Raspberry Pi

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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.[6][7][8][9][10]

The Raspberry Pi is manufactured in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online.[11] Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers.

The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC),[3] which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU,[12] and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB.[4][13] It does not include a built-in hard disk or solid-state drive, but it uses an SD card for booting and persistent storage.[14]

The Foundation provides Debian and Arch Linux ARM distributions for download.[15] Tools are available for Python as the main programming language,[16][17] with support for BBC BASIC[18] (via the RISC OS image or the Brandy Basic clone for Linux),[19] C,[16] Java[20] and Perl.[16]

Contents

Raspberry Pi

Raspberry Pi computer Model-B Rev1

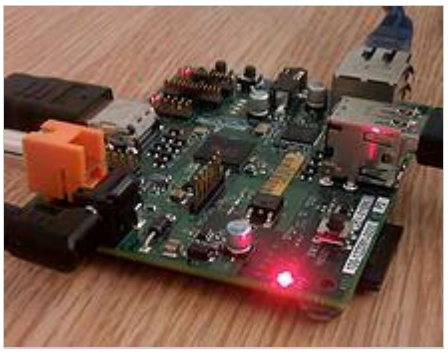
Developer	Raspberry Pi Foundation
Type	Single-board computer
Release date	29 February 2012[1]
Introductory price	US$ 25 (model A) and US$ 35 (model B)
Operating system	Linux (Raspbian, Debian GNU/Linux, OpenELEC, Fedora, Arch Linux ARM, Gentoo),[2] RISC OS, FreeBSD, NetBSD, Plan 9, Inferno, Openwrt
Power	2.5 W (model A), 3.5 W (model B)
CPU	ARM1176JZF-S (ARMv6**k**) 700 MHz[3]
Memory	256 MB[4] (Model A) 256 MB (Model B rev 1) 512 MB (Model B rev 2)[5]
Storage	SD card slot (SD or SDHC card)
Graphics	Broadcom VideoCore IV[3]
Website	www.raspberrypi.org (http://www.raspberrypi.org)

History

In 2006, early concepts of the Raspberry Pi were based on the Atmel ATmega644 microcontroller. Its schematics and PCB layout are publicly available.[21] Foundation trustee Eben Upton assembled a group of teachers, academics and computer enthusiasts to devise a computer to inspire children.[22] The computer is inspired by Acorn's BBC Micro of 1981.[23][24] The first ARM prototype version of the computer was mounted in a package the same size as a USB memory stick.[25] It had a USB port on one end and an HDMI port on the other.

The Foundation's goal was to offer two versions, priced at US$25 and US$35. They started accepting orders for the higher priced model B on 29 February 2012,[26] and the lower cost model A on 4 February 2013.[27]

Pre-launch



An early alpha-test board in operation. Its layout is different from the beta and production boards.

In August 2011, fifty Alpha boards were manufactured. These boards were functionally identical to the planned model B,[28] but they were physically larger to accommodate debug headers. Demonstrations of the board showed it running the LXDE desktop on Debian, *Quake 3* at 1080p,[29] and Full HD MPEG-4 video over HDMI.[30]

In October 2011, a version of RISC OS 5 was demonstrated in public, and following a year of development the port was released for general consumption in November 2012.[31][32][33][34]

In December 2011, twenty-five model B Beta boards were assembled and tested[35] from one hundred unpopulated PCBs.[36] The component layout of the Beta boards was the same as on production boards. A single error was discovered in the board design where some pins on the CPU were not held high; it was fixed for the first production run.[37] The Beta boards were demonstrated booting Linux, playing a 1080p movie trailer and the Rightware Samurai OpenGL ES benchmark.[38]

During the first week of 2012, the first 10 boards were put up for auction on eBay.[39][40] One was bought anonymously and donated to the museum at The Centre for Computing History in Suffolk, England.[41][42] The ten boards (with a total retail price of £220) together raised over £16,000,[43] with the last to be auctioned, serial number No. 01, raising £3,500.[44] In advance of the anticipated launch at the end of February 2012, the Foundation's servers struggled to cope with the load placed by watchers repeatedly refreshing their browsers.[45]

Launch

The first batch of 10,000 boards was manufactured in Taiwan and China.[46][47]

Raspberry Pi Model A

Shipping delays for the first batch were announced in March 2012, as the result of installation of an incorrect Ethernet port,[48][49] but the Foundation expected that manufacturing quantities of future batches could be increased with little difficulty if required.[50]

> "We have ensured we can get them [the Ethernet connectors with magnetics] in large numbers and Premier Farnell and RS Components [the two distributors] have been fantastic at helping to source

components," Upton said.

Initial sales commenced 29 February 2012[51] at 06:00 UTC;. At the same time, it was announced that the Model A, originally to have had 128 MB of RAM, was to be upgraded to 256 MB before release.[26] The Foundation's website also announced: "Six years after the project's inception, we're nearly at the end of our first run of development – although it's just the beginning of the Raspberry Pi story."[52] The web-shops of the two licensed manufacturers selling Raspberry Pi's within the United Kingdom, Premier Farnell and RS Components, had their websites stalled by heavy web traffic immediately after the launch (RS Components briefly going down completely.)[53][54] Unconfirmed reports suggested that there were over two million expressions of interest or pre-orders.[55] The official Raspberry Pi Twitter account reported that Premier Farnell sold out within a few minutes of the initial launch, while RS Components took over 100,000 pre orders on day one.[26] Manufacturers were reported in March 2012 to be taking a "healthy number" of pre-orders.[56] As of February 2014, about 2.5 million boards had been sold.[57]

Post-launch

On 16 April 2012 reports started to appear from the first buyers who had received their Raspberry Pi.[58][59] As of 22 May 2012 over 20,000 units had been shipped.[60] On 16 July 2012 it was announced that 4000 units were being manufactured per day, allowing Raspberry Pis to be bought in bulk.[61][62] On 5 September 2012 the Raspberry Pi Foundation announced a second revision of the Model B Raspberry Pi.[63] On 6 September 2012 it was announced that in future the bulk of Raspberry Pi units would be manufactured in the UK, at Sony's manufacturing facility in Pencoed, Wales. The Foundation estimated that the plant would produce 30,000 units per month, and would create about 30 new jobs.[64][65] In October 2012 it was reported that some customers of one of the two main distributors had been waiting more than six months for their orders. This was reported to be due to difficulties in sourcing the CPU and conservative sales forecasting by this distributor.[66]

On 17 December 2012 the Raspberry Pi Foundation, in collaboration with IndieCity and Velocix, opened the Pi Store, as a "one-stop shop for all your Raspberry Pi (software) needs". Using an application included in Raspbian, users can browse through several categories and download what they want. Software can also be uploaded for moderation and release.[67]

In October 2013 the Foundation announced that the one millionth Pi had been manufactured in the United Kingdom.[68]

In November 2013 they announced that the two millionth Pi shipped between 24 October and 31 October.[69]

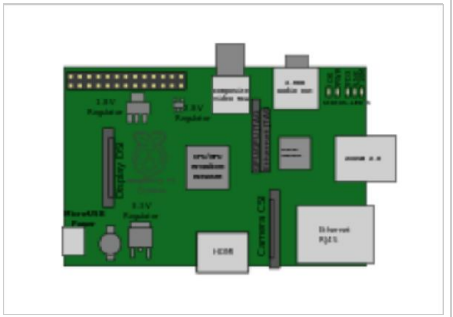
On 28 February 2014, on the day of the second anniversary of the Raspberry PI Broadcom, together with the Raspberry PI foundation, announced the release of full documentation for the

VideoCore IV graphics core, and a complete source release of the graphics stack under a 3-clause BSD license[70][71]

In June 2014 Official Raspberry blog mentioned that the three millionth Pi shipped in early May 2014.[72]

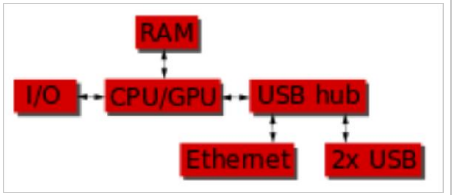
Hardware

Initial sales were of the Model B, with Model A following in early 2013. Model A has one USB port and no Ethernet controller, and costs less than the Model B with two USB ports and a 10/100 Ethernet controller.[73]



Location on the PCB of connectors and major ICs

Though the Model A does not have an 8P8C (RJ45) Ethernet port, it can connect to a network by using an external user-supplied USB Ethernet or Wi-Fi adapter. On the model B the Ethernet port is provided by a built-in USB Ethernet adapter. As is typical of modern computers, generic USB keyboards and mice are compatible with the Raspberry Pi.[14]



Block diagram of the Model-B; in a Model-A the lowest two blocks and the rightmost block are missing (note that these three blocks are in a chip that actually contains a three-port USB hub, with a USB Ethernet adapter connected to one of its ports). In the Model-A the USB port is connected directly to the SoC.

The Raspberry Pi does not come with a real-time clock,[7] so an OS must use a network time server, or ask the user for time information at boot time to get access to time and date for file time and date stamping. However, a real-time clock (such as the DS1307) with battery backup can be added via the I²C interface.

On 20 April 2012 the schematics for the Model-A and Model-B were released by the Raspberry Pi Foundation.[74]

Hardware accelerated video (H.264) encoding became available on 24 August 2012 when it became known that the existing license also covered encoding. Previously it was thought that encoding would be added with the release of the announced camera module.[75][76] However, no stable software support exists for hardware H.264 encoding.[77]

At the same time the Raspberry Pi Foundation released two additional codecs that can be bought separately, MPEG-2 and Microsoft's VC-1. Also it was announced that the Pi will support CEC, enabling it to be controlled with the television's remote control.[78]

Further changes occurred in late 2012. A revision 2.0 board was announced on September 5, with a number of minor corrections and improvements.,[79] and later on the Raspberry Pi Foundation further announced on October 15 that new Raspberry Pi model B's would be fitted

with 512 MB instead of 256 MB RAM.[13]

Performance & overclocking

The Broadcom SoC used in the Raspberry Pi is equivalent to a chip used in an old smartphone (Android or iPhone). While operating at 700 MHz by default, the Raspberry Pi provides a real world performance roughly equivalent to the 0.041 GFLOPS.[80][81] On the CPU level the performance is similar to a 300 MHz Pentium II of 1997-1999,[82] but the GPU, however, provides 1 Gpixel/s, 1.5 Gtexel/s or 24 GFLOPS of general purpose compute and the graphics capabilities of the Raspberry Pi are roughly equivalent to the level of performance of the Xbox of 2001.[82] The Raspberry Pi chip operating at 700 MHz by default, will not become hot enough to need a heatsink or special cooling.[82]

The LINPACK single node compute benchmark results in a mean single precision performance of 0.065 GFLOPS and a mean double precision performance of 0.041 GFLOPS for one Raspberry Pi Ver. B board.[83] A cluster of 64 Raspberry Pi Ver. B computers, labeled "Iridis-pi", achieved a LINPACK HPL suite result of 1.14 GFLOPS (n=10240) at 216 watts for c. US$4,000.[83]

Most Raspberry Pi devices can be overclocked to 800 MHz and some even higher to 1000 MHz. Via the Raspbian Linux distro the overclocking options on boot can be done by a software command running "sudo raspi-config" without voiding the warranty. In case of issues, the overclocking settings can be reduced until stability is restored, or one can put an appropriately sized heatsink on it.[82]

Specifications

	Model A	Model B
Target price:[7]	US$25	US$ 35[84]
SoC:[7]	Broadcom BCM2835 (CPU, GPU, DSP, SDRAM, and single USB port)[3]	
CPU:	700 MHz ARM1176JZF-S core (ARM11 family, ARMv6 instruction set)[3]	
GPU:	Broadcom VideoCore IV @ 250 MHz[85][86] OpenGL ES 2.0 (24 GFLOPS) MPEG-2 and VC-1 (with license[78]), 1080p30 h.264/MPEG-4 AVC high-profile decoder and encoder[3]	
Memory (SDRAM):	256 MB (shared with GPU)	512 MB (shared with GPU) as of 15 October 2012
USB 2.0 ports:[14]	1 (direct from BCM2835 chip)	2 (via the built in integrated 3-port USB hub)[73]
Video input:	A CSI input connector allows for the connection of a RPF designed camera module[87]	
Video outputs:[7]	Composite RCA (PAL and NTSC), HDMI (rev 1.3 & 1.4),[88] raw LCD Panels via DSI[89][90] 14 HDMI resolutions from 640×350 to 1920×1200 plus various PAL and NTSC standards.[91]	
Audio outputs:[7]	3.5 mm jack, HDMI, and, as of revision 2 boards, I²S audio[92] (also potentially for audio input)	
Onboard storage:[14]	SD / MMC / SDIO card slot (3.3 V card power support only)	
Onboard network:[7][14]	None	10/100 Mbit/s Ethernet (8P8C) USB adapter on the third port of the USB hub[73]
Low-level peripherals:	8 × GPIO,[93] UART, I²C bus, SPI bus with two chip selects, I²S audio[94] +3.3 V, +5 V, ground[85][95]	
Power ratings:	300 mA (1.5 W)[96]	700 mA (3.5 W)
Power source:[7]	5 V via MicroUSB or GPIO header	
Size:	85.60 mm × 56 mm (3.370 in × 2.205 in)[97]	
Weight:	45 g (1.6 oz)[98]	
Operating systems:	Arch Linux ARM,[2] Debian GNU/Linux, Gentoo, Fedora, FreeBSD, NetBSD, Plan 9, Inferno, Raspbian OS, RISC OS,[31] Slackware Linux[99]	

Notes

1. **Model A** and **Model B** are cultural references[100] to the original models of the British educational BBC Micro computer, developed by Acorn Computers, who originally developed the ARM processors (the architecture of the Raspberry Pi) and operating system RISC OS, which will also be able to be run on the Raspberry Pi (version 5.17).[31]
2. On the older beta model B boards, 128 MB was allocated by default to the GPU, leaving 128 MB for the CPU.[101] On the first 256 MB release model B (and Model A), three different splits were possible. The default split was 192 MB (CPU RAM), which should be sufficient for standalone 1080p video decoding, or for simple 3D, but probably not for both together. 224 MB was for Linux only, with just a 1080p framebuffer, and was likely to fail for any video or 3D. 128 MB was for heavy 3D, possibly also with video decoding (e.g. XBMC).[102] Comparatively the Nokia 701 uses 128 MB for the Broadcom VideoCore IV.[103] For the new model B with 512 MB RAM initially there were new standard memory split files released(arm256_start.elf, arm384_start.elf, arm496_start.elf) for 256 MB, 384 MB and 496 MB CPU RAM (and 256 MB, 128 MB and 16 MB video RAM). But a week or so later the RPF released a new version of start.elf that could read a new entry in config.txt (gpu_mem=xx) and could dynamically assign an amount of RAM (from 16 to 256 MB in 8 MB steps) to the GPU, so the older method of memory splits became obsolete, and a single start.elf worked the same for 256 and 512 MB Pis.[104]
3. Level 2 cache is 128 KB, used primarily by the GPU, not the CPU.
4. The ARM11 is based on version 6 of the ARM architecture (ARMv6k), which due to its age is no longer supported by several popular versions of Linux, including Ubuntu which dropped support for processors below ARMv7 in 2009.[105]
5. The Raspberry Pi also contains a 15-pin MIPI camera interface (CSI) connector, which is used with the Raspberry Pi Camera Addon.[106][107]
6. Support for raw LCD panels is available in hardware through the available DSI connector from the Mobile Industry Processor Interface (MIPI) Alliance.[89] Software support is being planned.
7. Supported digital video resolutions are: 640 × 350 EGA; 640 × 480 VGA; 800 × 600 SVGA; 1024 × 768 XGA; 1280×720 720p HDTV; 1280 × 768 WXGA Variant; 1280 × 800 WXGA Variant; 1280 × 1024 SXGA; 1366 × 768 WXGA Variant; 1400 × 1050 SXGA+; 1600 × 1200 UXGA; 1680 × 1050 WXGA+; 1920 × 1080 1080p HDTV; 1920 × 1200 WUXGA.[91] Also to be supported are the generation of 576i and 480i composite video signals for PAL-BGHID, PAL-M, PAL-N, NTSC and NTSC-J[108]

8. Size dimensions do not include overhanging components such as the USB and RCA connectors.
9. Newer versions of the firmware contain the option to choose between five overclock ("turbo") presets that when turned on try to get the most performance out of the SoC without impairing the lifetime of the Pi. This is done by monitoring the core temperature of the chip, and the CPU load, and dynamically adjusting clock speeds and the core voltage. When the demand is low on the CPU, or it is running too hot, the performance is throttled, but if the CPU has much to do, and the chip's temperature is acceptable, performance is temporarily increased, with clock speeds of up to 1 GHz, depending on the individual board, and on which of the turbo settings is used. The five settings are:
    1. None; 700 MHz ARM, 250 MHz core, 400 MHz SDRAM, 0 overvolt,
    2. Modest; 800 MHz ARM, 250 MHz core, 400 MHz SDRAM, 0 overvolt,
    3. Medium 900 MHz ARM, 250 MHz core, 450 MHz SDRAM, 2 overvolt,
    4. High; 950 MHz ARM, 250 MHz core, 450 MHz SDRAM, 6 overvolt,
    5. Turbo; 1000 MHz ARM, 500 MHz core, 600 MHz SDRAM, 6 overvolt[109][110]

In the highest (*turbo*) preset the SDRAM clock was originally 500 MHz, but this was later changed to 600 MHz because 500 MHz sometimes causes SD card corruption. Simultaneously in *high* mode the core clock speed was lowered from 450 to 250 MHz, and in *medium* mode from 333 to 250 MHz.

Accessories

The Foundation reported on its blog in May 2012 about a prototype camera module they had tested. The prototype used a 14 megapixel module, while the released version will be 5 megapixels.

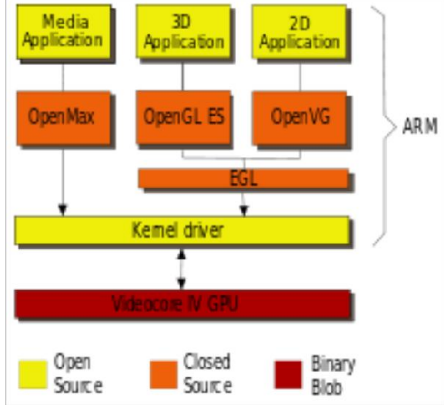
On 14 May 2013 the foundation and the distributors RS Components & Premier Farnell/Element 14 launched the Raspberry Pi camera board with a firmware update to support it.[111] The camera board is shipped with a flexible flat cable that plugs into the CSI connector located between the Ethernet and HDMI ports. In Raspbian support can be enabled by the installing or upgrading to the latest version of the OS and then running Raspi-config and selecting the camera option. The cost of the camera module is 20 EUR in Europe (9 September 2013).[112] and supports 1080p, 720p, 640x480p video. The footprint dimensions are
25 mm x 20 mm x 9 mm.[112]

A number of Raspberry Pi specific peripheral devices and cases are available from third-party suppliers.[113] These include the Raspberry Pi Foundation sanctioned Gertboard, which is designed for educational purposes, and expands the Raspberry Pi's GPIO pins to allow interface with and control of LEDs, switches, analog signals, sensors and other devices. It also includes an optional Arduino compatible controller to interface with the Pi.[114]

Software

Driver APIs

The Raspberry Pi primarily uses Linux kernel-based operating systems.



Scheme of the supported APIs: OpenMAX, OpenGL ES and OpenVG.

The VideoCore IV SIP block (i.e. the GPU) is supported through a binary blob, which is loaded into the GPU at boot time from the SD-card, and additional software, that initially was closed source.[115] This part of the driver code was later released,[116] however much of the actual driver work is done using the closed source GPU code. Application software uses calls to closed source run-time libraries (OpenMax, OpenGL ES or OpenVG) which in turn calls an open source driver inside the Linux kernel, which then calls the closed source Videocore IV GPU driver code. The API of the kernel driver is specific for these closed libraries. Video applications use OpenMAX, 3D applications use OpenGL ES and 2D applications use OpenVG which both in turn use EGL. OpenMAX and EGL use the open source kernel driver in turn.[117]

Raspbian

After cycling through several recommendations since just before the hardware was first made available, the Raspberry Pi Foundation created the *New Out Of Box System* (NOOBS) installer, and as of July 2013 suggests using it to install the Debian-derived Raspbian.[15] The Foundation intends to create an application store website for people to exchange programs.[118]

Raspbian is a Debian-based free operating system optimized for the Raspberry Pi hardware; using the LXDE desktop environment. It is the current recommended system, and was officially released in July 2012,[119] although it is still in development. It is free software and maintained independently of the Raspberry Pi Foundation.[120] It is based on ARM hard-float (armhf)-Debian 7 'Wheezy' architecture port, that was designed for a newer ARMv7 processor (or one with Jazelle RCT/ThumbEE, VFPv3 and NEON SIMD extensions built-in) whose binaries would not work on the Rapberry Pi, but Raspian is compiled for the ARMv6 instruction set of the Raspberry Pi making it work but with slower performance. It provides some available deb software packages, pre-compiled software bundles.[120] A minimum size of 2 GB SD card is required for Raspbian, but a 4 GB SD card or above is recommended. The downloaded Raspbian Wheezy image file has to be unzipped and then written to a suitable SD card, formatting it for use.[15]

History

On 19 February 2012, the Raspberry Pi Foundation released its first proof of concept SD card

image that could be loaded onto an SD card to produce a preliminary operating system. The image was based on Debian 6.0 (Squeeze), with the LXDE desktop and the Midori browser, plus various programming tools. The image also runs on QEMU allowing the Raspberry Pi to be emulated on various other platforms.[121][122]

On 8 March 2012 The Raspberry Pi Foundation released Raspberry Pi Fedora Remix, at the time its recommended Linux distribution,[123] which was developed at Seneca College in Canada.[124]

The Debian port was initiated by Mike Thompson, former CTO of Atomz, in March 2012, a week after the Raspberry Pi's launch. The effort was largely carried out by Thompson and Peter Green, a volunteer Debian developer, with some support from the Raspberry Pi Foundation, who tested the resulting binaries that the two produced during the early stages (neither Thompson nor Green had physical access to the hardware, as boards were not widely accessible at the time due to demand.)[125] While the preliminary proof of concept image distributed by the Foundation before launch was also Debian-based, it differed from Thompson and Green's Raspbian effort in a couple of ways.

The POC image was based on then-stable Debian Squeeze, while Raspbian aimed to track then-upcoming Debian Wheezy packages.[122][126] Aside from the updated packages that would come with the new release, Wheezy was also set to introduce the armhf architecture,[127] which became the *raison d'être* for the Raspbian effort.

The Squeeze-based POC image was limited to the armel architecture,[126] which was, at the time of Squeeze's release, the latest attempt by the Debian project to support the newest ARM EABI.[128] The armhf architecture in Wheezy intended to support the ARM VFP hardware floating-point unit, while armel was limited to emulating floating point operations in software.[126][129][130] Since the Raspberry Pi included a VFP, being able to make use of the hardware unit would result in performance gains and reduced power usage for floating point operations.[125] The armhf effort in mainline Debian, however, was orthogonal to the work surrounding the Pi and only intended to support ARMv7 at a minimum, which would mean the Pi, an ARMv6k device, would not benefit.[127] As a result, Thompson and Green set out to build the 19,000 Debian packages for the device using a custom build cluster.[125]

On 3 June 2013 the Raspberry Pi foundation introduced a new tool called *New Out Of Box Software* or NOOBS which makes the Raspberry Pi easier to use by simplifying the installation of an operating system. Instead of using specific software to prepare an SD card, a file is unzipped and the contents copied over to a FAT formatted (4 GB or bigger) SD card. That card can then be booted on the Raspberry Pi and a choice of six operating systems is presented for installation on the card. The system also contains a recovery partition that allows for the quick restoration of the installed OS, tools to modify the config.txt and an online help button and web browser which directs to the Raspberry Pi Forums.[131]

The operating systems the NOOBS installer is tailored for are:

- Archlinux ARM
- OpenELEC
- Pidora (Fedora Remix)
- Raspbmc
- Raspbian (recommended)
- RISC OS

Third-party system software

A server computer systems oriented edition of Raspbian, the *Raspbian Server Edition (RSEv2.4)*,[132] is a stripped version of Raspbian with other software packages bundled as compared to the usual desktop computer oriented Raspbian.[133]

Slackware ARM (formally ARMedslack) version 13.37 and later runs on the Raspberry Pi without modification.[134][135][136][137] The 128–496 MB of available memory on the Raspberry Pi is at least twice the minimum requirement of 64 MB needed to run Slackware Linux on an ARM or i386 system.[138] (Whereas the majority of Linux systems boot into a graphical user interface, Slackware's default user environment is the textual shell / command line interface.[139]) The Fluxbox window manager running under the X Window System requires an additional 48 MB of RAM.[140]

In addition, work is being done on system-specific light Linux distributions such as IPFire,[141] OpenELEC,[142] Raspbmc[143] and the XBMC open source digital media center.[144] Many of these ports are available on NOOBS.

Trustee Eben Upton publicly approached the RISC OS Open community in July 2011 to enquire about assistance with a port.[145] Adrian Lees at Broadcom has since worked on the port,[146][147] with his work being cited in a discussion regarding the graphics drivers.[148] This port is now included in NOOBS.

On 24 October 2012 the Raspberry Pi Foundation announced that "all of the VideoCore driver code which runs on the ARM" had been released as free software under a BSD-style license, making it "the first ARM-based multimedia SoC with fully-functional, vendor-provided (as opposed to partial, reverse engineered) fully open-source drivers", although this claim has not been universally accepted.[116] On February 28, 2014, they also announced the release of full documentation for the VideoCore IV graphics core, and a complete source release of the graphics stack under a 3-clause BSD license[70][71]

On 25 May 2013 the Raspberry Pi foundation pre-announced that (initially) for Raspbian they would switch from using the X Window System to the Wayland display server protocol. This would enable the efficient use of the GPU for hardware accelerated GUI drawing functions.[149] on April, 16th 2014 a GUI shell for Weston called Maynard (software) was released.

Third party application software

On 11 February 2013, a version of *Minecraft* was released for the Raspberry Pi. Users can go in the game's code to modify things.[150] On 21 November 2013, Raspbian included a full installation of proprietary Mathematica, for free.[151][152]

List of operating systems

This is a list of operating systems that have been, or are being, ported to Raspberry Pi:

- **Full OS:**
  - AROS
  - ChibiOS/RT[153]
  - Haiku[154]
  - Linux
    - Android
      - Android 2.3 (Gingerbread)
      - Android 4.0 (Ice Cream Sandwich)
    - Arch Linux ARM
    - Debian ARM architecture ports, but not the Debian ARMhf architecture ports (introduced with Debian 7 Wheezy), since these are compiled for ARMv7 and the Raspberry Pi CPU is ARMv6
      - Raspbian[155] (Debian 7 Wheezy ARMhf backported for ARMv6)
        - XBian
    - Firefox OS
    - Puppy Linux[156]
    - Gentoo Linux[157]
    - Google Chromium OS
    - openSUSE[158]
    - PiBang Linux[159]
    - Raspberry Pi Fedora Remix
    - Slackware ARM (formerly ARMedslack)
    - QtonPi, a cross-platform application framework based Linux distribution based on the Qt framework
    - WebOS
      - Open webOS[160]

- Plan 9 from Bell Labs[161][162]
- Inferno[163]
- RISC OS
- Unix
  - FreeBSD[164]
  - NetBSD[165][166]
- Windows CE[167]

- **Multi-purpose light distributions:**
  - Moebius operating system, a light ARM HF distribution based on Debian. It uses Raspbian repository, but it fits in a 1 GB SD card. It has just minimal services and its memory usage is optimized to keep a small footprint.
  - Minibian, another light ARM HF distribution based on Raspbian repository.
  - OpenWrt "Attitude Adjustment" 12.09
  - Squeezed Arm Puppy, a version of Puppy Linux (Puppi) for the ARMv6 (sap6) specifically for the Raspberry Pi.[168]
  - Kali Linux

- **Single-purpose light distributions:**
  - IPFire
  - OpenELEC
  - Raspbmc
  - RasPlex
  - Raspberry Digital signage, an operating system for digital signage purposes (web and media views)
  - Ark OS, website and email self-hosting

Reception and use

Technology writer Glyn Moody described the project in May 2011 as a "potential BBC Micro 2.0", not by replacing PC compatible machines but by supplementing them.[169] In March 2012 Stephen Pritchard echoed the BBC Micro successor sentiment in *ITPRO*.[170] Alex Hope, co-author of the Next Gen report, is hopeful that the computer will engage children with the excitement of programming.[171] Co-author Ian Livingstone suggested that the BBC could be involved in building support for the device, possibly branding it as the BBC Nano.[118] Chris Williams, writing in The Register sees the inclusion of programming languages such as Kids Ruby, Scratch and BASIC as a "good start" to equip kids with the skills needed in the future –

although it remains to be seen how effective their use will be.[100] The Centre for Computing History strongly supports the Raspberry Pi project, feeling that it could "usher in a new era".[42] Before release, the board was showcased by ARM's CEO Warren East at an event in Cambridge outlining Google's ideas to improve UK science and technology education.[172]

Harry Fairhead, however, suggests that more emphasis should be put on improving the educational software available on existing hardware, using tools such as Google App Inventor to return programming to schools, rather than adding new hardware choices.[173] Simon Rockman, writing in a ZDNet blog, was of the opinion that teens will have "better things to do", despite what happened in the 1980s.[174]

In October 2012 the Raspberry Pi won T3's Innovation of the Year award,[175] and futurist Mark Pesce cited a (borrowed) Raspberry Pi as the inspiration for his ambient device project MooresCloud.[176] In October 2012 the BCS reacted to the announcement of enhanced specifications by stating, "it's definitely something we'll want to sink our teeth into."[177]

Community

The Raspberry Pi community was described by Jamie Ayre of FLOSS software company AdaCore as one of the most exciting parts of the project.[56] Community blogger Russell Davis said that the community strength allows the Foundation to concentrate on documentation and teaching.[56] The community is developing fanzines around the platform, such as *The MagPi*.[178] A series of community *Raspberry Jam* events have been held across the UK[179] and further afield,[180] led by Alan O'Donohoe,[179][181][182] principal teacher of ICT at Our Lady's High School, Preston,[182][183] and a teacher-led community from RaspberryJam has started building a crowdsourced scheme of work.[184]

Use in education

As of January 2012, enquiries about the board in the United Kingdom have been received from schools in both the state and private sectors, with around five times as much interest from the latter. It is hoped that businesses will sponsor purchases for less advantaged schools.[22] The CEO of Premier Farnell said that the government of a country in the Middle East has expressed interest in providing a board to every schoolgirl, in order to enhance her employment prospects.[185][186]

The Raspberry Pi Foundation and Oxford, Cambridge and RSA Examinations launched a beta of the Cambridge GCSE Computing Online course or MOOC (Massive Open Online Course) based around the current GCSE Computing syllabus. The MOOC will consist of videos, animations and interactive tasks on every part of the curriculum presented by UK teachers. The beta is currently presented by Clive Beale who is the Head of Educational Development. All tasks will be supported by written materials & audio and text transcripts available for disabled students. The first MOOC will be linked to a formal GCSE qualification.[187]

Oxford, Cambridge and RSA Examinations also provide resources to use with a Raspberry Pi for teachers who would like to use the device in their lessons including Getting started, Singing Jelly Baby and other features about the Raspberry Pi.[188]

See also

- List of single-board computers
- BBC Micro

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External links

- Raspberry Pi Foundation official website and forums (http://www.raspberrypi.org)
- Raspberry Pi Wiki, supported by the RPF (http://elinux.org/RaspberryPiBoard)
- Raspberry Pi unofficial Q&A site on StackExchange (http://raspberrypi.stackexchange.com)
- Raspberry Pi Resources at the IET (http://mycommunity.theiet.org/communities/home/368)
- *Raspberry Pi gpio pinout* (http://www.panu.it/raspberry/)
- *Raspberry Pi component map* (http://raspmap.everpi.net)