go2MONITOR

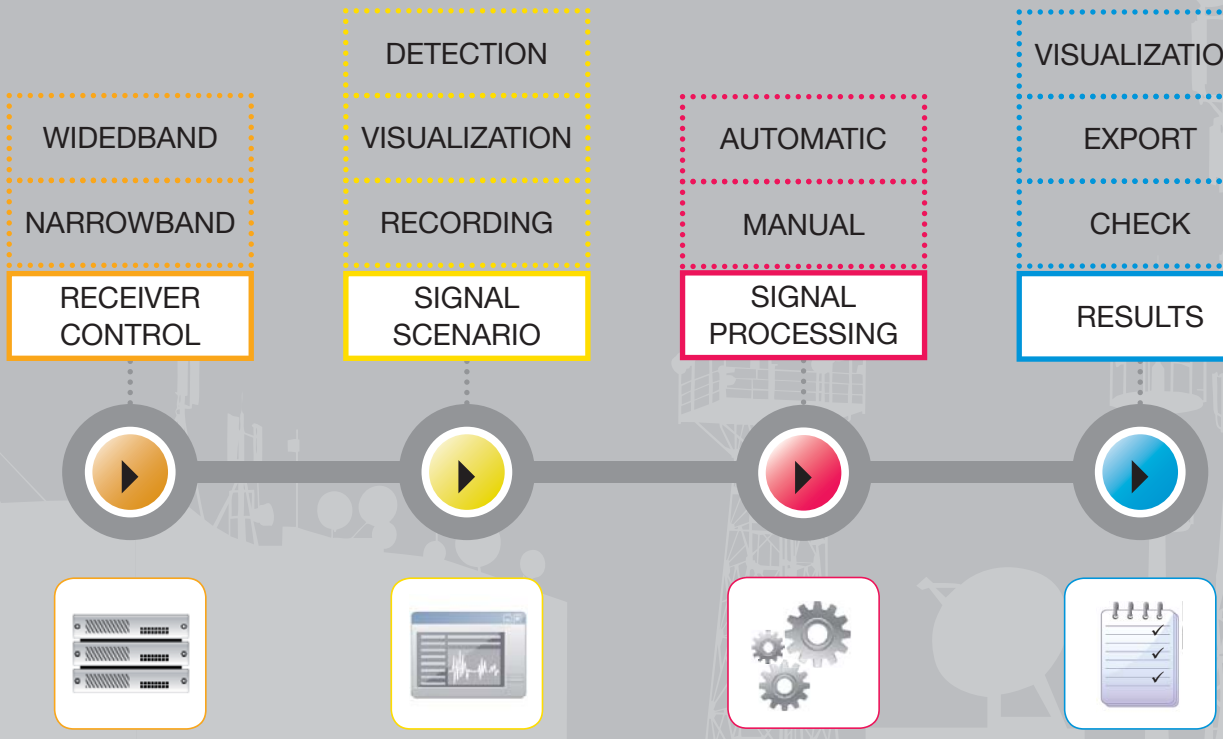
Compact Radio Signal Monitoring Solution

go2MONITOR is a high-performance, automatic radio monitoring solution for multichannel analysing and processing of HF and V/UHF signals.

Key facts

- Multiple wideband input up to 20 MHz each (spectrogram, classifier, recording, DDC)
- Modular scalability from 1-channel to hundreds of channels
- Automated classification and production using an extensive decoder library
- Integrated receiver control with direct Software Defined Radio (SDR) interface
- Parallel processing production channels either with buffered Digital Down Conversion (DDC) or narrowband receiver input
- User-configurable automatic signal search with task-based control for processing with defined depth of analysis and results
- User-expandable decoder-library via Decoder Description language (DDL)
- State-of-the-art GUI includes window presets, drag & drop, and integrated station list

WORKFLOW



go2MONITOR

Automatic radio monitoring, multichannel analysis and processing of radio signals

go2MONITOR consists of modular HF, V/UHF radio monitoring, classification, decoding and signal recording applications. They are based on a highly modular system architecture using standard COTS hardware.

- 2,4 MHz (HF) / 20 MHz (V/UHF) coherent. 6 GHz Scan mode
- Permanent classification of all signals in the input band
- Efficient job control by focusing on signal of interest
- Parallel and permanent classification and production of signals
- More than 250 modes for demodulating and decoding
- Use of standard hardware (COTS) and current receiver models
- Easy integration through open APIs
- Expandable with user-defined procedures and decoders

Automatic interception workflow

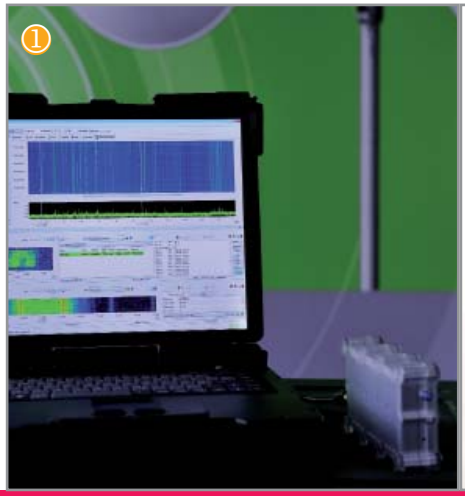
go2MONITOR has a fully automatic approach for interception, classification, demodulation, decoding and recording of radio signal emissions in a wide-band signal scenario.

In combination with monitoring receivers go2MONITOR defines a full featuring workplace.

A frequency range is intercepted and its signal scenario monitored fully automatic. Detected activities are classified and technical parameters of the signals are determined. Known signals are automatically recorded, demodulated to listen in or passed to decoding, gathered results are stored into a database.

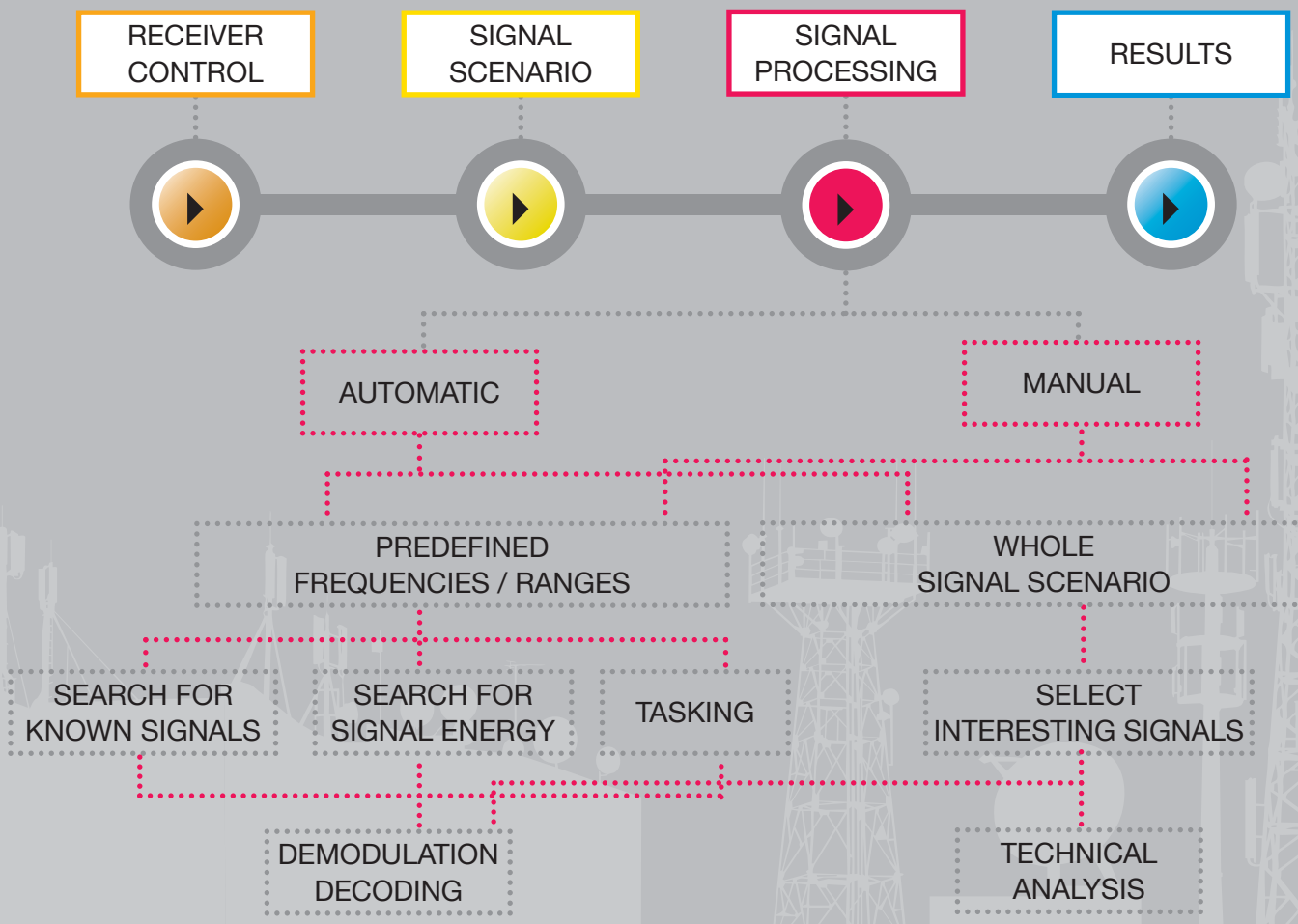
Unkown signals are recorded for more in depth manual analysis. This enables the operator to concentrate on signals of interest for his daily work. Analysing new unkown signals to expand the soft-ware with own decoders keeps it up to date with the signal scenario.

The entire functionality is also available for manual, and automatic operation: From manual signal processing and analysis of an individual signal up to fully automatic signal search, interception and processing.



MODULAR SCALABILITY

The modular and scalable design enables various different component combinations to create customised product setups perfectly suited for specific applications:
From a manually operated wideband signal workstation ① over a fully automatic working radio monitoring solution ② to a signal processing component integrated in a larger system ③.



Use Cases

Automatic search and production of known signal types

The user is able to search in predefined frequency ranges for well-known signal types. This feature includes the search for speech transmissions and for all signals matching a list of transmission methods of interest. The system will run in automatic mode, search for all signals using one of these transmission methods in the defined frequency range, extract and store these signals in a storage server. Task results like decoded text or demodulated audio signals are stored in the storage server for evaluation.

Automatic determination of frequency allocation

A main use case of automated systems is to provide an overall survey of the signal scenario without having any preknowledge about the frequency allocation. In this use case the system searchs for energy in a predefined frequency range and determines if the energy could be a signal. The detected energy is processed up to the level of information that is parameterised for this task: signal detection, specific signal parameters (e.g. SNR, bandwidth), modulation type or transmission method.

Automatic frequency monitoring with production

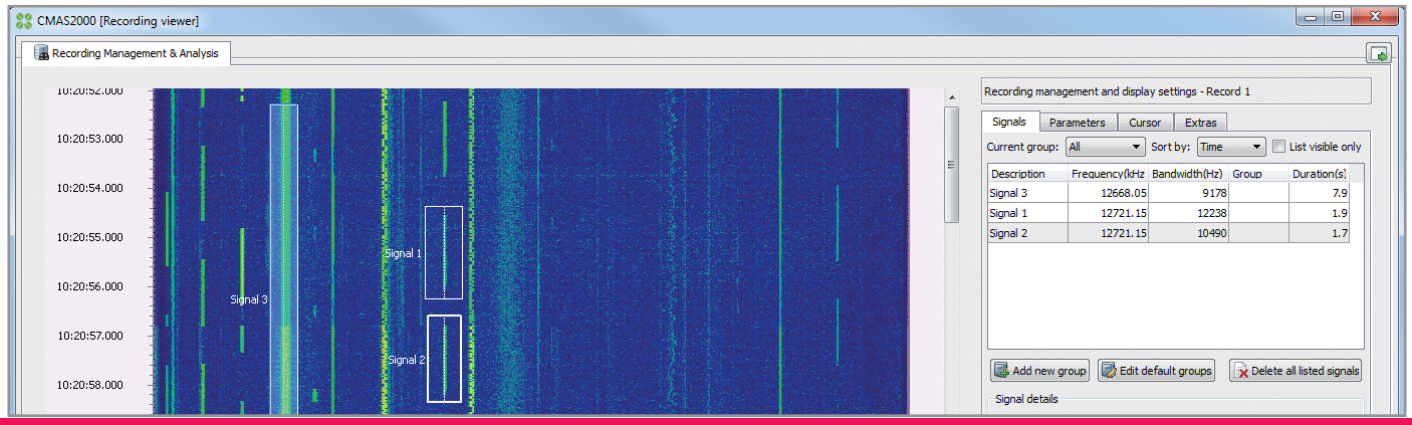
For some operations it is necessary to monitor specific frequencies. After starting a frequency monitoring task, the defined frequencies are constantly checked for signal activity. In case of activity the signal is processed without delay. If the type of the active signal matches the list of interesting transmission methods the signal is recorded, demodulated and decoded.

Manual online monitoring of frequencies

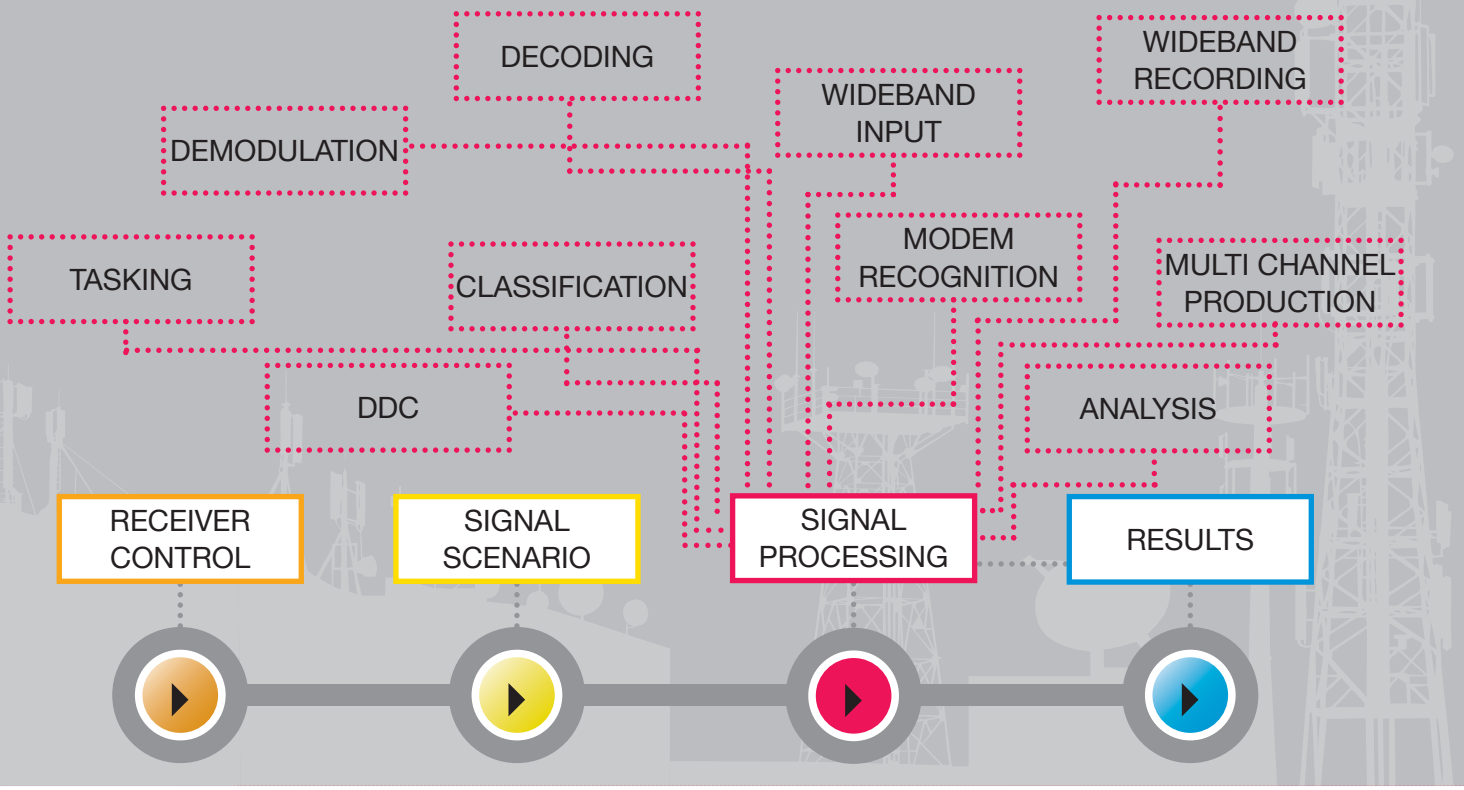
For visual real-time monitoring of the electromagnetic spectrum an online spectrogram is provided. The operator observes the current signal scenario in a spectrogram display. Zoom and cursor functionality allow for rough estimation of signals. The operator selects signals of interest directly in the online spectrogram for listening or to pass them to narrowband analysis software for technical analysis, demodulation or decoding.

Recording and offline analysis of frequency ranges

The recording of frequency ranges can be triggered by system events, is parameterised as a time based task or is started manually by an operator observing a frequency range. For evaluation the operator uses an offline spectrogram for a quick overview and navigation within the recorded signal scenario. Specific emissions can easily be selected and highlighted and a description and text annotation can be added. Selected signals can be exported to file or streamed to arbitrary external signal analysis tools.



Selecting and grouping of recorded signals for later signals export



Functions

Signal selection in wideband input

go2MONITOR displays an overview of the signal scenario utilising a spectrogram and a spectrum FFT. Various display settings, cursors and a dynamic zoom are available.

Using the wideband view the operator is able to select signals to be extracted by Digital Down Conversion (DDC) simply by selecting them in the display.

The output of the DDC is assigned to a production channel, the user interface is enhanced 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 wideband frequency range.

Narrowband channel processing

Signals of interest can be selected from the wideband spectrum to a production channel by drag and drop. All production channels can be reviewed at a time and can be configured individually.

A production channel features a detailed display of the selected signal. Spectrograms, FFT displays and the wideband view are easily configurable.

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

Operating modes of the production channel:

- Classification mode: detailed determination of frequency allocation and classification of modulation type.
- Decoding mode: the channel works as a decoder. The suitable decoder/ modem is manual selected from a decoder/ modemlist.
- Recognition and decoding mode: an assigned signal will be decoded automatically.
- Classification, recognition and decoding mode: suitable decoder/ modems will be automatically selected depending on the classification result.

Filtering of results

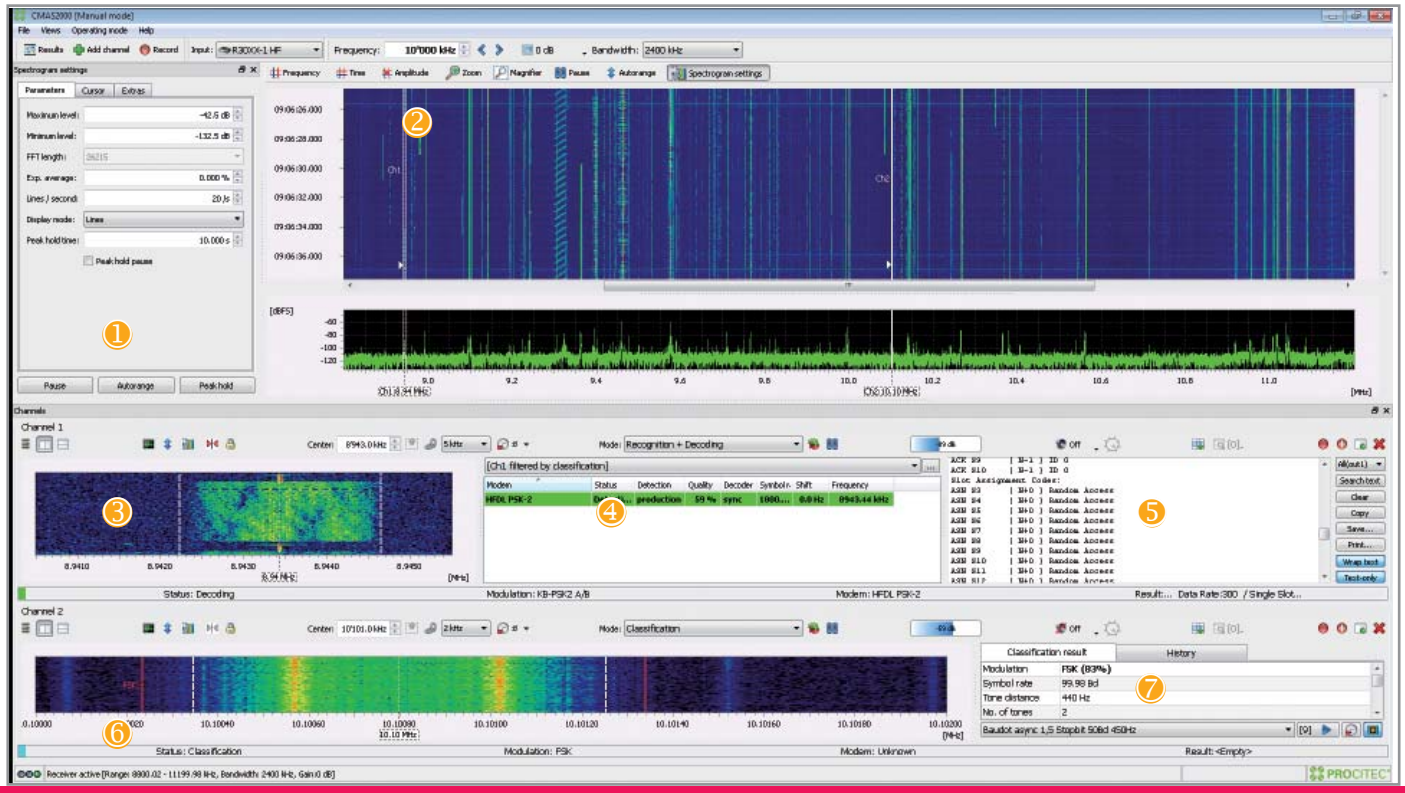
The Result View shows all collected results in detail and can be configured using the Extensible Stylesheet Language (XSLT). The results are shown as tabular or graphical representation. Results can be filtered to find the interesting signals.

Automatic recognition and decoding

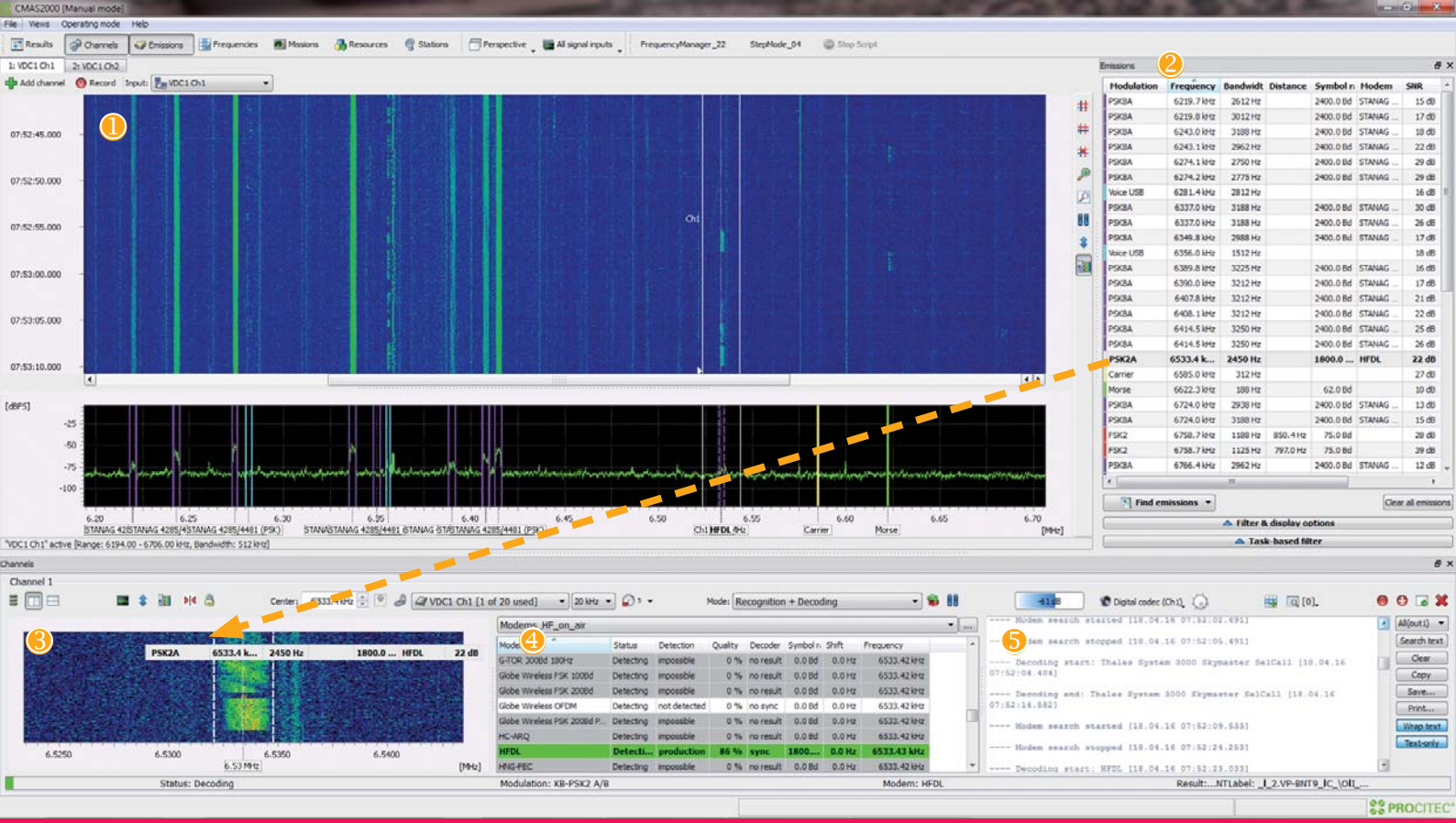
A production channel uses a configurable list of decoders/modems and checks which of them matches the signal.

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

This way the operator defines specific decoders/modems to be used according to his monitoring task. A previous classification enhances the production. go2DECODE (go2SIGNALS product for analysis recognition, demodulation and decoding) can be used for analysis and creation of customer specific decoders (using DDL programming language), which can be used directly in go2MONITOR.



① Configuration of wideband spectrogram
② Wideband signal scenario 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: found 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



① Wideband signal scenario displayed in a spectrogram and a spectrum FFT
② Emission list with classified signals
④ Select a signal in the emission list, import the signal per drag and drop to a production channel and start production of the signal
⑤ List of possible decoders/modems for automatic modem recognition
⑥ After automatic decoder/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 features the operator in manual mode with two types of classifiers and an automatic decoder/modem recognition and content decoding mode.

1. Monitoring of a wideband input band means a lot of signals to process. The Wideband Classifier function helps you by automatic detecting and classifying all signals. With the emission list the operator gets a quick and easy overview.

2. Easy select a signal in the emission list to start further signal operation. Narrowband Classification helps to track parameters in detail.

3. With the classification result, the operator gets a list of possible decoders/modems types matching to the modulation type.

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

5. The automatic decoder/modem recognition finds out the decoder of the signal and after recognition, changes into the decoding of the signal content. Internal signal buffers and processing faster than realtime take care that no bit is lost (decoding of the first bit) even during tracking of signal changes.

IMPORT OF SIGNALS PER DRAG & DROP

Signals of interest can easily be added from the emission list or directly from the spectrogram view per drag and drop to a production channel.

Automatic mode with tasking

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

The option automatic monitoring and tasking turns go2MONITOR into a fully automated signal search and processing system. To use automatic processing features, the operator creates tasks and groups them into missions. The results are stored into a database for further evaluation. An advanced result viewer 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.

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)
- Signal energy found
- Modulation type recognized
- Modulation parameters

Action = Defines the action to be executed when the signal or event defined in the trigger was detected. Possible actions are (actions could be combined):

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

Stop criteria = Defines, when the task is finishes. Stop if:

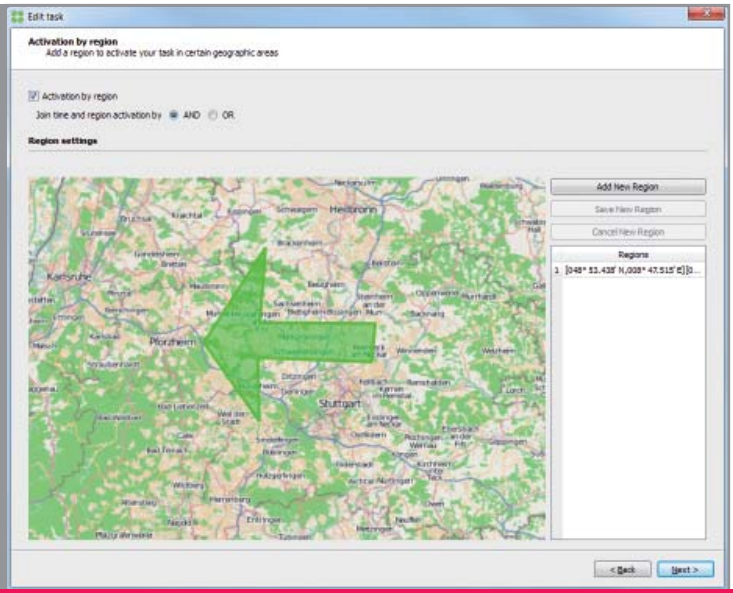
- Signal energy lost (incl. dwell time)
- Signal lost during decoding
- Maximum duration

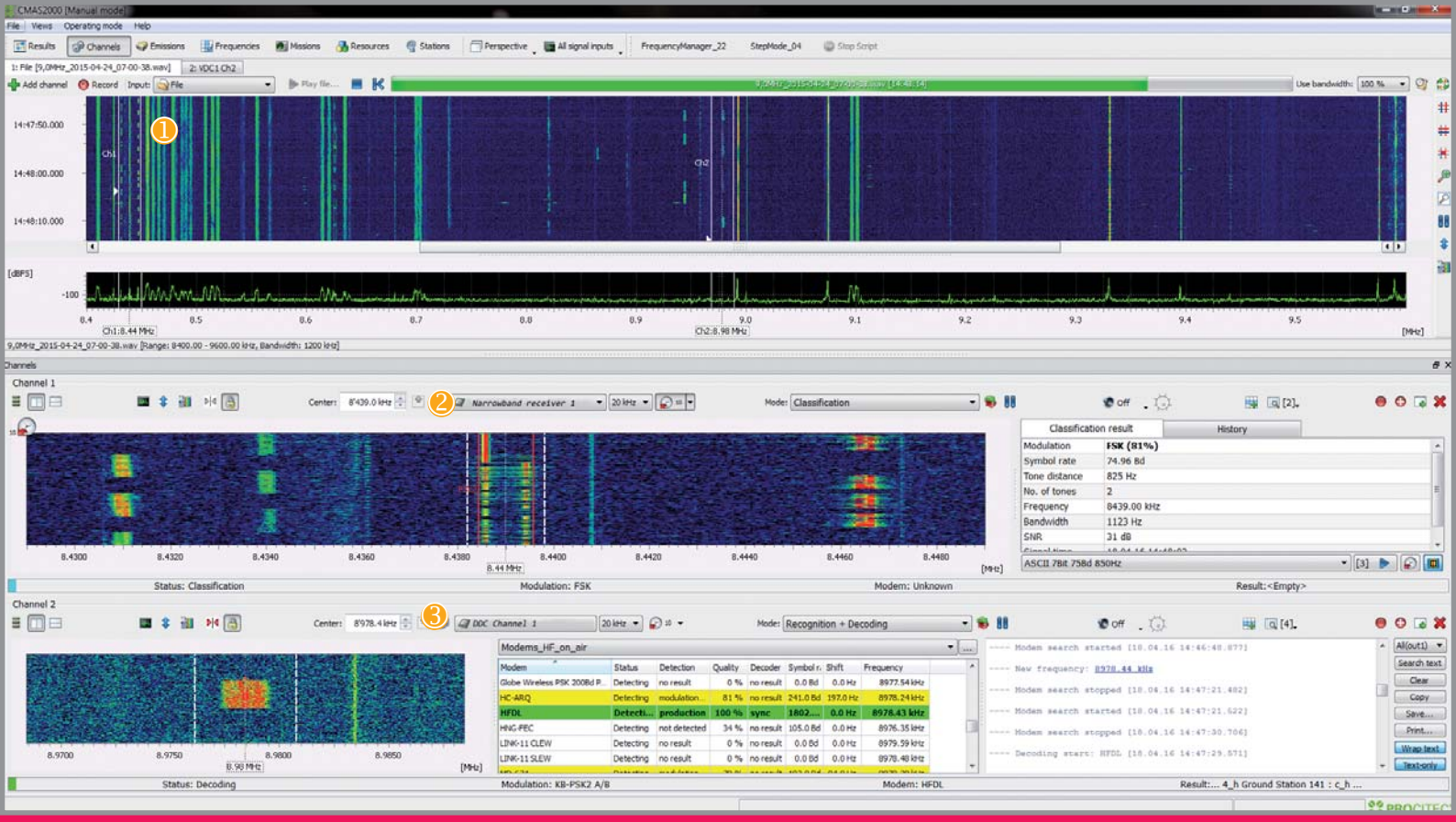
Alert actions can be defined by the operator by specifying an external application which will be started in the case of an alert. This interface makes it possible that go2MONITOR can work with other software without modification.

TASKING BY GEOGRAPHICAL POSITION

Define the geographical locations where the task should be active. They are defined as list of map-based polygons. A graphical map display is provided for the operator to define these polygons. Additionally, it can be defined whether time and position activations will be combined by using the “AND” or “OR” operator.

By double-clicking on a Region entry in the “Regions” list, position entries can be edited manually.





Seamless usage of DDC channels and narrowband receivers:

① Wideband signal scenario displayed in a spectrogram and a spectrum FFT
② Production channel 1 classifies the selcted signal using a drop off narrowband receiver
③ Production channel 2 is recognising and decoding the selcted signal using a DDC channel

Special Functions

Using drop off narrowband receivers

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

By default software DDC-channels are used as signal input for the processing channels. This limits the input band to the bandwidth of the wide-band receiver and pauses the processing during receiver scan mode.

The option “Narrowband receiver control“ allows the usage 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. The bandwith 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 inde-pendecy from the input frequency range of the wide-band receiver. Also in many cases a better receiver sensitivity is available.

Each extracted narrowband channel is 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 then in the wide-band spectrogram.

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

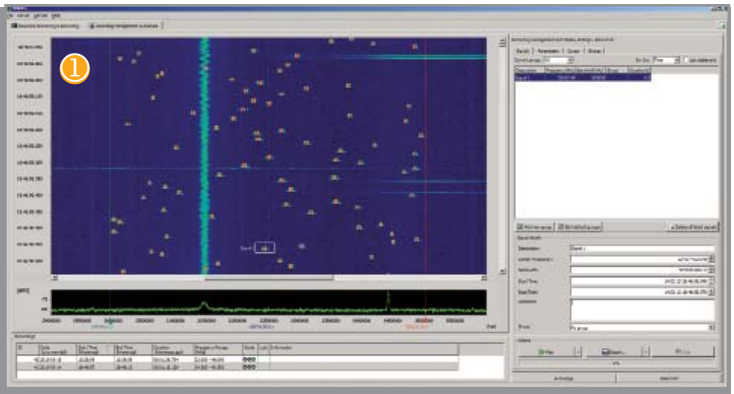
Fast navigation and signal extraction in 20 MHz recordings

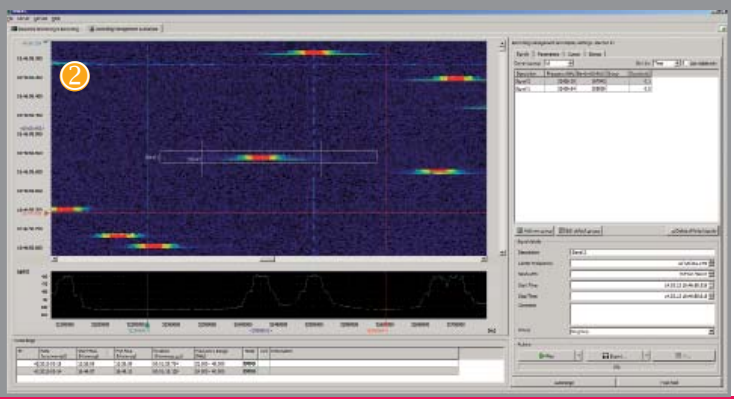
The option “Wideband recording 20 MHz“ extends the recording bandwidth up to 20 MHz. To achieve this, a separate wideband recording component is used. Additionally to recording the signal input, the wideband recording option will calculate the FFT of the input signal and stores it along with the wideband IF-signal files to enable fast spectrum display and navigation. Operation modes are sequential recording and recording scheduler.
Review and edit your recordings in the recording editor by selecting and marking signals or group of signals.
Export a single signal or a complete group of signals to a new recording file, useable as new wideband input in go2MONITOR or for further signal operation. Even manual dehopping is possible by exporting a signal group to the same frequency merged in one file.

MANUAL DEHOPPING

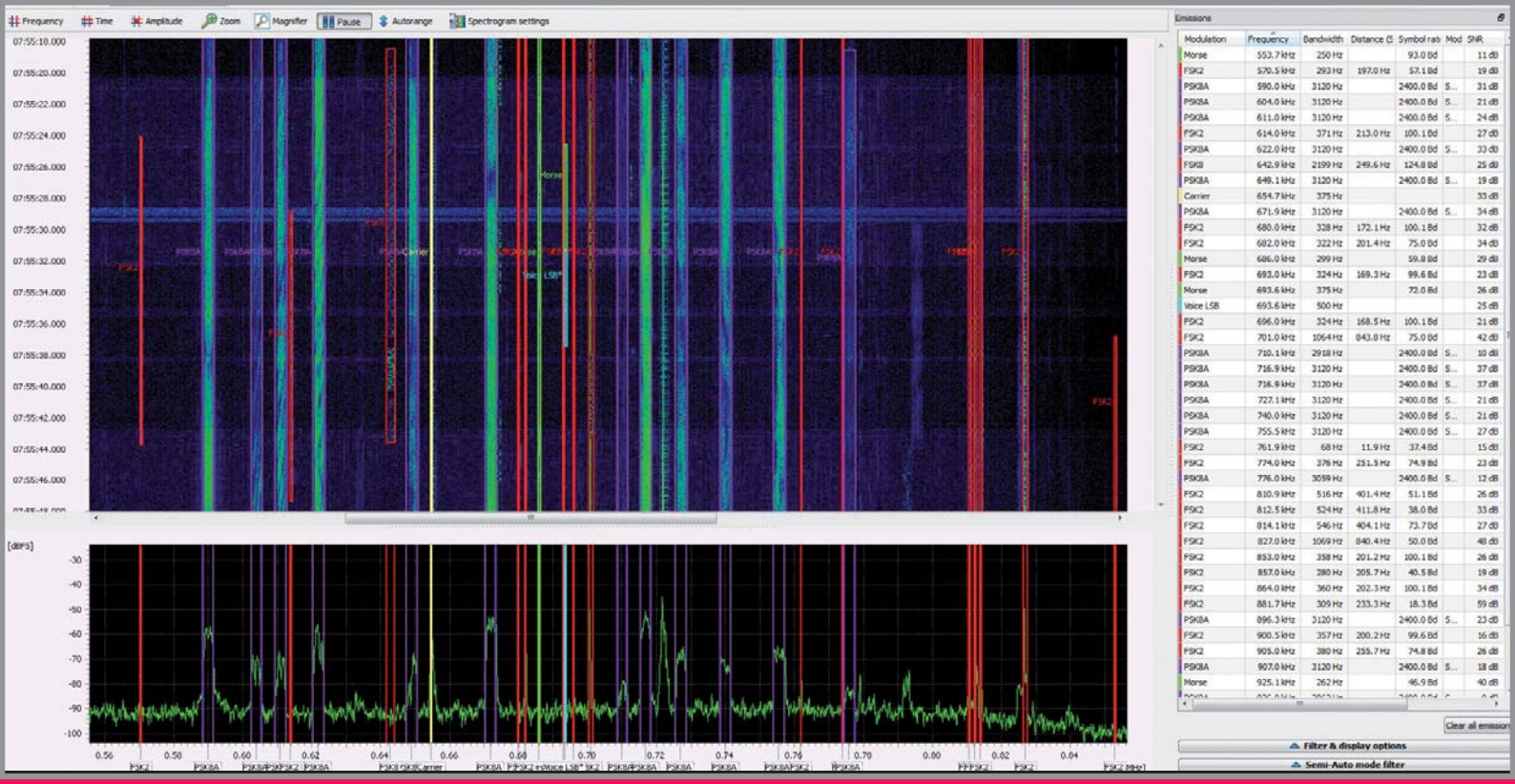
Select and mark all single hopper bursts in the go2MONITOR wideband recording, save them as .wav-files and open them as a stack in go2DECODE (go2SIGNALS product for analysis, recognition, demodulation and decoding) for further signal analysis and fingerprinting. Demodulation and decoding on the stitched/de-hopped signal is possible – whereas a content production most likely will fail, since frequency-hopped (military) communication usually is encrypted.

The following screenshots show the recording and analysis of a newest generation Harris V-/UHF hopper (captured at a hop rate of 125 Hops per second – insofar applicable even for higher hop-rates than can be found for HF hoppers).





① go2MONITOR - recorded V-/UHF Harris Hopper with a hop-rate of 125 Hops per second
② go2MONITOR - marked hopper bursts can be exported directly to the PROCEED signal analysis software for further processing



Wideband classifier

Scenario Analysis Functions

Wideband modulation classification

The feature “Wideband input 20 MHz“ extends the signal input bandwidth and the continuous, real time wideband classifier and signal tracking up to 2.4 MHz in HF or 20 MHz in V/UHF. It offers also a snapshot classification. It is possible to automatically detect, measure and determine RF parameters for all signals in the available frequency range during receiver scanning. The results are displayed in the GUI and can be used as an input for further processing.

Multichannel production

To handle wideband signal input bands, automatic processing of many signals of interest at the same time may be necessary. Therefor, 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 updated in steps of 32. The software can be increased to hundreds of channels installing the 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, to process the signals faster than realtime.

PROCESSING OF SIGNALS FASTER THAN REALTIME

The signal is recorded to a signal file first and then processed with the APC channel. Advantage of this strategy is that APC channel can process signals faster than realtime because the file is faster replayed. The advantage:

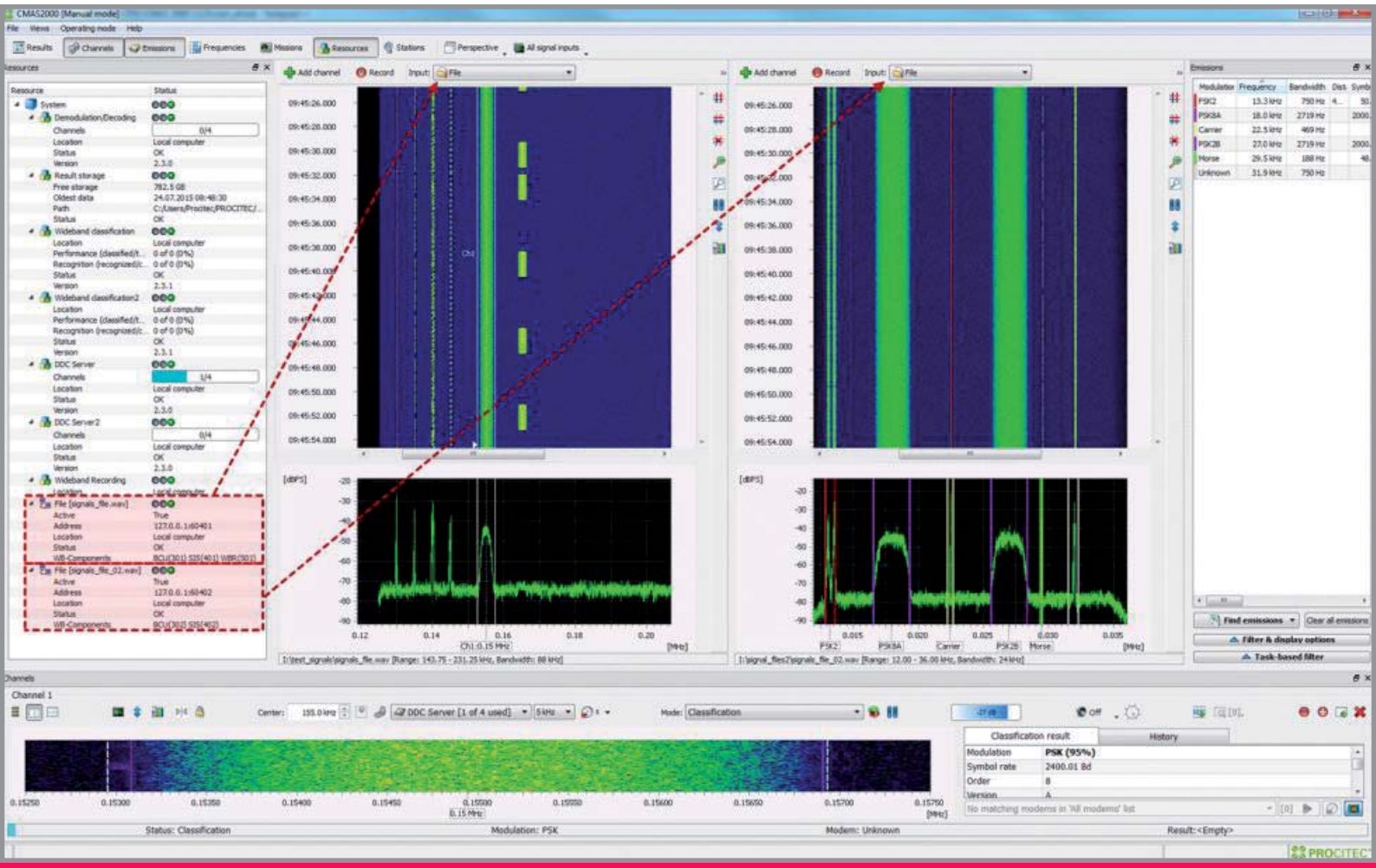
- Increase of the overall system throughput
- Automatic storage of the IF for each signal
- Reduction of the number of production channel licenses needed

Multiple wideband signal input

Control multiple broadband receivers using the same GUI

go2MONITOR provides the opportunity to control multiple broadband receivers (even ones made by different manufacturers) using one and the same user interface. The user now no longer needs to alternate between different operation applications, but can use in parallel the same user-friendly control interface for all receivers connected to the system.

The highlight: The receivers can even be used at once, which makes the simultaneous processing of different frequency bands using the same software possible.



Each signal input with its components is represented by a “WB-Components” entry in the Resource View. As displayed this entry also shows the unique system identifiers of the assigned components in active state.

Technical specifications

Decoders

Our set of standard, military and PMR decoders is subject to continuous development.
You find a current list of available decoders attached or on our website: www.go2signals.de

Demodulators

AM / A3E	Clover 2000	FSK 2, 3, 4 disc.	MPSK 2, 4, 8, 16 A/B	PSK 2, 4, 8, 16 A/B
Analogue Selcal	Clover 2500	FSK 2,3 auto shift	MT63	PSK data aided
ASK 2, 4	Coquelet	MSK / GMSK	MultiModem	QAM 16, 32, 64, 128, 256
ASK2PSK4	DPSK 2, 4, 8, 16 A/B	J3E (USB, LSB)	MultiTone (FSKn)	TFM3
ASK2PSK8	FM / F3E	MDPSK 2, 4, 8, 16 A/B	OFDM	THROB / THROBX
ASK4PSK8	F6/F7B	MFSK 2	OQPSK	
Clover II	FSK 2 matched	Morse	Pactor II, III	

Classifier

Technical parameters	**Specification**	**Recognition quality (Eb/No) for a detection rate > 90% and false alarms < 1%**
Max. signal bandwidth	HF 20 kHz, V/UHF 50 kHz	
Min. carrier to noise ratio	6 dB	
LSB/USB, AM, FM		
Carrier	unmodulated tone	
Morse	30 - 250 CPM	
FSK 2	HF: 25 - 4800 Bd V/UHF: 1200 - 25000 Bd m = 0,5 - 10	11 - 15 dB
FSK 4	HF: 25 - 4800 Bd V/UHF: 1200 - 25000 Bd	11 - 15 dB
MSK	HF: 25 - 4800 Bd V/UHF: 1200 - 25000 Bd	
Multitone (FSKn)	3 - 200 ms (5 - 330 Bd) 5 - 64 tones	11 - 15 dB
(D)PSK 2 A/B	HF: 25 - 4800 Bd V/UHF: 1200 - 25000 Bd	7 - 10 dB, A/B Decision: 8 - 10 dB
(D)PSK 4 A/B	HF: 25 - 4800 Bd V/UHF: 1200 - 25000 Bd	8 - 12 dB, A/B Decision: 10 - 12 dB
(D)PSK 8 A/B	HF: 25 - 4800 Bd V/UHF: 1200 - 25000 Bd	HF: 8 - 12 dB, A/B Decision: 10 - 14 dB V/UHF: 10 - 14 dB, A/B Decision: 12/14 dB
Multichannel (D)PSK 2, 4 A/B	max. 10kHz signal band-width 50 - 300 Hz channel spacing 2 - 64 channels	
(D)PSK 16 A	HF: 300 - 4800 Bd V/UHF: 300 - 4800 Bd	

Specifications overview

Data acquisition	Digital IF (complex baseband I/Q) , bandwidth ≤ 1 MHz, optional up to 20 MHz per wideband input
Localisation	English, German (others on request)
Documentation	PDF User manual / PDF Online-Help
Min. PC hardware	Min. Intel i7, 8 GB RAM 8 GB for 8 channel version, Screen resolution ≥ 1920 x 1080 or two displays ≥ 1280 x 1024 pixels
OS	Windows 7 / 8 64 bit English or German
Supported receivers (ask for additional receivers)	IZT R3XXX, PLATH SIR 511X, R&S EM 100, SDR 14, SDR IQ, WinRadio G31 DDC, WinRadio G33 DDC, WinRadio G39 DDC, Grintek GRX Lan, Perseus

go2MONITOR TRAINING

go2MONITOR training comprises the complete signal flow from connected receiver to content output of a radio signal. We place particular emphasis on the efficient and task oriented application of the comprehensive operating possibilities.

The aims of our training courses are therefore, in particular, rapid assimilation of information as well as clear administration and presentation of the communicated data. Training on the semi and fully automatic operation of go2MONITOR can be organised on request.

Training content:

- Introduction to operation
- Receiver control
- Scenario analysis (overview of numerous simultaneous emissions)
- Signal processing (processing a concrete signal, classification, demodulation, decoding)
- Display of results (temporal, spectral, merger of raw data and content output)
- Optional: Transfer from manual to automatic mode, creation of automated tasks
- Practical exercises

go2SIGNALS

... monitoring a connected world

go2WLAN

go2DECODE

go2MONITOR

go2ANALYSE

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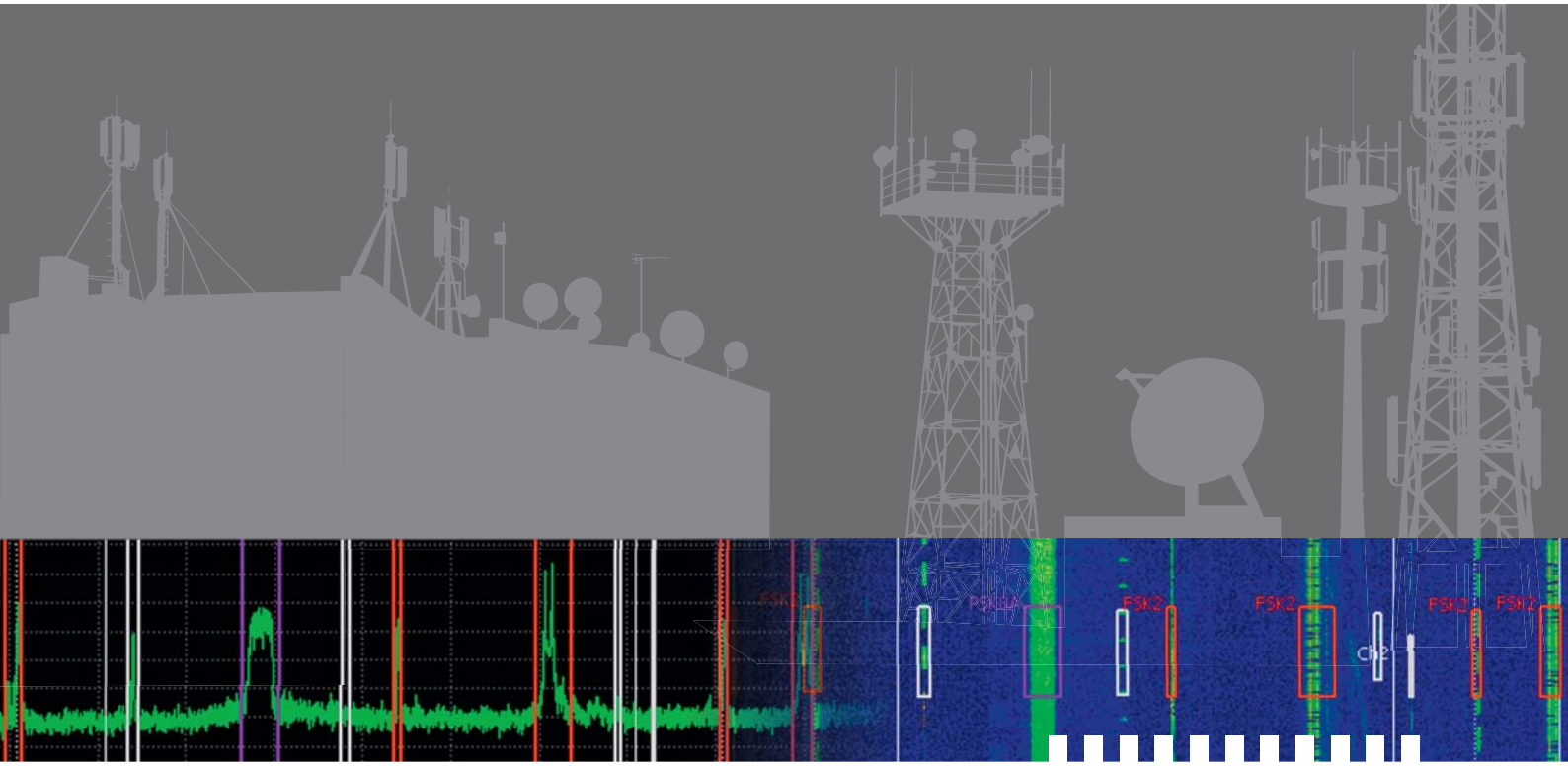

Management System
ISO 9001:2008

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