
# RASPBERRY PI BASICS

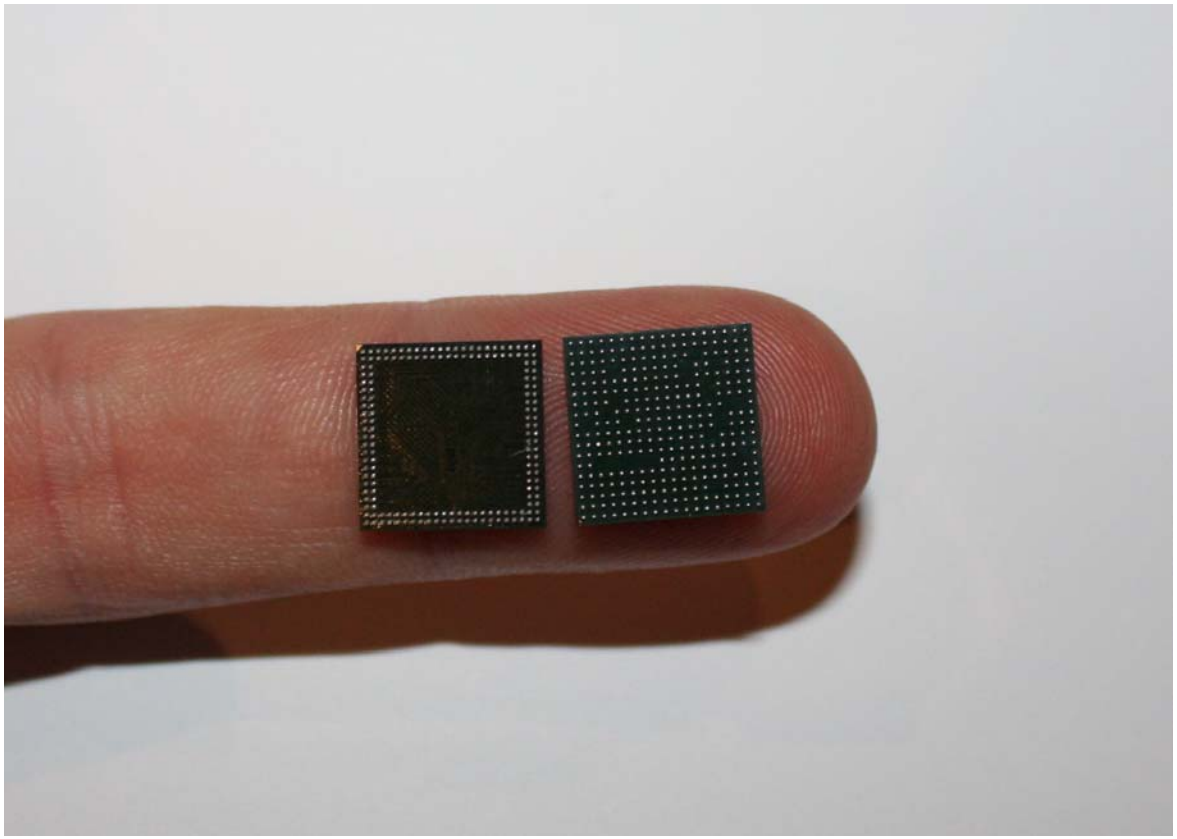
# System on Chip (SoC)

- What is System on Chip?
  - A complex IC that integrates the major functional elements into a single chip or chipset.
    - programmable processor
    - on-chip memory
    - accelerating function hardware (e.g. GPU)
    - both hardware and software
    - analog components
- Benefits of SoC
  - Reduce overall system cost
  - Increase performance
  - Lower power consumption
  - Reduce size

# SoC in Raspberry Pi: Broadcom BCM2835 SoC Multimedia processor

- CPU
  - ARM 1176JZF-S (armv6k) 700MHz
  - RISC Architecture and low power draw
  - Not compatible with traditional PC software
- GPU
  - Broadcom Video IV
  - Specialized graphical instruction sets
- RAM
  - 512MB (Model B rev.2)
  - 256 MB (Model A, Model B rev.1)

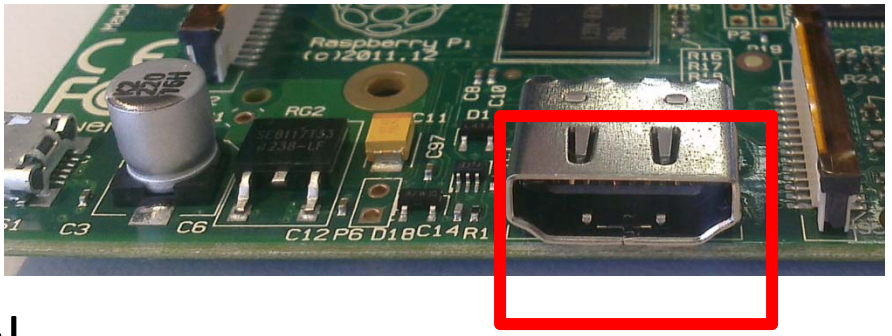
# SoC in Raspberry Pi: Broadcom BCM2835 SoC

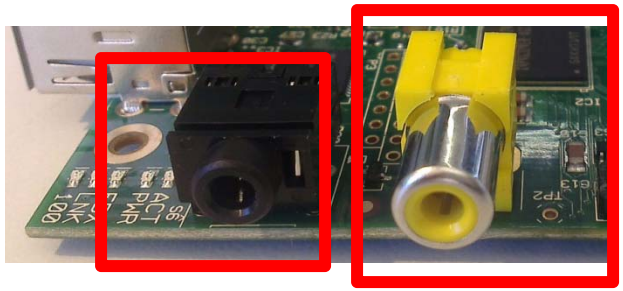


BCM2835 SoC (right) and Samsung K4P2G324ED Mobile DRAM (left)

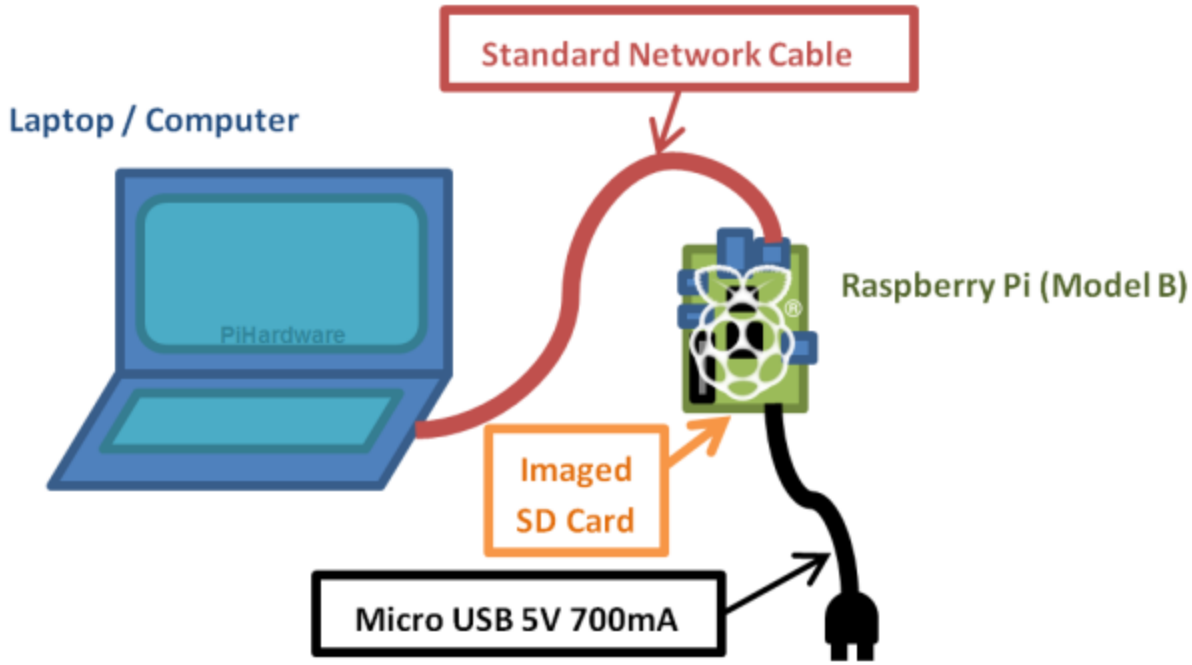
# Connecting a Display and Audio

- HDMI
  - Digital signal
  - Video and audio signal
  - DVI cannot carry audio signal
  - Up to 1920x1200 resolution
- Composite RCA
  - Analog signal
  - 480i, 576i resolution
- 3.5mm jack





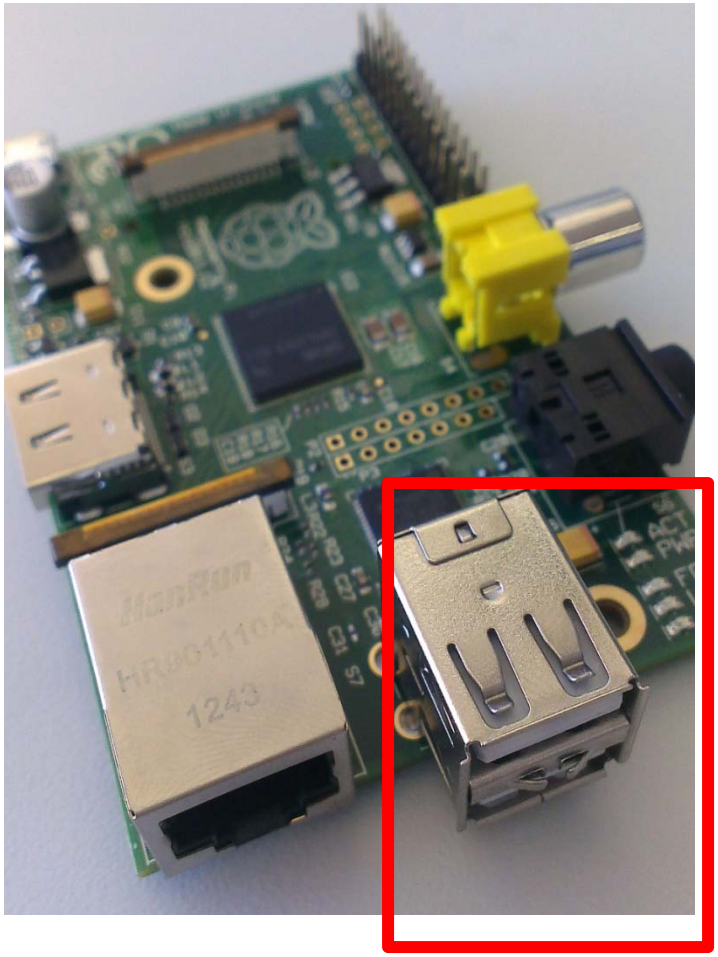
# RPi Remote Connections




http://pihw.wordpress.com/guides/direct-network-connection/

# Universal Serial Bus

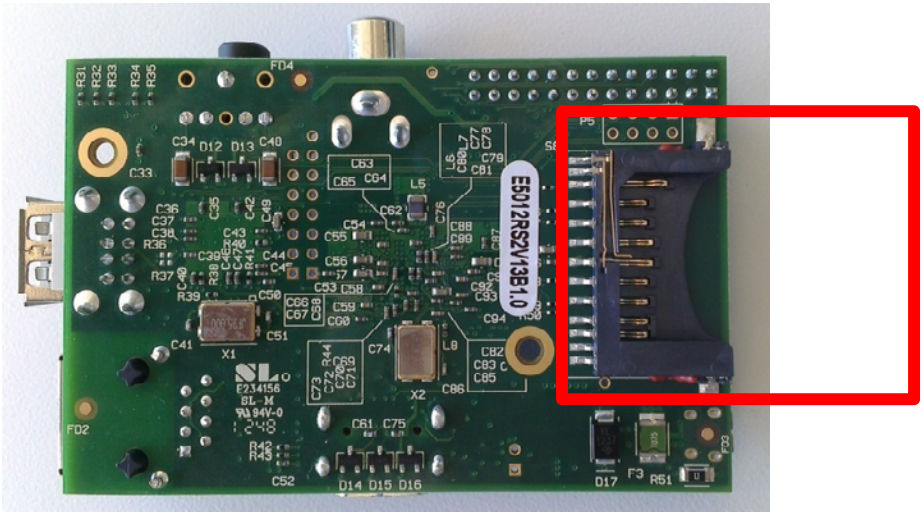
- Two USB 2.0 ports in RPi
- Buy a powered USB hub

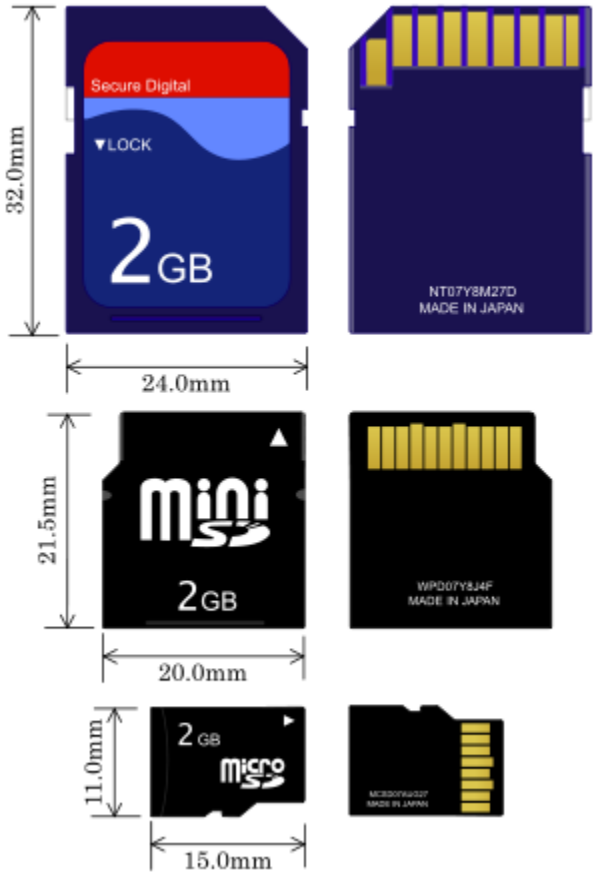


Passive models are cheaper and smaller, but lack the ability to run current-hungry devices like CD drives and external hard drives.

# Storage: Secure Digital (SD)

- Form factor
  - SD, Mini SD, Micro SD
- Types of Card
  - SDSC (SD): 1MB to 2GB
  - SDHC: 4GB to 32 GB
  - SDXD up to 2TB






The card should be at least 2GB in capacity to store all the required files

# Storage: Continue

SD Formatter:

https://www.sdcard.org/downloads/formatter_4/

How to mount USB flash drive from command line:

http://linuxcommando.blogspot.co.uk/2007/12/how-to-mount-usb-flash-drive-from.html

# Networking

Ethernet (IEEE 802.3)


USB Ethernet Converter

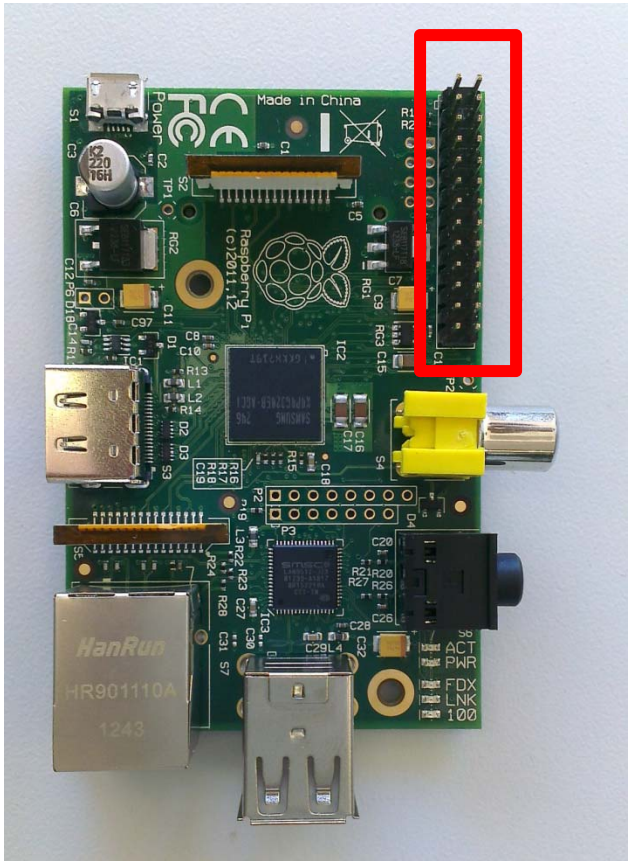

Wi-Fi Adapter

# Networking - wireless

- IEEE 802.11 Wi-Fi
  - Protocols
    - 802.11 b, up to 11Mbps
    - 802.11 g, up to 54Mbps
    - 802.11 n, up to 300Mbps
    - 802.11 ac (draft), up to 1Gbps
  - Frequency band
    - 2.4GHz, 5GHz

# Low Speed Peripherals

- General Purpose Input/Output (GPIO)
  - Pins can be configured to be input/output
  - Reading from various environmental sensors
    - Ex: IR, video, temperature, 3-axis orientation, acceleration
  - Writing output to dc motors, LEDs for status.



# RASPBERRY PI Revision 2 Pinout

http://www.pinballsp.com

| | | | | | | |
|---|---|---|---|---|---|---|
| | 3V3 | 1 | 2 | 5V | +5v | |
| I2C PULL-UP | GPIO2 SDA | 3 | 4 | 5V | | |
| | GPIO3 SCL | 5 | 6 | Ground | GND | |
| | GPIO4 | 7 | 8 | GPIO14 TXD | UART | |
| | Ground | 9 | 10 | GPIO15 RXD | | |
| UART-RTS | GPIO17 | 11 | 12 | GPIO18 | PWM | |
| | GPIO27 | 13 | 14 | Ground | | |
| | GPIO22 | 15 | 16 | GPIO23 | | |
| | 3V3 | 17 | 18 | GPIO24 | | |
| SPI | GPIO10 MOSI | 19 | 20 | Ground | | |
| | GPIO9 MISO | 21 | 22 | GPIO25 | | |
| | GPIO11 CLK | 23 | 24 | GPIO8 CE0 | SPI | |
| | Ground | 25 | 26 | GPIO7 CE1 | | |

Revision 2.0

https://www.facebook.com/pages/PinballSP/336137879799788

# Power Consumption

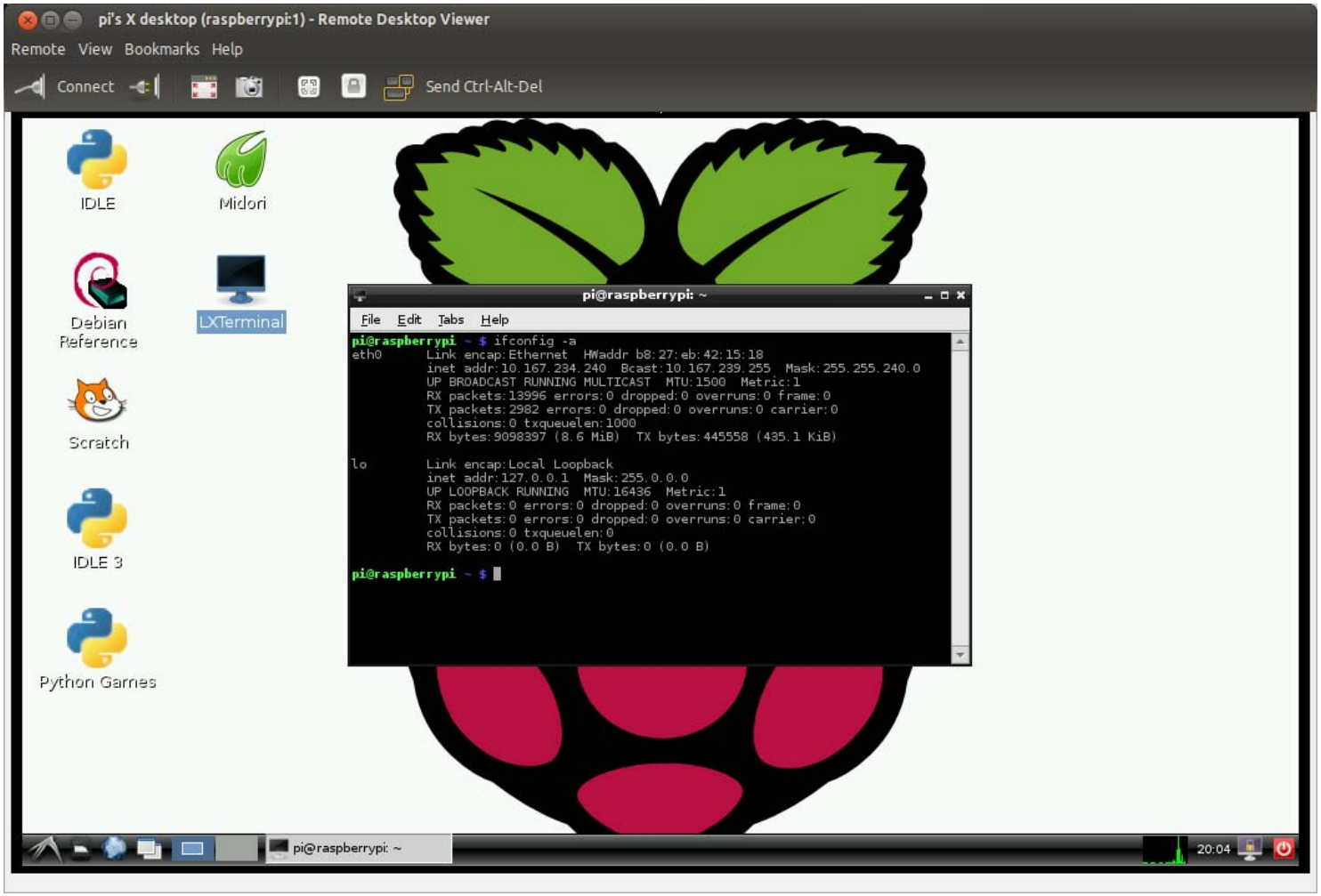
- microUSB power connector
  - 2.5W (model A)
  - 3.5W (model B)
- Powered USB hub
  - To provide more power for USB peripherals

# Useful links

- Raspberry Pi official website
  - http://www.raspberrypi.org/
- Raspberry Pi wiki
  - http://elinux.org/RaspberryPiBoard
- Raspberry Pi verified peripherals
  - http://elinux.org/RPi_VerifiedPeripherals
- The MagPi
  - http://www.themagpi.com
- Raspberry Pi on Adafruit Learning System:
  - http://learn.adafruit.com/category/learn-raspberry-pi

# Raspberry Pi Setup

- 1. Download the Raspberry Pi operating system
  - Linux releases compatible with the Pi: http://www.raspberrypi.org/downloads
  - The recommended OS is Raspbian: http://downloads.raspberrypi.org/raspbian_latest
- 2. Unzip the file that you just downloaded
  - Right click on the file and choose “Extract all”.
  - Follow the instructions—you will end up with a file ending in .img


pi's X desktop (raspberrypi:1) - Remote Desktop Viewer
Remote View Bookmarks Help
Connect
Send Ctrl-Alt-Del
IDLE
Midori
Debian Reference
LXTerminal
Scratch
IDLE 3
Python Games
pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi ~ $ ifconfig -a
eth0 Link encap:Ethernet HWaddr b8:27:eb:42:15:18
inet addr:10.167.234.240 Bcast:10.167.239.255 Mask:255.255.240.0
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:13996 errors:0 dropped:0 overruns:0 frame:0
TX packets:2982 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:9098397 (8.6 MiB) TX bytes:445558 (435.1 KiB)
lo Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
UP LOOPBACK RUNNING MTU:16436 Metric:1
RX packets:0 errors:0 dropped:0 overruns:0 frame:0
TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)
pi@raspberrypi ~ $
pi@raspberrypi: ~
20:04

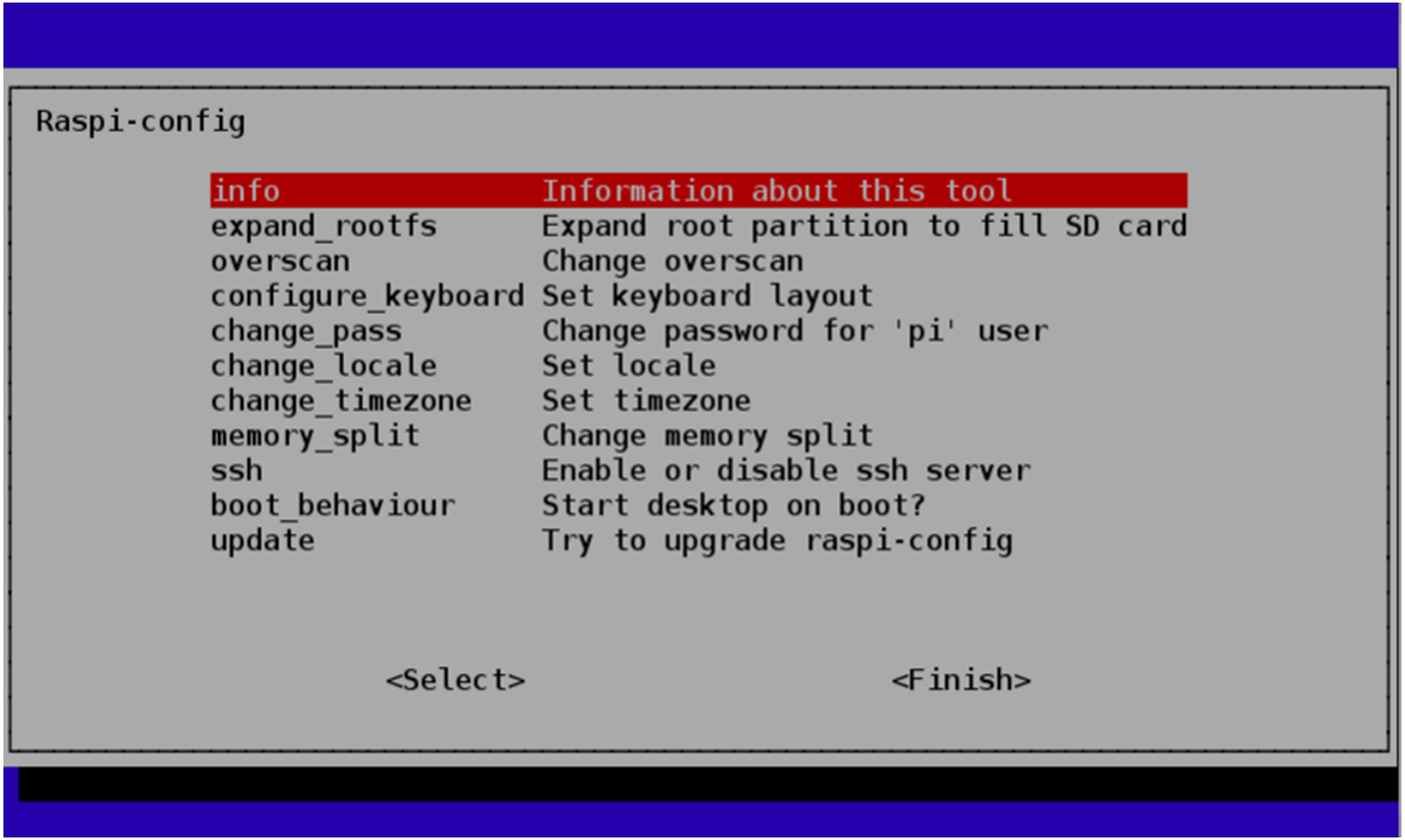

xbmc
1:42 PM
Sun, 29 Jul 2012
PICTURES
VIDEOS
MUSIC
Files
Add-ons
BenQ
TECHNIKA

- 3. Download the Win32DiskImager software
  - a) Download win32diskimager-binary.zip (currently version 0.6) from:

    https://launchpad.net/win32-image-writer/+download
  - b) Unzip it in the same way you did the Raspbian .zip file
  - c) You now have a new folder called win32diskimager-binary

- 4. Writing Raspbian to the SD card
  - a) Plug your SD card into your PC
  - b) In the folder you made in step 3(b), run the file named Win32DiskImager.exe
  - c) If the SD card (Device) you are using isn't found automatically then click on the drop down box and select it
  - d) In the Image File box, choose the Raspbian .img file that you downloaded
  - e) Click Write
  - f) After a few minutes you will have an SD card that you can use in your Raspberry Pi

- 5. Booting your Raspberry Pi for the first time
  - On first boot you will come to the Raspi-config window
  - Change settings such as timezone and locale if you want
  - Finally, select the second choice: **expand_rootfs** and say ‘yes’ to a reboot
  - The Raspberry Pi will reboot and you will see raspberrypi login:
    - Username: pi, password: raspberry
  - Start the desktop by typing: **startx**
  - The desktop environment is known as the Lightweight X11 Desktop Environment (LXDE)


Raspi-config
info Information about this tool
expand_rootfs Expand root partition to fill SD card
overscan Change overscan
configure_keyboard Set keyboard layout
change_pass Change password for 'pi' user
change_locale Set locale
change_timezone Set timezone
memory_split Change memory split
ssh Enable or disable ssh server
boot_behaviour Start desktop on boot?
update Try to upgrade raspi-config
<Select>
<Finish>

# Re-mapping Keyboard:

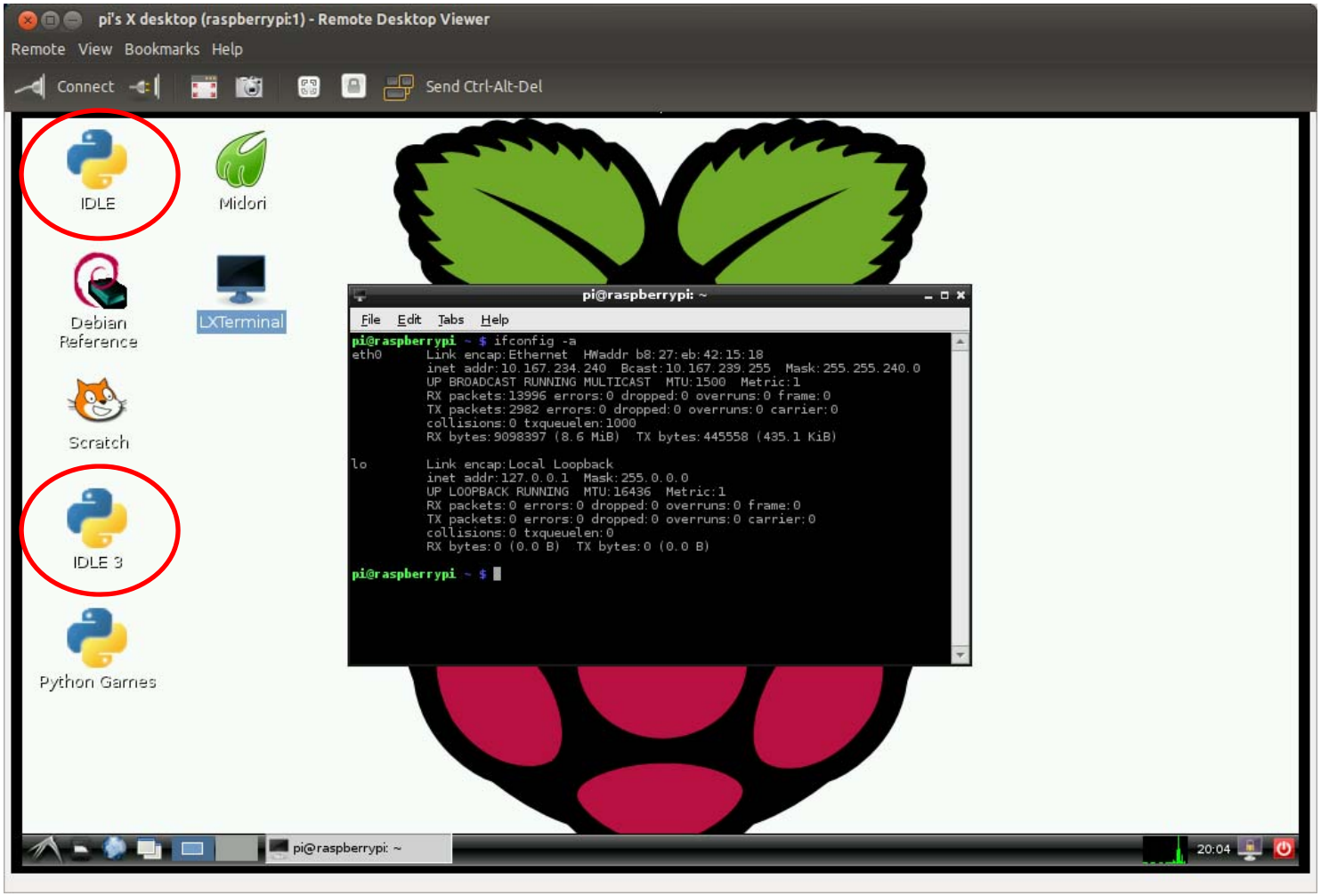
- sudo vi /etc/default/keyboard
  XKBLAYOUT=”gb”
  Change “gb” to “us”

- (This assumes you want a us mapping, if not replace the gb with the two letter code for your country)

# Install and Start SSH

- Update apt-get package index files:
  - sudo apt-get update
- Install SSH:
  - sudo apt-get install ssh
- Start SSH server:
  - sudo /etc/init.d/ssh start
- To start the SSH server every time the Pi boots up:
  - sudo update-rc.d ssh defaults

- SSH client for Windows:
  - PuTTY
  - http://www.putty.org/
- SSH Secure File Transfer
  - http://www.utexas.edu/learn/upload/ssh_client.html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RX bytes:0 (0.0 B) TX bytes:0 (0.0 B)
pi@raspberrypi ~ $
pi@raspberrypi: ~
20:04

# Install Java

- 1. JDK 8 (with JavaFX) for ARM Early Access http://jdk8.java.net/fxarmpreview/
  - Download from Raspberry pi
  - Download from your own PC and copy it (scp) to Raspberry pi
- Extract the JDK tar.gz file
  - tar –zxvf fileToExtract.tar.gz
  - You will get a folder “jdk1.8.0”

# Set Java PATH

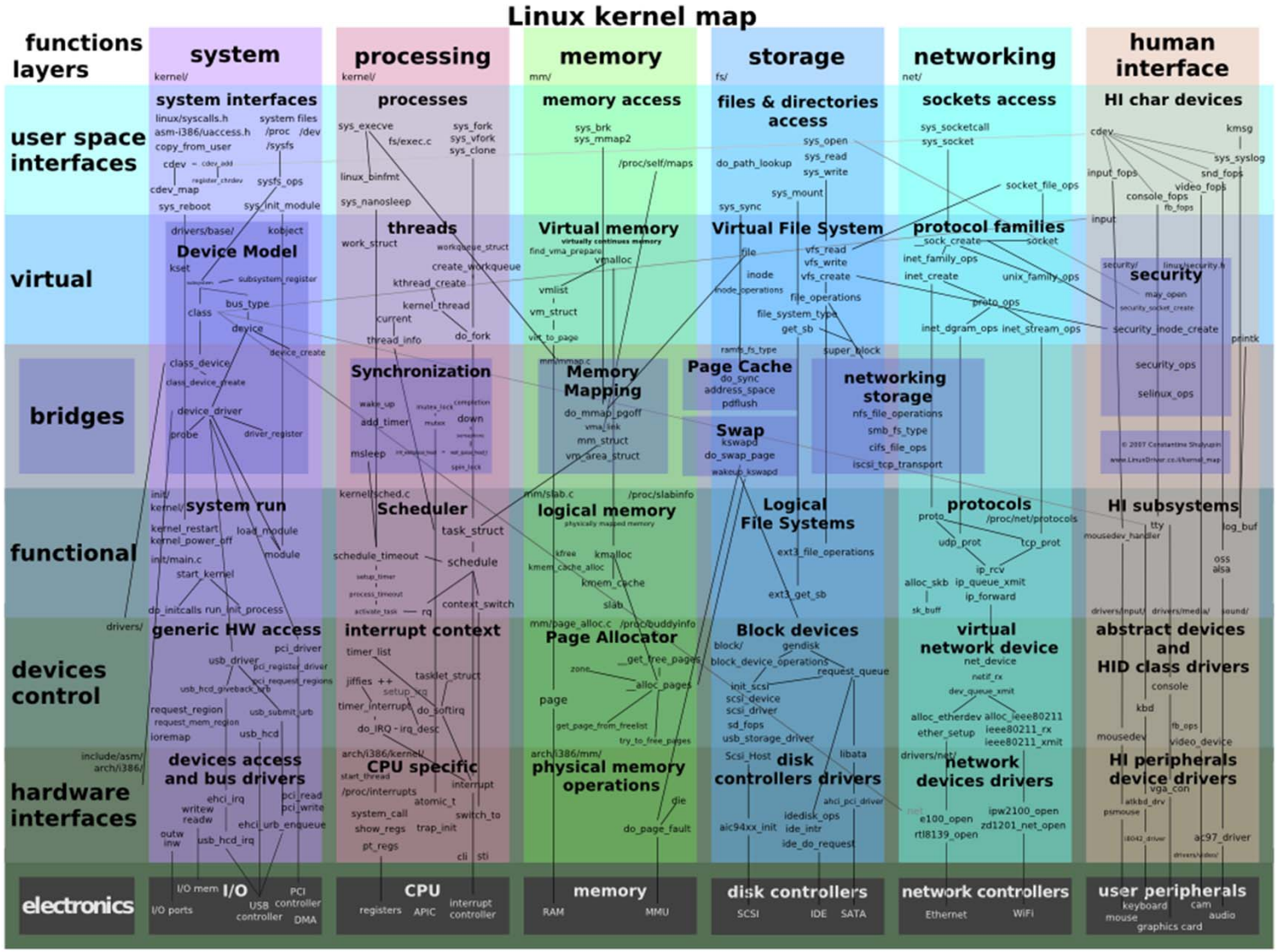
- If you put the folder “jdk1.8.0” in the home directory (i.e. /home/pi), you will see the java executables (e.g. javac, java, appletviewer) in the directory: /home/pi/jdk1.8.0/bin
- open /etc/profile
  add:

  ```
  PATH=$PATH:/home/pi/jdk1.8.0/bin
  export PATH
  ```
- Reboot:

  sudo reboot

# Linux System Administration

# Kernel and Distribution



# Kernel and Distribution

Although only the kernel itself is rightly called Linux, the term is often used to refer to a collection of different open-source projects from a variety of companies. These collections come together to form different flavors of Linux, known as distributions.

# File System Logical Layout

**boot:** This contains Linux kernel and other packages needed to start the Pi

**bin:** OS-related binary files, like those required to run the GUI, are stored here.

**dev:** Virtual directory, which doesn't actually exist on the SD card. All devices connected to the system can be accessed from here.

**etc:** This stores miscellaneous configuration files, including the list of users and their encrypted passwords

**home:** Each user gets a subdirectory beneath this directory to store all their personal files

**lib:** This is a storage space for libraries, which are shared bits of code required by different applications.

**lost+found:** A special directory where file fragments are stored if the system crashes.

**media:** A special directory for removable storage devices, like USB memory sticks or external CD drives.

# File System Logical Layout

**mnt:** This folder is used to manually mount storage devices, such as external hard drives.

**opt:** This stores optional software that is not part of the OS itself. If you install new software to your Pi, it will usually go here.

**proc:** Another virtual directory, containing information about running programs which are known in Linux as processes.

**selinux:** Files related to Security Enhanced Linux, a suite of security utilites originally developed by the US National Security Agency.

**sbin:** Stores special binary files, primarily used by the root account for system maintenance.

**sys:** This directory is where special OS files are stored.

**tmp:** Temporary files are stored here automatically.

**usr:** This directory provides storage for user accessible programs.

**var:** This is virtual directory that programs use to store changing values or variables.

# Software

LXTerminal and Root Terminal: use the Linux command line in a window without leaving the GUI.

Midori & NetSurf: Lightweight web browser

IDLE and IDLE 3: IDE for Python 2.7 and 3

Task Manager: Checks the available memory, processor workload, closes crashed or unresponsive programs

Music player at the console: moc

OpenOffice.org: sudo apt-get install openoffice.org

Image Editing: Gimp

LAMP (Linux, Apache, MySQL and PHP) stack

Sudo apt-get install apache2 php5 php5-mysql mysql-server

# Installing, Uninstalling and Updating Software

- Package manager in Debian: apt
  - GUI for apt, Synaptic Package Manager doesn't work well on Pi due to the lack of memory
- Make sure that the apt cache is up to date:
  - apt-get update
- Finding software:
  - apt-cache search emacs
- Installing software and dependencies:
  - sudo apt-get install emacs
- Uninstalling software:
  - sudo apt-get remove emacs
  - sudo apt-get purge emacs (removes everything including configurations)
- Upgrading software:
  - Sudo apt-get upgrade
  - Sudo apt-get install emacs

# Troubleshooting

Keyboard and Mouse Diagnostics

Power Diagnostics

Display Diagnostics

Network Diagnostics

Emergency Kernel

# Wired Networking Configuration

sudo nano /etc/ntework/interfaces

iface eth0 inet static
[tab] address 192.168.0.10
[tab] netmask 255.255.255.0
[tab] gateway 192.168.0.254

sudo /etc/init.d/networking restart

sudo nano /etc/reslov.conf

nameserver 8.8.8.8
nameserver 8.8.4.4

sudo /etc/init.d/networking restart

ping –c 1 www.raspberrypi.org

# Wireless Networking Configuration

- USB Wi-Fi adapters are very power-hungry. Connect a powered USB hub to the Pi, and then insert the Wi-Fi adapter into that.
- Print out the entire kernel ring buffer and find out the company that makes the actual chip: mesg | grep ^usb

Atmel-firmware
Firmware-atheros
Firmware-brcm80211
Firmeware-intelwimax
Firmware-ipw2x00
Firmware-iwlwifi
Firmware-ralink
Firmware-realteck
Zd1211-firmware

- Check the current status of the network: iwconfig

# Configurating the Raspberry Pi

RPi doesn’t have a BIOS menu. It relies on text files containing configuration strings that are loaded by the chip when powers on.

- Hardware settings: config.txt
- Memory Partitioning: start.elf
- Software Settings: cmdline.txt

# References for Python

Beginner's Guide to Python
http://wiki.python.org/moin/BeginnersGuide

A free, interactive tutorial
http://www.learnpython.org

Learn Python the Hard Way (Shavian Publishing, 2012)

Dive Into Python 3 (APRESS, 2009)