Raspberry Pi

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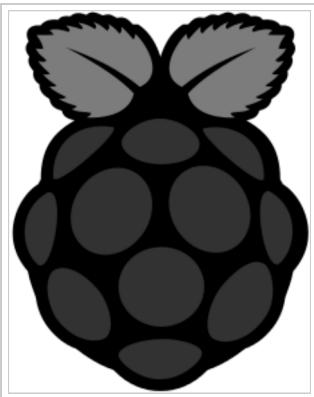
The **Raspberry Pi** is a series of credit card–sized single-board computers developed in England, United Kingdom by the Raspberry Pi Foundation with the intent to promote the teaching of basic computer science in schools and developing countries.[6][7][8] The original Raspberry Pi and Raspberry Pi 2 are manufactured in several board configurations through licensed manufacturing agreements with Newark element14 (Premier Farnell), RS Components and Egoman.[9] The hardware is the same across all manufacturers.



Raspberry Pi logo

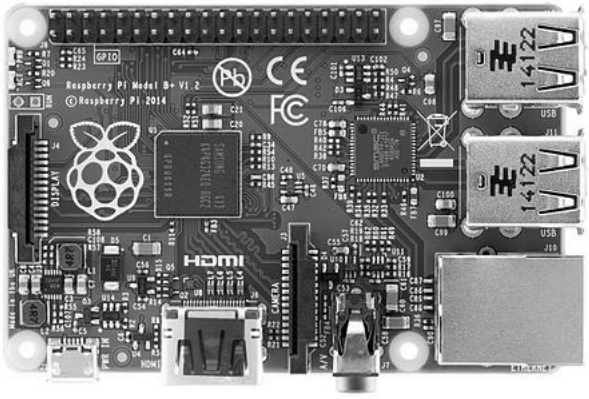
In February 2016, the Raspberry Pi Foundation announced that they had sold eight million devices, making it the best selling UK personal computer, ahead of the Amstrad PCW.[10][11]

All Raspberry Pis include the same VideoCore IV graphics processing unit (GPU),[12] and either a single-core ARMv6-compatible CPU or a newer ARMv7-compatible quad-core one (in Pi 2); and 1 GB of RAM (in Pi 2), 512 MB (in Pi 1 models B and B+),[3][13] or 256 MB (in models A and A+, and in the older model B). They have a Secure Digital (SDHC) slot (models A and B) or a MicroSDHC one (models A+, B+, and Pi 2) for boot media and persistent storage.[14] In 2014, the Raspberry Pi Foundation launched the *Compute Module*, for use as a part of embedded systems for the same compute power as the original Pi.[15] In early February 2015, the next-generation Raspberry Pi, Raspberry Pi 2, was released.[16] That new computer board is initially available only in one configuration (model B) and has a quad-core ARM Cortex-A7 CPU and 1 GB of RAM with remaining specifications being similar to those of the prior generation model B+. The Raspberry Pi 2 retains the same US$35 price of the model B,[17] with the US$20 model A+ remaining on sale. In November 2015, the Foundation launched the Raspberry Pi Zero, a smaller product priced at US$5.[18] Raspberry Pi 3 was released on 29 February 2016.[19]

The Foundation provides Debian and Arch Linux ARM distributions for download,[20] and promotes Python as the main programming language, with support for BBC BASIC[21] (via the RISC OS image or the Brandy Basic clone for Linux),[22] C, C++, Java,[23] Perl, Ruby,[24] Squeak Smalltalk and more also available.

On 29 February 2016, Raspberry Pi 3 is now on sale for US$35 (the same price as the existing Raspberry Pi 2). Pi 3

Raspberry Pi 1



Raspberry Pi 1 model B+

Release date	February 2012
Introductory price	US$25 (model A, B+[1]), US$20 (model A+), US$35 (RPi 1 model B, RPi 2 model B, RPi 3), US$30 (CM)
Operating system	Linux (e.g. Raspbian), RISC OS, FreeBSD, NetBSD, Plan 9, Inferno, AROS
CPU	700 MHz single-core ARM1176JZF-S (model A, A+, B, B+, CM)[2]
Memory	256 MB[3] (model A, A+, B rev 1) 512 MB (model B rev 2, B+, CM)
Storage	SDHC slot (model A and B), MicroSDHC slot (model A+ and B+), 4 GB eMMC IC chip (model

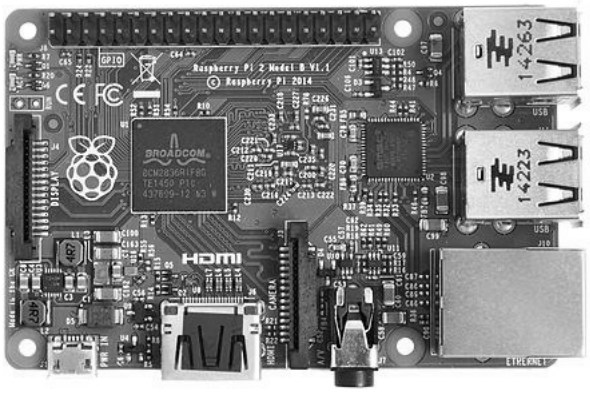
adds the following new features: A 1.2 GHz quad-core ARM Cortex-A53 CPU (~10× the performance of Raspberry Pi 1 and compared with Pi 2 which is ~6× performance of Raspberry Pi 1) based on ARM's latest ARMv8-A architecture (which is compatible with older, and at first not used to its full potential); has integrated 802.11n wireless LAN and Bluetooth 4.1. Complete compatibility with Raspberry Pi 1 and 2.

Raspberry Pi 3 has a new BCM2837 SoC retaining compatibility with the GPU, CPU and connectors of its predecessors BCM2835 (Pi 1) and BCM2836 (Pi 2), so all those projects and tutorials for Pi 1 and Pi 2 hardware should continue to work. The 900 MHz 32-bit quad-core ARM Cortex-A7 CPU complex has been replaced by a 1.2 GHz 64-bit quad-core ARM Cortex-A53. Combining a 33% increase in clock speed with various architectural enhancements, this provides a 50–60% increase in performance in 32-bit mode versus Raspberry Pi 2, or roughly a factor of ten over the original Pi 1.

Contents

	CM)
Graphics	Broadcom VideoCore IV[2]
Power	1.5 W (model A), 1.0 W (model A+), 3.5 W (model B), 3.0 W (model B+) or 0.8 W (model Zero)

Raspberry Pi 2

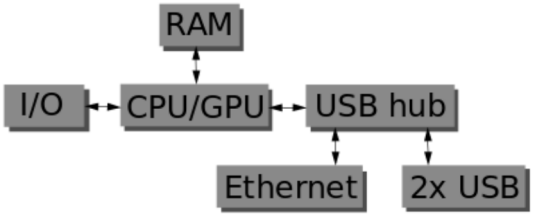


Raspberry Pi 2 model B

Release date	February 2015
Introductory price	US$35
Operating system	Same as for Raspberry Pi 1 plus Windows 10 IoT Core[4] and additional distributions of Linux such as Ubuntu
CPU	900 MHz quad-core ARM Cortex-A7
Memory	1 GB RAM
Storage	MicroSDHC slot
Graphics	Broadcom VideoCore IV
Power	4.0 W

Hardware

The Raspberry Pi hardware has evolved through several versions that feature variations in memory capacity and peripheral-device support.

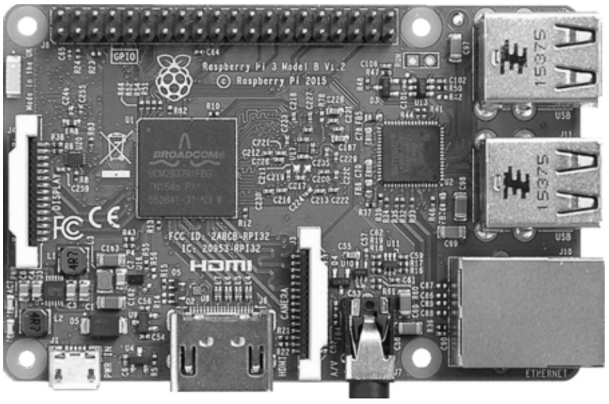


This block diagram depicts models *A*, *B*, *A*+, and *B*+. Model *A* and *A*+ and *Zero* lack the Ethernet and USB hub components. The Ethernet adapter is connected to an additional USB port. In model *A* and *A*+ the USB port is connected directly to the SoC. On model *B*+ and later models the USB/Ethernet chip contains a five-point USB hub, of which four ports are available, while model *B* only provides two. On the model *Zero*, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

Processor

The system on a chip (SoC) used in the first generation Raspberry Pi is somewhat equivalent to the chip used in older smartphones (such as iPhone, 3G, 3GS). The Raspberry Pi is based on the Broadcom BCM2835 SoC,[2] which includes an 700 MHz ARM1176JZF-S processor, VideoCore IV graphics processing unit (GPU),[12] and RAM. It has a Level 1 cache of 16 KB and a Level 2 cache of 128 KB. The Level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its

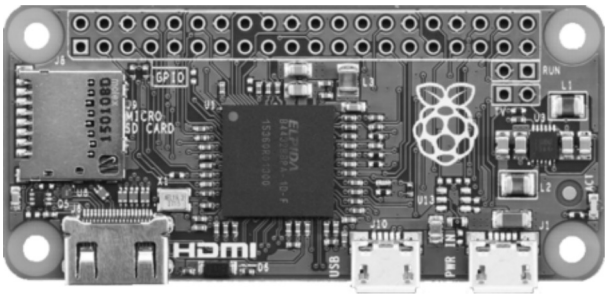
Raspberry Pi 3



Raspberry Pi 3 model B

Release date	29 February 2016
Introductory price	US$35
Operating system	Same as for Raspberry Pi 1 plus Windows 10 IoT Core[4] and additional distributions of Linux such as Ubuntu
CPU	1200 MHz quad-core ARM Cortex-A53
Memory	1 GB RAM
Storage	MicroSDHC slot
Graphics	Broadcom VideoCore IV at higher clock frequencies than previous that run at 250 MHz
Power	4.0 W

Raspberry Pi Zero



Raspberry Pi Zero

Release date	November 2015
Introductory price	US$5

edge is visible.

The Raspberry Pi 2 uses a Broadcom BCM2836 SoC with a 900 MHz 32-bit quad-core ARM Cortex-A7 processor, with 256 KB shared L2 cache.

The Raspberry Pi 3 uses a Broadcom BCM2837 SoC with a 1.2 GHz 64-bit quad-core ARM Cortex-A53 processor, with 512 KB shared L2 cache.[19]

Operating system	Linux (Raspbian[5]) or the same as for Raspberry Pi 1
CPU	1000 MHz single-core ARM1176JZF-S
Memory	512 MB RAM
Storage	MicroSDHC slot
Power	0.8 W

Performance of first generation models

While operating at 700 MHz by default, the first generation Raspberry Pi provided a real-world performance roughly equivalent to 0.041 GFLOPS.[25][26] On the CPU level the performance is similar to a 300 MHz Pentium II of 1997–99. The GPU provides 1 Gpixel/s or 1.5 Gtexel/s of graphics processing or 24 GFLOPS of general purpose computing performance. The graphics capabilities of the Raspberry Pi are roughly equivalent to the level of performance of the Xbox of 2001.

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 Model-B board.[27] A cluster of 64 Raspberry Pi Model-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.[27]

Raspberry Pi 2 is based on Broadcom BCM2836 SoC, which includes a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM. It is described as 4–6 times more powerful than its predecessor. The GPU is identical to the original.

Overclocking

The first generation Raspberry Pi chip operated at 700 MHz by default, and did not become hot enough to need a heat sink or special cooling unless the chip was overclocked. The second generation runs at 900 MHz by default; it also does not become hot enough to need a heatsink or special cooling, although overclocking may heat up the SoC more than usual.

Most Raspberry Pi chips could be overclocked to 800 MHz and some even higher to 1000 MHz. There are reports the second generation can be similarly overclocked, in extreme cases, even to 1500 MHz (discarding all safety features and over voltage limitations). In the Raspbian Linux distro the overclocking options on boot can be done by a software command running "sudo raspi-config" without voiding the warranty.[28] In those cases the Pi automatically shuts the overclocking down in case the chip reaches 85 °C (185 °F), but it is possible to overrule automatic over voltage and overclocking settings (voiding the warranty). In that case, an appropriately sized heatsink is needed to keep the chip from heating up far above 85 °C.

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 seven settings are: