Digital Shortwave Broadcasting

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Outline

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- How to Receive DRM Broadcasts
- DRM in Amateur Radio
- DRM Resources

DRM Overview

Worldwide Shortwave Broadcasting

- An estimated 2.5 billion people tune in to programs broadcast on shortwave, and about a billion receivers pick up shortwave transmissions. At any given moment, over 200 million receivers are tuned in to shortwave broadcasts.
- Today, almost all of these listeners receive analog (AM) transmissions.

Shortwave Advantages

- The difficulty in censoring programming by authorities in target countries.
- Low cost Shortwave radios are widely available in all but the most repressive countries in the world.
- In many countries, particularly in most third world nations and in the Eastern bloc during the cold-war era, ownership of Shortwave receivers is widespread. In many of these countries some domestic stations also use SW.
- Many newer SW receivers are portable and can be battery operated making them useful in difficult circumstances such as war-torn regions, disaster struck areas, refugee camps etc.
- Shortwave radios can be used in situations where internet or satellite technology is unavailable or unaffordable.

Shortwave Drawbacks

- Shortwave broadcasts often suffer from serious interference problems.
- The dependence of shortwave radio propagation on atmospheric conditions means that it can be difficult to use by non-technical listeners.
- Even under ideal reception conditions the audio quality of AM shortwave is usually inferior to that of domestic stations, particularly FM stations.
- As more people around the world have access to television and the Internet old technologies such as shortwave radio find it difficult to compete.
- In most Western countries ownership of shortwave radios is limited to interested enthusiasts. Therefore audiences are limited.

Because of these reasons, many broadcasters are discovering they can reach a wider audience through other methods -- particularly the Internet and satellite television -- and are cutting back or even entirely dropping shortwave.

DRM Overview

- Digital Radio Mondiale (DRM) is an open standard digital radio system for shortwave, AM/mediumwave, and longwave.
- DRM offers clear, near-FM quality audio without the interference, noise, and fading normally associated with shortwave broadcasts.
- DRM transmissions can also integrate data and text.
- The DRM signal is designed to fit in existing broadcast band plans.
- DRM has been endorsed by the ITU, IEC and ETSI.
- On June 16, 2003, leading shortwave broadcasters simultaneously started live, daily DRM transmissions.

DRM Source Coding

- MPEG-4 HE-AAC (High Efficiency - Advanced Audio Coding) -- *most commonly used by DRM broadcasters*
  - a perceptual coder suited for voice and music. The High Efficiency is an optional extension for reconstruction of high frequencies (SBR: spectral bandwidth replication) and stereo image (PS: Parametric Stereo)
- MPEG-4 CELP (Code Excited Linear Prediction)
  - a parametric coder suited for voice only (vocoder) but that is robust to errors and needs a small bitrate
- MPEG-4 HVXC (Harmonic Vector Excitation Coding)
  - a parametric coder for speech programs that uses an even smaller bitrate than CELP

DRM Transmission Parameters

- Modulation: COFDM (Coded Orthogonal Frequency Division Multiplexing) carriers modulated with QAM
- OFDM Carrier Spacing (Hz): determines robustness against Doppler
- OFDM Guard Interval Length (msec): determines robustness against multipath propagation
- Bandwidth:
  - 9 or 10 kHz = standard AM broadcasting channel
  - 4.5 or 5 kHz = half-channels for simultaneous AM and DRM
  - 18 or 20 kHz = 2 adjacent channels for better quality or multiplex channels

4 DRM Profiles

- A: Gaussian channel with very little multipath propagation and Doppler effect. This profile is suited for local or regional broadcasting.
- B: multipath propagation channel. This mode is suited for medium range transmission.
- C: similar to mode B, but with better robustness to Doppler (more carrier spacing). This mode is suited for long distance transmission.
- D: similar to mode B, but with a resistance to large delay spread and Doppler spread. This case exists with adverse propagation conditions on very long distance transmissions. The useful bitrate for this profile is decreased.

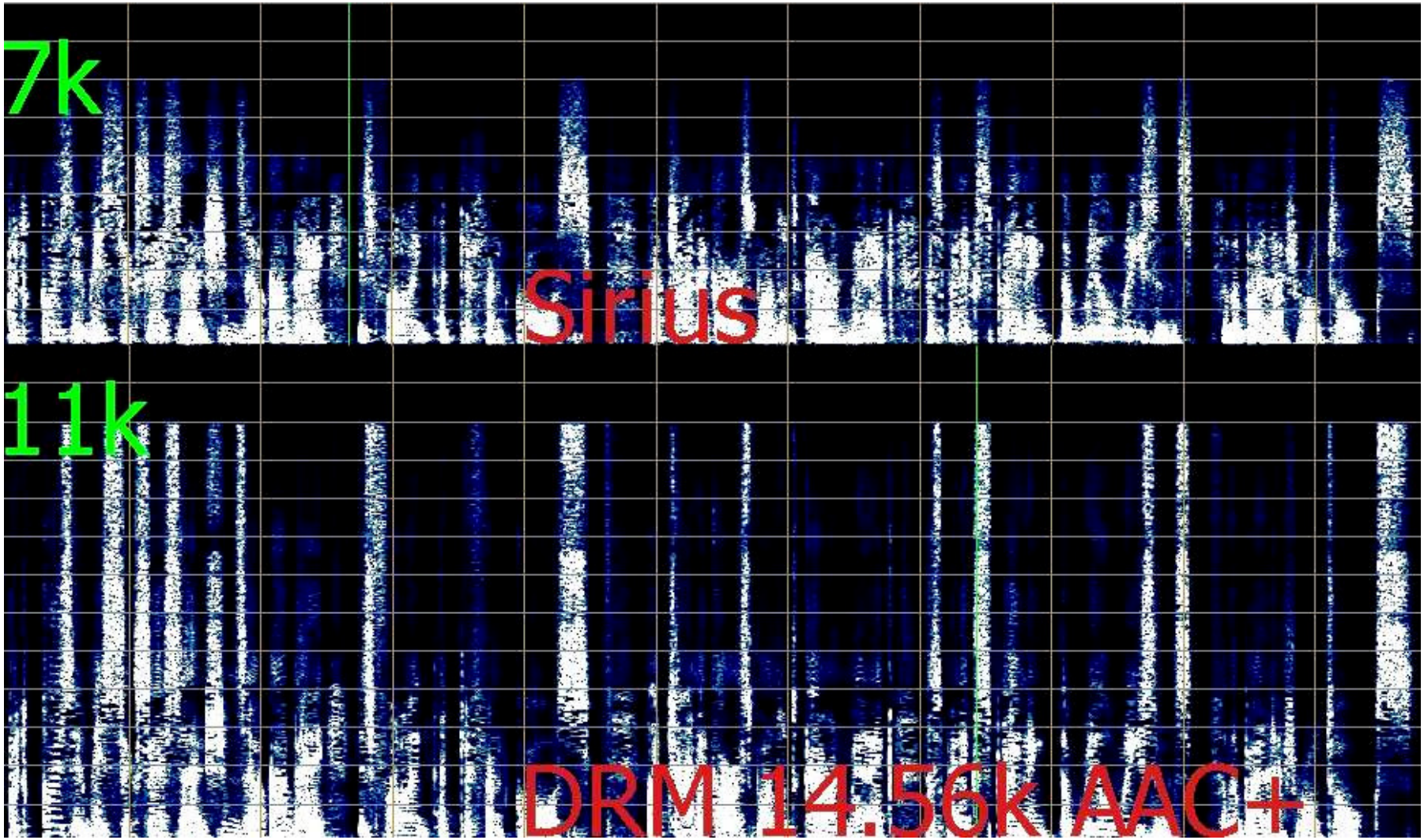
Example Uses of OFDM Modulation

- ADSL and VDSL (DSL) broadband access via POTS copper wiring.
- Wi-Fi (IEEE 802.11a/g) Wireless LANs.
- DAB systems EUREKA 147, Digital Radio Mondiale, HD Radio, T-DMB and ISDB-TSB.
- DVB terrestrial digital TV systems DVB-T, DVB-H, T-DMB and ISDB-T.
- IEEE 802.16 or WiMAX Wireless MANs.
- IEEE 802.20 or Mobile Broadband Wireless Access (MBWA) systems.
- Flash-OFDM cellular systems.
- Certain Ultra wideband (UWB) systems.
- Power line communication (PLC).
- MoCA home networking.

Some Current DRM Broadcasters

- BBC World Service
- Radio Luxembourg
- Radio Canada International
- Deutsche Welle
- Radio New Zealand International
- HCJB
- biteXpress (15.896 MHz, Nuremberg)
- Passion Radio (1386 kHz, Sussex)

Sirius and DRM Spectra



From DRMRX Forum 4/16/07

HCJB on 15680 KHz
Hi all,

We're back! Starting on April 17th, HCJB will be doing some test transmissions to the western USA on 15680 KHz. We will start at 1600 UTC and go until 0200 UTC. The propagation is pretty bad for getting to the Western USA during the day, so we will start at 9 kbps and gradually move up to 17 kbps like we did for the eastern USA a few weeks ago. We plan to do the test for 2 weeks (through the 29th) unless the reception is so bad that no one can decode us. We then plan to move to the eastern USA and then eventually to Europe. So stay tuned....

How to Receive DRM Broadcasts

What You Need To Receive DRM

- Commercial DRM Radio
  - Not generally available in USA

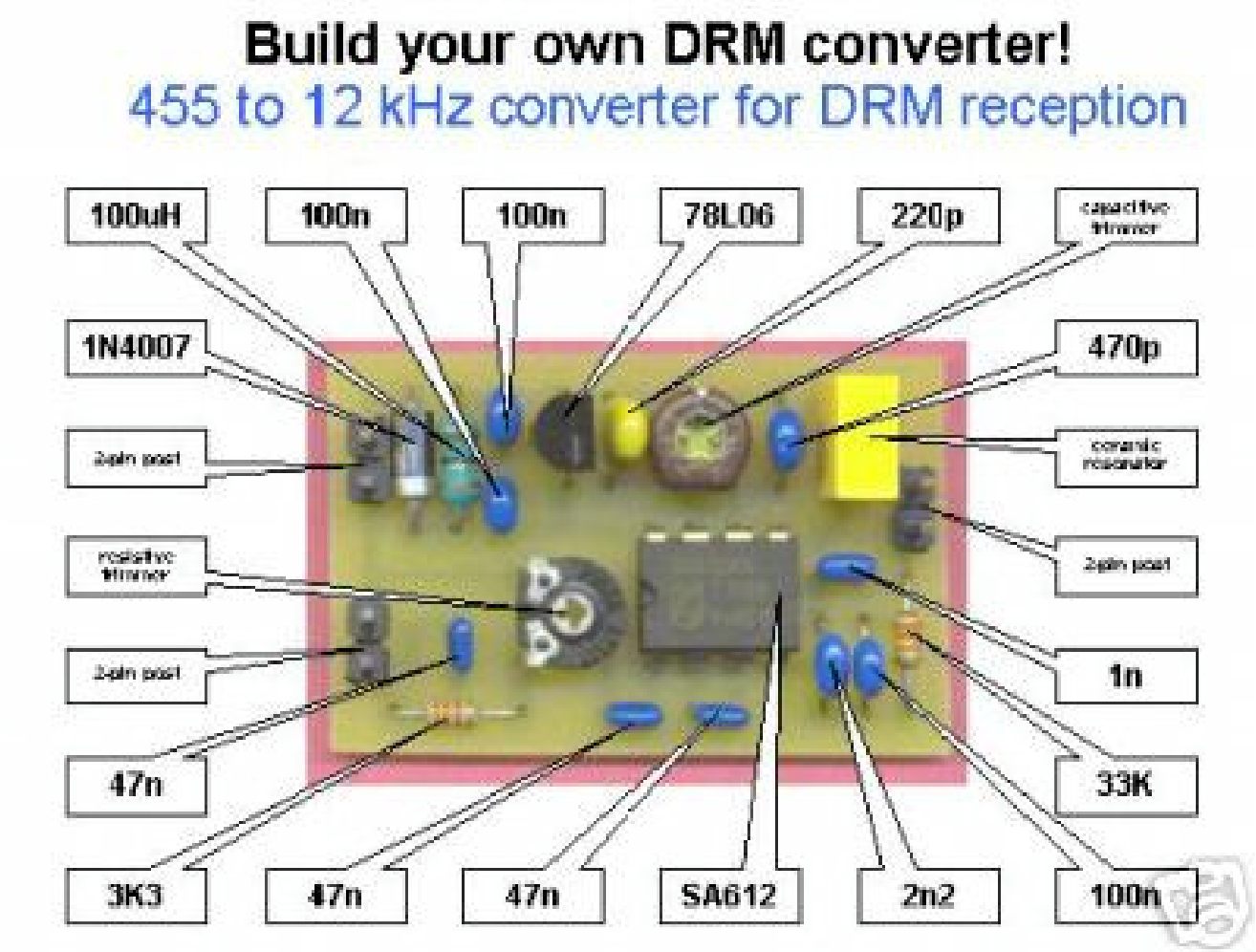
-or-

- Shortwave Radio with 12 kHz IF output
  - most radios require a simple modification
- DRM Software Radio Application on PC
  - soundcard input = 12 kHz IF
  - soundcard output = DRM audio

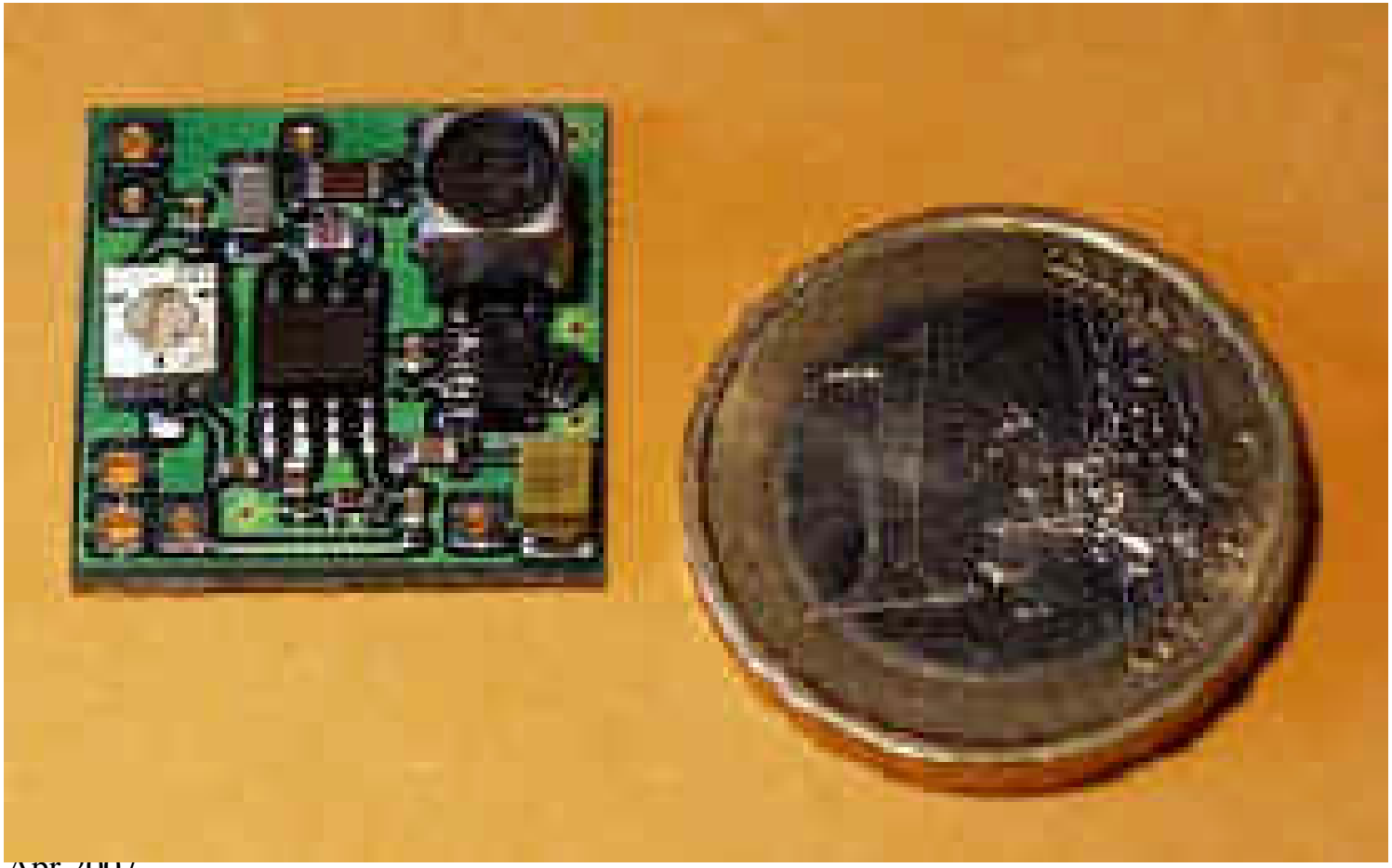
DRM Converter Kits

- Convert 455 kHz IF to 12 kHz IF
- Connect to 455 kHz IF output before filter
- DRM mods for many shortwave radios posted on web
- eBay seller i5xww
  - kit $16 + $4 shipping
  - assembled $22 + $4 shipping
- http://www.sat-schneider.de/
  - assembled $25 + ? shipping

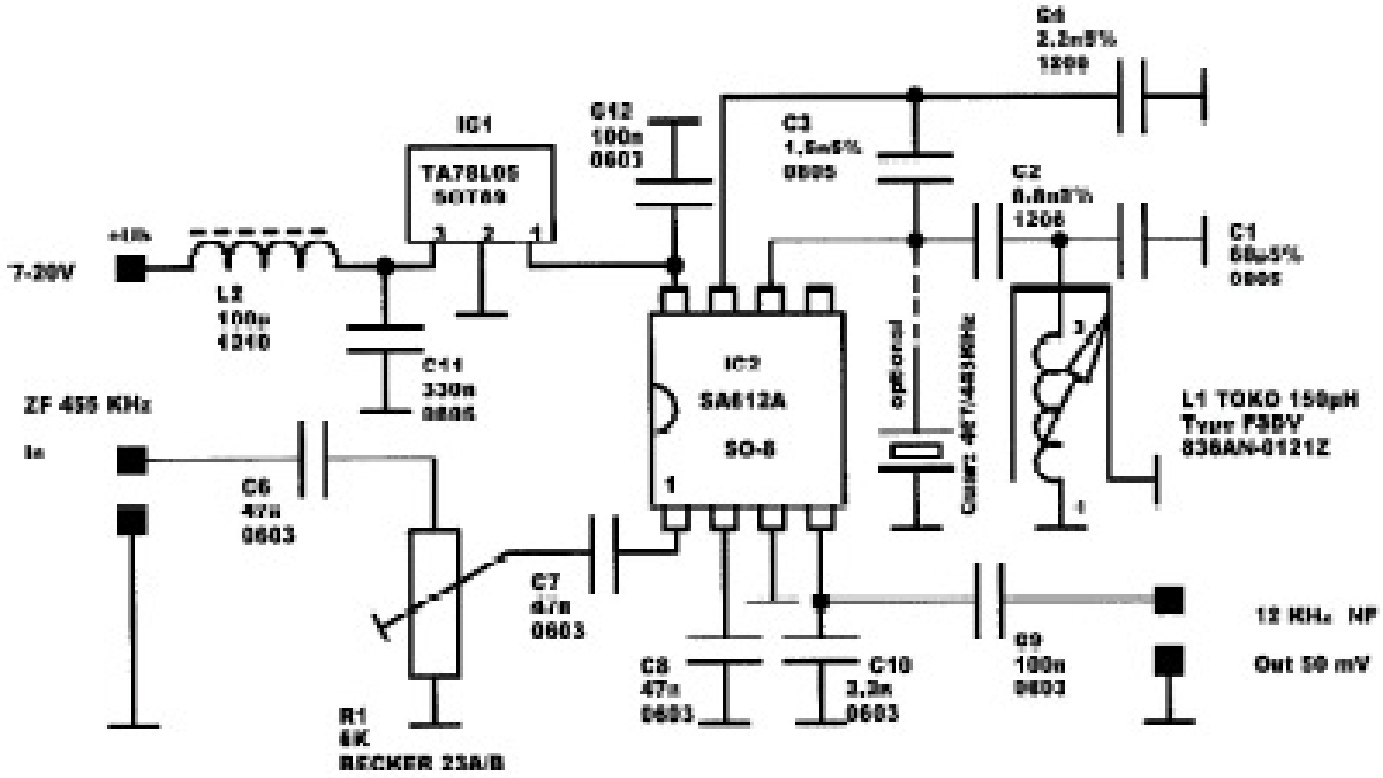
DRM Converter (I5XWW)



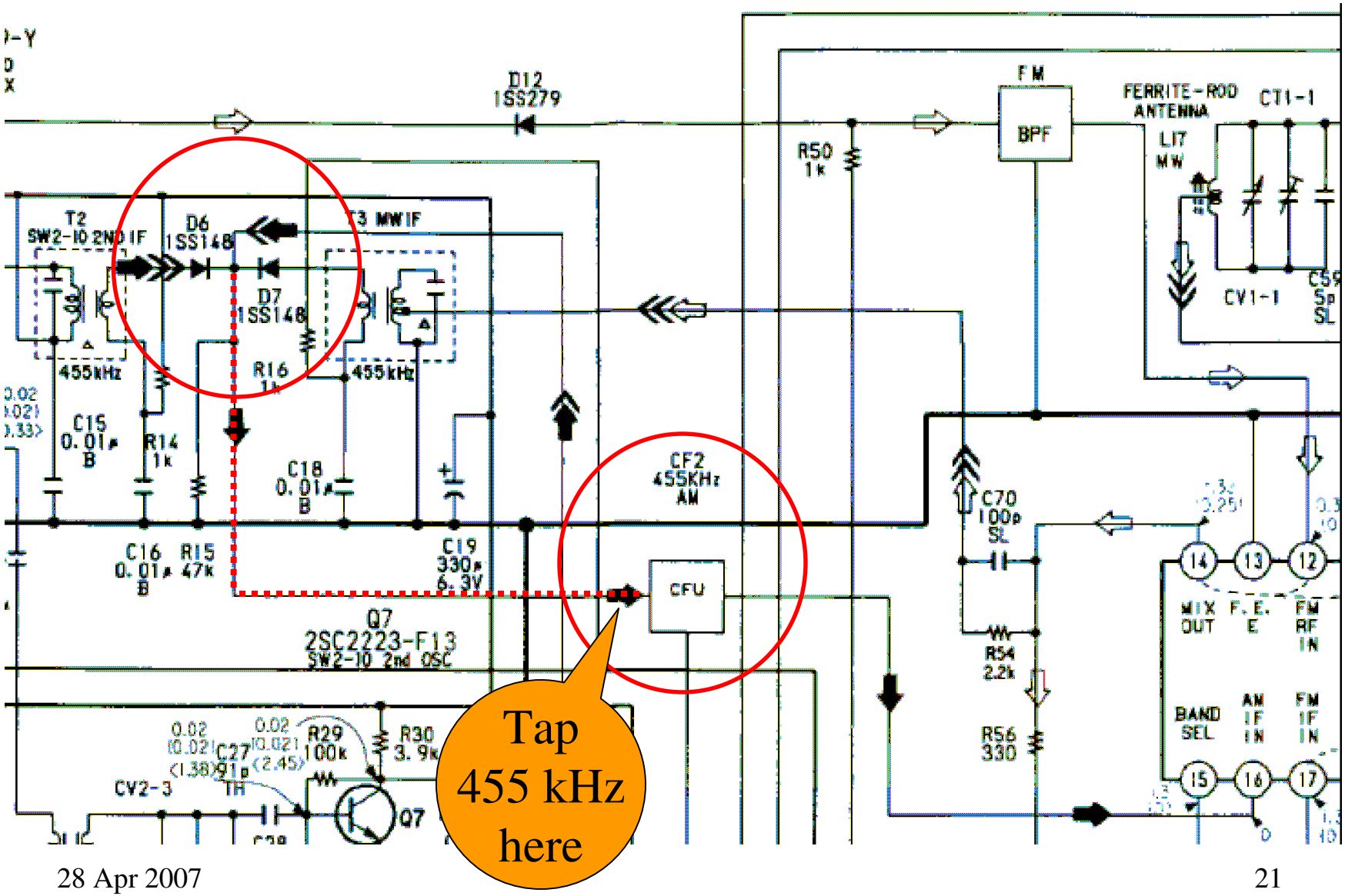
DRM Converter (sat-schneider.de)



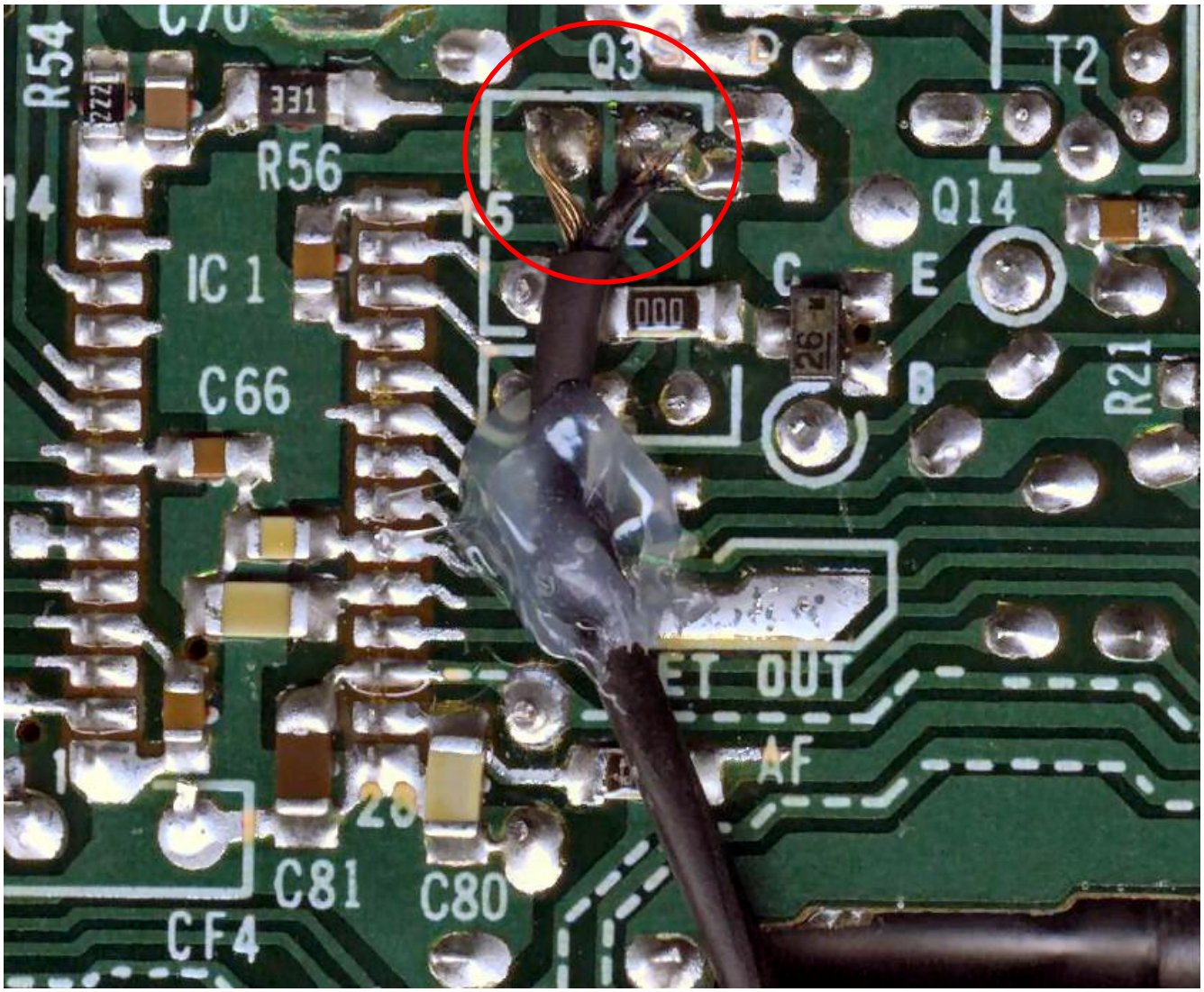
DRM Converter (sat-schneider.de)



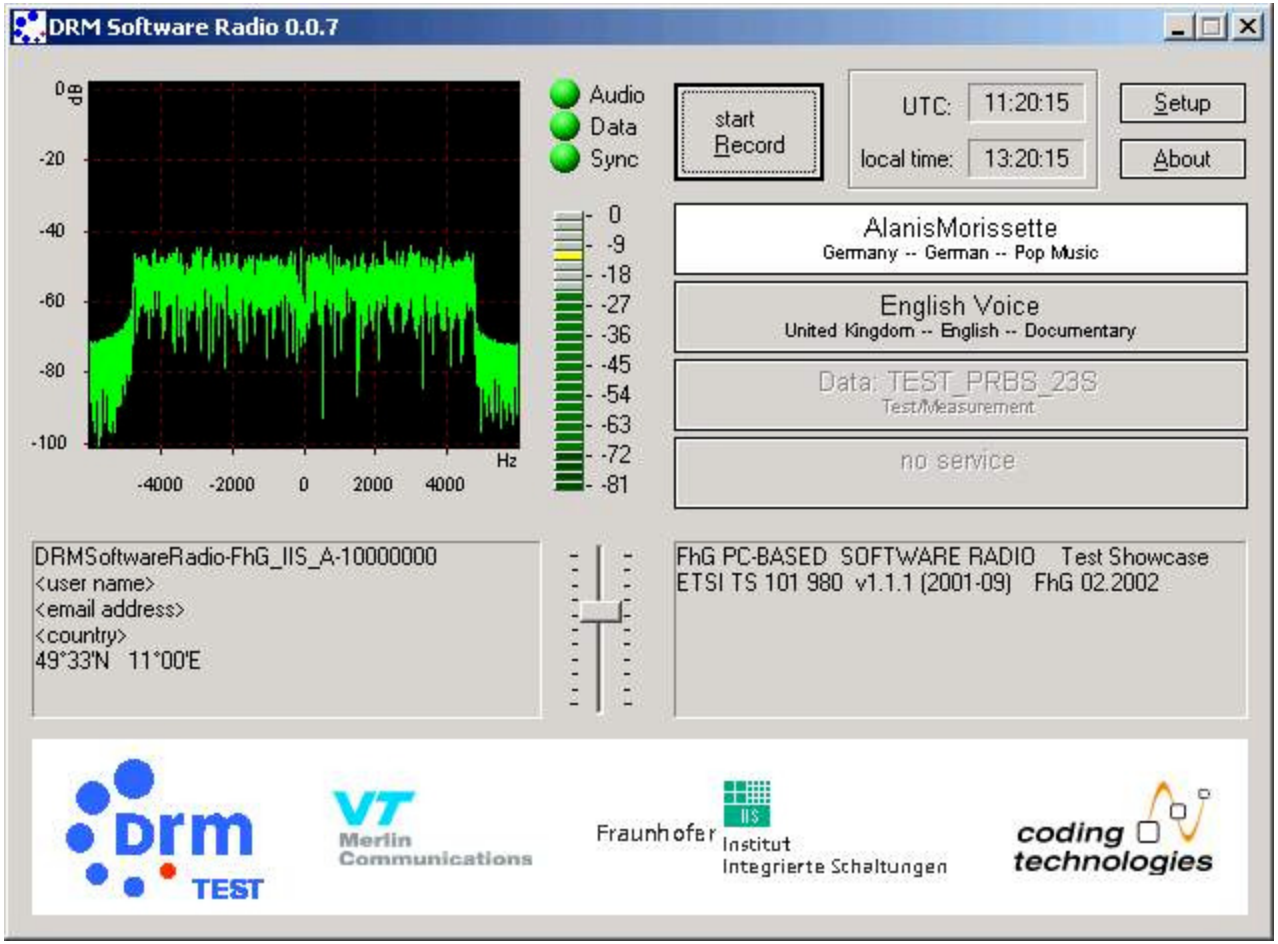
Sony ICF-7601 455 kHz IF



Tapping Sony ICF-7601 455 kHz IF



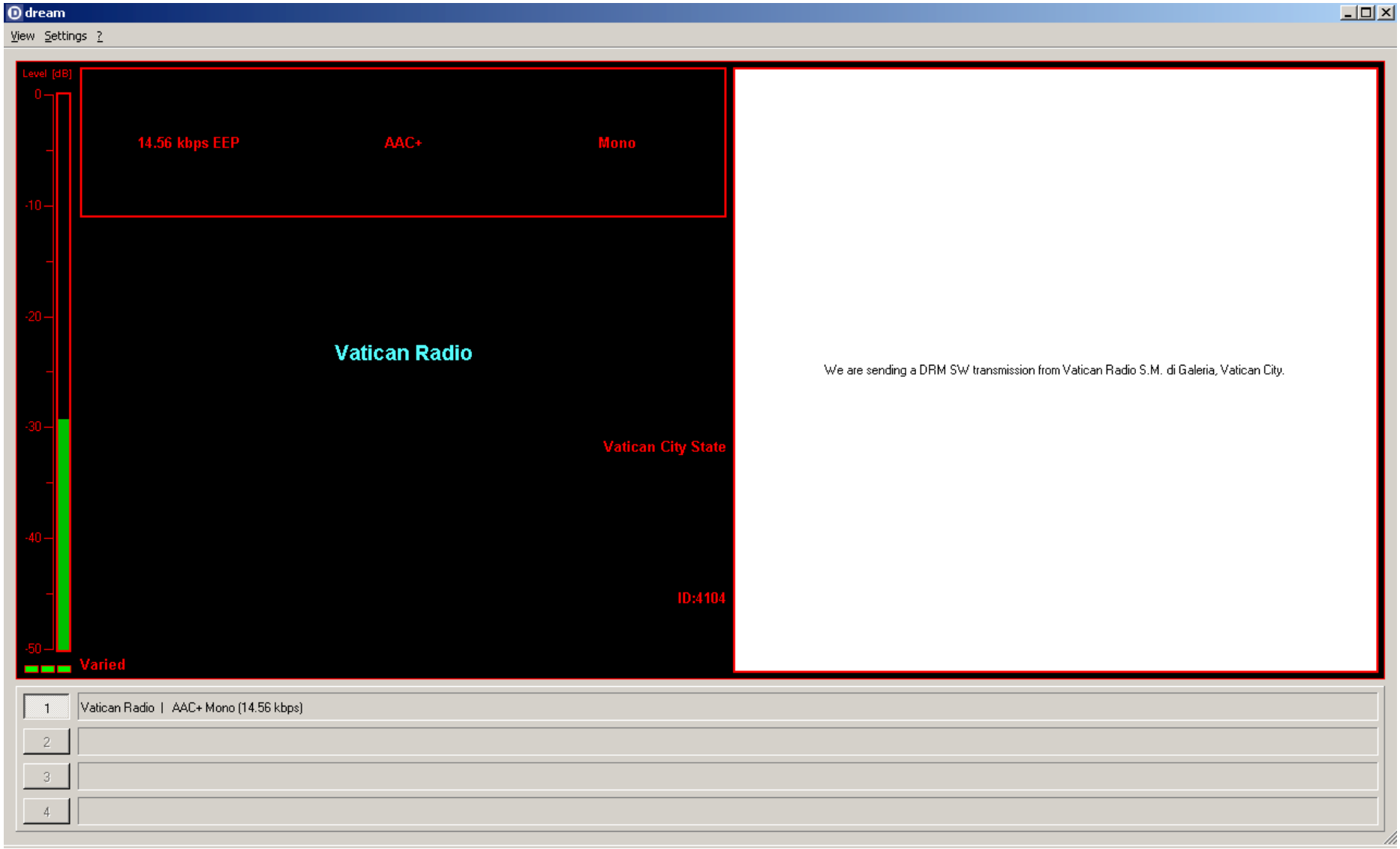
Licensed DRM Software Radio



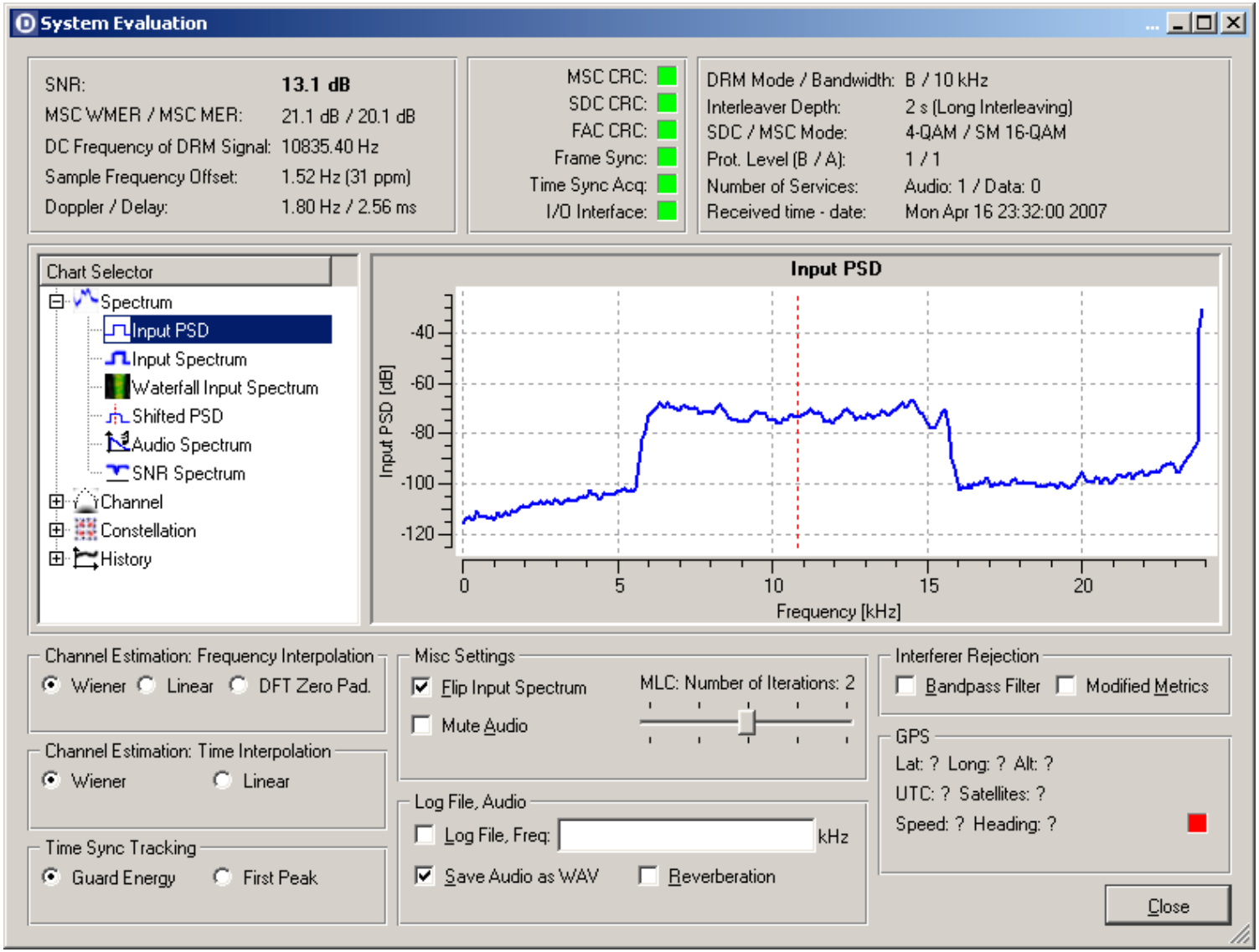
DReaM Software Radio

- Open-Source Software Implementation of a DRM Receiver under the GNU General Public License (GPL)
- Written in C++
- Runs on Microsoft Windows and Linux
- Distributed in source code form
  - DRM technology is covered by patents, so binary distribution is probably illegal in USA
  - Pre-compiled binaries available from international websites, e.g. I5XWW

DReaM Main Window



DReaM Evaluation Dialog



Digital Voice in Amateur Radio

AOR ARD9000Mk2

- List - $359
- Specifications
  - Modulation: OFDM
  - Bandwidth: 300-2500 Hz, 36 carriers
  - Vocoder: AMBE (Advanced Multi-Band Excitation)
    - Proprietary coder developed by Digital Voice Systems, Inc.
    - Used by Inmarsat, Iridium, XM Satellite Radio, G4GUO

AOR ARD9800

- List - $549
- Similar to ARD9000, but with image capability

ARRL Seeks Comments on New HF Digital Protocol

NEWINGTON, CT, Feb 22, 2007 -- The ARRL is seeking comments from amateurs concerning development of an open-source (non-proprietary) data communications protocol suitable for use by radio amateurs over high-frequency (HF) fading paths. This is not a Request for Proposals (RFP). An RFP may or not be forthcoming depending on evaluation of the information received.

Specifically, the League is asking for comments and information on the following issues:

*Access Method: Is Orthogonal Frequency-Division Multiplexing (OFDM) the best candidate technology, or should other competitive technologies be considered?
*Data Rate and Bandwidth: What data rates/throughputs are achievable at various bandwidths up to 3 kHz bandwidth?
*Adaptivity: What adaptive features should be considered, such as automatic adjustment of transmitter power, modulation waveform and coding, in order to maximize throughput and efficiency in two-way contacts?
*Robustness: What is achievable for reliable operation at power levels typical in the Amateur Radio Service and low signal/noise and interference ratios?
*Error control: What are the appropriate applications of error control suitable for HF channels? For example, how should Repeat reQuest (ARQ) and Forward Error Control (FEC) be applied to two-way contacts and one-to-many (roundtable and bulletin) transmissions?
*Activity Detection: What is an effective method of determining whether a frequency is busy prior to transmission?
*Operating System: What operating systems (such as Windows or Linux) are appropriate for Amateur Radio use with this protocol?
*Hardware: What practical and affordable hardware platforms are suitable for amateur stations? Consider the use of personal computers with or without sound cards. Provide any information about the need for an additional "box" if needed.

Please provide the following with your response: (1) name of respondent, (2) respondent's contact information, (3) related experience, and (4) type of respondent: (individual, partnership, corporation or group). Do not include proprietary information as part of your response.

Post, fax or e-mail your response by 1900 UTC, May 15, 2007, to ARRL Chief Technology Officer Paul Rinaldo, W4RI, 3545 Chain Bridge Rd -- Suite 209, Fairfax, VA 22030; Fax: 703-934-2079.

DRM in Amateur Radio

HamDream

- HamDream was an adaption of the open source DRM software DREAM written by V.Fisher and A. Kurpiers
- The DRM standard defines bandwidths of 4.5 to 20 khz. HamDream uses only 2.5 khz.
- HamDream is the basis for the current 2.5khz DRM programs
- The project has been discontinued and is no longer supported

WinDRM

- WinDRM is the successor to HamDREAM
- WinDRM is essentially a new GUI for HamDREAM, with Rx and Tx combined, and some new data capabilities implemented.
- Vocoders used
  - MELP (Mixed Excitation Linear Prediction) vocoder
    - MELP is protected by patents, so MELP DLL is distributed as source code in USA
  - SPEEX (based on CELP) <http://www.speex.org>
  - LPC 10 <http://www.hawksoft.com>
- One can transfer data at almost 1KB/s without using proprietary hardware

DRMDV

- The latest DRM digital voice mode on HF
- Optimized for high quality digital voice under poor band conditions
- Advanced interference rejection

Amateur Radio DRM Activity

- 14236.0 @ 1500-1800 UTC Mon-Fri
- 14236.0 @ 1900 UTC Sat-Sun
- Some activity on 75 and 40 meters in evening
- Initiating contacts
  - Some call CQ on SSB and then switch to DRM
  - Some call CQ in DRM

DRM Resources

DRM Software

- Licensed DRM Software Radio
  - http://www.winradio.com/home/download-drm.htm
- Open Source Dream Software Radio
  - http://drm.sourceforge.net/
- WinDRM
  - http://www.n1su.com/windrm/
- DRMDV
  - http://www.n1su.com/drmdv/

DRM IF Converter Hardware

- I5XWW
  - Search eBay for “DRM Converter”
  - http://xoomer.alice.it/i5xww/drm.htm
- Sat-Schneider
  - http://www.sat-schneider.de/

DRM Mailing Lists

- Yahoo! Groups (number of members)
  - DRM-L (509)
  - hifi-am (162)
  - drmna: DRM North America (117)
  - Ham-DRM (101)
  - drm-shortwave-dx (50)
- Google Groups (number of members)
  - WinDRM (725)

DRM Articles

- “Life Could Be A DReaM”, Steve Ford, QST, April 2007, page 38.
  - http://www.ecommercetimes.com/story/6gsTq2hlUz6phY/Life-Could-Be-a-DReaM.xhtml

DRM Reference Material

- DRM Broadcast Schedule
  - http://www.drm.org/livebroadcast/livebroadcast.php
- DRM Receivers and Equipment
  - http://www.drm.org/receiversequip/receiversequip.php
- DRM Standard Specification
  - http://www.drm.org/specifications/specifications.php

Appendix

FM IBOC (In-Band On-Channel)

- Transmits digital radio and analog radio simultaneously on the same frequency
  - iBiquity HD Radio
    - Digital sidebands are inserted just outside the analog channel
  - Digital Radio Express FMeXtra
    - uses subcarriers within existing FM signal
  - DRM
    - in initial stages of creating an open system for FM