DRM Software Radio

PC based software for DRM reception

User Manual
Version 1.3

Content

1. Document Info

Document   DRM Software Radio User Manual

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VT Merlin Communications takes no responsibility for wrong or missing information in this document.
As the DRMSoftwareRadio is still under development all information given in this document, especially the graphical outfit and the available functions, are subject to change without notice.

Revision Index

Revision	Changes
0.1	Draft, Initial Version
0.2	revised by Alexander Zink, added chapter user registration
0.3	revised document info
0.5	revision by VT Merlin Communications
0.6	Updated screenshots for version 0.0.16 and GUI description
1.0	Revision for software general release. Sound card info update. HVXC support. Information on service buttons added. Screenshots updated. Multimedia section revised.
1.01	Comment on receiving keys via e mail section 7.2
1.2	Added section 8.0 (WiNRADiO), change in format to VT Merlin style.
1.3	Section 6.3 (Multimedia) completely revised.

2. Copyright information

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Parts of the software are under copyright of Fraunhofer IIS (http://www.iis.fhg.de).

Portions of Enhanced MPEG-4 AAC+SBR coding technology are licensed by CODING TECHNOLOGIES (http://www.codingtechnologies.com).

Portions related to WiNRADiO receivers are copyright of WiNRADiO Communications (http://www.winradio.com).

3. Contact, information and Updates of software

Via Website at
http://www.DRMrx.org/
http://www.DRMswr.com

This web site will be supported and maintained for a 2 year period from December 2002 to January 2005. Updates and new versions of the software will be downloadable for registered users from this web site. After initial purchase of the software, future upgrades will be provided free of charge to registered users.
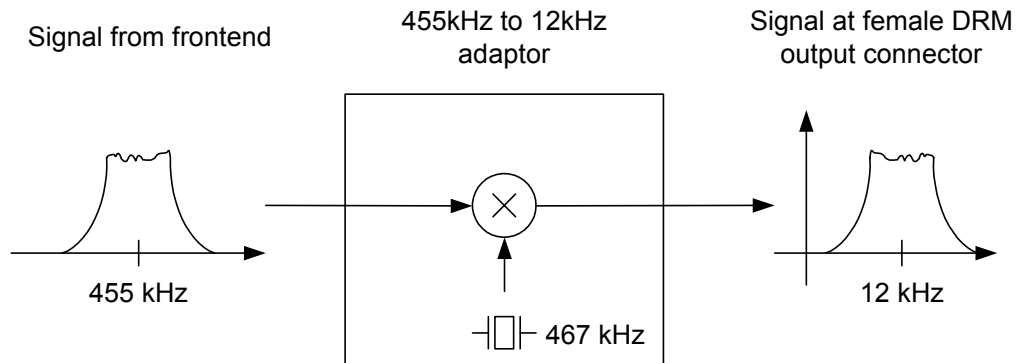
4. Overview

4.1 Receiving path

The following picture shows the DRM Software Radio system for reception of DRM signals.
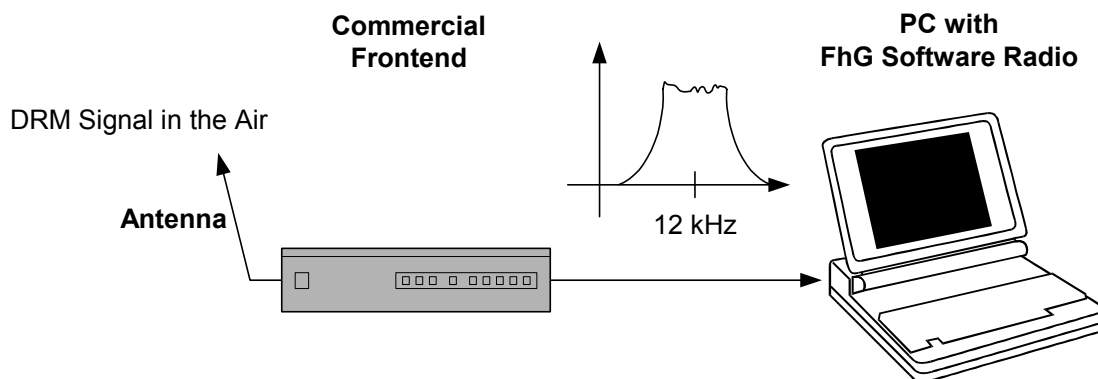
The DRM Signal is received by an commercial long, medium, shortwave (SW, MW, LW) front-end. Any front-end should be usable which can provide an IF of 12 kHz direct or with a adapter circuit. The bandwidth must be greater 10 kHz for normal transmissions and greater 20 kHz for transmissions with channel bundling.
This signal is then fed into a standard soundcard. The soundcard must offer a sampling rate of 48 kHz. For output of the audio signal also a soundcard with a sampling rate of 48 kHz is required. If one sound card is used for sampling the signal and output of the music the soundcard must provide full duplex operation. Most of all newer soundcards provide all these features (e.g. SoundBlaster Live! from Creative Labs). Attention must be taken not to use an input with AGC (Automatic Gain Control) as this disturbs the DRM signal. Please pay attention that most of the internal soundcards of newer notebooks have the AGC enabled and offer no way to disable it. They also have very often low pass filters which can not be disabled. In order to get the system working on such notebooks (or also on other PCs with no or no suitable soundcard) we suggest the use of an external USB soundcard (e.g. „USB One" USB Audio Interface).

4.2   Modifications of existing frontends

If a frontend provides an IF of 455 kHz it can be used for the DRM Software Radio by adding an 455 kHz to 12 kHz adaptor.

Worked examples of frontend modifications, are posted (by the general public) at http://www.drmrx.org/receiver_mods.html

4.3 Block diagram of the Software

The following picture gives an overview about the software modules of the DRM Software Radio.
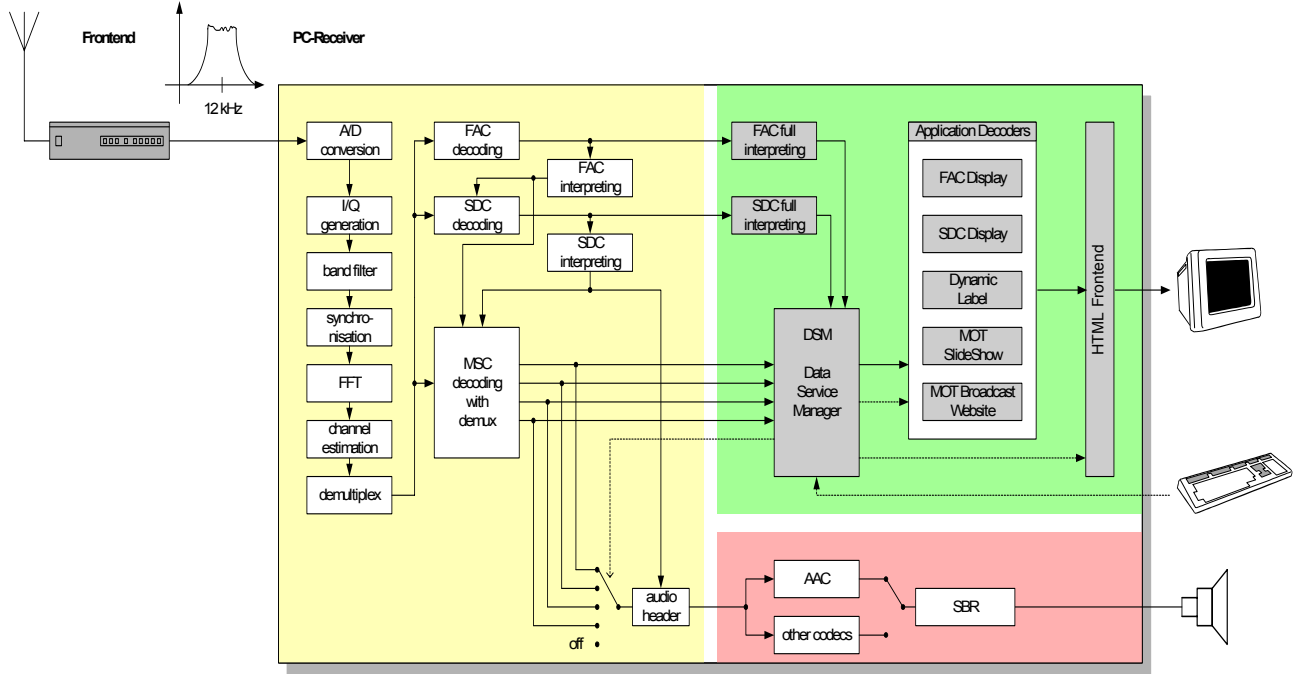
4.4 Minimum System Requirements

- Windows 2000 or Windows XP or Windows 98
- The software can run under Windows NT, but is not officially supported. Users using Windows NT should install service pack 6A or later.
- AT-compatible PC
  - 500 MHz Intel Pentium processor (or equivalent)
  - 64 MB RAM
  - 50 MB free disk space
  - 16-bit SoundBlaster (or compatible) soundcard that supports full duplex at 48 kHz sampling rate for input and output; the input must be without AGC (Automatic Gain Control); recommended: Creative SoundBlaster Live! or „USB One" USB Audio Interface
- LAN network driver or dial-up network installed
- Suitable frontend with 12 kHz IF output, output level suitable for soundcard

4.5 Tested soundcards

The following soundcards have been reported as suitable to work in full duplex mode:
The internal soundcards have been tested and work in the following PC's.
Dell Inspiron 4100
Dell Inspiron 8000
Dell Inspiron 8100
Dell Inspiron 8200
Dell Latitude 800
Dell Latitude 810
Dell Latitude 840

Sony VAIO PCG-C1MHP, 860Mhz/128MB with Yamaha AC-XG soundcard
Dell Dimension (desktop) 4100, 800Mhz/512MB with Creative SB Audio PCI 64V

Dell 2 GHz Pentium 4 machine with a 'SoundBlaster live' card

Fujitsu Siemens T-bird Desktop PC with a 933 MHz PIII & Soundblaster Live Player 5.1 Soundcard.

Unbranded Pentium 1.8 GHz with a "low cost" sound Blaster PCI 128

1200MHz AMD Duron on Elitegroup Corp.(ECS) K7VVM main board with intergrated sound card

Laptop Gericom Webengine Force 2440 XL (2,4 GHz, 512 MB RAM)SIS 7012 Wave (built-in)

Unbranded PC with AMD Athlon 1.7 GHZ & Soundblaster Live 5.1

MEDION 2,5GHz from ALDI (HOFER in Austria)

Sometimes you need to disable the AGC or "sound boost" via the settings for the soundcard. This depends on the driver you have loaded for the soundcard.

An external soundcard had to be used with the following PC as the internal one was not suitable:

Compaq Armada E500
Unspecified mainboard with integrated C-media sound

Sometimes soundcards can seem to work, but do not have full duplex ability. In this case audio dropouts will occur. The following procedure can give an indication of the location of the problem.

Use the record function to generate a file:
Here is a file recorded and posted by tido1322 in the forum (www.drmrx.org/forum)

DRMSoftwareRadio-MERLIN-00000127		*software type and licence number*
Software Version 2.0.34		*software version number*
Starttime (UTC) 2004-01-11 15:18:00		*derived from users PC internal clock*
Frequency	6095 kHz	*user enters this at start of recording*
Latitude	44°49'N	*user enters this at start of recording*
Longitude	0°38'W	
Label	RTL DRM	*derived from the first correctly decoded SDC data block at the start of the transmission It is recomended that users allow the receiver to lock up to the transmission before recording starts, otherwise this field will be "N/A"*
Bitrate	20.88 kbps	*derived from the first correctly decoded FAC data block at the start of the transmission*
Mode	B	*derived from the first correctly decoded SDC data block at the start of the transmission*
Bandwidth	10 kHz	*Bandwith of signal derived from the first correctly decoded FAC data block at the start of the transmission*
Comment	TS440+ Thinkpad	*User comment entered at start of recording*

MINUTE SNR SYNC AUDIO TYPE
0000 26 150 1492/10 0
0001 26 150 1474/10 0
0002 25 150 1399/10 0
0003 24 150 1409/10 0
0004 25 150 1348/10 0
0005 24 149 1242/10 0
0006 24 150 1380/10 0
0007 25 150 1429/10 0
0008 25 150 1422/10 0
0009 25 150 1472/10 0
0010 24 150 1342/10 0

0011 25 150 1346/10 0
0012 26 150 1348/10 0
0013 26 150 1401/10 0
0014 24 150 1086/10 0
0015 22 150 908/10 0
0016 21 150 790/10 0
0017 19 150 500/10 0
0018 21 149 805/10 0

Here is a guide for the meaning of the figures:

MINUTE: minute of recording
SNR: average SNR of this minute
SYNC: number of frames in this minute where FAC CRC
was OK
AUDIO: number of error free audio frames in this minute
and (separated by '/') number of audio frames per
transmission frame
TYPE: 0 = AAC, ..etc (audio coding type)

If we take a look at the AUDIO column, we can see how many audio frames are
decoded correctly. Each audio transmission frame is 400 mS long, and Tidos1322
file (the /10 part) indicates there are 10 audio frames per transmission frame. So this
means, for this transmission, there are 150 transmission frames and 1500 audio
frames per minute.
For minute 0, the average SNR is 26, 150 (i.e. maximum) FAC frames were received
correctly, and 1492 audio frames were received correctly.
This means 8 audio frames were received with errors.
I am a little surprised that all 1500 frames were not received correctly, as a SNR of
26 is very good: perhaps there was some transient noise.
8 corrupted audio frames would not cause any dropout, in practice the audio is still
OK if 50-60% of audio frames are received OK.

If we look at minute 17 in the file, then we can see there were only 500 correctly
received audio frames, so for this minute, we certainly would expect to hear audio
drop outs as only 33% of the frames were correctly received.

So, if the file indicates few audio drop outs, but you are hearing many, then most
likely there is a problem with the soundcard

Features

⇨ **Channel decoder**
 ☑ 4.5 and 5.0 kHz
 ☑ 9.0 and 10.0 kHz

 ☑ Mode A, B, C, D
 ☑ 4 and 16 QAM for SDC
 ☑ 16 and 64 QAM for MSC
 ☑ MLC with two iterations
 ☑ All code rates
 ☑ EEP and UEP

 ☑ spectral inversion of input signal

 ☑ Complete FAC and SDC decoding
 ☑ Display of Service Label and Service Information
 ☑ Display of Text messages

 ☑ All implemented features ETSI TS 100 980 V1.1.1 compliant

⇨ **Multimedia**
 ☑ Program associated and stand-alone data application support
 ☑ Text messages
 ☑ Slideshow service
 ☑ Broadcast Website
 ☑ News Service Journaline decoder

⇨ **Audio decoder**
 ☑ AAC
 ☑ SBR
 ☑ HVXC

5. Features of the DRM Software Radio

The DRM Software Radio enables you to receive and to listen to DRM transmissions by using a suitable PC (see chapter System Requirements) and a suitable frontend.

DRMSoftwareRadio.exe includes

Channel Decoder
The Channel Decoder is the Software inside the DRMSoftwareRadio which does the decoding of the DRM signals. The Channel Decoder is part of the DRMSoftwareRadio.exe program.
The Channel decoder is based on technology developed and licenced from the Fraunhofer Institute http://www.iis.fhg.de

MPEG4 AAC + SBR Decoder
The Audio Decoder decodes the binary data transmitted in a DRM signal and produces audio output. It is part of the DRMSoftwareRadio.exe program. The decoding libraries were provided by Coding Technologies (www.codingtechnologies.de).

Graphical user interface

Includes user localization based on Airport locations.
Includes recording of status files.
Description please see following chapters.

**Multimedia**
Description see following chapters.

6. Operation of the DRM Software Radio

6.1 User registration

To enable the functionality of the DRMSoftwareRadio the user needs a personalized key file. This file is provided after the purchase of the software. The file has to be copied into the installation directory. The user is not allowed to distribute this key file.

6.2 Graphical user Interface

The picture below shows a running DRMSoftwareRadio. On the right side you can see the four buttons to select the DRM Service. Up to four services may be available in a DRM transmission.
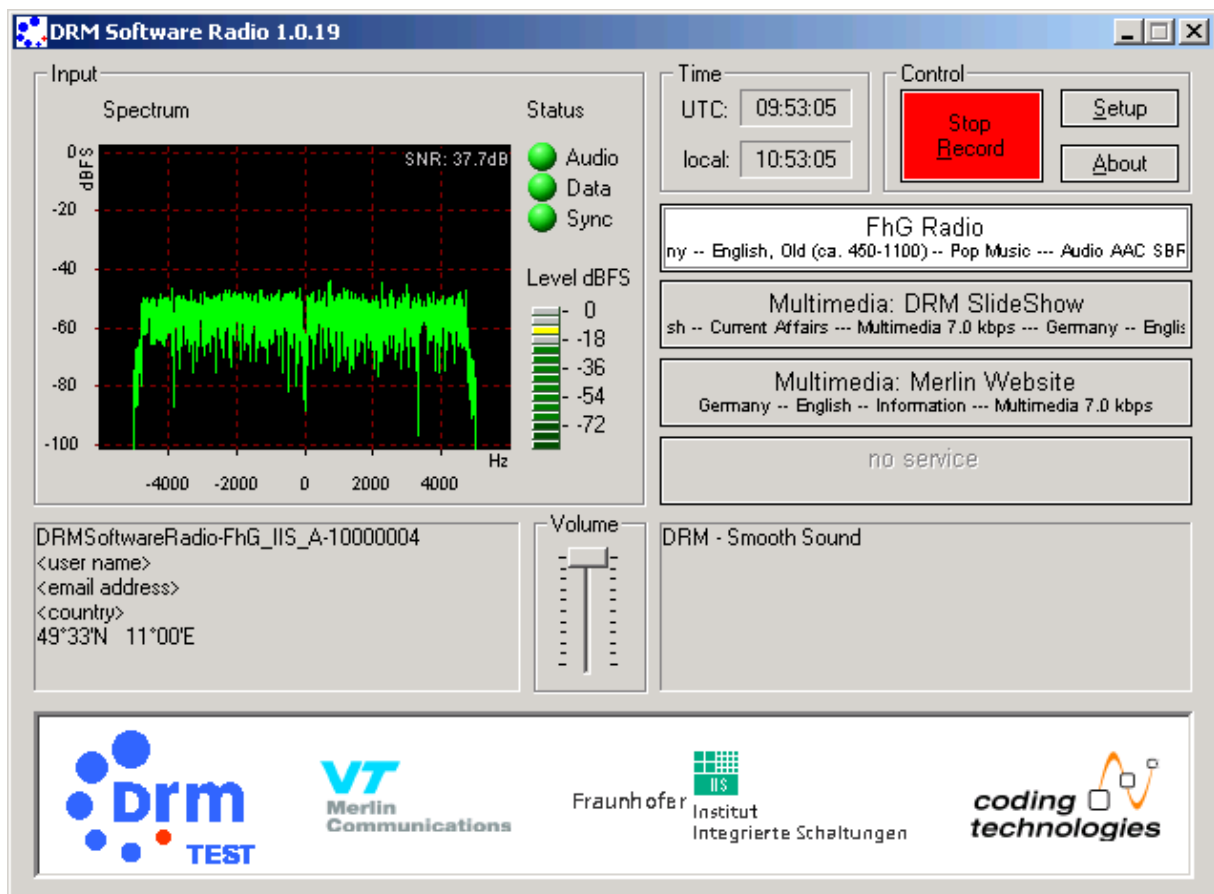
The DRMSoftwareRadio window displays:
- Input Level as an 'LED' level meter
- FFT of the Input Signal as an plot
- SNR of the Input Signal
- status of the decoder (sync, data , audio decoding state) as an green/red 'LED'

- Service buttons with service labels, service information (e.g. language, country,...) audio type (with/without SBR, mono/stereo) and bitrate of the service content
- DRM text message
- Local / UTC time display

The user can:
- Select one of the 4 possible services (with the 4 buttons on the right)
- Start the Multimedia Player for streams with multimedia content by pressing the according stream button
- Adjust the output volume (slider in the lower middle of the screen)
- Record status data to file ('Record' button)

- 4 services can be transmitted
- the services can contain audio and/or multimedia/data content
- the button with the audio service that is played by the soundcard is displayed in white (light grey), buttons for possible other audio services are grey with back labels
- buttons for services with multimedia content are also grey with black labels
- when clicking on an button with multimedia, the multimedia viewer will be opened, or if the multimedia viewer is already running, the display will be switched to this content. If an audio service is also containing multimedia/data clicking on this button will also open the multimedia viewer.
- buttons for unused services are grey with a grey label 'no service'
- the text on the buttons have on the first line the name of the service and on the second line information on the content of this service: country, Language, type (audio/multimedia/data) and bitrate

Setup dialog:
This dialog is used to:
- Select the input soundcard for the DRM IF input
- Select the output soundcard used for the playback of the decoded audio signal
- Switch the spectral inversion of the input signal on/off
- Disable the Multimedia support
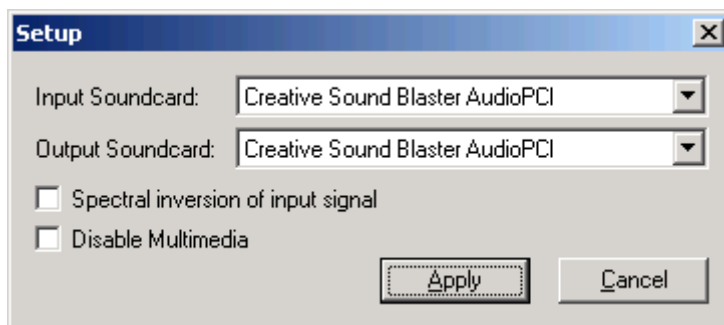
Recording:

After pressing the 'Record' button on the main window, a new dialog is displayed, where specific information on the reception can be entered (e.g. the frequency the frontend is tuned to, the receiver location). Also the output directory for the recording can be selected in this dialog. If you do not know your exact position (e.g. from a GPS device) you can press the 'Calculate' button to open a further dialog box, where your position can be determinated by using an airport nearby as an reference point.
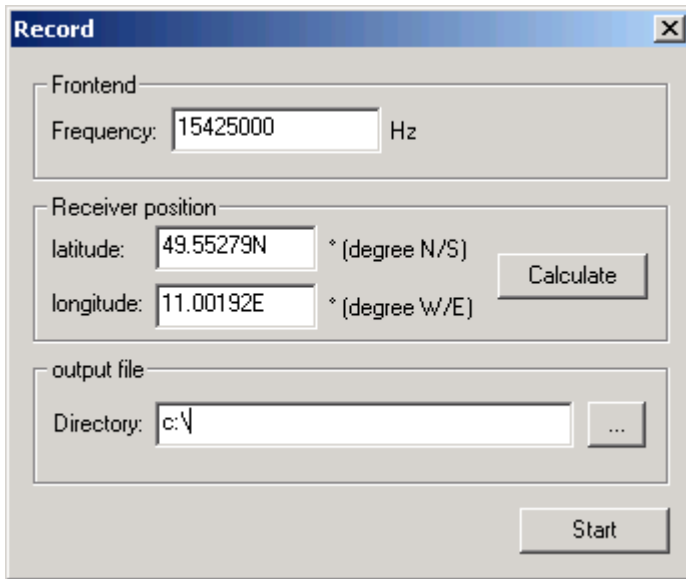
Below is the dialog for estimating the current receiver position by using an nearby airport as a reference.
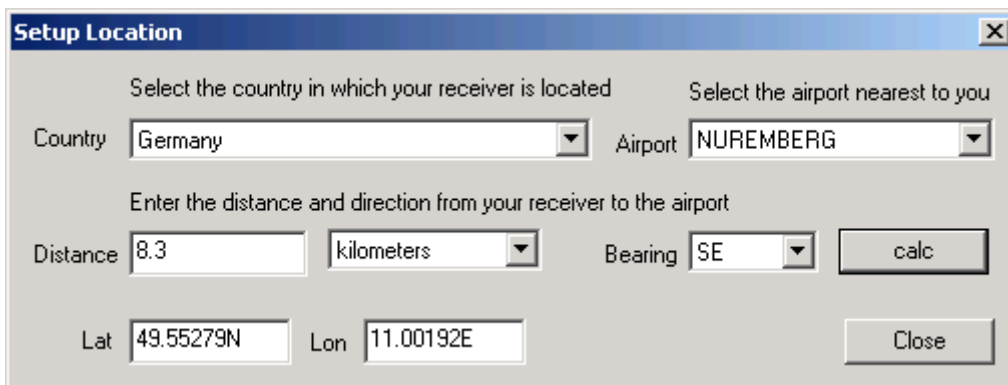
About Box:

The about box provides Version number(s), copyright information and Web addresses of the evolved project partners.
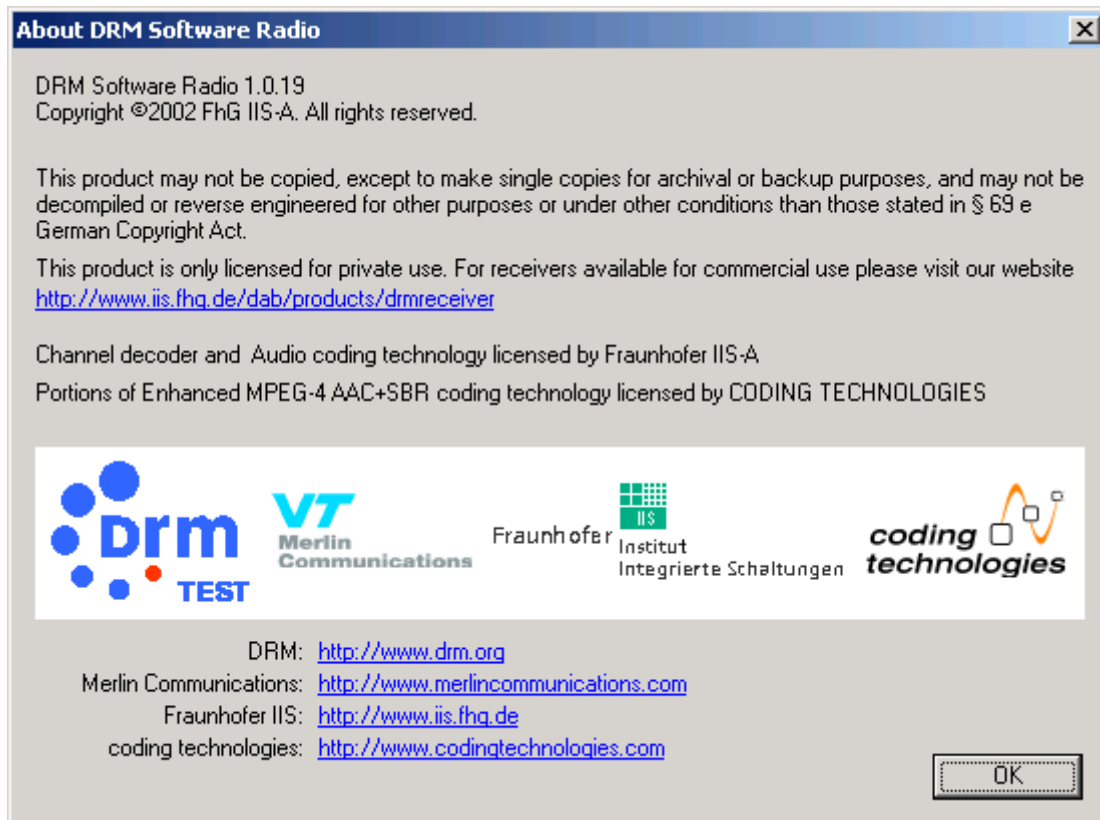
6.3 Multimedia

The Fraunhofer DRM MultimediaPlayer is shipped as an integrated part of the DRM Software Radio.
It permits the presentation of multimedia content which is sent in addition to audio services as part of the DRM signal.

6.3.1 Available types of multimedia applications

The following pages describe the types of multimedia applications can currently be explored by using the Fraunhofer DRM MultimediaPlayer:

NewsService Journaline®

NewsService Journaline® provides textual information in a hierarchically structured way. It is very easy to navigate to exactly the type of information the user is currently interested in.

NewsService Journaline® is especially optimized for the limited data capacities available in digital broadcast systems. It is tailored to the typical hardware infrastructure available in mobile environments (like a car radio) and can just as well be used with graphic-oriented user interfaces (like a PC).

The service always starts with the main welcome page. This page typically contains a menu giving the user access to sub-menus and/or news messages by just clicking on a topic. Grayed-out menu items have not yet been received.
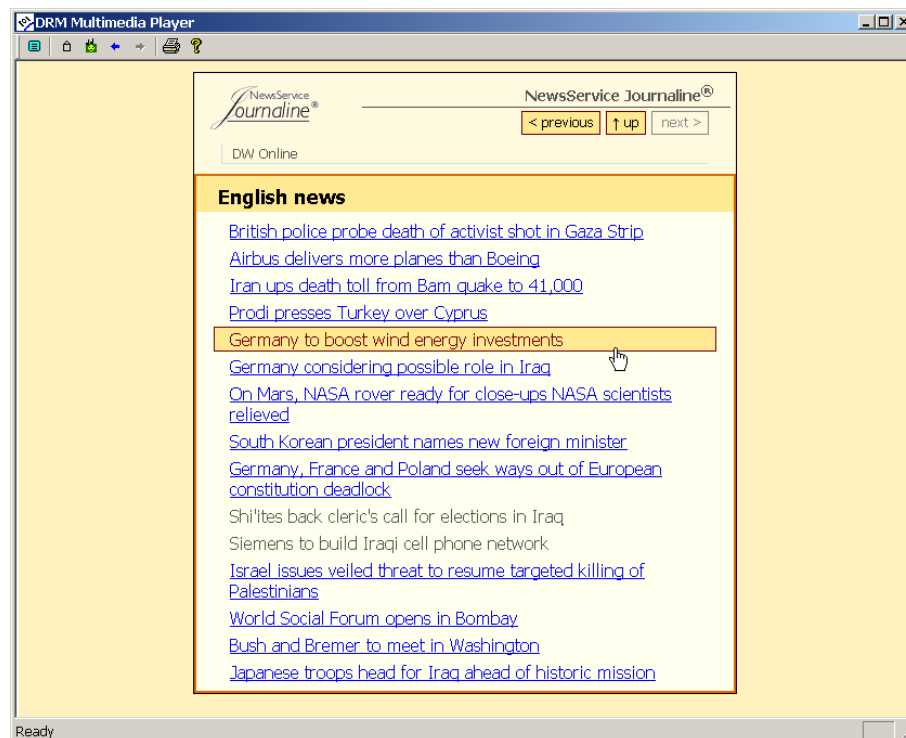
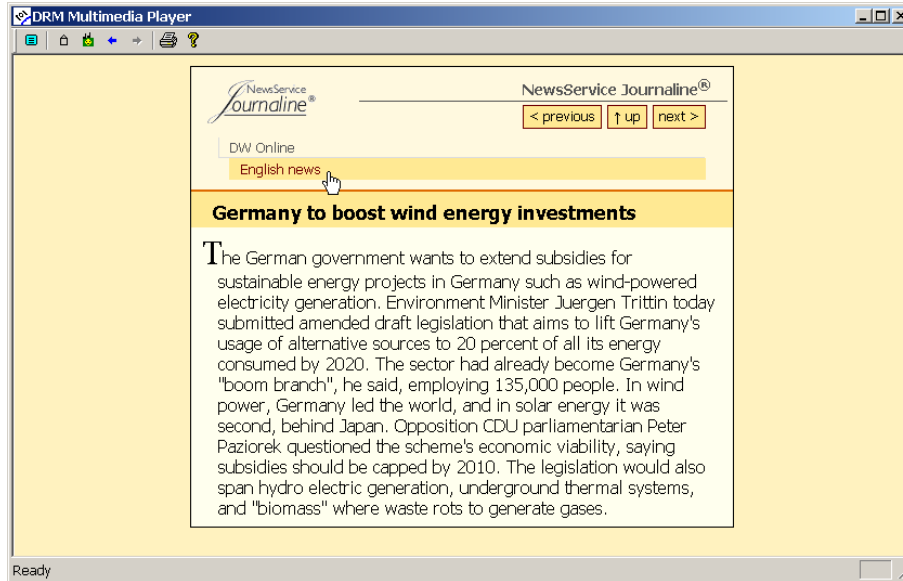The top of the screen contains the navigation area:
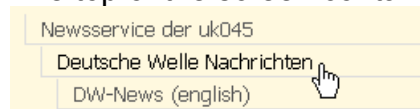
The user can easily return to any higher-level menu by just clicking on its name.

The 'up' button ↑up returns to the next higher menu level.

The 'previous' and 'next' buttons < previous next > allow easy and quick navigation through all the news messages and sub-menus contained in the current menu.

- **MOT Broadcast Website**
  This multimedia service allows the broadcast of complete web sites including HTML pages and images.
  The individual capabilities of a receiver are defined as receiver profiles. The Fraunhofer DRM MultimediaPlayer supports the full unrestricted profile. This means easy access to all current and future features of the HTML and other internet standards.
  The user can navigate through the received HTML pages as if they were loaded from the Internet.
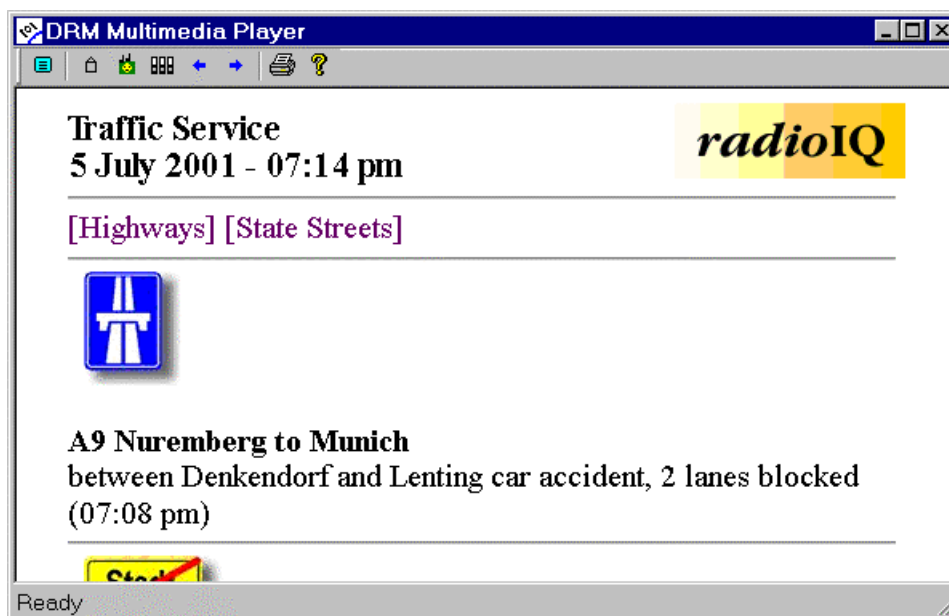
- **MOT SlideShow**
  The MOT SlideShow is a very convenient application especially when combined with an audio main program. In this case, the user receives automatically updated visual information while listening to the audio service.
  A typical example is the weather forecast. While the radio speaker explains the weather situation for the next days, the user of the Fraunhofer DRM MultimediaPlayer can even see the weather map!

- **DRM TextMessages**
  This application type is also known as "Dynamic Labels".
  While the user listens to an audio program, he receives the latest news and updates on the screen in textual form immediately when they are broadcast. This information may comprise artist/title of the current song, studio telephone numbers, traffic news, stock information, weather updates or other individual messages from the broadcast station to its listeners.

Every type of DRM multimedia service can be signaled in two ways within the DRM multiplex:

- **PAD** ("Program Associated Data")
  The multimedia application is tightly linked to an audio program. It is only decoded when the associated audio service is currently selected.
  When the user selects this audio service, the PAD multimedia application is automatically started.

- **DATA-ONLY (Non-PAD)**
  The multimedia application is independent from any audio program. It is presented to the user as a stand-alone DRM service and can individually be selected.
  If a DRM Multiplex does not contain any audio services, all multimedia services are signaled as stand-alone DRM services.

Please note that the 'DRM TextMessage Service' is the only type of multimedia service which cannot be signaled as 'Data-only'.
All other types of multimedia services can be signaled either as PAD (if the broadcaster wants to link the multimedia service to his audio program) or as 'Data-only' (if their content is independent from any audio service).

6.3.2   Starting the Fraunhofer DRM MultimediaPlayer

The Fraunhofer DRM MultimediaPlayer can be started by directly pressing one of the up to four available DRM service buttons (if the selected DRM service carries a multimedia service as PAD or 'Data-only').
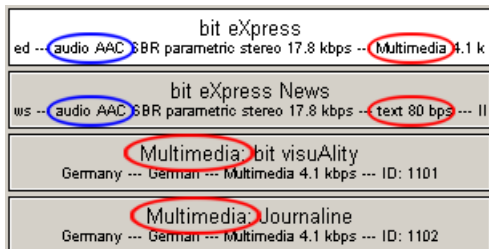
The example above shows a DRM Multiplex carrying a full set of four possible DRM services: two audio services (blue circles; both being linked to a PAD multimedia service – red circles) and two stand-alone multimedia services (red circles with 'Multimedia:' service label prefix).

After startup, the Fraunhofer DRM MultimediaPlayer will initially either show the current PAD multimedia service (if an audio service with attached PAD multimedia service is currently selected) or the overview page, which allows the user to select one of the signaled 'Data-only' services (stand-alone multimedia services).

6.3.3   Using the Fraunhofer DRM MultimediaPlayer

The Fraunhofer DRM MultimediaPlayer allows the user to switch between the program associated data (PAD, tightly belonging to the audio program which is currently played) and the stand-alone data services which are broadcast on the same frequency.

If the user wants to access the stand-alone data services, he gets an overview in form of a list of all data services currently broadcast on the tuned DRM frequency to choose from (see graphic below).

The following features can be accessed by pressing the corresponding buttons:

| Button	Description	Shortcut key
	Toggles between full screen and regular view	F11
	Switches to the **DATA-ONLY selection page**; all stand-alone multimedia services which are broadcast within the current DRM program will be listed for selection	CTRL+ALT+H
	Switches to the **PAD page**; the multimedia service marked as belonging to the currently selected audio program will be displayed	CTRL+ALT+P
	Navigates back in browsing history	ALT+LEFT ARROW
	Navigates forward in browsing history	ALT+RIGHT ARROW
	Prints the content of the currently displayed page	CTRL+P
	Shows the About dialog (indicating the version of the Fraunhofer DRM MultimediaPlayer)	

An example for the DATA-ONLY selection page is shown below.

It is accessed by clicking on the 'Home' button ⬚).

The actual content of this page depends on the DRM multimedia services which are currently received.

Each of the listed multimedia services can be selected by clicking on the corresponding hyperlink. From there it is possible to navigate further (depending on the kind of service selected).
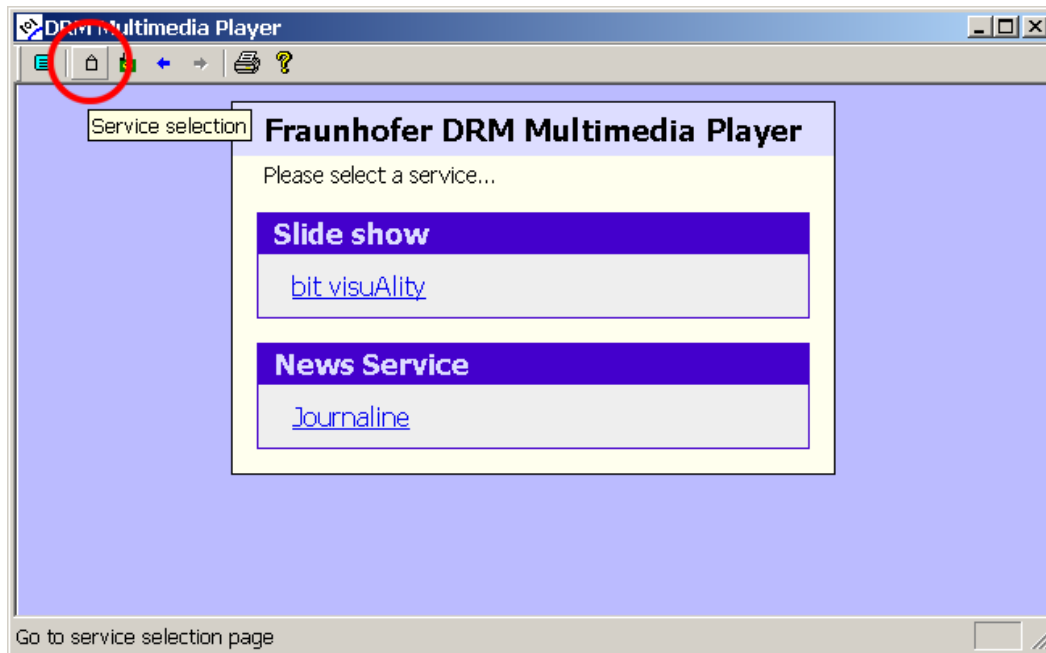
7. Software Setup

7.1 Software Installation

1. Insert CD.
2. Run Setup_DRMSoftwareRadio_x.x.x.exe and follow the instructions. (x.x.x is a placeholder for the actual revision of the software)
3. Copy the license key file into the installation directory.
4. Run DRMSoftwareRadio.exe (link is placed on desktop).

7.2 Setup FAQ's

Q. The software can not see the key even though I know it is in the directory.
A. Some e mail programmes may rename the key: for instance a keyfile sent as "DRMSoftwareRadio-00000173.key" is renamed to " DRMSoftw.key" when saved to the hard disk. In this case the software will not recognise the key due to the invalid name. Rename the key with its original name

8. DRM Decoder plug-in for WiNRADiO G303 Software Defined Receivers

8.1 WiNRADiO G303 Software Defined Receivers

The WiNRADiO G303 is the first commercially available Software Defined Receiver where the entire demodulator and last intermediate frequency are performed by software running on a personal computer. The output of the receiver hardware is 12 kHz intermediate frequency with 15 kHz bandwidth; the receiver has excellent sensitivity and phase noise, and is therefore suitable for DRM reception, without the requirement for any hardware modifications to the receiver: www.winradio.com/home/drm.htm .

The WiNRADiO G303i is a PCI card-based model, covering the frequency range from 9 kHz to 30 MHz:


A USB or serial controlled external version (WiNRADiO G303e) is to be available in the first quarter of 2004:

8.2 DRM Decoder Plug–in for WiNRADiO G303 Receiver

In co-operation with VT Merlin Communications, WiNRADiO developed a DRM decoder "plug-in" for the G303 receiver, which is now available through the DRM software receiver web site www.DRMrx.org. This plug-in replaces the conventional demodulator of the receiver with a DRM one, which is based on the Fraunhofer (FhG) software library:
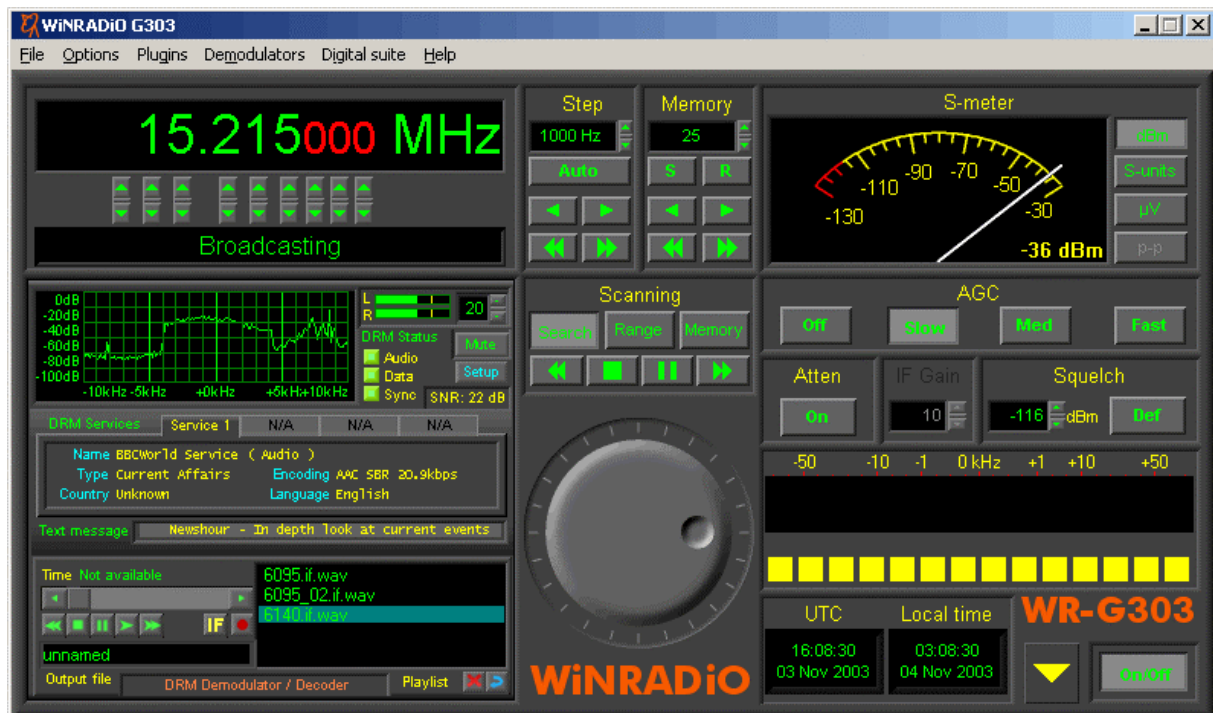
The WiNRADiO DRM decoder plug-in contains similar features to the FhG DRM Software Radio, including multimedia and logging. There is also a facility to record the signal both at audio and IF (intermediate frequency) level.

8.3 Installing WiNRADiO DRM Decoder Plug-in

Unzip the downloaded DRM decoder plug–in into a temporary file. Then run the unzipped ".exe" file. This will install the plug-in in the appropriate folder (which in most cases will be C:/Program files/WiNRADiO/Plugins).

The software key (issued on purchase of a licence) needs to be copied to the same folder. When the WiNRADiO G303 application is restarted, the DRM decoder should then appear under the "Demodulators" top bar menu.

If it does not appear, check that:

1. Your WiNRADiO G303 receiver software version is 1.27 or higher. If not, please download the latest application software from the WiNRADiO Web site www.winradio.com/home/download.htm .

2. The DRM decoder plug-in is installed in the correct Plugins folder. (Upon unzipping and running the installer, the resulting file will have the extension ".xrs", which stands for "Extensible Radio Specification". The DRM decoder is in fact an "XRS plug-in", conforming to WiNRADiO expandable radio receiver standard.)

3. The DRM software key is located in the same folder as the XRS plug-in.

If the installation was successful and the DRM decoder appears in the Demodulators top-bar menu, then select the DRM decoder from the menu and proceed to configure the Setup panel. To enter this panel, press the Setup button, which is located under the Mute button in the DRM decoder window:
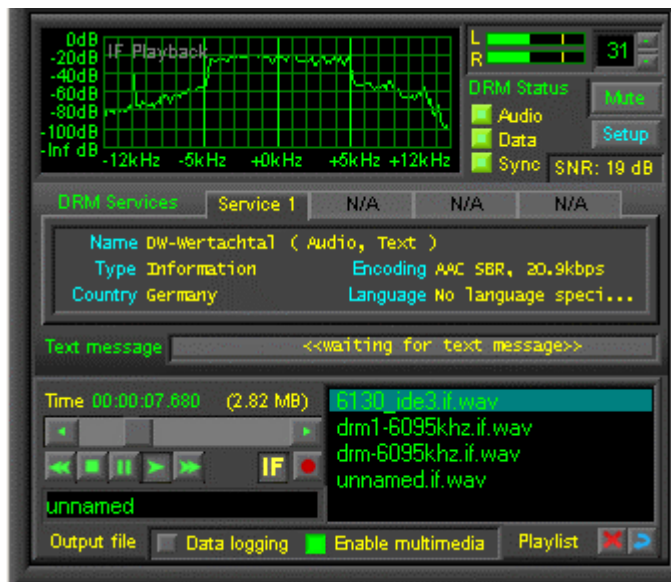
Upon pressing the Setup button, the following window appears:

Firstly, you will need to configure the sound card (i.e. the Wave device, Mixer device and Mixer line parameters). These parameters are the same as used to set up the conventional demodulator supplied with the G303 receiver, and exactly the same settings should be used, and the same steps for trouble-shooting.

Most initial problems associated with setting up this decoder can be attributed to incorrect sound card settings. Typical problems include not selecting the Recording input line correctly (which will manifest itself by the absence of any signal appearing in the spectrum scope window), failing to mute the Playback input line (which will result in listening to the disturbing high-pitched 12kHz intermediate frequency sound instead of the useful audio signal), or failing to enable the Wave output in the sound card Playback window (which will result in no audio). Some cards (most notably Creative Audigy2) do not provide full duplex on the Line Input, therefore alternative inputs must be used (e.g. Microphone input in the case of Audigy2).

Detailed installation steps are also available under the Help button of the DRM demodulator panel.

The "Default Audio Codec" settings in the Setup panel are used only for recording of the decoded audio and have no effect on the actual DRM decoding process.

To test the operation of the DRM demodulator, you might also like to download and install intermediate frequency sample files from the WiNRADiO Web site www.winradio.com/home/g303-drm.htm to your audio files folder. (This folder is specified as "Recording directory" in the Setup window, and its default location is C:/Program files/WiNRADiO/Audio files.)

A listing of all available ".wav" files will be displayed in the DRM decoder "playlist". Intermediate frequency files have the ".if.wav" extension. Double click on the file name to hear a playback. (There is about 5 seconds of silence for the acquisition and synchronisation to take effect.)

8.4   Using WiNRADiO DRM Decoder Plug-in

The real-time spectrum display is located in the top left part of the decoder window.

It shows the received signal from the receiver in the frequency domain.
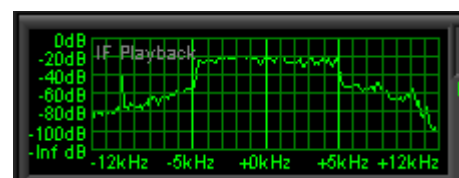
The center reference frequency marked as 0 corresponds to 12 kHz, the intermediate frequency of the receiver. For best receiving results, finely tune the DRM signal around the zero frequency mark in the spectrum scope window. (In the picture above you can see the spectrum of a typical correctly tuned DRM signal.)

The indicator panel shows stereo audio levels, volume setting, the status of the DRM decoding process (Sync will appear first, followed by Data and Audio), and signal SNR (signal-to-noise) ratio. For uninterrupted audio decoding, a SNR level of at least 18 – 20 dB is required. If the level is lower, you will hear drop-outs or there will be no audio: If the sound card and receiver adjustments do not help, then you will need to improve your antenna.
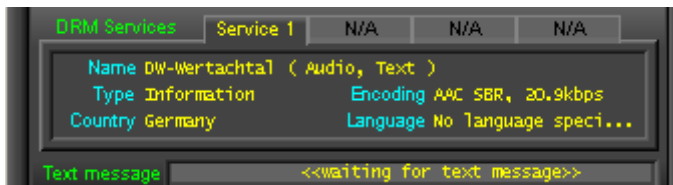
The information window displays the digital data embedded in the transmission.

The recording window is used to record and play back the received signal in the ".wav" format. If the IF button is released, then recording will be made of the decoded audio, for playback on any "wav" device. The type of codec used for the audio recording can be selected under the Setup button ("Default audio codec").

If the IF button is down, the 12 kHz intermediate frequency recording will be made using 48kbit/s PCM, 16 bit mono format. The IF recordings have an extension ".if.wav" and can only be played back through the WiNRADiO G303i DRM software or software compatible with the 12 kHz IF input and capable of decoding DRM signals.

The two check buttons at the bottom can be used to enable data logging (the location and data file path can be set up in the Setup window), and multimedia. The last two buttons at bottom right can be used to delete a file from the playlist and refresh the playlist, respectively.

For detailed operational instructions use the Help button in the DRM decoder panel.