

go2MONITOR

go2signals



**AUTOMATIC SIGNALS
SEARCH, MONITORING
AND DECODING**



go2 MONITOR

GO2SIGNALS IS AN INNOVATIVE SOFTWARE PACKAGE, DESIGNED TO MEET TODAY'S TACTICAL AND STRATEGIC REQUIREMENTS IN THE FIELDS OF RADIO-MONITORING, COMMUNICATIONS INTELLIGENCE AND SIGNALS ANALYSIS AND EXPLOITATION.

GO2SIGNALS – THE ONE FOR ALL RADIO MONITORING TASKS

The go2signals toolset consists of a collection of complementary software applications to search, monitor, process and analyze radio communication from SLF up to SHF frequency range, specialized on HF and V/UHF signals. Its open design concept allows the users to adapt, tailor and automate their monitoring tasks, improving the quality of results, managing the increasing density of signals and subbands in the RF spectrum, and 'staying current' with new requirements.

Employing wideband parallel-processing techniques, our go2signals monitoring application offers powerful capabilities for HF-V/UHF voice/data-signals interception, monitoring and recording even on small sized COTS hardware. It includes automatic detection, modulation classification, modem recognition, deep context decoding, sensor controlling and a database to collect all the results.

To improve quality of automated results use go2signals toolsets for signal analysis and decoder development, to analyze and adapt demodulator parameters, to develop new customer decoders and protocols and to 'fine-tune' signals monitoring tasks. Even forensic analysis of demodulated data signals at the bitstream level are possible.

In this way, the User's knowledge and experience are incorporated into all signals exploitation objectives based on our range of go2signals.

AUTOMATIC INTERCEPT WORKFLOW

go2signals monitoring software has a fully automatic approach for interception, monitoring and recording, with automatic detection, modulation classification, recognition and decoding of radio signal emissions in a wideband spectrum environment. In combination with wideband monitoring receivers, go2signals delivers a full-feature capability.

Detected signal activities are classified and technical parameters are determined. Known signals are automatically recorded and demodulated to live audio and automatically decoded to get the transmitted information. All collected results are stored in the tools database.

New or unknown signals can be recorded for more in depth manual analysis, enabling the operator to concentrate on priority Signals Of Interest. The records are analysed and related decoders written by the customer are easily installed to enhance automatic performance of the software. The entire capability is available for manual and automatic operation: From manual signal processing and rapid analysis of an individual signal up to fully automatic signal search, intercept and processing.



FEATURE OVERVIEW

FUNCTION OVERVIEW

- ✓ 2.4 MHz (HF) / 20 MHz (V/U/SHF) coherent input (scalable), 6 GHz scan mode
- ✓ Multiple wideband inputs and features (spectrogram, classifier, recording, DDC)
- ✓ Modular scalability from one channel to hundreds of channels
- ✓ Automated parallel and continuous classification and production (collection) of signals using an extensive decoder library
- ✓ Expandable with user-defined decoders, modems and procedures
- ✓ Parallel production channels either with buffered Digital Down Conversion (DDC) or narrowband receiver input
- ✓ Integrated receiver control with direct Software Defined Radio (SDR) interface
- ✓ Efficient tasking control for processing, analysis and results by focusing on Signals Of Interest

YOUR BENEFITS

- ✓ For civil, tactical and strategic applications
- ✓ Modular and scalable design
- ✓ More than 350 demodulation and decoding modes
- ✓ Use of standard COTS hardware and current receiver models
- ✓ Easy integration through open APIs

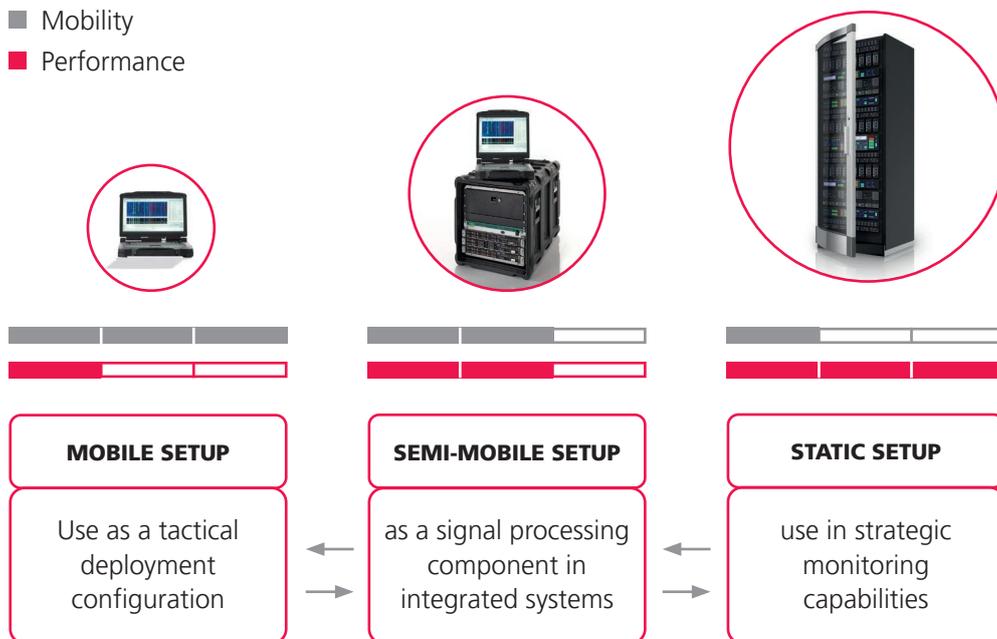
go2 your solution

ONE SOFTWARE PACKAGE - FLEXIBLE FOR UNLIMITED INDIVIDUAL SOLUTIONS.

The modular and scalable design enables many different go2signals component combinations to create customised signals monitoring setups tailored to the user's needs:

■ Mobility

■ Performance



USE CASES

AUTOMATIC SEARCH AND PRODUCTION OF KNOWN SIGNAL TYPES

The software is able to search full automatically in predefined frequency ranges for known signal types to get the complete picture of active transmissions. This feature includes the search for analogue transmissions (e.g. voice) and for all signals matching a list of digital transmission modes defined of interest.

Running in automatic mode, the software searches for all signals using these transmission modes in the defined frequency ranges, extracts the contents and stores these signals on a storage server. Results such as decoded text or demodulated audio are stored on the storage server for further analysis and reporting.

AUTOMATIC DETERMINATION OF FREQUENCY ALLOCATION

A main use case of automated systems is to provide an overall survey of the RF environment without preknowledge of the frequency allocations. In this use case, the system searches for energy in a predefined frequency range and determines if the energy could be a Signal Of Interest.

The detected energy is processed up to the level of information that is parametrized for this task: signal detection, specific signal parameters (e.g. SNR, bandwidth), modulation type and parameters or transmission mode and content.

AUTOMATIC FREQUENCY MONITORING WITH PRODUCTION (COLLECTION)

For some operations, it is necessary to monitor specific frequencies. After starting a frequency monitoring task, the defined frequencies are permanently checked for signal activity. In case of activity, the signal is processed immediately.

If the type of active signal matches the list of tasked transmission modes, the signal is recorded, demodulated and decoded.

MANUAL ONLINE MONITORING OF FREQUENCIES

An online spectrogram is provided to enable realtime visualisation of the electromagnetic spectrum. The operator observes the wideband spectrum in the spectrogram display. Zoom and cursor functionalities provide a rough estimation of signals' characteristics. The wideband classifier delivers modulation type and parameters on all signals received.

The operator selects Signals Of Interest directly in the online spectrogram for live classification, decoding, audio monitoring and recording in a narrowband channel. Multiple channels are available to monitor multiple signals parallel.

RECORDING AND OFFLINE ANALYSIS OF FREQUENCY RANGES AND SUB-BANDS

Recording of frequency ranges can be triggered by system events, parametrized as time based tasks or started manually by an operator. For evaluation, the operator uses an offline spectrogram for rapid overview and navigation within the recorded spectrum bandwidth.

Specific emissions can be easily selected and highlighted and a description and text annotation can be added. Selected signals can be extracted and exported to files or processed as signal input to external signal analysis tools.



FUNCTIONS

SIGNAL SELECTION FROM A WIDEBAND INPUT

go2MONITOR displays an overview of the wideband spectrum utilising a spectrogram and a spectrum (FFT) display. Various display settings, cursors and a dynamic zoom are available. Using the wideband view the operator is able to select signals to be demodulated by Digital Down Conversion (DDC) simply by selecting them in the display.

The output of the DDC is assigned to a narrowband channel; the DDC's user interface is updated to show the results. Alternatively, the wideband classification results can be used to select Signals Of Interest. Modulation, bandwidth, symbol rate, shift and other parameters are shown for all classified signals within the selected wideband frequency range.

NARROWBAND CHANNEL PROCESSING

Signals Of Interest can be assigned from the wideband spectrum to a production channel by drag and drop. All production channels can be reviewed in parallel and configured individually. A production channel shows a detailed display of the selected signal. Its zoom spectrogram and spectrum display is easily configurable.

Up to eight parallel production channels can be set up in manual mode; hundreds of channels in automatic mode.

OPERATING MODES OF THE PRODUCTION CHANNELS:

-  **Classification mode:** Detailed determination of frequency allocation and classification of modem type, modulation type and modulation parameters.
-  **Decoding mode:** The channel works as a static decoder. The suitable decoder / modem is manually selected from a decoder / modem list.
-  **Recognition and decoding mode:** An assigned signal will be recognized and decoded automatically.
-  **Classification, recognition and decoding mode:** Suitable decoders / modems will be full automatically selected depending on the classification and recognition result.

AUTOMATIC RECOGNITION AND DECODING

A production channel uses a configurable list of decoders / modems and checks which of them matches the signal.

The signal is automatically demodulated, decoded and the results are displayed in the result view. The decoder / modem lists can be configured, loaded and saved.

This way, specific decoders / modems to be processed are defined according to the user's mission priorities and tasking; existing classification results enhance the production results. go2DECODE can be used for analysis and creation of customer specific decoders by using the DDL/pyDDL programming language; these customer-derived decoders can be used directly in go2MONITOR to adapt and enlarge the decoding performance.

RESULTS PROCESSING AND EXPORT

The integrated ResultViewer shows all collected results in tabular or graphical representation. Results can be filtered, sorted, grouped, marked, audio-monitored, viewed, edited and exported. All results are stored in a database for postprocessing, analysis and reporting.

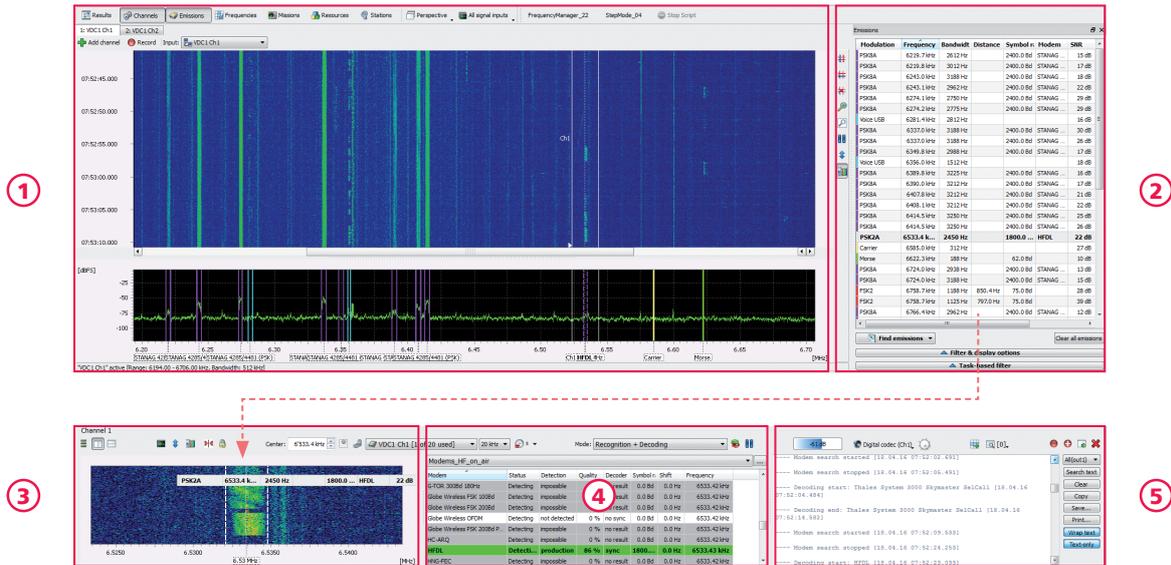
Automatic monitoring of wideband input, narrowband channel processing

The screenshot displays the go2MONITOR software interface with several key components highlighted by red circles and numbered 1 through 7:

- 1**: Configuration panel for wideband spectrogram, showing parameters like Modulus level, FFT length, and Display mode.
- 2**: Wideband input displayed in a spectrogram and a spectrum FFT plot.
- 3**: Production of a selected narrowband signal in production channel 1, operation mode: Recognition and decoding.
- 4**: Recognition results: Identified decoder / modem (e.g., HFDL PSK-2).
- 5**: Decoding results: Decoded text (e.g., "Data Rate: 300 / Single Slot...").
- 6**: Production of a second selected narrowband signal in production channel 2, operation mode: Classification.
- 7**: Classification results: Detected modulation type and parameters (e.g., Modulation: PSK (80%), Symbol rate: 99.98 Bd).

- 1 Configuration of wideband spectrogram
- 2 Wideband input displayed in a spectrogram and a spectrum FFT
- 3 Production of a selected narrowband signal in production channel 1, operation mode: Recognition and decoding
- 4 Recognition results: Identified decoder / modem
- 5 Decoding results: Decoded text
- 6 Production of a second selected narrowband signal in production channel 2, operation mode: Classification
- 7 Classification results: Detected modulation type and parameters

Automatic monitoring of wideband input, manual signal selection for production



- ① Wideband input displayed in a spectrogram and a spectrum FFT
- ② Emission list with classified signals
- ③ Select a signal in the emission list, drag and drop to a production channel to start production of the signal
- ④ List of mission / task-specific decoders / modems for automatic modem recognition
- ⑤ After automatic modem recognition the system starts to decode the signal content

MODES

INTERACTIVE MANUAL MODE

Using classification and decoder / modem recognition, monitoring of wideband input

go2MONITOR operates in manual mode with wideband and narrowband classifiers, automatic decoder / modem recognition and content decoding.

1. Monitoring of a wideband input requires the processing of multiple signals at the same time. The Wideband Classifier function assists automatic detection and classification of all signals. The resulting emission list provides a quick and easy overview to the operator.

2. The operator simply selects a signal in the emission list to start further signal processing. Narrowband Classification helps to track signal parameters in detail.

3. With the classification result, the operator gets a list of possible decoder / modem types matching the modulation type.

4. If modulation parameters are unique, the specific decoder / modem is detected. If not, a matched list of decoders / modems is generated ready to use with the decoder / modem recognition function.

5. The automatic decoder / modem recognition evaluates the correct decoder for the signal and automatically starts the decoding of the signal content. Internal signal buffers and processing faster than realtime assure that no bit is lost (decoding of the first bit) even during tracking of signal changes.

AUTOMATIC MODE WITH TASKING

Fully automatic signal detection with configurable, loss-free automatic processing

Automatic monitoring and tasking option turns go2MONITOR into a fully automated signal search and processing system. To use automatic processing features, the operator creates tasks and missions. The results are stored in a database for further evaluation. An advanced ResultViewer shows a tabular or graphical representation of the stored data.

The operator can define various tasks which are automatically processed. Task definition consists of three parts.

1. Trigger

Select signal types the system should search for.

Parameters are:

- Time ranges (from-to)
- Frequency ranges (from-to)
- Geographical areas (activate signal trigger at specific site, if GPS location is available)
- Signal energy found
- Modulation type recognized
- Modulation parameters
- Modem recognized

2. Action

Defines the action to be executed when the signal or event defined in the trigger is detected. Possible actions are (actions can be combined):

- Alert (send network notification to an external system)
- Record signal (Narrowband or wideband)
- Classify modulation type
- Demodulate / decode signal (with predefined decoder / modem)
- Detect decoder / modem demodulate / decode (with search decoder / modem list)

3. Stop criteria

Defines, when the task is finished.

Stop if:

- Signal energy lost
- Signal lost during decoding
- Maximum duration

Alert actions

Alert actions can be defined by the operator by specifying an external application which will be started in the case of an alert. This interface ensures that go2MONITOR can interface to third-party software without modification.

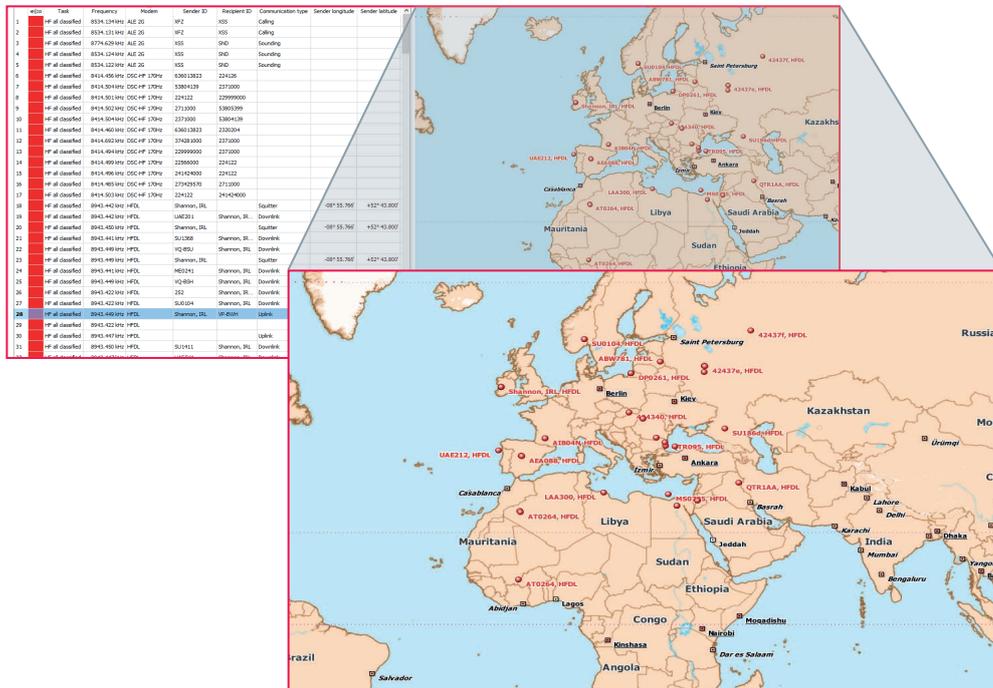
Automatic / manual mode

Automatic mode and manual mode can be used together at the same time to manually process interesting signals during the automatic is running in the background.

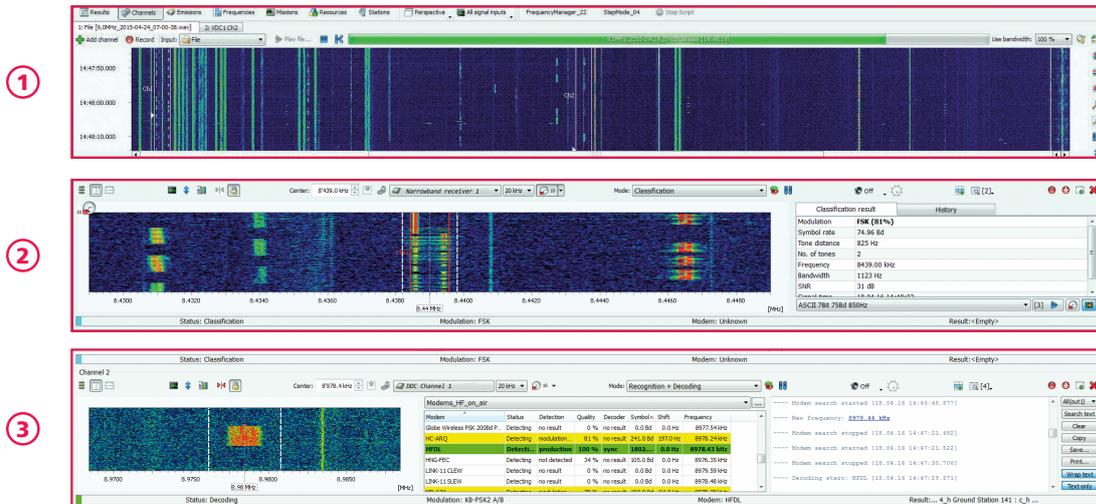
Automatic extraction of decoder metadata

Depending on the signal type (e.g. HFDL, ALE-2G, ACARS, VDL2, etc.), decoded text will include interesting metadata such as sender and / or recipient identification, callsigns, aircraft locations or ship positions, types of communication, etc. This new go2signals function automatically extracts decoded metadata and stores it in new database fields for use during results analysis and reporting tasks such as filtering and sorting, or showing platforms' geographic locations and positions on the map.

ResultViewer showing metadata extracted and decoded transmission locations plotted to map



Seamless usage of DDC channels and narrowband receivers:



- ① Wideband input displayed in a spectrogram and a spectrum FFT
- ② Production channel 1 classifies the selected signal using a hand-off narrowband receiver
- ③ Production channel 2 is recognising and decoding the selected signal using a DDC channel

SPECIAL FUNCTIONS

USING HAND-OFF NARROWBAND RECEIVERS

Continuous searching for new emissions in a wide frequency range with additional narrowband receivers

Software DDC-channels are used as signal input for the processing channels. This limits the input band to the bandwidth of the wideband receiver and pauses a receiver scan during signal processing.

The option “Narrowband receiver control” allows the use of additional narrowband receivers as a signal input for processing channels. The operator can choose the emission / frequency in the GUI and decide if it should be extracted from the wideband input by using a DDC-channel or by using external narrowband-receivers. All receiver types supported for the wideband input can also be used for this hand-off function. The bandwidth of a channel using a narrowband receiver can be up to 500 kHz. The advantage of a narrowband receiver

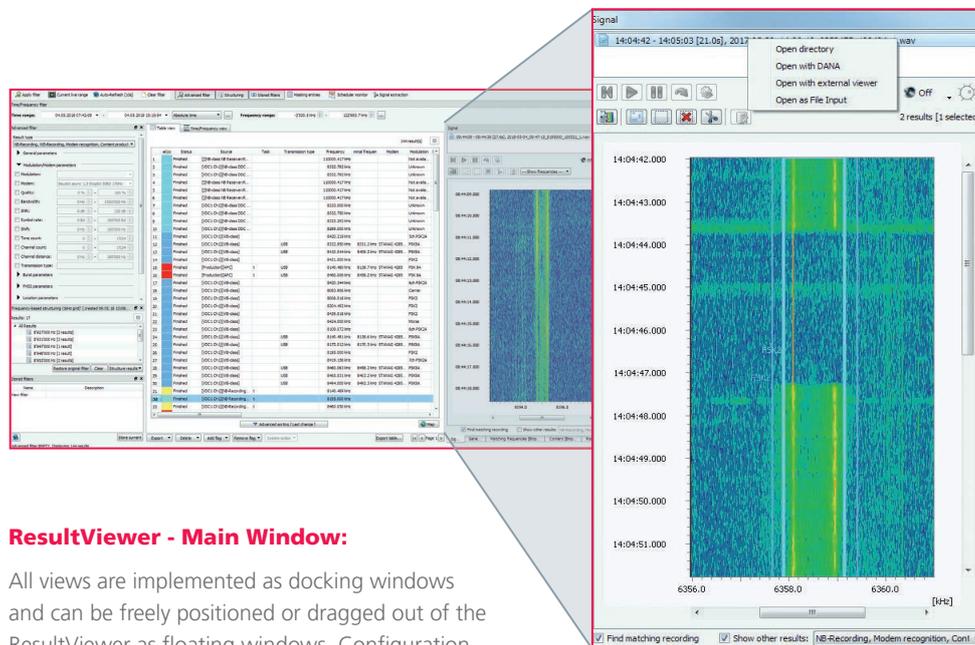
based channel against a software DDC channel is the independency from the input frequency range of the wideband receiver. Additional, in many cases, a better receiver sensitivity is available. Frequency ranges of narrowband channels are marked in the wideband spectrogram. An interactive interface for processing and fine-tuning the narrowband signal is available in the GUI. This interface can also display a zoomed-in spectrogram of the single channel with much higher spectrum resolution than in the wideband spectrogram.

The required frequency of the channel can be selected directly in the wideband spectrogram by using the mouse or by entering numerical values directly in the channel fine-tuning interface.

FAST NAVIGATION AND SIGNAL EXTRACTION IN 20 MHZ RECORDINGS

The option "Wideband Recording 20 MHz" extends the recording bandwidth up to 20 MHz. To achieve this, a separate wideband recording component is used. In addition to the recording of the signal input, the Wideband Recording option will calculate the FFT of the input signal and store it along with the wideband IF-signal files to enable fast spectrum display and navigation.

From the wideband recordings narrowband signals can be selected and extracted. Extracted signals can be used as new inputs to go2MONITOR or for further signals development, e.g. analysis with go2DECODE.



ResultViewer - Main Window:

All views are implemented as docking windows and can be freely positioned or dragged out of the ResultViewer as floating windows. Configuration of views will be stored and reused in the next session. Easy result post processing with filtering, preview, editing and export functions.

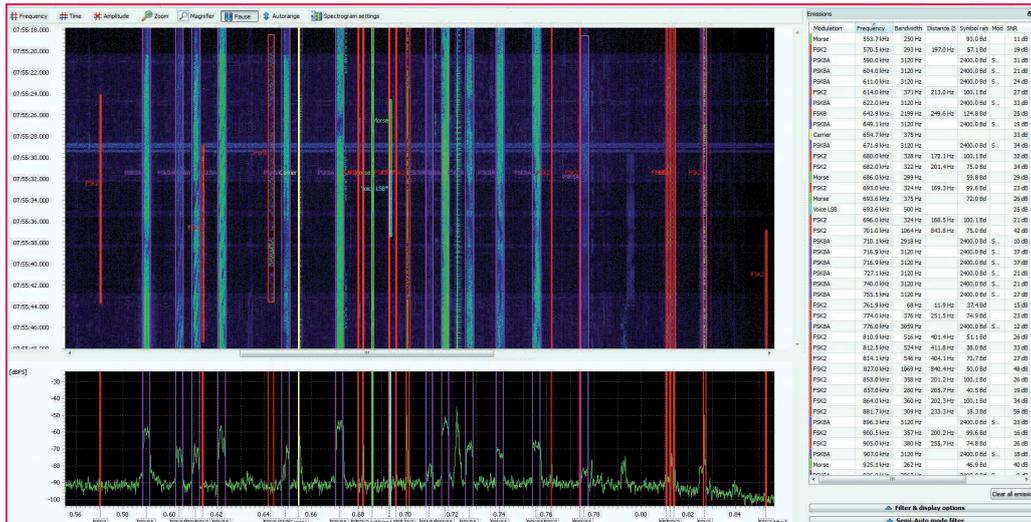
ResultViewer - Signal View:

Clicking on a file will show it in the spectrogram preview.

RESULT VIEWER

Recordings can be extracted in the spectrogram of the signal view for selected time / frequency ranges and for results. The time / frequency ranges of mouse selection areas and of results are extracted into a new narrowband recording, with either the wideband- or narrowband recording being used as the source of extraction. The extracted recordings will be added to the database as new results. After completion of the extraction the new results can be viewed in the Signal view spectrogram as well as in the Table view of the ResultViewer.

Wideband classifier



WIDEBAND ANALYSIS FUNCTIONS

WIDEBAND MODULATION CLASSIFICATION

The option “Wideband input 20 MHz” extends the signal input bandwidth for the continuous and snapshot classification up to 2.4 MHz in HF or 20 MHz in V/UHF. It is possible to automatically detect, measure and determine RF parameters for all signals in the selected frequency range. The results are displayed in the GUI and can be used as an input for further processing like automatic monitoring.

MULTICHANNEL PRODUCTION

To handle wideband signal input bands, automatic processing of many Signals Of Interest at the same time may be necessary. Therefore, the number of processing channels can be increased by the feature “Multi channel production”. The number of processing channels and software-DDCs for automated processing is extendable in steps of 32. The software can be increased to hundreds of channels installing this option multiple times.

Additional “Offline processing” will be included into the processing channels. This separates the realtime part (recording) from the processing (narrowband classifying and decoding) part, and enables processing faster than realtime.

PROCESSING OF SIGNALS FASTER THAN REALTIME

The signal is first recorded to a signal file and then processed with the Automatic Production Channel (APC). Advantages of this technique are:

- Increase of overall system throughput
- Automatic storage of the I&Q for each signal
- Reduction in the number of production channel licenses needed

MULTIPLE WIDEBAND SIGNAL INPUT

Control multiple wideband receivers using the same GUI

go2MONITOR can control multiple wideband receivers (including those manufactured by different manufacturers) using the same user interface. The user no longer needs to alternate between different receivers GUIs, but can use the same user-friendly control interface for all receivers connected to the system.

Highlight: Multiple receivers can be used in parallel, this makes the simultaneous processing of different frequency bands using the same software possible.

Wideband input overview display

With the overview display the features (fast scan mode, overview Power Spectral Density (PSD) data) from modern digital receivers are now available within go2MONITOR.

Wideband input overview display shows



- 1 Wideband spectrum overview
- 2 Wideband input selection
- 3 Channel setting
- 4 Zoom spectrogram for easy signal selection

TECHNICAL SPECIFICATIONS

SPECIFICATIONS OVERVIEW

Data acquisition	<ul style="list-style-type: none"> • Digital IF (complex I/Q), bandwidth up to 20 MHz coherent (5 MHz (1 MHz HF) in standard version) • Digital IF/AF recordings (real / complex WAV 8, 16, 32 Bit) • 2 wideband inputs in parallel. Other configurations on request
Localization	English or German; Others on request
Documentation	PDF Online-Help
Recommended PC Hardware	<ul style="list-style-type: none"> • Min. Intel i5 4 Core, 2 GHz, 8 GB RAM for 4 channels version • Min. Intel i7 8 Core, 2 GHz, 16 GB RAM for 8 channels version • HDD: min. 500 GB recommended (depends on recordings) • Screen Resolution: min. 1920 x 1080 pixel or two displays 1280 x 1024 pixels (multiple monitors recommended) • Fast Ethernet for digital IF input
OS	<ul style="list-style-type: none"> • Windows 7 SP1 (with Microsoft Windows patches KB2999226 and KB2533623, deprecated)/10/11 de/en, 64 bit • Linux CentOS 7 (7.5 or higher, 7.5 is recommended) and RHEL 8 (8.4 recommended) 64 Bit
ISO 9001:2015	Company is certified
Licence	<ul style="list-style-type: none"> • USB-Dongle (CodeMeter) • License sharing with license server • The AMBE+2™ voice coding Technology embodied in this product is protected by intellectual property rights including patent rights, copyrights and trade secrets of Digital Voice Systems, Inc. This voice coding Technology is licensed solely for use within this Licensed Product. The user of this Technology is explicitly prohibited from attempting to extract, remove, decompile, reverse engineer, or disassemble the object code, or in any other way convert the Object Code into a human-readable form. US Patent Nos. #8,595,002, #8,359,197, #8,315,860, #8,200,497, #7,970,606, #6,912,495 B2, #6,199,037.

FEATURES

Software Feature	Remarks
Alphabets	<ul style="list-style-type: none"> • Adjustable using decoder parametrizing. New alphabets can be freely added to the decoder using DDL/pyDDL (Requires go2DECODE)
Classifiers	<ul style="list-style-type: none"> • 5 MHz (1MHz HF) bandwidth (up to 2.4 HF / 20 MHz V/U/SHF with option WCL) • Manually triggered or repetitive snapshots (at 10, 20, ... sec intervals) or continuous (with option AMT)
Channels/Decoders	<ul style="list-style-type: none"> • 1, 2, 4 or 8 channels or more in steps of 32 (with option WMPC) • Automatic change of decoder if signals change in „Recognition + Decoding“ mode • Customizable decoder lists for automatic decoding • Buffering for lossless decoding (first bit)

The performance of our software products depends on the hardware used. Technical parameters can differ under real operational conditions. The parameters specified are limit values that cannot be guaranteed in all combinations. Specifications subject to change.

TECHNICAL SPECIFICATIONS

FEATURES

Software Feature	Remarks
Channels / Decoders	<ul style="list-style-type: none"> • No loss of data during analyzing and protocol changes • Python language based Decoder Description Language (DDL/pyDDL) • Extension with user-defined decoders (with go2DECODE)
Demodulators	<ul style="list-style-type: none"> • Universal demodulators with AGC and AFC • Automatic baud rate synchronization (less problems with playback of files recorded on other inaccurate devices) • For types and parameter details please refer to the go2DECODE datasheet
GUI	<ul style="list-style-type: none"> • Simple and intuitive to operate • Supports multiple monitors • Drag-and-drop of frequencies, classifier results, stations • Receiver control • Wideband input spectrogram and spectrum • Manual channel control • Result Viewer • Simultaneous working with multiple receivers and with multiple narrowband channels
Input Files	<ul style="list-style-type: none"> • Digital IF (complex baseband I/Q 32bit), Bandwidth \leq 5 MHz (standard) or up to 20 MHz (with option WCL) • Playback of standard wav files • Digital AF/IF (WAV 8, 16, 32 Bit and TCI cap format)
Input TCP/IP Streaming	<ul style="list-style-type: none"> • Generic PROCITEC / PLATH format • VITA 49 • PXGF
Option *: AMT Automatic Monitoring and Tasking	<ul style="list-style-type: none"> • Full automatic task based monitoring (decoding, recording, classification) • Continuous classification • Missions and Tasks based on time, frequencies (ranges), RX location, modulation, modulation parameters, modems, ... • Powerful filtering functions • Easy overview over decoded, classified or recorded signals • ResultViewer with continuous updates
Option *: NRC Narrowband Receiver Control	<ul style="list-style-type: none"> • Frequency independent production on all 1 / 2 / 4 or 8 production channels • Monitor signals in different frequency ranges • Narrowband receivers offer a better sensitivity compared to wideband receivers • Narrowband receivers consume less resources, as no DDC is required • Possibility to add „virtual“ receivers using ExtIO, which can connect to third party DDCs or streams
Option *: WCL Wideband Input, Classification 10 or 20 MHz	<ul style="list-style-type: none"> • Continuous classifier emission tracking (only if AMT option available) • Wideband spectrogram display (HF/V/U/SHF): 1 / 10 MHz or 2.4 / 20 MHz • Wideband classification (HF/V/U/SHF): 1 / 10 MHz or 2.4 / 20 MHz • Delivered as a complete package with server and receiver

FEATURES

Software Feature	Remarks
Option*: WMPC Wideband Multi Production Channels 16 or 32	<ul style="list-style-type: none"> • Extends the number of channels in steps to 16, 32 or more (in steps of 32) • Each channel supports DDC, demodulation, decoding, narrowband classifier and narrowband recording functionality • Easy overview over decoded, classified or recorded signals
Option* : WBR Wideband Recording 10 or 20 MHz	<ul style="list-style-type: none"> • Lossless recording of up to 10 or 20 MHz digital IF IQ data in standard WAV files • Parallel storage of spectrum data for fast preview • Recording replay and signal extraction • Recording scheduler (with option AMT) • Delivered as a complete package with server and receiver
Option*: Hopper Detection	Recognition and recording of hopper signals in 20 MHz (option WCL-20, WBR-20 and AMT are required) input bandwidth V/UHF (2.4 MHz HF) frequency range
Option*: SCL Narrowband Classifier	<ul style="list-style-type: none"> • Automatic narrowband classifier channels C++ library. Each narrowband classifier channel (number set with license) classifies a signal in a recording; the processing is performed „faster than real-time“ • Useful for backend integration, go2MONITOR software is not needed
Output	<ul style="list-style-type: none"> • Visual decoder result output, configurable using XSLT • All results are continuously saved in files and SQL data base • Protocol detection and production down to the content (text, audio, binaries) • Various export functions
Metadata extraction	Automatic decoder output post processing with metadata extraction (sender ID, recipient ID, position, ...)
Recording	<ul style="list-style-type: none"> • Wideband (1/ 5 MHz up to 20 MHz with option WCL and WBR) • Narrowband up to 4 MHz for each DDC IQ channel • Bitstream (demodulated bits)
ResultViewer	<ul style="list-style-type: none"> • Display, filter and export result data • Display of: <ul style="list-style-type: none"> - Decoder output, demodulated audio files (CW, TETRA etc.), text output (ALE, HF DL, etc.), binary files - Audio demodulation and playback - Recognized modems (protocols) - Wide- / Narrowband classification results - Recorded wide- / narrowband IF-signals, Advanced filter, Result detail and Time / frequency filter are implemented as docking / floating windows and can be freely positioned - Table and graphical (time-frequency plane) result display - Filter data using GUI, SQL or scripting
Third party decoder	<ul style="list-style-type: none"> • Interface to the DDC channel output • Interface to the audio output
Training	<ul style="list-style-type: none"> • Very short training period • Same technology as in large decoding systems

* The products are configurable. The software delivered will be configured as stated in the order confirmation.

TECHNICAL SPECIFICATIONS

MODULATION TYPE CLASSIFIER*

Modulation	Spec. general	Spec. HF	Spec. V/UHF	Recognition quality (Eb/No) for a detection rate > 90% and false alarms < 1%
Max. signal bandwidth		50 kHz	50 - 300 kHz (depending on modulation type)	
Signal energy detection min. SNR		6 dB	6 dB	
Analogue modulation types		<ul style="list-style-type: none"> • USB J3E • LSB J3E • AM A3E • DSB-SC (optional) 	<ul style="list-style-type: none"> • USB J3E • LSB J3E • AM A3E • NFM F3E (Radio frequency ≥ 25 MHz) • DSB-SC (optional) 	
ASK 2/4			1.2 - 25 kBd Radio frequency: ≥ 300 MHz	20 dB
FSK 2	$m = 1 - 10$	25 - 4800 Bd	1.2 - 25 kBd	11 - 15 dB
FSK 2	$m = 0.75 - 1.5$		25 - 75 kBd	≥ 25 dB
FSK 4	(shift > sr)	25 - 4800 Bd	1.2 - 25 kBd	14 - 16 dB
GMSK	$m = 0.5$	300 - 4800 Bd	1.2 - 125 kBd	14 - 16 dB
MCFSK2	$m \geq 1$; 2 - 64 channels	40 - 250 Bd 120 - 1000 Hz channel spacing (min. 2x shift)	40 - 250 Bd 120 - 1000 Hz channel spacing (min. 2x shift)	17 dB
MORSE		30 - 250 CPM	30 - 250 CPM	
MSK	$m = 0.5$	100 - 4800 Bd	1.2 - 125 kBd	14 - 16 dB
Multitone FSKn	5 - 64 tones (shift > sr)	3 - 200 ms (5 - 330 Bd)	3 - 200 ms (5 - 330 Bd)	14 - 16 dB
OFDM	Tg/Tu: 0.125 - 1 25 - 512 channels	<ul style="list-style-type: none"> • 25 - 200 Bd • 30 - 250 Hz channel spacing 	<ul style="list-style-type: none"> • 25 - 200 Bd • 30 - 250 Hz channel spacing 	14 - 18 dB
OTH Radar		Detection only		FM-CW variants only
Multichannel (D)PSK 2, 4 A/B	max. 10 kHz signal bandwidth; 2 - 64 channels	<ul style="list-style-type: none"> • 31.25 - 250 Bd • 50 - 300 Hz channel spacing 	<ul style="list-style-type: none"> • 31.25 - 250 Bd • 50 - 300 Hz channel spacing 	13 - 15 dB
(D)PSK 2 A/B		31.25 - 4800 Bd	1.2 - 125 kBd	7 - 10 dB, A/B Decision: 8 - 15 dB
(D)PSK 4 A/B		31.25 - 4800 Bd	1.2 - 125 kBd	8 - 12 dB, A/B Decision: 10 - 15 dB

*Measuring interval 4 sec with correctly segmented signal. Shift is defined as frequency difference between neighbouring tones.

MODULATION TYPE CLASSIFIER*

Modulation	Spec. general	Spec. HF	Spec. V/UHF	Recognition quality (Eb/No) for a detection rate > 90% and false alarms < 1%
(D)PSK 8 A/B		31.25 - 4800 Bd	1.2 - 125 kBd	<ul style="list-style-type: none"> • HF: 8 - 12 dB, A/B Decision: 10 - 15 dB • V/UHF: 10 - 14 dB, A/B Decision: 12 - 15 dB
OQPSK			<ul style="list-style-type: none"> • Within Freq. Ranges 1545-1551 MHz and 3600-3629 MHz • 2400 Bd – 500 kBd 	15 dB
PSK 16		300 - 4800 Bd	1.2 - 125 kBd	14 - 16 dB
QAM	Order: 16, 32, 64 Rectangular constellations only	1600 - 4800Bd	1.6 - 25 kBd	22 dB
WFM (FM Broadcast only)			Radio frequency: 65 MHz - 108 MHz Bandwidth 50 kHz - 300 kHz	

*Measuring interval 4 sec with correctly segmented signal. Shift is defined as frequency difference between neighbouring tones.

MODEM CLASSIFIER

HF/VUHF	PMR	MIL
ACARS-VHF	APCO-25	ALE 3G
CODAN 3212 16 Channel PSK	APCO-25 Phase 2 Downlink	ALE 4G
CODAN 3012 16 Channel PSK	DECT	CHN 4+4
DAB	DMR	CHN hybrid
DVB-T (8 MHz Mode only)	DMR Continuous	CIS-45 (33 / 45 Bd)
HFDL	dPMR	CIS-60
PACTOR (I, II, II FEC, III, 4)	D-STAR	CIS-93
	GSM (<3G), UMTS, LTE	CIS-112
	Inmarsat Satphone Uplink	CIS-128
	Iridium Satphone Uplink	LINK11 (CLEW)
	MPT1327 1200Bd MSK	LINK 11 (SLEW)
	NXDN 2400 Bd, 4800 Bd	MIL-STD-188-110A Serial (single-tone) mode (a.k.a. STANAG 4539)
	TETRA Downlink	MIL-STD-188-110B/C App. C (a.k.a. STANAG 4539 HDR)
	TETRA Uplink	MIL-STD-188-110C App. D
	TETRAPOL	STANAG 4285/4481 (PSK)
	Thuraya Satphone Uplink	STANAG 4529
	Yaesu System Fusion	STANAG 4539

The parameters specified are limit values that cannot be guaranteed in all combinations. Specifications subject to change.

TECHNICAL SPECIFICATIONS

MEASURED MODULATION TYPE PARAMETERS

Parameters	Description	OFDM	CARRIER	FSK	MFSK (FSK _n)	MSK	CW	PSK	MCPSK	QAM	ASK	MCFSK	Voice	FM Broadcast	Unknown
Modulation	The type of modulation and its quality	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pitch	Pitch of the modulated voice												X		
Type	Type of voice like LSB, USB, AM, FM												X		
Symbol rate	The symbol rate in Bd	X		X	X	X		X	X	X	X	X			
Order	The number of phase shifts / levels							X	X		X				
Version	Version of PSK A or B							X	X						
CPM	Transmitted character per minute						X								
Dash Dot Ratio	The ratio between the length of dashes and dots						X								
Shift	The measured shift			X	X	X						X			
Channel spacing	The measured distance between channel in Hz	X							X			X			
Frequency	The center frequency of the signal	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bandwidth	The overall bandwidth of the signal	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SNR	The signal to noise ratio in dB	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Signal time	Time of measurement	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Number of tones				X	X										
Number of channels									X			X			

SUPPORTED RECEIVERS

Receiver	Max. Rx bandwidth*	Spectrum overview	Scan	Windows	Linux	Remark
AirSpy	8 MHz			X		Experimental support
CommsAudit CA7851	5 MHz			X	X	VITA 49
CommsAudit CA7852	20 MHz			X	X	VITA 49
Grintek GRX Lan	1 MHz			X		
IZT R3xxx series	20 MHz	X	X	X	X	Up to 3 channels + spectrum
IZT R4000 (SignalSuite)	1 MHz			X	X	1 channel only
Microtelecom PERSEUS	800 kHz			X		Limited USB 3.0 compatibility
narda® NRA-3000 RX	320 kHz			X	X	
narda® NRA-6000 RX	320 kHz			X	X	
narda® IDA 2	320 kHz			X	X	
narda® SignalShark® 3310	20 MHz			X	X	VITA 49
PLATH SIR 2110	20 MHz			X	X	LINUX recommended. External receiver control only
PLATH SIR 2115	4x20 MHz			X	X	External receiver control only
PLATH SIR 5110	12 MHz			X	X	16x768 kHz subbands External receiver control only
PLATH SIR 5115	Full HF			X	X	40x768 kHz subbands External receiver control only
R&S EB 500	2 MHz	X	X	X	X	
R&S EB 510	5 MHz	X	X	X	X	
R&S EM100/PR100	500 kHz	X	X	X	X	
R&S ESMD	15 MHz	X	X	X	X	External receiver control only
RFSPACE NetSDR	2 MHz			X	X	
RFSPACE SDR-14	190 kHz			X		
RTLSDR/Noxon USB-sticks	3.2 MHz			X		Experimental support. Continuous signal up to 2.4 MHz
SDRplay RSP1 & RSP2	6 MHz			X		Experimental support
SignalHound BB60C	27 MHz	X	X	X	X	
SignalHound SM200 A/B	20 MHz	X	X	X	X	
ThinkRF R5500-408	6.25 MHz			X	X	VITA 49
ThinkRF R5500-427	6.25 MHz			X	X	VITA 49
ThinkRF WSA5000-408	780 kHz			X	X	VITA 49
ThinkRF WSA5000-427	780 kHz			X	X	VITA 49
USRP X310	20 MHz			X	X	
WiNRADiO G31DDC	800 kHz			X		
WiNRADiO G33DDC	4 MHz	X		X		

* The bandwidth of the product is limited by its license / options and the maximum IQ streaming bandwidth of the receiver, the used computer hardware and its interfaces.

TECHNICAL SPECIFICATIONS

SUPPORTED RECEIVERS

Parameters	Max. Rx bandwidth*	Spectrum overview	Scan	Windows	Linux	Remark
WiNRADiO G35DDC	4 MHz	X		X		
WiNRADiO G39DDC	4 MHz	X		X		Up to 2 channels + spectrum
Generic VITA 49 receiver support	Max. receiver bandwidth	X		X	X	Can be configured in a wide range for different receiver types
Other generic „Winrad ExtIO“ supported receivers	Max. receiver bandwidth			X		Experimental support

* The bandwidth of the product is limited by its license / options and the maximum IQ streaming bandwidth of the receiver, the used computer hardware and its interfaces.

DEMODULATORS

AM/A3E (Voice)	F1A	MDPSK 2, 4, 8, 16 A/B	Pactor II, III, 4	QAMn 16, 32, 36, 64, 128, 144, 256
Analogue Selcal	FM/F3E (Voice)	MCFSK 2	PSK 2, 4, 8, 16 A/B	QAMn var:
ASK 2 (OOK), 4, 8	F6/F7B	Morse	PSK data aided	- APSK16_dvbs2
Chirp	FSK 2 matched	MPSK 2, 4, 8, 16 A/B	Robust Packet	- ASK2PSK2 abs/diff
Clover II	FSK 2, 4, 8 disc.	MT63	TFM3, 5	- ASK2PSK4 abs/diff
Clover 2000	FSK 2,3 auto shift	MultiModem	THROB / THROBX	- ASK2PSK8 abs/diff
Clover 2500	MSK/GMSK	MultiTone (FSKn)	Wideband HF* (MIL 110 App.D)	- ASK2PSK16 diff
Coquelet	J3E (USB, LSB) (Voice)	OFDM		- QAM 8
DPSK 2, 4, 8, 16 A/B	LINK11*	OQPSK		- QAM 16 circle/square
				- QAM 16 v17 abs/diff
				- QAM 16 v22 abs/diff
				- QAM 32 circle
				- QAM 64 circle/square
				- QAM 256 square

* only with Option Military decoder package

DECODERS

Our list of standard, military and PMR decoders is subject to continuous development. See the current list of available decoders on our website: www.procitec.de

1. MIL and PMR decoders may need an End-User-Certificate (depending on the country of the user)
2. Automatic sideband detection can be achieved via two modems set to inverse sidebands.
3. A gap between message bursts and acknowledge burst must be detectable.
4. Separation of slow selcall types cannot be guaranteed.
5. Slow multitone modems are recommended to operate with fixed nominal frequency

The performance of our software products depends on the hardware used. Technical parameters can differ under real operational conditions. The parameters specified are limit values that cannot be guaranteed in all combinations. Specifications subject to change.

TRAINING

GO2MONITOR | STANDARD OPERATOR TRAINING

Automatic Detection, Classification, Recognition, Decoding and Reporting of Communications Signals using Wideband Multichannel techniques

Our go2MONITOR Standard Operator Training Course captures the go2MONITOR host-system's complete signal flow from connected receiver or sensor to the content of the processed radio signals. We place particular emphasis on the efficient and task-orientated application of the available go2MONITOR features and resources to ensure rapid assimilation of information and successful application of the presented instructions by the Students.

COURSE CONTENT:

- ✓ Introduction to go2MONITOR operational usage
- ✓ Host Receiver or Sensor control
- ✓ Wideband spectrum analysis and classification of signals within the RF spectrum
- ✓ Narrowband multichannel signal processing (auto-processing signals, classification, demodulation, decoding)
- ✓ Display of results (temporal, spectral, merger of raw data and content output)
- ✓ Transfer from manual to automatic mode, creation of automated tasks (where applicable)
- ✓ Lectures and practical exercises

TARGET AUDIENCE:

-  Spectrum Monitoring
-  Policing Operatives
-  Communications Surveillance
-  Intelligence System Operators

ENTRY CRITERIA:

Basic understanding of the RF Spectrum and signaling techniques.

COURSE DURATION:

3 days / 24 training hours for a maximum of 8 Students.

CONTACT US

For further information please contact our sales team: [✉ sales@procitec.com](mailto:sales@procitec.com)

GO2MONITOR | IN TACTICAL OPERATIONS

Multichannel Exploitation of Communications Signals For Situational Awareness

Exploitation of communications signals using go2MONITOR to derive tactical Indications and Warnings for Situational Awareness in the land, littoral and maritime space.

COURSE CONTENT:

- ✓ go2MONITOR running on low-SWaP Laptop or Portable PCs with low display resolution
- ✓ Terminologies and Signals: Student refresh for tactical context
- ✓ Radio-communications network topologies (civil / military / paramilitary)
- ✓ Data modulation techniques HF-UHF (tactical focus)
- ✓ V/UHF Signals Of Interest (tactical focus)
- ✓ Line-Of-Sight [LOS] / point-to-point / multipoint / direct and trunked networks)
- ✓ HF Signals Of Interest (tactical focus – short-range groundwave and 'Near Vertical Incidence Skywave' ['NVIS'] propagation)
- ✓ Operational focus – automatic signals detection, classification, recognition, decoding and reporting in real-time
- ✓ Operational scenarios based upon Land, Littoral and Maritime Tactical Use-Cases

TARGET AUDIENCE:



For new and experienced Land Electronic Warfare (Land-EW) and Maritime Communications Electronic (Warfare) Support Measures (Maritime-CESM) Operators

ENTRY CRITERIA:

A basic knowledge of the RF spectrum and Tactical Operations.

COURSE DURATION:

5 days / 40 training hours for a maximum of 8 Students.

CONTACT US

For further information please contact our sales team: ✉ sales@procitec.com

GO2MONITOR | INTEGRATOR TRAINING

Efficient Systems Integration of go2MONITOR for Software Engineers

This training course focuses on the integration of go2MONITOR components into the customer's systems and applications. The course provides a comprehensive introduction to the protocols, standards and vital considerations in designing their own applications and toolsets which uses key features of the go2MONITOR components. This course is designed for Design Teams who have an interest in the complete or partial integration of go2MONITOR capabilities into their systems, and wish to improve their ability to successfully commission and maintain their overall system solutions.

COURSE CONTENT:

- ✔ functionalities of the go2MONITOR application
- ✔ information flow inside software
- ✔ remote control of the product components
- ✔ Interface Control Document (ICD)
- ✔ Input and output data formats

TARGET AUDIENCE:



C++ Developers

ENTRY CRITERIA:

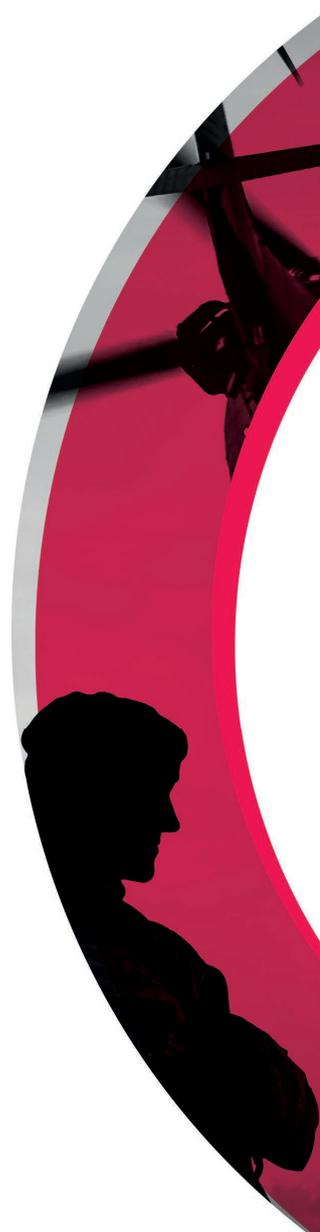
Experience in C++ (incl. Network, Threads, OOP). Examples will be coded with Microsoft Visual Studio C++.

COURSE DURATION:

2 days / 16 training hours for a maximum of 2 Students, with 10 additional hours of online-support via service@procitec.de.

CONTACT US

For further information please contact our sales team: ✉ sales@procitec.com



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Management System
ISO 9001:2015

