Topics covered

• A little about me
• Raspberry Pi 5
• Compute Module 4
• RP2040 Microcontroller
• Q & A
A little about me

- Part of Raspberry Pi’s commercial team
- Based in California
- Semiconductors, networking technologies
- Consumer and industrial electronics
- Ex-Broadcom, Nest, Google, eero and Thread Group
- Dog is called Fritz
# Raspberry Pi 5 Comparison

<table>
<thead>
<tr>
<th></th>
<th><strong>Raspberry Pi 4</strong></th>
<th><strong>Raspberry Pi 5</strong></th>
<th>2-3 × performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU</strong></td>
<td>Broadcom BCM2711, quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.8GHz</td>
<td>Broadcom BCM2712, quad-core Cortex-A76 (ARM v8), 64-bit SoC @ 2.4GHz</td>
<td></td>
</tr>
<tr>
<td><strong>RAM</strong></td>
<td>1GB, 2GB, 4GB, 8GB</td>
<td>1GB, 2GB, 4GB, 8GB</td>
<td>4GB and 8GB only at launch</td>
</tr>
<tr>
<td><strong>Connectivity</strong></td>
<td>2.4GHz and 5.0GHz 802.11ac wireless</td>
<td>2.4GHz and 5.0GHz 802.11ac wireless</td>
<td></td>
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<tr>
<td></td>
<td>Bluetooth 5.0, BLE</td>
<td>Bluetooth 5.0, BLE</td>
<td></td>
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<tr>
<td></td>
<td>Gigabit Ethernet</td>
<td>Gigabit Ethernet</td>
<td></td>
</tr>
<tr>
<td><strong>N/A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 × USB 3.0, 2 × USB 2.0 ports</strong></td>
<td></td>
<td><strong>1 × PCIe 2.0 interface</strong></td>
<td>High-speed peripheral interface (for SSDs etc)</td>
</tr>
<tr>
<td><strong>Standard 40-pin GPIO header</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 × micro HDMI ports (up to 4Kp60)</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>2-lane MIPI DSI, 2-lane MIPI CSI</strong></td>
<td></td>
<td><strong>2 × 4-lane MIPI (DSI/CSI)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4-pole stereo audio and composite video</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>OS and data storage</strong></td>
<td>microSD card slot</td>
<td><strong>microSD card slot with support for high-speed SDR104 mode</strong></td>
<td>2 × interface speed</td>
</tr>
<tr>
<td><strong>Input power</strong></td>
<td>5V/3A DC (via USB-C connector or GPIO)</td>
<td>5V/5A DC (PD-enabled)</td>
<td>New Raspberry Pi power supply for launch</td>
</tr>
<tr>
<td><strong>PoE</strong></td>
<td>Via separate PoE HAT</td>
<td>Via separate new PoE HAT</td>
<td>Fully PoE 802.3at compliant</td>
</tr>
<tr>
<td><strong>Real Time Clock (RTC)</strong></td>
<td>N/A</td>
<td><strong>RTC and RTC battery connector</strong></td>
<td></td>
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</tbody>
</table>
The anatomy of Raspberry Pi 5

- Model indicator
- BCM2712 processor
- PCI Express interface
- On/off button
- Power-management IC
- Heatsink mounts
- RTC battery connector
- UART connector
- Raspberry Pi RP1 I/O controller
- Fan connector
- Ethernet and USB connectors reversed (vs Raspberry Pi 4)
- PoE HAT connector
- 2 × 4-lane MIPI DSI/CSI connectors
Broadcom BCM2712

- Quad-core Arm Cortex-A76 @ 2.4GHz
  - ARMv8-A ISA
  - 64KByte I and D caches
  - 512KB L2 per core, 2MB shared L3
- New Raspberry Pi-developed ISP
- Improved HVS and display pipeline
  - Dual 4Kp60 support
- VideoCore VII V3D
  - ~2-2.5x faster
  - OpenGL ES 3.1, Vulkan 1.3
- 4Kp60 HEVC hardware decode
Raspberry Pi 5 is the first full-size Raspberry Pi computer to use silicon developed in-house at Raspberry Pi.

The RP1 “southbridge” provides the majority of the I/O capabilities for Raspberry Pi 5.

Pushing most system I/O onto a separate southbridge allows the main SoC to be simpler: Reducing cost, risk and timescales.
RP1 – I/O Controller

- 4-lane PCIe 2.0 endpoint
- Gigabit Ethernet MAC
  - Connection to external PHY using RGMII
- 2 × USB 3 host controllers
  - Each has 1 × USB 3 and 1 × USB 2 port
  - More than double the usable USB bandwidth vs Pi 4
- MIPI transceivers (4-lane, supporting DSI and CSI-2)
- Video DAC (3-channel, supporting PAL/NTSC and VGA)
  - Only one channel (composite) used on Pi 5
- Low-speed peripherals (SPI, UART, I2C, PWM, GPIO, I2S)
- Delta Sigma PWM audio out
- 12 × 12mm, 0.65mm-pitch BGA
  - Very optimised ballout
RP1 internal architecture

- TSMC 40LP
- Dual ARM M3 CPUs
- PIO block (Not available to host yet)
- 64KByte SRAM
- 8 channel DMA for slower peripherals
- 5 channel ADC (4 inputs + temp)
- High bandwidth AXI busses
Model indicator
BCM2712 processor
PCI Express interface
On/off button
Power-management IC
Heatsink mounts
RTC battery connector
UART connector
Raspberry Pi RP1 I/O controller
Fan connector
Ethernet and USB connectors reversed (vs Raspberry Pi 4)
PoE HAT connector
2 x 4-lane MIPI DSI/CSI connectors
Pre-applied thermal gap pads contact CPU, Wi-Fi, and PMIC.

Laser-etched logo

Active Cooler
Heatsink fins dissipate heat

30mm screw-mounted blower fan

Fan connects to header on Pi 5

2 × push pins

Active Cooler
Compute Module 4
Raspberry Pi Compute Module 4

- Raspberry Pi OS
  - Based on Debian Bookworm
  - Tools for programming and provisioning
- BCM2711, quad core Cortex-A72 64-bit SoC @ 1.5GHz
- Small Footprint 55mm × 40mm × 4.7mm module
  - 4 × M2.5 mounting holes
- Single +5V PSU input
- Options for 1GB, 2GB, 4GB or 8GB LPDDR4-3200 SDRAM with ECC
- Options for 0GB (CM4Lite), 8GB, 16GB, or 32GB eMMC flash memory
  - Peak eMMC bandwidth 100MByte/S
Raspberry Pi Compute Module 4

- Option for certified radio module with:
  - Dual-band 2.4 GHz, 5.0 GHz IEEE 802.11 b/g/n/ac wireless
  - Bluetooth 5.0, BLE
  - Electronic switch to select between PCB trace or external antenna

- Gigabit Ethernet PHY supporting IEEE 1588
- 1 × PCIe 1-lane Host, Gen 2 (5Gbps)
- 1 × USB 2.0 port (high speed)
- 28 × GPIO supporting either 1.8V or 3.3V signaling and peripheral options:
  - Up to 5 × UART
  - Up to 5 × I2C
  - Up to 5 × SPI
  - 1 × SDIO interface
  - 1 × DPI (parallel RGB display)
  - 1 × PCM
  - Up to 2× PWM channels
  - Up to 3× GPCLK outputs
Raspberry Pi Compute Module 4

- 2 × HDMI 2.0 ports (up to 4Kp60 supported)
- MIPI DSI:
  - 1 × 2-lane MIPI DSI display port
  - 1 × 4-lane MIPI DSI display port
- MIPI CSI-2:
  - 1 × 2-lane MIPI CSI camera port
  - 1 × 4-lane MIPI CSI camera port
- H.265 (HEVC) (up to 4Kp60 decode)
  - H.264 (up to 1080p60 decode, 1080p30 encode)
- OpenGL ES 3.0 graphics
RP2040 – Microcontroller

- Designed by Raspberry Pi’s in-house ASIC team
- Symmetric dual Arm Cortex-M0+ @ 133MHz
- 264kB on-chip SRAM in six independent banks
- Support for up to 16MB of off-chip flash memory via dedicated QSPI bus
- DMA controller
- Interpolator and integer divider peripherals
- On-chip programmable LDO to generate core voltage
- 2 on-chip PLLs to generate USB and core clocks
- 30 GPIO pins, 4 of which can be used as analogue inputs
- Peripherals:
  - 2 UARTs
  - 2 SPI controllers
  - 2 I2C controllers
  - 16 PWM channels
  - USB 1.1 controller and PHY, with host and device support
  - 8 PIO state machines
RP2040 – PIO

- Our Programmable I/O Accelerator
  - Designed in-house
- Two identical PIO blocks
  - Each has 4 state machines
- Designed for timing critical IO
  - WS2812B addressable LEDs
  - VGA/DVI-D
  - RMII
- General purpose IO
  - Parallel
  - I2S
  - SPI / QSPI / I2C / UART
  - On any GPIO pin!
- Lots of community PIO projects

Figure 38. PIO block-level diagram. There are two PIO blocks with four state machines each. The four state machines simultaneously execute programs from a shared instruction memory. FIFO data queues buffer data transferred between PIO and the system. GPIO mapping logic allows each state machine to observe and manipulate up to 30 GPIOs.
RP2040 – SDKs and software

- **C / C++ SDK**
  - Libraries and tools
  - Debugging via GDB / SWD
  - Example apps, including Wireless LAN and Bluetooth

- **Python SDK**
  - MicroPython environment

- **Built-in UF2 Bootloader**
  - “Drag and drop” programming of flash from your computer

- **Amazing opensource projects from the community**
  - Too many to list
Thank you!

Questions & Answers