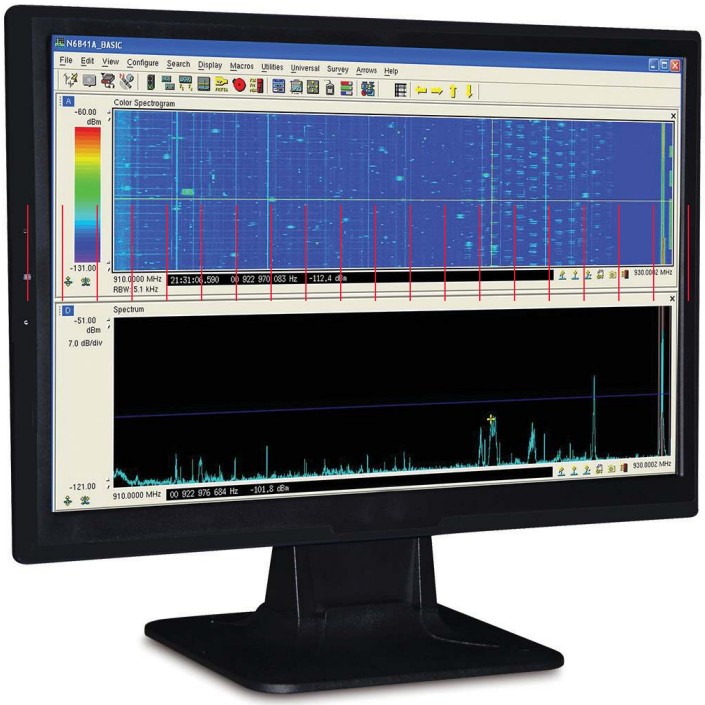
Keysight Technologies
N6820ES Signal Surveyor 4D Software

Technical Overview



"I need a Spectrum tool that will tell me when and where the problem is before the phone starts ringing again ..."

Surveyor 4D
frequency•amplitude•time location

KEYSIGHT TECHNOLOGIES

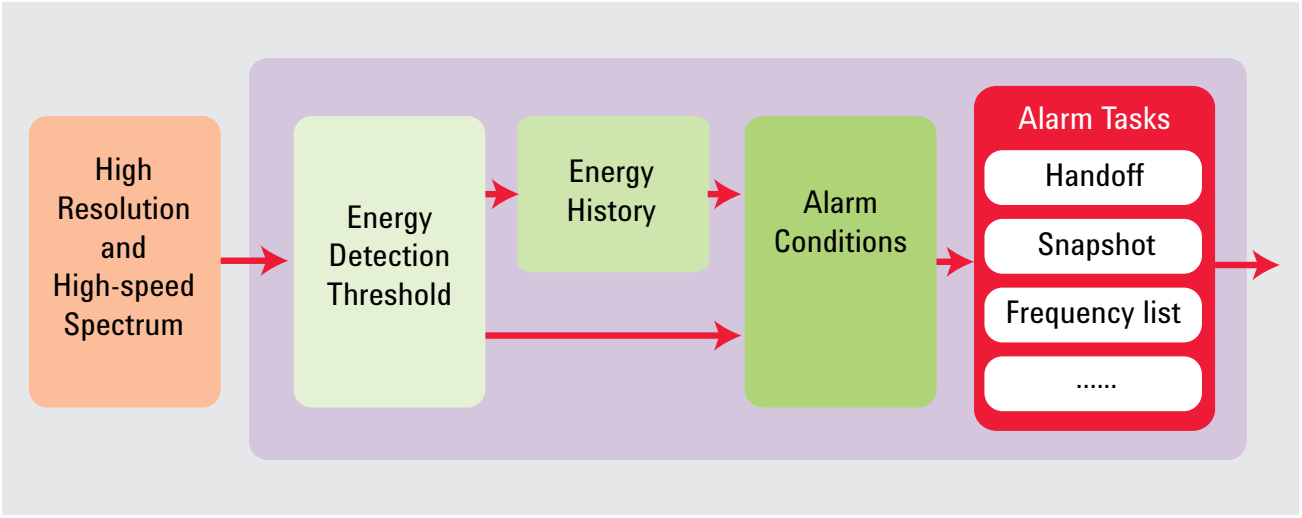
Overview

Key Features

- High-Speed, High-Resolution Spectrum Search
- Automated Signal Survey and Classification Tools
- Powerful triggering and mask functions
- Technical Identification toolkit in accordance with ITU-R Recommendation SM.1600
- Easy to use manual operations
- Signal Isolation and IQ recording
- Scheduled Alarm functions and flexible tasking
- Scalable and affordable using the N6841A RF Sensor
- Automated Geolocation of short or long duration signals

The N6820ES "Surveyor 4D" software operates exclusively with the Keysight Technologies, Inc. N6841A RF Sensor providing a highly affordable and portable tool for RF professionals. Designed for outdoor operation, the N6841A is an IP67-rated wideband RF Sensor with a frequency range of 20 MHz to 6 GHz and a processing bandwidth of 20 MHz. With integrated GPS receiver, it operates alone or synchronously with other RF Sensors to perform monitoring, detection, recording, classification, direction-finding and location tasks in fixed, temporary or mobile deployments. For more information on the N6841A, refer to the Technical Datasheet, publication no. 5990-3839EN.

Surveyor 4D is spectrum monitoring software capable of automating signal search and survey functions. It tasks internal or external processes to capture and analyze spectrum events or conduct comprehensive surveys of the RF environment. Its powerful triggering and alarm functions are unrivalled in the commercial spectrum monitoring industry. It can also be used manually as a high speed spectrum display with the ability to task audio handoff receiver, modulation recognition, recording, direction-finding, and emitter location measurements. Here is how it works



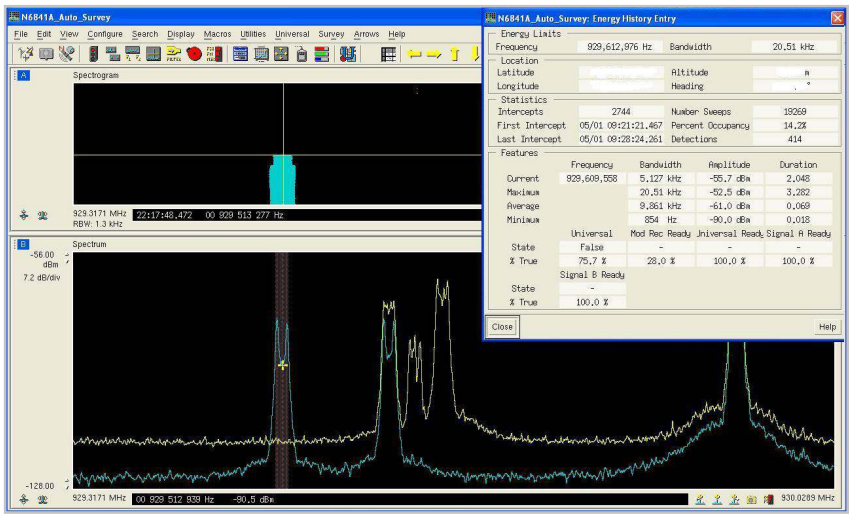
Wideband Search to Signal Isolation and Alarm Tasking

Energy Detection

Energy detection requires a spectral threshold line. Surveyor 4D offers four formats:

- **Level** provides an absolute dBm value. This is most useful in the UHF band where the noise floor is flat and unvarying.
- **Auto** is a noise riding algorithm which allows detection of energy that exceeds a dB value abovethe instantaneous noise floor. Auto threshold is computed on a segment by segment basis with user controls to optimize for different environments. This is most useful in HF, VHF and environments experiencing broadband noise, interference or jamming.
- **Environment** is a high-resolution max-hold threshold that represents a known spectrum baseline. It is used to isolate energy not present when the threshold was created and is very useful for detection of strong in-band interferers.
- **File** is a stored Threshold (normally based on an Environment) which can be saved, recalled and manipulated by the user.

Surveyor 4D conducts high-speed, high-resolution RF searches across single or multiple radio bands processing energy that meets intentional detection criteria.



The EHD is used as an interim repository where intercept data is further processed and refined through Energy History Filtering and Alarms.

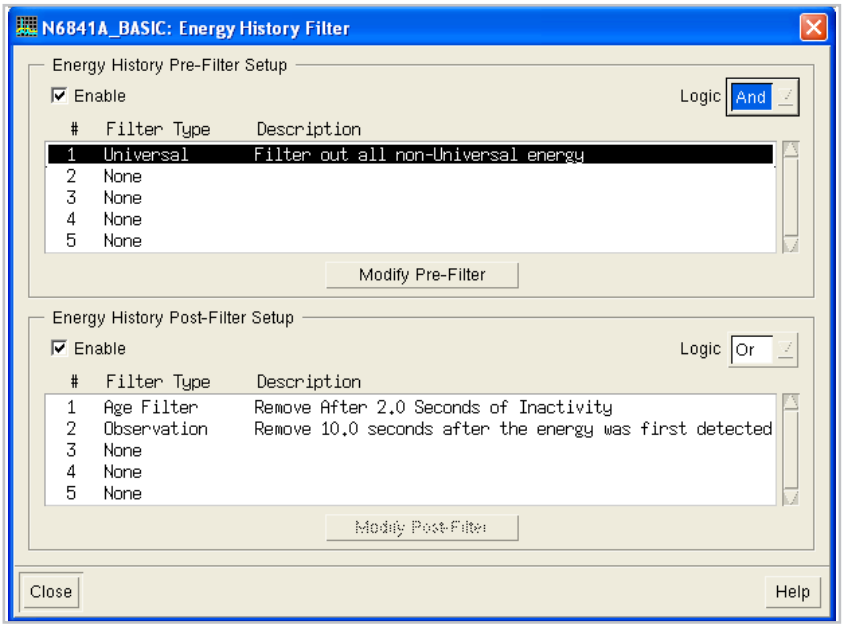
When the energy threshold is exceeded, an entry is made into the Energy History Database (EHD). Each entry in the EHD contains over 20 parameters based on signal externals that are associated with the detection. These parameters include but are not limited to:

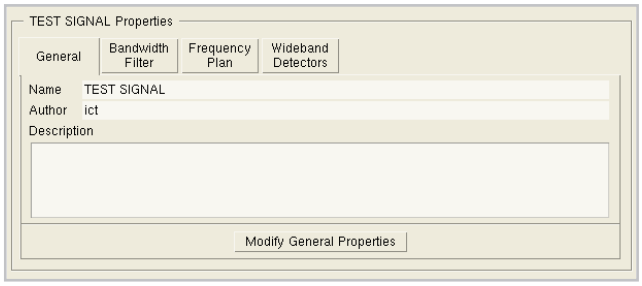
- Center frequency, bandwidth, amplitude and duration (with Min, Max and Average values)
- Duration
- # of Intercepts, # of Detections, Percent Occupancy
- Time of first and last intercept
- Energy History Pre-Filter status (True or False)
- Sensor location as logged by the GPS receiver in the N6841A RF Sensor

Energy History Filters

Surveyor 4D includes the ability to invoke Energy History Pre- and Post-Filters designed to restrict or open the flow of intercept data into—or out of—the Energy History Database.

A simple example is the Age Post-Filter. This filter simply removes any entry from the EHD after a specified number of seconds of inactivity on the frequency. When that energy drops below the threshold, the Age filter begins counting seconds of inactivity. When the number of seconds is exceeded, the entry is removed.





The most commonly used Pre-Filter is called the Universal Signal Detector (USD). USD has three parameters that can be used together or independently to perform Signal Isolation or Signal Classification. The three parameters are:

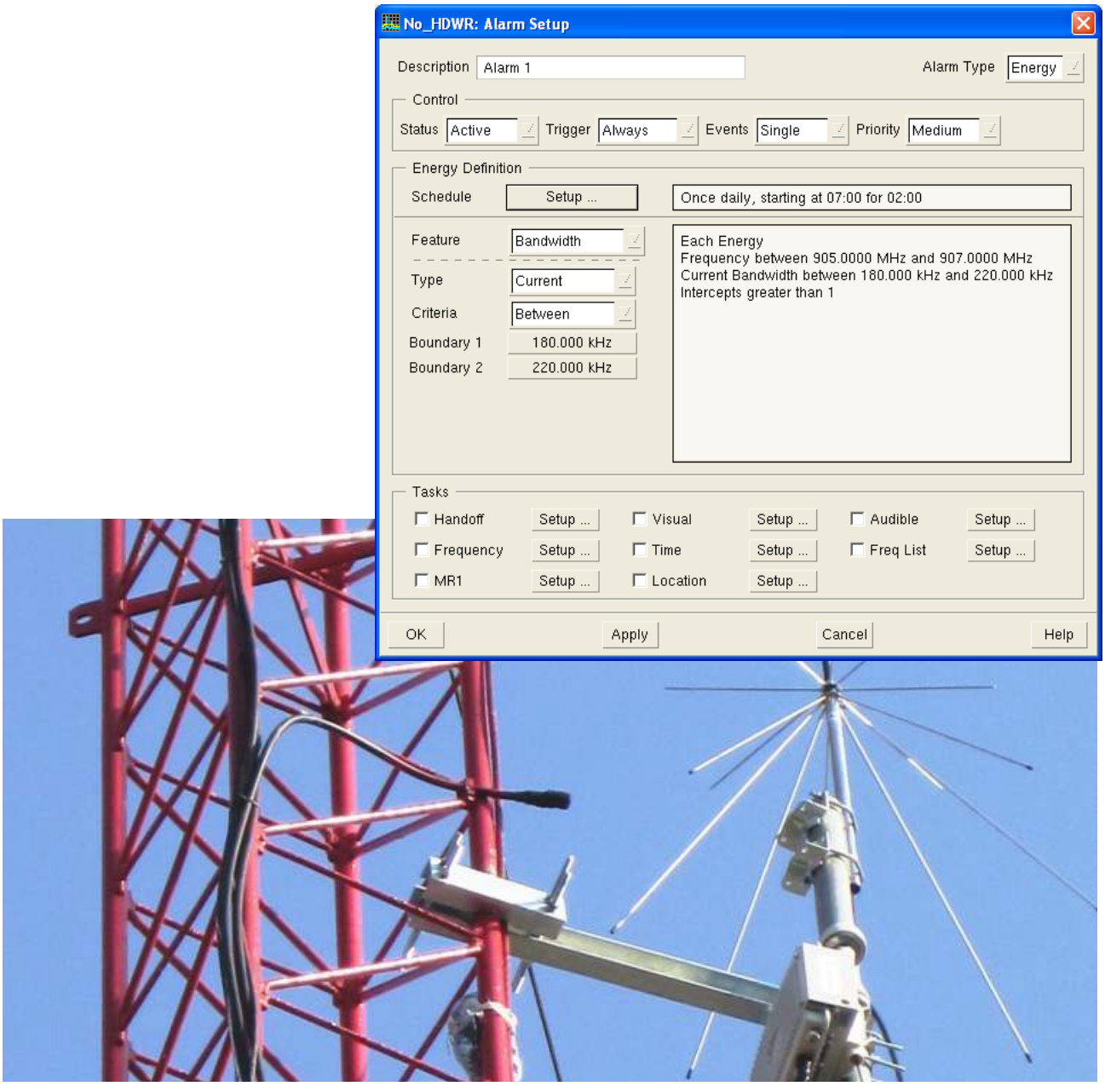
- Frequency Plan
- Bandwidth Filter
- Wideband Spectral Shape Detector

USD will be described in detail later in this datasheet.

Energy Alarms

An Energy Alarm is used to define a trigger based on a set of signal externals. The criteria are pulled from the EHD. All of the parameters collected in the EHD and described above, can be used individually or in combination by an Alarm to isolate an energy event of interest to the user.

For example, a user may want to isolate energy that is seen occasionally between 905 MHz and 907 MHz. The energy has only been observed between 7:00 and 9:00 a.m. The energy is believed to have a bandwidth of 200 kHz but is very short in duration. An Energy Alarm can be created to isolate the energy as shown below.



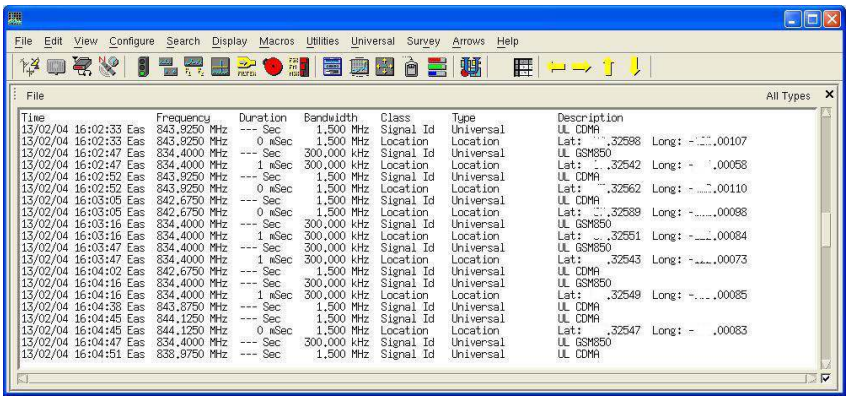
When the Alarm triggers, one or more actions (referred to as “Tasks”) are executed. These tasks can include:

- Handoff of the frequency to an external or internal (digital) receiver and output/record the audio.
- Take a Frequency Snapshot of a user-defined portion of the spectrum.
- Send an IQ cut of the energy to the Modulation Recognition algorithm (MR1).
- Give the operator a Visual indication on the computer screen that the Alarm was tripped.
- Take a Time series (IQ) recording on the frequency that tripped the Alarm.
- Task the network of RF Sensors to Locate the emitter that tripped the Alarm.
- Give the operator an Audible indication that the Alarm tripped.
- Add/Remove the frequency that tripped the Alarm to/from one of ten Frequency Lists.
- Custom, user-defined alarms can be created by Keysight for special cases. For example, send an email or call a pager.

Signal Database and Reporting

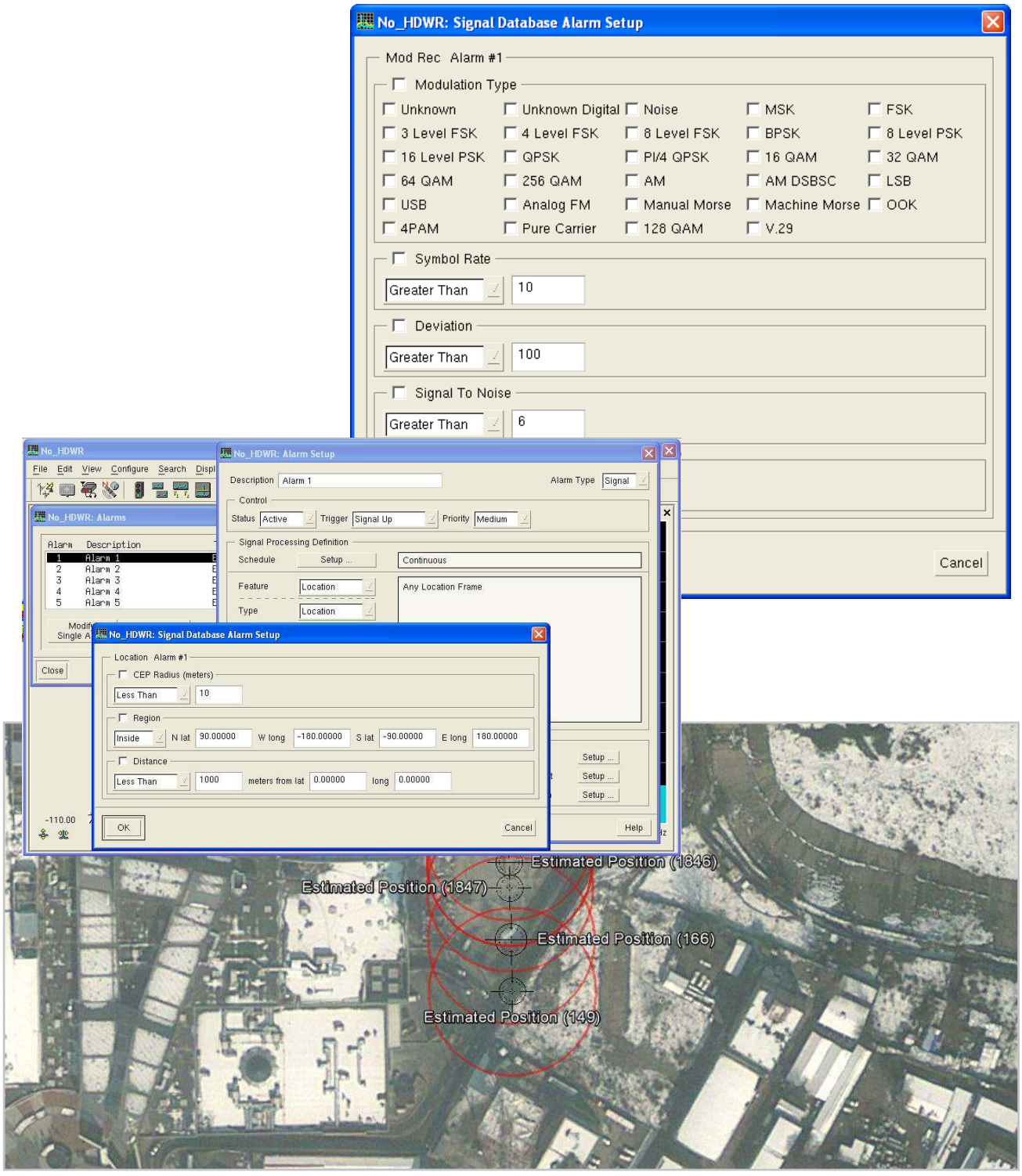
When an Alarm task is completed, an entry is made in the Signal Database (SDB). The SDB is the final work product of Surveyor 4D software. SDB files can be saved or appended with new information as needed. Contained in the SDB is information from signal processing tasks like Universal Signal Detection, Modulation Recognition, Direction-Finding, Emitter Location or Time/Frequency Recording.

The Survey function allows export of all the system results including Energy History and Signal Databases to a format readable by Microsoft Excel© where report data can be prioritized, sorted, and filtered.



Signal Alarms

An additional processing step can be taken by creating an Alarm function that operates based on the contents of the SDB. This is used to alert the user when all criteria are satisfied. For example, a signal alarm can trigger when a specific modulation format or symbol rate is observed as shown below. Or, it can alarm when a transmitter is located in a restricted area or when it originates from a specific line of bearing.



Universal Signal Detection (Option USD)–classification by signal externals

Option USD gives the user a flexible and effective toolkit to isolate signals of interest in complex spectral environments. USD offers three utilities that can be applied individually or in combination to search and isolate spectrum events of interest. These utilities are described in the next paragraphs.

Frequency Plan

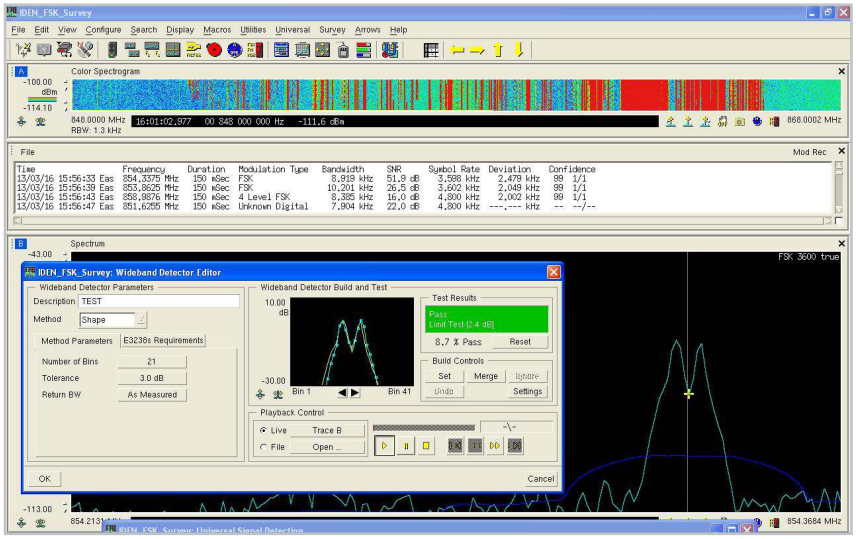
USD enables creation of a frequency plan for signal types operating on a known frequency allocation and channel plan. It can also use specified frequency bands (multiple F1 – F2) for signals that may not appear where they are expected due to drift, age, quality, or other issues.

Bandwidth Filter

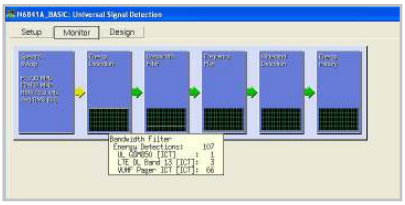
This is used to associate only signals meeting a bandwidth criterion with a specific USD signal detector. It is a simple, but highly effective approach to parsing and classifying different types of signals.

Wideband Detector (Spectral shape correlation)

This provides three types of signal detectors (spectral shape correlation, peaks, and limit lines). These are used to both characterize transmitters and create a signal detector unique to a spectrum event (see the example below). USD offers recording with the wideband detector creation tool. Transmitter classification can be achieved by identifying one or two unique modes or features of the device turn on.



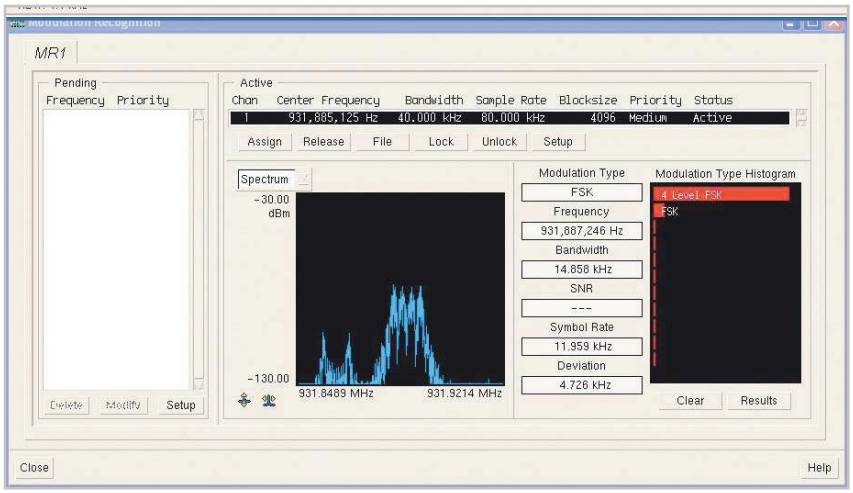
Application of USD



In many cases, the three USD utilities (frequency plan, bandwidth filter, and wideband detector) are used in combination to isolate candidate signals of interest. The USD Monitor Pane displays how effectively each stage of the USD process is sorting and filtering candidate signals. In many cases, after a candidate signal passes through USD, it is tasked to Option MR1 for automated analysis of signal internals.

Modulation Recognition (Option MR1) – classification by signal internals

Option MR1 is used for automated or manual modulation recognition to identify formats and symbol rates on signals of interest. It provides a library of analog and digital modulation recognizers to help with classification based on signal internals. This powerful option can be used in an automated mode in which it operates as an Alarm Task or used manually to post-process IQ files recorded previously in the field. This is very useful for report preparation. Popular modulation types supported with Option MR1 include:



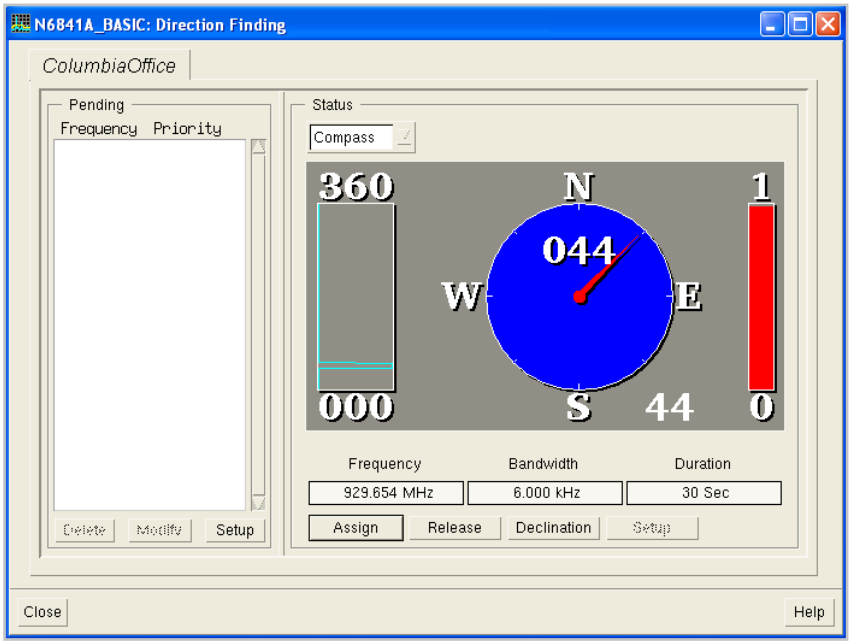
Noise	128 QAM
Unknown digital	256 QAM
MSK	AM
FM MSK	AM DSBSC
FSK	LSB
3 level FSK	USB
4 level FSK	Analog FM
8 level FSK	Pure Carrier
BPSK	Manual Morse
QPSK	OOK
PI/4 QPSK	FM OOK
8 Level PSK	4 PAM
16 Level PSK	V.29
16 QAM	64 QAM

Enable Direction Finding (Option EDF)

Users can integrate a narrowband DF system into the operation of Surveyor 4D by ordering Option EDF and appropriate consulting hours to program the interface. With this option, Surveyor 4D and a DF system can be operated from one convenient display.

DF becomes one of the many Alarm tasks available to the operator to initiate automatic measurement of the signal's line of bearing. Results are saved in the Signal Database where they can be correlated with the rest of the system's work product.

DF can also be initiated manually from the Spectrum pane with one easy click. Marker center frequency and bandwidth are automatically passed to the DF system.



User Programming (Option ASD)

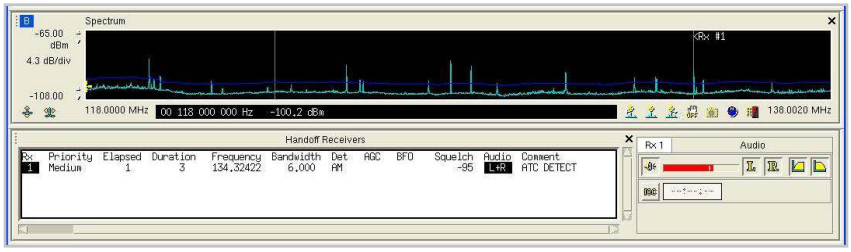
User Programming opens certain aspects of the Surveyor 4D software for programming by users. Such programming may include development of custom control panes, energy history filters, or alarm tasks. This option typically requires training and consulting services to implement successfully.

Synchronized Sweep (Option SSY)

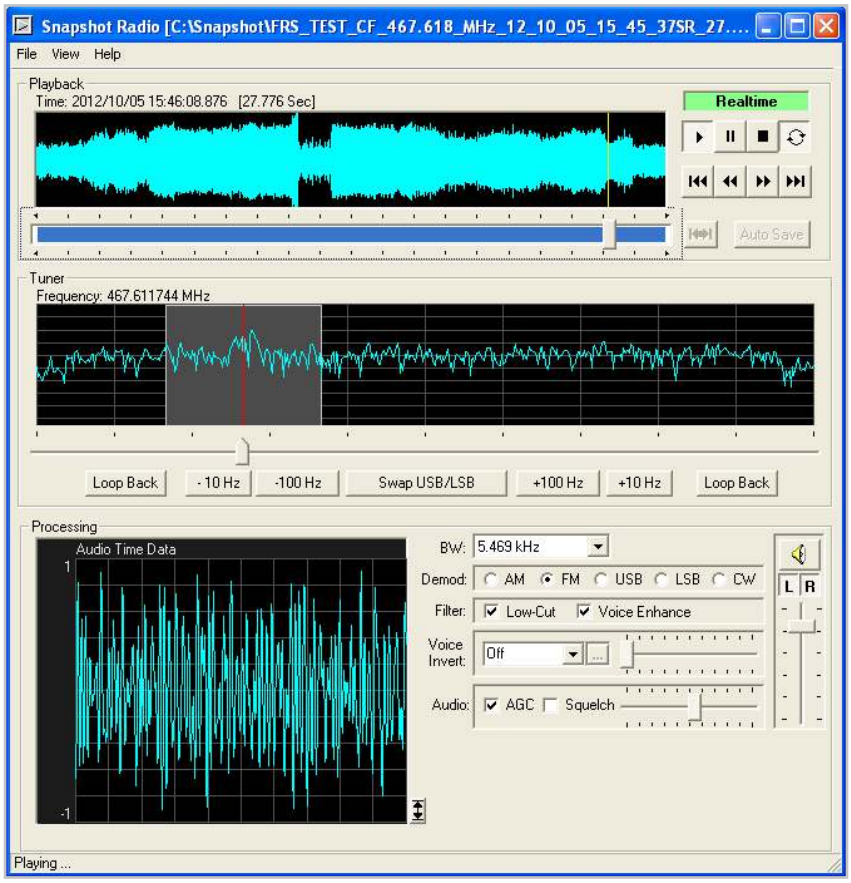
Option SSY provides a utility to allow programming of synchronous sweep of multiple instances of Surveyor each operating a single N6841A. It provides the Client-Server application, GUI, documentation and utilities to perform the functions described above. This option typically requires training and consulting services to implement successfully.

Audio

For frequency spans less than 20 MHz, audio tune-and-listen is available while spectrum displays and energy detection are running. AM and FM formats are provided for live audio. High and Low pass filters along with a manual recording feature give the operator choices to optimize the quality of the audio and to initiate recording of important events. Real-time audio is standard on the Surveyor 4D software.



With Keysight's N6829BS "Snapshot Radio Player", a user can playback IQ recordings and demodulate using AM, FM, USB, LSB, and CW. Voice inversion is also possible. Snapshot Radio is sold separately from Surveyor 4D, but is a great companion product for those processing large amounts of audio files.



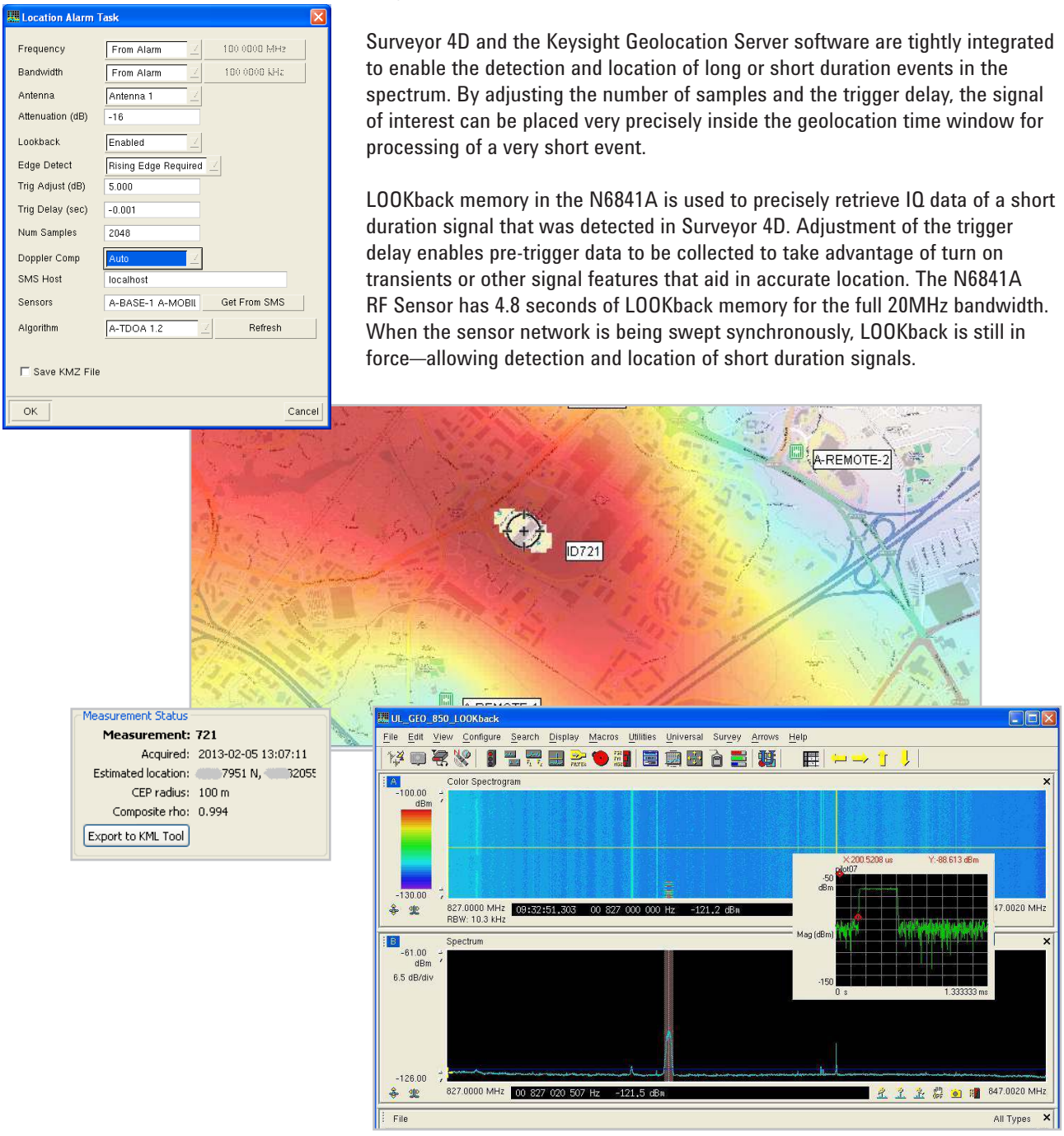
Location

Location Alarm Tasking is a standard feature of Surveyor 4D software. It is used to assign a frequency of interest to the network of synchronized RF Sensors for the purpose of geolocation.

The Location Alarm task causes synchronous, time-stamped data to be fed into one of three geolocation algorithms that estimate the emitter position based on the locations and geometry of the sensor network and the time and/or power of the signal received at each location. After the location has been computed, the results are returned toThe Location Alarm task also allows saving of a KML image to the location in Google Earth© or another Graphical Information System GIS).

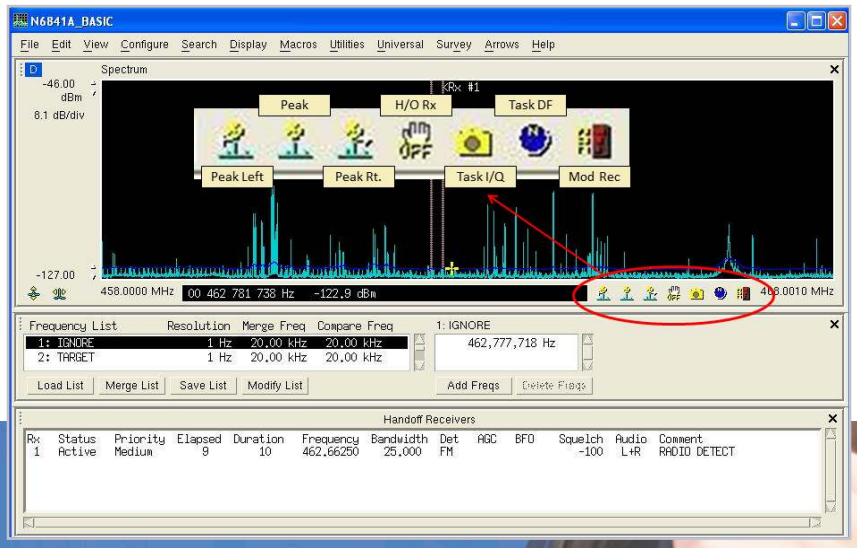
Surveyor 4D and the Keysight Geolocation Server software are tightly integrated to enable the detection and location of long or short duration events in the spectrum. By adjusting the number of samples and the trigger delay, the signal of interest can be placed very precisely inside the geolocation time window for processing of a very short event.

LOOKback memory in the N6841A is used to precisely retrieve IQ data of a short duration signal that was detected in Surveyor 4D. Adjustment of the trigger delay enables pre-trigger data to be collected to take advantage of turn on transients or other signal features that aid in accurate location. The N6841A RF Sensor has 4.8 seconds of LOOKback memory for the full 20MHz bandwidth. When the sensor network is being swept synchronously, LOOKback is still in force—allowing detection and location of short duration signals.



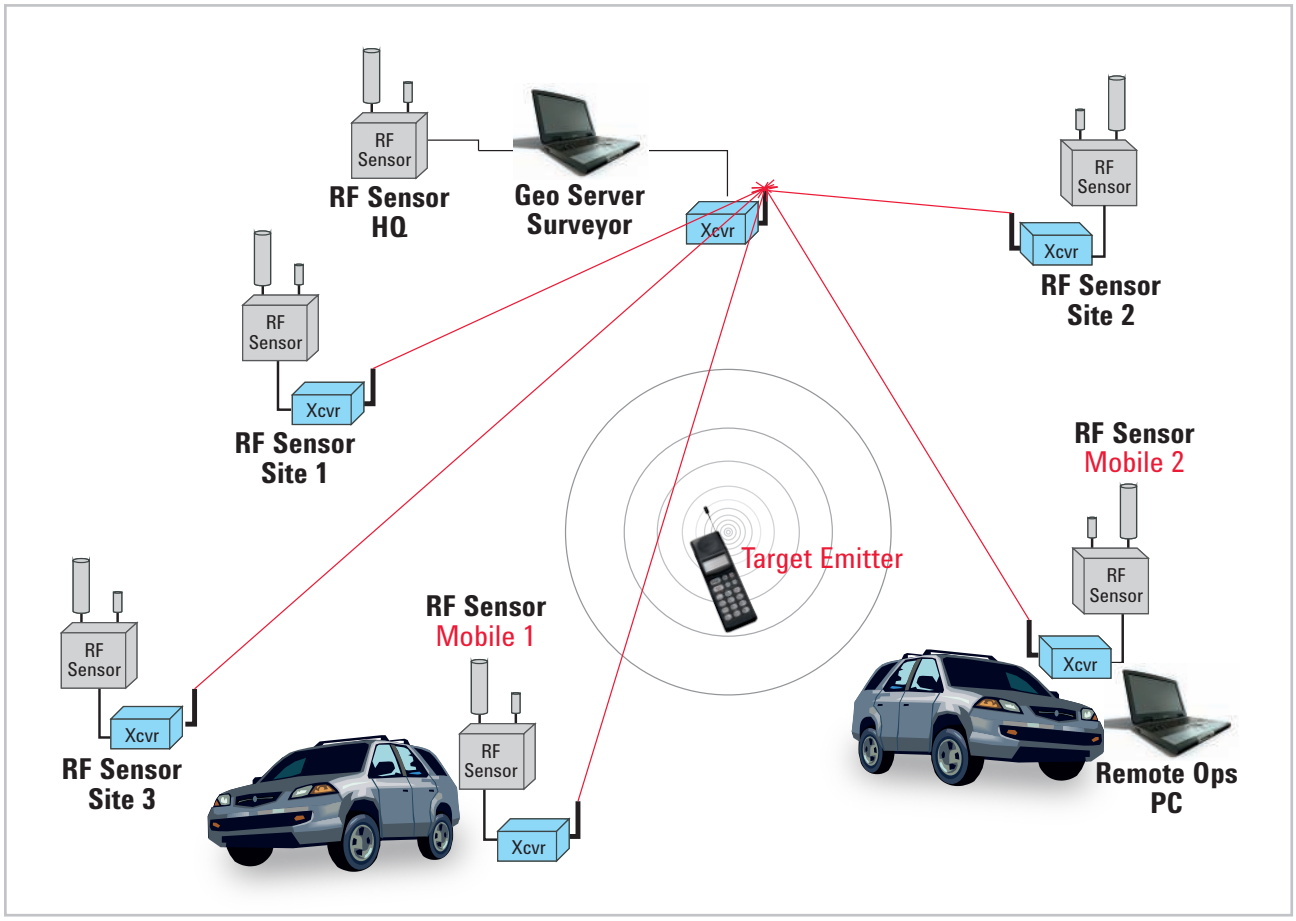
Signal Surveyor 4D Manual Operations

Manual operation of Surveyor 4D is fast and easy. The ToolBar gives the user quick access to the most frequently used controls for frequency range, resolution bandwidth, display settings and others. Shortcuts are customizable for handoff of the marker frequency to modulation recognition, geolocation, audio, IQ or frequency recording, tuning to Peak-Right-Left. From one basic Spectrum Trace, a user can tap into all the capabilities of Surveyor 4D with one click of the mouse. Also, Macro functions allow a user to easily program a multiple step process into a single button click.



Deployments

One license on one PC can operate up to six sensors simultaneously (dependent on the available network bandwidth). In this use model, a central PC can run up to six instances on six different sensors in different locations—whether across the room, across the city or across the world. Since all of the spectral data and trace averaging is done in the Sensor, the data backhaul is dramatically reduced.



Another deployment model places a ruggedized computer with each RF Sensor for unattended operation, using 3G or 4G backhaul to connect remotely into the computer. This arrangement affords the most robust data connection between the Surveyor 4D PC and the RF Sensor. For more information on PC selection, and on deployable PC's, refer to the N6841A QUICK Note 1, publication 5991-1583EN. This can be viewed on the Keysight RF Sensor website, *www.keysight.com/find/RFSensor*

Training

A two-day training course is available for up to eight students at either a customer or a Keysight facility. The class includes both lecture and labs to assure the student gets a good start with this powerful spectrum tool. The curriculum includes the following:

1. Establish default system configurations based on customer use model.
2. System Familiarization to include:
   - Graphic User Interface for the N6820ES Software
   - Energy Detection Schemes (Auto, Level, Environment, File), Energy History Filters
   - Creating effective Energy Alarms
   - Use of the Universal Signal Detection (if ordered)
   - Use of Modulation Recognition (if ordered)
   - Creating effective Signal Alarms
   - File Management
   - Recording Signals of Interest
     - Methods
     - File formats
3. Analysis of recordings of Signals of Interest using tools such as N6829B Snapshot Radio and Snapshot Viewer applications.
4. Creating mission specific setups and standard operation procedures for N6820ES Software.
5. Integration of N6854A Geolocation with N6820ES Alarms and Signal Database (if ordered)
6. Reporting of system results.
   - Signal Database
   - Survey export to Excel© spreadsheets

Ordering Information

Surveyor 4D
frequency•amplitude•time location

Model	Description
N6820ES	Signal Surveyor 4D Software for the RF Sensor
N6820ES-114	Basic Search, intercept and collection software
N6820ES-SSY	Synchronous Sweep enabler
N6820ES-USD	Universal Signal Detector
N6820ES-MR1	Host-Based Modulation Recognition
N6820ES-EDF	Enable Direction Finding
N6820ES-ASD	User Programming
N6820ES-1RU	1 year of software updates and factory support
N6820ES-2RU	2 years of software updates and factory support
N6820ES-B02	Software bundle includes all software options plus 1RU

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