- Elchariato
- suksama
- Shukria

