

Raspberry Pi and Ham Radio

Terry Paddack

K5DXD (Formerly KF5TOK)

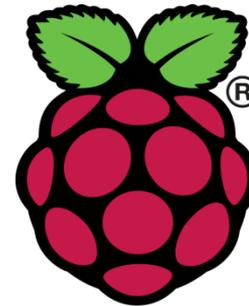
Cowtown Hamfest - 2019

What is Raspberry Pi?



Single-Board Computer featuring:

- On-board CPU, RAM, GPU, Storage, Ports, GPIO Pins
- Low cost – typically \leq \$35 US
- Free*, open-source, software
 - Raspbian Operating System (based on Debian Linux)
 - Programmable in a number of languages including:
 - Python
 - C, C++
 - BASH scripts
 - Many more!



Raspberry Pi Boards



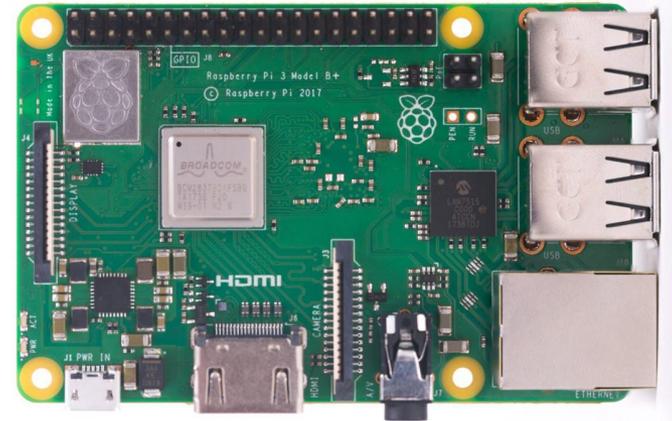
Pi Zero

- \$5-\$15
- Single-core, 1 GHz
- 512 MB RAM
- ~ 1W power draw
- Smallest form factor
- 1 micro USB port
- Pi Zero W has:
 - 802.11n
 - Bluetooth 4.1



Pi 3A+

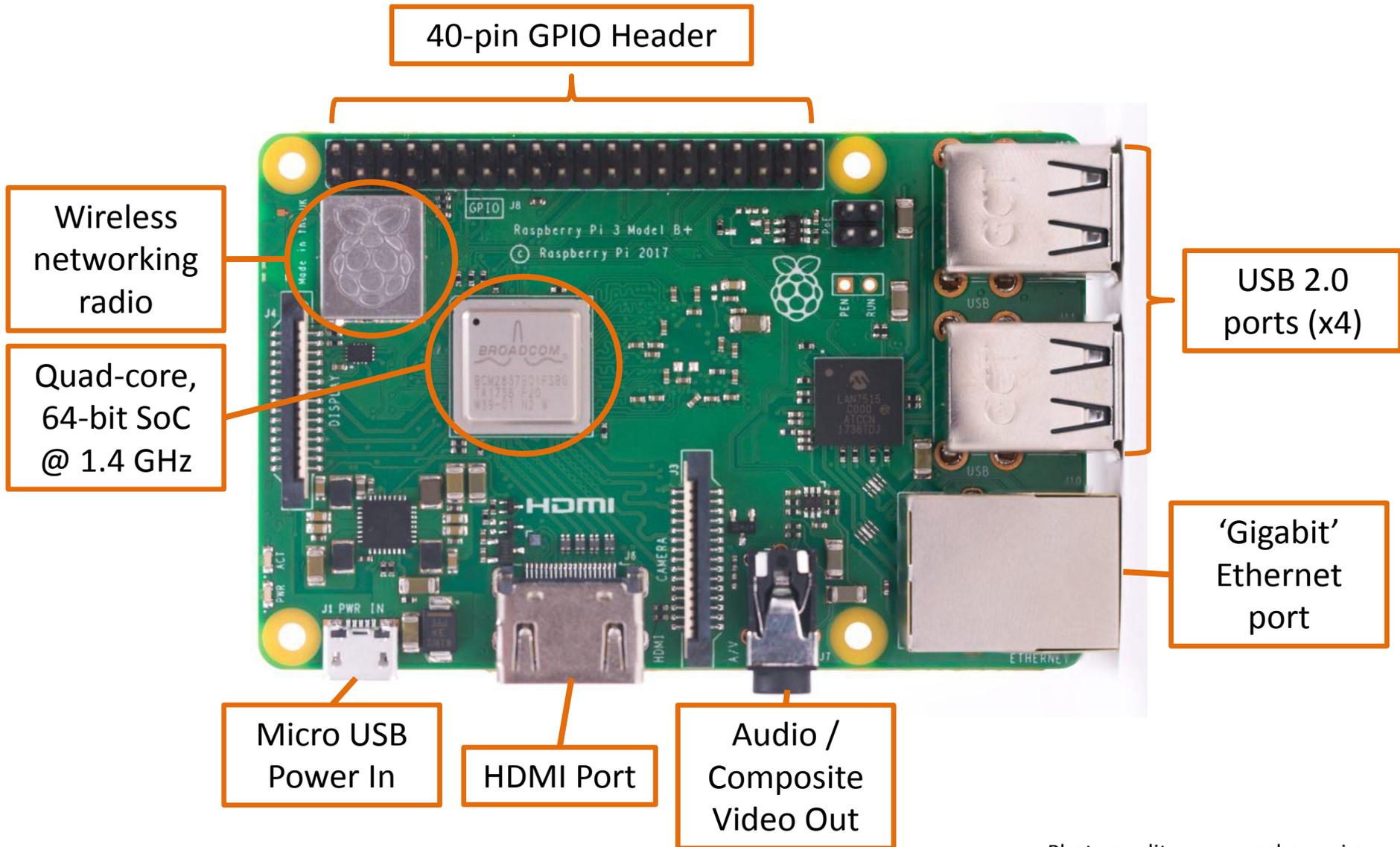
- \$25
- Quad-core, 1.4 GHz
- 512 MB RAM
- ~ 4W power draw
- Medium form factor
- 1 USB 2.0 port
- 802.11b/g/n/ac
- Bluetooth 4.2



Pi 3B+

- \$35
- Quad-core, 1.4 GHz
- 1 GB RAM
- ~ 5.6W power draw
- Largest form factor
- 4 USB 2.0 ports
- 802.11 ac/n
- Bluetooth 4.2

Anatomy of a Raspberry Pi3B+



40-pin GPIO Header

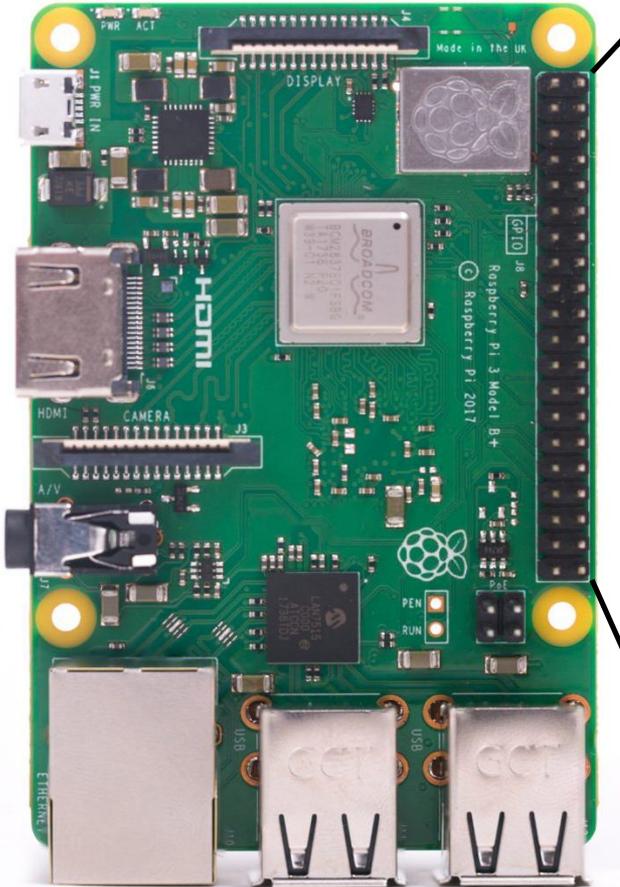


Photo credit: www.raspberrypi.org

		+3.3 V	1	2	+5 V		
I ² C	SDA	GPIO 2	3	4	+5 V		
	SCL	GPIO 3	5	6	GND		
		GPIO 4	7	8	GPIO 14	TXD	UART
		GND	9	10	GPIO 15	RXD	
		GPIO 17	11	12	GPIO 18	CLK	PCM
		GPIO 27	13	14	GND		
		GPIO 22	15	16	GPIO 23		
		+3.3 V	17	18	GPIO 24		
SPI	MOSI	GPIO 10	19	20	GND		
	MISO	GPIO 9	21	22	GPIO 25		
	SCLK	GPIO 11	23	24	GPIO 8	CE0	SPI
		GND	25	26	GPIO 7	CE1	
		ID SD	27	28	ID SC		
		GPIO 5	29	30	GND		
		GPIO 6	31	32	GPIO 12		
		GPIO 13	33	34	GND		
PCM	FS	GPIO 19	35	36	GPIO 16		
		GPIO 26	37	38	GPIO 20	DIN	PCM
		GND	39	40	GPIO 21	DOU T	

Setting up the Raspberry Pi



Raspbian OS image files:

- <https://www.raspberrypi.org/downloads/raspbian/>

Installation Guide:

- <https://www.raspberrypi.org/documentation/installation/installing-images/README.md>

Other useful software and links:

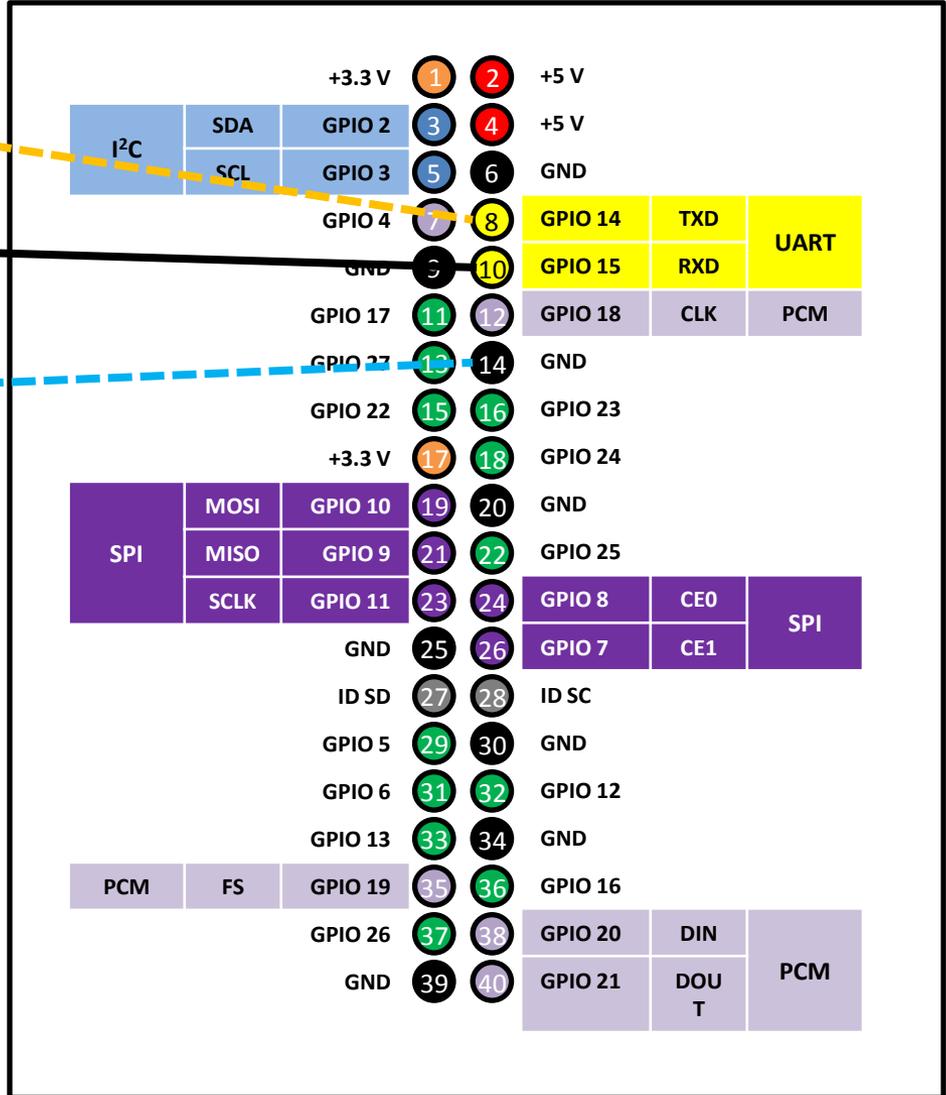
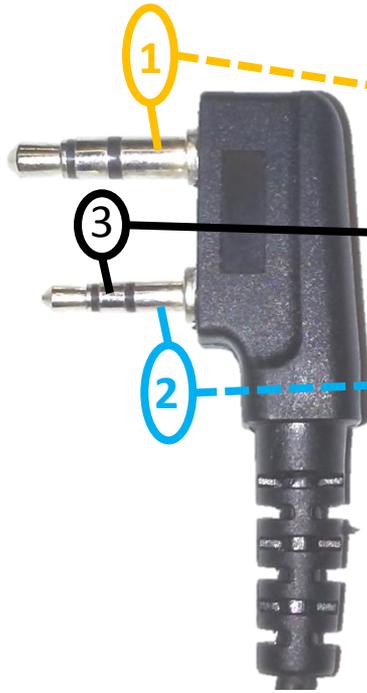
• **Direwolf User Guide:**

- <https://github.com/wb2osz/direwolf/blob/master/doc/User-Guide.pdf>

• **Chirp Downloads:**

- <https://chirp.danplanet.com/projects/chirp/wiki/Download>

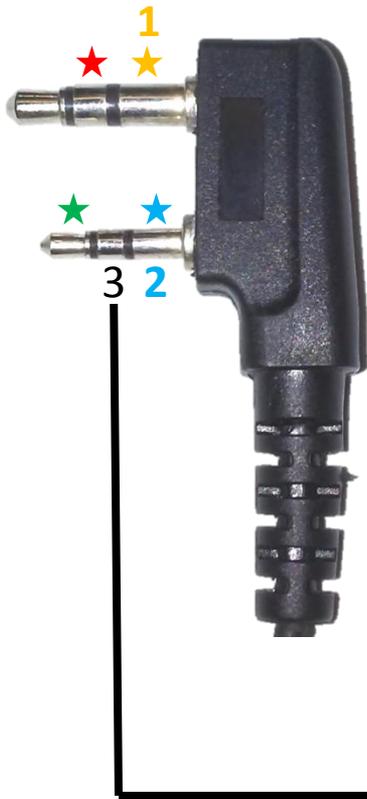
Project #1 – Programming a UV5-R (with a home-made cable)



Wires for Programming with UART	
1	To TxD on Pi (GPIO 14)
2	To GND on Pi
3	To RxD on Pi (GPIO 15)

Project #1 – Programming a UV-5R

(with a home-made cable)



Wires connected in UV5R headset	
★	PTT
★	Microphone
★	GND
★	Speaker



UV-5R



BF-888

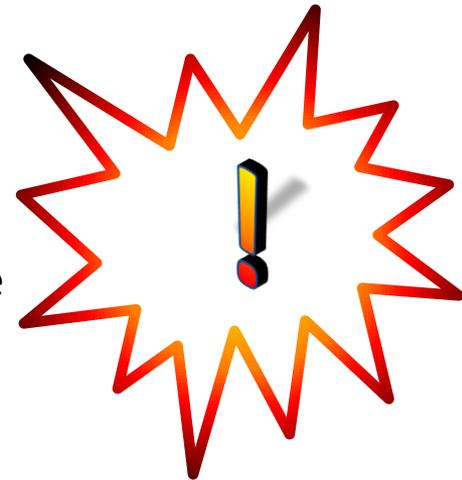
★ These are the only wires present in the headset included with the UV5R, so there is no way to use this connector to program the radio using the Pi's on-board UART ☹️

We need access to this part of the connector.

Project #1 – Programming a UV-5R

(with a home-made cable)

Software Configuration



The following changes must be made:

- Install chirp according to instructions at [Chirp Downloads](#) website
- Stop & disable the pre-configured serial console service
 - `sudo systemctl stop serial-getty@ttyS0.service`
 - `sudo systemctl disable serial-getty@ttyS0.service`
- Remove the serial console from cmdline.txt
 - `sudo leafpad /boot/cmdline.txt`
 - Delete this text “console=serial0,115200” from the file
 - Save changes to the file and reboot
- Edit the config file to force on-board Bluetooth to use the software-based UART so the programming cable gets the (higher-performance) hardware UART
 - `sudo leafpad /boot/config.txt`
 - Add the following lines to the end of the file:
 - `enable_uart=1`
 - `core_freq=250`
 - `dtoverlay=pi3-miniuart-bt`
 - Save changes and reboot
- Plug in your home-made cable, start up Chirp, and program your radio

Project #2 – DTMF Relay Controller Hardware Overview

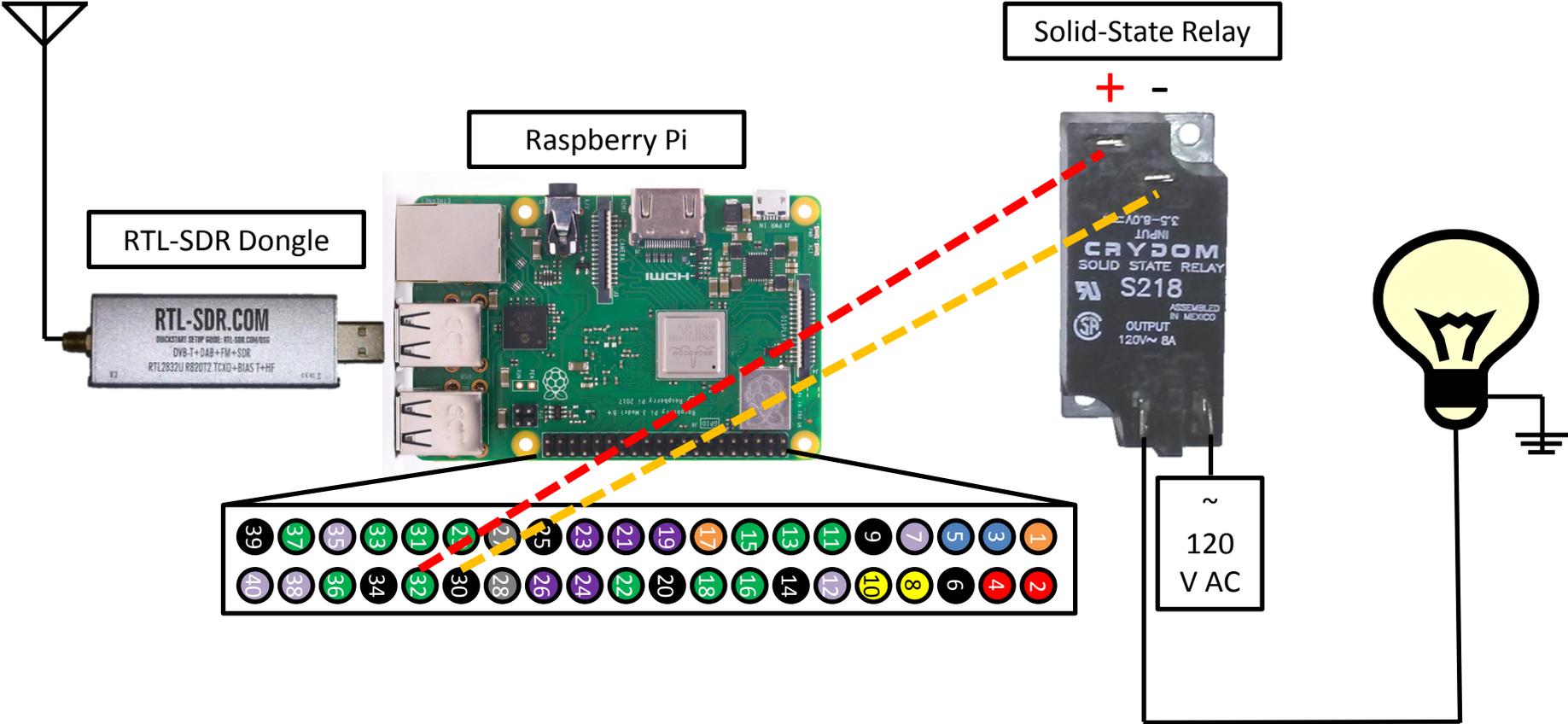
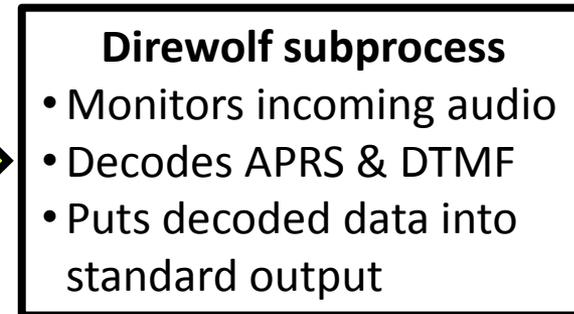
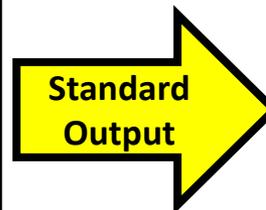
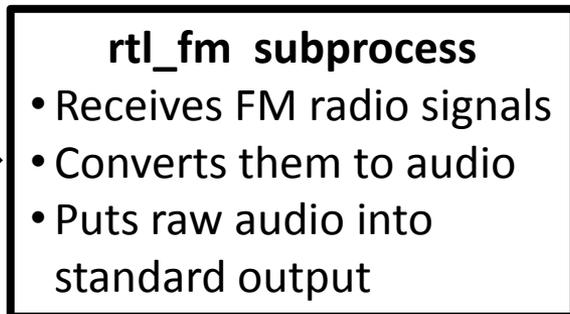
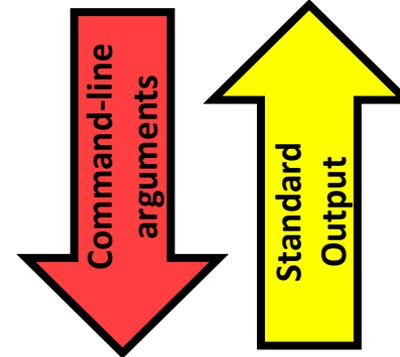
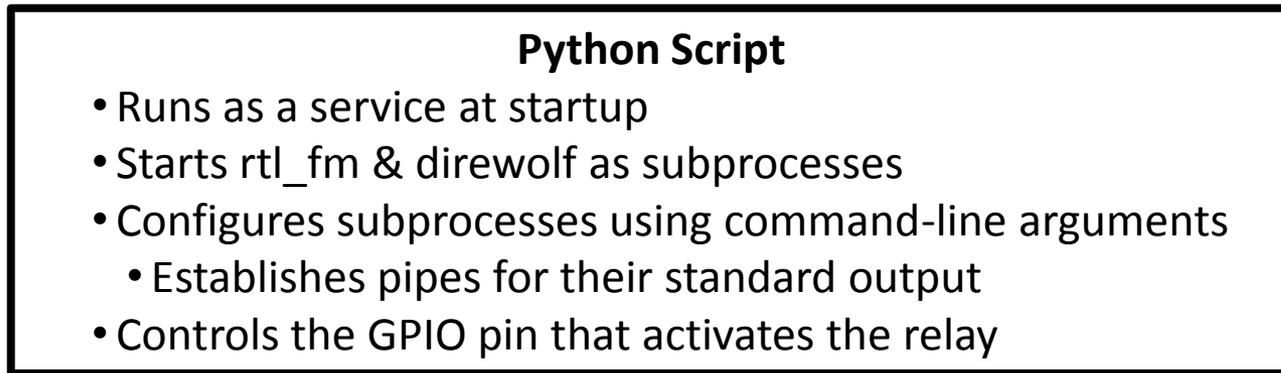


Photo credit: www.raspberrypi.org

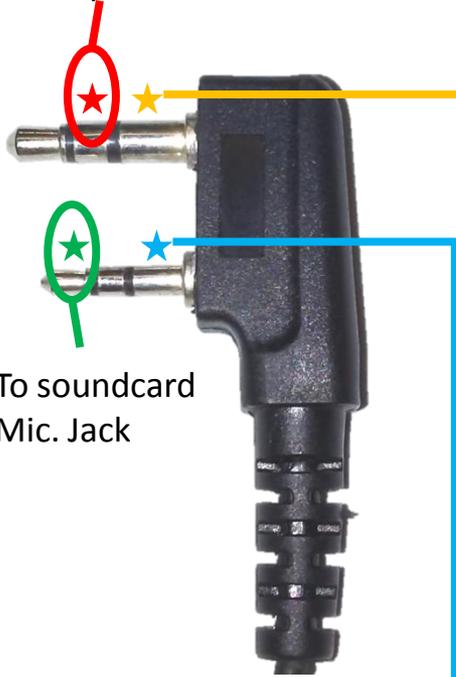
Project #2 – DTMF Relay Controller

Software Overview

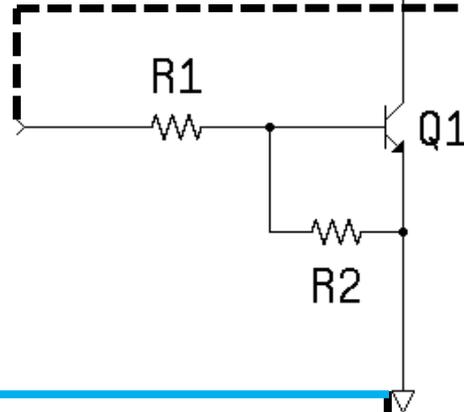


Project #3 – APRS Station

To soundcard
Headphone Jack



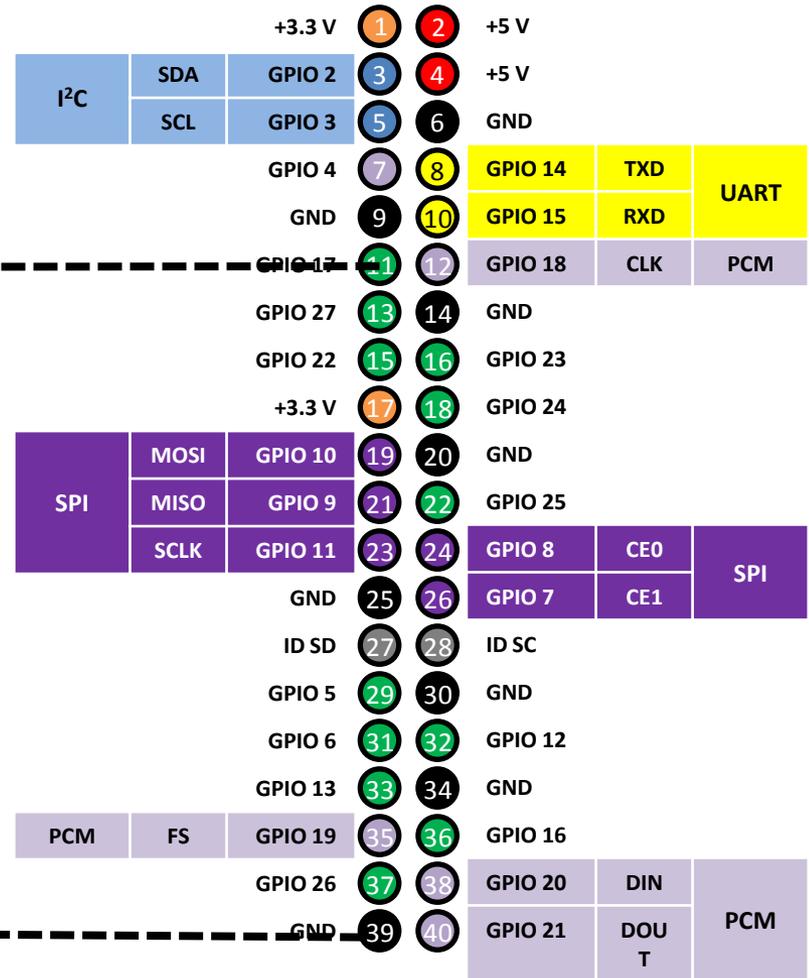
To soundcard
Mic. Jack



Wires connected in UV5R headset

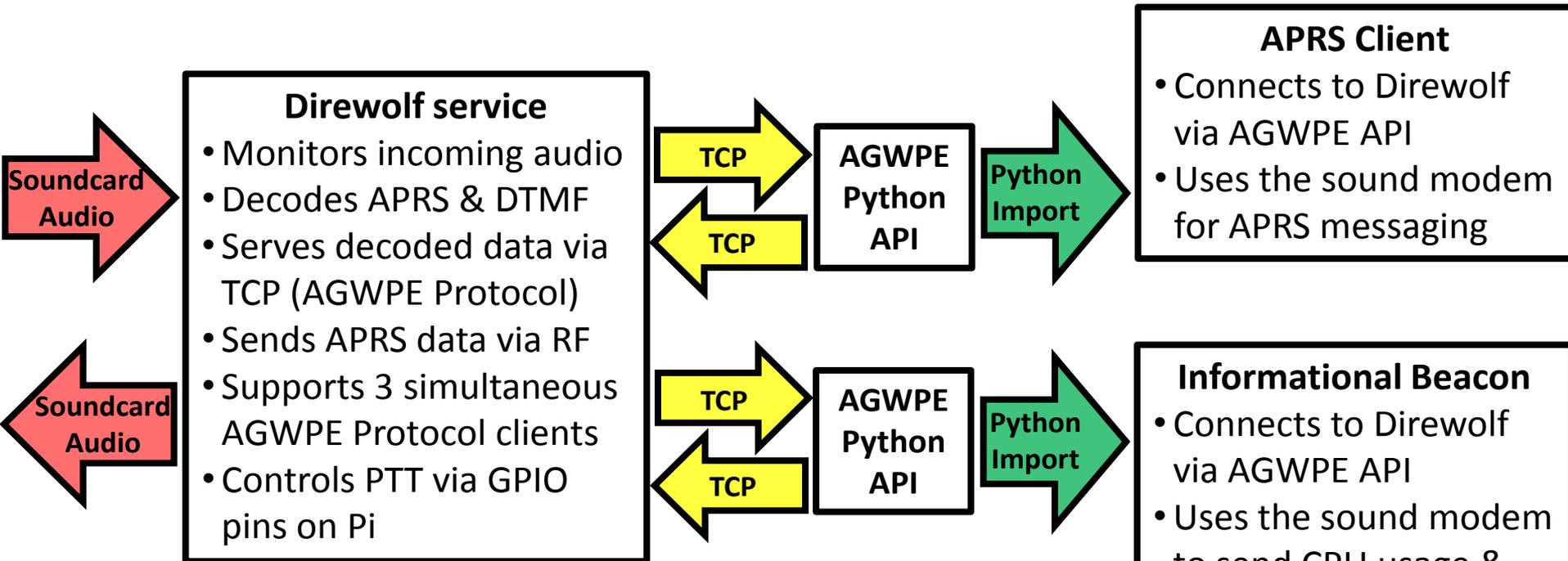
★	PTT
★	Microphone
★	GND
★	Speaker

R1 = 2.4 kΩ
R2 = 110 kΩ
Q1 = 2N2222



Project #3 – APRS Station

Software Overview



Glossary of terms:

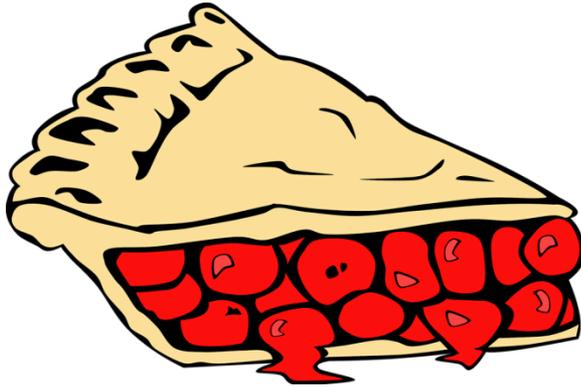
Direwolf: software-based soundcard modem; an acronym for

Decoded Information from Radio Emissions for Windows Or Linux Fans

AGWPE: communication protocol used by Direwolf. Originally from AGW Packet Engine; a Windows-only soundcard modem created by SV2AGW.

API: Application Programming Interface; a set of software tools that allows you to interface with a program written by someone else.

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Questions?

I can haz ham?

