

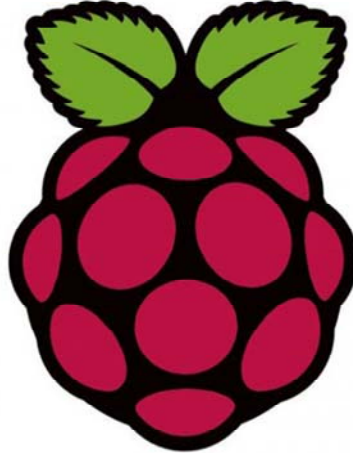
Raspberry Pi

An Overview

By

Allen D. Heberling

Welcome to Raspberry Pi



Introductions:

Good Afternoon and Welcome to the Raspberry Pi Overview

Just some General House keeping Items before we begin:

Cell Phones – As a courtesy to your fellow attendees please switch them to vibrate mode or turn them off

Handouts – If you would like a copy of the presentation slides, please place your name and e-mail address on the attendance sheet so that I may e-mail a copy to you.

Before we start lets each of us introduce ourselves by standing up calling out our name and by telling us what your favorite activity is whether it be technical, recreational, athletic, or just chilling out. Lets start from your left front of the room.

My name is Allen Heberling. I've been developing embedded software for microprocessors such as the 8080, 8085, Z-80, 8088, 8086, 80286, PowerPC, and ARM processors throughout my embedded software engineering career. In addition, I've had the experience of developing embedded software to run on operating systems such as main line loops with interrupts, custom roll our own corporate RTOSes, PSoS, uCOS, Thread-X, and Linux.

The Pi Journey Begins...

Where Did the Raspberry Pi Come
From & Why?

What is it?

What Can It Do?

Where Can I Get One?

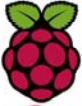
So what is it about this oddly named entity known as Raspberry Pi that has induced me to stand up here to talk about it to a room full of strangers? For me, I guess it is the device's coolness factor... its size, performance, and cost. I haven't been this excited about a computing platform since my first days building my first CPM based computer out of a surplus Xerox 820 mother board, 8" Floppy Drive, "monster" 5V power supply, and CRT. By the end of this session, I hope you will share my enthusiasm for the Raspberry Pi platform.

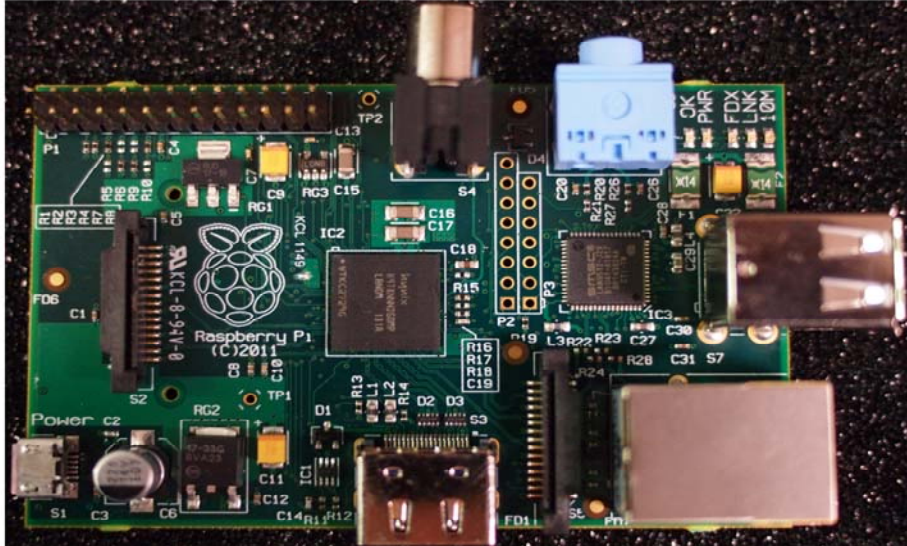
Where Did the Raspberry Pi Come From & Why?

What is a Raspberry Pi?

What Can a Raspberry Pi Do?

Where Can I Get One?

The  Pi is a Single Board Computer (SBC).



What is Raspberry Pi?

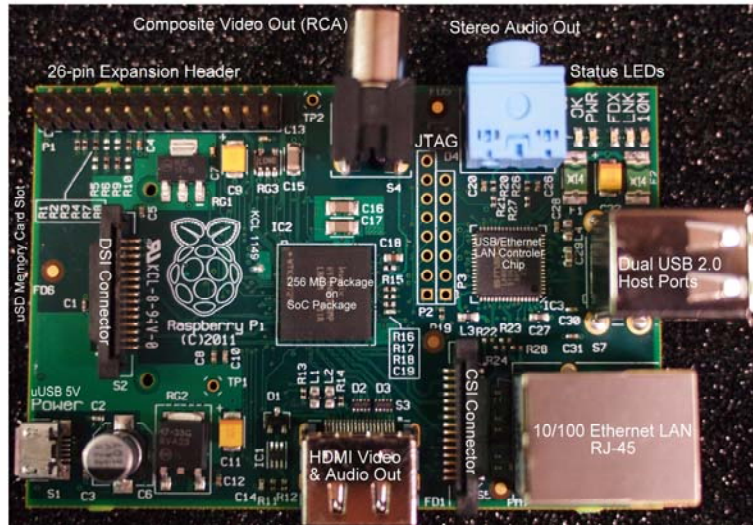
Raspberry Pi is a USD \$35.00 credit card sized single board computer (3.4"x2.1").



Where did it Come From and Why?

Raspberry Pi Foundation located in Cambridge England. The founding members of the Raspberry Pi Foundation: Eben Upton, Rob Mullins, Jack Lang, Alan Mycroft, and Pete Lomas were becoming concerned over the declining number of A-Level students with sophisticated programming skills applying to read Computer Science at Cambridge University. Consequently, Dr. Upton and team set out to develop a platform that would cost the equivalent of an inexpensive textbook and would provide young people with a platform that would not only be fun to play with, but also fun to learn how to program. Similar to the experiences, Dr. Upton and company had while they were growing-up with the BBC Micro, Sinclair Z-80, and the Commodore 64/128. Their root-cause analysis for the decline in programming skill seemed to correlate with the closed nature of the Nintendo Wii, Sony PlayStation, and Microsoft Xbox platforms, as well as parents being hesitant to allow a young, budding programmer to use the family PC as a computer science lab.

Here Are the Physical Attributes of the Pi SBC.



What are the Raspberry Pi's Standard Physical Attributes?

SoC – Broadcom BCM2835 (CPU, GPU, DSP, and SDRAM)

CPU – 700 MHz ARM1176JZF-S core (ARM 11 family)

GPU – Broadcom VideoCore IV, OpenGL ES 2.0, 1080p30/H.264/MPEG-4 AVC decoder

PoP Memory - 256 MB SDRAM (shared w/ GPU) // PoP = Package on Package

USB/LAN Controller

10/100 Ethernet (RJ-45)

2-USB 2.0 Host ports

5-Status LEDs

Stereo Audio Out

JTAG ports for CPU and GPU (unpopulated)

Composite Video Out (RCA)

Expansion Header with 26 Pins:

8xGPIO,

UART,

I2C bus,

SPI bus

+5V , +3v3, Ground

SD Memory Card Slot – Left side, underneath

DSI Connector for connecting to an LCD (DSI = Display Serial Interface).

Micro-USB Power Connector +5 volt at $\geq 700\text{ma}$

HDMI – 1080p Video and Audio

CSI Connector for connecting to a digital camera module (CSI = Camera Serial Interface).

Essential Peripherals for the Pi SBC:

What Peripherals Are Required for the Raspberry Pi SBC?

1. +5V/700ma cell phone battery charger with micro-USB cable
2. SD-Memory Card (2GB minimum) with a Linux OS Image installed
3. USB Keyboard & USB Mouse
4. HDMI cable or RCA Video Cable
5. Display with either an HDMI, DVI, or Composite Video input
6. Ethernet LAN Cable with RJ-45 Connectors

Non-Essential Peripherals for the Pi SBC:

Other Nice to Have Peripherals

1. Wireless Bluetooth-USB dongle for use with a wireless Bluetooth keyboard and mouse.
2. USB Flash Drive or Hard drive.
3. USB Wi-Fi dongle

Linux Variants Currently Available for the Pi SBC:

1. Debian-6 Linux
2. Arch Linux
3. *OpenELEC*
4. *Fedora14 Remix**
5. *Android***

Which Operating Systems are Available for the Raspberry Pi SBC?

These operating systems are available:

1. Debian-6 Linux: Is Currently the Most Stable Release and is recommended for those who want to get the system up and running quickly.
2. Arch Linux – Recommended for Experienced Linux Hackers
3. OpenELEC – Open Embedded Linux Entertainment Center OS (70 MB) Geared Towards Supporting the XBMC Application see <http://openelec.tv>
4. Fedora14 Remix – * However it is not quite ready for prime time.
5. Android – ** Is just a rumor at this time, albeit an interesting one...

Programming Languages Available on the Pi SBC:

1. C/C++
2. Python
3. Scratch
4. Qt-on-Pi

Which SW Languages are available?

Currently these programming languages are supported:

1. C/C++
2. Python
3. Scratch – a drag and drop Smalltalk variant from MIT.
4. Qt-on-Pi – a Nokia & ICS sponsored Port of Qt5 for Raspberry Pi SBC



Pi and Its' Competitors:

1. Beagle Board-XM
2. Beagle Bone
3. Arduino Uno

Raspberry Pi and Its' Competitors:

1. Beagle Board-XM
2. Beagle Bone
3. Arduino Uno

Here's How the Pi SBC Compares:

| Attributes | Arduino Uno | Raspberry Pi | Beagle Bone | Beagle-XM |
|---------------------|-------------|-------------------|---------------|---------------|
| Dimensions | 2.7"x2.1" | 3.4"x2.1" | 3.4"x2.1" | 3.35"x3.37" |
| Cost | \$27 | \$35 | \$89 | \$149 |
| CPU Clock Speed | 16 MHz | 700 MHz | 700 MHz | 1-GHz |
| Clock Speed/Cost = | 0.6 | 20.0 | 7.9 | 6.7 |
| CPU | ATmega328 | ARM-11 | ARM Cortex-A8 | ARM Cortex-A8 |
| GPU | 0 | BCM Video Core IV | 0 | 0 |
| Memory | 32 KB | 256 MB | 256-MB | 512-MB |
| SD Memory Card Slot | 0 | 1 | 1 | 1 |
| Ethernet LAN | 0 | 10/100 | 10/100 | 10/100 |
| USB Host | 0 | 2-Ports | 1 | 4-Ports |
| USB Client | 1 | 0 | 1 | 0 |

Content on the slide above was taken from the

- BeagleBoard-xM SRM reference manual at this URL:

www.beagleboard.org

- BeagleBone System Reference Manual at this URL:

<http://beagleboard.org/static/beaglebone/latest/README.htm>

- Raspberry Pi GPIO info located at this URL:

http://elinux.org/RPi_Low-level_peripherals

- Arduino Uno Tech Data Sheet located at this URL:

<http://arduino.cc/en/Main/ArduinoBoardUno>

Here's How the Pi SBC Compares (continued...):

| Attributes | Arduino Uno | Raspberry Pi | Beagle Bone | Beagle-XM |
|---------------------|-------------|--------------|-------------|-----------|
| Audio Stereo In/Out | 0 | 0/1 | 0 | 1/1 |
| HDMI Audio Out | 0 | 1 | 0 | 1 |
| 1080p Video | 0 | HDMI | 0 | DVI-D |
| Composite Video Out | 0 | 1 | 0 | 0 |
| S Video Out | 0 | 0 | 0 | 1 |
| LCD Interface | 0 | DSI | 0 | 2 |
| Camera Interface | 0 | CSI | 0 | 1 |
| Status LEDs | 4 | 5 | 5 | 6 |
| Reset | 1 | 0 | 1 | 1 |
| JTAG | 0 | 1-CPU/1-GPU | 1-CPU | 1-CPU |
| DB9 RS232 | 0 | 0 | 0 | 1 |

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Here's How the Pi SBC Compares (continued...):

| Attributes | Arduino Uno | Raspberry Pi | Beagle Bone | Beagle-XM |
|--------------------------|-------------|--------------|--------------------|-----------------|
| Expansion Header: | | 1-26 pin Hdr | 2-46 pin Hdrs | 1-28 pin Hdr |
| +5V | 1 | 1 | 4 | 1 |
| +3v3 | 1 | 1 | 2 | 1 -1v8 pin |
| GND | 3 | 1 | 8 | 2 - pin |
| DNCs | 0 | 6 - pins | 0 | 0 |
| REGEN/Nreset | 1 | 0 | 1 | 2 - pin |
| GPIO | 12 pins | 8 pins | 36 pins | 22 pins (max) |
| UART | 1 - 2 pin | 1 - 2 pin | 3 - 4pin + 1 -2pin | 1 - 4 pin |
| I2C | 1 - 2 pin | 1 - 2 pin | 2 - 2 pin | 1 - 2 pin |
| SPI | 1 - 4 pin | 1 - 5 pin | 1 - 4 pin | 1-5pin + 1-4pin |
| PWM | 6 - 1 pin | 0 | 4 - 1 pin | 3 - 1 pin |
| Timers | 0 | 0 | 4 - 1 pin | 0 |
| Analog in | 6 - 1 pin | 0 | 7 - 1 pin | 1-pin |

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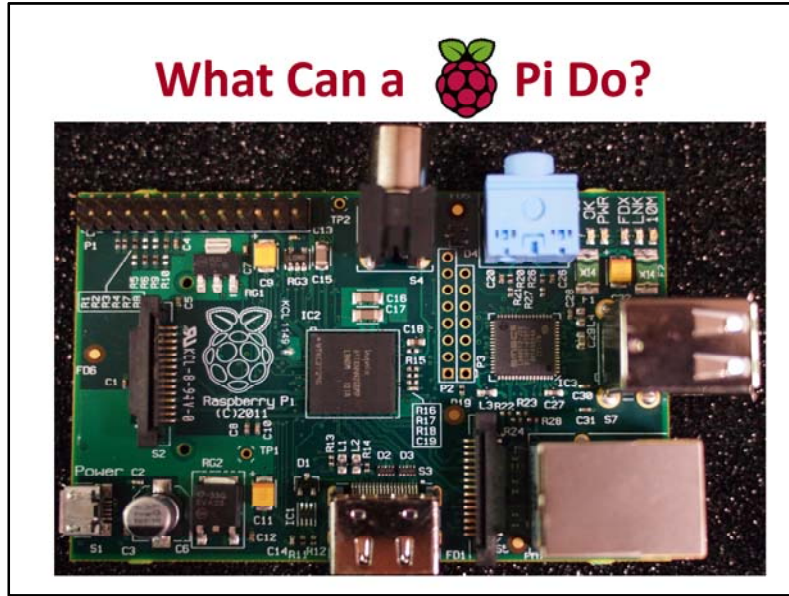
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Here's How the Pi SBC Compares (the end):

| Attributes | Arduino Uno | Raspberry Pi | Beagle Bone | Beagle-XM |
|---------------------------|-------------|--------------|-------------|-----------|
| Operating Systems: | | | | |
| Android | N | N | Y | Y |
| Angstrom | N | N | Y | Y |
| ArchLinux | N | Y | Y | Y |
| Debian | N | Y | Y | Y |
| Gentoo | N | N | Y | Y |
| OpenELEC | N | Y | N | ? |
| QNX | N | N | Y | Y |
| Ubuntu | N | N | Y | Y |

The Arduino Uno makes use of an interruptible main line loop.



What can a Raspberry Pi do?

The primary use envisioned by the creators of the Raspberry Pi SBC is to provide young people an inexpensive platform upon which to learn programming. However, given the overwhelming interest by tech hobbyists and other interested parties these other evolving uses for the Raspberry Pi SBC have become prominent:

- Development platform for hobbyists – via an Expansion Header Interface Card (e.g. Adafruit and others are already developing prototyping daughter cards).
 - Robotics development platform – via an Expansion Header Interface Card
 - Pi-duino – a pairing of an RPi SBC and a redesigned Arduino Uno board as a daughter card connected via the Expansion Header Interface
 - Inexpensive Xbox Media Center (XBMC) – <http://openelec.tv>
 - Network Attached Storage (NAS) device – see discussion on Raspberry Pi Forum webpage
 - Cluster Computing Test bed – see Discussion item in Element-14 Website
 - Etc. ... the list continues to grow. Just check out the Raspberry Pi Forum for project ideas.
- Allen D. Heberling - mobile:760-696-8194
website: www.allen-d-heberling.com

Where Can One Learn More About the Pi SBC?

- **Raspberry Pi Quick Start Guide** – on line at:
www.element14.com/community/docs/DOC-43088/l/raspberry-pi-quick-user-guide-for-raspberry-pi-single-board-computer
- **Broadcom BCM2835 ARM Peripherals Manual** –
online at: <http://www.element14.com/community/docs/DOC-43016/l/broadcom-datasheet-for-bcm2835-soc-used-in-raspberry-pi>
- **Raspberry Pi SBC Schematics** online at:
http://www.designspark.com/files/ds/supporting_materials/Raspberry-Pi-Schematics-R1.0.pdf

Where can one Learn More About the Raspberry Pi SBC?

Raspberry Pi Quick Start Guide – on line at:

www.element14.com/community/docs/DOC-43088/l/raspberry-pi-quick-user-guide-for-raspberry-pi-single-board-computer

Broadcom BCM2835 ARM Peripherals Manual – online at:

<http://www.element14.com/community/docs/DOC-43016/l/broadcom-datasheet-for-bcm2835-soc-used-in-raspberry-pi>

Raspberry Pi SBC Schematics online at:

http://www.designspark.com/files/ds/supporting_materials/Raspberry-Pi-Schematics-R1.0.pdf

Where Can One Learn More About the Pi SBC...?

- **Raspberry Pi Video Tutorials** – online at:
<http://www.element14.com/community/docs/DOC-43015/l/raspberry-pi-training-videos>
- **Raspberry Pi Wiki** online at:
<http://elinux.org/RaspberryPiBoard>
- **Raspberry Pi Forum** online at:
<http://www.raspberrypi.org/forum>
- **Raspberry Pi Foundation** online at:
www.raspberrypi.org

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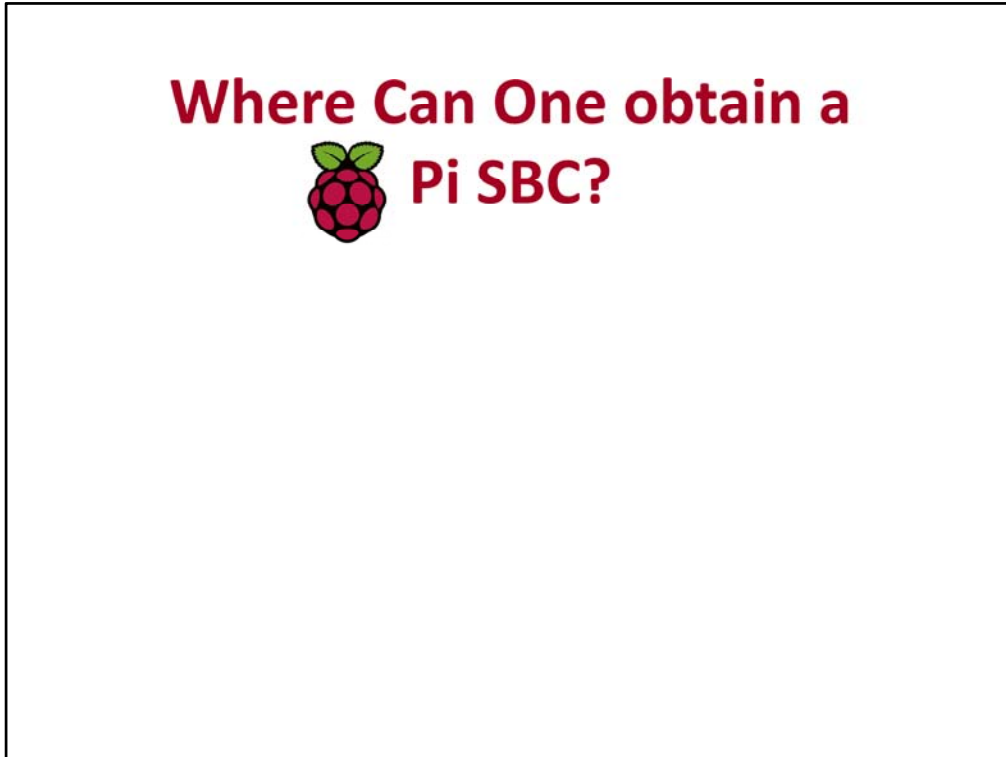
Raspberry Pi Foundation on line at: <http://www.raspberrypi.org>

**Where Can One Obtain Software
for the  Pi SBC?**

Where can one obtain SW for the Raspberry Pi SBC?

One can obtain software for the Raspberry Pi SBC through these websites:

- Raspberry Pi Foundation for working Linux Distros:
<http://www.raspberrypi.org/downloads>
- Element-14 for working Linux Distros:
www.element14.com
- openelec.tv for an XBMC for the Raspberry Pi:
<http://openelec.tv/> and www.raspbmc.com
- Qt-on-Pi: <http://wiki.qt-project.org/QtOnPi>



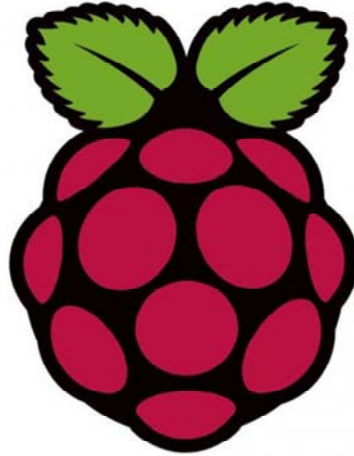
Where can one obtain a Raspberry Pi SBC?

One can obtain the Raspberry Pi HW platform through these vendors:

- RS Components/Allied – www.alliedelec.com
- Premier Farnell/Newark/Element-14 – www.element14.com

Please be aware the Raspberry Pi SBC is seriously backordered at both vendors!

Q & A



The End is Just the Beginning...



What have we learned?

- 1) What the Raspberry Pi is.
- 2) Where it came from and why.
- 3) What it can do.
- 4) Where it can be purchased.

As to what is next? I hope you will:

1. Buy a Raspberry Pi for Your Self as well as one or more for your favorite young person(s)
2. Begin Playing with the Raspberry Pi SBC...
 - A. If you're a HW oriented person begin designing and implementing Adapter Boards.
 - B. If you're a SW oriented person begin developing interesting Programs.
3. Become a Mentor; Have Fun with it and Spread the Word

Contact Information

