# Cheap Dynamic RDS System

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## Overview

WUVT implemented a dynamic RDS system using the shareware Airomate RDS encoder, a Windows XP-capable PC, and a 192-kHz sample-rate capable sound card (M-Audio Revolution 5.1). WUVT installed the Chronos scheduler program (http://www.heinecke.nl/chronos.html) to schedule RDS messages. The student-run station became the first in the market with an operational dynamic RDS system, at less than ¼ of the cost of a comparable stand-alone RDS unit that the big commercial stations are running – to date of this document, they STILL haven't figured out how to make theirs dynamic!

## Materials

- >600 MHz PC
- Windows XP Professional
- M-Audio Revolution 5.1 Sound Card
  (a list of working cards here: http://www.heinecke.nl/soundcards.html)
- Registered version of Airomate RDS/Stereo encoder
  (http://www.heinecke.nl/airomate2.html), and Chronos Scheduler (optional)
- BNC – 1/8" stereo phono coax jumper (details on how to "roll your own" are included)
- Calibrated and somewhat accurate modulation monitor, with at least 1% resolution at mod levels below 10%.

## Price List

| | |
|---|---|
| Computer | <$200 |
| Sound card: | ~$70 |
| Registered version of Airomate: | ~$30 |
| WinXP | ~$150, or University license discount… |
| Cabling | ~$10 |
| TOTAL | <$460 |
| Comparable operation to stand-alone Audemat-Aztec RDS Generator | **>$2000** |
| You save | >$1540 !!!! |

# Method

Install and configure Windows XP & the M-Audio card to your liking. Remember to disable all system alert sounds in the control panel. Then install the Airomate program. If you want to run the Chronos scheduler for the RDS system, install it now. You will also want to install an NTP client, or some other time synchronization program to ensure your scheduled messages are sent on time.

Airomate is designed to replace your entire stereo multiplex encoder. It's not recommended that the program be used in this manner, as your current stereo generator is probably more versatile, and far cleaner (thus reducing multipath). However, it's a very good idea to have Airomate configured such that you can use it in a pinch as a back-up multiplex generator. We'll only focus on RDS configuration here.

- Start the program.

- Click on **SETUP -> MPX**.
    - Disable Stereo
    - Click Apply, and Save Settings Now

- Click on **RDS.**
    - Check the "Enable" box.
    - Set volume to 10.0%
    - Set phase shift to 0
    - Set frequency to automatic
    - Click Apply, and Save Settings Now

- Under **RDS -> Various Settings**
    - Language identification should be English
    - Set your program type (PTY). Remember that this program came from Europe, and subsequently uses European PTY codes instead of American ones. You'll need to use the European – American PTY code look up table at the end of this document. For example, WUVT has its PTY set as "Education," which shows up as "Rock" on an American receiver.
    - Leave PTYN blank… again, a European bit setting only.
    - Under DI, check "Stereo"
    - No Program Item Numbers need to be loaded, as again this is a EU-only setting.
    - Click Apply, and Save Settings Now

- Under **PI and ECC**
    - PI and ECC should be set to USA 3
    - Set coverage to Local
    - Prog ref number should be set to 0 (00)
    - Click Apply, and Save Settings Now

- Under **Program Service**
    - Here, you can select to run a static list of Program Types (this is the text the replaces the freq readout on most systems). The list is built in this window. Take care to not exceed the character limitations (no more than 8 chars).
    - Alternatively, you can set Airomate to read PS from a text file. If you're using the Chronos scheduler or other software that writes PS data to a text file, use this setting and point it to your datafile.
    - Click Apply, and Save Settings Now

- Under **Radio Text**
    - Enable Radio Text, uncheck "Send RT as group 2B).
    - Like the PS dialog, you can set a static list of RT messages or point to a text file that updates with new text… (if you're running Scott Studios or Enco, I believe there is a way to get the air playout machines to spit Artist-Track of currently playing audio to a text file).
    - Click Apply, and Save Settings Now
- Under **Alt Freqs.**
    - If you have translators and/or boosters, you can input their freqs here, and most receivers will search those freqs when the mothership station drops below a certain signal threshold. The aux stations MUST carry the same RDS hexadecimal station ID as the mothership transmitter. If the auxes are off-air-fed, or are fed from the same composite microwave system, this shouldn't be a problem.
    - Click Apply, and Save Settings Now

Next, you'll need to inject the 57 kHz baseband (coming from the computer) into a MUX/SCA port on the STL or Exciter. This can be accomplished using a cable (coax, RG-162 or similar) with a 1/8" stereo mini phono plug on one end, and a BNC on the other. These parts can be obtained at Radio Shack. ONLY THE LEFT CHANNEL NEEDS TO BE CONNECTED TO THE CENTER CONDUCTOR OF THE COAX!

Set the master output of the soundcard to 0. Turn ON Airomate. Connect the sound card to your RF system. If you have a modulation monitor handy that can read the 57kHz subcarrier (like some of the newer Innovonics), you can simply set the mod monitor to watch that carrier and set your sound card volume until you achieve 2-4% injection.

If you don't have a modulation monitor that can discrimate between subcarriers, find a time when you can drop all audio from your station. With no audio on the station, read your total modulation (should be somewhere near 9% with stereo enabled, 0% mono. If you have other subcarriers on, such as control back-hauls or talk-back channels, these will show up too). Once you have that reference, increase sound card volume until you are 2-4% higher than you started. You may need to pull back you main audio modulation to stay within the legal modulation limits.

**TECHNICAL NOTES:**

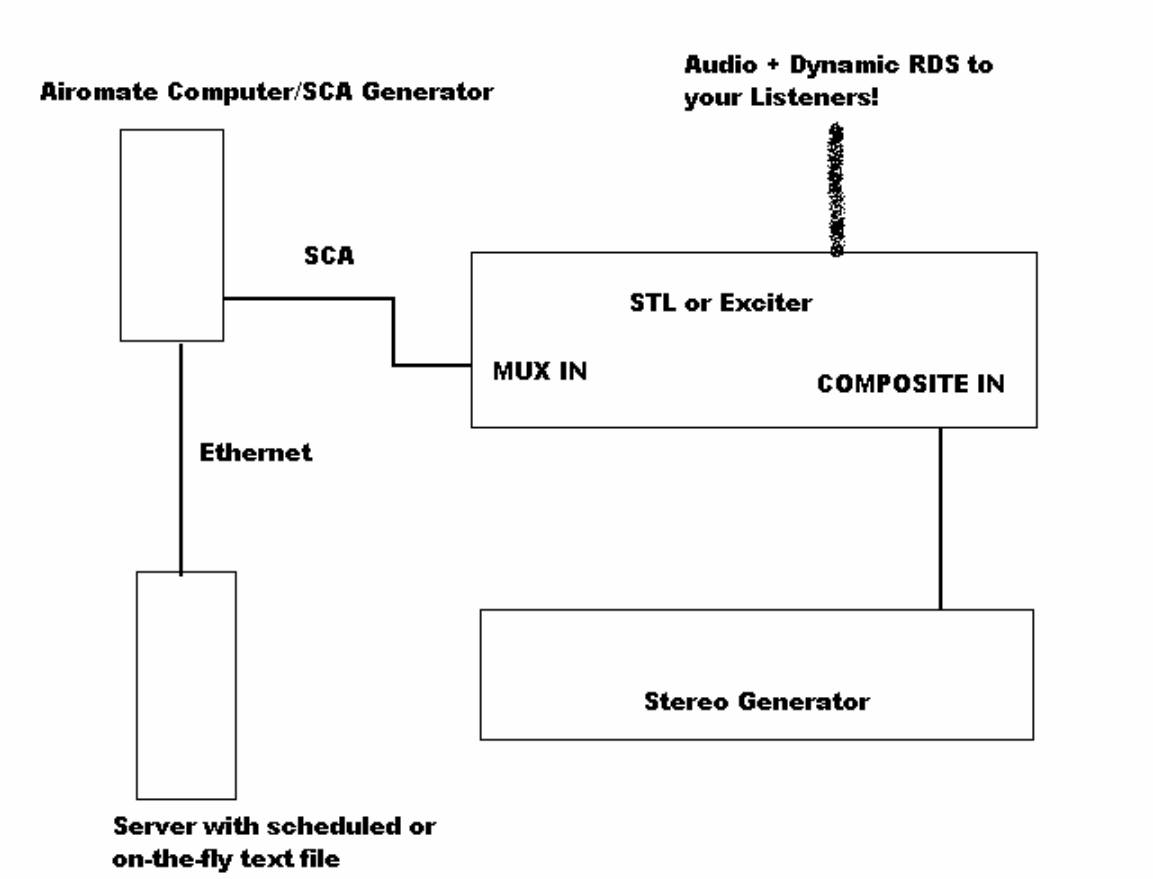
Sound cards are not linear SCA generators, and the noise from this non-linearity can exacerbate multipath effects. You'll want to choose a soundcard with a high Signal to Noise Ratio. The M-Audio Revolution 5.1 proved far superior to Creative's SoundBlaster Audigy in this figure when bench tested with the scope.

Given this, even with the better audio card, it may be advisable to build an outboard variable pad to attenuate the RDS subcarrier coming out of the soundcard. That way you can run maximum volume out of the sound card, providing maximum SNR, and still have control over the SCA injection.

There is no way to synchronize this 57kHz SCA with the 19kHz stereo pilot tone in your multiplex, unless you use Airomate to generate your entire multiplex. This mean the RDS subcarrier could cause audible beat products in the station's audio, given the harmonic relationship between the two signals. Phase alignment in Airomate will not correct un-sunk oscillators, and the oscillator resolution in the manual frequency set-up in Airmoate leaves a lot to be desired.

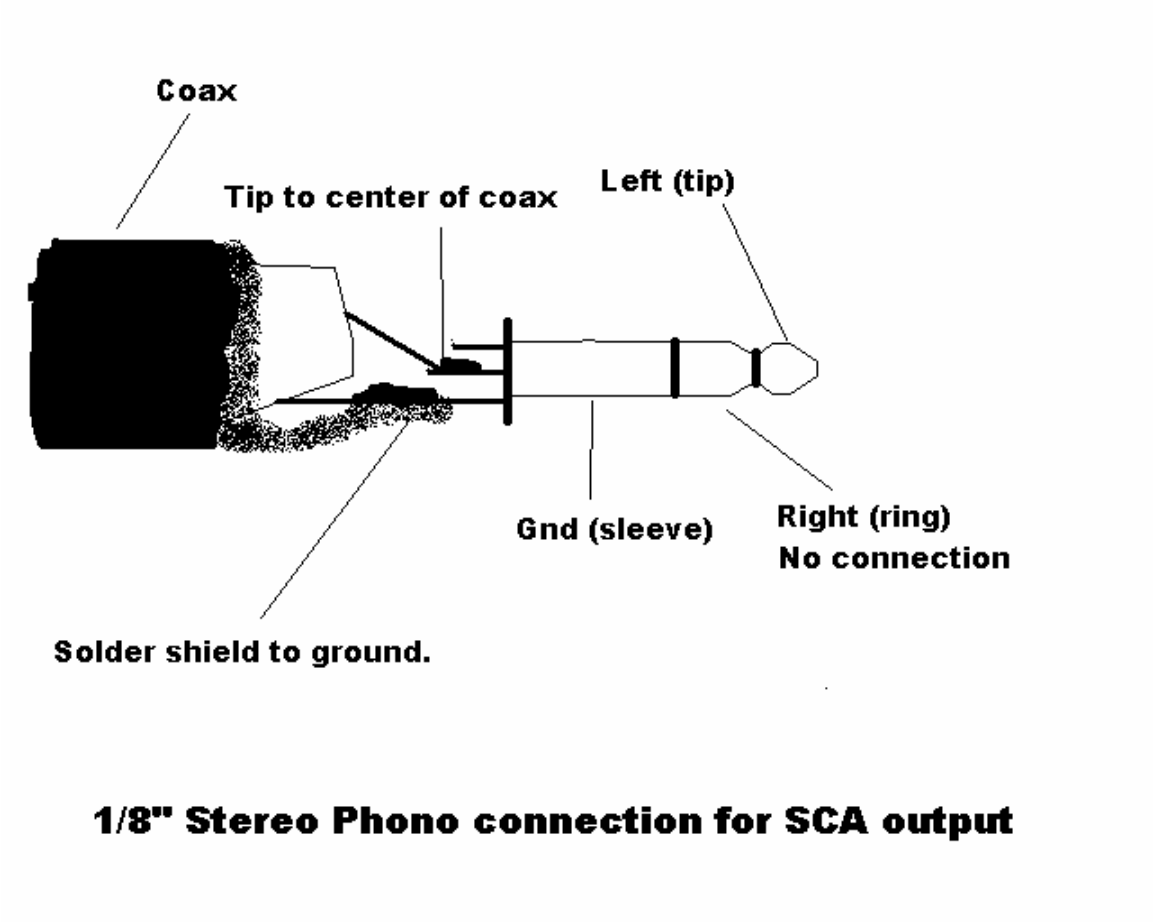
The RDS subcarrier generated by Airomate is NOT the best quality, and will fall apart quicker than carriers generated by pilot-sunk boxes like the Innovonics 702, or internal generators like in the BE FXi-series exciters. This is especially true in high-multipath environments. That being said, it's still effective means of getting dynamic RDS on the air.

# APPENDIX A – System Block Diagram




A simple schematic representation of the system described in this document.

# APPENDIX B – Cable Termination




**1/8" Stereo Phono connection for SCA output**

Here, it's probably easiest to buy a pre-fab BNC-to-BNC cable, cut one end off, and solder your mini phono plug on the bare coax. Make sure you run the outer sheath of the connector onto the cable before soldering! Only the Left channel is used – the right channel is left unconnected. IT'S STILL NECESSARY TO USE A STEREO CONNECTOR, so as to not short the right channel output amplifier in the audio card, in case you want to use it for audio later.

# APPENDIX C – American-European PTY Conversions

*1993 Table: European (CENELEC) and US Program type codes*

| Number | CENELEC PTY (RDS) | | US PTY (RBDS) | |
|---|---|---|---|---|
| 0 | No program type or undefined | NONE | No program type | __****__ |
| 1 | News | NEWS | News | NEWS |
| 2 | Current affairs | AFFAIRS | Information | INFORM |
| 3 | Information | INFO | Sports | SPORTS |
| 4 | Sport | SPORT | Talk | TALK |
| 5 | Education | EDUCATE | Rock | ROCK |
| 6 | Drama | DRAMA | Classic rock | CLS_ROCK |
| 7 | Culture | CULTURE | Adult hits | ADLT_HIT |
| 8 | Science | SCIENCE | Soft rock | SOFT_RCK |
| 9 | Varied | VARIED | Top 40 | TOP_40 |
| 10 | Pop music | POP_M | Country | COUNTRY |
| 11 | Rock music | ROCK_M | Oldies | OLDIES |
| 12 | M.O.R. music | M.O.R._M | Soft | SOFT |
| 13 | Light classical | LIGHT_M | Nostalgia | NOSTALGA |
| 14 | Serious classical | CLASSICS | Jazz | JAZZ |
| 15 | Other music | OTHER_M | Classical | CLASSICL |
| 16 | Spare | | R&B | R_&_B |
| 17 | Spare | | Soft R&B | SOFT_R&B |
| 18 | Spare | | Language | LANGUAGE |
| 19 | Spare | | Religious music | REL_MUSIC |
| 20 | Spare | | Religious talk | REL_TALK |
| 21 | Spare | | Personality | PERSNLTY |
| 22 | Spare | | Public | PUBLIC |
| 23-29 | Spares | | Spares | |
| 30 | Spare | | Emergency test | TEST |
| 31 | Alarm | ALARM | Emergency | ALERT! |

From http://www.qsl.net/wa5iyx/rds.htm