

Ubiquitous Unix Units

Plummeting hardware costs means a full-blown Unix system can be had for as little as \$5.

This is part of my collection of tiny single-board Unix systems, including a \$5 Raspberry Pi and a Netgear router rescued from a Dumpster. Each runs some version of Linux in as little as 32 MB of memory and 8 MB of nonvolatile flash.

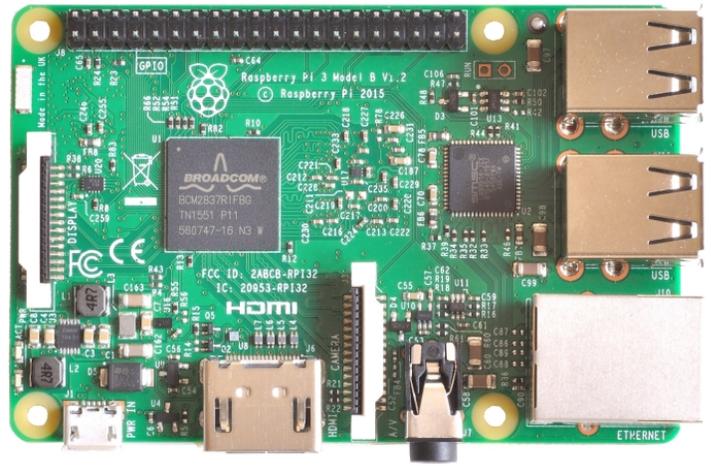
Each of these relies on an ARM- or MIPS-based System-on-Chip (SoC), which contains a processor, cache, memory, and a variety of peripherals such as Ethernet controllers, WiFi radios, and graphics accelerators.

While ARM has captured the lion's share of the embedded processor market (there is at least one in your cell phone), MIPS processors are still going strong in consumer wireless routers, such as the one you have at home.

All of these run Unix.

Raspberry Pi 3 Model B

\$25



Broadcom BCM2837

1.2 GHz ARM Cortex A53 (Quad Core)

1 GB LPDDR2-900

32 GB SD card

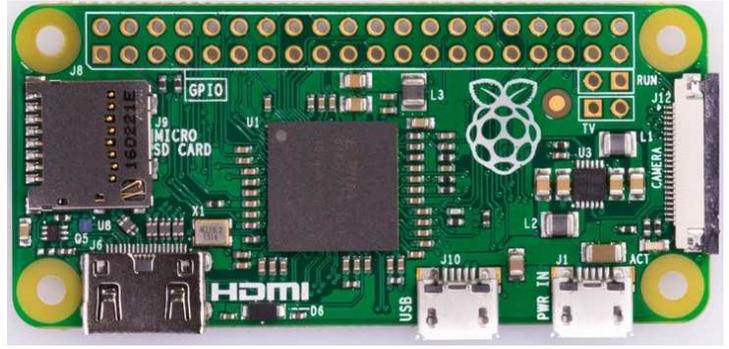
Raspbian, based on Debian Linux

The Raspberry Pi is the king of the hobbyist single board Unix machines. Based on Broadcom SoCs intended for smartphones, over 19 million Pi's have been sold since their debut in 2012 because they are inexpensive, powerful, and well-supported.

While all Pi's have included a graphics processor an HDMI video, newer models include WiFi and Bluetooth.

Raspberry Pi Zero v1.3

\$5



Broadcom BCM2835

1 GHz ARM1176

512 MB LPDDR2

8 GB SD card

Raspbian, based on Debian Linux

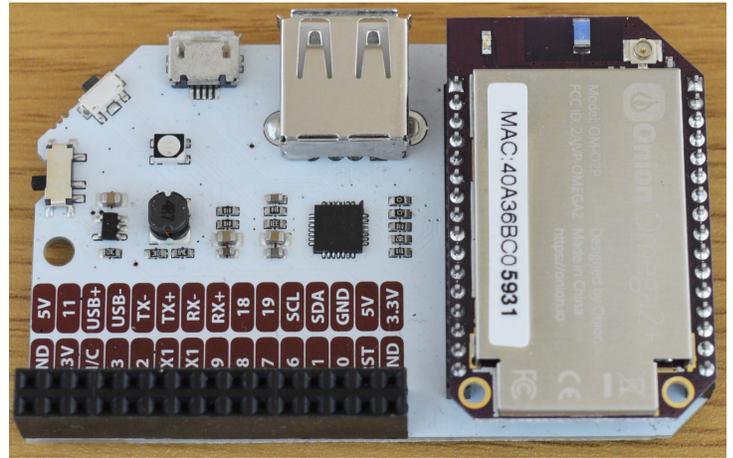
This is an extremely inexpensive, stripped-down version of the Raspberry Pi that is nevertheless able to run a full graphical Unix environment.

This earlier version (2015) does not have WiFi or Ethernet; later versions include WiFi.

The Raspberry Pi Zero was likely the first Unix computer to have been given away with a magazine (MagPi 40, December 2015)



Onion Omega2+ \$13



MediaTek MT7688
580 MHz 32-bit MIPS 24KEc
128 MB DDR2
32 MB Flash

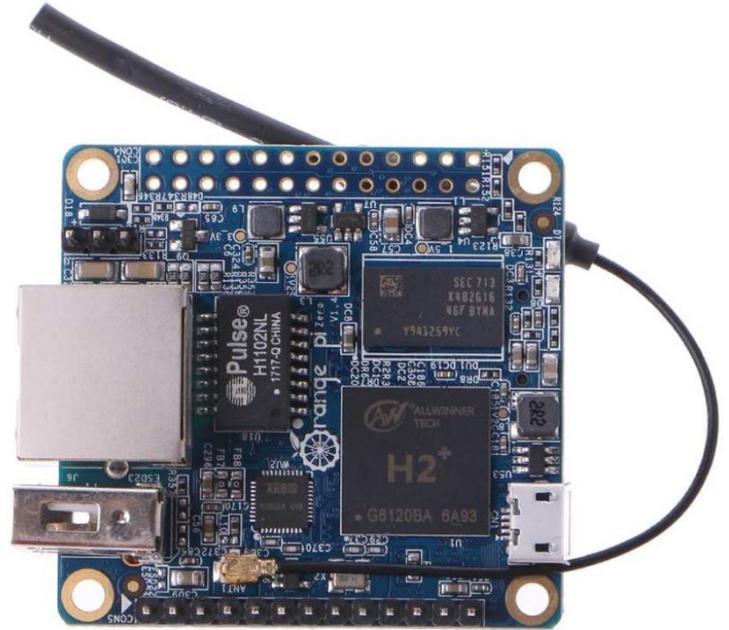
OpenWRT 18.06

Onion's Omega computing module is based on a MIPS-based SoC intended for consumer wireless routers. It includes WiFi, Ethernet, and USB, but no video output.

It runs Onion's variant of OpenWRT, a hobbyist Linux distribution designed for wireless routers with minimal RAM and flash.

Orange Pi Zero H2

\$15



Allwinner H2+

1.2 GHz ARM Cortex A7 (Quad Core)

256 MB DDR3

2 GB SD Card

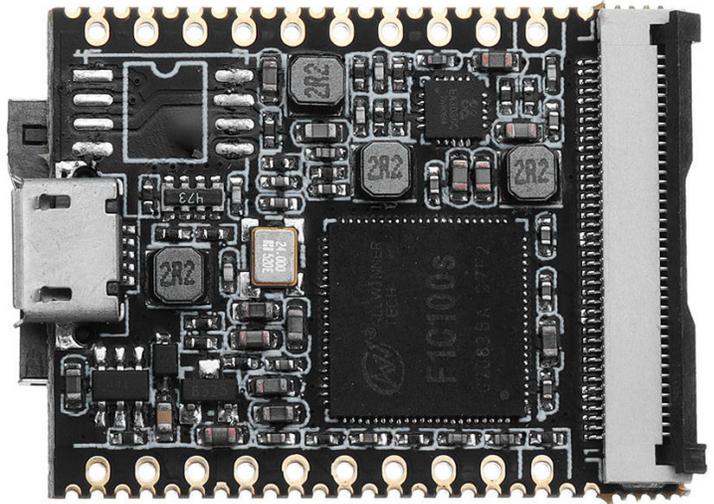
Debian Buster with Armbian

One of many Chinese Raspberry Pi knockoffs, the Orange Pi series ranges from this modest board to 6-core low-end desktop replacements. All are able to run Raspberry Pi operating systems as well as Android and others.

Armbian is a Debian Linux distribution tailored to ARM development boards

Lichee Pi Nano H2

\$9



Allwinner F1C100s
900 MHz ARM926-EJS
32 MB DDR
64 MB SD Card

OpenWRT 18.06

The Lichee Pi series is another Chinese Raspberry Pi knockoff. The Nano is the smallest single-board Unix computer in my collection, yet still supports USB, SD cards, and an LCD controller.

Nexx WT3020H Mini Router \$17



MediaTek MT7620N
580 MHz MIPS 24KEc
64 MB DDR
8 MB Flash

OpenWRT 18.06

This small, inexpensive consumer wireless router can nevertheless accommodate a reasonably powerful embedded Unix environment. Sporting one of the many MIPS-based SoCs designed for consumer wireless routers, the Nexx has Wifi, two Ethernet ports, and USB.

I replaced the stock firmware with an OpenWRT image designed for this router and added a connection to the serial debug console.

Netgear WNDR3400v1 WiFi Router



\$40

Broadcom BCM4718

480 MHz MIPS 74Kc

64 MB

8 MB Flash

OpenWRT 18.06

Representative of consumer wireless routers, this Netgear sports a Broadcom MIPS-based SoC, WiFi radios, a pair of Ethernet interfaces, and enough RAM and flash to run a small Unix.

I took this router from the trash and installed an OpenWRT image. While new firmware can be installed without opening the router, I added a connection to the serial debug console, which most router manufacturers leave onboard.