

Getting Started in LoRaWAN Hands On

Class 4: No Service? No Problem!
Building your own LoRaWAN server

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This Week's Agenda

11/27 An Overview of Low-Power IoT Technologies

11/28 Introduction to LoRa and LoRaWAN

11/29 The design of a LoRaWAN node, hands-on

11/30 No Service? No Problem!

Building your own LoRaWAN server

12/1 Testing Our LoRaWAN design

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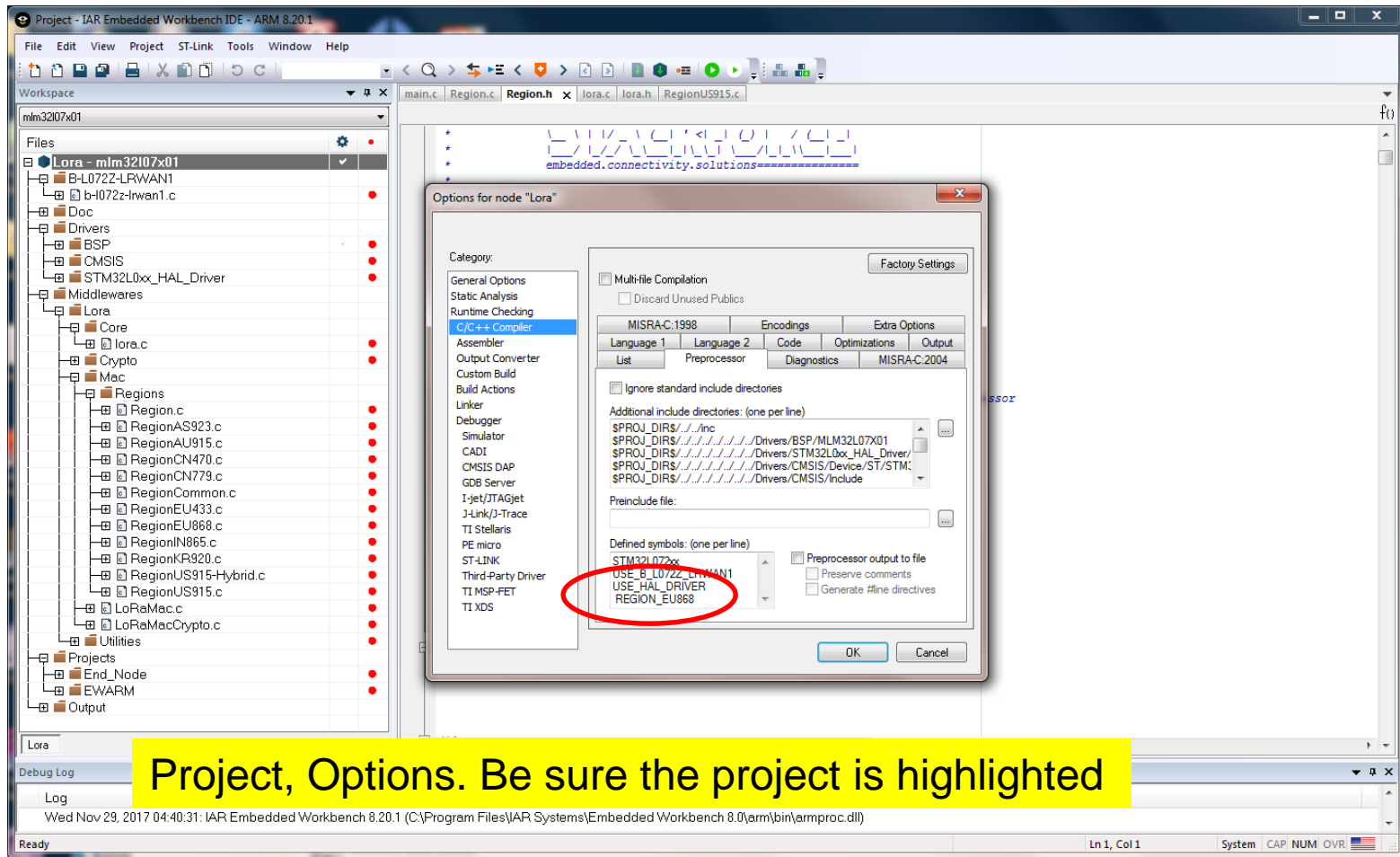
11/29 The design of a LoRaWAN node, hands-on

11/30 **No Service? No Problem!**

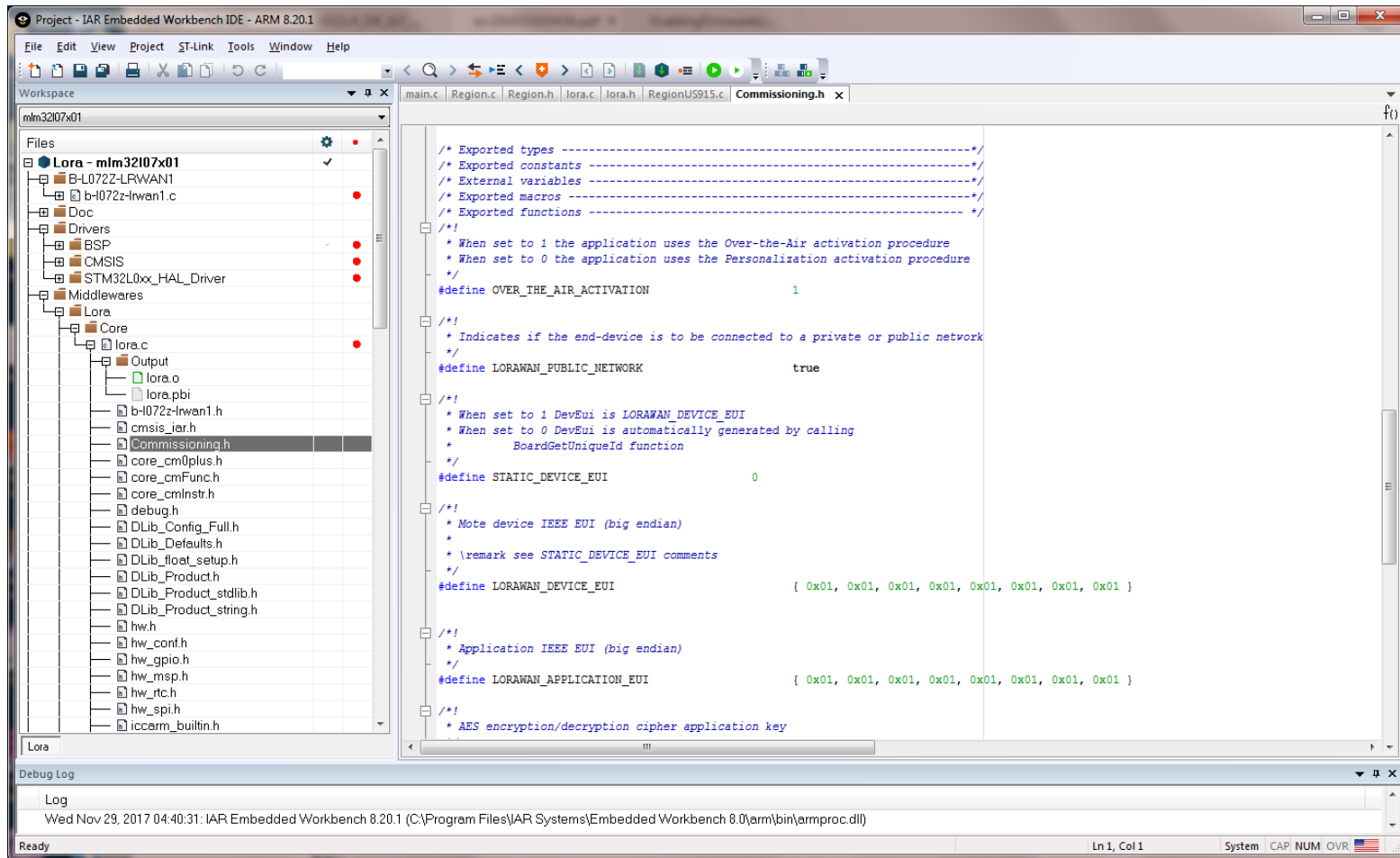
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Picking up from Yesterday



Defining Commissioning



Presented by:

Commissioning in LoRaWAN

- One of the features built into LoRa is the option of Over the Air Authentication (OTAA)- This allows a node to be brought into the network dynamically without local interaction
- Note that some services such as the free tier of LORIoT do not support OTAA

Keys

- Another method of authentication is the assignment of a network and a device key by the service provider. These are entered into the node and are typically stored in a secure memory area (trust zone or external crypto chip)
- Most secure way of commissioning but is also the most labor intensive is not done OTA

EUI

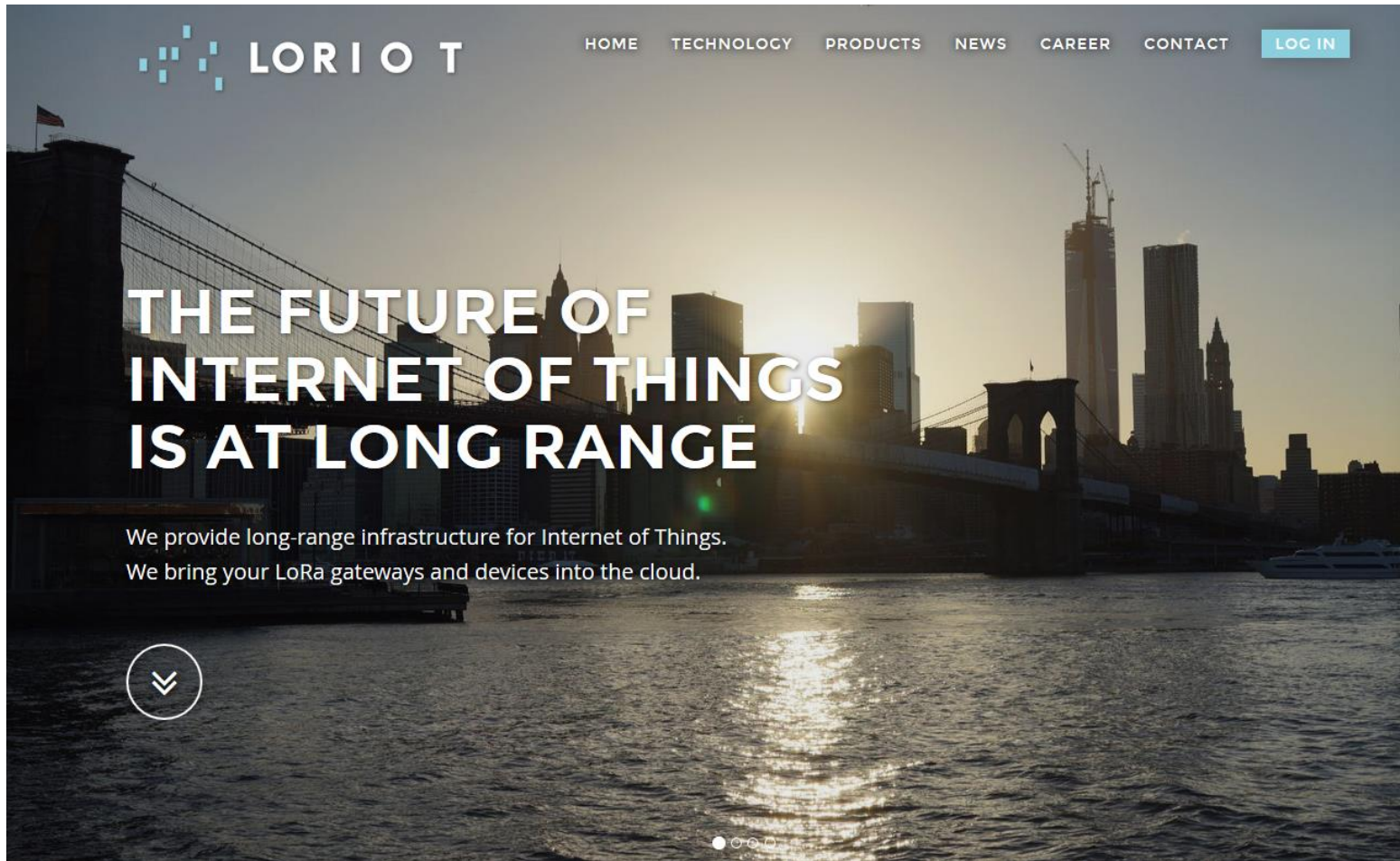
- Extended Unique Identifier
- 64 bits – part of IPv6
- Extended version of the 48-bit “MAC address”
– a globally unique address assigned to every networked device
- The EUI can be used in commissioning as a universal node identifier in the early commissioning process

Question 1 – why not just use the EUI as the node identifier?

Adding a Local Gateway

- Even with a local commercial provider, it is wise in developing LoRa devices to have your own development gateway
- Due to the flexibility of the LoRaWAN standard and OpenLoRa, an end node will operate the same with a local gateway through a network concentrator as it will through a commercial network – but you have control over your own gateway

We will use LORIoT.io



Join the free Community Network

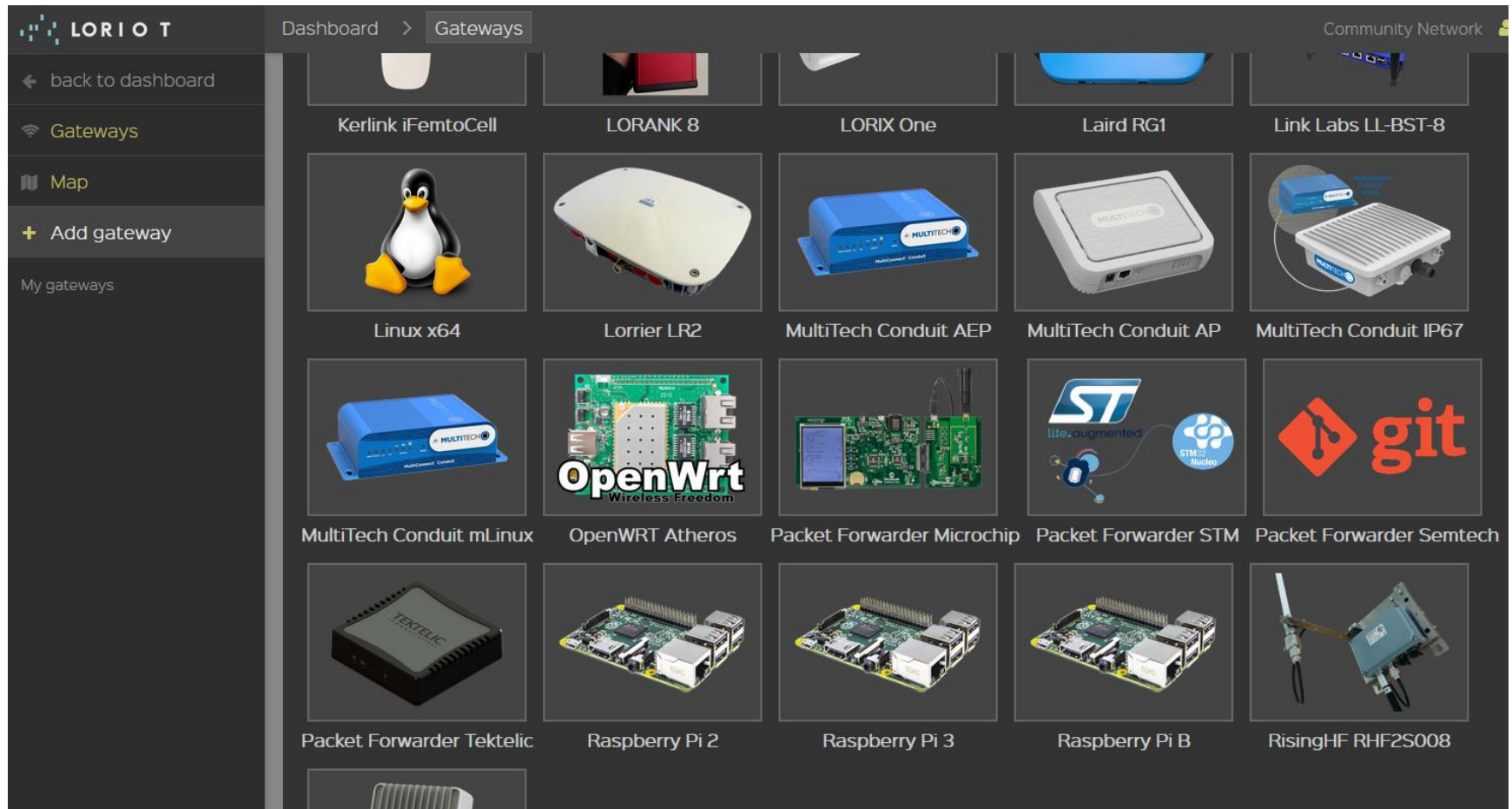
The screenshot shows the LORIoT Community Network dashboard. The user is logged in as c.j.lord@ieee.org. The dashboard is divided into several sections:

- Account Information:** Email: c.j.lord@ieee.org, Name: Charles Lord. A Logout button is visible.
- tier COMMUNITY NETWORK:** A welcome message: "Welcome to LORIoT.io Community Network! You are now part of a world-wide ecosystem of LoRaWAN developers. Your devices can use any community gateway to reach our network. As a reward for sharing your gateway, we provide you one Free Network Application."
- COMMUNITY NETWORK features:** A list of features:
 - No account expiration
 - Roaming among all community gateways
 - OpenLoRa Forum support
 - One Free Network Application
- News:** Two news items:
 - 9th October 2017 03:00: New version of the back-end and front-ends (release notes) has been deployed. The legacy UI does not include the new features, but should remain in a working state until the end of the year.
 - 10th July 2017 07:00: We have a fresh new user interface ready for you. You will need to login separately into this interface, but can use both the current and the new in parallel. The old user interface will be sunset by October 2017. The release notes for the last update are now also available.
- Gateways:** A table showing the last 10 gateways. It is currently empty with the text: "No gateways registered. Start by registering your gateway." Below the table, it says: "Your account has capacity of 1 gateway".
- Applications:** A table showing the last 10 applications. It contains one application:

Name	AppID	Devices
SampleApp	BE-7E-03-25	0

Below the table, it says: "Community tier is currently limited to one application per account."

LORIoT supports all known gateways



Seeed Studio Gateway Kit



RisingHF RHF0M301



- 10 channel LoRa transceiver
- Designed to work with Raspberry Pi
- Simple SPI port allows use with most processors

How They Map

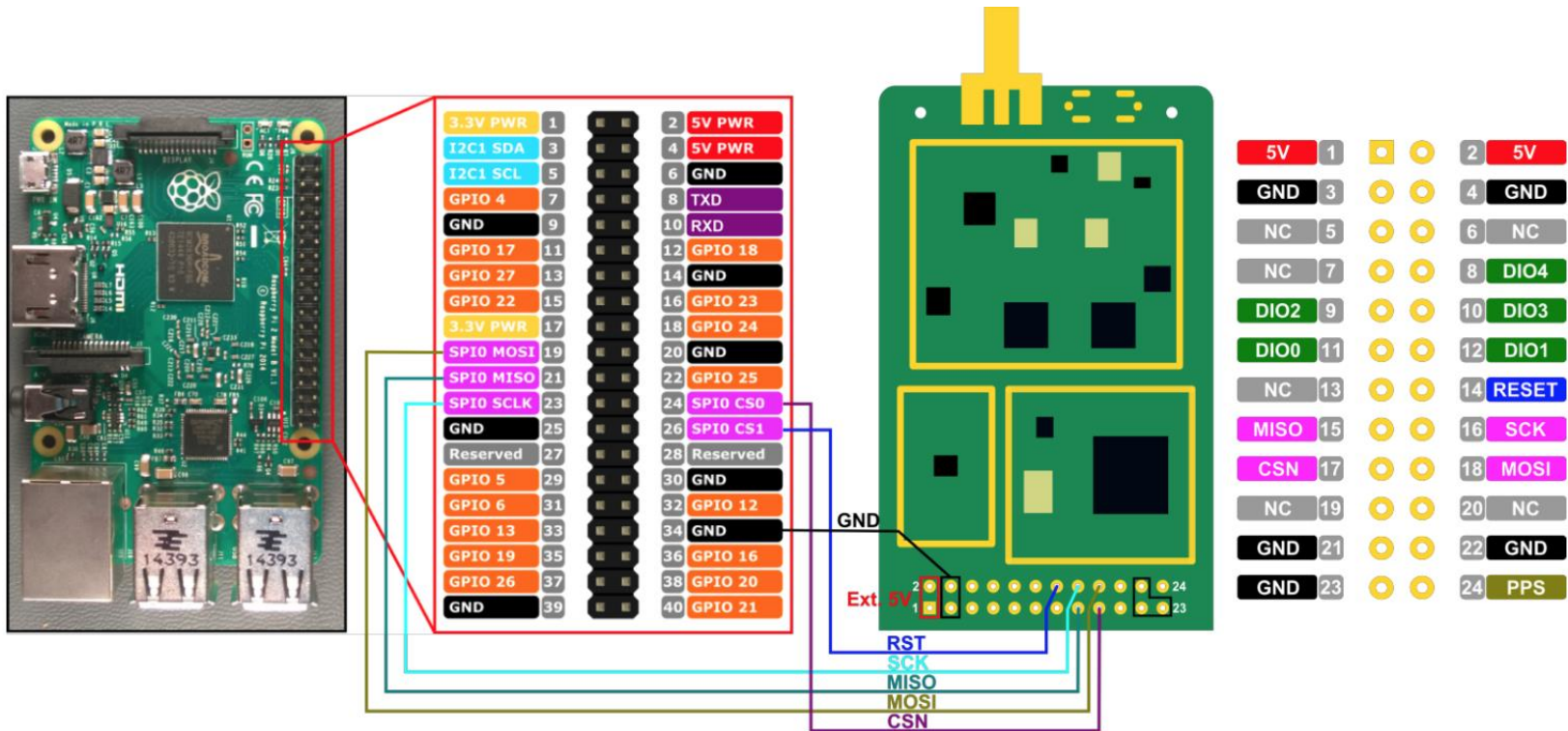
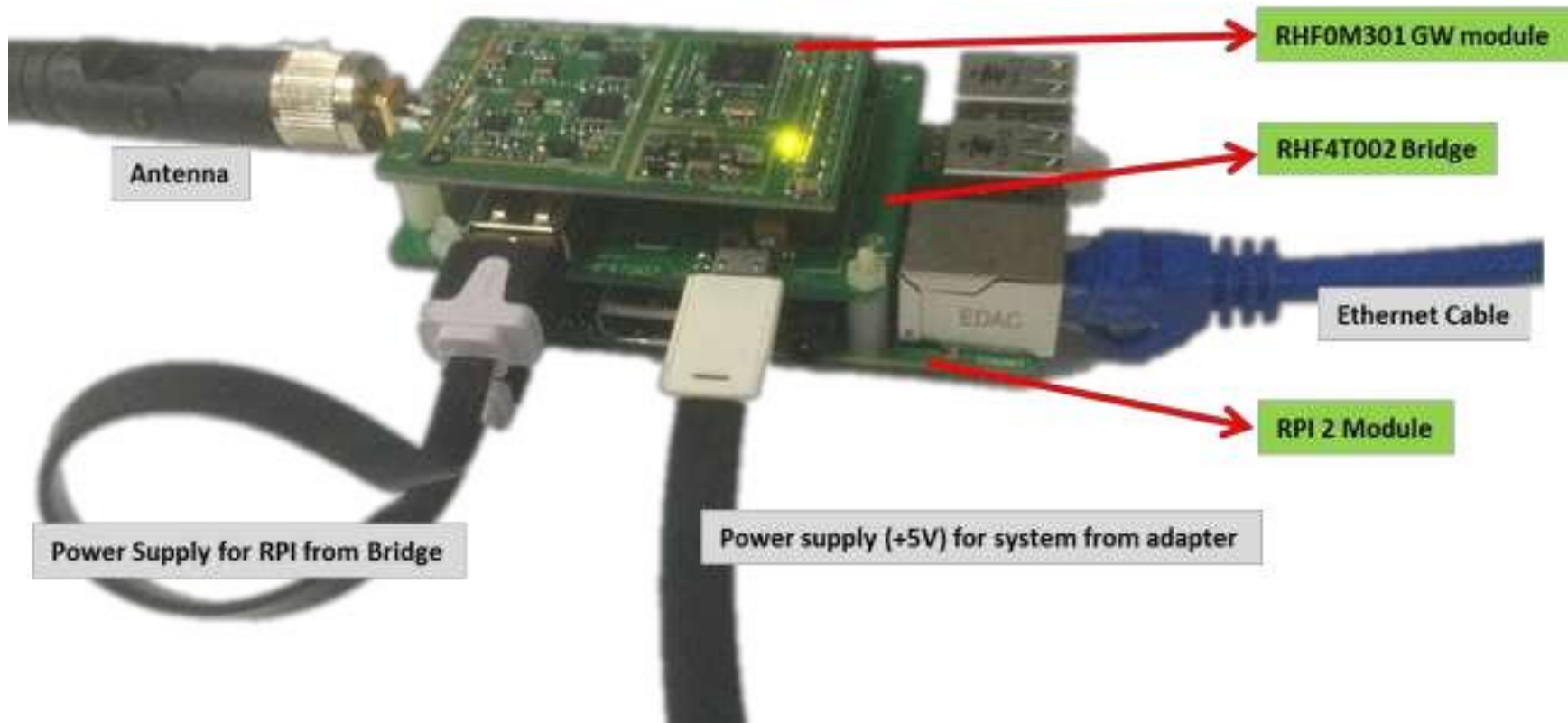


Figure 4-1 RHF0M301 and RPi Connection

Bridge Board



RisingHF / Seeed Kit

- Includes the bridge board, all cables, ant
- Does not include Raspberry Pi (but does include a compatible port of Raspian on microSD along with LORIOT and Things code)
- Also includes a FTDI serial-to-USB to patch and log into the RPi linux to get ethernet MAC as well as local IPv4 address (for SSH)

Manual for Setup

RisingHF

IoT Discovery User Manual

UM01649

IoT Discovery User Manual

V2.1

Document Information

Item	Content
Keyword	<i>LoRaWAN, UM, IoT, Wireless communication</i>
	This document describes how to use, test and configure

Community Allows One Gateway

The screenshot shows the LORIoT Gateway management interface. The main heading is "Gateway / Raspberry Pi B B8:27:EB:59:8F:ED". The interface is divided into several sections:

- Uptime this month:** A donut chart showing 100% uptime. Legend: Uptime (days) in blue, Downtime (days) in grey.
- Gateway information:** A list of details for the gateway, including EUI, Title, Base and model, Concentrator, Frequency plan, TX gain adjustment, and Ignore data. A "Remove gateway" button is present at the bottom.
- Actions:** Buttons for "Data tap" (Tap into data stream), "Ping" (Ping gateway), and "Restart" (Restart gateway).
- Status:** Shows "Connected" with a green checkmark and "Version" 2.6.828-JKS-US-5.
- Downloads:** A list of download links for the gateway software, including "LORIoT Gateway self-extracting installer Quick install" and "LORIoT Gateway binary only Quick run".

Question 2 - What is the distinguishing feature of the Raspberry Pi 3B versus 3?

Register the Gateway

The screenshot displays the LORION Gateway management interface. The top navigation bar includes the LORION logo, a breadcrumb trail (Dashboard > Gateways), and user information (Community Network, c.j.lord@ieee.org). The left sidebar contains navigation options: 'back to dashboard', 'Gateways', 'Map', 'Gateway capacity exhausted', and 'My gateways'. A specific gateway is selected, showing its MAC address (B8:27:EB:59:8F:ED) and a small device icon.

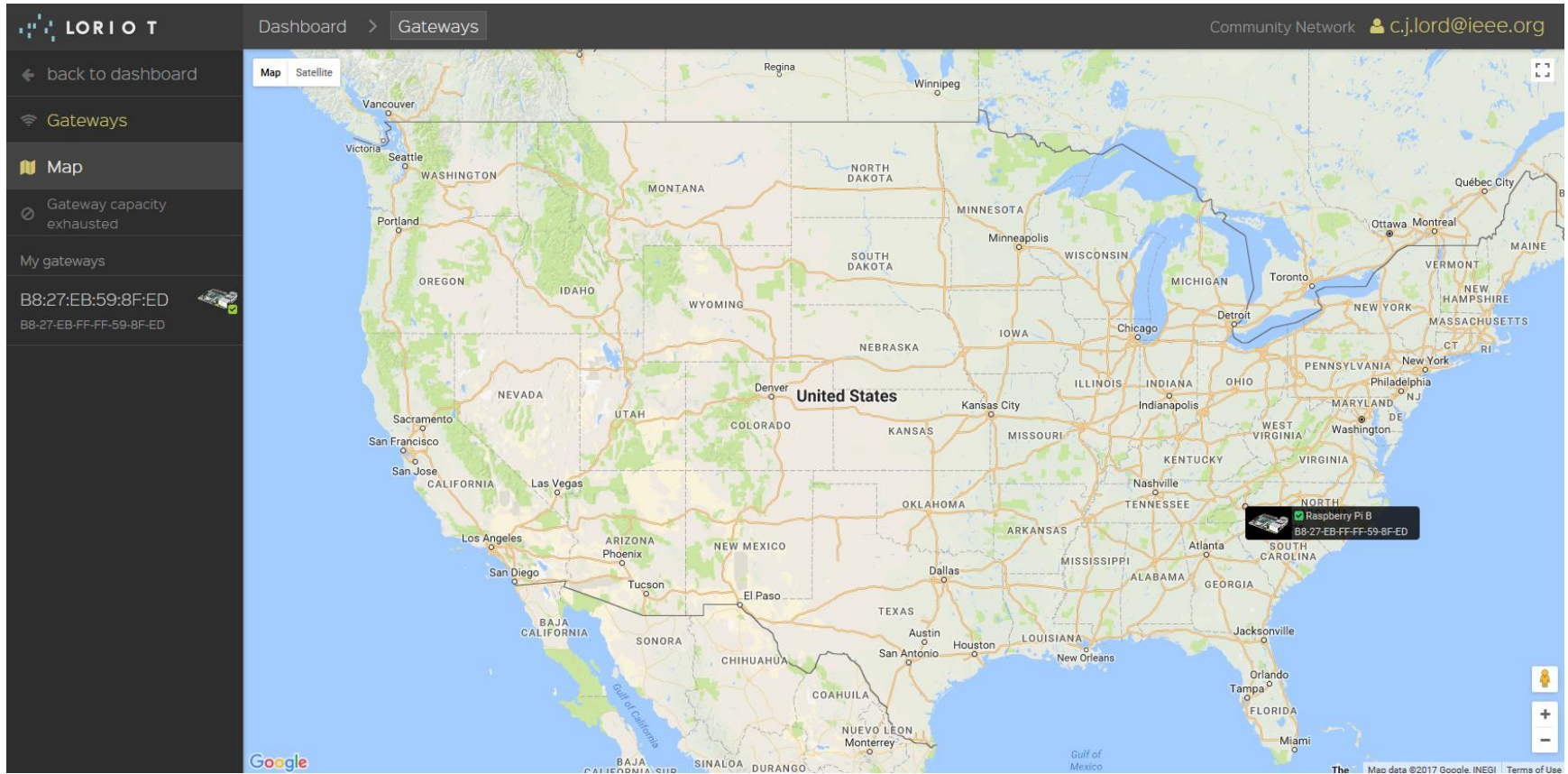
The main content area is divided into several sections:

- Location:** A table with fields for Address (5 Dogwood Rd), City (Asheville), Zip (28804), Country (US), Lat (35.6304643), Lon (-82.54568499999999), LatProtected (35.6304643), and LonProtected (-82.54568499999999). A 'Move gateway location' button is present.
- Identification:** A table with fields for MAC (B8:27:EB:59:8F:ED), EUI (B8-27-EB-FF-FF-59-8F-ED), Base (Raspberry Pi), Model (B), Concentrator (sx1301_ref), and Connected over (SPI).
- Satellites information:** A section header at the bottom of the left column.
- Radio statistics:** A message stating 'No radio statistics data available, gateway needs to receive some data first.'
- Satellites history:** A message stating 'GPS information not available.'
- System history:** A line graph showing system performance metrics over time. The x-axis represents time from 11/27/2017 21:13:35 to 11/28/2017 00:36:06. The y-axis represents values from 0.00 to 0.82. The legend includes 'load avg 1m', 'load avg 5m', 'load avg 15m', and 'free memory'. The graph shows low, stable values for all metrics.
- Uptime history:** A section header for a graph showing uptime hours per day.

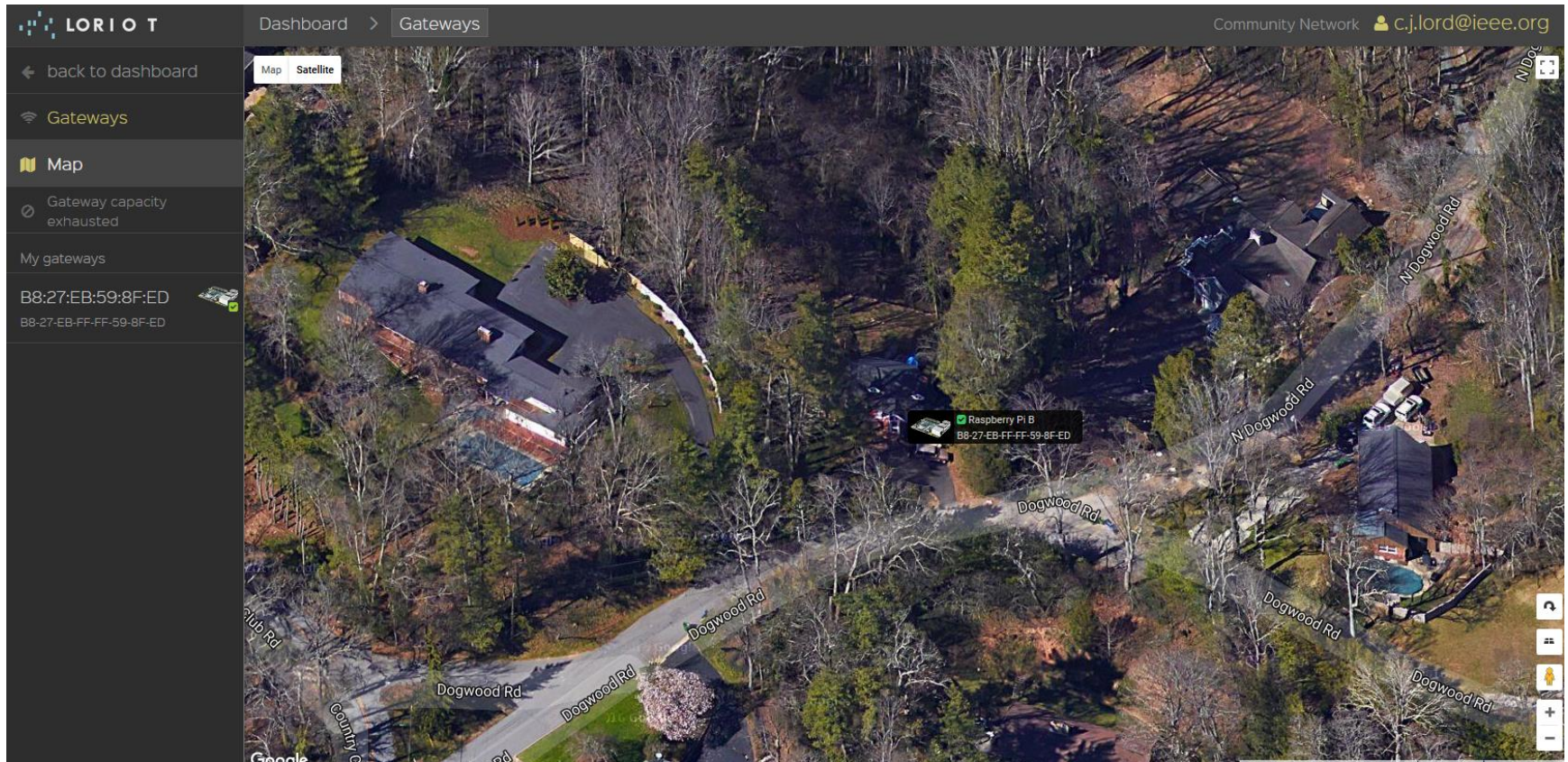
Channel Plan (US)

Channel allocation			
Radio	Center frequency [MHz]	Bandwidth [kHz]	Modulation
0	902.300	125	MultiSF
0	902.500	125	MultiSF
0	902.700	125	MultiSF
0	902.900	125	MultiSF
1	903.100	125	MultiSF
1	903.300	125	MultiSF
1	903.500	125	MultiSF
1	903.700	125	MultiSF
0	903.000	500	SF8
0	902.700	250	FSK

There I am



...up close and personal...



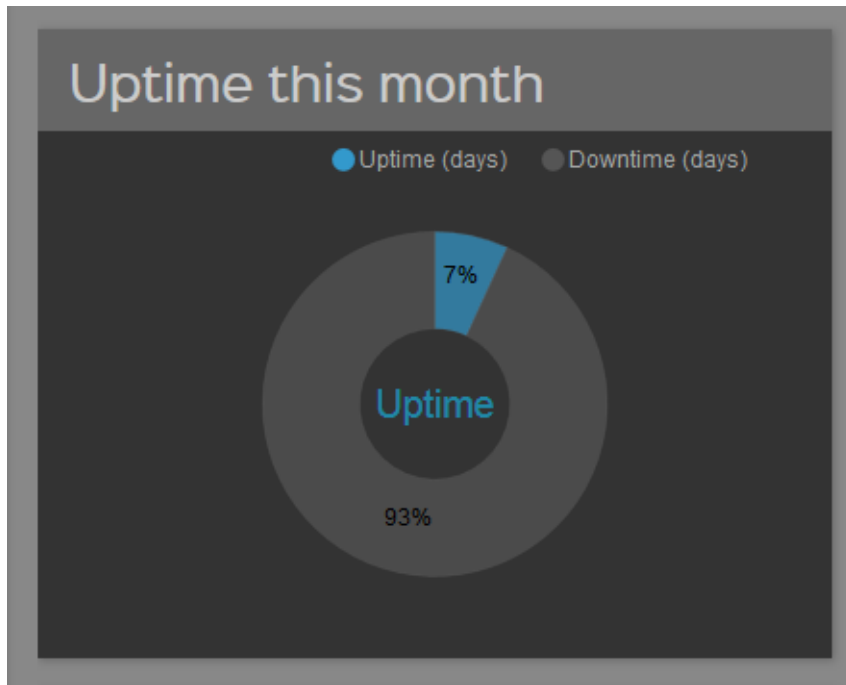
top command – There is Our Server

```
192.168.1.106 - rxhf@rhf2s001: ~/loriot/1.0.2 VT
File Edit Setup Control Window Help
top - 01:07:13 up 1:41, 1 user, load average: 0.00, 0.03, 0.00
Tasks: 132 total, 1 running, 131 sleeping, 0 stopped, 0 zombie
%Cpu(s):  0.2 us,  0.1 sy,  0.0 ni, 99.7 id,  0.0 wa,  0.0 hi,  0.0 si,  0.0 st
KiB Mem:  947740 total,  239580 used,  708160 free,  10424 buffers
KiB Swap:  0 total,  0 used,  0 free,  138344 cached Mem

  PID USER      PR  NI  VIRT  RES  SHR  S  %CPU  %MEM    TIME+  COMMAND
 29018 rxhf      20   0   5112   2440 2076  R   0.7   0.3   0:15.90  top
 1191 mysql    20   0 324920 40624 8824  S   0.3   4.3   0:09.23  mysqld
 1216 www-data 20   0 112800 13156 8516  S   0.3   1.4   0:00.87  apache2
 1325 root     20   0  26268  4168 3708  S   0.3   0.4   0:10.71  loraNS
 1327 root     20   0 230004  3948 3496  S   0.3   0.4   0:07.19  loraAS
 1329 root     20   0  21944  4056 3604  S   0.3   0.4   0:05.49  loraCS
25676 root     20   0  31896  3848 3352  S   0.3   0.4   0:11.64  loriot_rpi+
   1 root     20   0  22820  3972 2740  S   0.0   0.4   0:06.27  systemd
   2 root     20   0     0     0   0  S   0.0   0.0   0:00.00  kthreadd
   3 root     20   0     0     0   0  S   0.0   0.0   0:00.18  ksoftirqd/0
   5 root     0 -20     0     0   0  S   0.0   0.0   0:00.00  kworker/0:++
   7 root     20   0     0     0   0  S   0.0   0.0   0:03.25  rcu_sched
   8 root     20   0     0     0   0  S   0.0   0.0   0:00.00  rcu_bh
   9 root     rt   0     0     0   0  S   0.0   0.0   0:00.06  migration/0
  10 root     rt   0     0     0   0  S   0.0   0.0   0:00.07  migration/1
  11 root     20   0     0     0   0  S   0.0   0.0   0:00.13  ksoftirqd/1
  13 root     0 -20     0     0   0  S   0.0   0.0   0:00.00  kworker/1:++
```

Question 3 – What is the Windows equivalent command?

After Two Days...



Status

Connected	✓ Connected
Version	2.6.828-JKS-US-5
Latency	97 ms
Last keep-alive	a minute ago 30th Nov 2017, 00:49:47
Last data	never
Last connect	2 days ago 28th Nov 2017, 00:22:22
Remote time offset	a few seconds

Time is shown in your local time (UTC-05:00)

Coming Up Next

Dashboard > Applications > SampleApp

Community Network c.j.lord@ieee.org

Application / SampleApp

Controls

- Data output
- Security tokens
- Manage devices

Capacity

Allocated capacity: 10 devices

Used capacity: 0 devices

Upgrade to [commercial account](#) to increase the capacity

Features

Join EUI	Not available on your tier
Join Server interface configuration	
Application EUI	APPEUI not set

Network Application

Name	SampleApp	Edit name
Application ID	BE-7E-03-25	
Data output	WebSocket	Edit output
Documentation	API Documentation	

Traffic history

Message count history

Hourly Daily

● Daily up message cou... ● Daily down message c...

Last 25 frames received

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Please stick around as I answer your questions!

- Please give me a moment to scroll back through the chat window to find your questions
- I will stay on chat as long as it takes to answer!
- I am available to answer simple questions or to consult (or offer in-house training for your company)

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