mangOH™ Red

Getting Started Guide (Windows)

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Rev 1
Contents subject to change

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Revision History

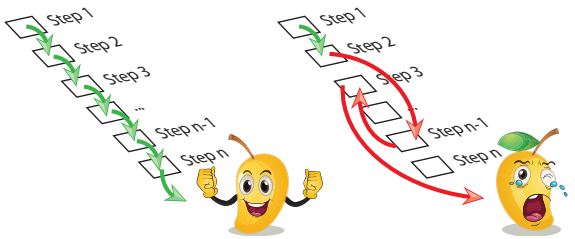
Revision number	Release date	Changes
1	April 2018	Document created

Contents

1: Get Started

Thanks for purchasing the mangOH™ Red development kit! Use this guide to prepare your mangOH Red and computer for IoT development.

Important: *Follow all steps as described. If you skip, change, or 'jump around' steps, your device or development environment may not work properly.*



Before you begin, make sure your development machine (the computer you'll use for mangOH Red application development) meets the following minimum suggested requirements.

Table 1-1: Minimum System Requirements

O/S	Windows 7 and higher (64-bit)
CPU	Dual core @ 2.6 GHz
RAM	4 GB
HDD	10 GB free space
USB Ports	• Preferred—2 (for full functionality) • Minimum—1

Important: *Use this guide if you are using a Windows system.*

Windows

To get started with a native Linux system, or for other mangOH Red resources (guides, tutorials, etc.), visit mangoh.io/mangoh-red-resources.

Note: *This guide has been tested using the Legato Virtual Machine (64-bit Ubuntu 16.04), available at mangoh.io/mangoh-red-resources-getting-started. For assistance with different configurations, visit the mangOH forum at forum.mangoh.io.*

When you are ready to begin, work straight through the rest of this guide:

- STEP 1: Register a mangoh.io Account on page 7
- STEP 2: Set Up Your mangOH Red on page 8
- STEP 3: Prepare Your Windows Dev Machine For Legato Development on page 16
- STEP 4: Prepare Your mangOH Red For Development on page 22
- STEP 5: Register On Mobile Network on page 31
- STEP 6: Connect to the IoT Cloud on page 34

Things to check out after you finish the steps above:

- Develop and Test Applications on page 47
- Update Legato Application Framework on page 55
- Tips on page 57
- Hardware Tips on page 62
- Console Access on page 63
- Quick Reference—Commands in this Guide on page 67
- Terminology on page 69

2: Register a mangoh.io Account

The mangOH ecosystem of products, tutorials, documentation and more is constantly evolving.

Please register for a mangoh.io account to:

- Receive notices of new mangOH products, IoT cards, and project code samples
- Receive periodic device-specific notices
- Be automatically included for a chance to win IoT cards in periodic giveaways

If you already have an account, please log in and register your new device so we can provide you with news about your device.

To register for an account:

1. Go to https://mangoh.io and click Register.
2. Enter the requested data to create your account.

   Some quick notes about your account data:
   - Your email address will be your mangoh account login.
   - Password requirement—8–29 characters, including at least 1 lowercase letter, 1 uppercase letter, and 1 number
   - IoT Applications—We'd like to know what fields you are planning to develop for with your mangOH Red so we can identify potential enhancements to the mangOH ecosystem. Please select all that apply to you.
3. Click Register.

   If all required fields are filled correctly, your account is created and you are logged in automatically.

   Otherwise, the fields that must be updated are indicated. Fix them, re-enter the password fields, and click Register again.
4. Now that you're logged into your account, click Device Registration and select your new mangOH type:
   - mangOH Green—If your device is a mangOH Green, finish the registration process and then use the mangOH Green Getting Started Guide (Windows) available from https://mangoh.io/mangoh-green-resources-getting-started.
   - mangOH Red—Choose the SIM type included in your kit:
     - AT&T—Activate your SIM by clicking the AT&T link.
     - Sierra Wireless—Your SIM will be activated later in this guide when you register for your AirVantage account.
5. Click Submit.

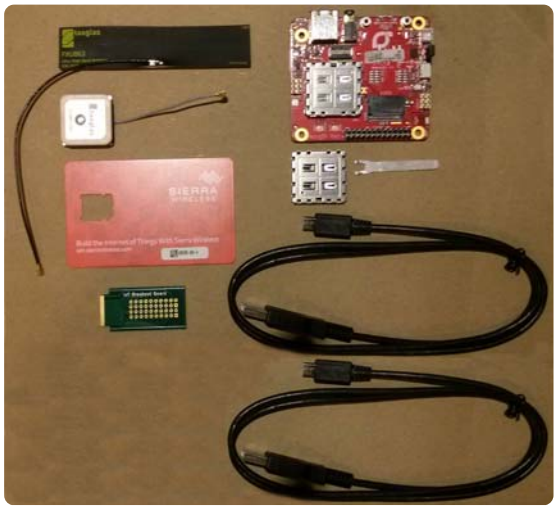
Now you are ready to Set Up Your mangOH Red on page 8.

3: Set Up Your mangOH Red

In this chapter, you will set up your mangOH Red to begin developing applications.

The mangOH Red kit typically includes:

- (1) mangOH Red board
- (1) CF3 module, pre-installed (e.g. WP76xx, WP77xx, WP8548, etc.)
- (2) module covers (for 2.5 mm and 4.0 mm height modules)—One pre-installed with the CF3 module, and one for use with a CF3 module of a different height.
- (1) module cover release tool
- (2) micro-USB cables
- (1 or 2) Ultra Wide Band antennas (taoglas FXUB63)—Second antenna included if CF3 module supports diversity.
- (1) GNSS antenna (taoglas AGGBP.25B)
- (1) micro-SIM card (Sierra Wireless or AT&T)
- (1) Breakout board (IoT expansion card format)
- (2) M2 screws for IoT card installation



Note: The images used in this guide show the 4.0 mm cover.

Cover for 4.0 mm module | 4.0 mm module (e.g. WP8548, WP76xx) | Cover for 2.5 mm module | 2.5 mm module (e.g. WP77xx)

3.1 Install Drivers

Download and install the Windows drivers for your mangOH Red's CF3 module:

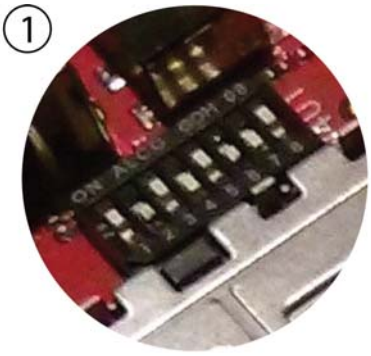
1. Go to http://mangoh.io/mangoh-red-resources-getting-started.
2. In the Getting Started with mangOH section, click Drivers for mangOH-compatible CF3 Modules (under the Windows icon) to download the driver installation file.
3. Run the downloaded file (GenericDriverSetup.exe) and follow the prompts to install the drivers.

3.2 Assemble Your mangOH—Quick Steps

Your mangOH kit comes partially assembled with the CF3 module and cover pre-installed.

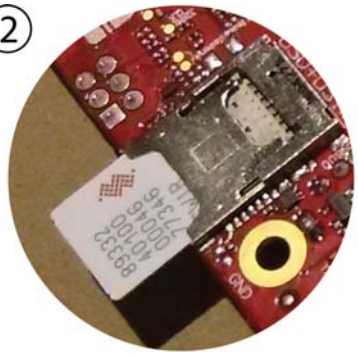
Follow the example below to finish assembling the mangOH Red. Detailed instructions are available for each step if needed (see Assemble Your mangOH—Detailed Steps on page 10

1



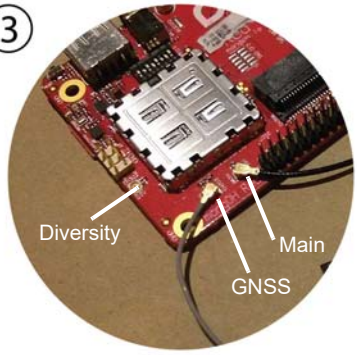
Verify pins 1, 3, 5, 8 are ON.
(Detailed step: page 10)

2

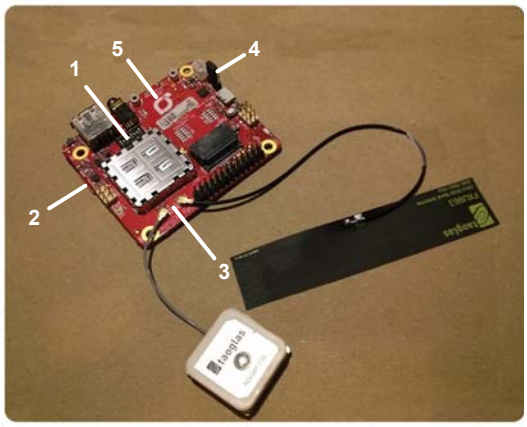


Insert SIM in slot on bottom side of board.
(Detailed step: page 11)

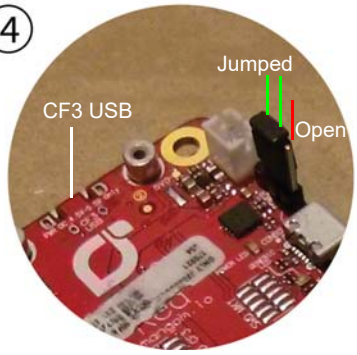
3



Connect antennas (Main, GNSS, and (if included) Diversity).
(Detailed step: page 11)

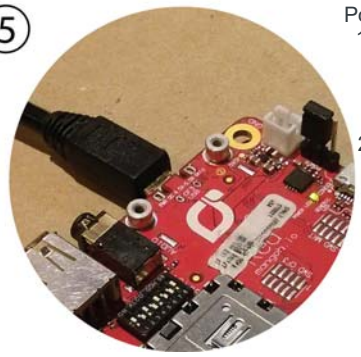


4



Set the Power Header jumper on the pair of pins that are closes to the CF3 USB port.
(Detailed step: page 12)

5



Power up the board:

1. Use a micro-USB cable to connect the mangOH Red's CF3 USB port to your computer.
2. Wait for the module to enumerate, then ping it to make sure it is working. Use: "ping 192.168.2.2"

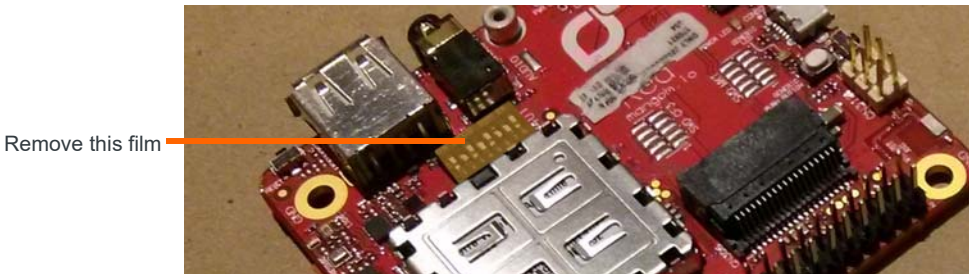
(Detailed step: page 12)

Now you are ready to Prepare Your Windows Dev Machine For Legato Development on page 16.

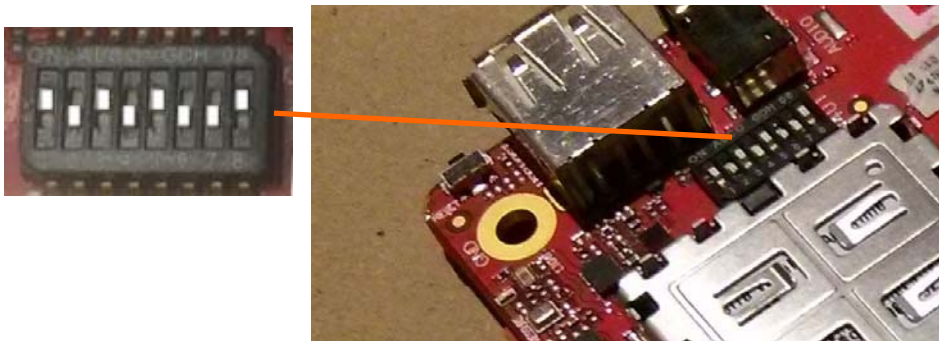
3.3 Assemble Your mangOH—Detailed Steps

The following steps match and provide more detail for those shown in Assemble Your mangOH—Quick Steps on page 9.

1. Verify the SW401 dipswitch pins are set correctly:
   a. Remove the protective film from the dipswitches:



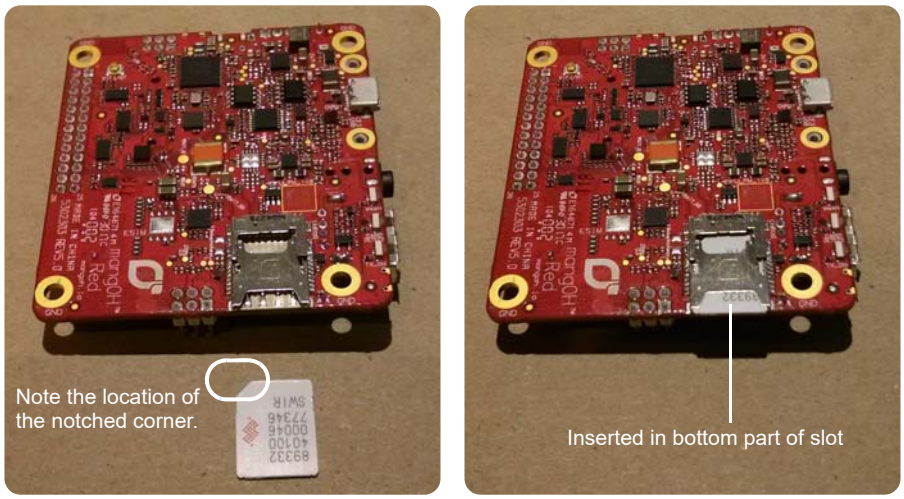
   b. Make sure the dipswitches are set as follows:
      - ON—1,3,5,8
      - OFF—2,4,6,7



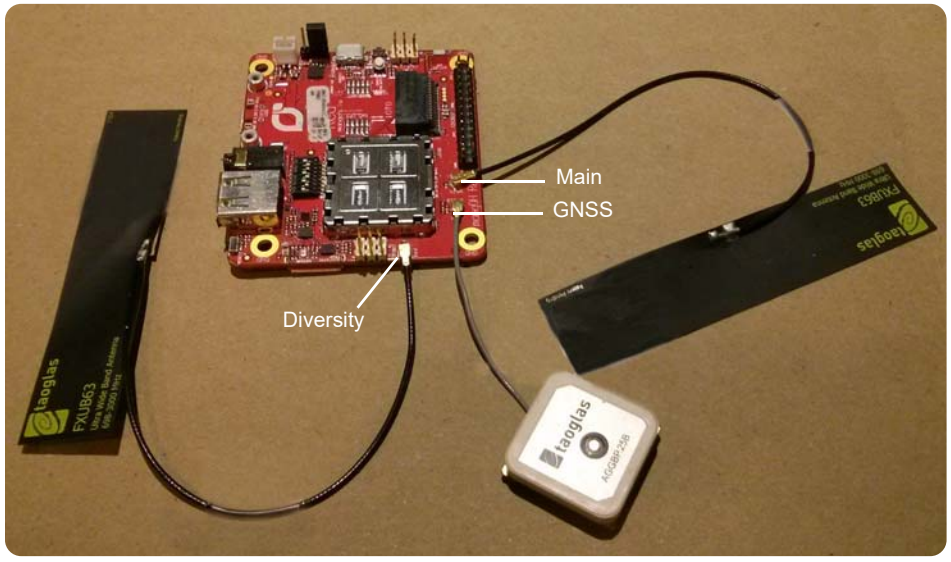
For switch details (not needed for this tutorial), see Dipswitch Settings on page 62.

2. Insert a micro-SIM in the slot on the bottom side of the mangOH Red. (Either the micro-SIM included with the kit, or one that has been activated by another mobile network provider.)

> **Note:** *If you do not have an activated micro-SIM, you can continue the tutorial, but will not be able to complete* *Register On Mobile Network on page 31* and *Connect to the IoT Cloud on page 34.*



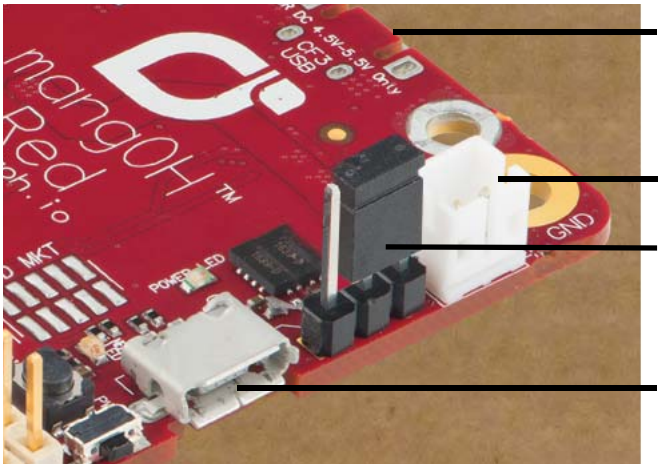
3. Attach the main antenna, the GNSS antenna, and (for WP76xx modules) the diversity antenna.



> **Tip:** *If you have trouble connecting an antenna, make sure it is positioned directly on the connector and push straight down. The antenna will not connect at an angle.*

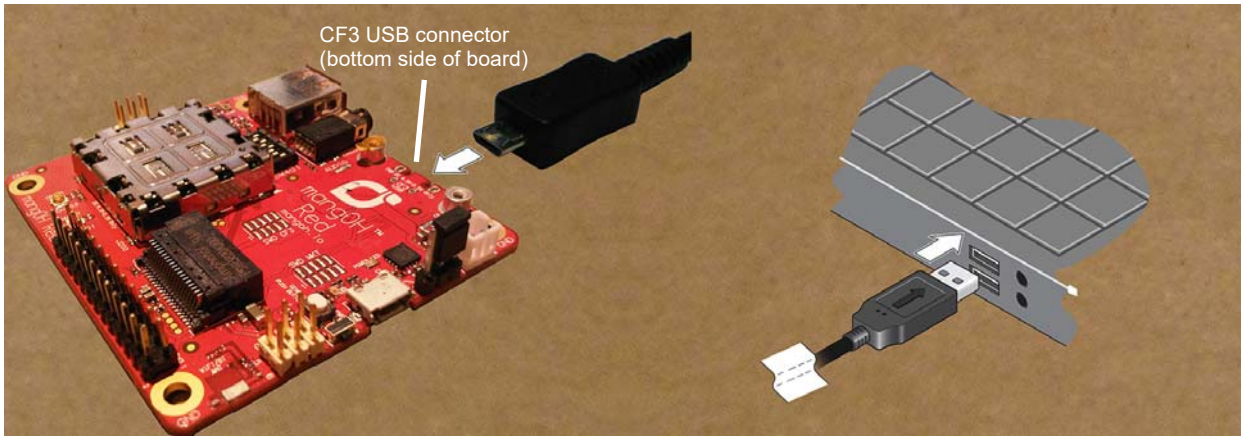
4. Move the power select jumper onto the pins closest to the battery connector to select the CF3 USB connector. (In this guide, power is supplied from the dev machine's USB port to this connector when you connect it in a later step.)

> **Note:** *The mangOH Red has two USB connectors:*
> - *CF3 USB is used for SSH connections, AT commands, and firmware downloads.*
> - *CONSOLE_USB is a serial connection used to access the module's console for diagnostic purposes.*

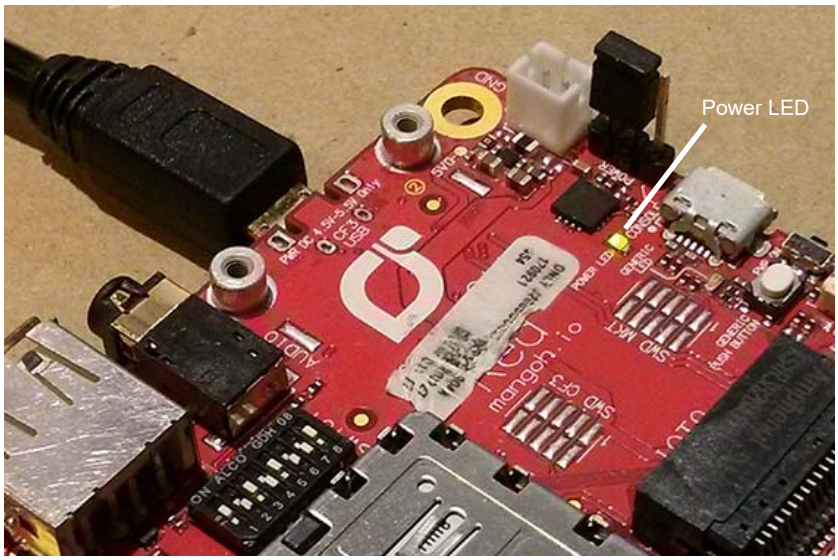


> **Note:** *OPTIONALLY, if you want to be able to display the CF3 module's console messages (diagnostic messages) and have two available USB ports on your dev machine, follow the instructions in Console Access on page 63. This is NOT a required step for this tutorial.*

5. Power up the mangOH Red:
   a. Use a micro-USB cable to connect the CF3 USB connector to a USB port on the dev machine.



When the mangOH Red is powered, the Power LED turns solid green.

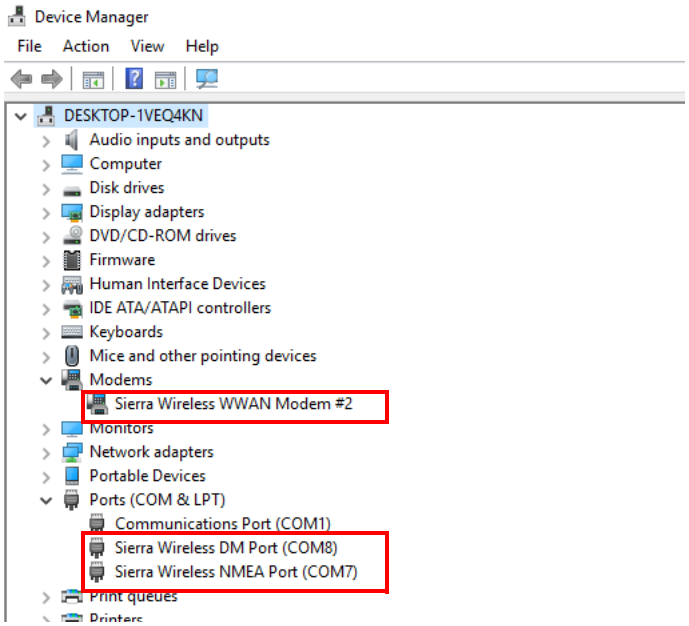


Tip: *If the Power LED does not turn on:*
- *Make sure the cable is securely connected to the correct USB port (as shown in the image).*
- *Make sure the jumper block is on the correct pins (as shown in the image).*

Note: For future reference, the mangOH Red's power supply (USB port on your dev machine, or an AC adapter) connects to the board via either USB connector—CF3 USB or CONSOLE USB (depending on the jumper position on the power header). If an AC adapter is connected to CF3 USB, SSH/AT connections are not possible; if it is connected to CONSOLE USB, serial USB connections are not possible.

6. Wait for the device to enumerate (1–4 minutes, typically)

   You can confirm the device has enumerated by viewing Display Manager—the device appears under Modems, and its COM ports appear under Ports (COM & LPT):



7. Confirm that the connection between the computer and mangOH Red is functioning correctly:

   a. Open a Windows command prompt window—press Win+R (or Start > Run), then enter "`cmd`" and press Enter.

   b. Test the connection by 'pinging' the CF3 module (which has a default IP address of 192.168.2.2):

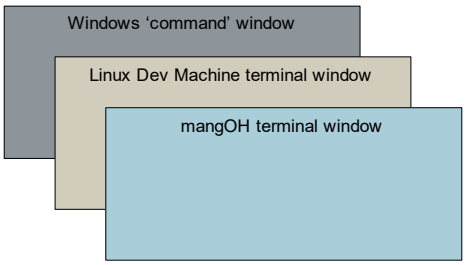
      `> ping 192.168.2.2`

      You should receive ping responses. Press Ctrl+C to return to the command prompt.

```
C:\Windows\System32>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:
Reply from 192.168.2.2: bytes=32 time<1ms TTL=64
Reply from 192.168.2.2: bytes=32 time=1ms TTL=64
Reply from 192.168.2.2: bytes=32 time=2ms TTL=64
Reply from 192.168.2.2: bytes=32 time=2ms TTL=64

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 1ms
```



Tip: *Many examples in this guide show sample output when running commands while logged into your mangOH Red, logged into your Linux VM system, or entered from your Windows command prompt.*
Background colors indicate 'where' commands are entered (and output displayed)—blue (mangOH), brown (Linux), and gray (Windows).

Now you are ready to Prepare Your Windows Dev Machine For Legato Development on page 16.

4: Prepare Your Windows Dev Machine For Legato Development

In this chapter, you will prepare your dev machine for Legato application development by installing Oracle VirtualBox (a 'hypervisor' (virtual machine monitor)) and a custom pre-configured virtual machine (VM) image.

Important: *To install and use the development environment, your dev machine must meet the requirements in Table 1-1 on page 6.*

Note: *The Legato development environment runs on a Ubuntu Linux guest OS running under Oracle VirtualBox. Compared to running a Linux OS natively, the performance is decreased due to the overhead of virtualization.*

After assembling your mangOH Red in Set Up Your mangOH Red on page 8, including installing drivers on your computer and connecting the mangOH Red, you can prepare your computer for Legato development.

Your computer requires an Oracle Virtualbox virtual machine image configured with the Legato development environment. The following sections describe how to get and install the virtual machine.

4.1 Prepare Your Computer—Quick Steps (Expert Users)

Tip: *This procedure is intended for use by expert users only (those familiar with setting up VirtualBox and installing VMs). Other users should follow the procedure in Prepare Your Computer—Detailed Steps on page 17.*

Follow the procedure below to prepare your computer for Legato development. Detailed instructions are available for each step if needed (see Prepare Your Computer—Detailed Steps on page 17).

1. Install Oracle VirtualBox for Windows hosts, available from https://www.virtualbox.org. (Detailed instructions—Step 1 on page 17)
2. Download the Legato VM from https://mangoh.io/mangoh-red-resources-getting-started (in the Legato Virtual Machines section). (Detailed instructions—Step 2 on page 17)
3. In VirtualBox, import the Legato VM (File > Import Appliance). (Detailed instructions—Step 3 on page 17)
4. Select the Legato VM and make sure it is set up properly (Detailed instructions—Step 4 on page 19):
   a. Select Settings > Network > Adapter 1 > Advanced, and select Cable Connected (to use the Internet connection). Click OK.
   b. Make sure virtualization is enabled on your computer—Select Settings > System > Acceleration.
      - If Acceleration cannot be selected (grayed out), enable virtualization in your computer's BIOS, then launch the VM and repeat step c.
      - If Acceleration can be selected, make sure both Hardware Virtualization options are selected and click OK.
5. Select the Legato VM and click Start, then select the Ubuntu boot option when prompted. (Step 5 on page 21)

Now you are ready to Prepare Your mangOH Red For Development on page 22.

4.2 Prepare Your Computer—Detailed Steps

The following steps match and provide more detail for those shown in Prepare Your Computer—Quick Steps (Expert Users) on page 16.

1. The VM image provided for mangOH Red is built for use with Oracle VirtualBox. If you do not have Oracle VirtualBox installed on your computer yet:
   a. Go to https://www.virtualbox.org to download the VirtualBox binary for Windows hosts.

   Note: *When you install VirtualBox, default settings will work, but you can modify them if you prefer (see VirtualBox Tips on page 60 for details.)*

   b. Install VirtualBox by running the downloaded file.

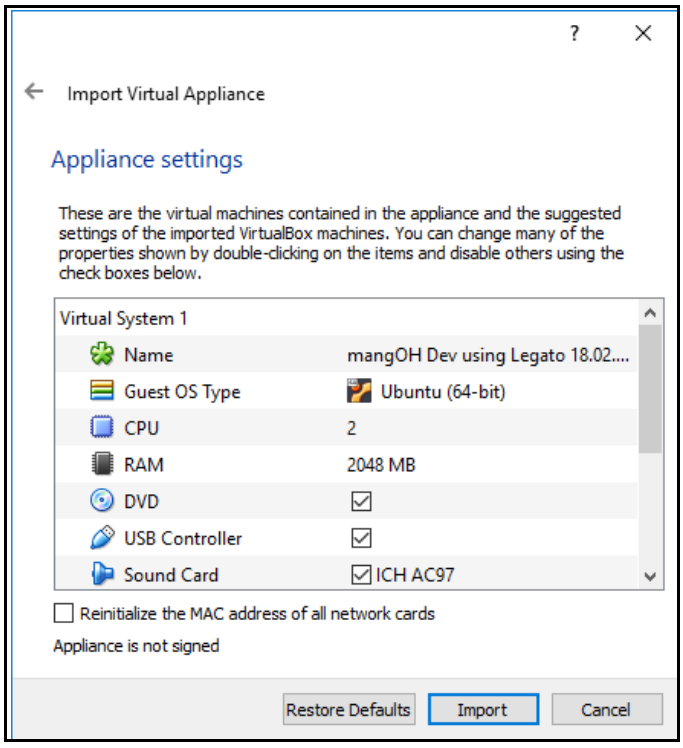
      VirtualBox opens automatically when it finishes installing.
2. Download the Legato virtual machine (VM):

   (The guest OS on the VM image provided for mangOH Red is 64-bit Ubuntu Linux 16.04, pre-loaded with the Legato toolchain (tools for building Legato applications), and files for building the mangOH platform.)
   a. Go to http://mangoh.io/mangoh-red-resources-getting-started.
   b. In the Legato Virtual Machines section, locate and click Download VM.

   Note: *The VM image size is ~3 GB. Download time will vary depending on your Internet connection.*

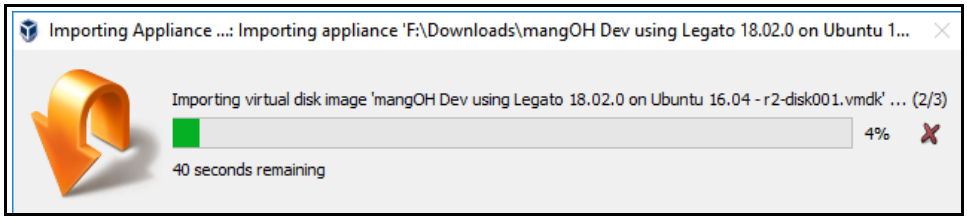
   Important: *Download, installation and use of Legato Application Framework and Platform Services is subject to the Legato License and Open Source Licenses.*
3. Import the Legato VM into VirtualBox:
   a. In VirtualBox, select File > Import Appliance.
   b. Browse to the local folder where you downloaded the VM image (for example, “mangOH Dev using Legato *YY.MM.R* on Ubuntu 16.04 - r*X*.ova”), select the file, and click Open.
   c. Click Next.

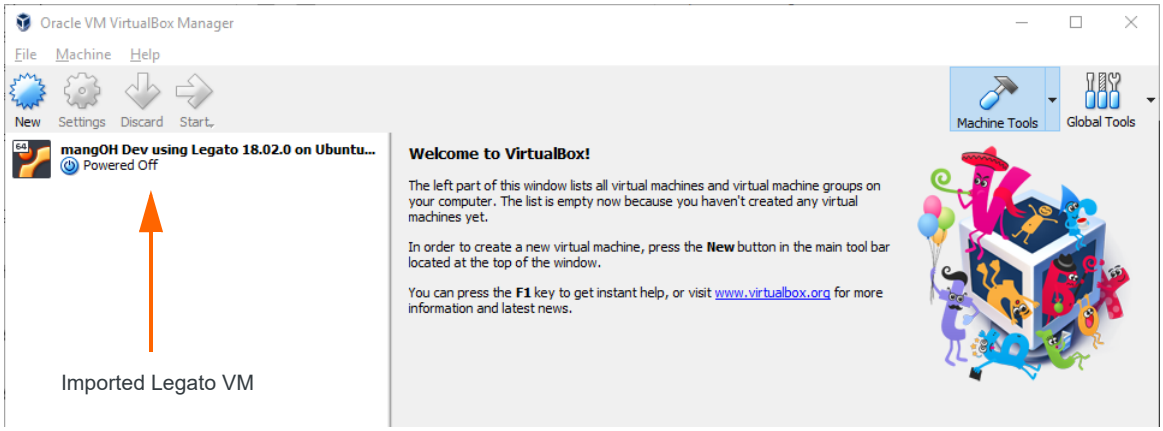
      VirtualBox opens and displays the Import Virtual Appliance window.



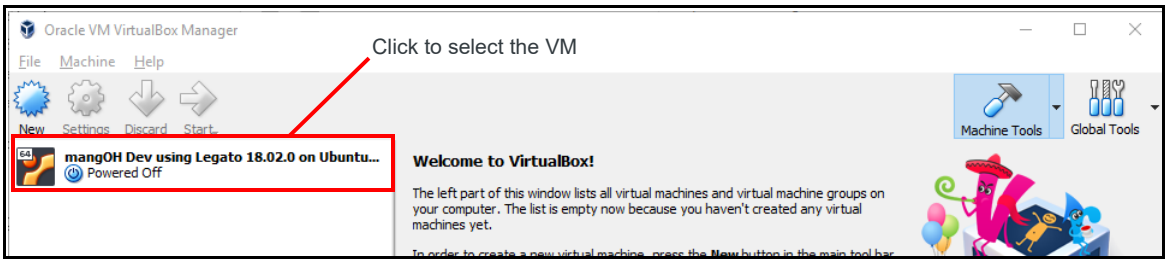
d. If you want to assign a different name to the VM, double-click the Name field, type the new name, and press Enter.

e. Click Import. The Linux VM begins importing into VirtualBox—this may take 1–10 minutes to run, depending on your computer.

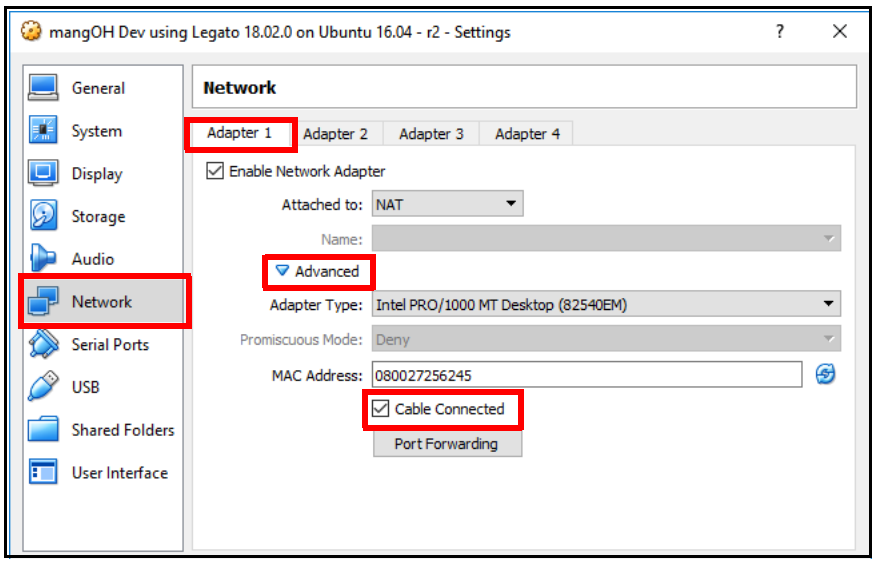




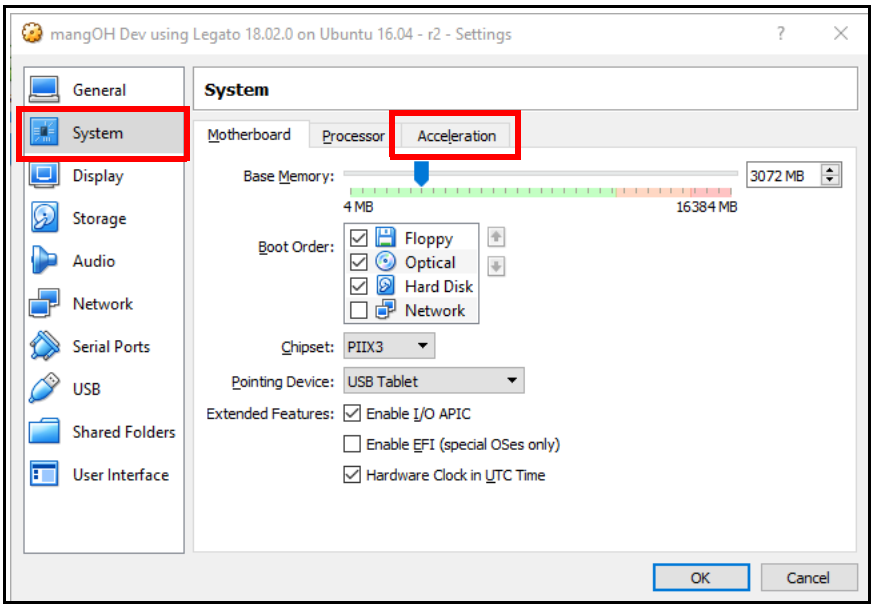
4. Make sure the Legato VM is set up properly:
   a. Make sure the Legato VM is set up to use the Internet connection:
      i. In the VirtualBox window, select (click) the newly imported VM (for example, "mangOH Dev using Legato ...").



      ii. Click Settings. The Settings window appears.
      iii. Select Network.
      iv. Select Adapter 1.
      v. Click Advanced.
      vi. Select Cable Connected.
      vii. Click OK.

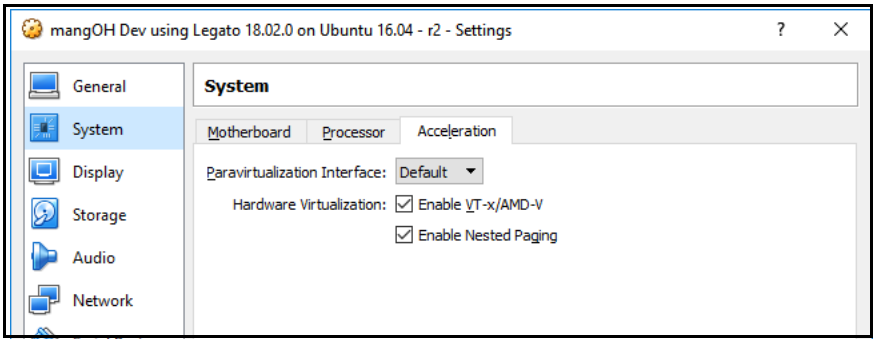


   b. Check whether your computer has virtualization enabled (which allows you to run the Linux VM):
      i. In the VirtualBox window, click Settings. The Settings window appears.
      ii. Select System.



iii. Try to select Acceleration:

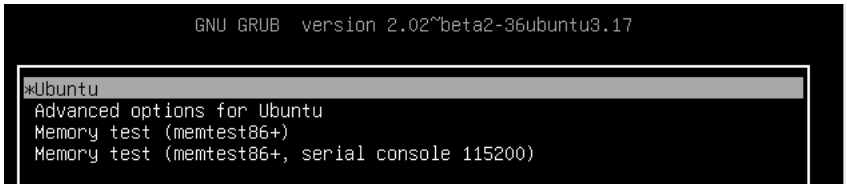
- If Acceleration cannot be selected (grayed out):
  - **i.** You must enable virtualization in your computer's BIOS. See C.7 Enable virtualization on a Windows computer on page 60 for details.
  - **ii.** After you reboot, launch VirtualBox from your Start menu, and restart Step b.
- If Acceleration can be selected:
  - **i.** Make sure both Hardware Virtualization options are selected.
  - **ii.** Click OK.

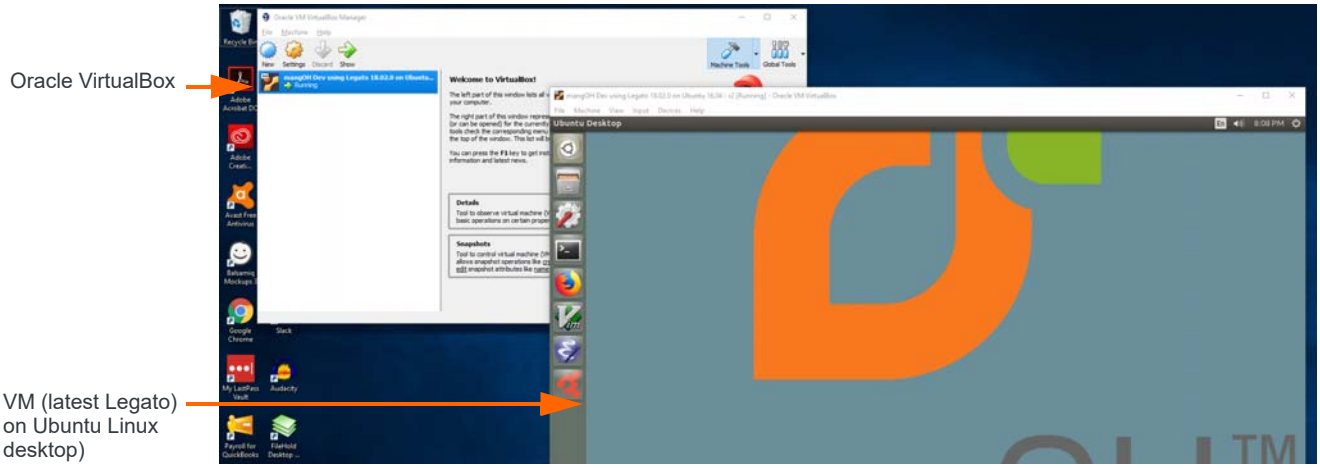


5. In the VirtualBox window, launch (double-click, or click to select and click Start) the virtual machine (for example, “mangOH Dev using Legato ...”).

   As VirtualBox begins to load the image, one of the following will happen:

   - A VirtualBox window will appear, and then a menu will appear (briefly) with the first option ("Ubuntu") selected. This will quickly be replaced with progress messages that appear while the image loads. This may take a few minutes before the Ubuntu desktop appears:





   - If a VirtualBox Error appears with the message “VT-x/AMD-V hardware acceleration is not available on your system...”, you must enable virtualization in your computer’s BIOS. See C.7 Enable virtualization on a Windows computer on page 60 for details.
   - If the image doesn’t load properly (the program hangs, or the desktop does not appear), you must:
     i. Close VirtualBox.
     ii. Start VirtualBox.
     iii. Delete the VM image.
     iv. Re-import the VM image—Go back to Step 3 on page 17.

Important: *The Linux VM will not lock if it is left unused. However, if you manually lock it, the password to unlock it is ‘mangoh’.*

Now that the VM is loaded and running and you have a terminal emulator installed, you can Prepare Your mangOH Red For Development on page 22 .

5: Prepare Your mangOH Red For Development

In this chapter, you will build the mangOH Distribution (mangOH Platform and Legato Application Framework) on your computer, and install the mangOH Platform applications on your mangOH Red.

The mangOH Platform includes a suite of applications customized for the mangOH hardware platform, and a set of Linux kernel modules. The platform is built using features of the Legato Application Framework, which includes its own set of applications and Linux kernel modules.

Note: Although the Legato VM includes a pre-built mangOH Distribution, follow the procedure below to make sure you have the most recent build available.

5.1 Build/Install mangOH Distribution—Quick Steps (Expert Users)

Tip: *This procedure is intended for use by expert Legato AF users only. Other users should follow the procedure in Build/Install mangOH Distribution—Detailed Steps on page 23.*

Follow the procedure below to build the mangOH Distribution, and then install the it on your mangOH Red. Detailed instructions are available for each step if needed (see Build/Install mangOH Distribution—Detailed Steps on page 23).

1. Set environment variables to use Legato tools:

   ```
   $ cfglegato
   ```

2. Update the module's firmware to the latest available version:

   a. Go to your CF3 module's device page at http://source.sierrawireless.com and click Firmware in the Software Download Section.

   b. Download, and then launch, the Windows one-click tool for the Generic (Generic GCF) firmware release.

   Note: *This will take several minutes to run.*

3. Build the mangOH Distribution for the module in your mangOH Red—In the Legato VM, open a terminal window and run the following commands (replace <module_series> with your CF3 module series—red_wp750x, red_wp76xx, red_wp77xx, red_wp85). (Detailed instructions—Step 5 on page 27):

   ```
   $ cd ~/mangOH
   $ git pull && git submodule update --init
   $ make <module_series>
   ```

   (e.g. "make red_wp76xx" to build for the WP7603 module. For optional make parameters, see Section C.3 mangOH Platform 'make' parameters.))

4. Install the mangOH Red distribution for your module (use the correct device-specific <updatefile> for your module). (Note: The mangOH Red must be powered on and connected to your dev machine.) (Detailed instructions—Step 6 on page 29)

   ```
   $ update ~/mangOH/build/update_files/red/<updatefile> 192.168.2.2
   ```

5. Verify that the distribution installed correctly (Detailed instructions—Step 7 on page 30):

   ```
   $ ssh root@192.168.2.2
   $ app status
   ```

   (If redSensorToCloud is listed, the install worked.)

Now that the mangOH Red distribution is installed, you will learn how to Register On Mobile Network on page 31.

5.2 Build/Install mangOH Distribution—Detailed Steps

The following procedure steps match and provide more detail for those shown in Build/Install mangOH Distribution—Quick Steps (Expert Users) on page 22.

Now that your dev machine is set up with the Legato VM, build the mangOH Distribution, and install it on the CF3 module in your mangOH Red.

Important: You MUST do the following step! *The mangOH Distribution that you are going to install in this procedure requires you to have the correct (latest) firmware installed on your CF3 module. The distribution applications may not install or work correctly if you do not have the correct firmware.*

1. Set the configuration (environment variables) required to use available Legato tools:

   ```
   $ cfglegato
   ```

```
mangoh@mangoh-virtualbox: cfglegato
Configuring shell for Legato development
----------------------------------------
[ar7] No toolchain found for target 'ar7'.
[ar86] No toolchain found for target 'ar86'.
[wp85] Toolchain dir[/opt/swi/y17-ext-wp85/sysroots/x86_64-pokysdk-linux/usr/bin/arm-poky-l
gnueabi] prefix[arm-poky-linux-gnueabi-]
[wp750x] Toolchain dir[/opt/swi/y17-ext-wp750x/sysroots/x86_64-pokysdk-linux/usr/bin/arm-po
linux-gnueabi] prefix[arm-poky-linux-gnueabi-]
[wp76xx] Toolchain dir[/opt/swi/y22-ext-wp76xx/sysroots/x86_64-pokysdk-linux/usr/bin/arm-po
linux-gnueabi] prefix[arm-poky-linux-gnueabi-]
[wp77xx] Toolchain dir[/opt/swi/y22-ext-wp77xx/sysroots/x86_64-pokysdk-linux/usr/bin/arm-po
linux-gnueabi] prefix[arm-poky-linux-gnueabi-]
[ar758x] No toolchain found for target 'ar758x'.
[ar759x] No toolchain found for target 'ar759x'.
[virt] No toolchain found for target 'virt'.
```

Ignore 'No toolchain found' messages.

Important: *You must enter the 'cfglegato' command in any terminal window that you open in the Legato VM, if you want to use the framework's tools in that window.*

2. If you did not load the latest Drivers for your module yet, load them now—see Install Drivers on page 8 for instructions.
3. The VM includes the required (latest) firmware versions for WP CF3 modules. Do a firmware update to make sure your module is up to date:
   a. Connect to the mangOH Red using your terminal emulator:

      ```
      $ ssh root@192.168.2.2
      ```

b. The following message appears if you are using your CF3 module for the first time (modules are shipped without a password).

```
It is strongly recommended to setup credentials for remote login.
Please select one of the following options:
  1) Setup ssh keys and disable passwords-based authentication via ssh
     (the most secure)
  2) Setup password (better than nothing)
  3) Do nothing
```

For now, type `3` and press Enter, then type `Y` and press Enter to be reminded the next time you connect. (During this tutorial, do this each time you open an SSH connection to the mangOH Red.)

> **Note:** *After completing this tutorial, you should select an appropriate login authentication method (ssh keys or password) from this menu—see legato.io/legato-docs/latest/basicTarget.html for details.*

c. Confirm your device type and current firmware version:

```
# cm info
```

```
root@swi-mdm9x28:~# cm info
Device:                 WP7603
IMEI:                   357409080008792
IMEISV:                 4
FSN:                    U3734285370206
Firmware Version:       SWI9X07Y_02.14.04.00 000000 jenkins 2018/02/14 20:19:41
Bootloader Version:     SWI9X07Y_02.14.04.00 000000 jenkins 2018/02/14 20:19:41
MCU Version:            002.007
PRI Part Number (PN):   9906965
PRI Revision:           002.001
Carrier PRI Name:       GENERIC
Carrier PRI Revision:   002.025_000
SKU:                    1103194
Last Reset Cause:       Power Down
Resets Count:           Expected: 21     Unexpected: 5
```

d. Close the terminal session:

```
# exit
```

4. Update the module's firmware to the latest available version:

a. Connect to the mangOH Red using your terminal emulator:

```
$ ssh root@192.168.2.2
```

b. The following message appears if you are using your CF3 module for the first time (modules are shipped without a password).

```
It is strongly recommended to setup credentials for remote login.
Please select one of the following options:
  1) Setup ssh keys and disable passwords-based authentication via ssh
     (the most secure)
  2) Setup password (better than nothing)
  3) Do nothing
```

For now, type `3` and press Enter, then type `Y` and press Enter to be reminded the next time you connect. (During this tutorial, do this each time you open an SSH connection to the mangOH Red.)

> **Note:** *After completing this tutorial, you should select an appropriate login authentication method (ssh keys or password) from this menu—see legato.io/legato-docs/latest/basicTarget.html for details.*

c. Confirm your device type and current firmware version:

```
# cm info
```

```
root@swi-mdm9x28:~# cm info
Device:                 WP7603
IMEI:                   357409080008792
IMEISV:                 4
FSN:                    U3734285370206
Firmware Version:       SWI9X07Y_02.14.04.00 000000 jenkins 2018/02/14 20:19:41
Bootloader Version:     SWI9X07Y_02.14.04.00 000000 jenkins 2018/02/14 20:19:41
MCU Version:            002.007
PRI Part Number (PN):   9906965
PRI Revision:           002.001
Carrier PRI Name:       GENERIC
Carrier PRI Revision:   002.025_000
SKU:                    1103194
Last Reset Cause:       Power Down
Resets Count:           Expected: 21     Unexpected: 5
```

Example data

d. Close the terminal session:

```
# exit
```

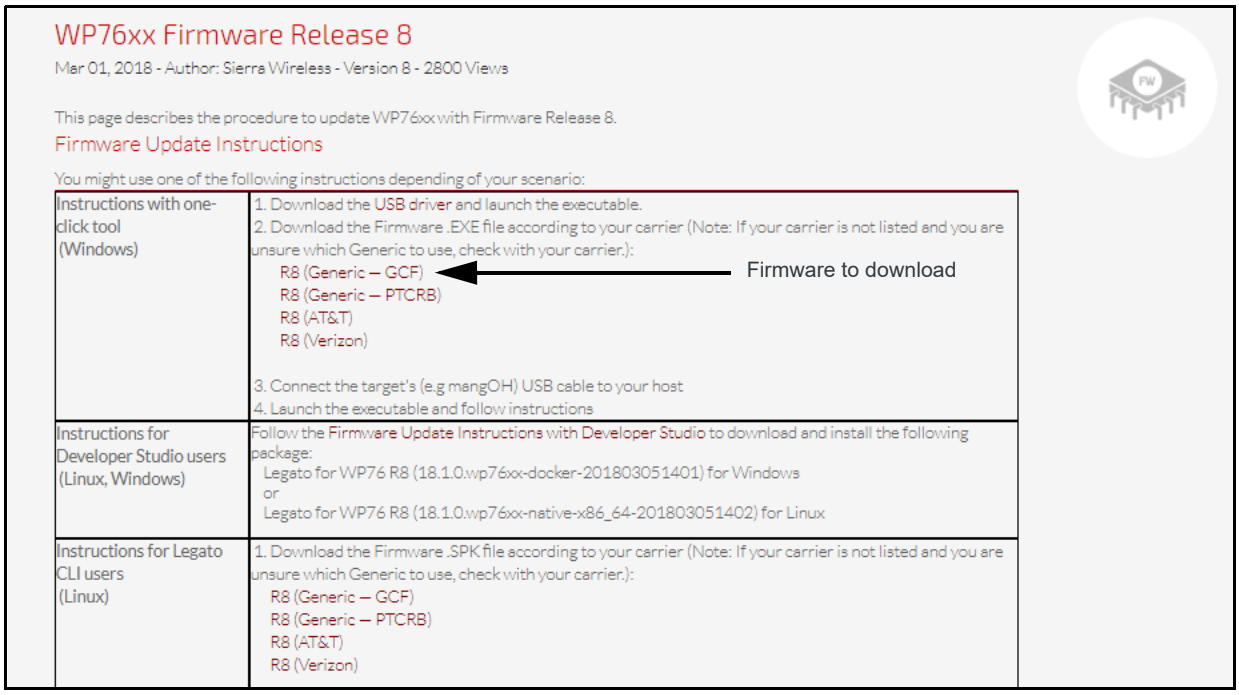
e. Go to your CF3 module's device page at http://source.sierrawireless.com. (Select AirPrime > WP Series > (your module type).

f. If you already have a Source account, log in.

Otherwise, register for a Source account, which is required to download files.

g. In the Software Download section, click Firmware.

h. In the Firmware Update Instructions table's Instructions with one-click tool (Windows) row, click the Generic firmware link (if there is more than one Generic, click the Generic GCF link).



i. Launch the downloaded executable file (e.g. WP76xx_Release8...exe). A progress window appears.

```
Awaiting suitable port or adapter ...
Switching to boot & hold mode ...
Disabling selective suspend ...
Awaiting download port ...
Switching to streaming mode ...
Downloading images ...
Writing image -
Flashing image -
Awaiting adapter ...
Checking update status ...
Enabling selective suspend ...
Firmware image download succeeded.
Final Firmware update succeeded.

Preexisting images information:
        Current:
                Firmware:
                        ImageId: 002.025_000
                        BuildId: 02.14.04.00_GENERIC
                Configuration:
                        ImageId: 002.025_000
                        BuildId: 02.14.04.00_GENERIC
Final images information:
        Current:
                Firmware:
                        ImageId: 002.025_000
                        BuildId: 02.14.04.00_GENERIC
                Configuration:
                        ImageId: 002.025_000
                        BuildId: 02.14.04.00_GENERIC

OEM PRI: 9906965 002.001

IMEI: 357409080008792

Total time elapsed: 105625 ms.

Time to switch to boot mode: 24063 ms.

Images downloaded:
        Image ID: 002.025_000
        Build ID: 02.14.04.00_GENERIC
                write time: 24593 ms
                additional flash time: 13672 ms

Time to reset to application mode: 42641 ms.

Press Enter to continue ...
```

Note: *This will take several minutes to run.*

j. Wait (1–2 minutes) while the module reboots with the new firmware.

Tip: *Ping the mangOH Red—when replies appear, the module has rebooted and you can continue.*
$ ping 192.168.2.2 (Press CTRL-C to cancel)

k. Verify that the firmware updated:

i. Connect to the mangOH Red using your terminal emulator:

```
$ ssh root@192.168.2.2
```

ii. Display the firmware version now loaded on the CF3 module, and compare it to the version before the firmware update was installed—the version should be the same or a higher value:

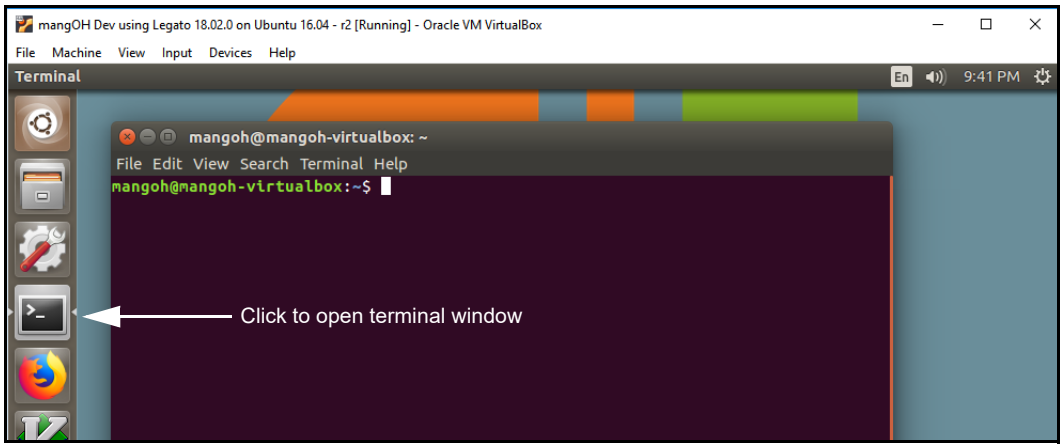
```
# cm info
```

iii. Disconnect from the mangOH Red:

```
# exit
```

5. Build the mangOH Distribution:

   a. In the VM, open a terminal window.



   b. Change directory to the mangoh work directory:

```
$ cd ~/mangOH
```

   c. Get the latest files for building the mangOH Distribution (the VM is pre-installed with the distributions for all mangOH products, but for best results, you should rebuild with the latest files):

```
$ git pull && git submodule update --init
```

```
mangoh@mangoh-virtualbox: ~/mangOH$ git pull
remote: Counting objects: 22, done.
remote: Compressing objects: 100% (10/10), done.
remote: Total 22 (delta 12), reused 19 (delta 9), pack-reused 0
Unpacking objects: 100% (22/22), done.
From https://github.com/mangOH/mangOH
   e26b94c..6c61f4c  master     -> origin/master
Updating e26b94c..6c61f4c
Fast-forward
 README.md                                |  46 +++--
 linux_kernel_modules/mangoh/mangoh_red.c |   6 -
 scripts/cfg_gateway.sh                   | 322 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 targets/mdm9x07.sinc                     |   6 +-
 4 files changed, 355 insertions(+), 25 deletions(-)
 create mode 100644 scripts/cfg_gateway.sh
```

Example data

Tip: *The output you see when you run some commands in the Linux VM or on the mangOH Red may differ from the examples shown. To check if a command succeeded or failed, enter the following command:*

$ echo $?

If the value returned is '0', the command succeeded. If it is any other value, the command failed.

   d. Build the mangOH Distribution for the module in your mangOH Red (replace <module_series> with your CF3 module series; see the list of supported values below the example):

```
$ make <module_series>     (Or use "make" with no parameters to build all plat-
      forms.)
```

   (For example, "make red_wp76xx".)

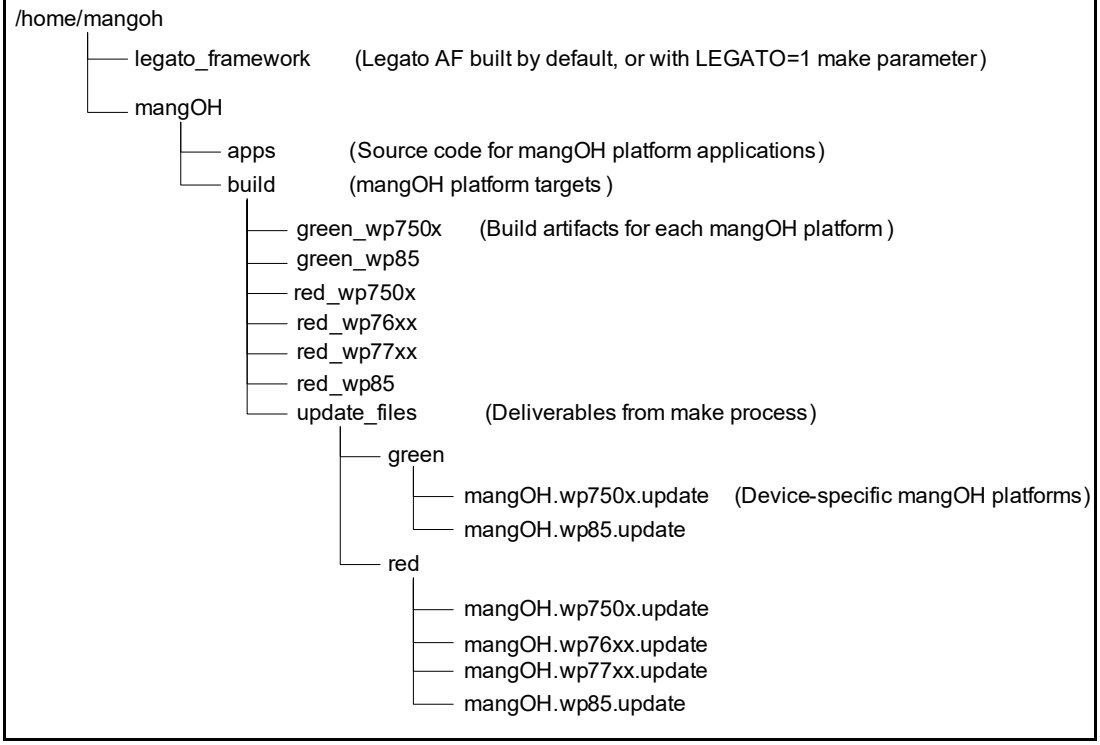
```
mangoh@mangoh-virtualbox: ~/mangOH$ make red_wp76xx
make -C /home/mangoh/legato_framework/legato framework_wp76xx
make[1]: Entering directory '/home/mangoh/legato_framework/legato'
Module: WiFi
Module: Dualsys
make -f Makefile.hostTools
make[2]: Entering directory '/home/mangoh/legato_framework/legato'
Using ninja installed at: /usr/bin/ninja
ln -sf ../build/tools/mk bin/mk
...
...
make[1]: Leaving directory '/home/mangoh/mangOH/build/red_wp76xx/component/
b40423db541c8eac7b2fb6750dbba543'
[235/235] Packaging system
```

Note: *• This may take several minutes to run.*
• The number of packages listed will vary (newer platform releases will have different numbers of files).

Note: *The make command uses optional parameters to limit the deliverables being built.*
Full command format: [LEGATO=<enable>] make <module_series>
Where:
LEGATO=<enable>
0 —Legato AF is not built
1 —Legato AF is built (Default)
<module_series>—Build only the specified mangOH distribution (additional distributions will be added as new products become available):
• green_wp85
• green_wp750x
• red_wp85
• red_wp750x
• red_wp76xx
• red_wp77x

Tip: *Optionally, before using the make command to build the mangOH Distribution, you can use "make clean" to clear out any build artifacts that are generated and stored by the make command.*

mangOH Distribution build structure



e. Verify that the mangOH Distribution update file(s) were created:

```
$ ls -al build/update_files/*
```

```
mangoh@mangoh-virtualbox: ls -al build/update_files/*
build/update_files/green:
total 8768
drwxrwxr-x 2 mangoh mangoh    4096 Mar 13 14:54 .
drwxrwxr-x 4 mangoh mangoh    4096 Mar 13 14:57 ..
-rw-rw-r-- 1 mangoh mangoh 4482347 Mar 29 10:25 mangOH.wp750x.update
-rw-rw-r-- 1 mangoh mangoh 4483761 Mar 29 10:24 mangOH.wp85.update

build/update_files/red:
total 20088
drwxrwxr-x 2 mangoh mangoh    4096 Mar 13 15:09 .
drwxrwxr-x 4 mangoh mangoh    4096 Mar 13 14:57 ..
-rw-rw-r-- 1 mangoh mangoh 4739082 Mar 29 10:25 mangOH.wp750x.update
-rw-rw-r-- 1 mangoh mangoh 5534901 Mar 29 10:26 mangOH.wp76xx.update
-rw-rw-r-- 1 mangoh mangoh 5534836 Mar 29 10:26 mangOH.wp77xx.update
-rw-rw-r-- 1 mangoh mangoh 4740299 Mar 29 10:25 mangOH.wp85.update
```

Example data

6. Install the mangOH Red Distribution:

a. Make sure the mangOH board is powered on and is connected to your dev machine—the board is connected if you receive ping responses:

```
$ ping 192.168.2.2
```

Press Ctrl+C to return to the command prompt.

b. Install the mangOH Red Distribution specific to the CF3 module on your mangOH board:

```
$ update ~/mangOH/build/update_files/red/<updatefile> 192.168.2.2
```

For example, if the CF3 module in your mangOH Red is a WP7603, use:

```
$ update ~/mangOH/build/update_files/red/mangOH.wp76xx.update 192.168.2.2
```

Tip: *For detailed information about the VM and the build process, view the Readme files in /home/mangOH and /home/mangOH/mangOH.*

If the applications install successfully, the last message shown will be "SUCCESS Done".

Note: *If the CF3 module has any problems starting the mangOH Red applications, it automatically reboots and restores to its original state (prior to the instsys command). If this happens, the CF3 module will not be reachable while it is rebooting.*

```
mangoh@mangoh-virtualbox: update ~/mangOH/build/update_files/red/mangOH.wp76xx.update
192.168.2.2
Applying update from file '/home/mangoh/mangOH/build/update_files/red/mangOH.wp76xx.update' to
device at address '192.168.2.2'.
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++
Applying update: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++
SUCCESS
Done
```

7. Verify the mangOH Distribution installed correctly:
   a. Connect to the mangOH Red:
      `$ ssh root@192.168.2.2`
   b. Show the list of installed apps to confirm the build and install succeeded:
      `# app status`
      The Legato system distributed as part of the WP firmware image does not include the redSensorToCloud app. If redSensorToCloud appears in the list, then the update has been applied:

```
root@swi-mdm9x28:~# app status
[running] atService
[running] audioService
[running] avcService
[stopped] batteryService
[running] cellNetService
[running] dataConnectionService
[stopped] dataPushTest
[running] dataRouter
[running] devMode
[stopped] drTool
[running] fwupdateService
[running] gpioService
[running] ledService
[running] modemService
[running] mqttClient
[running] portService
[running] positioningService
[running] powerMgr
[stopped] redSensorToCloud   <-- Distribution installed if this application appears
[running] secStore
[stopped] smsInboxService
...
```

   c. Disconnect from the mangOH Red:
      `# exit`

Now that the mangOH Red platform is installed, you will learn how to Register On Mobile Network on page 31.

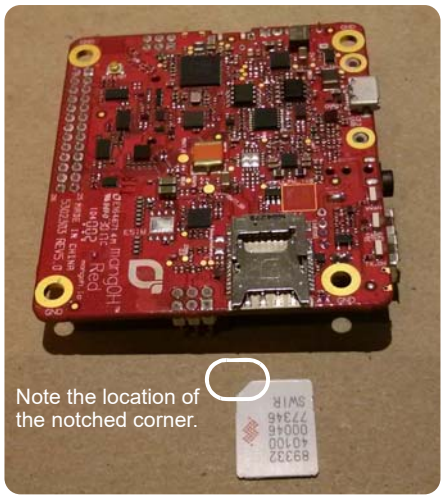
6: Register On Mobile Network

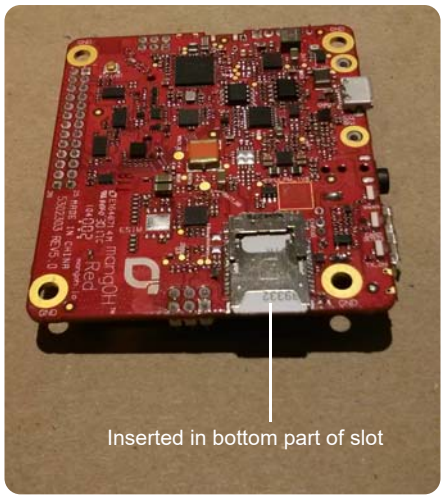
In this chapter, you will make sure the mangOH Red can connect to the mobile network (for your SIM provider).

6.1 Connect To a Mobile Network

To connect to a mobile network, you must have a micro-SIM in the mangOH Red.

1. If you do not have a micro-SIM in the mangOH Red, insert one before continuing:
   a. Disconnect power from the mangOH Red (remove the jumper from the power header, or unplug the micro-USB cable that is providing power).
   b. Insert a micro-SIM in the slot on the bottom side of the mangOH Red. (Either the micro-SIM included with the kit, or one that has been activated by another mobile network provider.)





   c. Reconnect the power (plug in the micro-USB cable or insert the jumper on the power header on the same pins it was removed from in step a. The Power LED will light immediately.

> **Note:** *You must disconnect the power before switching SIMs so the mangOH_Red can detect the SIM while powering on.*

   d. Wait until the device enumerates.
2. Connect to the mangOH Red:
   ```
   $ ssh root@192.168.2.2
   ```
3. Turn off the CF3 module's radio (it may have been started automatically by other processes):
   ```
   # cm radio off
   ```
4. Set the CF3 module to use IPv4 addressing (this is required for use with AirVantage later in the guide):
   ```
   # cm data pdp ipv4
   ```

5. Turn on the CF3 module's radio:

   ```
   # cm radio on
   ```

6. Display the status of the CF3 module's radio:

   ```
   # cm radio
   ```

```
root@swi-mdm9x28: ~# cm radio
Power:                  ON
Current Network Operator:
Current RAT:            Not available
Status:                 Not registered but currently searching for a new operator
(LE_MRC_REG_SEARCHING)
Signal:                 No signal strength (0)
PS:                     Packet Switched Not registered (LE_MRC_REG_NONE)
```

Example response when Power is ON, and Status is Searching

```
root@swi-mdm9x28: ~# cm radio
Power:                  ON
Current Network Operator: Rogers Wireless
Current RAT:            LTE network (LE_MRC_RAT_LTE)
Status:                 Registered to a roaming network (LE_MRC_REG_ROAMING)
Signal:                 Good signal strength (3)
PS:                     Packet Switched Registered, home network (LE_MRC_REG_HOME)
```

Example response when Power is ON, and Status is Registered

```
root@swi-mdm9x28: ~# cm radio
Power:                  OFF
Current Network Operator:
Current RAT:            Not available
Status:                 Not registered and not currently searching for new operator (LE_MRC_REG_NONE)
Signal:                 No signal strength (0)
PS:                     Packet Switched Not registered (LE_MRC_REG_NONE)
```

Example response when Power is OFF

Important: *Typically, your module will register on a network in < 1 minute. However, the very first time your CF3 module and Sierra SIM are used, registration may take from 5–20 minutes.*

7. If the:
   - Power is ON and Status is "... searching ..."'—Wait 10–15 seconds while the radio searches for a network to register on, then repeat Step 6.
   - Power is ON and Status is Registered—Continue to Step 8.
   - Power is OFF—Turn on the radio and then go back to Step 6:

     ```
     # cm radio on
     ```

8. Display the SIM card's ICCID value (which will be used when you register for your free AirVantage account):

   ```
   # cm sim info
   ```

```
root@swi-mdm9x28: ~# cm sim info
Type:                   EXTERNAL_SLOT_1
ICCID:                  89332401000004550147
Home Network Operator: I TIM
EID:
IMSI:                   222013094587037
```

Your SIM data should appear as shown above.

Note: *The Home Network Operator is the ISP that provides the network on which the CF3 module is connected. This may be different than the provider of the SIM if you are connecting to a network that your SIM's provider has an agreement with. For example, Sierra Wireless SIMs will connect to a variety of networks as in the example above.*

9. Check the connection status:

   `# cm data`

```
root@swi-mdm9x28: ~# cm data
Index:      1
APN:        internet.sierrawireless.com
PDP Type:   IPV4
Connected:  no
```

Example response when Not connected, and APN is set

```
root@swi-mdm9x28: ~# cm data
Index:      1
APN:
PDP Type:   IPV4
Connected:  no
```

Example response when Not connected, and no APN

   a. Determine which APN to use for your SIM:
      - Sierra Wireless (included with kit)—internet.sierrawireless.com
      - AT&T (included with ATT_mangOH_Red kit only)—m2m.com.attz
      - Others—Check with the mobile network provider, or search the Internet for "<provider> APN". For example, "Rogers Wireless APN"

> **Note:** *If your mobile network operator uses different APNs for 3G and LTE, make sure to use the correct APN for your CF3 module type. (e.g. WP8548 is a 3G module, and WP7603 is an LTE module.*

   b. Set the APN (replace <apn_value> with the actual APN):

      `# cm data apn <apn_value>`

      (e.g., "# cm data apn internet.sierrawireless.com")

```
root@swi-mdm9x28: ~# cm data apn internet.sierrawireless.com
root@swi-mdm9x28: ~# cm data
Index:                1
APN:                  internet.sierrawireless.com
PDP Type:           IPV4
Connected:          no
```

Example data

   c. Check the connection status again to make sure you set the APN correctly:

      `# cm data`

```
root@swi-mdm9x28: ~# cm data
Index:                1
APN:                  internet.sierrawireless.com
PDP Type:             IPV4
Connected:            no
```

Example data

   d. If the APN is not the value you set, go back to step b.

10. The CF3 module is registered on a mobile network, and the SIM is installed and configured with the correct APN. You are now ready to transmit data to "the cloud" (AirVantage).

In the next section—Connect to the IoT Cloud on page 34, you will set up your free account on the Sierra Wireless AirVantage IoT Acceleration Platform and begin sending data to the 'cloud'.

7: Connect to the IoT Cloud

In this chapter, you will register your device with Sierra Wireless' AirVantage IoT Acceleration platform (a cloud-based service to collect data from your device), and begin sending/receiving data.

7.1 Claim Your Free AirVantage Account

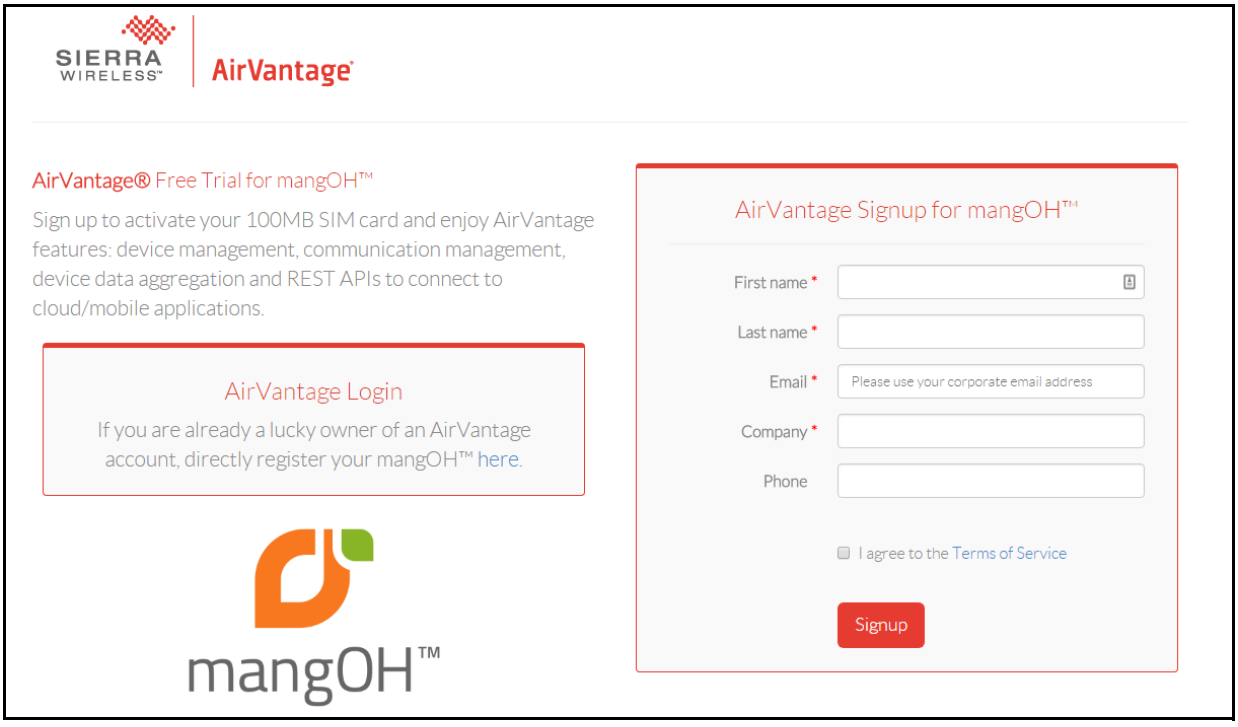
Your mangOH Red kit includes a free mangOH-customized account on the AirVantage IoT Acceleration Platform for your CF3 module. This platform provides Sierra Wireless' cloud-based services for over-the-air (OTA) device management and application enablement. These services provide the infrastructure for you to build, connect, and operate your IoT applications in a single platform.

Note: *You can register up to five devices on your free account.*

To use AirVantage, you must register your device and then connect your mangOH Red to the AirVantage server. If you have an AirVantage account for non-mangOH devices, register for a new account for your mangOH device(s) to enable access to the mangOH-specific customizations.

7.1.1 Register/Log In to AirVantage

1. In a browser, go to https://eu.airvantage.net/accounts/signup?type=Mangoh.



2. If you already have a mangOH AirVantage account, click the link in the AirVantage Login section and go to Step 10 on page 37. Otherwise, continue to the next step.

3. Enter your registration details, including:
   - First and last names
   - Email address

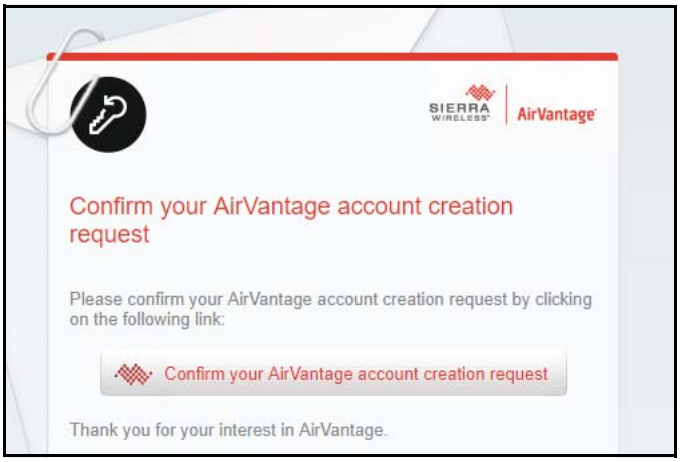
   Important: *Use a valid email address—This is your username for accessing AirVantage, and is needed to complete the registration process.*

   - Company—Descriptive name to identify this AirVantage account. Use a unique name such as a combination of your company name, the project name, your name, etc.

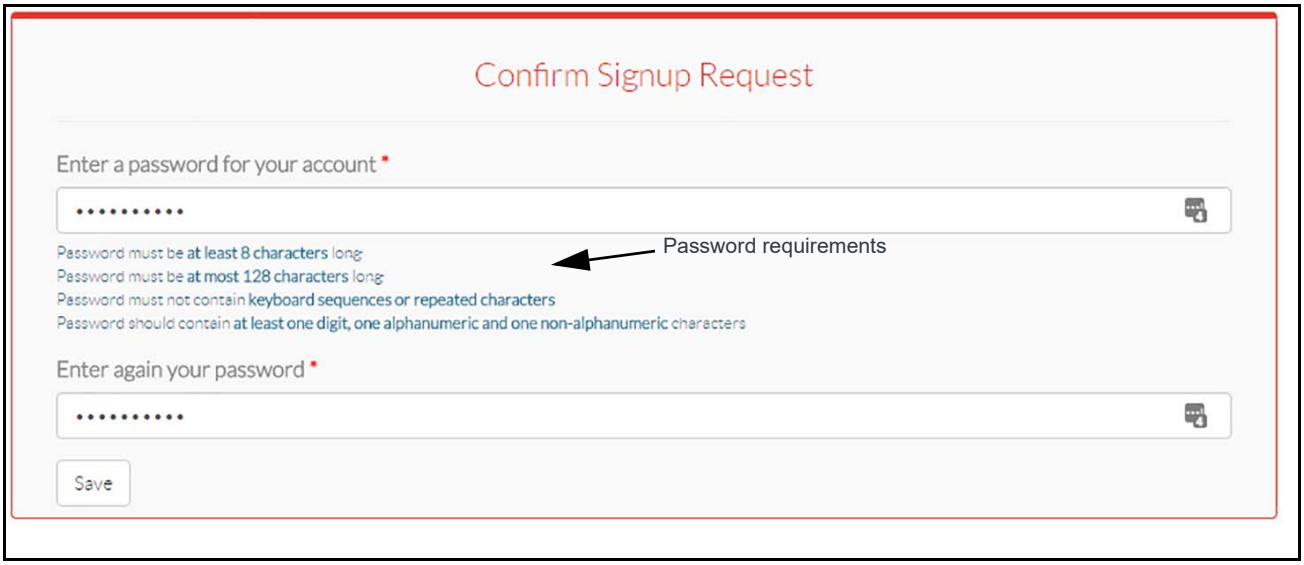
   Important: *Company name must be unique—If the name has been used by any other person to set up their account, you will have to change this to make it unique.*

   - Phone number—Use international format (for example, for North American phone numbers, use "001" plus the 10-digit area code and phone number).
4. Review the Terms of Service and select "I agree to the Terms of Service".
5. Click Signup.

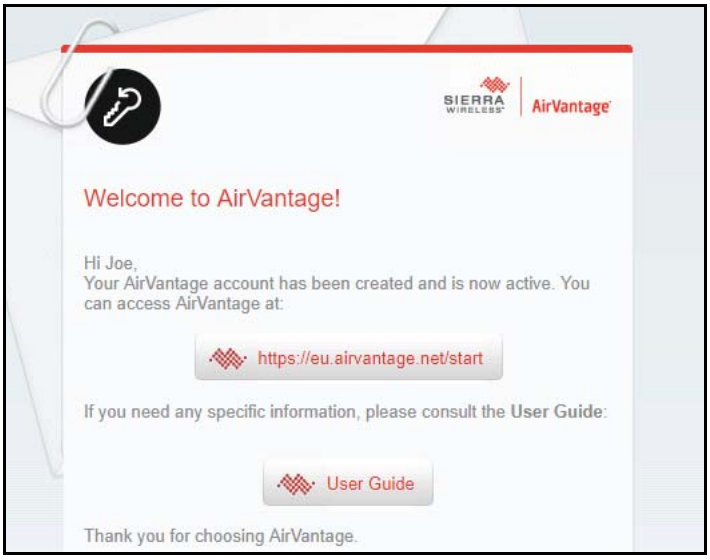
   An email is sent automatically to your email address with a confirmation link.
6. Open the email and click the link to confirm your signup request.



7. When your browser opens to confirm the signup request, enter a password that satisfies the requirements shown on-screen, and re-enter it to confirm.

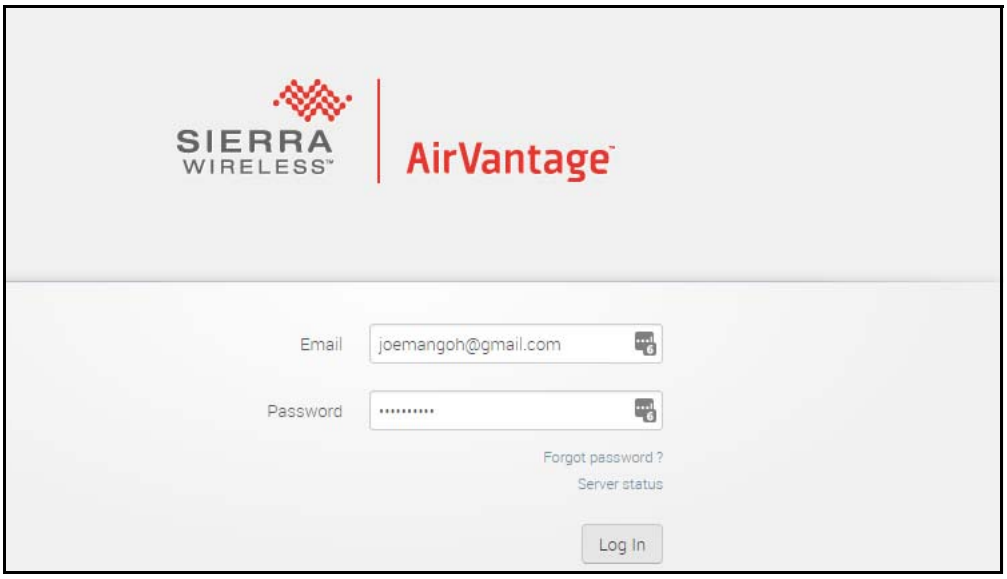


8. Click Save.
   If your password is acceptable, You will receive an email to confirm your account creation.

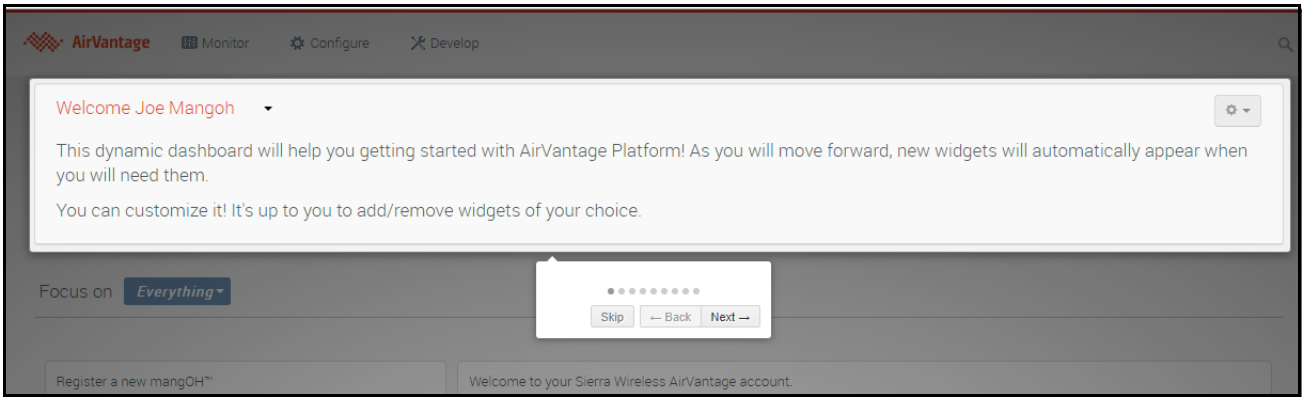


9. Click the link to go to http://eu.airvantage.net/start. The AirVantage Login screen appears.

10. Enter your account's email address and password, and click Log In.



11. The first time you log in to your AirVantage account, a walkthrough tutorial appears. If you don't want to use it, click Skip. Otherwise, click Next to step through it.



12. If you did not record your SIM's ICCID and your device's FSN and IMEI earlier, record them now:

a. Connect to the mangOH Red:

```
$ ssh root@192.168.2.2
```

b. Display the device information (including the FSN and IMEI):

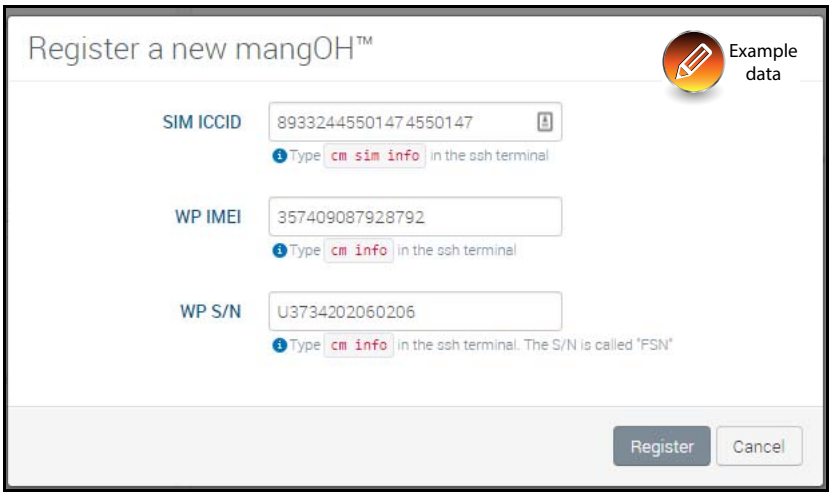
```
# cm info
```

c. Display the SIM information (including the ICCID):

```
# cm sim info
```

13. In the mangOH tile, click Register.

14. In the Register a new mangOH window, enter your SIM and device's information:

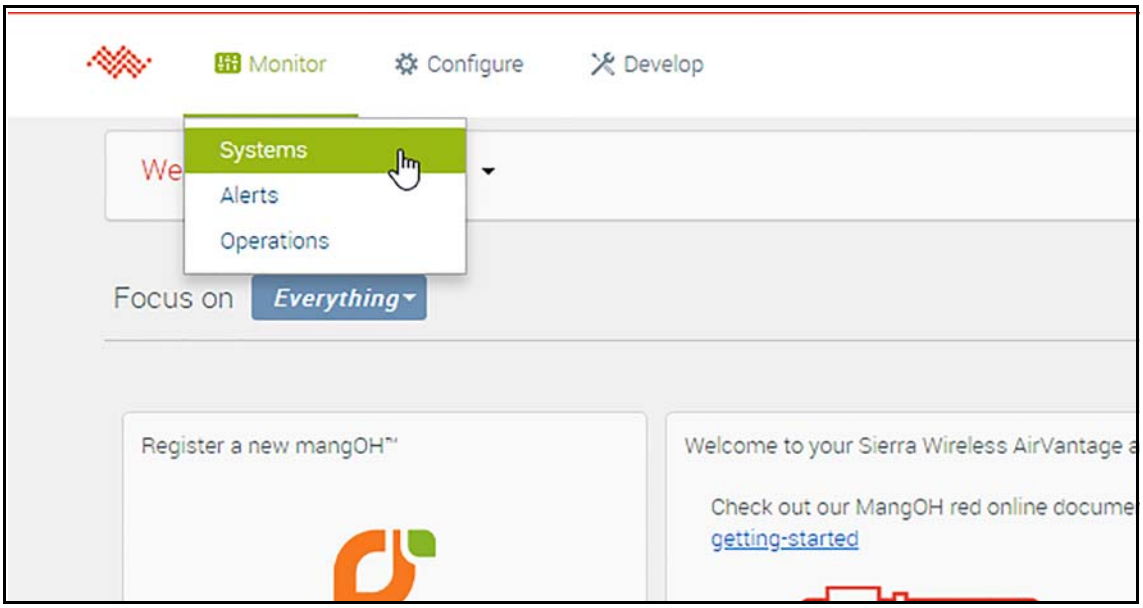


- SIM ICCID—Enter the SIM's ICCID.
- WP IMEI—Enter the module's IMEI.
- WP S/N—Enter the module's FSN.

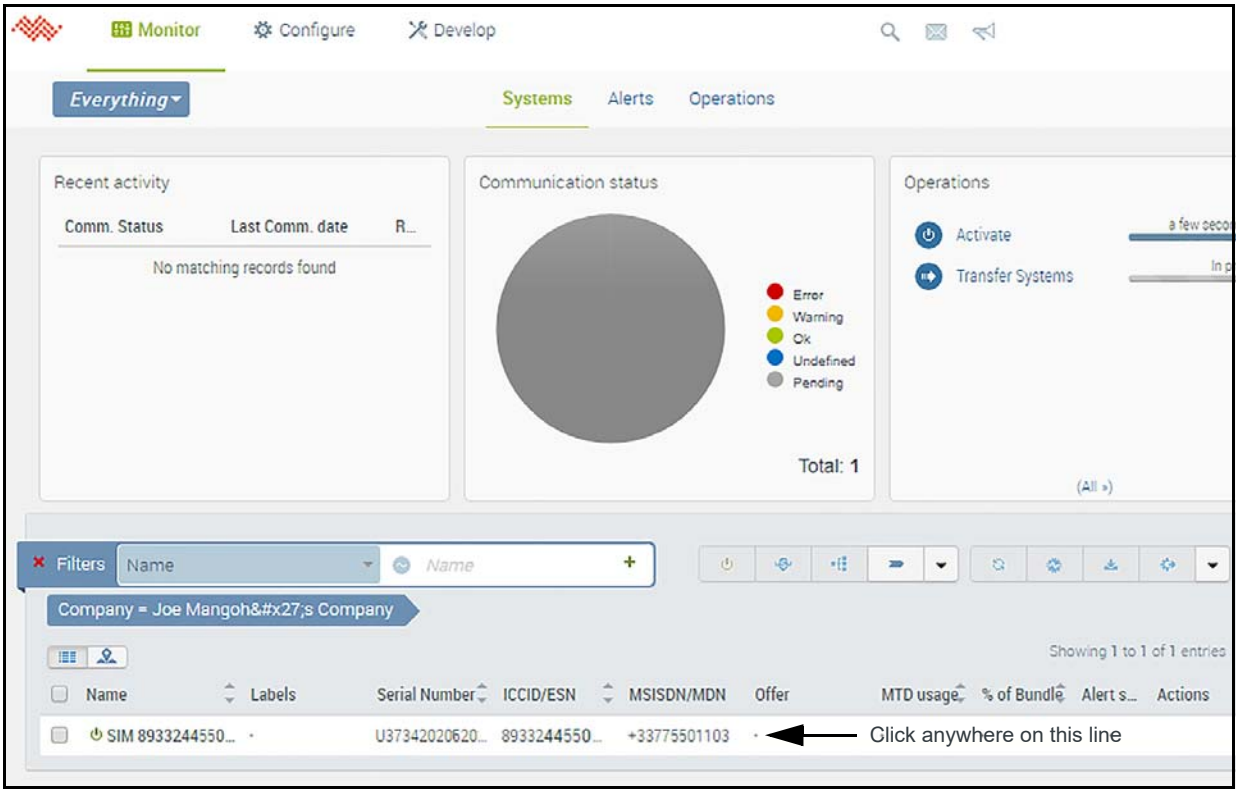
Note: Your device and SIM are linked in AirVantage. If you change your SIM at some point after registering the device, you will have to unlink the module from the SIM, and then re-register the device with a new SIM:
On the dashboard, select More > Edit, clear the IMEI and Serial Number, and click Save. Then re-register the device with your new SIM ICCID.

15. Click Register.

16. Click Monitor, then select Systems to display your registered devices.

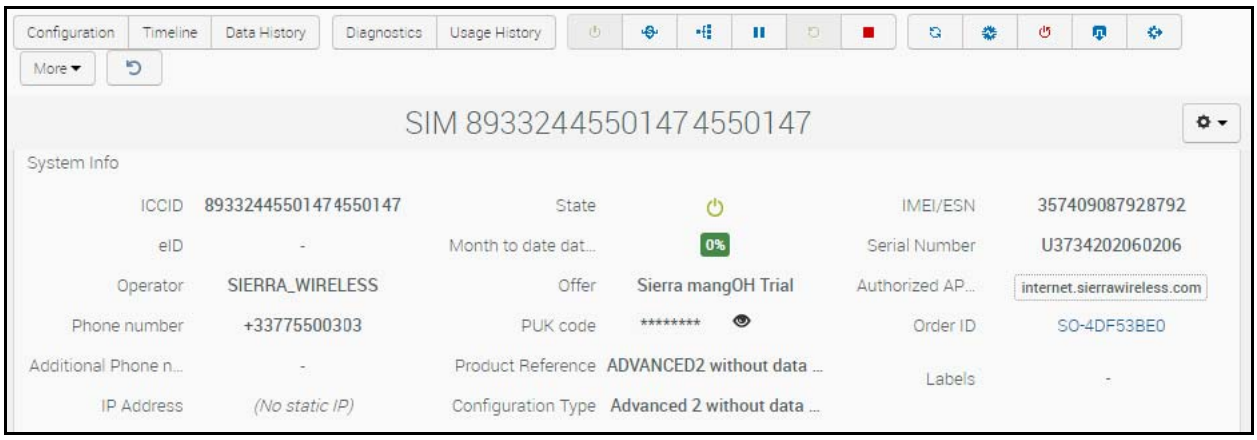


17. Click anywhere in the line showing your device to display the device dashboard (System Details) screen. (All the devices registered on your account appear in this list; make sure to click the correct device.)



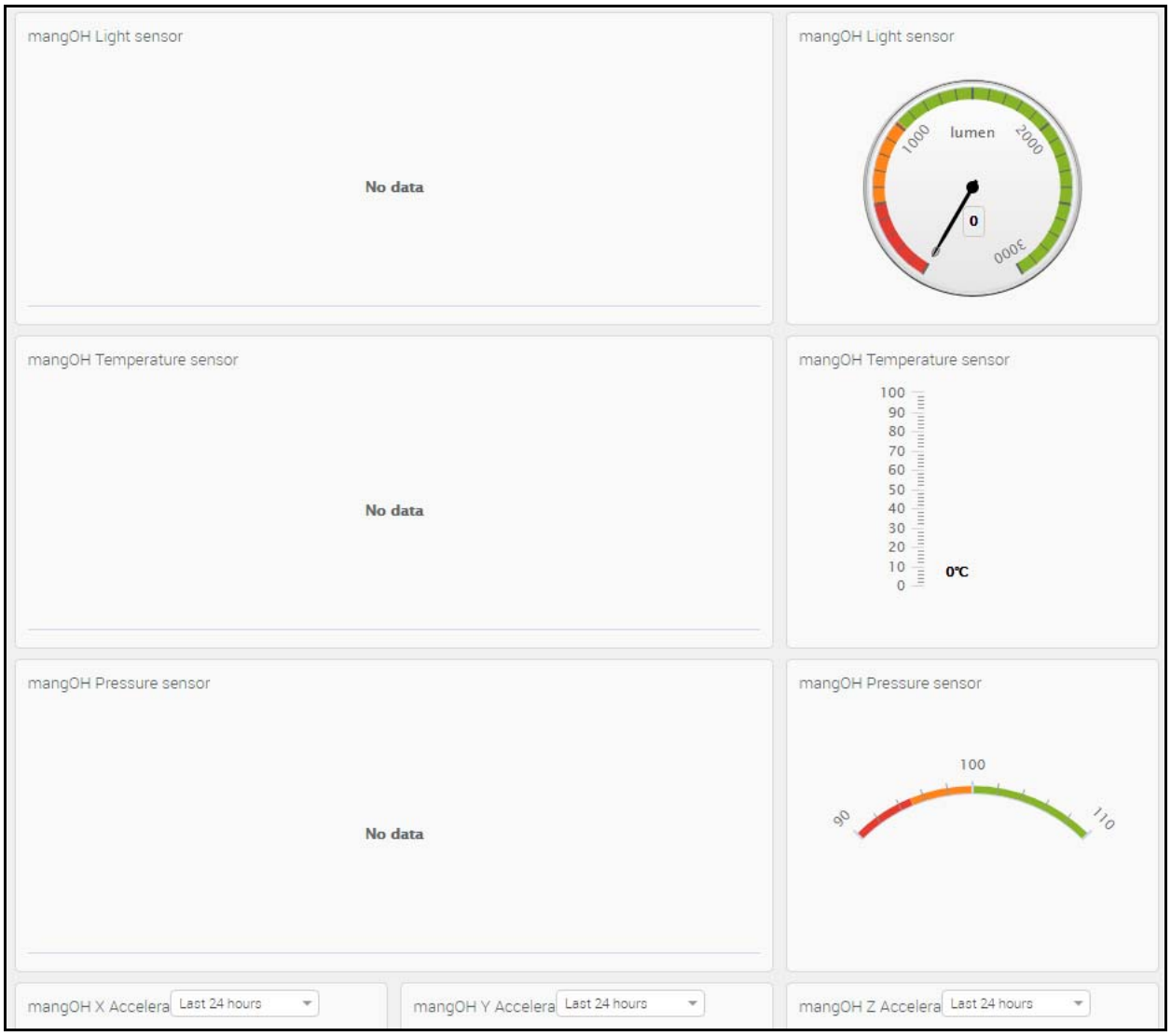
18. The device dashboard displays:

- System information—Device registration details (ICCID, IMEI, Serial Number), month-to-date SIM data usage, and more.

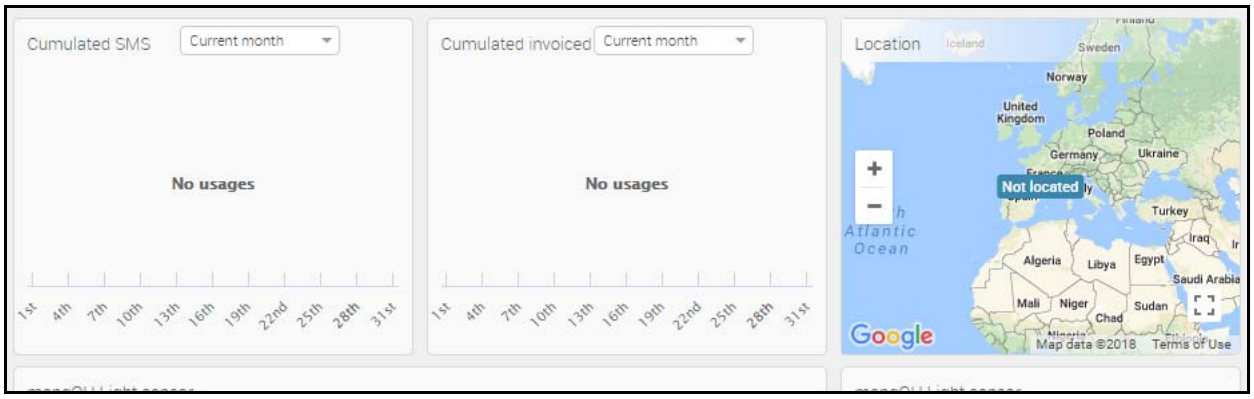


- Last Communication—Details about the most recent communication from/to your device, plus a link to a full list of all communications.

- Widgets showing your device's most recent sensor readings and charts of those readings over time.



- GPS location (if your device is in view of GPS satellites)



- Switch mangOH LED—A widget to demonstrate how AirVantage can push data to your device.

Note: The communication and sensor widgets are initially blank because you have not connected your mangOH Red to AirVantage yet. Leave this browser window open and continue to *Connect to AirVantage on page 42**.*

7.1.2 Connect to AirVantage

Now that you are registered on AirVantage, you can connect your mangOH Red to the AirVantage server and begin transmitting sensor data:

1. On the dev machine, open a terminal window.
2. Connect to the mangOH Red:

   ```
   $ ssh root@192.168.2.2
   ```

3. The mangOH Red platform includes redSensorToCloud, an application that reports sensor data from your mangOH Red to the IoT cloud. Start the application to send data to AirVantage, and confirm that it started running:

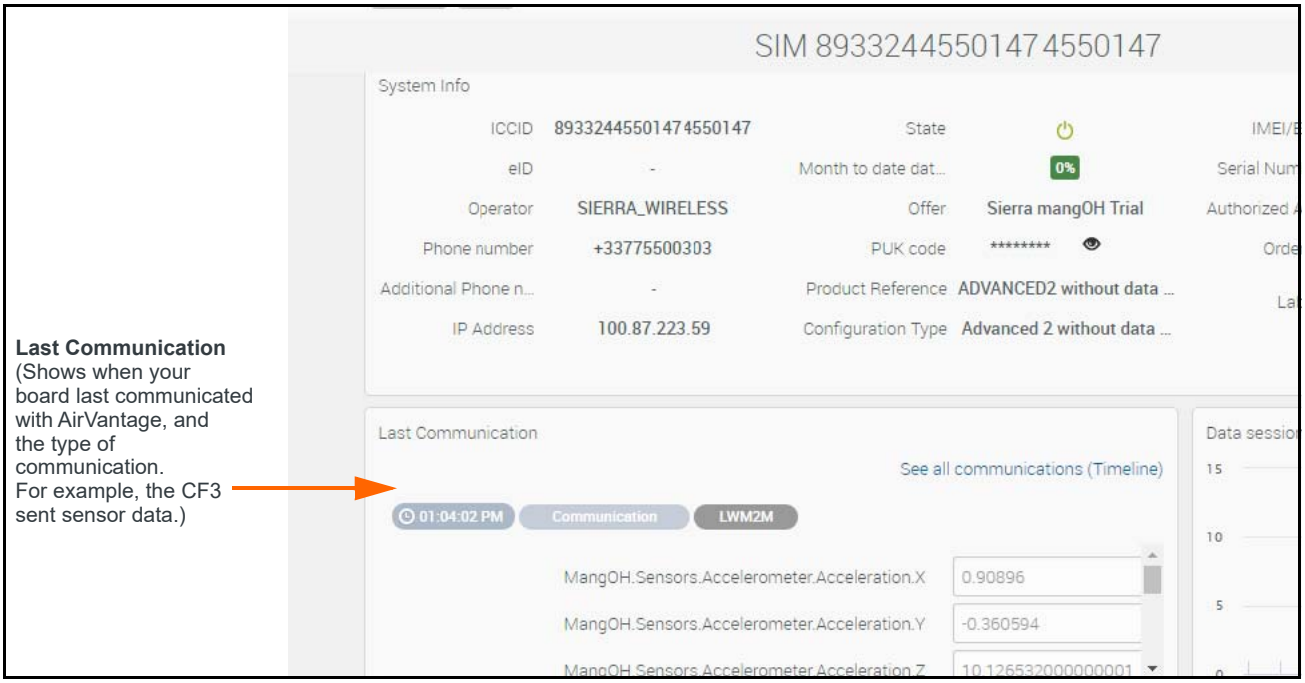
   ```
   # app start redSensorToCloud
   # app status
   ```

```
root@swi-mdm9x28: ~# app status
[running] atService
[running] audioService
[running] avcService
[stopped] batteryService
[running] cellNetService
...
[running] positioningService
[running] powerMgr
[running] redSensorToCloud
[running] secStore
...
```

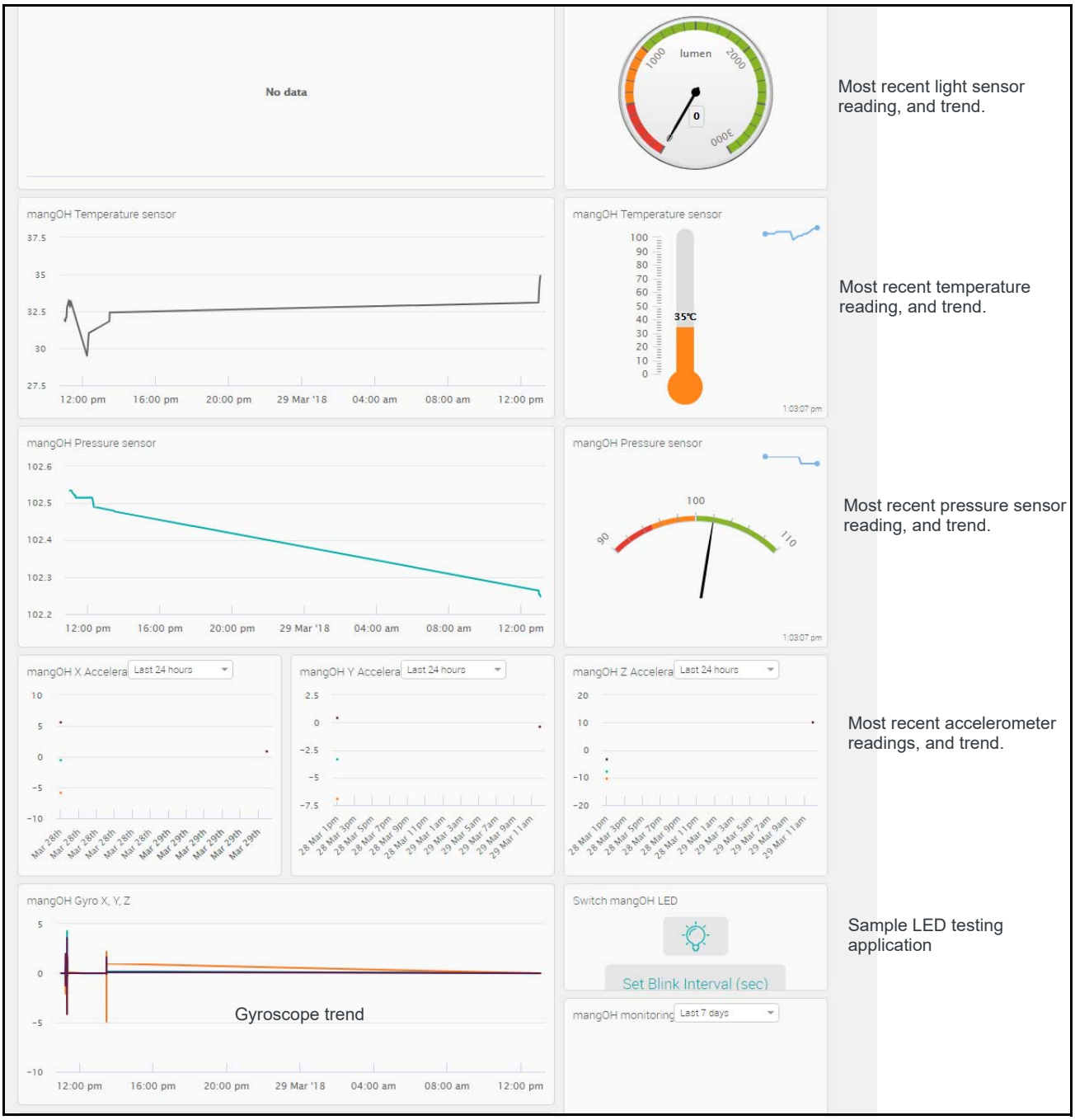
Note: *redSensorToCloud automatically opens a data connection, so you do not need to use "cm data connect".*

4. In your browser, refresh the device dashboard screen.

   The Last Communication section shows your Registration connection or sensor data (whichever was most recently received) and the sensor widgets will show the readings that are detailed in the communication entries.



Last Communication (Shows when your board last communicated with AirVantage, and the type of communication. For example, the CF3 sent sensor data.)



Most recent light sensor reading, and trend.

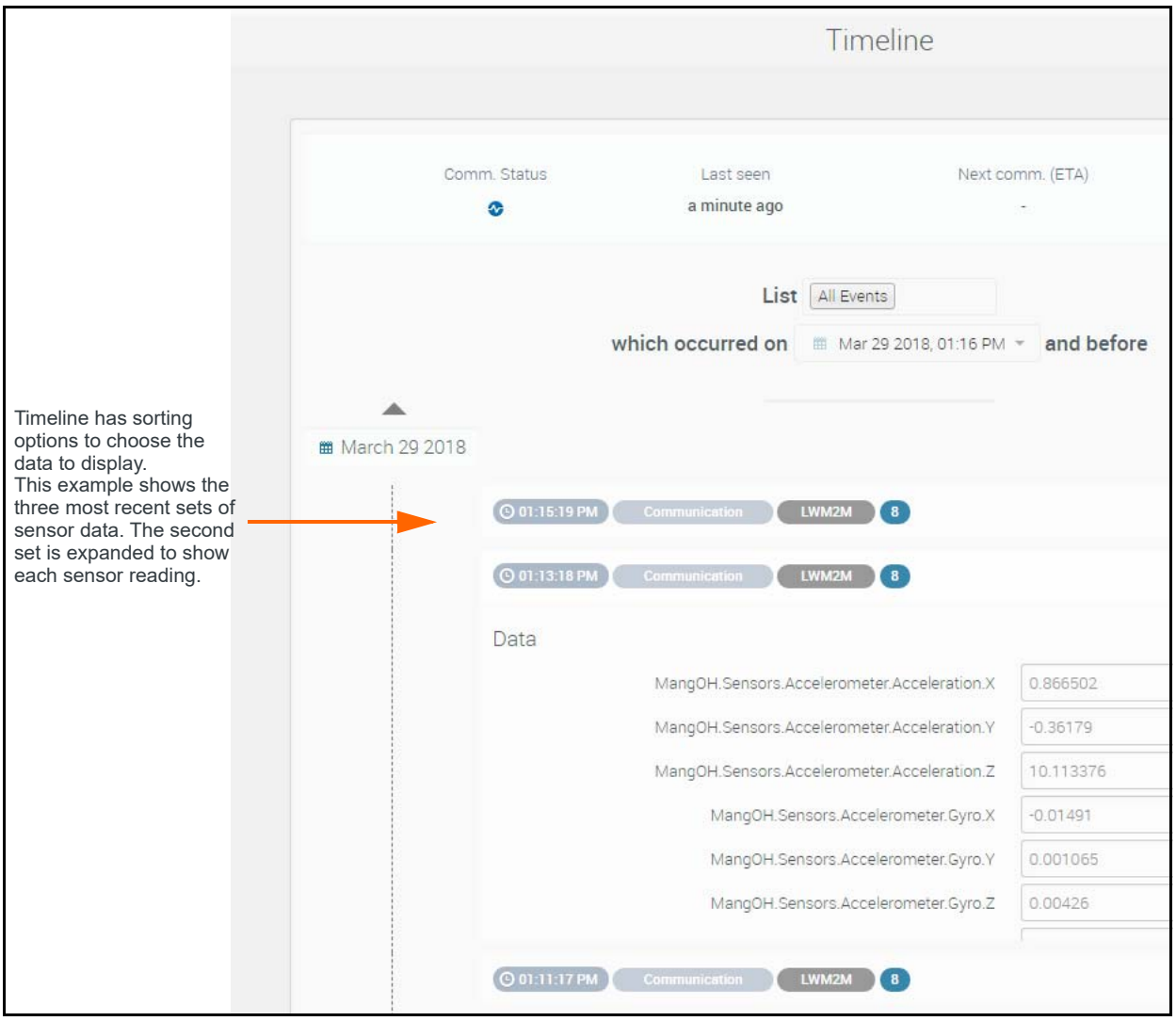
Most recent temperature reading, and trend.

Most recent pressure sensor reading, and trend.

Most recent accelerometer readings, and trend.

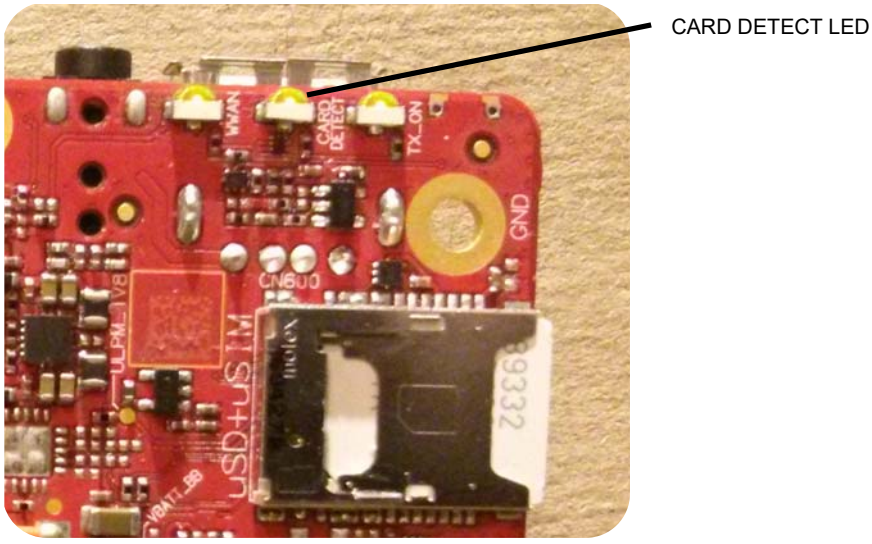
Sample LED testing application

5. For details on all transmissions received, in the Last Communication Section, click See all communications (Timeline).



6. Now that your device is connected to AirVantage, you can also push data to the device. The Switch mangOH LED widget demonstrates this by enabling you to turn on the mangOH Red's CARD DETECT LED from AirVantage and make it start blinking:

   a. In the Switch mangOH LED widget, click the light bulb icon to turn on the CARD DETECT LED. (Note: To turn the LED off, click the light bulb icon again.)



b. Click Set Blink Interval (sec) and enter a blink interval (in seconds), then click OK. AirVantage sends the command to your device and when the command is received, the LED begins to blink at the requested rate.

7. You have now successfully transmitted and received data to/from the cloud. You can now stop sending sensor data from the device (if desired):

```
# app stop redSensorToCloud
```

8. Make sure redSensorToCloud has stopped:

```
# app status
```

```
root@swi-mdm9x28: ~# app status
[running] atService
[running] audioService
[running] avcService
[stopped] batteryService
[running] cellNetService
...
[running] positioningService
[running] powerMgr
[stopped] redSensorToCloud
[running] secStore
...
```

Note: *redSensorToCloud uses the Legato data connection service, so the data connection closes automatically when redSensorToCloud is stopped.*

You have now registered and connected your device to AirVantage, and completed the mangOH Red Getting Started tutorial. For more information on the mangOH platform, visit mangoh.io.

To begin developing simple applications or modifying existing applications, work through the examples in Develop and Test Applications on page 47.

A: Develop and Test Applications

A

In this section, you will learn how to develop applications in the Legato development environment, install them onto your mangOH Red, and test that they run.

Legato provides two interfaces for developing applications:

- CLI—Command Line Interpreter in a terminal window.
- Developer Studio—A GUI (Graphical User Interface) development environment.

This section describes development using CLI.

Note: *You will be updating application source code in this section. Use whichever editor you prefer—these instructions do not refer to a specific editor.*

Note: *This tutorial touches on the basics of using the Legato development environment. After completing the examples in this chapter, see http://legato.io/legato-docs/latest/mangOH_developers.html for detailed references, forums, etc.*

A.1 Develop using the CLI—Command Line Interpreter

A.1.1 Configure the Dev Machine's Terminal Windows for Development

To use the CLI in a terminal window to compile and build applications, you must configure the window to work with Legato tools.

Each time you open a new terminal window, do the following:

1. Configure the window:

   ```
   $ cfglegato
   ```

```
mangoh@mangoh-virtualbox:~$ cfglegato
Configuring shell for Legato development
----------------------------------------
[ar7] No toolchain found for target 'ar7'.
[ar86] No toolchain found for target 'ar86'.
[wp85] Toolchain dir[/opt/swi/y17-ext-wp85/sysroots/x86_64-pokysdk-linux/usr/bin/arm-poky-linux-
gnueabi] prefix[arm-poky-linux-gnueabi-]
[wp750x] Toolchain dir[/opt/swi/y17-ext-wp750x/sysroots/x86_64-pokysdk-linux/usr/bin/arm-poky-linux-
gnueabi] prefix[arm-poky-linux-gnueabi-]
[wp76xx] Toolchain dir[/opt/swi/y22-ext-wp76xx/sysroots/x86_64-pokysdk-linux/usr/bin/arm-poky-linux-
gnueabi] prefix[arm-poky-linux-gnueabi-]
[wp77xx] Toolchain dir[/opt/swi/y22-ext-wp77xx/sysroots/x86_64-pokysdk-linux/usr/bin/arm-poky-linux-
gnueabi] prefix[arm-poky-linux-gnueabi-]
[ar758x] No toolchain found for target 'ar758x'.
[ar759x] No toolchain found for target 'ar759x'.
[virt] No toolchain found for target 'virt'.
```

Ignore the 'No toolchain found' warnings. These apply to devices that are not supported by the mangOH Red.

Note: *One thing the command does is check to see which toolchains you have on your development machine and warn you about any that are missing. Since you have loaded only the wp85 toolchain, warnings appear about the others. You can ignore these messages.*

2. Confirm that the environment was set correctly:

```
$ echo $LEGATO_ROOT
```

```
mangoh@mangoh-virtualbox:~$ echo $LEGATO_ROOT
/home/mangoh/legato_framework/legato
```

If a directory path appears, the command worked. If no value was returned, there was a problem with the command—make sure that you entered the alias correctly, using the actual directory name that you used to install Legato.

A.1.2 Update an Installed Application

As you saw when you set up your AirVantage account, one of the mangOH platform applications loaded on your device in Build/Install mangOH Distribution—Detailed Steps on page 23 was redSensorToCloud. This application reports sensor readings to the cloud (e.g. AirVantage) every two minutes.

In this section you will increase the reporting frequency of the redSensorToCloud application and install the new version on the mangOH Red.

To update redSensorToCloud:

1. On the dev machine, open a new terminal window.
2. Configure the window for development:

```
$ cfglegato
```

3. Change directory to the folder containing the application's source code:

```
$ cd $MANGOH_ROOT/apps/RedSensorToCloud
```

4. The source code components for this application are in two sub-folders—avPublisherComponent and sensorsComponent. The code that controls the publishing frequency is in avPublisherComponent—change directory to that folder:

```
$ cd avPublisherComponent
```

5. Open and edit avPublisher.c (the source code file) with your preferred editor—two values must be updated to adjust the reporting frequency:
   a. Search for the variable declaration for MaxIntervalBetweenPublish.

      static const int MaxIntervalBetweenPublish = 120;

   b. Change the interval value to 30—This increases the reporting frequency to at least once every 30 seconds from once every 120 seconds.
   c. Search for the variable declaration for TimeToStale.

      static const int TimeToStale = 60;

   d. Change the stale value to 30—This decreases the length of time a sensor reading is considered to be 'current' before a new sensor reading must be taken.
   e. Save your changes and exit the editor.

At this point, you have modified the redSensorToCloud application's source code. Now you have to build (compile) it.

This application was created as part of the mangOH Red platform; to rebuild the application, you will rebuild the whole platform. This method is suggested when applications may interact with each other. If only one application is rebuilt, it may not work properly with other applications that it depends on (or that depend on it).

To rebuild the mangOH Red platform, including redSensorToCloud with your changes, and install it onto your mangOH Red:

1. Build and install the mangOH Red platform (use 'make' to build for all devices, or use the correct device-specific parameter for your module—see Section C.3 mangOH Platform 'make' parameters for details):

```
$ cd $MANGOH_ROOT
$ make red_wp76xx     (Or use "make" with no parameters to build all platforms.)
```

```
mangoh@mangoh-virtualbox:~$ cd $MANGOH_ROOT
mangoh@mangoh-virtualbox:~$ make red_wp76xx
make -C /home/mangoh/legato_framework/legato framework_wp76xx
make[1]: Entering directory '/home/mangoh/legato_framework/legato'
Module: WiFi
Module: Dualsys
make -f Makefile.hostTools
make[2]: Entering directory '/home/mangoh/legato_framework/legato'
Using ninja installed at: /usr/bin/ninja
ln -sf ../build/tools/mk bin/mk
..
..
make[1]: Leaving directory '/home/mangoh/mangOH/build/red_wp76xx/component/
4148e1dd38cd5155909636fadbb0800b'
[414/569] Running external build step
make[1]: Entering directory '/home/mangoh/mangOH/build/red_wp76xx/component/
b40423db541c8eac7b2fb6750dbba543'
make[1]: Nothing to be done for 'wakaama'.
make[1]: Leaving directory '/home/mangoh/mangOH/build/red_wp76xx/component/
b40423db541c8eac7b2fb6750dbba543'
[569/569] Packaging system
```

> **Note:** *This may take several minutes to run.*

> **Note:** *This 'make' command uses the Makefile in $LEGATO_ROOT to build the entire system.*

2. Verify that the update files were created:

```
$ ls -al build/update_files/*
```

```
mangoh@mangoh-virtualbox:~$ ls -al build/update_files/*
build/update_files/green:
total 8768
drwxrwxr-x 2 mangoh mangoh    4096 Apr  3 13:08 .
drwxrwxr-x 4 mangoh mangoh    4096 Apr  3 13:12 ..
-rw-rw-r-- 1 mangoh mangoh 4484156 Apr  4 02:40 mangOH.wp750x.update
-rw-rw-r-- 1 mangoh mangoh 4483912 Apr  4 02:39 mangOH.wp85.update

build/update_files/red:
total 20088
drwxrwxr-x 2 mangoh mangoh    4096 Apr  3 13:24 .
drwxrwxr-x 4 mangoh mangoh    4096 Apr  3 13:12 ..
-rw-rw-r-- 1 mangoh mangoh 4740962 Apr  4 02:40 mangOH.wp750x.update
-rw-rw-r-- 1 mangoh mangoh 5535928 Apr  4 20:58 mangOH.wp76xx.update
-rw-rw-r-- 1 mangoh mangoh 5535676 Apr  4 02:41 mangOH.wp77xx.update
-rw-rw-r-- 1 mangoh mangoh 4740192 Apr  4 02:50 mangOH.wp85.update
```

3. Make sure the mangOH board is powered on and is connected to your dev machine—the board is connected if you receive ping responses:

   ```
   $ ping 192.168.2.2
   ```

   Press Ctrl+C to return to the command prompt.

4. Install the mangOH Red platform specific to the CF3 module on your mangOH board:

   ```
   $ update ~/mangOH/build/update_files/red/<updatefile> 192.168.2.2
   ```

   If the applications install successfully, the last message shown will be "SUCCESS Done".

   Note: *If the CF3 module has any problems starting the mangOH Red platform applications, it automatically reboots and restores to its original state (prior to the instsys command). If this happens, the CF3 module will not be reachable while it is rebooting.*

```
mangoh@mangoh-virtualbox:~/mangOH$ update ~/mangOH/build/update_files/red/mangOH.wp76xx.update
192.168.2.2
Applying update from file '/home/mangoh/mangOH/build/update_files/red/mangOH.wp76xx.update' to
device at address '192.168.2.2'.
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Applying update: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
SUCCESS
Done
```

5. After the installation is done, open a terminal window and connect to the mangOH Red:

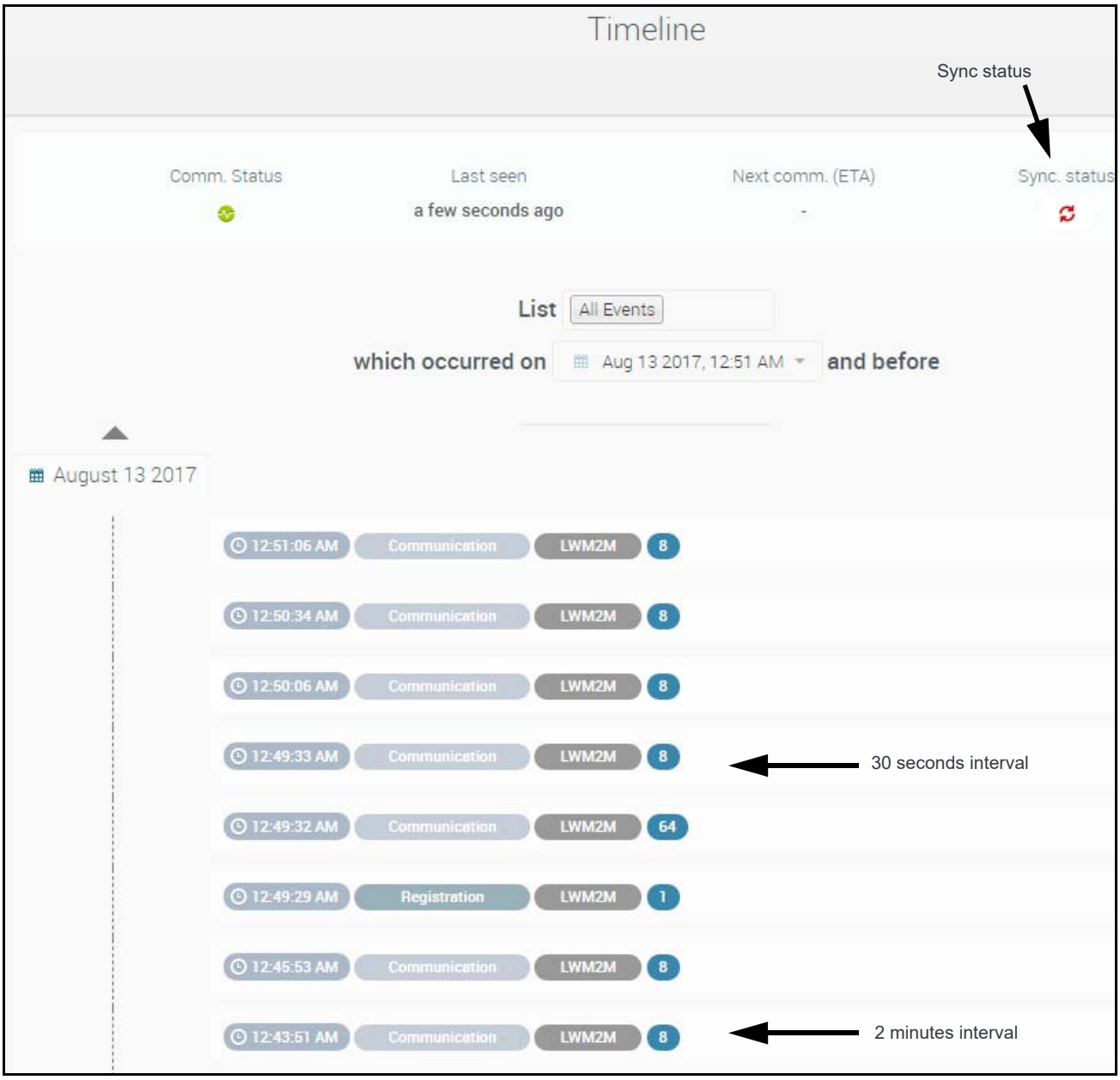
   ```
   $ ssh root@192.168.2.2
   ```

6. By default, redSensorToCloud is installed but not started. Start the application to send data to AirVantage:

   ```
   # app start redSensorToCloud
   ```

   Note: *redSensorToCloud automatically opens a data connection, so you do not need to use "cm data connect".*

   In your AirVantage account, you will start to see sensor reports appearing on your new schedule—on the Timeline screen you can compare the timestamp intervals for new reports compared to reports received before you made your changes as shown in the following figure. (To see new reports received while this screen is being viewed, click the Sync. status icon.)



7. When you're ready to stop sending data:

```
# app stop redSensorToCloud
```

Note: redSensorToCloud automatically closes the data connection, so you do not need to use "cm data connect -1".

A.1.3 Update and Install a New Application

When you installed Legato, sample application files were also stored. In this section, you will build and then install the "hello world" application on the mangOH Red's CF3 module.

Build (compile) an application on the dev machine and install it on the CF3 module:

1. On the dev machine, open a new terminal window.
2. Configure the window for development:
   ```
   $ cfglegato
   ```
3. Change directory to the sample application directory for Hello World:
   ```
   $ cd $LEGATO_ROOT/apps/sample/helloWorld
   ```
4. Compile the application. (Valid module series are listed in the $LEGATO_ROOT/Makefile—wp750x, wp85, wp76xx, wp77xx)
   ```
   $ make wp76xx     (Or use "make" with no parameters to build all distributions.)
   ```

Note: *This 'make' command uses the Makefile in the current directory to build only the sample application. It does not build the entire system like the 'make' command in* *Update an Installed Application on page 48**.*

5. Verify that the update file helloWorld.wp76xx.update was created:
   ```
   $ ls -al
   ```

```
mangoh@mangoh-virtualbox:~/legato_framework/legato/apps/sample/helloWorld$ ls -al
total 52
drwxrwxr-x  4 mangoh mangoh 4096 Apr  4 11:17 .
drwxrwxr-x 21 mangoh mangoh 4096 Jan 18 15:30 ..
drwxrwxr-x  9 mangoh mangoh 4096 Apr  4 11:17 _build_helloWorld
-rw-rw-r--  1 mangoh mangoh  337 Jul 24  2017 CMakeLists.txt
drwxrwxr-x  2 mangoh mangoh 4096 Jul 24  2017 helloComponent
-rw-rw-r--  1 mangoh mangoh  168 Jul 24  2017 helloWorld.adef
-rw-rw-r--  1 mangoh mangoh 8272 Apr  4 21:45 helloWorld.wp76xx.update
-rw-rw-r--  1 mangoh mangoh 8295 Apr  4 11:17 helloWorld.wp77xx.update
-rw-rw-r--  1 mangoh mangoh  151 Aug 23  2017 Makefile
```

6. Install the application on the mangOH Red's CF3 module:
   ```
   $ update helloWorld.wp76xx.update 192.168.2.2
   ```

```
mangoh@mangoh-virtualbox:~/legato_framework/legato/apps/sample/helloWorld$ update
helloWorld.wp76xx.update 192.168.2.2
Applying update from file 'helloWorld.wp76xx.update' to device at address '192.168.2.2'.
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Applying update: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
SUCCESS
Done
```

Note: *This application will remain on the CF3 module until you either specifically remove it, or until the next time you reinstall the system on the CF3 module.*

Log in to the mangOH Red's CF3 module and run the application:

1. Set up a window to show the application's output (the "Hello World" application writes to a log file) as follows:
   a. Open a new terminal window (referred to as LOG_TERM in this procedure).

b. Connect to the mangOH Red:

```
$ ssh root@192.168.2.2
```

c. Watch the log file and show when a message from "hello world" appears:

```
# logread -f | grep "Hello"
```

> **Note:** *Nothing will appear to happen until you run the Hello World application in the next step. Leave this command running until after you see the Hello World output, then you can press Ctrl+C to cancel it and return to the command prompt.*

2. Run the application:

a. Open another terminal window to run the application.

b. Connect to the mangOH Red:

```
$ ssh root@192.168.2.2
```

c. Check that the application is installed:

```
# app status
```

```
root@swi-mdm9x28:~# app status
[running] atService
[running] audioService
[running] avcService
...
...
[stopped] wifiClientTest
[running] wifiService
[stopped] wifiWebAp
[running] helloWorld
```

The "hello world" application should appear in the list with a status of 'running'. The application was built to run automatically; when you write your own applications, you can make them install without running, if you prefer.

d. Stop the application (so you can restart it and see the output):

```
# app stop helloWorld
```

e. Run the application and see that it outputs a "Hello, world." message to the LOG_TERM terminal window:

```
# app start helloWorld
```

```
root@swi-mdm9x28:~# app stop helloWorld
root@swi-mdm9x28:~# app start helloWorld
```

LOG_TERM window

```
root@swi-mdm9x28:~# logread -f | grep "Hello"
Apr  5 04:54:32 swi-mdm9x28 user.info Legato:  INFO | helloWorld[4471]/helloComponent T=mair
helloWorld.c _helloComponent_COMPONENT_INIT() 5 | Hello, world.
```

f. (Optional) If you want to see information about the application, enter the following command:

```
# app info helloWorld
```

```
root@swi-mdm9x28:~# app info helloWorld
helloWorld
  status: running
  running processes:
    helloWorld[4471] (4471)
  app.name: helloWorld
  app.md5: bbff7d67a5be492dbc09fa2780f206db
  app.version:
  legato.version: 18.02.0-3-g376bfbf
```

g. In the LOG_TERM terminal window, press Ctrl+C to return to the command prompt.

You have now successfully compiled a working application, and installed, stopped, and run it on the module.

Note: *To learn more about the Legato development environment, visit http://legato.io/legato-docs/latest/.*

B: Update Legato Application Framework

The Legato VM that you installed on your dev machine in Prepare Your Windows Dev Machine For Legato Development on page 16 was pre-configured with the latest version of the Legato Application Framework (AF).

When new versions of the framework are released, you can install them on your dev machine using the procedure below.

B.1 Update the Legato AF on Your Dev Machine

To update the Legato AF in the VM on your dev machine:

1. Open a terminal window.
2. Configure your environment for development:

   ```
   $ cfglegato
   ```

3. Check the version of the Legato AF that is currently installed:

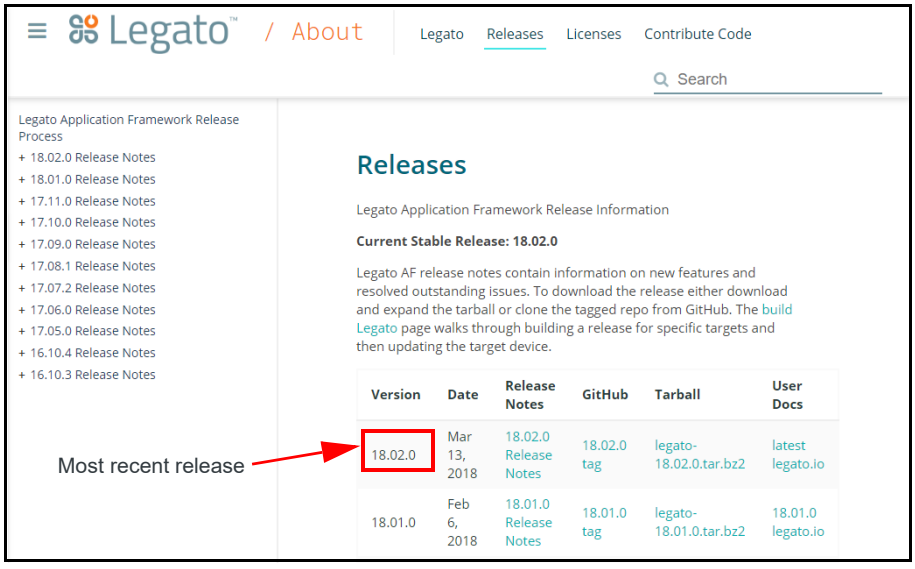
   ```
   $ cd $LEGATO_ROOT/..
   $ ls -al .repo
   ```

   ```
   mangoh@mangoh-virtualbox:~/legato_framework$ cd $LEGATO_ROOT/..
   mangoh@mangoh-virtualbox:~/legato_framework$ ls -al .repo
   total 36
   drwxrwxr-x  7 mangoh mangoh 4096 Mar 13 12:38 .
   drwxrwxr-x  4 mangoh mangoh 4096 Feb 20 08:56 ..
   drwxrwxr-x  4 mangoh mangoh 4096 Jul 24  2017 manifests
   drwxrwxr-x 10 mangoh mangoh 4096 Apr  3 14:02 manifests.git
   lrwxrwxrwx  1 mangoh mangoh   44 Mar 13 12:38 manifest.xml -> manifests/legato/releases/18.02.0/
   legato.xml
   ```

   Currently installed Legato AF version

   The installed version is indicated in the manifest.xml link.

4. Go to http://legato.io/legato-docs/latest/aboutReleaseInfo.html to get the version number of the most recent release.



5. If your release is older (lower version number) than the most recent release:
   a. Download the framework files into your working directory (for example, "~/legato_framework")—Replace the release number in the 'repo' command below with the most recent release (this example downloads version 18.02.0):
      i. Download the framework files into the work directory and follow any prompts that may appear:

```
$ repo init -u git://github.com/legatoproject/\
      manifest -m legato/releases/18.02.0/legato.xml
$ repo sync
```

```
mangoh@mangoh-virtualbox:~$ cd legato_framework/
mangoh@mangoh-virtualbox:~/legato_framework$ repo init -u git://github.com/legatoproject/
manifest -m \
> legato/releases/18.02.0/legato.xml
Get https://gerrit.googlesource.com/git-repo/clone.bundle
...
...
repo has been initialized in /home/mangoh/legato_framework
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ repo sync

... A new repo command ( 1.23) is available.
... You should upgrade soon:

    cp /home/mangoh/legato_framework/.repo/repo/repo /usr/bin/repo

Fetching project legato-Dualsys
...
...
 * [new tag]         2.6        -> 2.6
Fetching projects: 100% (23/23), done.
Syncing work tree: 100% (23/23), done.
```

Note: *This may take several minutes to run.*

6. Build the mangOH Distribution for the module in your mangOH Red — In the Legato VM, open a terminal window and run the following commands (replace <module_series> with your CF3 module series — red_wp750x, red_wp76xx, red_wp77xx, red_wp85) (Detailed instructions —Step 4 on page 26):

```
$ cd ~/mangOH
$ git pull && git submodule update --init
$ make <module_series>     (For optional make parameters, see Section C.3 mangOH
      Platform 'make' parameters.)
```

(e.g. "make red_wp76xx" to build for the WP7603 module)

```
$ cfglegato      # Set up the environment
```

C: Tips

C.1 Finding your SIM's APN

Your SIM provider should give you the APN that you use to connect to their network. If you don't have the APN, you should be able to find it online.

If your mobile network operator uses different APNs for 3G and LTE, make sure to use the APN for the correct network based on your CF3 module type (e.g. WP8548 is a 3G-only module—the APN for the network operator's 3G network should be used).

Examples:

- Sierra Wireless—internet.sierrawireless.com
- Rogers Wireless—internet.com (GPRS); ltemobile.apn (LTE)
- AT&T (included with ATT_mangOH_Red kit only)—m2m.com.attz
- Others—Search the Internet for "<provider> APN". For example, "Rogers Wireless APN"

C.2 Using the Linux Terminal program

Ubuntu includes a terminal emulator, which is labeled as "Terminal" in the desktop environment. The emulator allows you to execute command-line programs that interact with the Legato framework tools on your dev machine and the CF3 module in the mangOH Red.

For this tutorial, here are some useful tips:

- Open a terminal window. For example, in the Unity desktop shell used by default on Ubuntu Linux, do this using either of these methods:
  - Click the Search icon and type "terminal", then run the application that is listed.
  - Press Ctrl+Alt+T
- Open a new tab in a window—Press Ctrl+Shift+T
- Change a tab name in a window—Right-click in the tab and select Set Title.
- Copy text from a window—Highlight the text and press Ctrl+Insert.
- Paste text into a window—Press Shift+Insert.
- For in-depth detail, refer to https://help.ubuntu.com/community/UsingTheTerminal.

C.3 mangOH Platform 'make' parameters

The make command uses optional parameters to limit the deliverables being built.

Command format: [LEGATO=<enable>] make <module_series>

Parameters:

- LEGATO=<enable>
  - 0 — Legato AF is not built
  - 1 — Legato AF is built (Default)
- <module_series> — Build only the specified mangOH platform (additional platforms will be added as appropriate):
  - green_wp85
  - green_wp750x
  - red_wp85
  - red_wp750x
  - red_wp76xx
  - red_wp77x

C.4 Useful commands for this tutorial (and more)

The following table describes the Legato and Linux commands used in this tutorial, plus other useful commands.

Table C-1: Legato commands

Command types	Command	Description
Versioning	cm info	Display the module's model, IMEI, FSN (serial number), and firmware and bootloader versions.
Radio	cm radio	Display the radio status.
	cm radio on cm radio off	Enable or disable the radio.
	Refer to cm radio (http://legato.io/legato-docs/latest/toolsTarget_cm.html#toolsTarget_cm_radio) for more details and command options.	
Data connections	cm data cm data info	Display information about the current profile in use.
	cm data apn <yourAPN>	Set the APN for your profile to the APN from your SIM provider.
	cm data connect	Start a data connection.
	cm data connect -1	Stop a data connection
	cm data connect <timeout>	Start a data connection (keep trying for up to <timeout> seconds).
	Refer to cm data (http://legato.io/legato-docs/latest/toolsTarget_cm.html#toolsTarget_cm_data) for more details and command options.	

Table C-1: Legato commands (Continued)

Command types	Command	Description
SIM	cm sim info	Display information about the SIM.
	cm sim status	Display the SIM status
	cm sim enterpin	Enter a SIM PIN code to be able to use the SIM.
	Refer to cm sim (http://legato.io/legato-docs/latest/toolsTarget_cm.html#toolsTarget_cm_sim) for more details and command options.	
Applications	app status	Display the status of installed applications (running, stopped).
	app start <appName> app stop <appName> app remove <appName>	Start, stop, or remove an application.
	Refer to app (http://legato.io/legato-docs/latest/toolsTarget_app.html) for more details and command options.	

Table C-2: Linux commands

Command types	Command	Description
Packages	add-apt-repository	Add a package repository to your list of locations where the apt-get package management tool searches for the packages you request.
	apt-get update	Update the list of repositories to include those you added with add-apt-repository.
	apt-get install	Search the repositories for a package, and install it.

C.5 Definitions

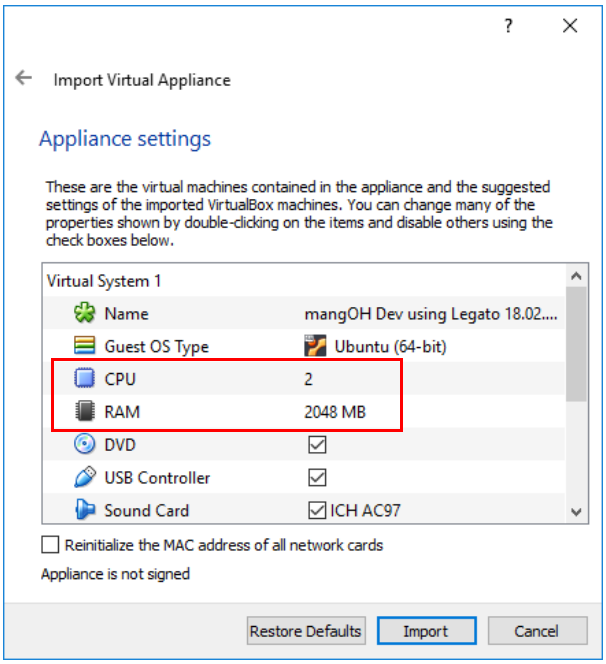
Table C-3: Definitions

Term	Definition
sudo	Allows you to run commands that require another user's security privileges. In this tutorial, the sudo command is used to run commands that require root/admin privileges.
Legato Application Framework (AF)	Collection of daemons (Supervisor, Config tree, service directory, etc.), liblegato, and tools that provide a framework for developing and installing apps on modules (e.g. WP8548)
Legato Platform	Legato Application Framework, Platform services, and a toolchain (applications) running on top of a supported operating system (e.g. Linux or RTOS).
Platform Services	Collection of apps installed with the Legato Application Framework to provide connectivity to module hardware. Platform Services exposes APIs for developers to connect apps running on the hardware to the Cloud.
wget	Gets files from a web server

C.6 VirtualBox Tips

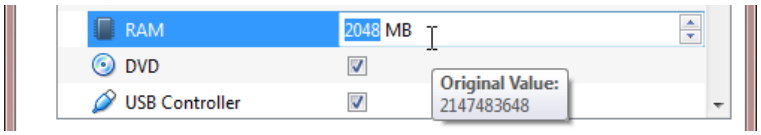
C.6.1 Modifying resources

When you open a virtual machine (.ova) file, the Import Virtual Appliance window opens, showing the suggesting settings for VirtualBox. Before you click Import to load the VM into VirtualBox, you can adjust the CPU and RAM settings to fine-tune its performance if necessary.

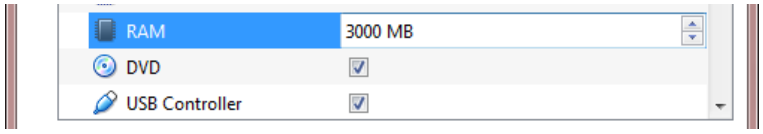


To adjust the CPU or RAM value:

1. Double-click the value.



2. Type your new value and press Enter.



C.7 Enable virtualization on a Windows computer

1. Consult your computer's BIOS manual (or search online for instructions) to find where your 'Virtualization' setting is stored. This may be called "Secure Virtual Machine", "... Virtualization Technology", etc., and may be under your Advanced, Config, Security, or CPU options (location varies by computer).

2. If you do not know how to boot directly into your computer's BIOS, check online for instructions specific to your operating system. Some typical methods include:
   - Windows 7—Reboot the computer and press the appropriate key to go to the BIOS screen (for example, F2, Esc, Del, blue ThinkVantage on Lenovo machines, etc.)
   - Windows 8—Search online for "windows 8.1 bios access" for tips, and add your computer type to the search string to refine your results.
   - Windows 10—See http://acer.custhelp.com/app/answers/detail/a_id/37064/~/windows-10%3A-access-the-uefi-bios for details. You can also search online for "windows 10 bios access" for tips and add your computer type to the search string to refine your results.
3. Reboot the computer and go to the BIOS screen (press F2, Delete, etc.—whichever key is appropriate).
4. Go to the BIOS screen that has the Virtualization setting. This will currently be disabled. Change this to 'Enabled'.
5. Save and Exit.
6. When the computer boots, open Virtual Box, go to System > Acceleration. and make sure both Hardware Virtualization options are selected.
7. You should now be able to launch the Legato 1604 VM.

D: Hardware Tips

D.1 Dipswitch Settings

The multi-function dipswitch block (SW401) is used to control module signals.

Note: *The 'Default' switch positions are the settings recommended when using this guide.*

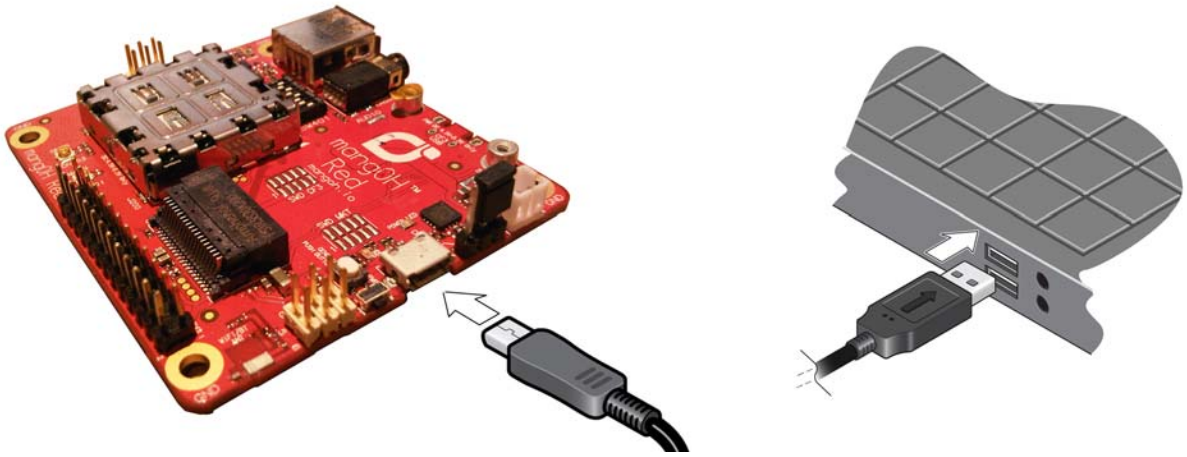
Signal	Dip	On/Off	State
1	PWR_ON	On (Default)	Enable CF3 module's POWER_ON signal
		Off	Disable POWER_ON signal
2	WIFI_UART1_TX	On	Enable CF3 module's firmware download (recovery) mode. *Note: Similar functionality to TP1_BOOT*
		Off (Default)	Normal operation
3	VCC_3V7_ULPM	On (Default)	While in ULPM, sensors receive power
		Off	While in ULPM, sensors are not powered
4	HL_MODE	On	When combined with LowPower_RESET, indicates that board is in HL mode.
		Off (Default)	When combined with LowPower_RESET, indicates that board is in WP mode.
5	BATT_TS+	On (Default)	Enable backup battery charging.
		Off	Disable backup battery charging.
6	CONS_DIR	On	Console USB connector accesses the Wi-Fi/Bluetooth module's console. *Note: To download firmware to the Wi-Fi module, set CONS_DIR OFF and WIFI_UART1_TX ON.*
		Off (Default)	Console USB connector access the CF3 module's console.
7	TP1_BOOT	On	Enable CF3 module's TP1 (boot) signal functionality. Pull the signal low to enter download mode for firmware updates.
		Off (Default)	CF3 module functions normally.
8	LowPower_RESET	On (Default)	When combined with HL_MODE, indicates that board is in WP mode.
		Off	When combined with HL_MODE, indicates that board is in HL mode.

E: Console Access

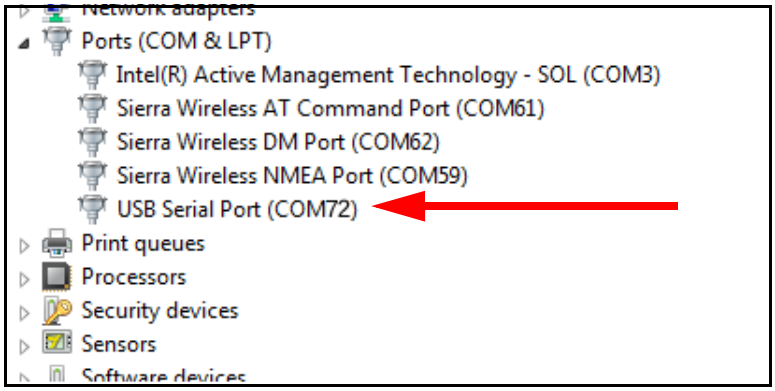
If you have two USB ports on your dev machine, you can use one of them to display the mangOH Red's diagnostic messages when the device boots, when certain commands are run, etc.

To set up a window to display diagnostic messages:

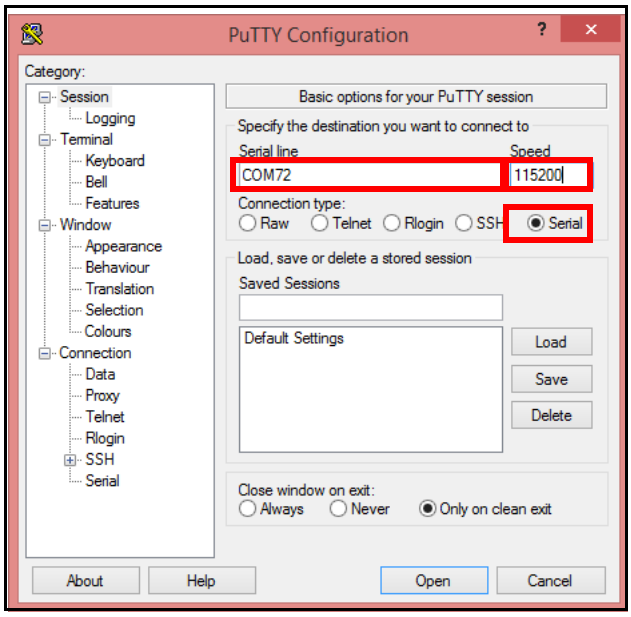
1. Use a micro-USB cable to connect the mangOH Red's CONSOLE USB port to a USB port on the dev machine.



2. Open a terminal window connected to the CF3 module's Linux console as follows:
   a. Open Windows Device Manager, then expand Ports (COM &LPT). The mangOH Red's CONSOLE USB port enumerates as USB Serial Port (COMxx). (In the example below, it enumerates as COM72.)



   b. Open a terminal window (e.g. PuTTY) connected to the mangOH Red's console using the following settings:
      - Connection type = Serial
      - Serial line = [USB Serial port COM port]
      - Speed = 115200



c. Click Open. The window will remain empty until you power up the mangOH Red in the next step.

Note: *Only one console connection can be opened at any time since it locks the USB serial port.*

Example

If you open the console terminal window before you connect power to the mangOH Red, you will see the messages that are generated during the module boot process:

```
...
[    0.275753] cpu cpu0: dev_pm_opp_get_opp_count: device OPP not found (-19)
[    0.275772] msm_thermal:get_cpu_freq_plan_len Error reading CPU0 freq table len. error:-19
[    0.275788] cpu cpu0: dev_pm_opp_get_opp_count: device OPP not found (-19)
[    0.275801] msm_thermal:get_cpu_freq_plan_len Error reading CPU0 freq table len. error:-19
[    0.370170] AXI: msm_bus_scale_register_client(): msm_bus_scale_register_client: Bus driver
not ready.
[    0.371913] AXI: msm_bus_scale_register_client(): msm_bus_scale_register_client: Bus driver
not ready.[    0.372200] i2c-msm-v2 78b8000.i2c: NACK: slave not responding, ensure its powered:
msgs(n:1 cur:0 tx) bc(rx:0 tx:2) mode:FIFO slv_addr:0x3a MSTR_STS:0x081343c8 OPER:0x00000090
[    0.427857] msm_bus_fabric_init_driver
[    0.647191] uart_tx_gpio is not available
[    0.647211] uart_rx_gpio is not available
[    0.647230] uart_cts_gpio is not available
[    0.647250] uart_rfr_gpio is not available
[    0.647938] sps: BAM device 0x07884000 is not registered yet.
...
```

Console messages describing module boot-up process

F: Removing/Inserting a CF3 Module

F.1 Removing a CF3 module

To remove a CF3 module from the mangOH Red:

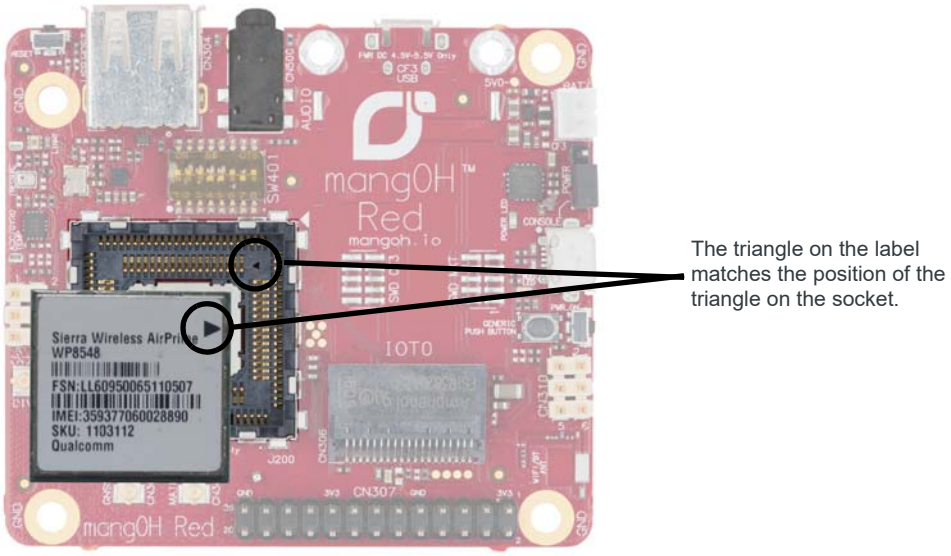
1. Remove the module cover using the module cover removal tool—Starting at one corner, insert the tool in the pair of holes and carefully pry the cover away from the module.
2. Repeat at the other locations (pairs of pry holes are on each side).

3. Lift the cover off the module.
4. Carefully lift the module straight up out of the socket.

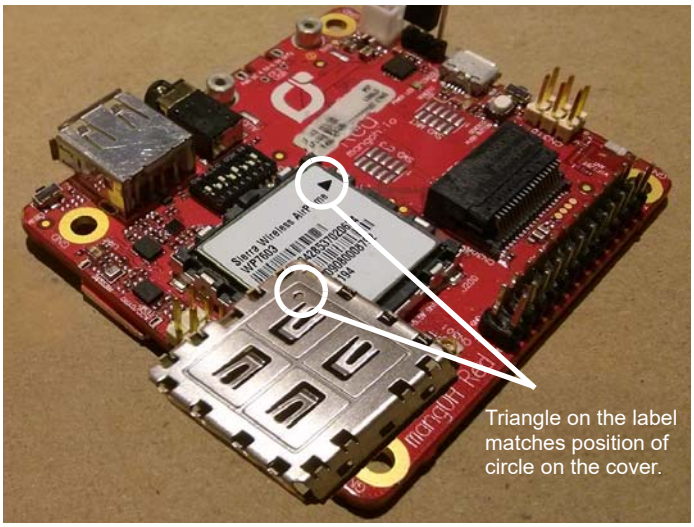
F.2 Inserting a CF3 module

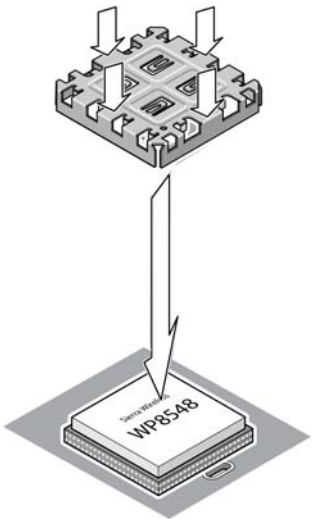
To insert a CF3 module on the mangOH Red board:

1. Insert the CF3 module—Hold the module above the socket and line up the triangles on the module and socket. The module will drop straight into the socket. (Position matters!)



2. Hold the module cover over the module and line up the circle on the cover with the triangle on the label, then press the cover (on the edges) into place.





G: Quick Reference—Commands in this Guide

The following table contains a list of the commands that are used in this guide with explanations of their purposes.

Table G-1: Commands Used in the Getting Started Guide

Command	Description
app install <update_file> <ip_address>	Install the specified file on the device at <ip_address>.
app start <appname>	Start (run) the specified application
app status	Display the status (running/stopped) of all installed applications.
app stop <appname>	Stop the specified application
cd <directory>	Change directory to the specified <directory> Note: '~' is an alias of the user's home directory.
cfglegato	This is an 'alias' that you set up in your ~/.bashrc file. The .bashrc is a startup script that runs each time a new terminal window is opened. This is a shortform command to run the longer series of commands needed to go to the Legato AF directory and set up the environment variables used for Legato development.
cm Refer to http://legato.io/legato-docs/latest/toolsTarget_cm.html for more details and command options.	
cm data	Display current connection status details (information about the current profile).
cm data apn	Show the APN value currently being used for the SIM card.
cm data apn <APN>	Set the APN value to use for the SIM card.
cm data connect	Start a mobile network data connection.
cm data connect -1	Stop the mobile network data connection.
cm data pdp ipv4	Set the IP addressing method to IPv4.
cm info	Display the module's model, IMEI, FSN (serial number), and firmware and bootloader versions.
cm radio	Display the power status of the CF3 module's radio (ON/OFF).
cm radio on	Power on the CF3 module's radio.
cm sim info	Display information about the SIM.
echo <parameter>	Display the <parameter> information. e.g.: • echo $?—Display the error code returned by the previous command (typically, '0' indicates the previous command completed successfully (no errors)) • echo $LEGATO_ROOT—Display the pathname held in the LEGATO_ROOT environment variable.
exit	Close the terminal window

Table G-1: Commands Used in the Getting Started Guide (Continued)

Command	Description
git pull	Retrieve any updates that have been made to the revision history of the remote git repository, and merge the current (local) branch with the corresponding remote branch.
git submodule init	Update the git configuration with any new submodules added recently.
git submodule update	Check out the version of the submodule specified by the current version of the parent repository.
instsys <update_file> <ip_address>	Install the specified file on the device at <ip_address>
logread -f | grep "Hello"	Print any new syslog messages that contain the string "Hello"
ls -al <files>	List details about the identified <files>.
make <module_series>	Build the programs for each listed module series. Module series are named after module types and other unique features. e.g.: • wp85—Build for wp85 modules • wp750x—Build for wp750x modules • red_wp85—Build for wp85 modules used in mangOH Red boards • green_wp85—Build for wp85 modules used in mangOH Green boards.
make clean	Remove 'build artifacts' (clutter left over from previous builds)
mv <file> <destination>	If <destination> is an existing directory name, move the <file> into that directory. Otherwise, rename the <file> using the <destination> name.
ping <ip_address>	Test the connection between the device and the a network host at <ip_address>.
repo init -u git:<path> -m <manifest>	First, clone the manifest repository indicated by '-u' option (e.g. git://github.com/legatoproject/manifest). Then use the <manifest> located in that cloned repository to clone and check out the specified version of each repository in the manifest.
repo sync	Get the latest updates for all git repositories and perform all updates allowed by the manifest.
ssh root@<ip_address>	Log in as the root user to the device at <ip_address>.

H: Terminology

Here are a few items that you might find helpful:

- Some terminology:
  - "CF3"—The mangOH Red supports CF3 (Common Form Factor) embedded modules, such as the WP8548 and HL8548.
    Throughout this tutorial, "CF3" refers to the module that comes with your mangOH Red kit.
  - "Dev(elopment) machine"—Your Legato VM with Ubuntu 16.04 guest OS.
- Some symbols:
  - '$', '#'— Command prompts.
    - '$'—Command prompt when you are logged in to a device as a regular user.
    - '#'—Command prompt when you are logged in as the 'root' user.

      Note: *In the examples in this document, you will be logged in as a regular user on your dev machine (command prompt will be '$'), and logged in as the root user on the CF3 module (command prompt will be '#').*

    - '>'—Command is entered on the Windows computer
  - '~', "$HOME"—Your 'home directory' on your dev machine.
- Command examples—Many steps in this guide require you to enter commands in a terminal window. These commands are shown like this:

  ```
  $ ping 192.168.2.2
  # cd ~
  ```

  Note: *You can copy commands from this guide and paste them in to your terminal window to save time and avoid typing errors. Copy the command only, do not include the command prompt. (In the first example above, you would enter "ping 192.168.2.2", not "$ ping 192.168.2.2".)*

- CF3 module default credentials and IP address (used to connect to the CF3 module from the dev machine):
  - USB ECM IP address—192.168.2.2
  - User name—root
  - Password—<none>
- VM password—mangoh. You will need to use this to unlock the VM if you manually lock it.
- Terminal window tips:
  - Shortcut to open a terminal window (on the default Unity desktop used in Ubuntu Linux)—Ctrl+Alt+T
  - Cancel command to break out of a running process—Ctrl+C