



AdRadionet to IBM Bluemix Connectivity User Guide

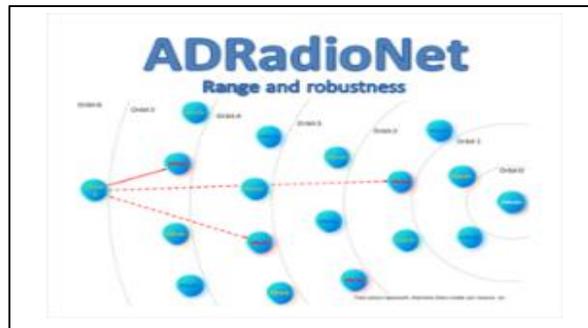
Platform: EV-ADRN-WSN-1Z Evaluation Kit

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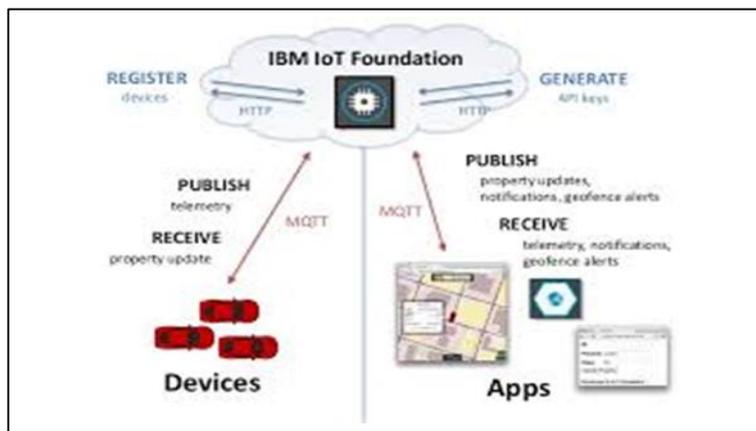
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Introduction

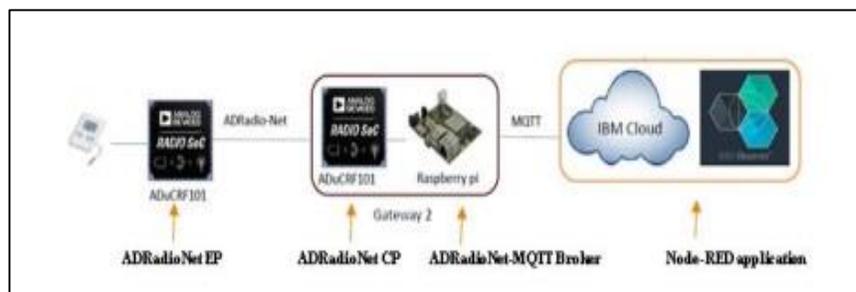
ADRadioNet is self-healing wireless communication protocol focused on providing a high level of scalability, extreme ease of use, and small code footprint. It is suitable for use in a wide range of applications, including wireless sensor networks, building automation, and infrastructure monitoring.



IBM Bluemix is an open-standard, cloud-based platform for building, managing, and running apps of all types, such as web, mobile, big data, and smart devices. Capabilities include Java, mobile back-end development, and application monitoring, as well as features from ecosystem partners and open source—all provided as-a-service in the cloud. The Device side connectivity is enabled through the IBM IoT Foundation which implements publish subscribe model using MQTT.



AdRadionet-MQTT gateway built using the Node.js framework enables sensors from the WSN to connect to IBM Bluemix through this gateway.



This document is intended to help users in setting up the connectivity from AdRadionet Network to IBM Bluemix cloud service.

Things to Acquire

Hardware

- **Analog Devices EV-ADUCRF101QS1Z Quick start kit with**
 - Segger J-LINK Lite ARM emulator
 - USB↔UART Converter
- **Analog Devices EV-ADRN-WSN-1Z WSN Development Kit**
- **Raspberry Pi Model B+ with**
 - SD Card
 - Micro usb Power Supply
 - HDMI Cable
 - Wifi Dongle / Ethernet Cable.
 - Keyboard
 - Mouse

Software

- **AdRadionet software for ADuCRF101 V1.1 from**
 - <http://sdk.analog.com/dw/sdks.aspx?file=AMEDK01>
- **AdRadionet MQTT Gateway**
 - <http://wiki.analog.com/resources/eval/user-guides/wsn/iot>

Software download and installation

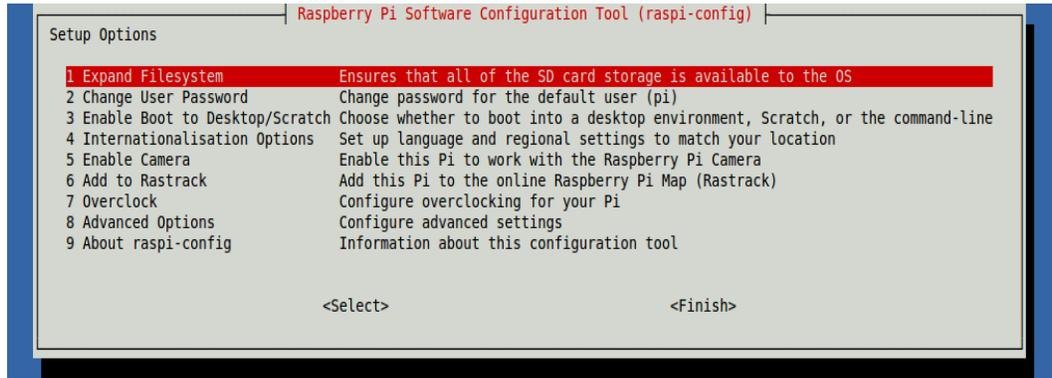
The setup and installation procedure is step by step instructions to bring up the demo setup from scratch. In cases where part of the setup is available for Raspberry Pi or AdRadionet users can skip those sections.

Raspberry Pi Basic Setup

- **Step 1: Hardware setup**

Follow this like for basic device setup instruction
<http://www.raspberrypi.org/documentation/setup/README.md>
- **Step 2: OS Setup**
 - Follow this like for operating system installation instructions
<http://www.raspberrypi.org/documentation/installation/installing-images/README.md>
 - Raspbian OS can be downloaded from
<https://www.raspberrypi.org/downloads/raspbian>
 - Please note that this is as of August 2015. For later versions of Raspberry pi, there may be an updated version of the raspbian os that you may need to download and install

- After completing these steps and boot the Raspberry Pi. While booting raspi-config will run automatically, please select “Expand Filesystem” in the menu as shown below image. And follow the raspi-config onscreen instructions.



Follow the steps given in section [Setup Quick Start – Visualization Application](#).

➤ **Step 4: Instructions for Node Red Setup**

Follow the steps given in sections [IBM IoT Foundation Cloud Instance setup](#) and [Creating IBM Bluemix – NODE-RED Application Instance](#).

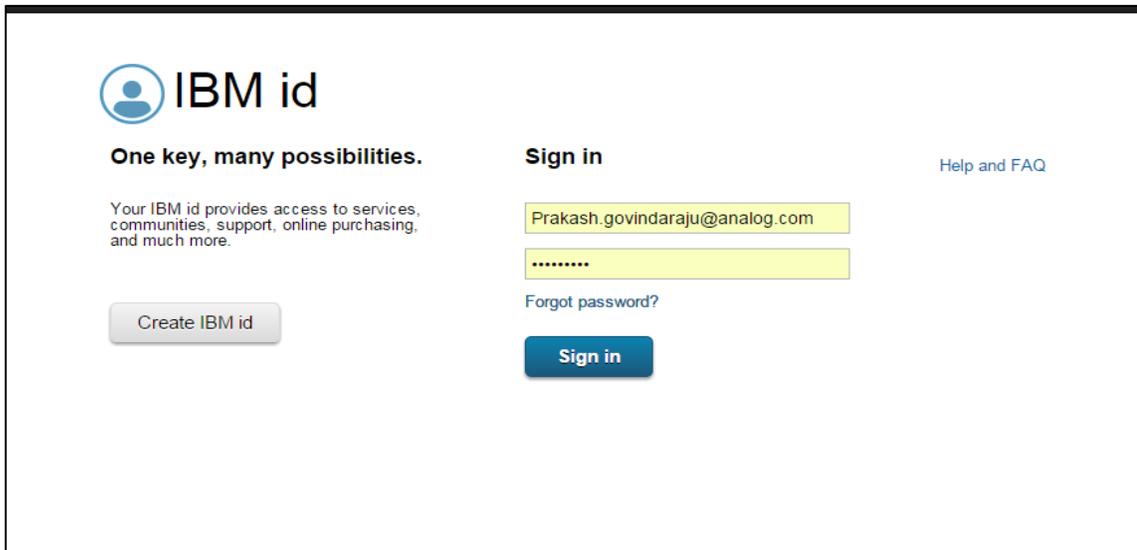
IBM IoT Foundation Cloud Instance setup

This step requires Chrome or Internet Explorer running on Windows 7 or higher versions of Windows operating system.

➤ Step 1: Login or Register

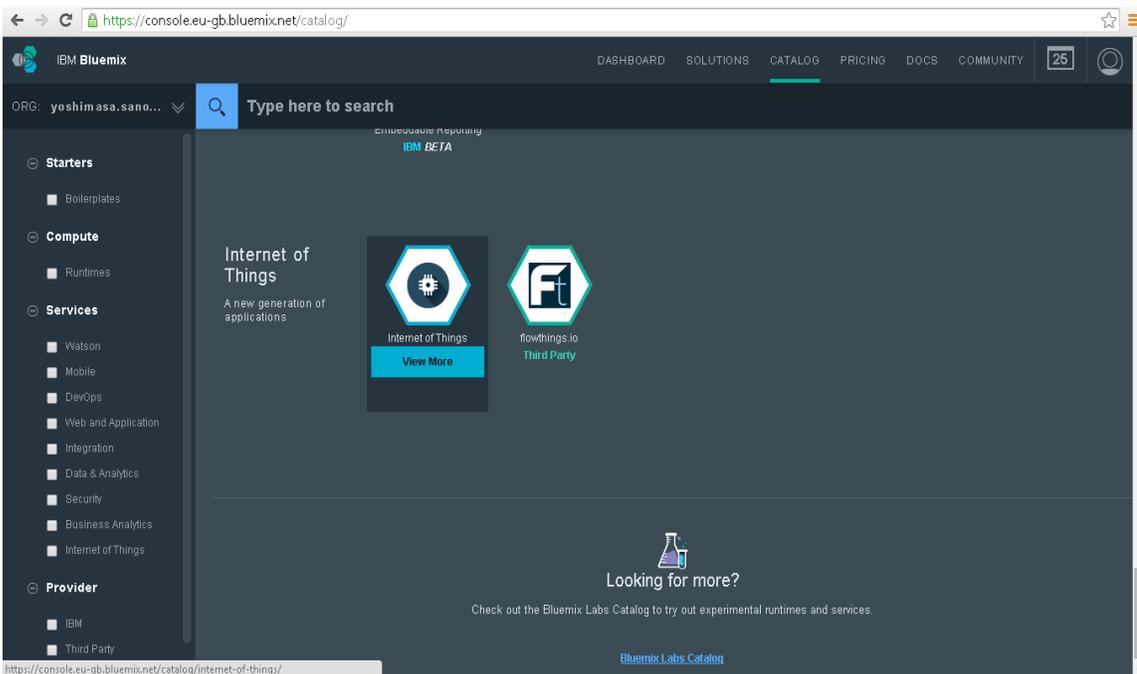
<https://idaas.ng.bluemix.net/idaas/public/tamlogin.jsp>

you may need to create account on several different locations or link them up together to be able to reach the IBM Bluemix. They change their layout every now and then.



➤ Step 2: Add IoT Foundation service

Select "CATALOG" tab and click on "Internet of Things"



Select “Leave unbound” under App, Give a name to the Service, Select “Free” and click on “CREATE”

The IBM Internet of Things service lets your apps communicate with and consume data collected by your connected devices, sensors, and gateways. Our recipes make it super easy to get devices connected to our Internet of Things cloud. Your apps can then use our real-time and REST APIs to communicate with your devices and consume the data you've set them up to collect.

- Connect your devices securely to the cloud**
Before your apps can get to work, you need to get your devices connected up! We have a set of verified instructions, or 'recipes', for connecting devices, sensors and gateways from a variety of partners and individuals.
- Build an app that talks to your devices**
Communications between your devices and the cloud happen via the open, lightweight MQTT protocol. For example you might have a sensor that collects and sends humidity readings every minute. Our REST and real-time APIs allow you to quickly pull that device data into your apps for further analysis.

How it works

Pick a plan

Plan	Features	Price
Free	Includes up to 20 active devices, 100 MB of data traffic and 1 GB of storage	Free

Monthly prices shown are for country or region: [United Kingdom](#)

Add Service

Space:

App:

Service name:

Selected Plan:

USE

Launch the IoT Foundation service by pressing Launch Dashboard. New windows will open.

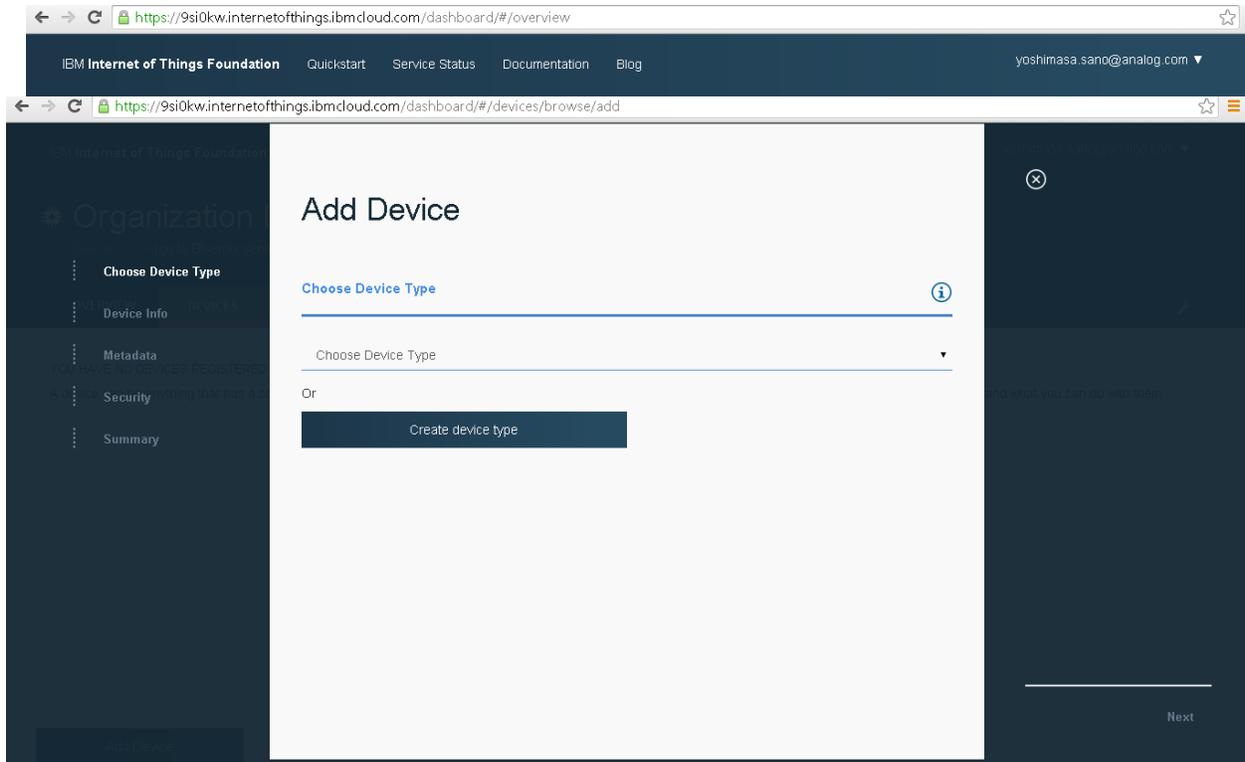
Hi! Welcome to the Internet of Things Foundation

Take a look at the steps below to get you going with your Internet of Things app

- Connect your devices**
Use our [recipes](#) to find out how to add your devices. We work with partners and have sample connection recipes for many devices.
Launch the Internet of Things Foundation dashboard and add your devices by clicking the 'Add Device' button under the 'Devices' tab.
Launch dashboard
- Learn how to build your app**
When you have added your devices, you can come back to Bluemix to start building your app using your real-time and historical device data.
Go to docs
- Learn how to extend your app**
Use other Bluemix services to extend your app to start creating a great Internet of Things app.
Here are some of the services you could use:

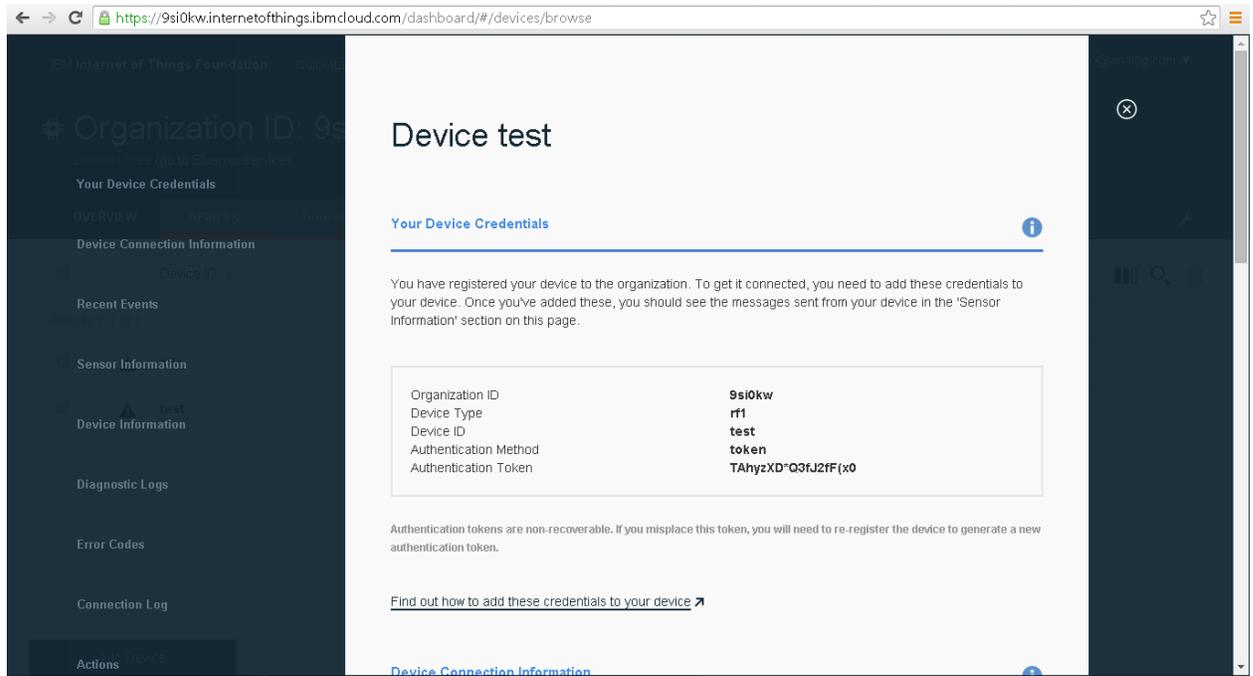
<https://9s10kw.internetofthings.ibmcloud.com/dashboard>

Step 3: Add devices



Select “Create a device type..”, give a device type name for e.g. rf101, give a unique Id for the device under “Device Id” for e.g. Mac address or any number & Click on “Next” until the end without selecting anything else.

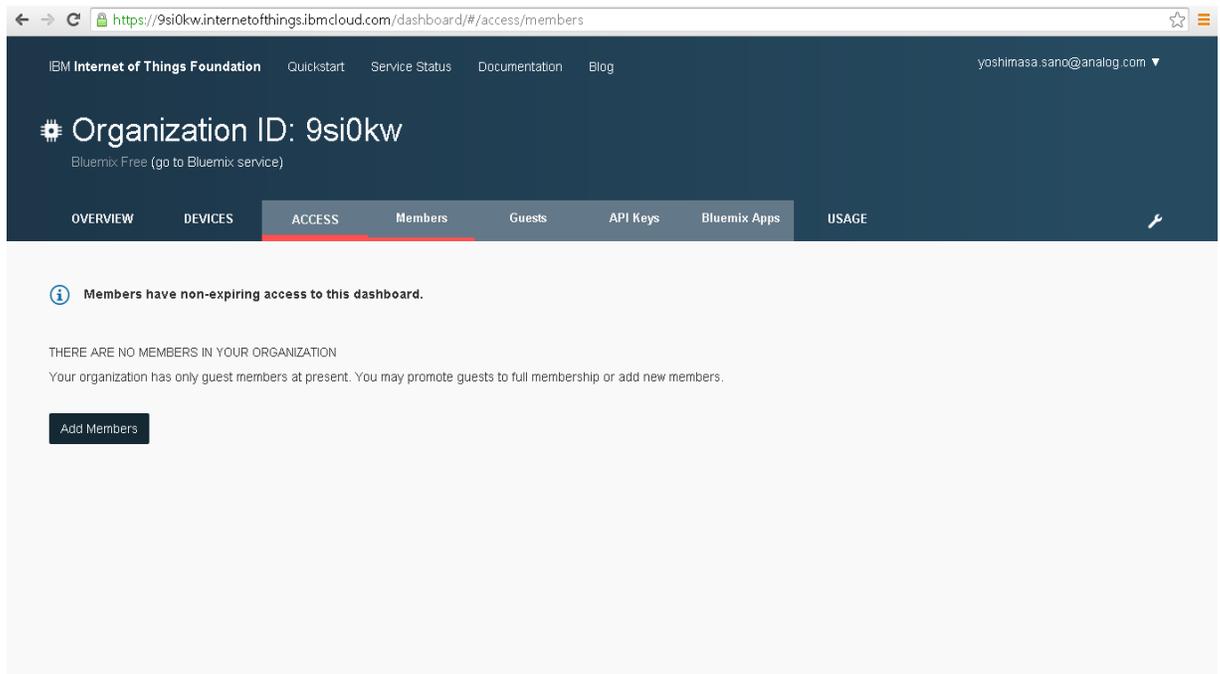
You will then be prompted to add a new device on a similar screen. Add device ID, and go until the end.



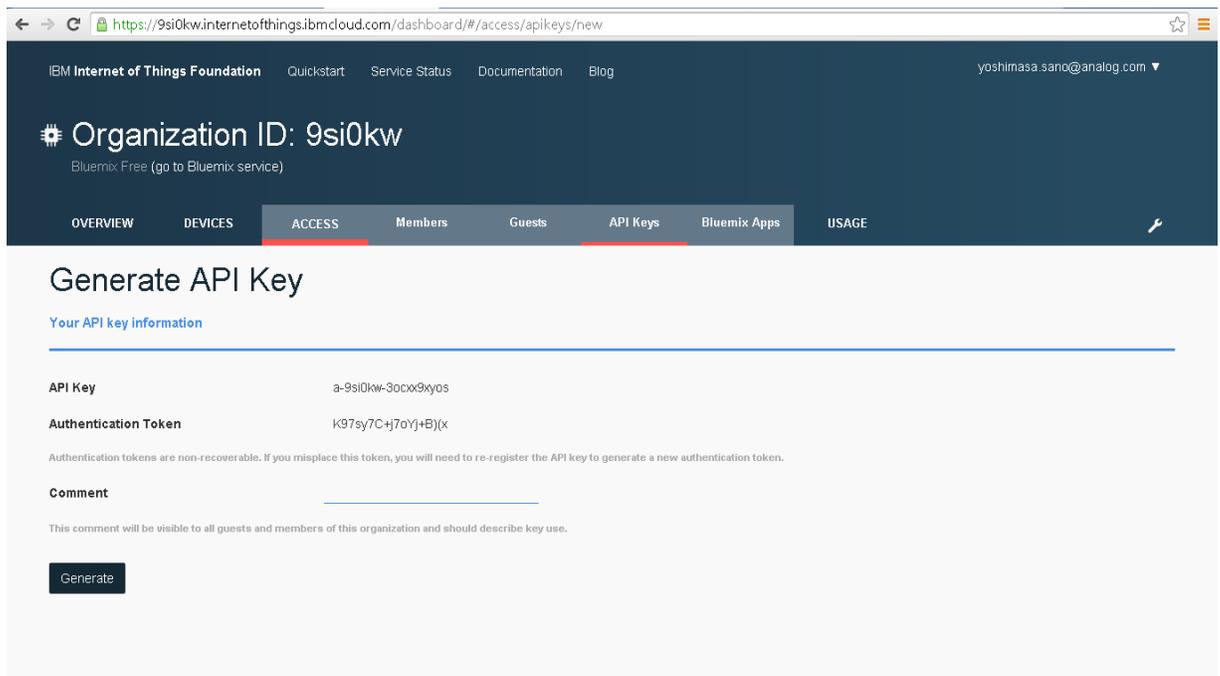
Note: Make a note of credentials displayed in the page, this will be needed for the MQTT client to connect to the IBM IoT Foundation Cloud platform & close.

➤ Step 4: Generate API Keys

Select "Access" -> "API Keys" on the main dashboard



The screenshot shows the IBM Internet of Things Foundation dashboard for Organization ID: 9si0kw. The user is logged in as yoshimasa.sano@analog.com. The 'ACCESS' tab is selected, and the 'Members' sub-tab is active. A message states: "Members have non-expiring access to this dashboard." Below this, it says "THERE ARE NO MEMBERS IN YOUR ORGANIZATION" and "Your organization has only guest members at present. You may promote guests to full membership or add new members." There is an "Add Members" button.



The screenshot shows the 'Generate API Key' page. The 'API Keys' sub-tab is active. The page displays the following information:

API Key	a-9si0kw-30c0x9xy0s
Authentication Token	K97sy7C-Hj70Yf+B)(x

Authentication tokens are non-recoverable. If you misplace this token, you will need to re-register the API key to generate a new authentication token.

Comment

This comment will be visible to all guests and members of this organization and should describe key use.

There is a "Generate" button at the bottom.

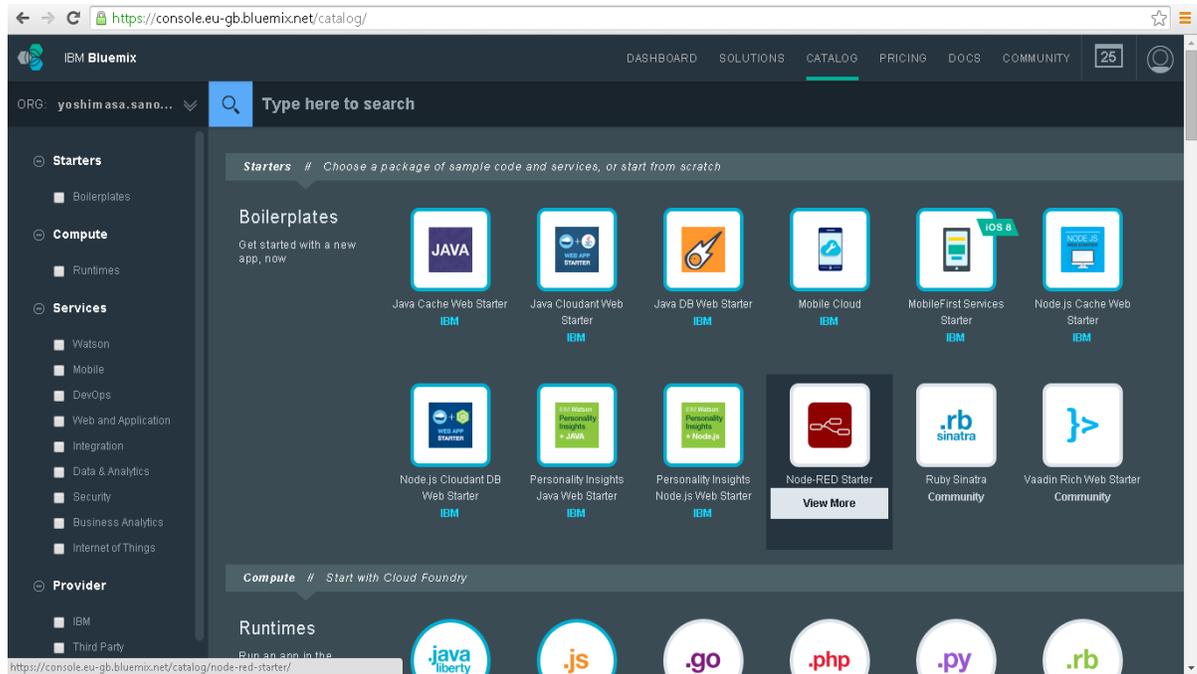
Click on generate, then generate key.

Note: Key & Auth Token shall be displayed, make a note of these credentials, these credentials will be needed for the IBM Bluemix Node-Red application to connect to this instance of IBM IoT Foundation Cloud platform

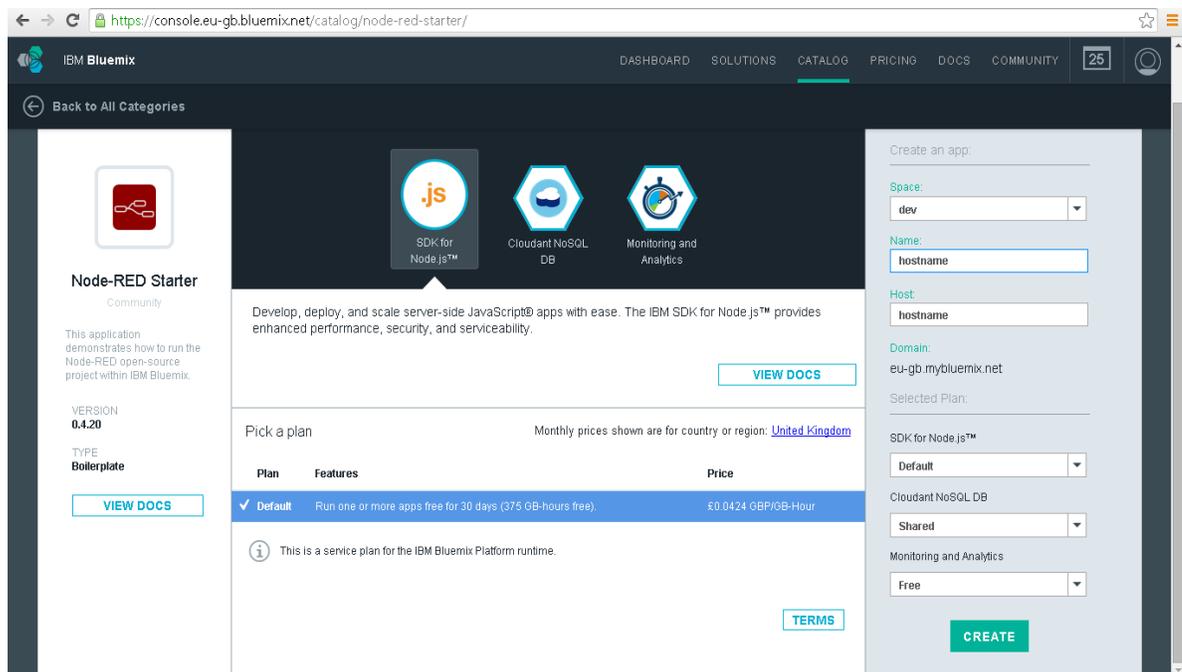
Creating IBM Bluemix – NODE-RED Application Instance

➤ Step 1: Add NODE-RED Instance

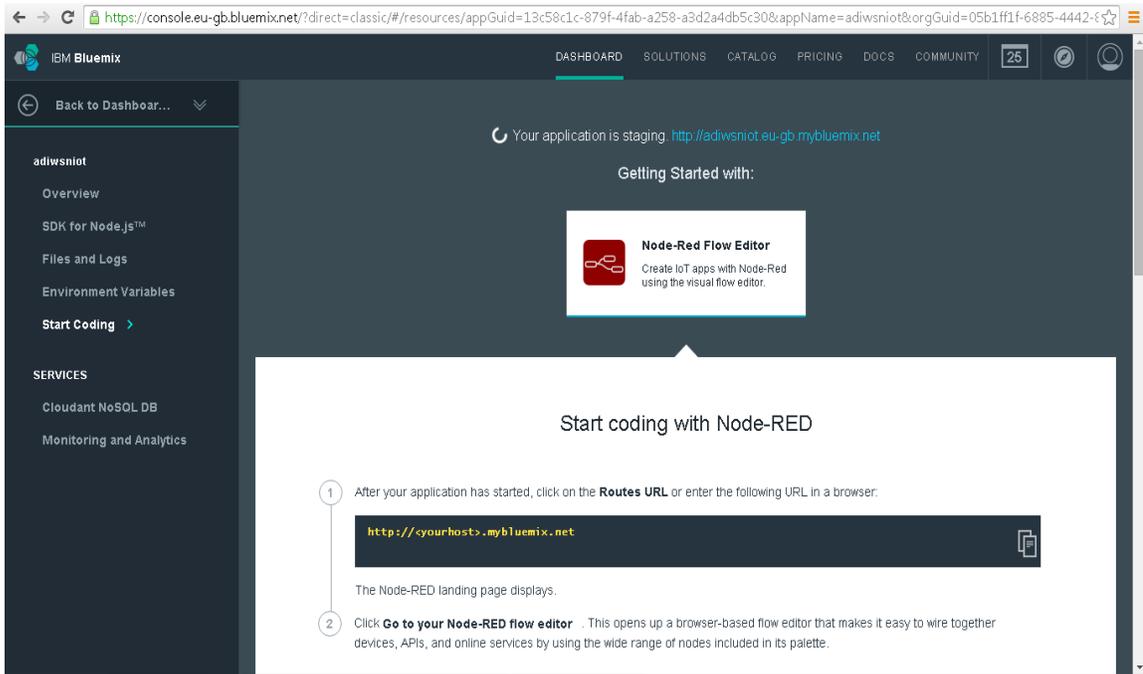
Navigate to <https://console.ng.bluemix.net/>, select “CATALOG” and under select “Node-RED Starter” from “Boilerplates”



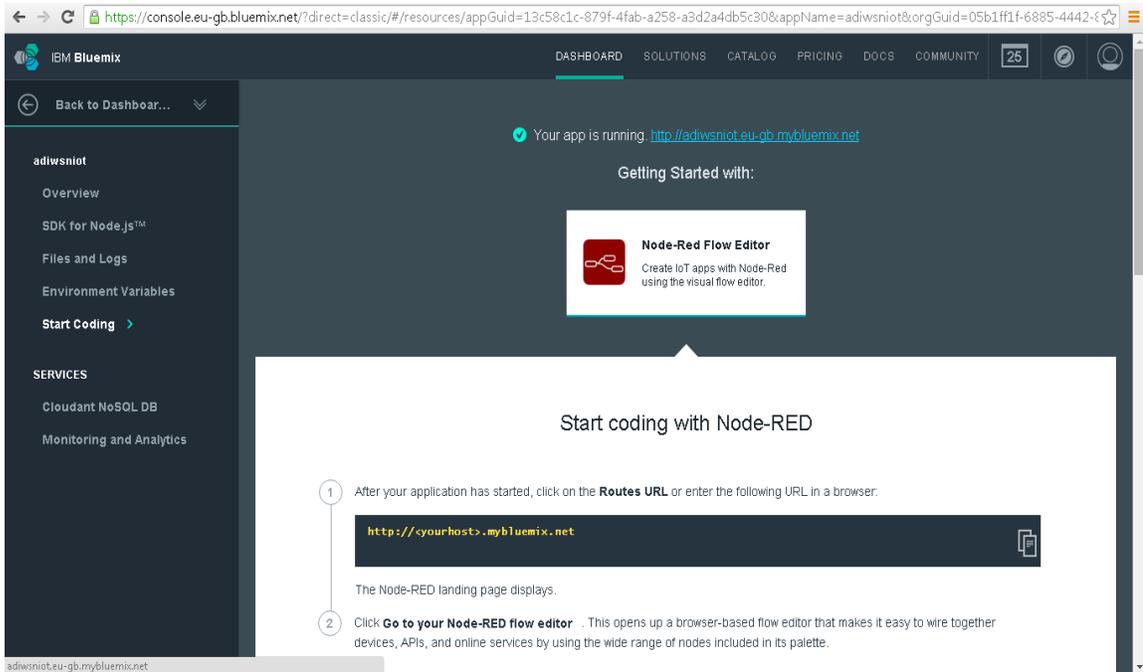
Give a name, give a Host (try avoiding any special characters in the host as it is part of the application URL), Select “Default” for “SDK for Node.js”, select “Shared” for “Cloudant NoSQL DB” and click on “CREATE”



This will start launching an instance, it takes approx. 3-5 minutes, keep watching the application running status at the top where it says “Your application is staging.”.



Once your application is running, click on the link.



➤ Step 2: Connect to NODE-RED Application Instance

To launch the Node-Red IOT Application instance, click on the “Routes” link which would look like <host>.mybluemix.net

Node-RED in Bluemix for IBM Internet of Things Foundation

Node-RED in Bluemix

A visual tool for wiring the Internet of Things
IBM Internet of Things Foundation



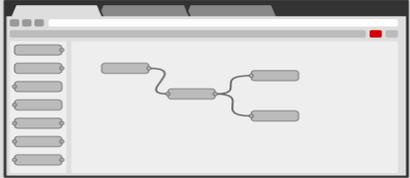
Node-RED provides a browser-based editor that makes it easy to wire together flows that can be deployed to the runtime in a single click.

The version running here has been customized for the IBM Internet of Things Foundation.

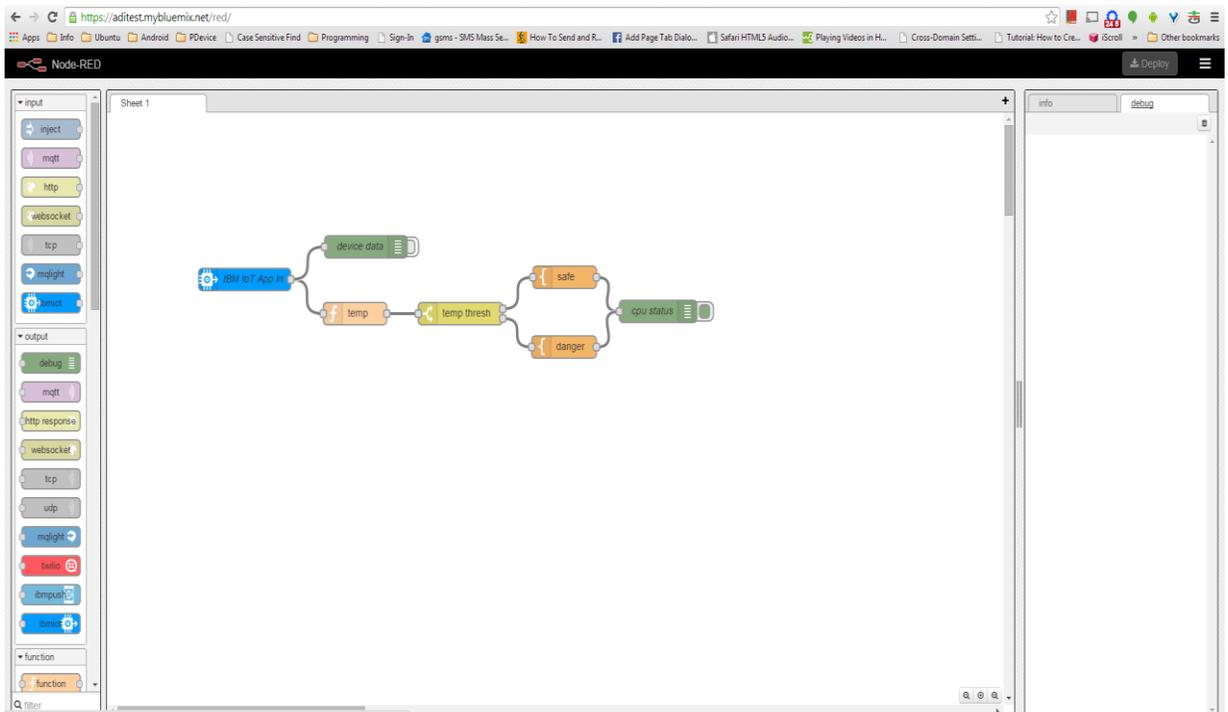
We strongly suggest you secure your Node-RED flow editor with a username and password, as otherwise anyone who can guess the URL of this application will be able to launch the flow editor and access your IoT device data.

To do this, follow the instructions that you find [here](#).

[Go to your Node-RED flow editor](#)



In the browser change the URL & prefix `https://`, so that the URL looks like `https://<host>.mybluemix.net` & Click on “Go to your Node-RED flow editor”, that will open the Node-RED canvas



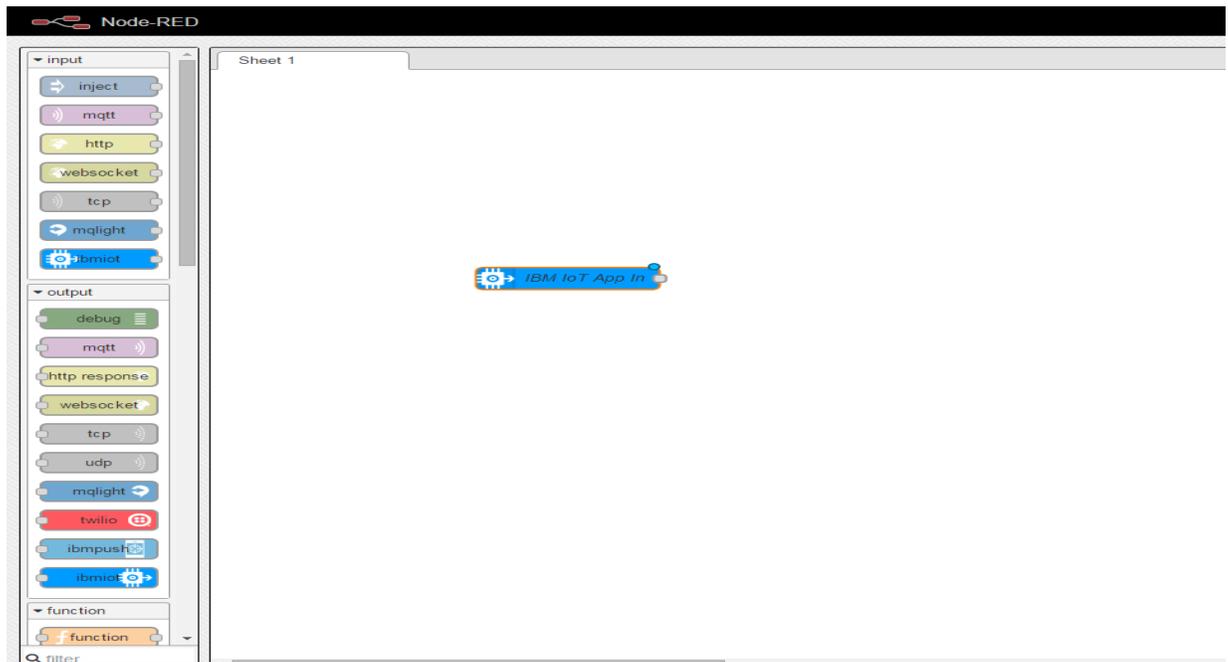
The screenshot shows the Node-RED web interface in a browser. The address bar displays `https://aditest.mybluemix.net/red/`. The interface includes a left sidebar with various nodes categorized into 'input' and 'output'. The main canvas shows a flow diagram with the following nodes: 'IBM IoT App' (input), 'device data' (output), 'temp' (function), 'temp thresh' (function), 'safe' (output), 'danger' (output), and 'cpu status' (output). The right sidebar contains 'info' and 'debug' panels.

➤ Step 3: Modifying the NODE-RED Flow

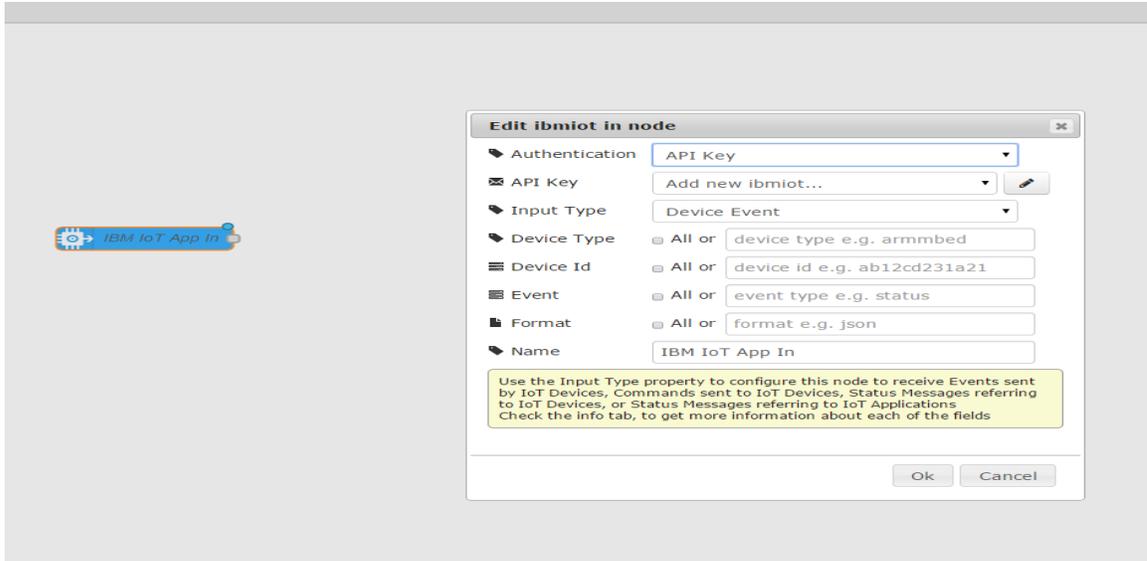
The Flow can be modified as per the application logic, the sample workflow used in the document uses an application which

- Distinguishes between the data coming from CoAP channel of ADRadionet channel.
- Sensors are currently identified by their corresponding MAC addresses.
- It dumps Sensor Node Ids, Channel info & Sensor values with current timestamp in the Node-RED output debug console
- Separate log for each sensor
- Sends out Tweets if the sensor value reaches a threshold
- Sends out Tweets periodically with Sensors ID, Value, Channel & Timestamp

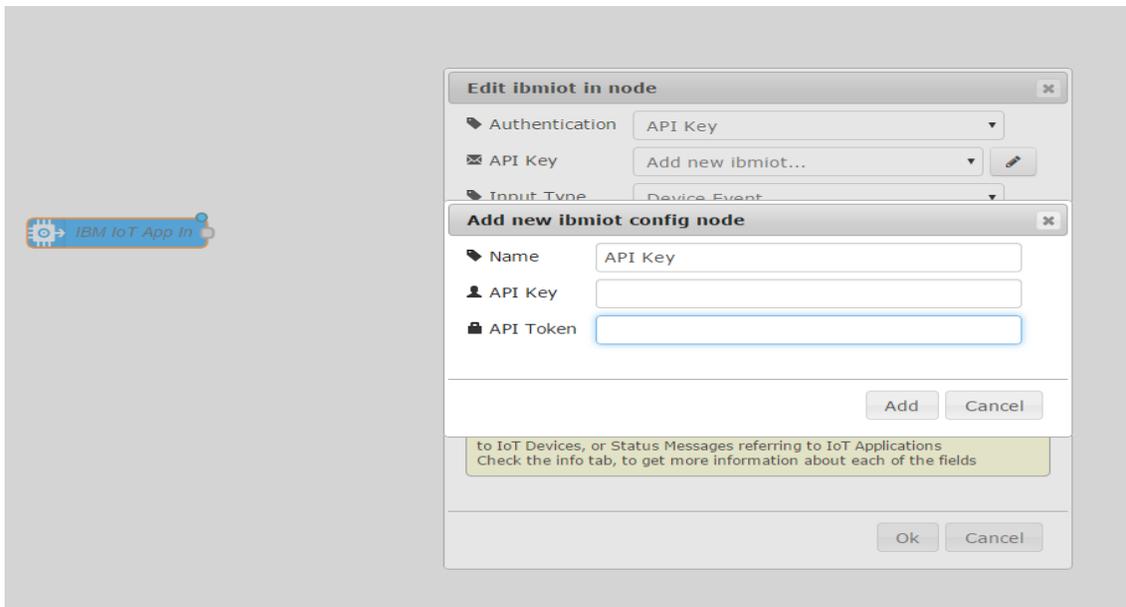
Navigate to <https://<host>.mybluemix.net> to open visual programming canvas of Node-RED application, select all nodes one by one and delete to make canvas empty. Select “ibmiot” from “input” and drag to the canvas. This is a MQTT client connecting to the IBM IOT Foundation Cloud platform, hence configure the credentials obtained in [section](#) to allow it connect to the specific instance.



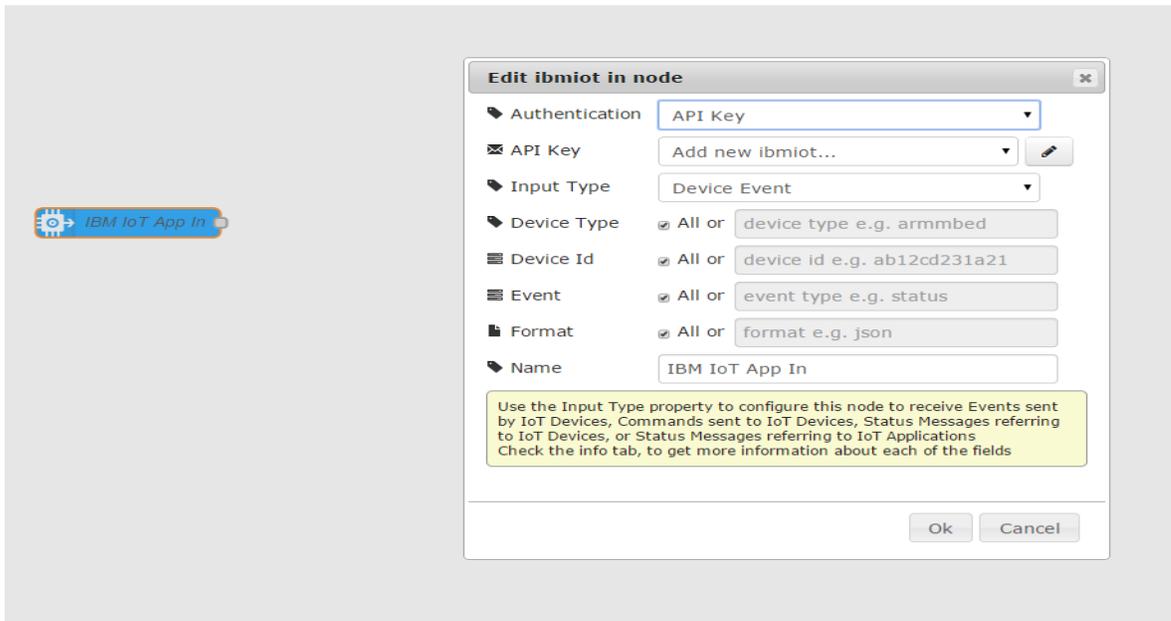
Double Click on the node, to open its properties page, select Authentication as “API Key”, under API Key select edit icon on the right to open “Add new ibmiot config node” dialog.



Enter the API Key & API Token obtained earlier as explained in [section](#) & click on Add



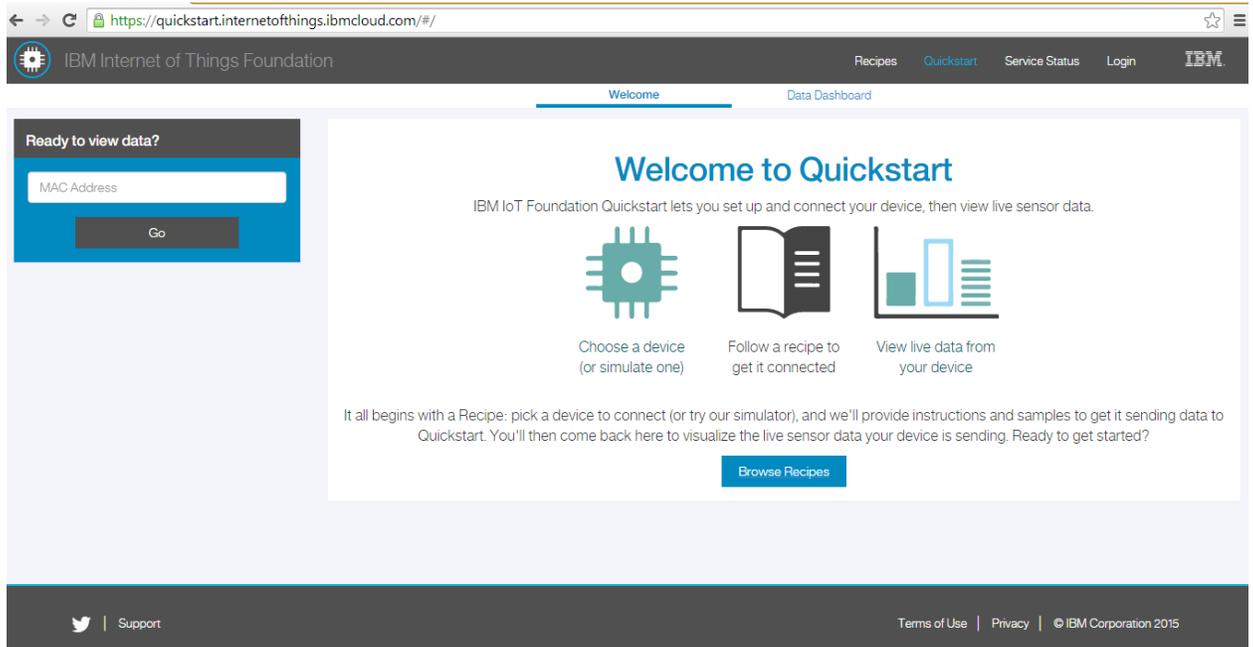
Select Input Type “Device Event”, check on all checkboxes & Click on Ok. This shall create a subscription for all the data coming to IBM IoT Foundation Cloud platform, hence any data received at IBM IOT Foundation Cloud platform shall also be received in this node. Further from this node, application logic can be created through visual programming. For more details on the visual programming kindly refer the Node-Red documentation [here](#).



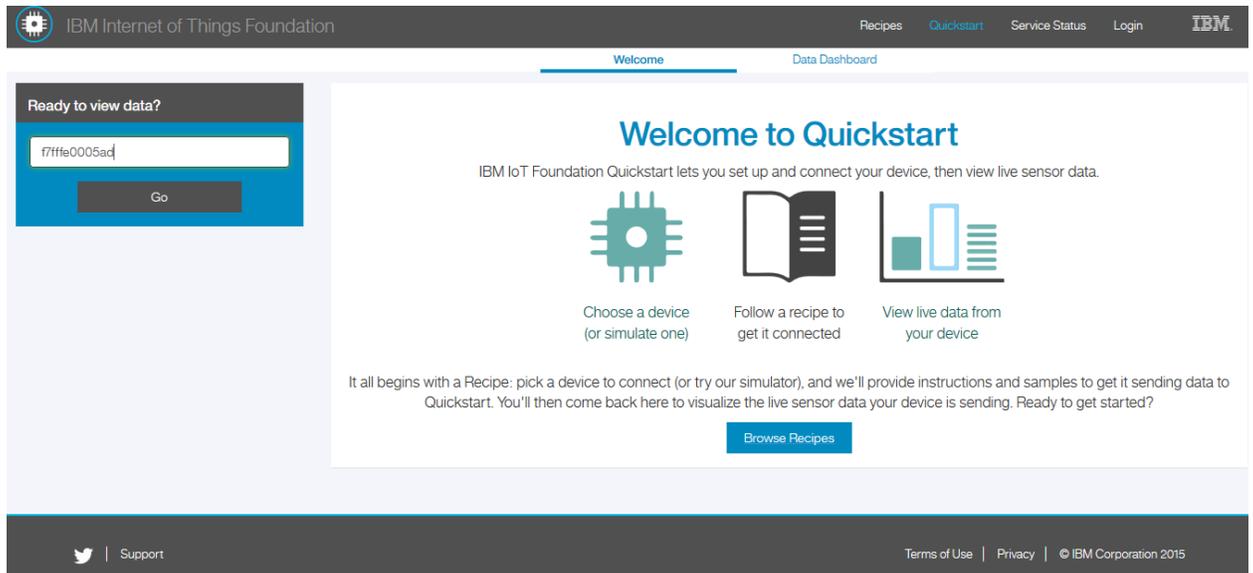
- NOTE: In the sample app, double clicking the node will also display the source code for the node logic.

Setup Quick Start – Visualization Application

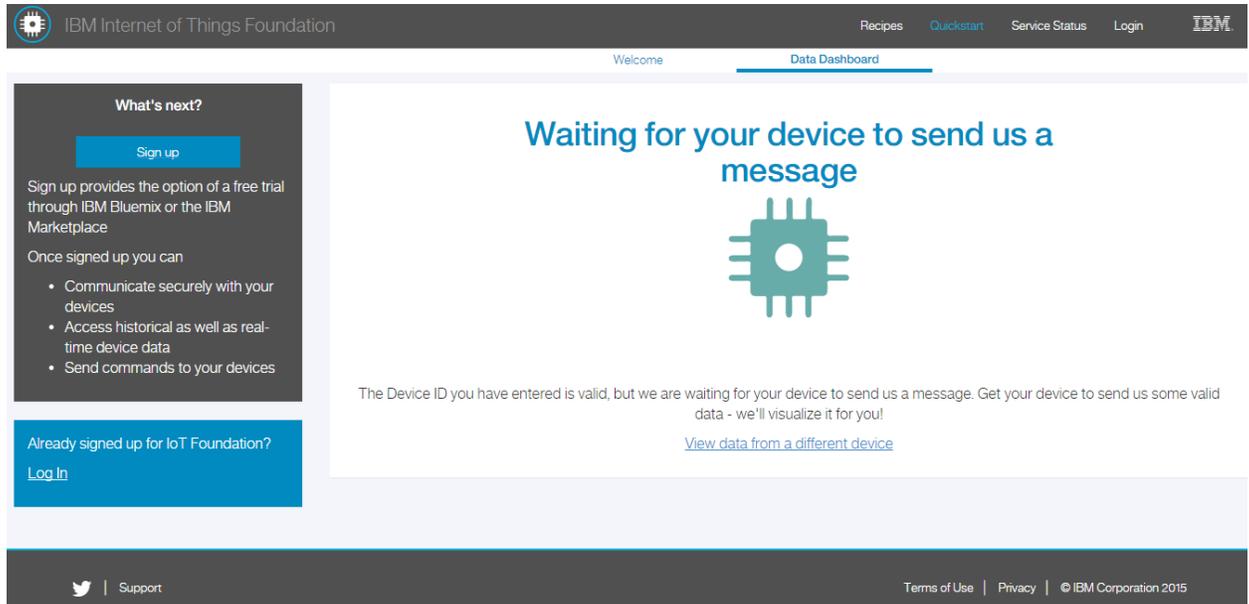
1. Run <https://quickstart.internetofthings.ibmcloud.com/#/> link on Google Chrome browser as shown below.



2. Enter MAC address of end point as shown below. Note that MAC address should be 12 characters. If MAC address is 16 characters, then remove first 4 characters. For example, if MAC address is AABBF7FFFE0005AD, then remove first four characters. MAC address will be F7FFFE0005AD.



- And then click on “go” button. It directs to data dashboard page as shown below.



AdRadionet↔MQTT Gateway Setup

- Login to the RPi using the following login credentials username: pi and password: raspberry.
- Type startx to the commandline to start the GUI
- Download the “AdRadionet_MQTT_Gateway.zip” file and unzip on raspberry pi.
- If sensor data to be updated on <https://quickstart.internetofthings.ibmcloud.com/#/> , then continue with [step 5](#). Ensure that section ‘[Setup Quick Start – Visualization Application](#)’ is done.
- If sensor data to be updated on <https://adi.mybluemix.net/red/#/> , then follow below steps. Ensure that section ‘[Creating IBM – NODE-RED Application Instance](#)’ is done.
 - Open “_config.cfg” file in a text editor present in ‘AdRadionet_MQTT_Gateway’ folder.
 - Replace “org”, “type”, “id”, “auth-token” with the credentials from Section ‘[IBM IoT Foundation Cloud Instance setup – Step 3](#)’ as shown below.

```

1 {
2   "params": {
3     "platformIp": "messaging.internetofthings.ibmcloud.com",
4     "platformPort": 8883,
5     "org": "w1xacn",
6     "type": "rf101",
7     "id": "4",
8     "username": "use-token-auth",
9     "auth_token": "DBpBtjEWC4x7z34x(m"
10  }
11 }

```

- Login to Raspberry Pi using login credentials username: pi and password: raspberry.
 - For quick start setup, continue with [step 7](#) and skip [step 8](#).
 - For Node Red setup, skip [step 7](#) and continue with [step 8](#).

- Execute following commands for Quick Start setup.

```
$ cd /home/pi/AdRadionet_MQTT_Gateway
```

```
$ sudo bash ./install.sh
```

Choose **1** for **Quick Start** as shown in below image.

```
Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
```

```
Last login: Thu Mar 12 09:33:36 2015 from 172.16.0.148
```

```
pi@raspberrypi ~ $ cd /home/pi/AdRadionet_MQTT_Gateway/
```

```
pi@raspberrypi ~/AdRadionet_MQTT_Gateway $ sudo bash ./install.sh
```

```
node is installed already...
```

```
Udev rule file is already exists...
```

```
1. Update Sensor data on Quick-Start
```

```
2. Update Sensor data on Node-Red
```

```
exit: To exit script
```

```
Pick from above options...
```

```
1
```

```
Quick Start
```

```
starting to copy daemons...
```

```
No Bluemix Gateway process to be deleted
```

```
update-rc.d: using dependency based boot sequencing
```

```
insserv: warning: script 'bluemix_log.sh' missing LSB tags and overrides
```

```
insserv: warning: script 'bluemix.sh' missing LSB tags and overrides
```

```
Updating Daemons...
```

```
update-rc.d: using dependency based boot sequencing
```

```
insserv: warning: script 'bluemix_log.sh' missing LSB tags and overrides
```

```
insserv: warning: script 'bluemix.sh' missing LSB tags and overrides
```

```
Installation Completed.
```

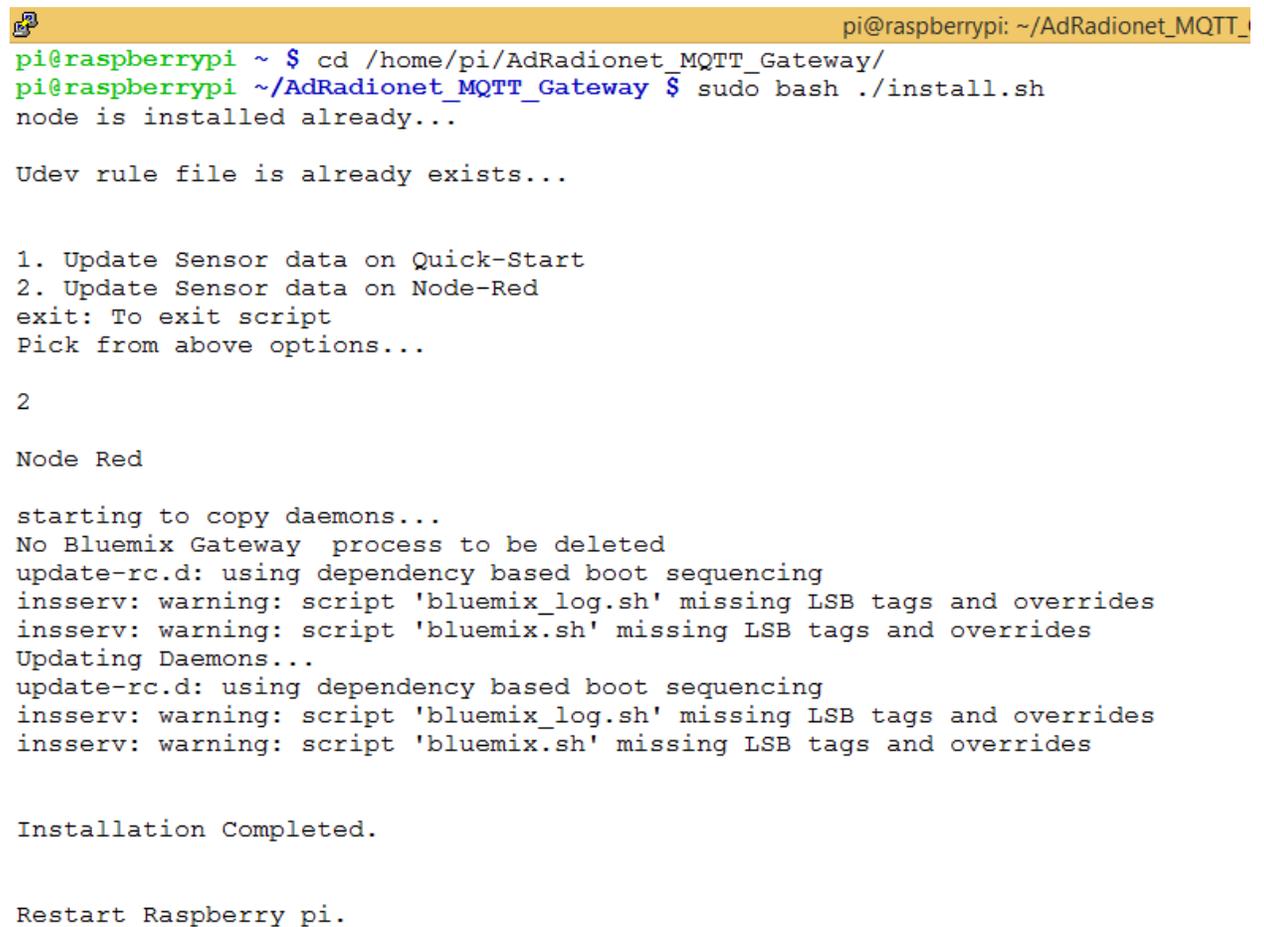
```
Restart Raspberry pi.
```

- Execute following commands for Node Red setup.

```
$ cd /home/pi/AdRadionet_MQTT_Gateway
```

```
$ sudo bash ./install.sh
```

Choose **2** for **Node Red** as shown in below image.



```
pi@raspberrypi: ~/AdRadionet_MQTT_Gateway
pi@raspberrypi ~ $ cd /home/pi/AdRadionet_MQTT_Gateway/
pi@raspberrypi ~/AdRadionet_MQTT_Gateway $ sudo bash ./install.sh
node is installed already...

Udev rule file is already exists...

1. Update Sensor data on Quick-Start
2. Update Sensor data on Node-Red
exit: To exit script
Pick from above options...

2

Node Red

starting to copy daemons...
No Bluemix Gateway process to be deleted
update-rc.d: using dependency based boot sequencing
insserv: warning: script 'bluemix_log.sh' missing LSB tags and overrides
insserv: warning: script 'bluemix.sh' missing LSB tags and overrides
Updating Daemons...
update-rc.d: using dependency based boot sequencing
insserv: warning: script 'bluemix_log.sh' missing LSB tags and overrides
insserv: warning: script 'bluemix.sh' missing LSB tags and overrides

Installation Completed.

Restart Raspberry pi.
```

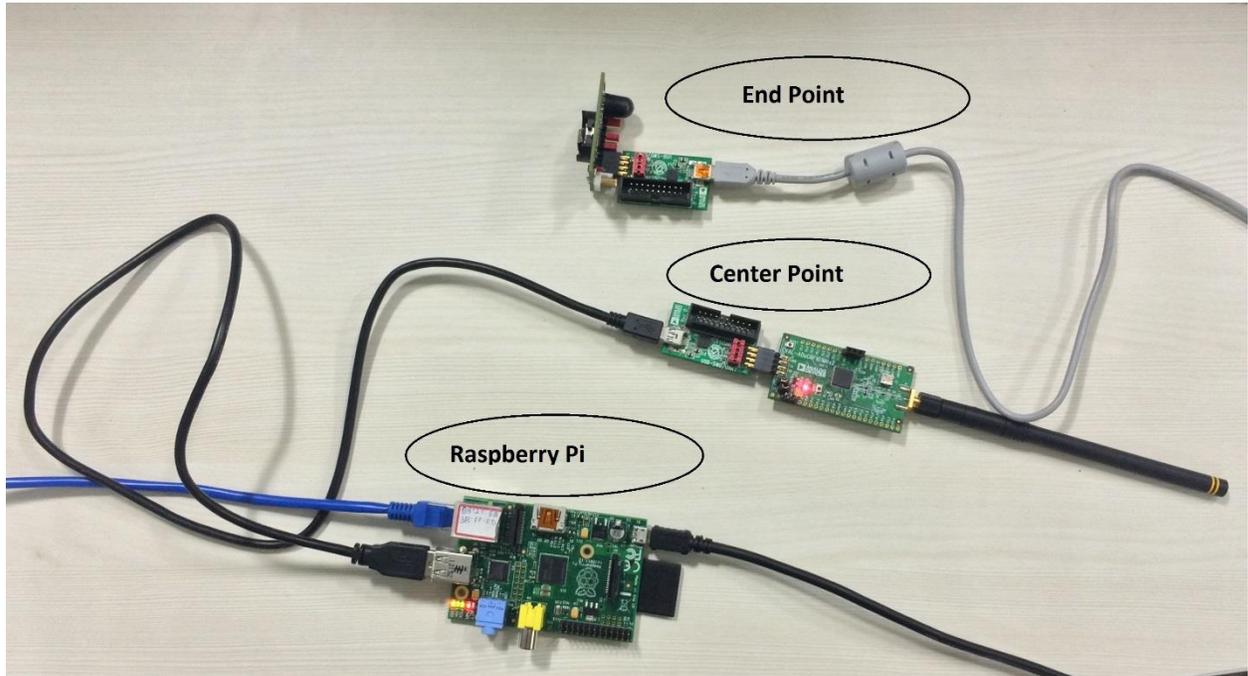
Demostration

➤ Setup of WSN Kit

- In order to use the BUNCH WSN board to send the data to the basestation, it will first need to be flashed with the appropriate binaries, found in the wsn Bluemix site on ADI Wiki (<http://wiki.analog.com/resources/eval/user-guides/wsn/iot>) as adrn01_binaries.zip.
- After downloading and unzipping the folder, you will see two .hex files. ADRN01_EP_Periodic_LPM.hex is for the WSN sensor node, and ADRN01_ROUTER.hex is for the base station node.
- You will first need to install the AD6LoWPAN01 development kit from the link below. <https://ez.analog.com/community/wireless-sensor-networks/ad6lowpan> and click AD6LoWPAN EDK download on the right of the webpage (green button). You will have to register for engineer zone prior to being able to download the file. Unzip, and install the program. Make sure you know where the installation directory is.

4. To flash the firmware, please read the [adradienet-to-bluemix-connectivity-quickstartuserguide_v1.0-.pdf](#) in <installed directory>/AD6LOWPAN01/.

5. Setup



6. Demonstration steps

1. Connect the ADRadienet End Point to a power source or batteries.
2. Connect the ADRadienet CenterPoint to the RPi.
3. Make sure the RPi is connected to the Ethernet network that connects to the internet. RPi is configured for DHCP.
4. Power ON the RPi.
5. Run one of following link on Google Chrome browser from internet connected PC.
 - For Node Red, enter <https://adi.mybluemix.net/red/#> link. Sensor data will be visible on this page as shown in the [image](#).
 - For Quick Start, enter <https://quickstart.internetofthings.ibmcloud.com/#/> link. Graphical representation of sensor data will be visible on this page as shown in the [image](#).

7. Demonstration Outputs

1. Output observed on <https://adi.mybluemix.net/red/#> as shown below.

The screenshot shows the Node-RED interface for a project named "ANALOG DEVICES-RF". The flow starts with an inject node that splits into two paths: one through a RadioNet node and another through a CoAP node. Both paths lead to five sensors (Sensor-1 to Sensor-5). Each sensor is connected to a corresponding log node (e.g., Sensor-1 Log). The log nodes are connected to a Periodic Trigger and an Alerter node. The debug console on the right shows log messages for each sensor, including the sensor node ID, value, protocol, and time.

```
GMT+0000 (UTC)
3/9/2015, 11:38:29 AM [Sensor-1 Log]
45-279pe+1d+ve+4+hts+
Sensor Node: f7fffe0005ad Value:
23.3125 Protocol: radionet Time:
Mon Mar 09 2015 06:08:32
GMT+0000 (UTC)
3/9/2015, 11:38:30 AM [Sensor-1 Log]
45-279pe+1d+ve+4+hts+
Sensor Node: f7fffe0005ad Value:
23.3125 Protocol: radionet Time:
Mon Mar 09 2015 06:08:33
GMT+0000 (UTC)
3/9/2015, 11:38:31 AM [Sensor-1 Log]
45-279pe+1d+ve+4+hts+
Sensor Node: f7fffe0005ad Value:
23.3125 Protocol: radionet Time:
Mon Mar 09 2015 06:08:34
GMT+0000 (UTC)
3/9/2015, 11:38:32 AM [Sensor-1 Log]
45-279pe+1d+ve+4+hts+
Sensor Node: f7fffe0005ad Value:
23.25 Protocol: radionet Time: Mon
Mar 09 2015 06:08:35 GMT+0000
(UTC)
3/9/2015, 11:38:33 AM [Sensor-1 Log]
45-279pe+1d+ve+4+hts+
Sensor Node: f7fffe0005ad Value:
23.25 Protocol: radionet Time: Mon
Mar 09 2015 06:08:35 GMT+0000
(UTC)
```

2. Output observed on <https://quickstart.internetofthings.ibmcloud.com/#/> as shown below.

The screenshot shows the IBM Internet of Things Foundation Data Dashboard. The dashboard displays a line graph for device f7fffe0005ad, labeled "Device Simulator, IoT Sensor". The graph shows temperature data over time, with values ranging from approximately 23.25 to 24.5. The dashboard also includes a "Viewing live data" section and a "What's next?" section with a "Sign up" button.

Viewing live data
f7.ff.fe.00:05.ad Change device
Device connected at 11:44:35 AM
You cannot register this device.

What's next?
Sign up
Sign up provides the option of a free trial through IBM Bluemix or the IBM Marketplace
Once signed up you can
• Communicate securely with your devices
• Access historical as well as real-time device data
• Send commands to your devices

Already signed up for IoT Foundation?
Log In

f7fffe0005ad
Device Simulator, IoT Sensor
Temperature

Time	Temperature
11:38:29 AM	23.3125
11:38:30 AM	23.3125
11:38:31 AM	23.3125
11:38:32 AM	23.25
11:38:33 AM	23.25
11:38:34 AM	23.25
11:38:35 AM	23.25
11:38:36 AM	23.25
11:38:37 AM	23.25
11:38:38 AM	23.25
11:38:39 AM	23.25
11:38:40 AM	23.25
11:38:41 AM	23.25
11:38:42 AM	23.25
11:38:43 AM	23.25
11:38:44 AM	23.25
11:38:45 AM	23.25
11:38:46 AM	23.25
11:38:47 AM	23.25
11:38:48 AM	23.25
11:38:49 AM	23.25
11:38:50 AM	23.25
11:38:51 AM	23.25
11:38:52 AM	23.25
11:38:53 AM	23.25
11:38:54 AM	23.25
11:38:55 AM	23.25
11:38:56 AM	23.25
11:38:57 AM	23.25
11:38:58 AM	23.25
11:38:59 AM	23.25
11:39:00 AM	23.25
11:39:01 AM	23.25
11:39:02 AM	23.25
11:39:03 AM	23.25
11:39:04 AM	23.25
11:39:05 AM	23.25
11:39:06 AM	23.25
11:39:07 AM	23.25
11:39:08 AM	23.25
11:39:09 AM	23.25
11:39:10 AM	23.25
11:39:11 AM	23.25
11:39:12 AM	23.25
11:39:13 AM	23.25
11:39:14 AM	23.25
11:39:15 AM	23.25
11:39:16 AM	23.25
11:39:17 AM	23.25
11:39:18 AM	23.25
11:39:19 AM	23.25
11:39:20 AM	23.25
11:39:21 AM	23.25
11:39:22 AM	23.25
11:39:23 AM	23.25
11:39:24 AM	23.25
11:39:25 AM	23.25
11:39:26 AM	23.25
11:39:27 AM	23.25
11:39:28 AM	23.25
11:39:29 AM	23.25
11:39:30 AM	23.25
11:39:31 AM	23.25
11:39:32 AM	23.25
11:39:33 AM	23.25
11:39:34 AM	23.25
11:39:35 AM	23.25
11:39:36 AM	23.25
11:39:37 AM	23.25
11:39:38 AM	23.25
11:39:39 AM	23.25
11:39:40 AM	23.25
11:39:41 AM	23.25
11:39:42 AM	23.25
11:39:43 AM	23.25
11:39:44 AM	23.25
11:39:45 AM	23.25
11:39:46 AM	23.25
11:39:47 AM	23.25
11:39:48 AM	23.25
11:39:49 AM	23.25
11:39:50 AM	23.25
11:39:51 AM	23.25
11:39:52 AM	23.25
11:39:53 AM	23.25
11:39:54 AM	23.25
11:39:55 AM	23.25
11:39:56 AM	23.25
11:39:57 AM	23.25
11:39:58 AM	23.25
11:39:59 AM	23.25
12:00:00 AM	23.25