Raspberry Pi
A Low Cost Platform
For Amateur Radio Projects

Ed James, KA8JMW
ARRL NM Assistant Section Manager
Brian Mileshosky, N5ZGT
ARRL Rocky Mountain Division Director

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Raspberry Pi (Wiki)

“The Raspberry Pi is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools.”

“The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor”

Two versions available:

<table>
<thead>
<tr>
<th></th>
<th>RAM</th>
<th>USB</th>
<th>Ethernet</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model A</td>
<td>256MB</td>
<td>1</td>
<td>NO</td>
<td>$25</td>
</tr>
<tr>
<td>Model B</td>
<td>512MB</td>
<td>2</td>
<td>YES</td>
<td>$35</td>
</tr>
</tbody>
</table>

Raspberry Pi layout (Model B)

5V at 1A
Supported Operating Systems

Linux *(The Preferred Environment)*
Raspbian, Debian GNU/Linux, Fedora, Arch Linux ARM

RISC OS

Unix:
FreeBSD, NetBSD

Plan 9

Android 2.3 (Gingerbread), 4.0 (Ice Cream Sandwich)

Google Chrome OS
Firefox OS

DOS, 80486 200MHz, SVGA, SoundBlaster, COM1:
AROS, Amiga Research Operating System

... 

And the list just keeps on growing.

Connecting with your RPi
The User Interface

- X-windows GUI
- Keyboard, mouse, HDMI
- Xrdp (headless)

- Command line
- Serial Terminal
- SSH user interface (headless)
Let’s Dig in a little deeper
Raspberry Pi (RPi) General Purpose Input/Output (I/O)

• The RPi board has a 26-pin expansion header with 17 GPIO pins as well as +3.3 V, +5 V and GND supply lines.
• The default configuration provides 15 GPIO pins and a UART.
• The operating system also supports predefined alternate functions for some of the pins
  • I²C (Inter-Integrated Circuit) is a two wire communication bus developed by Philips, for chip to chip communication. Commonly used for connecting sensors and port expanders.
  • Serial Peripheral Interface (SPI) bus is a synchronous serial data bus designed by Motorola. Commonly used in high speed applications such as digital audio, digital signal processing and telecommunications.
  • UART, TXD and RXD
  • A Pulse Width Modulator (PWM)
• Operating system makes the hardware available to a variety of high level program languages including Python, C, Java, BASIC along with Perl and Bash shell scripts.
• Additional I/O pins are available via bit-banging and hacking
1. The RPi is a 3.3V device
2. The GPIO pins are unbuffered and unprotected, so if you short something out, you could fry your whole RPi, be careful!
What Can I Do With My RPi?

32 RPi low-cost
“Supercomputer” Cluster
An Eclectic Mix of RPi Projects

- WiFi Internet Radio Player
- XBMC Media Player remote control
- Event Countdown Clock
- High Altitude Balloon Controller
- Soil Moisture Monitor
- Lighting Controller
- Cat Feeder
- Home Alarm System
piGate – an APRS iGate implementation using the Raspberry-Pi
Software running on the Raspberry-Pi reads the audio signal coming into the sound-card, demodulates the signal, decodes the packet and then sends it to an APRS-IS server over the WiFi link

http://www.ultratechie.com/2012/10/pigate/
TNC-Pi RPi

TNC-Pi is a special version of TNC-X designed to interface directly with the Raspberry Pi computer. It can connect to the Pi either via the Pi's serial port, or via the I2C protocol. In the latter case, a single Pi can support multiple TNC-Pi's at the same time, since each TNC-Pi can be given a unique I2C address.

Run a pair of TNC-Pi's with a single RPi to create a dual frequency digipeater.

http://tnc-x.com/
D-Star DV Access Point Dongle & RPi

Creates a point of presence on the D-Star network
A Communications Tool For D-STAR

- **D-RATS** is a D-STAR communications tool that supports text chat, TCP/IP forwarding, file transfers, and can act as an e-mail gateway. There is also the ability to map user's positions using the D’PRS function of D-STAR. The application is written in Python/GTK and is cross-platform. It runs on Windows, Mac OS X, and Linux.
- A Ratflector is a hub that allows multiple D-RATS users using either Ethernet or RF connections to communicate with each other.

**W5MPZ Ratflector**

- The Internet
- Ethernet
- Dell Optiplex 755
  - Running **D-RATS** ratflector software
- USB
- **Moencom**
  - Starboard
  - GMSK modem
- Audio in/out
- PTT
- Yaesu FT-2600FM
  - 9600 bps capable
A Communications Tool For D-STAR

W5MPZ ratflector (Rpi)

Ethernet
USB
Audio in/out
PTT

The Internet

RPi
Running
D-RATS ratflector software

Moencom
Starboard
GMSK modem

Yaesu FT-2600FM
9600 bps capable
GMSK modems for the RPi

- A RPi with either of these GMSK modems and a 9600bps capable narrowband FM radio to create a D-Star hotspot.
- With TWO radios and you get a D-Star repeater
  - Add an internet connection for a fully functioning D-Star gateway

http://ki6zum.com/dstar/dv_overview.htm

http://www.dutch-star.eu/
Turning the RPi into an FM Transmitter PiFM

- Using the existing hardware on the RPi that is intended to generate spread-spectrum clock signals to output FM RF.
- This means that all you need to do to turn the Raspberry-Pi into a FM Transmitter is to connect an antenna onto GPIO pin 4 and run the code.

http://www.icrobotics.co.uk/wiki/index.php/Turning_the_Raspberry_Pi_Into_an_FM_Transmitter
PiFM Demonstration

```
sudo ./pifm sound.wav 100.1
```
RPi LF/MF/HF/VHF WSPR Transmitter

• Weak Signal Propagation Reporter (WSPR).
• Used for weak-signal radio communication between amateur radio operators.
• Designed for sending and receiving low-power transmissions to test propagation paths on the MF and HF bands.
• WSPR implements a protocol designed for probing potential propagation paths with low-power transmissions.
• Transmissions carry a station's callsign, Maidenhead grid locator, and transmitter power in dBm.
• Stations with internet access can automatically upload their reception reports to a central database called WSPRnet, which includes a mapping facility.

• With a little code
  • PiFM with a wrapper
  • A low pass filter
  • Your RPi is good to go
    • 0 to 250MHz
    • +10dBm (10mw)

https://github.com/threeme3/WsprryPi
PiRLP (IRLP on a RPi)

http://www.irlp.net/pi/
A Software Defined Radio Server

RPi and SDR mounted at antenna

RPi
Running
GNU Radio
Open SDR
client software

RTLSDR

5VDC

USB

I & Q data
Streamed
Across network

Home
LAN

LAN client(s) running SDR# software
Satellite Tracking and Antenna Rotator Control
(a work in progress)

GPREDICT

- **Gpredict** is free software that runs under Windows, Linux and Mac OS.
- Gpredict has the hooks in it for interfacing to antenna rotors.
- Gpredict runs on the Raspberry Pi!
Rotor Power (24VAC)

Solid State Relays
- cw
- ccw

Optoisolator
- Rotor position pulse (every 5 deg)
- Rotor home switch

Other LAN client(s) running Gpredict

Based in part on the work of:
Dec 1998 - QST (Pg. 42)
‘An Inexpensive Az-El Rotator System’
Koehler, Jim, VE5FP
Portable Webcam

- RPi running Motion software
- Software captures video whenever motion has been detected
- Captures a still frame every minute
- Streaming video available via Wifi

Mount on a tripod for your next Hamfest, tailgate, Field day or club activity
Portable Webcam W5MPZ

ARRL Field Day
June 22 & 23, 2013
www.arrl.org
MESH Networking & RPi

- Use you RPi to create a MESH network node
- OLSR software running on the RPi
  - Configured as a MESH node
  - Able to perform other simultaneous tasks
    - Webcam server
    - Wireless sensor network node
    - Internet gateway
    - File server
    - D-RATS server/bridge
    - ...
- With the RPi, MESH networking is no longer tied to out of production hardware or the 2.4GHz band (3.3, 5GHz)
- Limited only by your imagination and FCC part 97 regulations

https://github.com/urlgrey/hsmm-pi
Third Party Prototype & I/O Boards for the RPi

**Pi Face**: Allows the RPi to control and sense physical devices such as lights, motors and sensors.

- Four momentary contact push switches
- Four LEDs.
- Two 10-A relays
- 8 general purpose open-collector outputs

**Com Pi**:

- RS232 Serial port
- I²C serial bus
RIO (Raspberry IO)

- I/O and power supply card for Raspberry PI.
- 13 Ana/Digital/Pulse Inputs
- 2 Ana Outs
- 8 Digital 1A Outs
- RS232
- RS485
- CAN
- Optional 3 AXIS AHRS
- Connects via the SPI buss

Powering your RPi

Raspberry Pi Power Supply (RPiPS)
- 8-30VDC input
- 5V at 3A
- 3.3V at 800mA
- $35
- [http://rpips.com/](http://rpips.com/)

Echidna 6.5V – 24V
- Power switch.
- Reset button
- $18
- [https://geekroo.com/products/352](https://geekroo.com/products/352)

Echidna (Premium)
- 6.5V – 24V
- Power switch.
- Reset button
- Serial port
- Two voltage or current digital meters
- $35
- [https://geekroo.com/products/526](https://geekroo.com/products/526)
And Many More…

Over 140 different boards and counting!

http://elinux.org/RPi_Expansion_Boards
Setting up your RPI

It’s almost this easy
Rpi Setup Quick Start

1. Insert SD card
   See page 3 for how to prepare the SD card

2a. Connect display
   Plug in the micro USB power supply

2b. Connect display
   If not using HDMI, plug in your analogue TV or display

3. Connect input
   Plug in a USB keyboard and mouse

4. Connect network
   Connect to your wired network [optional]

Raspberry Pi Cookbooks
Additional Resources


Raspberry Pi Amateur Radio Yahoo Group

http://groups.yahoo.com/group/Raspberry_Pi_4-Ham_RADIO/

Raspberry Connect

http://www.raspberryconnect.com/raspbian-packages-list/item/71-raspbian-hamradio
Discussion/Questions?
Speaker Bio

Ed James, KA8JMW of Albuquerque, NM is originally from Canton, OH where he was licensed over thirty five years ago. Since then, Ed has savored from the broad palette that amateur radio offers. Activities have included the design and fabrication of various projects from DC to daylight, QRP, net operations, traffic handling, rag chewing, contesting, DX, transmitter hunting, Search and Rescue, public service, satellites, EME and as an elmer to many a new ham. The thrill of that first QSO hasn't diminished. He has over 29 years of service as an electrical engineer leading space based and defense projects at Sandia National Laboratories. Ed, his wife Carol and their five daughters are all active amateur radio operators. Ed is an Assistant Section Manager for the ARRL New Mexico Section and can be reached via email at ka8jmw@arrl.net
Speaker Bio

Brian Mileshosky N5ZGT was first licensed at the age of 12 in 1992. Twenty one years later, ham radio is just as exciting now as it was when that highly anticipated envelope from the FCC with his ticket arrived in the mail. Brian is active on the air between 80 meters and 10 GHz, chasing DX, contesting, experimenting with novel technologies, assisting with public service communications, and mentoring new hams who seek the thrill of ham radio. Brian has served in numerous club and ham convention leadership positions and has sat on ARRL's Board since 2005, currently serving League members as Director of the Rocky Mountain Division (composed of the Colorado, New Mexico, Utah and Wyoming sections). Professionally, Brian is an RF/microwave engineer engaged in research and development of RF systems and applications from UHF through 30 GHz. Brain can be reached via email n5zgt@arrl.net