MX28007A
Mobile
Interference Hunting System

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Anritsu envision : ensure

Detecting and locating interference in LTE uplink bands

Wireless networks today are being impacted by interference that degrades network performance. For wireless service providers, issues such as dropped calls, blocked calls, and data throughput are all impacted negatively by harmful interference. Operators need to utilize the full of capacity of their networks to keep up with demand. Focused on an LTE scenario the speaker shows in the presentation how to detect and locate potential LTE uplink interferers.

Ferdinand Gerhardes, Anritsu GmbH

11:45 – 12:15h

Mobile Interference Hunting System

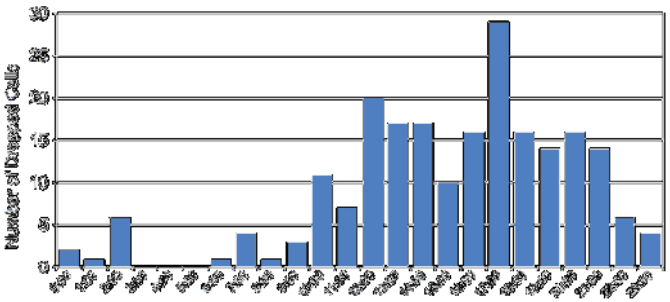
Agenda

- Motivation
- MX28007A system concept
- Operation principles
- Product features
- Additional interference hunting tools
- Field examples

Mobile Interference Hunting System

Motivation

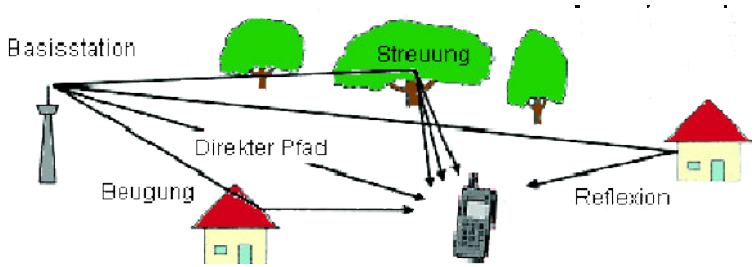
- Wireless networks today are being impacted by interference that degrades network performance.
- For wireless service providers, issues such as dropped calls, blocked calls, and data throughput are all impacted negatively by harmful interference.
- Operators need to utilize the full capacity of their networks to keep up with demand.
- Interference must be found quickly with a tool that is fast and simple to use by even inexperienced RF maintenance technicians.
- The Anritsu Mobile Interference Hunting System delivers on the requirement for fast and simple interference hunting.

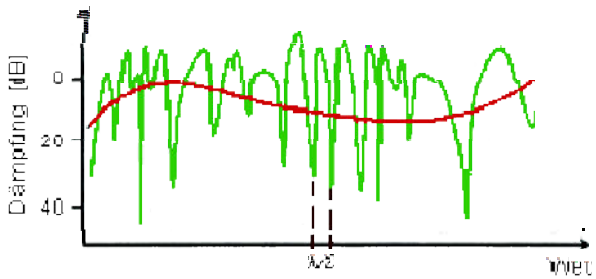


Mobile Interference Hunting System

Why Mobile Interference Hunter in urban and sub-urban areas?

- Manual process can be time consuming and inefficient – multiple measurements at various locations required
  - Often need to stop and move away from car to get accurate bearing
- Difficult to mitigate multi-path effects unless many measurements taken at different locations
- Multipath means receiving a signal from different directions simultaneously
- Caused by reflections, most commonly in an urban environment
- Multipath can make direction finding very difficult



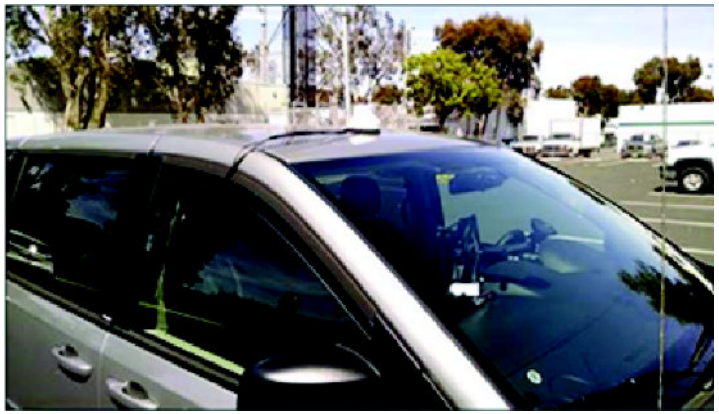


MX28007A
System Concept

Mobile Interference Hunting System

Mobile Interference Hunting Approach

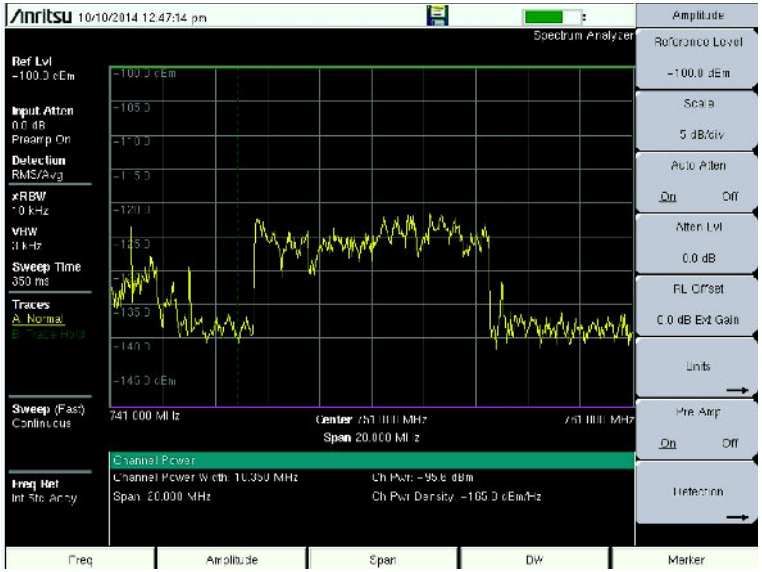
- MX28007A automatically identify and locate sources of interference
  - Maps for interference locating are provided on tablet/laptop
  - Power on Arrival (POA) algorithm is used for localization
  - Large quantities of measurements are accumulated and filtered for multi-path
  - Based on POA the MX280007A software draws a circle on the map indicating the position of the interference source
  - MX28007A is a mobile platform that reduces needed equipment to a SPA and an omnidirectional antenna
  - Concept behind:
    HH SPA is the <u>Tool</u> for every job



Mobile Interference Hunting System

Locatable interference types

- **Type of Interferers Found**
  - **Low power**
  - **Narrowband and wideband**
  - **Modulated**
  - **Pulsed signals (similar to radar)**
  - **Signals hidden in LTE uplink channels**
  - **"Black" TV/radio stations & BTS cellular equipment operating illegally**



Spectrum Analyzer in Channel Power Mode

- **Channel Power Measurements are used to feed data for POA**
  - **Track signals drifting in frequency**
  - **Track both wideband and narrowband interference**

Mobile Interference Hunting System

Basic Configuration

- **Basic configuration for the Anritsu interference hunting system:**
  - **MX280007A Interference Hunter™ Software**
  - **Anritsu handheld spectrum analyzer**
  - **Off-the-shelf omnidirectional (magnet mount) RF antenna**
- **Inbuilt GPS antenna or separate solution**
- **Windows Tablet, Laptop or PC with Windows 7 or 8 operating system running the MX280007A software**

Anritsu Handheld Spectrum Analyzer

Antenna 2000-1647-R
700 MHz – 6 GHz + GPS

Windows Tablet with Mounting Hardware

Mobile Interference Hunting System

Applicable HH SPA

- Compatible with most existing HH spectrum analyzers (no firmware updates needed, but GPS option required)
- Supported HH SPA
  - Spectrum Master MS2720T, MS27xx B/C/E
  - BTS Master MT8220T, MT822xB
  - Cell Master MT8221xE
  - Site Master S3x2E
  - LMR Master S412E
  - VNA Master MS203xB, MS203xC

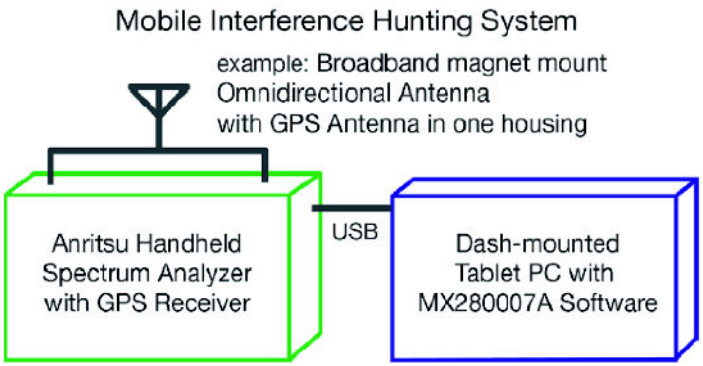
Spectrum Master™ MS2720T

BTS Master™ MT8220T

Mobile Interference Hunting System

Operation preparations

- **MX28007A System Setup**
  - **Connect Spectrum Analyzer to tablet with USB cable**
  - **Set analyzer**
    - **Frequency,**
    - **RefLev**
    - **PreAmp**
    - **RBW/VBW,**
    - **Channel BW,**
    - **GPS ON**
  - ▶ **Load Map into MX280007A, adjust settings as needed**
  - ▶ **Select Single, Multiple Emitter detection or Spectrum Clearing mode**
  - **Start the system and begin driving**



MX28007A
Product Features

Mobile Interference Hunting System

Important Features in a Mobile Hunting System

- Features
  - Channel Power Measurements
  - Operationmode
    - Single emitter detection
    - Multiple emitter detection
      (ideal for locating multiple cable TV interferers)
    - Spectrum clearing mode
      (map signals above a certain power threshold
  - Spectrum View
- Voice Prompts (allow one-person operation)
  - Min Hold (LTE uplink channels)
  - Max Hold (periodic or “radar type” signals
  - Sensitivity settings
    - Dense Urban
    - Rural terrain
  - Ability to capture and store interference hunt log files for later playback and analysis

Mobile Interference Hunting System

Important Features in a Mobile Hunting System

- RF antenna used should be off-the-shelf, have a small form-factor and be highly portable
  - Off-the-shelf antennas are non-proprietary, inexpensive and available in a multitude of frequency ranges
  - Small size allows users to be "discreet" when interference hunting in neighborhoods
  - Portability allows easy transfer of hunting system from one vehicle to another (magnetic mount antennas are preferable)

RF/GPS Antenna
700 MHz–6 GHz

- Spectrum Analyzer for multi-purpose applications
  - High dynamic range and low noise floor
  - Options for spectrograms, signal quality analysis and demodulations

Graphical User Interface

Mobile Interference Hunting System

Graphical User Interface

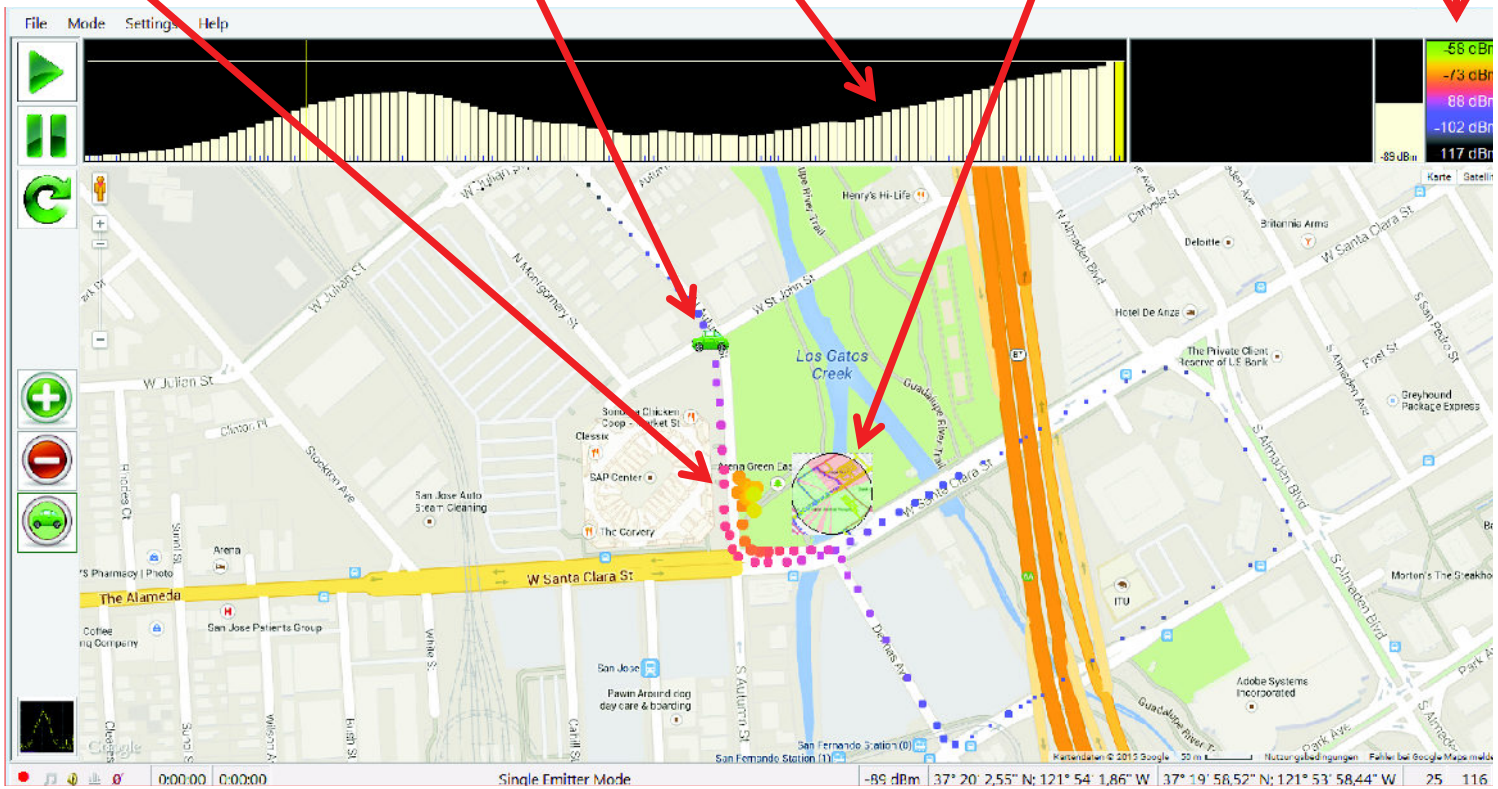
Colored "breadcrumbs' left along drive indicating power levels along drive

GPS position of car visible on map

Power vs. Time vs. Position

Circle indicates probable interferer location

Breadcrumbs Power vs Color Chart

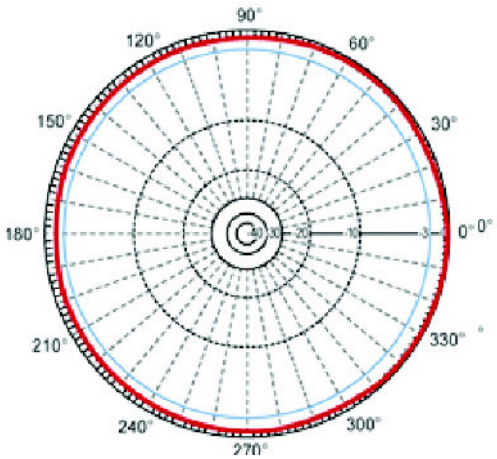


Operation Principle

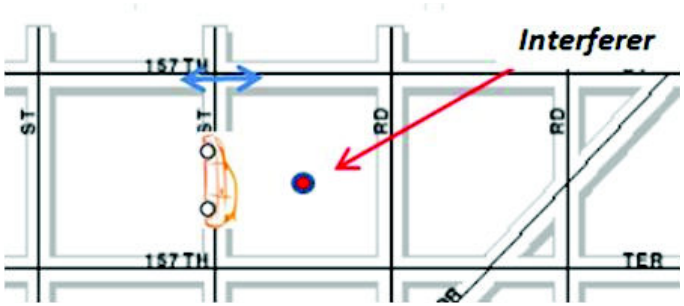
Mobile Interference Hunter – Power of Arrival

Operation principle

- **Power of Arrival - Omni-directional antenna used**
  - **Interference localization based on signal strength**
  - **Signal strength proportional to $1/r^2$**
  - **Massive data is taken to feed math. algorithm**
- **Omni Antenna Key Benefits**
  - **Inexpensive**
  - **Simple to Use**
  - **Readily Available**
  - **Good performance in multi-path environment**



Omni Radiation Pattern

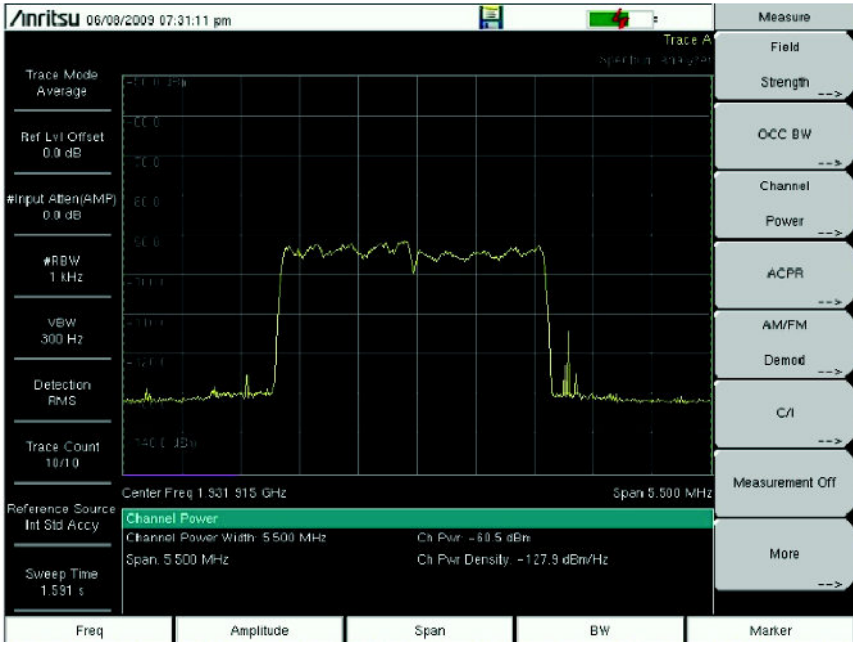


Drive on Grid to Determine Direction

Mobile Interference Hunting System

Important Features in a Mobile Hunting System

- **Mitigate Multipath**
  - Take large number of averaged measurements continuously
  - Guide user to interference location using power of arrival
- **Use Channel Power Measurements**
  - Important for finding wideband signals
  - Essential for finding interference which varies in frequency over time

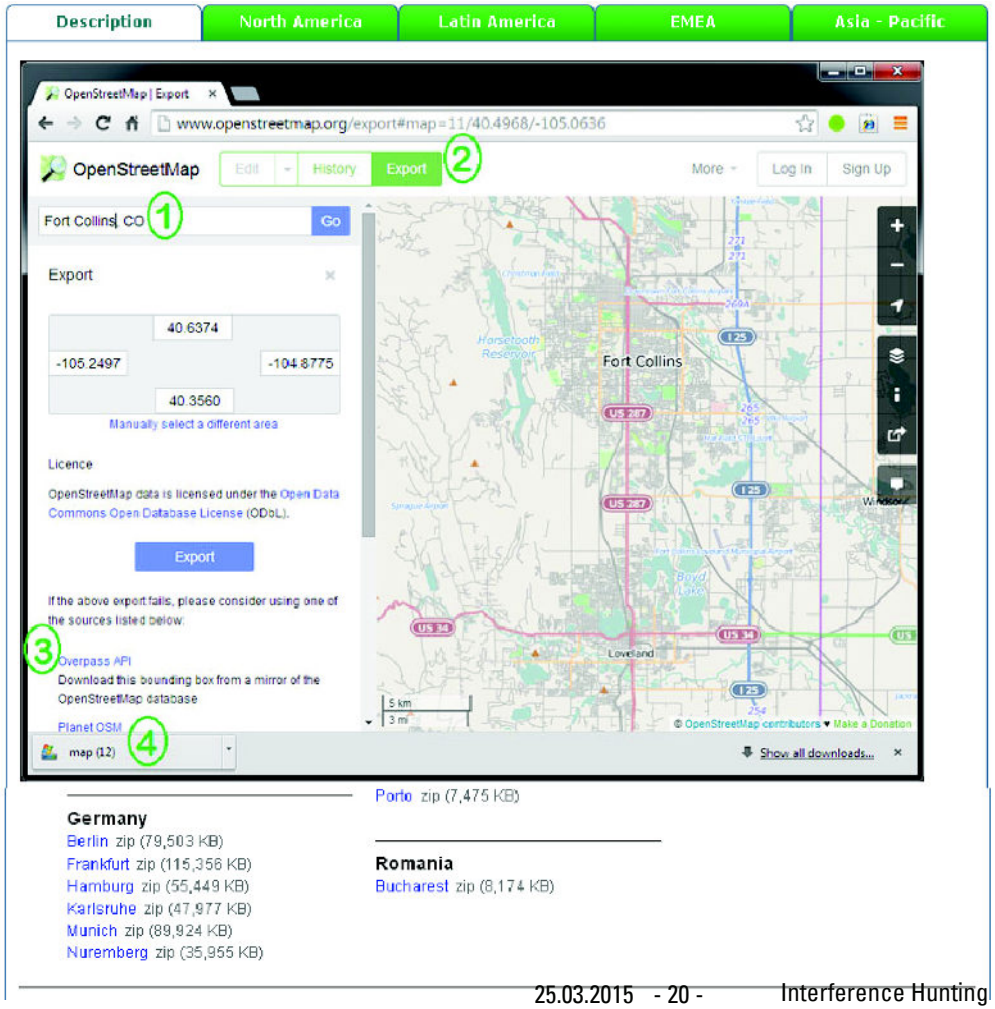


Channel Power Measurement

Mobile Interference Hunting System

Download of embedded maps

- Download predefined local map via Anritsu webpage
- Define and download own, individually prepared maps (using Open StreetMaps).
- Use Google Maps in case of online internet access
- MX280007A works with both GoogleMaps™ and OpenStreetMap™
- Both mapping systems are open source and free of charge !

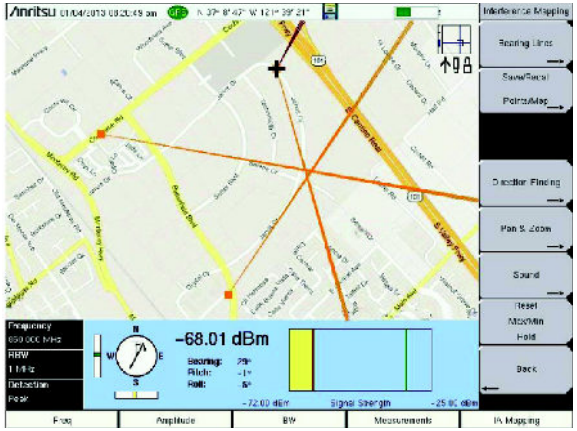


Additional
Interference Hunting equipment

Mobile Interference Hunting System

Additional Equipment for Interference Hunt – MA2700A

- **Anritsu mobile interference hunting system MA2700A allows the user to find interference positions quickly and easily**
  - **The ideal tool for pin-pointing exact interference locations (such as on rooftops or inside office buildings)**

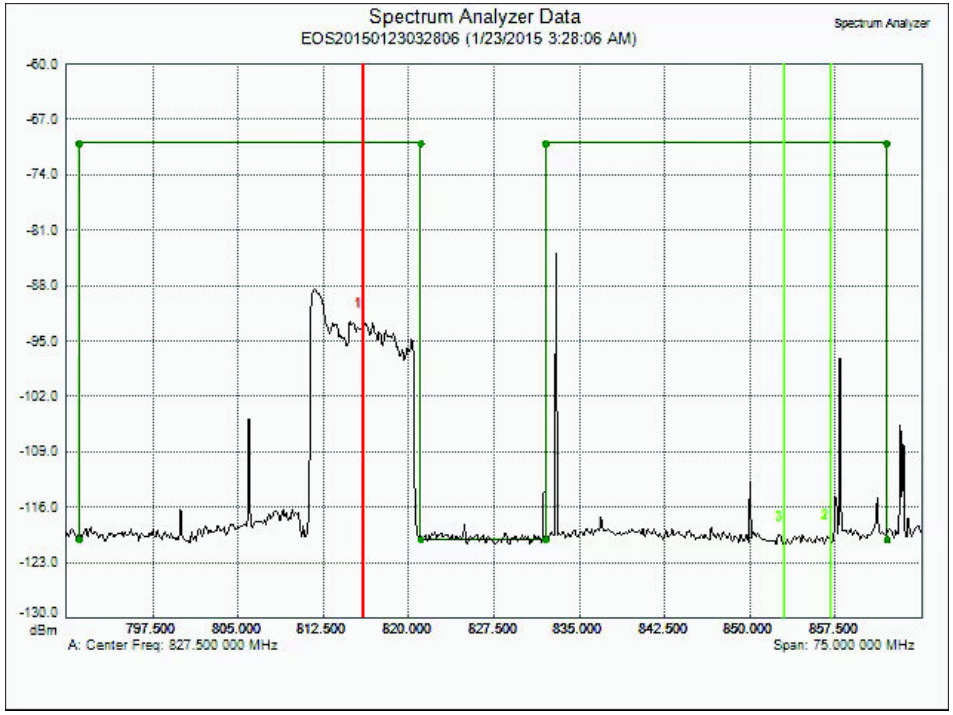


Field Example
LTE uplink interference

Mobile Interference Hunting System

Field Example – LTE Band 20 without significant interference

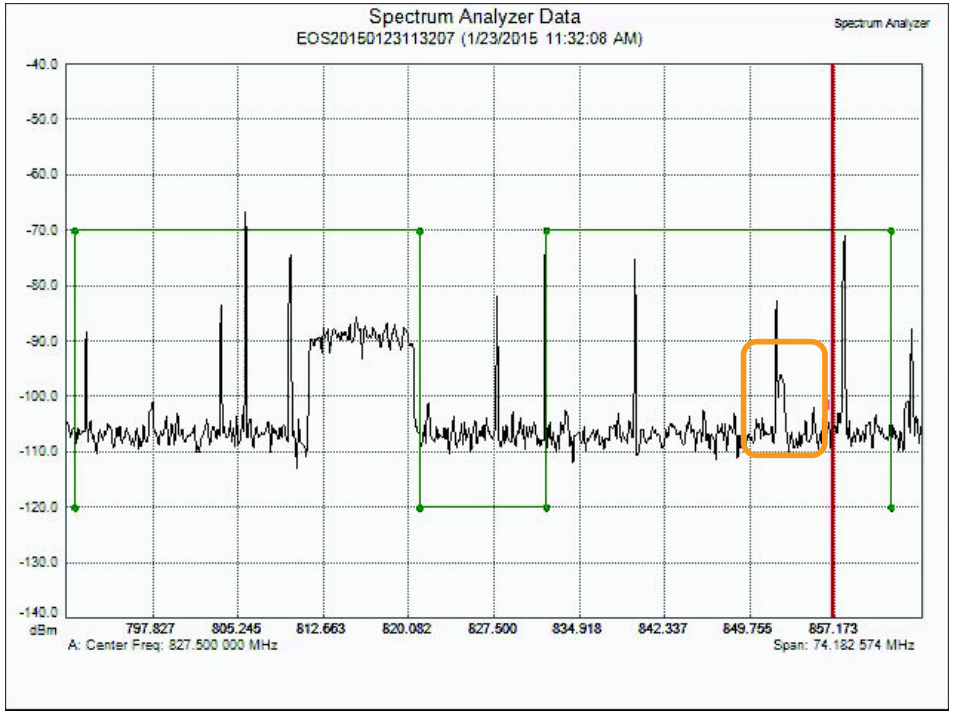
- **Visible**
  - **DL TX ARFCN 6400**
  - **no UL traffic**
  - **unusual high level CW like emissions**
  - **Emitter source unknown (not investigated further on)**



Mobile Interference Hunting System

Field Example – LTE Band 20 with significant interference

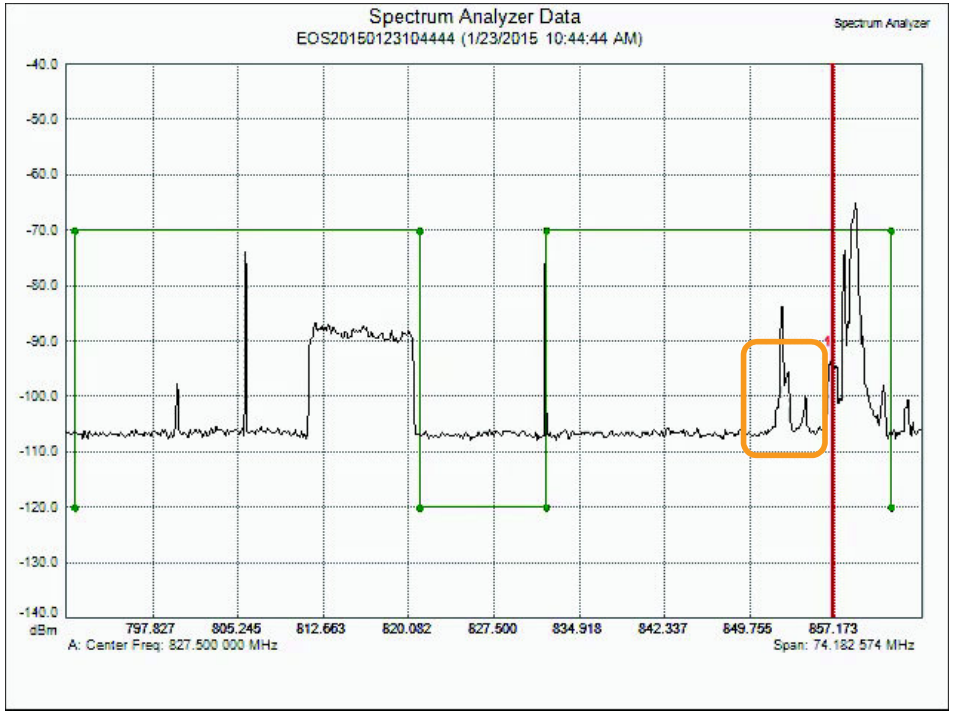
- **Visible**
  - **DL TX ARFCN 6400**
  - **some UL traffic on ARFCN 24400**
  - **“moving” emission on left side of UL channel**
  - **difficult to “see / detect” due to Uplink Bursts**



Mobile Interference Hunting System

Field Example – LTE Band 20 with significant interference

- **Visible**
  - DL TX ARFCN 6400
  - some UL traffic on ARFCN 24400
  - "moving" emission on left side of UL channel
  - **Averaging is underlining burst like UL traffic and assumed interference**



Mobile Interference Hunting System

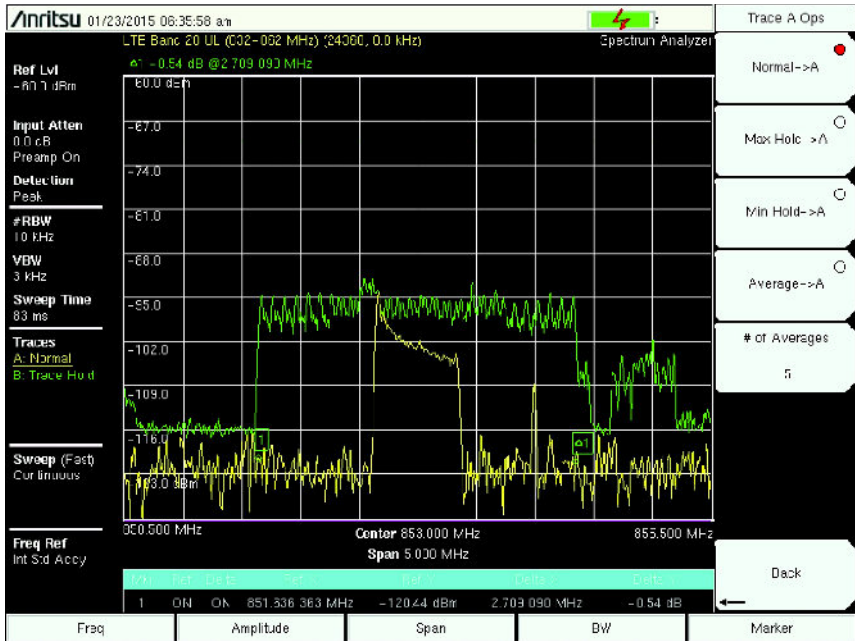
Field Example – LTE Band 20 with significant interference

- A spectrogram reveals even more information

Mobile Interference Hunting System

Field Example – detailed view of interferer

- **Visible**
  - **Total interference bandwidth approximately 2,5 MHz**
  - **Interferer is moving continuously from left to right**
  - **Task:**
    - What kind of radiation is it?
    - Where is it coming from?

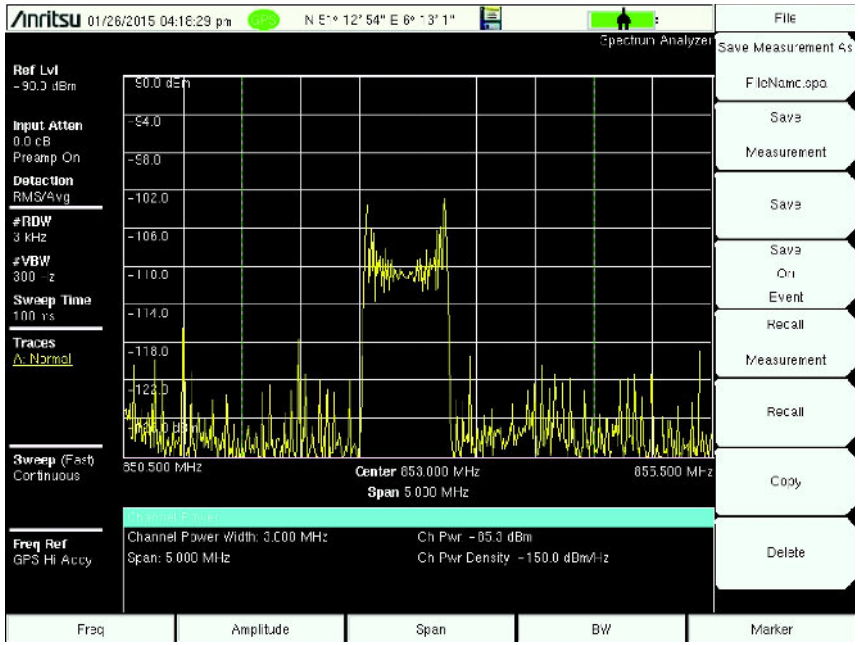


Mobile Interference Hunting System

Field Example – LTE Band 20 with significant interference

- **Channel Power measurement**
  - **over a bandwidth of 3 MHz**
  - **ChPwr of approx. -85 dBm**

- **This kind of measurement is used by MX28007A Mobile Interference Hunter to come to a localization of the signal.**



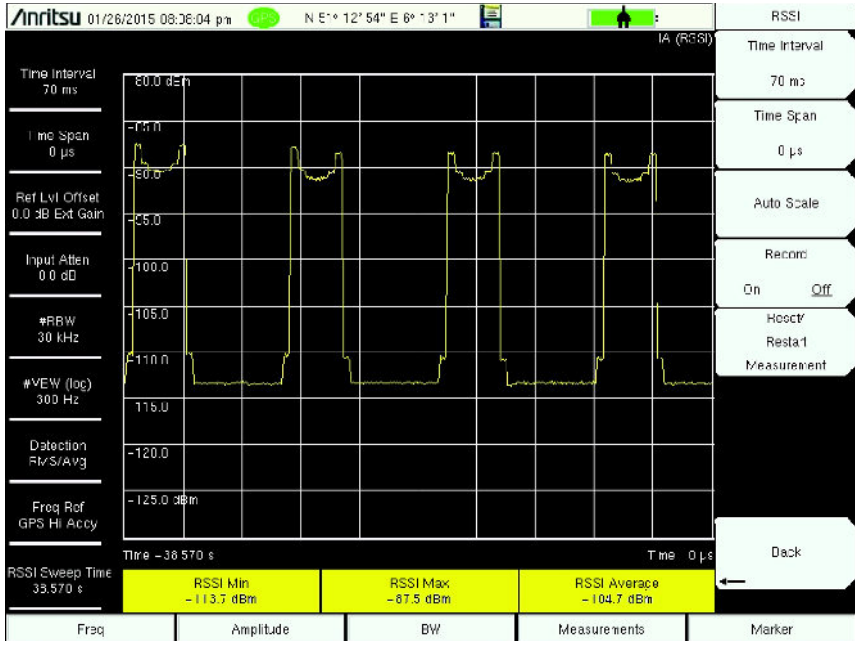
Mobile Interference Hunting System

Field Example - detailed view of interferer using Zero SPAN or RSSI measurement

- **Zero SPAN operation reveals**
  - **"hopping interval" of 10 s**

  or use

- **RSSI measurement option**
  - **No special configuration needed**
  - **You can use recording function for documentation**



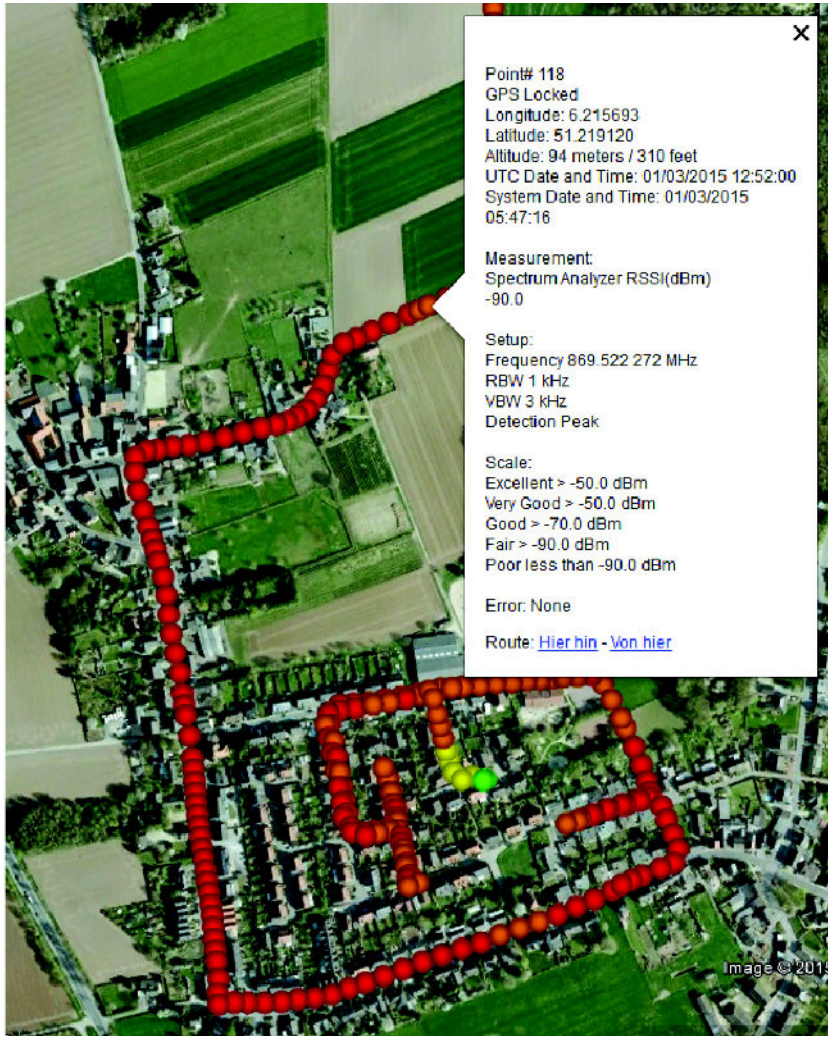
Localization
Field Examples

Localization
Field Examples I
“Bursty TRX”

Mobile Interference Hunting System

Field Example I

- How is POA working?
  - Bursty transmitter is used as an interferer
  - Radio Coverage mapping was done to "see" where the signal is strong and weak
  - Averaging or Max Hold was used in order to get the agile signal smooth within the predicted bandwidth
  - Zero SPAN based RSSI measurement performed and results visualized
- Now it is easier to imagine how POA might work ☺



Mobile Interference Hunter – Power of Arrival

Field Example I

- **TRX module SK-iM880A used as an "interferer"**

RF:	SRD Band 863 to 870 MHz
Modulation:	LoRa Spread-Spectrum
TX Pwr.:	up to +19 dBm
RX Sens.:	-134 dBm @ SB 250 kHz -128 dBm @ SB 500 kHz
RF datarate:	0.24 to 37.5 kbps
RF range:	up to 15000 m

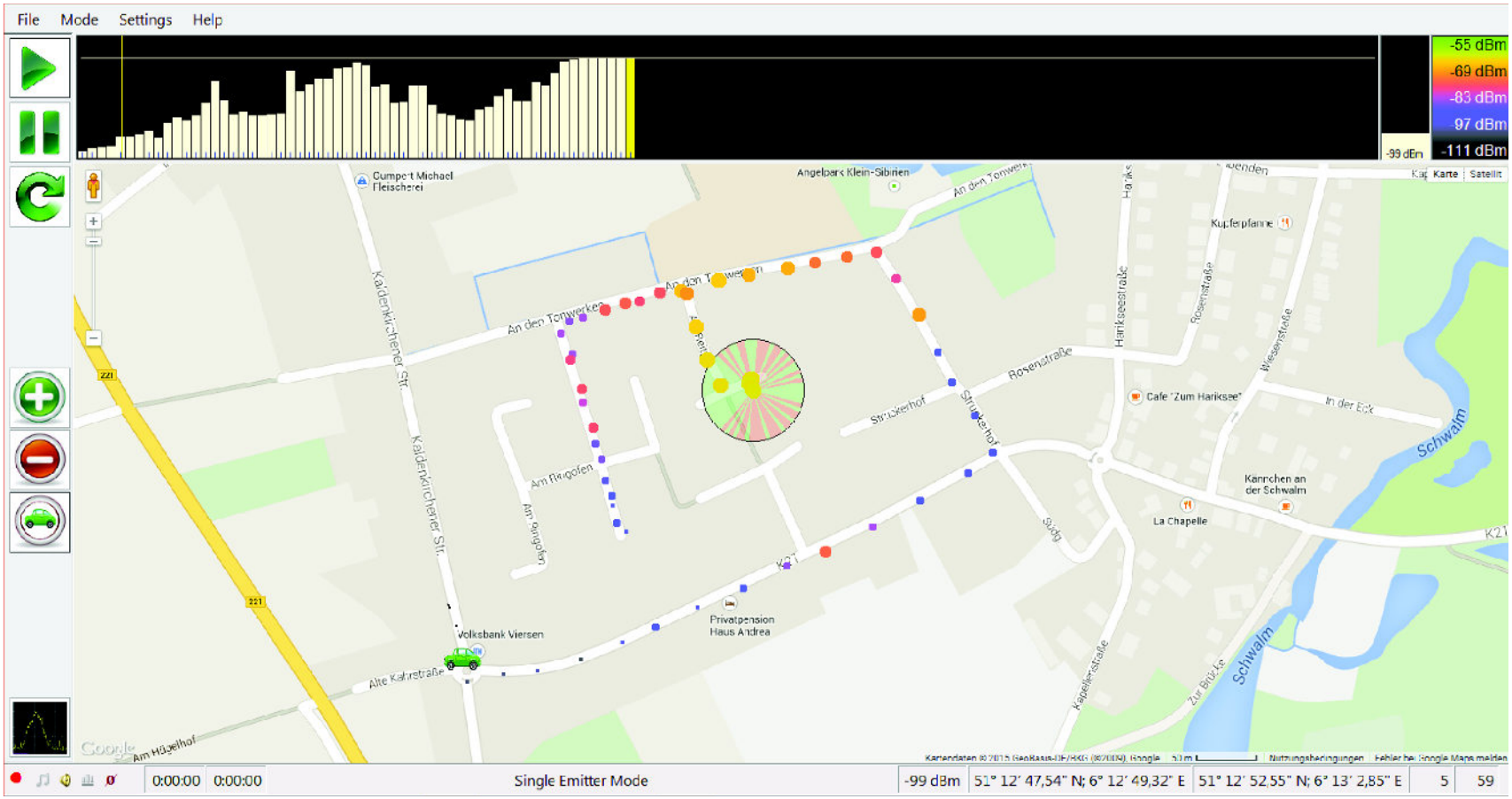
Mobile Interference Hunting System

Field Example I

- Frequency agile TX with Occ Bw ~ 125 kHz
- Short data bursts visible in Time Domain representation
  - clear hint that two TRX are communication with each other

Mobile Interference Hunting System

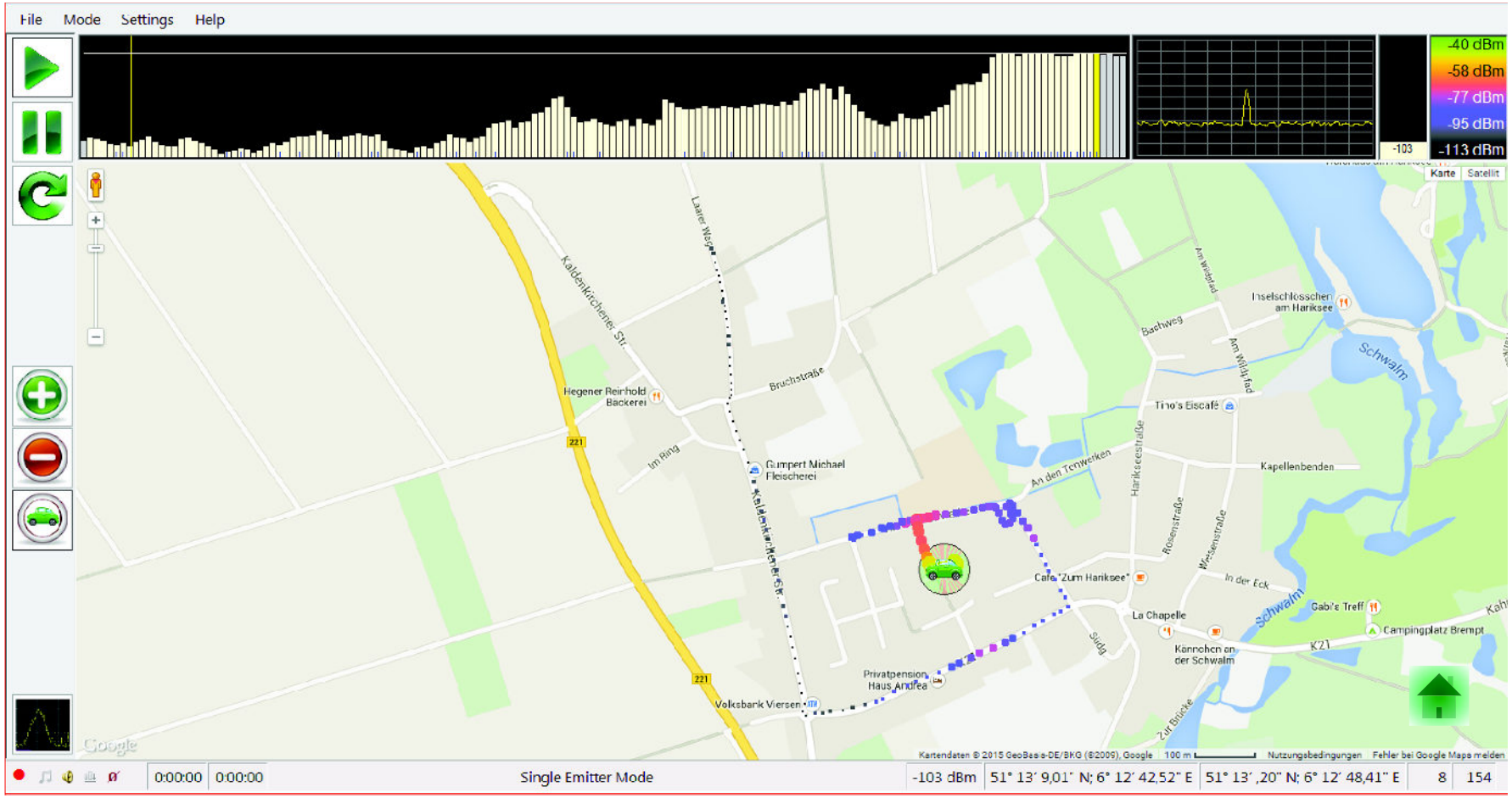
Field Example I



Localization
Field Examples II
“Weak CW signal”

Mobile Interference Hunting System

Field Example II – MX28007A log file replay



Localization
Field Examples IV
“Stationary TETRA TRX”

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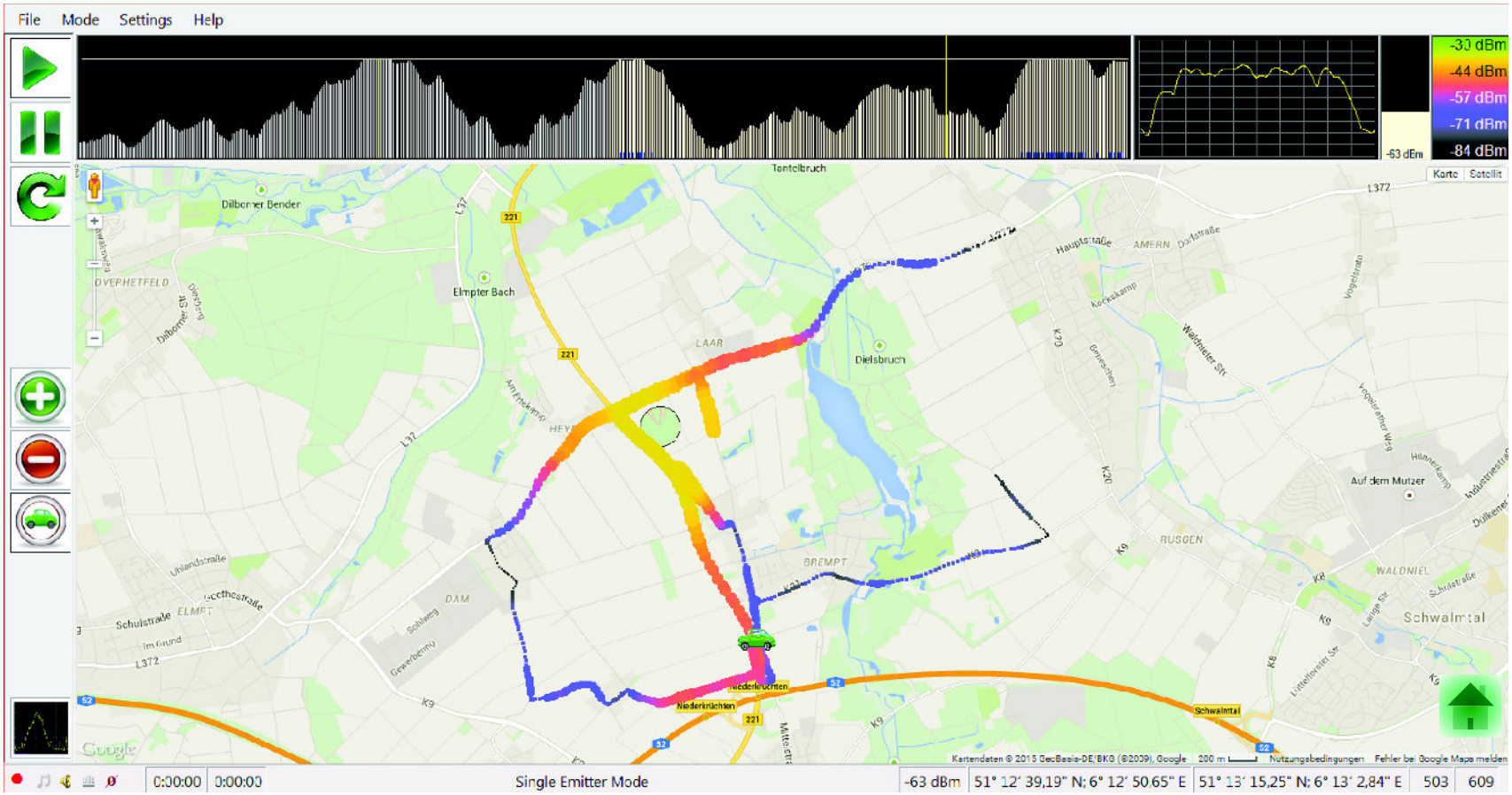
Field Example IV – TETRA TX



Mobile Interference Hunting System

Summary

- **Value**
  - Eliminate need for expensive proprietary antenna
  - Spectrum Analyzer is a multi tool for a lot of applications
  - One person operation
- **Frequency Range**
  - 9 kHz to 43 GHz
  - Just another omni-antenna
- **High Sensitivity**
  - Detect signal from further distances
  - Limit is SPA DANL e.g.
    -116 dBm @ 25 kHz RBW or
    -160 dBm @ 1 Hz RBW
- **User Friendliness & Driver Safety**
  - Requires < 5 min setup, 1-person operation)
  - Small unobtrusive antenna


Thank
you
Merci
Graciias
Arigato
Dankscheen
Mehrbani
Shukuria
Tashakkur
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