FAQs and best practice for finding interference signals

Technical Parameters / Specification:

- **What is the frequency range of the antenna and the spectrum analyzer?**
  - SignalShark:
    - 8 kHz to 8 GHz
  - ADFA 1:
    - 200 MHz to 2.7 GHz
  - ADFA 2:
    - 10 MHz to 8 GHz
    - Divided in three bands:
      - 10 MHz to 200 MHz
      - 200 MHz to 2.7 GHz
      - 2.7 GHz to 8 GHz
  - You can find the full specs under:
    - [SignalShark Handheld (narda-sts.com)](narda-sts.com)
    - [SignalShark Remote Analyzer (narda-sts.com)](narda-sts.com)
    - [SignalShark Outdoor Unit (narda-sts.com)](narda-sts.com)
    - [ADFA 2 DF Antenna (narda-sts.com)](narda-sts.com)

- **What is the scan rate needed to detect fast signal interference?**
  - The rate in scan mode is up to 50 GHz/s @ RBW = 1.6 MHz
  - In real-time mode with up to 40 MHz span, SignalShark captures the spectrum of even very short impulses of > 3.125 µs with a POI of 100 %.

- **How long is the battery life, especially for a longer car ride?**
  - Without ADFA antenna, the operating time of SignalShark with two fully charged batteries is approx. 3 hours.
  - If ADFA is connected, it draws power from the basic unit (no battery in ADFA). Operating time with connected ADFA is approx. 2.5 hours.
  - The basic unit is powered by two separate batteries, so you can hot swap them to keep operating for as long as you want.
  - The batteries can be charged while in the device or using an external charger.
  - The batteries are commercially available from various suppliers.
  - You can use the vehicle's on-board power supply (12V/24V) to power the device.

- **How fast can you drive with the automatic DF antenna installed on the car roof?**
  - Up to about 130 km/h (depending on wind conditions and local speed limits).

- **What is the temperature range of the automatic DF antennas:**
  - -40 °C to 85 °C.
  - (IP 55).

- **What is the antenna detection circle radius?**
  - The antenna aperture is:
    - 200 MHz to 2.7 GHz 380 mm diameter
   - 2.7 GHz to 8 GHz 128 mm diameter
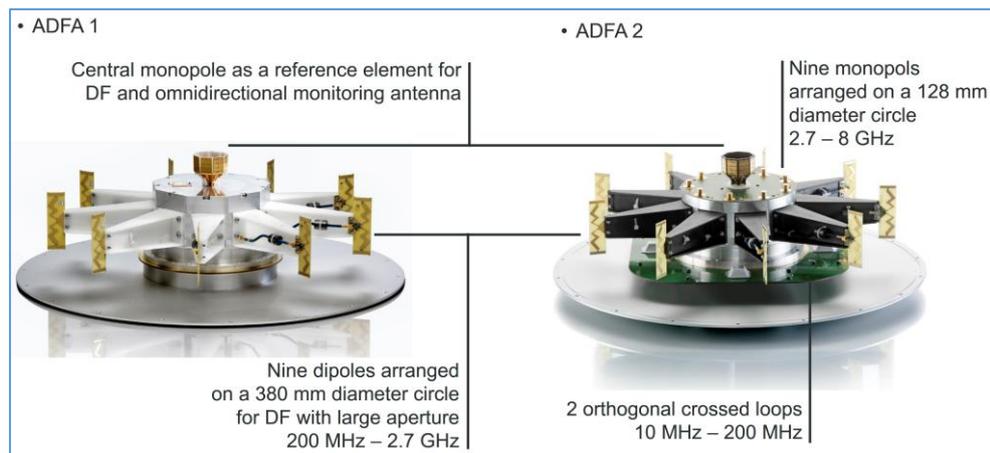
- **Can you briefly explain how the ADFA 2 works and the difference between ADFA 1 and ADFA 2?**
  - 1: You can find a general description of how a single channel direction-finding antenna works here:
    Elevation measurement
  - 2: The difference between ADFA 1 and 2 is that ADFA 1 is a subset of ADFA 2. There is an additional circle of 9 monopoles installed in the ADFA 2 to measure frequencies from 2.7 GHz up to 8 GHz, plus a Watson-Watt DF sensor to measure the direction of signals between 20 MHz and 200 MHz.

- **Do I need to install software on a laptop to access logs or tool snapshots?**
  - No. You can access the measurement data as on any other Windows computer. If you connect SignalShark to your network, you can also make its internal drive accessible on your network.

- **What kind of data can be stored on the analyzer?**
  - Screenshots (PNG format)
  - Data sets (HDF5 format, convertible to CSV) incl. measurement parameters and GNSS position
  - IQ data (VITA49 compatible)
  - Records, e.g. bearings during driving (HDF5 format)
  - Demodulation records (Wave file)
 - Setups (XML format)

  - The following additional information can be stored with the result:
    - Text comments
    - Voice comments
  - Results can be stored to
    - Internal SSD
    - Plug-in µSD card
    - USB stick or drive (Win10 operating system)

- **What parameters beside frequency, position, and level, are recorded?**
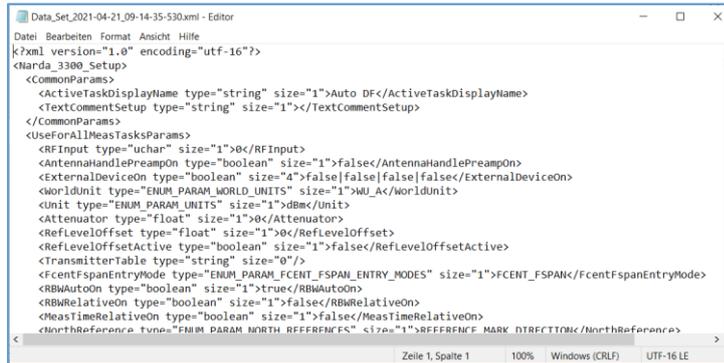 - First we have taken a screenshot to give an idea what is on the screen at the moment:
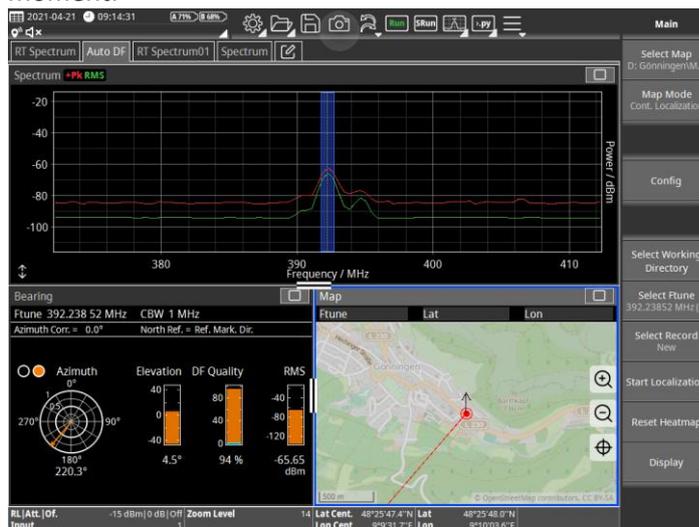
  It is a spectrum, a bearing and map view

  - 4 seconds later, we pressed "save" to store results
    When you go to the file system of the SignalShark you will find:
    - The screenshot as a PNG-file, and, dated 4 seconds later
    - an XML and a HDF5 file with the saved results
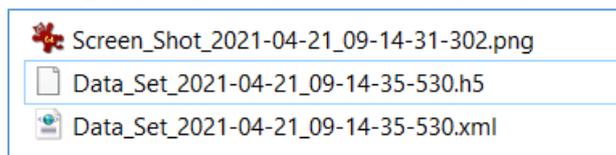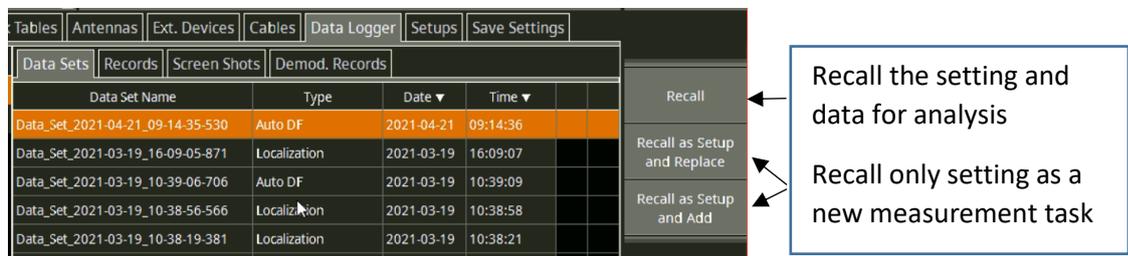

  - The PNG you can see above.

o The XML file contains the setting of the instrument:

The XML-file contains the full setting of the instrument including all parameters. This gives you not only the possibility to open the file with results on the analyzer and to analyze the stores results, but you can also open it as a setup so that you can redo the measurement with exactly the same setting

Recall the setting and data for analysis

Recall only setting as a new measurement task

o Finally the HDF5 file contains the measurement values, here visualized on a PC by the software "HDFView":
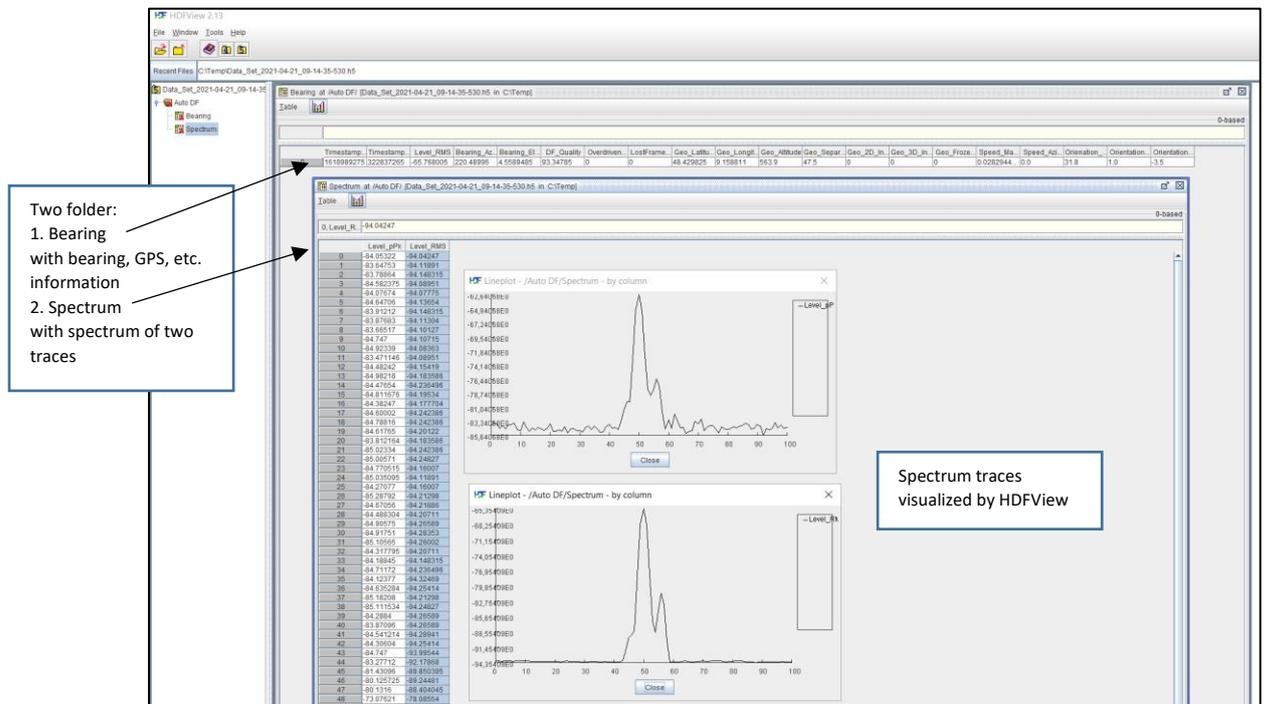
Two folder:
1. Bearing with bearing, GPS, etc. information
2. Spectrum with spectrum of two traces

Spectrum traces visualized by HDFView

For sure, when you open the "saved" results on the analyzer itself, you will see the results like on the screenshot. As the results are in the background, you can still adapt with the visualization and do further evaluation, e.g.: setting marker:

Or change the amplitude display of the spectrum view, and and and....

- **Is the automatic DF antenna active or passive?**
  - Active DF antennas are well known for their sensitivity. On the other hand, they tend towards intermodulation, overmodulation, and fluctuation in the noise floor, etc., especially in urban areas with a high density of transmitters.
  Passive antennas have good large signal immunity, but they are not sensitive enough to capture weak interference signals.
  Narda's ADFA antennas combine the best of both worlds: They are as sensitive as an active antenna but at the same time have the large signal immunity of a passive antenna.
  Due to its unique design and well-balanced dynamic range, ADFA can cover all applications in a single range. ADFA antennas are perfectly matched to the dynamic range world champion, the SignalShark.
  - For those who love technical details:
  All the receiving coils, monopole and dipole elements in the ADFA 1 and ADFA 2 are designed as "passive" antennas.
  For frequencies above 1 GHz, the central, omnidirectional element is also designed as a passive antenna. The design is active for frequencies below 1 GHz. Good to know, but what really counts is: Does it work? We are proud to say: Yes!

- **What about the calibration of the instrument and antennas? How often do they need calibration?**
  - The SignalShark Analyzer comes with a full calibration report. ADFA antennas are supplied with an extensive test report. Everything else is up to you and we can only make recommendations.
  - We recommend calibration of the handheld and the remote analyzers every two years. This is easy to do for the handheld unit. But are you likely to travel, say, to north Alaska to pull a remote unit from an operating observation station for recalibration? Or to climb a 50-meter mast to remove an ADFA and its outdoor unit?
  - Narda has taken care to ensure that all ADFA and SignalShark devices are built to operate 24/7/365. And all SignalSharks have an integrated test source so they can perform a self-calibration and test of all stages of the analyzer to keep the "downtime" as low as possible.

- **How do you change/edit the noise floor or Y axis scale on spectrum scanner between -40 and -110 or for any other range?**
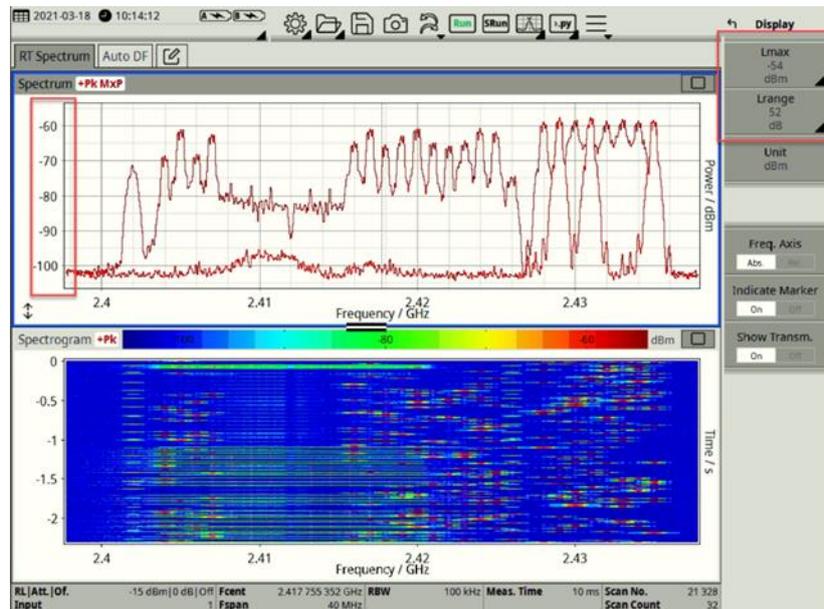
- The amplitude range setting is very flexible. It can be set practically anywhere between 10 dB and 160 dB. The picture above shows a setting of 52 dB for Lrange.
- The same applies for the top of the screen, Lmax; shown here is -54 dBm.
- The smart grid is visible on the left side. The horizontal lines on the screen always correspond to round numbers even if Lmax and Lrange are not. This makes it much easier to read out results even without a marker.
- The level axis can be set manually or aligned automatically. It can be coupled to the spectrogram "color-range", or not, among other options.
- There is a short video on the basic use of the SignalShark on the internet. More will follow soon. Subscribe to our News Ticker (narda-sts.com) to stay informed.

- **What is the maximum range of this portable scanner?**
  - That depends on what you mean by "range" ☺:
    - Display range: 160 dB
    - Amplitude range: from DANL to max nominal level, from -162 dBm/Hz to +15 dBm
    - Frequency range:
      - Scanned spectrum: from 8 kHz to 8 GHz;
      - Real time spectrum: same as above, maximum span/instantaneous bandwidth 40 MHz
    - Intermodulation free dynamic range:
      - 2nd order: 100 dB
      - 3rd order: 115 dB
    - Area coverage range e.g. with ADFA: See under "What area would be covered if 3 SignalShark were used to detect pulsed signals?"

- **How do you add a map?**
  - Refer to a video [on the internet](#) for details of how to add a map view.
 - You can zoom in and out of the map, re-center it, move it, etc. in the Map view.

- **When the spectrum antenna is moved towards a mobile tower and the frequency spike bounces continuously, what is the reason? Is this the tower itself interfering?**
  - This is very hard to answer, as there are so many influencing factors. As the saying goes: a picture is worth a thousand. So, if you send a picture to info@narda-sts.com, we will be able to see the type of service that you are measuring, the instrument setting, and much more. Better still, take a video. With the SignalShark, you can use screen recorder software, and then we can also see how the signal bounces. Best of all, connect SignalShark to the internet and run e.g. TeamViewer or Anydesk on it, which will allow experts to "look over your shoulder" and provide help and guidance.

- **Do you need a bandpass filter?**
  - Yes and no. SignalShark has huge immunity to large signals, and the best dynamic range on the market. It also has a built-in subharmonic pre-selector. All of these things help, but they also have limitations. In some situations, e.g. when searching for interferers in an FDD network, the uplink and downlink frequencies are quite close together. This can cause problems if you are on a rooftop with the base station behind you and you want to measure the uplink. Of course, you won't point the directional antenna towards the base station antennas. But, as the front to back insulation of such an antenna is limited, even if you point away from them there may still be enough field strength at the input for the input attenuator to be needed. Or, you can use a filter to suppress the downlink and keep full sensitivity for the uplink. We have dedicated [filters](#) in our program for such cases.

- **Do you need a bandpass filter all the time?**
  - No. Only in very critical situations, such as when the full sensitivity of the receiver is needed when you are on a rooftop with transmitting antennas directly behind you. See also: Do you need a bandpass filter?

- **Is SignalShark a receiver or a spectrum analyzer?**
  - It's the best of both worlds: It is an RF receiver: Low noise, high IP2 and IP3, sub-octave preselector, two DDCs, etc. – these are features normally only found in receivers. Operationally, it has all the capabilities of a spectrum analyzer: 8 markers, large touch screen, easy operation, etc. You will also find all the receiver functionalities such as demodulators, squelch, AFC, loudspeaker, tone search, etc. So, whatever you need for efficient interference hunting is included. With the ease of use of a spectrum analyzer and all the functionalities of a receiver.

- **How do you add, set/reset markers?**
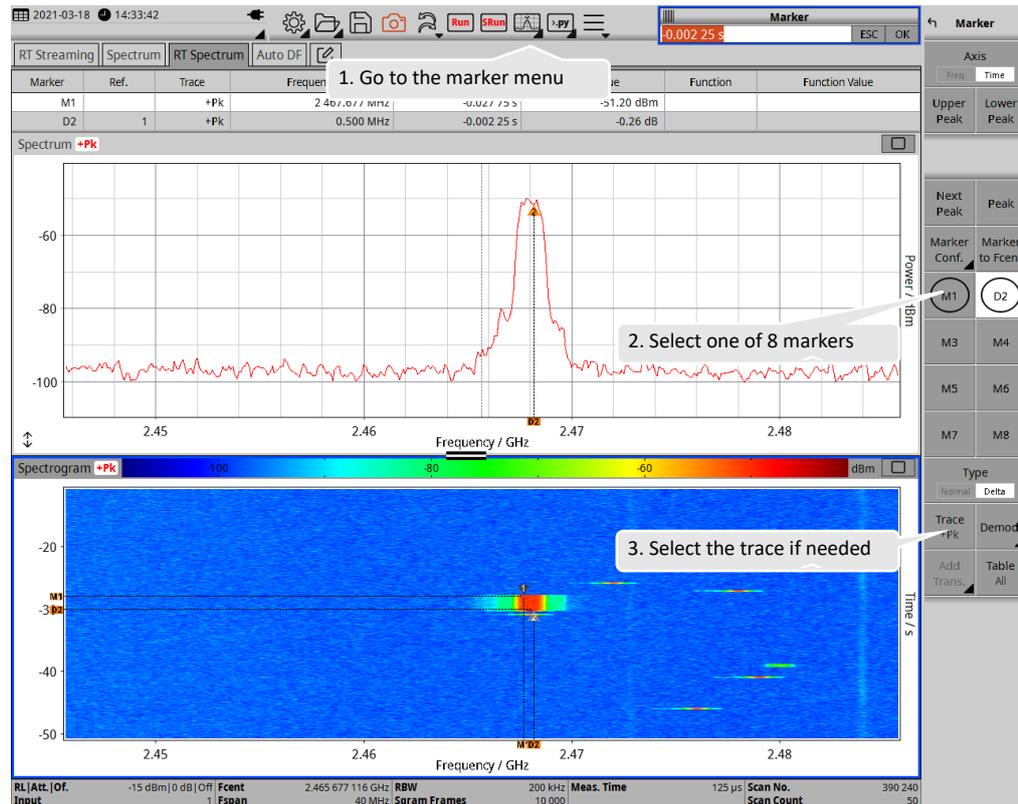
- o Above is a brief example of how to set a marker.
- o As you can see, many more functions are available, e.g. highest peak, next peak, … All the functions that you normally find in a good spectrum analyzer. Under the Marker Conf. button, you will also find functions such as channel power, noise power, occupied bandwidth, etc.
- o Missing something? ☺ By the way, remember that SignalShark has a touchscreen, so you can move the marker with your finger.

- **What is the instantaneous bandwidth?**
- o The instantaneous bandwidth is 40 MHz.

- **What is the ADFA antenna, and how does it work?**
  - An ADFA (= automatic direction finding antenna) translates signals from several antenna elements into a single channel DF signal. The ADFA is controlled by SignalShark, which automatically determines bearings, based on the single channel DF signals. Measurement results can be bearings, as well as omnidirectional level and spectrum values. Additionally SignalShark calculates the statistical distribution of bearing lines and provides transmitter localization visualized live as a heat map.
  - The ADFA can be used with a tripod, can be mounted to an antenna mast or can be attached to the roof of a vehicle via a magnetic mount adapter.
  - In an ADFA, there are several elements of antenna arrays, an omnidirectional reference antenna, four phase shifters, a summing stage and a switch matrix. SignalShark controls and synchronizes the switch matrix with its extremely fast internal measurement unit. A complete bearing cycle can be as short as 1.2 ms. During each bearing cycle the omnidirectional channel power and the spectrum are measured. This makes it possible to monitor changes in the signal level or spectrum concurrently with the bearings.

- **How does SignalShark analyze the signal? RTSA or FFT?**
  - RTSA is a special form of a FFT analyzer. In a RTSA the FFT is so fast, that there are no "time gaps" between each separate FFT. That means that you will capture any signal, regardless of how short it or how frequently it occurs. Even a single pulse will be indicated.
    Read more under: [From sweep time to measurement time to interference search on TDD systems](#)

Application-oriented questions

- **How is elevation measurement used?**
- **Can elevation measurement be used to find the floor in a higher building where the interferer is located?**
  - Most DF antennas can only measure direction in the horizontal plane. However, the signals come more and more from above the antenna when approaching a transmitter on a tall building or generally in city centers. ADFA antennas can also measure the elevation, still generate proper bearing results, and do not lose the connection to the interferer even when located directly in front of it. Hard to believe? Read more here: Elevation measurement (narda-sts.com)
  - SignalShark with ADFA will not give you the exact floor number but will indicate if the transmitter is located at ground level, in the middle at the top of the building. You can determine the exact floor number by using e.g. the elevator method with a manual antenna.
  Read more here: Pocket Glossary of interference localization terms, Page 52 onwards
  Extract of Pocket Glossary of interference localization terms - Original can be obtained from your local sales partner (narda-sts.com)

- **Can the ADFA give you negative elevation info?**
  - Yes. ADFA antennas can measure the elevation for frequencies above 200 MHz in a range between -20° to +40°

- **Where do I get map material for my region?**
  - Narda offers a free tool, "NardaMapTools", which can be used to download map material for nearly any region (OpenStreetMap-based).
  - The map material provided offers zoom levels from the whole earth down to house plan and number, all easy to access and select on the instrument.
  - 3rd party tools like GlobalMapper can also be used to convert existing map material or to use e.g. aerial photography as map.
  Read more in our application note: User-generated maps on the SignalShark and IDA2 (narda-sts.com)

- **Can I use Google Maps on this unit?**
  - Technically yes. You will need software such as GlobalMapper to convert Google Maps into Slippy Tile Maps. Read more in our application note: User-generated maps on the SignalShark and IDA2 (narda-sts.com).
  - Legally: Read the terms and conditions of use for Google Maps.

- **What is the best frequency range to use for interference hunting, uplink or downlink?**
  - The downlink signal is normally strong for its frequency to have no problems with interferers. Interference may occur only at the cell borders. The uplink is much more sensitive to interferers as the signal is weak. So, if you have no idea why a cellphone cannot connect, try the uplink frequencies first. You will have to play around with the frequency range or Fspan. For example, if you see periodic interference in the uplink band, widen the span. You may then see a downlink with the same periodicity. This could be the neighboring service in terms of frequency. But, it could also be a completely different service. For example, the harmonics of a 900 MHz service fall in the receiving band of a 1800 MHz service.

- **What happens to the auto DF map system if your GNSS-reception is blocked by interference (assuming the positioning in the map is given by GNSS)?**
  - To date, there is no solution for automatic localization.
  - In this situation, we recommend that you switch to manual bearing and type in your position and your bearing as a base for a localization.

- **Can upstream and downstream be analyzed separately for a TDD signal?**
  - Yes, it is possible, even without a special option.

CW signal (interferer)

5G TDD signal, 100% load
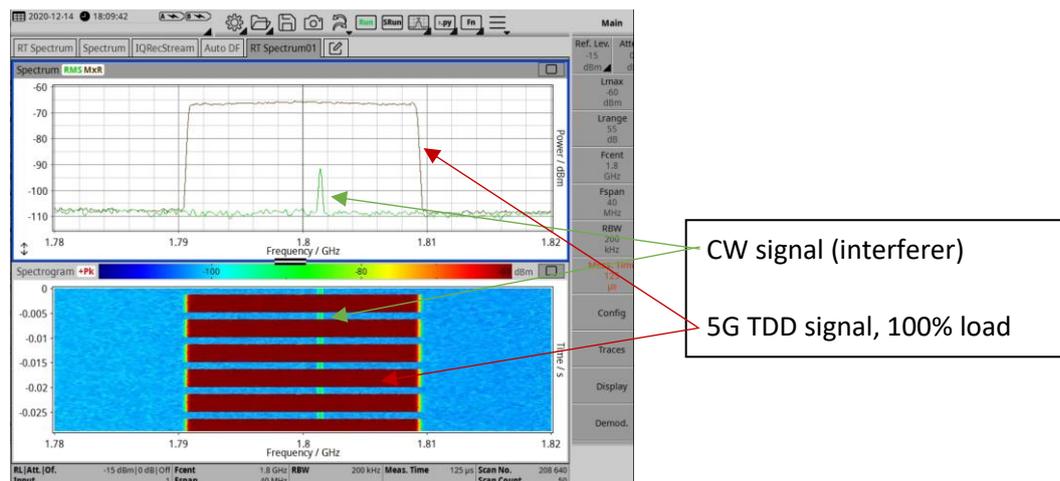
  - You can constantly update the spectrum view during the uplink or downlink time of a 4G or 5G TDD signal. This makes interference hunting much simpler in TDD networks. In contrast with other analyzers, this capability is already included in the SignalShark firmware without the need of an additional option.
  - Read more about this function in: From sweep time to measurement time to interference search on TDD systems such as 4G/LTE and 5G/NR (narda-sts.com)

- **Is there a function to detect an interfering signal on LTE without shutting down the sectors (or no maintenance time)?**
  - TDD see above
  - FDD: Signal under signal is tricky; here are some hints:
  - Step 1: Finding the signal and its frequency
    - With low traffic on the LTE or 5G, activate Spectrogram / waterfall and set the measurement time to "as fast as possible". You should then see the interferer "through" the framing grid of 4G/5G
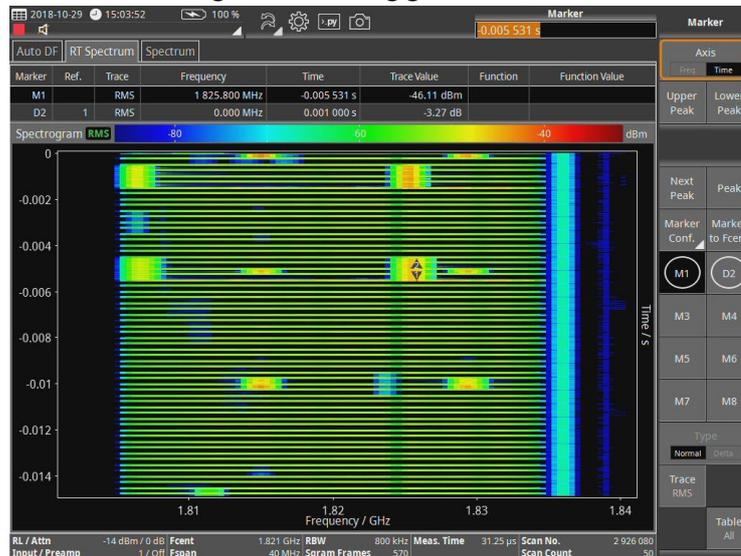
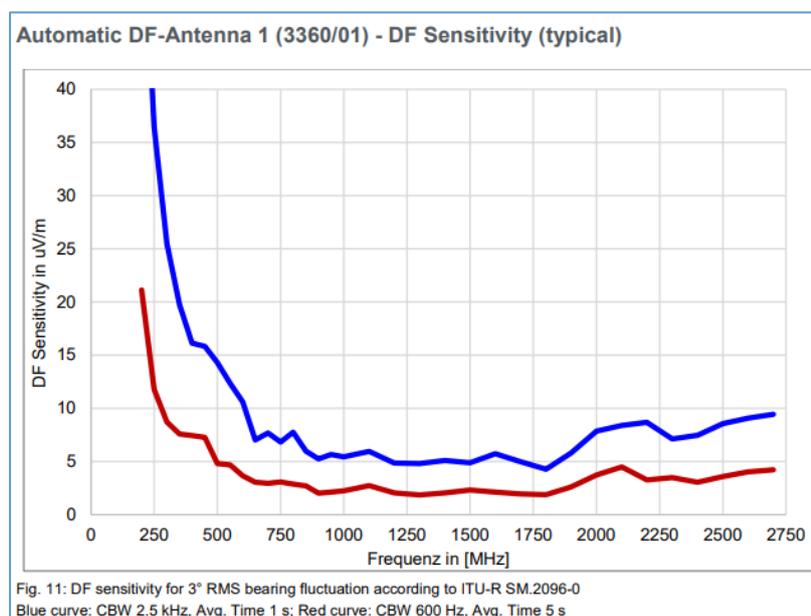View "through" the grid, seen here without interferer

- At high traffic levels, the grid fills up with resource elements so you cannot see "through" the grid. Persistence mode can help here.
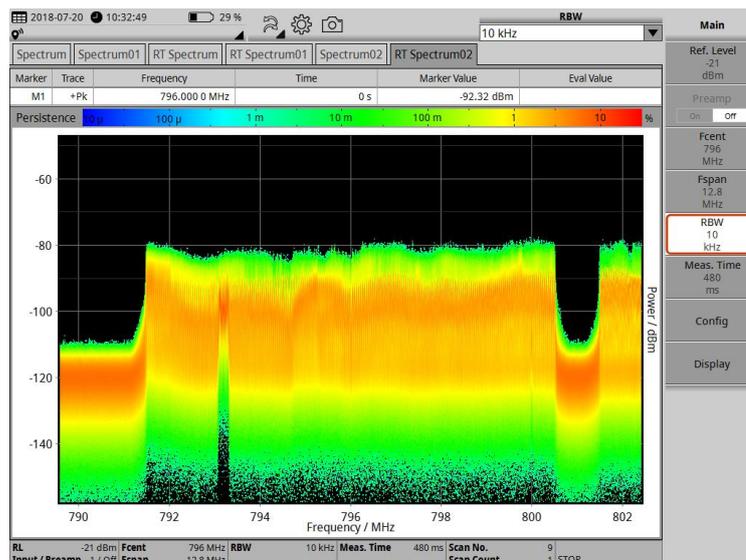
Persistence view of a fully loaded LTE with modulated interfering carrier at 793.2 MHz

- o Step 2: Localization
- o Handheld antennas: You can see the strength of the interferer, so you can point in the direction of the strongest received signal and use the map, etc. for triangulation / heatmap to localize the interferer.
  It is sometimes helpful to walk around a building to find a place where the signal strength of the LTE signal is low (shadowing effect of the building) but of the interferer is high.
- o Automatic antenna: Spectrogram and Persistence are not available in direction-finding mode. (In a single channel direction-finding receiver, the input constantly switches between different dipoles, so real-time modes like persistence are not useful.)
  Set Ftune and CBW according to the discovered frequency and bandwidth of the interferer. Start localization and pause it immediately. Start driving and watch the spectrum. When you reach a point where the interferer is higher than the LTE, release the pause. This must be done manually; the integrated thresholds will not help, as the LTE signal is too agile. If you can carry out this procedure at different locations, you can again use the map for localization.

- **What is the importance of CBW values?**
  - o The channel bandwidth CBW is the window in which the analyzer measures the direction of the signal.
    Rule 1: There should be only one signal inside the window, the interferer.
    Rule 2: The signal level should be higher than the noise level.
  - o The bandwidth should be as narrow as possible, but as wide as necessary.
  - o As narrow as possible: A smaller CBW increases the sensitivity of the measurement, which is a positive. The noise floor goes down and the risk of other signals in the measurement window is minimized.
  - o As wide as necessary: Remember that much interference is caused by faulty electronics. Perhaps an incorrectly installed repeater is oscillating. It will not oscillate at a fixed frequency with phase-locked loop precision, but will sweep around and constantly change its frequency. The window, the CBW, should therefore be big enough to always keep the interferer inside the window. So, observe the signal for a while, perhaps in real time spectrum mode with spectrogram view, and select the CBW accordingly. However, remember that a wider window increases noise and reduces sensitivity. As the saying goes: You can't have everything.

- **What CBW value should be used for 3G and 4G?**
  - o If you want to locate the transmitter of a 3G or 4G signal, select the CBW according to the bandwidth of the service. That means 4 – 5 MHz for 3G and for 4G it is 1.4, 3, 5, 10, 15 or 20 MHz. A narrower bandwidth can also be used, but this will not have a positive impact on the signal to noise ratio, which will stay the same.

- **Is it possible to search for signal interference for a specific mobile operator, so that we know which mobile operator's signal is being interrupted?**
  - Normally, every operator has a dedicated frequency. Therefore, if you know the frequency, you should be able to identify the operator. If the problem is across a frontier or e.g. a foreign cruise ship with its own mobile infrastructure is in a harbor, you will have to use decoding tools e.g. from Decodio or Procitec. They all run on the SignalShark and can analyze the mobile service protocol.

- **The demo was of a fixed frequency interferer. What if the interferer's frequency is unstable?**
  - You will have to widen the CBW so that the interferer stays within the CBW. See also: "What is the importance of CBW values?

- **When will Narda share the Python script for cooperative bearing?**
  - It is now available on our homepage

- **What is the ADFA signal to noise ratio?**
  - We have sometimes seen that ADFA was able to direction find even when the level was already lost in noise and no longer visible, so we cannot say. It must be at least 6 dB above the noise, but this depends a lot on the type of signal. However, much better, we can tell you the absolute field strength needed for a proper bearing. You will find this information in our data sheets:

Fig. 11: DF sensitivity for 3° RMS bearing fluctuation according to ITU-R SM.2096-0
Blue curve: CBW 2.5 kHz, Avg. Time 1 s; Red curve: CBW 600 Hz, Avg. Time 5 s

- **Really? Hunt for LTE uplink interference with an LTE stick connected to your analyzer?** ☺
  - Why not, different operators work at different frequencies. So, if you are a regulator, use a stick from an operator other than the one that has the problem. If you are an operator, do something good for your competitor and buy a stick from them ☺.
    We are using sticks that have a connection to an external antenna. We place this antenna on the car at a position where it does not transmit directly into the beam of the ADFA antenna, e.g. on the dashboard.

- **Do you have any recommendations for detecting an interfering signal that is not constant during the day?**
  - 1: Be patient ☺
  - 2: Use the spectrogram/waterfall so you can monitor changes versus time
  - 3: Use Max Hold traces in spectrum mode
  - 4: If possible use real-time mode, so that you will not miss any event
  - 5: If notification of an interferer comes from a base station, see if there is any periodicity in the report and then compare it with events with similar periodicity e.g.:
    - a delivery truck that comes every morning
    - tram schedule
    - exterior shop lights (LED) switching on and off
    - etc.
  - 6: Keep your base station online so that you only start hunting when the interferer is really "on-air"

- **Can the CPU handle Decodio (in our experience, Decodio RED has quite high power demands)?**
  - As the SignalShark is an open platform and the operating system is Windows 10, you can run almost any software on the internal PC, e. g.: screen recorder, office software, remote desktop applications, etc. Nevertheless, you should remember that it is primarily a measuring device, and especially the battery powered handheld device has limited resources in terms of the power supply.
  Narda is currently changing the SignalShark CPU from dual to quad core to provide more CPU power. It is hard to define a general rule, as each application or service demands different CPU power. The SignalShark's internal CPU cannot match the power of a 19'' rack server with line power supply. We feel it is more important to keep the SignalShark's footprint small so that you can power it e.g. from a solar panel.
  As far as we know, SignalShark is the only commercially available handheld receiver that can handle third party software for demodulation and decoding without an external PC. As we do not know your minimum requirements for e.g. decoding capabilities, we invite you to try it out. We will do some stress tests here at Narda at the same time so that we can give you some hints. However, this will take some time to do. News on such matters is published in our News Ticker. Feel free to subscribe.

- **Can SignalShark with or without options decode base or sector identity code, e.g. BSIC for GSM?**
  - SignalShark on its own is not able to do so, but Procitec software has GSM decoding capabilities. Procitec runs on the SignalShark. You will find more information about the latest capabilities of the Procitec decoder at: Homepage - Procitec EN

- **Is the SignalShark considered as "sensitive equipment" when used with the Decodio software?**
  - Yes and no. Some software packages available from Decodio require an export license or are not allowed to be exported to specific countries, but software packages which are not restricted are also available. Please check the Decodio homepage, or ask Decodio or your national office for export control.

- **Do you have any practical experience in detecting jammers (especially portable, wideband)?**
- **Do you have any experience with hunting GPS jammers when SignalShark uses GPS for its location? How is close location performed?**
  - So far, we have no experience in detecting jammers as we do not have permission to operate a jammer ☺. However, we will try to get permission and, if we do, we will publish the results. To stay informed, subscribe to our News Ticker. Or, invite us for a trial.

- **Are we going to have a webinar on Python scripting?**
  - Not at the moment. Please check our website, especially: SignalShark (narda-sts.com), where a lot of information is available.
  - You can also find the "PyCharm Development Project" there, which is a great help in developing scripts for the SignalShark.
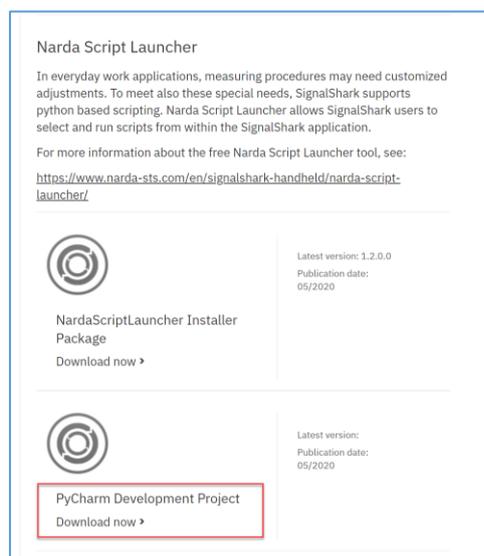

  - We will not have a seminar on the basics of Python, as this is not our core competence. Nevertheless, if you need something special for SignalShark, let us know what you want and we will see how we can help you.

- **Can we detect a normal GPS signal with this Narda device on spectrum?**
  - Yes. It is a little challenging, but it is possible. Equipment: SignalShark with active antenna handle and Antenna 3 (LogPer) pointing towards the sky. The key to success is to use Spectrum mode, not Real time mode, as you can reduce the RBW further in Spectrum mode. And to also use a long measurement time to get good averaging. Preamp on, full sensitivity, small RBW and here we go:
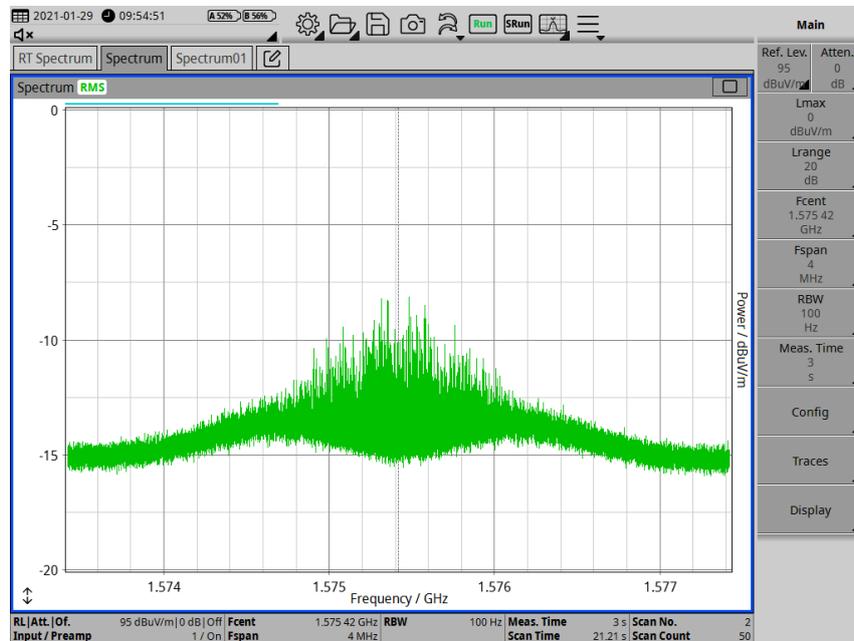
- **How many channels can be located simultaneously? Can a black list or a white list be created for direction finding?**
  - Automatic direction finding locates one channel at a time.
  - You can define Fstep to quickly change the center frequency Fcent for direction finding in steps.
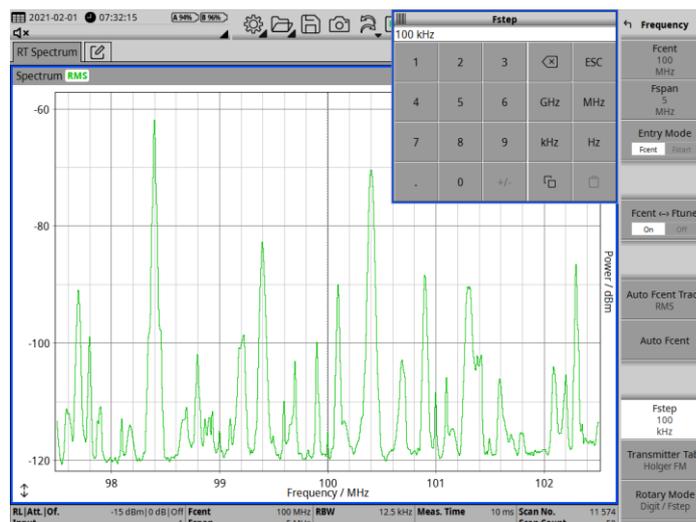

  - You can mark channels with their center frequency and bandwidth and enter them in a table (transmitter table). These services are then highlighted in color on the screen.
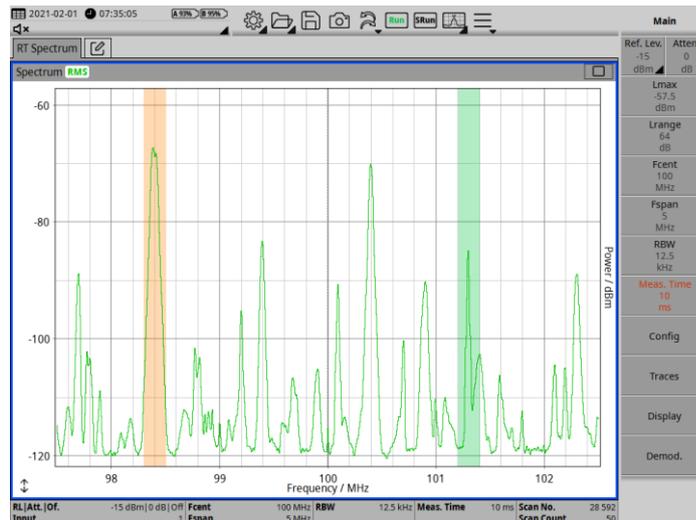
- This transmitter table information can be used as a white list. Each colored background corresponds to a "legal" service
- It can also be used more effectively as a black list, e.g.:
  - Step 1: Monitor the spectrum and mark each suspicious signal, and transfer this signal information into the transmitter table.
  - Step 2: Switch to DF Mode and set FCent to "according to transmitter table". You can then jump from one suspicious signal to the next in a single step.

- **What is the area that can be covered if 3 SignalShark units are used to detect pulsed signals?**
  - This question probably relates to a TDOA network
  - The area covered depends on:
    1. the sensitivity of the receiver,
    2. the gain of the receiving antenna,
    3. the propagation of the transmitted signal,
    4. the gain of the transmitting antenna,
    5. the transmitting power of the device under test,

    to mention only the main factors.

  - As you can see, there are various factors, so the answer is beyond the scope of these FAQs.
  - Referring to point 3: You can imagine that it makes a huge difference if the area covered is a desert, countryside, rain forest or a big city. The attenuation and reflection of the signal will be different in each location. Also, the measurement location makes a difference: is it on a hilltop, or in an urban canyon?

- The factors that Narda can influence are the sensitivity of the receiver and the gain of the receiving antenna:
  - In terms of sensitivity, the SignalShark is one of the most sensitive receivers available on the market (even without preamp!). Consider that a 12 dB better noise figure means that you can cover four times the distance or sixteen times the area.
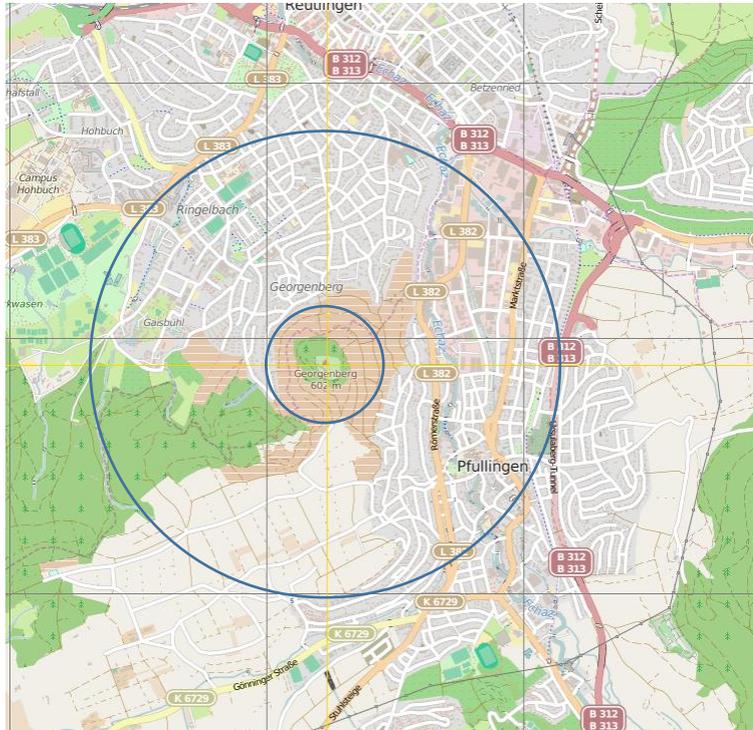
- **Are amplitude masks or thresholds available for DF, so that any signal above a threshold can be located automatically? Is this possible with a frequency mask?**
  - There is already a threshold available which specifies that bearings are taken only if a certain amplitude is exceeded.
  - More functions e.g. frequency masks, etc. will follow in a future firmware release, or as Python scripts.

- **The localization accuracy changes with different parameters such as DF quality, LOS probability, and the localization area. Often, the above parameters are unknown, as is the probable location of the source. If the wrong (or a wider) localization area is set, the localization could also be wrong.**
  - These topics should be included in training, as this is too complex for these FAQs. However, here are a few hints:
    - SignalShark includes predefined setups for different situations. These can be very helpful.
    - DF quality: Minimum 40%.
    - LOS probability: Depends a lot on the environment; rural maybe 50%, urban canyon maybe 5%. Ask: If there is an emitter somewhere, how often can the antenna directly "see" the interferer? In open countryside this will be much more than in, say, downtown Manhattan.
    - Localization area: Better too large than too small. And, the lower the frequency, the bigger the area. Below 700 MHz, the good propagation of the signal enables long distance broadcast services. We have tracked down a Tetra service (400 MHz) over a distance of more than 100 km. At 2 GHz, however, a distance of 10 km is normally enough.

- **In an urban environment, where there are multiple interfering sources, how would SignalShark lead us to the source?**
  - Interferers do not usually all operate at the same frequency. You can therefore separate them by frequency and search for each interferer one by one. See also: "How many channels can be located simultaneously? Can a black list or white list be created for direction finding?"

- **Can you listen to the intercepted signal?**
  - Yes. SignalShark has all sorts of analog demodulators and a large loudspeaker on board, and you can also connect headphones.

- **Can we connect SignalShark scanner to BTS to check interference?**
  - If the BTS has an RF-connector to measure e.g. the signal from the receiving antenna, yes. If there is only a digital output available, you need an adapter e.g. from CPRI to RF. Please be aware of maximum input level.

- **What are the general sources of external interference in the South Asian region?**
  - Repeaters are often the major problem in cellular networks. Illegal imported cordless phones are a common source.

- **Please explain PIM**
  - A good description is found here:
    [Passive Intermodulation (PIM) Test and Measurement | IEEE Conference Publication | IEEE Xplore](#)

- **Can the tool identify small indoor sources, such as a DECT cordless phone?**
    - We did some tests:
    - Test object (position = red dot on map): DECT base station, in idle mode, no active connection, in a domestic environment, 40 cm above floor level, so no line of sight through the window:


    - First test (position = blue dot on map), inside the same room, distance 6 meters:
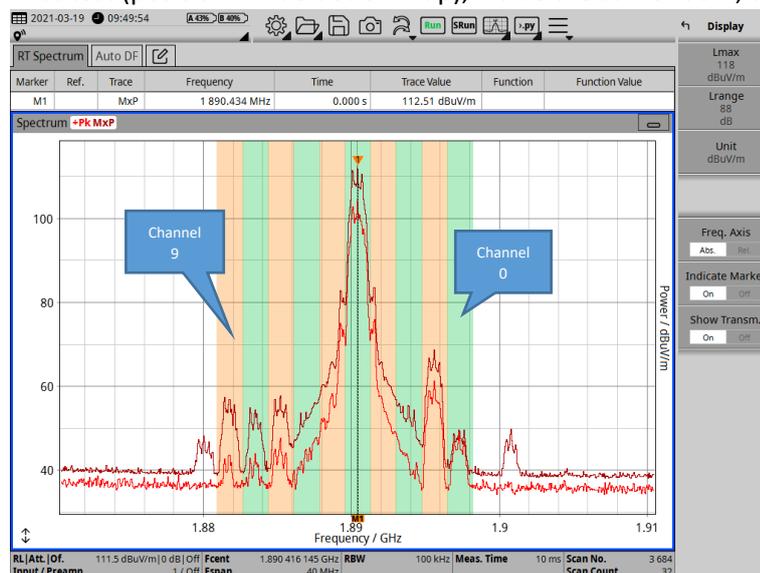

    - The colored backgrounds (transmitter table) indicate the different DECT channels.
      +Peak and MaxHold of +Peak detector activated
      Channel 4 is dedicated to the DECT station under test
      Manual antenna type 3 (LogPer), Preamp off
      Result: Maximum level 112 dBµV/m

o Second test (position = green dot on map), in the garden, door to the garden open, distance 15 meters from base station:
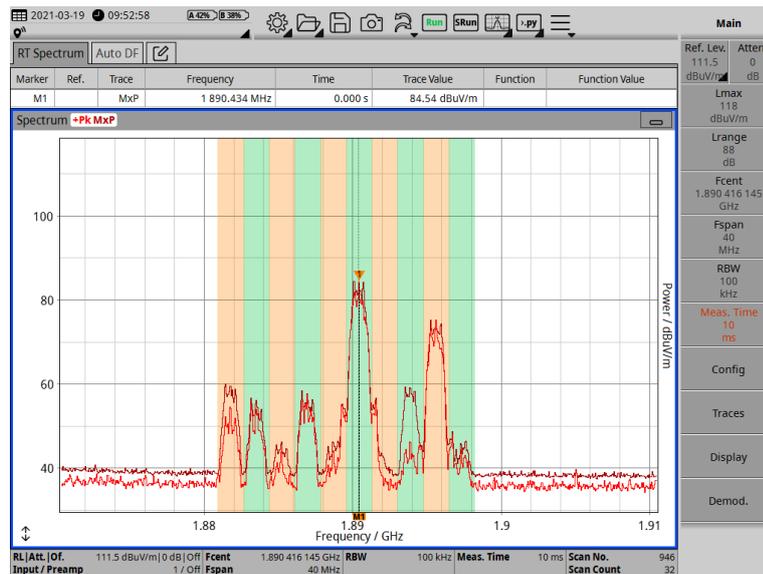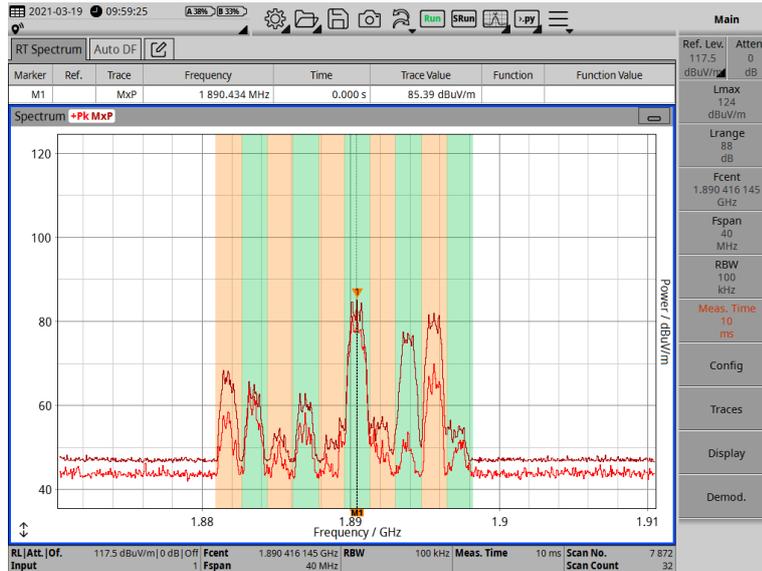

Maximum level 84 dBµV/m

o Same test, but with door closed:
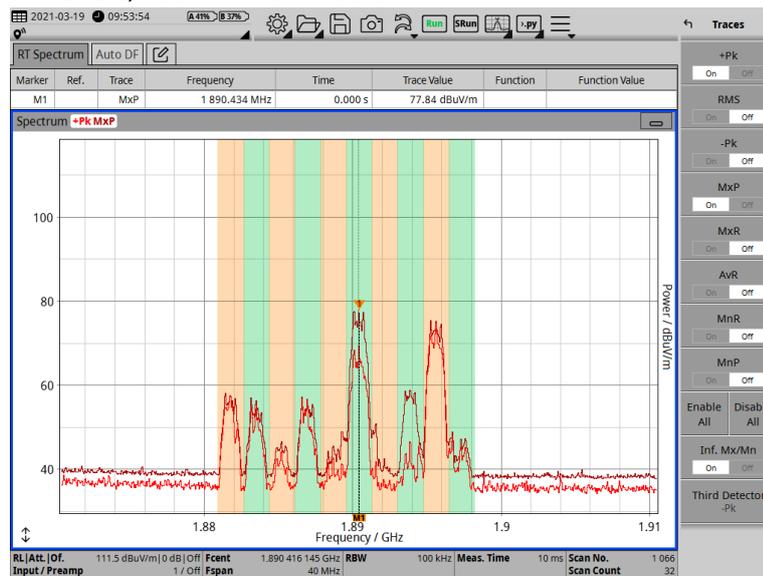
Maximum level 77 dBµV/m, which means that the well-insulated glass door attenuates the signal by ~7 dB

o Same position, door open, automatic antenna ADFA 1 instead of LogPer:

Maximum level 85 dBµV/m

> By the way: If you compare noise floors, the ADFA antenna @ 1.89 GHz is only approx. 7 dB higher than a huge LogPer antenna, which means that the ADFA is very sensitive.
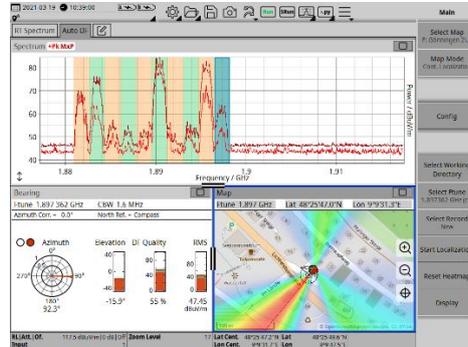
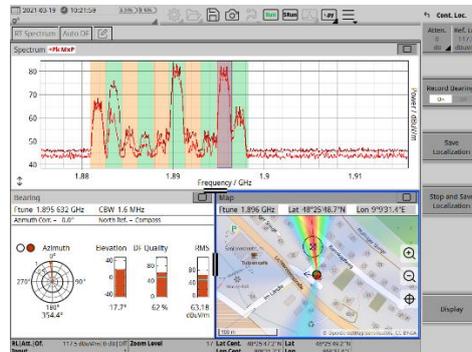o Same position, door open, automatic antenna ADFA 1, now in Direction finding mode:
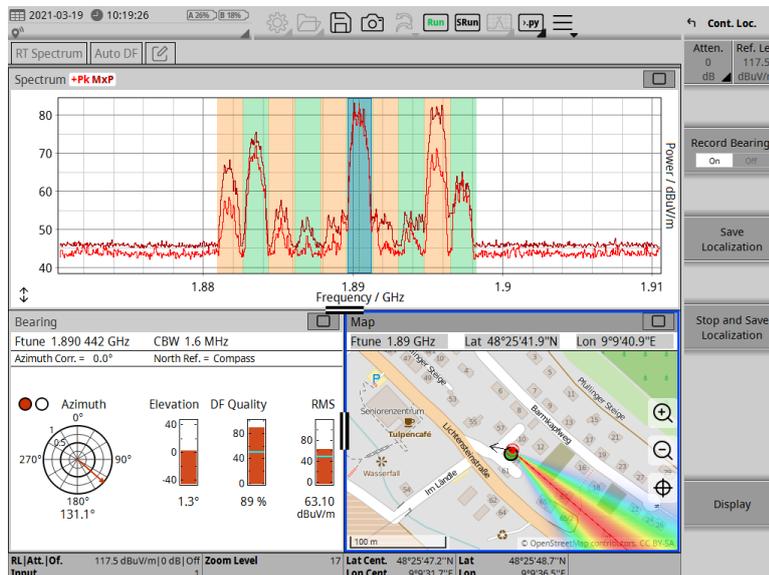
Ideally, the ADFA points into the house towards the DECT station

o Measurement of other channels will find the directions of other DECT telephones in the neighborhood:
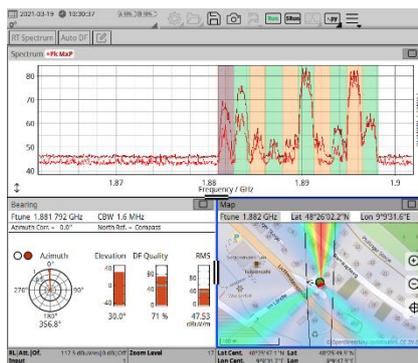
Channel 0:

Channel 1:

Channel 9:

- How far can we measure?
  - At the main road (position = purple point on the map, approx. 50 meters from the base station) the DECT telephone loses connection to the base station. Nevertheless, the level is still > 50 dBµV/m, which is easily visible on the SignalShark display.
- Returning to the question:
  Yes, it is possible to locate even small indoor sources like a DECT telephone from outside. In our case, a drive test is not useful, because the device under test is a legal phone transmitting at its dedicated frequency. Also, other neighbors are using the same frequency 100 meters further down the road. So, we can only drive for 50 meters ☺, or SignalShark will find a new DECT phone every 100 meters.
  An illegal (wrong frequency range) or faulty DECT will transmit on a different frequency to the legal one, and should be much easier to detect as it will be "alone" in the illegal frequency band.

- **What is the receive range of an ADFA located on the coastline for a 500 mW FM walkie talkie?**
  - We would love to go to the seaside and make practical measurements as we did for DECT ☺. The current situation means that we are not allowed to travel, but we will do some simulations and calculations to give you more information. The question: How far can SignalShark measure? will be answered with theoretical and practical examples in a forthcoming Application Note. Keep up to date with our News Ticker (narda-sts.com).

- **Does SignalShark draw lines on a map for triangulation in manual mode like the IDA2?**
  - No, even a single bearing with a handheld antenna is displayed as a colored cone that indicates the direction as well as the uncertainty. As the number of bearings with the IDA is very limited, it makes sense to visualize these with individual lines. With an ADFA, a bearing can be taken every 1.2 msec, which means that you can have up to 50,000 bearings after just one minute of driving. A black line on the display for each bearing would make it unreadable in seconds. The statistical process to produce a heatmap is therefore the only display option provided.

- **Why does the accuracy of the direction that is found change?**
  - The receiving conditions change, e.g. due to reflections, with every meter that you move the antenna. Therefore, the accuracy, or more correctly, the DF quality, also changes. The accuracy in fact stays the same. This brings us to the next question:

- **What is the difference between accuracy and DF quality?**
  - Accuracy or uncertainty describes the precision with which an automatic direction-finding antenna can find the direction of an emitter. This value is measured in a calibration environment with no reflections, etc. Briefly, the DF quality describes the difference between theory (calibration) and real life with all the environmental uncertainties, such as reflection, multipath propagation, etc. 100% DF quality means that the signal is received from one direction only. 0% DF quality means that the signal is coming from so many directions that a proper bearing is impossible. For this reason, the SignalShark lets you a threshold for DF quality so that bearings below a certain level will be ignored.

- **Non ITU compliant repeaters usually have very low power and are deployed inside buildings. Can SignalShark also locate them with the same precision as shown in the video? Also, can it detect multiple sources of interference at once, e.g. multiple low-quality repeaters in the same area?**
  - Question 1: Yes; see our trial with the DECT phone.
  - Question 2: Yes; again, see our trial with the DECT phone located in the neighborhood. What is your application? ADFA will show the building in which the source or sources are located, but the handheld antenna is used for the final "cleanup", e.g. knocking on the doors of apartments in a building to find and remove illegal cordless phones, or going through a shopping mall to locate faulty receivers installed behind the suspended ceiling.

- **Can this device only identify external interference, or can it also identify internal interference (generated by equipment / antenna)?**
  - Internal interference can also be identified if it is emitted by the antenna or you have test points inside the base station.

- **What does the Python report generator script do?**
  - The Python report generator script fills out your individual Word document template (with your logo, etc.) with all the active views.

- **Can SignalShark use GPS to guide you to the potential UL source?**
  - The SignalShark's heatmap process calculates the position of the interference source. This position can be transferred into a navigation system so that it can guide you to the interferer.

- **Are there different connection options for linking the SignalShark to the navigation system of the vehicle to transfer the target position, e.g. cable?**
  - The connection used in our video is via WiFi. We attached a small USB WiFi modem to the SignalShark, set the smartphone as a WiFi hotspot and connected them in this way. A Python script was used to facilitate communication between the SignalShark and the smartphone. This script will be available soon. As the link is a standard PC (SignalShark) to smartphone connection, other options are possible.

- **Is there a magnetic effect on the antenna from the magnetic holder that attaches to the car?**
  - For most direction or location findings, it is mandatory to have a proper north reference. SignalShark/ADFA offer three different possibilities for a north reference:
    - The magnetic compass
    - The mechanical north mark reference on the ADFA
    - North direction given by the GNSS/GPS system.
  - For a final alignment, it is also possible to correct the magnetic declination, an azimuth offset etc..
  - If you install the ADFA on a car even without magnet-mount, e.g. mechanical fixing, the car body will have a heavy impact to the magnetic compass. Sorry, not on the compass itself because the compass will still measure the magnetic field of the earth. However, the car body has a heavy impact to the homogeneity of the earth magnetic field. This will become much worth, if you fix the antenna not mechanically but with the magnet-mount. That is why the magnetic compass is not the preferred solution

as a north reference when mounted on a car. We strongly suggest using the GNSS/GPSS north while driving.

- **What about magnetic declination adjustment, (urban, rural)?**
  - Magnetic declination results from the inhomogeneity in the earth's magnetic field, which means that true north is not magnetic north. More information under: Magnetic declination - Wikipedia
  - You only need to consider the magnetic declination if you are using a handheld antenna in conjunction with a map, or the ADFA when using the magnetic compass. If the equipment is mounted on a car, you will be using the GNSS compass. Examples: In France, magnetic declination is around zero, so no problem. In Brazil, it can be more than 20°, which must be compensated for. Otherwise, the measured bearing on the map will be off by this declination of 20°. For this reason, the Bearing view allows you to apply a magnetic declination value.
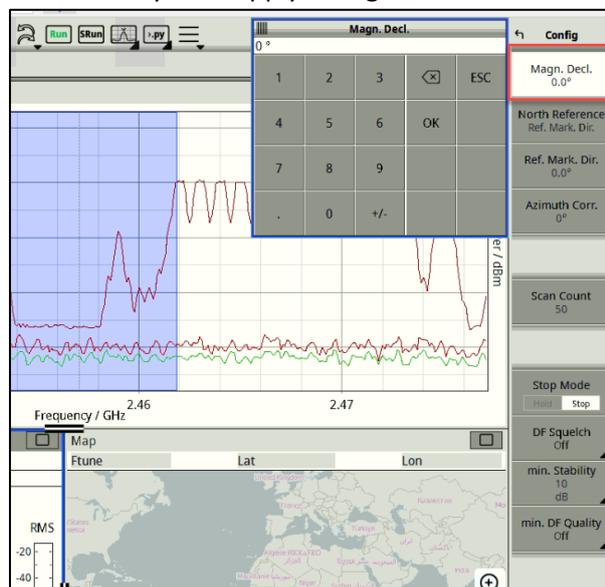
- **Is it possible to localize moving transmitters (airborne / UAV / drone, jammer)?**
  - With a handheld antenna: yes. Finding the direction is easy, but you then have to type in the position and bearing of the second station, which takes time. Maybe this could be done by a script.
  - With ADFA antenna: yes, but not with the "normal" heatmap, which is designed for you to be moving and the thread to remain stationary. However, the "cooperative bearing" Python script works perfectly for this application: Two SignalSharks with ADFA and LTE sticks; one SignalShark takes the lead and the second responds on demand. In this way, every bearing produces a new heatmap on the SignalShark screen and you can see the new localization results with a refresh rate of a few seconds. Even better: both SignalSharks be mobile and e.g. drive towards a moving thread, for example a bicycle rider with a Tetra jammer in their backpack.
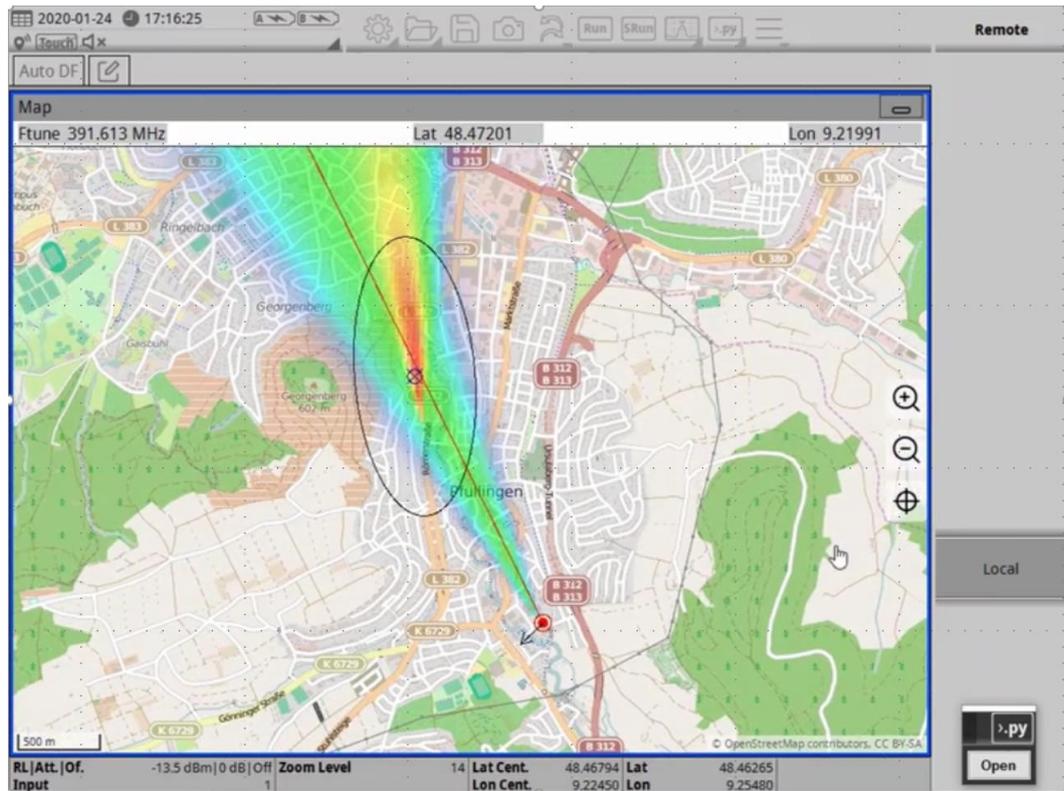
Visualization of a cooperative bearing on SignalShark.

Your Narda Team