Sonifex PCIe AM and FM Radcap
Set-up for Linux Debian (and derivative) systems

Overview

These drivers operate through the ALSA API, providing multi-station recording of AM and stereo FM broadcasts. Each station is selected using the ALSA identifier

hw:card**,**device**,**substream

where card is the zero-based card number of the Radcap, device is always 0 for the Radcap cards and substream is the zero-based station number.

The native sampling rate is 22050Hz for the AM card and 48000Hz for the FM card, however automatic sampling rate conversion can be inserted by using **plughw:** instead of **hw:** in the ALSA identifier.

Installation

The files supplied for use with the Radcap cards are:
amradcappcie.c	Kernel module for the AM Radcap card
fmradcappcie.c	Kernel module for the FM Radcap card
radcap.c	Simple text-based utility to configure Radcap cards
Makefile	For compiling the above files
etc_init.d_radcap	Boot / shutdown script - **/etc/init.d/radcap**
etc_default_radcap	Local parameters - **/etc/default/radcap**

The above files should be placed in an appropriate directory, such as the local system source code area at **/usr/local/src/radcap** or in an administrator's home directory tree. The directory owner should be set to the user maintaining the Radcap system.

The **/etc** files are only used where system boots start the Radcap capture process, rather than a user doing this manually. If the automated method is to be used, first verify manually that the capture process works correctly, then install the system files into their respective locations as described below.

There are 4 Debian packages to be installed, if they are not already:
linux-headers-*	Kernel header files - see below.
gcc	GNU C compiler
make	Project compilation utility
libasound2-dev	Development files for ALSA shared library

The particular linux-headers package to be installed is dependent on the system and will typically involve a choice of a 32-bit or 64-bit version. One of the meta-packages (for example, **linux-headers-generic**) should be chosen rather than a specific kernel version, so that if the kernel is updated, the header files are as well. Any of the normal package management utilities (apt-get, synaptic, etc) may be used for this. Some of these packages have dependencies that are also required.

The commands shown are entered via the shell. Change to the directory where the Radcap files are stored. Compilation need only be done on initial installation or when the kernel is updated. It consists simply of entering the command:

make

No special permissions other than read/write access to the directory are required to do this. Ignore warnings from the compilation; these will be addressed in a subsequent version. The kernel module files and the Radcap configuration utility should now be ready.

Loading modules into the kernel requires superuser privileges. The Radcap modules are dependent upon the **snd_pcm** module being already loaded, so if it is not, it must be loaded before the Radcap module:

sudo modprobe snd_pcm

The relevant Radcap module is then loaded. Using the FM Radcap as an example:

sudo insmod fmradcappcie.ko

The Radcap card should now be visible both to the configuration utility **radcap** and to ALSA itself. Enter the command:

.**/radcap**

The installed Radcap cards should be reported, with their respective configurations.

At present, unloading the modules causes a system crash. This is being investigated.

To test the audio stream, configure a station on a Radcap card. For instance, if there is an FM card at ALSA card 1 and a local FM station on 105.7 MHz, enter the command:

./radcap -c 1 -s 2 -f 105700

to set station number 2 to receive it. Setting a station's frequency to 0 disables it.

The standard ALSA **arecord** utility may be used to capture the stream:

arecord –D hw:1,0,2 –c 2 –f S16_LE –r 48000 –M –d 20 recording.wav

This will save 20 seconds of 16-bit little-endian stereo 48kHz PCM audio from the above station to the file **recording.wav**, which may then be played through a regular ALSA sound device.

Radcap configuration utility

The options to the **radcap** software are described near the top of the source file; a manual page is under development. An overview of the options is available with the command:

./radcap -h

Automated set-up at system boot

Once proper operation of the Radcap card has been verified, it is possible to allow the

Radcap card state to be maintained across systems reboots, using the system boot scripts mechanism.

To set this up, run the following command:

sudo make install

This command will install the start up script **/etc/init.d/radcap** which will be run at system boot time and on shutdown.

The default location for the kernel module files is **/usr/local/src/radcap** and this should be the case after following the installation instructions. However, if the .ko kernel module files are not located at **/usr/local/src/radcap** they can either be copied to that location or the **MODULE_PATH** variable in **/etc/init.d/radcap** can be modified to provide the correct path to the .ko files.

The default location for the **radcap** utility is **/usr/local/bin/radcap.** This may also be changed by modifying the **DAEMON** variable in **/etc/init.d/radcap.**

On start up using the **/etc/init.d/radcap** script, **radcap** will load the configuration that is stored at **/var/local/radcap/radcap.state**.

When the computer is shutdown, **/etc/init.d/radcap stop** will be run and the current **radcap** configuration will be stored in **/var/local/radcap/radcap.state** so it can be restored the next time the computer is booted.

Note that the **radcap** utility is not a daemon in the normal sense; it was made to look like one simply for the purposes of the common runtime configuration subroutines. **/usr/local/bin** is normally in a user's execution path, so once installed there, there is no need for the ./ or any other qualifier at the beginning of an invocation of **radcap**.

Any time the user wants to modify the existing configuration, they can run the **radcap** utility manually from the command line. If the -o option is used, the modified configuration can also be stored in a file.

For example:

radcap /var/local/radcap/radcap.state -c 0 -s 1 -a -o /tmp/newradcap

Will load the current configuration stored in **/var/local/radcap/radcap.state**, modify station 1 and store the updated configuration in **/tmp/newradcap**. The path passed after -o option gives the location where the modified configuration file will be written to.

Expansion keys

The AM and FM PCIe Radcap cards are factory-configured for 6, 12, 18, 24 or 32 stations, however the lower range ones can be expanded to a greater number of channels by purchasing an expansion key from Sonifex.

To apply an expansion key to a card under Linux, the hardware ID of the card is required. This is a unique 60-bit value burnt into the card's FPGA by Xilinx (referred to in their documentation as the chip's DNA value) and which is reported by the **radcap** utility described above.

The kernel module uses the expansion key at initialisation and is provided this information on the **insmod** command line:

> **sudo insmod fmradcappcie.ko expansion_keys=**"hardware_id**:**expansion_key"

where hardware_id is the hexadecimal hardware identifier string and expansion_key is the supplied key number. If more than one card is present in the system, their keys may be specified using a comma-separated list of hardware_id**:**expansion_key pairs. The driver will use the hardware identifiers to assign the correct key to each card.

In a system where the automated Radcap startup is used, the expansion keys are stored in the file **/etc/default/radcap** :

> **FMRADCAPPCIE_OPTIONS="expansion_keys=**"hardware_id**:**expansion_key\""

Similarly, **AMRADCAPPCIE_OPTIONS** is used for the AM cards.

FM de-emphasis

The default FM de-emphasis is 50µs. A de-emphasis of 75µs may be set on the **insmod** command line or in the **/etc/default/radcap** file by adding an option **deemphasis=75**, either with or without the **expansion_keys** option. White space separates expansion key specifications from the de-emphasis setting.

De-emphasis may also be set at run time with the **radcap** utility.

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