



WIR VERSTEHEN DIE ZEICHEN DER ZEIT
KEEPING PACE WITH THE SIGNAL OF TIME



ARS-8000

Automatic Reconnaissance System

Powerful reconnaissance and production system
Automatic processing of routine tasks
HF and VUHF capabilities

ARS-8000 Key Features

ARS-8000 is an **automatic reconnaissance system** providing functionality to increase efficiency and throughput in the detection, acquisition, processing and analysis of radio emissions. The system design is **modular**, **scalable** and **flexible** and allows configurations from **20 to more than 1000 processing channels**.

The pressure of work for the operators is reduced by **delegating routine processes** to the machine and giving the human operators the possibility to focus their manpower on signals of special interest.

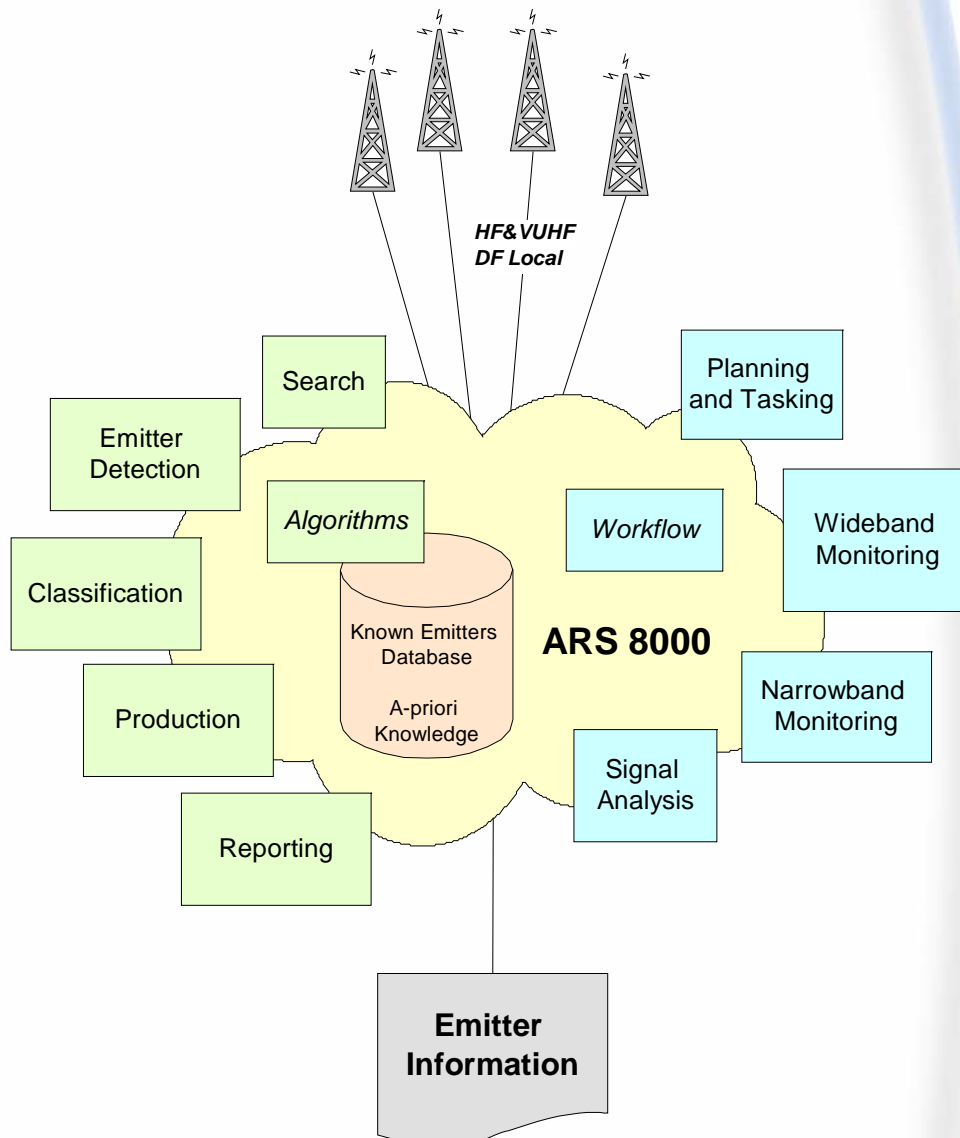
An overview of the main features is:

- Powerful
- Automatic production of 20 to thousands of channels in HF and/or VUHF
- No operator needed for the production. For analysis (depending on the setup of the system) an operator typically works on 500 channels.
- Analogue and digital transmission methods
- Automatic processing of routine tasks
- Low level reports about detected emitters
- DF Support
- Interactive operator intervention possible
- Modular and scalable system design

The ARS-8000 System

The ARS-8000 automatic reconnaissance system manages the complete information flow beginning with receiving wideband radio signals, down to detection of emitters in the wideband signal, determination of the technical parameters of the emissions, extraction of contents, direction finding or location of the emitter, and production. For known emitters, the process runs widely automatically.

The figure shows the way of information from top to down, beginning with receiving signals by the antennas down to emitter information. Automatic activities of the system are depicted on the left, on the right the activities of reconnaissance staff, organized by the workflow as implemented in the ARS-8000 system:



ARS-8000 recognizes a-priori known emitters by their transmission parameters and automatically applies previously proven successful production methods (intercept robot). Unknown emitters are classified and best suitable production methods are tried. If all automatic methods fail, the system can record a sample of the emission for later manual analysis. The results of the manual analysis can be added to a system database, so that the system is able to learn and can produce this emitter automatically as well in future.

How does ARS-8000 Generate the Automatic Results?

The system proceeds in the following steps:

- **Search** – the system receives a wideband signal, either by scanning or by using tuners with large bandwidth.
- **Detection** – the system detects emitters in the wideband signal.
- **Classification** – the system classifies the emitters and searches for a-priori knowledge about them or similar emitters in the internal database.
- **Production** – the system produces an emitter if it finds a-priori knowledge about it, or tries production with parameters of similar emitters. If production fails, the system may take a sample record for later manual analysis.
- **Report** – all activities and results are logged and summarized in emitter specific reports stored on a central server.

The steps are embedded in a system specific workflow beginning with setting up, scheduling and planning missions and tasks, followed by monitoring spectra and emitters, and ending in analysis and post processing.

How “Big” is ARS-8000?

In size, ARS-8000 is a very flexible system and can be used in very different ways: in small reconnaissance environments (for example: submarine, airplane) as well as for large land based areas (for example to protect the borders of a country by putting up reconnaissance posts along the border and interconnecting them by means of ARS-8000).

An analogy: the concept is similar to a working machine, which can be set up to produce different types of work pieces by using different types of tools. Here as well as in the ARS-8000 system, the framework and the process are given, however, the material and shape of the work pieces and tools to be used depend on the decision of the operator.

How is this Flexibility Achieved?

The flexibility is achieved by:

- The software based concept: extensive use of MEDAV Virtual Devices. Virtual Devices are software products which can easily be configured to special signal processing flows, and are scalable, e.g. in number of channels. Virtual Devices use commercial standard IT devices (PC, network) as hardware platform.
- The wide range of analysis and classification methods is available through Virtual Devices. New methods can easily be incorporated into the system without risk.
- Our wideband approach for acquisition and the software based (narrowband) processing.
- Scalability of the system in hardware and software. Higher performance can be obtained by additional hardware and/or by additional software channels. Storage capacity can easily be enhanced by using more or larger hard disks.

The following table lists the parameters of two sample systems in comparison:

Search heads:	1	5
Tuners:	1	5
Channels:	50	250
Bandwidth:	2 MHz	10 MHz
Workstation(s):	1 notebook	3 (planning, monitoring, analysis)

Inband and Outband Production

ARS-8000 supports two ways of application, depending on the advantages meeting your requirements most:

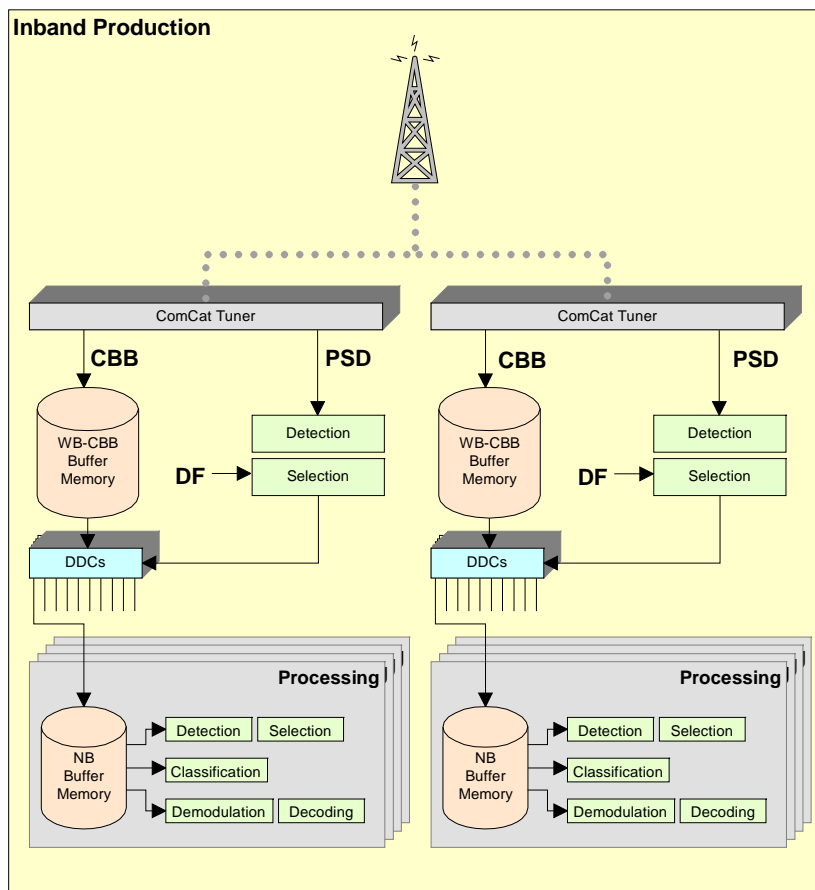
- **Inband Production:** loss-free production of a detected signal from the beginning of the signal with a larger observation interval for detection and selection and large number of narrowband channels (software based digital down converters - DDCs). The frequency range is, however, limited to online bandwidth
- **Outband Production:** huge frequency ranges can be observed by scanning. However, hand-off receivers and more complex antenna management are needed. Using outband production, the beginning of an emission may be lost, which may affect automated demodulation and decoding.

Inband Production

When inband production is used, the wideband frequency range is covered by a number of tuners each working at fix frequency storing the wideband complex base band (CBB) signal as well as power spectra density (PSD). The CBB is stored in a circular memory so that the signal history is accessible and thus the signal contents are available from the beginning, even before it was detected.

The tuner data are used to detect the emitters whose signals are then extracted from the CBB by software DDCs. The extracted narrowband signals are forwarded to further processing, e.g. classification, demodulation, decoding etc.

The figure shows as an example inband production at which the complete frequency range to observe is covered by 2 tuners. The number of DDCs and subordinate processing units is variable:

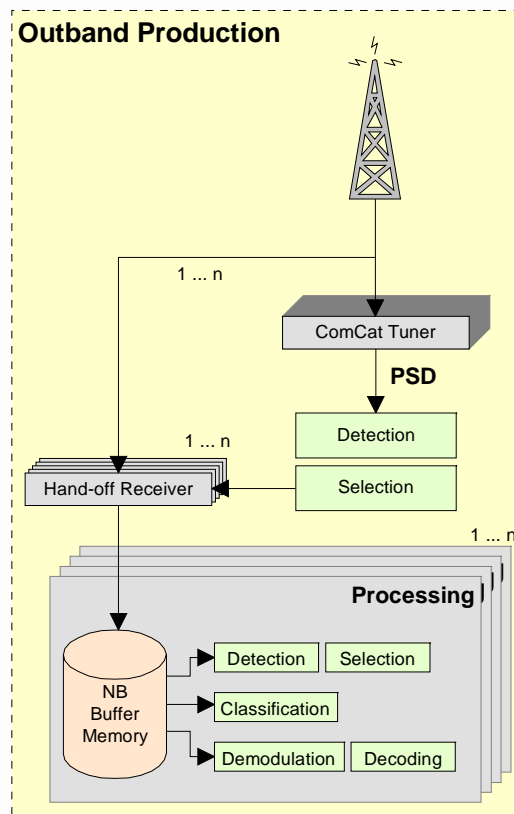


Outband Production

When outband production is used, a tuner scans the desired wideband frequency range step-by-step over time. For this reason, no wideband CBB recording is possible, signal history is not available so that a signal cannot be produced before it was detected.

The PSD information is used for detection of emitters. The emitter information is passed to hand-off receivers that pass a narrowband CBB signal to further processing, e.g. classification, demodulation, decoding etc.

The figure shows the principle:



The advantages of both inband and outband production types are:

Inband Production

Detection and observation of *numerous* emitters within the intercept bandwidth online.

Examples:

- HF
- V/UHF in narrowband FM/SSB bands

Outband Production

Detection and observation of *few* emitters within the intercept bandwidth online.

Appropriate for hand-off receivers in preset operational mode, also as an extension of inband production environments.

Suitable for scan mode.

Examples:

- complete VUHF

Search Heads in ARS-8000



Another aspect in regards of size and application is the fact that the autonomic receiving units can work remotely and without human intervention under normal operation conditions. Their number is variable.

ARS-8000 is open to use different antennas and tuners and combinations of them. An antenna, a tuner and a number of processing computers constitute a **search head** within the system generating all the information the system needs to control and manage the information flow. There is practically no limit of the number of search heads within a system, except for the computing performance, which can easily be increased by adding further computers. Frequency ranges are limited by antennas and tuners, not by the system.

The search heads can be remote stations that are connected to a central station, for example, via LAN or WAN, and can be run unmanned. They may be mobile or stationary, depending on the demands of the reconnaissance scenario that is intended to be observed. The search heads reduce and condense the information for minimum transmission and network load.

Sample Search Heads in ARS-8000

Examples of search heads as already used are:

- Example 1: The tuner is operated with fix frequency in an HF scenario, DDCs pick the desired narrowband signals for further processing, DF is optional
- Example 2: The tuner scans in an VUHF scenario, narrowband signals are passed to hand-off receivers for further processing
- Example 3: The tuner scans. Information on the emitters are passed to hand-off receivers for receiving the narrowband signals and further processing as in the example before. The results are completed by DF information.

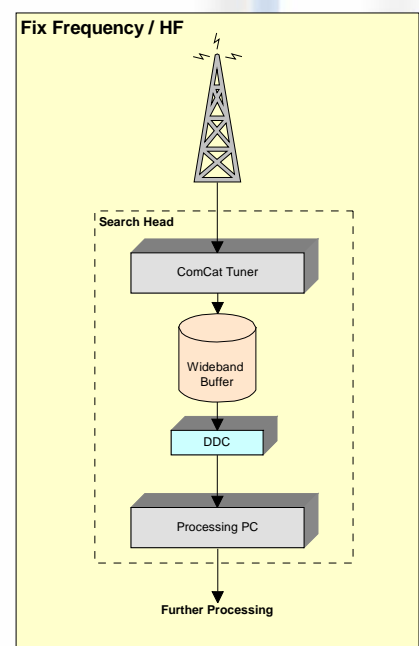
The examples are described and explained in more detail in the following paragraphs.

Example 1:

This is an example for inband production.

The tuner is set to a **fix frequency** and its largest available bandwidth. The wideband signal is stored in a memory, thus ensuring that the beginning of emissions cannot get lost. Software DDCs extract and buffer narrowband signals from the wideband memory and pass them to further processing steps. The number of DDCs is only dependent of the available processing power, which can easily be extended by adding more PCs.

This type of search head can be used in **HF** scenarios.

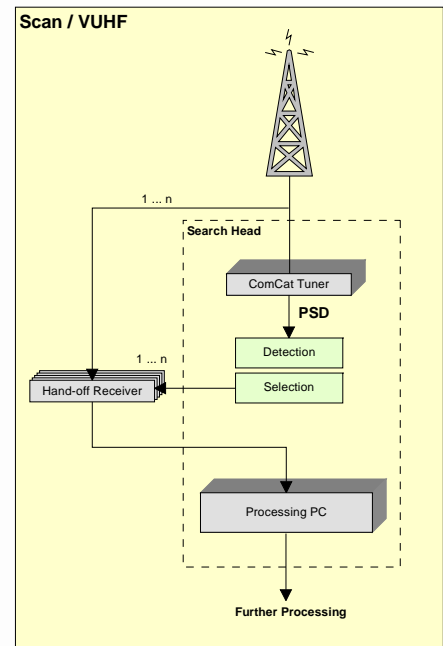


Example 2:

This is an example for outband production.

The tuner **scans**, that means: it changes its frequency stepwise over a wideband frequency range within a certain period of time. Once the desired frequency band is scanned, the wideband signal is present in a wideband memory. If the search head detects emissions, it passes the frequency segment with the emission to a separate hand-off receiver, which then continues receiving the signal and passes it to further processing steps.

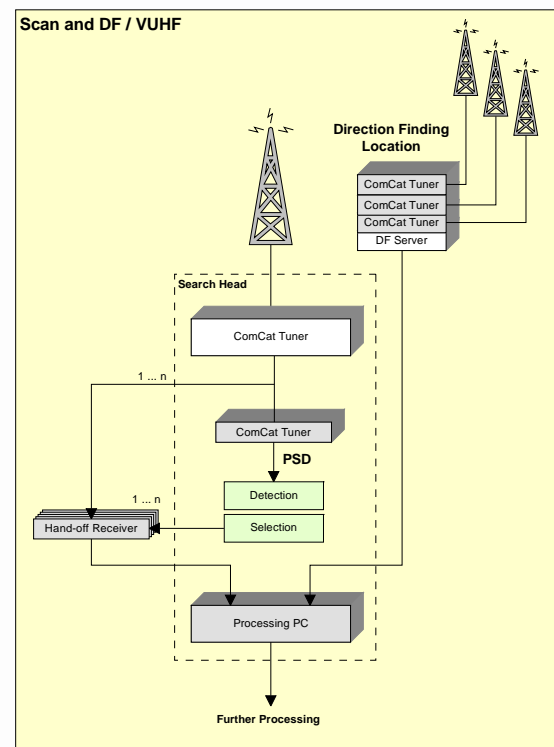
This type of search head can be used in **VUHF** scenarios.



Example 3:

A **scanning** search head can pass not only narrowband signals to hand-off receivers but also process direction finding or location information. This allows ARS-8000 to produce more robust results, enhanced about the direction or location information.

This type of search head can be used in **VUHF** scenarios where direction or location information is desired.



Note that an emission cannot be captured completely, when scanning tuners are used because the tuner changes its frequency continuously. Therefore, content analysis may not be successful. If emission content is relevant, consider operating tuners on fix frequencies or hand-off receivers.

Other technologies are possible, as well as a combination of different types of search heads.

As can be seen by the examples, there are nearly no limits in usage of different receiving technologies, frequency ranges etc. The search head receives a wideband signal and extract narrowband signals from it. Information and signal management is then done by the ARS-8000 system.

Direction Finding and Location

Along with the information about the direction or position of the emitters, DF and localization information is useful to make the results of the ARS-8000 system more robust and reliable.

Independently of the type of production or search head, the ARS-8000 can process direction finding (DF) and location information. Systems gathering this information are considered to be external parts, which can be easily connected to an ARS-8000 system by specific interfaces. The DF or location system can be, for example, an existing system. However, MEDAV provides DF and localization systems as well, so do not hesitate to ask for more details.

Direction and location finding can be controlled per mission or over the knowledge data base if system resources are needed for activities of higher priority. A special database controls location finding of emitters by comparison their characteristics with prior-knowledge.

Which Signals can the System Detect, Demodulate and Decode?

It is also in the responsibility of the system operator to decide, which transmission methods of radio emissions the system can classify and produce. The decoders and demodulators are optional, modular, separate units (Virtual Devices), and can be ordered according to the requirements or desires of the operator.

The supported transmission methods are permanently updated and extended. A programming interface is provided to allow users to add own demodulators and decoders, and external systems can be connected to ARS-8000 for special applications or specific transmission methods.

Following these concepts, also new or own demodulators can be integrated into the system easily.

What is the Focus of the System?

A primary goal of the system is to make the work of the reconnaissance more effective by:

- Filtering relevant from irrelevant information
- Production of known emitters
- Concentration on unknown emitters

The reduction of obsolete information is the key to efficient work of reconnaissance workers. Therefore, the system is designed to exclude irrelevant information by excluding frequency ranges and directions from observation as well as excluding emitters with certain parameters from being processed (negative list). Furthermore, ARS-8000 conducts most of recurring reconnaissance work on its own, such as producing known emitters with special, a-priori known production parameters (positive list).

This optimizes not only the system performance but also the efficiency of the operator, who now can better care about relevant production results and unknown emitters.

The system is dedicated to detect and produce emissions of longer durations automatically. For detection and analysis of short term emissions ask MEDAV for more appropriate tools.

How is the Workflow Organized?

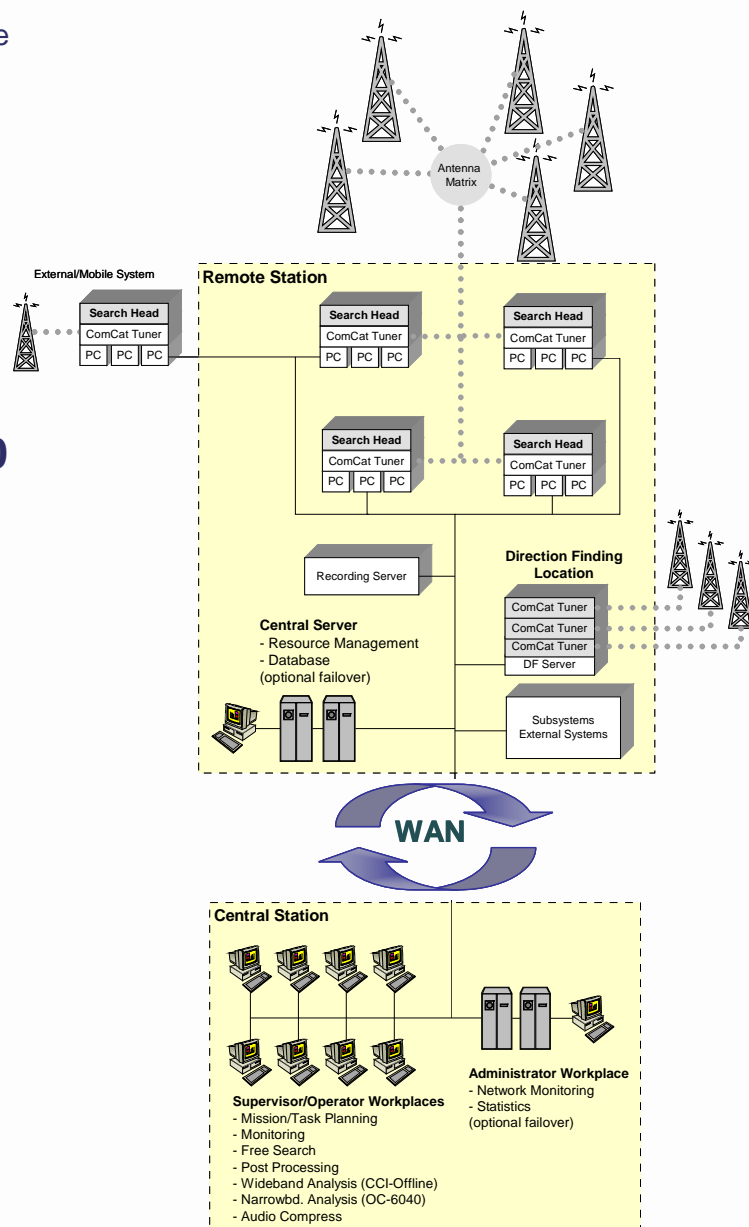
Participants in the process are: supervisors, monitoring operators, analyzing operators, and system administrators. After login, they are provided with the specific functions for their jobs:

- **Supervisors** – schedule reconnaissance missions and tasks.
- **Monitoring operators** – observe the system and intervene if they discover unknown emitters, listen-in to emitters under production, or try to analyse narrowband signals.
- **Analyzers** – post process and analyze the records of unknown emitters taken by the system, or try to improve or enhance the results automatically gathered by the system (for example by transcription of audio messages).
- **System Administrators** – ensure the system health and functionality, solve computer and network problems, and take care for backups and updates.

The scope of functionalities widely depends on the system configuration, as it is composed and ordered by the operators. Additional roles can be added; the system provides interfaces to other, existing systems and subsystems and can be adapted to specific reconnaissance scenarios.

The manpower needed depends on the size of the system. Typically 1 operator can monitor 100 to 150 channels.

Programming skills are not required to operate the system.



Sample Structure of ARS-8000

The figure shows a sample configuration of the system and its components in an overview:

The next section lists the components and their functions.

Components of an ARS-8000 System

The figure in the previous section shows a sample configuration of the system and its components in an overview. This section explains the components and their function.

Remote Station Central Station

The sample system provides a remote and a central station, however this is not mandatory, there can also be more than one remote station. Else, the function of the components of both stations can be present in the one station.

The receiving equipment can be summarized and located in a remote station, which should be close to the antennas but can be far away from the central station, connected via WAN or other transmission technologies, and which can be operated without human intervention.

Search Head

Search heads consist of antenna, tuner and one or more processing PCs.

- The **ComCat tuner** receives and digitises the radio wide-band signal. The technical parameters of the antennas are the limitation to the system in regards of frequency ranges and sensitivity. MEDAV offers search heads for different purposes but feel free to use own or existing antenna equipment.
- **Processing PC:** receives the digitised signal from the tuner and processes it according to the settings specified in the missions and tasks which are assigned to it at the moment. Processing covers detection, classification, production and reporting of emitters. The result is a report of each emitter with either production results, or, if production failed, logging information and a sample record.

Depending on whether inband or outband production type is applied, the processing server may be equipped with more disk space for wideband recording, or more tuners or receivers are in use as hand-off receivers.

The search heads are connected to the central server, from which they are managed and to where they deliver results.

Direction Finding

If installed, direction (DF) and location finding can add further information to the processing results of an emitter.

Location Finding

MEDAV provides different types of DF and location: e.g. Goniometer, Watson Watt, and Interferometer.

Contact MEDAV for details.

Recording Server	Wideband records taken by the system or manually initiated by monitoring operators are stored on this special server.
Central Server	<p>Manages the search heads, as well as the missions and tasks that are assigned to them according to the schedule. Stores information about the system configuration, database and processing results.</p> <p>The server can provide failover functionality: if the server fails, the system automatically switches to a secondary server to keep the system running.</p>
Subsystems External Systems	<p>ARS-8000 provides defined interfaces to connect subsystems, for example: subordinate ARS-8000 systems or other reconnaissance systems, as they may already exist.</p> <p>Another external system may also be used for production of very special transmission methods, which can only or better be conducted by external modems or other production systems.</p> <p>Contact MEDAV for details.</p>
WAN	<p>Connects the central station and the remote station in the sample configuration. In principle, any other type of transmission can be chosen, and is usually not part of the shipment.</p> <p>The bandwidth requirements depend on the system size and the arrangement of the system components.</p>
Operator Workplaces	<p>Client workplaces where the reconnaissance staff logs on to the system and works according to the selected role as:</p> <ul style="list-style-type: none"> • Monitoring operator • Wideband operator • Supervisor • Analyser • Administrator
Administrator Workplace	Workplace for the system administrator with tools for system health control, user management, computer, service and network monitoring and management, etc.
Printers	(not depicted) Any common computer printer can be used. They are commonly used for documentation purposes.

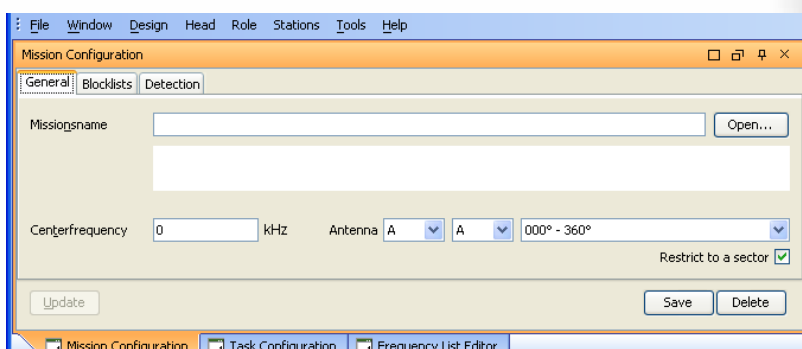
The following sections describe how the reconnaissance staff works at the workplaces.

Workplaces and Roles

The system provides different roles, which can be invoked at any operator workplace. There are roles for planning missions and tasks, different operators, analyses, and post processing.

Mission and Task Planning and Scheduling

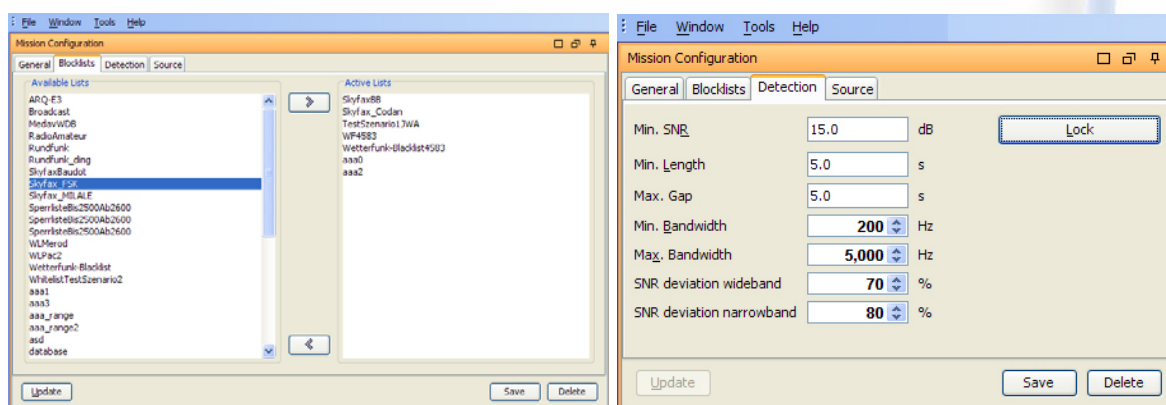
Signal acquisition is organised by missions, which are subdivided in tasks. They specify the parameters of the emissions, on which the system shall either concentrate or filter. To plan missions and tasks, an operator or supervisor logs on to the system in the planning role. Mission and task parameters are then entered into software forms:



Setting up Missions

To set up a mission, the following information is required:

- Frequency range within the search head is intended to scan
- Antenna if there is a choice of several antennas connected to the search head
- Direction of interest
- Negative lists to exclude disturbing or obsolete emitters from being processed
- Parameters controlling the detection of emissions



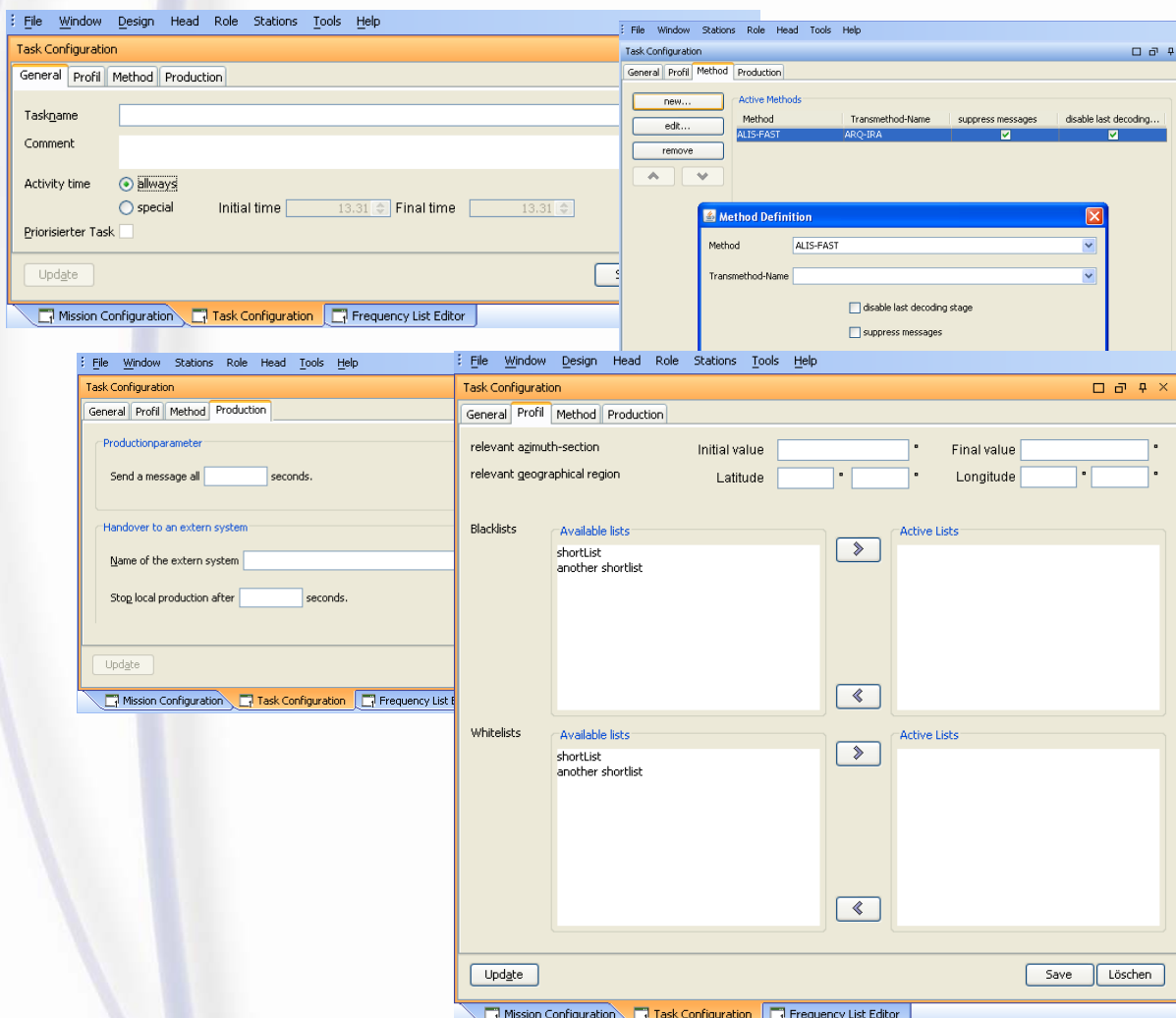
This information pre-adjusts a search head and thus pre-filters the emissions before they are passed to the processing by tasks. The more concise the parameters are set, the better it is for the system performance; however, there is a risk that relevant emitters may be ignored if they are present in excluded ranges.

Setting up Tasks

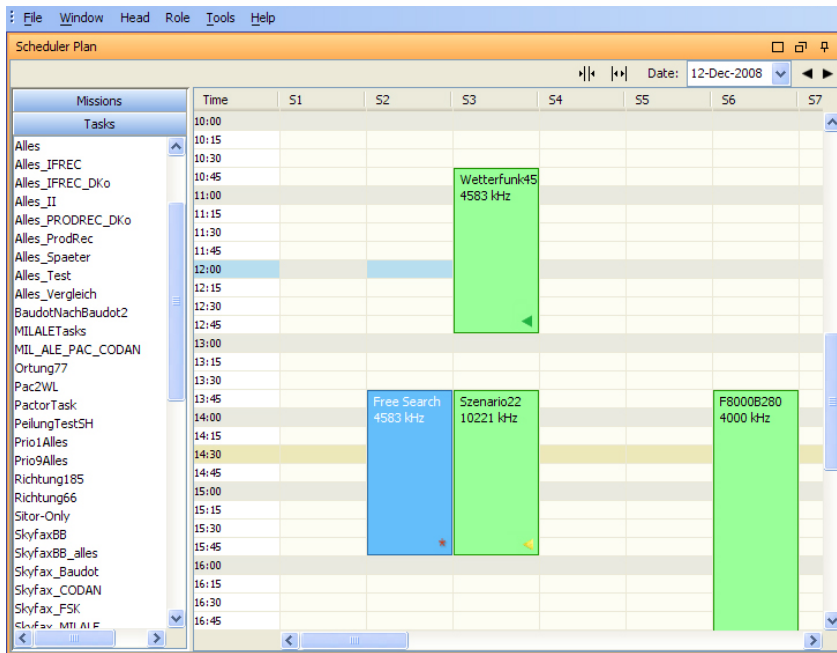
The task specifies how the system proceeds with a detected emitter during a mission run. The parameters of the emitter are entered at which they are to be identified. Then positive- and negative-lists are selected, controlling whether or not the emitter is further processed. If so, another panel allows specifying the parameters for production of the emitter.

To set up a task, the following information is required:

- Direction and area of interest
- Observation time
- Positive and negative lists
- Parameters with which the emission is recognized and the task is triggered (e. g. frequencies, ranges, baud rates, geo data, transmission methods, etc.)
- Parameters with which the emission is to be produced



Scheduling Missions and Tasks



When the parameters of missions and tasks are specified, they can be manually scheduled and thus be directed to search heads where they are executed. Later on, the monitoring operators will select a search head that he observes. However, the search head can also run and produce if no operator observes it.

The scheduler is a time table, into which the supervisor can comfortably drag and drop the missions and tasks.

Once missions and tasks are scheduled, they can be activated and will start when the time has come.

The central server manages the missions and tasks. The mission sets tuner and antenna to the specified parameters and starts scanning to receive the wideband signal, within which the emissions are detected and classified. If a task is waiting for an emission, it will process it according to the task parameter settings.

Using the *Set-task* option, narrowband channels can be set for a certain time on a specific frequency and processing method. The processing of these channels is guaranteed as long as the number of set tasks does not exceed the number of channels in the search head. If defined in the task, direction finding and recording can be performed.

The following time-scheduled functionalities for set-tasks are available:

- Periodic direction finding/location
- Periodic writing of messages
- Recording of the signal

Set-tasks are planned in the same manner as a normal task via calendar planning. The scheduler controls set-tasks on the search head.

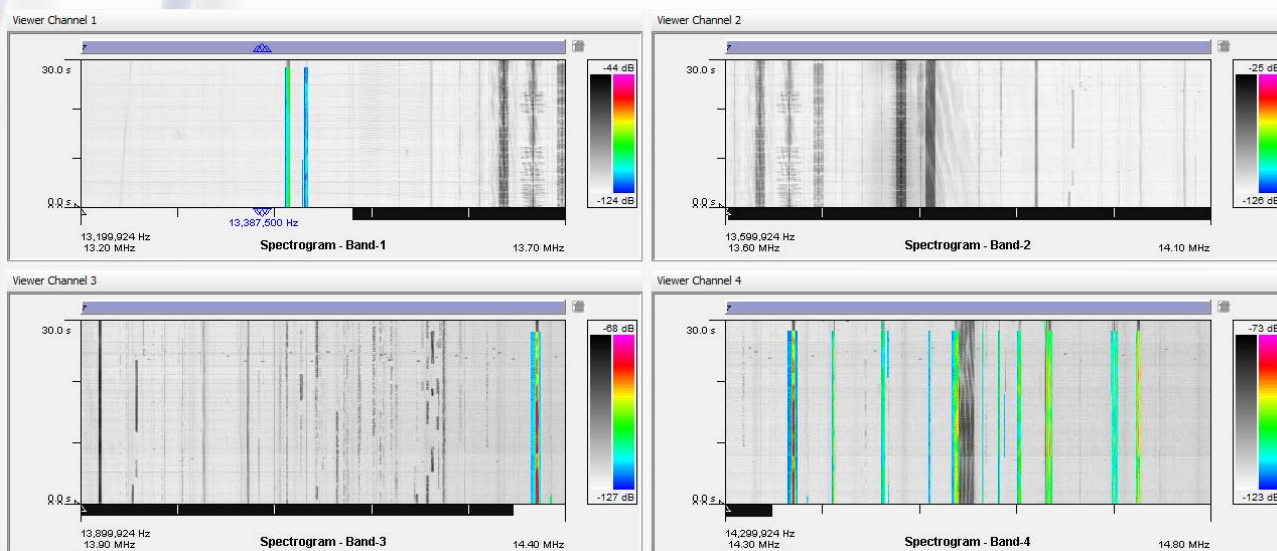
Monitoring

Monitoring operators observe the system run and look after abnormalities and emissions of special interest. Monitoring operators can watch wideband spectra and a narrowband signal in parallel.

Wideband Monitoring

Monitoring means that the system is **automatically operating** (missions/tasks are active) while operators watch the received wideband spectra in panorama and waterfall displays of the selected search head. The operators observe the parameters of detected emissions (for example frequency, bandwidth, duration, direction, or location) either on the fly, or later on recorded signals.

The graphical displays give an overview of the wideband signal that is subdivided into 4 channels by DDCs in the tuner. Frequency areas that are excepted from processing by the task setup are indicated (black bars below the displays in the figure).



The system can either work as a robot in automatic mode or be used in free search.

- In automatic mode, the observed **wideband** frequency range and direction are determined by the mission planning, for the operators there is no way to alter these values. The display shows the complete spectrum scanned, and, indicated by colour, detected emissions.
- **Free search** allows the monitoring operator to search for emissions by hand.

When wideband signals are stored on the server, not only the signal but also specific navigation data is generated and stored on the server allowing very fast access to each part of the signal at less data transfers. This supports fluent work of the operator and saves network resources.

Activities and Channels

Each emission is assigned to a narrowband channel. The number of channels per search head is limited by computing power and can be enhanced by adding more computers to the search head.

ID	Frequency [kHz]	Bandwidth [Hz]	Average SNR [db]	TOA	Duration	Bearing	State	Info	Active	Nr	Count
49719745382241...	7,026.44	1,417	31.78	11.12.2008 10:2...	00:00:00	32°	queued		✓	1	0
49719745424846...	8,202.93	953	14.47	11.12.2008 10:2...	00:00:00	32°	queued		✓	2	0
49719745424859...	7,058.48	4,025	17.73	11.12.2008 10:2...	00:00:00	32°	queued		✓	3	0
49719745449208...	7,064.16	3,159	21.81	11.12.2008 10:2...	00:00:00	32°	queued		✓	4	0
49719745449208...	8,757.86	986	20.46	11.12.2008 10:2...	00:00:00	32°	queued		✓	5	0
49719745449233...	8,195.06	858	14.82	11.12.2008 10:2...	00:00:00	32°	queued		✓	6	0
49719745470385...	8,981.62	1,214	13.25	11.12.2008 10:2...	00:00:00	32°	queued		✓	7	0
49719745512187...	7,024.98	1,077	27.04	11.12.2008 10:2...	00:00:00	32°	queued		✓	8	0
49719745573440...	8,184.99	1,034	13.85	11.12.2008 10:2...	00:00:00	32°	queued		✓	9	0
49719745596746...	8,090.14	3,424	0.00	11.12.2008 10:2...	00:00:00	32°	queued		✓	10	0
49719745596748...	8,090.41	3,155	0.00	11.12.2008 10:2...	00:00:00	32°	queued		✓	11	0

ID: 4971974542484676084 Center Frequency: 8,202.93 kHz Bandwidth: 953 Hz
 Start Time: 11.12.2008 10:20:34 Duration: 00:00:00 [h:m:s] SNR: 14.47 dB
 Actual Bearing Results: 32° State: queued Autoscroll:

A list of the found emissions with their parameters and a channel usage indication shows the emissions the system is currently busy with, and how the status of the processing of the emissions is:

Channel	Frequency [kHz]	Bandwidth [Hz]	Update Bandwidth
00	0.00 kHz	18,601	Update Bandwidth
01	SITOR-ARQ 8,431.51 kHz		
02	0.00 kHz		
03	SD 7,019.97 kHz		
04	SD 8,418.38 kHz		
05	8,177.99 kHz		
06	7,051.08 kHz		
07	STANAG-4285-BIN 8,150.88 kHz		
08	8,421.59 kHz		
09	TM 8,138.49 kHz		
10	[STANAG-4285-BIN 5] 8,133.82 kHz		
11	7,079.15 kHz		
12	SD 7,634.70 kHz		
13	SD 8,589.16 kHz		
14	STANAG-4285-BIN 8,699.19 kHz		
15	[BALDDOT] 8,988.00 kHz		
16	FD 8,180.54 kHz		
17	STANAG-4285 8,464.67 kHz		
18	STANAG-4285-BIN 8,493.68 kHz		
19	STANAG-4285-BIN 8,158.08 kHz		
20	STANAG-4285 8,454.57 kHz		
21	8,224.99 kHz		
22	7,637.47 kHz		
23	[BALDDOT] 8,080.00 kHz		
24	STANAG-4285-BIN 8,613.87 kHz		
25	7,980.14 kHz		
26	8,591.10 kHz		
27	[STANAG-4285-BIN 5] 8,135.73 kHz		
28	[BALDDOT] 8,503.00 kHz		
29	SW 8,136.83 kHz		
30	SD 8,223.00 kHz		
31	STANAG-4285-BIN 8,619.93 kHz		
32	SD 8,590.90 kHz		
33	7,041.48 kHz		
34	8,349.00 kHz		

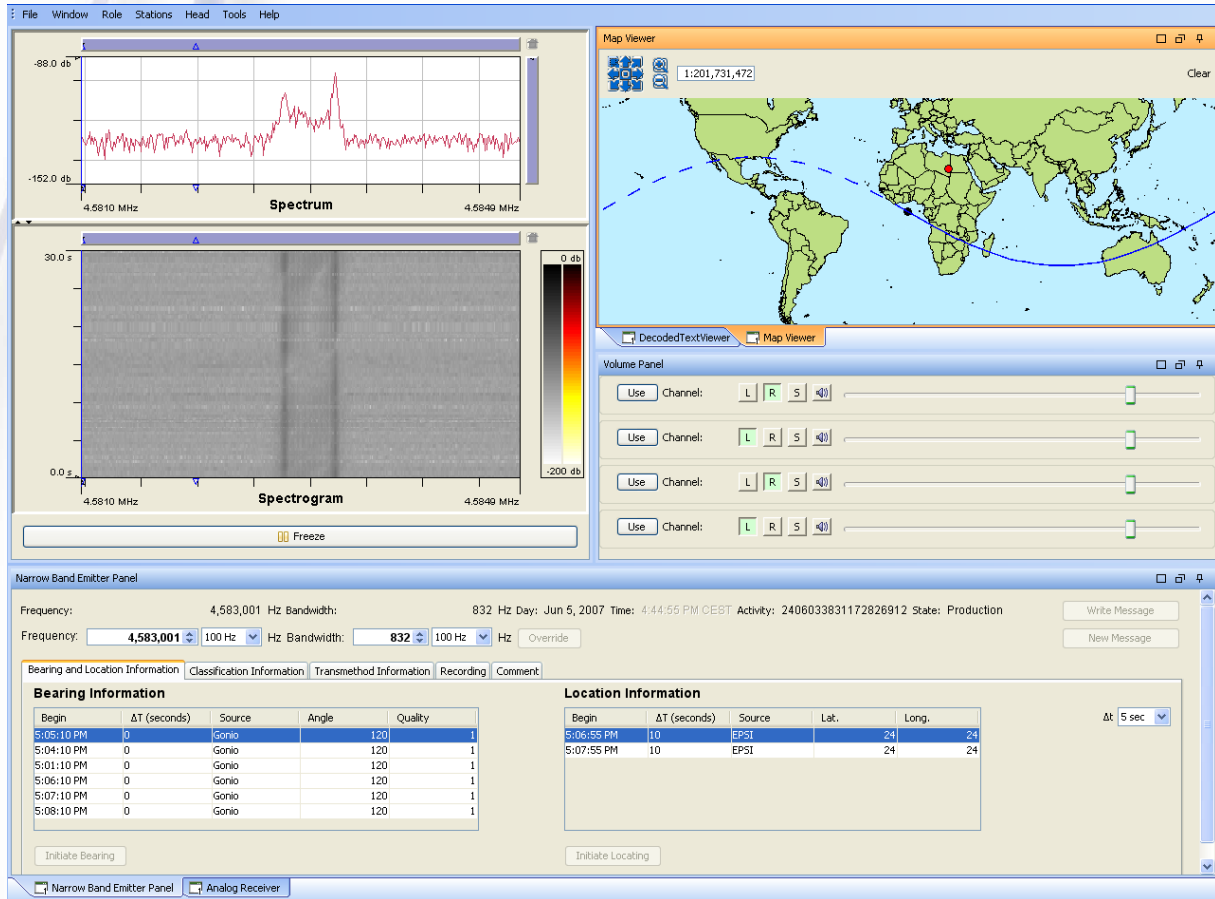
The status of the channels is indicated by the colour and a text entry:

- The colour indicates the status: green = channel is being produced, red = production failed, yellow = ongoing classification, blue = private channel, etc.
- The text entries depend on the status. During production or test production, the currently applied method is indicated, during classification, intermediate classification results are indicated, etc.

Note that the distribution of frequencies over the channels is at random. The system assigns emissions to channels that are available at the moment of the emission's occurrence.

Narrowband Monitoring

In parallel, operators can select channels and watch the narrowband spectrum and waterfall displays, and observe the results the system is producing: examine the classification, decoding and other automatic results. They can concurrently make measurements on the signal in the graphical viewers or listen-in to audio signals on the fly, or when recorded, the signals can later be replayed.



Operators can decide to examine unidentified signals or signals causing problems in private channels, or they examine the spectrum of the search head on their own in free search.

- **Private Channels:** operators can occupy a free channel and set it to a narrowband signal. The channel is not available for automatic search anymore, as long as it is used by the operator. In this case, the operators can manipulate the demodulation, decoding and production parameters. This is intended to be used for signals that cannot be processed by the system automatically.
- **Free Search:** in this mode, operators can search for emitters within the wideband signal on their own, without using automatic processing; therefore, automatic detection and acquisition are disabled in this mode.

All activities on an emission are logged and stored in reports (XML). These can be viewed, improved and completed by analysis and investigation staff members.

Analysis and Investigation

In this role, operators work offline on the reports the system has created and saved on the central server.

The screenshot displays the Messages software interface. The main window is titled 'Messages' and contains several panes:

- Messages List:** A table listing messages with columns for Day, Mi..., Trans..., Bandwi..., Freque..., Pri..., H..., Lat..., Lon..., and Rec... The table shows 24 messages, with the first one selected.
- Message Editor:** A pane for editing the selected message, showing 'General Message Parameters' and 'Signal Illustration'. The signal illustration is a spectrum plot showing a signal between 3,974 MHz and 3,979 MHz.
- Decoded Text:** A pane showing the decoded text of the selected message, which is a weather forecast for the Central Norwegian Sea.

The decoded text is as follows:

```
17:05:36,279 58: 08,236,3'42 88# 1030 CENTRAL NORWEGIAN SEA, MOVING A LIT
17:05:47,237 TLE
17:05:48,233 NORTH. RIDGE 1015 CARPATHIAN MTS., AT FIRST NEARLY UNCHANGED
17:05:58,195
17:05:58,195 LATER WEAKENING. LOW 1008 IN THE AREA OF WHITE SEA, DEEFEMIN
17:06:09,152 G,
17:06:10,148 MOVING>>AST. =17,4-0988 IN THE ARE
17:06:17,121 061. FURTHER LOW 1010
17:06:21,106 AZORES, DEEPENING, NEARLY UNCHANGED. FRIDAY 998 WEST-C
17:06:30,569 >>ERR. OVER CENTRAL EUROPE AT FIRST SMALL UUSURE
17:06:40,531 DIFFERENCES. =>
17:06:42,523 >01008 IN THE AREA OF BELGIUM.
17:06:51,489
17:06:51,489
17:06:51,489 DWD FORECAST 0
```

A collection of possible results in the reports is listed. The list can, however, be extended:

- **General data** about the emission: date and time, emitter ID, priority, receiving antenna, frequency, bandwidth
- **Signal Illustration:** contains different visualizations of the signal
- **Bearing/DF:** contains the results of direction finding and location, if installed. The results can be visualised on maps.
- **Decoded Text:** if a signal containing text or symbols could be produced, the decoded text or symbols can be stored.
- **Log Entries:** the processing logs and results. They may be of special interest if problems occurred or a signal could not be produced.
- **Comments:** contains the technical parameters the system used to produce the signal and the results. Operators can add own comments.
- **Recordings:** if the system or operators recorded signal samples, they can be analyzed here. Different tools are available and selectable according to the type of signal: analysis tools for unidentified signals, audio play tool to listen-in to audio files, etc.

Decoded text can be viewed directly in the message or more comfortably in a text viewer. The reports are stored in platform independent XML format and can be exported if they are to be further processed by other external tools.

How do the Analysis Operators Work?

Analysis operators analyse the information in the reports and either delete irrelevant reports or try to work out more in-depth information of relevant reports if possible, especially on signals that could not be identified by the system.

Operators can retrieve reports by different search parameters and select them from the list of reports saved on the server (left window half). Once selected, the properties and information stored in the report are shown in the right half of the window. Information is structured and easily accessible.

Operators act as follows:

- examine the recordings attached to the reports by listening-in and turning speech to text by typing down what they hear in the signal (audio recordings),
- or try to classify the signal supported by automatic classification functions of the system
- or try a more detailed analysis
- or improve the classification rules
- or improve demodulation and decoding, depending on the type of signal

Their results are added to the report, to which the operators can add individual comments, observations, and notices. Furthermore, the results are used to maintain the classification rules for higher classification accuracy, and the system database, which is in turn the base for new or improved positive lists and negative lists.

Post Processing Tools

MEDAV offers a set of post processing tools for the further analysis of demodulated messages. A software frame is included into ARS-8000. Using this frame, special algorithms can be embedded that perform post-processing:

- ARS-OPT-Post-PKLib for PKLIB decompressing
- ARS-OPT-Post-FBB for F6FBB protocol
- ARS-OPT-Post-UUDec for uuencoded data
- ARS-OPT-Post-MTX65 for mtx65 standard
- ARS-OPT-Post-MTX69 for mtx69 standard
- ARS-OPT-Post-CODAN-File for codan files
- ARS-OPT-Post-M6550 for milserial standard 6550
- ARS-OPT-Post-Zip for zipped/gzipped files
- ARS-OPT-Post-TerminalDec for removing terminal structures like
 - ITA2 5N1, 5N2, 5E1, 5O1, 5E2, 5O2,
 - 7bit ASCII 7N1, 7N2, 7E1, 7O1, 7E2, 7O2,
 - 8bit ASCII 8N1, 8N2, 8E1, 8O1, 8E2, 8O2

Other algorithms may be embedded upon request.

Additionally, MEDAV offers different useful tools for further analysis, such as

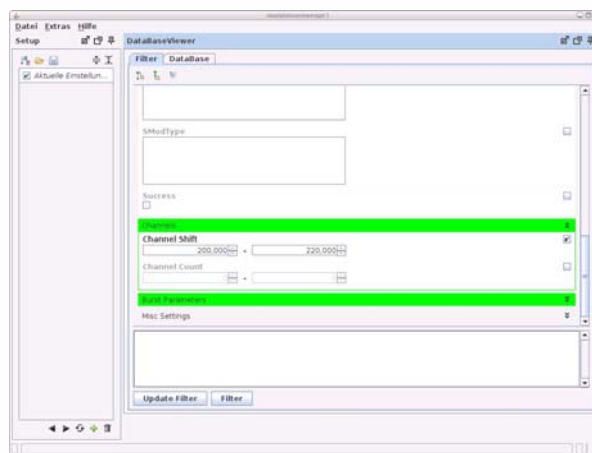
- transcribers helping to type text from an audio file containing speech into a text file
- the wideband analysis tool **CCI-Offline** helping to find and isolate narrowband emissions within a wideband recording
- the extensive narrowband analysis toolset **OC-6040** for detailed analysis and post processing of narrowband signals

Classification Database

Along with the reports of production or unidentified signals, the system is able to save information about any classification within a database which can be queried for classification results easily. Using this database, new signals of interest can be identified, and thus automated processing with ARS can be adjusted accordingly.

Using the classification database, the ARS-8000 system can be used for the classification of emitters.

- Classification results are optionally automatically recorded within an ARS-8000 report and can be further evaluated separately.
- Classification results are stored in a database. The user of ARS-8000 can perform searches in this database.



Data base entries for activities:

- ID of activity
- Name of corresponding message file
- Emitter frequency
- Emitter bandwidth
- Emitter direction
- Latitude, longitude of the sensor
- Latitude, longitude of the emitter
- TOA (time of arrival) of emitter
- SNR (signal noise ratio) of emitter

Data base entries for classification:

- ID of activity
- Classifier description
- Measured frequency,
- Measured bandwidth
- Measured baud rate
- Measured shift
- Measured channel shift
- Measured channel count
- Measured if burst signal
- Measured length of one burst, burst length + burst break
- Classified name
- Boolean for success of classification
- Name of successful method
- Accuracy of measured values
- Primary / secondary modulation type
- TOA of classification
- Periodicity of the measurement

An Oracle license is required (not included) for the classification database.

Statistical Analysis

In this role, extensive statistics can be viewed and evaluated. They help to optimise the system in regards of performance.

Statistics of the following information are available:

- Idle channels
- Classified channels
- Unlocked
- Produced
- Direction Finding/Location

The diagrams can cover the following periods:

- Last hour
- Last 4 hours
- Last day
- Last week

System Administration

The administrator tasks are briefly described in the following:

- **System configuration:** covers setting up the PCs, operating system and network connections (routers, switches), as well as installing the software and managing the user accounts in the network and the ARS-8000 system. The system administrator is supported by software programs for efficiency and comfort in configuring the system.
- **Network management:** means that the system administrator monitors the network for availability and performance, and to take counter measures if network connections are down.
- **Backup:** requires saving system and user data to tape or other persistent data carrier daily or according to a backup schedule.
- **Software maintenance:** means that the system administrator installs software updates on the server and cares for proper software configuration settings. Software is automatically installed at all workplaces.

The system administrator is also the contact person for the software manufacturer in all regards of software configuration and operation.

- **Interface control:** means that the system administrator monitors the external interfaces over which messages, basics, tasks etc. are transmitted, e.g. to and from intelligence processing department.

Selected System Features

Flexibility in size and application	The concept of remote and autonomic search heads with receiving infrastructure opens a wide application range for the system.
Distributed	The system can be distributed over different locations and consists of different clients and servers, connected over LAN and WAN.
Operating System	The recommended operating system for all servers and full scope of service and comfort is Linux, for workplaces is MS-Windows. Other operating systems are available on request.
Platforms	<p>The software is available on multiple platforms: GUIs and middle layers are programmed in Java™ combined with MEDAV Virtual Devices (VD), which are also available for different platforms.</p> <p>Note that different platforms (and operating systems) provide different levels of support for automation in configuration, installation, and system management.</p>
Fail safe concept	<p>The system is fail safe, provides uninterruptible power supply, failover servers, critical hardware is redundant. The software is robust to cope with most of failing hardware.</p> <p>Where possible, the design avoids locks and synchronous communication to minimize propagation of failure (in hardware and in software). This design has proven its robustness in installed systems.</p>
Connectivity	Connectivity to different types of antenna and receivers (depending on the requirements, open interfaces for easy adaptation to specific tuners) is given, as connectivity to different types of LAN and WAN (depending on the requirements and open interfaces for easy adaptation to specific network technologies).
Compatibility	Compatibility to existing systems (e.g. TRS 8000) and most existing customer installations is given due to the usage of standard interfaces.
Communication	<p>The modules communicate over an adequate LAN infrastructure, however wherever possible, connectionless and asynchronously following a 1:N distribution concept, where possible. This concept is applied for WAN communication to other stations as well.</p> <p>Information interchange functions provide built-in facilities to handle temporary loss of connections, especially on WAN. Implementations are proven using cable bound and satellite WAN infrastructure.</p>
Network Management	Network management tools can be integrated optionally. It is also possible, to forward relevant events (i.e. SNMP traps) to an existing management system.
Installation/Maintenance	<p>Updates are typically held in a central software repository, from which it is</p> <ul style="list-style-type: none">• directly used or• automatically transferred to and installed on the workstations.
Remote Administration	Each workplace can be administered from remote using a GUI, assumed sufficient communication bandwidth is available. Otherwise, a remote shell connection can be used instead and usual remote monitoring/ management over SNMP.

Technical Data

Performance data CC-WBB

Bandwidth	2 MHz (4 MHz on request)
No. of single channels	50 channels x 20 kHz
Functions	Search with wideband detection, narrow-band classification (modulation and transmission method) demodulation & decoding in the individual channel recording of speech signals Automatic creation of reports
Wideband storage	2 MHz
Storage depth	1 Tera Byte
Interfaces	Antenna (N-Connector) Query finder (CORBA) VD-direction to the client



Sensor Tuner

ComCat Tuner	CCT-D2-NG (for detailed data see separate data sheet CCT NG) Interface N-Connector
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CC-Boxes

Platform	Professional Standard Hardware Server
Performance data	2 Quad Core No system disk 16 GB RAM
Software downloads	The server does not contain any system disk with bootable software. After switched on, the server loads its software through the network. This takes care of an identical configuration status on all the servers.
Software	System Software (open SUSE 10.3) LINUX Functions executed in VD technology CORBA - Interface
Operating temperature	10 to 35 C
Storage temperature	-40 to 70°C
Power supply	100 - 240 V, 50-60 Hz



Product Philosophy

MEDAV offers complete signal reconnaissance systems, as well as special dedicated solutions or OEM devices.

Signal Reconnaissance System Design

MEDAV signal reconnaissance systems cover all phases of the intelligence cycle.

In close cooperation with our clients and partners, we have developed innovative ideas and concepts for tailor-made, integrated complete solutions for all phases of the intelligence cycle from planning and direction, through collection and processing, to analysis, production and dissemination.

Several customers have performed competitions of automated reconnaissance systems for HF. Our systems and those of others were subject of intensive tests. We were winner in all tests through extensive and reliable results obtained in the trials whereby the customers have operated the systems by their own.

You can trust our expertise to provide precisely the technology you require for all phases of the intelligence cycle. We have developed system solutions for optimum collection of the information and data you have gathered, for discussing them in a team, and for their evaluation and distribution, giving you the best possible support throughout the entire intelligence cycle.



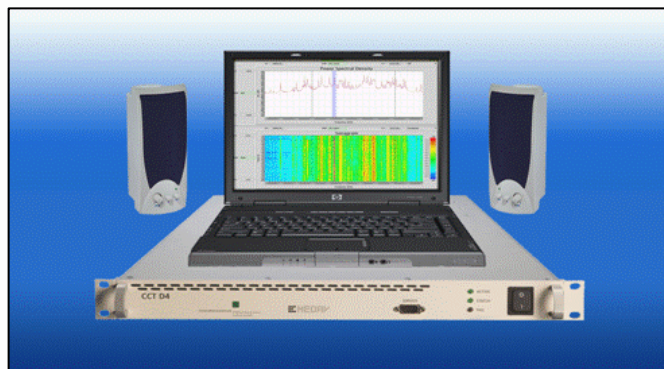
ARS-8000 can be integrative part of such systems, which are of high complexity and usually need engineering effort. The result is a system that meets your special signal reconnaissance requirements and suits your infrastructure, environmental conditions and the habits and practices of your signal reconnaissance staff.

The delivery time of new systems including engineering is usually between 6 and 18 months.

Solutions

ARS-8000 provides all functionality required for the reconnaissance process. Core functionalities are implemented as modules that can be added to ARS-8000 as well as to many other MEDAV systems.

Depending on the requirements of your reconnaissance scenario, you can select the options needed and leave out obsolete ones.



MEDAV provides solutions for the following functions:

- **Wideband Technology** – MEDAV is continuously establishing new standards in wideband technology for the reliable detection of all types of signals, including bursts or frequency hoppers.
- **Wideband Search and Direction Finding Systems** – technology based on the ComCat tuners by MEDAV can be used in direction finding systems for synchronization and calibration. Wideband DF systems are also provided.
- **Signal Analysis** – MEDAV offers innovative solutions and products for interactive signal analysis and processing.
- **Signal Detection and Classification** – software by MEDAV allows signal detection and classification to be performed automatically delivering lists of emitters with all the important technical parameters, e. g. modulation types and other meta data.
- **Speech Technology** – MEDAV offers programs for natural language technology for different purposes such as speech signal detection, gender identification, language identification, speaker identification and keyword spotting, topic spotting and speech recognition.
- **Finished Intelligence** – solutions by MEDAV supports you in the steps of data collection, information fusion and decision making using methods to collect, analyse and archive data.

Devices

MEDAV supplies different types of devices for the systems and solutions:

- on the one hand special devices that suit best to the MEDAV software and infrastructure, e. g. tuners and antennas
- MEDAV implements many functions in software modules (modems, codecs etc.) as Virtual Devices, where others provide expensive special hardware devices.
- on the other hand, systems and solutions by MEDAV use common off-the-shelf products as PCs, switches, LAN infrastructure etc. for communication and computing power.



The devices supplied by MEDAV are:

- **Antennas** – by forming partnerships and joint ventures with highly specialised companies, we can offer a wide range of antennas.
- **Tuners** – we can offer different types of tuners. Our innovations are digital CCT ComCat tuners and LAN-Receivers with a frequency range up to 18 GHz (optional).
- **Virtual Devices** – our virtual devices replace expensive and highly specialised hardware and offer more flexibility, an improved integration into server-based IT systems and considerable cost savings.

Sensors

Signals

Classification

Content

Information

Intelligence

Corporate Policy

Technology

... in the products, development and in the company management is state-of-the-art and represents a top level.

Quality

... in all divisions of our company is considered as the indispensable prerequisite for a risk-free and successful cooperation with our customers and business partners.

Position in the market

... is affected by extensive experience gained from signal and information processing. We are prepared best to face competition.

Product and engineering spectrum

... are comprehensive, complete and tailored to meet all requirements. As a single source supplier of solutions, we offer standard devices, systems and services.

Employees

... form the roots of the company and render the services necessary for maintaining and expanding the technical basis and a trustful and fair cooperation.

Growth

... on a stable technical and economical basis at home and abroad is our declared long-term goal.

Trust and fairness

... vis-à-vis our business partners and within the company are the basis of our business.

Compliance

... with excessive sensibility and compliance with German and international export regulations we act on a worldwide basis.