Intel® Galileo Board

Getting Started Guide

16 October 2013

Order Number: 329685-004US

Getting Started Guide

This document explains how to connect your Intel® Galileo board to the computer, install the software on your computer, and upload your first sketch.

You should be able to do this in under an hour (not counting your download time).

Note: This release uses a special version of the Arduino IDE. The first thing you **must** do is download it from the Intel website below and update the SPI flash on the board.

The basic steps you will follow are:

See these sections for advanced tasks:

For more information about Intel® Galileo, including online communities and support, try these links:

http://www.intel.com/support/galileo

http://communities.intel.com/community/makers

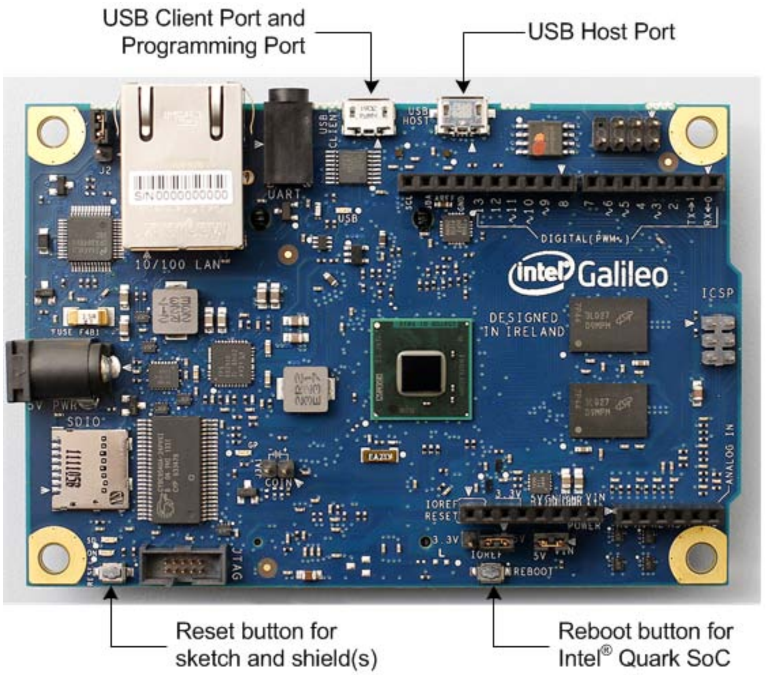
http://maker.intel.com

1. Get a board and cables

The kit contains:

- 1x Intel® Galileo Customer Reference Board (CRB) (Fab D with blue PCB)
- 1x 5v power supply with cable
  Warning: You must use a power supply or you will damage the board!
- 4x standoff separators
- 4x screws
- 1x USB Type A Male to Micro-B Male cable

Intel® Galileo Board


USB Client Port and Programming Port
USB Host Port
Reset button for sketch and shield(s)
Reboot button for Intel® Quark SoC

Note: The I/O headers are identical to the Arduino Revision 1.0 pinout.

2. Download the Arduino environment and board firmware

Download the latest IDE and firmware files here:
https://communities.intel.com/community/makers/software/drivers

You will need up to 200 MB of free space, depending on which OS you are using.

Note: When unzipping the packages:

- Extract the package into the `C:\` directory due to a known issue unzipping packages with long file paths.
- Use an unzip tool that supports an extended file path (for example, 7-zip from http://www.7-zip.org/).

This release contains multiple zip files, including:

- Operating system-specific IDE packages, contain automatic SPI flash update:
  - `Intel_Galileo_Arduino_SW_1.5.3_on_Linux32bit_v0.7.5.tgz` (72.2 MB)
  - `Intel_Galileo_Arduino_SW_1.5.3_on_Linux64bit_v0.7.5.tgz` (73.5 MB)
  - `Intel_Galileo_Arduino_SW_1.5.3_on_MacOSX_v0.7.5.zip` (54.3 MB)
  - `Intel_Galileo_Arduino_SW_1.5.3_on_Windows_v0.7.5.zip` (104 MB)
- (Mandatory for WiFi) Files for booting board from SD card. See Section 11.
  `LINUX_IMAGE_FOR_SD_Intel_Galileo_v0.7.5.7z` (36.7 MB)

- (Optional) Files for updating SPI flash manually. See Section 12 for details.
  `LITTLE_LINUX_IMAGE_FirmwareUpdate_Intel_Galileo_v0.7.5.7z` (5.5 MB)
  - `CapsuleApp.efi`
  - `sysimage_Intel_Galileo_v0.7.5.cap`
- (Optional) Board Support Package (BSP) sources:
  The BSP build process requires additional 30 GB of free disk space.
  - `Board_Support_Package_Sources_for_Intel_Quark_v0.7.5.7z` (3.2 MB)
- (Optional) Board Support Package (BSP) sources including Yocto archive:
  The BSP build process requires additional 30 GB of free disk space.
  `Board_Support_Package_Sources_for_Intel_Quark_v0.7.5+full_yocto_archive.tar.gz` (1.4 GB)

  If you are working with the BSP sources, see the *Intel® Quark SoC X1000 BSP Build Guide* [https://communities.intel.com/docs/DOC-21882]

Windows*:

1. Unzip the IDE file to the `C:\` directory.
2. Make sure to preserve the folder structure. Double-click the folder to open it.

   If you are updating your IDE, be sure to uninstall the previous IDE version first.

Linux*:

1. In your home directory, extract the package with the appropriate command:
   ```
   tar -zxvf arduino-1.5.3-linux32.tar.gz
   ```
   or
   ```
   tar -zxvf arduino-1.5.3-linux64.tar.gz
   ```
2. To avoid interference with the IDE, you **must** disable modem manager. The exact command will depend on your Linux distribution.
   For example, the command sudo `apt-get remove modemmanager` may work.
3. In the same directory where the package was downloaded, launch the Arduino IDE by executing `./arduino`

Note: The first time you compile and install a sketch, the Galileo software will be installed automatically. This requires appropriate file and directory access permissions. You may be required to run the IDE as root or using `sudo arduino` depending on your Linux distribution.

Mac OS*:

Caution: You must unzip the IDE on your Mac's normal hard disk. Once the IDE is unzipped, you cannot run it from or transfer it to USB drives or any other media formatted for use in Windows computers or it will be corrupted.

1. Download the zip file on the Mac hard drive and unzip it.
2. Drag and drop the Arduino application onto the Applications folder on your Mac.

3. Connect the board

WARNING: You must use the power supply or you will damage the board.
Connect the 5V power cable to the Galileo board and to a power outlet.

Note: **Always** connect the 5V power before any other connection.

The green power LED (labelled ON) will turn on.

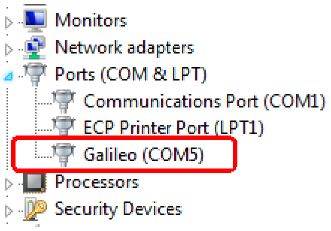
4. Install the drivers and other software

Windows:

1. If not done already, connect the 5V power cable to the Galileo board and to a power outlet.

Note: **Always** connect the 5V power before the USB connection.

2. Connect the USB cable to the USB Client Port (closest to the Ethernet) and to a PC. Wait for Windows to begin its driver installation process. After a few moments, the process will fail.
3. Click on the **Start** Menu, and open up the **Control Panel**. While in the Control Panel, navigate to **System**. Next, click on **System**. Once the System window is up, open the **Device Manager**.
4. Look under **Ports (COM & LPT)**. You should see an open port named **Gadget Serial V2.4**. If you **do not** see this open port, follow steps a-c in the ***Note*** below.
5. Right-click on the **Gadget Serial V2.4** port and choose the **Update Driver Software** option.
6. Choose the **Browse my computer for Driver software** option.
7. Navigate to the `hardware/arduino/x86/tools` directory. This allows the proper driver file `linux-cdc-acm.inf` to be installed.
8. Once the driver is successfully installed, Device Manager will show a **Galileo (COMx)** device under **Ports (COM & LPT)**. Note the *COMx* port number as it will be needed in the IDE later. The example below shows COM5.



Monitors
Network adapters
Ports (COM & LPT)
Communications Port (COM1)
ECP Printer Port (LPT1)
Galileo (COM5)
Processors
Security Devices

Note: You may find **Gadget Serial 2.4** under **Other devices** in Device Manager. If this is the case, do the following:

a. In Windows Explorer, go to `C:\Windows\System32\drivers` and look for `usbser.sys`. If it is present, you can skip these steps. If it is missing, copy `usbser.sys` **from** the archive location identified below:

   Windows 7:
   `C:\Windows\System32\DriverStore\FileRepository\mdmcpq.inf_amd64_neutral_fbc4a14a6a13d0c8\usbser.sys` (archive file)

   Windows 8:
   `C:\Windows\System32\DriverStore\FileRepository\mdmcpq.inf_amd64_d9e0b9c4fe044b4d\usbser.sys` (archive file)

b. In Windows Explorer, copy **to**: `C:\Windows\System32\drivers`
   You may need to provide Administrator Permission to complete the copy.

c. Once `usbser.sys` is copied, continue with step 5 above.

Linux:

1. If not done already, connect the 5V power cable to the board and to a power outlet. Wait for the board to boot.

Note: **Always** connect the 5V power before the USB connection.

2. Connect the USB cable to the USB Client Port (closest to the Ethernet) and to a PC.
3. Check that ACM port is available by typing in the terminal `ls /dev/ttyACM*`

Note: If the `/dev/ttyACM0` port is not present, follow the procedure below:

a. Create a file `etc/udev/rules.d/50-arduino.rules` and add the following: `KERNEL=="ttyACM[0-9]*", MODE="0666"`

b. Restart the udev with the following command: `sudo service udev restart` If you are using a virtual machine (VM), you may need to reboot Linux within the VM.

4. Launch the IDE.

   The first time you compile and install a sketch, the Galileo software will be installed automatically. This requires appropriate file and directory access permissions. You may be required to run the IDE as root or using `sudo arduino` depending on your Linux distribution.

5. Select your board via **Tools > Board > Intel® Galileo**
6. Select the port **Tools > Serial Port > /dev/ttyAMC0**

Note: If the serial `ttyACM0` is not available, make sure you have the proper rights to access the ports. If the serial port is disabled on your IDE, exit the IDE and execute again using the command: `sudo arduino`

Mac OS:

The Galileo board is supported by the Mac OS built-in USB drivers, however, the board has to boot for it to show up because the port is driven by software on the board.

1. If not done already, connect the 5V power cable to the board and to a power outlet. Wait for the board to boot.

Note: **Always** connect the 5V power before the USB connection.

2. Connect the USB cable to the USB Client Port (closest to the Ethernet) and to your Mac. Check the **System Profiler > USB** setting to be sure that **Gadget Serial** is selected. If you are installing a new version of the IDE, you may need to re-select this setting.
3. In the Arduino IDE, the correct serial port shows in the **Tools > Serial Port** menu as **/dev/cu.usbmodem*nnnnn*** where ***nnnnn*** is a number such as **fd121**.

   Do not select the **/dev/tty** port.

5. Launch the Arduino IDE application

Windows: In the folder `arduino-1.5.3`, double-click `arduino.exe`

Linux: In the folder `arduino-1.5.3`, launch Arduino by executing `./arduino`

Note: You may see an error stating Java is not present. If you are using Ubuntu, run the command sudo `apt-get install default-jre` to clear this error.

Mac OS: Double-click the Intel Galileo Install disk image. When the disk volume mounts, drag and drop the Arduino application on your Applications folder.

6. Update your board firmware

The IDE contains the release-specific firmware for your board. Follow the steps below to update your board firmware using the IDE.

1. Remove all power from the board (USB and 5 V power cord). This makes sure that no sketch is running on the board.
2. Remove the SD card from the board (if it is inserted).
3. Power up the board by plugging in the 5V power supply.
4. Connect the USB cable to the USB Client Port (closest to the Ethernet). Note which COM port it is connected on.
5. Launch the IDE and select the board via **Tools > Board > Intel® Galileo**
6. Select the correct serial port using **Tools > Serial Port**

Note: Do not download any sketch to the board before you upgrade the firmware.

7. Launch the software upgrade using **Help > Firmware Upgrade**
8. A message is displayed asking you to confirm that 5V power cable is plugged in. Click **Yes** if it is connected. If no cable is plugged in, exit the upgrade process by selecting **No**, connect the power, and restart this process.
9. The board can be upgraded to newer software or downgraded to older software. The next message displays the current software version that is on the board and the software version that you are trying to flash onto the board. Select **Yes** to either Upgrade/Downgrade or flash the same software again.
10. The upgrade progress takes about 6 minutes and is displayed in several popup messages. During the upgrade process, you will not have access to the IDE.

Note: The power and USB cables **must** stay connected during the upgrade process.

11. When the upgrade completes, a message is displayed stating **Target Firmware upgraded successfully**. Click **OK** to close the message.

If you want to flash a different firmware version that is not contained in the IDE, download the SPI flash image capsule files as described in Section 2.

The downloaded capsule should be copied to the following locations, depending upon your operating system. Make sure that there is only one `*.cap` file in the location below. If you are downloading a new file, rename the previous `*.cap` to some other extension.

- Windows: `Arduino-1.5.3/hardware/tools/x86/bin/`
- Linux: `Arduino-1.5.3/hardware/tools/`
- Mac OS: `Arduino.app/Contents/Resources/Java/hardware/tools/x86/bin/`

Note: If you see a failure at any stage of the upgrade, refer to the *Release Notes* for known issues and possible workarounds.

7. Open the blink example

Open the LED blink example sketch: **File > Examples > 1.Basics > Blink**.

8. Select your board

Select **Tools > Board > Intel® Galileo**.

Note: If the IDE was closed and then reopened, it will default to a board that was previously selected. You may need to explicitly select **Intel® Galileo**.

9. Select your serial port

Select the serial device of your board from the **Tools > Serial Port** menu.

Windows: Use the *COMx* number assigned earlier. You can retrieve the port number by navigating to:
Start > Control Panel > System and Security > System > Device Manager
Look under **Ports (COM & LPT)** to see which *COMx* is assigned to **Gadget Serial**.

Linux: Use `/dev/ttyAMC0`

Mac OS: Use **/dev/cu.usbmodem*nnnnn***

10. Upload the program

Click the **Upload** button in the IDE and wait a few seconds. If the upload is successful, the message **Done uploading.** will appear in the status bar.

A few seconds after the upload finishes, you will see a green LED on the board start to blink. Congratulations! You've gotten your board up and running.

For more information about Intel® Galileo, including online communities and support, try these links:

http://www.intel.com/support/galileo

http://communities.intel.com/community/makers

http://maker.intel.com

11. Booting your board from an SD card (mandatory for WiFi)

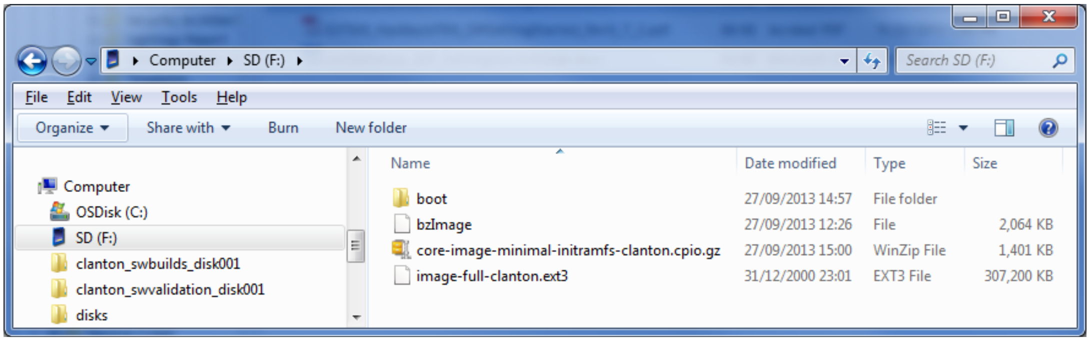
Follow these steps to boot your board from an SD card. This setup also allows you to save your sketch to the Galileo board, so it will be able to repeat sketches after board power-down. (These steps create a persistent `/sketch` folder and `rootfs`.)

Note: If you want to use WiFi, you **must** follow these steps. The WiFi driver is not present in the Linux image in SPI flash because it is too large. The Linux SD image also includes `ALSA, V4L2, python, SSH, node.js, and openCV`.

Required files are in the `LINUX_IMAGE_FOR_SD_Intel_Galileo_v0.7.5.7z` zip file (download link in Section 2).

1. Copy all files and directories from the zip file to your SD card.

   You do not need to create a directory on the SD card. The zipfile contains all the necessary files and structure. Be sure it is extracted at the top level of the SD card. See the screenshot below for a sample view.



Name	Date modified	Type	Size
boot	27/09/2013 14:57	File folder	
bzImage	27/09/2013 12:26	File	2,064 KB
core-image-minimal-initramfs-clanton.cpio.gz	27/09/2013 15:00	WinZip File	1,401 KB
image-full-clanton.ext3	31/12/2000 23:01	EXT3 File	307,200 KB

2. Insert the SD card, then power on the board.

Note: The first time you boot the board may take several minutes. This is expected behavior due to the SSH component creating cryptographic keys on the first boot.

12. Manually update your board firmware (optional)

Note: This method has been replaced by functionality in the IDE. It is provided for reference only.

You must update the firmware the first time you use the board to ensure the firmware on the board is in sync with the IDE.

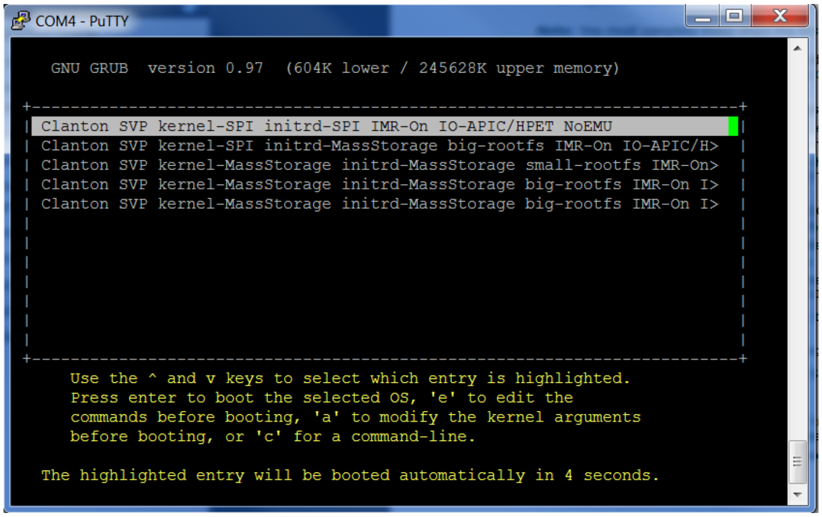
These steps assume you have a microSD card inserted into the slot on the board, which contains the release-specific `sysimage_nnnn.cap` file and the `CapsuleApp.efi` file.

Caution: The `CapsuleApp.efi` and the `*.cap` file are a matched pair and must be used together. When a new `*.cap` file is released, you must use the corresponding `CapsuleApp.efi` to install it.

Perform the steps below:

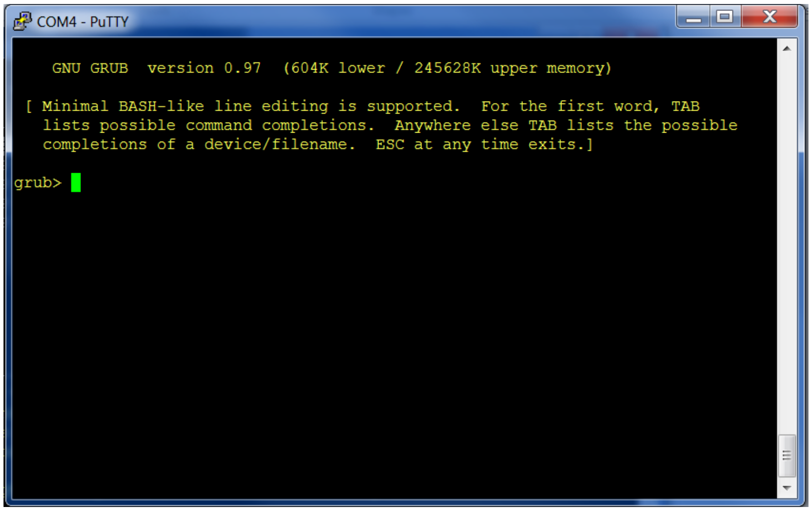
1. Download the SPI flash image capsule files as described in Section 2.
2. Copy `CapsuleApp.efi` and `sysimage_nnnnn.cap` to a microSD card and insert it into the slot on the board.
3. Connect the serial cable between the computer and the Galileo board. Set up a serial console session (for example, PuTTY) and connect to the Galileo board’s COM port at 115200 baud rate.
4. Configure the serial console session to recognize special characters. For example, if you are using PuTTY, you must explicitly enable special characters. In the PuTTY `Configuration` options, go to the `Terminal > Keyboard` category and set the `Function keys and Keypad` option to SCO.

5. Power on the board. A GNU GRUB boot loader menu is displayed (below). Exit GRUB by entering c and quit as shown below.



```
    GNU GRUB  version 0.97  (604K lower / 245628K upper memory)

 +-------------------------------------------------------------------------+
 | Clanton SVP kernel-SPI initrd-SPI IMR-On IO-APIC/HPET NoEMU              |
 | Clanton SVP kernel-SPI initrd-MassStorage big-rootfs IMR-On IO-APIC/H>  |
 | Clanton SVP kernel-MassStorage initrd-MassStorage small-rootfs IMR-On>  |
 | Clanton SVP kernel-MassStorage initrd-MassStorage big-rootfs IMR-On I>  |
 | Clanton SVP kernel-MassStorage initrd-MassStorage big-rootfs IMR-On I>  |
 |                                                                         |
 |                                                                         |
 |                                                                         |
 |                                                                         |
 |                                                                         |
 |                                                                         |
 |                                                                         |
 +-------------------------------------------------------------------------+
      Use the ^ and v keys to select which entry is highlighted.
      Press enter to boot the selected OS, 'e' to edit the
      commands before booting, 'a' to modify the kernel arguments
      before booting, or 'c' for a command-line.

   The highlighted entry will be booted automatically in 4 seconds.
```

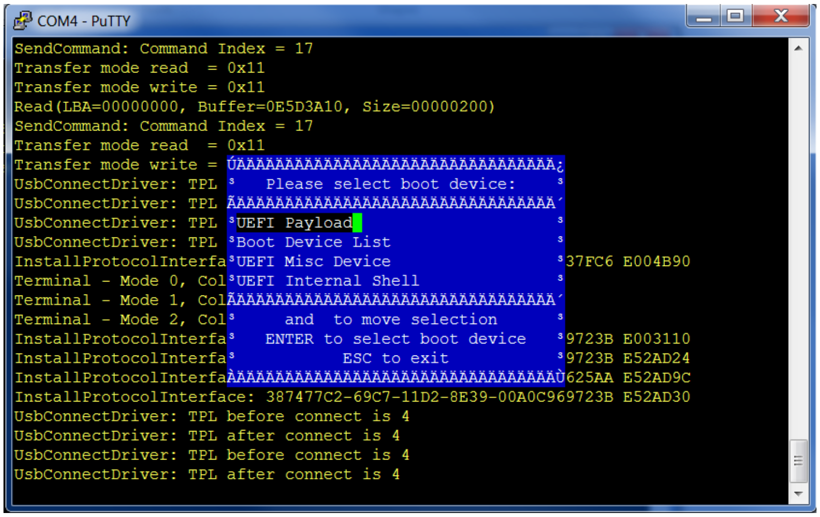
Press c to get a command line.



```
    GNU GRUB  version 0.97  (604K lower / 245628K upper memory)

 [ Minimal BASH-like line editing is supported.  For the first word, TAB
   lists possible command completions.  Anywhere else TAB lists the possible
   completions of a device/filename.  ESC at any time exits.]

grub>
```

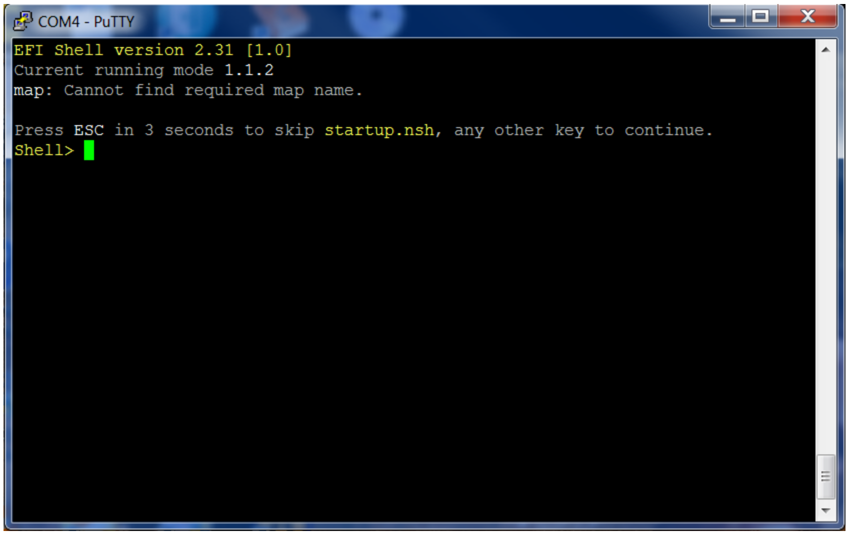
At the GRUB command line, type quit.

6. The serial console displays a boot device selection box (below). Select `UEFI Internal Shell`.



```
SendCommand: Command Index = 17
Transfer mode read  = 0x11
Transfer mode write = 0x11
Read(LBA=00000000, Buffer=0E5D3A10, Size=00000200)
SendCommand: Command Index = 17
Transfer mode read  = 0x11
Transfer mode write = ÚÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ¿
UsbConnectDriver: TPL ³   Please select boot device:    ³
UsbConnectDriver: TPL ÃÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ´
UsbConnectDriver: TPL ³UEFI Payload                     ³
UsbConnectDriver: TPL ³Boot Device List                 ³
InstallProtocolInterfa³UEFI Misc Device                 ³37FC6 E004B90
Terminal - Mode 0, Col³UEFI Internal Shell              ³
Terminal - Mode 1, ColÃÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ´
Terminal - Mode 2, Col³      and  to move selection     ³
InstallProtocolInterfa³   ENTER to select boot device   ³9723B E003110
InstallProtocolInterfa³           ESC to exit           ³9723B E52AD24
InstallProtocolInterfaÀÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÙ625AA E52AD9C
InstallProtocolInterface: 387477C2-69C7-11D2-8E39-00A0C969723B E52AD30
UsbConnectDriver: TPL before connect is 4
UsbConnectDriver: TPL after connect is 4
UsbConnectDriver: TPL before connect is 4
UsbConnectDriver: TPL after connect is 4
```

You will see a display similar to this:



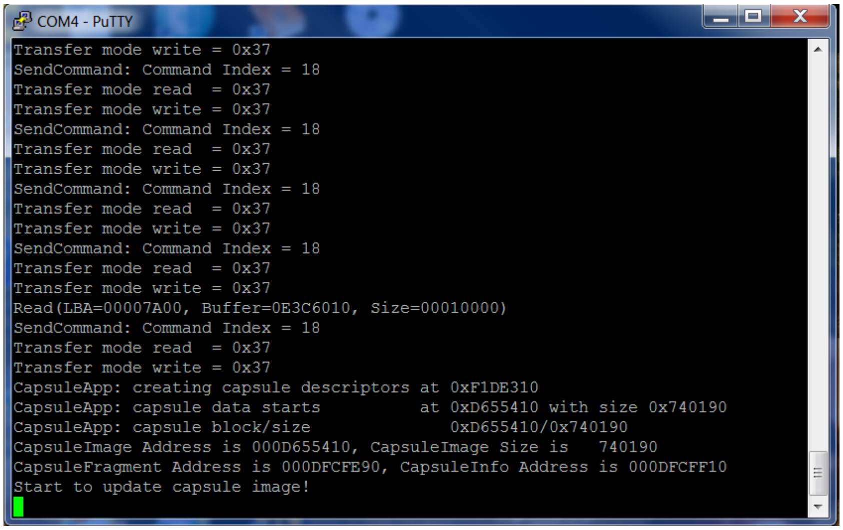
```
EFI Shell version 2.31 [1.0]
Current running mode 1.1.2
map: Cannot find required map name.

Press ESC in 3 seconds to skip startup.nsh, any other key to continue.
Shell>
```

7. You will see a print out, the top line of which looks like this:
   `fs0   :HardDisk - Alias hd7b blk0`

   This is your SD card. To mount it, type: `fs0:`
8. Verify you are using the correct version of `CapsuleApp.efi` by using the `-?` or `–h` option. You **must** use version 1.1 or later.
9. Enter the following command:
   `CapsuleApp.efi sysimage_nnnnn.cap`

Note: You must enter the full filename of the `sysimage_nnnnn.cap` file.

You will see a display similar to this:

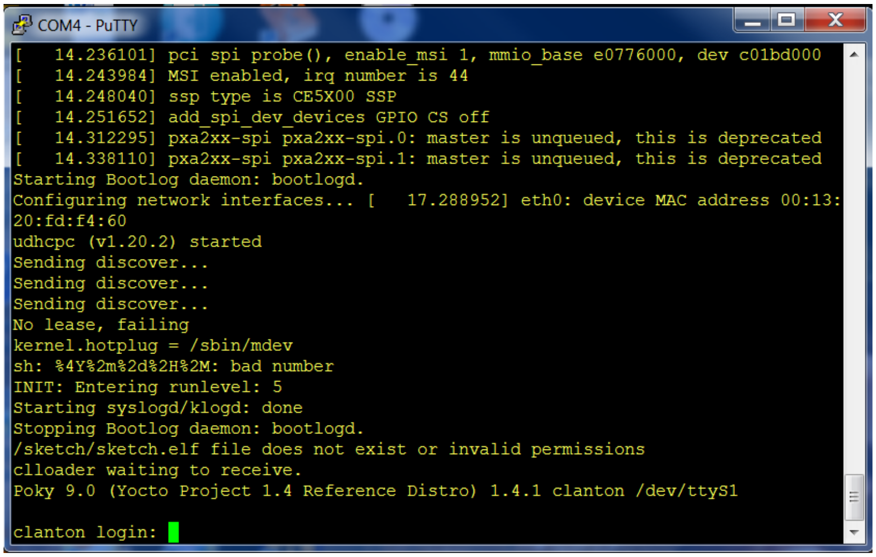


```
Transfer mode write = 0x37
SendCommand: Command Index = 18
Transfer mode read  = 0x37
Transfer mode write = 0x37
SendCommand: Command Index = 18
Transfer mode read  = 0x37
Transfer mode write = 0x37
SendCommand: Command Index = 18
Transfer mode read  = 0x37
Transfer mode write = 0x37
SendCommand: Command Index = 18
Transfer mode read  = 0x37
Transfer mode write = 0x37
Read(LBA=00007A00, Buffer=0E3C6010, Size=00010000)
SendCommand: Command Index = 18
Transfer mode read  = 0x37
Transfer mode write = 0x37
CapsuleApp: creating capsule descriptors at 0xF1DE310
CapsuleApp: capsule data starts          at 0xD655410 with size 0x740190
CapsuleApp: capsule block/size              0xD655410/0x740190
CapsuleImage Address is 000D655410, CapsuleImage Size is   740190
CapsuleFragment Address is 000DFCFE90, CapsuleInfo Address is 000DFCFF10
Start to update capsule image!
```

The `CapsuleApp` will update your SPI flash image. This process takes about 2 minutes.

Warning: DO NOT remove power or try to exit during this process. Wait for the prompt to return, otherwise your board will become non-functional.

10. When the update completes, reboot the board by removing and reconnecting the power cable. You will see a display similar to this:



```
[   14.236101] pci spi probe(), enable_msi 1, mmio_base e0776000, dev c01bd000
[   14.243984] MSI enabled, irq number is 44
[   14.248040] ssp type is CE5X00 SSP
[   14.251652] add_spi_dev_devices GPIO CS off
[   14.312295] pxa2xx-spi pxa2xx-spi.0: master is unqueued, this is deprecated
[   14.338110] pxa2xx-spi pxa2xx-spi.1: master is unqueued, this is deprecated
Starting Bootlog daemon: bootlogd.
Configuring network interfaces... [   17.288952] eth0: device MAC address 00:13:
20:fd:f4:60
udhcpc (v1.20.2) started
Sending discover...
Sending discover...
Sending discover...
No lease, failing
kernel.hotplug = /sbin/mdev
sh: %4Y%2m%2d%2H%2M: bad number
INIT: Entering runlevel: 5
Starting syslogd/klogd: done
Stopping Bootlog daemon: bootlogd.
/sketch/sketch.elf file does not exist or invalid permissions
clloader waiting to receive.
Poky 9.0 (Yocto Project 1.4 Reference Distro) 1.4.1 clanton /dev/ttyS1

clanton login:
```

Revision History

Date	Document Revision	Description
16 October 2013	004	Updated download URL and other minor text updates.
10 October 2013	003	Updated file names and sizes.
04 October 2013	002	Added links to maker community and support pages. Updated board picture with additional callouts.
02 October 2013	001	First external release: Package Version: 0.7.5 for Arduino IDE v1.5.3

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