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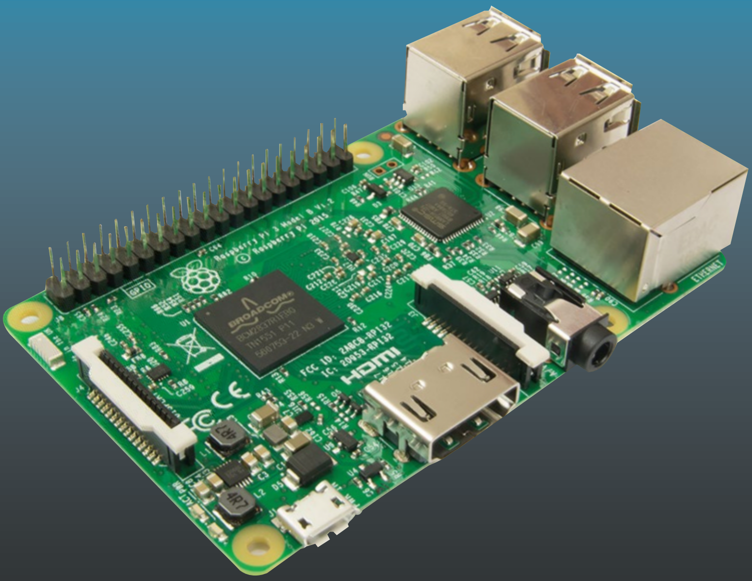

Expanding Your Raspberry Pi

Storage, printing, peripherals, and network connections for your Raspberry Pi

Mark Edward Soper

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Expanding Your Raspberry Pi: Storage, printing, peripherals, and network connections for your Raspberry Pi

Mark Edward Soper
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About the Author

Mark Edward Soper is an internationally published expert on technical topics ranging from CompTIA A+ Certification to Microsoft Windows and an instructor who has taught thousands of students in industry seminars and employee training about computer and device troubleshooting and repair, digital imaging, Microsoft Windows, and networking. Mark has seen the industry change from an emphasis on understanding hardware and what makes it work to the computer as appliance. He's excited to see that devices such as the Raspberry Pi are not only useful for teaching how computers work but also capable of being put to work in home and business environments. Mark thanks God for the opportunity to share technical knowledge around the world and for his family, who use technology at work and play.

About the Technical Reviewer

Massimo Nardone has more than 22 years of experience in Security, Web/Mobile development, Cloud, and IT Architecture. His true IT passions are Security and Android.

He has been programming and teaching how to program with Android, Perl, PHP, Java, VB, Python, C/C++, and MySQL for more than 20 years.

He holds a Master of Science degree in Computing Science from the University of Salerno, Italy.

He has worked as a Project Manager, Software Engineer, Research Engineer, Chief Security Architect, Information Security Manager, PCI/SCADA Auditor, and Senior Lead IT Security/Cloud/SCADA Architect for many years.

Technical skills include: Security, Android, Cloud, Java, MySQL, Drupal, Cobol, Perl, Web and Mobile development, MongoDB, D3, Joomla, Couchbase, C/C++, WebGL, Python, Pro Rails, Django CMS, Jekyll, Scratch, etc.

He currently works as Chief Information Security Officer (CISO) for Cargotec Oyj.

He worked as visiting lecturer and supervisor for exercises at the Networking Laboratory of the Helsinki University of Technology (Aalto University). He holds four international patents (PKI, SIP, SAML, and Proxy areas).

Massimo has reviewed more than 40 IT books for different publishing companies, and he is the coauthor of *Pro Android Games* (Apress, 2015).

This book is dedicated to Antti Jalonen and his family, who are always there when I need them.

CHAPTER 1

Raspberry Pi System Anatomy

Raspberry Pi is a family of low-cost single-board computers originally designed for computer and electronics education. The combination of low cost, flexibility, and widespread operating systems support has made the Raspberry Pi family one of the leading computer platforms for hobbyists as well as educators. IT professionals are also taking a closer look at the Raspberry Pi as a platform for the Internet of Things (IoT), thanks to the introduction of a Windows 10 edition that supports the Raspberry Pi 3.

In this chapter, we'll introduce you to the members of the family to help you find the best model for your needs.

Model Overview

Current models of the Raspberry Pi include the following:

- Pi 1 Model A+
- Pi 2 Model B
- Pi 3 Model B
- Pi Zero

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These are shown in Figure 1-1, along with the older Pi 1 Model B.

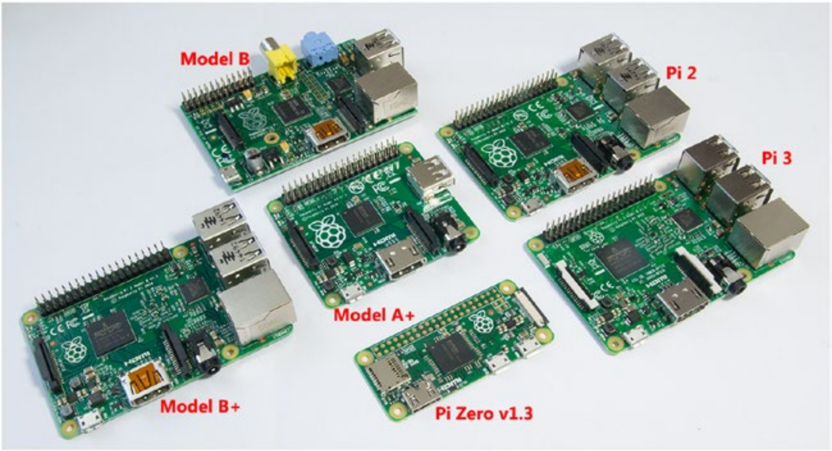

Figure 1-1. *Raspberry Pi Model B, Model B+, Model A+, Pi 2, Pi 3, and Pi Zero*

Common Features

All Pi models have these common features:

- ARM architecture
- Broadcom BCM28xx series SoC (System-on-a-Chip)
- At least one USB 2.0 port
- HDMI video output
- SD-family memory card slot
- GPIO (General-Purpose Input/Output) connector

Beyond these common features, there are plenty of differences to keep in mind as you work to select the best model for your needs.

■ **Note** GPIO pins have user-defined functions. The GPIO connector on Raspberry Pi includes pins for GPIO, power, ground, and other functions. See the pinouts in Chapter 9 for details.

Model A vs. Model B Boards

Raspberry Pi Model A boards have limited expandability, slower processors, and less RAM than comparable Model B boards. See the following sections for details.

Model A Family

Model A boards can be distinguished from later models by their lack of an Ethernet port and the inclusion of only one USB port. They use 32-bit single-core 700MHz processors.

Model A

The original Model A board (not shown) features a 26-pin GPIO bus, a single standard-size SD card slot, and both composite analog and HDMI digital video output.

Model A+

Model A boards have largely been replaced by Model A+ boards, which use the same 40-pin GPIO connector as Model B boards. The Model A+ board was the smallest Raspberry Pi board until the introduction of the Raspberry Pi Zero. The Model A+ board remains the smallest board to have a 40-pin GPIO connector, as the Pi Zero has open GPIO solder holes rather than a connector. Model A+ is pictured in Figures 1-2, 1-3, and 1-4.

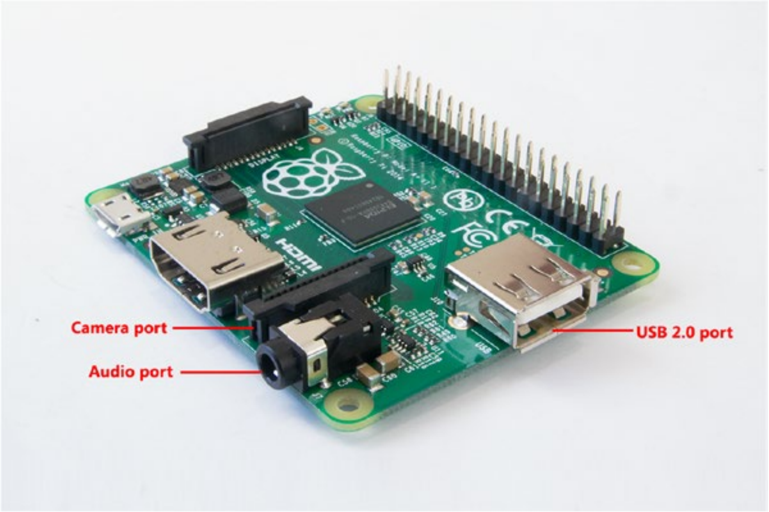

Figure 1-2. *Raspberry Pi Model A+'s camera port, audio port, and USB port*

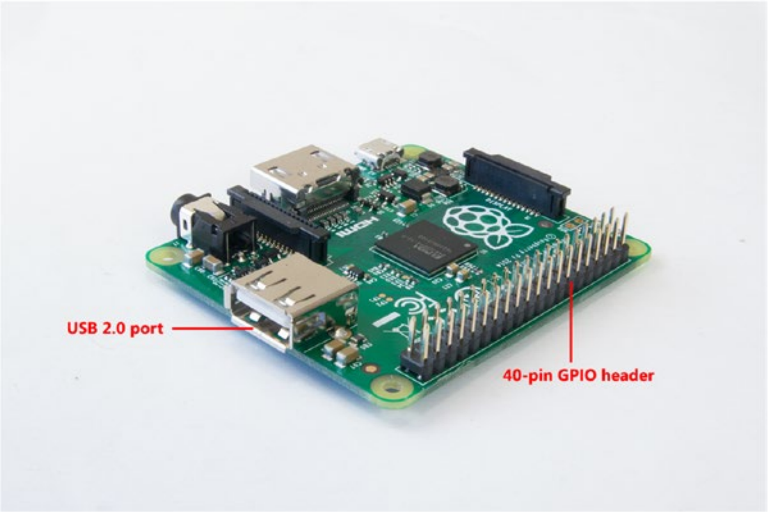
USB 2.0 port
40-pin GPIO header

Figure 1-3. *Raspberry Pi Model A+ USB port and 40-pin GPIO connector*

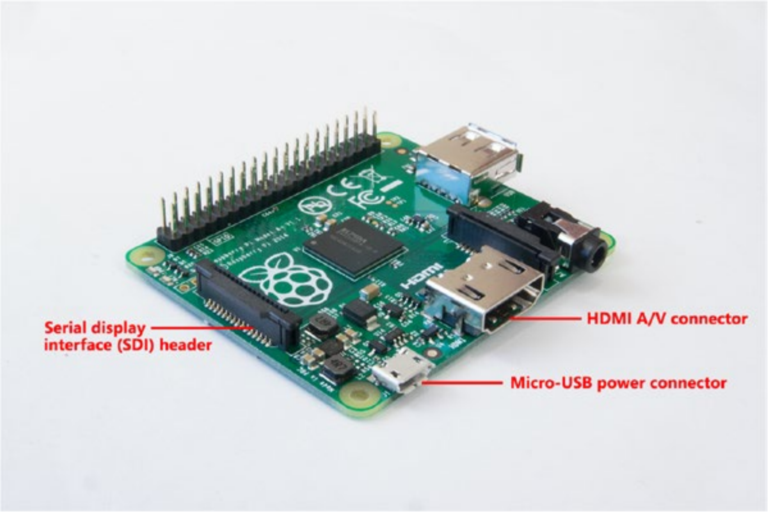
Serial display interface (SDI) header
HDMI A/V connector
Micro-USB power connector

Figure 1-4. *Raspberry Pi Model A+'s serial display interface (SDI), Micro-USB power connector, and HDMI video port. The microSD card slot is beneath the display connector.*

Model B Family

The Model B family includes more expandability than the Model A family because it features more USB ports and an Ethernet port. Model B boards represent three generations of Raspberry Pi:

- First generation (B, B+)
- Second generation (Pi 2)
- Third generation (Pi 3)

Model B (First Generation)

The original Model B board (see Figures 1-5 and 1-6) was the first Raspberry Pi board to include two USB 2.0 ports and a 10/100 Ethernet port. It also featured the same combination of HDMI A/V, audio, composite video ports, 26-pin GPIO connector, and full-size SD card slot as found on the Model A.

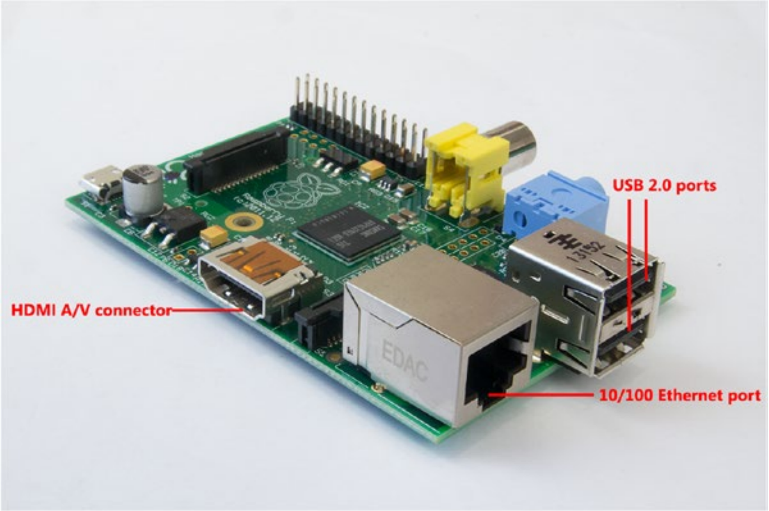

Figure 1-5. *Raspberry Pi Model B's HDMI port, Ethernet port, and dual USB 2.0 ports*

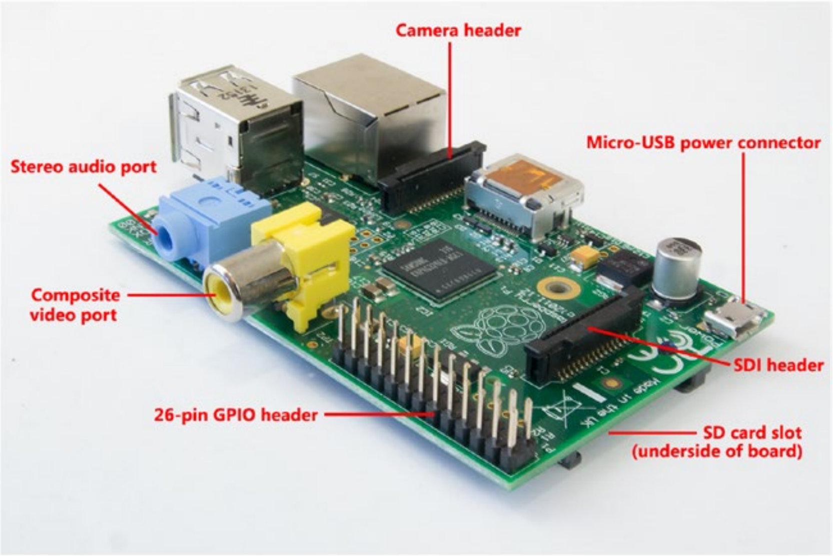
Camera header
Micro-USB power connector
Stereo audio port
Composite video port
SDI header
26-pin GPIO header
SD card slot (underside of board)

Figure 1-6. *Raspberry Pi Model B's stereo audio port, composite video port, 26-pin GPIO connector, serial display interface (SDI), and Micro-USB power connector. The SD card slot is beneath the display connector.*

Model B+, Pi 2, and Pi 3

Currently, Model B computers are available as improved first-generation (B+), second-generation (Pi 2), or third-generation (Pi 3) models. These boards feature

- 40-pin GPIO connector
- Four USB 2.0 ports
- 10/100 Ethernet port
- microSD card slot

B+ boards use the same single-core 700MHz ARM processor used by Model A and A+ boards.

The original Pi 2 uses a 900MHz quad-core 32-bit processor. Pi 2 v1.2 also includes a 900MHz quad-core processor, but one which also supports 64-bit operating systems.

From the top, Pi 3 looks almost identical to Pi 2 v1.1 and Pi 2 v1.2, but includes Pi's first 1.2GHz 64-bit processor. It's easier to distinguish these boards from each other from the bottom. Figures 1-7 and 1-8 illustrate the top and bottom views of these boards.

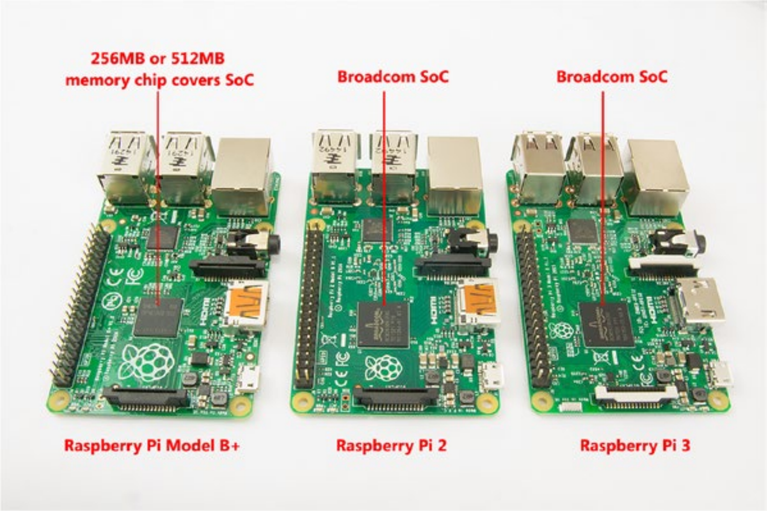
256MB or 512MB memory chip covers SoC
Broadcom SoC
Broadcom SoC
Raspberry Pi Model B+
Raspberry Pi 2
Raspberry Pi 3

Figure 1-7. *Top view of Raspberry Pi B+ (left), Pi 2 (center), and Pi 3 (right)*

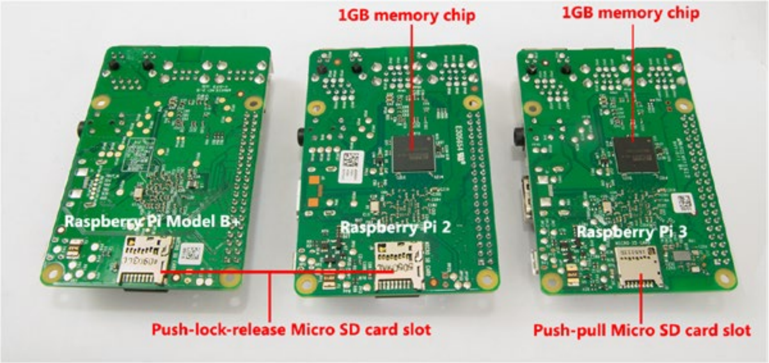
1GB memory chip
1GB memory chip
Raspberry Pi Model B+
Raspberry Pi 2
Raspberry Pi 3
Push-lock-release Micro SD card slot
Push-pull Micro SD card slot

Figure 1-8. *Bottom view of Raspberry Pi B+ (left), Pi 2 (center), and Pi 3 (right)*

Figures 1-9 and 1-10 provide a closer look at the Pi 3. The features called out in these figures are also present on Pi Model B+ and Pi 2.

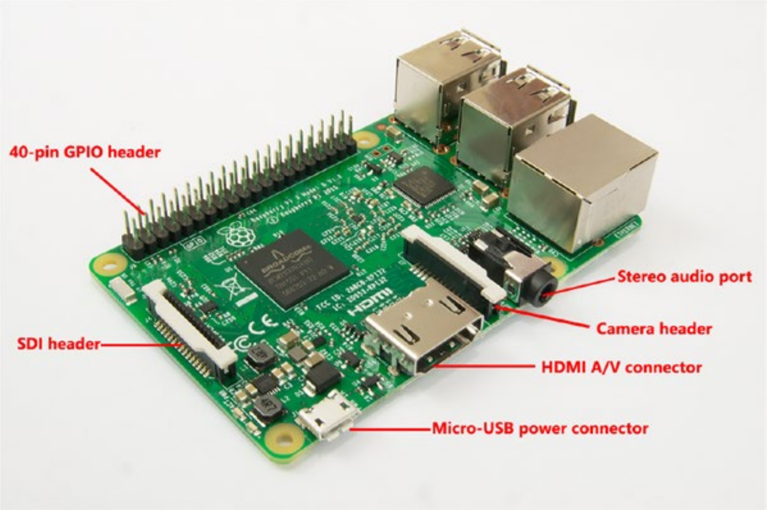
40-pin GPIO header
Stereo audio port
Camera header
SDI header
HDMI A/V connector
Micro-USB power connector

Figure 1-9. *Raspberry Pi 3's GPIO header, display header, Micro-USB power connector, HDMI audio/video port, camera header, and stereo audio port*

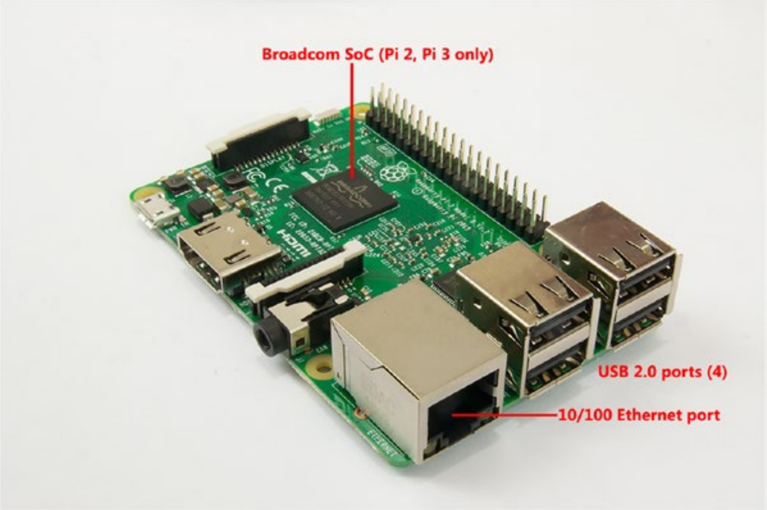
Broadcom SoC (Pi 2, Pi 3 only)
USB 2.0 ports (4)
10/100 Ethernet port

Figure 1-10. *Raspberry Pi 3's 10/100 Ethernet port and quartet of USB 2.0 ports*