Software Phonepatch for the Asterisk PBX

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29 April 2006

Revision History

Revision 0.1 25/05/2006 Introduction

Revision 0.2 31/05/2006 Hardware, Asterisk configuration, Phonepatch configuration, Test

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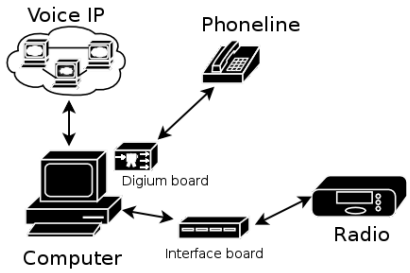
1. Introduction

A *phonepatch* is a device that allows radio stations to make phone calls. On the past, that could only be achieved with a hardware device, connected to the *PSTN* (Public Switched Telephone Network) and with a radio transceiver. Nowadays, with the arise of software PBX, the versatility of a phonepatch is not constrained to hardware, and can be integrated as part of the software. This radio-phonepatch has been designed to work together with the Open-Source Asterisk PBX on a GNU/Linux operating system.

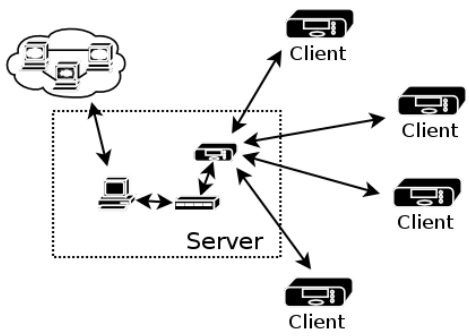
Figure 1. Hardware phonepatch

Figure 2. Software Asterisk-phonepatch



The phonepatch has been designed to work on centralized networks, so the phone link can be used for more than one radio station. The only limitation is, of course, that just one simultaneous talk is possible. In those networks, each radio-user will have its own Asterisk extension.

Figure 3. Typical network using an Asterisk phonepatch



1.1. Features

- Incoming calls (from phoneline or VoIP links) to radio users.
- Outgoing calls (from radio to phoneline or VoIP links)

- Audio language configurable, available for english and spanish.
- Use festival for text-to-speech.
- Audio gain for phone, radio link and festival are configurable.
- Radio users can control phonepatch with DTMF tones.
- VOX (Voice Operated Transmitter) processing for automatic PTT keying (*phoneline->radio*)
- Compatible with HF and VHF/UHF transceivers (with carrier detection if available)
- Configurable DTMF decoding.
- PTT control configurable: minimum on time, maximum on time, penalty for maximum_on_time reached.
- Uses soundcard to send and receive voice.
- Serial/parallel port (plus extenal apps) to interface PTT and carrier detection.
- Phonepatch audio messages (incoming, outcoming call, errors...) are configurable. All audio formats (WAV, AU, GSM, PCM, ...) can be used.
- Asterisk-style configuration files (follow RFC-822)

2. Hardware

Although the phonepatch is esentially software, the interface between radio transceiver and the computer requires still some hardware, which involves sound, PTT (Pust-to-Talk) activation and carrier detection (needed only for VHF and UHF transceivers).

2.1. Audio

The easiest way to interface voice with a computer is undoubtely using the soundcard as cheap D/A & A/D converter. It has no special needings, except for, of course, that must be compatible with GNU/Linux. The 2.6.x kernel series brings drivers from the ALSA project (hyyp://www.alsa-project.org), an excellent software that covers eventually any existing soundcard. Refer to its web for more details.

You can check the soundcard installed, and its id-number, with the command:

```
$ cat /proc/asound/cards

0 [ICH            ]: ICH4 - Intel ICH
                     Intel ICH with STAC9752/53 at 0xdfebfe00, irq 16
```

Phonepatch uses the *OSS* (Open Sound System) interface to access the soundcard, so make sure you have the module `snd-pcm-oss` loaded, apart from the ones needed for your soundcard:

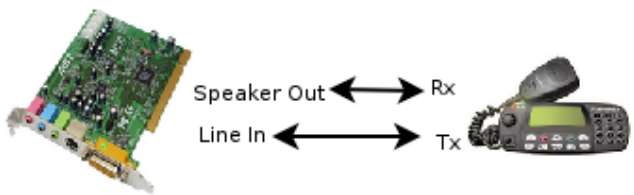
```
modprobe snd-pcm-oss
```

With the OSS library soundcards are accesed via device files `/dev/dsp` (device 0), `/dev/dsp1` (device 1), `/dev/dsp2` (device 2), and so on. Before trying to run the phonepatch, make sure that your soundcard is not used by any other process:

```
$ lsof /dev/dsp
```

On the radio port (usually at the back) you must be find the transmission (Tx) and received (Rx) audio pins, and connect them to, respectively, soundcard's speaker and microphone (or line-in, if available).

Figure 4. Soundcard to radio connection



Make sure that the mixer values are correctly configured (use the *alsamixer* or *rexima*): *Line In* (or *Mic*) must be selected for recording. Volume recording depends on line *InGain*. Test that the soundcard output and recording works with utilities that use OSS devices, as *rawplay* and *rawrec* (both on *rawrec* debian package)

2.2. Radio control

2.2.1. PTT

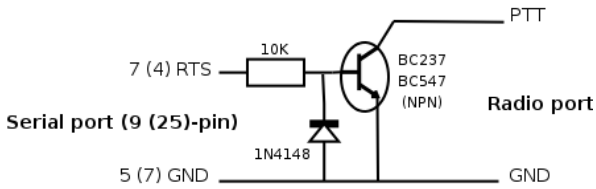
By default, radios are always in receiving state, so you have to indicate when to transmit. Note that this is also true for full-duplex radio (which can transmit and receive at the same time)- The line responsible for this task is PTT (Push-to-Talk), activated at low-level (Ground) and deactivated at high-impedancy.

There are many ways to interface the PTT, the phonepatch provides applications for the two most common alternatives:

- Serial

  Use a serial port (pin RTS) to set/unset PTT.

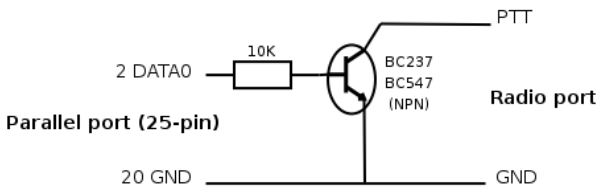
Figure 5. PTT signalling using a serial port



- Parallel

  Use the parallel port (pin DATA0) to set/unset PTT.

Figure 6. PTT signalling using a parallel port



This schemes have been taken from the Soundmodem (http://www.baycom.org/~tom/pcf/ptt_circ/ptt.html) page. Soundmodem is an interesenting project that uses soundcards as modem for digital transmission, so the hardware involved is similar to what we need for building the phonepatch hardware.

You must find the PTT (located usually at the rear part of the radio) and connect it to your serial or parallel port depending on what solution is best for you.

After that, you should test that PTT works well, using the utility *radiocontrol*:

```
radiocontrol -v -m serial -d /dev/ttyS0 -p on
radiocontrol -v -m parallel -d /dev/parport0 -p off
radiocontrol -v -m command -d eboard -o "unset ptt, set ptt„" -p on
```

2.2.2. Carrier detection

UHF/VHF transceivers work usually with FM modulations, which means that they have a way to determine if a radio is receiving audio or not: that’s called *carrier detection*. When using such transceivers, apart from the PTT signalling the phonepatch

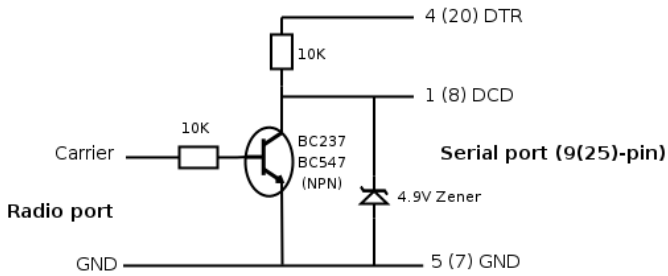
must poll the state of that signal, to decide whether the audio received is real or not. If detected, this audio will be send to the phone link.

As for the PTT, the carrier detection could be achieved by many ways, two of them being the serial and parallel port solution.

- Serial

  Use a serial port (pin DCD) to get carrier detection state

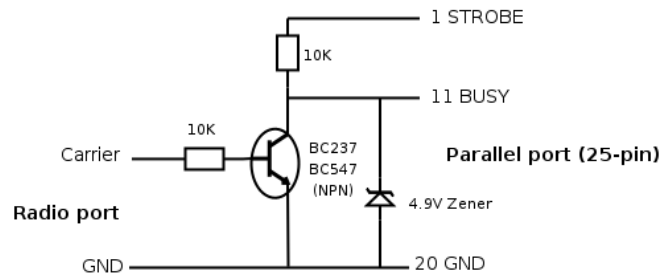
Figure 7. Carrier detection using a serial port



- Parallel

  Use a parallel port (pin Busy) to get carrier detection state

Figure 8. PTT signalling using a parallel port



After that, you should test that carrier detection works well, using as well the utility *radiocontrol*:

```
radiocontrol -v -m serial -d /dev/ttyS0 -c
radiocontrol -v -m parallel -d /dev/parport0 -c
radiocontrol -v -m command -d eboard -o "„get carrier,get carrier: (1|0)" -c
```

3. Asterisk configuration

3.1. Modules

Make sure that the modules *res_agi.so* and *format_sln.so* are enabled on `/etc/asterisk/modules.conf`:

```
...
; Formats
load => res_sln.so
...
; Channels
load => res_agi.so
...
```

3.2. Extensions

On the asterisk's extensions file configuration we have to add all the radio statios for which we want incoming calls. Imagine we have two stations to connect, *Munichis* and *Puerto Saija*. Although not really necessary, it's recomendable that yout create a new context (for example: *radio*) for this special users.

On this example, we will asign extension *10* for *munichis* and *11* for *puertosaija*. We have to add the following lines to `/etc/asterisk/extensions.conf`

```
[radio]

; Munichis radio station
exten => 10,1,Answer()
exten => 10,2,EAGI(phonepatch.agi|-i|munichis)
exten => 10,3,Hangup

; Puerto Saija radio station
exten => 11,1,Answer()
exten => 11,2,EAGI(phonepatch.agi|-i|puertosaija)
exten => 11,3,Hangup
```

Outgoing extensions also use the EAGI script, so it's necessary to enable one (and only one) extension (in this example, *100*) that would serve *all* users to make an outgoing call. Notice that the *callerid* will be common for all these users, since calls from radio users are anonymous. For simplicity, use the same context that you choose for the incoming calls:

```
[radio]

...

exten => 100,1,Answer()
exten => 100,2,EAGI(phonepatch.agi|-o)
exten => 100,3,Hangup
```

4. Phonepatch configuration

As base configuration file, you can use the example located at `/usr/share/asterisk-phonepatch/phonepatch.conf.example`. Copy it to `/etc/asterisk/phonepatch.conf` and costumize it. Take a look on the manual page (*man phonepatch.conf*) to see a detailed explanation of all the variables. Default values are good for most situations, but take care on the following ones:

- **radio: ptt**

  On most cases you will have to enable this options to turn on PTT when sending audio to the radio.

- **radio: radio_control**

  Use *serial:device*, *parallel:device* or *command:external_command*. Valid values are for example *serial:/dev/ttyS0*, *parallel:/dev/parport0* or *command: /usr/sbin/external-app-to-interface-board*.

  When using parallel port, make sure that the module *ppdev* is loaded.

  The *command* option runs an external command which is supposed to accept commands from the *stdin* and returning its output through *stdout*. When using the *command* option, you have to fill *ptt_on*, *ptt_off*, *get_carrie*r and *get_carrier_response* parameters. The first three are the strings that would be sent to process to turn ptt of, turn it off, and get carrier state. The last one, *get_carrier_response*, expects a special regular expression: let's imagine that the external application returns *"get carrier: on"* to say there is carrier and *"get carrier: off"* if there is not. In that case you would have to set *get_carrier_response* parameter to *"get carrier: (on|off)"*.

- **radio: carrier_detection**

  It prevents PTT activation when the carrier is detected. Must be enabled for VHF/UHF transceivers, but of course only if your interface board is able to read the *carrier_detection* state, otherwise the phonepatch won't work. Sometimes enabling *carrier_detection* is optional, but in other cases is compulsory, because the radio outputs noise on the Rx audio signal (noise that the phone user will listen!). Motorola transceivers are known to behave that way.

  If *carrier_detection* is enabled, the *carrier_polling_time* applies. This is the time that the phonepatch waits between succesive looks to carrier state. Use small values carefully as it will surey be a CPU intensive task. *0.5 seconds* should be enough for most cases.

- **radio: full_duplex**

  You should enable this parameter only if you have a full duplex transceiver (notice that it will only work if *carrier_detection* is also enabled). Notice that most transceivers are half-duplex and this options should remain disabled.

- **radio: ptt_threshold_signal**

  Phones don't have a PTT, so we need to guess when the phone user is talking or not, and activate the PTT automatically (this is called a VOX mechanism). The *ptt_threshold_signal* is the parameter you need to adjust depending on your

phoneline and soundcard levels. Maximum received power is the unity (1.0), so *values around 0.05-0.2* should work in most scenarios.

- **outcall: noisy_mode_button**

  It has been implemented for very noisy links (i.e. HF) where a tone can be decoded accidentally more than once. With this DTMF button you indicate that you are going to push next number. Example (using #): user pressed "1#2#3#4#", but the number was decoded, due to noise, as *1111#2#333333###4444##*; however, this will be correctly interpreted as *1234*. Therefore, you can repeat as many times as you want a number to assure it's decoded, and then press *noisy_mode_button* (also so the times you want).

- **outcall: channel**

  That's the channel used on outgoing calls. Example: *IAX2/user:password@IP*

- **outcall: context/extension**

  Must correspond to the *context* and *extension* where *"phonepatch.agi|-o"* has been configured.

5. Outcall daemon

After the configuration is done, incoming calls should work without doing anything else, since it's asterisk responsability to launch the EAGI script when a call is received. However, for outgoing calls we need the phonepath to listen the server radio in order to hear DTMF tones and destination numbers.

That means that we need the daemon that listens the radio link to be configured at startup. Although Debian installation makes this automatically, make sure that the init script runs at startup:

```
$ update-rc.d asterisk-phonepatch default
```

After a reboot or a */etc/init.d/asterisk-phonepatch restart*, you sould see the process on a *ps* and the pidfile:

```
$ sudo init.d/asterisk-phonepatch start
starting asterisk-phonepatch: done

$ ps awx |grep phonepatch
19119 ?        S      0:00 /usr/bin/python /usr/sbin/phonepatch ....

$ cat /var/run/asterisk-phonepatch.pid
19119
```

Daemon info and errors won't appear on asterisk logs, they are written to `/var/log/daemon.log`, check this file to see what is its state:

```
$ sudo tail -f /var/log/daemon.log
Jun  9 14:41:41 localhost asterisk-phonepatch[6561]: no phonepatch pidfile found
Jun  9 14:41:41 localhost asterisk-phonepatch[6561]: soundcard opened: /dev/dsp1 (8000 sps)
Jun  9 14:41:41 localhost asterisk-phonepatch[6561]: radio control opened: command:eboard -p
Jun  9 14:41:41 localhost asterisk-phonepatch[6564]: creating pidfile: /var/run/asterisk-phonep
Jun  9 14:41:41 localhost asterisk-phonepatch[6564]: waiting for askfortone_button
```

When debugging, you can start phonepatch daemon directly from the console:

```
$ sudo init.d/asterisk-phonepatch stop
stopping asterisk-phonepatch: done

$ asterisk-phonepatch
phonepatch -- daemon -  -- start of state: daemon
phonepatch -- daemon -  -- soundcard opened: /dev/dsp (8000 sps)
phonepatch -- daemon -  -- radio control opened: command:eboard -ep
phonepatch -- daemon -  -- creating pidfile: /var/run/asterisk-phonepatch.pid
```

6. Testing the phonepatch

When using the phonepatch for the first time, you surely will need tune some parameters, so it's useful to see the log info to know what's happening. Therefore, kill any running asterisk and run again on a console with high-level verbose:

```
$ killall asterisk
$ asterisk -vvvvvvvvv
```

6.1. Incoming calls

- From a telephone make a call to the extension defined for a configured radio station.
- On the telephone link and the user radio, a message like *"Radio call for _station_"* (defined on *report_call_audio*) will be heard. Station name is syntetized with Festival. You can create your own audio files to hear a more friendly voice.
- Press *answer_button* on the microphone of the user radio.
- Now it should be possible to talk in both directions

6.2. Outgoing calls

- From the user radio press the button *askfortone_button*, a tone should be heard for *tone_audio_time* seconds.
- When the tone audio finishes dial the destination number and finally press *call_button*.
- While asterisk is trying to stablish the call, a ring audio will be listened (*ring_audio*) on the radio.
- If the call is not answered, an audio will be listened (*ring_timeout_audio*) and the communication will be closed.

- If the call is answered, then the communication is opened and it should be possible to talk in both directions

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