

LoRa IOT Starter Kits

User's Guide



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1. Goal of this Kit

This kit is designed to offer a self-contained Plug'n Play local loop for all IOT object designers, allowing them to verify that their design is able to connect to a public IOT network following the LoRaWAN specification.

No connection to an Ethernet network is required, simplifying the setup. A simple cross over Ethernet cable can be used to access the kit.

2. Contents of the Development Kit

- RaspberryPi B+ with its LoRa IOT shield unit and pre-installed micro SD card
- SX1301-based concentrator reference design
- Active GPS antenna
- USB cables
- Power adapter
- Example end-point: LoRaMote or MBED shield unit. It is provided as a reference to confirm the functionality of this setup.





3. Getting Started

Two ways to get connected to the starter kit are possible.

- Connection to an Ethernet network composed of a router and a DHCP server.
- Connection using an Ethernet cable connected between the development PC and the starter kit.

3.1. Connection to an Ethernet Network

1) Plug the simplified network setup as per the picture below. It must be connected to the same network as the one your development PC is connected to.



2) When all ready, power it up and wait about 2mn for the device to boot-up.

3) Look-up the LCD screen to see the IP address that the RaspberryPi was given by the DHCP server.

4) On your PC, launch a web browser session and type this IP address into the web browser address bar.

5) The following page will appear:





6) Click on "Demonstration" link



7) Click on the "RecentActivity" link:

- 8) Power up the provided end-point device.
- 9) Its packets should start flowing in the database and will be displayed on the screen (hit F5 to refresh).

A local network has been successfully deployed on your bench. Any proprietary end-point design can now try and connect to the network.



3.2. Connection using an Ethernet Cable

- 1) Connect the RaspberryPi to your PC using an Ethernet cable.
- 2) On the PC, go to Network settings.



3) Click on "Local Area Connection"

ieneral		
Connection		
IPv4 Connect	ivity:	Internet
IPv6 Connect	ivity:	No Internet access
Media State:		Enabled
Duration:		3 days 05:38:38
		1.0.01
Speed:	ו	1.0 Gbps
Speed: Details Activity]	1.0 Gbps
Speed: Details Activity	Sent —	1.0 Gbps
Speed: Details Activity — Bytes:	Sent —	1.0 Gbps — Received 11'935'680'944



4) Click on "Properties"

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Connect using	•			
Market (R)	82579LM G	Sigabit Network Co	nnection	
			Confi	aure
This connection	on uses the	following items:		
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VMw	are Bridge I	Protocol		Ē
Kasp	ersky Anti-V	/irus NDIS 6 Filter		
Virtua	Box Bridge	ed Networking Driv	/er	=
QoS	Packet Sch	neduler		_
🗹 📙 File a	nd Printer S	Sharing for Microso	oft Networks	
🗹 🛶 Interr	net Protocol	Version 6 (TCP/I	Pv6)	*
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•			1 6	1
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5) Select "Internet Protocol Version 4 (TCP/IPv4)

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	201					
	101112121 IS IN	Configure				
This connection	n uses the following items:					
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6) Click "Properties" button

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You car this cap for the	n get IP settings assigned an ability. Otherwise, you nee appropriate IP settings.	utomatically if d to ask your i	your n netwoi	etwork : rk admin	supports strator
0	otain an IP address automa	tically			
US	e the following IP address:				
<u>I</u> P ac	ldress:	•2	2		
Sybr	iet mask:		0		
Defa	ult gateway:		-34	S.	
() Ot	otain DNS server address au	utomatically			
O Us	e the following DNS server	addresses:			
Prefe	erred DNS server:	•		3	Ĩ.
Alter	nate DNS server:	8	3		
Πv	aļidate settings upon exit			Adva	anced



7) Select "Use the following IP address:"

General	
You can get IP settings assigne this capability. Otherwise, you for the appropriate IP settings.	ed automatically if your network supports need to ask your network administrator .
🔘 Obtain an IP address auto	omatically
Use the following IP address	ess:
IP address:	192.168.1.101
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	1 1 1 I
Obtain DNS server addres	ss automatically
() Use the following DNS ser	ver addresses:
Preferred DNS server:	
Alternate DNS server:	10 21 31
🔲 Vaļidate settings upon ex	it Advanced

8) Enter the IP address like 192.168.1.XXX where XXX is different from 100 as it is the Raspberry static IP address.

9) Click the "OK" button.

10) Click the "OK" button on "Local Area Connection Properties" window.

11) Close "Local Area Connection Status".

12) Please follow the same steps as on previous chapter starting from step 4. REMARK: Don't forget to replace the IP address for 192.168.1.100 instead of the one assigned by DHCP

A local network has been successfully deployed on your bench. Any proprietary end-point design can now try and connect to the network.



4. RaspberryPI Software

The LoRaWAN server and gateway software run on the RaspberryPI.

Once the RaspberryPI has boot up the LCD screen will show information about the LoRaWAN server and gateway applications status, the percentage of used disk space on the SD card as well as the DHCP and static IP addresses.



The indications meaning of the LCD first line are:

- G: Indicates if the gateway application is running dor not
- S: Indicates if the LoRaWAN server application is running dor not
- D: Used disk space in percent

The second line displays the DHCP assigned IP address as well as the static IP address. Each one is displayed every 5 seconds when both are available.

4.1. RaspberryPI Command Line Access

To access the RaspberryPI one must use an SSH client such PuTTY on Windows platforms or a terminal console on UNIX based systems.

The RaspberryPI user name is lora and the password lora.



4.2. Access Using PuTTY

1) Launch PuTTY



- 2) Enter the IP address displayed on the RaspberryPI LCD display
- 3) Click the "Open" button
- 4) If a security alert window is displayed Please click on "Yes" button.



5) The login prompt is then displayed





6) Please enter lora as username



7) Please enter lora as password



8) You are now logged on



4.3. Access Using UNIX Terminal Console

1) Launch a terminal console





- 2) Please enter the following command in the terminal window
 - \$ ssh lora@RaspberryPi-IP-address



3) After pressing the Enter key, enter the password Lora



4) You are now logged on



5. Application Software Locations

All the software applications used by the RaspberryPI to run the IOT starter kit are located under /opt/lora-net.

This directory contains 4 directories:

- gateway, this directory contains the
- 1) lora_gateway, SX1301 control library source code

https://github.com/Lora-net/lora_gateway.git

This source code has been adapted to use the RaspberryPI hardware SPI as well as the control of the SX1301 board reset pin.

2) packet_forwarder, gateway application source code

https://github.com/Lora-net/packet_forwarder.git

The configuration JSON files have been modified in order to use the GPS module as well as the network server connection parameters.

3) Ir-nwk-gw, gateway script to start/stop/restart the daemon.

- misc, contains the Python and shell scripts need for the LCD management.
- server, contains the precompiled LoRaWAN network server as well as the script to start/stop/restart the daemon
- www, contains the web server pages



6. Starting / Stopping the Demon Scripts

To control the server and gateway daemons the following commands must be issued:

- Starting The server: sudo /etc/init.d/lr-nwk-srv start The gateway: sudo /etc/init.d/lr-nwk-gw start
- Stopping The server: sudo /etc/init.d/lr-nwk-srv stop The gateway: sudo /etc/init.d/lr-nwk-gw stop
- Restarting The server:sudo /etc/init.d/lr-nwk-srv restart The gateway: sudo /etc/init.d/lr-nwk-gw restart
- Getting the demon status The server: sudo /etc/init.d/lr-nwk-srv status The gateway: sudo /etc/init.d/lr-nwk-gw satus

The 2 daemons output their logs to files located in the /tmp directory. The LCD "G:" and "S:" indicate the 2 daemons status



7. Server MySQL Database

The RaspberryPI disk usage will increase over the time by recording all the end-devices frames onto the MySQL database.

It is advisable that once the disk usage displayed on the RaspberryPI LCD screen is getting close to 90% of disk usage that the database is cleaned up.

7.1. Cleanup

It is possible to clean-up the database for a fresh-start.

- 1) Please stop the server application as described in chapter "Starting / Stopping the demon scripts"
- 2) Open a web browser

3) Type the IOT Starter Kit IP address followed by the following text "/phpmyadmin" to the web browser address bar.

B 17238.67.226/ghpmysdmin/		r 🕑 🚺 - Gagar	Q	÷	ŧ	\$ ė	•-	=
	php <mark>MyAdm</mark> Welcome to phpMy	Admin						
	Language English •							
	Log in w Username: Password:							
		60						

4) The user name is root and password is also root



5) Click "Go" button



6. Click "lora" database on the left of the window

C G 1/218.6(226 phpmysdmar	vindes php/dba/bra6ctos	units Decisio 532743/8678433940	entrovacio - C	• bogue	<u> </u>	ਸ 🖬 🚇 📲
phpMyAdmin	📢 localhast 🖡 😡	hira				
28690¢	Table -	Action	G Query 🔛 E	xport 📑 Impor	t POpen Rows Type	ations V More
loca	IT nateways	Browce 14 Storture	Search Sel Incert	G Emety O Dain	H Innol	DR latint swedish ri
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ranges	🔲 ranges	🖀 Browse 🖗 Structure	Search 🐕 Insert	🐮 Empty 😂 Drop	^a Innol	DB latin1_swedish_ci
serverversion	serverversion	🛄 Browse 🧏 Structure	Rearch Hinsen	🖀 Empty 🤤 Drop	1 Innol	06 armscii8_general_
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	Check All /	Uncheck All With	elected.			
	Plint view 👼 Da	ita Dictionary				
	Name		Number of columns			
						Go

7) Click on "Empty" (trash can icon) link for each table

7.2. MySQL Server Users

Three more users have been defined (in addition to the root user) to access the database:

- loraadmin, has full access to the database (password: loraadmin)
- lorarw, has the right to read and update the tables (password: lorarw). The server uses this user to access the database.
- loraro, has the right to only read the tables (password: loraro). Used by the web server to access the tables.



8. Updates and Upgrades

Semtech will issue some releases of the network software under the form of a new RaspberryPi image file to be programmed onto a SD card. Please ask your Semtech representative for an update.

The current delivery of the IOT kits contains the following versions of the different components:

- LoRaWAN specification R3.0 (production)
- Server release v1.4.2 (Semtech's example network server implementation)
- LoRaMote end-point firmware v3.0
- mbed platform end-point firmware (not yet available)

9. End-devices Firmware

9.1. LoRaMote

LoRaWAN firmware projects are available as source code in GitHub at the following address:

https://github.com/Lora-net/LoRaMac-node.git

The firmware must be configured to use activation by personalization and the NwkSKey and AppSKey must be modified to:

- NwkSKey: {0x11,0x22,0x33,0x44,0x55,0x66,0x77,0x88,0x99,0xAA,0xBB,0xCC,0xDD,0xEE,0xFF,0x00}
- AppSKey:
 {0x11,0x22,0x33,0x44,0x55,0x66,0x77,0x88,0x99,0xAA,0xBB,0xCC,0xDD,0xEE,0xFF,0
 x00}

These keys correspond to the application server implemented in this demo. They are hardcoded and compiled in the LoRaWAN server and can't be changed in this release.

9.2. mbed

LoRaWAN firmware projects aren't yet available at the time of this document release. Please check:

http://www.mbed.org

as sources will be provided by Semtech soon.

9.3. How-to Upgrade the RaspberryPi SD Card

To upgrade the SD card you can follow the instructions described in the following link:

http://www.raspberrypi.org/documentation/installation/installing-images/

The image to be used is the one that you get from Semtech.



10. Ordering Information

Option 1: LoRaMote with integrated antenna

- A variety of sensors to select from
- GPS is built-in
- Download sources for Keil and Ride on: https://github.com/Lora-net/LoRaMac-node

Ordering Code: IOT868STKLM1

Option 2: MBED shield unit plugged onto MBED Freedom platform

- MBED-enabled, with online development environment
- Multiple ARM vendors to select from
- Download sources on: http://mbed.org/components/SX1276MB1xAS/

Ordering Code: IOT868STKMB1

11. Troubleshooting

Q: The IP address I type doesn't lead me to the corresponding landing page.

A: It is probably because the Raspberry Pi device did not get a DHCP lease from the network router (this depends of companies' network policies, please talk to your IT manager). If it is not possible to whitelist this device, the fall back solution is to use the second connection option described in "Connection using an Ethernet cable connected between the development PC and the starter kit." chapter.







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