

Raspberry Pi Description



What is the Raspberry Pi?

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and developing countries.

Several generations of Raspberry Pis have been released. The first generation (Raspberry Pi 1 Model B) was released in February 2012. It was followed by a simpler and inexpensive model Model A. In 2014 the foundation released a board with an improved design in Raspberry Pi 1 Model B+. The model laid the current "mainline" form-factor. Improved A+ and B+ models were released a year later. A cut down "compute" model was released in April 2014, and a Raspberry Pi Zero with smaller size and limited input/output (I/O), general-purpose input/output (GPIO), abilities released in November 2015 for US\$5. The Raspberry Pi 2 which added more RAM was released in February 2015. Raspberry Pi 3 Model B released in February 2016 is bundled with on-board WiFi and Bluetooth. As of 2016, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. These boards are priced between US \$20-35.

All models feature a Broadcom system on a chip (SoC), which includes an ARM compatible central processing unit (CPU) and an on chip graphics processing unit (GPU, a VideoCore IV). CPU speed ranges from 700 MHz to 1.2 GHz for the Pi 3 and on board memory range from 256 MB to 1 GB RAM. Secure Digital (SD) cards are used to store the operating system and program memory in either the SDHC or MicroSDHC sizes. Most boards have between one and four USB slots, HDMI and composite video output, and a 3.5 mm phone jack for audio. Lower level output is provided by a number of GPIO pins which support common protocols like I²C. The B-models have an 8P8C Ethernetport and the Pi 3 has on board Wi-Fi 802.11n and Bluetooth.

The Foundation provides Raspbian, a Debian-based Linux distribution for download, as well as third party Ubuntu, Windows 10 IOT Core, RISC OS, and specialised media center distributions. It promotes Python and Scratch as the main programming language, with support for many other languages. The default firmware is closed source, while an unofficial open source is available.

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, A+, and the Pi Zero lack the Ethernet and USB hub components. The Ethernet adapter is internally connected to an additional USB port. In Model A, A+, and the PI Zero, the USB port is connected directly to the system on a chip (SoC). On the Pi 1 Model B+ and later models the USB/Ethernet chip contains a five-point USB hub, of which four ports are available, while the Pi 1 Model B only provides two. On the Pi Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

Processor

The Broadcom BCM2835 SoC used in the first generation Raspberry Pi is somewhat equivalent to the chip used in first generation smartphones (its CPU is an older ARMv6architecture),^[11] which includes a 700 MHz ARM1176JZF-S processor, VideoCore IV graphics processing unit (GPU),^[12] and RAM. It has a level 1 (L1) cache of 16 KB and a level 2 (L2) cache of 128 KB. The level 2 cache is used primarily by the GPU. The SoC is stacked underneath the glued to RAM chip, so only its edge is visible.

The Raspberry Pi 2 uses a Broadcom BCM2836 SoC with a 900 MHz 32-bit quad-core ARM Cortex-A7 processor (as do many current smartphones), 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.

Performance

While operating at 700 MHz by default, the first-generation Raspberry Pi provided a real-world performance roughly equivalent to 0.041 GFLOPS. 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 graphical capability of the Raspberry Pi is roughly equivalent to the 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.^[17] 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\$4000.

Raspberry Pi 2 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. In parallelized benchmarks, the Raspberry Pi 2 could be up to 14 times faster than a Raspberry Pi 1 Model B+.

The Raspberry Pi 3, with a quad-core Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1. This was suggested to be highly dependent upon task threading and instruction set use. Benchmarks showed the Raspberry Pi 3 to be approximately 80% faster than the Raspberry Pi 2 in parallelized tasks.

RAM

On the older beta Model B boards, 128 MB was allocated by default to the GPU, leaving 128 MB for the CPU. On the first 256 MB release Model B (and Model A), three different splits were possible. The default split was 192 MB (RAM for CPU), 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 only 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). Comparatively the Nokia 701 uses 128 MB for the Broadcom VideoCore IV. 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 Raspberry Pis.

The Raspberry Pi 2 and the Raspberry Pi 3 have 1 GB of RAM. The Raspberry Pi Zero has 512 MB of RAM.

Networking

The Model A, A+ and Pi Zero have no Ethernet circuitry and are commonly connected to a network using an external user-supplied USB Ethernet or Wi-Fi adapter. On the Model B and B+ the Ethernet port is provided by a built-in USB Ethernet adapter using the SMSC LAN9514 chip.^[29] The Raspberry Pi 3 is equipped with 2.4 GHz WiFi 802.11n (150 Mbit/s) and Bluetooth 4.1 (24 Mbit/s) in addition to the 10/100 Ethernet port.

Peripherals

The Raspberry Pi may be operated with any generic USB computer keyboard and mouse.

Video

The video controller can emit standard modern TV resolutions, such as HD and Full HD, and higher or lower monitor resolutions and older standard CRT TV resolutions. As shipped (i.e., without custom overclocking) it can emit these: 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.

Higher resolutions, such as, up to 2048×1152, may work or even 3840×2160 at 15 Hz (too low a framerate for convincing video). Note also that allowing the highest resolutions does not imply that the GPU can decode video formats at those; in fact, the Pis are known to not work reliably for H.265 (at those high resolution, at least), commonly used for very high resolutions (most formats, commonly used, up to full HD, do work).

Although the Raspberry Pi 3 does not have H.265 decoding hardware, the CPU, more powerful than its predecessors, is potentially able to decode H.265-encoded videos in software. The Open Source Media Center (OSMC) project said in February 2016:

The new BCM2837 based on 64-bit ARMv8 architecture is backwards compatible with the Raspberry Pi 2 as well as the original. While the new CPU is 64-bit, the Pi retains the original VideoCore IV GPU which has a 32-bit design. It will be a few months before work is done to establish 64-bit pointer interfacing from the kernel and userland on the ARM to the 32-bit GPU. As such, for the time being, we will be offering a single Raspberry Pi image for Raspberry Pi 2 and the new Raspberry Pi 3. Only when 64-bit support is ready, and beneficial to OSMC users, will we offer a separate image. The new quad core CPU will bring smoother GUI performance. There have also been recent improvements to H265 decoding. While not hardware accelerated on

the Raspberry Pi, the new CPU will enable more H265 content to be played back on the Raspberry Pi than before.

The Pi 3's GPU has higher clock frequencies—300 MHz and 400 MHz for different parts—than previous versions' 250 MHz.

The Raspberry Pi can also generate 576i and 480i composite video signals, as used on old-style (CRT) TV screens through standard connectors—either RCA or 3.5mm phone connector depending on models. The television signal standards supported are PAL-BGHID, PAL-M, PAL-N, NTSC and NTSC-J.

Real-time clock

The Raspberry Pi does not have a built-in real-time clock, and does not "know" the time of day. As a workaround, a program running on the Raspberry Pi can get the time from a network time server or user input at boot time, thus knowing the time while powered on.

This concludes the presentation of the Raspberry Pi, and if even more details are required please visit:

https://en.wikipedia.org/wiki/Raspberry_Pi, which is also the source of the information from this document.