Raspberry Pi Radio Projects

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WA9ONY

www.stargazing.net/david/RPi/hrrpi.html

SDRs with USB Interface

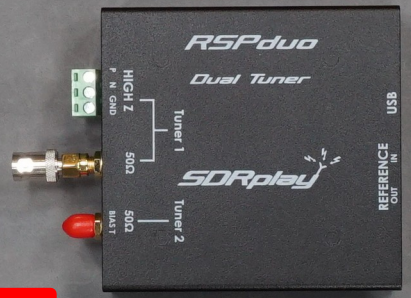
DVB-T: Digital Video Broadcasting — Terrestrial

DVB-T+DA3+FM

NESDR Mini

RTL

LimeSDR Mini



RFSpace
SDR-IQ

NESDR Smart

RTL-SDR Blog V3 R820T2 RTL2832U

RTL

SDRplay
RSP1

Key Specs.

Frequency range
I/Q rate
A/D bits
Noise floor
Transmit
SW support
Price

WHAT MAKES OUR RTL-SDR V3 BETTER THAN OTHERS?

24-1766 MHz

RF

IMPROVED FRONT END DESIGN
(HIGHER SNR IN L-BAND)

REDESIGNED THERMALS
(HELPS FIX L-BAND HEAT VCO LOCK PROBLEM)

ENTIRE PCB REDESIGNED FOR LOWER NOISE

RTL2832U

USB 8-bit I/Q data streams

4.5V BIAS TEE
(SWITCHABLE IN SOFTWARE)

R820T2

1PPM TCXO

BETTER LDO
(LOWER VOLTAGE OPERATION)

5V LINE FERRITE CHOKE

SMA FEMALE CONNECTOR

I

Q

ADDITIONAL ESD PROTECTION

DIRECT SAMPLING CIRCUIT FOR HF RECEPTION
(WITH FM FILTER)

EXPANSION PORTS

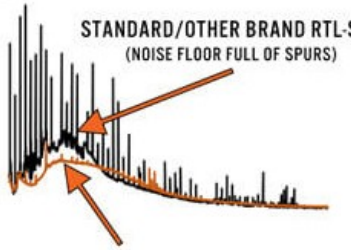
CLK SELECTOR JUMPER

GPIO EXPANSION PORTS

USB RF CHOKE
(REMOVES USB NOISE)

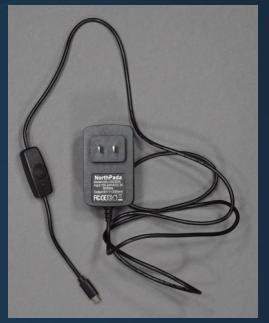
TOUGH METAL ENCLOSURE
(REDUCES INTERFERENCE)

THERMAL PAD COOLING
(REMOVES HEAT FROM PCB AND TRANSFERS IT TO THE METAL CASE RESULTING IN NO HEAT RELATED VCO LOCK PROBLEMS)



STANDARD/OTHER BRAND RTL-SDR
(NOISE FLOOR FULL OF SPURS)

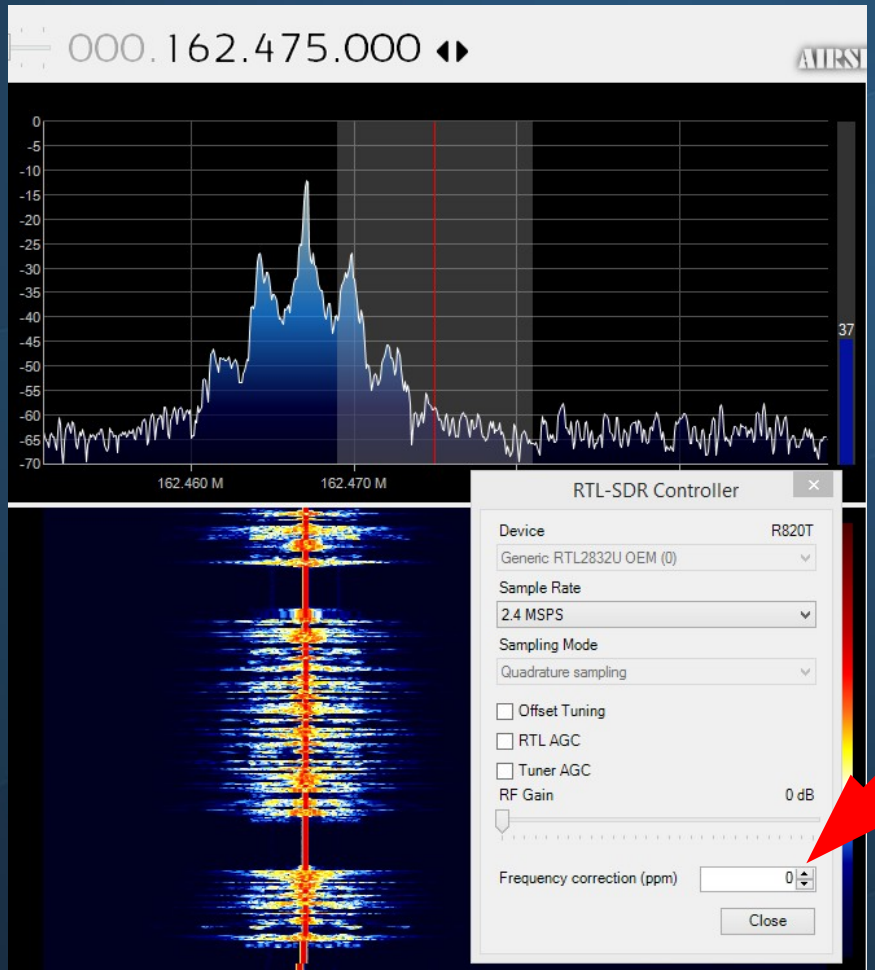
RTL-SDR V3 NOISE FLOOR
(SIGNIFICANTLY REDUCED SPURS/BIRDIES)

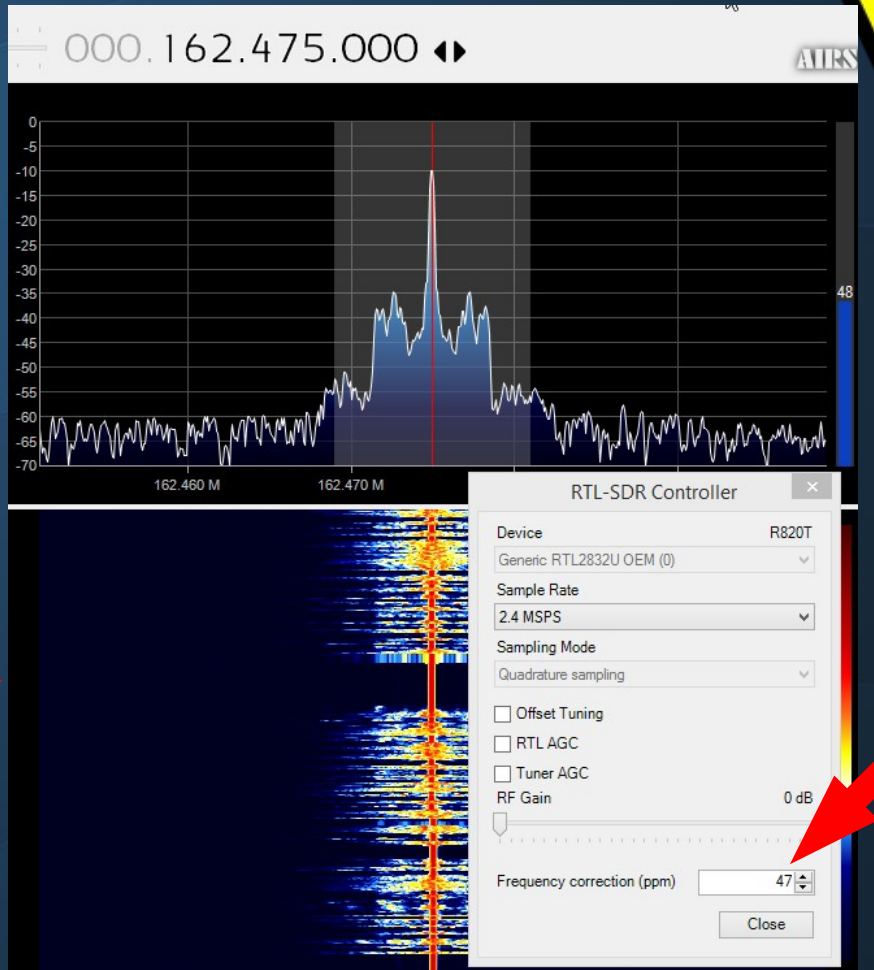


Audio

https://www.rtl-sdr.com/buy-rtl-sdr-dvb-t-dongles/

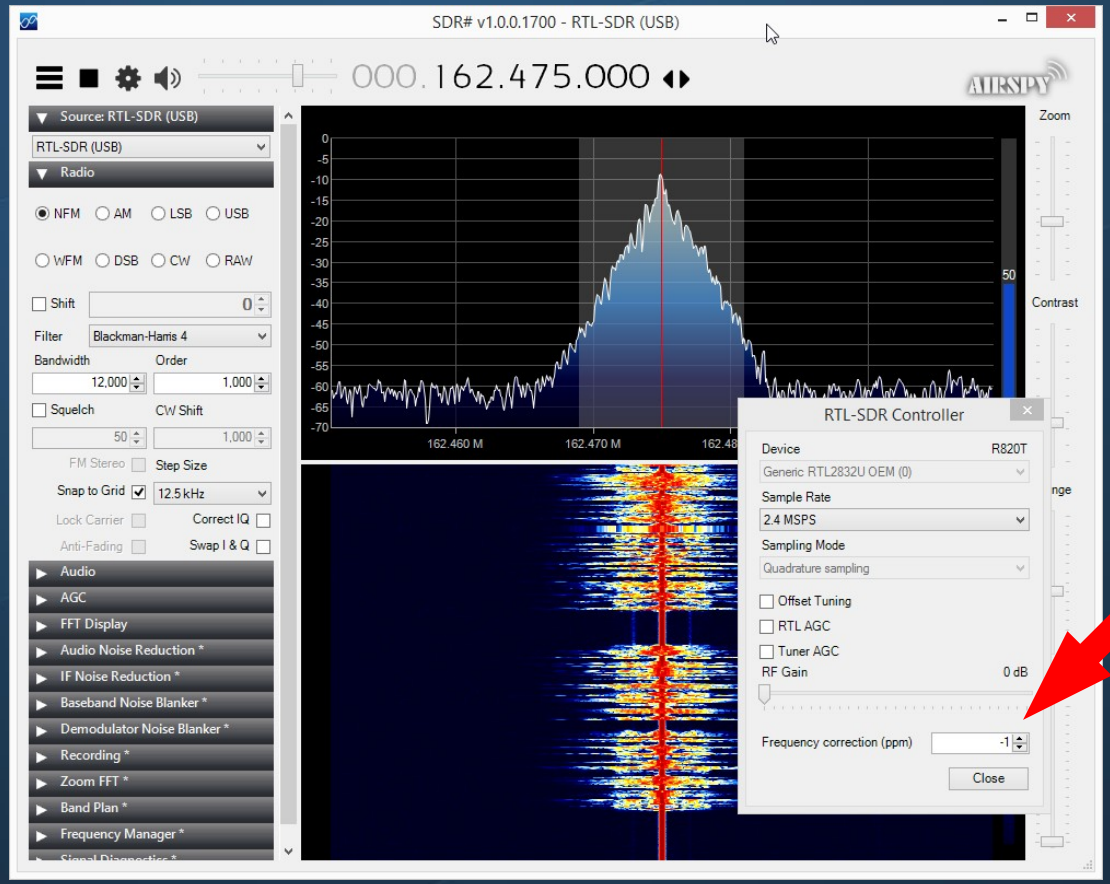
SDR# Frequency Correction (47 ppm)





SDR# Frequency Correction (<1 ppm)

- **<1 PPM temperature compensated oscillator (TCXO)** – Accurate tuning and almost zero temperature drift (2 PPM max. initial offset, 0.5-1 PPM temperature drift)



Amazon RTL-SDR.COM Kit $29.95

www.amazon.com/gp/product/B011HVUEME/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&psc=1

RTL-SDR Blog R820T2 RTL2832U 1PPM TCXO SMA Software Defined Radio with 2x Telescopic Antennas

by RTL-SDR Blog

4.3 out of 5 stars 666 customer reviews | 221 answered questions

Amazon's Choice for "rtl sdr"

Price: $29.95 prime

FREE One-Day Pickup. Details

Pay ~~$29.95~~ $0.00 after using available Discover Cashback Bonus®.

Free Amazon tech support included

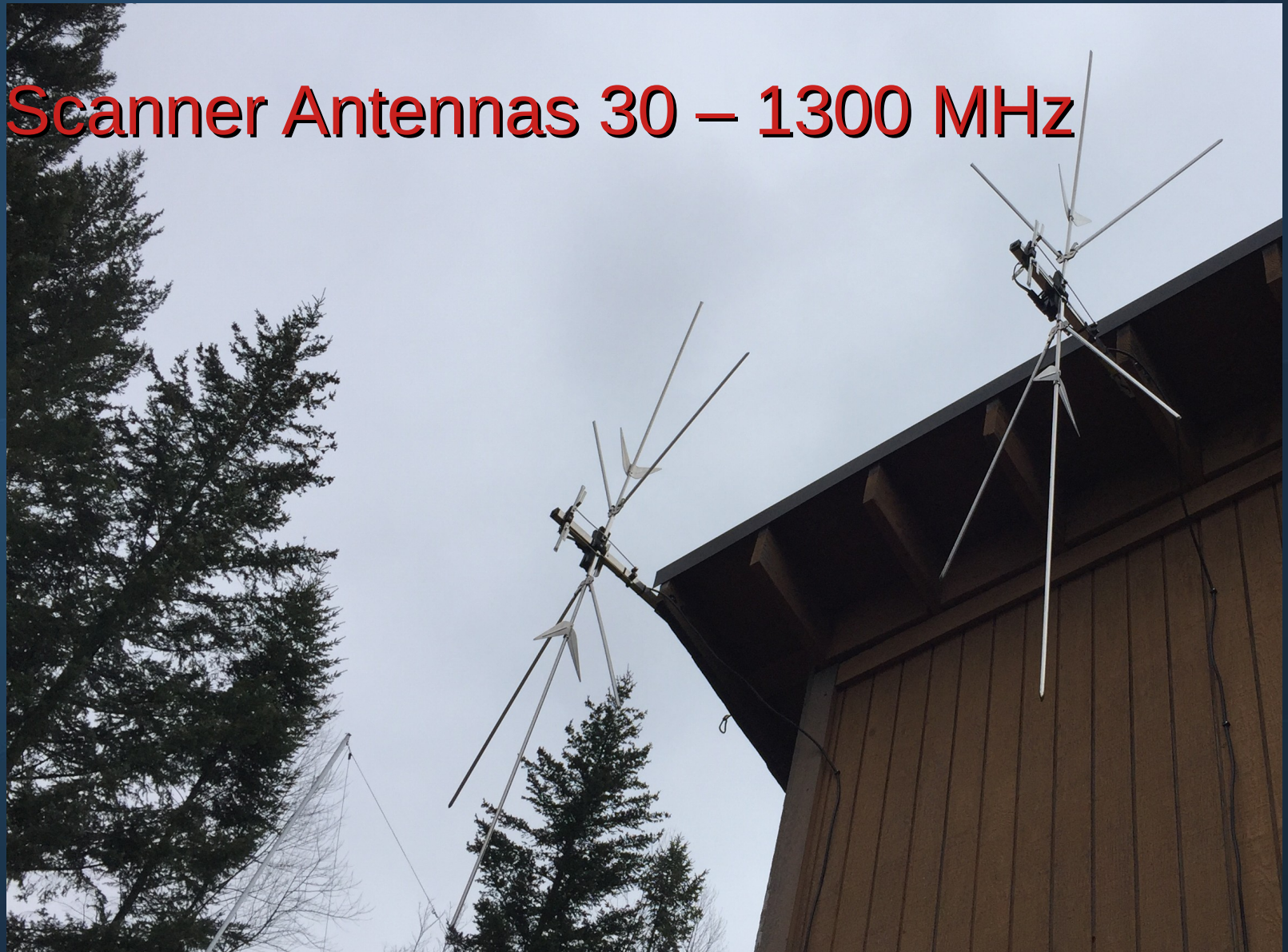
- Includes 1x RTL-SDR Blog brand R820T2 RTL2832U 1PPM TCXO HF Bias Tee SMA Dongle (V3), 1x portable multipurpose dipole antenna set. Dipole set includes 1x dipole base with 60cm RG174, 2x 23cm to 1m telescopic antenna, 2x 5cm to 13cm telescopic antenna, 1x 3m RG173 extension cable, 1x flex tripod mount, 1x suction cup mount.
- Great for many applications including general radio scanning, air traffic control, public safety radio, ADSB, ACARS, trunked radio, P25 digital voice, POCSAG, weather balloons, APRS, NOAA APT weather satellites, radio astronomy, meteor scatter monitoring, DAB, or for use as a low cost panadapter with a traditional ham radio.
- Several improvements over other brands including use of the R820T2 tuner, improved component tolerances, a 1 PPM temperature compensated oscillator (TCXO), SMA F connector, aluminium shielded case with thermal pad for passive cooling, activatable bias tee circuit and a much improved antenna set.
- Can tune from 500 kHz to 1.7 GHz and has up to 3.2 MHz of instantaneous bandwidth (2.4 MHz stable). (HF reception below 24 MHz in direct sampling mode). Please note RTL-SDR dongles are RX only.
- The multipurpose portable dipole kit is great for beginners! Use it either for terrestrial or satellite reception just by changing the orientation of the antenna. The mounts and extension cable allow you to temporarily place the antenna outside for improved reception.

Compare with similar items

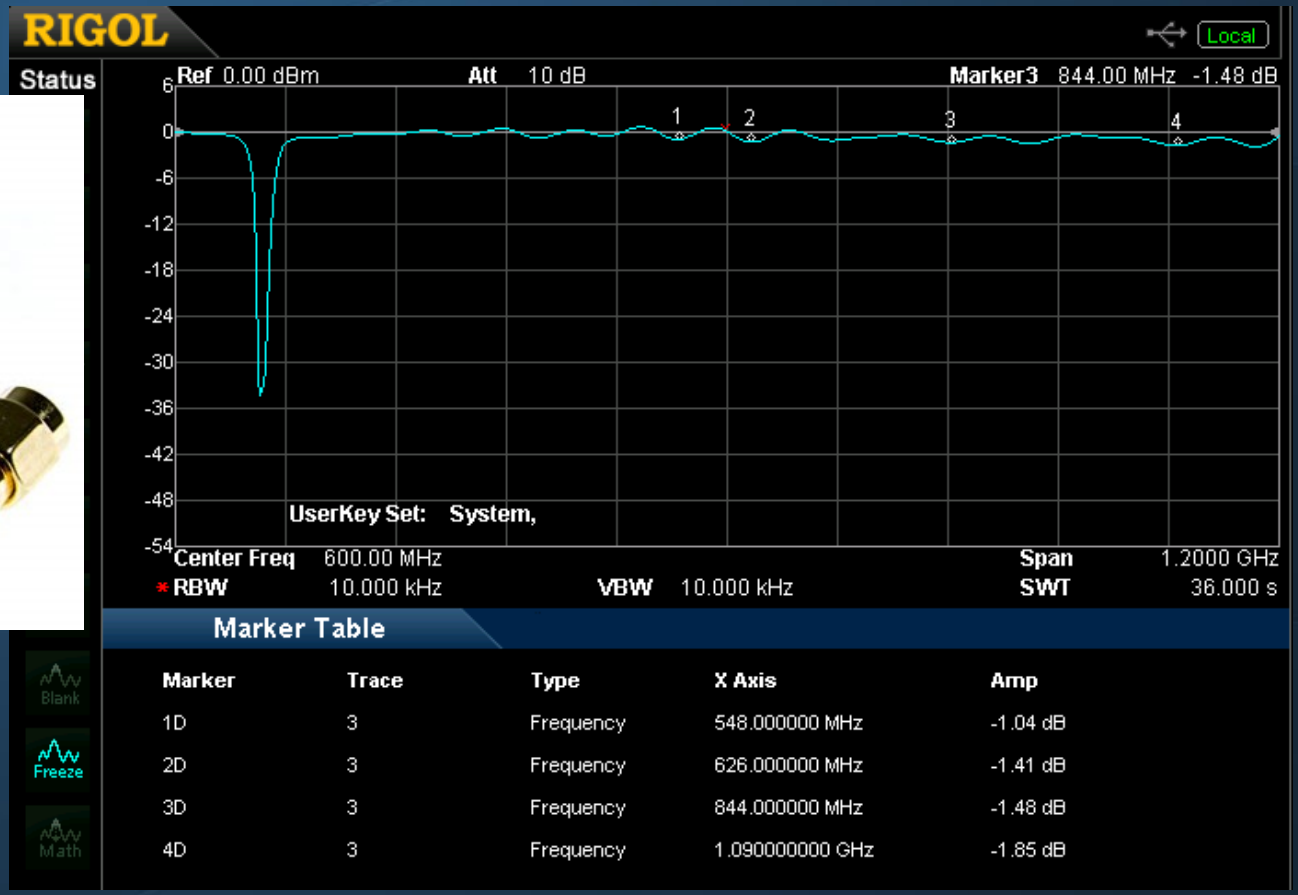
New (1) from $29.95 prime

Report incorrect product information.

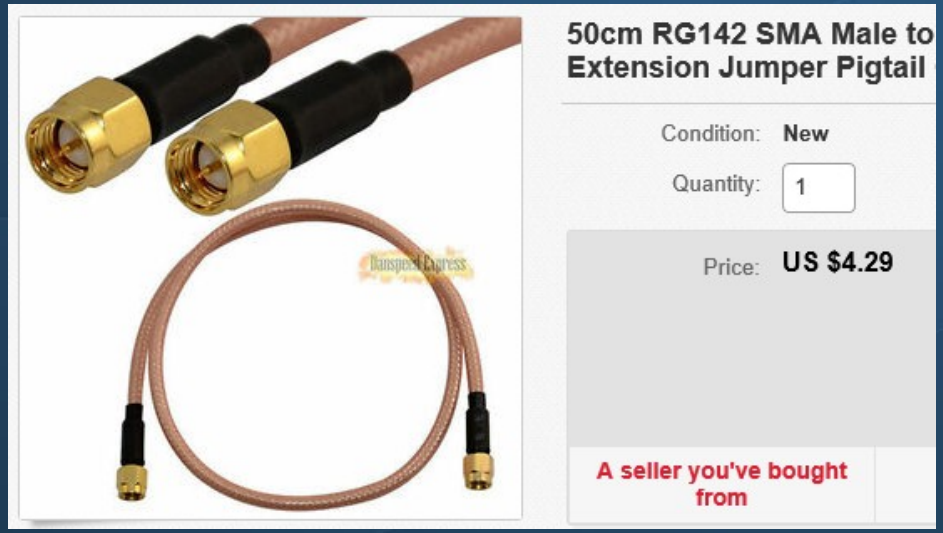
Scanner Antennas 30 – 1300 MHz



NooElec Broadcast FM Bandstop Filter



SMA RG142 Coax Cables
Loss at 750MHz, 100’

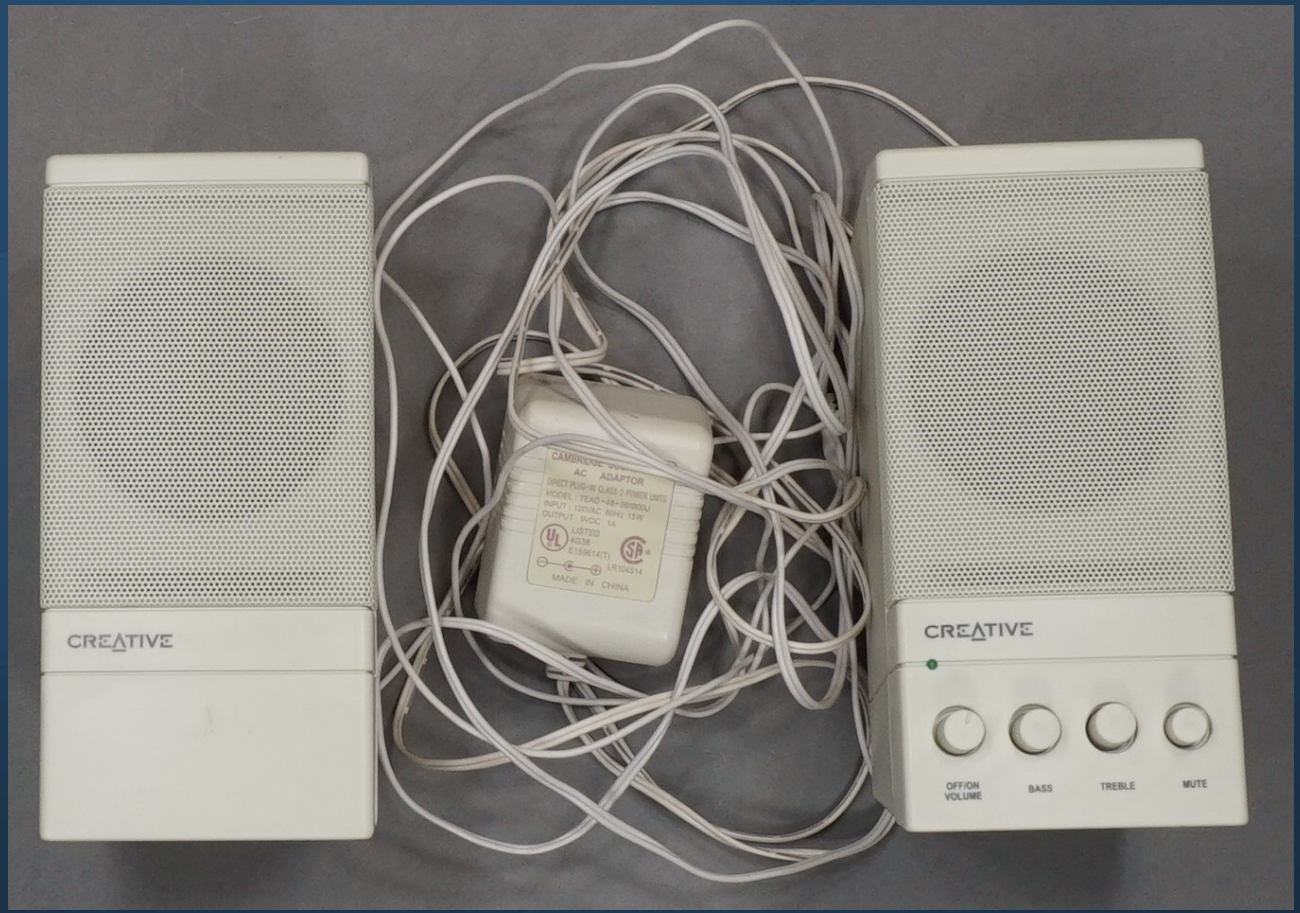


- RG-6 5.6 dB 75Ω
- RG-142 9.6 dB 50Ω
- RG-8X 11 dB 50Ω
- RG-58 13 dB 50Ω
- RG-316 22 dB 50Ω
- RG-174 24 dB 50Ω

Mini-Circuits Amp. ZFL-500LN+

MODEL NO.	FREQUENCY (MHz)		NOISE FIGURE (dB)	GAIN (dB)	
					Flatness Max.
	f_L	f_u	Typ.	Min.	Total Range
ZFL-500LN+	0.1	500	2.9	24	±0.5

AC Powered Speakers with Volume Control

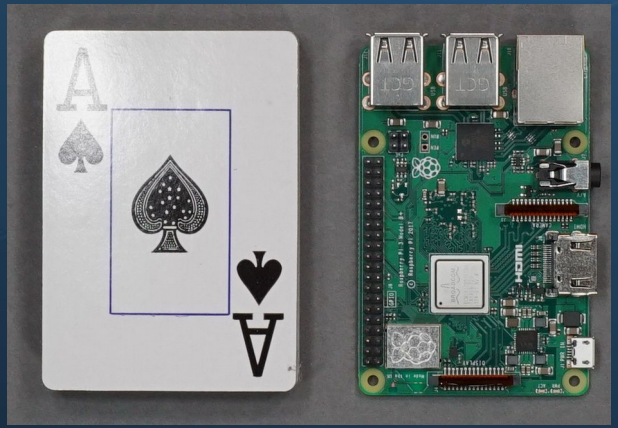


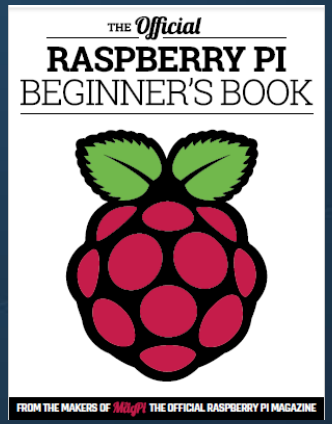
SDR: Software Defined Radio

- RTL-SDR USB device
- Raspberry Pi computer
- Software
  - rtl_sdr: demodulates RTL-SDR USB I/Q data stream
  - SoX: audio processing & recording
  - QSSTV: Slow scan TV decoder

Raspberry Pi Computer

- Low cost, $35, small single board computer (SBC)
- Large ecosystem
  - 19 million sold 2012 to 2018
  - 1/3 to education, 1/3 to hobbyist & 1/3 to commerical
  - Websites, books, magazines, forums, etc.

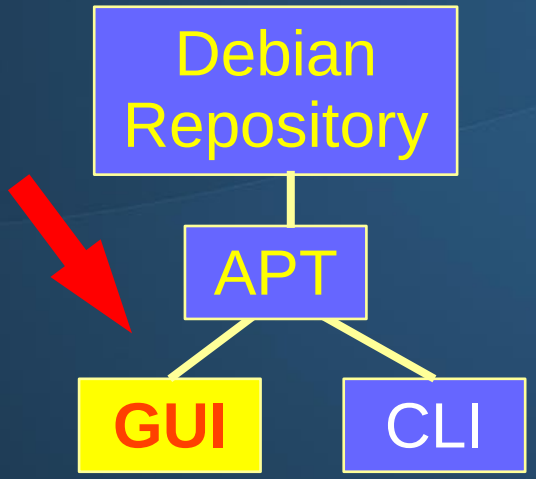


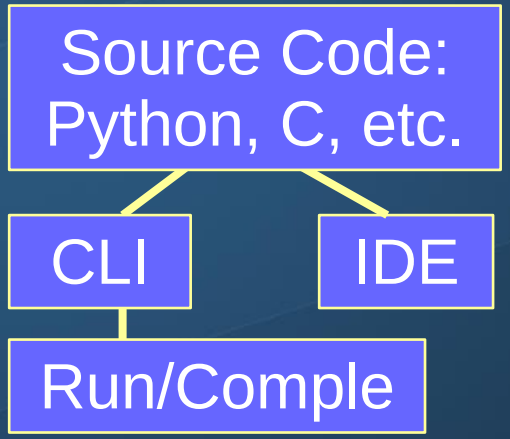


Raspbian Operating System

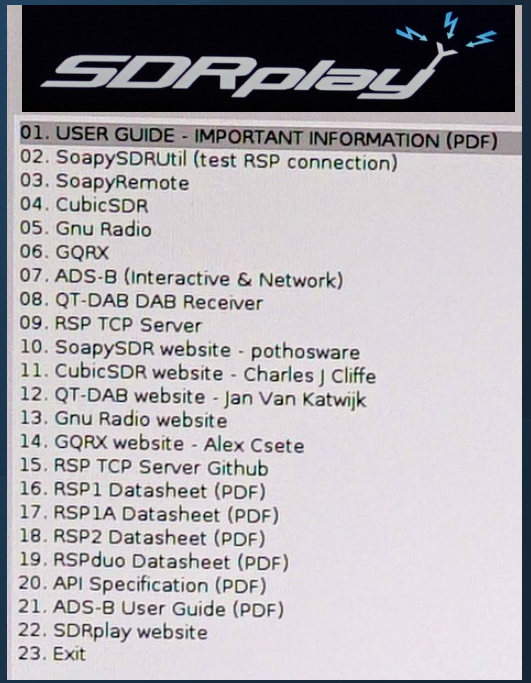
- 1970 UNIX, AT&T Bell Labs
  - Multitasking & Multiuser
  - Pipes, SW tools & Portable
- 1984 X Windows, MIT
- 1991 Linux, Linus Torvalds
  - An UNIX like kernal
- 1993 Debian - GNU/Linux
  - SW repository – >51,000 packages
- 2013 Raspbian based on Debian
  - For Raspberry Pi computers

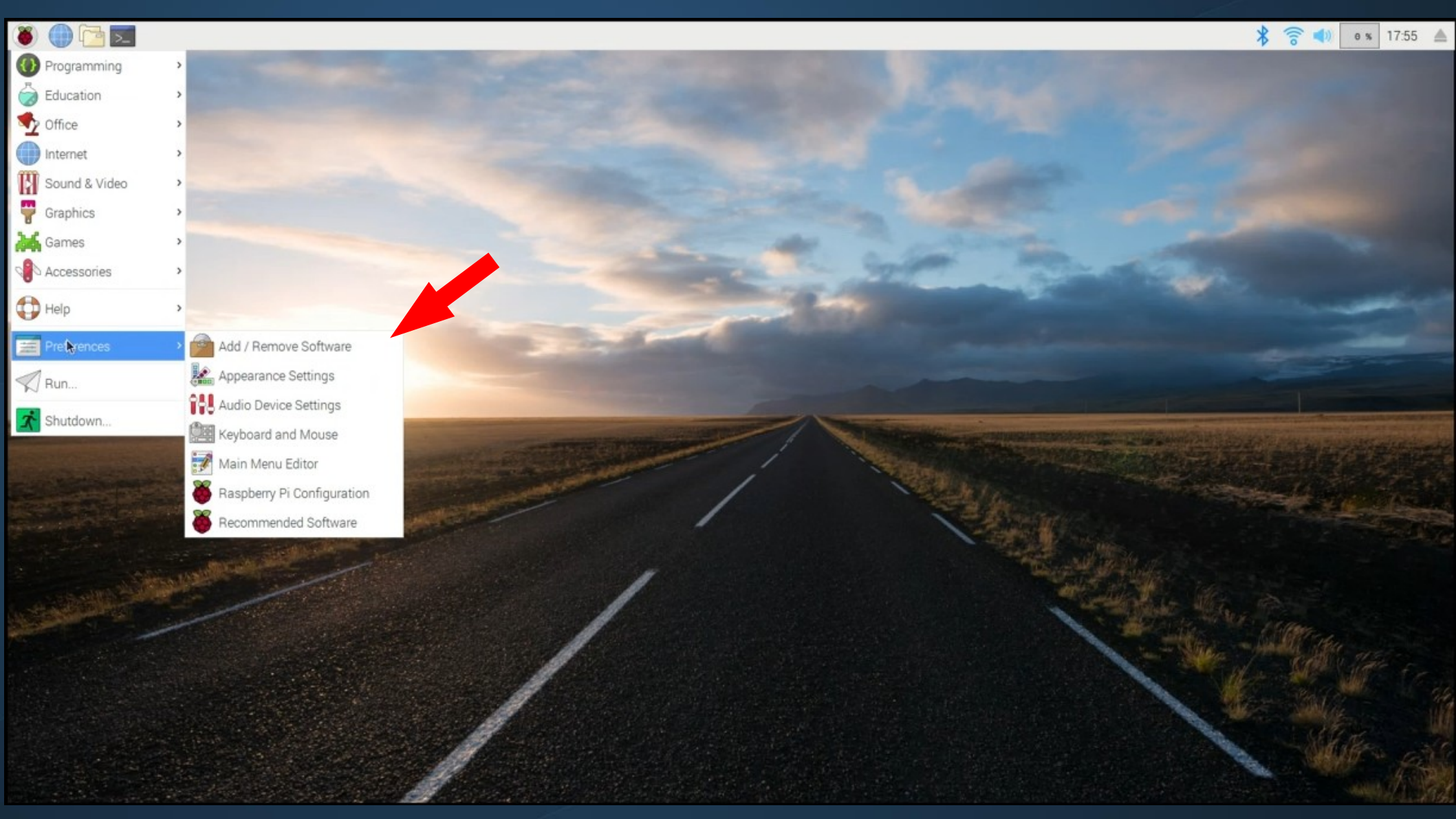
Installing Raspberry Pi Software



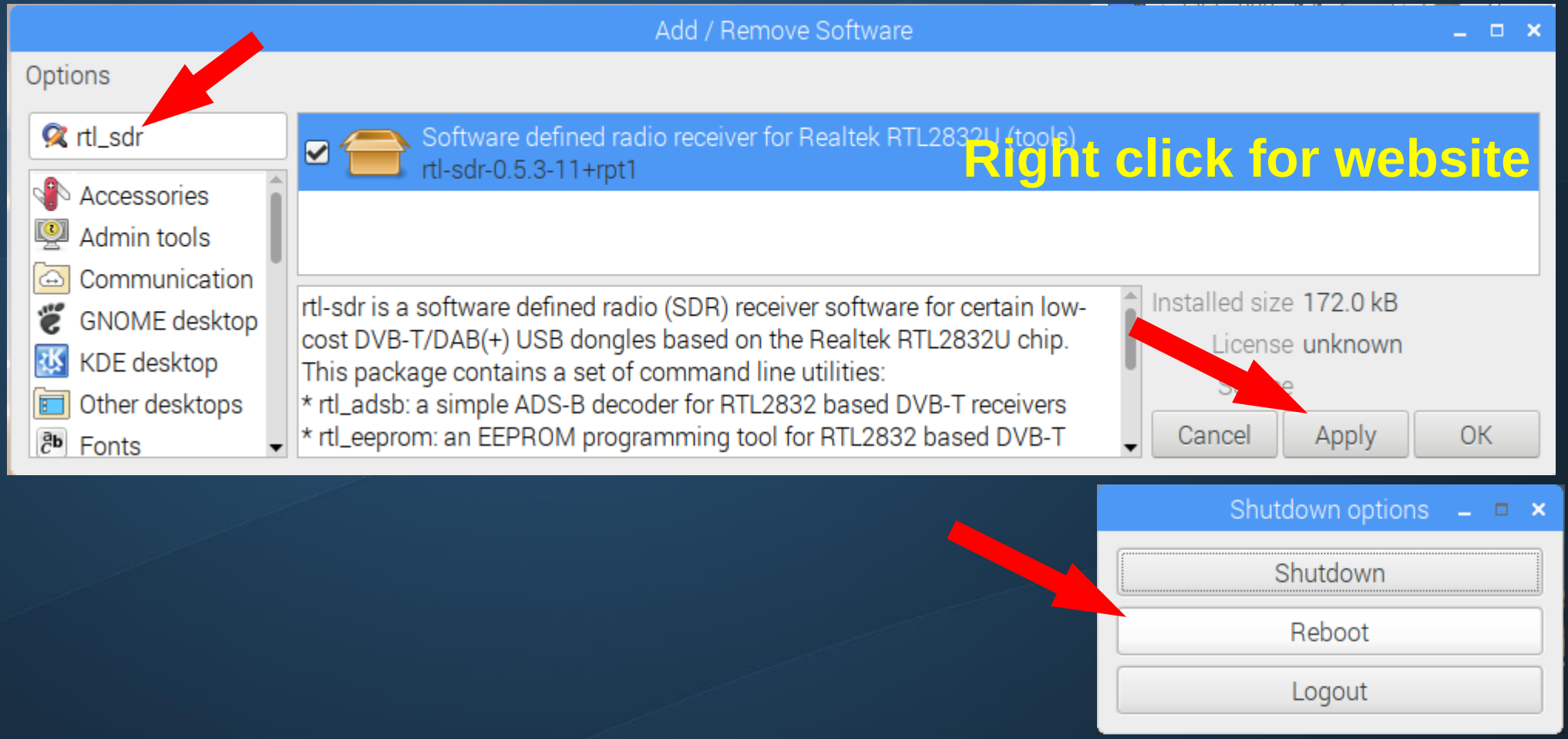


MicroSD image

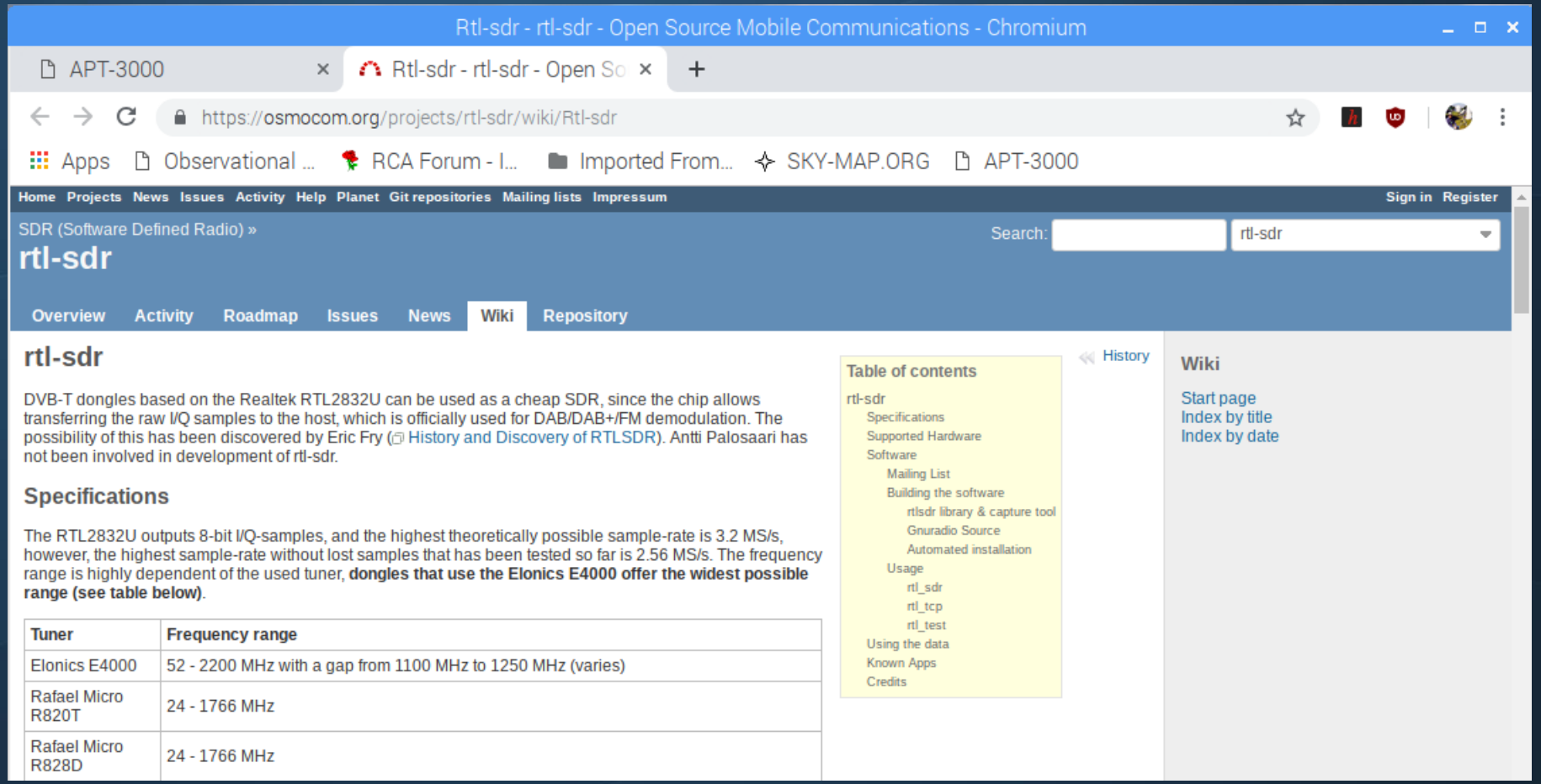



Programming
Education
Office
Internet
Sound & Video
Graphics
Games
Accessories
Help
Preferences
Run...
Shutdown...
Add / Remove Software
Appearance Settings
Audio Device Settings
Keyboard and Mouse
Main Menu Editor
Raspberry Pi Configuration
Recommended Software
0 %
17:55

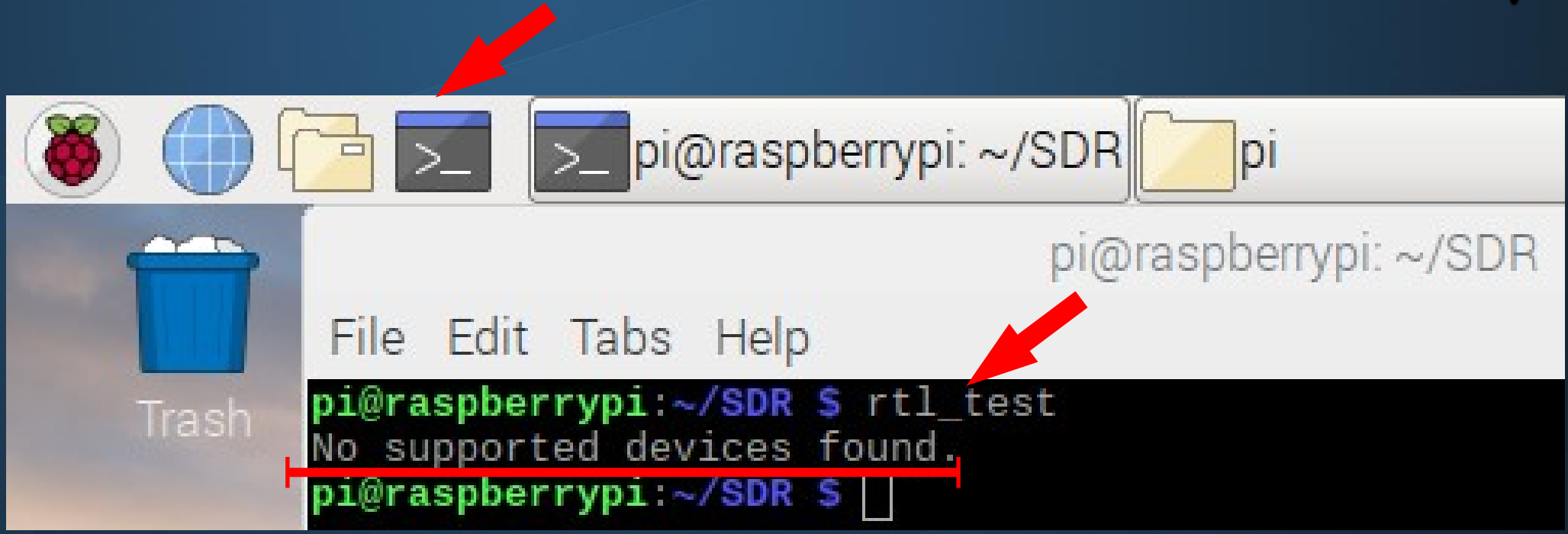
Add / Rewmove Software: rtl_sdr



Add / Rewmove Software: rtl_sdr Website



No SDR found by rtl_test

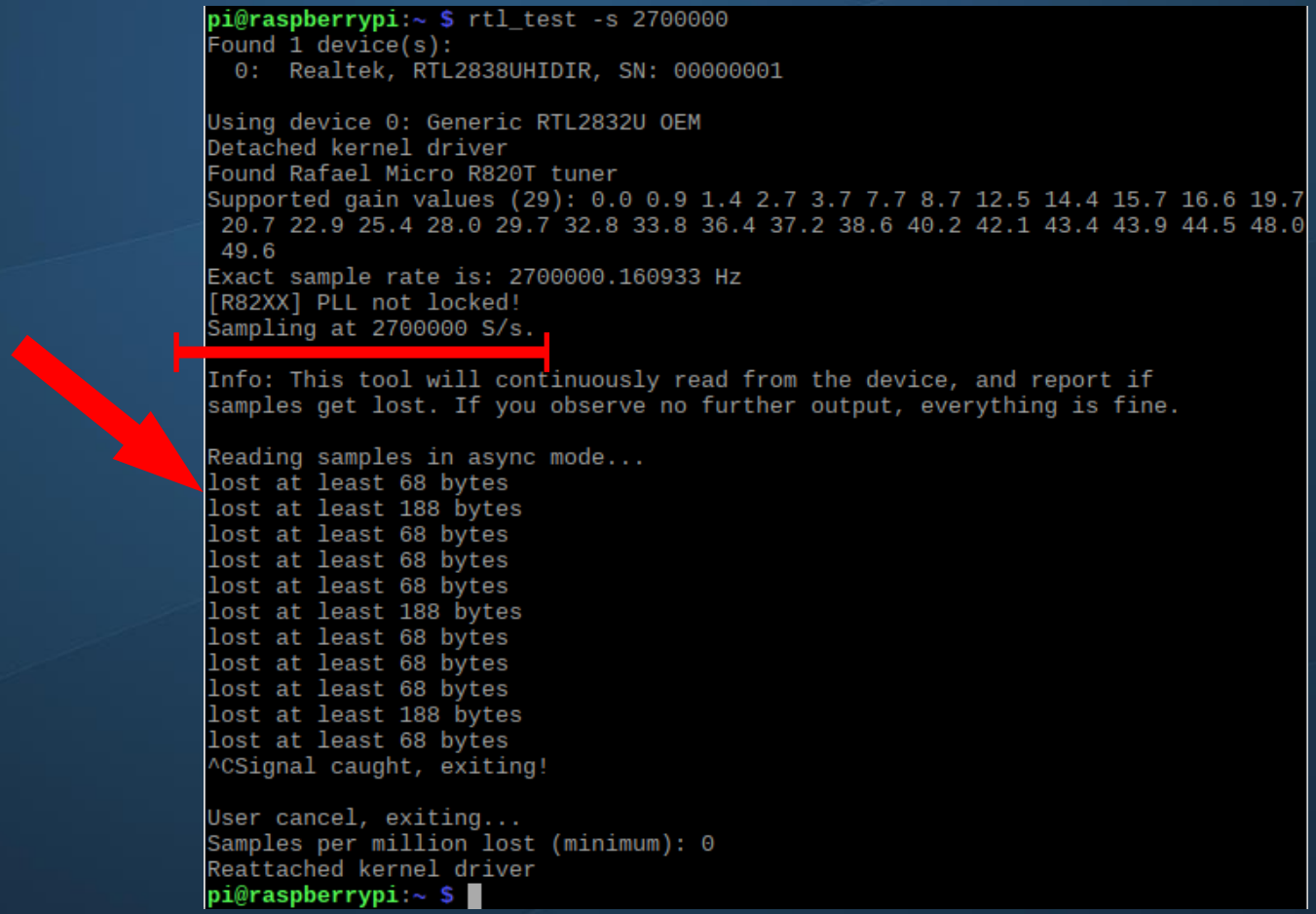


Need to plug in the SDR

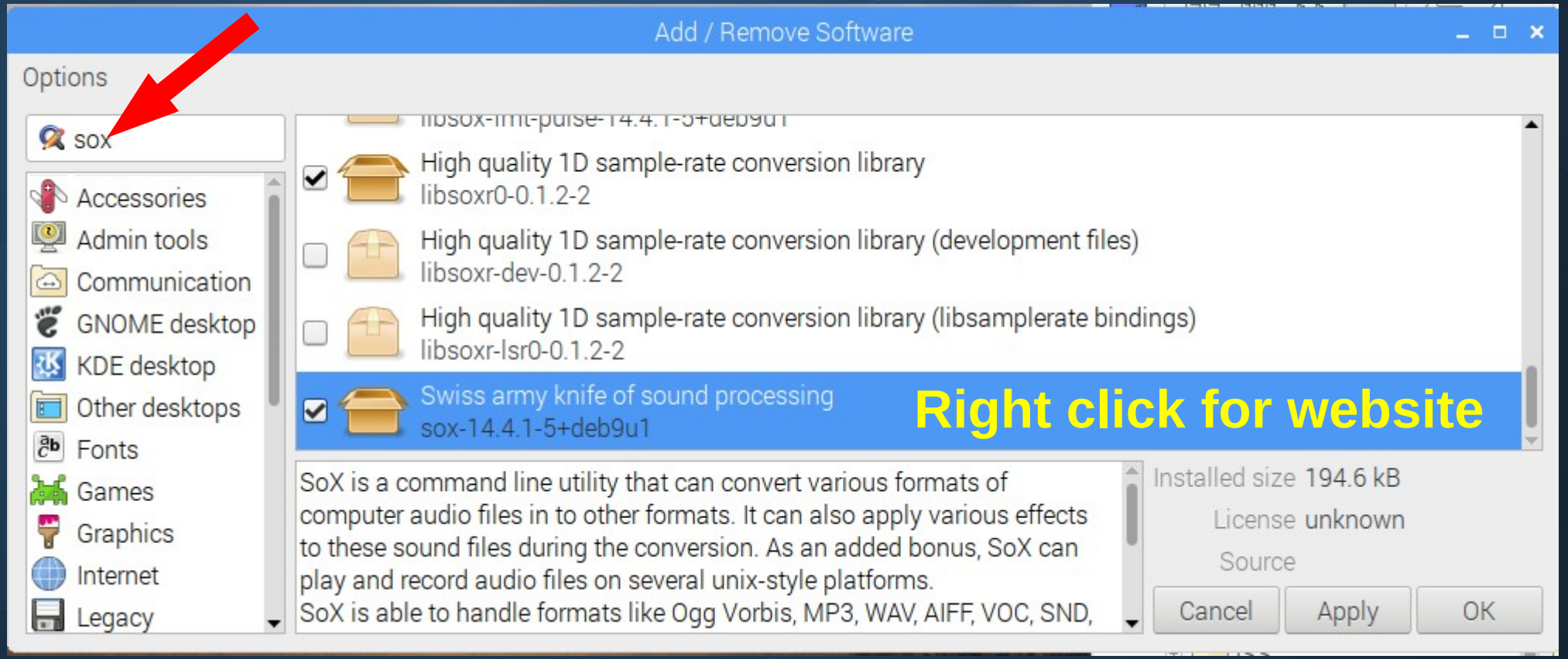
CLI: rtl_test at 2,048,000 S/s
CTRL-C to exit

```
pi@raspberrypi:~/SDR $ rtl_test
Found 1 device(s):
  0:  Realtek, RTL2838UHIDIR, SN: 00000001

Using device 0: Generic RTL2832U OEM
Detached kernel driver
Found Rafael Micro R820T tuner
Supported gain values (29): 0.0 0.9 1.4 2.7 3.7 7.7 8.7 12.5 14.4 15.7 16.6 19.7
 20.7 22.9 25.4 28.0 29.7 32.8 33.8 36.4 37.2 38.6 40.2 42.1 43.4 43.9 44.5 48.0
 49.6
[R82XX] PLL not locked!
Sampling at 2048000 S/s.

Info: This tool will continuously read from the device, and report if
samples get lost. If you observe no further output, everything is fine.

Reading samples in async mode...
^CSignal caught, exiting!

User cancel, exiting...
Samples per million lost (minimum): 0
Reattached kernel driver
pi@raspberrypi:~/SDR $
```

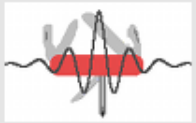
CLI: rtl_test at 2,700,000 CTRL-C to exit



Add / Rewmove Software: SoX



SoX - Sound eXchange | HomePage



Home Page
Features
FAQ
Documentation
Mailing Lists
Links

Project Page
Browse git

Welcome

Welcome to the home of SoX, the Swiss Army knife of sound processing programs.

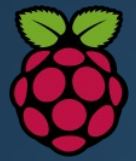
SoX is a cross-platform (Windows, Linux, MacOS X, etc.) command line utility that can convert various formats of computer audio files in to other formats. It can also apply various effects to these sound files, and, as an added bonus, SoX can play and record audio files on most platforms.

The screen-shot to the right shows an example of SoX first being used to process some audio, then being used to play some audio files.

For the list of all file formats, device drivers, and effects supported in the latest release, click here. To see the complete set of SoX documentation, click here.

If you find SoX to be useful, please consider supporting the project with a donation. We can accept PayPal donations through the SourceForge donation system, although currently a SourceForge login ID (or an openID), is required. Creating a SourceForge ID takes only a few seconds—click on the Paypal logo below to make a donation.

```
$ sox track1.wav track1-processed.flac remix - norm -3 highpass 22
gain -3 rate 48k norm -3 dither

Input File     : 'track1.wav'
Channels       : 2
Sample Rate    : 44100
Precision      : 16-bit
Duration       : 00:02:54.97 = 7716324 samples = 13123 CDDA sectors
Sample Encoding: 16-bit Signed Integer PCM
Endian Type    : little

Output File    : 'track1-processed.flac'
Channels       : 1
Sample Rate    : 48000
Precision      : 16-bit
Duration       : 00:02:54.97 = 8398720 samples ~ 13123 CDDA sectors
Sample Encoding: 16-bit FLAC

sox: effects chain: input      44100Hz 2 channels 16 bits (multi)
sox: effects chain: remix      44100Hz 2 channels 16 bits (multi)
sox: effects chain: norm       44100Hz 1 channels 16 bits
sox: effects chain: highpass   44100Hz 1 channels 16 bits
sox: effects chain: gain       44100Hz 1 channels 16 bits (multi)
sox: effects chain: rate       44100Hz 1 channels 16 bits
sox: effects chain: norm       48000Hz 1 channels 16 bits
sox: effects chain: dither     48000Hz 1 channels 16 bits
sox: effects chain: output     48000Hz 1 channels 16 bits (multi)

$ play *.ogg

01 - Summer's Cauldron.ogg:

  Encoding: Vorbis
```



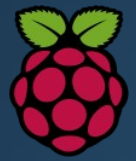
Tip

CLI: man rtl_fm

pi@raspberrypi: ~/SDR

File Edit Tabs Help

```
rtl_adsb(1)                    User Commands                    rtl_adsb(1)

NAME
       rtl_fm - a simple FM demodulator for RTL2832 based DVB-T receivers

DESCRIPTION
       Uses  a  re-purposed  DVB-T  receiver  as  a  software defined radio to
       receive narrow band FM signals and demodulate to audio. Written for and
       incorporated in the osmocom rtl-sdr project.

       Narrowband  FM  is commonly used by public service agencies and commer-
       cial dispatch operations in the VHF and UHF bands.  Also can demodulate
       Wideband  FM, as found in the 88-108 MHz FM broadcast band.  Experimen-
       tal options include AM, LSB, USB and DSB demodulation.

       Much software is available for the  RTL2832.  Most  of  the  user-level
       packages  rely on the librtlsdr library which comes as part of the rtl-
       sdr codebase. This codebase contains both the library itself and also a
       number  of  command  line tools such as rtl_test, rtl_sdr, rtl_tcp, and
       rtl_fm. These command line tools use the library to test for the  exis-
       tence  of  RTL2832 devices and to perform basic data transfer functions
       to and from the device.

       Because most of the  RTL2832  devices  are  connected  using  USB,  the
       librtlsdr library depends on the libusb library to communicate with the
       device.

USAGE
       With a suitable antenna for receiving the signal attached to  the  rtl-
       sdr  supported  device, this program will output the digital audio data
       decoded from that signal. The data can be listened to by piping to  Sox
       or aplay applications to play the stream on the computer sound card.

SYNOPSIS
       rtl_fm [-f freq] [-options] [filename]

OPTIONS
       -f frequency_to_tune_to [Hz]
              use multiple -f for scanning, (requires squelch)
              ranges supported, -f 118M:137M:25k

       [-M modulation (default: fm)]
              fm, wbfm, raw, am, usb, lsb
              wbfm == -M fm -s 170k -o 4 -A fast -r 32k -l 0 -E deemp
              raw mode outputs 2x16 bit IQ pairs

       -s sample_rate (default: 24k)

 Manual page rtl_fm(1) line 1 (press h for help or q to quit)
```



Tip

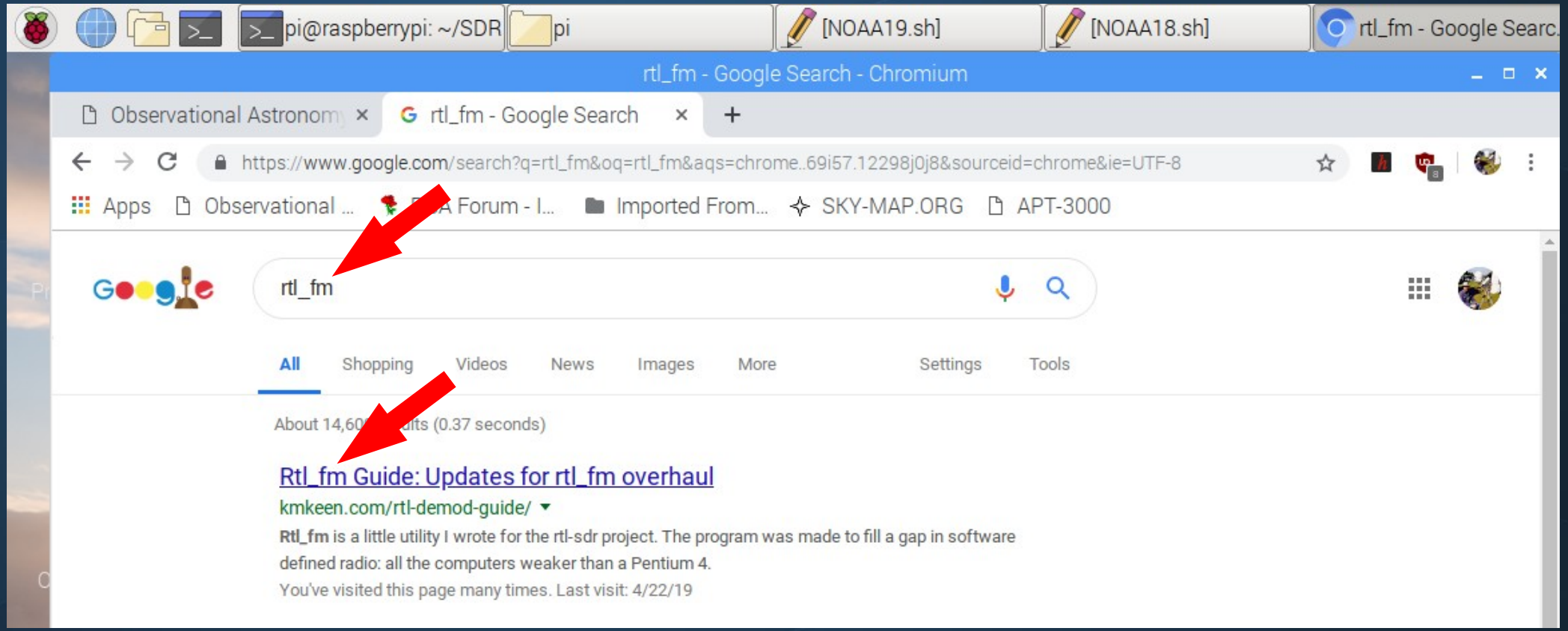
CLI: rtl_fm -h

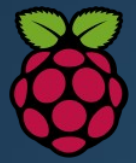
pi@raspberrypi: ~/SDR

File Edit Tabs Help

```
pi@raspberrypi:~/SDR $ rtl_fm -h
rtl_fm, a simple narrow band FM demodulator for RTL2832 based DVB-T receivers

Use:    rtl_fm -f freq [-options] [filename]
        -f frequency_to_tune_to [Hz]
            use multiple -f for scanning (requires squelch)
            ranges supported, -f 118M:137M:25k
        [-M modulation (default: fm)]
            fm, wbfm, raw, am, usb, lsb
            wbfm == -M fm -s 170k -o 4 -A fast -r 32k -l 0 -E deemp
            raw mode outputs 2x16 bit IQ pairs
        [-s sample_rate (default: 24k)]
        [-d device_index (default: 0)]
        [-g tuner_gain (default: automatic)]
        [-l squelch_level (default: 0/off)]
        [-p ppm_error (default: 0)]
        [-E enable_option (default: none)]
            use multiple -E to enable multiple options
            edge:   enable lower edge tuning
            dc:     enable dc blocking filter
            deemp:  enable de-emphasis filter
            direct: enable direct sampling
            offset: enable offset tuning
        filename ('-' means stdout)
            omitting the filename also uses stdout

Experimental options:
        [-r resample_rate (default: none / same as -s)]
        [-t squelch_delay (default: 10)]
            +values will mute/scan, -values will exit
        [-F fir_size (default: off)]
            enables low-leakage downsample filter
            size can be 0 or 9.  0 has bad roll off
        [-A std/fast/lut choose atan math (default: std)]

Produces signed 16 bit ints, use Sox or aplay to hear them.
        rtl_fm ... | play -t raw -r 24k -es -b 16 -c 1 -V1 -
                   | aplay -r 24k -f S16_LE -t raw -c 1
          -M wbfm  | play -r 32k ...
          -s 22050 | multimon -t raw /dev/stdin

pi@raspberrypi:~/SDR $
```

Google Search: rtl_fm





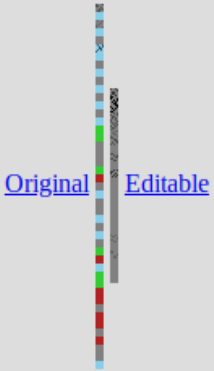
Not secure | kmkeen.com/rtl-demod-guide/

Apps | Observational ... | RCA Forum - I... | Imported From... | SKY-MAP.ORG | APT-3000

RSS

Rtl_fm Guide

Updates for rtl_fm overhaul



Original Editable

version 2 of 2

Rtl_fm is a little utility I wrote for the rtl-sdr project. The program was made to fill a gap in software defined radio: all the computers weaker than a Pentium 4. Basically, an Atom processor processor does not have enough oomph to demodulate something as simple as narrow band FM using the standard tools. (Recently a high performance FM demodulator was released, Simple FM but it works only passably on newer Atoms.) So rtl_fm was written with one goal, efficiency, in mind.

http://kmkeen.com/rtl-demod-guide/

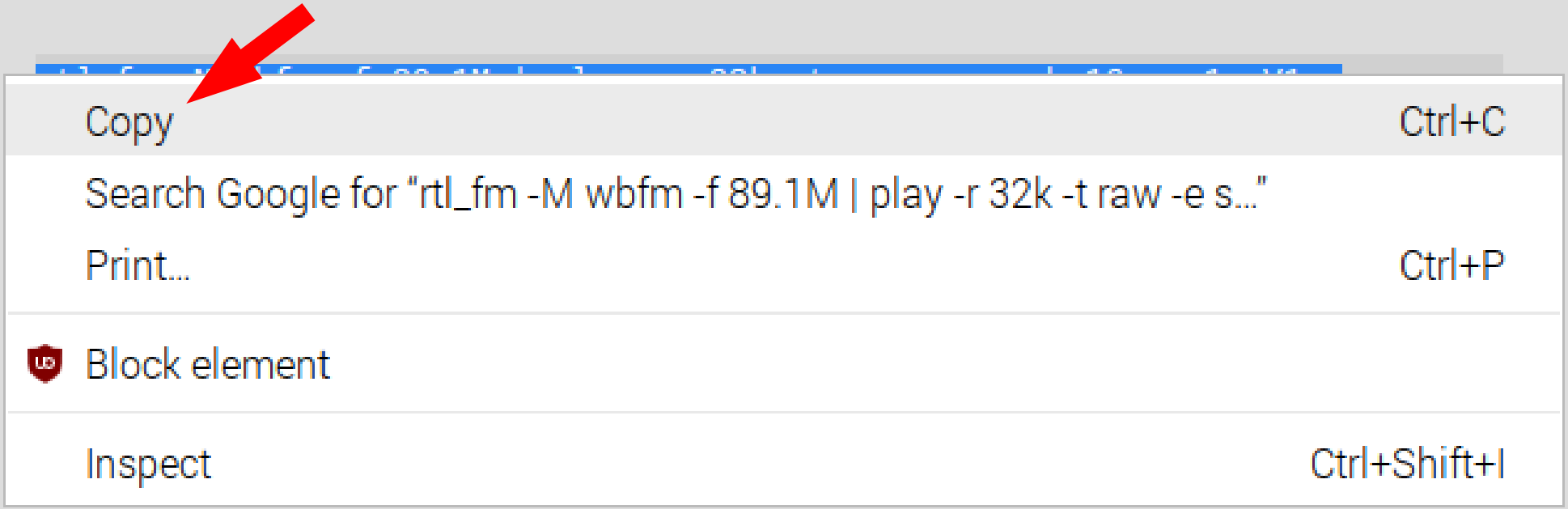
Select & Copy Command From Website

Music on the Radio

```
rtl_fm -M wbfm -f 89.1M | play -r 32k -t raw -e s -b 16 -c 1 -V1 -
```

Copy Website Text

Music on the Radio



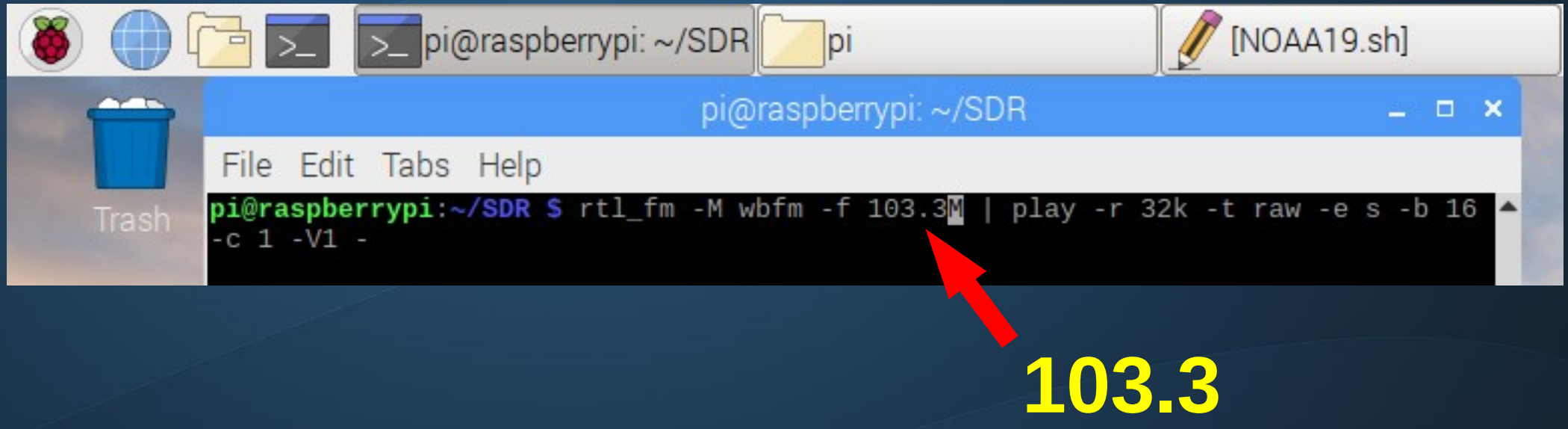
Paste Text in to Terminal

FM Stations

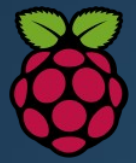
http://radiostationworld.com/locations/united_states_of_america/oregon/portland/radio_stations/

102.5 10w	**K273AJ** -- CSN	Elwood (Clackamas) OR	religious	
102.5 100w	**KIEV-LP -- Slavic Community Radio**	Camas (Clark) WA	community,religious	
102.9 99w	**K275CH -- The Game** KXTG-750	Gresham (Multnomah) OR	sports	
103.3 100kW	**KKCW -- K103**	Beaverton (Washington) OR	soft ac	
	KKCW-HD1 -- K103		soft ac	
	KKCW-HD2 -- Smooth Jazz Network (satellite feed)		smooth jazz	
	KKCW-HD3 -- Air1		worship music (CWM)	
103.7 99w	**K279BO -- 103.7 The Legend** KFBW-HD3	Portland (Multnomah) OR	classic country	
104.1 7kW	**KFIS -- The Fish**	Scappoose (Columbia) OR	contemporary Christian	
104.5 99w	K283BL -- Way FM KFBW-HD2	Portland (Multnomah) OR	contemporary Christian	
104.5 100w	**KVPB-LP -- The Sound**	Vernonia (Columbia) OR	new (->community)	

Change Freq. To 103.3 KKCW 100 kW
Left Arrow, Backspace, 103.3



Listening to 103.3 FM



rtl_fm

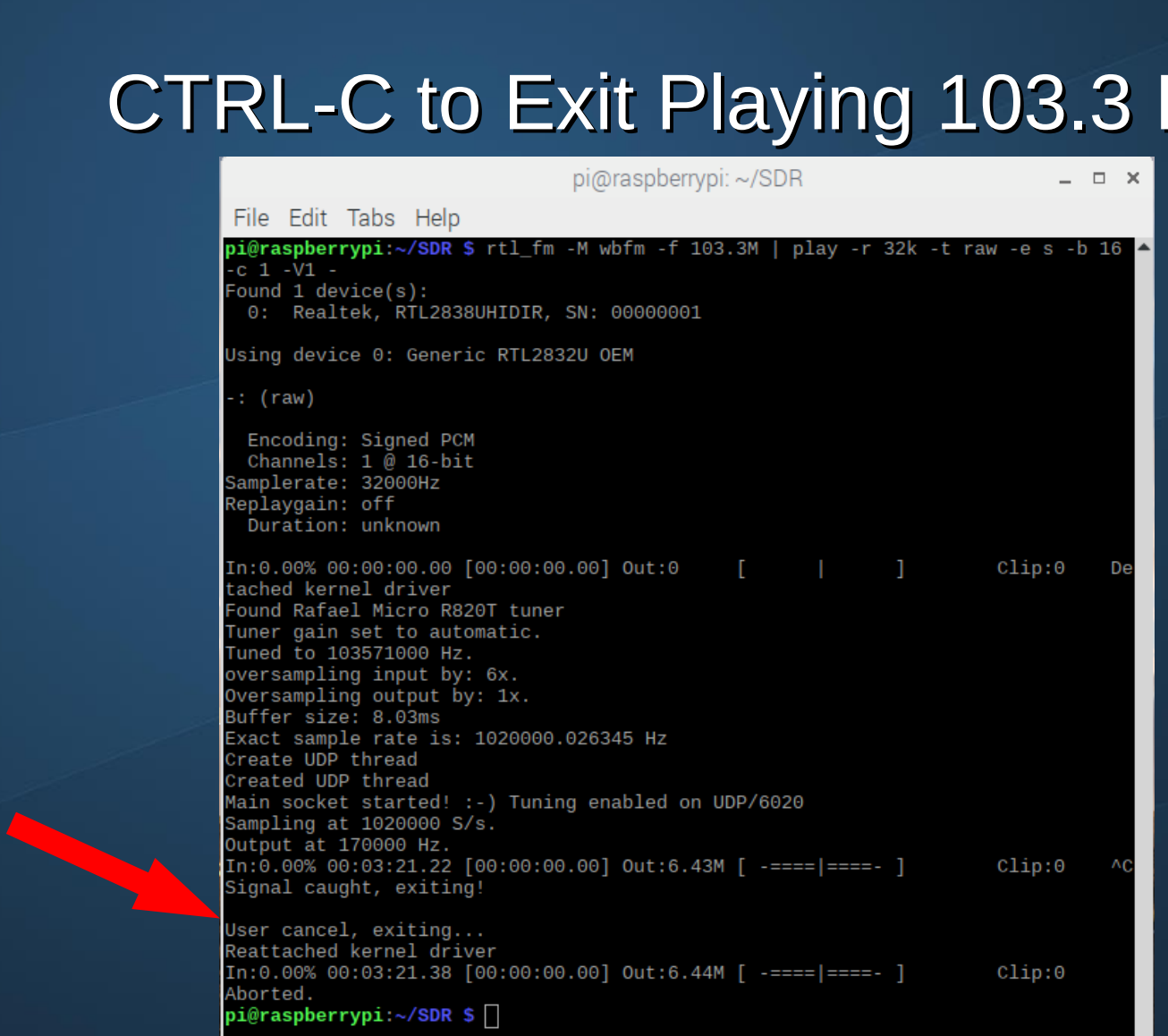
play

rtl_fm

play

```
pi@raspberrypi:~/SDR $ rtl_fm -M wbfm -f 103.3M | play -r 32k -t raw -e s -b 16
-c 1 -V1 -
Found 1 device(s):
  0:  Realtek, RTL2838UHIDIR, SN: 00000001

Using device 0: Generic RTL2832U OEM

-: (raw)

  Encoding: Signed PCM
  Channels: 1 @ 16-bit
Samplerate: 32000Hz
Replaygain: off
  Duration: unknown

In:0.00% 00:00:00.00 [00:00:00.00] Out:0     [      |      ]        Clip:0    De
tached kernel driver
Found Rafael Micro R820T tuner
Tuner gain set to automatic.
Tuned to 103571000 Hz.
oversampling input by: 6x.
Oversampling output by: 1x.
Buffer size: 8.03ms
Exact sample rate is: 1020000.026345 Hz
Create UDP thread
Created UDP thread
Main socket started! :-) Tuning enabled on UDP/6020
Sampling at 1020000 S/s.
Output at 170000 Hz.
In:0.00% 00:00:41.22 [00:00:00.00] Out:1.31M [ =====|===== ]        Clip:0
```

CTRL-C to Exit Playing 103.3 FM



NOAA Weather Frequencies

www.nws.noaa.gov/nwr/coverage/ccov.php?State=OR

NOAA WEATHER RADIO ALL HAZARDS

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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NWR County Coverage Listing for Oregon

DEGRADED - Indicates transmitter is experiencing a temporary degradation of service.
OUT OF SERVICE - Indicates transmitter is temporarily out of service.

State Selection for County Coverage

162.400	162.425	162.450	162.475	162.500	162.525	162.550

County Coverage as of April 21 2019 20:48:12. (UTC)

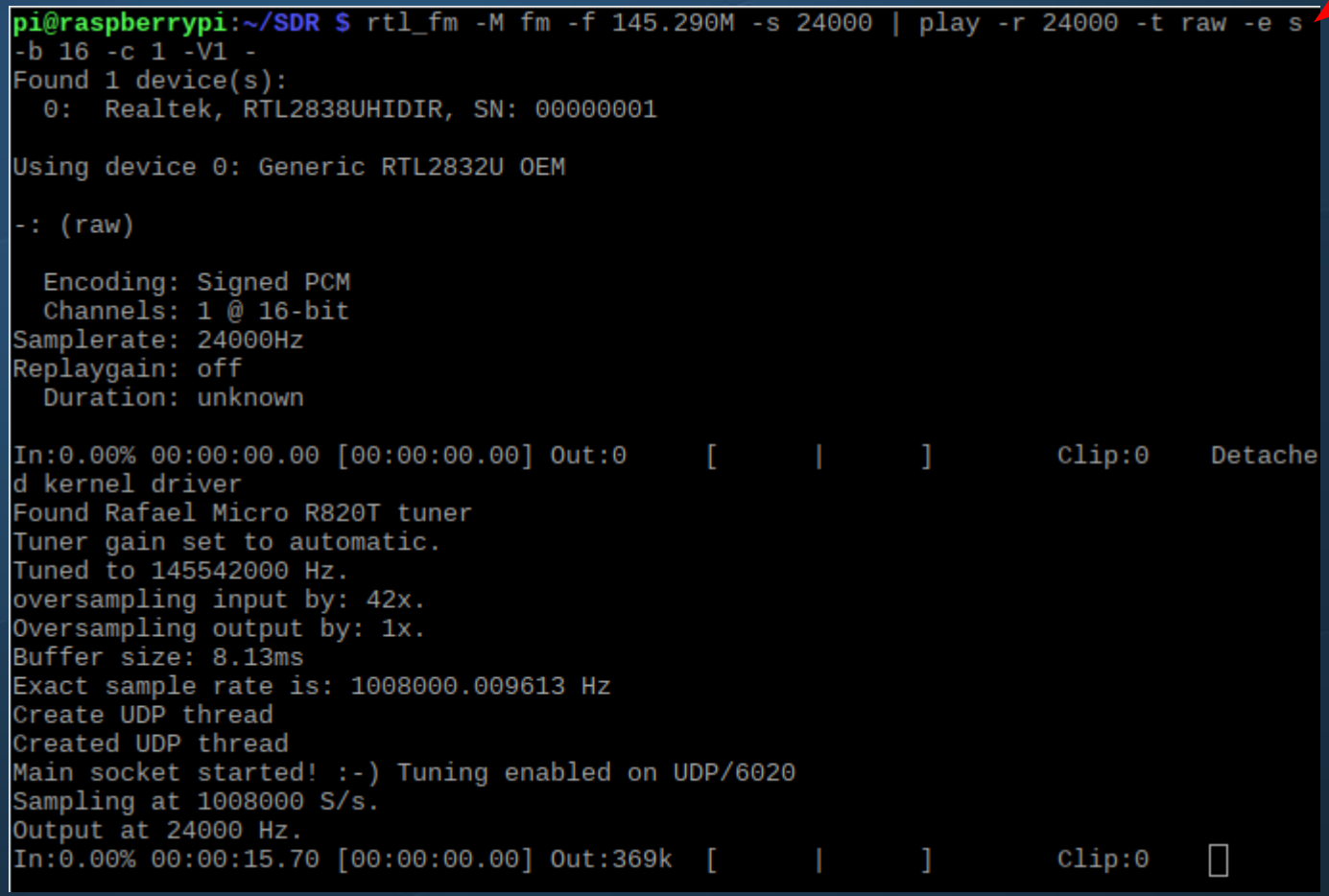
Print

County	SAME #	NWR Transmitter	Call Sign	Frequency	Remarks
Baker	041001	---No NWR Coverage---			
Benton	041003	Eugene	KEC42	162.400	
Benton	041003	Salem	WXL96	162.475	
Clackamas	041005	Portland	KIG98	162.550	
Clackamas	041005	Salem	WXL96	162.475	
Clatsop	041007	Astoria	KEC91	162.400	

WXL96 NOAA Weather 162.475 MHz FM

```
pi@raspberrypi:~/SDR $ rtl_fm -M fm -f 162.475M -s 24000 | play -r 24000 -t raw
-e s -b 16 -c 1 -V1 -
Found 1 device(s):
  0:  Realtek, RTL2838UHIDIR, SN: 00000001

Using device 0: Generic RTL2832U OEM

-: (raw)

  Encoding: Signed PCM
  Channels: 1 @ 16-bit
Samplerate: 24000Hz
Replaygain: off
  Duration: unknown

In:0.00% 00:00:00.00 [00:00:00.00] Out:0     [      |      ]        Clip:0    De
tached kernel driver
Found Rafael Micro R820T tuner
Tuner gain set to automatic.
Tuned to 162727000 Hz.
oversampling input by: 42x.
Oversampling output by: 1x.
Buffer size: 8.13ms
Exact sample rate is: 1008000.009613 Hz
Create UDP thread
Created UDP thread
Main socket started! :-) Tuning enabled on UDP/6020
Sampling at 1008000 S/s.
Output at 24000 Hz.
In:0.00% 00:00:33.11 [00:00:00.00] Out:786k  [      |      ]        Clip:0
```

WA7ABU 145.290 MHz FM Repeater



rtl_fm Command Parameters

```
pi@raspberrypi:~/SDR $ rtl_fm -M fm -f 145.290M -s 32000 | play -r 32000 -t raw -e s -b
 16 -c 1 -V1 -
```

- -M **fm** modulation
- -f **145.290** frequency
- -s **32000** audio sample rate
  - 8000, 11025, 22050, 32000, 44100 & 48000

Adding Fixed Gain & Squelch

```
pi@raspberrypi:~/SDR $ rtl_fm -M fm -f 145.290M -s 24000 -g 30 -l 80 | play -r 24000
-t raw -e s -b 16 -c 1 -V1 -
```

- -g 30 gain level
- -l 80 squelch level is sensitive to gain level & preamp

Linux Pipeline Function

```
pi@raspberrypi:~/SDR $ rtl_fm -M fm -f 145.290M -s 24000 | play -r 24000 -t raw -e s
-b 16 -c 1 -V1 -
```

RTL-SDR USB data stream

rtl_fm

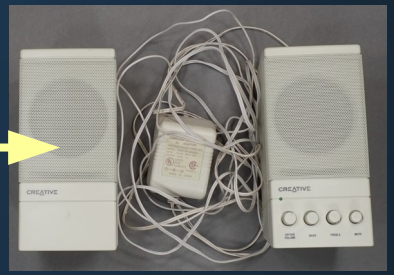
stdout

pipe

stdin

play

speaker



Sound eXchange: SoX play Command Parameters

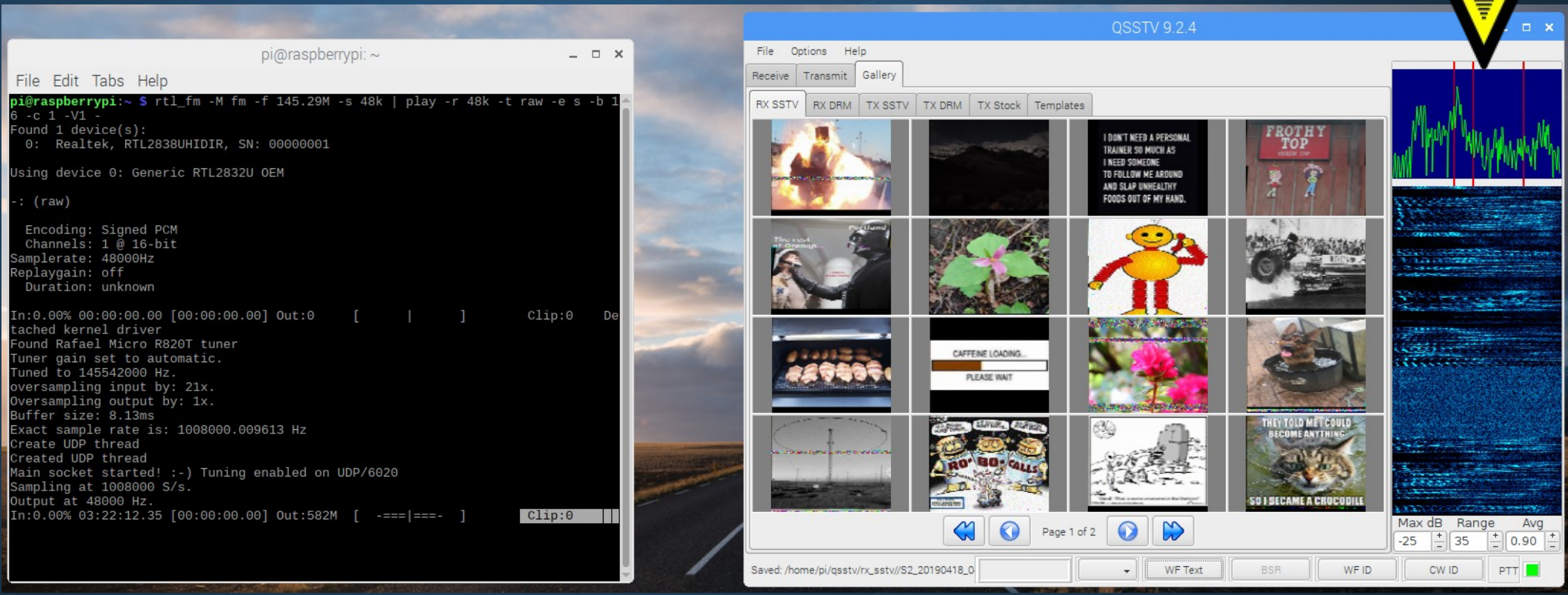
```
pi@raspberrypi:~/SDR $ rtl_fm -M fm -f 145.290M -s 32000 | play -r 32000 -t raw -e s -b
 16 -c 1 -V1 -
```

- -r 32000 audio sample rate, must match rtl_fm -s rate
  - 8000, 11025, 22050, 32000, 44100 & 48000
- -t raw audio data encoding
- -e s for signed-integer encoding
- -b 16 bits of audio date
- -c 1 audio channel
- -V1 -V1 SoX processig & only error messages are shown.
- \- - Use stdin pipeline

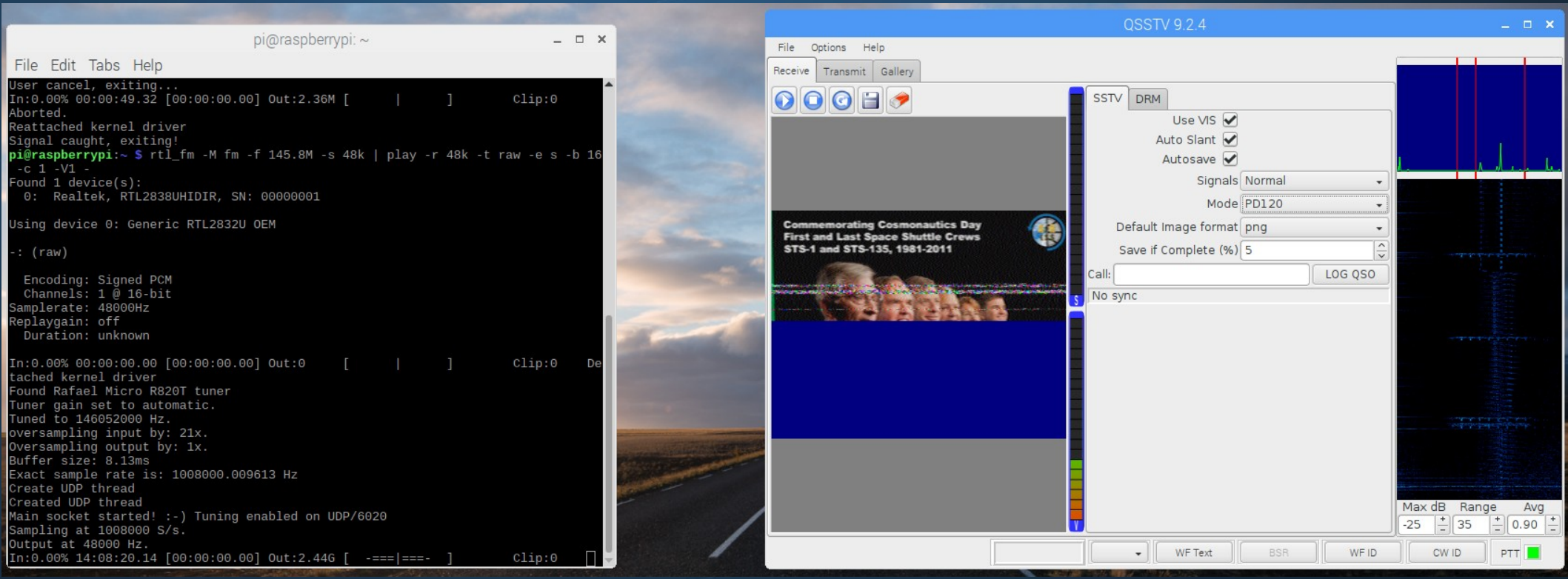
SoX 84 pages

```
In:0.00% 00:00:11.01 [00:00:00.00] Out:344k  [   -==|==-   ]        Clip:0
```

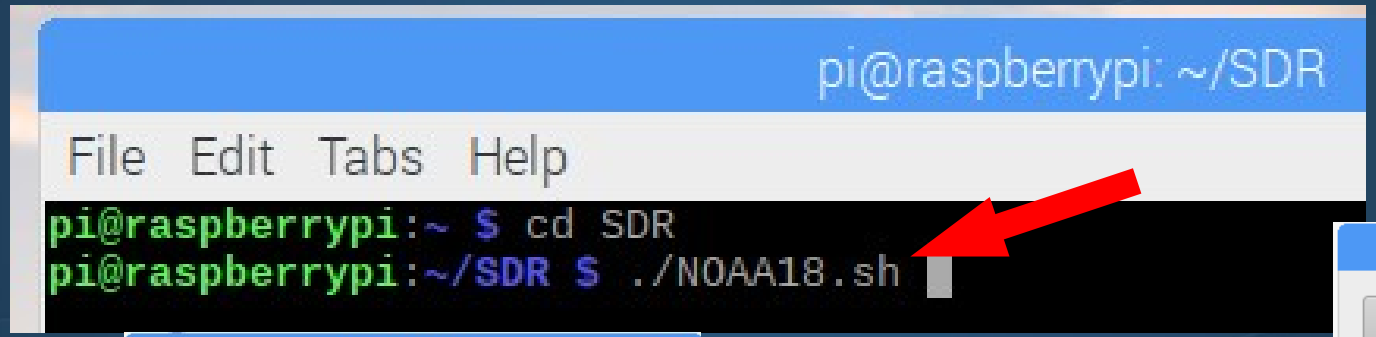
WA7ABU 145.290 MHz SSTV Wed. 8:30 pm

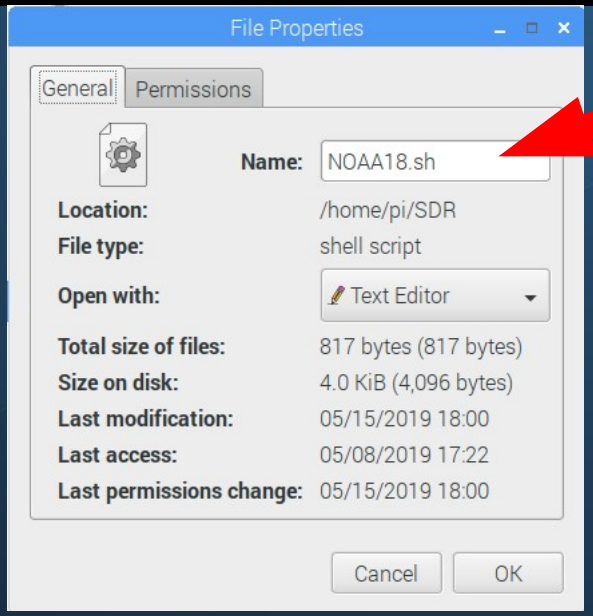


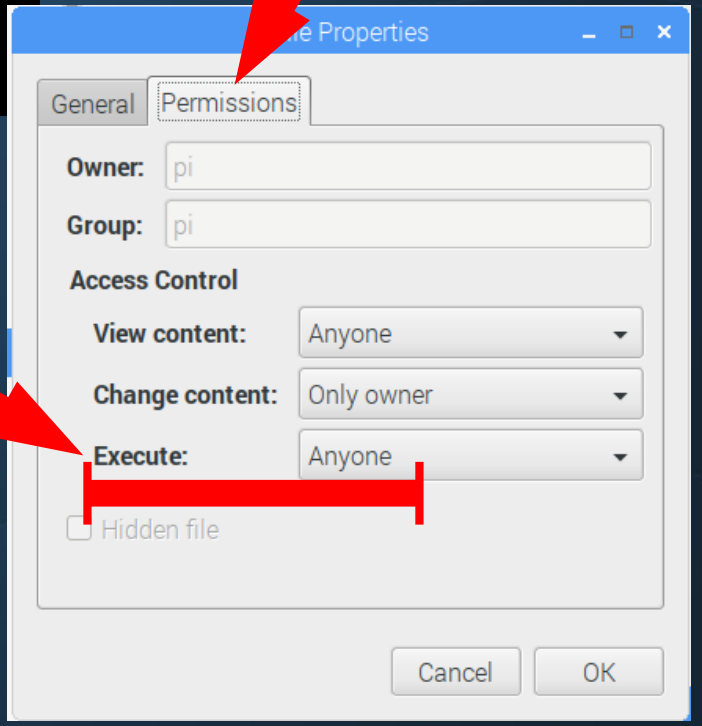
ISS SSTV 145.8 MHz FM

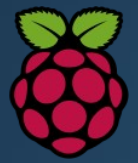


NOAA18.sh Bash Shell









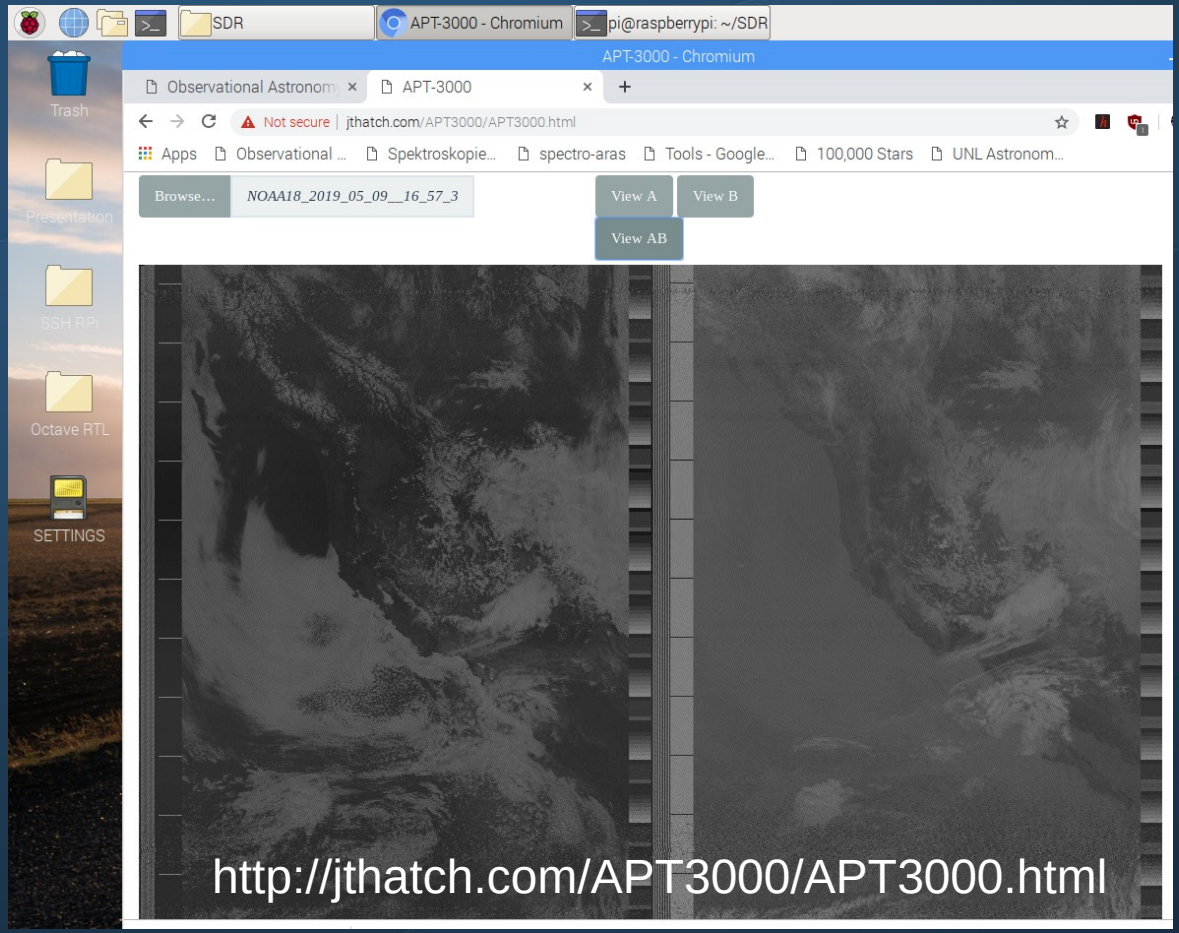
NOAA18.sh

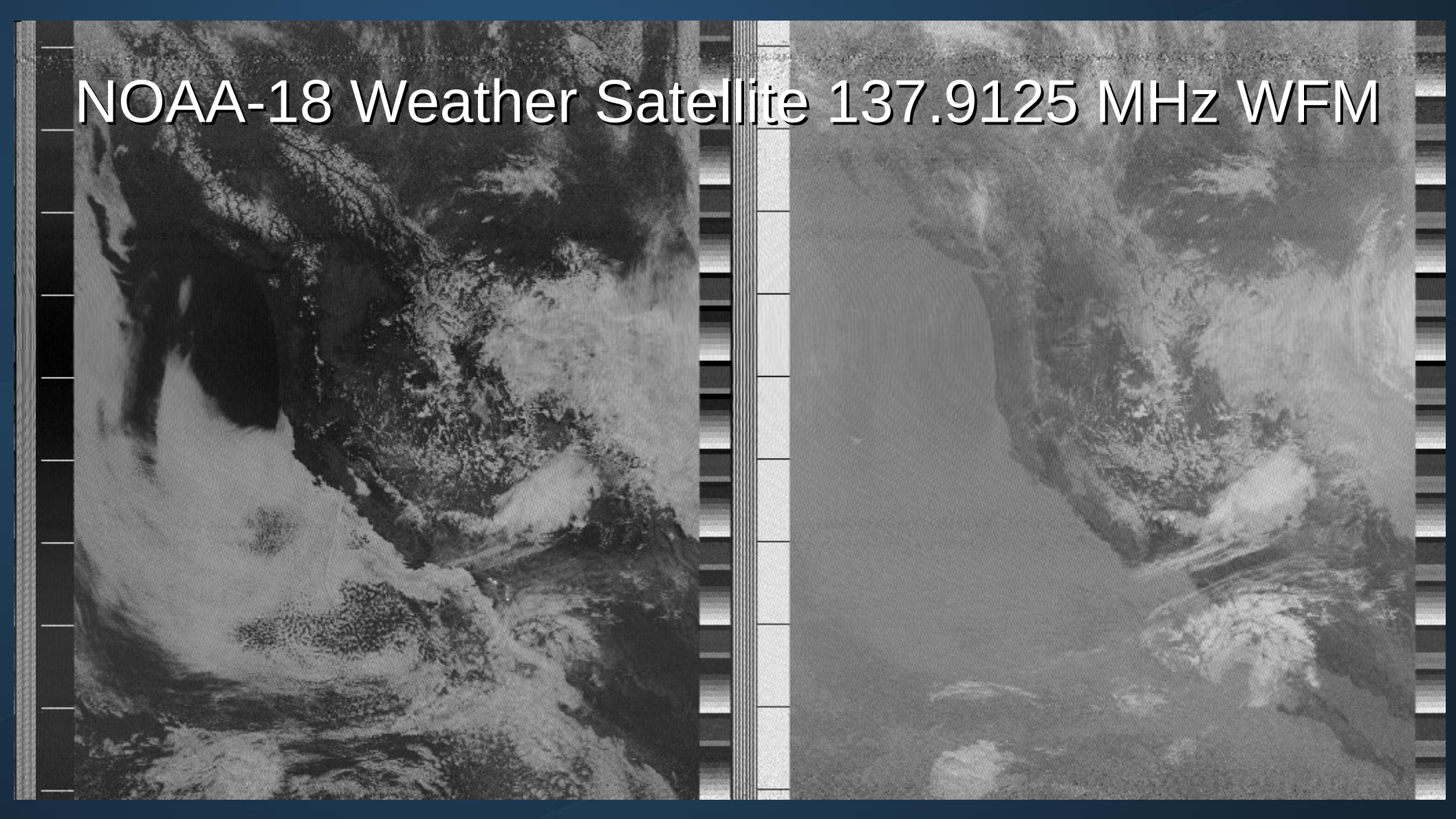
File Edit Search Options Help

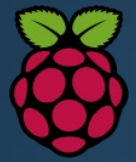
```
#!/bin/bash
#
# David Haworth, WA9ONY
# www.qrz.com/db/WA9ONY
#
#  $1 is gain parameter
#
gain=29.7
if [ $# -eq 0 ]; then
        echo 'Missing gain parameter 0 to 49.6, gain set to 29.7.'
else
        gain=${1}
fi
echo 'CTRL-C to stop'
echo 'NOAA-18 frequency 137,912,500 Hz WFM'
echo "Gain is $1"
echo 'Rafael Micro R820T tuner'
echo 'Supported gain values (29):'
echo '0.0 0.9 1.4 2.7 3.7 7.7 8.7'
echo '12.5 14.4 15.7 16.6 19.7'
echo '20.7 22.9 25.4 28.0 29.7'
echo '32.8 33.8 36.4 37.2 38.6'
echo '40.2 42.1 43.4 43.9 44.5 48.0 49.6'
echo
#
today=`date '+%Y_%m_%d__%H_%M_%S'`
filename="/home/pi/SDR/NOAA18_$today.wav"
rtl_fm -M fm -f 137912500  -g ${gain} -l 0 -s 150k -r 11025 -A fast -E deemo |
tee >( play -v 2 -r 11025 -t raw -e s -b 16 -c 1 -V1 - ) >( sox -v 2 -r 11025 -
t raw -e s -b 16 -c 1 - ${filename} ) > /dev/null
```

Gain parameter with default
Speaker
Save to file with auto file name

NOAA-18 Weather Satellite
137.9125 MHz WFM

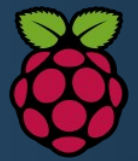



NOAA-18 Weather Satellite 137.9125 MHz WFM



Raspberry Pi Headless Operation
No Keyboard, No Mouse & No Monitor

- Enable SSH (Secure Shell) on Raspberry Pi
  - *man ssh*



- SSH on Windows 8.1

- SSH on Mac OS/X

- SSH on Linux / Raspberry Pi

Enable SSH

Raspberry Pi Configuration

System | Interfaces | Performance | Localisation

Camera:	○ Enable	◉ Disable
SSH:	◉ Enable	○ Disable
VNC:	◉ Enable	○ Disable
SPI:	○ Enable	◉ Disable
I2C:	○ Enable	◉ Disable
Serial Port:	○ Enable	◉ Disable
Serial Console:	◉ Enable	○ Disable
1-Wire:	○ Enable	◉ Disable
Remote GPIO:	○ Enable	◉ Disable

Cancel OK

Boot into CLI

Raspberry Pi Configuration

System | Interfaces | Performance | Localisation

Password: Change Passw...

Hostname: raspberrypi

Boot: To Desktop (•) To CLI

Auto login: ☑ Login a

Network at Boot: ☐ Wait for network

Splash Screen: ( ) Enable (•) Disable

Resolution: Set Resolution...

Overscan: (•) Enable ( ) Disable

Pixel Doubling: ( ) Enable (•) Disable

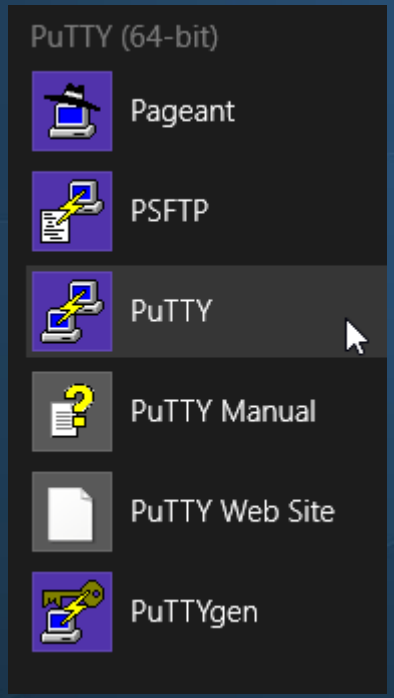
Cancel OK

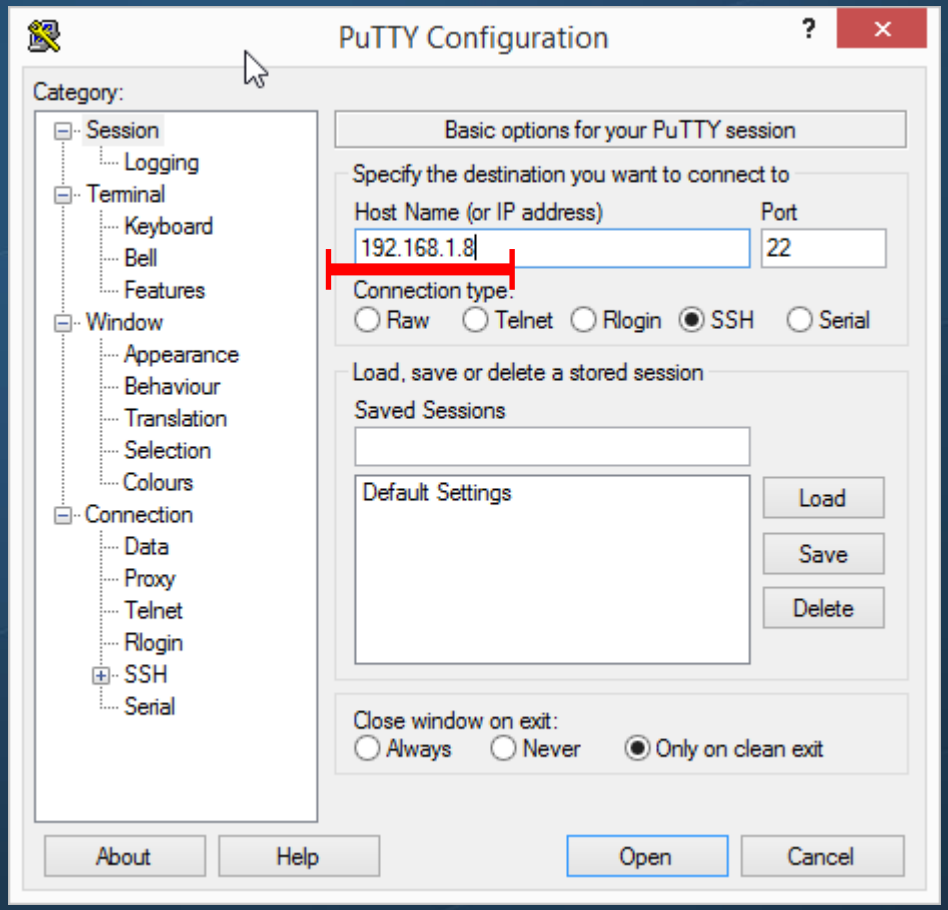
Boot into a command line shell rather than the desktop

udio
esktop
ocuments
stalls1
S
lagPi
<No subfolders>
lusic
ctave
ictures
<No subfolders>

Downloads
Installs1
ISS
MagPi
Music
Octave
Public
qsstv
Screens1
SDR
Templates
templates
tx_drm

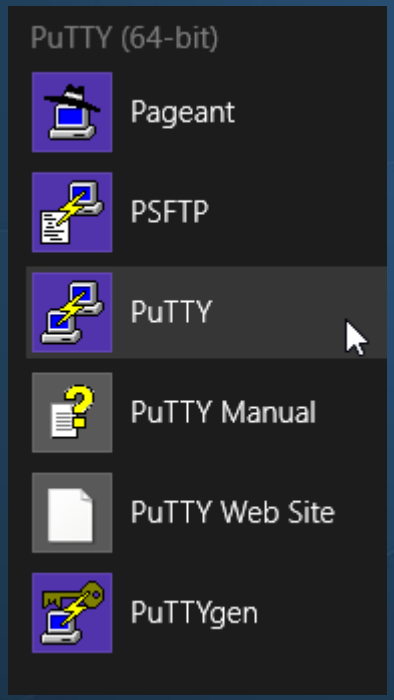
SSH: Windows 8.1 with PuTTY

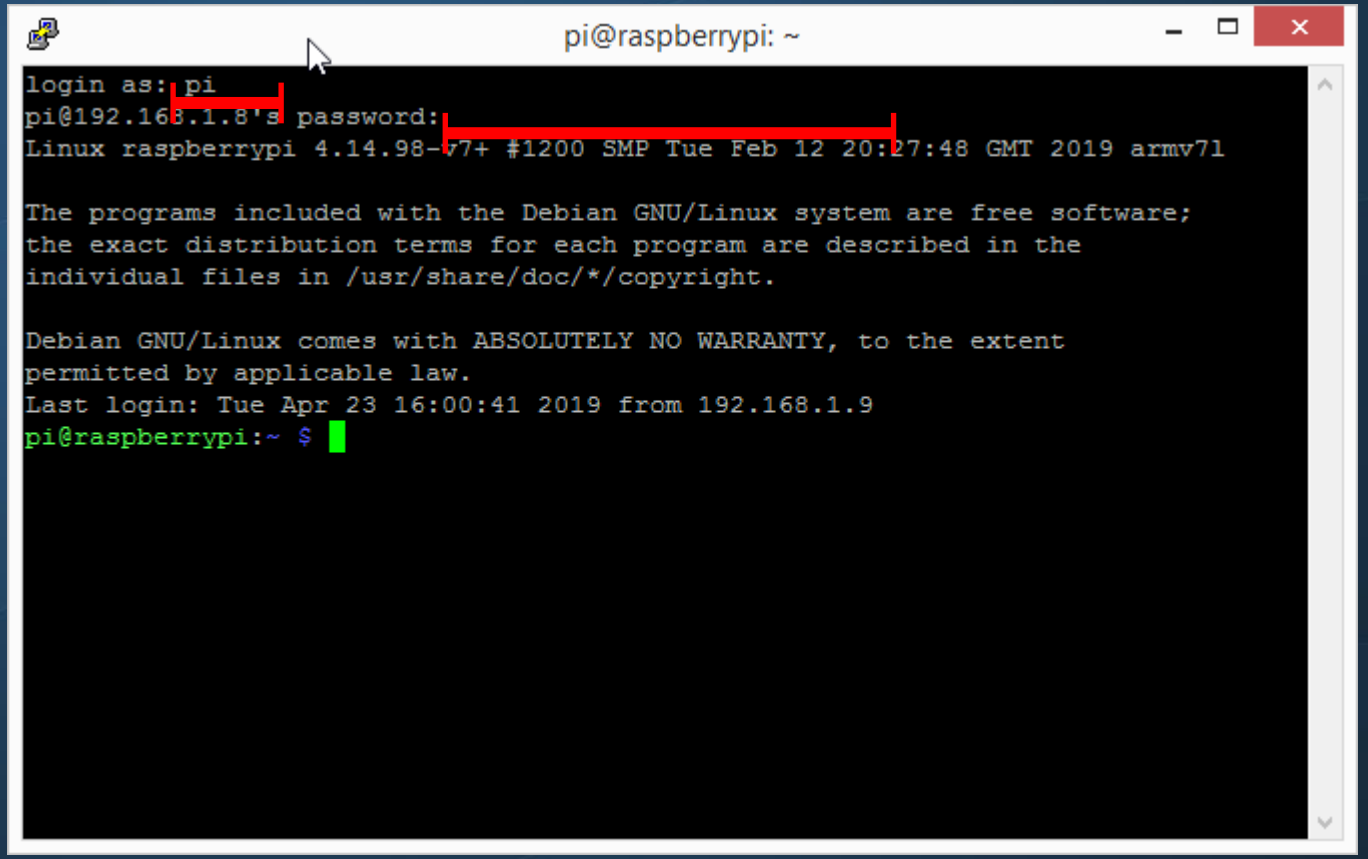




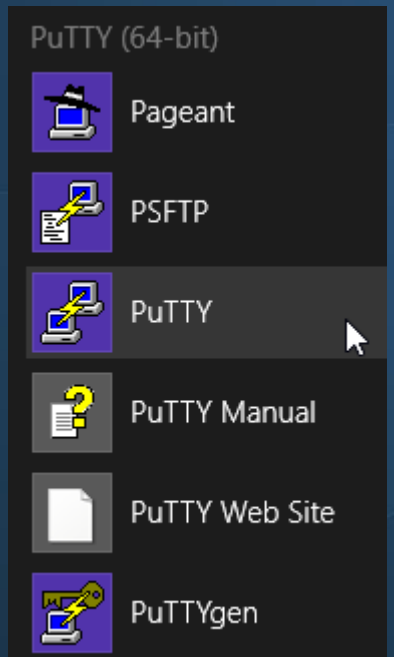
https://www.putty.org/

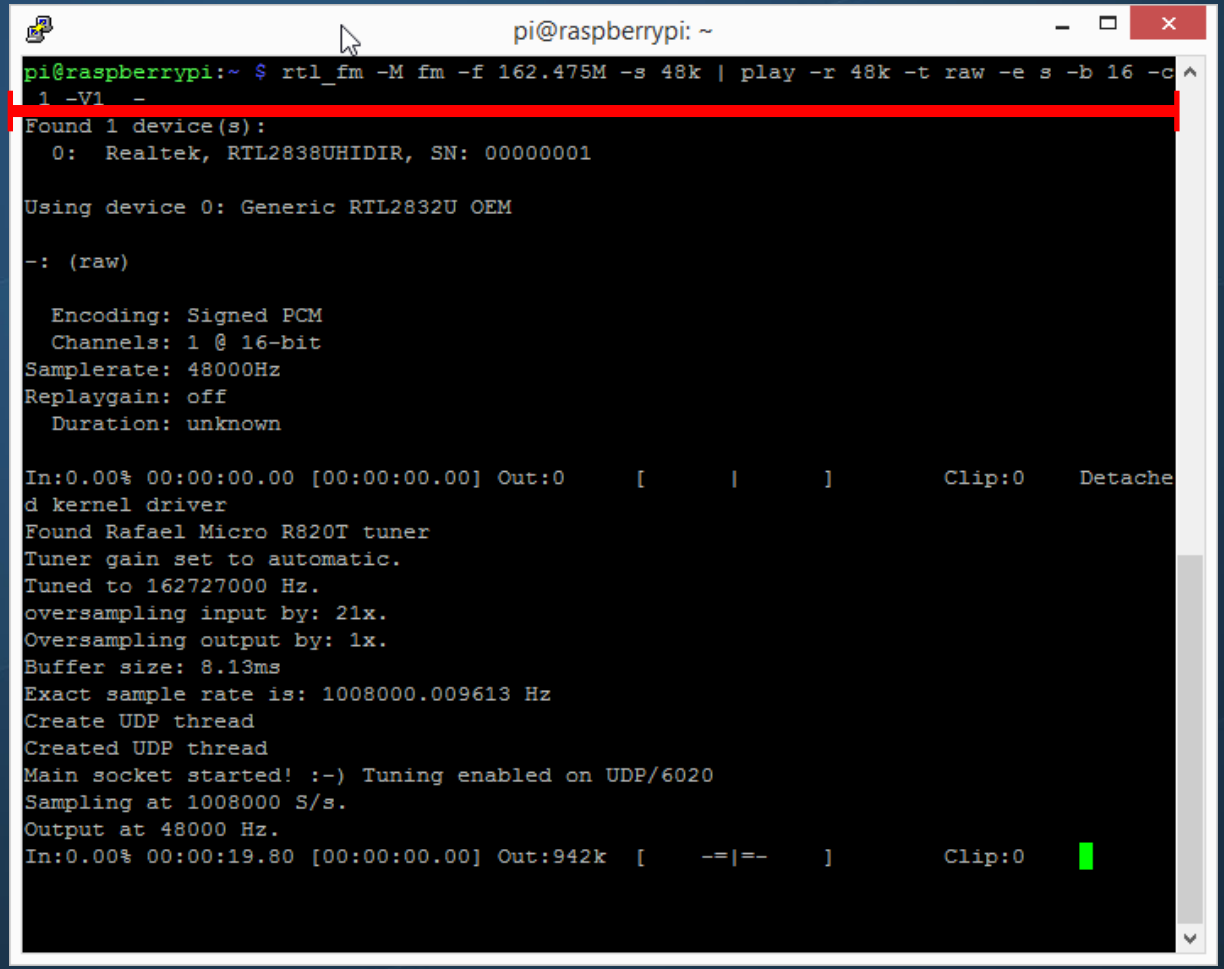
SSH: Windows 8.1 with PuTTY





SSH: Windows 8.1 with PuTTY





SSH: macOS

Terminal

```
davidhaworth — pi@raspberrypi: ~ — ssh pi@192.168.1.8 — 80×24
Last login: Wed Apr 24 15:07:18 on console
Davids-MacBook-Pro:~ davidhaworth$ ssh pi@192.168.1.8
The authenticity of host '192.168.1.8 (192.168.1.8)' can't be established.
ECDSA key fingerprint is SHA256:KiZNzMZ5qRTHU7o/NFTEGX7Hxiy3VXHvSfcxmjrmSgI.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.1.8' (ECDSA) to the list of known hosts.
pi@192.168.1.8's password:
Linux raspberrypi 4.14.98-v7+ #1200 SMP Tue Feb 12 20:27:48 GMT 2019 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sun Apr 28 10:39:08 2019 from 192.168.1.4
pi@raspberrypi:~ $
```

SSH: macOS

Terminal

```
davidhaworth — pi@raspberrypi: ~ — ssh pi@192.168.1.8 — 80×30
[pi@raspberrypi:~ $ rtl_fm -M fm -f 162.475M -s 48k | play -r 48k -t raw -e s -b ]
16 -c 1 -V1 -
Found 1 device(s):
  0:  Realtek, RTL2838UHIDIR, SN: 00000001

Using device 0: Generic RTL2832U OEM

-: (raw)

  Encoding: Signed PCM
  Channels: 1 @ 16-bit
Samplerate: 48000Hz
Replaygain: off
  Duration: unknown

In:0.00% 00:00:00.00 [00:00:00.00] Out:0     [      |      ]        Clip:0    De
tached kernel driver
Found Rafael Micro R820T tuner
Tuner gain set to automatic.
Tuned to 162727000 Hz.
oversampling input by: 21x.
Oversampling output by: 1x.
Buffer size: 8.13ms
Exact sample rate is: 1008000.009613 Hz
Create UDP thread
Created UDP thread
Main socket started! :-) Tuning enabled on UDP/6020
Sampling at 1008000 S/s.
Output at 48000 Hz.
In:0.00% 00:00:53.76 [00:00:00.00] Out:2.57M [    -=|=-    ]        Clip:0
```

```
[pi@raspberrypi:~ $ exit
logout
Connection to 192.168.1.8 closed.
Davids-MacBook-Pro:~ davidhaworth$
```

SSH: Another Raspberry Pi

pi@raspberrypi: ~

File Edit Tabs Help

```
pi@raspberrypi:~ $ ssh pi@192.168.1.8
pi@192.168.1.8's password:
Linux raspberrypi 4.14.98-v7+ #1200 SMP Tue Feb 12 20:27:48 GMT 2019 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sun Apr 21 10:21:59 2019
pi@raspberrypi:~ $ ifconfig
```

Future Raspberry Pi Radio Projects

- SDR DSP
  - rtl_sdr with GNU Octave

  - GNU Radio

This Presentation PDF URL is at
www.qrz.com/db/WA9ONY

SEA-PAC Presentations

- 2019 **Raspberry Pi Radio Projects**
- 2018 FT8 Digital Mode DX Fun with Modest Equipment Part 1
- 2018 FT8 Digital Mode DX Fun with Modest Equipment Part 2
- 2016 Fun with Satellites
- 2015 FUNcube-1 (AO-73) 2m Satellites Telemetry

Oregon Tualatin Valley Amateur Radio Club (OTVARC)

- May 16, 2019 7:00 PM: **Raspberry Pi Radio Projects presentation PDF**