mangOH™ Red

Getting Started—WPx5xx + Linux Dev Machine + CLI

41110481
Rev 3
Contents subject to change

Important Notice

Due to the nature of wireless communications, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors) or be totally lost. Although significant delays or losses of data are rare when wireless devices such as the Sierra Wireless modem are used in a normal manner with a well-constructed network, the Sierra Wireless modem should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. Sierra Wireless accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received using the Sierra Wireless modem, or for failure of the Sierra Wireless modem to transmit or receive such data.

Limitation of Liability

The information in this manual is subject to change without notice and does not represent a commitment on the part of Sierra Wireless. SIERRA WIRELESS AND ITS AFFILIATES SPECIFICALLY DISCLAIM LIABILITY FOR ANY AND ALL DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE OR ANTICIPATED PROFITS OR REVENUE ARISING OUT OF THE USE OR INABILITY TO USE ANY SIERRA WIRELESS PRODUCT, EVEN IF SIERRA WIRELESS AND/OR ITS AFFILIATES HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

Notwithstanding the foregoing, in no event shall Sierra Wireless and/or its affiliates aggregate liability arising under or in connection with the Sierra Wireless product, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Sierra Wireless product.

Patents

This product may contain technology developed by or for Sierra Wireless Inc.

This document contains information which is proprietary to Sierra Wireless Inc. and is licensed pursuant to Creative Commons Attribution 4.0 International License.

Document details

Title: mangOH Red Getting Started—WPx5xx + Linux Dev Machine + CLI

Author: Sierra Wireless

Source: http://mangoh.io/

Copyright

Disclaimer

Indicate any modifications made to the original document.

Trademarks

mangOH™ and the mangOH logo are trademarks of Sierra Wireless.

Other trademarks are the property of their respective owners.

Revision History

Revision number	Release date	Changes
1	August 2017	Document created

Contents

1: Introduction

Now that you have your mangOH™ Red, it's time to start using it!

Important: *Use this guide only if you are using a native Linux computer (dev(elopment) machine)—Ubuntu is recommended. This guide includes instructions for native Linux® dev machines using CLI (Command Line Interpreter).*

ubuntu

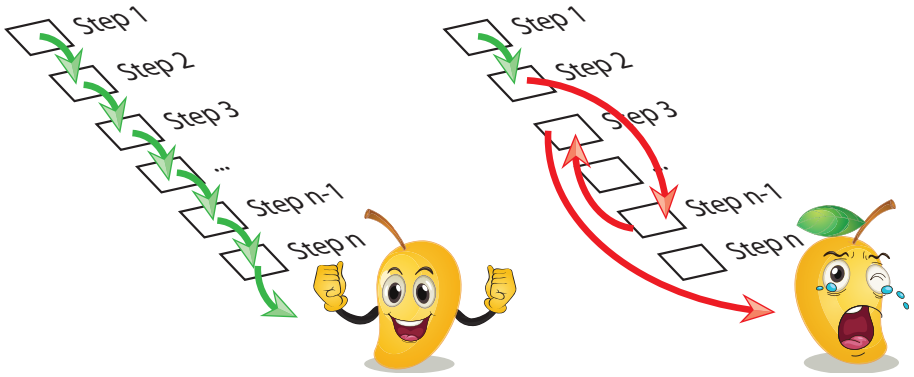
Use this guide to:

- Assemble your mangOH Red
- Set up your dev machine for mangOH development
- Install and run applications, and send data to the IoT Cloud via AirVantage, Sierra Wireless' cloud-based service platform for over-the-air (OTA) device management.

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

1.1 Get Started!

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 dev machine meets the minimum suggested requirements in Table 1-1 on page 7 for mangOH Red application development.

Note: *The instructions in this guide have been tested on Ubuntu 16.04. If you use a different distribution (e.g. Debian, Fedora, etc.), you may need to adjust commands, set permissions, etc. If you need assistance, please check out the forum at forum.mangoh.io.*

Note: *As you work through this guide, you can refer to Table G-1 on page 58 for descriptions of the commands you have to use.*

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

- STEP 1: Check Out Some Helpful Tips on page 8
- STEP 2: Set Up Your mangOH Red Hardware on page 9
- STEP 3: Prepare Your Linux Dev Machine For Legato Development on page 15
- STEP 4: Prepare Your mangOH Red For Development on page 20
- STEP 5: Connect To Mobile Networks on page 27
- STEP 6: Connect to the IoT Cloud on page 31

Things to check out after you finish the steps above:

- Develop and Test applications on page 39
- Update Legato Application Framework on page 47
- Tips on page 50
- Hardware Tips on page 53
- Console Access on page 54
- Quick Reference—Commands in this Guide on page 58

Table 1-1: Minimum System Requirements

	Linux
O/S	Ubuntu 16.04
CPU	Dual core @ 2.6 GHz
RAM	4 GB
HDD	10 GB free space
USB Ports	• Preferred—2 (for full functionality) • Minimum—1

2: Check Out Some Helpful Tips

Before you begin, 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 Linux computer
  - "Target"—The CF3 module in your mangOH Red.
- 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 '$'), and logged in as the root user on the target (command prompt will be '#').*
  - '~', "$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 target from the dev machine):
  - USB ECM IP address—192.168.2.2
  - User name—root
  - Password—<none>
- 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
  - minicom exit command—Ctrl+A, then press X

3: Set Up Your mangOH Red Hardware

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

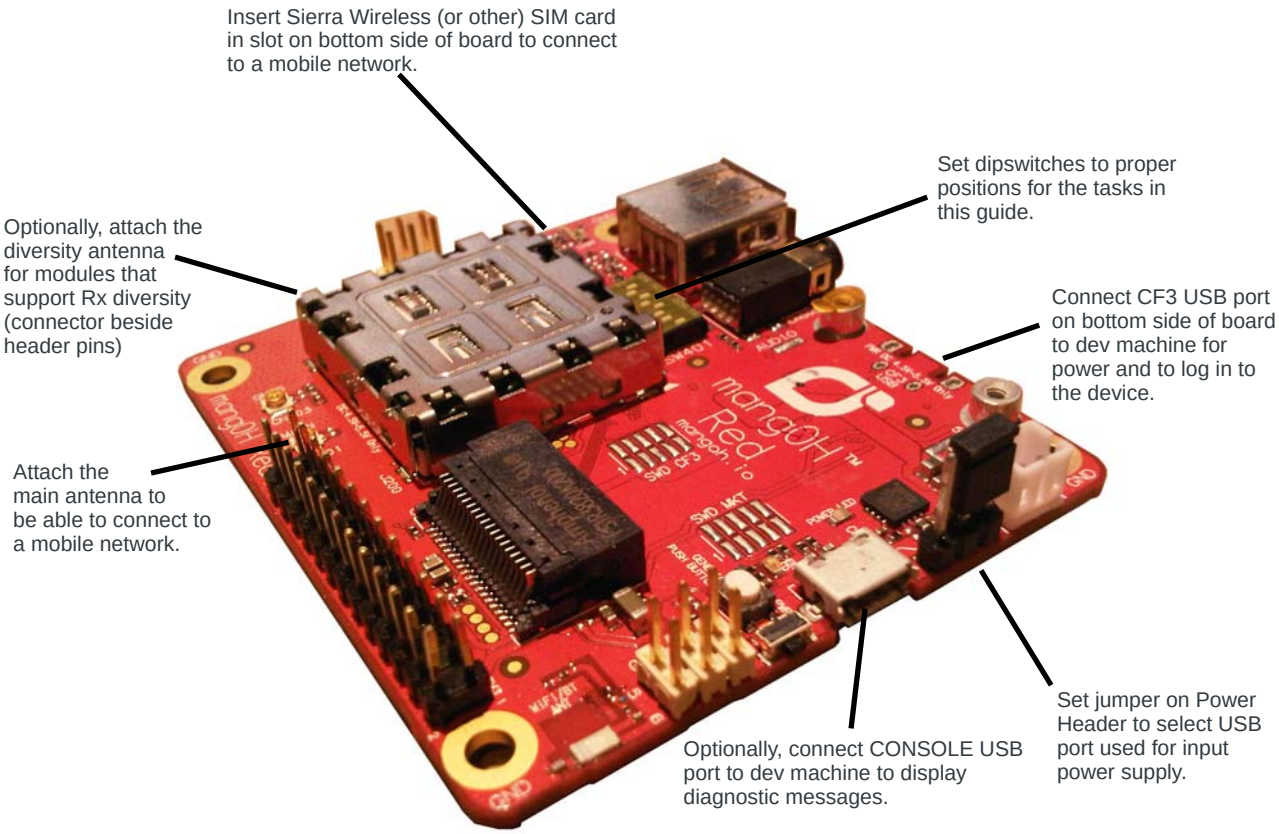
A typical mangOH Red kit includes:

- mangOH Red board
- Pre-installed CF3 (Common Form Factor) module and cover, and release tool
- micro-USB cables (2)
- Antenna (main)
- Antenna (diversity)—Included if the CF3 module supports LTE
- Sierra Wireless micro-SIM

The following image summarizes the parts of the mangOH Red that you will set up when you follow the instructions in Hardware Setup on page 10.

IMPORTANT

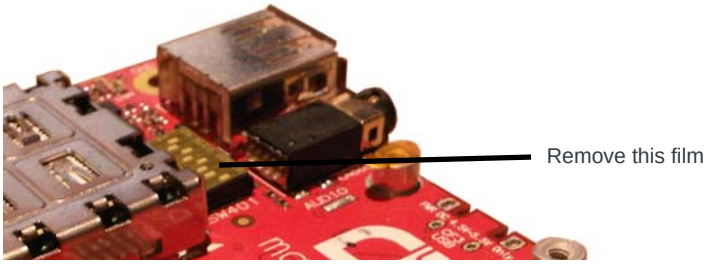
Important: *Do not start connecting components until told to in the instructions, otherwise you may encounter problems later in the guide.*



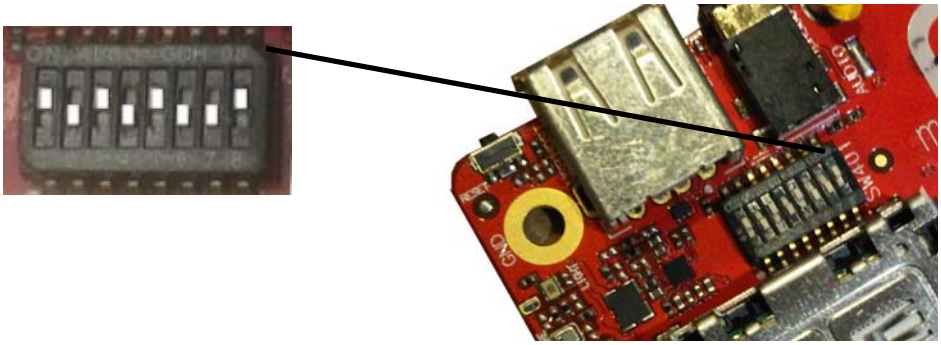
3.1 Hardware Setup

To set up the mangOH Red board:

1. Remove the protective film from the dipswitches:



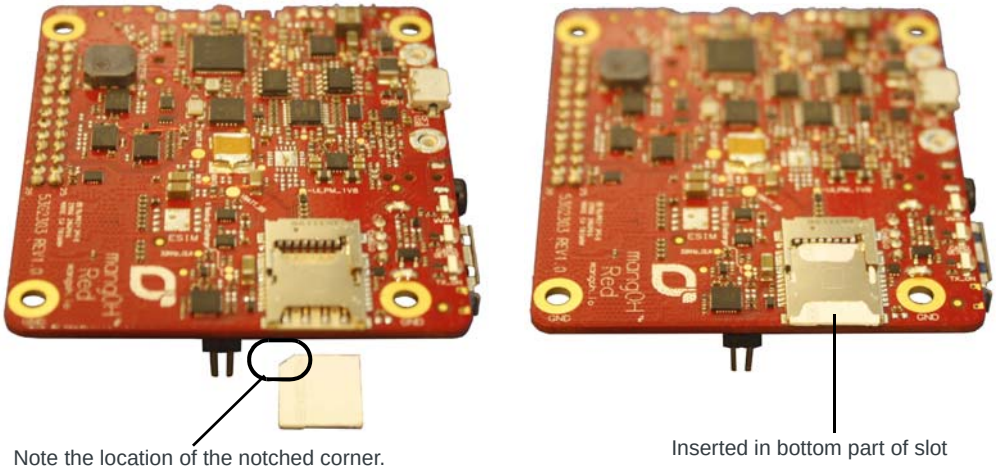
2. Make sure the dipswitches are set as follows:
   - ON—1,3,5,8
   - OFF—2,4,6,7



For switch details (not needed for this tutorial), see Dipswitch Settings on page 53.

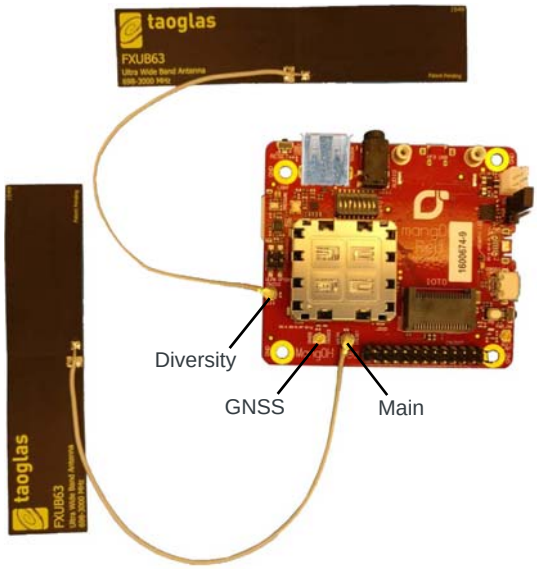
3. Insert a micro-SIM in the slot on the bottom side of the mangOH Red. You can use the Sierra Wireless micro-SIM that is included in the kit, or another micro-SIM that has been activated by a mobile network provider.

> **Note:** *If you do not have an activated micro-SIM, you can still continue with the tutorial, but will not be able to complete the following sections: Connect To Mobile Networks on page 27 and Connect to the IoT Cloud on page 31.*



4. Attach the main antenna and (for LTE CF3 modules) the diversity antenna.

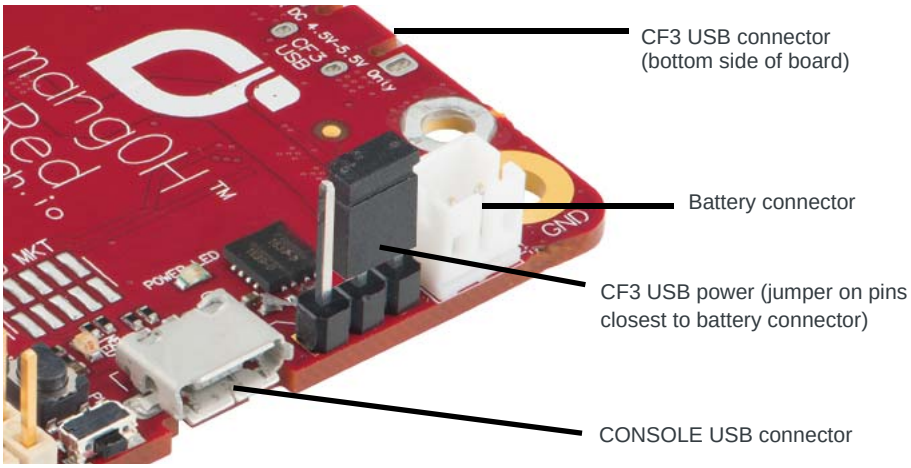
> **Note:** *The main antenna is required if you want to connect the mangOH Red to a mobile network in Connect To Mobile Networks on page 27.*



> **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.*

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.*

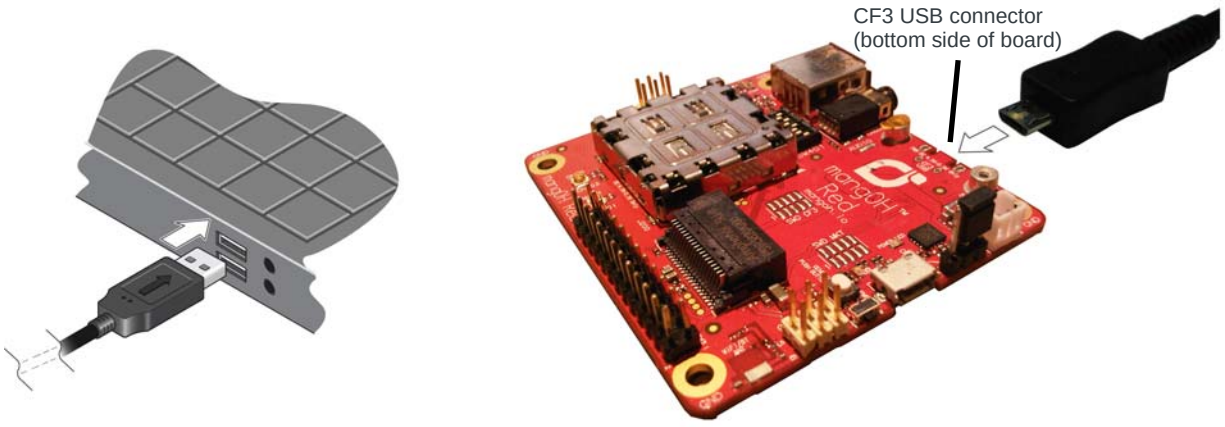
5. Move the power select jumper onto the pins closest to the battery connector to select the CF3 USB connector. (In this guide, power is supplied from the dev machine's USB port to this connector when you connect it in a later step.)



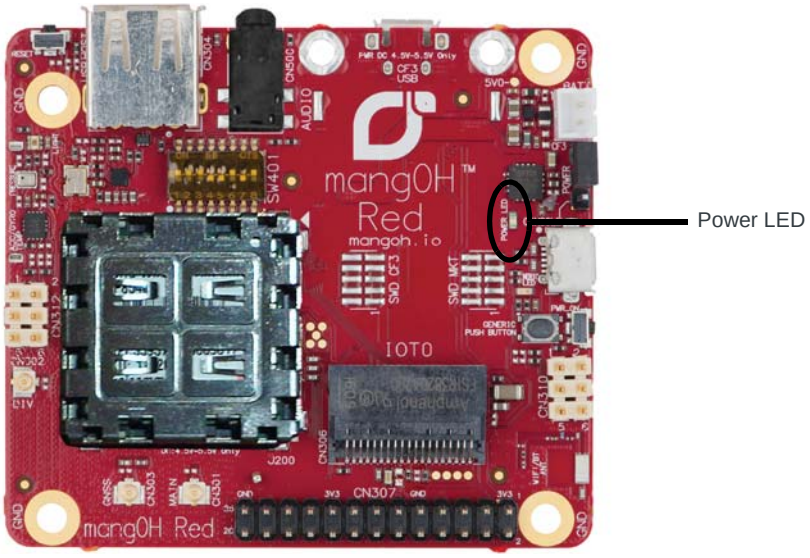
Note: *OPTIONALLY, if you want to be able to display the target's console messages (diagnostic messages) and have two available USB ports on your dev machine, follow the instructions in Console Access on page 54. This is NOT a required step for this tutorial.*

6. 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.



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.

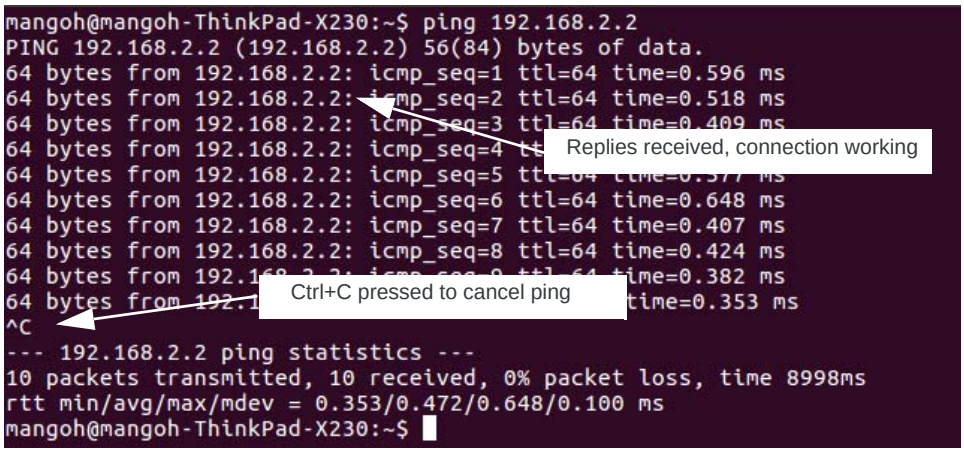
7. On the dev machine, open another terminal window.
8. Make sure the modemmanager package is removed from your system (this package causes problems with mangOH Red if it is not removed):

   ```
   $ sudo apt-get remove -y modemmanager
   ```

9. Wait 10-15 seconds for the mangOH Red to enumerate.
10. Test the CF3_USB connection:

    ```
    $ ping 192.168.2.2
    ```

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



Now you are ready to Prepare Your Linux Dev Machine For Legato Development on page 15.

4: Prepare Your Linux Dev Machine For Legato Development

In this chapter, you will prepare your dev machine for Legato application development by setting up the development environment with required applications and packages.

Important: *To install and use the development environment, your dev machine must meet the requirements in Table 1-1 on page 7.*

4.1 Prepare Dev Machine For Application Development

After preparing your mangOH Red hardware in Set Up Your mangOH Red Hardware on page 9, you can prepare your dev machine for application development:

Important: *Download, installation and use of Legato Application Framework and Platform Services is subject to the Legato License and Open Source Licenses. (Note: These links automatically download the licenses as PDF files.)*

4.2 Build and Install the Development Environment

In this section you will build and install the environment to develop applications for the CF3 module used in your mangOH Red. The environment includes:

- Legato toolchain—Tools and libraries used to build the Legato Platform for your CF3 module. The Legato toolchain is module-specific; you must make sure you install the toolchain designed for your module.
- mangOH Red platform—Drivers for on-board components, and a basic device-to-cloud application.

To build and install the development environment on your dev machine:

1. Open a terminal window.
2. Install packages required for the development environment:
   a. Display your Ubuntu version:
   ```
   $ lsb_release -d
   ```
   ```
   mangoh@mangoh-ThinkPad-X230:~/Downloads$ lsb_release -d
   Description:    Ubuntu 16.04.2 LTS
   ```

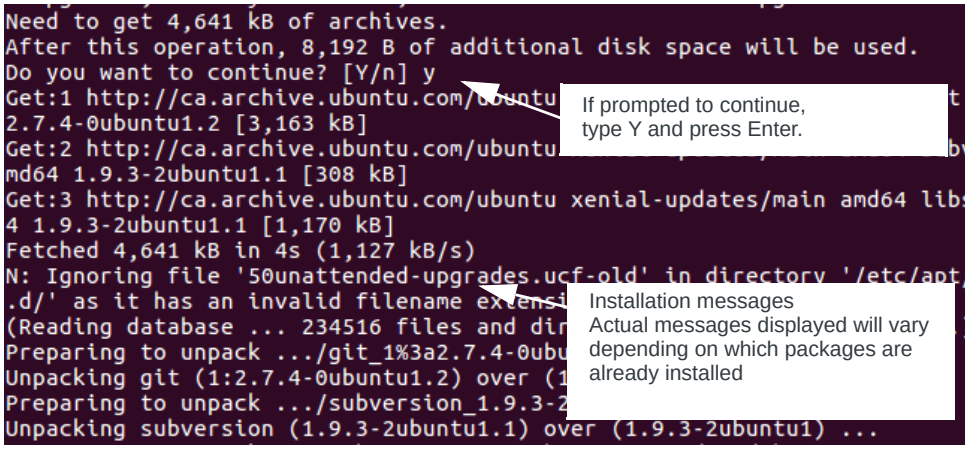
   Note: *If the version is less than 16.04, upgrade your operating system to 16.04 or higher, then continue with these instructions.*

3. Check whether your dev machine is 32-bit or 64-bit:
   ```
   $ uname -m
   ```
   ```
   mangoh@mangoh-ThinkPad-X230:~/Downloads$ uname -m
   x86_64
   ```
   The dev machine's hardware type appears —e.g. "x86_64" is a 64-bit system.

4. Install several packages that are required for the Legato Platform and the mangOH Red platform:

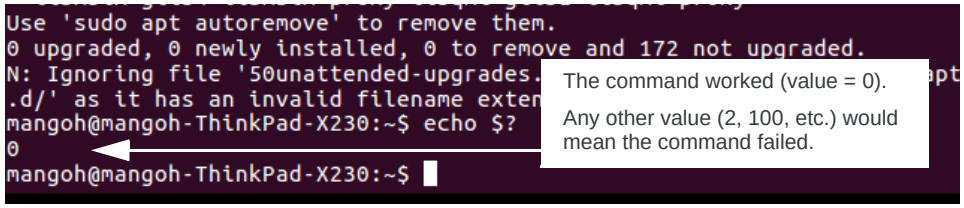
```
$ sudo apt-get install -y build-essential openjdk-8-jre \
      libwebkitgtk-1.0-0 python python-jinja2 cmake \
      git subversion libsdl-dev diffstat texinfo gawk \
      chrpath wget cpio vim zsh bash ninja-build screen \
      sshpass bc python-git unzip libxml2-utils gcovr \
      libcurl4-gnutls-dev zlib1g-dev libbz2-dev iputils-ping \
      bsdiff libssl-dev zip autoconf automake
```

> **Note:** *The '\' at the ends of the lines tells the system that the command continues on the next line. When you run this command (and any others in this guide that use the '\'), you can copy and paste the full command (including '\' characters) in your terminal window. If you type the command manually all on one line, do not type the '\' characters.*



5. As shown in the previous step, the output you see when you run some commands may be different 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.

6. If your dev machine is 64-bit, install additional dependencies:

```
$ sudo apt-get install -y lib32z1 lib32ncurses5
```

7. Build the Legato toolchain (SDK):

   a. If you have previously installed Legato toolchains, make sure you do not have any old toolchain files ("poky*.sh") in your Downloads directory (e.g. ~/Downloads), and remove any changes that may have been made to your .bashrc file:

      i. Go to your Downloads directory:

```
$ cd ~/Downloads
```

ii. Either move or delete any old toolchain files:

Delete files:

```
$ rm poky*
```

Move files:

```
$ mkdir old_toolchains
$ mv poky* old_toolchains
```

iii. Edit your ~/.bashrc file, comment out any items at the bottom of the file that begin with "LEGATO", and save and close the file.

b. Go to http://source.sierrawireless.com/resources/legato/downloads and click the latest Legato (32-bit or 64-bit) toolchain download link (the link is to a .sh file).

Note: You must register on the Source for an account before you can download files.

c. Click Download.

d. If prompted, save the file to your Downloads folder. (e.g. ~/Downloads)

e. In the terminal window, open the folder and run the file.

(In the command below, replace <file_name> with the actual file name.
e.g. If the file name is "poky-swi-ext-sample-1.7.3.sh", the command would be "bash poky-swi-ext-sample-1.7.3.sh"):

```
$ cd ~/Downloads
$ bash <file_name>
```

```
mangoh@mangoh-ThinkPad-X230:~$ cd ~/Downloads/
mangoh@mangoh-ThinkPad-X230:~/Downloads$ bash poky-swi-ext-glibc-x86_64-meta
lchain-swi-ext-armv7a-vfp-neon-toolchain-swi-ext-1.7.3.sh
Enter target directory for SDK (default: /opt/swi/y17-ext):
The directory "/opt/swi/y17-ext" already contains a SDK for this architectur
If you continue, existing files will be overwritten! Proceed[y/N]?y
Extracting SDK...done
Setting it up...
done
SDK has been successfully set up and is ready to be used.
mangoh@mangoh-ThinkPad-X230:~/Downloads$ _
```

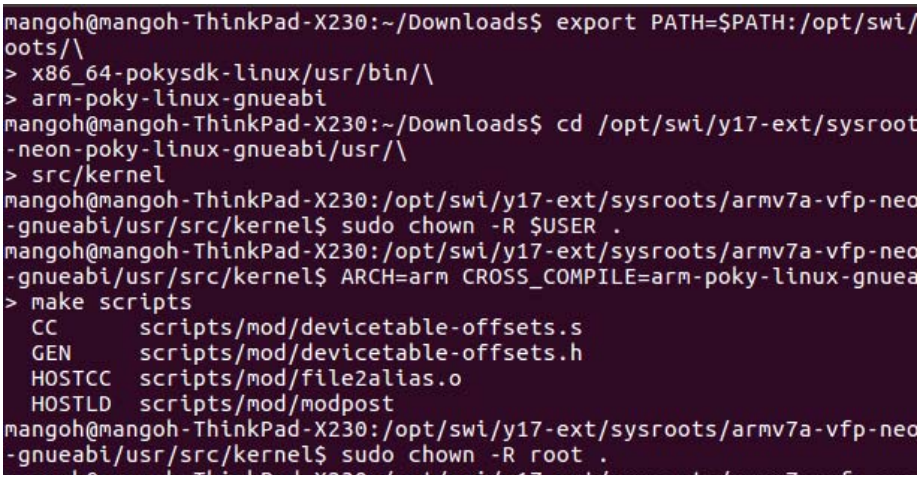
f. When prompted to enter a target directory for the SDK, press Enter to accept the default (/opt/swi/y17-ext).

g. When prompted to install or (possibly) replace the SDK, type 'Y' and press Enter.

When finished, installing, the message "SDK has been successfully set up and is ready to be used." will appear.

h. Configure the toolchain to make it available for use in generating the mangOH Red platform and the kernel modules that it references:

```
$ export PATH=$PATH:/opt/swi/y17-ext/sysroots/\
       x86_64-pokysdk-linux/usr/bin/\
       arm-poky-linux-gnueabi
$ cd /opt/swi/y17-ext/sysroots/\
       armv7a-vfp-neon-poky-linux-gnueabi/usr/\
       src/kernel
$ sudo chown -R $USER .
$ ARCH=arm CROSS_COMPILE=arm-poky-linux-gnueabi- \
       make scripts
$ sudo chown -R root .
```



8. Install the repo application, which will be used to clone the Legato file repository:

```
$ sudo apt-get install -y repo
```

> **Note:** *This may take a few minutes to run.*

9. If the install in Step 8 failed because phablet-tools was previously installed:

a. Enter the following command:

```
$ sudo apt-get remove -y --purge phablet-tools
```

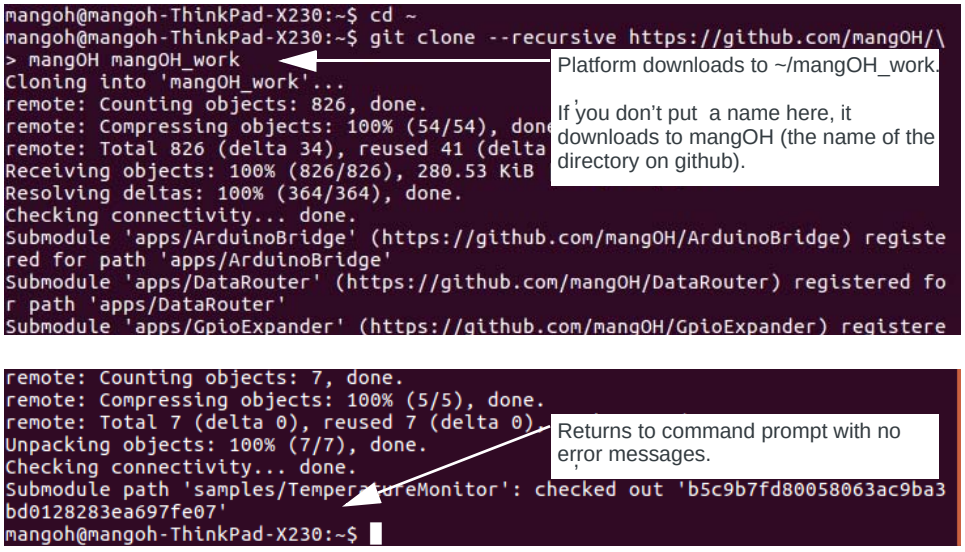
b. Go back to Step 8.

10. If you have not used git or git-repo to clone a project before, identify yourself as follows:

```
$ git config --global user.email "youremail@example.com"
$ git config --global user.name "your.name"
```

11. Download the mangOH platform files into a working directory—enter the following command and either replace <mangOH_work_directory> with a new directory name (e.g. "mangOH_work"), or remove it (to use the default directory name "mangOH").

```
$ cd ~
$ git clone --recursive https://github.com/mangOH/\
      mangOH <mangOH_work_directory>
```



> **Note:** *<mangOH_work_directory> is optional—if not used, a working directory is created with the same name as the repository (in this case, "mangOH").*

12. Add an environment variable (shortcut) for the mangoh work directory—this will be available each time you open a new terminal window:

a. Edit your ~/.bashrc file (the startup script that runs when you open a terminal window) and add the following line at the end of the file:

```
export MANGOH_ROOT=~/mangOH_work
```

> **Note:** *. If you downloaded into a different directory name in Step 11, replace "mangOH_work" with that name in the above export statement:*

b. Save and close the file.

c. Exit the window:

```
$ exit
```

d. Open a new terminal window, which automatically executes the .bashrc script, which now sets the MANGOH_ROOT shortcut automatically.

Now that the Legato development environment is installed, you can Prepare Your mangOH Red For Development on page 20.

5: Prepare Your mangOH Red For Development

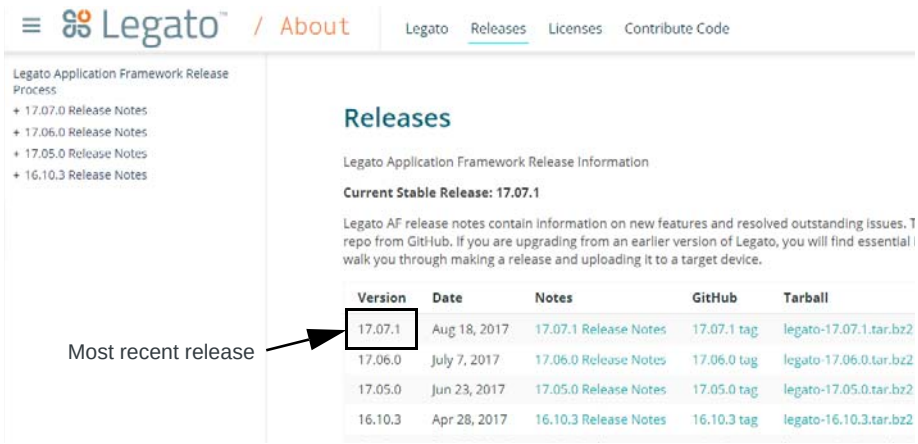
In this chapter, you will update the CF3 module on your mangOH Red with the basic mangOH Red Platform (application suite).

5.1 Build and Install Legato Platform and mangOH Red Platform on Target

Now that your dev machine has its development environment set up, you will:

- Build the Legato Platform (development applications) on your dev machine.
- Use the Legato Platform to build the mangOH Red Platform (target applications) and install it onto your target (the CF3 module in your mangOH Red)

1. Get the Legato Application Framework (AF):
   a. Go to http://legato.io/legato-docs/latest/aboutReleaseInfo.html to get the version number of the most recent release.



   b. Download the framework files into a working directory (for example, "legato_framework")::
      i. Create a working directory below your home directory to hold the framework files (for example, "legato_framework"):

```
$ mkdir ~/legato_framework
```

> **Note:** *Through the rest of this guide, "legato_framework" is assumed to be the file you created. If you used a different name, make sure to use that name in any commands that refer to legato_framework.*

      ii. Download the framework files into the work directory—Replace the release number in the 'repo' command with the most recent release (this example downloads version 17.07.1):

```
$ cd ~/legato_framework
$ repo init -u git://github.com/legatoproject/\
      manifest -m legato/releases/17.07.1.xml
$ repo sync
```

```
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ repo init -u git://githu
gatoproject/manifest \
> -m legato/releases/17.07.1.xml
Get https://gerrit.googlesource.com/git-repo/clone.bundle
Get https://gerrit.googlesource.com/git-repo
remote: Finding sources: 100% (33/33)
remote: Total 33 (delta 9), reused 33 (delta 9)
Unpacking objects: 100% (33/33), done.
From https://gerrit.googlesource.com/git-repo
   224a31a..c94d6eb  master     -> origin/master
Get git://github.com/legatoproject/manifest
remote: Counting objects: 135, done.
remote: Total 135 (delta 0), reused 0 (delta 0), pack-reused 135
Receiving objects: 100% (135/135), 14.40 KiB | 0 bytes/s, done.
Resolving deltas: 100% (41/41), done.
From git://github.com/legatoproject/manifest
 * [new branch]      master     -> origin/master
 * [new branch]      pull-request-17.05.0 -> origin/pull-request-17.05.0

Your identity is: J B <jb@ja.ca>
If you want to change this, please re-run 'repo init' with --config-name

repo has been initialized in /home/mangoh/legato_framework
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ ls
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ pwd
/home/mangoh/legato_framework
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ repo sync
```

```
 * [new tag]         16.10.3    -> 16.10.3
 * [new tag]         17.05.0    -> 17.05.0
 * [new tag]         17.06.0    -> 17.06.0
 * [new tag]         17.06.1    -> 17.06.1
 * [new tag]         17.07.0    -> 17.07.0
Fetching projects: 100% (19/19), done.
Syncing work tree: 100% (19/19), done.

mangoh@mangoh-ThinkPad-X230:~/legato_framework$
```

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

2. In a terminal window, build the Legato AF:

```
$ cd ~/legato_framework/legato
$ make clean    # Optional step to remove clutter from previous builds
$ make wp85     # Build the framework
```

Note: *You don't need to use make clean' the first time you use this procedure to build the Legato AF. If you have to redo the procedure for some reason, use this command to clear out build artifacts (files generated and stored by the 'make wp85' command.).*

```
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ make clean
Module: WiFi
Module: Dualsys
rm -rf build Documentation* bin doxygen.*.log doxygen.*.err
rm -f framework/doc/toolsHost.dox framework/doc/toolsHost_*.dox
rm -f sources.md5
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ make wp85
```

```
Output: /home/mangoh/legato_framework/legato/build/wp85
Version: 17.07.1 4cd70a5 mangoh-ThinkPad-X230 2017/08/22 14:51:09
wp85: Generating the framework image (yaffs2)
wp85: Generating the framework cwe (yaffs2)
wp85: Generating the framework image (squashfs.ubi)
wp85: Generating the framework image (squashfs)
wp85: Generating the framework cwe (squashfs.ubi)
No toolchain found for target 'ar7'.
Unable to find compatible cross-build toolchain for target 'ar7'.
No toolchain found for target 'ar86'.
Unable to find compatible cross-build toolchain for target 'ar86'.
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ echo $?
```

Ignore these toolchain warnings

3. To use the Legato AF's tools in the terminal window, you must configure it to work with the tools. To do this, you will define a short 'alias' in your ~/.bashrc file (the startup script that runs each time you open a new terminal window) that you can use to run the required commands (instead of entering the commands manually every time):
   a. Edit your ~/.bashrc file and add the following lines at the end of the file:

```
alias cfglegato=\
"pushd . && cd ~/legato_framework/legato && source ./bin/configlegatoenv ; popd"
```

   b. Save and close the file.
   c. Exit the window:

```
$ exit
```

   d. Open a new terminal window—This automatically executes the .bashrc script, which makes the cfglegato shortcut available for use.
4. Configure the terminal window to work with the Legato AF's tools:

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

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

Important: You MUST do the following step! *The Legato AF that you just installed, and the mangOH Red platform apps that you are going to install, both require you to have the correct (latest) firmware installed on your CF3 module. The platform apps will not install if you do not have the correct firmware.*

5. Update the target's firmware to the latest available version:
   a. Go to https://source.sierrawireless.com and do the following:
      i. In the Devices section, click AirPrime.
      ii. Click WP series.

iii. Click your module type.

iv. In the Software download section, click Firmware to display the list of available firmware packages.

v. In the Combined Images table, click the Download link in the Binaries column for the Generic carrier.

b. Install the firmware:

i. Open a terminal window.

ii. Change directory to the Downloads folder:

```
$ cd ~/Downloads
```

iii. Make sure you downloaded the correct file

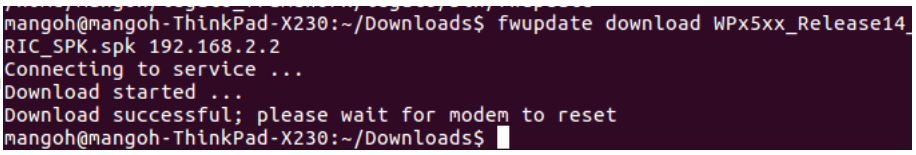
```
$ ls -al *.spk
```

> **Note:** *The downloaded file will be an ".spk" file. If the file is not listed, go back to Step v and make sure to click the Binaries link (not the Windows EXE link).*

iv. Install the new firmware (replace <file> with the name of the file that you downloaded):

```
$ fwupdate download <file> 192.168.2.2
```

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



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

d. Verify that the firmware updated:

i. Connect to the mangOH Red:

```
$ ssh root@192.168.2.2
```

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

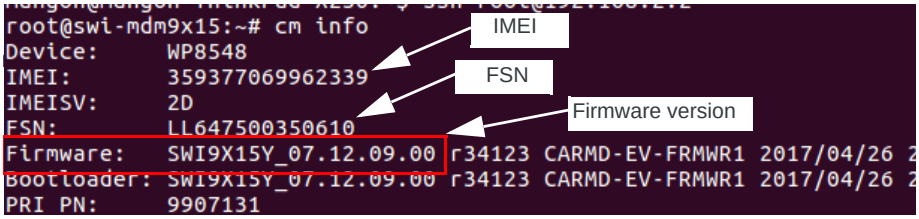
```
It is strongly recommended to setup credentials for remote l
  Please select one of the following options:
    1) Setup ssh keys and disable passwords-based authentica
    2) Setup password (better than nothing)
    3) Do nothing
```

For now, type `3` and press Enter, then type `Y` and press Enter to be reminded the next time you connect.

> **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.*

iii. Display information about the CF3 module and confirm that the Firmware version shown is the one that you downloaded:

```
# cm info
```



iv. Disconnect from the mangOH Red:

```
# exit
```

6. Change directory to the mangoh work directory:

```
$ cd $MANGOH_ROOT
```

7. Build the mangOH Red platform:

```
$ make red_wp85
```

```
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$ make red_wp85
```

```
configure: creating ./config.status
config.status: creating Makefile
config.status: creating doc/Makefile
config.status: creating doc/Doxyfile
config.status: creating tests/Makefile
config.status: creating platform-specific/Makefile
config.status: creating sha2/Makefile
config.status: creating aes/Makefile
config.status: creating ecc/Makefile
config.status: creating dtls_config.h
config.status: creating tinydtls.h
[905/905] Packaging system
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$
```

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: *In the command "make red_wp85", 'wp85' indicates the target type on which the applications will run. If a different module type is used, the make command must be modified to indicate the correct type. For example, if the CF3 module is a WP7602, the target must be changed from "wp85" to "wp76". This applies to all make commands described in this guide.*

8. Verify that the update file mangOH_Red.wp85.update was created:

```
$ ls -al *.update
```

```
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$ ls -al *.update
-rw-rw-r-- 1 mangoh mangoh 3998052 Aug 22 14:54 mangOH_Red.wp85.update
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$
```

9. 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.

10. Install the mangOH_Red platform on your mangOH board:

    ```
    $ instsys mangOH_Red.wp85.update 192.168.2.2
    ```

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

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

```
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Applying update: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++++++++
SUCCESS
Done
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$
```

11. Verify the mangOH platform apps installed correctly:

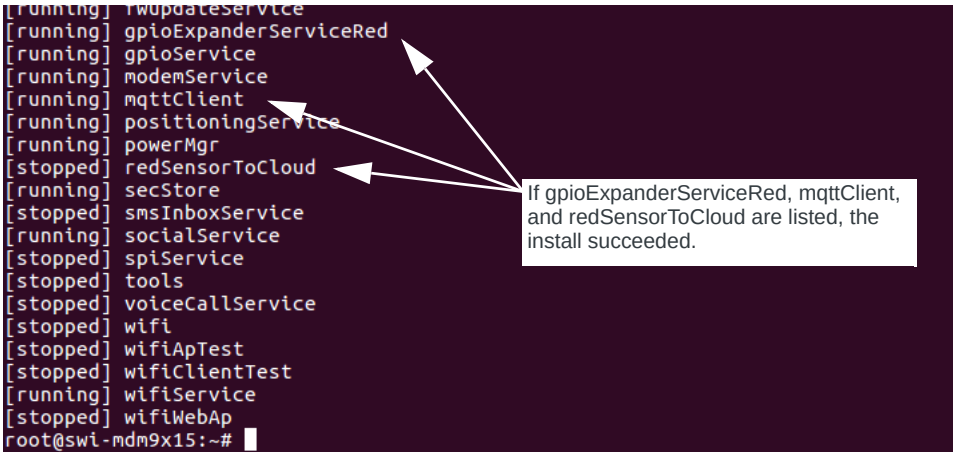
    a. Connect to the mangOH Red:

       ```
       $ ssh root@192.168.2.2
       ```

    b. Show the list of installed apps to confirm the build and install succeeded:

       ```
       # app status
       ```

       If the following apps appear in the list, the build and install succeeded:



    c. Disconnect from the mangOH Red:

       ```
       # exit
       ```

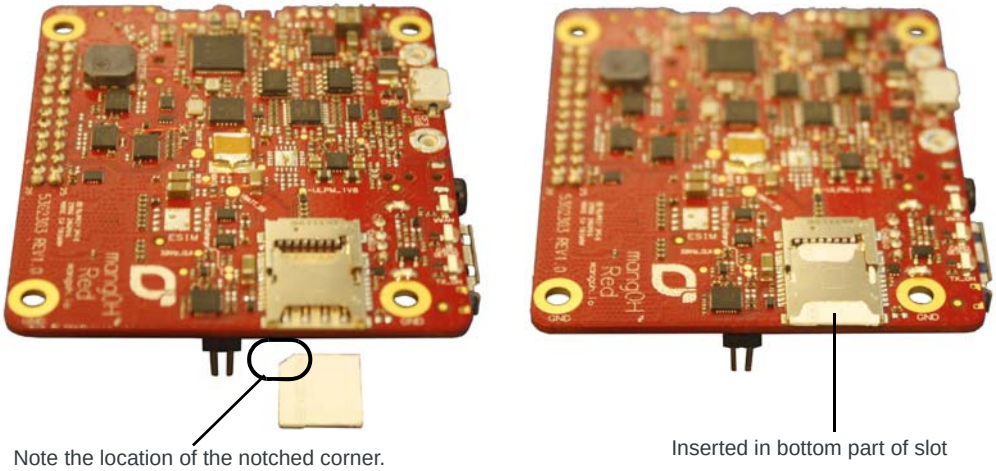
Now that the mangOH Red platform is installed, you will learn how to Connect To Mobile Networks on page 27.

6: Connect To Mobile Networks

In this chapter, you will learn how to connect the mangOH Red to a mobile network. When the mangOH_Red has a data connection, you can transmit data, including on-board sensor readings, to the IoT cloud.

6.1 Connect To a Mobile Network

To connect to a mobile network, you must have an activated 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 the 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. You can use the Sierra Wireless micro-SIM that is included in the kit, or another micro-SIM that has been activated by a 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.*

2. Connect to the target:
   a. On the dev machine, open a terminal window.
   b. Connect to the target:

```
$ ssh root@192.168.2.2
```

3. Display the status of the target's radio:

```
# cm radio
```

```
root@swi-mdm9x15:~# cm radio
Power:      OFF
Current Network Operator:
Status:     Not registered and not currently searching for new operator (LE_MRC_
REG_NONE)
Signal:     No signal strength (0)
PS:         Packet Switched Unknown state (LE_MRC_REG_UNKNOWN)

root@swi-mdm9x15:~#
```

Example response when Power is OFF

```
cmroot@swi-mdm9x15:~# cm radio
Power:      ON
Current Network Operator:
Status:     Not registered but currently searching for a new operator (LE_MRC_RE
G_SEARCHING)
Signal:     No signal strength (0)
PS:         Packet Switched Unknown state (LE_MRC_REG_UNKNOWN)

root@swi-mdm9x15:~#
```

Example response when Power is ON, Status is Searching

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.*

```
root@swi-mdm9x15:~# cm radio
Power:      ON
Current Network Operator: Rogers Wireless
RAT:        UMTS network (LE_MRC_RAT_UMTS)
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)

root@swi-mdm9x15:~#
```

Example response when Power is ON, Status is Registered

4. If the:
   - Power is OFF—Turn on the radio and then repeat Step 3:

     ```
     # cm radio on
     ```
   - Power is ON and Status is "... searching ..."'—Wait 10–15 seconds while the radio searches for a network to register on, then repeat Step 3.
   - Power is ON and Status is Registered—Continue to Step 6.
5. Make sure the SIM card is installed correctly:

```
# cm sim info
```

```
root@swi-mdm9x15:~# cm sim info
Type:       EXTERNAL_SLOT_1
ICCID:      89302728825964668820
Home Network Operator: Rogers Wireless
IMSI:       302728826466882
Phone Number: 15553853294
```

Your SIM data should appear as shown above.

Note: *The Home Network Operator is the ISP that provides the network on which the target 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.*

6. Set the target to use IPv4 addressing (this is required for use with AirVantage later in the guide):
   `# cm data pdp ipv4`
7. Check the connection status:
   `# cm data`

```
root@swi-mdm9x15:~# cm data
Index:      1
APN:        internet.sierrawireless.com
PDP Type:   IPV4
Connected:  no
root@swi-mdm9x15:~#
```

Example response when Not connected, APN is set

```
root@swi-mdm9x15:~# cm data
Index:      1
APN:
PDP Type:   IPV4
Connected:  no
```

Example response when Not connected, no APN

   a. If "Connected" is:
      - "no", and APN has a value—The mangOH Red is ready to connect to the network. Go to Step 8 on page 30.
      - "no", and APN is blank—You must set the APN. Continue to the next step (step b).
   b. If you need to set the APN for:
      - A Sierra Wireless SIM—Enter the following command:
        `# cm data apn internet.sierrawireless.com`

        Note: *The APN for the Sierra Wireless SIM is internet.sierrawireless.com.*

      - Other SIM:
        i., Replace "<your apn>" with the actual APN in the following command:
        `# cm data apn <your_apn>`

```
root@swi-mdm9x15:~# cm data apn internet.sierrawireless.com
root@swi-mdm9x15:~# cm data
Index:      1
APN:        internet.sierrawireless.com
PDP Type:   IPV4
Connected:  no
```

        Note: *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. For example, the WP8548 is a 3G-only module that does not support LTE—the APN for the network operator's 3G network should be used.*

        If you do not know the APN for your SIM:
        i. Search the Internet for the APN for your Home Network Operator that you showed in Step 5 (for example, search for "Rogers Wireless").
        ii. Set the APN as described above.
   c. Check the connection status again to make sure you set the APN correctly:
      `# cm data`

```
root@swi-mdm9x15:~# cm data apn internet.sierrawireless.com
root@swi-mdm9x15:~# cm data
Index:      1
APN:        internet.sierrawireless.com
PDP Type:   IPV4
Connected:  no
```

8. The target 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 IoT cloud.

In the next section—Connect to the IoT Cloud on page 31, 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 section, you will register your device with Sierra Wireless' AirVantage IoT Acceleration platform (a cloud-based service to collect data from your device), and begin submitting your mangOH Red's on-board sensor data.

7.1 Register and connect to AirVantage

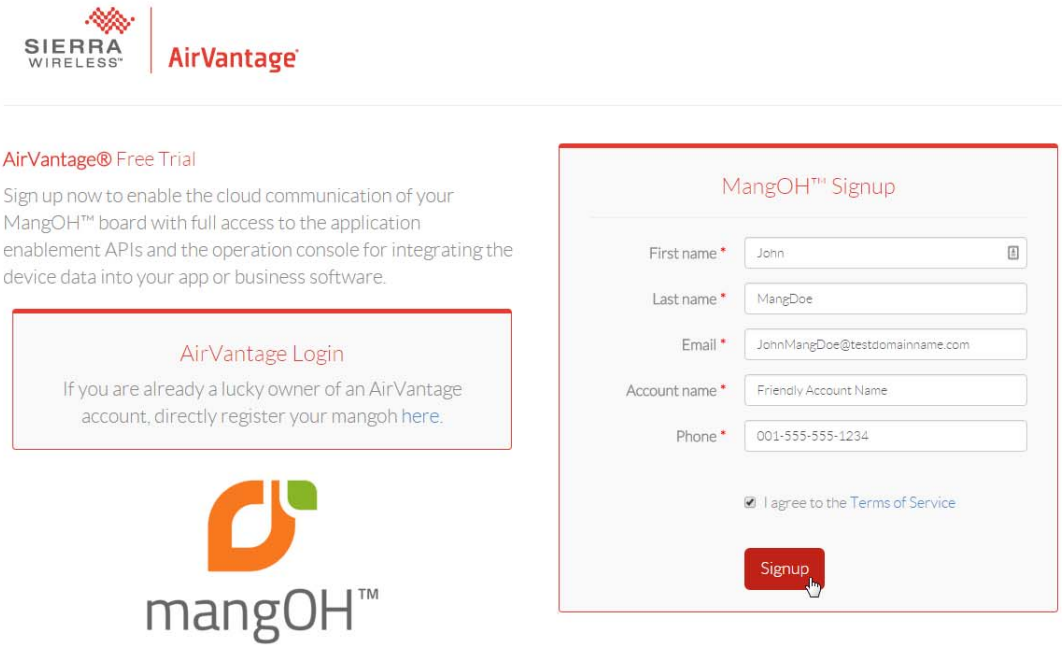
Your mangOH Red kit includes a free account on the AirVantage IoT Acceleration Platform for your CF3 module. This platform provides Sierra Wireless' cloud-based services for over-the-air (OTA) device management and application enablement. These services provide the infrastructure for you to build, connect,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

Note: *You can register up to five devices (CF3 modules and other supported devices) on your free account.*

To use AirVantage, you must register your device and then connect your mangOH Red to the AirVantage server.

7.1.1 Register with AirVantage

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

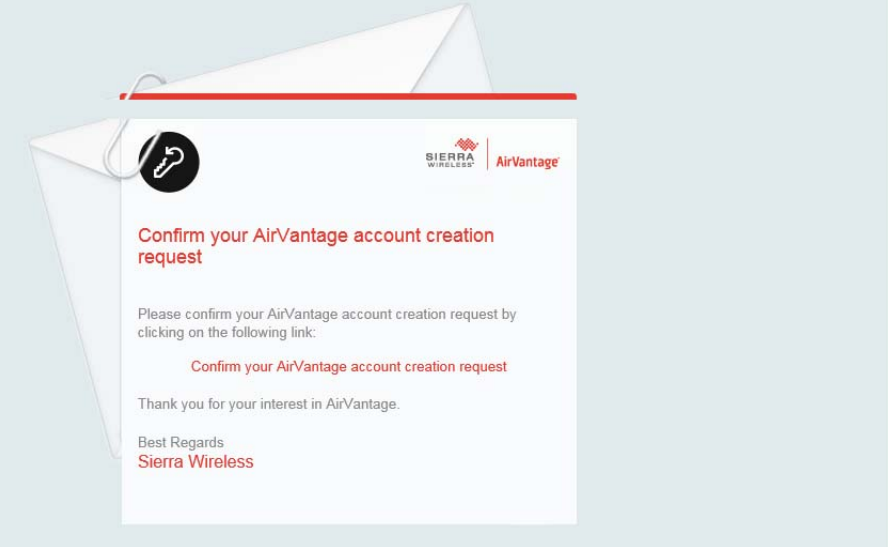


2. In the MangOH Signup area, enter your:
   - First and last names
   - Email address—Address to use as your AirVantage username.

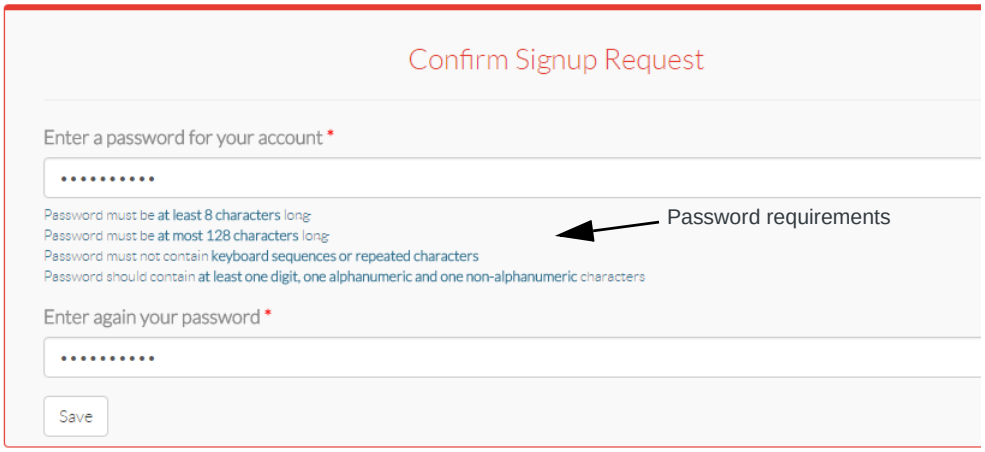
     Important: *Use a valid address—This is your username for accessing AirVantage, and is needed to complete the registration process.*

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

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



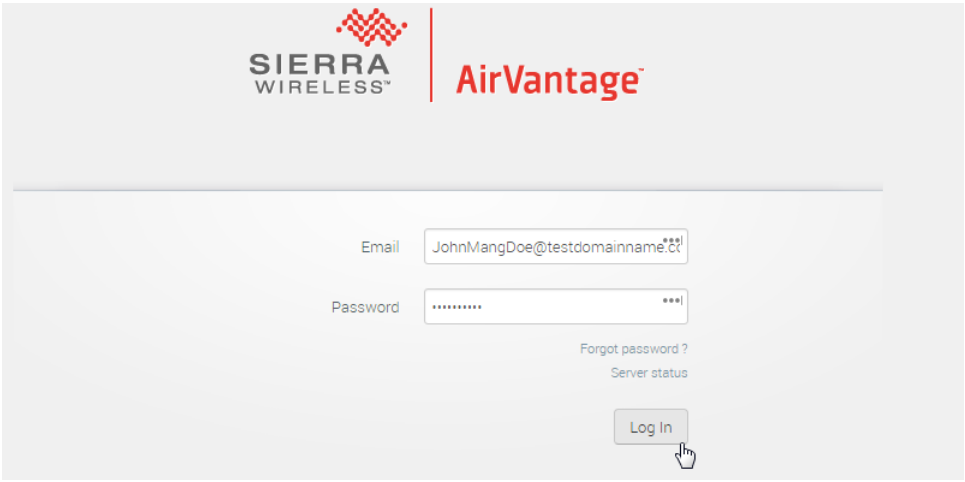
6. When your browser opens to confirm the signup request, enter a password that satisfies the requirements shown on-screen, and re-enter it to confirm.



7. Click Save.

   If your password is acceptable, the AirVantage Login screen appears.

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



9. If you did not record your device's FSN and IMEI earlier (in Build and Install Legato Platform and mangOH Red Platform on Target on page 20):

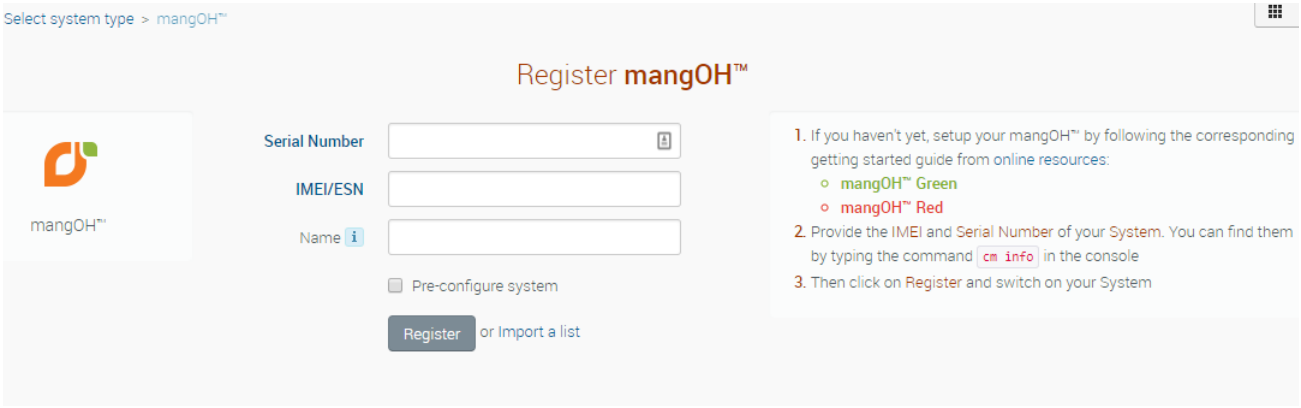
   a. Open a terminal window and connect to the device:

   ```
   $ ssh root@192.168.2.2
   ```

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

   ```
   # cm info
   ```

10. In the Register mangOH window in your browser, enter your device's information:



- Serial Number—Enter the module's FSN.
- IMEI/ESN—Enter the module's IMEI.
- Name—(Optional) Enter a descriptive name for the device (e.g. "Test Device 1", "Parking Meter", etc.)
- Pre-configure system—(IMPORTANT) Do NOT select this option.

11. Click Register.

The device appears in the 'Registered systems' section at the bottom of the screen.

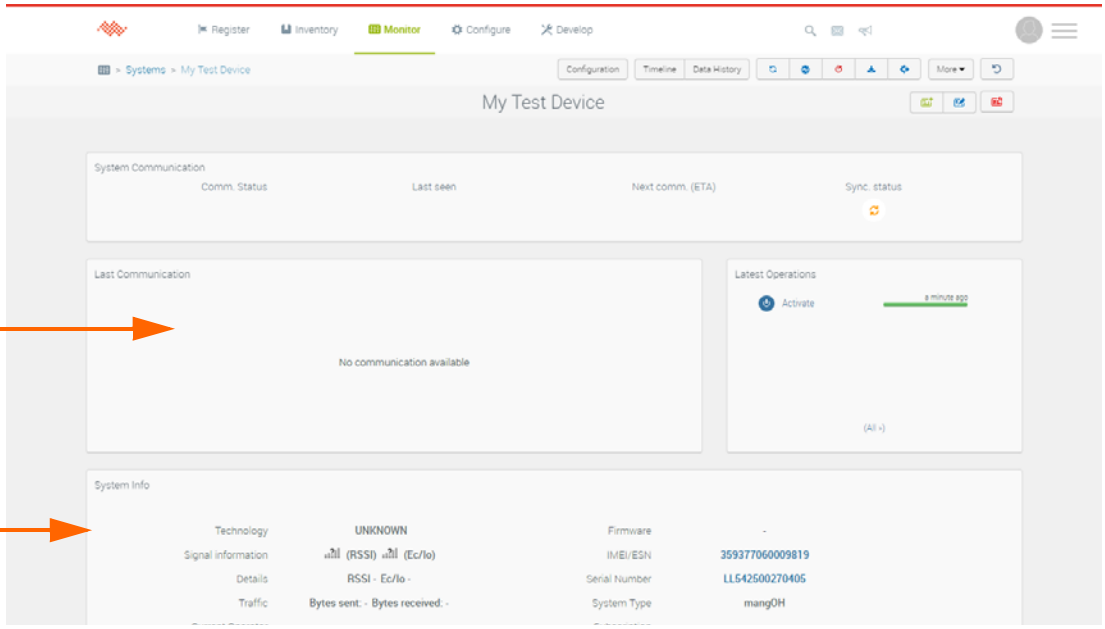
12. Now that your device is registered, click the monitor icon at the right side of your device entry ( ) (or click Monitor at the top of the screen and select Systems) to go to the System Details screen (see next step).

13. The System Details screen displays widgets reporting information about your device, communications received from it, running applications, etc.

The areas shown below (Last Communication and System Info) are both 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 35.

Last Communication
(When you have your device registered, your most recent communication will appear here.

System Info
(Details about the CF3 module in your mangOH will appear here.)



7.1.2 Connect to AirVantage

Now that you are registered on AirVantage, connect your mangOH Red to the AirVantage server and begin transmitting 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 that you installed earlier includes 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-mdm9x15:~# app status
[running] atService
[running] audioService
[running] avcCompat
[running] avcService
[running] cellNetService
[running] dataConnectionService
[running] devMode
[running] fwupdateService
[running] gpioExpanderServiceRed
[running] gpioService
[running] modemService
[running] mqttClient
[running] positioningService
[running] powerMgr
[running] redSensorToCloud
[running] secStore
```

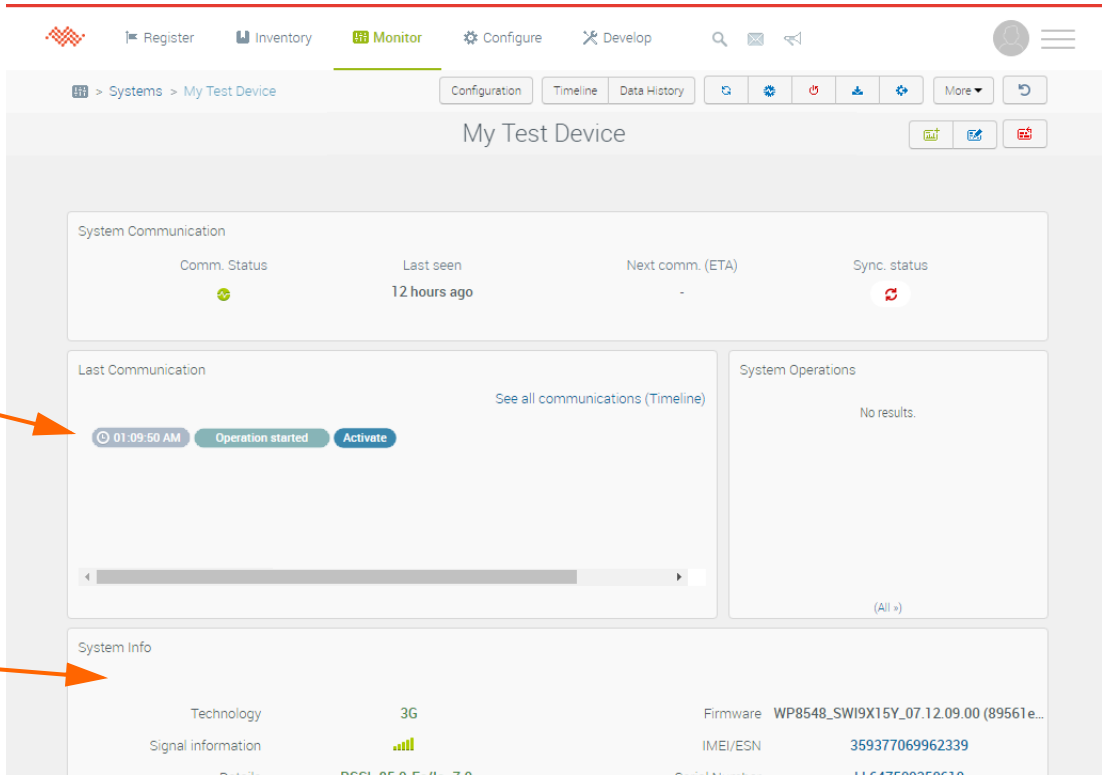
Note: *redSensorToCloud automatically opens a data connection, so you do not need to use "cm data connect".*

4. In your browser, refresh the AirVantage System Details screen.

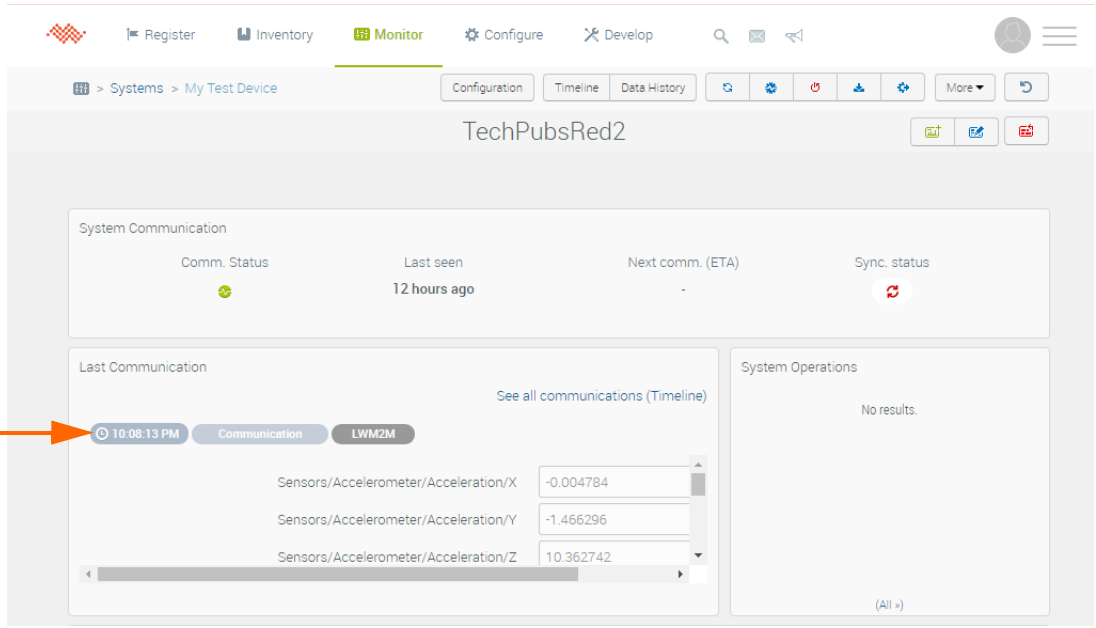
The System Info section now shows details about your module, and the Last Communication section shows your Registration connection or sensor data, whichever was most recently received.

Last Communication (Shows when your board last communicated with AirVantage, and the type of communication. For example, this CF3 communicated its Registration.

System Info (Information about the CF3 module in your mangOH board)

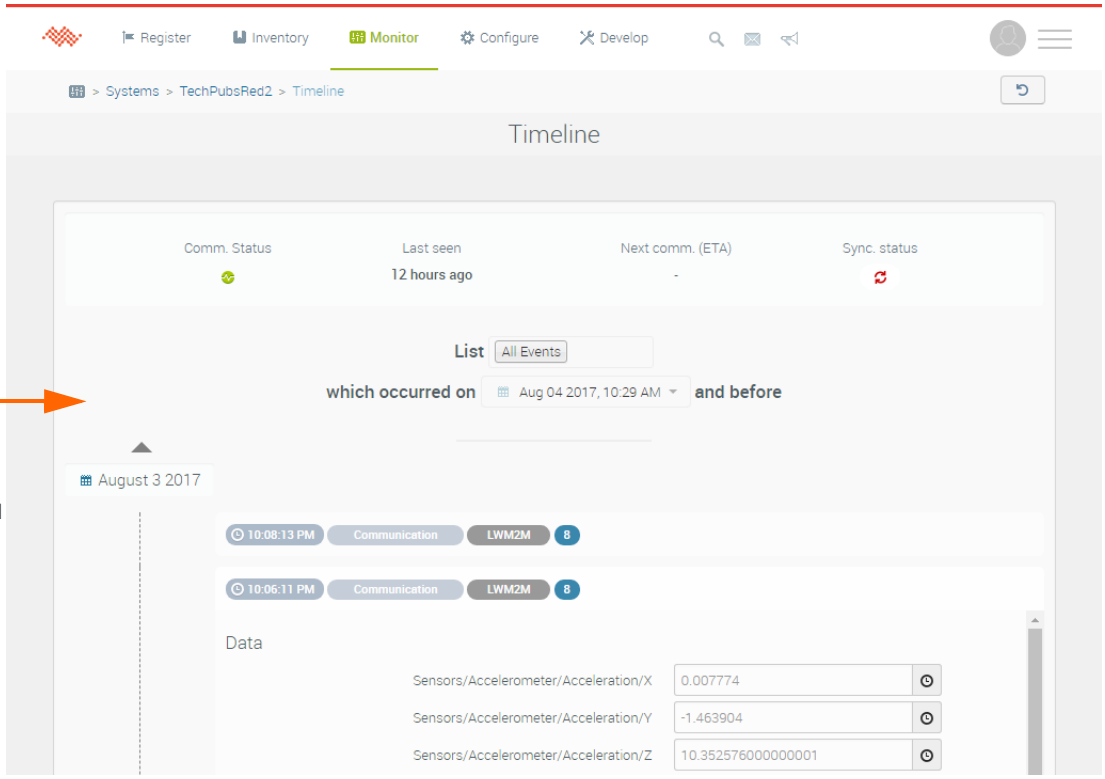


Last Communication Shows your most recent sensor data.



5. To see details on all transmissions received, click Timeline.

Timeline has sorting options to choose the data to display.
This example shows the two most recent sets of sensor data. The second set is expanded to show each sensor reading.



6. To stop sending data, and to confirm the app has stopped:

```
# app stop redSensorToCloud
# app status
```

```
root@swi-mdm9x15:~# app stop redSensorToCloud
root@swi-mdm9x15:~# app status
[running] atService
[running] audioService
[running] avcCompat
[running] avcService
[running] cellNetService
[running] dataConnectionService
[running] devMode
[running] fwupdateService
[running] gpioExpanderServiceRed
[running] gpioService
[running] modemService
[running] mqttClient
[running] positioningService
[stopped] redSensorToCloud
[stopped] smsInboxService
```

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

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 39.

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

Note: *If you installed Legato to a subdirectory of your home directory using a different name than 'legato', replace "~/legato" with "~/<yourDirectory>" in the commands in this section.*

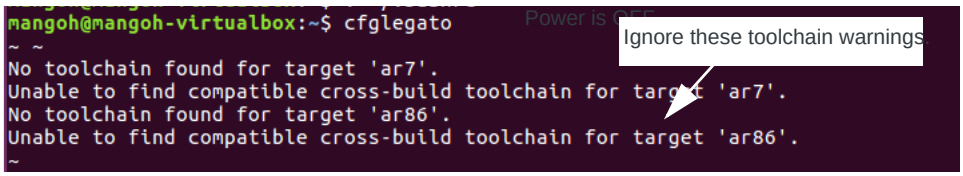
To use the CLI in a terminal window to compile and build applications, you must configure the window to work with Legato tools.

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

1. Configure the window:

```
$ cfglegato
```

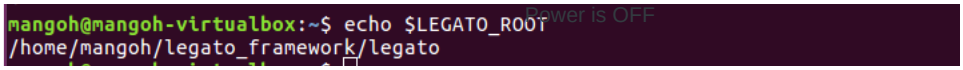
Note: *If you did not set up the cfglegato command in Step 3 on page 22 of Build and Install Legato Platform and mangOH Red Platform on Target, do it now.*



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
```



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.

Note: *You can also use the command "~/legato_framework/legato/bin/legs" to configure the terminal, but this starts a new shell session—your command history and any environment variables you have set will be lost.*

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 and Install Legato Platform and mangOH Red Platform on Target on page 20 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 the source code (avPublisher.c) 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 mangOH Red platform, including redSensorToCloud with your changes, and install it onto your mangOH Red:

6. Build and install the mangOH Red platform:

```
$ cd $MANGOH_ROOT
$ make red_wp85
```

```
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ cd $MANGOH_ROOT
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$ make red_wp85
```

```
configure: creating ./config.status
config.status: creating Makefile
config.status: creating doc/Makefile
config.status: creating doc/Doxyfile
config.status: creating tests/Makefile
config.status: creating platform-specific/Makefile
config.status: creating sha2/Makefile
config.status: creating aes/Makefile
config.status: creating ecc/Makefile
config.status: creating dtls_config.h
config.status: creating tinydtls.h
[905/905] Packaging system
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$
```

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

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

7. Verify that the update file mangOH_Red.wp85.update was created:

```
$ ls -al *.update
```

```
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$ ls -al *.update
-rw-rw-r-- 1 mangoh mangoh 3998052 Aug 22 14:54 mangOH_Red.wp85.update
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$
```

8. 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.

9. Install the mangOH Red platform on your mangOH board:
   `$ instsys mangOH_Red.wp85.update 192.168.2.2`
   If the applications install successfully, the last message shown will be "SUCCESS Done".

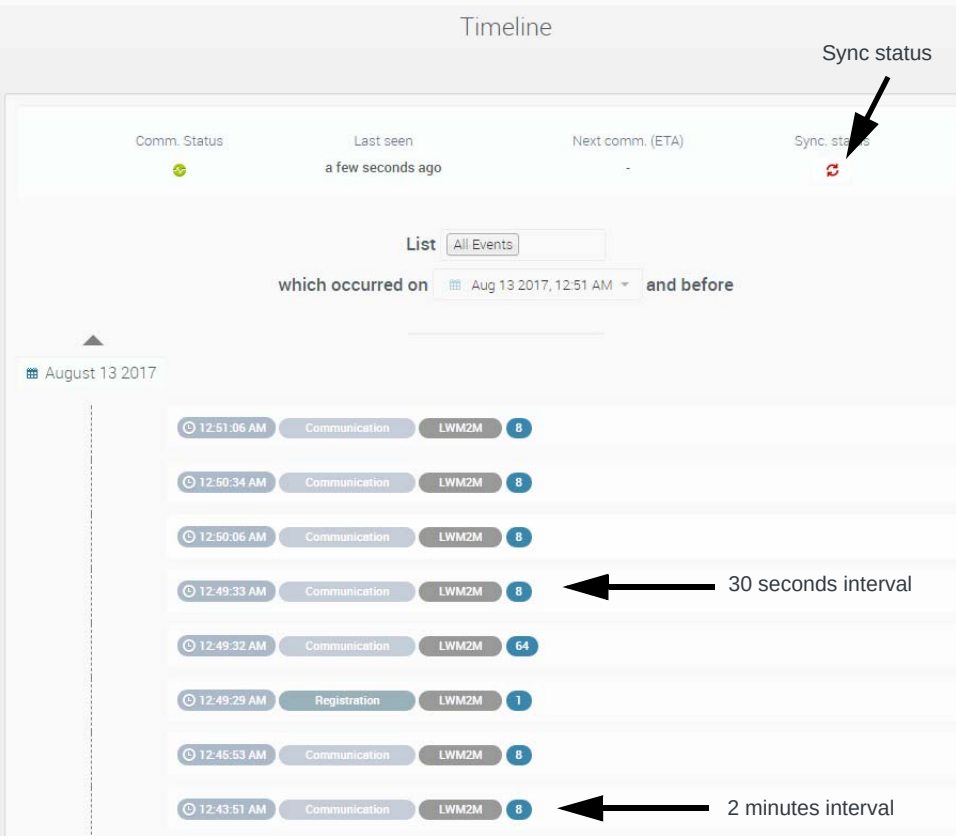
> **Note:** *If the target has any problems starting the mangOH Red platformat applications, it automatically reboots and restores to its original state (prior to the instsys command). If this happens, the target will not be reachable whlie it is rebooting.*

```
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Unpacking package: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
Applying update: 100% ++++++++++++++++++++++++++++++++++++++++++++++++++
SUCCESS
Done
mangoh@mangoh-ThinkPad-X230:~/mangOH_work$
```

10. After the installation is done, open a terminal window and connect to the mangOH Red:
    `$ ssh root@192.168.2.2`
11. 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.)



12. 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 target.

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

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

   ```
   $ cfglegato
   ```

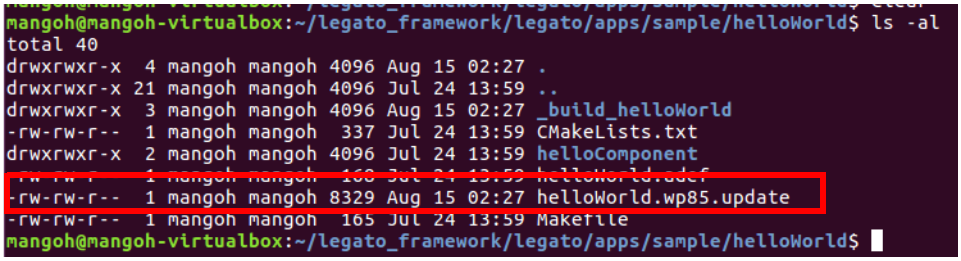
3. Change directory to the sample application directory for Hello World:

   ```
   $ cd $LEGATO_ROOT/apps/sample/helloWorld
   ```

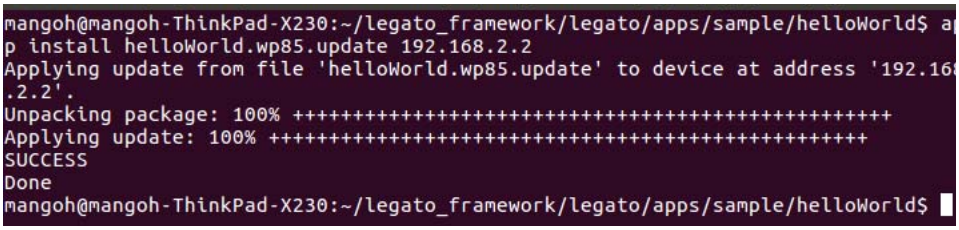
4. Compile the application.
   ```
   $ make wp85
   ```

   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 40**.*

5. Verify that the update file helloWorld.wp85.update was created:
   ```
   $ ls -al
   ```



6. Install the application on the target:
   ```
   $ app install helloWorld.wp85.update 192.168.2.2
   ```



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

Log in to the target 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 target:
      ```
      $ 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.*

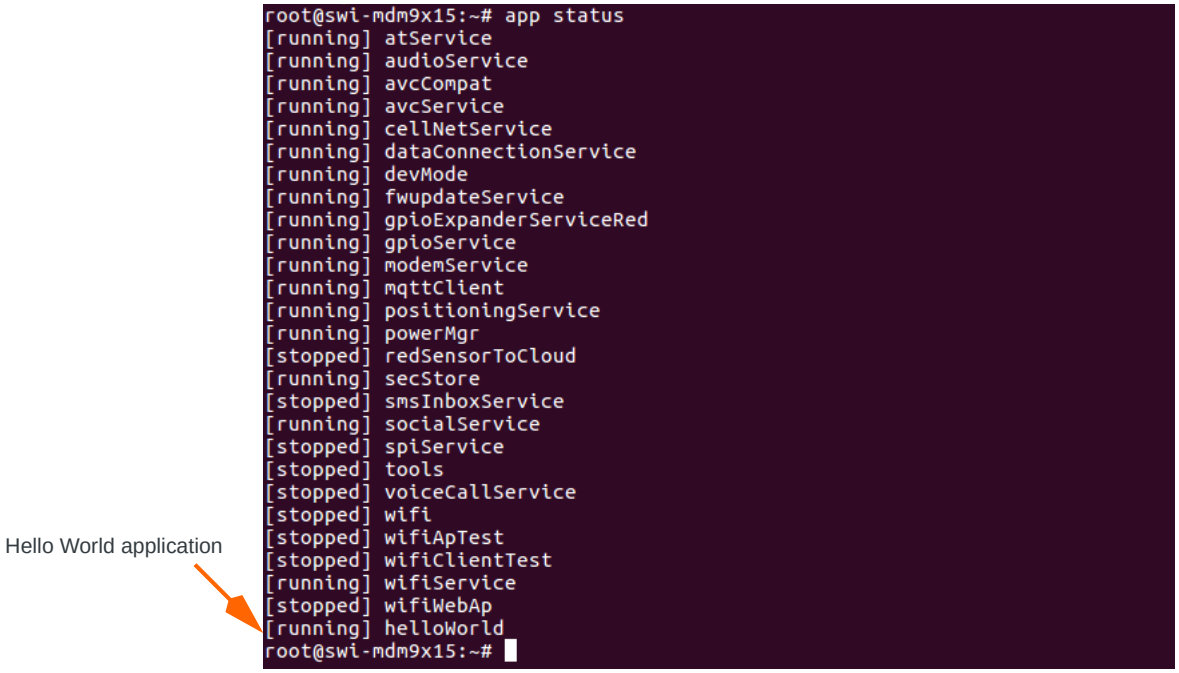
2. Run the application:
   a. Open a terminal window to run the application (referred to as APP_TERM in this procedure).

b. Connect to the target:

```
$ ssh root@192.168.2.2
```

c. Check that the application is installed:

```
# app status
```



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
```

```
mangoh@mangoh-ThinkPad-X230:~$ ssh root@192.168.2.2
root@swi-mdm9x15:~# logread -f | grep "Hello"
Aug 13 08:01:08 swi-mdm9x15 user.info Legato:  INFO | helloWorld[6110]/helloCom
onent T=main | 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-mdm9x15:~# app info helloWorld
helloWorld
  status: running
  running processes:
    helloWorld[6110] (6110)
  app.name: helloWorld
  app.md5: 97751334cbfe88812a6a0589156e0e38
  app.version:
  legato.version: 17.06.0
```

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

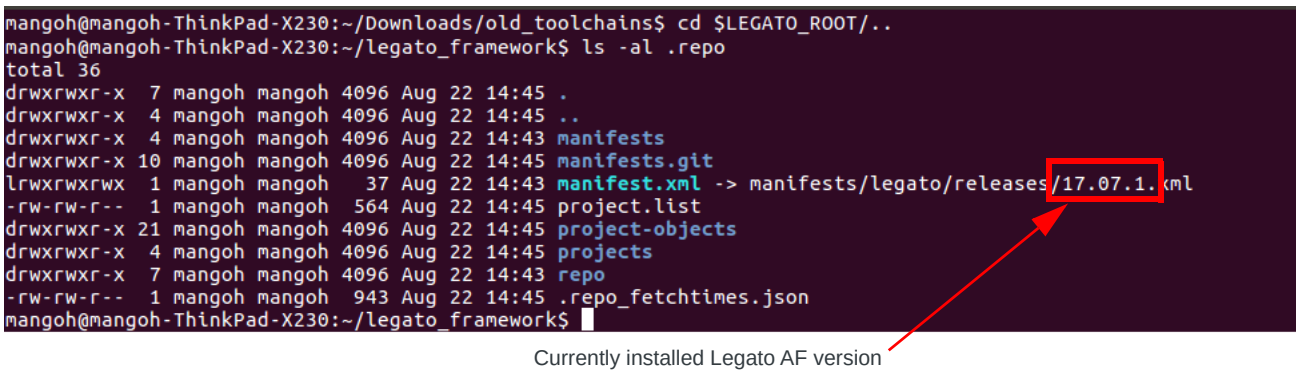
As part of the Build and Install Legato Platform and mangOH Red Platform on Target on page 20 process, you downloaded and installed the latest version of the Legato Application Framework (AF).

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

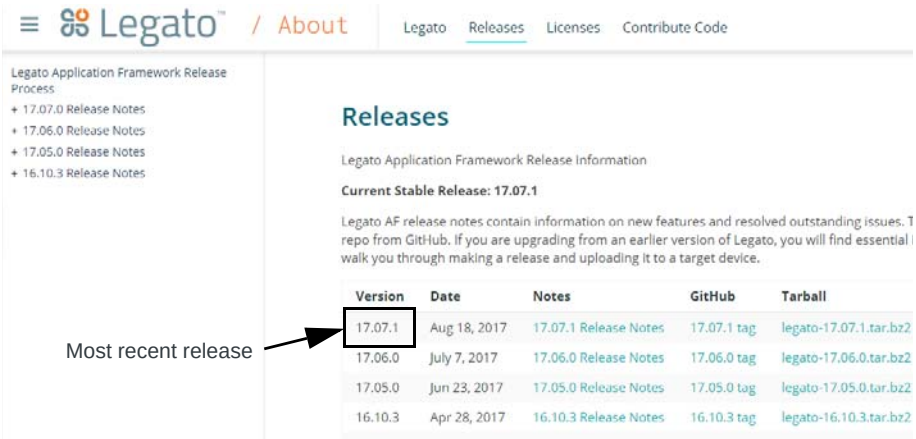
B.1 Update the Legato AF on Your Dev Machine

To update the Legato AF 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
   ```



   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 with the most recent release (this example downloads version 17.07.1):

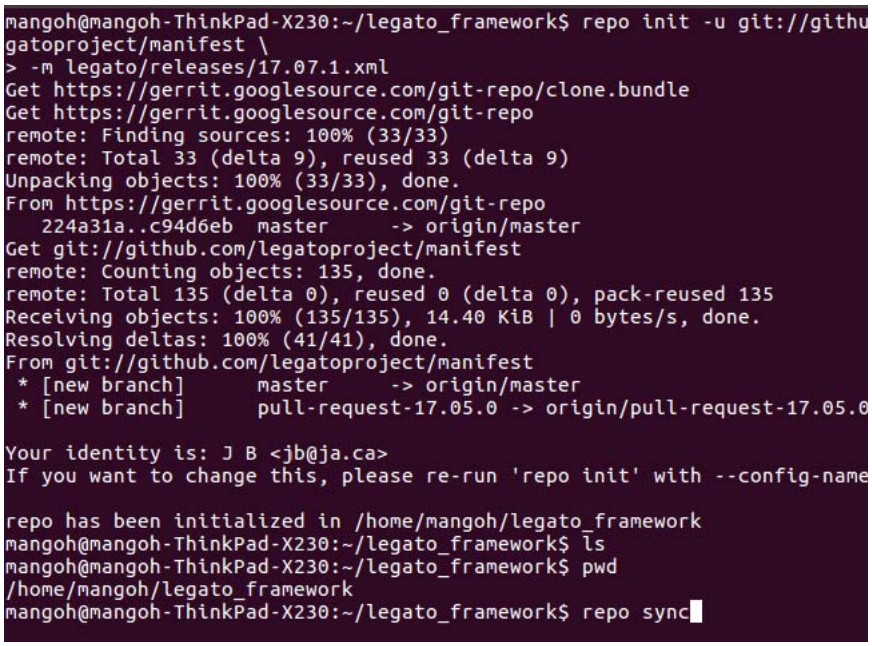
> **Note:** *Through the rest of this guide, "legato_framework" is assumed to be the file you created. If you used a different name, make sure to use that name in any commands that refer to legato_framework.*

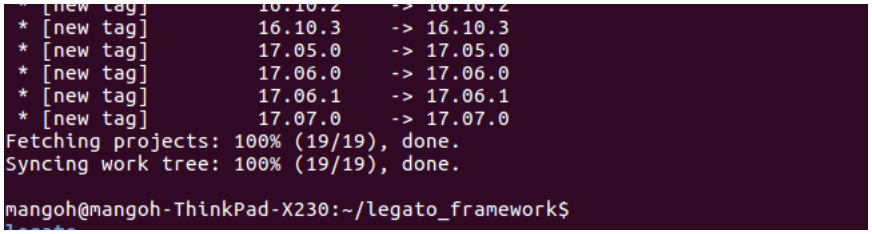
   i. Optionally, rename your existing legato folder so that you can restore the current framework if necessary at a later point (replace <version> with your current Legato AF version in the following command):

```
$ mv legato legato_<version>
```

   ii. 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/17.07.1.xml
$ repo sync
```





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

6. Build and install the Legato AF:

```
$ cd legato
$ make clean      # Optional step to remove clutter from previous builds
$ make wp85       # Build the framework
$ cfglegato       # Set up the environment
```

```
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ make clean
Module: WiFi
Module: Dualsys
rm -rf build Documentation* bin doxygen.*.log doxygen.*.err
rm -f framework/doc/toolsHost.dox framework/doc/toolsHost_*.dox
rm -f sources.md5
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ make wp85
```

```
Output: /home/mangoh/legato_framework/legato/build/wp85
Version: 17.07.1 4cd70a5 mangoh-ThinkPad-X230 2017/08/22 14:51:09
wp85: Generating the framework image (yaffs2)
wp85: Generating the framework cwe (yaffs2)
wp85: Generating the framework image (squashfs.ubi)
wp85: Generating the framework image (squashfs)
wp85: Generating the framework cwe (squashfs.ubi)
No toolchain found for target 'ar7'.
Unable to find compatible cross-build toolchain for target 'ar7'.
No toolchain found for target 'ar86'.
Unable to find compatible cross-build toolchain for target 'ar86'.
mangoh@mangoh-ThinkPad-X230:~/legato_framework/legato$ echo $?
0
```

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)
- 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 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 <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.	
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.
	update-alternatives	TBD

C.4 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
IDE perspective	A defined layout of the IDE. Each perspective will show different view (panel) combinations.
IDE view	A panel of information. For example, a directory structure, a panel for entering Terminal commands, etc.

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.*

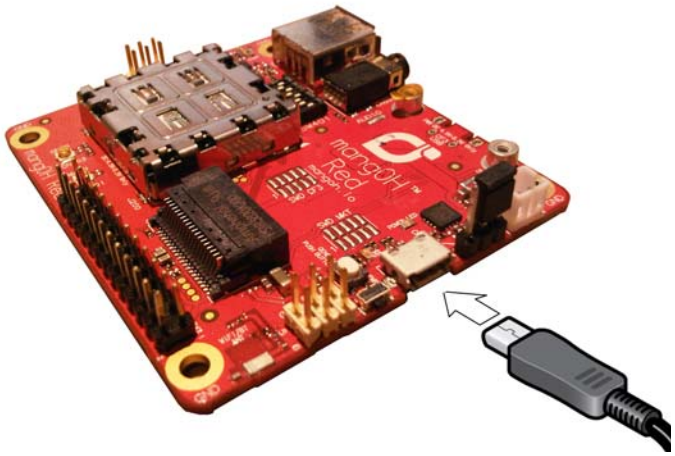
Signal	Dip	On/Off	State
1	PWR_ON	On (Default)	Enable CF3 module's POWER_ON signal
		Off	Disable POWER_ON signal
2	WIFI_UART1_TX	On	Enable CF3 module's firmware download (recovery) mode. *Note: Similar functionality to TP1_BOOT*
		Off (Default)	Normal operation
3	VCC_3V7_ULPM	On (Default)	While in ULPM, 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 on the dev machine—This window will display the target's console messages (kernel messages, warnings, etc.).

> **Note:** *Depending on your desktop, a terminal window may be opened using a keyboard shortcut (e.g. Ctrl+Alt+T for the Ubuntu Unity desktop), or an icon or menu item.*

3. Connect to the target's Linux console as follows:
   a. In the terminal window, enter the following command to install the minicom application on your dev machine (if it is not already there):

```
$ sudo apt-get install -y minicom
```

> **Note:** *'sudo' tells the dev machine to run the command as the 'superuser'. Each time you use sudo, you must enter your dev machine's password to continue.*

   b. Connect to the target's Linux console via the USB serial port (which enumerated when you connected the CONSOLE USB connector to the dev machine):

```
$ minicom -D /dev/ttyUSB0
```

   A welcome message appears, and the window will show console messages when the mangOH Red powers on in the next step.

```
Welcome to minicom 2.7

OPTIONS: I18n
Compiled on Feb  7 2016, 13:37:27.
Port /dev/ttyUSB0, 20:04:25

Press CTRL-A Z for help on special keys
```

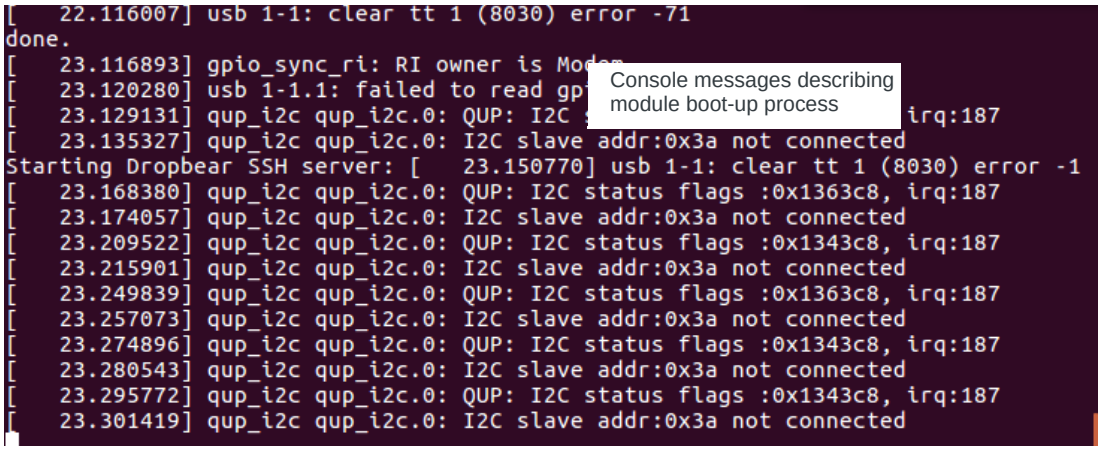
Note: *The USB serial port enumerates as ttyUSB0 because you connected CONSOLE USB to the host before connecting CF3 USB to the host (which you will do later). However, if you connected CF3 USB first, it would enumerate ttyUSB0, ttyUSB1, and ttyUSB2. Then when CONSOLE USB is connected, it will enumerate as ttyUSB3.*

Note: *You can exit minicom at any time—the purpose of showing it here is to demonstrate how to display console messages for debugging purposes. To exit minicom, press Ctrl+A, then press X. When prompted, select Yes to leave minicom.*

Note: *Through the rest of this guide, examples use terminal windows connected via ssh, but a console connection could also be used. However, 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:

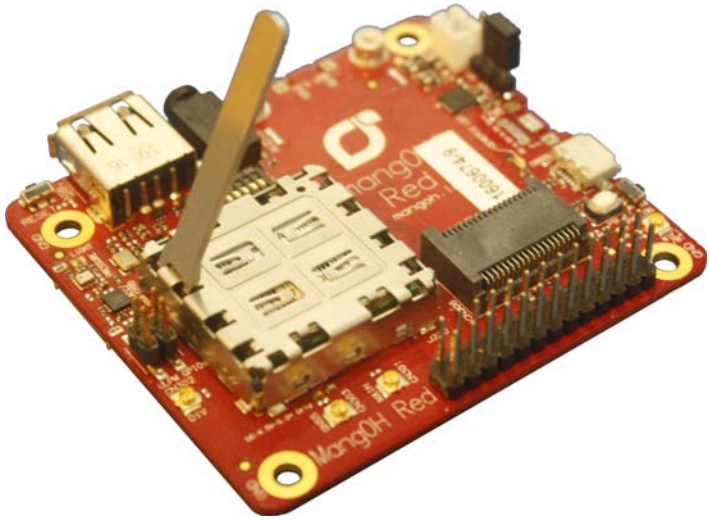


F: Removing/Inserting a CF3 Module

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).

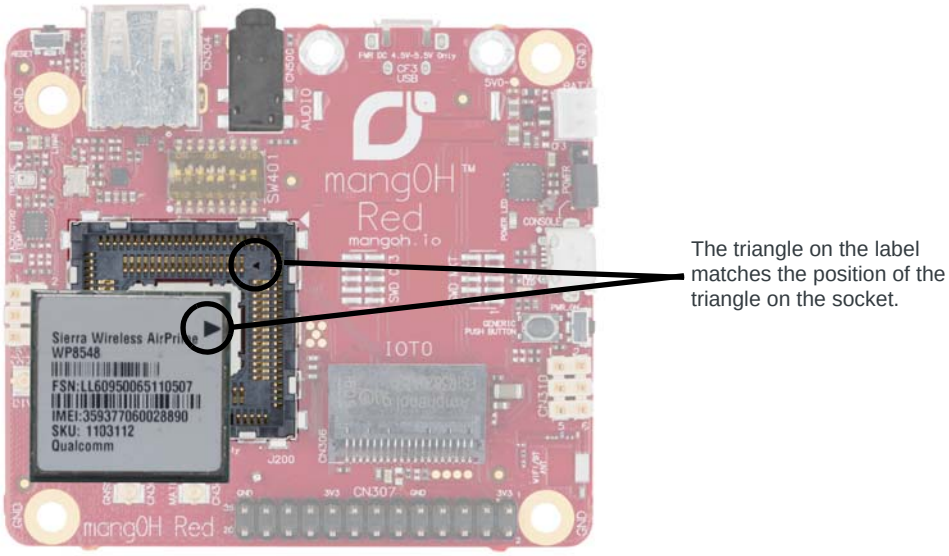


3. Lift the cover off the module.
4. Carefully lift the module straight up out of the socket.

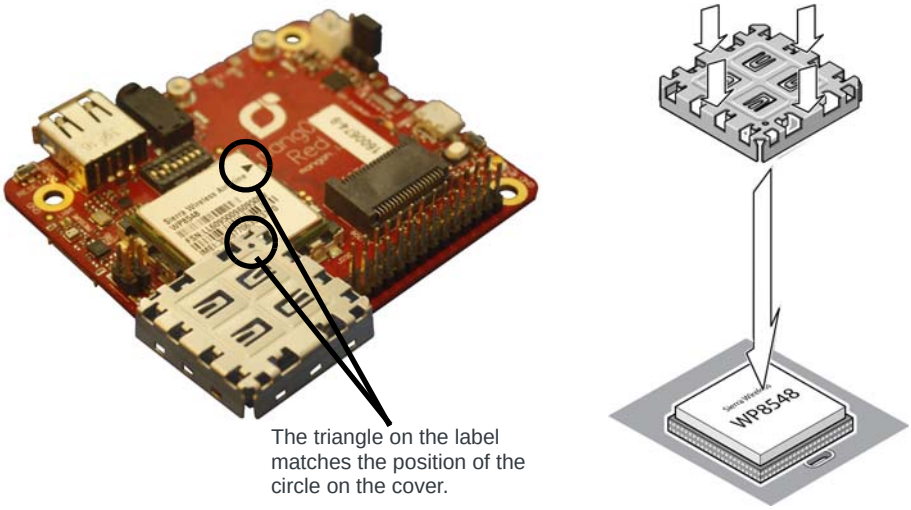
F.2 Inserting a CF3 module

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
apt-get install <package list>	Search repositories for the of listed packages (if not already installed) and install them.
apt-get remove <package>	Remove a package from the system.
ARCH=arm CROSS_COMPILE=arm-poky-linux-gnueabi- make scripts	Create the scripts that are required to build kernel modules.
bash <filename>	Run the <filename> as a bash script.
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.

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

Command	Description
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 $LEGATO_ROOT—Display the pathname held in the LEGATO_ROOT environment variable.
exit	Close the terminal window
export PATH=$PATH:<directory_path>	Add the named <directory_path> to the PATH environment variable.
fwupdate download <file> <ip_address>	Download the firmware <file> to the device at <ip_address>.
git clone --recursive <URL> [<target_directory>]	Get a local copy of the git repository located at <URL>. "--recursive" tells the command to also retrieve all submodules of the main repository.
git config --global <parameter> <string>	Set a git configuration parameter to the <string> value. "--global" adds the parameter into your user's git configuration file (~/.gitconfig)
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>.
lsb_release -d	lsb_release command displays information about the LInux distribution. lsb_release -d displays the distribution version.
make <target_list>	Build the programs for each listed target. Targets 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)
minicom -D /dev/ttyUSB0	Open a terminal window connected to the specified USB port. e.g. /dev/ttyUSB0—In the example in this guide, this is the Linux console.
mkdir <directory>	Make directory—Create the named directory as a subdirectory of the current directory

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

Command	Description
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.
rm <filename>	Remove (delete) the listed file.
ssh root@<ip_address>	Log in as the root user to the device at <ip_address>.
sudo <command>	Run the <command> as the 'superuser' (root/admin privileges).
sudo chown -R <username> <path>	Change the file ownership of all files in the named <path> to the named <username>.
uname -m	uname command displays information about the LInux environment. uname -m displays the machine hardare name (which indicates whether the machine is 32-bit or 64-bit)