



GEO-LOCATION OF RF EMISSIONS

Technological advances in improving Situational Awareness by Gathering of Critical Data from RF Spectrum

October 2021

Juergen Gehrig, Regional Sales Manager at Narda Safety Test Solutions

Content table (Geo-location of RF emissions)

From field strength measurement to geo-location of RF emissions – technological advances

Geo-localization based on AoA and PoA algorithms - semi-automated / fully automated

Geo-localization based on TDoA algorithm - - time difference between multiple RF receiving sites

Hybrid geo-localization and SIGINT capabilities

(a combination of AoA and PoA)

Use cases and network applications

COMINT classification and decoding

Questions and feedback



Geo-location of RF emissions
electromagnetic field strength
measurement know-how

Isotropic RF sensors
insuring human safety
working or just staying within
electromagnetic environment
part of the DNA of Narda
(Narda Safety Test Solutions, Germany)



Handheld measurement equipment
personal warning
broadband
frequency selective
RF level measurement
insuring the safety of people
exposed to electromagnetic fields in RF
environment

idea of compact and man portable RF
geo-location measurement devices
Optimization of Size, Weight and Power
(SWaP)



Handheld and portable receivers
radio direction finding antennas
geo-location of RF emissions

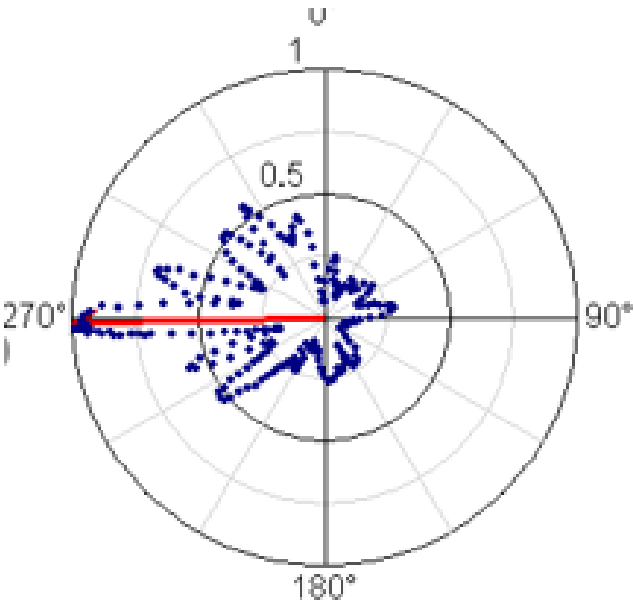
- Interference
- analysis of unknown communication
- creation of a RF situational awareness
- spectrum monitoring
- creation meta data from the RF emission
- Interception and production of content



Handheld Direction Finding

Manual Localization based on AoA & PoA

High bearing sensitivity – directivity and LNA (NF 5 dB)

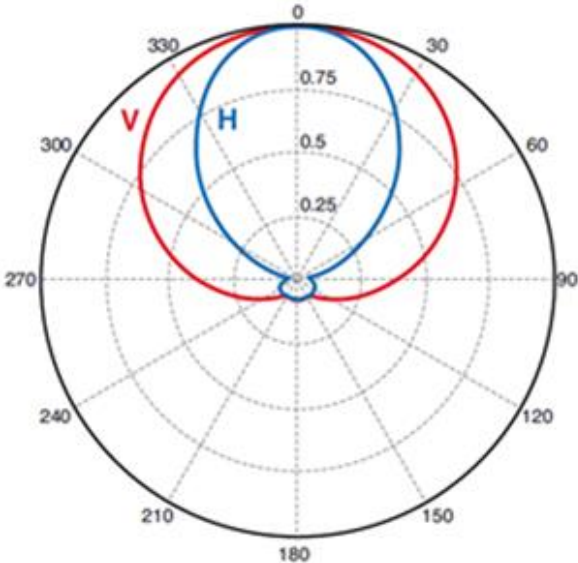
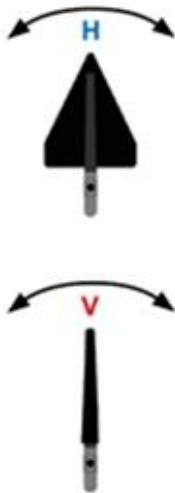


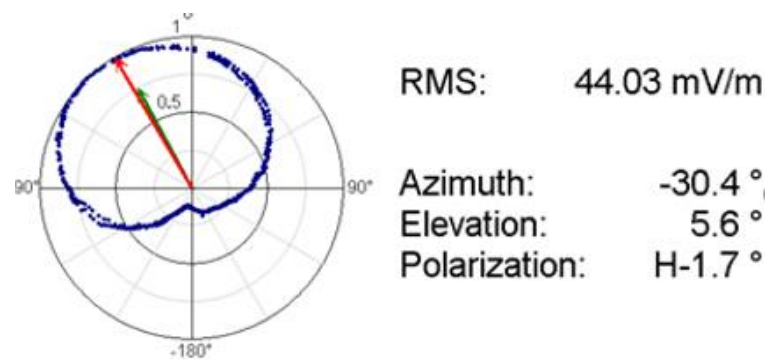
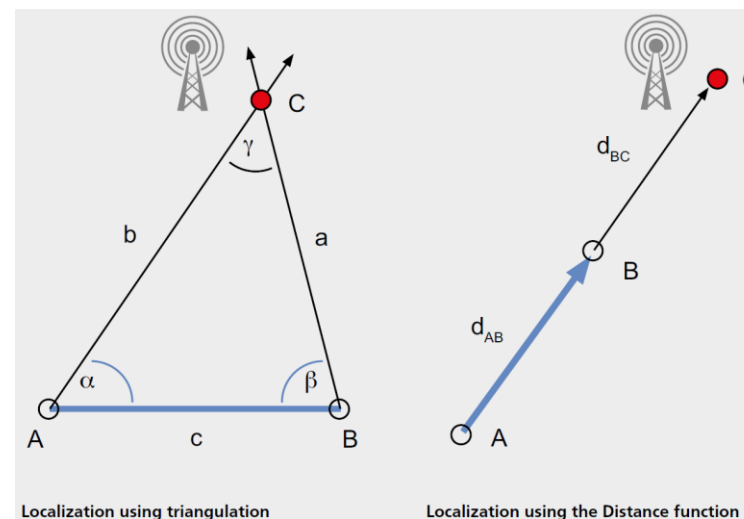
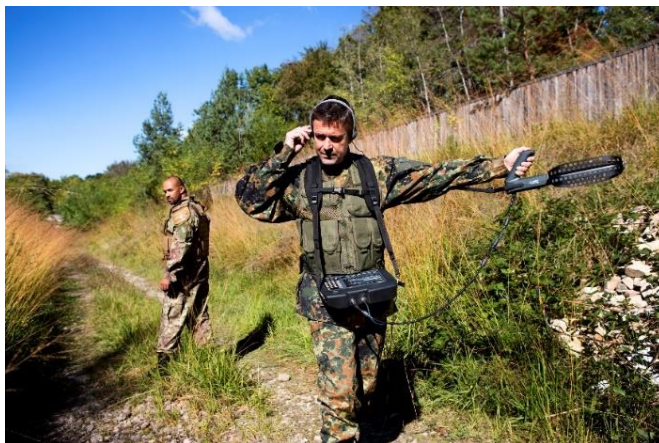
RMS: 83.23 dBμV/m

Azimuth: 269.2 °

Elevation: 0.7 °

Polarization: V-1.3 °





Technical data of measurement unit inside:

- Frequency range: 8 kHz to 8 GHz
- Real-time bandwidth: 40 MHz
- Scan rate: up to 50 GHz/s
- DANL (w/o pre-amp): $-159 \text{ dBm/Hz} \leq 3 \text{ GHz}$
- IP2, two tones: $+40 \text{ dBm}$
- IP3, two tones: $+14 \text{ dBm} \leq 3 \text{ GHz}$
 $+12 \text{ dBm} > 3 \text{ GHz}$

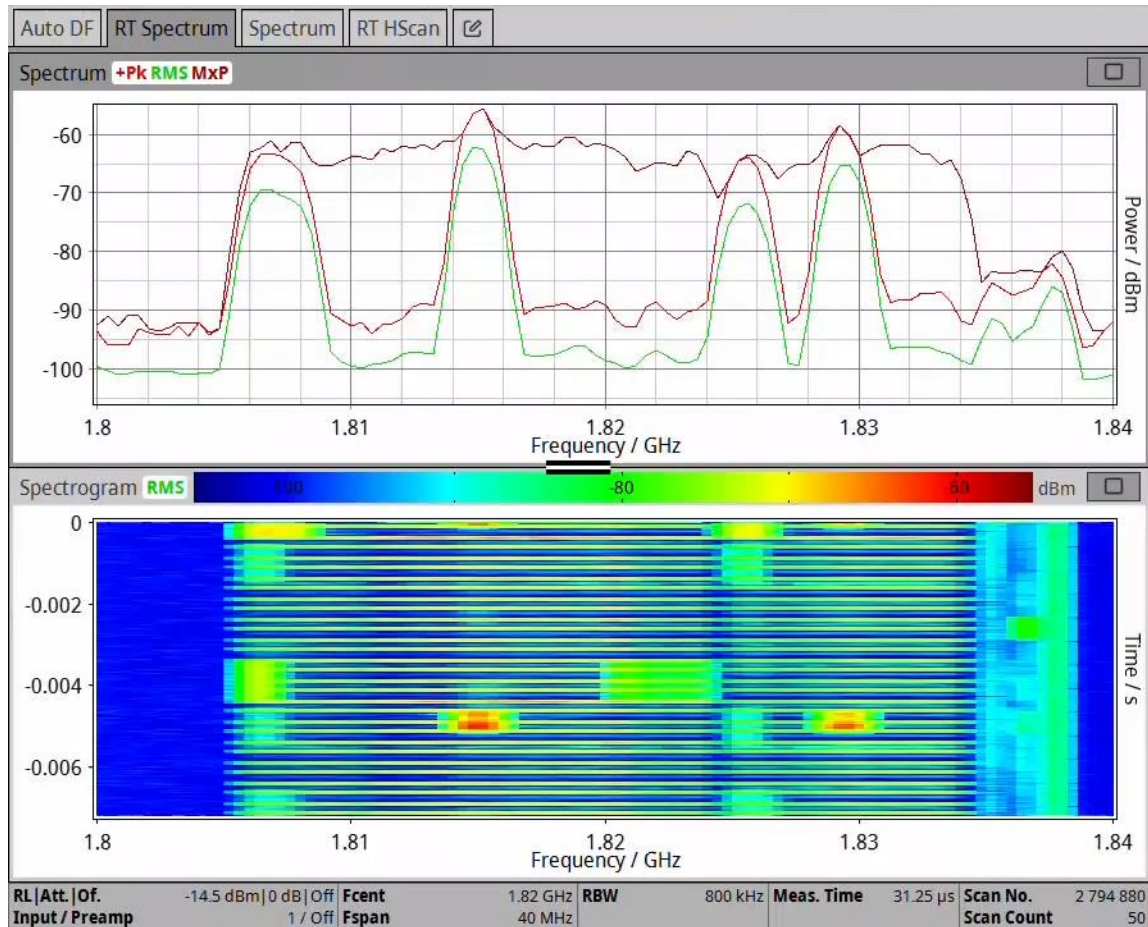
=> ITU driven performance

=> Desktop performance in handheld format

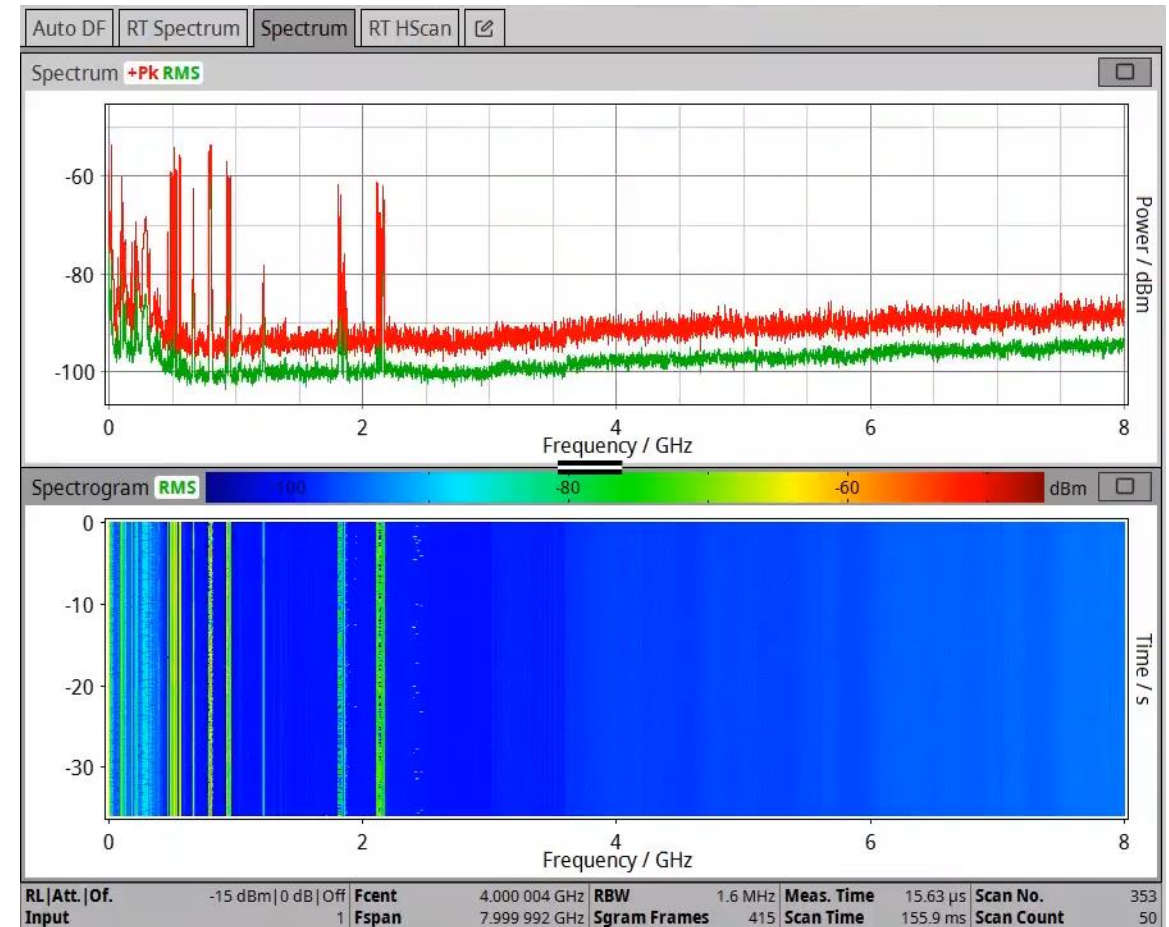


POI (probability of intercept) to nano seconds range

- Real time at 40 MHz gapless
 - sweep rate of 1.26 THz/sec



- Scanned spectrum / Panorama scan
 - 50 GHz/ s for fast overview over of entire 8 GHz frequency band



Use Cases - Radio Monitoring & DF



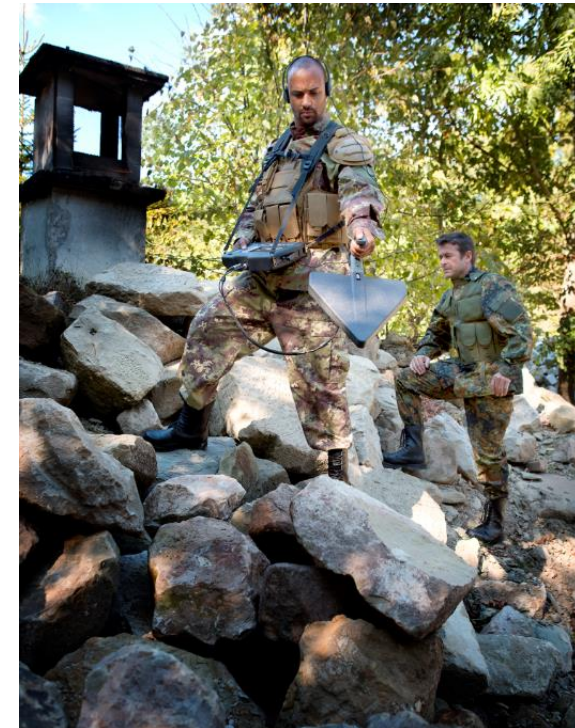
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Strategic, tactical and operational level sensor and intelligence system offering :

- RF interference emission identification of your own troops
- RF Emission of enemy's fixed location
- RF Emission of enemy's on the move position
- Tracking of suspicious objects on the move (land, sea, and air)
- Finding of buried persons by their RF ID
- Interference & illegal emission identification
- Homeland Security / border control missions
- Radio communications surveillance & interception
- Radio localization & direction finding (AoA / TDoA)



SignalShark – The Narda Platform

Three form factors: identical receiver / RT-SA



Automatic Direction Finding Antenna ADFA



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Central monopole
as a reference element for DF
and omnidirectional
monitoring antenna

Frequency range

ADFA 1: 200 MHz – 2.7 GHz

ADFA 2: 10 MHz – 8 GHz



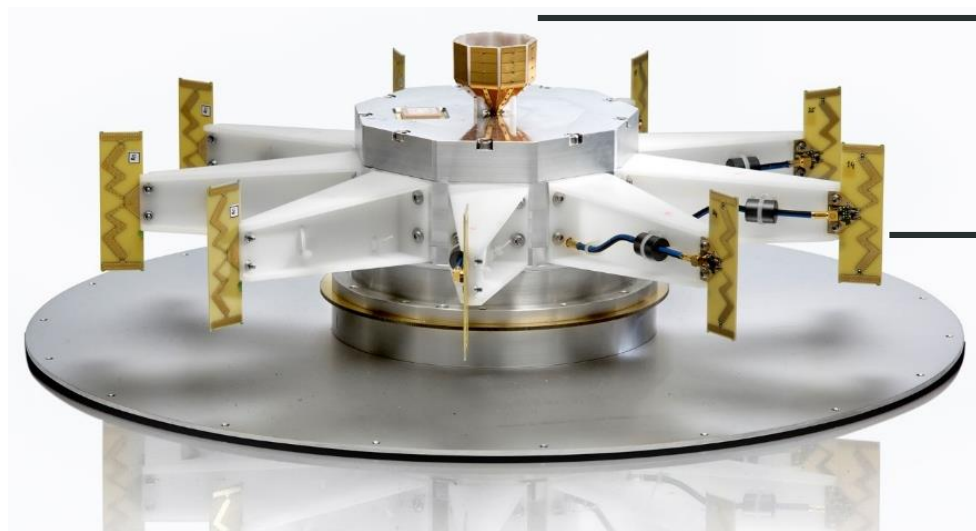
Fast bearing acquisition
down to 1.2 ms

Compact Design:
Diameter: 480 mm
Weight ADFA 1: 5.6 kg / 12.3 lbs
ADFA 2: 6.5 kg / 14.3 lbs

ADFA 1 & ADFA 2

- ADFA 1

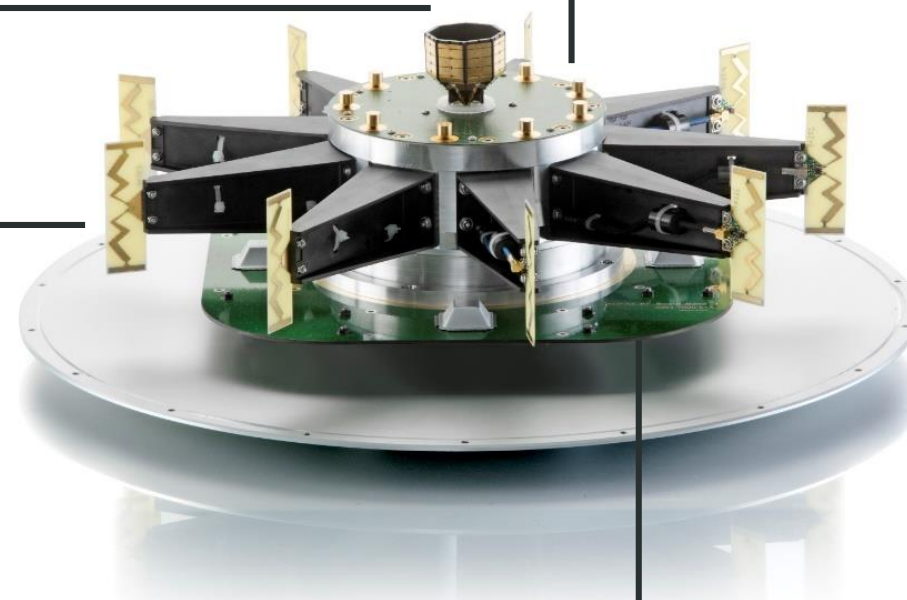
Central monopole as a reference element for
DF and omnidirectional monitoring antenna



Nine dipoles arranged
on a 380 mm diameter circle
for DF with large aperture
200 MHz – 2.7 GHz

- ADFA 2

Nine dipoles arranged
on a 128 mm diameter
circle 2.7 – 8 GHz



2 orthogonal crossed loops
10 MHz – 200 MHz

Possible site configurations I

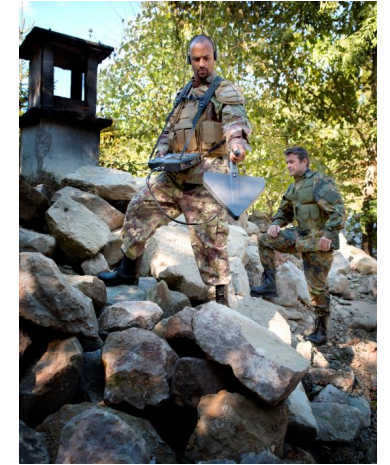
Outdoor left behind mast



Commercial vehicle

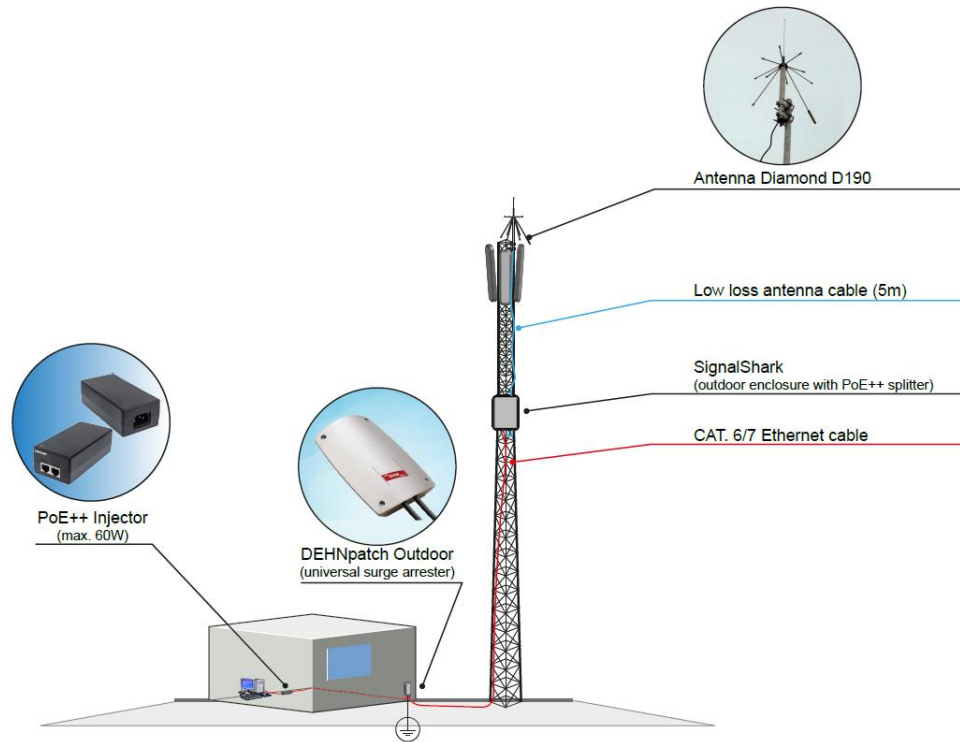


Handheld + Hardcase



Possible site configurations II

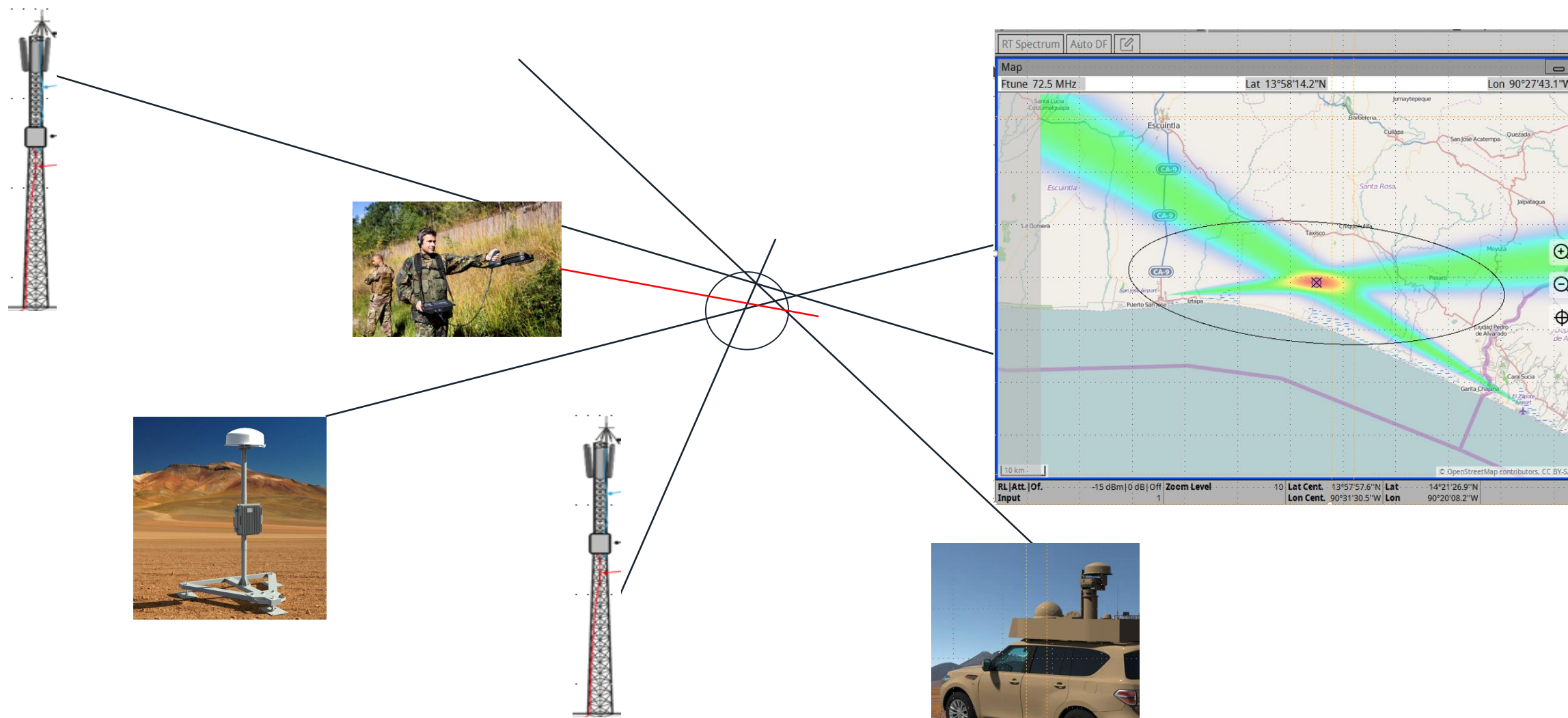
- Radio Monitoring (AoA / TDoA) on mast



- Radio DF and tactical SatCom link



Network of receivers to track moving target



SignalShark in conjunction with ADFA



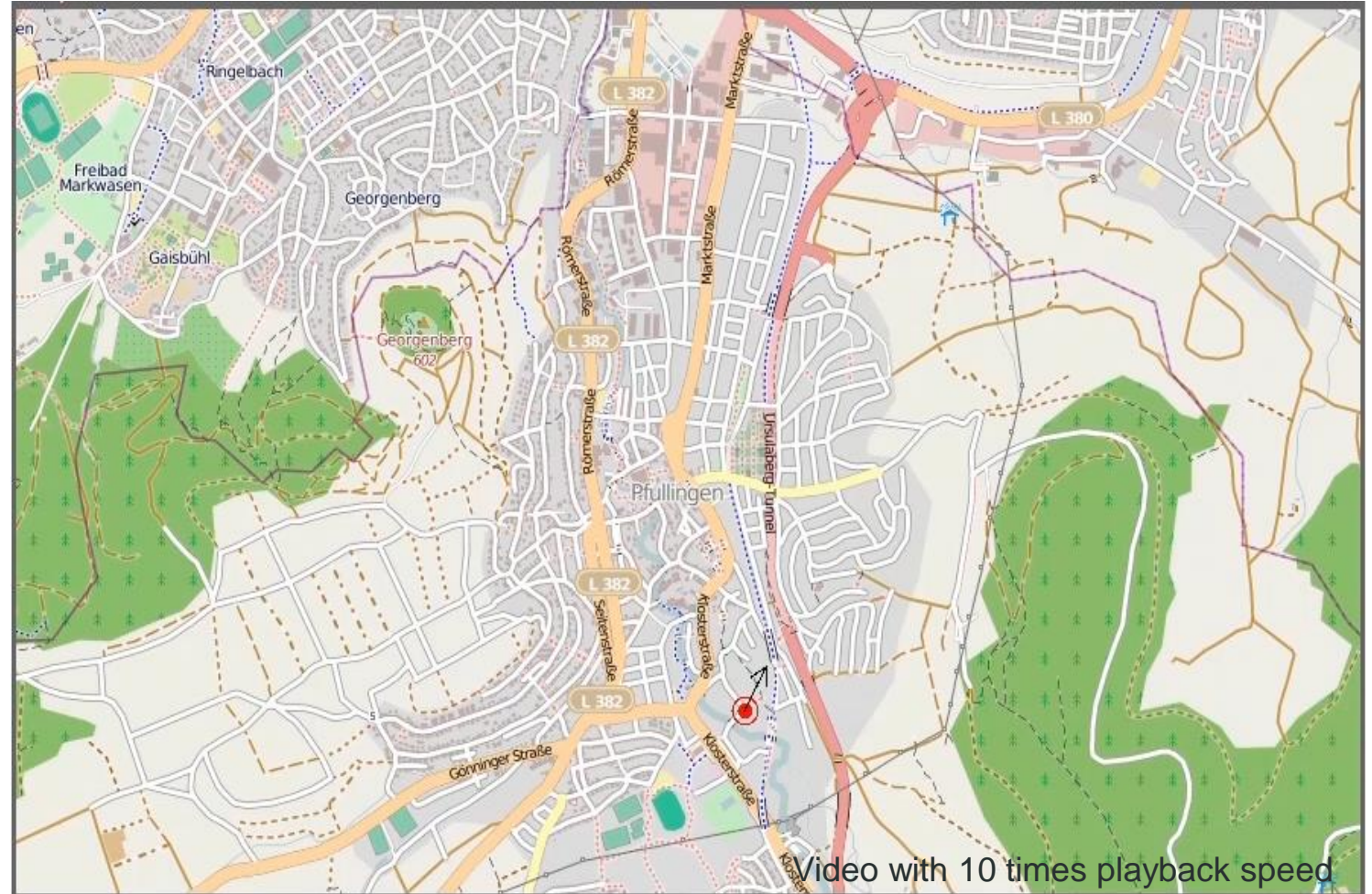
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- Powerful localization software for real-time evaluation of bearing results on SignalShark screen:
 - Heat-map view
 - Excellent localization uncertainty
 - Works even in urban environment due to innovative statistical algorithms
 - No external computer necessary

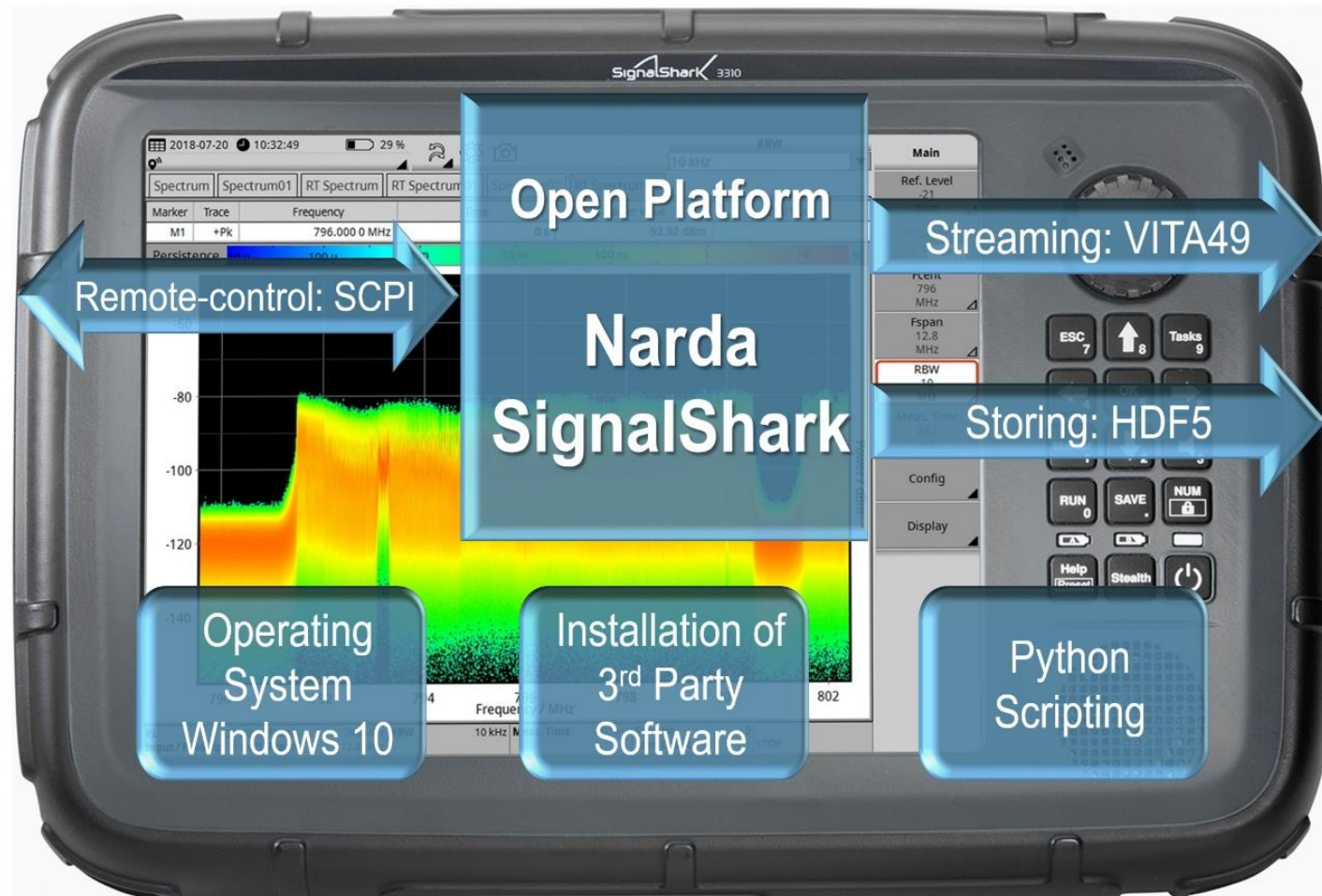


Automatic Direction Finding



SignalShark is an open platform

- It uses non-proprietary formats only



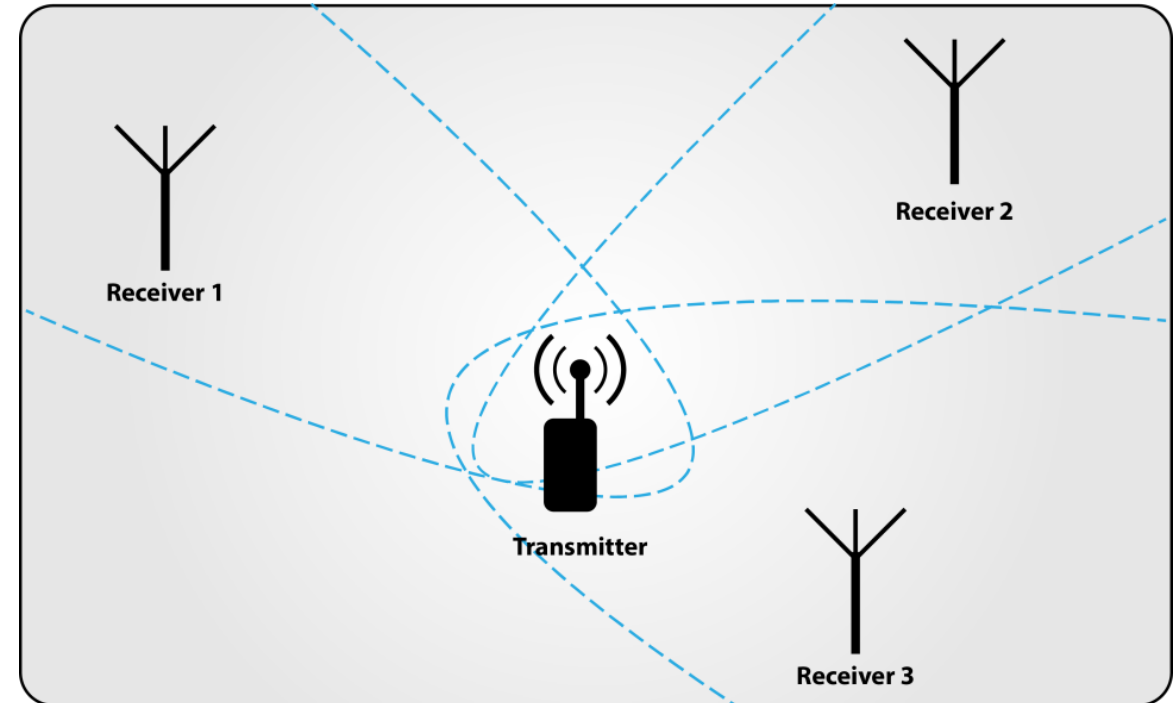
Support of AoA – TDoA ready – hybrid localization based on both methods



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- highest selection of signals being covered from few Hz (beacons) by AoA to signals up to 20 MHz (jammers) by TDoA
- Very simple antenna
- Target localization inside the polygon of receiver sites by time advance information of same signal from min. 3 sites:
crossing point of hyperbola: A-B, A-C, B-C
- Receiver is time stamping IQ streaming data with high accuracy based on GNSS



Possible implementation of TDoA / AoA hybrid system

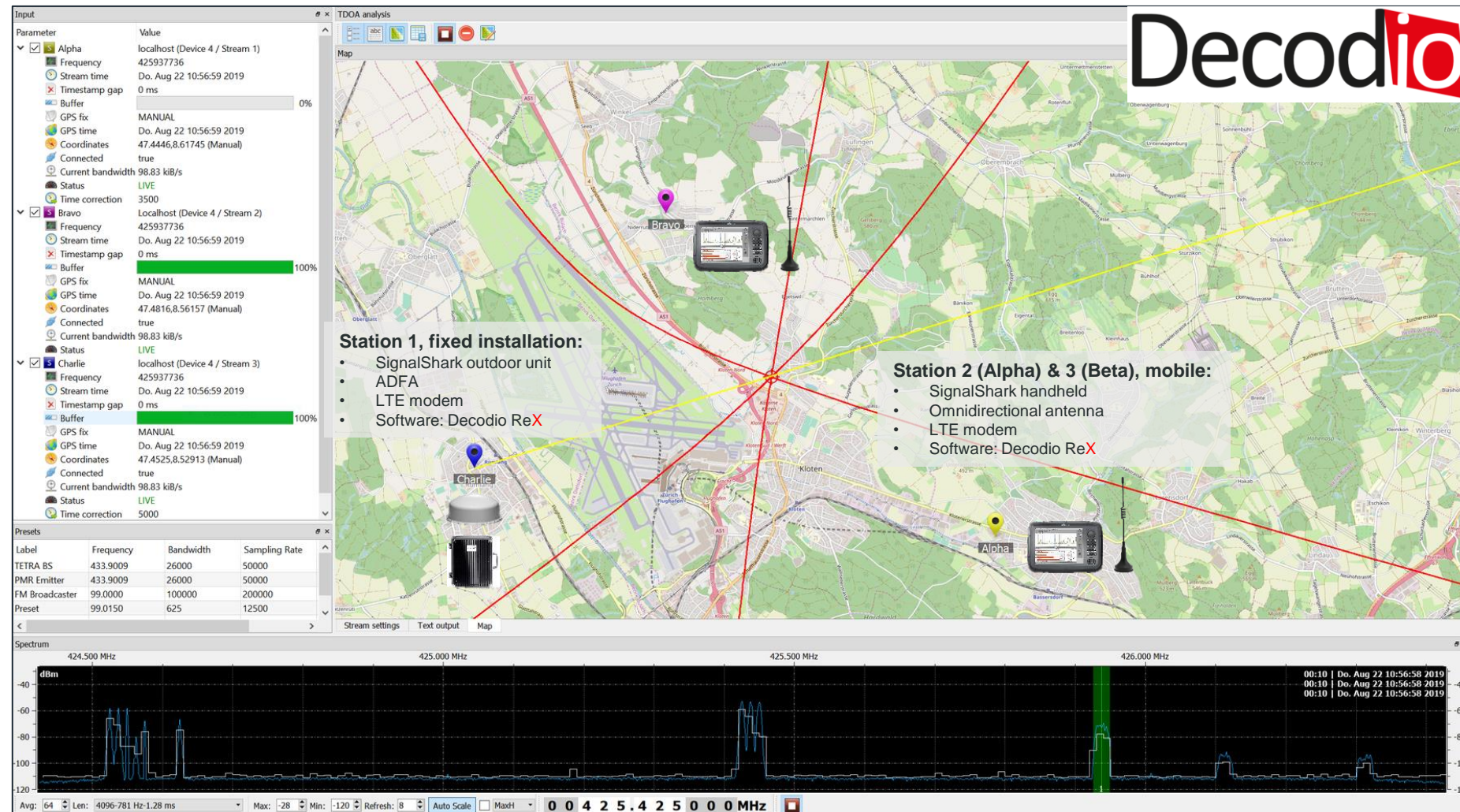


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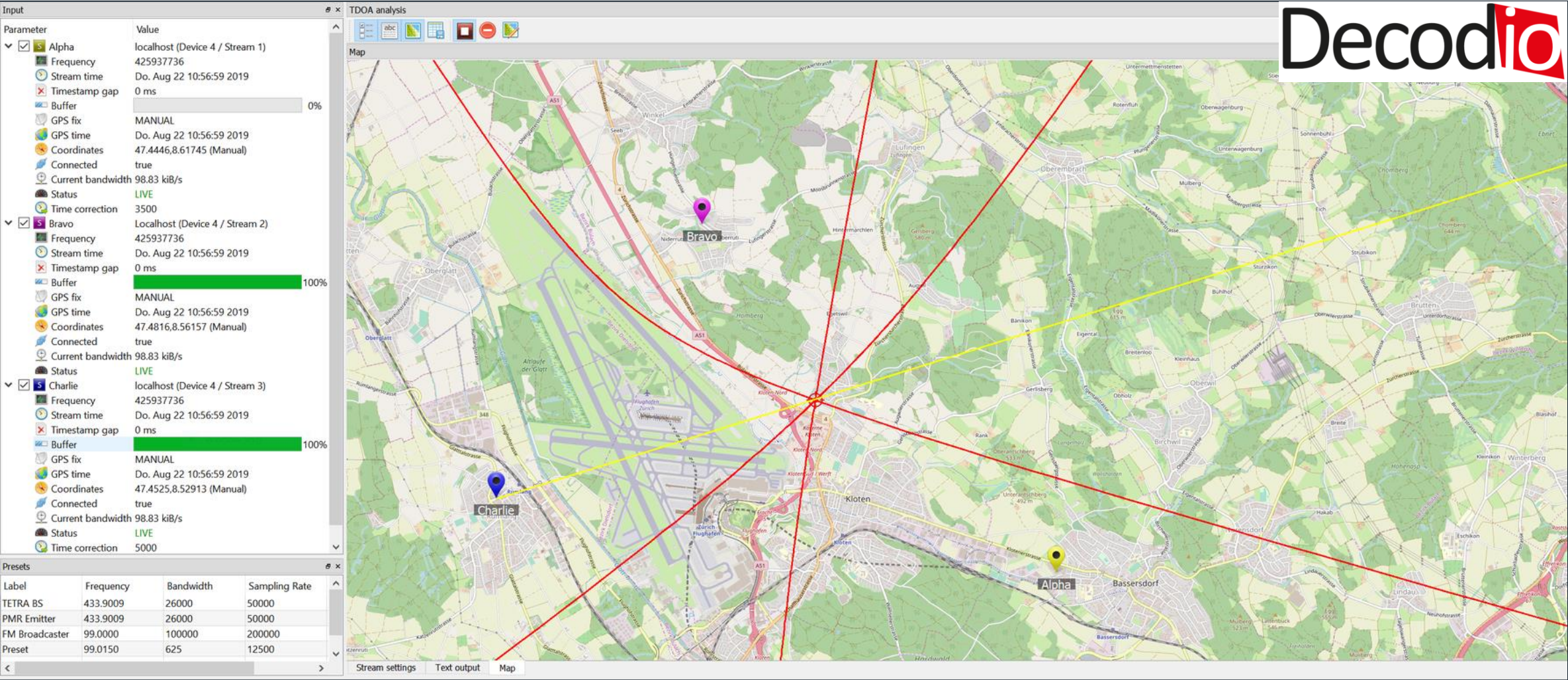
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Central system:

- PC
- Internet connection
- Software: Decodio ReX & Decodio Localizer



Possible implementation of TDoA / AoA hybrid system



Presets

Label

Frequency

Bandwidth

Sampling Rate

TETRA BS

433.9009

26000

50000

PMR Emitter

433.9009

26000

50000

FM Broadcaster

99.0000

100000

200000

Preset

99.0150

625

12500

TDOA analysis

Map



Decodio

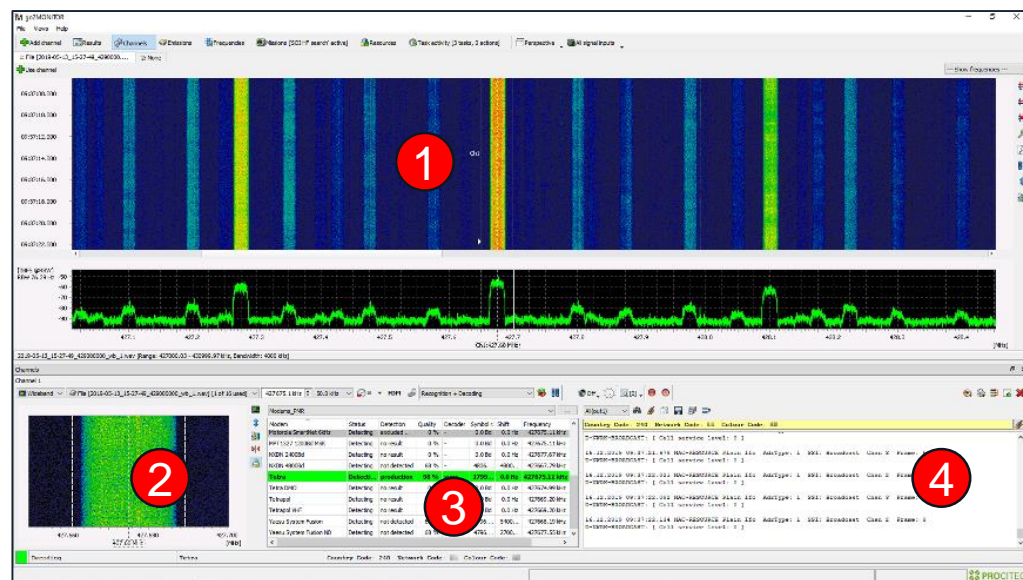
Procitec: go2MONITOR

- Mobile, compact, on site solution for radio monitoring
- Situational awareness via
 - Capture
 - Classification
 - Decoding
 - Recording
- of complete wireless signal scenarios
- (HF, VHF, UHF, SAT) directly on site.

 **PROCITEC®**

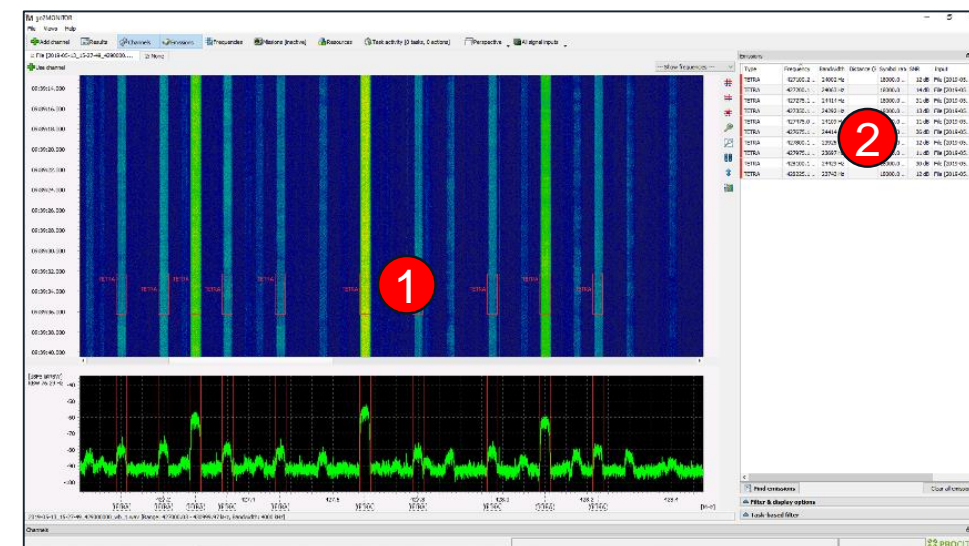


go2MONITOR software cannot be supplied to countries subject to a weapons embargo as defined by the Federal German Office of Economics and Export Control.



1. Broadband signal, shown as a waterfall diagram and as a FFT spectrum
2. Display of the selected narrow band signal, Process detection and Decoding mode
3. Classification results: decoder / modem
4. Decoding of the contents starts after classification

1. Broadband signal, shown as a waterfall diagram and as a FFT spectrum
2. List of classified signals



SignalShark - System Integration

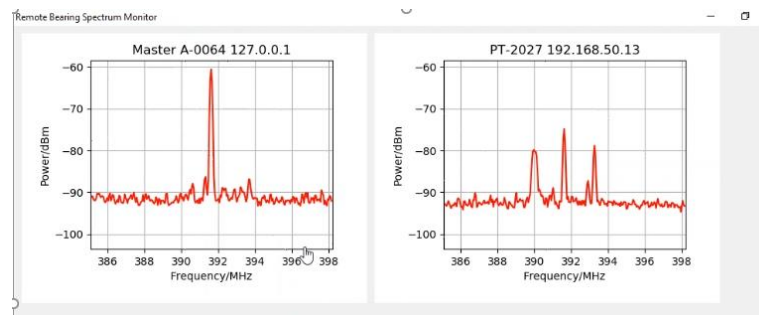
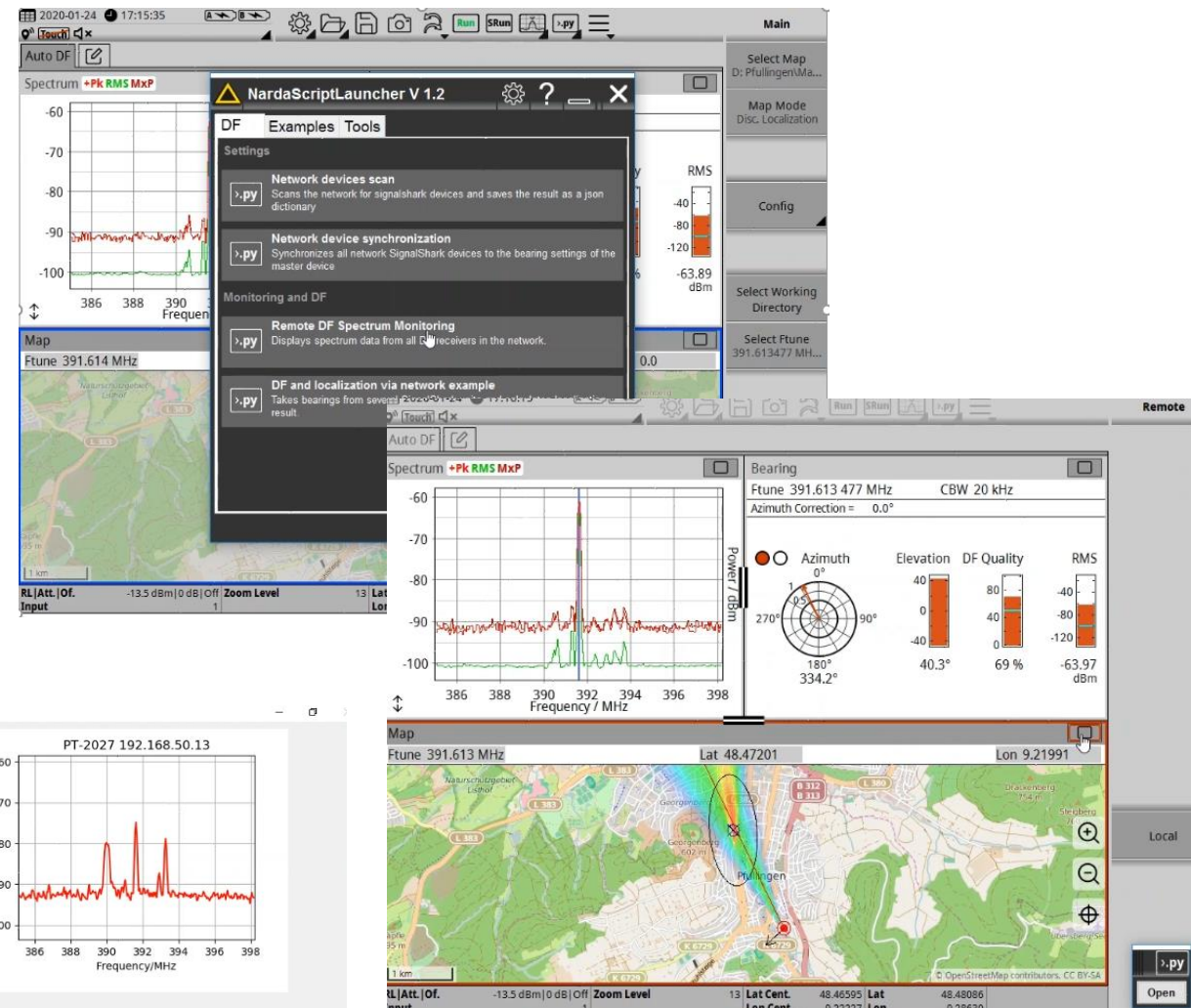


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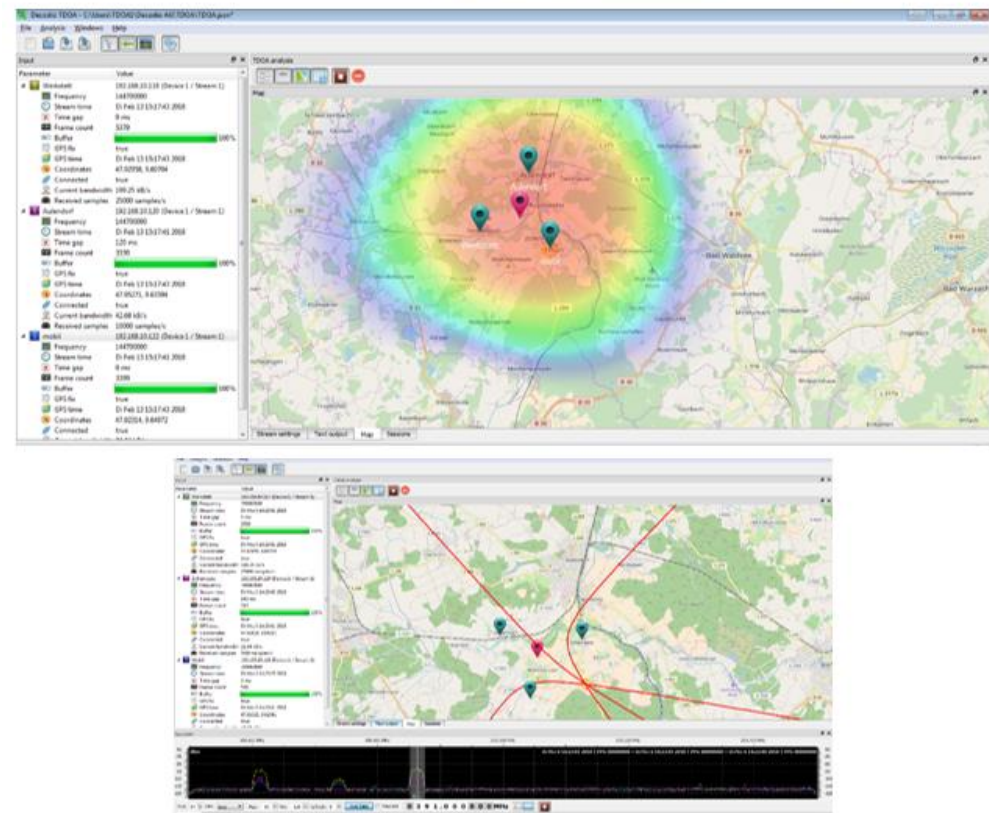
- Win10 computer – 3rd party software processing
- Open Interfaces and Scripting capability to achieve a one-button-operation
- Surveillance Mission Control Software (3rd party like from Boger Electronics)
- Support of Python scripts enabling 3rd parties to convert protocol (from output formats such as .csv, .xml, HDF5, ExtIO) into defense formats (CESMO for SDRs or JICD4.2x) to upload results (meta data such as GIS coordinates, signal strength, Fcent, bandwidth) and for control, i.e. sending commands to receiver and bearing system (Shark/ADFA/Decoders)



Various Makes of SignalShark in a DF Pack



- Non Penetrating Mount
- Military Tripod
- Fast installable masts
- HMVEE Mounted
- Hand-held DF in front of body
- Hand-held DF with receiver in a back-pack



The End