Introduction to IoT: Build Your Own Basic IoT App

World of Watson Hands-On Workshop

Download this PDF and Node-RED flows at :
https://github.com/johnwalicki/WorldofWatson-IoT-Lab

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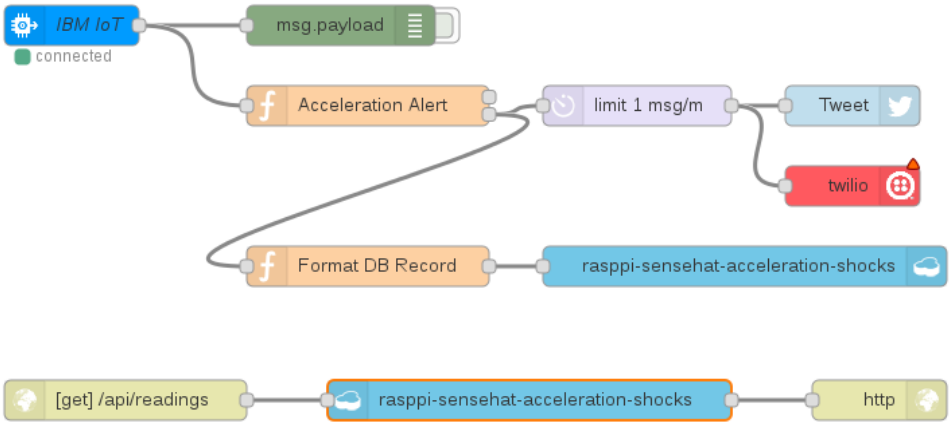
Topics covered: Raspberry Pi, Node-RED, Watson Internet of Things Platform, Cloudant NoSQL Database, Twitter, Twilio, and Weather Company Data for IBM Bluemix.

In this lab, we will unbox and set up a Raspberry Pi and Raspberry Pi SenseHat and connect to the IBM Bluemix and Watson IoT Platform. We will query the temperature via the SenseHat and send data to the Watson IoT platform. Watson IoT Platform will monitor the temperature and alert maintenance of a high temperature. Using Node-RED, running on the Raspberry Pi and in Bluemix, the application will read the temperature value from a SenseHat. If the temperature rises, a LED light is turned on. The temperature will be sent via Watson's Internet of Things Platform service to a Node-RED application hosted on IBM Bluemix. If the SenseHAT experiences excessive acceleration shocks, we'll send a tweet via Twitter. We will retrieve outside weather data and display it on a LED screen connected to the SenseHat. We'll store acceleration shocks in a Cloudant NoSQL database so we can track patterns. Finally, we'll create an HTTP endpoint that exposes the historical acceleration shocks that third-party applications could consume and perform analysis or other fun stuff.

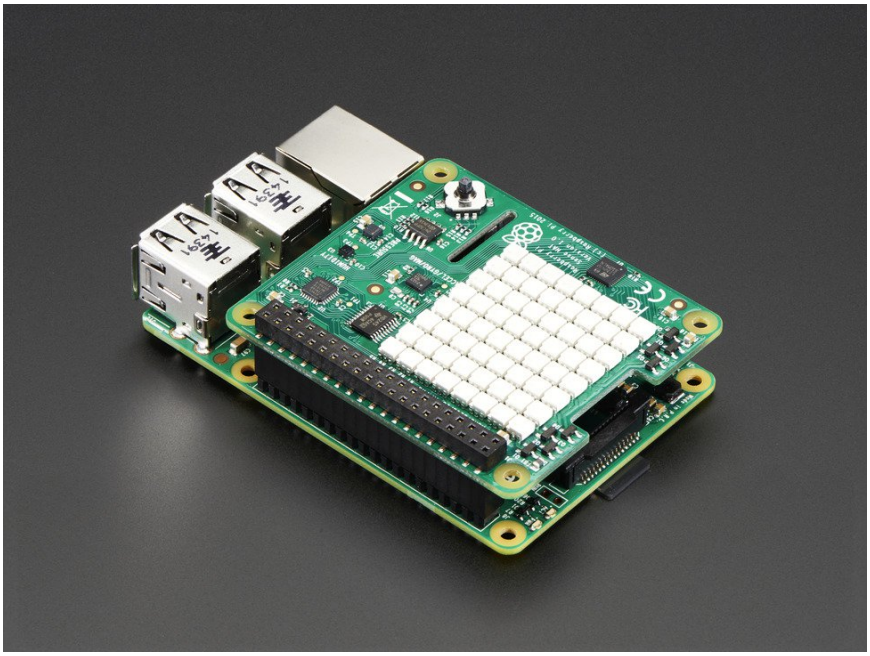


Lession 1 – Raspberry Pi Set Up

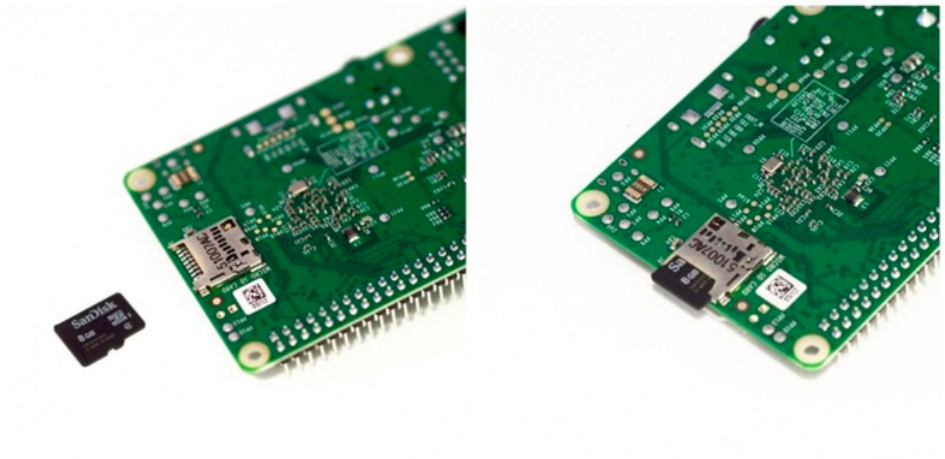
Step 1 - Unbox the Raspberry Pi and Raspberry Pi SenseHAT

Step 2 – Connect the Raspberry Pi SenseHAT to the Raspberry Pi

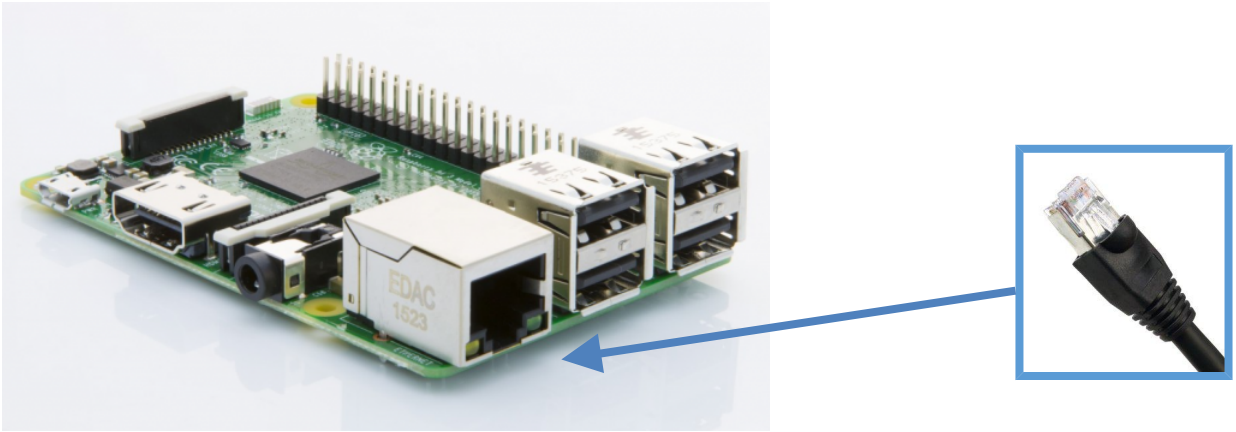
Connect your SenseHAT to the Raspbery Pi via the 40 GPIO Pins.



Step 3 – Insert the Raspbian Linux microSD card into the Raspberry Pi



Step 4 – Connect the Ethernet cable to the Raspberry



Step 5 - Power the Raspberry Pi via a microUSB Cable or 5v microUSB Power supply

Step 6 – Allow the Raspberry Pi to boot

The Raspberry Pi will display a red light if it is powered. After around 2 minutes, the IP addresses (Ethernet wired and WiFi) will scroll across the LED of the SenseHAT. The IP addresses will scroll for a few minutes and then turn off.
Write Down the IP address

Step 7 – Connect to the Raspberry Pi with a Terminal Client

In order to perform advanced configuration of the Raspberry Pi either a monitor and keyboard, or a Secure Shell (SSH) connection is required. On OSX and Linux there are default programs that can do this - Screen and SSH respectively. However on Windows no default exists, however PuTTY is light weight and easy to install and can be used to SSH into the Raspberry Pi.

For Windows Users:

- PuTTY is installed on the lab laptops
- or Visit the PuTTY download page.
- Under the "For Windows on Intel x86" heading, click on the "putty.exe" link to download the latest release version to your computer.

- Double-click putty.exe on your computer to launch PuTTY.
- Enter IP address of the Gateway
- You can login with the username **pi** and the password **raspberry**

For Mac and Linux Users:

- Open a Terminal
- Type $ *ssh pi@<<IP Address>>. Replace <<IP Address>> with the IP address of your gateway.*
- Enter ***raspberry*** as password

Step 8 – Open a Browser and enter http://<ip-address>:1880

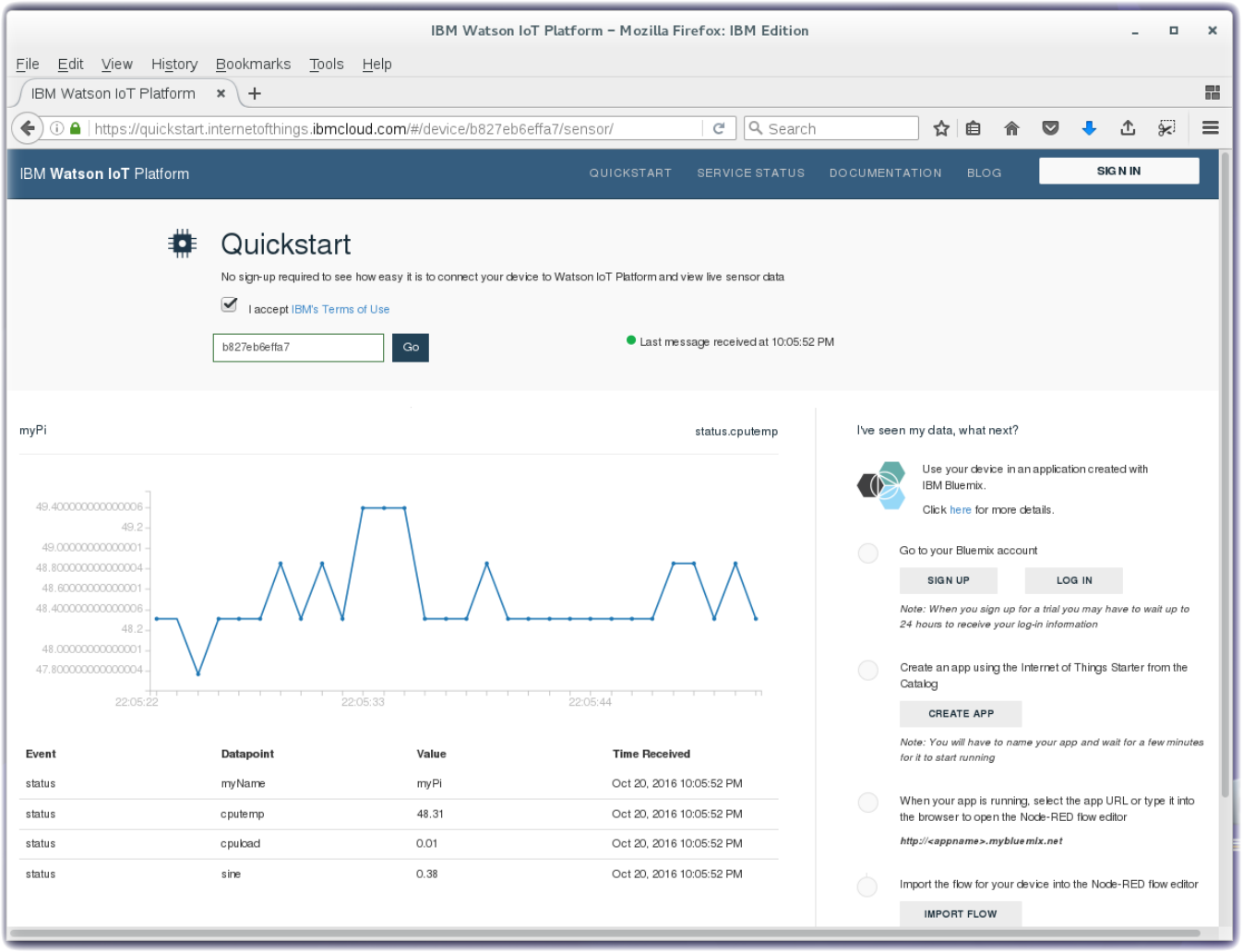
The Node-RED graphical programming tool will open in your browser.

Lesson 2 - Send data from the Raspberry Pi to Watson IoT

The Raspberry Pi Raspbian image provided in the World of Watson lab has a program installed and running that is automatically sending the CPU temperature of your Raspberry Pi to the IBM Watson IoT Platform QuickStart. In the terminal window, enter the **following two commands marked below in bold** and copy the device ID it reports.

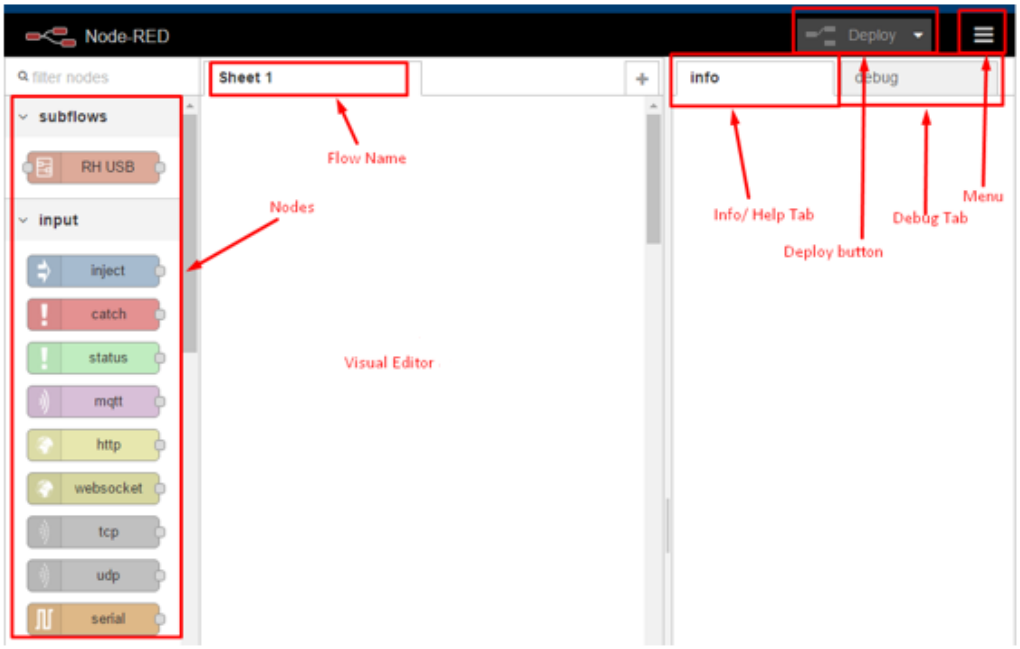
```
pi@raspberrypi:~ $ sudo service iot restart
pi@raspberrypi:~ $ service iot getdeviceid
 The device ID is b827eb6effa7
 For Real-time visualization of the data, visit
 http://quickstart.internetofthings.ibmcloud.com/?deviceId=b827eb6effa7
```

Open a browser tab to **http://quickstart.internetofthings.ibmcloud.com/?deviceId=<device id>**

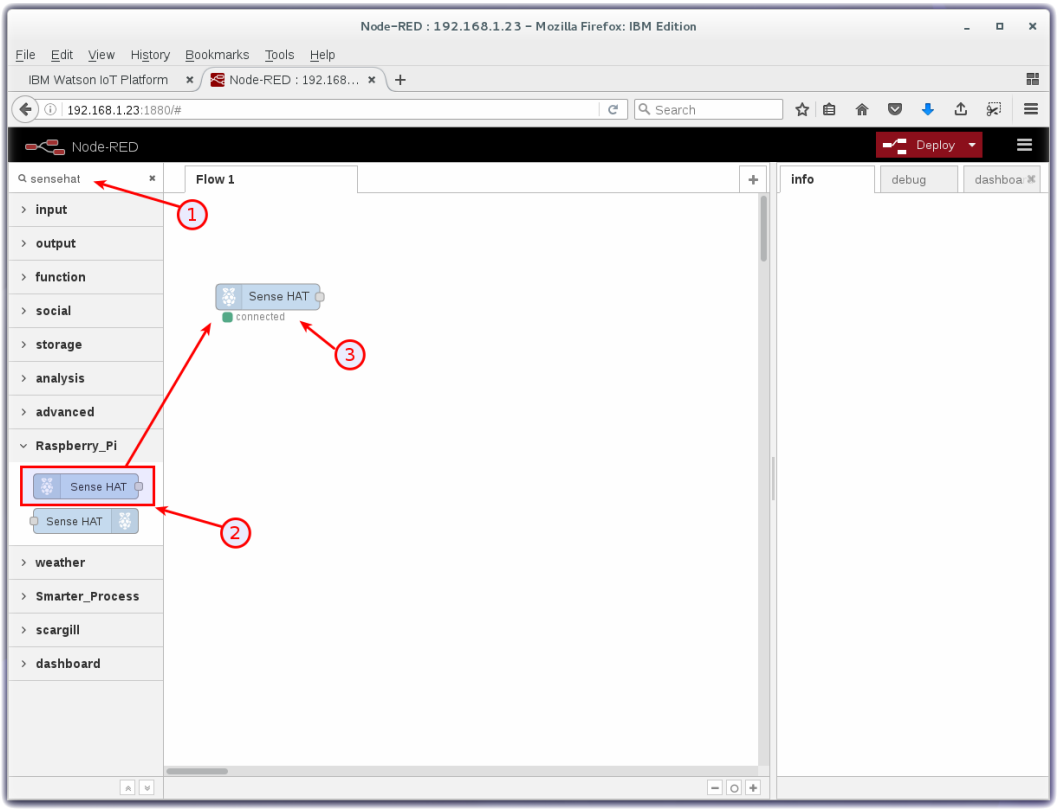


Sending SenseHAT data to IBM Watson IoT Platform Quickstart

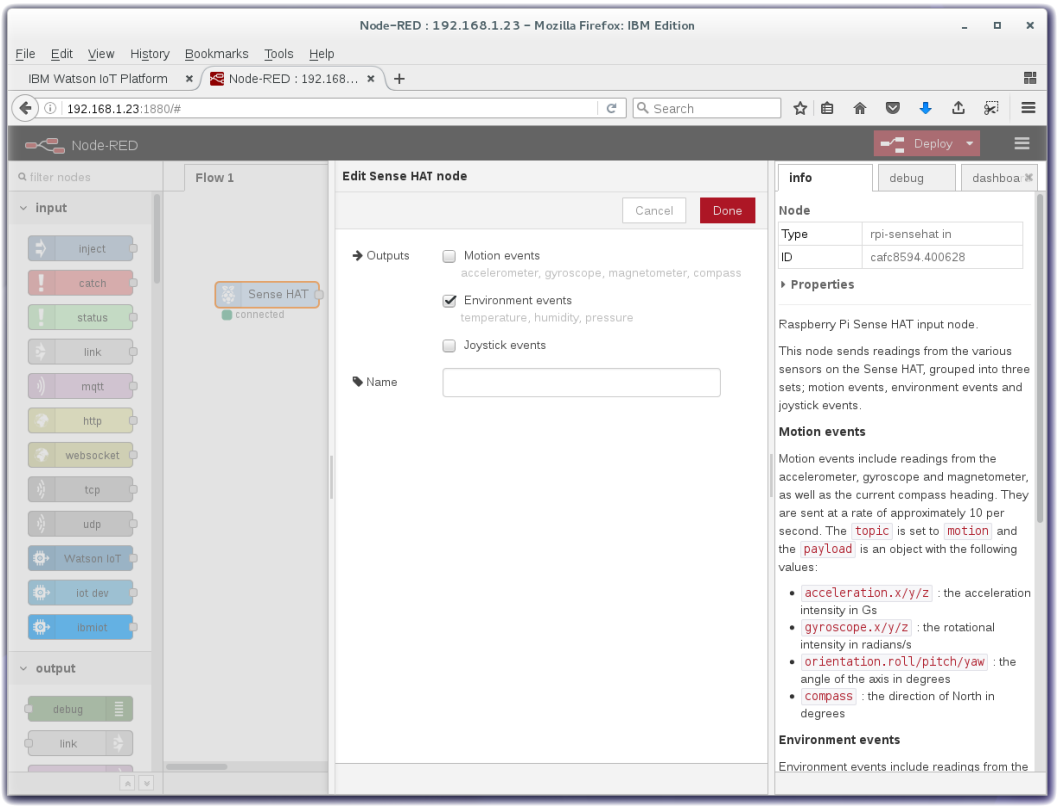
Now that we have sent the Raspberry Pi CPU temperature to Watson IoT, let's also send SenseHAT environmental sensor readings by using Node-RED. Create a new flow to program the rest of the exercises by clicking on the + button in the upper right corner of the Node-RED interface to open a Flow 1.



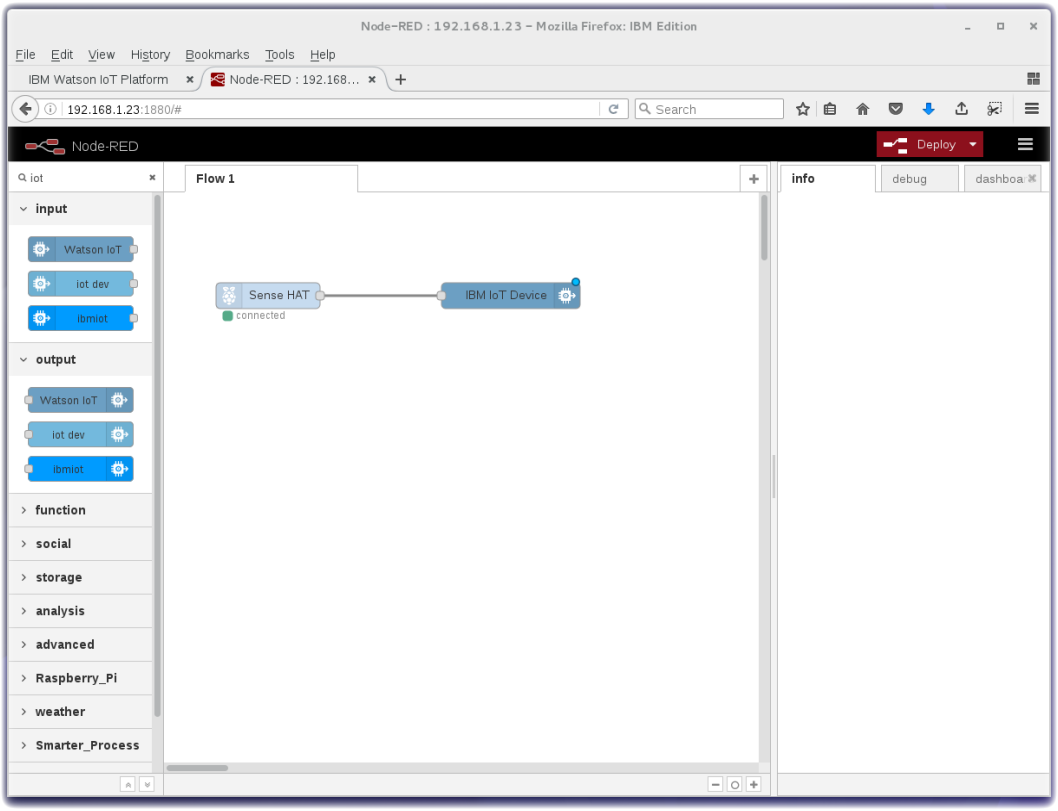
- Find a SenseHAT node by searching in the filter node box (1). Drag the SenseHAT node (2) from the palette onto the flow (3).



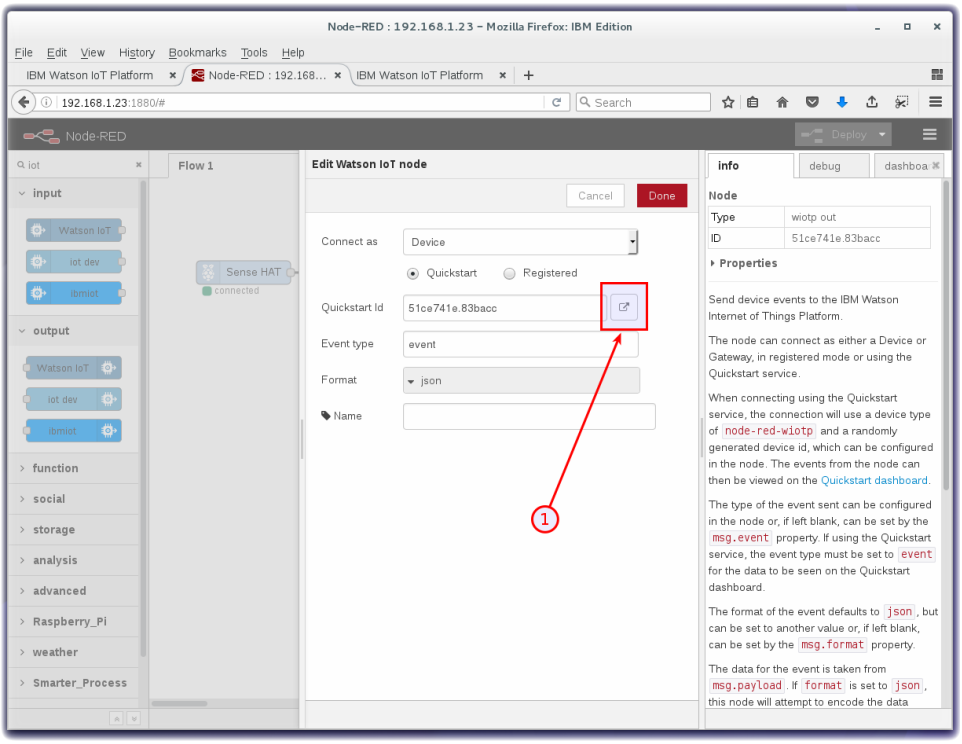
- Double click on the SenseHAT node on the Flow and select the “Environment events” checkbox and press the Done button.



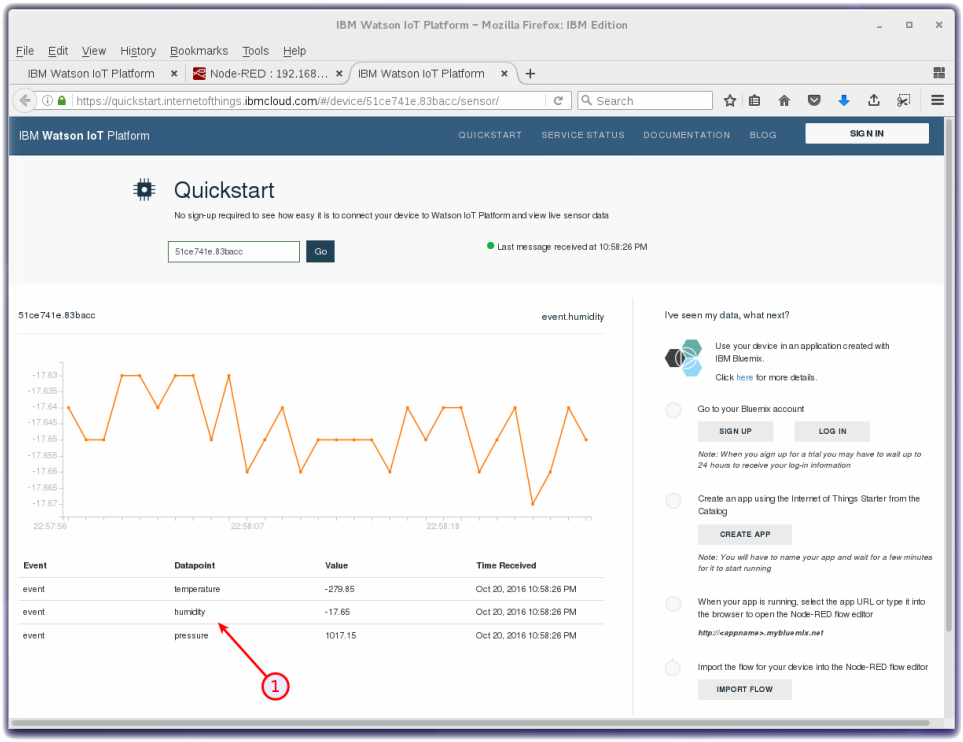
- Search for a Watson IoT output node on the palette and drag it onto the flow. Wire it to the SenseHAT node by dragging your mouse from one node point to the other. A wire will connect the two nodes.



- Click the Deploy  button on the top of menu bar to deploy the Node-RED flow.
- Doubleclick on the IBM IoT Device node and then click on the box (1) to the right of the Quickstart Id. A new browser tab will open. **Note the unique Quickstart Id**. This Id will be used in Lesson 4 and 5.

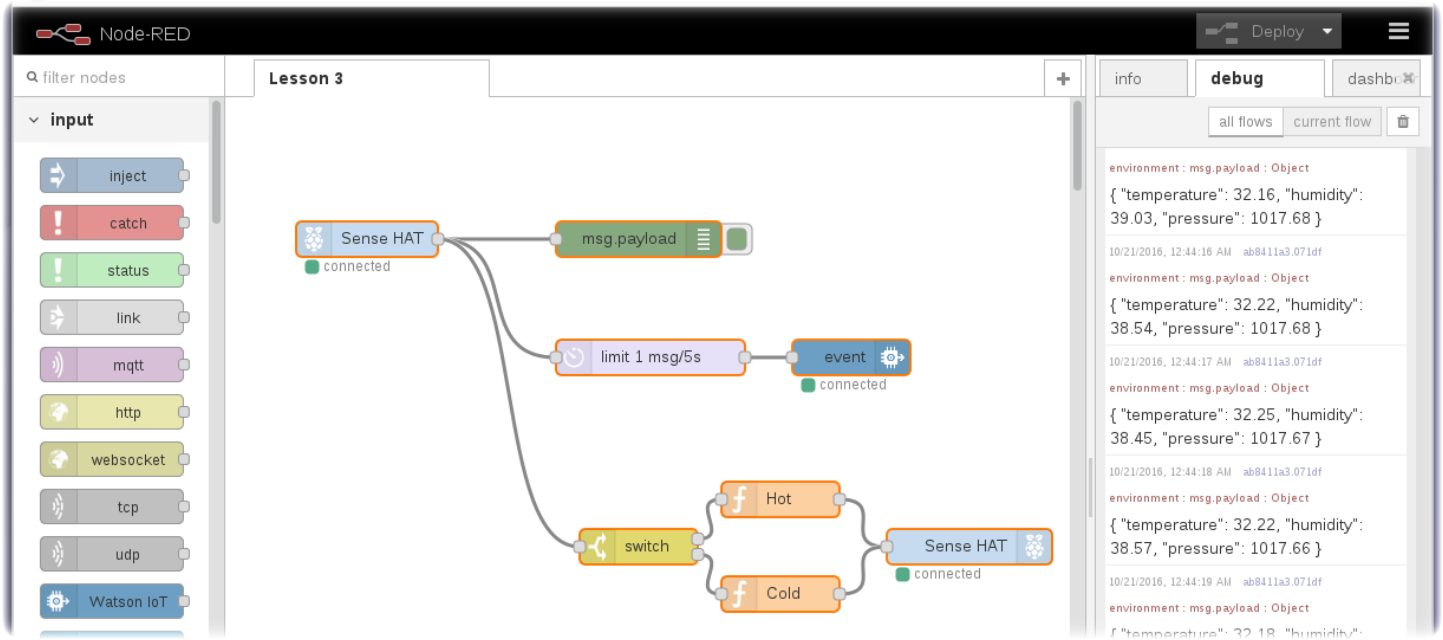


- Room temperature, humidity and air pressure sensor data from the SenseHAT is now being sent to the Watson IoT Platform and is being plotted in the Quickstart landing page. You can click (1) on any of the three datapoints to plot them.



Lesson 3 – Local Node-RED Temperature Alert

To practice with Node-RED visual programming, we might want to limit the amount of sensor data that is sent to Watson IoT Quickstart to 1 msg / 5 secs. It is also interesting to watch the SenseHAT environmental data by reporting it to a debug node before it is sent to Quickstart. Depending on the temperature, display if the room is hot or cold by changing the SenseHAT LEDs to red / green.



The text below is a Note-RED representation of the above graphical flow. You can copy it to the clipboard and paste it in your Node-RED browser tab. From the **Node-RED menu, select Import → Clipboard, paste the nodes and press the red Import button**. Finally press the Deploy button.

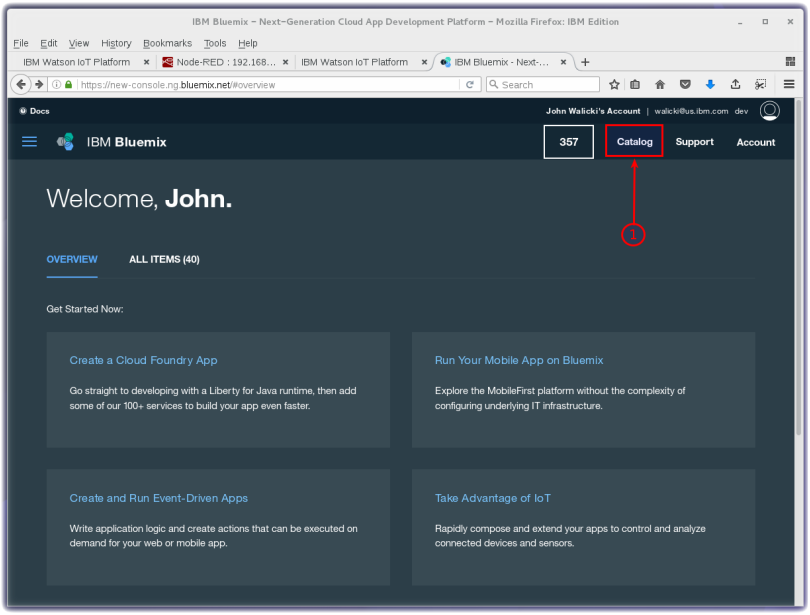
```
[{"id":"cafc8594.400628","type":"rpi-sensehat
in","z":"9e7e27aa.f908a","name":"","motion":false,"env":true,"stick":false,"x":120,"y":120,"wires":
[["ab8411a3.071df","9eeedaa.700b1a8","a8888a05.b142e"]]},{"id":"sampleDeviceID","type":"wiotp
out","z":"9e7e27aa.f908a","authType":"d","qs":"true","qsDeviceId":"sampleDeviceID","deviceKey":"","deviceType":"","deviceId":"","ev
ent":"event","format":"json","name":"","x":530,"y":220,"wires":[]},
{"id":"ab8411a3.071df","type":"debug","z":"9e7e27aa.f908a","name":"","active":true,"console":"false","complete":"false","x":350,"y":12
0,"wires":[]},
{"id":"9eeedaa.700b1a8","type":"delay","z":"9e7e27aa.f908a","name":"","pauseType":"rate","timeout":"5","timeoutUnits":"seconds","rat
e":"1","nbRateUnits":"5","rateUnits":"second","randomFirst":"1","randomLast":"5","randomUnits":"seconds","drop":true,"x":360,"y":22
0,"wires":[["51ce741e.83bacc"]]},
{"id":"a8888a05.b142e","type":"switch","z":"9e7e27aa.f908a","name":"","property":"payload.temperature","propertyType":"msg","rules"
:[{"t":"gte","v":"32","vt":"str"},{"t":"lt","v":"32","vt":"str"}],"checkall":"true","outputs":2,"x":350,"y":380,"wires":[["6860c85c.1c05f"],
["11a8bcf5.683c4b"]]},{"id":"6c9a9bfc.7b5ce4","type":"rpi-sensehat out","z":"9e7e27aa.f908a","name":"","x":630,"y":380,"wires":[]},
{"id":"6860c85c.1c05f","type":"function","z":"9e7e27aa.f908a","name":"Hot","func":"msg.payload = \"*,*,red\";\nreturn
msg;","outputs":1,"noerr":0,"x":470,"y":340,"wires":[["6c9a9bfc.7b5ce4"]]},
{"id":"11a8bcf5.683c4b","type":"function","z":"9e7e27aa.f908a","name":"Cold","func":"msg.payload = \"*,*,green\";\nreturn
msg;","outputs":1,"noerr":0,"x":470,"y":420,"wires":[["6c9a9bfc.7b5ce4"]]}]
```

This flow is available at : https://github.com/johnwalicki/WorldofWatson-IoT-Lab

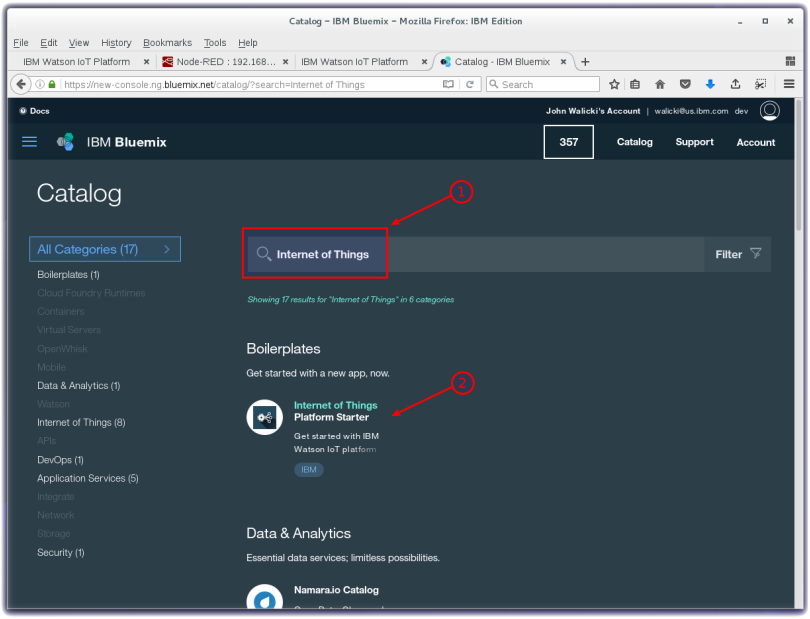
Lesson 4 - Send sensor data to a Bluemix Application

Quickstart is a fast way to send and see sensor data on the Watson IoT Platform. The next step is to create a Bluemix Watson IoT application that receives the Raspberry Pi sensor data via the Quickstart service and takes actions on it.

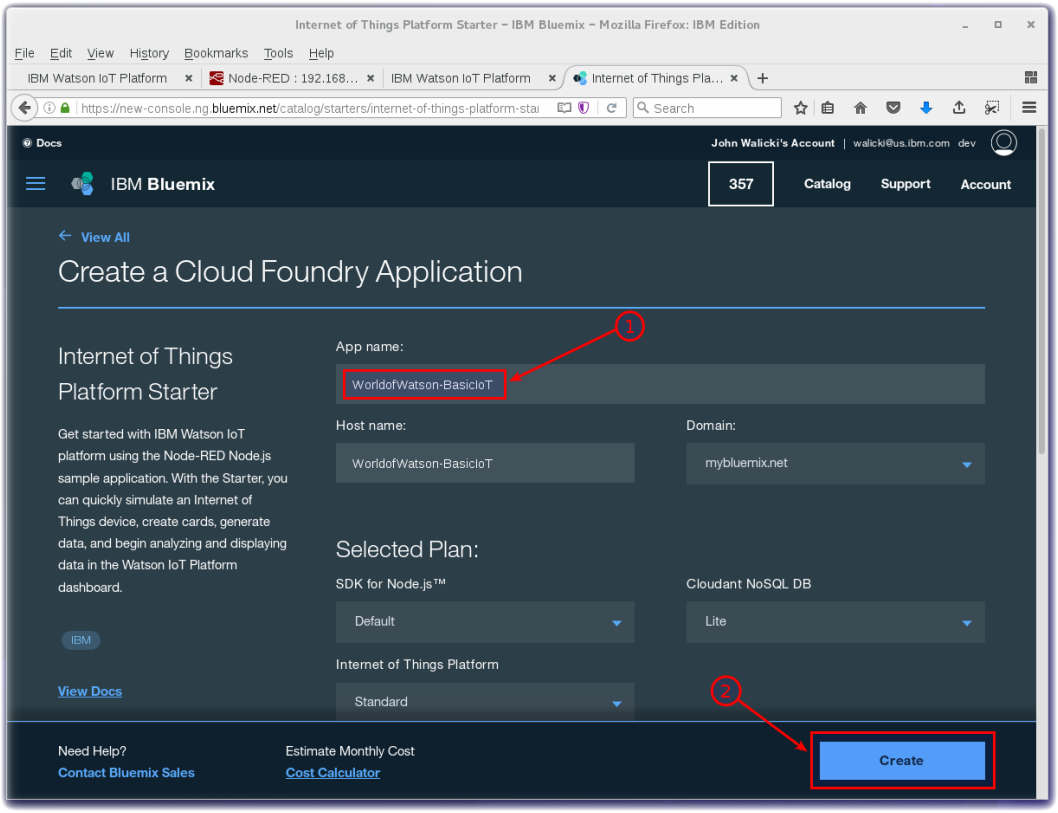
- If you do not yet have a Bluemix account, visit **http://bluemix.net/registration** and enter the requested information. Check your email to confirm the Bluemix account creation.
- See the lab instructor for a promocode to extend your 30 day free trial.
- Login into http://bluemix.net with your new account userid and password.
- Click on the word **Catalog** on the upper right side.



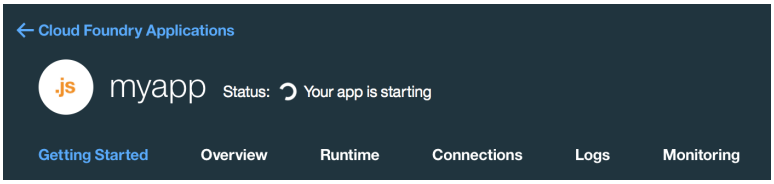
- Search for **Internet of Things Platform Starter** – The boilerplates are designed with pre-assembled services that work together. The Internet of Things Platform Starter includes a Node-RED Node.js web server, Cloudant database to store sensor data, and the IoT platform service so you can connect devices



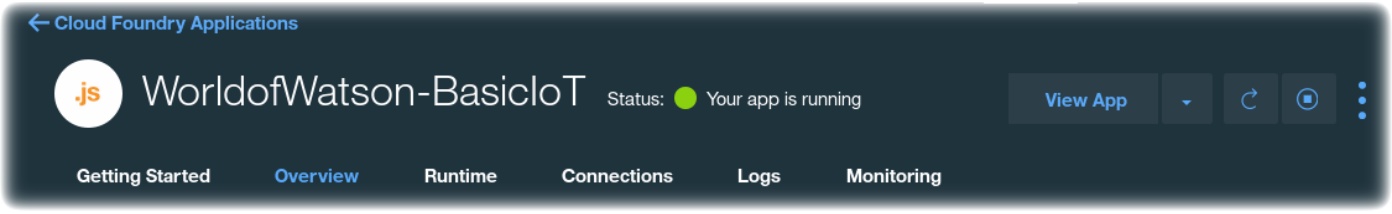
- Name your application something unique (1). If you choose ***myapp***, your application will be located at http://***myapp***.mybluemix.net There can only be one "***myapp***" application registered in IBM Bluemix. You can try adding your initials in front of the host if the host you choose is already taken by someone else. Click on **Create** (2) to create the application instance.



- IBM Bluemix will create an application in your account based on the services in the boilerplate. This is called staging an application. It can take a few minutes for this process to complete. While you wait, you can click on the **Logs** tab and see activity logs from the platform and Node.js runtime.

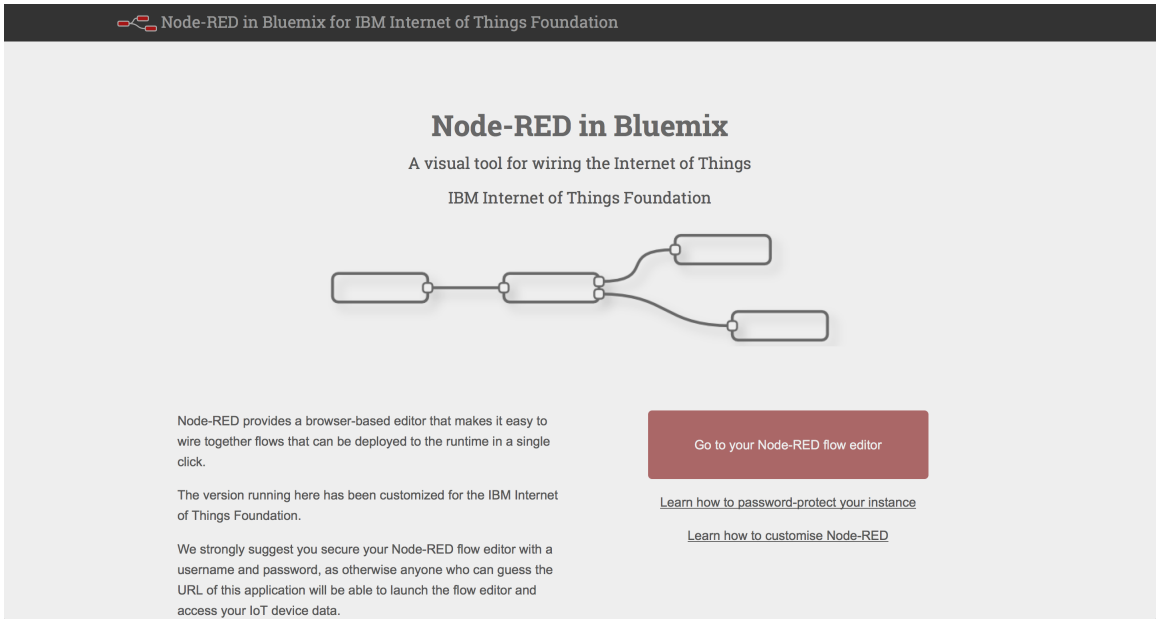


- You may need to press the **Cloud Foundry Applications** link and then re-enter your application.

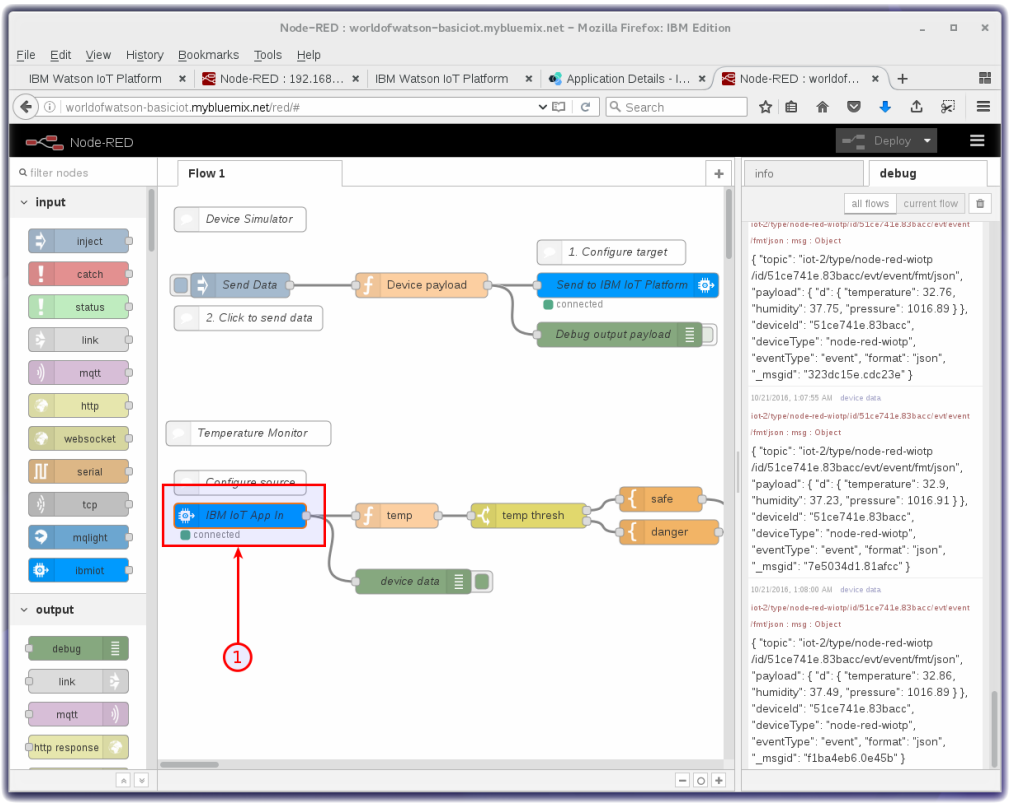


- Open your application by pressing the **View App** button.

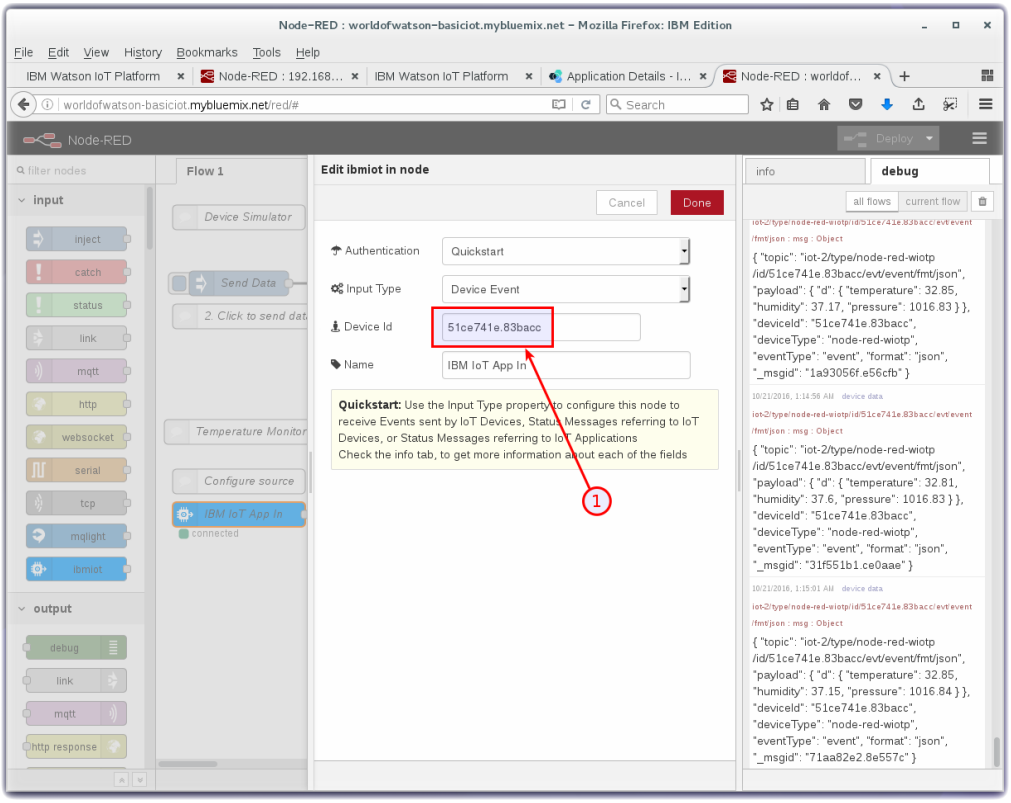
- A new browser tab will open to the Node-RED start page. Node-RED is an open-sourced Node.js application that provides a visual editor that makes it easy to wire together flows. Click on the red button **Go to your Node-RED flow editor** to launch the editor.



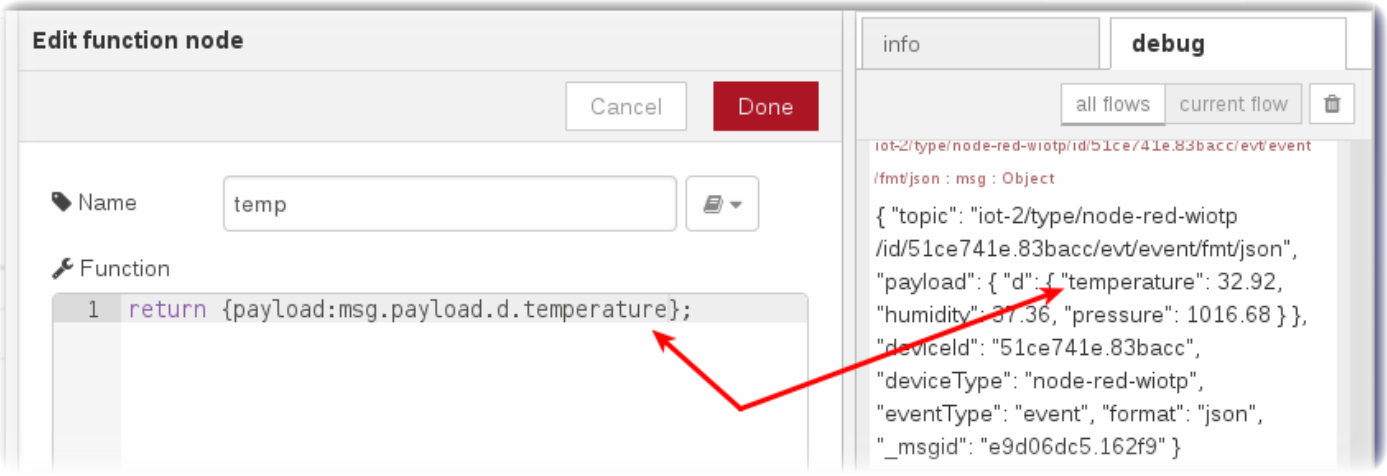
- The IoT Starter app has a default flow that can be modified. To receive the Raspberry Pi SenseHAT data from your **Quickstart ID** within our new Bluemix application, click on the IBM IoT App In node (1).

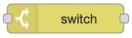


- Authentication by default is set to Quickstart. Provide the Device Id (1) from the local Node-RED Watson IoT node in Lesson 2. You can Copy and Paste the Device Id between browser tabs.



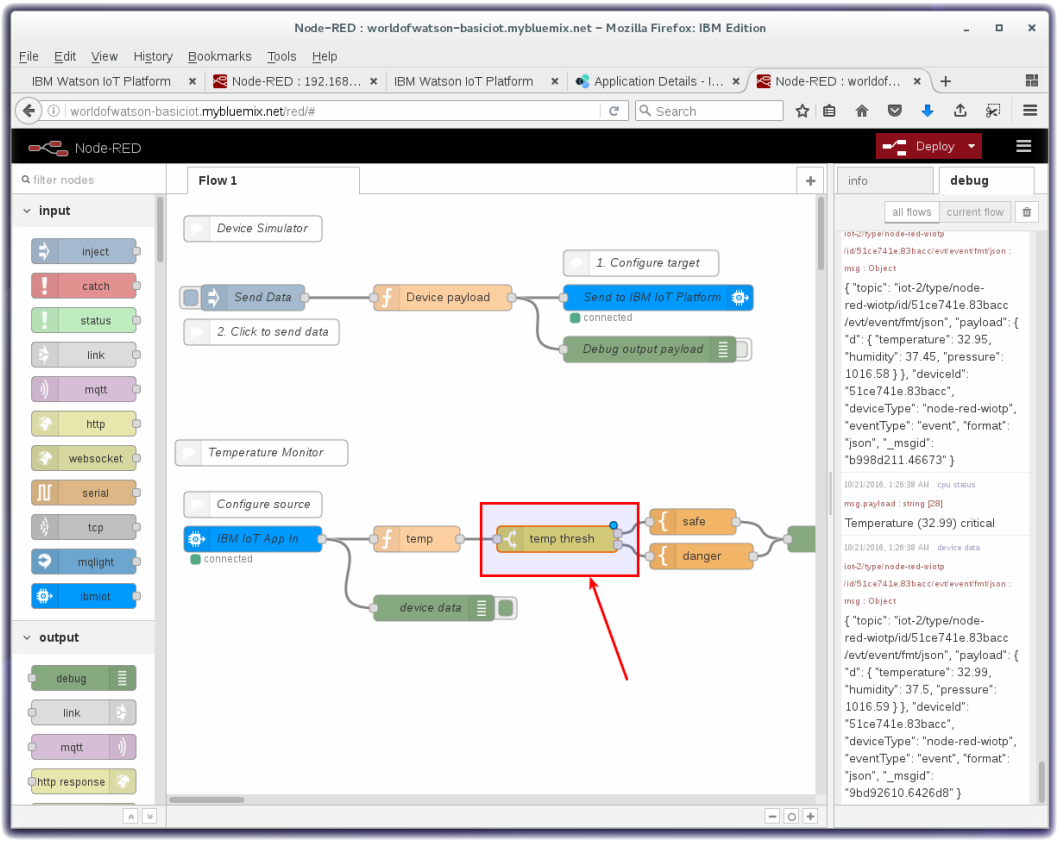
- Click on the "temp" Function node. Fix up the temp function so that it extracts the **msg.payload.d.temperature** value that is being sent from the Raspberry Pi SenseHAT.



- The yellow node is called a 

node. You can program logic using a switch node and split a flow into two or more flows based on a property's value. In this example, if the temperature is less than or equal to 30℃, it is considered "safe" and continues with the flow to the template labeled safe. If the temperature is greater than 30℃, it is considered "danger[ous]" and continues with the flow to the template labeled danger.

- Set the temp threshold calibrated to your SenseHAT by clicking on the temp thresh node.



- Click on the 

button in the top right of the screen to save and deploy your changes.

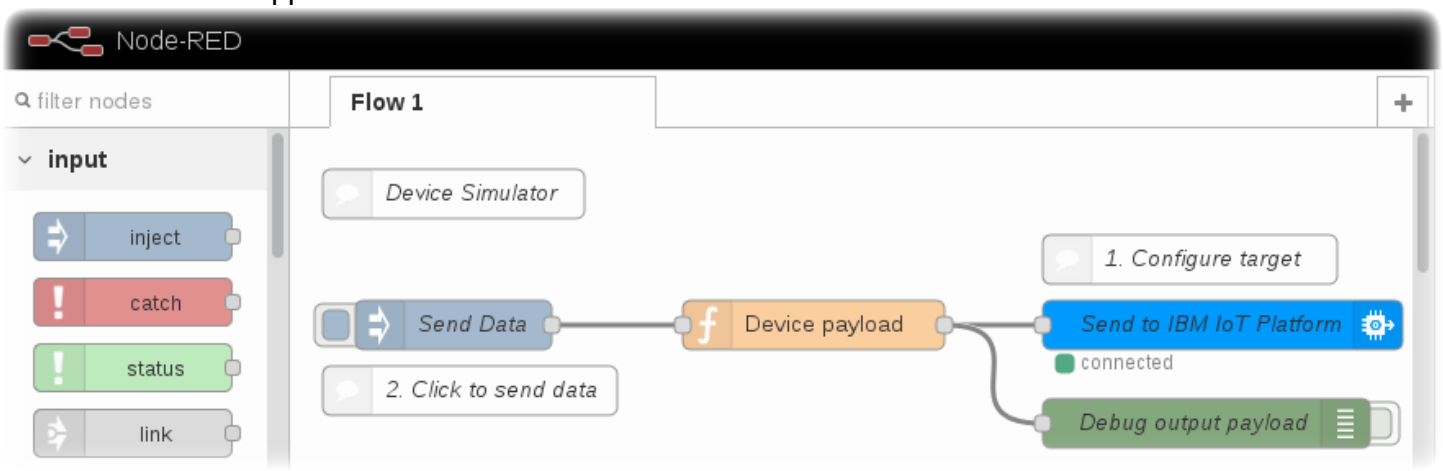
- Click on the debug tab in the right-hand pane. Every 5 second, the SenseHAT emits a device event to the Watson IoT platform with temperature and other data. The Node-RED application subscribes to these events and the IBM IoT In node triggers the flow with the temperature data in the message. When the debug nodes are processed, contents of the message object are in the debug tab. Adding debug nodes can be helpful when something doesn't work right and you want to see the values being passed around.The Quickstart sensor data should appear in the debug tab and the Temperature is reported as Critical or Safe within our Bluemix Watson IoT application.

Lesson 5 – Send command data from Bluemix Application

Until this point, the lessons have sent data from the Raspberry Pi to Watson IoT. Lesson 5 will send command data to the Raspberry Pi. Recall that in Lesson 3, the SenseHat LED red/green alert colors were set if the temperature exceeded a hard coded threshold value inside the switch statement. In this section, the threshold will be sent from the Bluemix application. You will be able to push the threshold temperature down to the Raspberry Pi and dynamically decide at what temperature you want the LED alert colors to change.

Warning: These modifications will require changes on both the Bluemix Node-RED and on the local Node-RED flows. Be careful as you make changes in the two browser tabs. It is easy to become disoriented by which flow you are editing.

1. Let's start the modifications on the Bluemix Watson IoT Application side. Recall that the default flow for a Watson IoT Starter Application looks like this:



Two changes are necessary:
A. Instead of sending simulated data that the default "Device payload" function generates, the function must be modified to set the threshold temperature at which you want to control the color of the SenseHat LED display. If you double click on the "Device payload" function, select all of the javascript code and delete it. Replace it with this javascript function. Pick your tempthresh.

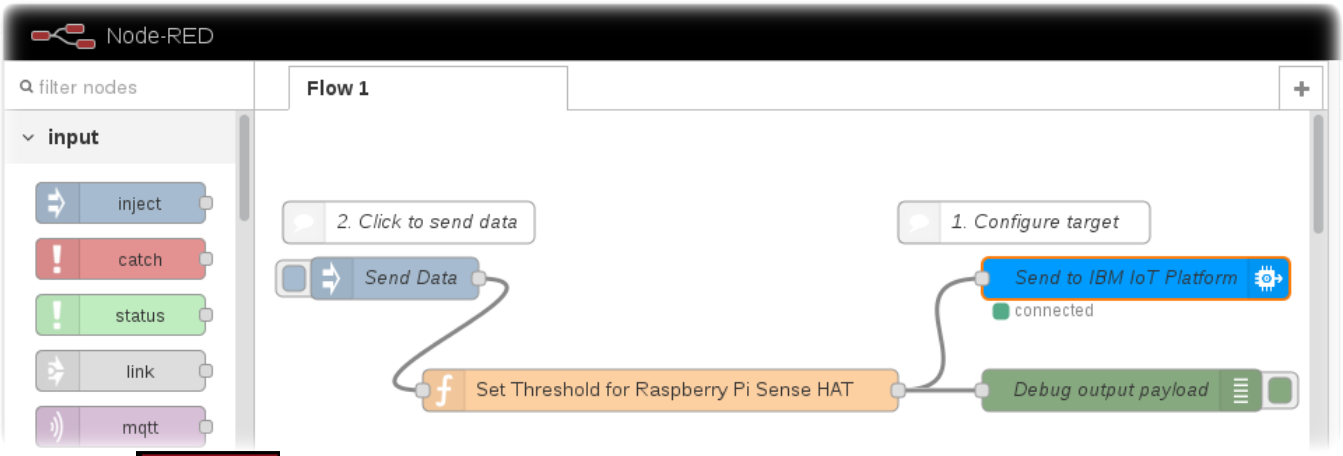
```
 // Set the temperature threshold that will trigger
// a colored alert on the SenseHat LED display.
var tempthresh = 35;

// Create MQTT message in JSON
msg = {
  payload: JSON.stringify(
    {
      d:{
        "tempthresh" : tempthresh
      }
    }
  )
};
return msg;
```

This flow is available at https://github.com/johnwalicki/WorldofWatson-IoT-Lab

B. The **Send to IBM IoT Platform** node needs to be configured to send the data to your Quickstart Id. Click on the Send to IBM IoT Platform node and paste in the **Quickstart Device Id** from Lesson 2 and Lesson 4.

The new flow might look like this:

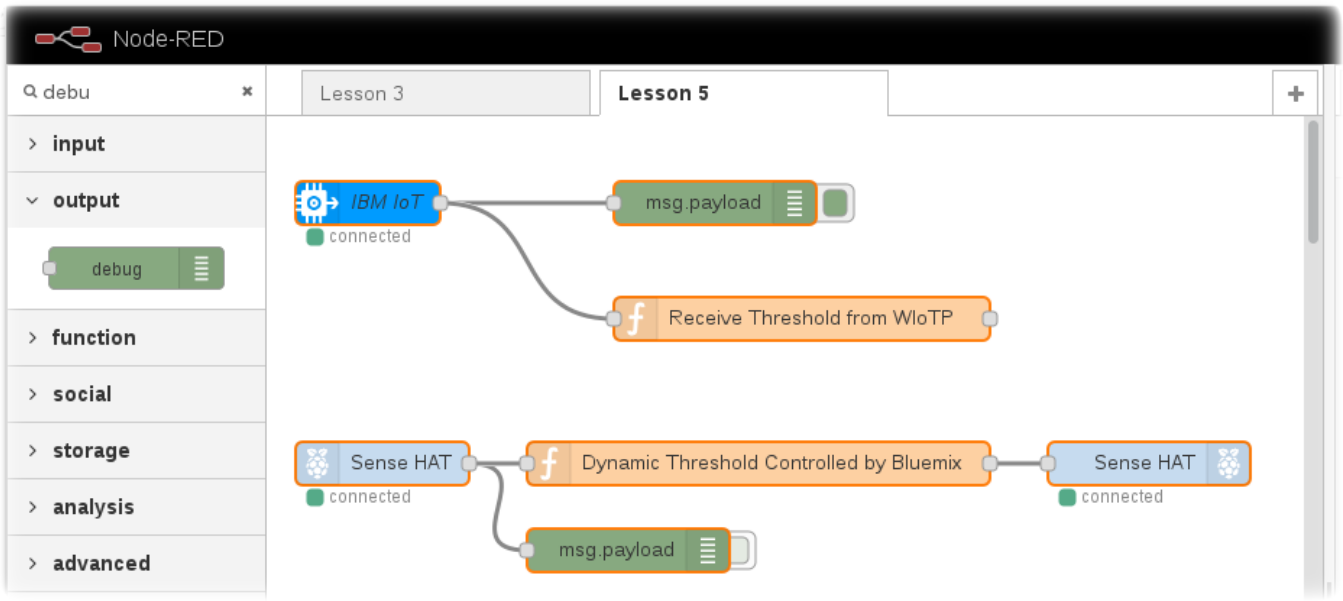


Remember to 

Deploy this flow.

2. On the local Node-RED browser tab, a new Lesson 5 flow will be added. It receives MQTT messages from Bluemix and saves the temperature threshold in a Node-RED context object. Any variables inside the node are lost every time the code is run (whenever the node gets a message input). In order to preserve the variables across iterations, the context object is used. There are also contexts for the entire flow and even across flows. Think of them as global variables. For more info see: http://nodered.org/docs/creating-nodes/context

The 2nd part of the Lesson 5 flow will look similar to Lesson 3 flow. It reads the environmental temperature from the SenseHAT but instead of a switch statement that decides whether to light the LED display in RED / GREEN, there is a function which compares the temperature to the global threshold variable received from Bluemix. Create a new flow (press the + sign) and Menu → Import → Clipboard paste the following page into Node-RED



If your LED display starts blinking RED / GREEN, it is possible you didn't disable part of the Lesson 3 flow. Turn to that flow and delete the output wire to the SenseHat node. Don't delete the entire flow however. You still want to send environmental sensor data to Watson IoT Platform.

Lesson 5 Local Node-RED flow :
This flow is available at https://github.com/johnwalicki/WorldofWatson-IoT-Lab


```
[{"id":"77c4e223.22c9cc","type":"ibmiot
in","z":"56e5b0e4.4f7e3","authentication":"quickstart","apiKey":"","inputType":"evt","devic
eId":"sampleDeviceID","applicationId":"","deviceType":"+","eventType":"+","commandTyp
e":"","format":"json","name":"IBM
IoT","service":"quickstart","allDevices":"","allApplications":"","allDeviceTypes":true,"allEv
ents":true,"allCommands":"","allFormats":"","qos":0,"x":70,"y":60,"wires":
[["84207463.6d2f7","e333bf4e.c5cb28"]]},
{"id":"84207463.6d2f7","type":"debug","z":"56e5b0e4.4f7e3","name":"","active":true,"cons
ole":"false","complete":"false","x":310,"y":60,"wires":[]},
{"id":"7acef8e.e779a88","type":"rpi-sensehat
in","z":"56e5b0e4.4f7e3","name":"","motion":false,"env":true,"stick":false,"x":80,"y":240,"
wires":[["6cacb1f7.6fea78","faba8af6.7b1668"]]},{"id":"88303e7c.0db3f8","type":"rpi-
sensehat out","z":"56e5b0e4.4f7e3","name":"","x":610,"y":240,"wires":[]},
{"id":"faba8af6.7b1668","type":"function","z":"56e5b0e4.4f7e3","name":"Dynamic
Threshold Controlled by Bluemix","func":"threshold = 0;\nthreshold =
global.get('threshold');\n\nif ( msg.payload.temperature > threshold ) {\n   msg.payload
= \"*,*,red\";\n} else if (msg.payload.temperature <= threshold){\n   msg.payload
= \"*,*,green\";\n}\nreturn msg;","outputs":"1","noerr":0,"x":340,"y":240,"wires":
[["88303e7c.0db3f8"]]},
{"id":"e333bf4e.c5cb28","type":"function","z":"56e5b0e4.4f7e3","name":"Receive
Threshold from WIoTP","func":"global.set('threshold',msg.payload.d.tempthresh);\nreturn
msg;","outputs":1,"noerr":0,"x":370,"y":140,"wires":[[]]},
{"id":"6cacb1f7.6fea78","type":"debug","z":"56e5b0e4.4f7e3","name":"","active":false,"con
sole":"false","complete":"false","x":250,"y":300,"wires":[]}]
```

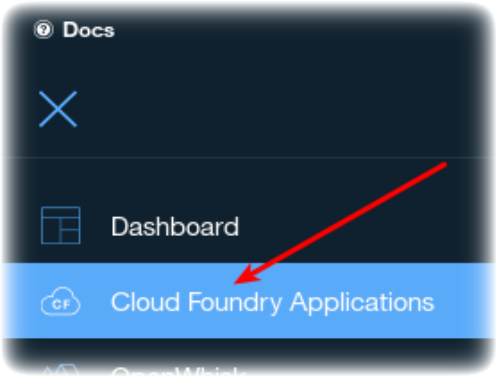
Lesson 7 Registered Watson IoT Platform Devices

The IBM Watson IoT Platform is a fully managed, cloud-hosted service that makes it simple to derive value from Internet of Things (IoT) devices. When combined with the IBM Bluemix platform, Watson IoT provides simple, but powerful application access to IoT devices and data. You can rapidly compose analytics applications, visualization dashboards and mobile IoT apps. Create IoT applications that feed insights to your backend enterprise applications.

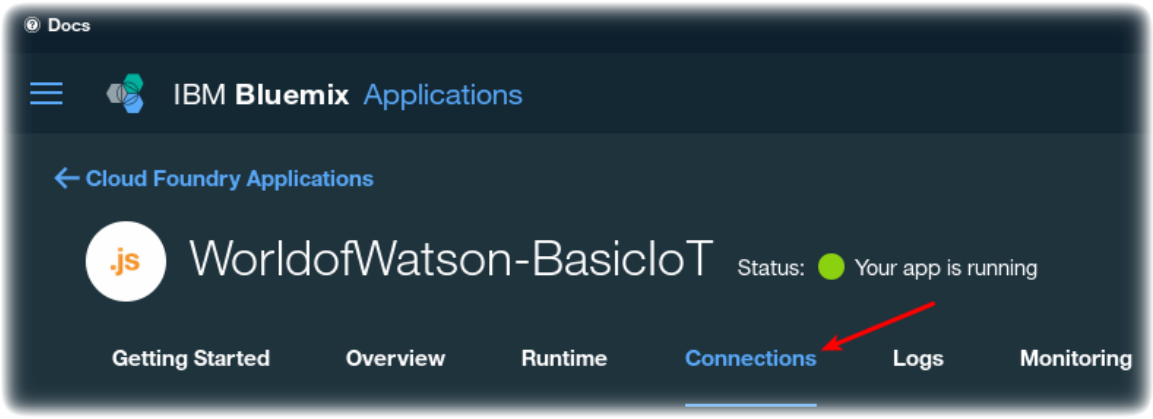
This section shows how one can setup an Watson IoT Organization and register devices in it. When you created the “Internet of Things Platform” Starter application in IBM Bluemix, a new Organization was created for you. This IBM Watson IoT Platform organization is a space used for connecting and managing devices to the IBM Watson IoT Platform, so that your applications can access their live and historical data.

1. Return to your Bluemix browser tab – http://bluemix.net
2. Click on the top left menu

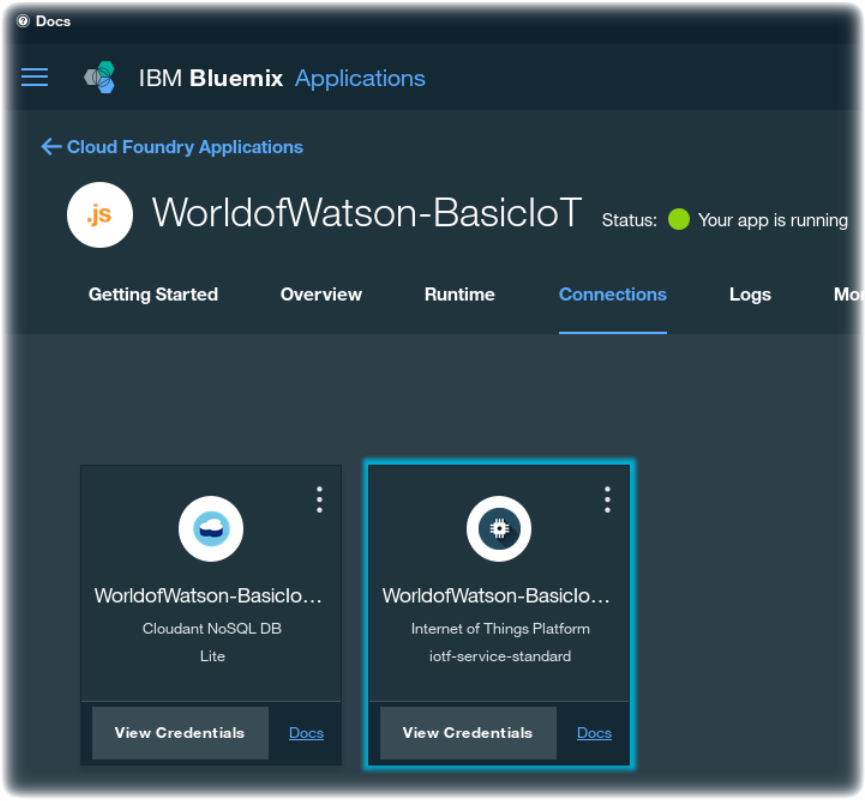
3. Click on **Cloud Foundry Applications**



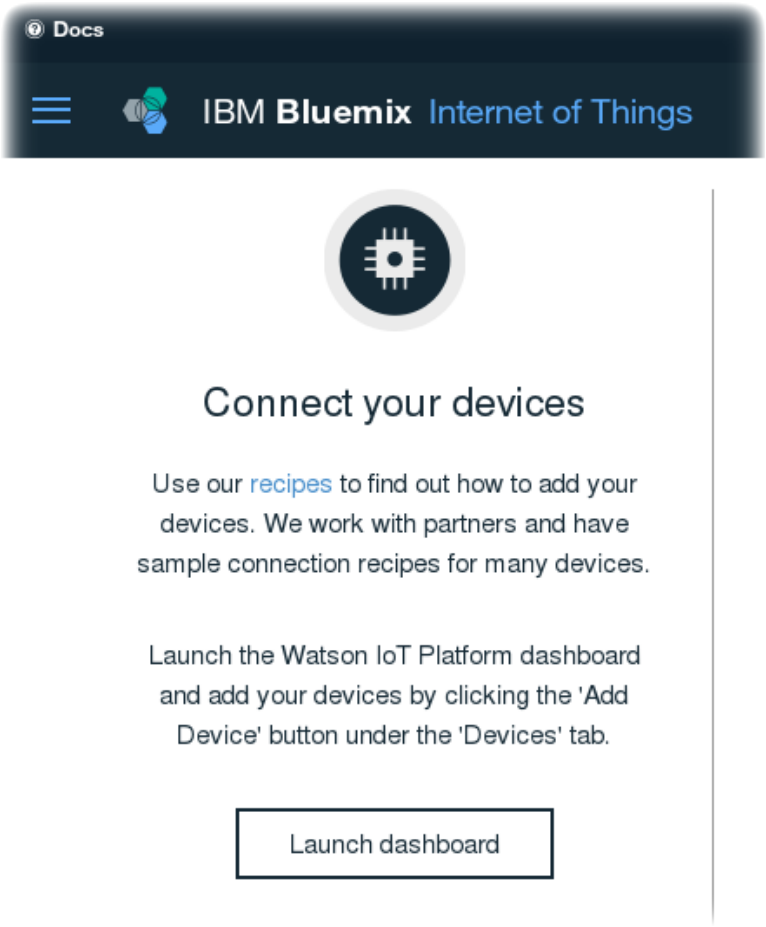
4. From the list of Cloud Foundry Applications, click on the left side of your Bluemix application to enter
5. Turn to the **Connections** tab



6. Find the **Internet of Things Platform** tile and click on it



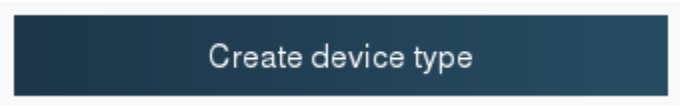
7. Scroll down underneath the **Connect your device**s and press the **Launch dashboard** button.



9. Click on the Devices chip logo.

10. Click on the **+ Add Device**

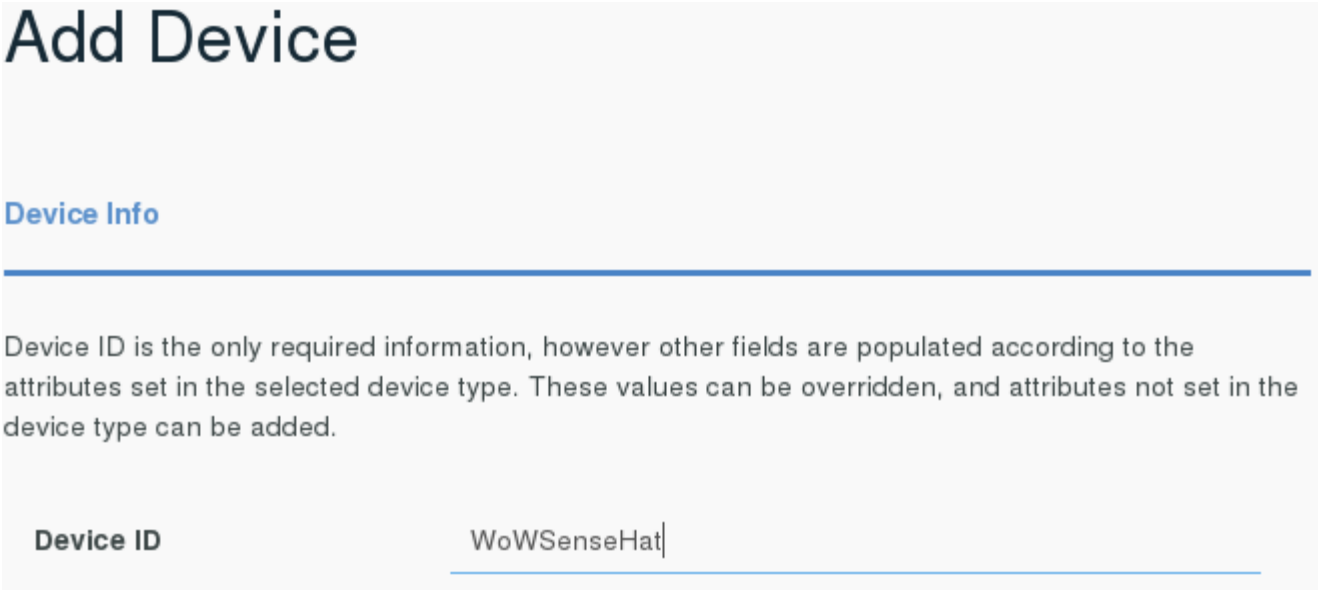
11. Click on the **Create device type**



12. Create a gateway type

13. Name your gateway “RaspberryPi”

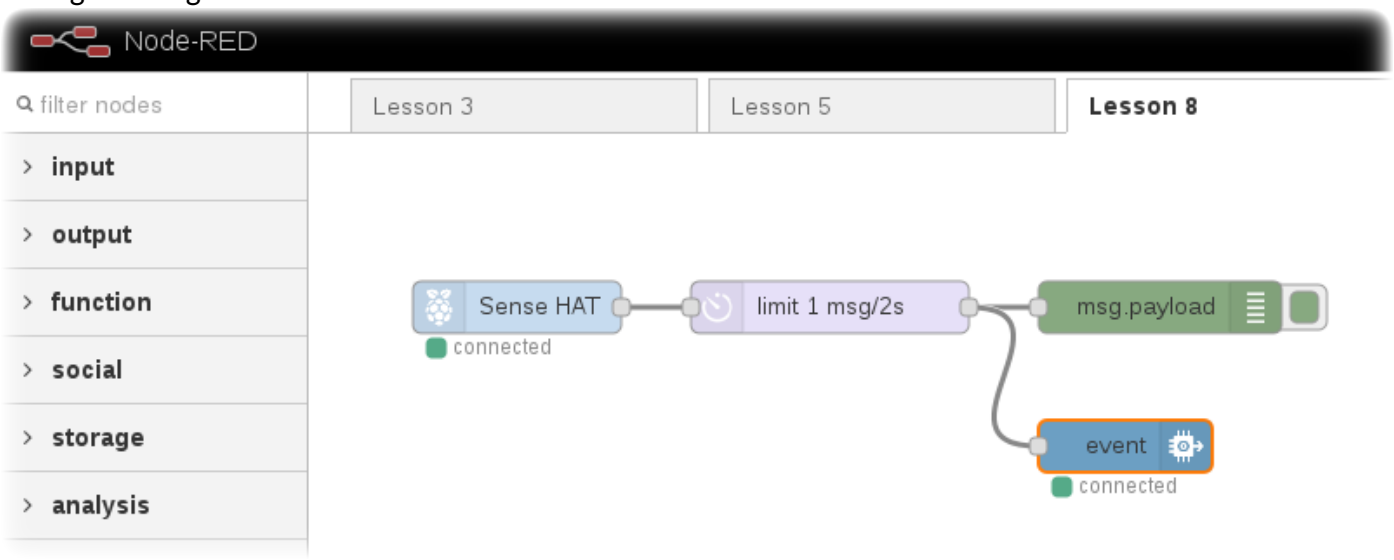
14. Press the **Next** button 3 times
15. Press the **Create** button
16. Now finally Add Device by pressing the **Next** button
17. Enter a Device ID name



18. Press the **Next** button twice
19. **Provide a token** that you will remember
20. Press the **Next** button
21. Press the **Add** button
22. Take a screenshot of the **Device Credentials** summary page. It is the only time that you will see the token.

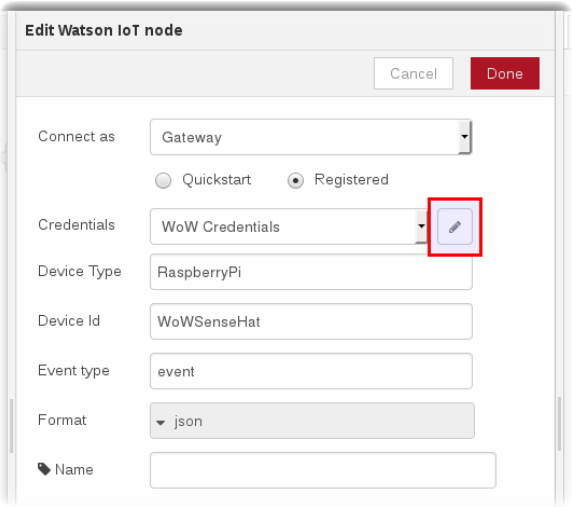
Lession 8 - Send SenseHAT Acceleration data to Watson IoT

In this section, the Acceleration data from the SenseHAT will be sent to the Watson IoT Platform registered device that was created in Lesson 7. Return to the local Node-RED browser tab and create a new flow by pressing the + sign. Name this flow “Lesson 8”



1. Drag a **SenseHat** node from the palette. Double click on it and only select the **Motion events** data.
2. There will be rapid motion data from the SenseHAT so limit the amount of data that is sent by adding a **delay** node. Set it to Limit to 1 msg per 2 seconds and check the “drop intermediate messages”
3. Drag a **Debug** node to the flow.
4. Press the **Deploy** button to observe the SenseHat data
5. Drag a **Watson IoT** output 

node from the palette onto your flow
6. Double Click on the Watson IoT Node to configure it with your WIoTP credentials
7. Enter all of the information from Lesson 7

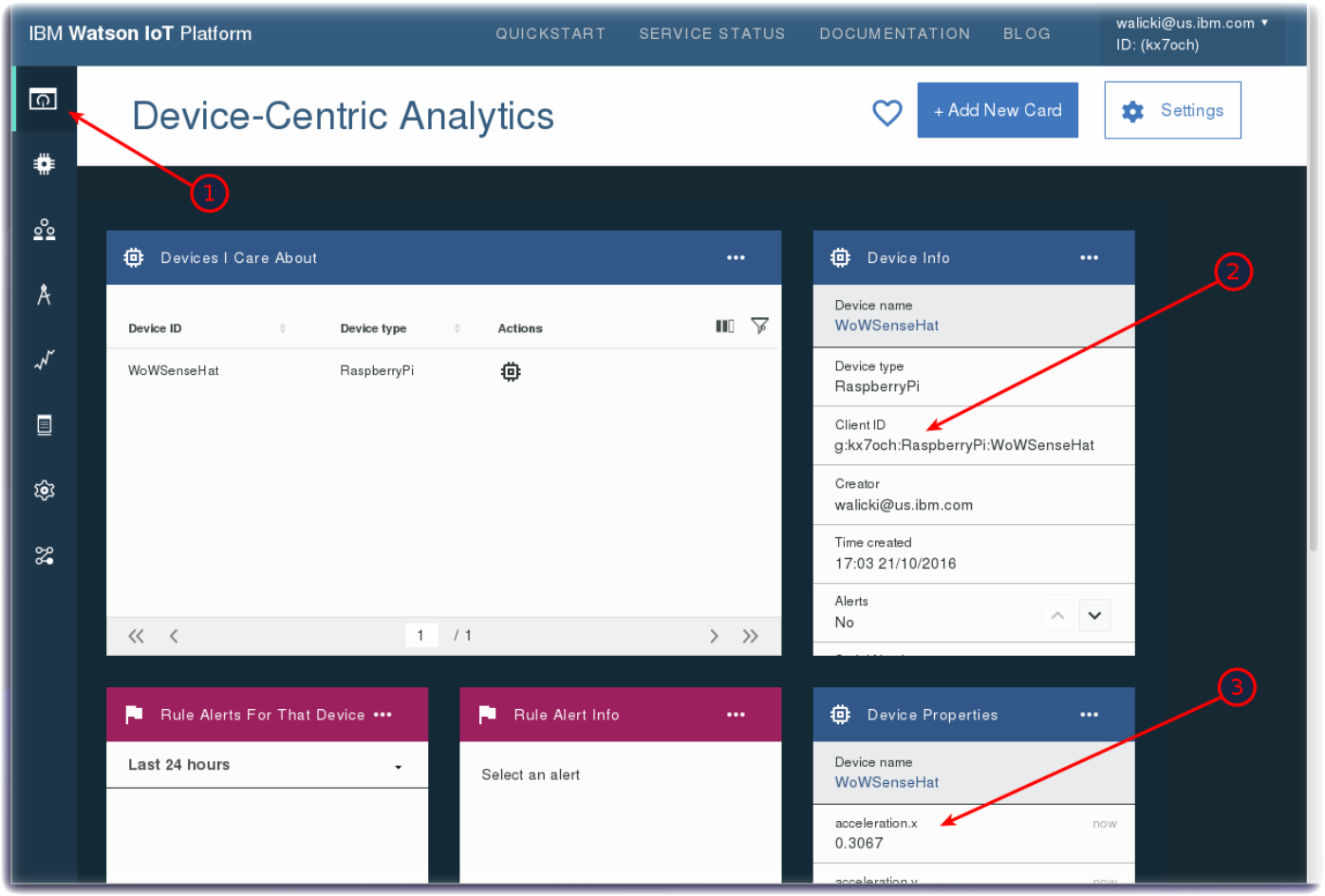


8. Click on the Credentials pencil to enter your authentication token
9. Deploy the Flow

Visualizing Bluemix Watson IoT Application Sensor data

There are several ways to visualize the acceleration data that is being sent from the Raspberry Pi SenseHAT to Watson IoT Platform. WIoTP has preconfigured dashboards called Boards that display Cards of the data.

1. Return to the Watson IoT Platform dashboard
2. You will find the Boards on the top of the list.
3. Click on the DEVICE-CENTRIC ANALYTICS card



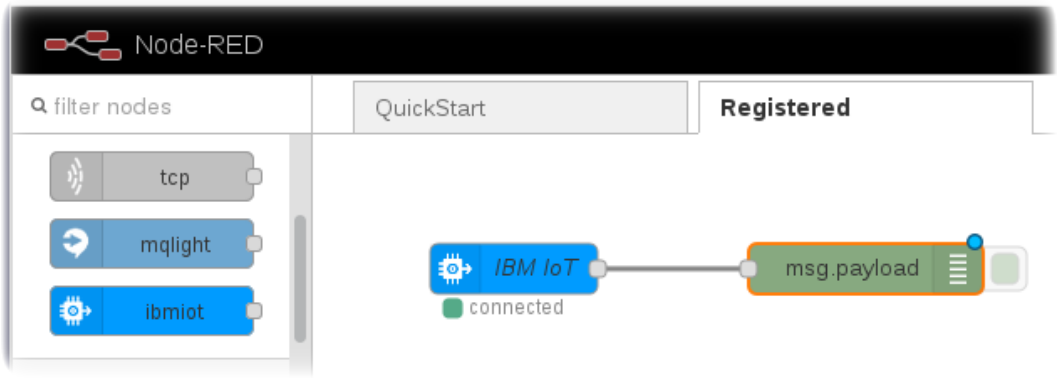
4. You will see Device Info and Device Properties with streaming acceleration data

5. Return to your Bluemix Node-RED browser tab

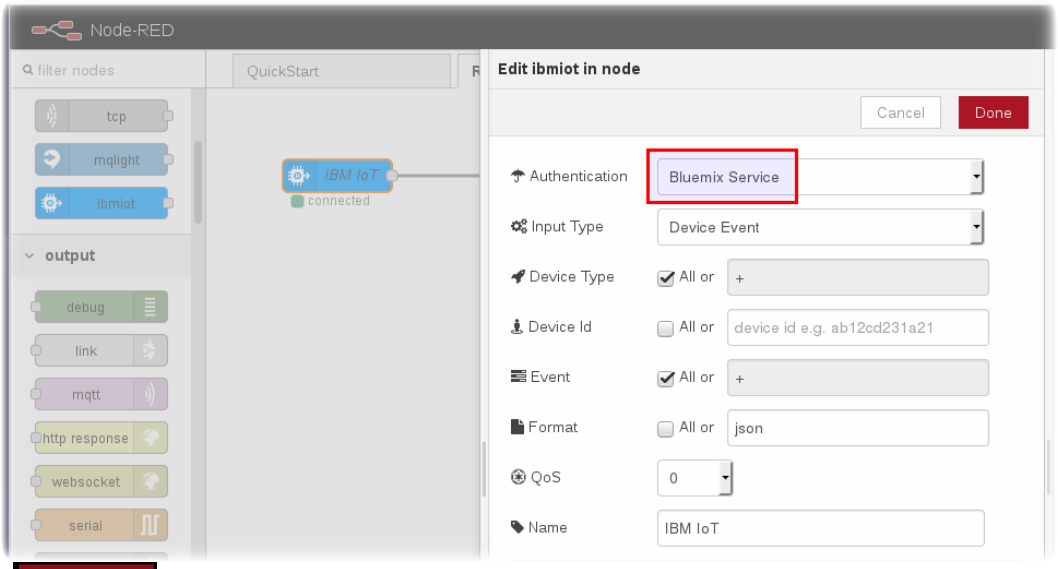
Node-RED Bluemix Watson IoT App Acceleration Sensor data

In this section of Lesson 8 you will create a Node-RED flow on your Bluemix Watson IoT Application which receives motion sensor data from the Raspberry Pi gateway and SenseHAT sensor device. If the x / y / z acceleration exceeds a warning threshold, tweet and text the alert.

1. Create a new flow by pressing the + in the upper right corner of the Node-RED visual programming editor.
2. Name the flow “Registered” by double clicking on the tab. Name the first flow “Quickstart” by double clicking on that tab.
3. Drag a **IBM IoT input** node onto the canvas
4. Drag a **Debug** output node onto the canvas
5. Wire the two nodes together



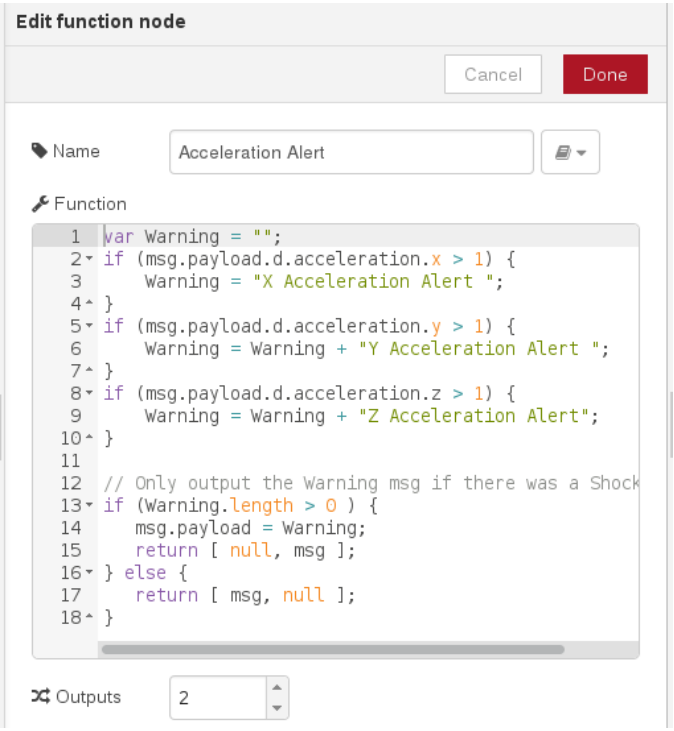
6. Double Click on the IBM IoT node. Once you select the Authentication as **Bluemix Service** it already knows your credentials.



7. Click on Deploy to save and deploy your changes.
8. You should see acceleration data from the SenseHAT in the Debug tab.

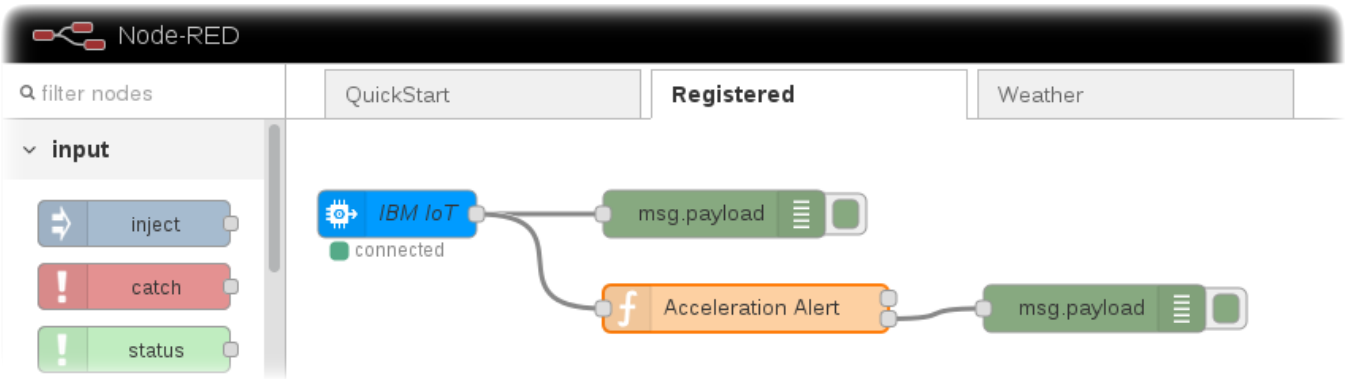
9. Next we will create a function that tests for excessive acceleration in the X / Y / Z coordinates.
10. Add a 

node as shown below.




```
var Warning = "";
if (msg.payload.d.acceleration.x > 1) {
   Warning = "X Acceleration Alert ";
}
if (msg.payload.d.acceleration.y > 1) {
   Warning = Warning + "Y Acceleration Alert ";
}
if (msg.payload.d.acceleration.z > 1) {
   Warning = Warning + "Z Acceleration Alert";
}

// Only output the Warning msg if there was a Shock
if (Warning.length > 0 ) {
  msg.payload = Warning;
  return [ null, msg ];
} else {
  return [ msg, null ];
}
```



These flows are available at https://github.com/johnwalicki/WorldofWatson-IoT-Lab

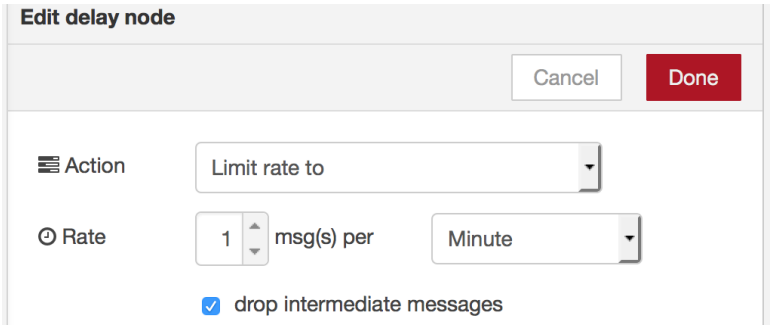
Lesson 9 - Connect to Twitter and Tweet Acceleration Shocks

In this section, we will connect a Twitter account and use the Twitter account to tweet when the acceleration data from the Raspberry Pi SenseHAT accelerometer reaches a shock threshold. This section is optional and may be skipped.

1. Sign up for a Twitter account at http://twitter.com . If you already have a Twitter account, proceed to step 2.

2. Add a 

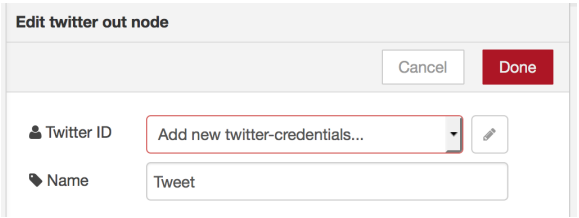
node as shown below.

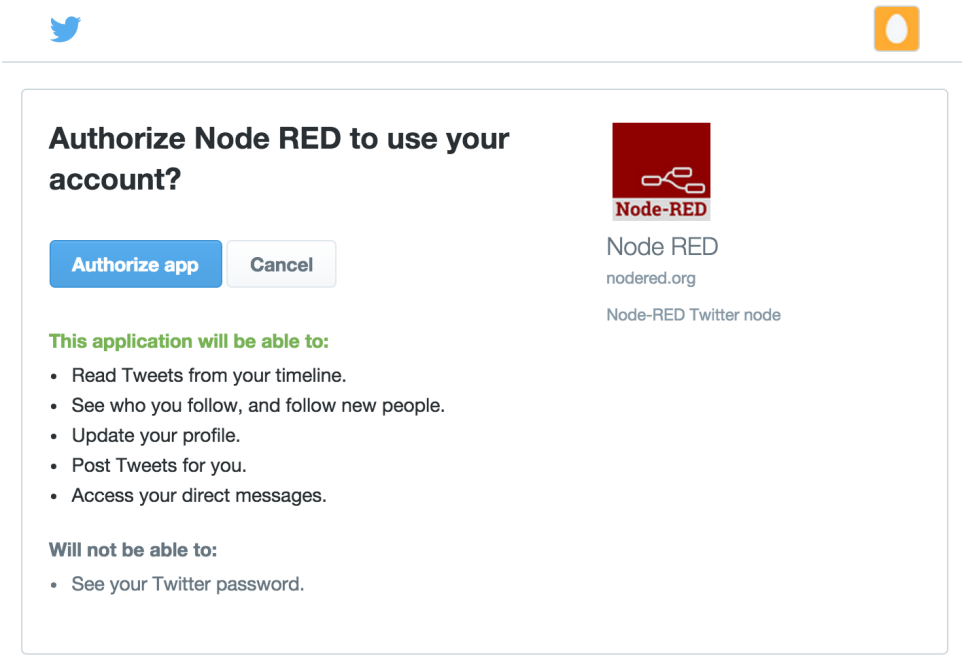


   The delay node limits how often the flow is run. Since the accelerometer can be set off often, without this node, a tweet would be sent every second. With this node limiting messages to once a minute, the Twitter node will send a tweet once a minute dropping any additional messages during the 60 second timeframe.

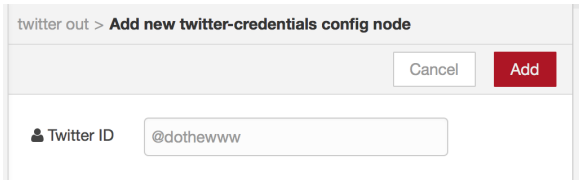
3. Add a 

node. Click on the pencil button and authenticate with Twitter. The account you sign in with will be used to send tweets.





Return back to the node configuration. The settings for the Twitter node should have your username set. Click **Add**.



4. Connect the nodes as shown below.

Get the code:
https://github.com/johnwalicki/WorldofWatson-IoT-Lab

5. Click on 

to save and deploy the changes.

6. Shake your Raspberry Pi / SenseHat. Be careful not to unplug it from the microUSB power.

7. Since the acceleration is a shock, the Alert function will compose a message, and pass it to the Twitter node. The Twitter node uses this message as the content for the tweet.

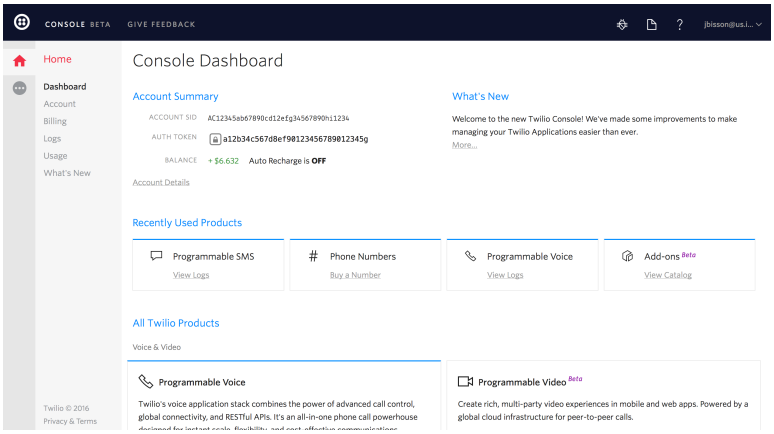
8. Visit the Twitter timeline for the user you authenticated with and verify the message has been tweeted.

Lesson 10 - Use Twilio to Text Acceleration Shocks

In this section, we will connect a Twilio phone number to the application and send a text message notification when an acceleration shock occurs. This section is optional and may be skipped.

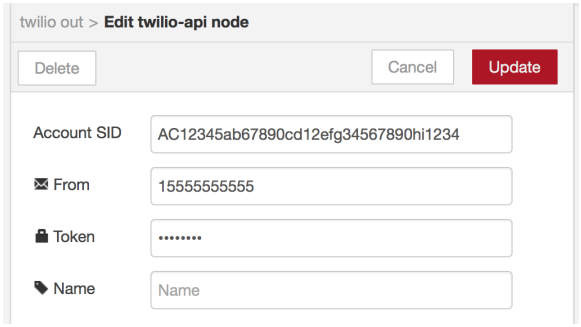
1. Sign up for a Twilio account at http://twilio.com . If you already have a Twilio account, sign in. Create a Twilio phone number that will be used in step #3.

2. In the Console Dashboard, click on the lock icon next to Auth Token. Copy the Account SID and Auth Token.

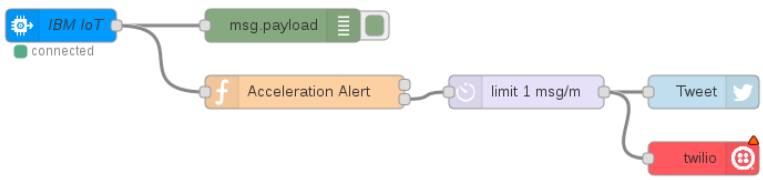


3. Add a 

node. Click on the Pencil to provide your **Account SID** and **Auth Token** from step #2, and **From** phone number using the Twilio phone number from step #1. Fill in the **SMS to** textbox with a phone number that will be texted to.



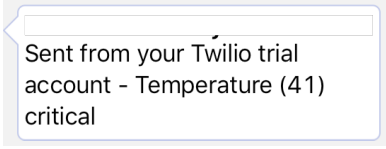
4. Connect the nodes together as shown.



Get the code:
https://github.com/johnwalicki/WorldofWatson-IoT-Lab

5. Click on 

to save and deploy the changes.
6. Shake your Raspberry Pi. You should receive a text message shortly.

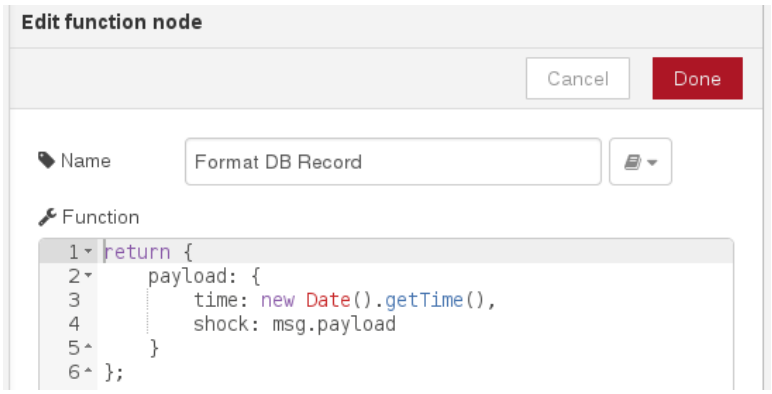


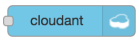
Lesson 11 - Store Acceleration Shock Events in a Cloudant NoSQL Database

This section will show how to add a Cloudant NoSQL database to the Node-RED application and store acceleration shock reports (one per minute). This functionality can be useful to run historical analysis (outside the scope of this lab) or find patterns over time. This section is optional and can be skipped. However, it is a prerequisite for the **Retrieve Acceleration Shocks From Cloudant NoSQL Database** section (below).

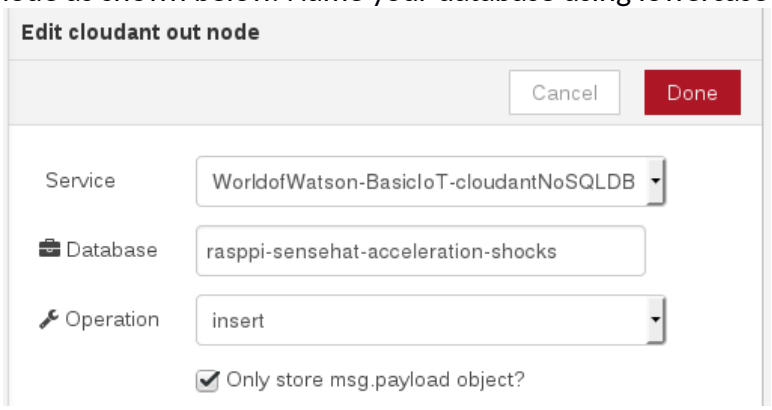
1. Add a 

node as shown below.

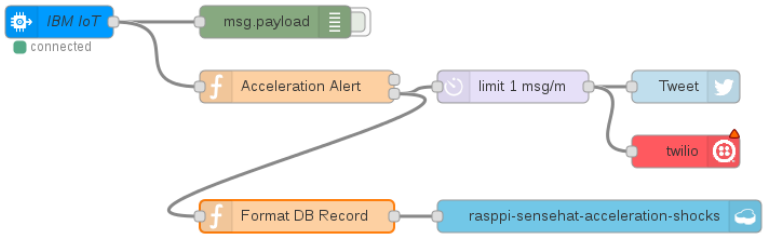


2. Add a 

node as shown below. Name your database using lowercase characters.



3. Connect the nodes together as shown below.

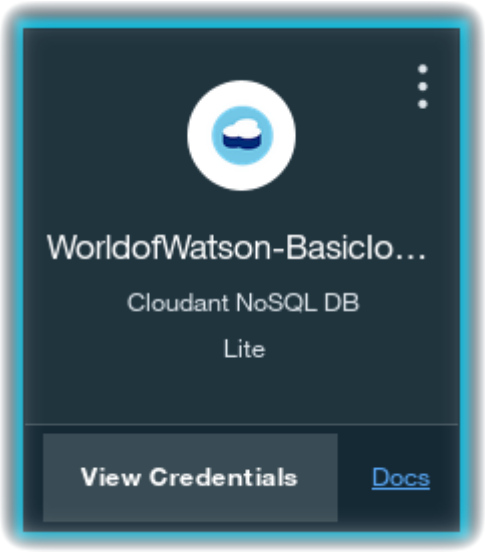


Get the Code:
https://github.com/johnwalicki/WorldofWatson-IoT-Lab

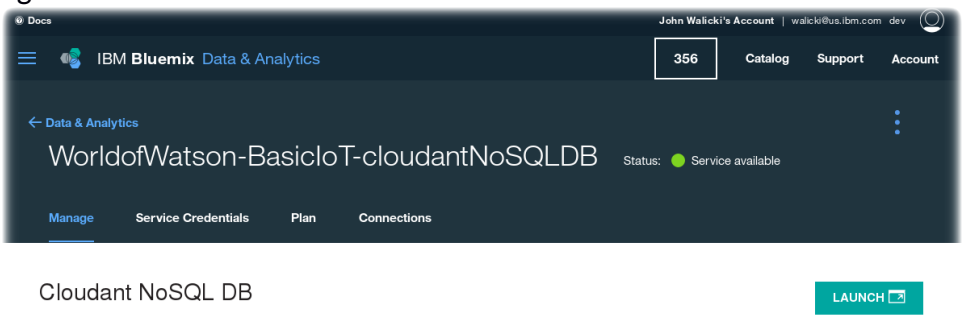
4. Click on 

to save and deploy your changes.

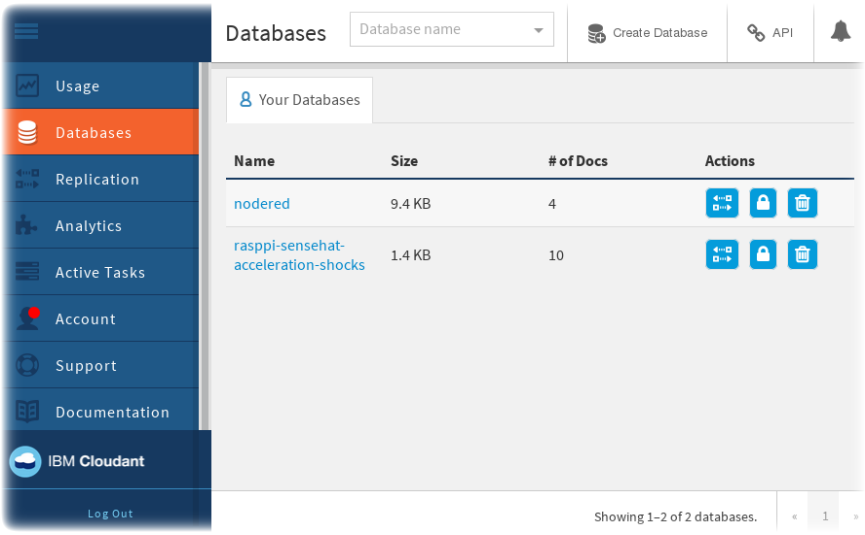
5. Go back to the IBM Bluemix application dashboard and the **Connections** tab. Click on the **Cloudant NoSQL DB** service tile.



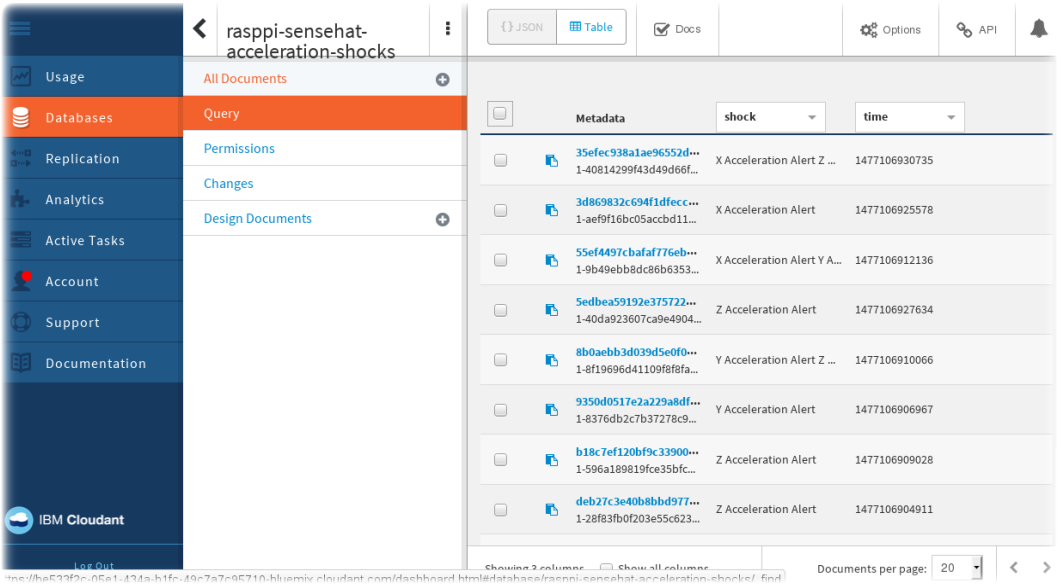
6. Click on the green **Launch** button.



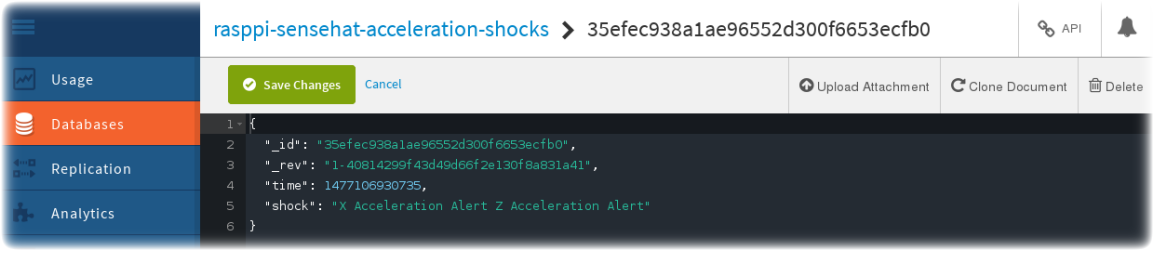
7. This is the Cloudant NoSQL database dashboard. A list of databases is displayed. The database named raspi-sensehat-acceleration-shocks contains documents representing each extensive acceleration shock event that has been stored by the Node-RED application. Click on the database named **raspi-sensehat-acceleration-shocks**



8. To see the expanded view of the documents, click on **Query**, check the box to include **Docs**.



9. Each box represents one document (in our case one acceleration shock event) that contains the payload (time and coordinate shock) we stored earlier.



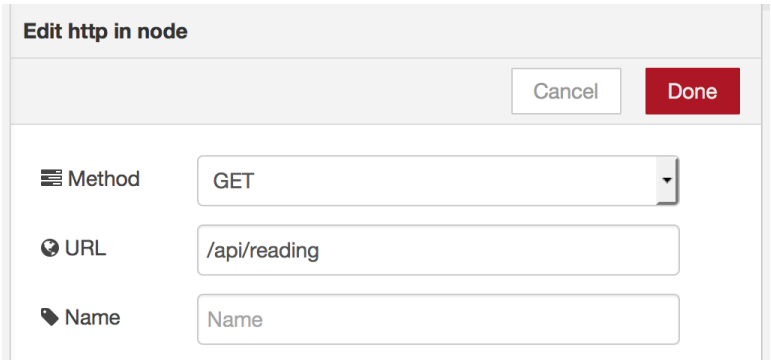
Lesson 12 - Retrieve Acceleration Shocks from a Cloudant NoSQL DB

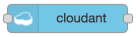
This section shows how to retrieve acceleration shock event data from a Cloudant NoSQL database and exposes it as a HTTP endpoint. This functionality can be useful to run historical analysis (outside of the scope of this lab) or find usage patterns over time. This section is optional and can be skipped. Completion of the section titled **Store Acceleration Shocks in a Cloudant NoSQL Database** is required before beginning this section.

Now that we have a Cloudant NoSQL database containing reported shocks, let's expose the data as an HTTP endpoint.

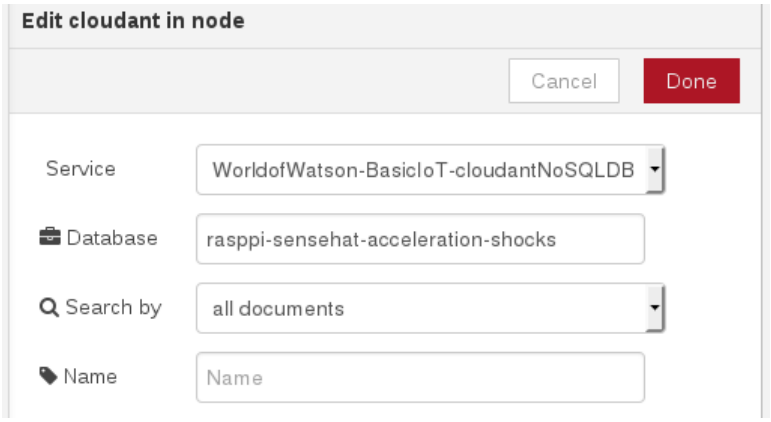
1. Add a 

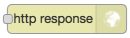
node as shown below.



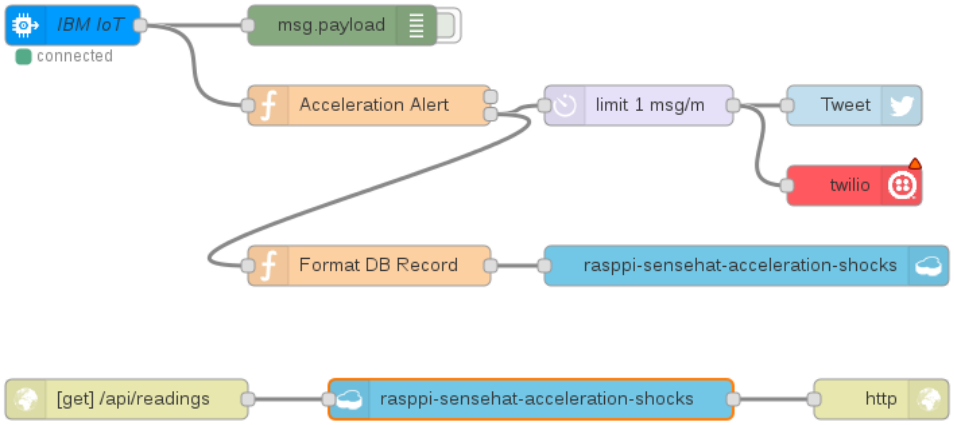
2. Add a 

node as show below.



3. Finally, add a 

node.
4. Connect the nodes together as shown below.



Get the Code:

https://github.com/johnwalicki/WorldofWatson-IoT-Lab

5. Click on  to save and deploy your changes.

6. Open a browser tab and visit your application's URL, appended by /api/reading. If you chose ***myapp*** when setting up your application, the URL would be:

   https://***myapp***.mybluemix.net/api/reading

   You should see data returned similar to the following:

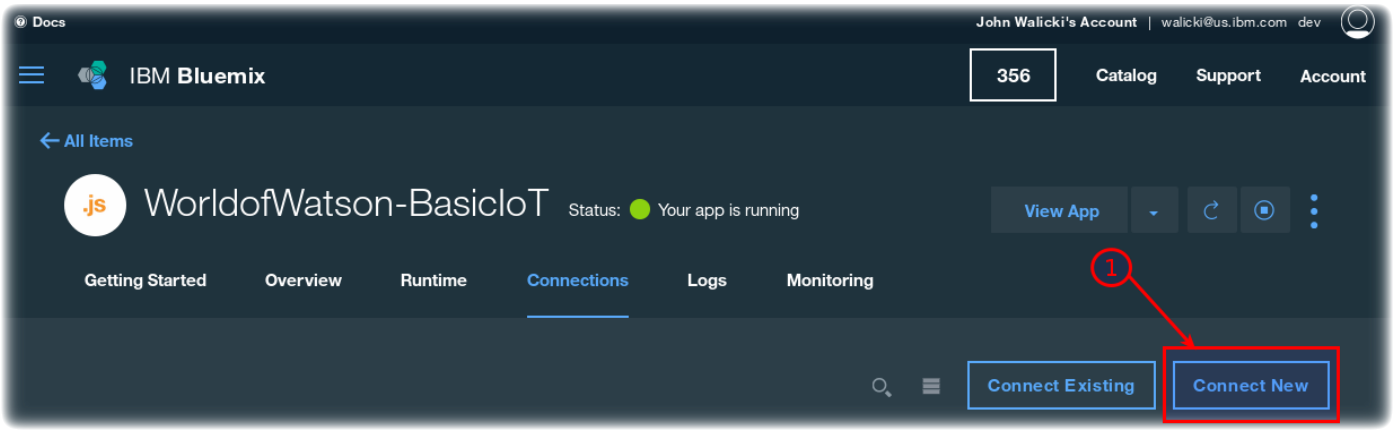
   The shock events values are returned in a JSON array. You can use this data in web applications or analytical tools. As you inject more data in the IoT example in Node-RED, this dataset will expand to include that data.

Lesson 13 - Send Weather Alerts to a Raspberry Pi

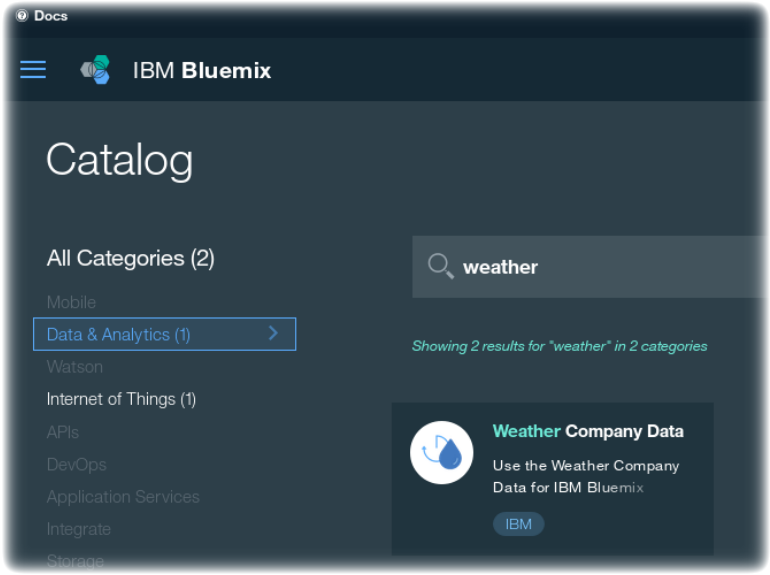
In this section, we will display the temperature of your favorite home town. The outside temperature will be retrieved via the **Weather Company Data for IBM Bluemix** service.

1. Return to the **Connections** tab of your Internet of Things Starter Application

2. Click on the **Connect New** button (1) of your Node-RED application in IBM Bluemix.

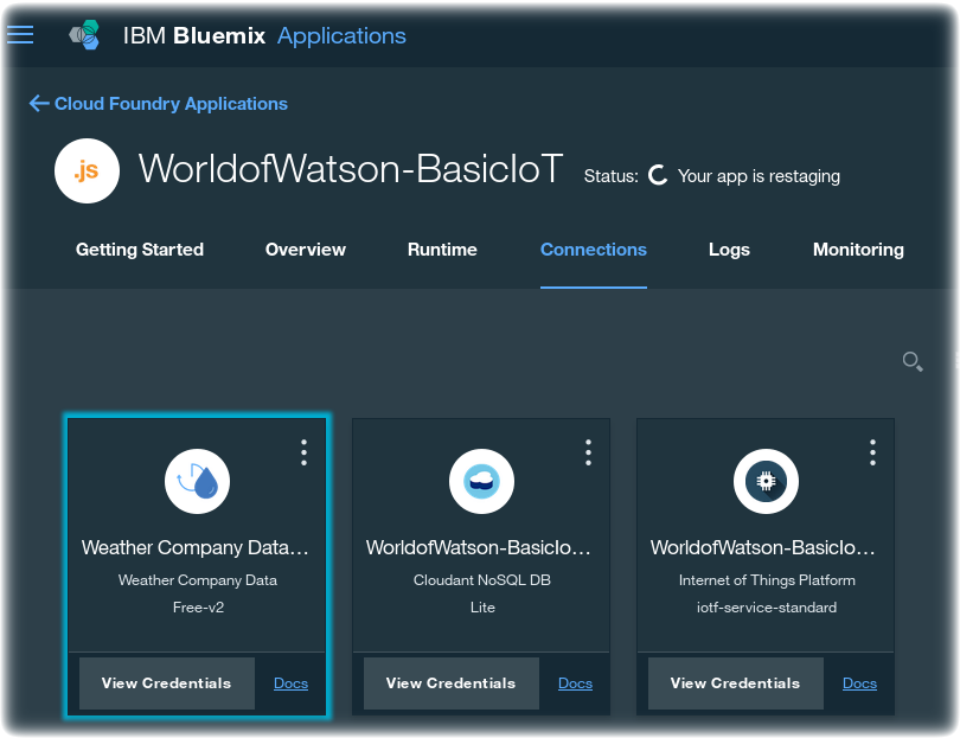


3. Select the **Weather Company Data for IBM Bluemix** under the Data & Analytics category.

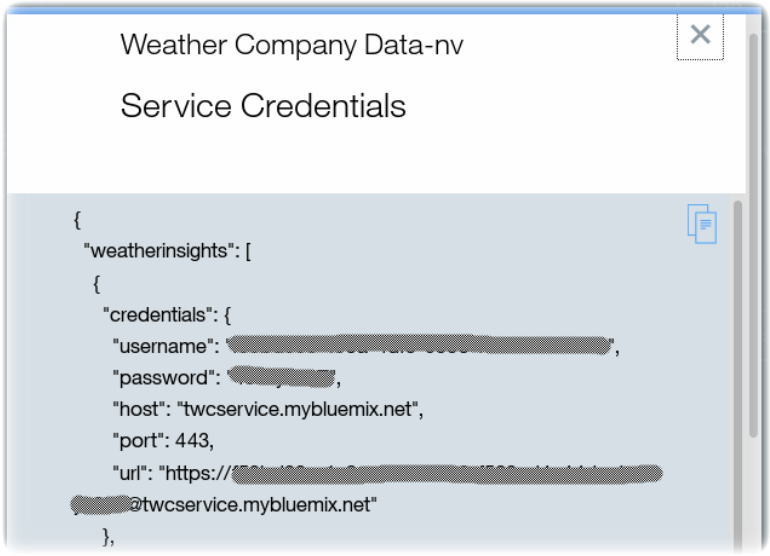


4. Click **Create** to add the service to your application.

5. When prompted to restage the application, click **Restage** to restart the application and update the environment with the credentials to the Weather service.

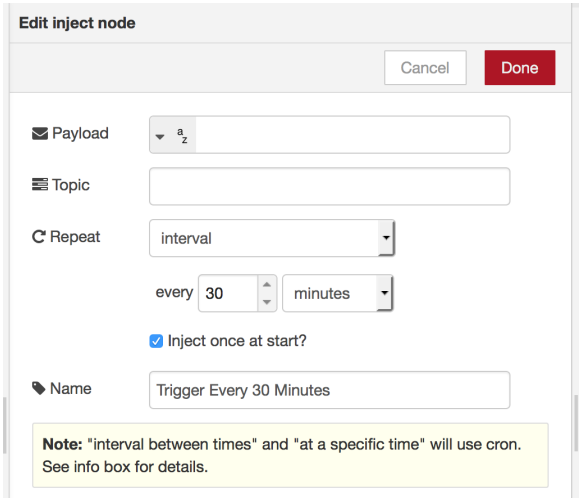


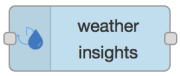
6. When the application has restarted, a third service tile will appear in the **Connections** tab. Click on **View Credentials** in the Weather Company Data service tile to show the service credentials.
7. Copy the username and password values and save them for use in step #10.



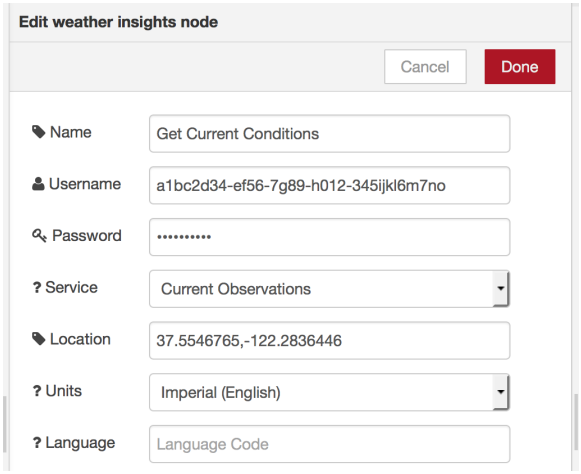
8. Return to your Node-RED application flows on Bluemix and add a new flow tab by clicking the +. Name the flow **Weather**
9. Add a 

node as shown below. This will trigger the flow once at startup, and then every 30 minutes.



10. Add a 

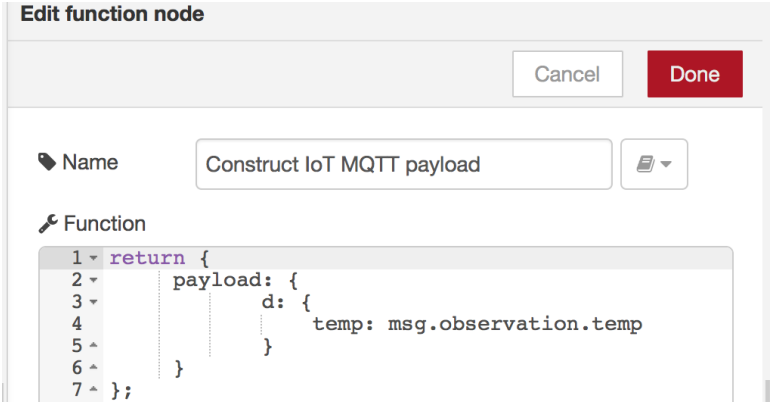
node as shown below. Use the Weather Company Data API credentials from step #7.



Look up the Geocode of your home town and enter the Longitude,Latitude in the Location field. Do not enter any spaces. Note the – minus symbol / negative sign if you live in the western hemisphere.

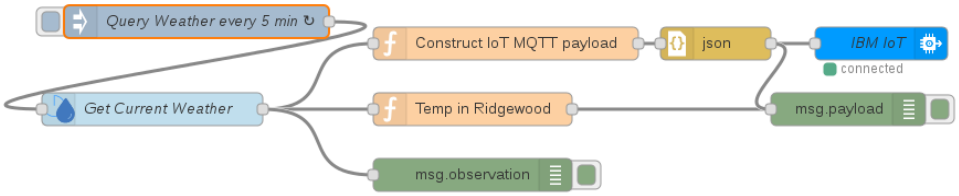
11. Add a 

node as shown below.



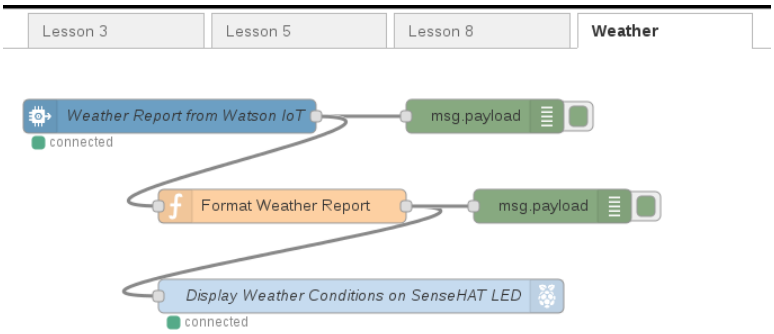
This will format the temperature in a MQTT message payload, for use in step #11. If the weather condition changes every 30 minutes, the value will be sent to the Raspberry Pi for display on the SenseHAT LED

12. On IBM Bluemix, connect the nodes together as shown below.



Get the Code:
https://github.com/johnwalicki/WorldofWatson-IoT-Lab

13. On the Raspberry Pi, connect the nodes together as shown.



14. Click on 

to save and deploy your changes.

15. You will need to **disable** the SenseHAT output nodes created in Lesson 3 and Lesson 5 so that those flows do not overwrite the LED. The LED should display the outside temperature and will update the temperature from the Weather service every 5 minutes.

Additional Raspberry Pi / SenseHAT Resources

In this final section, we will challenge the workshop attendees to implement additional SenseHAT projects.

There are many Raspberry Pi Recipes available at:

https://developer.ibm.com/recipes

An excellent Marble Maze project is great fun:

Connecting a Sense HAT to Watson IoT using Node-RED

https://developer.ibm.com/recipes/tutorials/connecting-a-sense-hat-to-watson-iot-using-node-red/