mangOH™ Green

mangOH Fundamentals— Linux Computer + Legato CLI

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Revision History

Revision number	Release date	Changes
1	April 2016	Document created
2	April 2016	Identified alternate methods of accessing attachments in main document introduction.

Contents

1: Getting Started

Now that you have your mangOH Green, it's time to start using it.

When you finish this tutorial, you will know how to assemble the mangOH Green, prepare your computer for Legato development, and develop, install, and run applications on the mangOH Green, and connect to the IoT Cloud via AirVantage, which is Sierra Wireless' cloud-based services platform for over-the-air (OTA) device management.

Tip: *If you have only one monitor, you may want to print this document and use it when you don't want to switch back and forth between the PDF and the various windows/applications you'll be opening during the tutorial.*

This tutorial includes:

Note: This tutorial includes instructions for Linux$^®$ computers using the Legato CLI (character interface).

Important: *To get maximum benefit from this tutorial, you are strongly recommended to carefully follow the procedures as described, since the tutorial continually builds on earlier procedures and results. If you skip steps or use alternate methods, you may encounter difficulty completing the tutorial.*

2: Before you begin

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Before you begin the tutorial, here are a few items that you might find helpful:

- Make sure your computer meets the requirements for Legato development. See

- A few terms:
  - "CF3"—The mangOH Green supports CF3 (Common Form Factor) embedded modules, such as the WP8548.
    Throughout this tutorial,"CF3" is used to refer to the module that comes with your mangOH Green kit.
  - In this tutorial, the 'host' is your computer, and the 'target' is the CF3 module in your mangOH Green.

- Some symbols used in this document:
  - Shell (console) commands are shown with a symbol before the command:
    - '$'—Command is entered on the Linux computer
    - '#'—Command is entered on the target (the CF3 module in your mangOH Green)
  - '~' and "$HOME" both represent your 'home directory' in Linux

- Passwords, etc:
  - CF3 module:
    - USB ECM IP address—192.168.2.2
   - User name—root
    - Password—<none>

3: Set up your mangOH Green

3

In this section, you will see how to connect the basic components of your mangOH Green that are needed to begin using it for developing applications.

Your mangOH Green kit comes with the basic parts you need to set up and begin developing applications:

- mangOH Green board
- CF3 (Common Form Factor) module, cover, and release tool
- micro-USB cable
- AC adapter
- Antennas (main and GNSS)
- USB Flash drive (adapter with microSDHC card), pre-loaded with Linux and Windows installation files

Top view
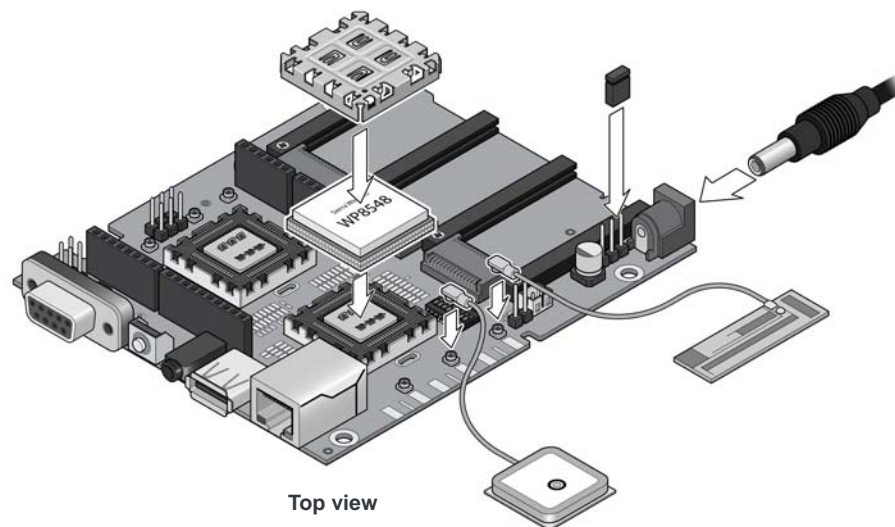
To set up the mangOH Green with these components:

1. Insert the CF3 module in the primary slot as shown. (Position matters!)

Make sure triangle is in this corner when you place the module.

Top view
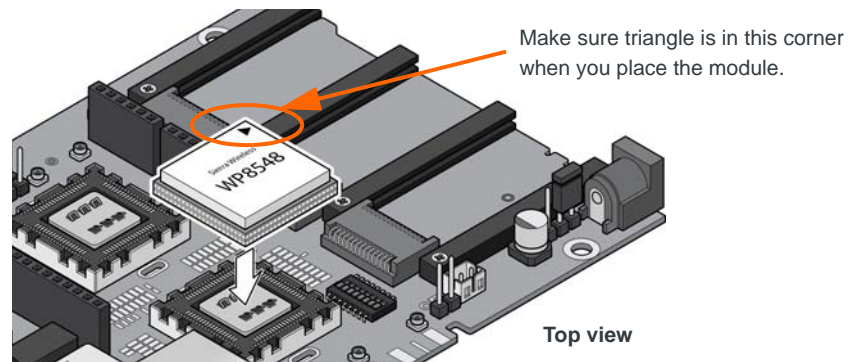
2. Place the cover over the module and press it (on the edges) in to place.

Top view
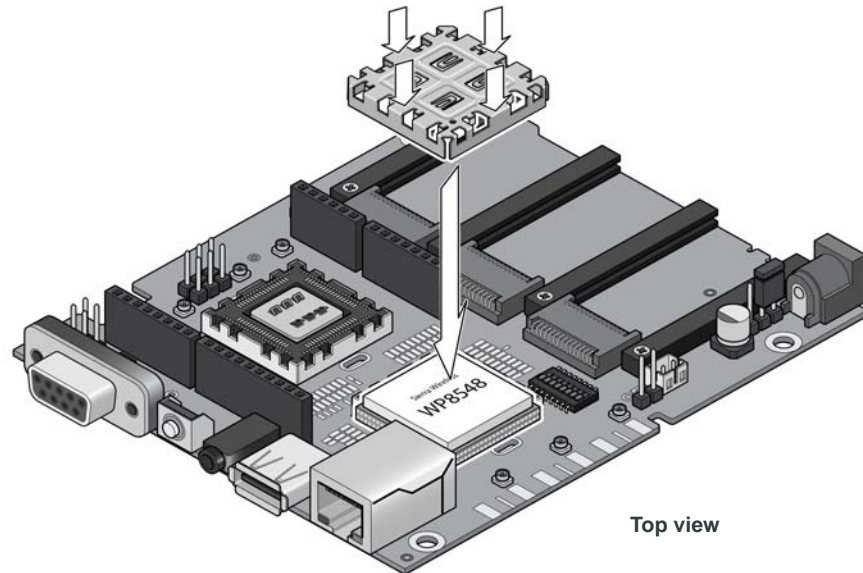
3. If you have a mini-SIM that has been activated by a mobile network provider, insert it in the appropriate slot on the bottom side of the mangOH Green. (micro-SIM support is forthcoming.)
   (Note: The SIM is needed if you want to connect the mangOH Green to a mobile network later in the tutorial. You can continue the tutorial without a SIM until Connect To Mobile Networks on page 21.)

Note the location of the notched corner.

Bottom view
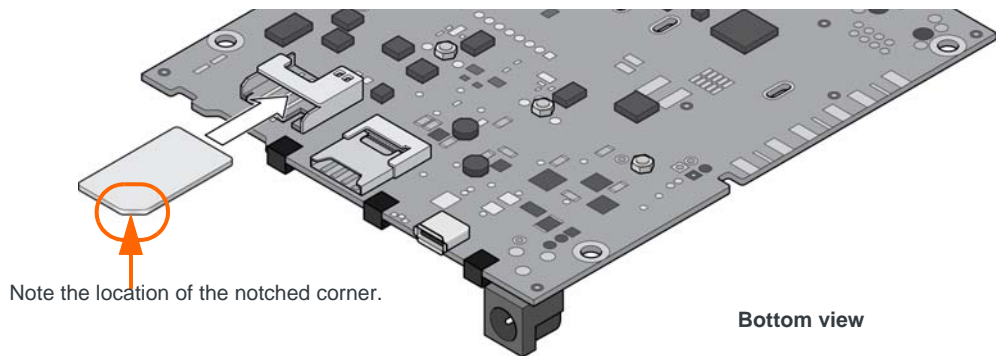
4. Attach the antennas.

(Note: The main antenna is required if you want to connect the mangOH Green to a mobile network in Connect To Mobile Networks on page 21. The GNSS antenna is not used in this tutorial.)

Top view

Main

GNSS
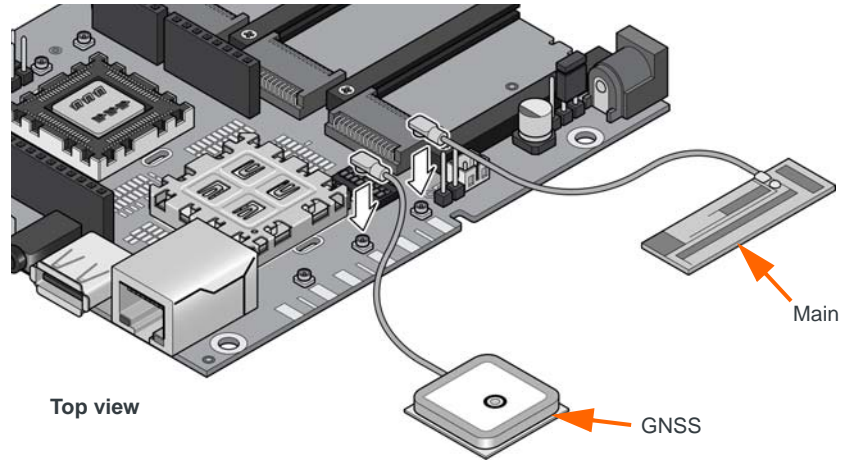
Tip: *If you have trouble connecting an antenna, make sure it is positioned directly on the connector and push straight down. If you try to attach the antenna to the connector at a slight angle, it will not connect.*

---

5. Connect the mangOH to your computer with the micro-USB cable.

Computer

Bottom view
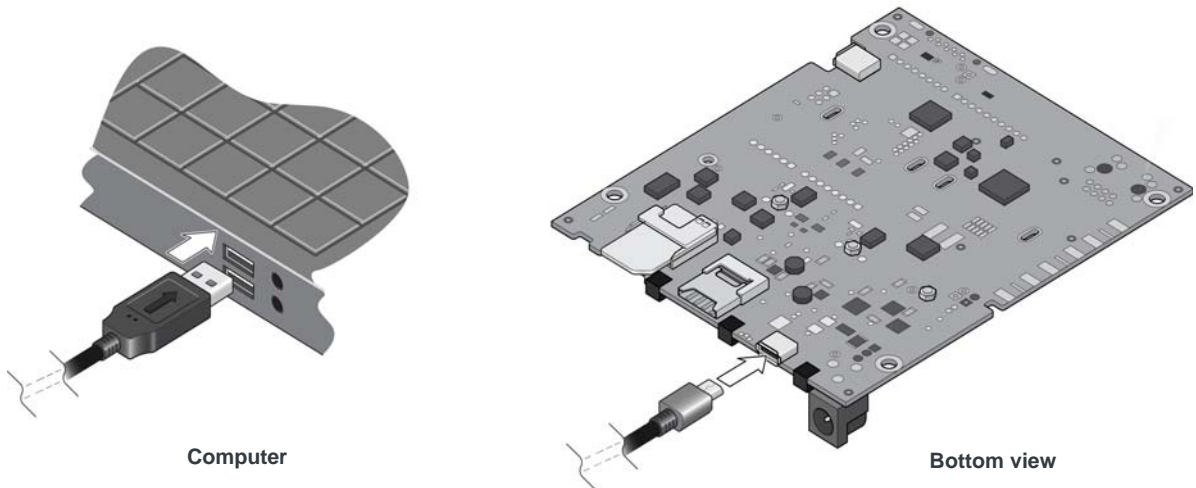
6. Power up the mangOH using the power adapter or micro-USB cable:

- Using the power adapter

  Move the power select jumper to select DC power, if required. (Note: The board comes with DC power selected).

DC power (jumper on pins closest to power connector) See detail below.

Top view

DC power (jumper on pins closest to power connector)

Top view
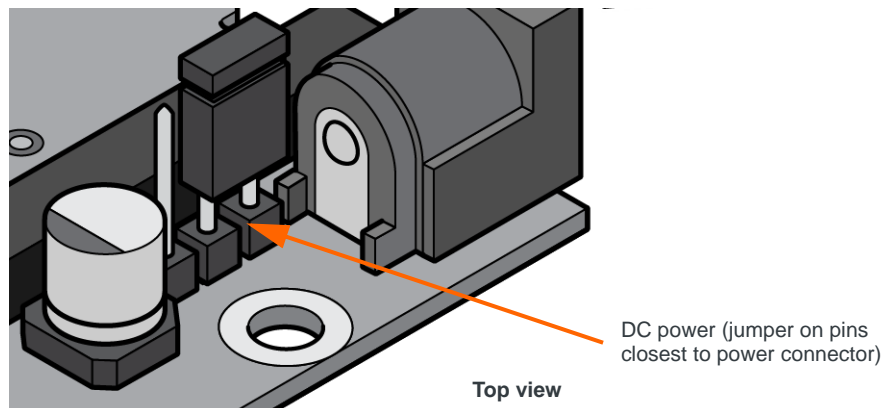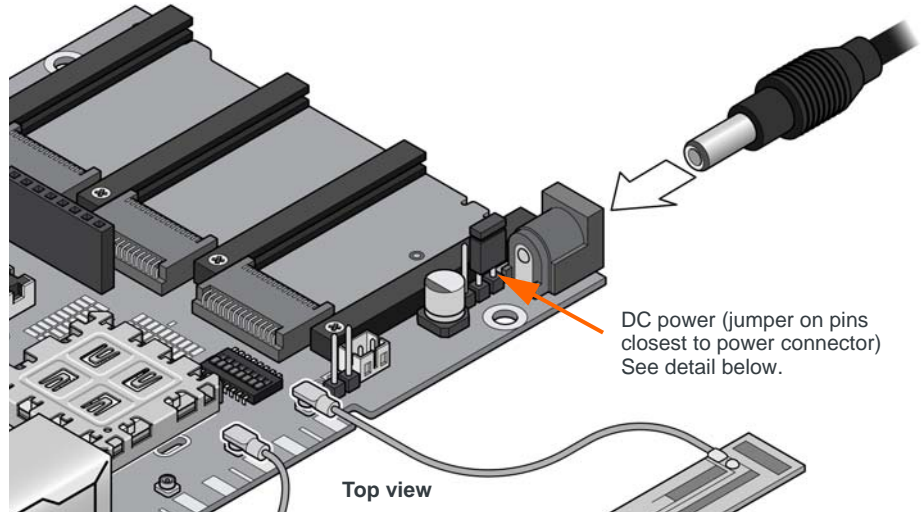
- Using USB

  Move the power select jumper to select USB power, if required. (Note: The board comes with DC power selected).

USB power (jumper on pins farthest from power connector) See detail below.

Top view

USB power (jumper on pins farthest from power connector)

Top view
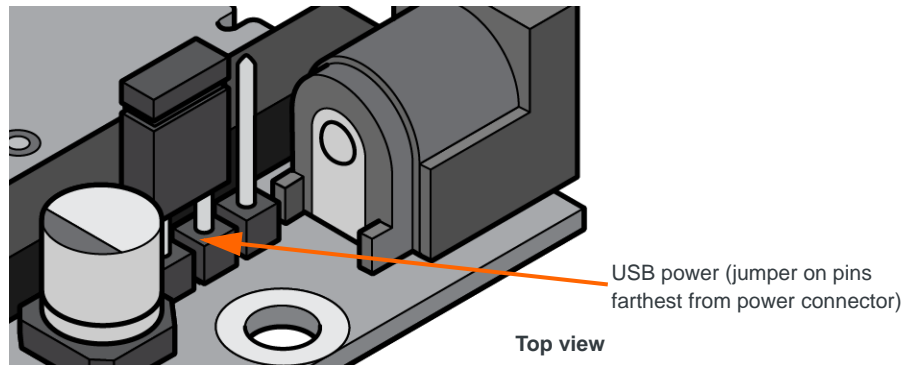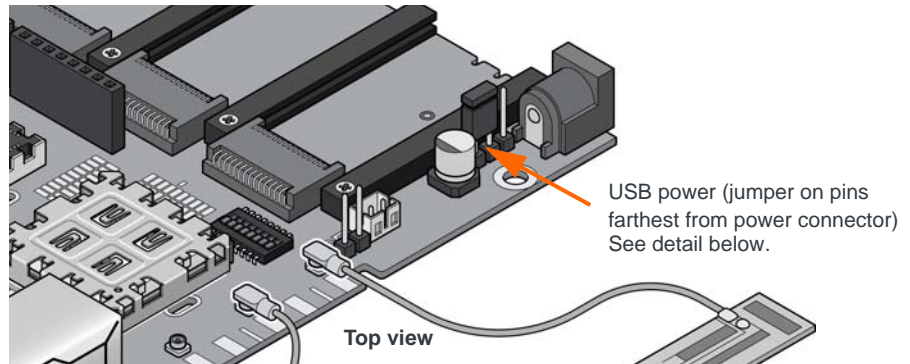
When the mangOH is powered:

- The Power LED turns on immediately—The mangOH is working.
- The W_Disable LED turns on as the CF3 module tries to connect to the mobile network (the CF3 module will not be able to connect until you set up the APN in the next tutorial)

Power LED

W_Disable LED

Top view
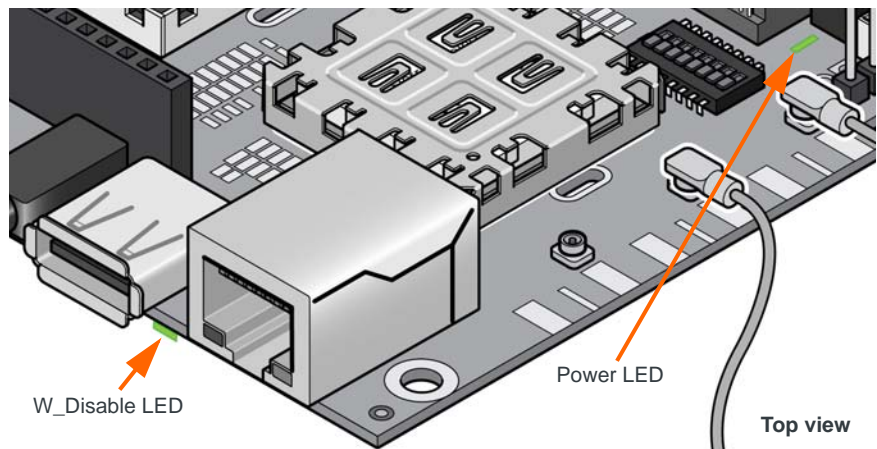
Now you are ready to Prepare your computer for Legato development on page 12.

4: Prepare your computer for Legato development

In this section, you will prepare your Linux or Windows computer for application development by installing the Legato development environment and any required applications or packages.

4.1 System requirements for using Legato

To install and use Legato, your computer must meet the requirements below.

Table 4-1: Minimum System Requirements

	Linux
O/S	Ubuntu
CPU	Dual core @ 2.6 GHz
RAM	4 GB
HDD	10 GB free space

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

Use your Legato installation USB drive to prepare your Linux computer for the Legato development environment.

4.2 Prepare a Linux computer

The Legato development environment can be installed on Ubuntu Linux distributions.

Ubuntu distributions

To use a Ubuntu Linux computer for Legato development, you must:
- Install Java 8, if required
- Install the Legato Developer Studio and CLI

4.2.1 Connect the mangOH Green to your computer

1. On the host, open a Terminal window—Press Ctrl+Alt+T (Note: This shortcut works for the Terminal program in Ubuntu. It may be different for other distributions.).

2. Test the USB connection to the mangOH Green:

   a. If not already connected, connect the computer to the mangOH Green using the micro-USB cable.

Computer   **Bottom view**
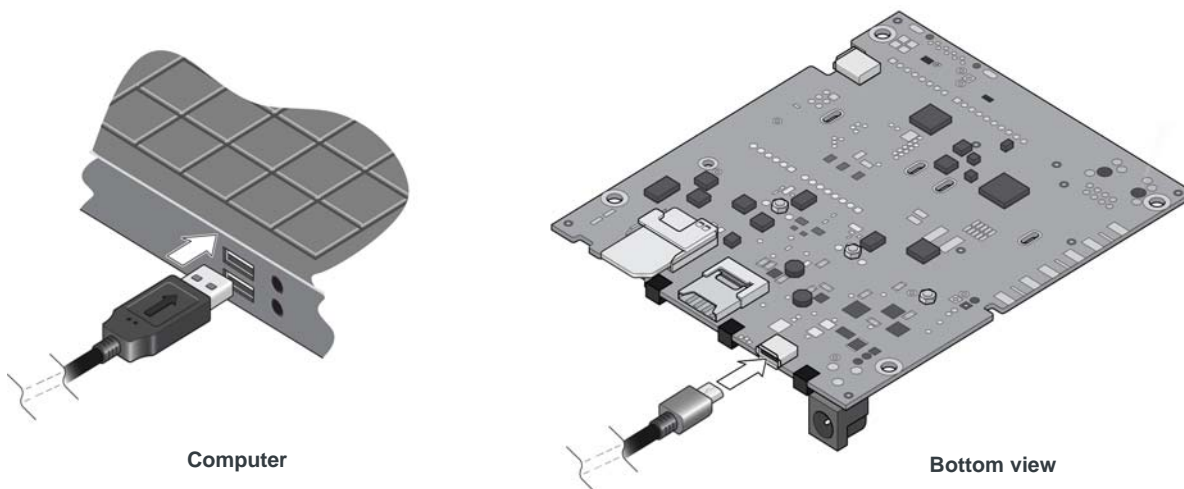
   b. Wait 10-15 seconds for the mangOH Green to enumerate.

   c. Test the connection:

   ```
   $ ping 192.168.2.2
   ```

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

4.2.2 Install Required Packages

1. Install packages that are required for the Legato development environment to work properly:

   a. Display your Ubuntu version:

   ```
   $ lsb_release -d
   ```

   b. If your version is lower than 14.10, download and install OpenJDK 8 Java Runtime Environment (Java 8 is pre-installed with 14.10 and higher). Enter the following commands and follow the prompts:

   ```
   $ sudo add-apt-repository ppa:openjdk-r/ppa

   $ sudo apt-get update

   $ sudo apt-get install openjdk-8-jre

   $ sudo update-alternatives --config java
   ```

   c. Install dependencies (additional required files):

   ```
   $ sudo apt-get install java8-runtime libwebkitgtk-1.0-0
   build-essential python-jinja2 ninja-build
   ```

2. Mount the USB drive onto the Linux filesystem:

   a. Make sure you are in your home directory:

   ```
   $ cd ~
   ```

   b. Make a directory to 'mount' the USB drive onto (for example, ~/usb):

   ```
   $ mkdir ~/usb
   ```

   This creates the 'usb' directory in your home directory.

   c. Mount the USB drive onto the directory (the USB drive's internal label is "mangoh"):

   ```
   $ sudo mount /dev/disk/by-label/mangoh ~/usb
   ```

   d. Check that the USB drive mounted properly:

   ```
   $ ls ~/usb
   ```

   ```
   mangoh@mangoh-ThinkPad-X230:~$ ls ~/usb
   Linux   Windows
   ```

   A list of files/folders appears.

3. Install the Legato development environment (Developer Studio and CLI):

   a. Check whether your Linux computer is 32-bit or 64-bit:

   ```
   $ uname -m
   ```

   ```
   legato@legato-VM:~$ uname -m
   x86_64
   ```

   The computer's hardware name appears —e.g. "x86_64" is a 64-bit system.

   b. Go to the Linux directory on the USB stick:

   ```
   $ cd ~/usb/Linux
   ```

   c. Extract the 32-bit or 64-bit legato zip archive to the 'legato' subdirectory in your home directory—the following command creates the subdirectory if it is not already there. (Replace "##" with "32" or "64" as appropriate.)

Note: 'legato' is the recommended subdirectory name. If you want to use a different subdirectory name, replace "~/legato" with "~/<yourDirectoryName>".).

   ```
   $ unzip legato*##* -d ~/legato
   ```

   Example: `unzip legato*64* ~/legato` extracts the 64-bit environment to the 'legato' directory.

   d. If you used a different subdirectory name than 'legato', run these commands to update the Legato spm.properties files—replace <legatoDir> with the subdirectory name you used:

   ```
   $ echo "SPMInstalledRepository=<legatoDir>/packages" > ~/
   <legatoDir>/ds/configuration/spm.properties
   ```

   ```
   $ echo "SPMInstalledRepository=<legatoDir>/packages" > ~/
   <legatoDir>/spm/spm.properties
   ```

e. Finish installing Legato:

```
$ cd ~/<legatoDir>/spm
$ ./legato-spm --installed --update-link
```

Note: This may take a minute to run.

Now that the Legato development environment is installed, you can begin to Develop and test applications on page 16 using the Legato CLI (Command Line Interface).

5: Develop and test applications

5

In this section, you will learn how to use the Legato development environment to build a simple application ("Hello World"), install it onto the CF3 module in your mangOH Green, and test that the application runs.

Legato provides two interfaces for developing applications:

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

This document describes development using CLI.

Tip: *This tutorial touches on the basics of using the Legato development environment. For detailed references, forums, etc., see http://legato.io/legato-docs/latest/mangOH_developers.html.*

5.1 Develop using the CLI (Command Line Interface)

5.1.1 Configure your host 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.

Every time you want to use the Legato CLI in a host terminal window, you must configure the window for Legato using the following command:

```
$ source ~/legato/packages/legato.sdk.latest/resources/con-
figlegatoenv
```

You can create an alias for the command to save time (and keystrokes) as follows:

1. In a host terminal window, make a backup copy of your .bashrc file, which is a script that runs automatically each time you open a new terminal window:

   ```
   $ cp ~/.bashrc ~/.bashrc.tmp
   ```

2. Copy the following command into the host terminal window and run it (this example uses 'cfgLegato' for the alias. If you want to use a different name, make sure it is not already a Linux or Legato command.) NOTE: Make sure to use ">>" in the command. If you use a single '>', your .bashrc file will be replaced and you will have to replace it with the backup copy from the previous step.

   ```
   echo 'alias cfgLegato="source ~/legato/packages/
   legato.sdk.latest/resources/configlegatoenv"' >> ~/.bashrc
   ```

Now each time you open a new host terminal window, you can enter the alias instead of the long command:

```
$ cfgLegato
```

Note: The alias is created when you open a terminal window. If you want to start using it immediately in your current window, enter the command:

```
$ . ~/.bashrc
```

Continue to 5.1.2 Develop and test applications.

5.1.2 Develop and test applications

When you installed Legato, sample application files were also stored, including a "hello world" application. This section uses the "hello world" application for examples.

Compile an application on the host computer, and install it on the target:

1. Connect the mangOH Green to the host using the micro-USB cable.

2. On the host, open a new terminal window (referred to as DEV_TERM in this procedure).

3. Use one of the following commands to configure the terminal window:
    · Configure DEV_TERM for Legato:

    ```
    $ cfgLegato
    ```
    or
    · If you did not create an alias in section 5.1.1 Configure your host terminal windows for development on page 16:

    ```
    $ source ~/legato/packages/legato.sdk.latest/resources/
    configlegatoenv
    ```

4. Go to the sample application directory for Hello World:

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

5. Compile the application for the correct target type. In this example, we are using a WP85XX CF3 module, and the target type is "wp85".

    ```
    $ make wp85
    ```

6. Install the application on the target:

    ```
    $ instapp helloWorld.wp85.update 192.168.2.2
    ```

7. If the message "The authenticity of host ..." appears, type "`yes`" and press Enter to continue.

Run the application on the target:

1. Set up a window to show the application's output (the "Hello World" application writes to a log file) as follows:

    a. Open a new terminal window (referred to as LOG_TERM in this procedure).

    b. Connect to the target's console:

    ```
    $ ssh root@192.168.2.2
    ```

c. The first time you use a ssh (secure shell) connection to your device, the following error message may appear.

```
legato@legato-VM:~$ ssh root@192.168.2.2
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@    WARNING: REMOTE HOST IDENTIFICATION HAS CHANGED!     @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
IT IS POSSIBLE THAT SOMEONE IS DOING SOMETHING NASTY!
Someone could be eavesdropping on you right now (man-in-the-middle attack)!
It is also possible that a host key has just been changed.
The fingerprint for the RSA key sent by the remote host is
SHA256:DQbAyZoELqieYefeBofh8R9ODg+jLS2aJdEGF3oDWHc.
Please contact your system administrator.
Add correct host key in /home/legato/.ssh/known_hosts to get rid of this message
.
Offending RSA key in /home/legato/.ssh/known_hosts:1
  remove with:
  ssh-keygen -f "/home/legato/.ssh/known_hosts" -R 192.168.2.2
RSA host key for 192.168.2.2 has changed and you have requested strict checking.
Host key verification failed.
```

If it does appear:

i. Enter the command:

```
$ ssh-keygen -f "/home/legato/ssh/known_hosts" -R
192.168.2.2
```

```
legato@legato-VM:~$ ssh-keygen -f "/home/legato/.ssh/known_hosts" -R 192.168.2.2
# Host 192.168.2.2 found: line 1
/home/legato/.ssh/known_hosts updated.
Original contents retained as /home/legato/.ssh/known_hosts.old
legato@legato-VM:~$ █
```

ii. Try again to connect to the target's console:

```
$ ssh root@192.168.2.2
```

iii. If prompted to continue connecting, type "yes" and press Enter.

Prompt to continue →

```
\The authenticity of host '192.168.2.2 (192.168.2.2)' can't be established.
RSA key fingerprint is c6:a0:f5:16:14:03:b6:4e:9f:3a:4f:94:81:ea:a6:a5.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.2.2' (RSA) to the list of known hosts.
Linux swi-mdm9x15 3.14.29ltsi-5d7a6bf7c6_ed88cc68b5 #2 PREEMPT Sat Feb 6 02:37:18
root@swi-mdm9x15:~# █
```

d. 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 ion in the next step. Leave this command running until after you see the Hello World output, then you can press Ctrl+C to terminate it.

2. Run the application:

a. Open an existing or new terminal window to run the application (referred to as APP_TERM in this procedure).

    b. Connect to the target's console:

```
$ ssh root@192.168.2.2
```

    c. Check that the application is installed:

```
# app status
```

```
root@swi-mdm9x15:~# app status
[running] audioService
[running] avcService
[running] cellNetService
[running] dataConnectionService
[running] fwupdateService
[running] gpioService
[running] modemService
[running] positioningService
[running] powerMgr
[running] secStore
[stopped] smsInboxService
[stopped] tools
[stopped] voiceCallService
[running] helloWorld
```

Hello World application ⟶ [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 LOG_TERM:

```
# app start helloWorld
```

```
legato@legato-VM: ~          APP_TERM
root@swi-mdm9x15:~# app start helloLegato_helloWorld
Starting app 'helloLegato_helloWorld'...
DONE
root@swi-mdm9x15:~#
```

```
legato@legato-VM: ~          LOG_TERM
root@swi-mdm9x15:~# logread -f | grep "Hello"
Apr  3 19:41:58 swi-mdm9x15 user.info Legato:  INFO | helloWorld[3291]/helloLega
toComponent T=main | helloLegato.c _helloLegatoComponent_COMPONENT_INIT() 5 | He
llo, world.
```

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

```
# app info helloWorld
```

```
root@swi-mdm9x15:~# app info helloWorld
helloWorld
  status: running
  running processes:
    helloWorld[3291] (3291)
  app.name: helloWorld
  app.md5: 0818a88021e74e8b9031613898804f2f
  app.version: 1.0.0.20160331123800
  legato.version: 16.01.0.Beta
```

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

Now you are ready to Connect To Mobile Networks on page 21.

Set up your mangOH Green   Prepare your computer for Legato development   **Develop and test applications**   ConnectTo Mobile Networks   Connect to the IoT Cloud

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6: Connect To Mobile Networks

6

In this section, you will learn how to connect your device to a mobile network. (Note: You must have an activated mini-SIM in the mangOH Green.

Note the location of the notched corner.
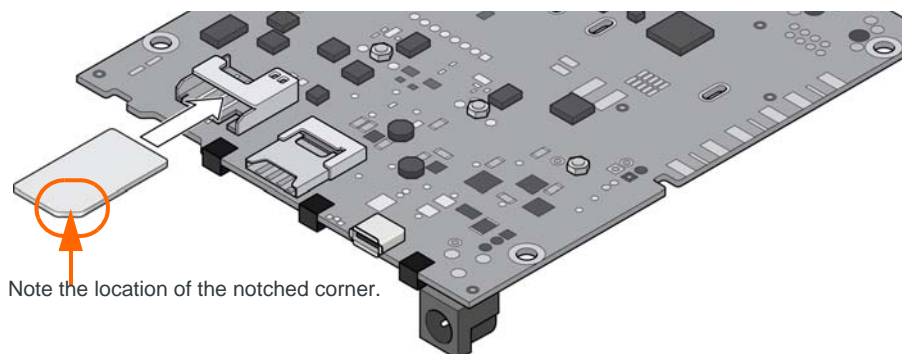
6.1 Connect the target to a mobile network

If you have installed an activated SIM in the mangOH Green, you can connect the target (the CF3 module) to a mobile network:

1. Connect to the target's console:

   a. On the host, open an existing or new terminal window.

   b. Connect to the target as the root user using the target's default USB ECM IP address:

   ```
   $ ssh root@192.168.2.2
   ```

2. Start a data connection:

   a. Enter the following commands:

   ```
   # cm info
   ```

   This shows information about the target. Record the FSN (serial number) and IMEI in case you need them in the future for support.

   ```
   root@swi-mdm9x15:~# cm info
   Device:     WP8548
   IMEI:       359377060009817
   FSN:        LL542500270403
   Firmware:   SWI9X15Y_07.08.02.00 r31088 CARMD-EV-FRMWR1 2016/02/05 2
   Bootloader: SWI9X15Y_07.08.02.00 r31088 CARMD-EV-FRMWR1 2016/02/05 2
   ```

   ```
   # cm radio
   ```

   This shows information about the mobile network the target is registered on.

   ```
   root@swi-mdm9x15:~# cm radio
   Current Network Operator: Rogers Wireless
   RAT:        UMTS network (LE_MRC_RAT_UMTS)
   Status:     Registered, home network (LE_MRC_REG_HOME)
   Signal:     Strong signal strength (4)
   ```

```
# cm data
```

This shows the connection status. Because your SIMs APN is not set yet, the device cannot connect to the network.

```
root@swi-mdm9x15:~# cm data
Index:      1
APN:
PDP Type:   IPV4V6
Connected:  no
```

b. Set the APN, replacing "<your apn>" with the actual APN (for example "cm data apn internet.com" for a Rogers Wireless SIM):

```
# cm data apn <your apn>
```

```
root@swi-mdm9x15:~# cm data apn internet.com
```

Note: If your mobile network operator uses different APNs for 3G and LTE, make sure to use the APN for the correct network based on your CF3 module type. For example, the WP8548 is a 3G-only module that does not support LTE—the APN for the network operator's 3G network should be used.

If you do not know the APN for your SIM:

i. Get your Home Network Operator name:

```
# cm sim info
```

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

ii. Search the Internet for the APN for your Home Network Operator (for example, search for "Rogers Wireless APN").

c. (Optional) If you want to make sure you set the APN correctly, enter:

```
# cm data
```

```
root@swi-mdm9x15:~# cm data apn internet.com
root@swi-mdm9x15:~# cm data
Index:      1
APN:        internet.com
PDP Type:   IPV4V6
Connected:  no
```

d. The target is now set up to attempt a data connection. Enter the following command (the ampersand ('&') runs the process in the background so you can keep working in the terminal):

```
# cm data connect &
```

```
root@swi-mdm9x15:~# cm data connect &
root@swi-mdm9x15:~# Connected through interface 'rmnet0'
```

When the data connection is established, the 'Connect through interface ...' message appears, and the Connection LED turns on.

e. (Optional) To prove that the target has a data connection to the mobile network, 'ping' a URL that you know is working:

```
# ping mangoh.io
```

```
root@swi-mdm9x15:~# ping mangoh.io
PING mangoh.io (185.31.17.133): 56 data bytes
64 bytes from 185.31.17.133: seq=0 ttl=39 time=571.464 ms
64 bytes from 185.31.17.133: seq=1 ttl=41 time=510.178 ms
64 bytes from 185.31.17.133: seq=2 ttl=39 time=529.834 ms
^C
--- mangoh.io ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max = 510.178/537.158/571.464 ms
```

Note: To stop the ping responses, press Ctrl+C.

Now that you know how to start a data connection, you are ready to to load your application to the 'cloud'.

7: Connect to the IoT Cloud

In this section, you will register your device with Sierra Wireless'AirVantage platform. which is a cloud-based service that you can use to collect data from your device.

7.1 Register and connect to AirVantage

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

Note: Your free account allows you to register up to five devices.

Before you can use AirVantage, you must register your device with AirVantage, and then start a connection to the AirVantage server.

7.1.1 Register with AirVantage

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

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2. In the MangOH Signup area, enter your:
   - First and last names
   - Email address—Use a valid address. This is needed to complete the registration process and is also used as your account name.
   - Account name—Use a unique name such as a combination of your company name, the project name, your name, etc.
   - Phone number—Use international format (for example, for North American phone numbers, use "001" plus the 10-digit area code and phone number).

3. Review the Terms of Service and select "I agree to the Terms of Service".

4. Click Signup.

   An email is sent automatically to your email address with a confirmation link.

5. Open the email and click the link to confirm your AirVantage signup request.
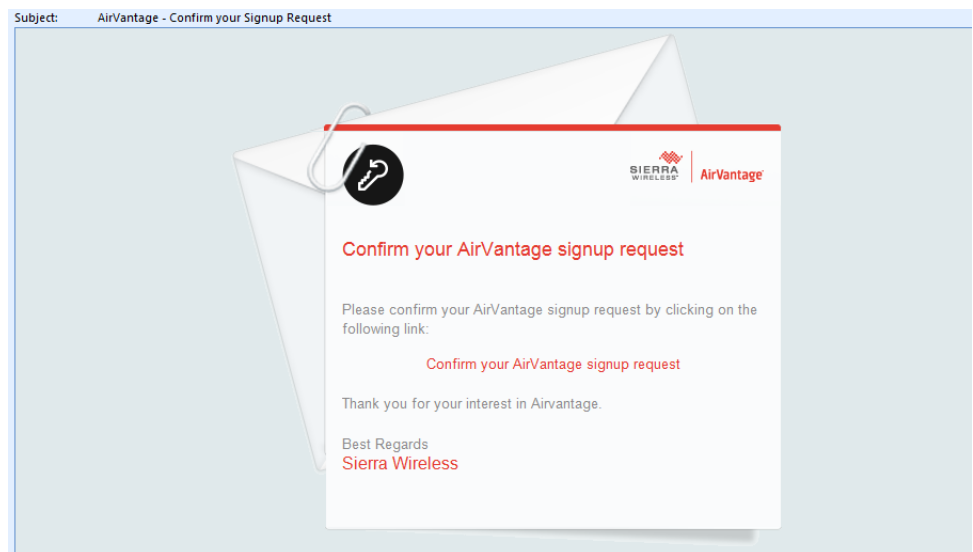
6. Your browser opens to confirm the signup request. Enter a password that satisfies the requirements shown on-screen, and re-enter the password to confirm.

7. Click Save.

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

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

Note: What you are registering on AirVantage is the CF3 module that is included with your mangOH Green Kit. If you purchase another module and want to use it with AirVantage (using the same mangOH Green), you must register that module separately.

9. In the Register mangOH section, enter the Serial Number (FSN) and IMEI of the module in your mangOH Green. If you did not record them earlier, open a terminal window and connect to the module's console, then use the command "`cm info`" to display the information.

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

10. Click Register.

The device appears in the 'Registered systems' section at the bottom of the screen.
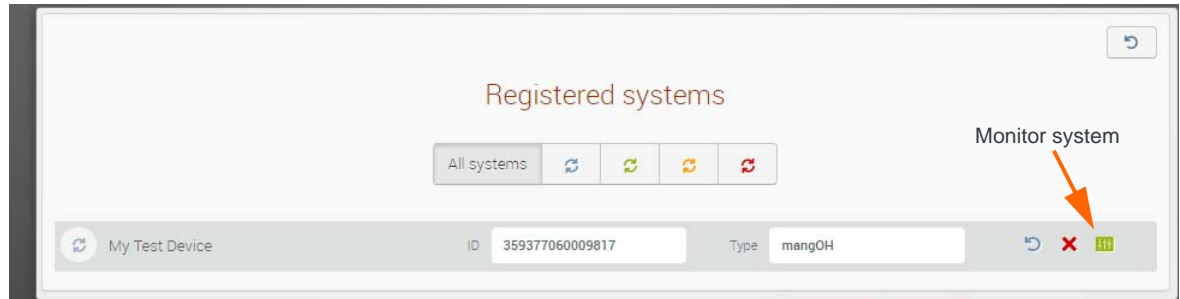
11. Now that your device is registered, click the monitor icon at the right side of your device entry ( ) to go to the System Details screen (see next step).

12. The System Details screen displays several widgets that report information about your device, communications received from it, running applications, etc.

The areas shown below (Last Communication andSystem Info) are both blank because you have not connected your mangOH Green to AirVantage yet. Leave this browser window open and continue to .

Last Communication
(When you have your device registered, your last communication will appear here.)

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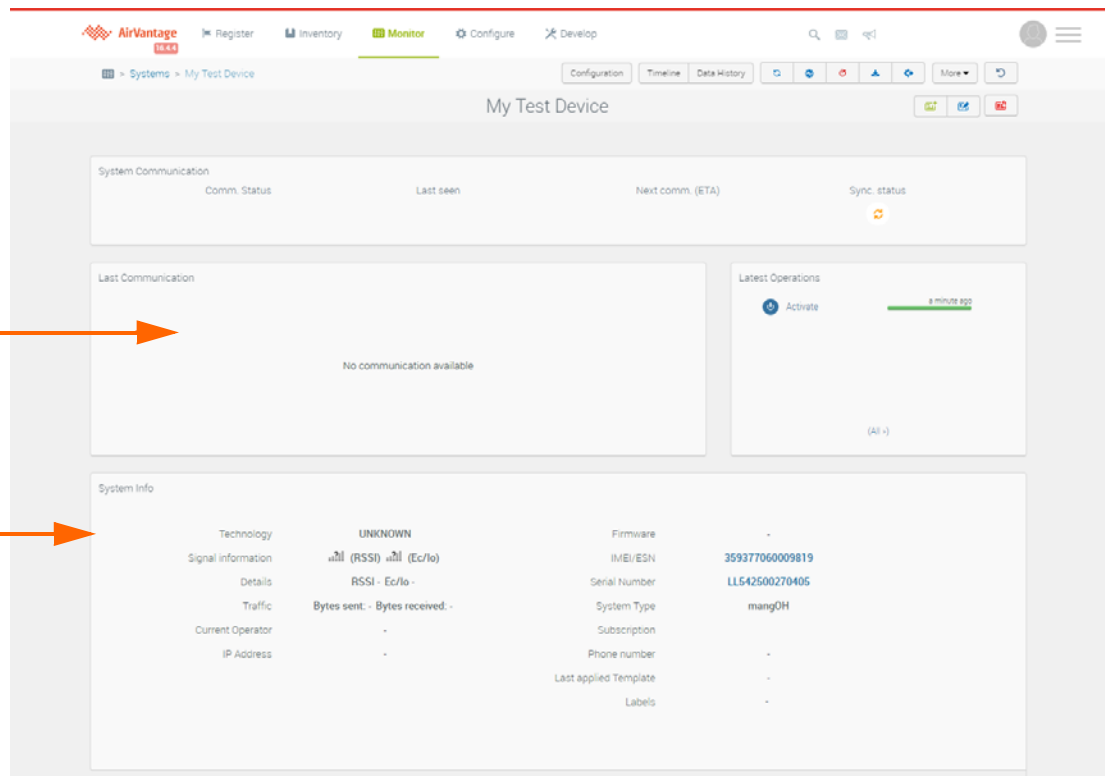
7.1.2 Connect to AirVantage

1. Start a connection to AirVantage:

   a. On the host, open an existing or new terminal window.

   b. Connect to the target as the root user using the target's default USB ECM IP address:

   ```
   $ ssh root@192.168.2.2
   ```

   c. Open an AT port on the target—after you enter this command, you will not see a command prompt (you are in the AT command entry mode):

   ```
   # microcom -E /dev/ttyAT
   ```

   Waiting for you to enter AT commands →
   ```
   root@swi-mdm9x15:~# microcom -E /dev/ttyAT
   ```

   d. Make sure you can enter AT commands—Type "at" and press Enter. If this is working, the command returns "OK":

   ```
   root@swi-mdm9x15:~# microcom -E /dev/ttyAT
   at
   OK
   ```

   e. Type "at+wdsi = 8191" and press Enter. This configures your CF3 module to connect to the AirVantage server.

   ```
   at+wdsi = 8191
   OK
   ```

   f. Type "at+wdss=1,1" and press Enter. This connects your CF3 module to the AirVantage server. If the command returns OK, you have connected to AirVantage.

   Connected to AirVantage →
   ```
   at+wdss=1,1
   OK

   +WDSI: 4

   +WDSI: 6

   +WDSI: 23,1
   ```

   Note: The values shown in the response above may vary. The "+WDSI" parts of the response are internal status codes. The key part of the response is the "OK" message. If you receive an error instead of "OK", redo step e and step f.

   g. Press Ctrl+X to leave AT entry mode and return to the command prompt.

h. Refresh the AirVantage System Details screen in your web browser—the System Info section now shows details about your module, and the Last Communication section shows the connection you just completed.

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

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

You have now completed the mangOH Green Fundamentals tutorial. For more information on the mangOH platform, visit mangoh.io.

A: Tips

A.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.

Common APNs:
- Rogers Wireless—"internet.com"
- Others—Search the Internet for "<provider> APN". For example, "Rogers Wirelesss APN"

A.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 computer and the CF3 module in the mangOH Green.

For this tutorial, here are some useful tips:

- Open a terminal window. 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.

A.3 Useful Linux commands for this tutorial (and more)

The following table describes the Linux commands you will use in this tutorial, plus other useful commands.

Table A-1: Linux commands

Command types	Command	Description
Versioning	cm info	Display the modules model, IMEI, FSN (serial number), and firmware and bootloader versions.
	legato version	Display the Legato framework version.
Radio	cm radio	Display the radio status.
	cm radio on cm radio off	Enable or disable the radio.
	Refer to cm radio (http://www.legato.io/legato-docs/latest/tools_target_cm.html) for more details and command options.	
Data connections	cm data cm data info	Display information about the current profile in use.
	cm data apn <yourAPN>	Set the APN for your profile to the APN from your SIM provider.
	cm data connect	Start a data connection.
	cm data connect <timeout>	Start a data connection (keep trying for up to <timeout> seconds).
	Refer to cm data (http://www.legato.io/legato-docs/latest/tools_target_cm.html) for more details and command options.	
SIM	cm sim info	Display information about the SIM.
	cm sim status	Display the SIM status
	cm sim enterpin	Enter a SIM PIN code to be able to use the SIM.
	Refer to cm sim (http://www.legato.io/legato-docs/latest/tools_target_cm.html) 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://www.legato.io/legato-docs/latest/tools_target_app.html) for more details and command options.	

Table A-1: Linux commands (Continued)

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

A.4 Definitions

Table A-2: 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	Open source platform for developing applications.
wget	Gets files from a web server
.bashrc	A shell script that runs when you open a Linux terminal window.
IDE perspective	A defined layout of the IDE. Each perspective will show different view (panel) combinations.
IDE view	A panel of information. For example, a directory strcuture, a panel for entering Terminal commands, etc.