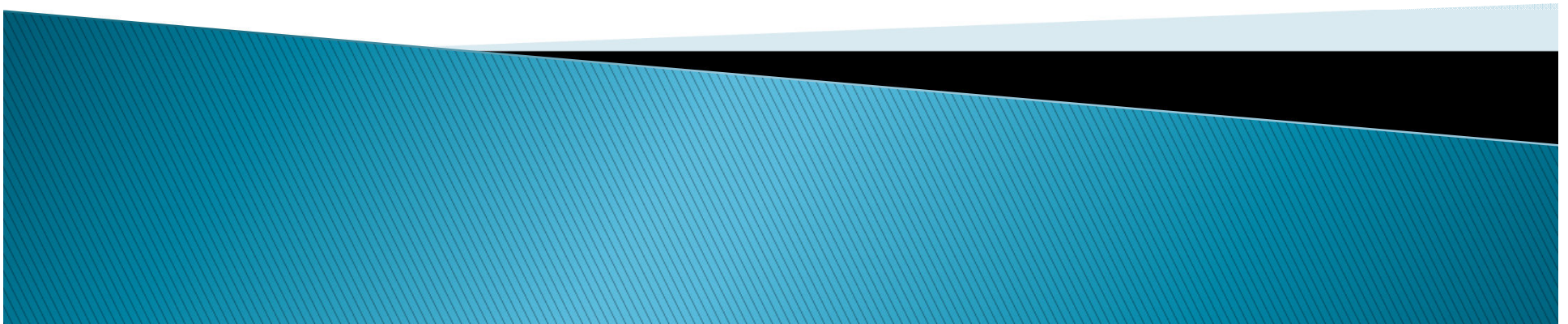


Raspberry Pi for Ham Radio

By Barry Basile KG5IRR
For the Oak Forest Amateur Radio Club
Presented 3/28/20



Topics

- ▶ What is it?
- ▶ What can you do with it?
- ▶ How to get started
- ▶ Working with Linux
- ▶ Links to other resources



What is Raspberry Pi?

- ▶ A single board computer, introduced in 2012
- ▶ Based on ARM processors and runs various distributions of Linux
- ▶ Can be used as a general purpose personal computer or used for a dedicated purpose
- ▶ Supports common computer interfaces
 - HDMI
 - GPIO
 - RS232 / I2C / SPI / DSI / CSI
 - USB
 - Keyboard / Mouse
 - Ethernet
 - WiFi
 - Bluetooth
 - uSD cards
 - Audio

Pi 3 Model B+

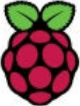
- ▶ About the size of a credit card
- ▶ Is very low cost: SBC ~\$35













CanaKits

- ▶ Your best value comes when you buy a kit ~\$80

KIT INCLUDES:

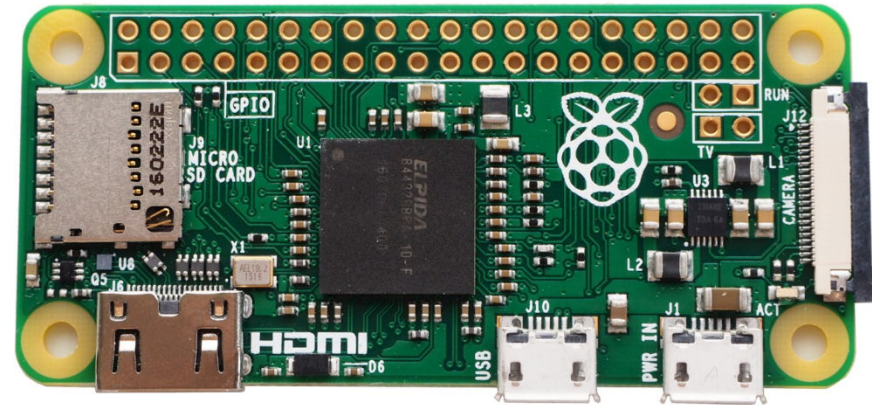
 **Raspberry Pi 3 Model B**
Model B | 1 GB RAM | 1.2 GHz | Quad-Core CPU



PREMIUM CASE 	32 GB CLASS 10 MICROSD CARD  PRE-LOADED WITH OPERATING SYSTEM	2.5A POWER ADAPTER 
MICROSD USB READER 	PREMIUM HDMI CABLE 	HEAT SINKS 
WiFi 	BLUETOOTH 	QUICK-START GUIDE 

Pi Zero

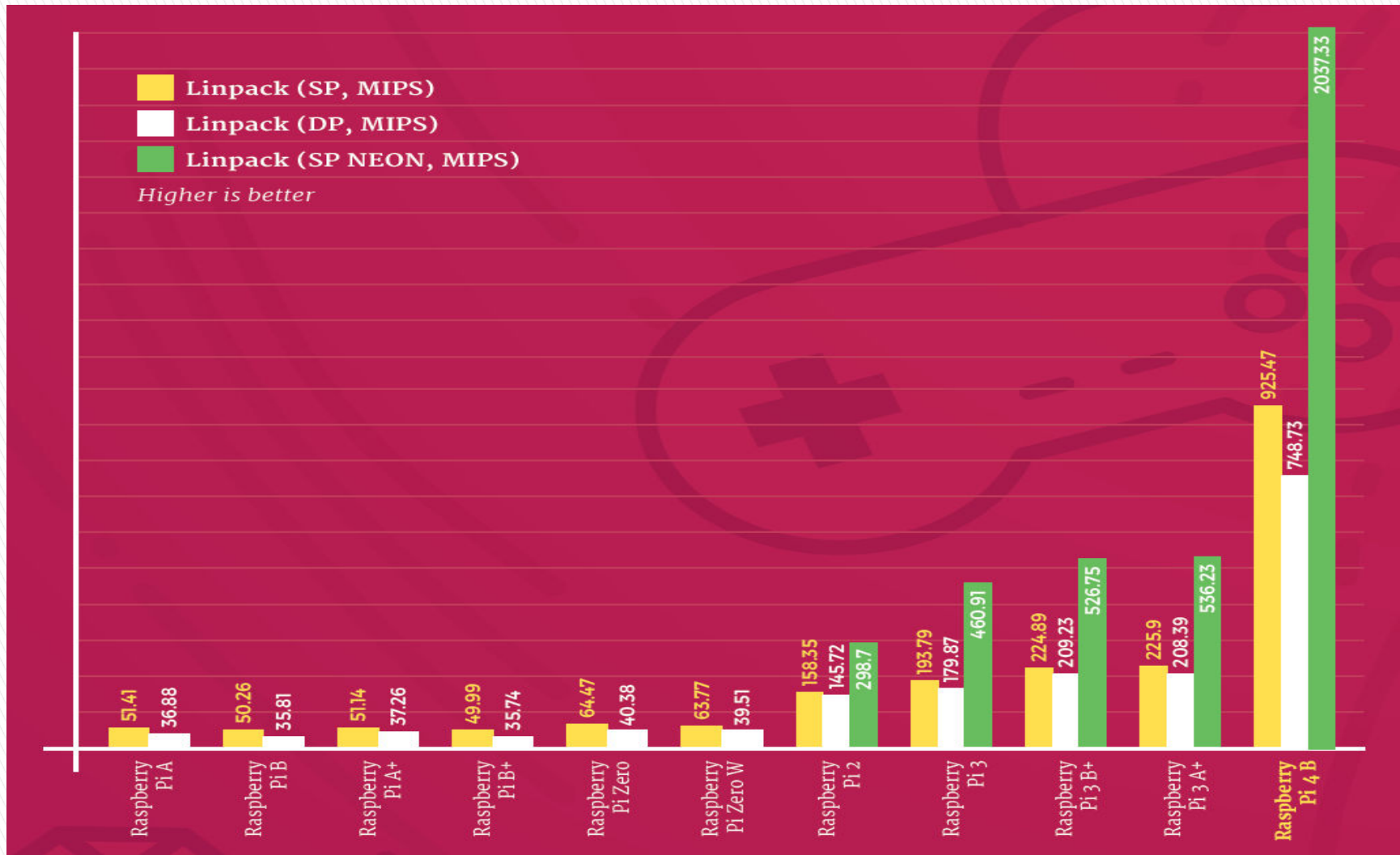
- ▶ Cost: \$5
- ▶ Broadcom BCM2835
1GHz processor
- ▶ 512MB RAM
- ▶ Mini HDMI and USB
- ▶ On-The-Go ports
- ▶ Micro USB power
- ▶ Unpopulated 40-pin
GPIO connector



So many to choose from...

Raspberry Pi Platform	RAM	Processor	USB	Ethernet	Wi-Fi	Bluetooth	HDMI	Other Video	MicroSD
Raspberry Pi A+	512MB	700 MHz ARM11	1 Port	-	-	-	Yes	DSI, Composite	Yes
Raspberry Pi B+	512MB	700 MHz ARM11	4 Ports	10/100Mbps	-	-	Yes	DSI, Composite	Yes
Raspberry Pi 2 B	1GB	900 MHz Quad-Core ARM Cortex-A7	4 Ports	10/100Mbps	-	-	Yes	DSI, Composite	Yes
Raspberry Pi 3 B	1GB	1.2 GHz, Quad-Core 64-bit ARM Cortex A53	4 Ports	10/100Mbps	802.11n	4.1	Yes	DSI, Composite	Yes
Raspberry Pi 3 B+	1GB	1.4 GHz 64-bit ARM Cortex A53	4 Ports	300/Mbps/PoE	802.11ac	4.2	Yes	DSI, Composite	Yes
Raspberry Pi Zero	512MB	1 GHz single-core ARM11	1 Micro USB	-	-	-	Mini-HDMI	-	Yes
Raspberry Pi Zero Wireless	512MB	1 GHz single-core ARM11	1 Micro USB	-	802.11n	4.1	Mini-HDMI	-	Yes

Performance Comparison



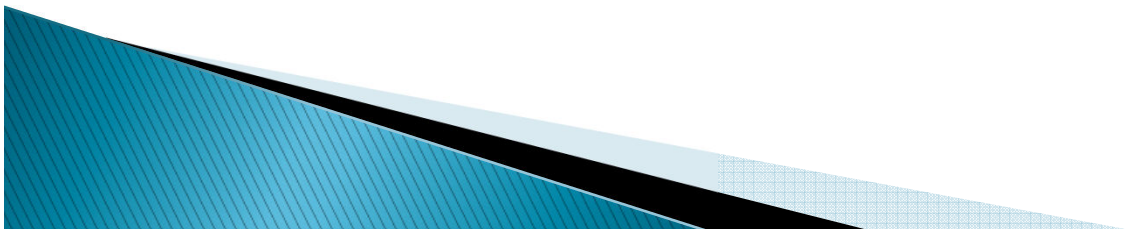
Common Operating Systems

- ▶ Raspbian is based on Debian Buster distribution
 - Desktop with recommended apps
 - Desktop bare bones
 - Buster Lite

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

- ▶ Most Kits come with NOOBS, used to install one of many distributions

<https://www.raspberrypi.org/downloads/noobs/>

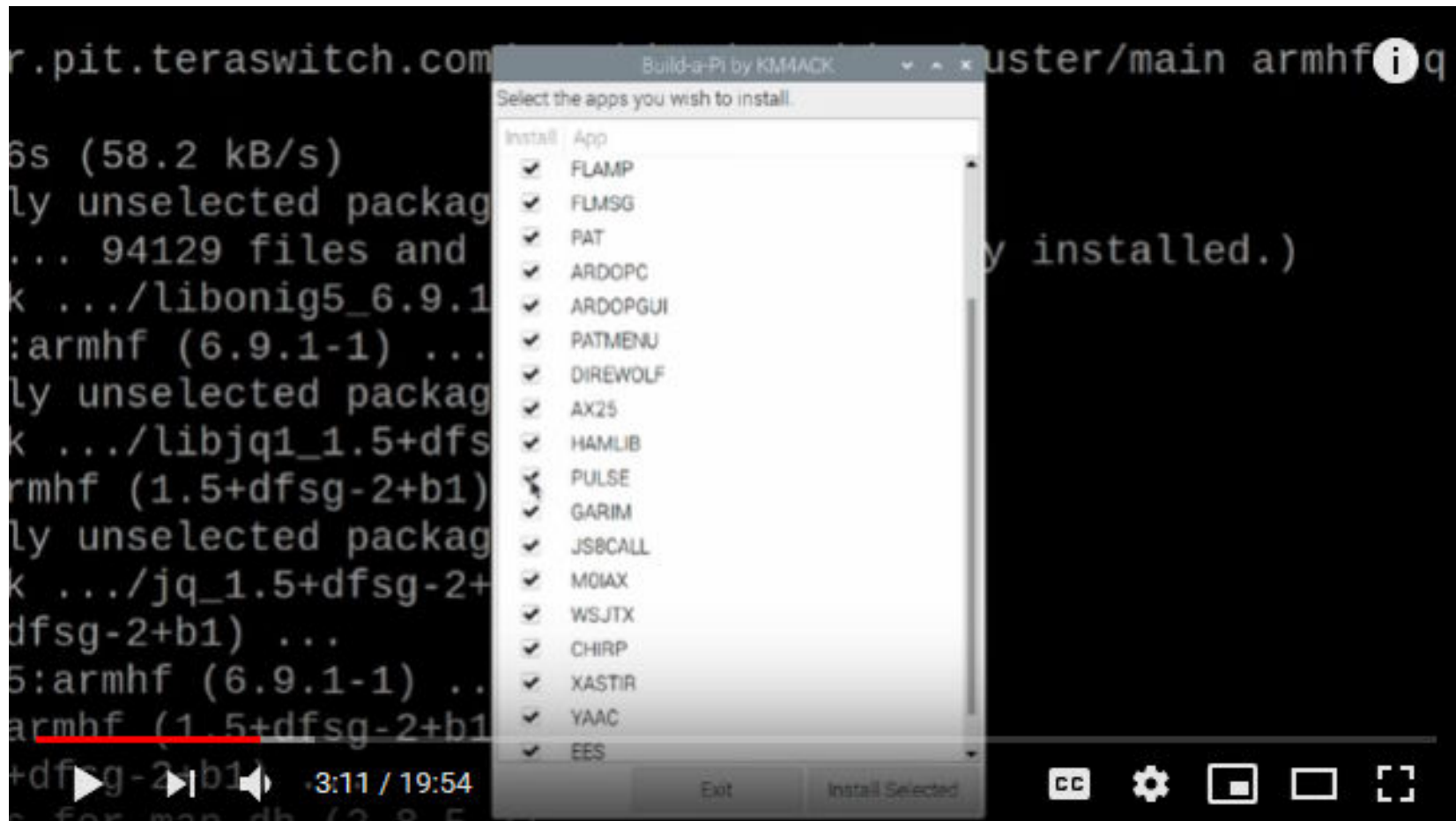


Ham Radio Apps

- ▶ One of the best resources I've found are the youtube videos prepared by Jason, KM4ACK
- ▶ He's created a "build-a-pi" script that will install any of the ham radio apps you'll likely want
- ▶ Here's a screen shot showing a partial list of available apps



Build-A-Pi Script



List of Apps (1)

RTC | Real Time Clock

Software for DS3231 real time clock

HOTSPOT:

Connect and control the pi from a wireless device.

GPS:

Installs the needed utilities to get a GPS device configured

<https://amzn.to/2R9Muup>

FLRIG:

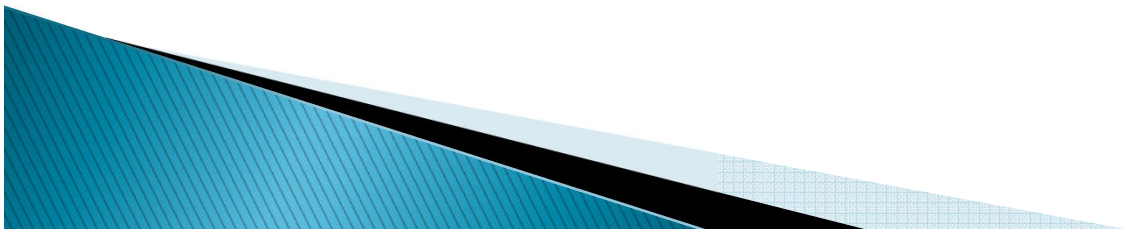
Rig control graphical interface. <http://www.w1hkj.com/>

FLDIGI:

Digital Mode Software <http://www.w1hkj.com/>

FLMSG:

Forms manager for FLDIGI <http://www.w1hkj.com/>



List of Apps (2)

FLAMP:

Amateur Multicast Protocol - file transfer program <http://www.w1hkj.com/>

PAT:

Winlink client for Raspberry Pi <https://getpat.io/>

ARDOPC:

HF modem for PAT. Recommended when installing PAT

<https://www.cantab.net/users/john.wiseman/Documents/ARDOPC.html>

ARDOPGUI:

GUI interface for ARDOPC. Recommended when installing PAT

PATMENU:

Menu for configuring PAT <https://github.com/km4ack/patmenu>

DIREWOLF:

Software TNC for 2m packet connection to PAT.

Can be used for APRS connection with Xastir.

<https://github.com/wb2osz/direwolf/tree/master/doc>



List of Apps (3)

AX25:

AX25 tools for Direwolf & PAT.

HAMLIB:

Rig control software library <https://sourceforge.net/projects/hamlib/>

PULSE:

Pulse audio. Provides a way to configure virtual sound cards. REQUIRED for AMRRON ops.

JS8:

JS8Call digital software <https://js8call.com>

M0IAX:

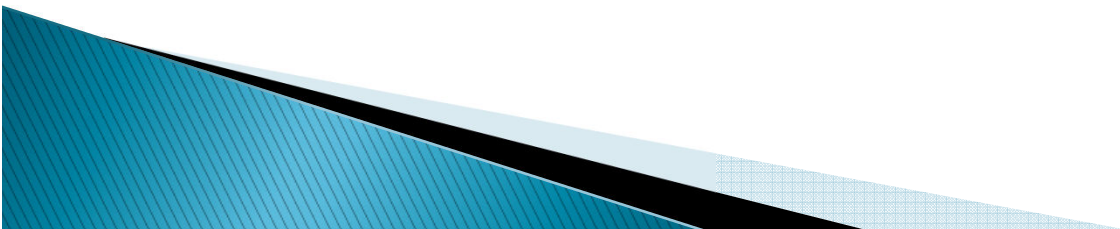
Tools for working with JS8Call. <https://github.com/m0iax/>

WSJTX:

FT8 & WISPR software suite. <https://sourceforge.net/projects/wsjt/>

CHIRP:

Software to program radios. <https://chirp.danplanet.com>



List of Apps (4)

XASTIR:

GUI interface useful when configuring APRS nodes.

<https://sourceforge.net/projects/xastir/>

YAAC:

Yet Another APRS Client GUI interface useful when configuring APRS nodes.

<https://www.ka2ddo.org/ka2ddo/YAAC.html>

PYQSO:

Logging software <https://github.com/ctjacobs/pyqso>

GPREDICT:

Satellite Tracking <http://gpredict.oz9aec.net/>

CQRLOG:

Loggin Software <https://www.cqrlog.com/>

QSSTV:

Slow scan tv <http://users.telenet.be/on4qz/qsstv/index.html>



List of Apps (5)

Gridtracker

<https://tagloomis.com/>

Propagation (VOACAP)

Propagation Prediction Software

<https://www.qsl.net/hz1jw/voacap1/index.html>

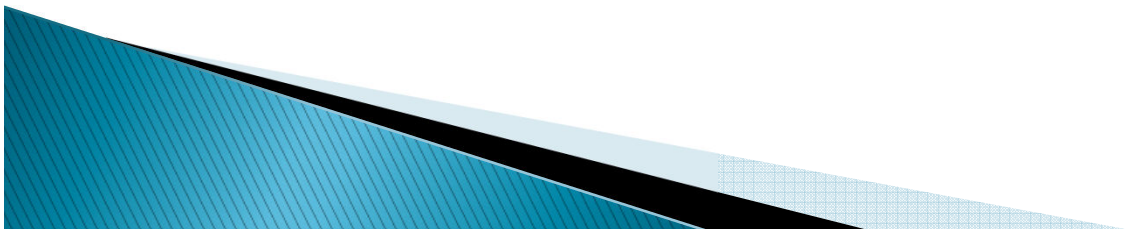
Emergency Email Server (EES)

<https://youtu.be/XC9vdAnol00>



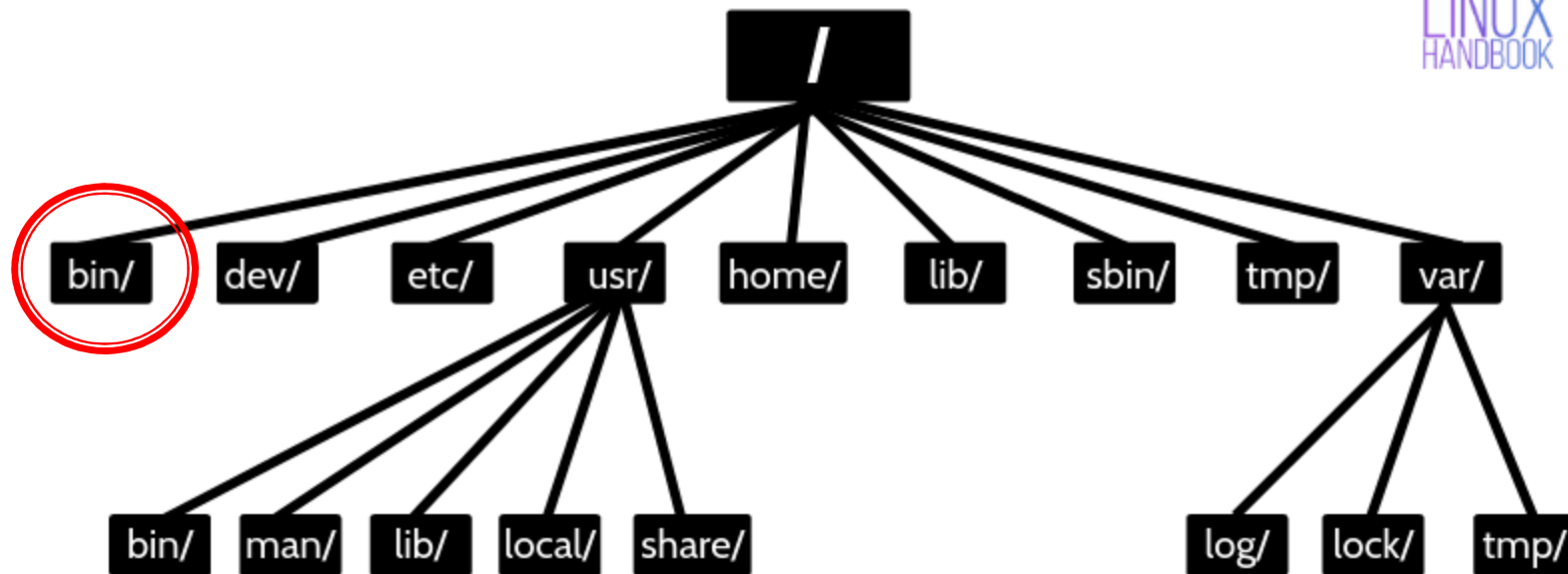
Getting Started

- ▶ Define your objectives
 - Just curious?
 - Want an extra PC?
 - Learn Linux/python?
 - Learn about peripheral buses?
- ▶ Choose a project
- ▶ Choose a Pi SBC that has the performance and features you need to build it
- ▶ Buy a kit that includes most of what you'll need to implement the project
- ▶ Use Jason's videos and scripts to jump start your installation



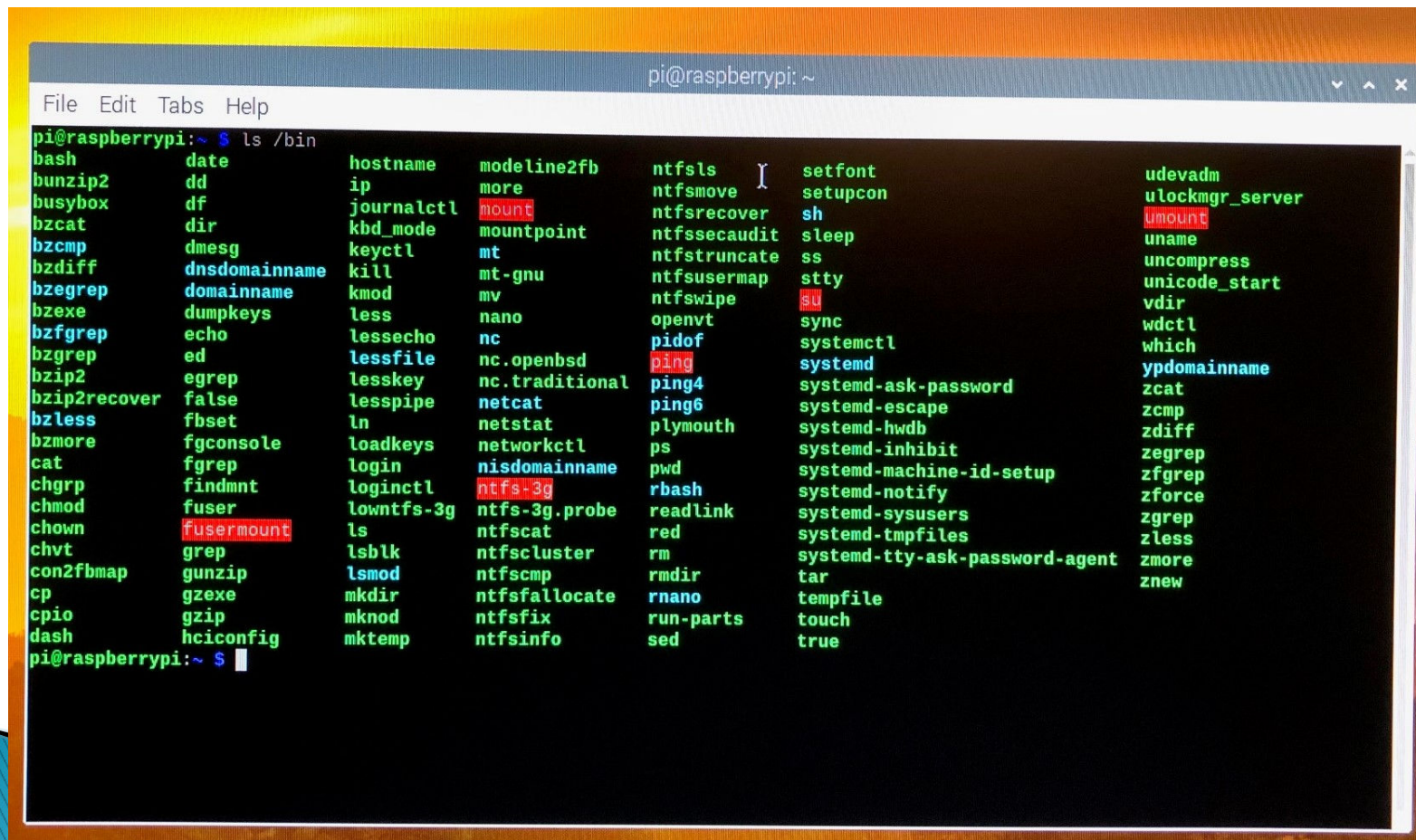
Linux Directory Structure

LINUX
HANDBOOK



Common Commands are in /bin

- ▶ Open a terminal window and enter: `ls /bin` for a listing of commands
- ▶ Light blue names are symbolic links to executables
- ▶ Red names require “super user” permissions



```
pi@raspberrypi: ~  
File Edit Tabs Help  
pi@raspberrypi:~ $ ls /bin  
bash          date          hostname      modeline2fb  ntfsls       setfont      udevadm  
bunzip2       dd            ip            more         ntfsmove     setupcon     ulockmgr_server  
busybox       df            journalctl   mount        ntfsrecover  sh           umount  
bzip2         dmesg        kbd_mode     mountpoint   ntfssecaudit sleep         uname  
bzcmp         dnsdomainname keyctl        mt           ntfstruncate ss           uncompress  
bzdiff        domainname   kill          mt-gnu       ntfsusermap  stty        unicode_start  
bzexe         dumpkeys     kmod          mv           ntfswipe     su          vdir  
bzfgrep       echo          lessecho     nano         openvt       sync        wdctl  
bzgrep        ed            lessfile     nc           pidof        systemctl   which  
bzip2         egrep        lesskey      nc.openbsd  ping         systemd    ydomainname  
bzip2recover false         lesspipe    nc.traditional ping4       systemd-ask-password zcat  
bzless        fbset        ln            netcat      ping6       systemd-escape zcmp  
bzmore        fgconsole   loadkeys    networkctl  plymouth    systemd-hwdb zdiff  
cat           fgrep        login        nisdomainname ps           systemd-inhibit zegrep  
chgrp         findmnt      loginctl     ntfs-3g     pwd         systemd-machine-id-setup zfgrep  
chmod         fuser        lowntfs-3g  ntfs-3g.probe readlink    systemd-notify zforce  
chown         fusermount  ls           ntfsclust   red         systemd-sysusers zgrep  
chvt          grep         lsblk        ntfscluster rm          systemd-tmpfiles zless  
con2fbmap     gunzip       lsmod        ntfscomp    rmdir      systemd-tty-ask-password-agent zmore  
cp            gzexe        mkdir        ntfsfalloc  rnano      tempfile   znew  
cpio          gzip         mknod        ntfsfix     run-parts  touch  
dash          hciconfig   mktemp       ntfsinfo    sed        true
```


The “man”ual command

- ▶ Syntax: `man [command/tool name]`
- ▶ Try this: `man man`

```
pi@raspberrypi: ~
File Edit Tabs Help
MAN(1) Manual pager utils MAN(1)
NAME
man - an interface to the on-line reference manuals

SYNOPSIS
man [-C file] [-d] [-D] [--warnings[=warnings]] [-R encoding] [-L locale] [-m system[,...]] [-M path] [-S list] [-e
extension] [-i|-I] [--regex|--wildcard] [--names-only] [-a] [-u] [--no-subpages] [-P pager] [-r prompt] [-7] [-E en-
coding] [--no-hyphenation] [--no-justification] [-p string] [-t] [-T[device]] [-H[browser]] [-X[dpi]] [-Z] [[sec-
tion] page[.section] ...] ...
man -k [apropos options] regexp ...
man -K [-w|-W] [-S list] [-i|-I] [--regex] [section] term ...
man -f [whatis options] page ...
man -l [-C file] [-d] [-D] [--warnings[=warnings]] [-R encoding] [-L locale] [-P pager] [-r prompt] [-7] [-E encod-
ing] [-p string] [-t] [-T[device]] [-H[browser]] [-X[dpi]] [-Z] file ...
man -w|-W [-C file] [-d] [-D] page ...
man -c [-C file] [-d] [-D] page ...
man [-?V]

DESCRIPTION
man is the system's manual pager. Each page argument given to man is normally the name of a program, utility or
function. The manual page associated with each of these arguments is then found and displayed. A section, if pro-
vided, will direct man to look only in that section of the manual. The default action is to search in all of the
available sections following a pre-defined order ("1 n l 8 3 2 3posix 3pm 3perl 3am 5 4 9 6 7" by default, unless
overridden by the SECTION directive in /etc/manpath.config), and to show only the first page found, even if page ex-
ists in several sections.

The table below shows the section numbers of the manual followed by the types of pages they contain.

1 Executable programs or shell commands
2 System calls (functions provided by the kernel)
Manual page man(1) line 1 (press h for help or q to quit)
```


ls command...

```
pi@raspberrypi: ~
File Edit Tabs Help
LS(1) User Commands LS(1)
NAME
  ls - list directory contents
SYNOPSIS
  ls [OPTION]... [FILE]...
DESCRIPTION
  List information about the FILES (the current directory by default). Sort entries alphabetically if none of -cftu-
  vSUX nor --sort is specified.

  Mandatory arguments to long options are mandatory for short options too.

  -a, --all
      do not ignore entries starting with .

  -A, --almost-all
      do not list implied . and ..

  --author
      with -l, print the author of each file

  -b, --escape
      print C-style escapes for nongraphic characters

  --block-size=SIZE
      with -l, scale sizes by SIZE when printing them; e.g., '--block-size=M'; see SIZE format below

  -B, --ignore-backups
      do not list implied entries ending with ~
Manual page ls(1) line 1 (press h for help or q to quit)
```

grep command – search for patterns in files/directories...

```
pi@raspberrypi: ~
File Edit Tabs Help
GREP(1) User Commands GREP(1)
NAME
  grep, egrep, fgrep, rgrep - print lines that match patterns
SYNOPSIS
  grep [OPTION...] PATTERNS [FILE...]
  grep [OPTION...] -e PATTERNS ... [FILE...]
  grep [OPTION...] -f PATTERN FILE ... [FILE...]
DESCRIPTION
  grep searches for PATTERNS in each FILE. PATTERNS is one or patterns separated by newline characters, and grep prints each line that matches a pattern.
  A FILE of "-" stands for standard input. If no FILE is given, recursive searches examine the working directory, and nonrecursive searches read standard input.
  In addition, the variant programs egrep, fgrep and rgrep are the same as grep -E, grep -F, and grep -r, respectively. These variants are deprecated, but are provided for backward compatibility.
OPTIONS
  Generic Program Information
  --help Output a usage message and exit.
  -V, --version Output the version number of grep and exit.
  Matcher Selection
  -E, --extended-regexp Interpret PATTERNS as extended regular expressions (EREs, see below).
Manual page grep(1) line 1 (press h for help or q to quit)
```


Awk – powerful text parser

```
pi@raspberrypi: ~
File Edit Tabs Help
MAWK(1) USER COMMANDS MAWK(1)
NAME
mawk - pattern scanning and text processing language

SYNOPSIS
mawk [-W option] [-F value] [-v var=value] [--] 'program text' [file ...]
mawk [-W option] [-F value] [-v var=value] [-f program-file] [--] [file ...]

DESCRIPTION
mawk is an interpreter for the AWK Programming Language. The AWK language is useful for manipulation of data files, text retrieval and processing, and for prototyping and experimenting with algorithms. mawk is a new awk meaning it implements the AWK language as defined in Aho, Kernighan and Weinberger, The AWK Programming Language, Addison-Wesley Publishing, 1988. (Hereafter referred to as the AWK book.) mawk conforms to the Posix 1003.2 (draft 11.3) definition of the AWK language which contains a few features not described in the AWK book, and mawk provides a small number of extensions.

An AWK program is a sequence of pattern {action} pairs and function definitions. Short programs are entered on the command line usually enclosed in ' ' to avoid shell interpretation. Longer programs can be read in from a file with the -f option. Data input is read from the list of files on the command line or from standard input when the list is empty. The input is broken into records as determined by the record separator variable, RS. Initially, RS = "\n" and records are synonymous with lines. Each record is compared against each pattern and if it matches, the program text for {action} is executed.

OPTIONS
-F value sets the field separator, FS, to value.
-f file Program text is read from file instead of from the command line. Multiple -f options are allowed.
-v var=value assigns value to program variable var.

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

Additional Information

Top 10 ham projects:

<http://www.hamblog.co.uk/top-10-amateur-radio-uses-for-raspberry-pi/>

Non-ham projects:

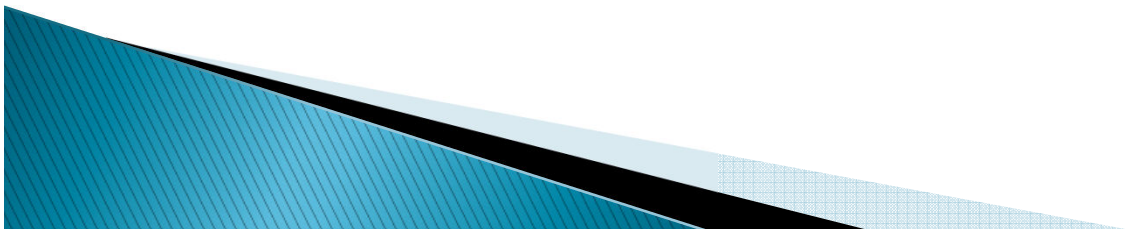
<https://projects.raspberrypi.org/en>

Build-A-PI video:

<https://www.youtube.com/watch?v=gBokG9FI-NM&t=182s>

Jason's videos:

<https://www.youtube.com/user/jasonoleham/videos>



Attribution

<https://magpi.raspberrypi.org/articles/raspberry-pi-4-specs-benchmarks>

<https://www.canakit.com/raspberry-pi/raspberry-pi-boards>

<https://linuxhandbook.com>

