mangOH™ Red

Getting Started Guide (Linux)

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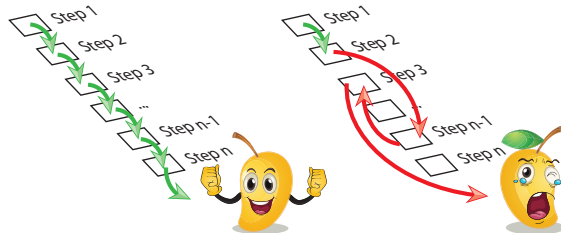
Before you begin, make sure your development machine (the computer you'll use for mangOH Red application development) meets the following minimum suggested requirements.

Table 1-1: Minimum System Requirements

O/S	Ubuntu 16.04	
CPU	Dual core @ 2.6 GHz	**Important:** *Use this guide if you are using a Linux system (Ubuntu is recommended).*
RAM	4 GB	
HDD	10 GB free space	
USB Ports	• Preferred—2 (for full functionality) • Minimum—1	To get started with a Windows system, or for other mangOH Red resources (guides, tutorials, etc.), visit mangoh.io/mangoh-red-resources.

Note: *This guide has been tested on Ubuntu 16.04. Other distributions (e.g. Debian, Fedora, etc.) may require command modifications, permissions being set, etc. For assistance, 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 Linux Dev Machine For Legato Development on page 15
- STEP 4: Prepare Your mangOH Red For Development on page 21
- STEP 5: Register On Mobile Network on page 29
- STEP 6: Connect to the IoT Cloud on page 32

Things to check out after you finish the steps above:

- Develop and Test Applications on page 45
- Update Legato Application Framework on page 53
- Tips on page 55
- Hardware Tips on page 59
- Console Access on page 60
- Quick Reference—Commands in this Guide on page 64
- Terminology on page 67

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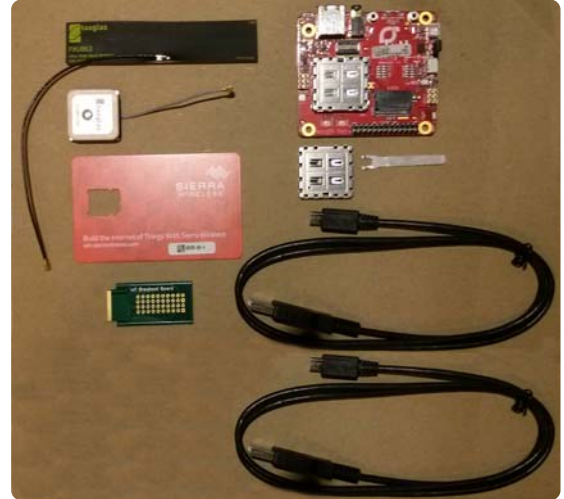
Note: The images used in this guide show the 4.0 mm cover.

| 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 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
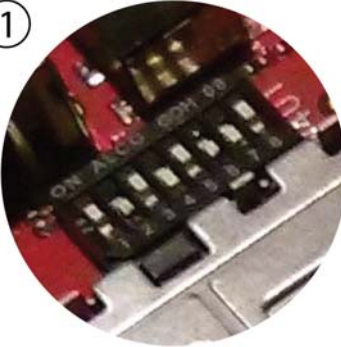
① Verify pins 1, 3, 5, 8 are ON.
(Detailed step: page 10)
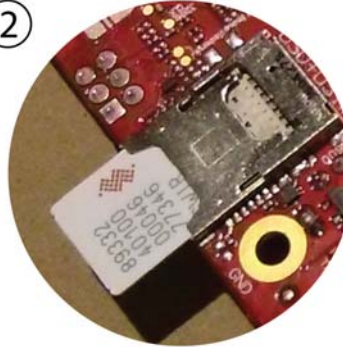
② Insert SIM in slot on bottom side of board.
(Detailed step: page 11)
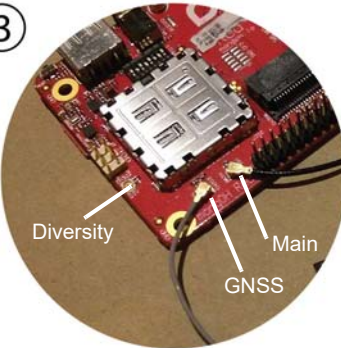
③ Connect antennas (Main, GNSS, and (if included) Diversity).
(Detailed step: page 11)

Diversity
GNSS
Main
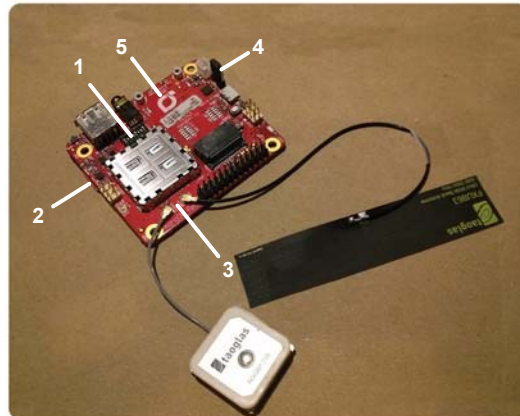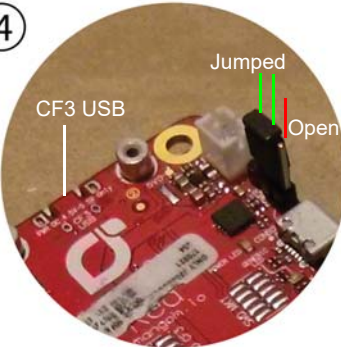
④ Set the Power Header jumper on the pair of pins that are closes to the CF3 USB port.
(Detailed step: page 12)

CF3 USB
Jumped
Open
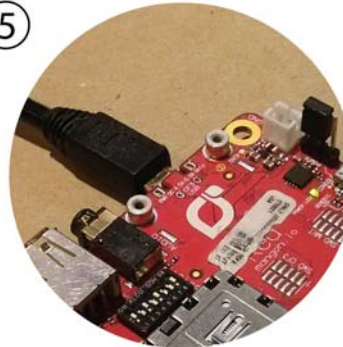
⑤ Power up the board:
1. Use a micro-USB cable to connect the mangOH Red's CF3 USB port to your computer.
2. Wait for the module to enumerate, then ping it to make sure it is working. Use: "ping 192.168.2.2"

(Detailed step: page 12)

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

3.2 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:
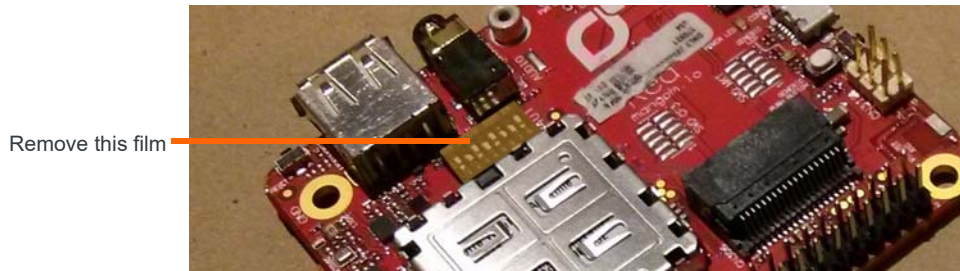
    b. Make sure the dipswitches are set as follows:
       - ON—1,3,5,8
       - OFF—2,4,6,7
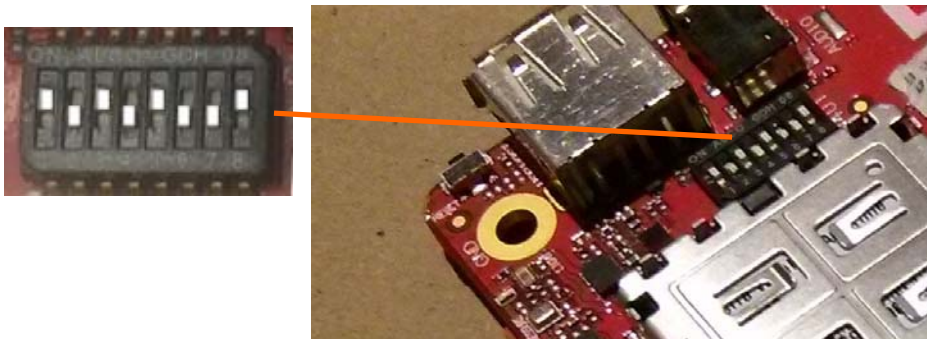
    For switch details (not needed for this tutorial), see Dipswitch Settings on page 59.

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 29 and Connect to the IoT Cloud on page 32.*
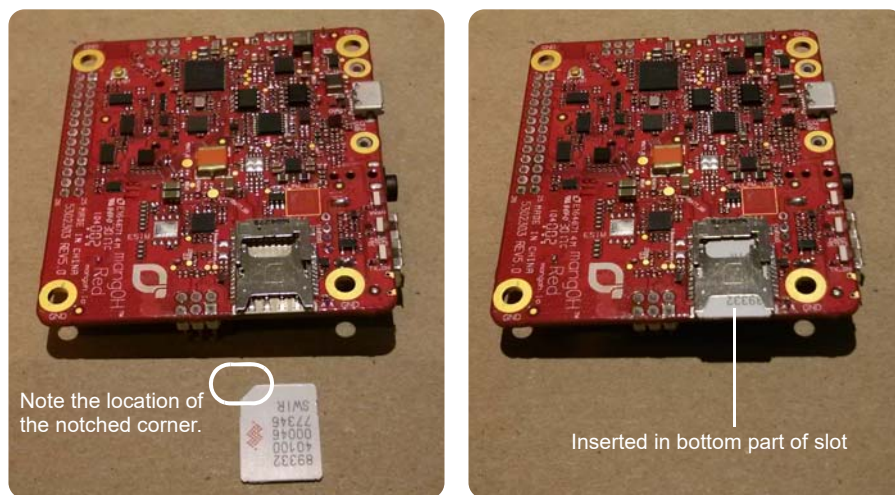
3. Attach the main antenna, the GNSS antenna, and (for WP76xx modules) the diversity antenna.
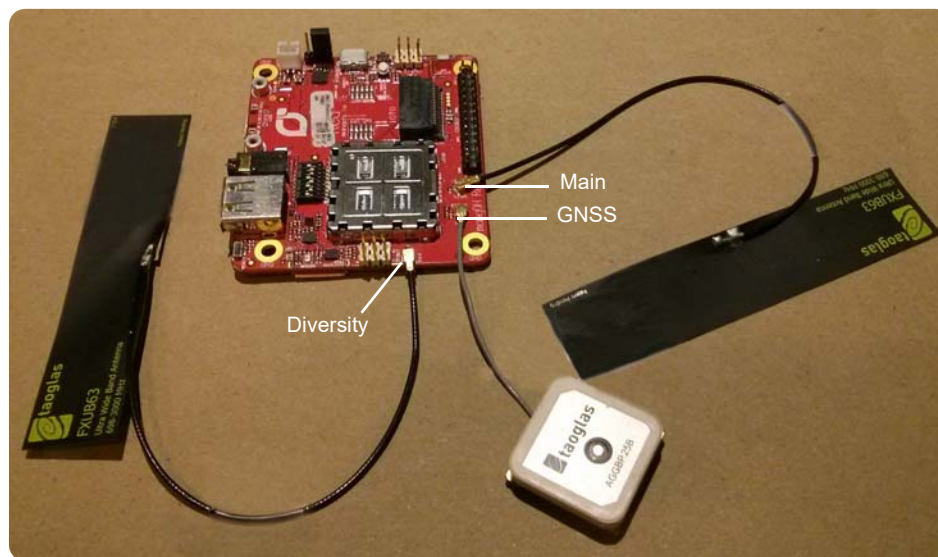
> **Tip:** *If you have trouble connecting an antenna, make sure it is positioned directly on the connector and push straight down. The antenna will not connect at an angle.*

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.*

CF3 USB connector
(bottom side of board)

Battery connector

CF3 USB power (jumper on pins
closest to battery connector)

CONSOLE USB connector
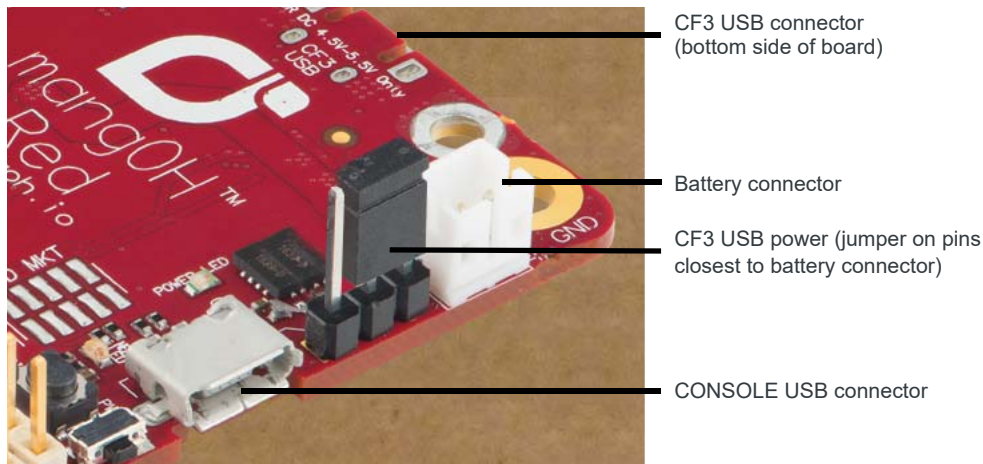
> **Note:** *OPTIONALLY, if you want to be able to display the CF3 module's console messages (diagnostic messages) and have two available USB ports on your dev machine, follow the instructions in Console Access on page 60. This is NOT a required step for this tutorial.*

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.

CF3 USB connector
(bottom side of board)
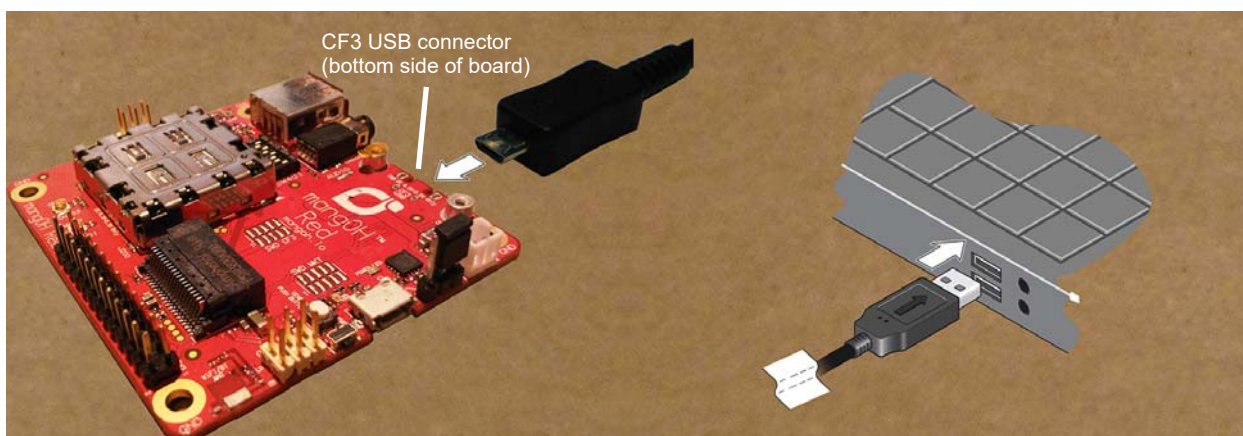
When the mangOH Red is powered, the Power LED turns solid green.
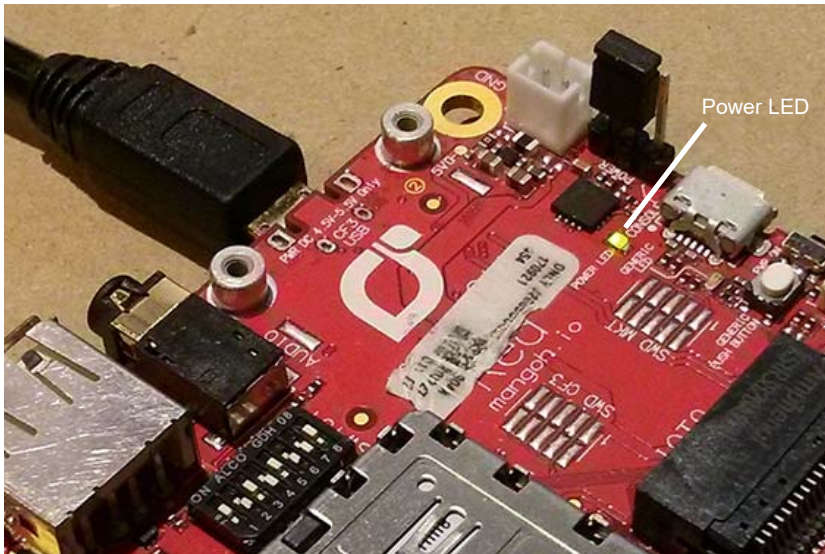
Power LED

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. On the dev machine, open a terminal window.

7. 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
```

8. Wait 10-15 seconds for the mangOH Red to enumerate.

9. 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.

```
mangoh@mangoh-ThinkPad-X230:~$ ping 192.168.2.2
PING 192.168.2.2 (192.168.2.2) 56(84) bytes of data.
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.596 ms          Replies received,
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.518 ms          connection working
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.409 ms
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.648 ms
64 bytes from 192.168.2.2: icmp_seq=1 ttl=64 time=0.407 ms
^C                                                                  Ctrl+C pressed to
--- 192.168.2.2 ping statistics ---                                cancel ping
5 packets transmitted, 5 received, 0% packet loss, time 2578ms
rtt min/avg/max/mdev = 0.407/0.516/0.648/0.100 ms
```

Linux Dev Machine terminal window

mangOH terminal window
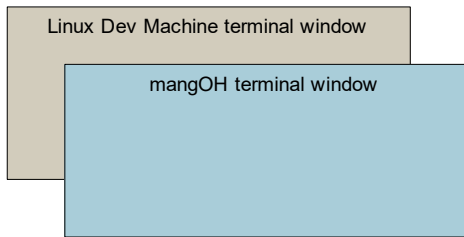
Many examples in this guide show sample output when running commands while logged into your mangOH Red or your Linux system.

Background colors indicate 'where' commands are entered (and output displayed)—blue (mangOH) and brown (Linux).

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 6.*

4.1 Prepare Dev Machine For Application Development

After preparing your mangOH Red hardware in Set Up Your mangOH Red on page 8, 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. Make sure you are running Ubuntu 16.04.0 or higher (these instructions will not work on older versions)— display your Ubuntu version:

   ```
   $ lsb_release -d
   ```

   ```
   mangoh@mangoh-ThinkPad-X230:~$ lsb_release -d
   Description:    Ubuntu 16.04.2 LTS
   ```

3. Check whether your dev machine is 32-bit or 64-bit:

   ```
   $ uname -m
   ```

   ```
   mangoh@mangoh-ThinkPad-X230:~$ uname -m
   x86_64
   ```

   The dev machine's hardware type appears —e.g. "x86_64" is a 64-bit system.

4. Optionally, make sure your Ubuntu release is up-to-date:

   ```
   $ sudo apt-get update       (Check to see which packages need to be updated)
   ```

```
$ sudo apt-get upgrade      (Installs the latest updates)
```

```
mangoh@mangoh-ThinkPad-X230:~$ sudo apt-get update
[sudo] password for mangoh:
Get:1 http://security.ubuntu.com/ubuntu xenial-security InRelease [102 kB]
Hit:2 http://ca.archive.ubuntu.com/ubuntu xenial InRelease
Get:3 http://ca.archive.ubuntu.com/ubuntu xenial-updates InRelease [102 kB]
Get:4 http://ca.archive.ubuntu.com/ubuntu xenial-backports InRelease [102 kB]
Fetched 306 kB in 1s (220 kB/s)
Reading package lists... Done
mangoh@mangoh-ThinkPad-X230:~$ sudo apt-get upgrade  (this step took about 3minutes for me,
lots of updates)
Reading package lists... Done
Building dependency tree
Reading state information... Done       If prompted to continue, type Y and press Enter.
Calculating upgrade... Done             Actual messages vary based on packages being installed.
...
```

5. Install required packages ('dependencies') for the Legato AF and the mangOH Red platform:

```
$ sudo apt-get install -y \
        cmake \
        git \
        ninja-build \
        repo \
        python-jinja2 \
        dh-autoreconf
```

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.*

```
mangoh@mangoh-ThinkPad-X230:~$ sudo apt-get install -y \
> cmake \
> git \
> ninja-build \
> repo \
> python-jinja2 \
> dh-autoreconf
Reading package lists... Done
Building dependency tree
Reading state information... Done
...
Selecting previously unselected package libfile-stripnondeterminism-perl.
Preparing to unpack .../libfile-stripnondeterminism-perl_0.015-1_all.deb ...
Unpacking libfile-stripnondeterminism-perl (0.015-1) ...             Example
Selecting previously unselected package dh-strip-nondeterminism.      data
...
```

Tip: *The output you see when you run some commands in the terminal window on the Linux system or 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.

6. Confirm the CF3 module type that is in your mangOH Red:

   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. Display information about the CF3 module and note your module type (Device) and 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. Disconnect from the mangOH Red:

`# exit`

7. Install the Legato toolchain (SDK):

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

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

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

c. In the Software Download section, click Firmware.

d. In a later step (in the next chapter), you will do a firmware update to make sure your module is up to date—download the firmware file now.

In the Firmware Update Instructions table's Instructions for Legato CLI Users (Linux) row, click the Generic firmware link (if there is more than one Generic, click the Generic GCF link).

WP76xx Firmware Release 8

Mar 01, 2018 - Author: Sierra Wireless - Version 8 - 2800 Views

This page describes the procedure to update WP76xx with Firmware Release 8.

Firmware Update Instructions

You might use one of the following instructions depending of your scenario:

Instructions with one-click tool (Windows)	1. Download the USB driver and launch the executable. 2. Download the Firmware .EXE file according to your carrier (Note: If your carrier is not listed and you are unsure which Generic to use, check with your carrier.): 　　R8 (Generic — GCF) 　　R8 (Generic — PTCRB) 　　R8 (AT&T) 　　R8 (Verizon) 3. Connect the target's (e.g mangOH) USB cable to your host 4. Launch the executable and follow instructions
Instructions for Developer Studio users (Linux, Windows)	Follow the Firmware Update Instructions with Developer Studio to download and install the following package: 　　Legato for WP76 R8 (18.1.0.wp76xx-docker-201803051401) for Windows 　　or 　　Legato for WP76 R8 (18.1.0.wp76xx-native-x86_64-201803051402) for Linux
Instructions for Legato CLI users (Linux)	1. Download the Firmware .SPK file according to your carrier (Note: If your carrier is not listed and you are unsure which Generic to use, check with your carrier.): 　　R8 (Generic — GCF)　　←　Linux firmware to download 　　R8 (Generic — PTCRB) 　　R8 (AT&T) 　　R8 (Verizon)

e. In the Release Content section, click the firmware components link.

All Vantage IoT Cloud | 2. Select More > Install Bundle.
3. Select the desired firmware bundle:
　　WP7601 (Generic) Release 8
　　WP7601 (Verizon) Release 8
　　WP7601-1 (Generic) Release 8
　　WP7601-1 (Verizon) Release 8
　　WP7603 (ATT) Release 8
　　WP7603 (PTCRB) Release 8
　　WP7603-1 (ATT) Release 8
　　WP7603-1 (PTCRB) Release 8
4. Start the install procedure. The operation will now be "In progress" state and visible in the System Operations widget.

Release Content

Consult the WP76xx Release 8 Customer Release Notes
For Information, this Firmware Release contains the following software components:

Carrier Approval	Modem Firmware	MCU Firmware	Linux Distribution	Base Legato System
Generic — GCF	SWI9X07Y_02.14.04.00 / 002.025_000	002.007	SWI9X07Y_02.14.04.00	18.01.0
Generic — PTCRB	SWI9X07Y_02.10.01.00 / 002.015_001	002.007	SWI9X07Y_02.14.04.00	18.01.0
AT&T	SWI9X07Y_02.10.01.00 / 002.015_001	002.007	SWI9X07Y_02.14.04.00	18.01.0
Verizon	SWI9X07Y_02.10.00.00 / 002.014_002	002.007	SWI9X07Y_02.14.04.00	18.01.0

If you build custom Linux Distribution or Base Legato System images for your product, see WP76xx Firmware Release 8 Components to create custom firmware packages.

Firmware components link

USB Driver

To download the standalone USB driver for Windows, see Driver Build 4773.

f. In the Rebuild Linux Distribution section, click the toolchain link for your system (32-bit or 64-bit) to download the Legato toolchain.

Legato Distro Source Version
Toolchain links

g. Make a note of the Legato Distro Source version.

h. Make the downloaded toolchain file executable:

```
$ chmod a+x ~/Downloads/poky*.sh
```

i. Install the toolchain (replace <toolchain> with the downloaded file (e.g. poky-swi-ext-glibc-x86_64-meta-toolchain-swi-ext-armv7a-neon-toolchain-swi-ext-2.2.2.sh):

```
$ sudo ~/Downloads/<toolchain>
```

```
mangoh@mangoh-ThinkPad-X230:~/Downloads$ sudo ~/Downloads/poky-swi-ext-glibc-x86_64-meta-
toolchain-swi-ext-armv7a-neon-toolchain-swi-ext-2.2.2.sh
Poky (Yocto Project Reference Distro) SDK installer version 2.2.2
================================================================
```

j. When prompted for the installation directory, append the version number from Step g to the default directory name:

For example, "/opt/swi/y22-ext-**SWI9X07Y_02.14.04.00**".

```
================================================================
Enter target directory for SDK (default: /opt/swi/y22-ext): /opt/swi/y22-ext/
SWI9X07Y_02.14.04.00
You are about to install the SDK to "/opt/swi/y22-ext/SWI9X07Y_02.14.04.00". Proceed[Y/n]? Y
Extracting SDK...................................done
Setting it up...done
  HOSTCC  scripts/basic/fixdep
  HOSTCC  scripts/basic/bin2c
...
```

k. Create a symlink (symbolic link) that points to the toolchain installation directory. The link is used by the Legato makefile and must include the module type in the name (e.g. wp750x, wp76xx, wp85, wp77xx):. Replace <toolchain_install_dir> and <symlink> as shown in the example below:

```
$ cd /opt/swi && sudo ln -f -s <toolchain_install_dir> <symlink>
```

```
mangoh@mangoh-ThinkPad-X230:~/Downloads$ cd /opt/swi && sudo ln -f -s y22-ext-
SWI9X07Y_02.14.04.00 y22_ext-wp76xx
```

8. To support multiple module types if needed (e.g. wp750x, wp85, wp76xx, wp77xx), repeat Step 7 for each required type.

Now that the Legato development environment is installed, you can Prepare Your mangOH Red For Development on page 21.

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

Now that your dev machine has its development environment set up, you will build the mangOH Distribution and install it on 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. Get the source files for the Legato AF:

   i. Create the legato_framework directory to hold the Legato AF:
   ```
   $ cd ~
   $ mkdir 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 18.02.0):
   ```
   $ cd legato_framework
   $ repo init -u git://github.com/legatoproject/manifest -m \
           legato/releases/18.02.0/legato.xml
   $ repo sync
   ```

```
mangoh@mangoh-ThinkPad-X230:~$ cd legato_framework/
mangoh@mangoh-ThinkPad-X230:~/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.*

2. Get the source files for the mangOH platform:

```
$ cd ~
```

```
$ git clone --recursive git://github.com/mangOH/mangOH
```

```
mangoh@mangoh-ThinkPad-X230:~$ cd ~
mangoh@mangoh-ThinkPad-X230:~$ git clone --recursive git://github.com/mangOH/mangOH
Cloning into 'mangOH'...
remote: Counting objects: 2004, done.
remote: Compressing objects: 100% (124/124), done.
remote: Total 2004 (delta 95), reused 145 (delta 62), pack-reused 1815
...
```

3. To work with the Legato AF in a terminal window, you must configure required environment variables and a command alias:

   - LEGATO_ROOT—Indicates the root directory of the Legato AF
   - device-specific SYSROOT variables—Indicates the root directory of device-specific toolchains (the pathname used includes the symlink(s) created earlier). Only the devices you support need to have a SYSROOT variable defined.
   - cfglegato—an alias to run a command sequence that makes the Legato AF tools available.

   a. Edit ~/.bashrc and add the following lines at the end of the file (include only the device-specific SYSROOTs that you are developing for):

```
$ export LEGATO_ROOT=~/legato_framework/legato
```

```
$ export \
WP750X_SYSROOT=/opt/swi/y17-ext-wp750x/sysroots/armv7a-vfp-neon-poky-linux-gnueabi
```

```
$ export \
WP76XX_SYSROOT=/opt/swi/y22-ext-wp76xx/sysroots/armv7a-neon-poky-linux-gnueabi
```

```
$ export \
WP85_SYSROOT=/opt/swi/y17-ext-wp85/sysroots/armv7a-vfp-neon-poky-linux-gnueabi
```

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

```
                                              .bashrc excerpt
alias cfglegato=\
"pushd . && cd ~/legato_framework/legato && source ./bin/configlegatoenv ; popd"
export LEGATO_ROOT=~/legato_framework/legato
export WP76XX_SYSROOT=/opt/swi/y22-ext-wp76xx/sysroots/armv7a-neon-poky-linux-gnueabi
```

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

`$ cd ~/mangOH`

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

(For example, "make red_wp76xx".)

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

Example data

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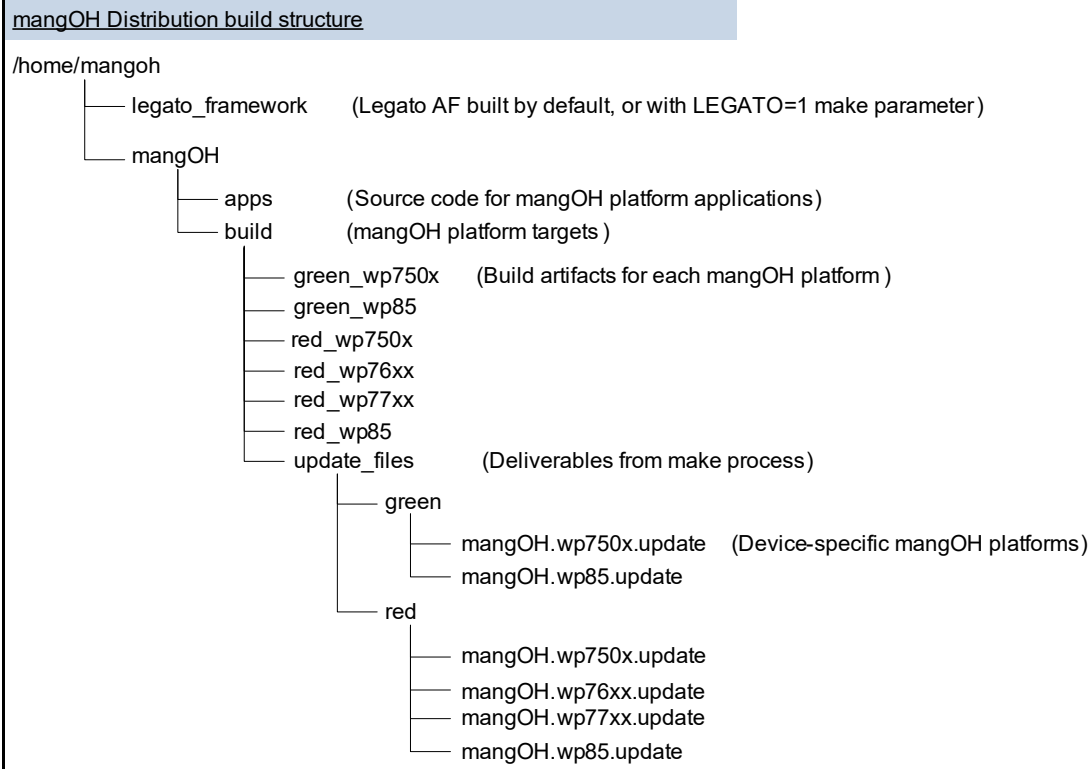   *LEGATO=<enable>*
        0 —Legato AF is not built
        1 —Legato AF is built (Default)
    <module_series>—Build only the specified mangOH platform (additional platforms will be added as new products become available):
        • *green_wp85*
        • *green_wp750x*
        • *red_wp85*
       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

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

```
mangOH Distribution build structure

/home/mangoh
        ├── legato_framework      (Legato AF built by default, or with LEGATO=1 make parameter )
        └── mangOH
                ├── apps          (Source code for mangOH platform applications)
                └── build         (mangOH platform targets )
                        ├── green_wp750x      (Build artifacts for each mangOH platform )
                        ├── green_wp85
                        ├── red_wp750x
                        ├── red_wp76xx
                        ├── red_wp77xx
                        ├── red_wp85
                        └── update_files      (Deliverables from make process)
                                ├── green
                                │      ├── mangOH.wp750x.update    (Device-specific mangOH platforms)
                                │      └── mangOH.wp85.update
                                └── red
                                       ├── mangOH.wp750x.update
                                       ├── mangOH.wp76xx.update
                                       ├── mangOH.wp77xx.update
                                       └── mangOH.wp85.update
```

5. Verify that the mangOH platform update file(s) were created:

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

```
mangoh@mangoh-ThinkPad-X230:~/mangOH$ ls -al build/update_files/*
build/update_files/green:
total 8744
drwxrwxr-x 2 mangoh mangoh    4096 Apr  6 01:32 .
drwxrwxr-x 4 mangoh mangoh    4096 Apr  6 01:33 ..
-rw-rw-r-- 1 mangoh mangoh 4470010 Apr  6 01:32 mangOH.wp750x.update
-rw-rw-r-- 1 mangoh mangoh 4469446 Apr  6 01:30 mangOH.wp85.update

build/update_files/red:
total 14636
drwxrwxr-x 2 mangoh mangoh    4096 Apr  6 01:36 .
drwxrwxr-x 4 mangoh mangoh    4096 Apr  6 01:33 ..
-rw-rw-r-- 1 mangoh mangoh 4726565 Apr  6 01:34 mangOH.wp750x.update
-rw-rw-r-- 1 mangoh mangoh 5521412 Apr  6 01:42 mangOH.wp76xx.update
-rw-rw-r-- 1 mangoh mangoh 4725694 Apr  6 01:33 mangOH.wp85.update
```

Example data

6. Configure the terminal window to work with the Legato AF's tools:

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

> **Important:** *You must enter the 'cfglegato' command in 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 distribution applications may not install if you do not have the correct firmware.*

IMPORTANT

7. Update the CF3 module's firmware to the latest available version (which you downloaded earlier along with the Legato toolchain):

   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. Install the "swiflash" command, which will be used to load the firmware update:

```
$ wget \
    http://updatesite.sierrawireless.com/legato-spm/debian/legato-spm.list \
    -O - | sudo tee /etc/apt/sources.list.d/legato-spm.lis
$ wget \
    http://updatesite.sierrawireless.com/legato-spm/debian/legato-spm.key \
    -O - | sudo apt-key add -
$ sudo apt-get update
$ sudo apt-get install swi-flash
```

```
mangoh@mangoh-ThinkPad-X230:~/Downloads$ wget \
    http://updatesite.sierrawireless.com/legato-spm/debian/legato-spm.list \
    -O - | sudo tee /etc/apt/sources.list.d/legato-spm.list
--2018-04-09 10:40:25--  http://updatesite.sierrawireless.com/legato-spm/debian/legato-
spm.list
Resolving updatesite.sierrawireless.com (updatesite.sierrawireless.com)... [sudo] password
for mangoh: 24.244.18.120, 24.244.18.121
Connecting to updatesite.sierrawireless.com
...
2018-04-09 10:40:25 (4.78 MB/s) - written to stdout [68/68]
[sudo] password for mangoh:
deb http://updatesite.sierrawireless.com/legato-spm/debian release/

mangoh@mangoh-ThinkPad-X230:~$ wget http://updatesite.sierrawireless.com/legato-spm/
debian/legato-spm.key -O - | sudo apt-key add -
--2018-04-09 10:42:12--  http://updatesite.sierrawireless.com/legato-spm/debian/legato-
spm.key
Resolving updatesite.sierrawireless.com (updatesite.sierrawireless.com)... 24.244.18.121,
24.244.18.120
Connecting to updatesite.sierrawireless.com
(updatesite.sierrawireless.com)|24.244.18.121|:80... connected.
...
2018-04-09 10:42:12 (71.9 MB/s) - written to stdout [1036/1036]
OK

mangoh@mangoh-ThinkPad-X230:~$ sudo apt-get update
Get:1 http://updatesite.sierrawireless.com/legato-spm/debian release/ InRelease [1,908 B]
...
Reading package lists... Done

mangoh@mangoh-ThinkPad-X230:~$ sudo apt-get install swiflash
Reading package lists... Done
Building dependency tree
...
Unpacking swiflash (4.5.1) ...
Setting up swiflash (4.5.1) ...
```

Example data

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.

d. Install the firmware (replace <module_series> with your CF3 module's series: WP85XX, WP750X, or WP76XX):

   i. Open a terminal window.

   ii. Change directory to the Downloads folder:

```
$ cd ~/Downloads
```

   iii. Check the name of the firmware file that you downloaded earlier:

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

```
mangoh@mangoh-ThinkPad-X230:~/Downloads$ ls -al *.spk
-rw-rw-r-- 1 mangoh mangoh 61490131 Apr  5 09:55 WP76xx_Release8_RC4_GENERIC_SPK.spk
-rw-rw-r-- 1 mangoh mangoh 56771656 Aug 29  2017 WPx5xx_Release14_GENERIC_SPK.spk
```

> **Note:** *The downloaded file will be an ".spk" file. If the file is not listed, repeat Step 7 on page 17 up to step Step d. Make sure to click the link in the Instructions for Legato CLI Users (Linux) row (do **not** click the link in the Instructions with one-click tool (Windows) row.*

   iv. Install the new firmware (replace <module_series> with your CF3 module's series: WP85XX, WP750X, or WP76XX, and replace <file> with the name of the file that you downloaded):

```
$ swiflash -m <module_series> -i <file>
```

(e.g. "swiflash -m WP76XX -i WP76xx_release8_RC4_GENERIC_SPK.spk"

```
mangoh@mangoh-ThinkPad-X230:~/Downloads$ swiflash -m WP76XX -i Downloads/
WP76xx_Release8_RC4_GENERIC_SPK.spk
Detecting USB of the target
DONE
Communicating with the target
DONE
Switching to firmware download mode
............DONE
Downloading the firmware
..................DONE
Rebooting the module
........DONE
Firmware Download SUCCESS
```

> **Note:** *This will take several minutes to run. If the download fails, repeat the swiflash command. If you still have difficulties, refer to source.sierrawireless.com/resources/airprime/software/swiflash for additional usage suggestions.*

e. 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)*

f. Verify that the firmware updated:

   i. Connect to the mangOH Red:

```
$ ssh root@192.168.2.2
```

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

```
# 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

iii. Disconnect from the mangOH Red:

```
# exit
```

8. Install the mangOH Red platform:

a. 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
```

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".

```
root@swi-mdm9x28:~# 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
```

> **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.*

9. 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
```

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          ◄───────── Platform 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 29.

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.)

Note the location of the notched corner.

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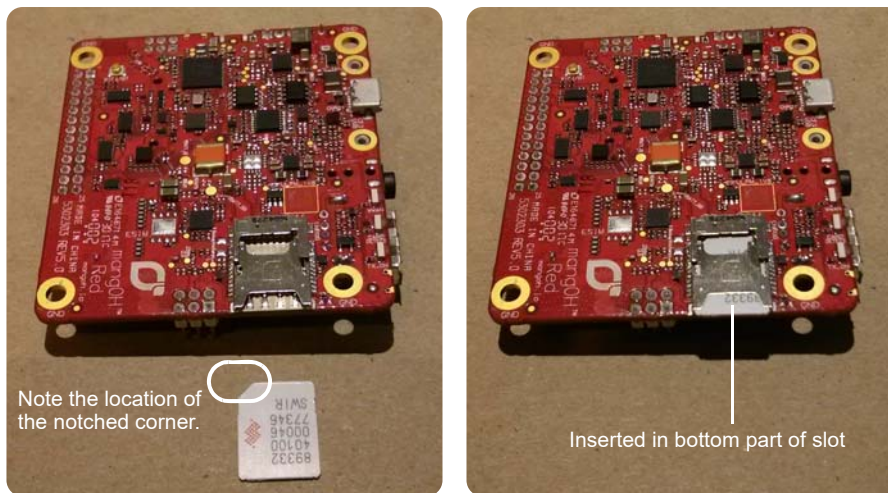
    c. Reconnect the power (plug in the micro-USB cable or insert the jumper on the power header on the same pins it was removed from in step a. The Power LED will light immediately.

    > **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                      Example response when Power is ON,
Current Network Operator:                     and Status is Searching
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)
```

```
root@swi-mdm9x28: ~# cm radio
Power:              ON                      Example response when Power is ON,
Current Network Operator: Rogers Wireless     and Status is Registered
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)
```

```
root@swi-mdm9x28: ~# cm radio
Power:              OFF               Example response when Power is 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)
```

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          ◄──────        Example
Home Network Operator: I TIM                                          data
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 32, 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 . 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".
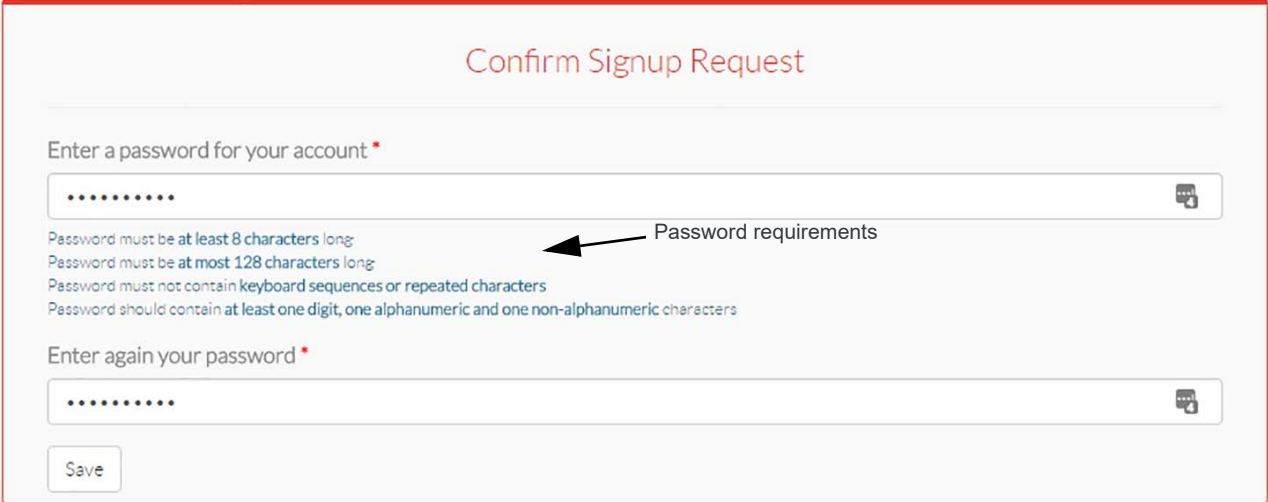
5. Click Signup.

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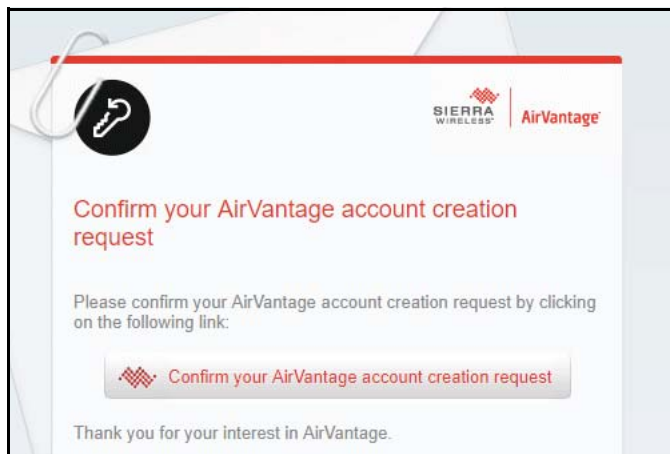
7. When your browser opens to confirm the signup request, enter a password that satisfies the requirements shown on-screen, and re-enter it to confirm.

8. Click Save.

If your password is acceptable, You will receive an email to confirm your account creation.
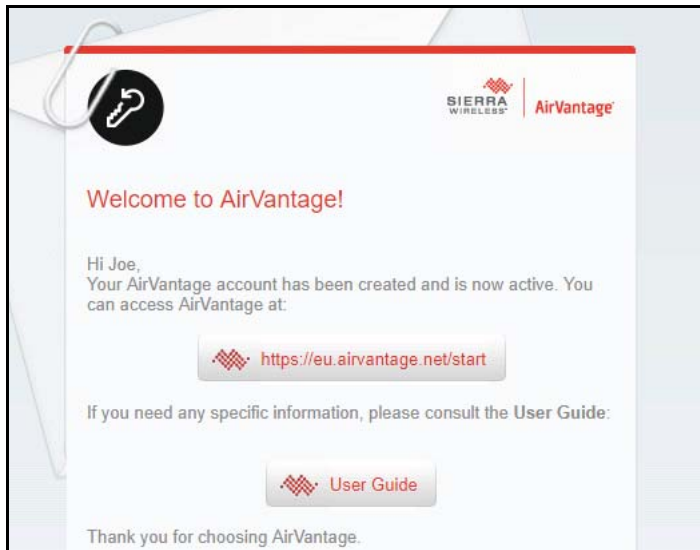
9. Click the link to go to http://eu.airvantage.net/start. The AirVantage Login screen appears.

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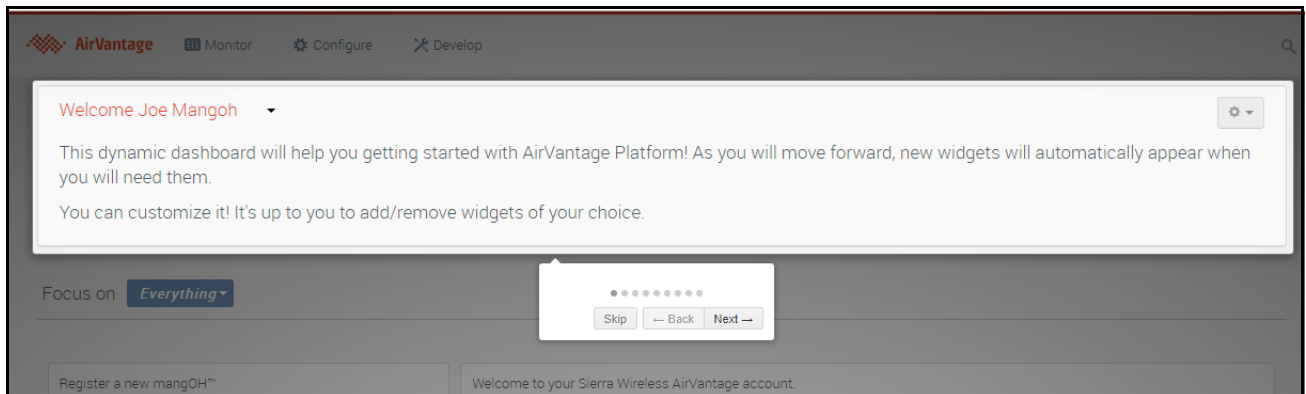
12. If you did not record your SIM's ICCID and your device's FSN and IMEI earlier, record them now:

   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.
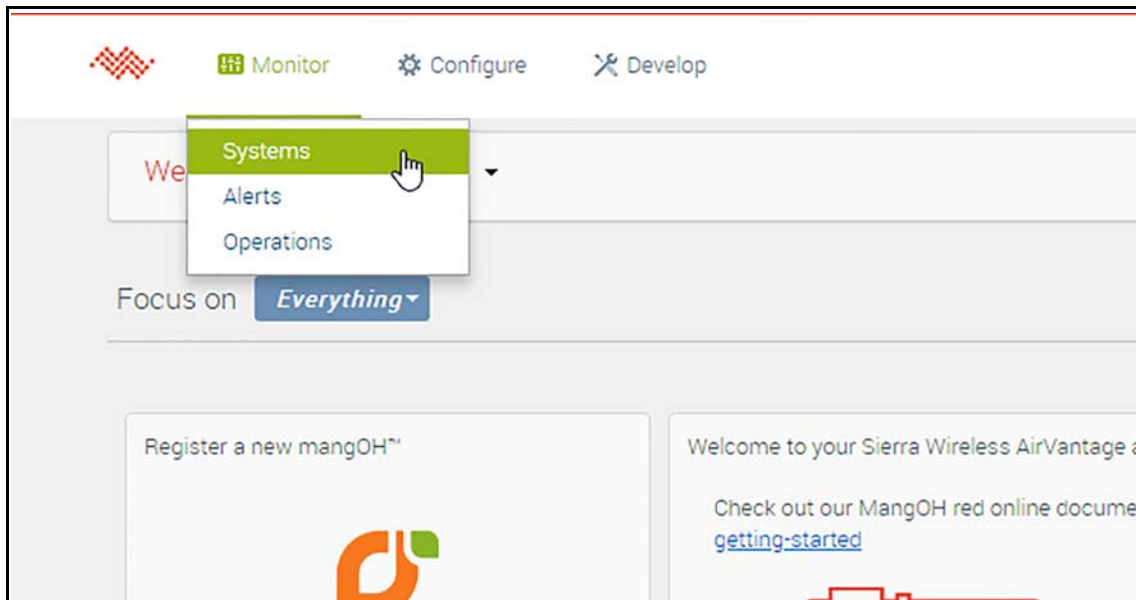


**17.** Click anywhere in the line showing your device to display the device dashboard (System Details) screen. (All the devices registered on your account appear in this list; make sure to click the correct device.)
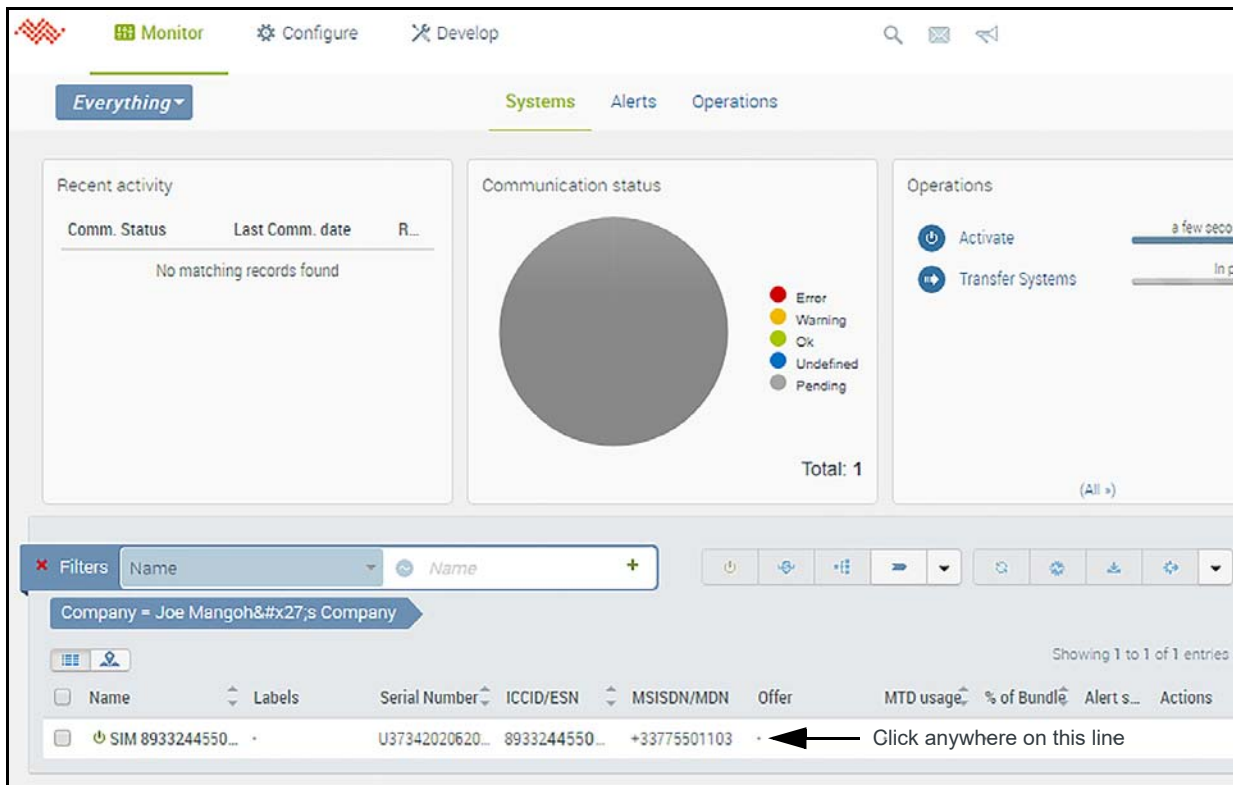
**18.** The device dashboard displays:

- 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.
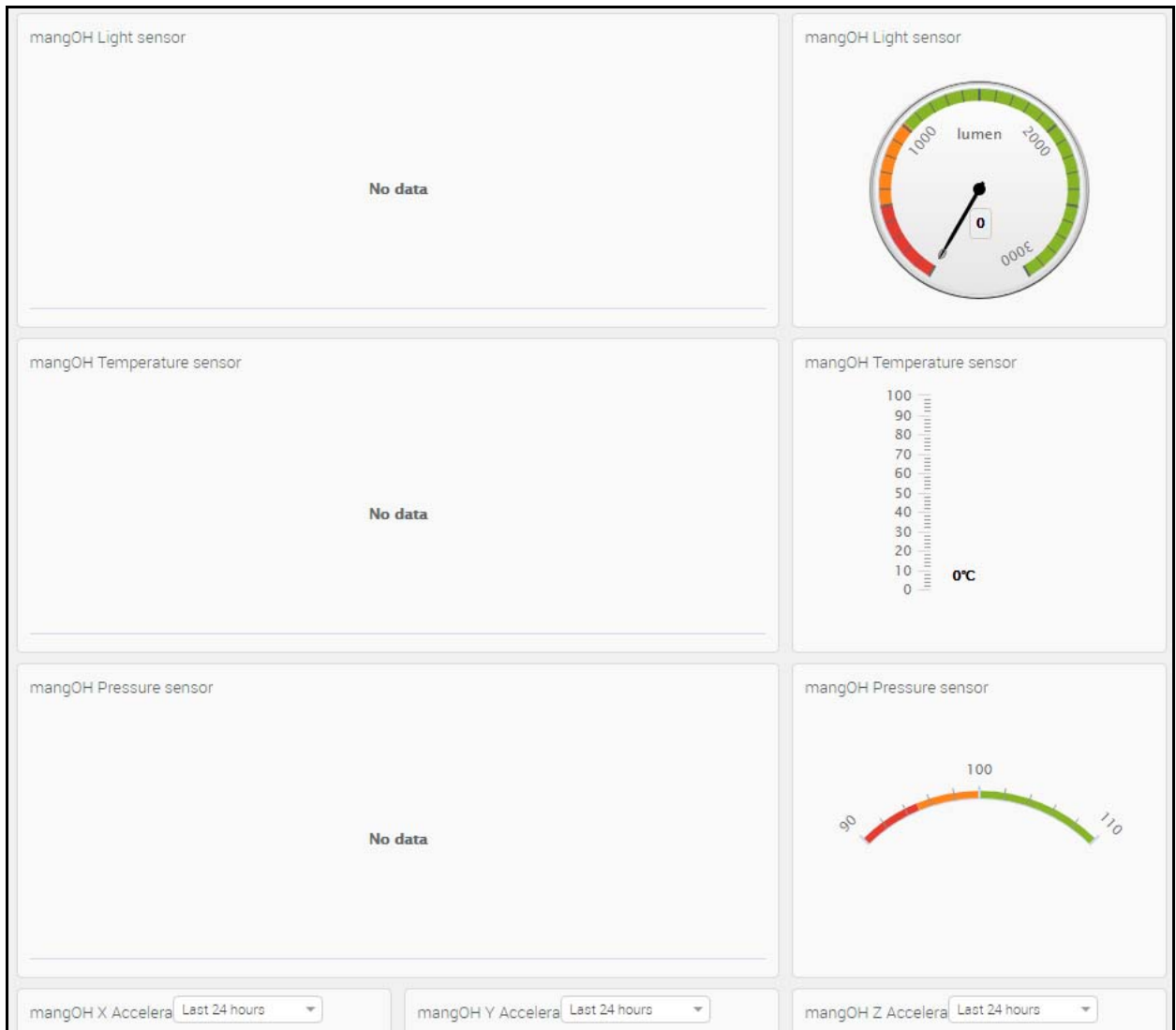


- GPS location (if your device is in view of GPS satellites)
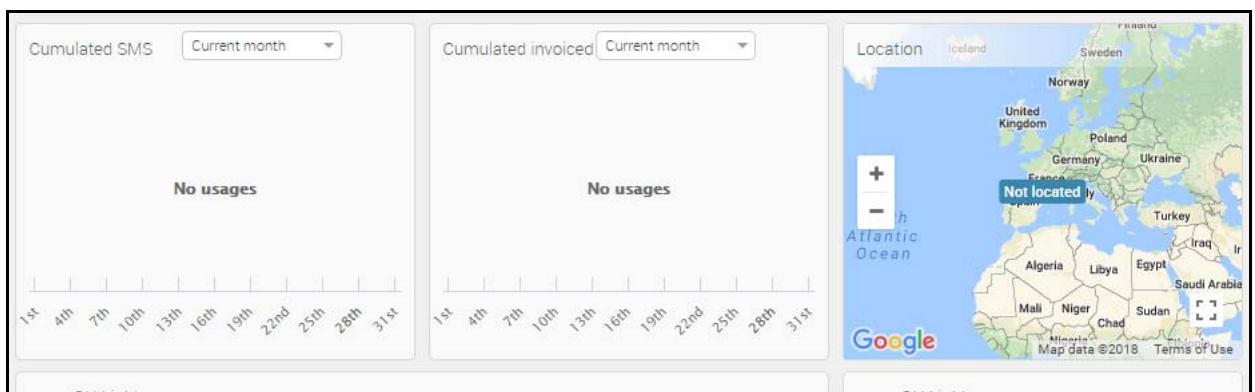
- Switch mangOH LED—A widget to demonstrate how AirVantage can push data to your device.
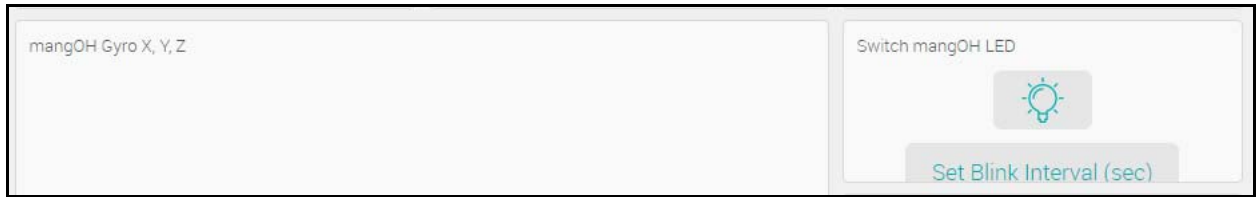


*Note: The communication and sensor widgets are initially blank because you have not connected your mangOH Red to AirVantage yet. Leave this browser window open and continue to .*

# 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.)

No data

Most recent light sensor reading, and trend.

mangOH Temperature sensor

Most recent temperature reading, and trend.

mangOH Pressure sensor

Most recent pressure sensor reading, and trend.

mangOH X Accelera | Last 24 hours

mangOH Y Accelera | Last 24 hours

mangOH Z Accelera | Last 24 hours

Most recent accelerometer readings, and trend.

mangOH Gyro X, Y, Z

Gyroscope trend

Switch mangOH LED

Set Blink Interval (sec)

mangOH monitoring | Last 7 days

Sample LED testing application

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

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

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.)
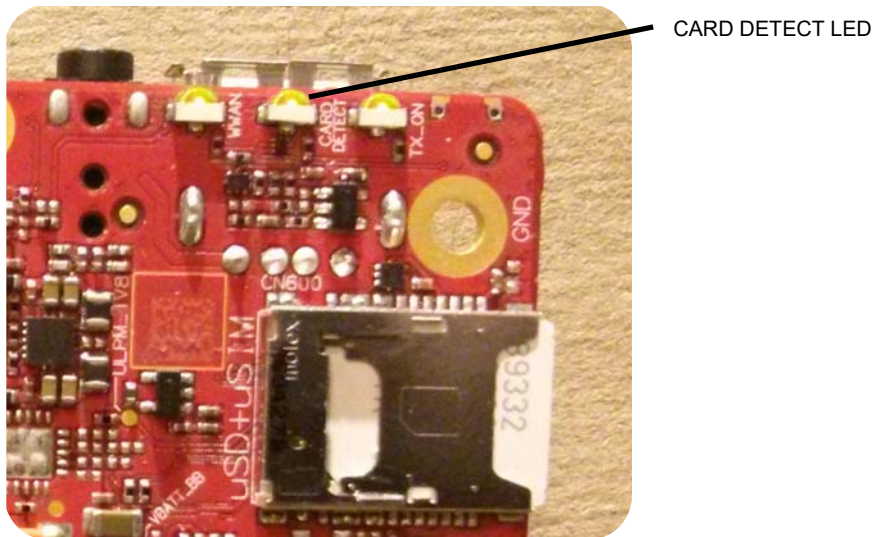
CARD DETECT LED

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 45.

A: Develop and Test Applications

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
```

```
mangoh@mangoh-ThinkPad-X230:~$ 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:** *If you did not set up the cfglegato command in* Step 3 on page 22 *of* Build/Install mangOH Distribution, *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
```

```
mangoh@mangoh-ThinkPad-X230:~$ 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 on page 21Build/Install mangOH Distribution 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-ThinkPad-X230:~$ cd $MANGOH_ROOT
mangoh@mangoh-ThinkPad-X230:~$ 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-ThinkPad-X230:~$ 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-ThinkPad-X230:~/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.)
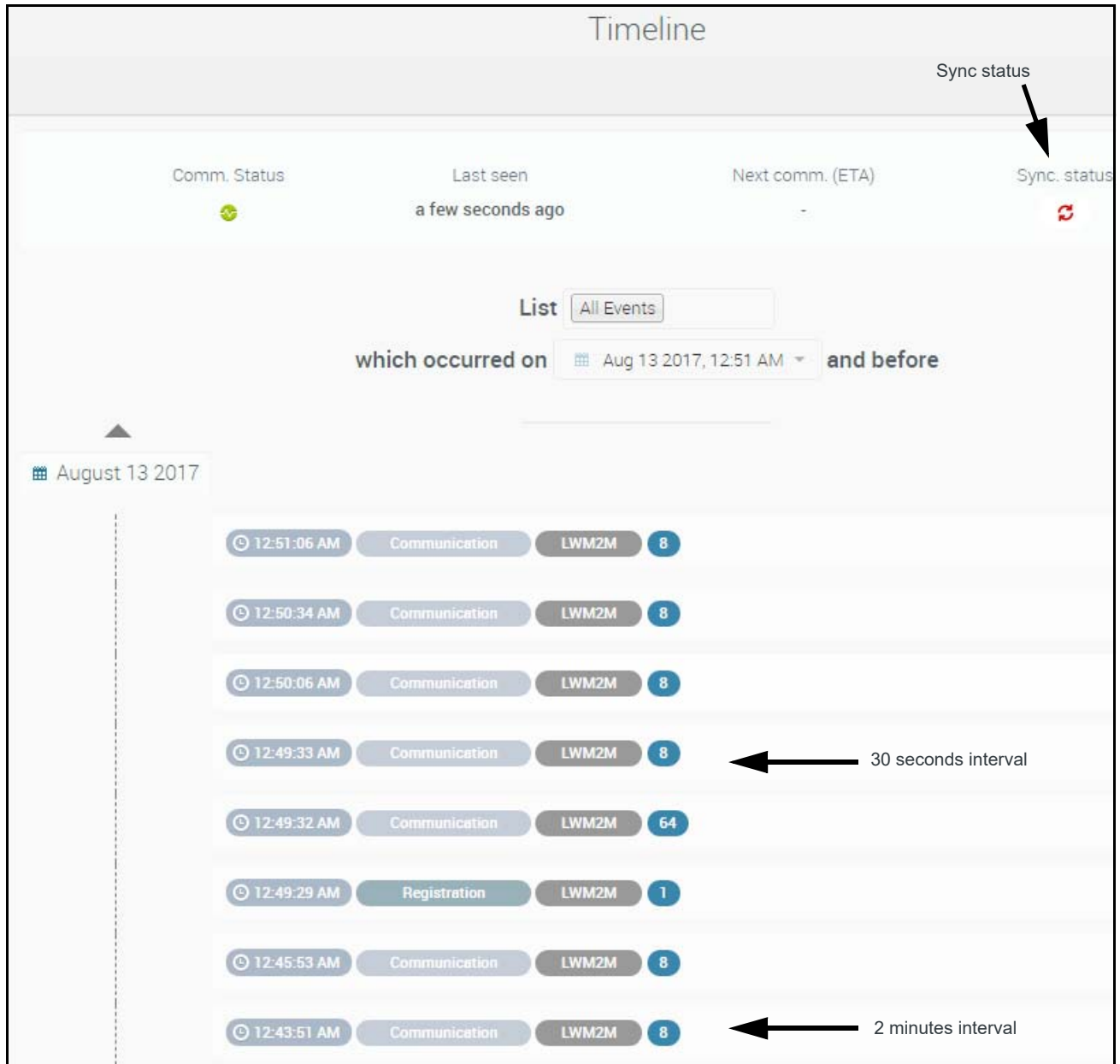
7. When you're ready to stop sending data:

```
# 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 46.

5. Verify that the update file helloWorld.wp76xx.update was created:

   ```
   $ ls -al
   ```

   ```
   mangoh@mangoh-ThinkPad-X230:~/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-ThinkPad-X230:~/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=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-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

As part of the Build/Install mangOH Distribution on page 21 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`

```
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ cd $LEGATO_ROOT/..
mangoh@mangoh-ThinkPad-X230:~/legato_framework$ 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-ThinkPad-X230:~$ cd legato_framework/
mangoh@mangoh-ThinkPad-X230:~/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

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.
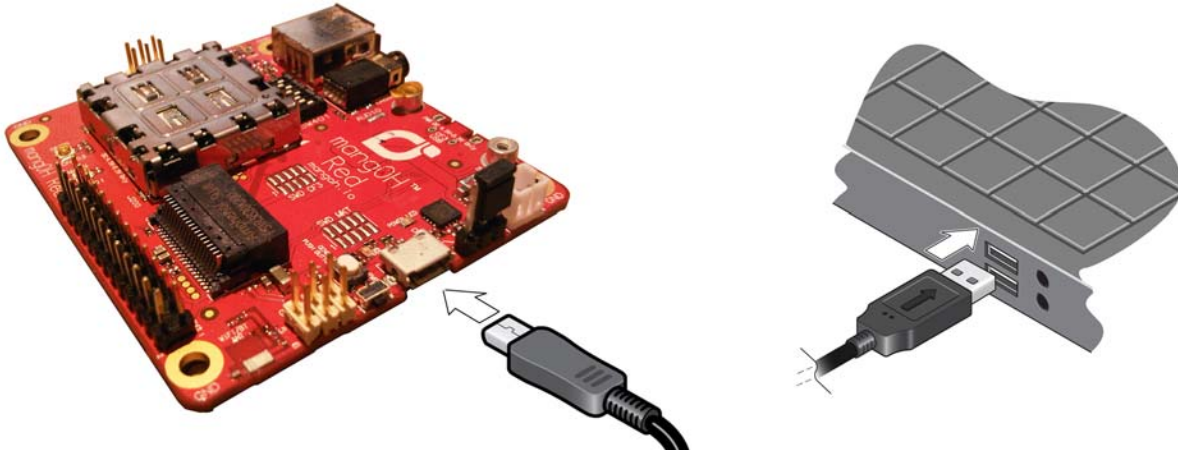
2. Open a terminal window on the dev machine—This window will display the CF3 module's console messages (kernel messages, warnings, etc.).

    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 CF3 module'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 CF3 module'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.

```
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:

```
...
[    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         Console messages describing
[    0.647230] uart_cts_gpio is not available        module boot-up process
[    0.647250] uart_rfr_gpio is not available
[    0.647938] sps: BAM device 0x07884000 is not registered yet.
...
```

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!)

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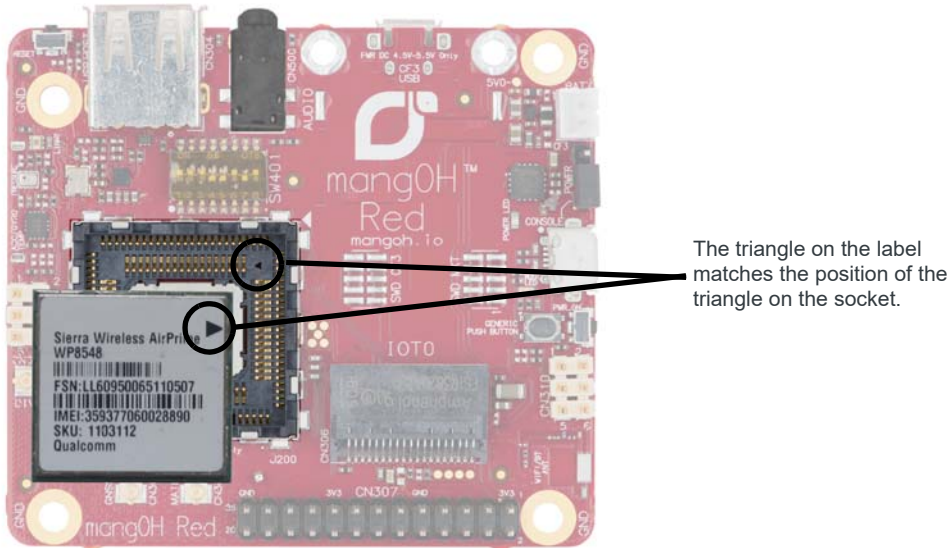
2. Hold the module cover over the module and line up the circle on the cover with the triangle on the label, then press the cover (on the edges) into place.

Triangle on the label matches position of circle on the cover.
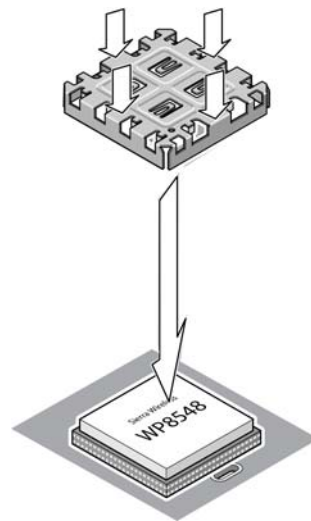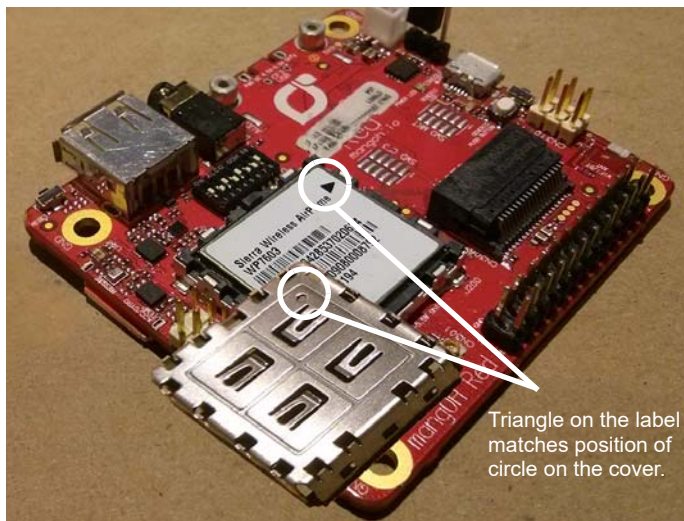
G: Quick Reference—Commands in this Guide

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 <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)
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)

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 Linux computer
- 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 '#').*

  - '~', "$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>
- 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