AdRadionet to IBM Bluemix Connectivity
User Guide
Platform: EV-ADRN-WSN-1Z Evaluation Kit
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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.

ADRationet-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 could 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

- AdRadionet MQTT Gateway
  - http://wiki.analog.com/resources/eval/user-guides/wnsn/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 link for basic device setup instructions

- **Step 2: OS Setup**
  - Follow this link for operating system installation instructions
  - Raspbian OS can be downloaded from
  - 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](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”

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

- Step 4: Generate API Keys

Select “Access” -> “API Keys” on the main dashboard

Select “Access” -> “API Keys” on the main dashboard

- Members have non-expiring access to this dashboard.

- Organization ID: 9si0kw

- THERE ARE NO MEMBERS IN YOUR ORGANIZATION
- Your organization has only guest members at present. You may promote guests to full membership or add new members.

- Generate API Key

- Your API key information

  - API Key
  - Authentication Token

  Authentication tokens are non-reuseable. If you misplace this token, you will need to re-generate 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 uses.

  - Generate

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/](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
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.
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/#/](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 AABBF7FFE0005AD, then remove first four characters. MAC address will be F7FFE0005AD.
3. And then click on “go” button. It directs to data dashboard page as shown below.

AdRadionet ⇔ MQTT Gateway Setup

1. Login to the RPi using the following login credentials username: pi and password: raspberry.
2. Type startx to the commandline to start the GUI
3. Download the “AdRadionet_MQTT_Gateway.zip” file and unzip on raspberry pi.
4. 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.
5. 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.

   ```
   {
   "params": {
   "platformIp": "messaging.internetofthings.ibmcloud.com",
   "platformPort": 8883,
   "org": "wixacn",
   "type": "rf101",
   "id": "a",
   "username": "use-token-auth",
   "auth_token": "DBpBtjEWC4x7z34X4(m"
   }
   }
   ```

   - For quick start setup, continue with step 7 and skip step 8.
   - For Node Red setup, skip step 7 and continue with step 8.
7. 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.
8. 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.

   ![Node Red setup command output]

   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
   inserv: warning: script 'bluemix_log.sh' missing LSB tags and overrides
   inserv: warning: script 'bluemix.sh' missing LSB tags and overrides
   Updating Daemons...
   update-rc.d: using dependency based boot sequencing
   inserv: warning: script 'bluemix_log.sh' missing LSB tags and overrides
   inserv: warning: script 'bluemix.sh' missing LSB tags and overrides

   Installation Completed.

   Restart Raspberry pi.

**Demonstration**

- **Setup of WSN Kit**
  1. 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/wn/iot](http://wiki.analog.com/resources/eval/user-guides/wn/iot)) as adrn01_binaries.zip.
  2. 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.
  3. You will first need to install the AD6LoWPAN01 development kit from the link below.
     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 adradionet-to-bluemix-connectivity-
quickstartuserguide_v1.0-.pdf in <installed directory>/AD6L0WPAN01/.

5. Setup

6. Demonstration steps
1. Connect the ADRadionet End Point to a power source or batteries.
2. Connect the ADRadionet 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/#](https://adi.mybluemix.net/red/#) as shown below.

![Image of Node-RED](image1.png)

2. Output observed on [https://quickstart.internetofthings.ibmcloud.com/#/](https://quickstart.internetofthings.ibmcloud.com/#/) as shown below.

![Image of IBM Internet of Things Foundation](image2.png)