Ask Me Anything: Connecting Node-RED Flows to the IBM Watson IoT Platform for an IoT Device **IDA-6963**

Henry Will IV – February 24. 2016

These Slides are from my Breakout Session: **IND-2119:** “A Primer to Programming an Internet of Things Device on IBM Bluemix”

Please review the replay of that presentation for more information.

The last few slides here are reference slides and have links which may be particularly helpful

Agenda

- The Story Behind the Project
- Requirements
- Bluemix Recipes
- Hardware
- Architecture
- MQTT
- IoT Foundation Quickstart
- Creating the Application in Bluemix
- Binding to IoT Foundation
- Node-RED flow

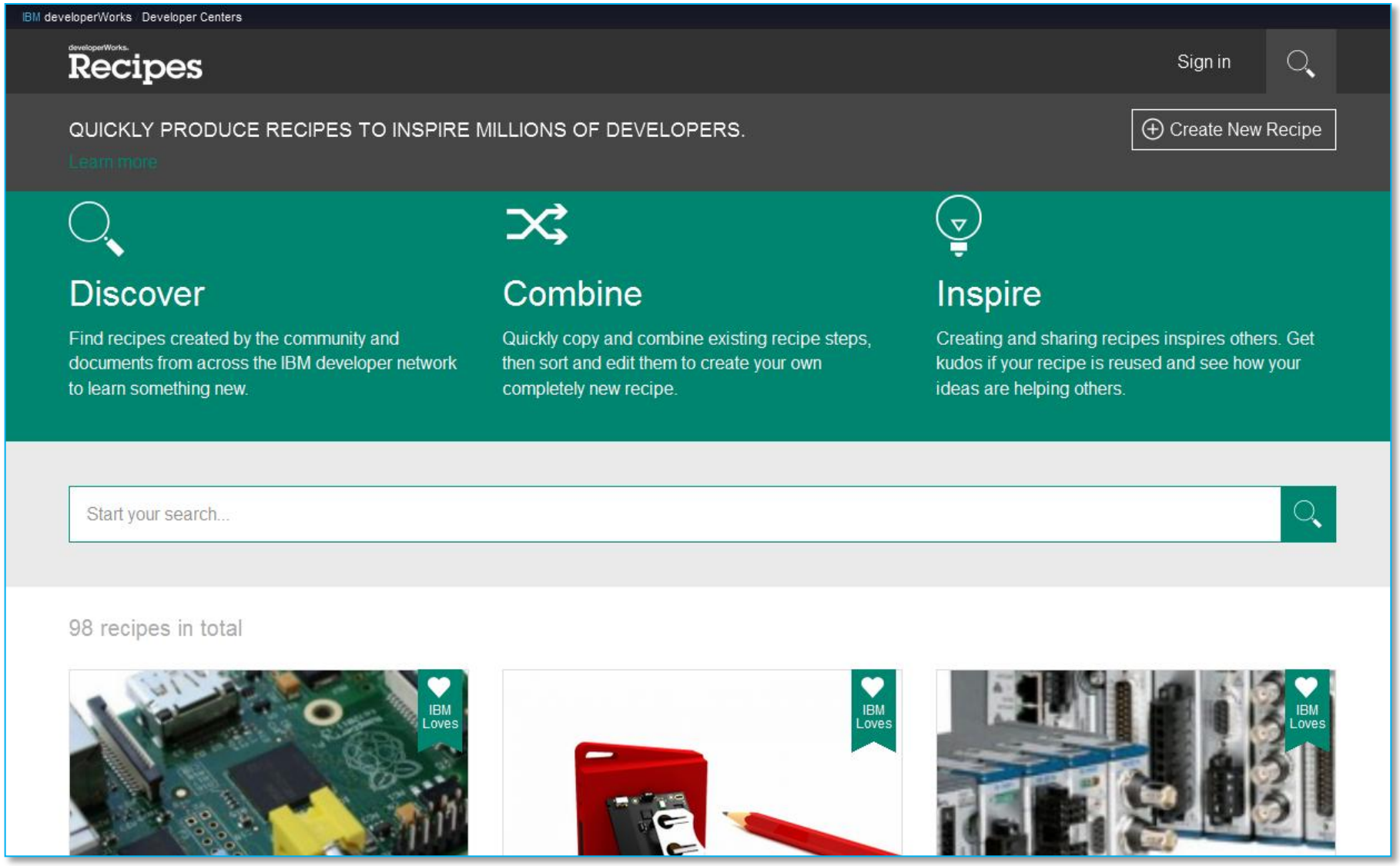
Cabin Fever

#ibminterconnect

Requirements

1. If the temperature goes above a set point (“low set point”) or above a “high set point,” then a notification is sent to the owner (preferably by SMS). The Unit will also continue to report the temperature every hour for 12 hours.
2. The owner may change the set points via an email (via SET command)
3. The owner may also request (via an email) temperature reports to be sent (via CMD command)
4. In case the unit is malfunctioning, the owner may stop all reporting by issuing a command via email (via RPT command)
5. The unit will send the temperature when it first powers up (this will help the owner to know that there was possibly a power loss and power has returned)
6. Every week (in intervals of a week since powering up or the last command received), a report will be sent of the temperature. This will be a reminder that the unit is still working

Recipes



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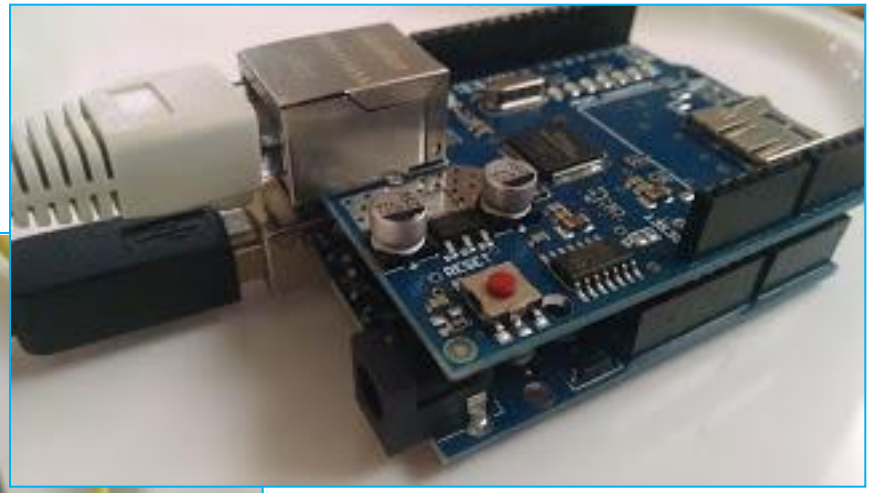
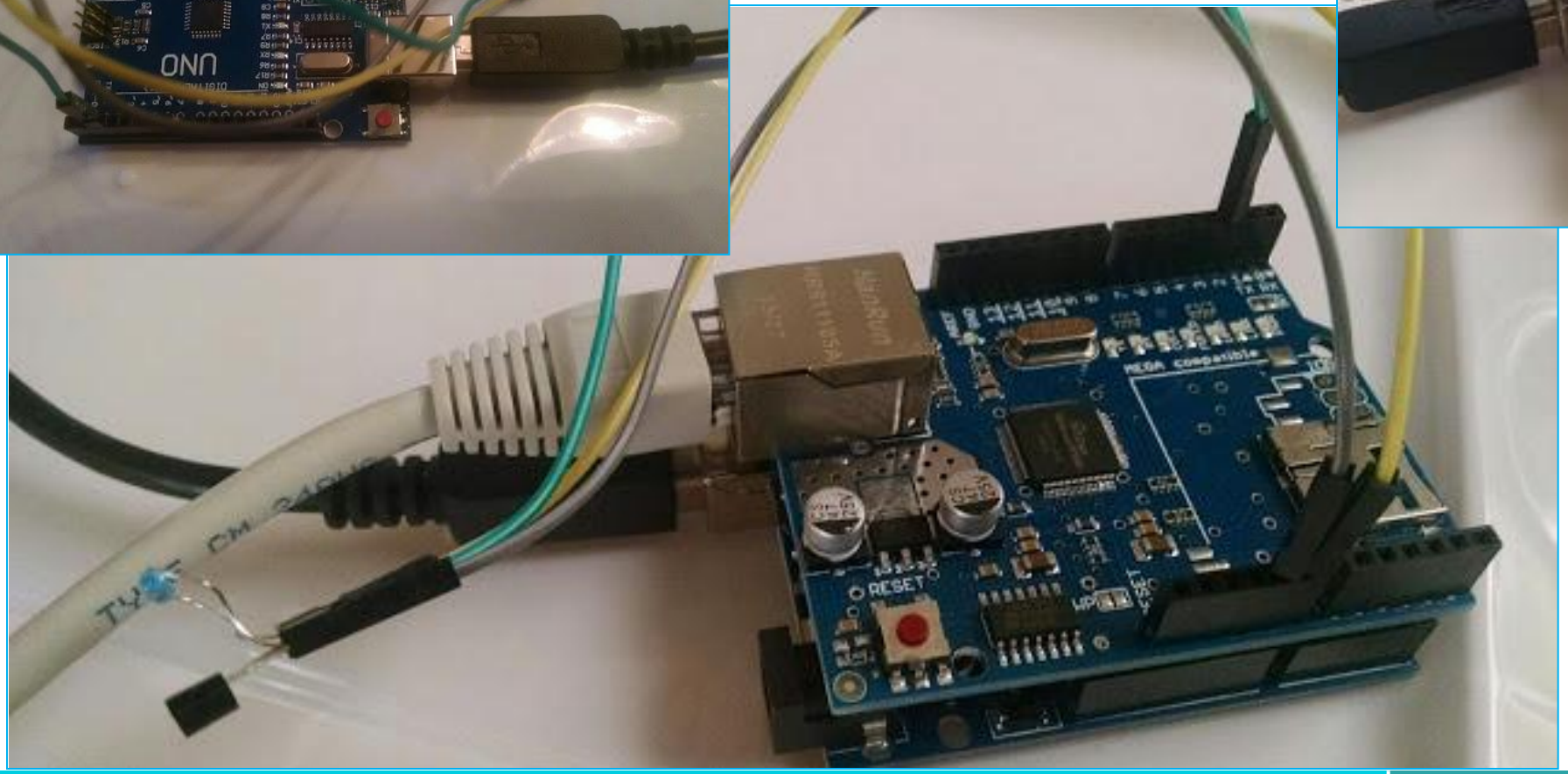
Hardware: Arduino Uno, Ethernet Shield, DS18B20 Temperature Sensor





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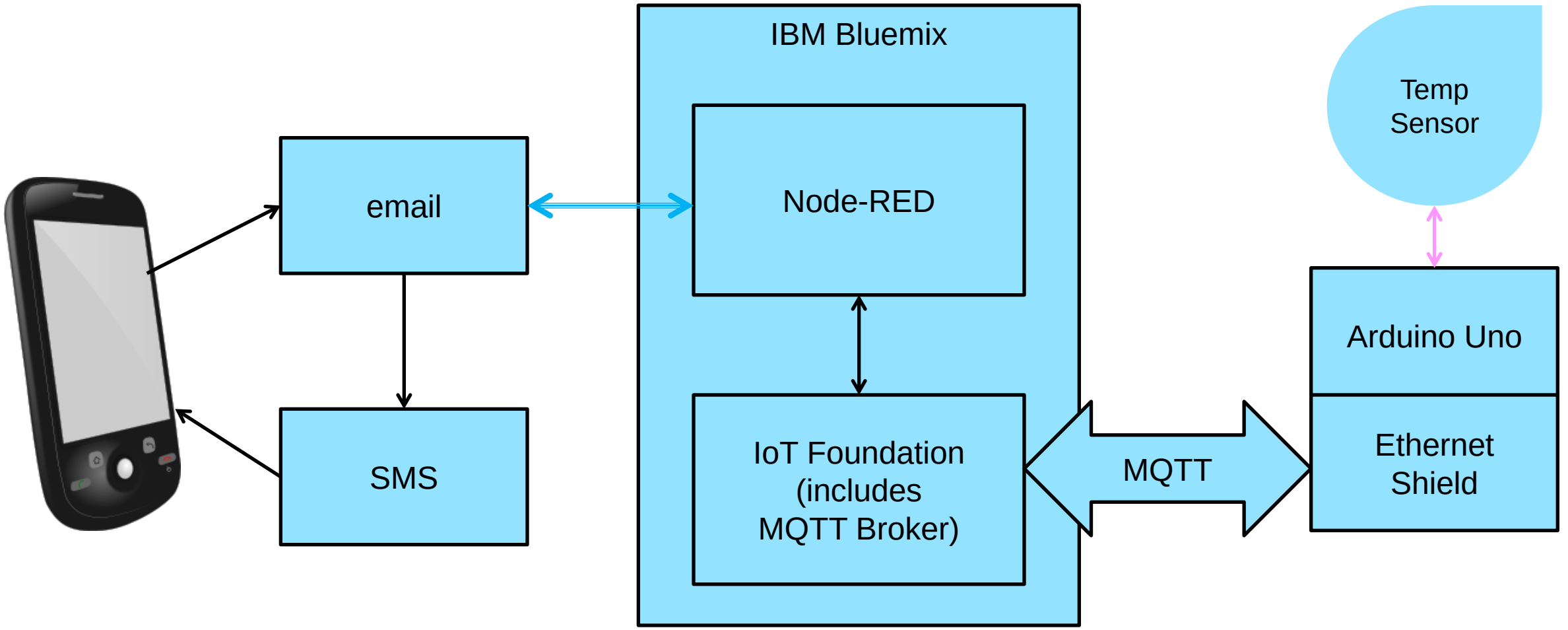
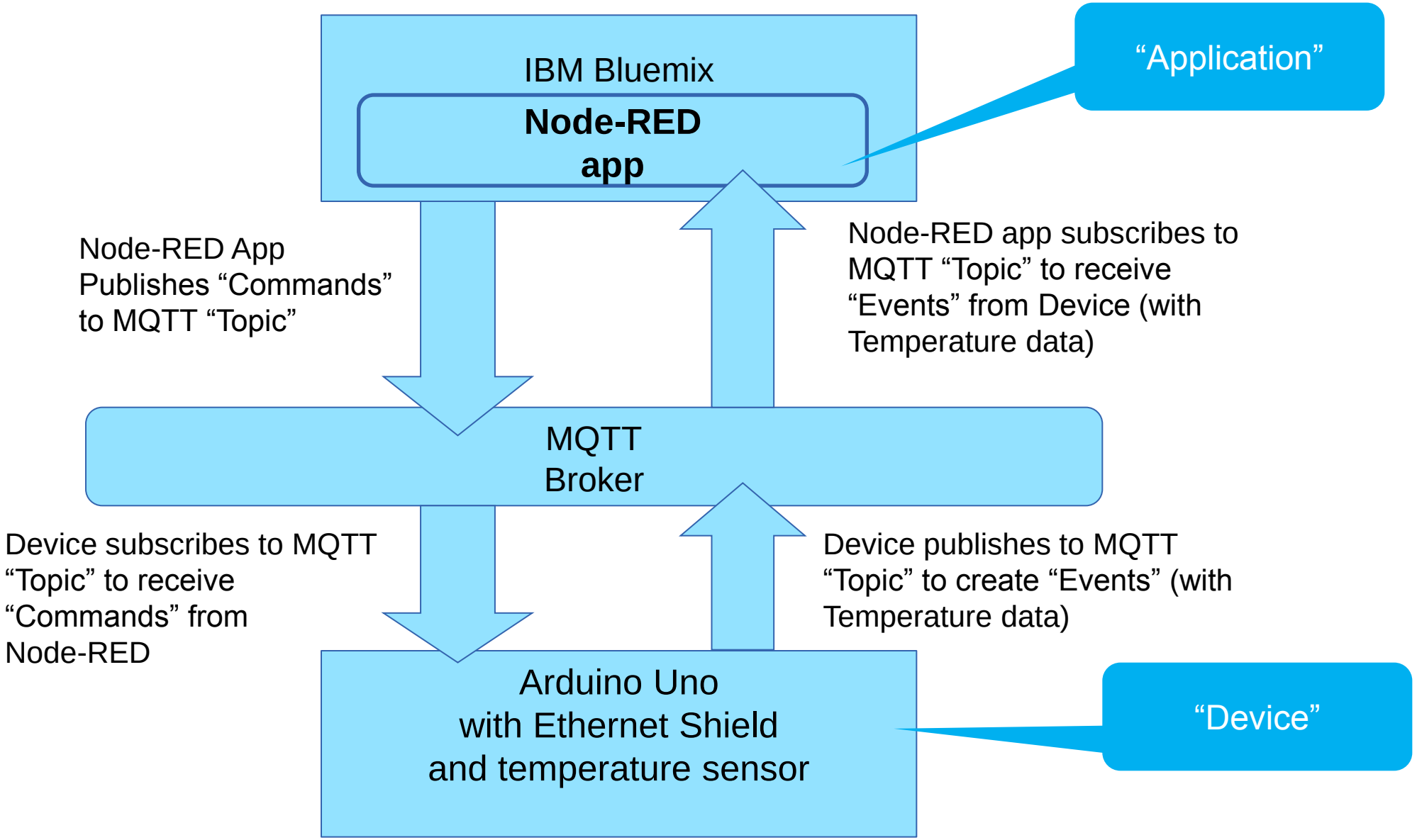
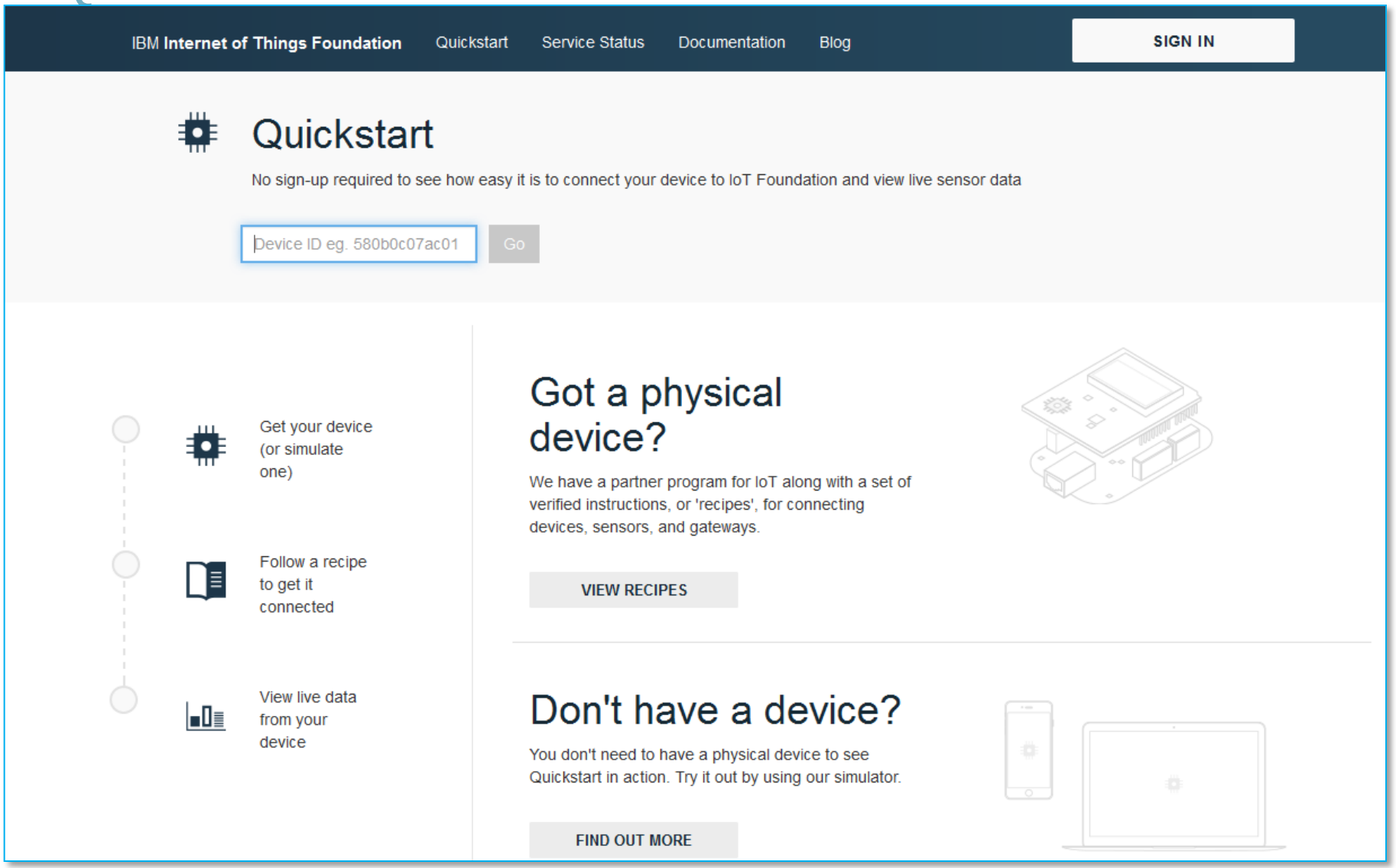
Architecture



MQTT


IBM Bluemix
Node-RED app
"Application"
Node-RED App Publishes "Commands" to MQTT "Topic"
Node-RED app subscribes to MQTT "Topic" to receive "Events" from Device (with Temperature data)
MQTT Broker
Device subscribes to MQTT "Topic" to receive "Commands" from Node-RED
Device publishes to MQTT "Topic" to create "Events" (with Temperature data)
Arduino Uno with Ethernet Shield and temperature sensor
"Device"

IBM IoTF Quickstart



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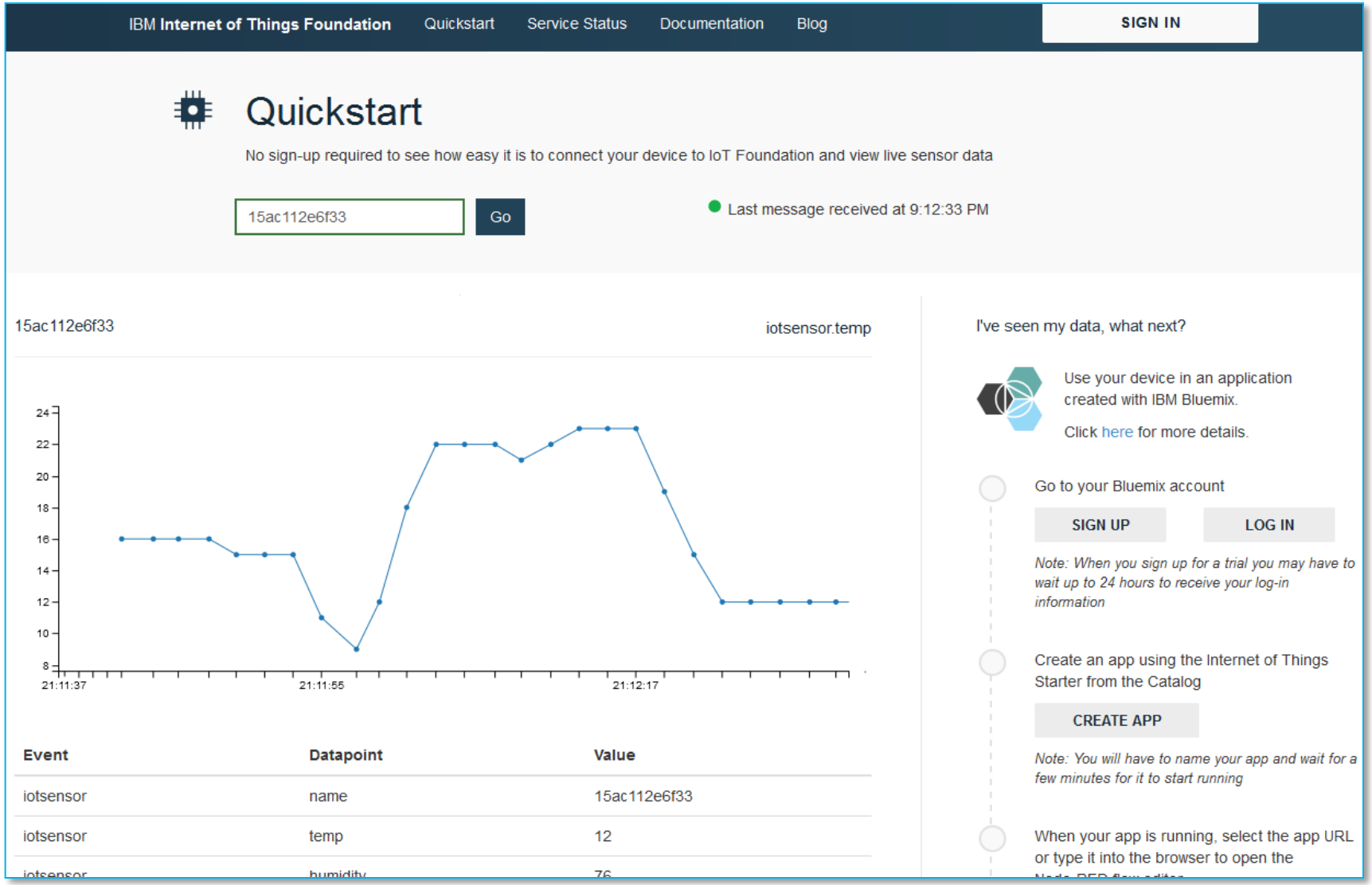
Quickstart Data Graph



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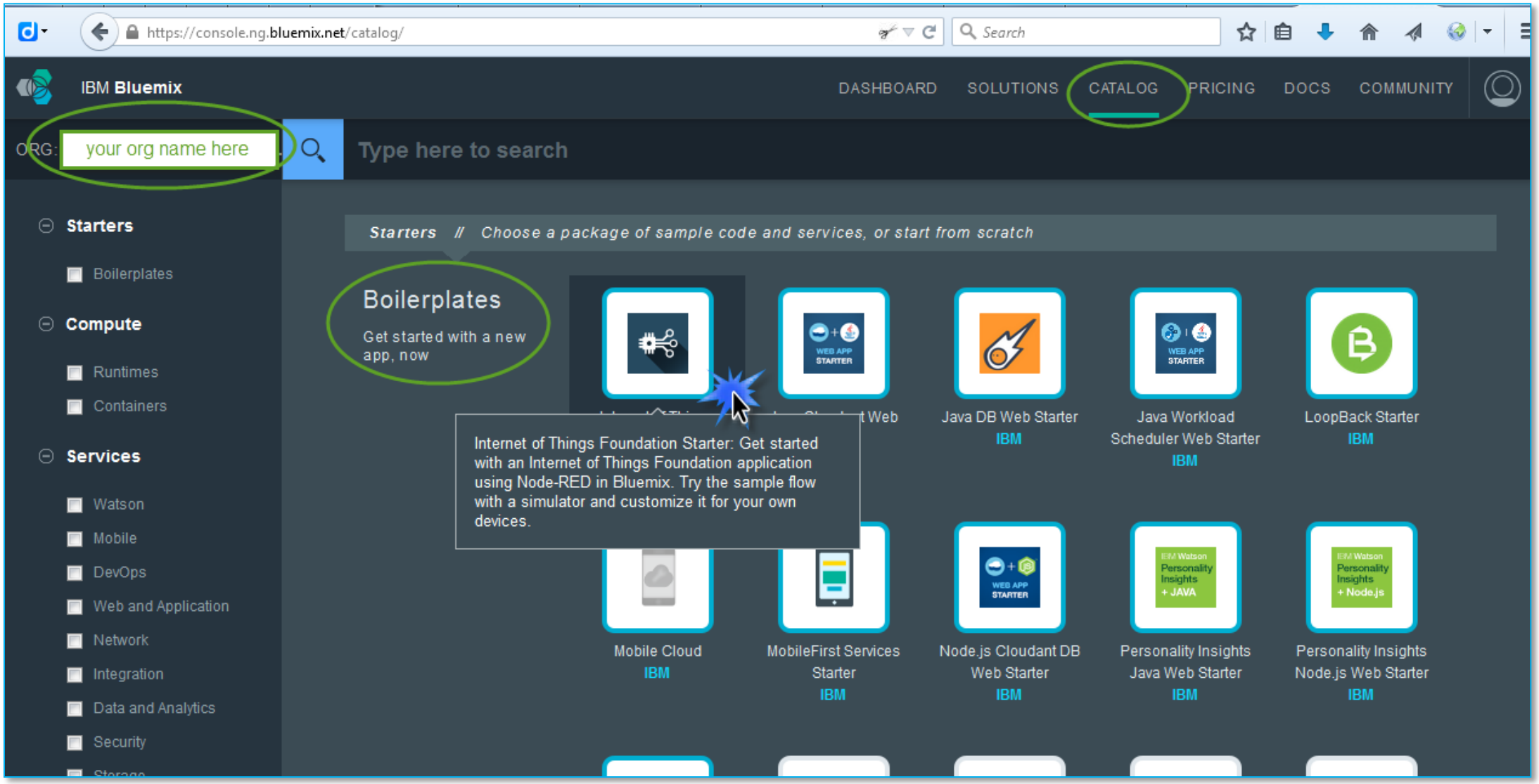
Bluemix Catalog: IoT Boilerplate



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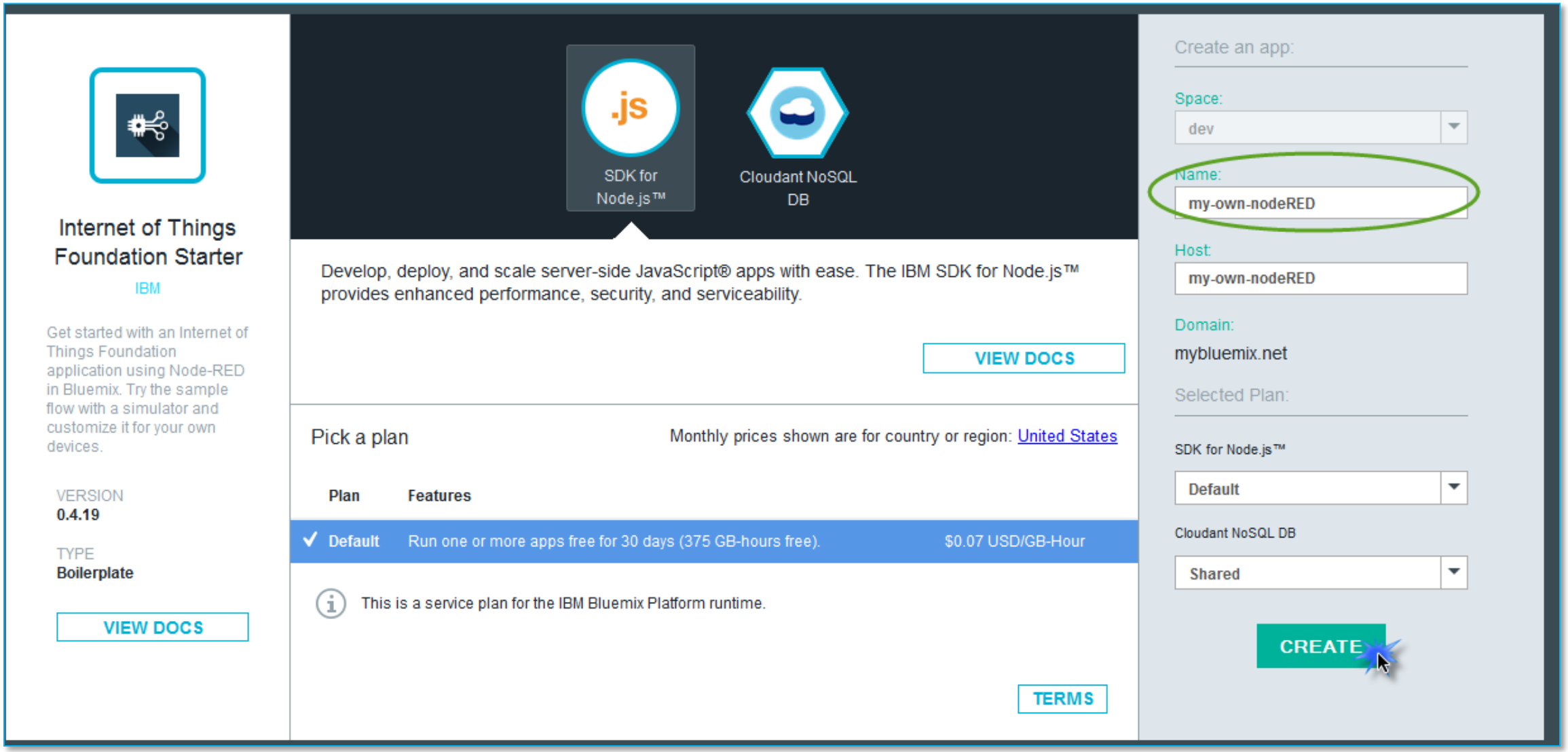
Creating an App



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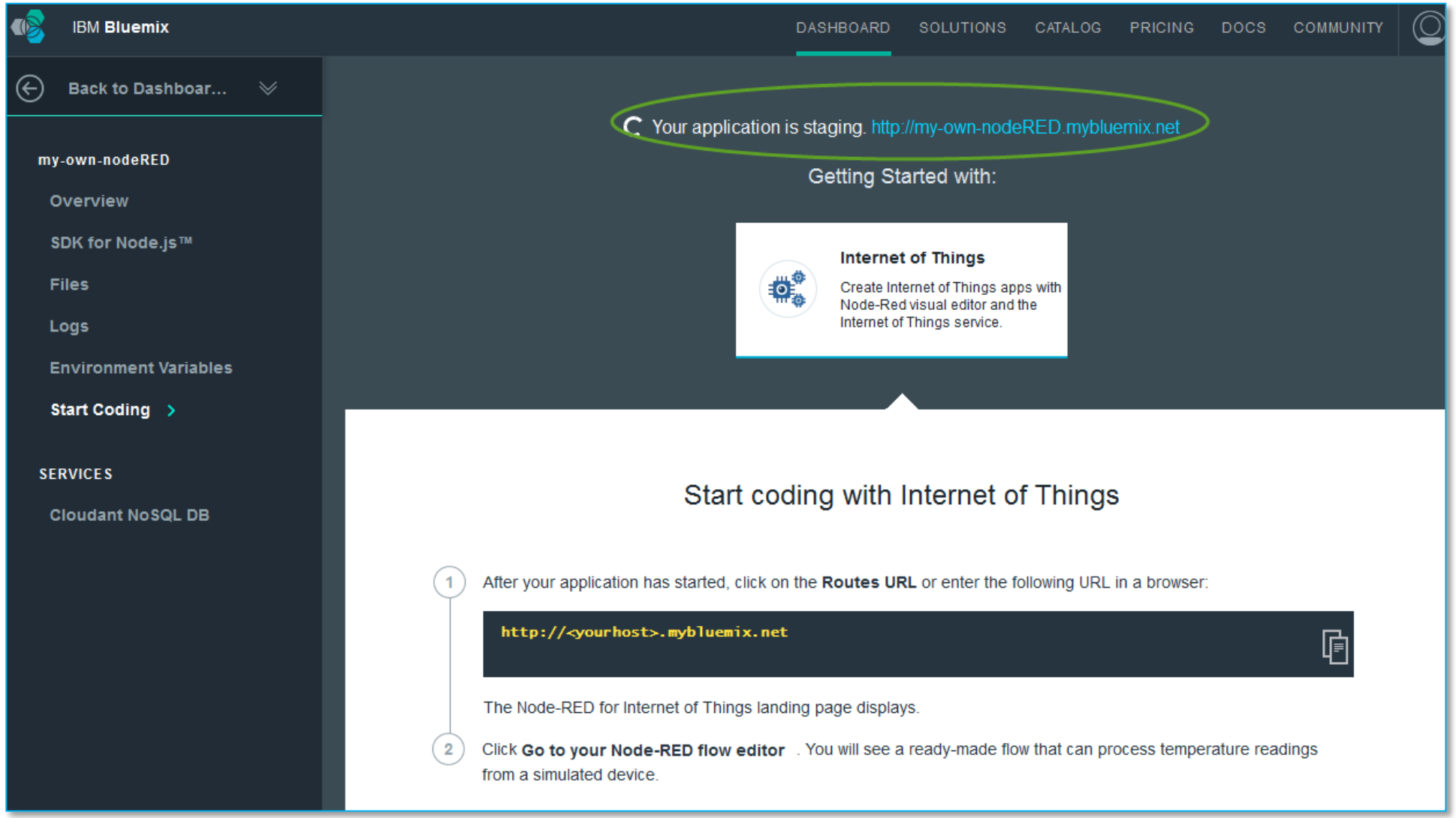
Staging



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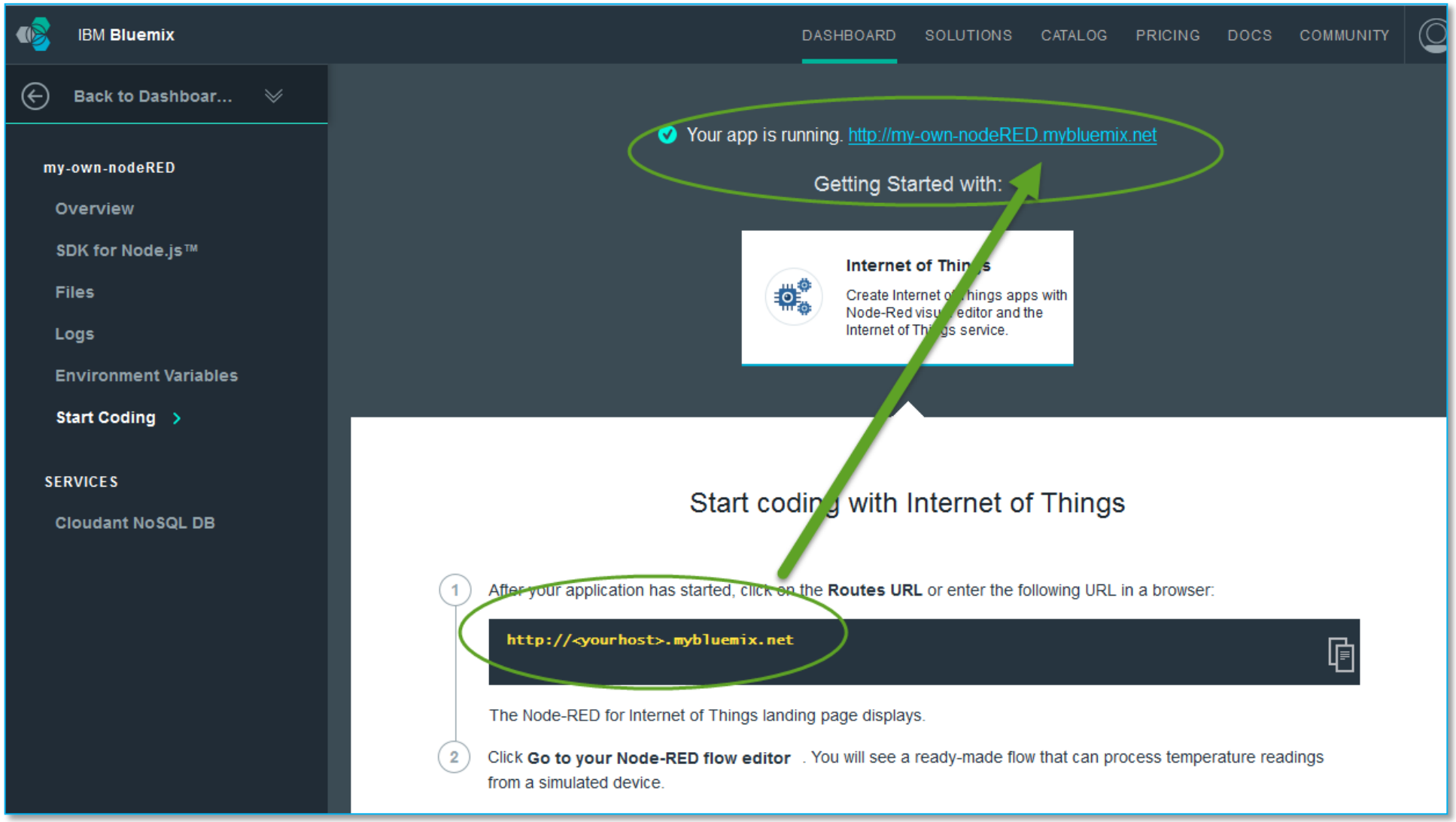
Running



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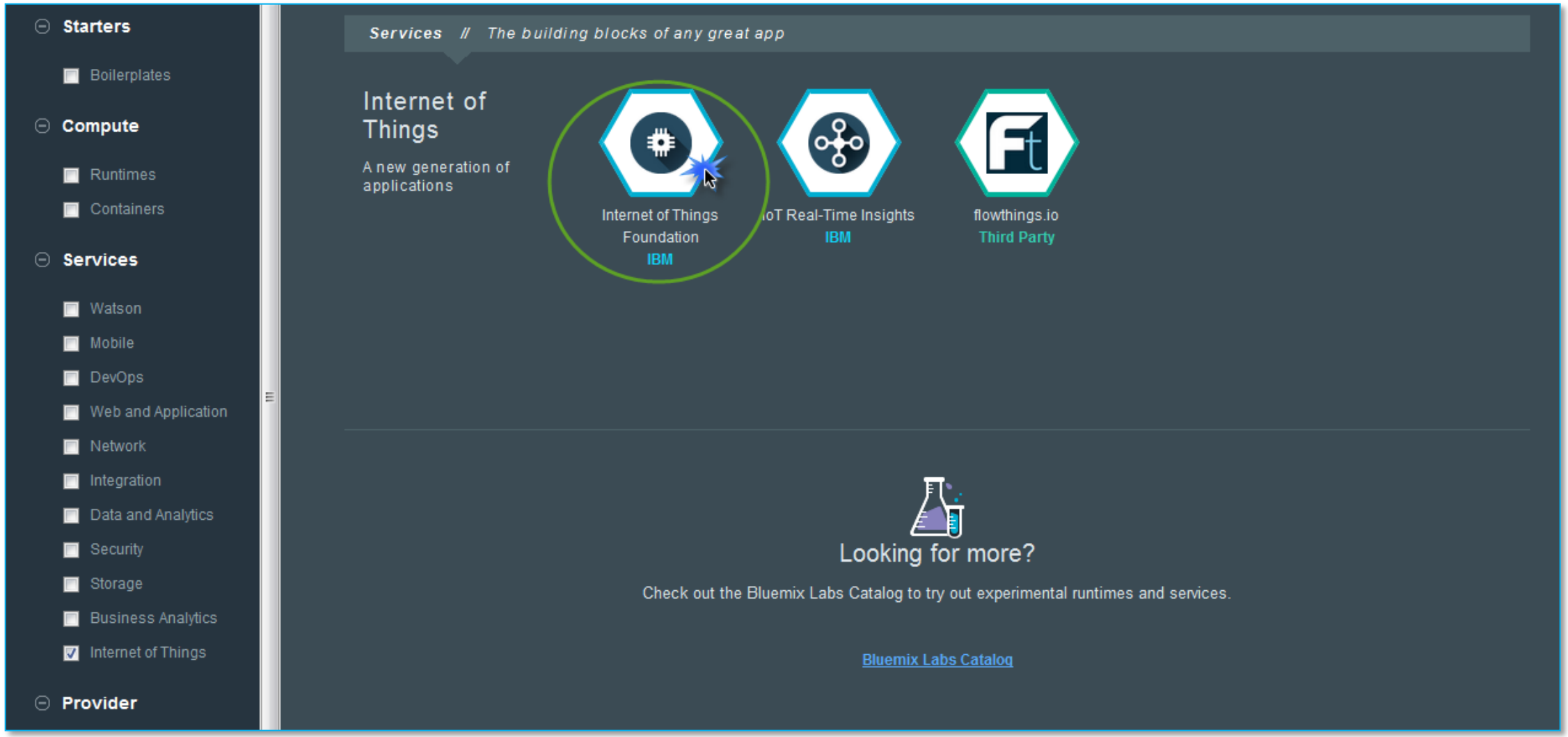
Internet of Things Foundation Service in Catalog



Link to IoTF Service

Internet of Things Foundation

IBM

PUBLISH DATE
10/26/2015

AUTHOR
IBM

TYPE
Service

LOCATION
US South

VIEW DOCS

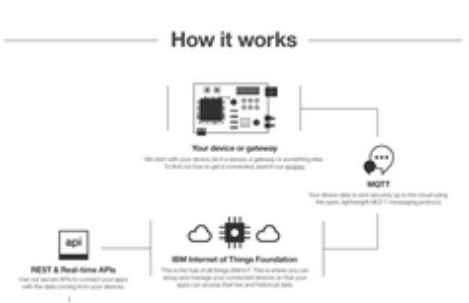
The IBM Internet of Things service lets your apps communicate with and consume data collected by your connected devices, sensors, and gateways. Our recipes make it super easy to get devices connected to our Internet of Things cloud. Your apps can then use our real-time and REST APIs to communicate with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



Add Service

Space:
dev

App:
my-own-nodeRED my-own-no...

Service name:
IoTF-mnR

Selected Plan:
Free

CREATE

Note: follow prompts to re-stage

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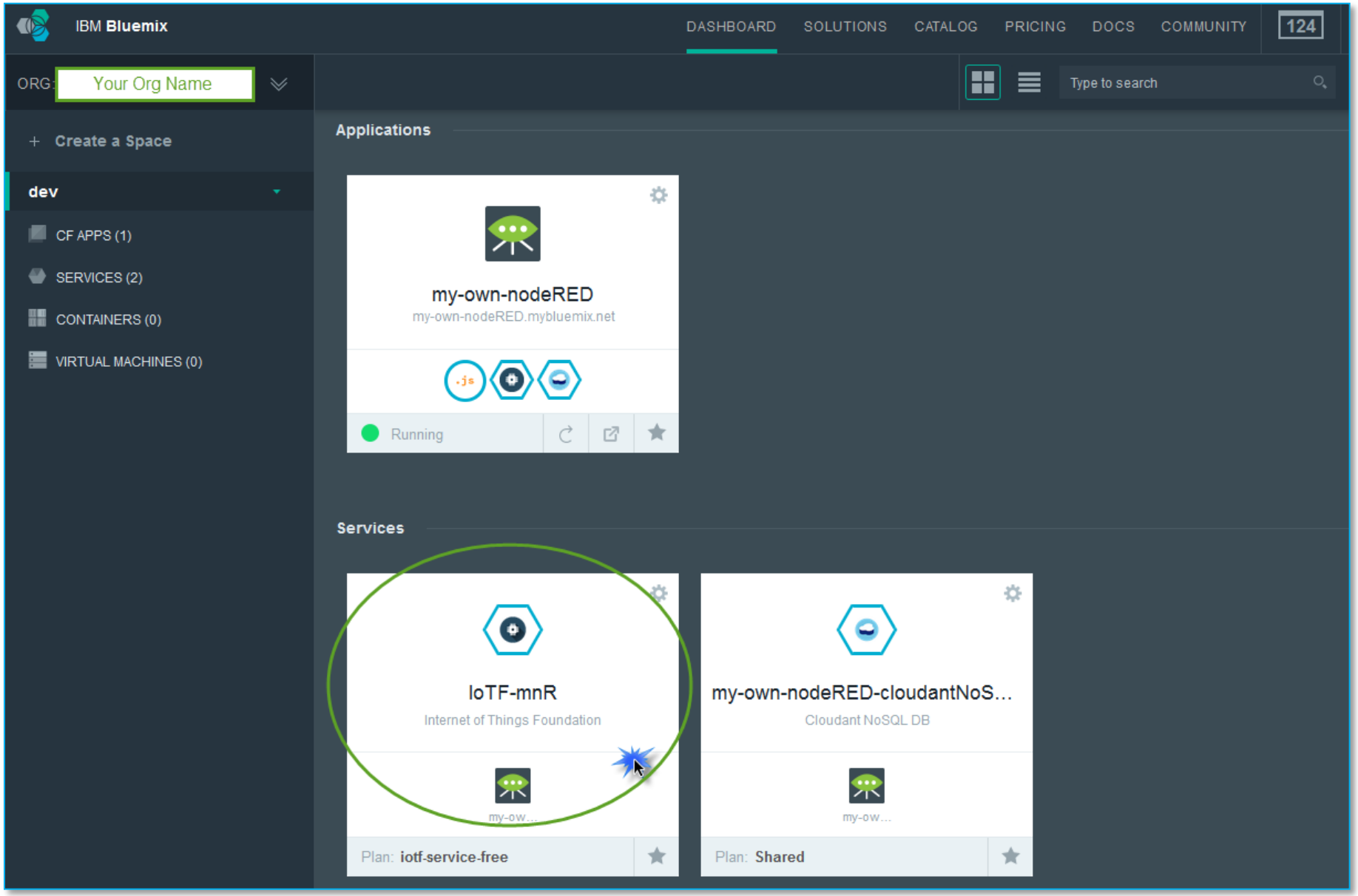
IoT Service



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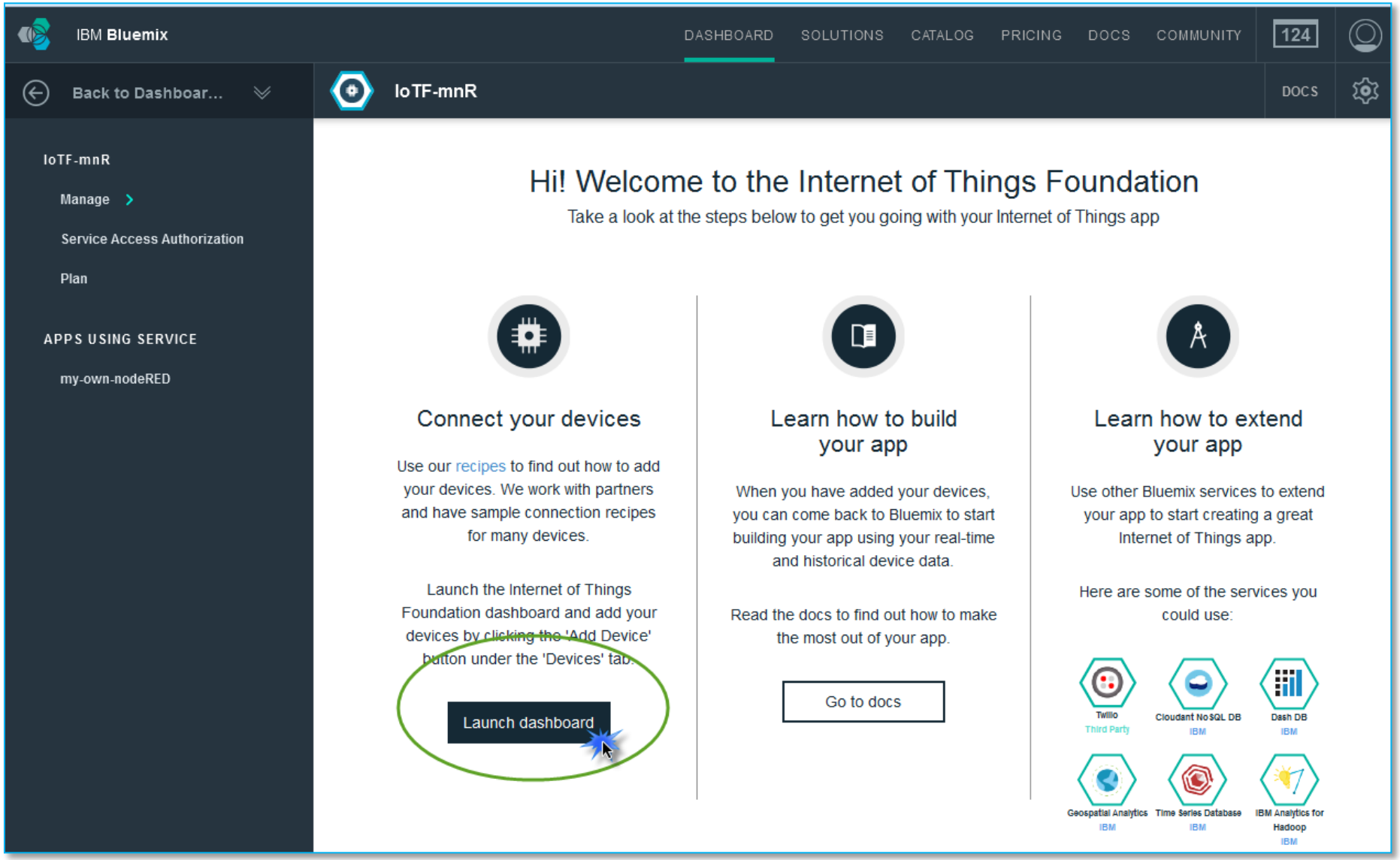
Register the Device



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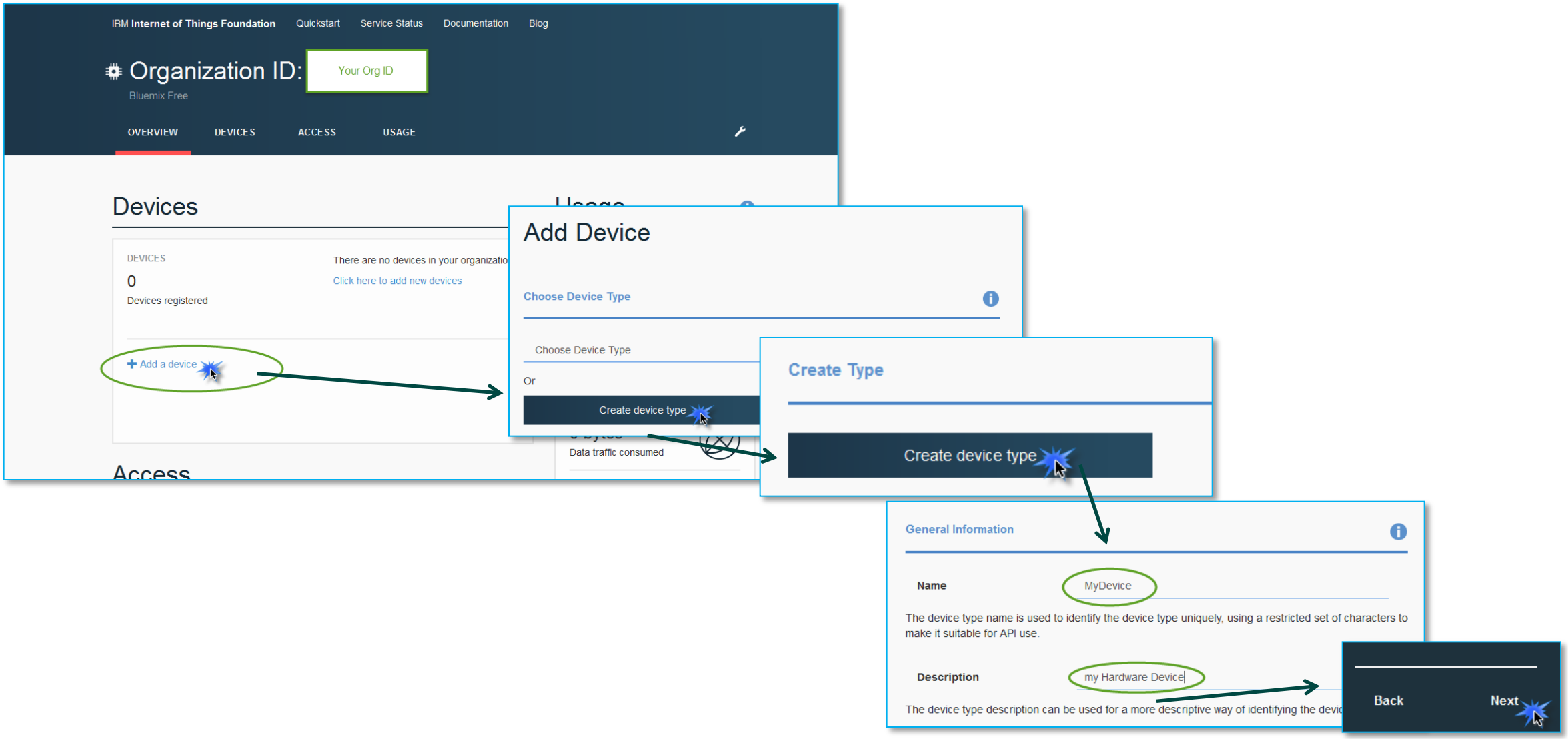
Add Device Type



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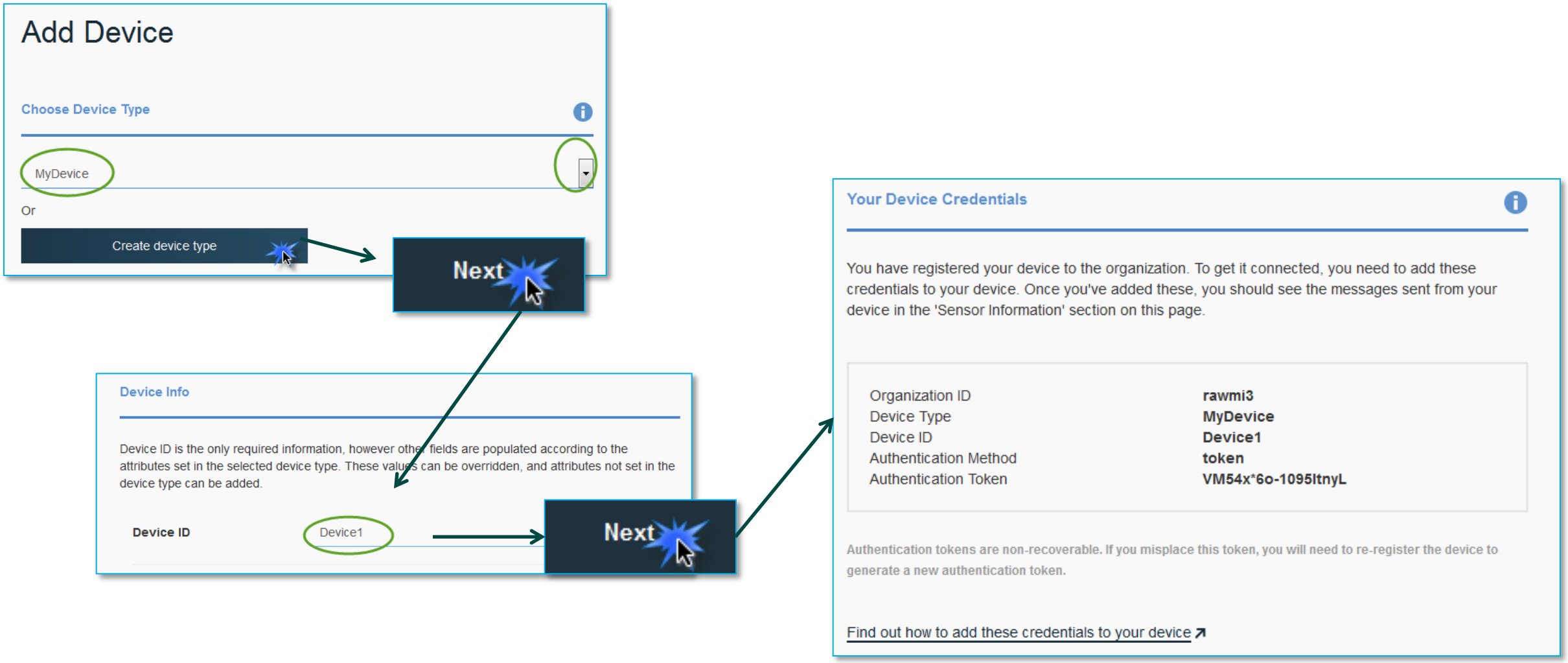
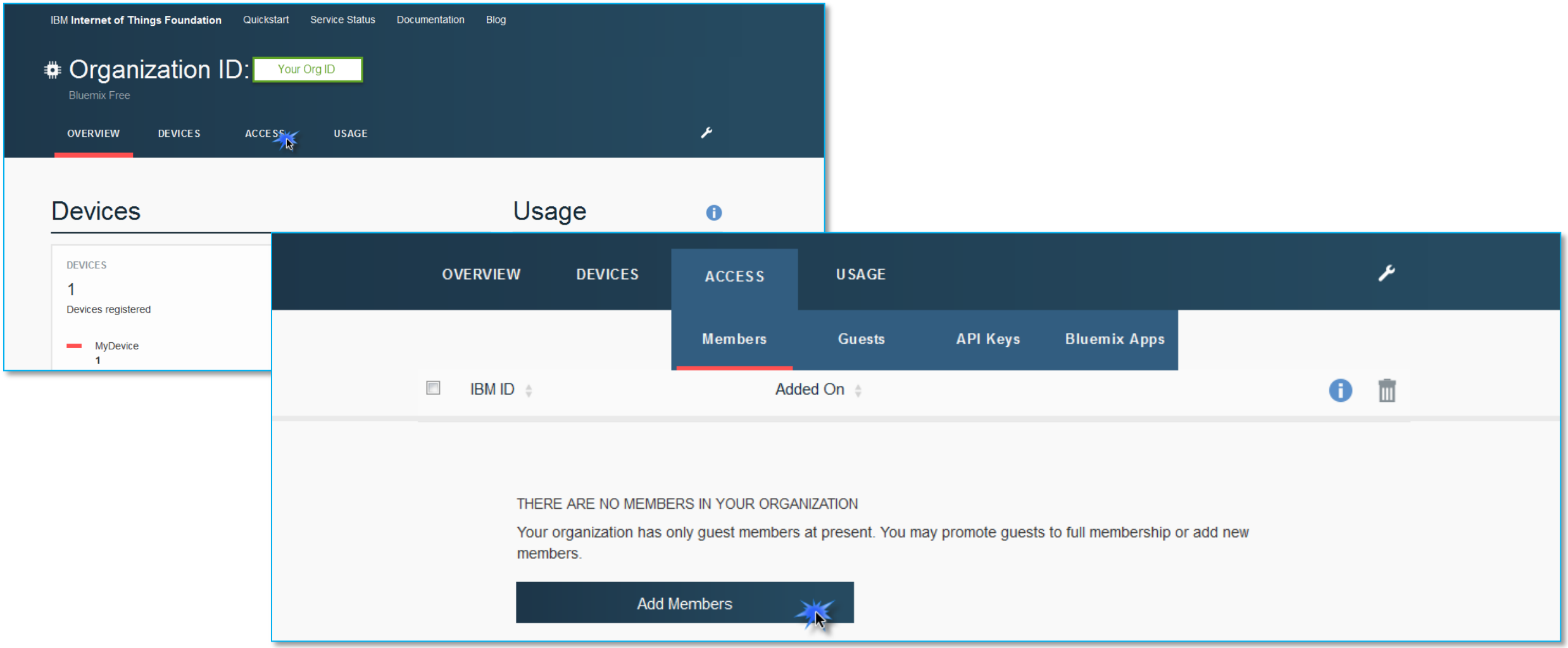
Add Device (and Registration)



Add Yourself to the Organization (Important)



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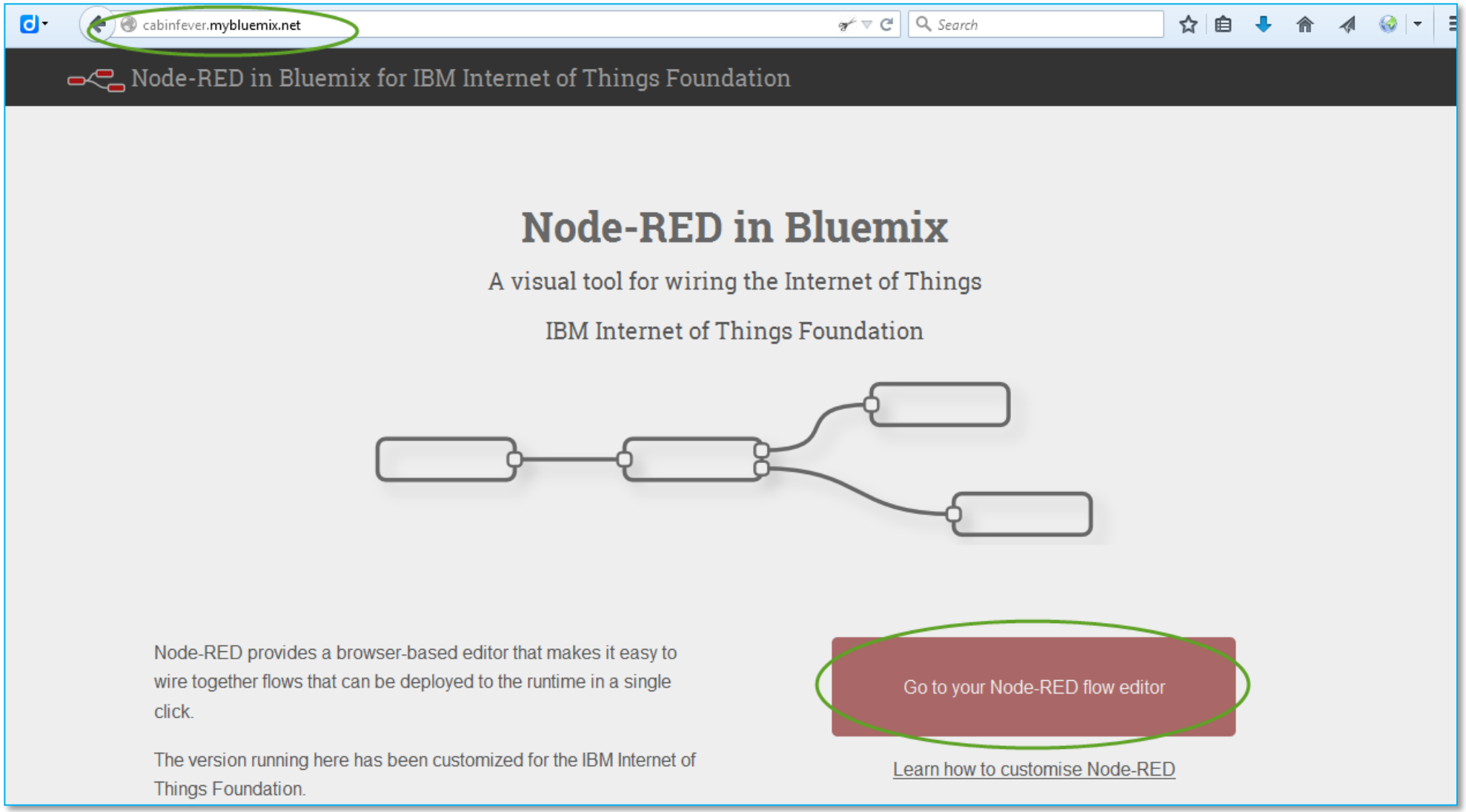
Bluemix Node-RED



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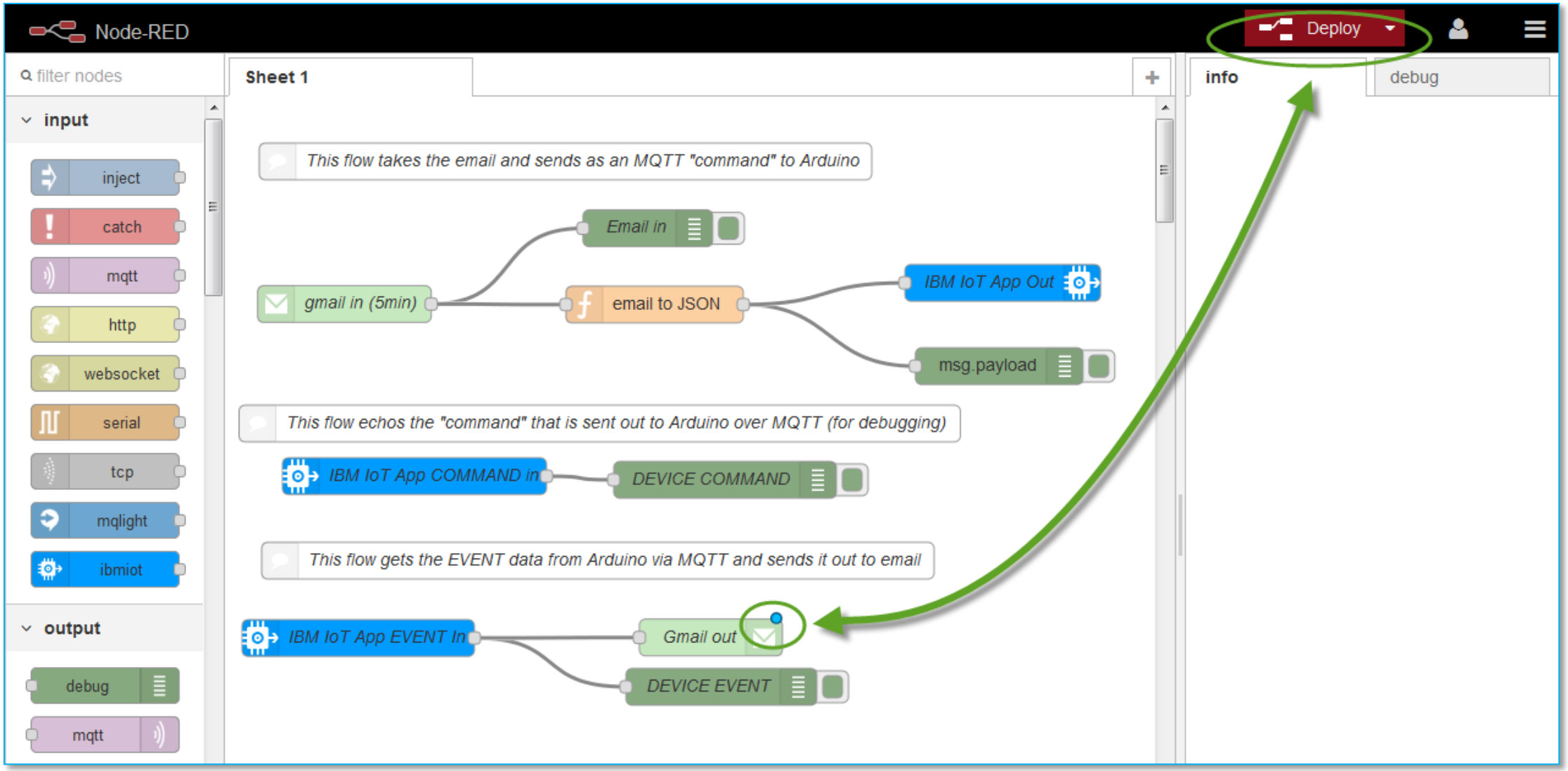
Node-RED flow



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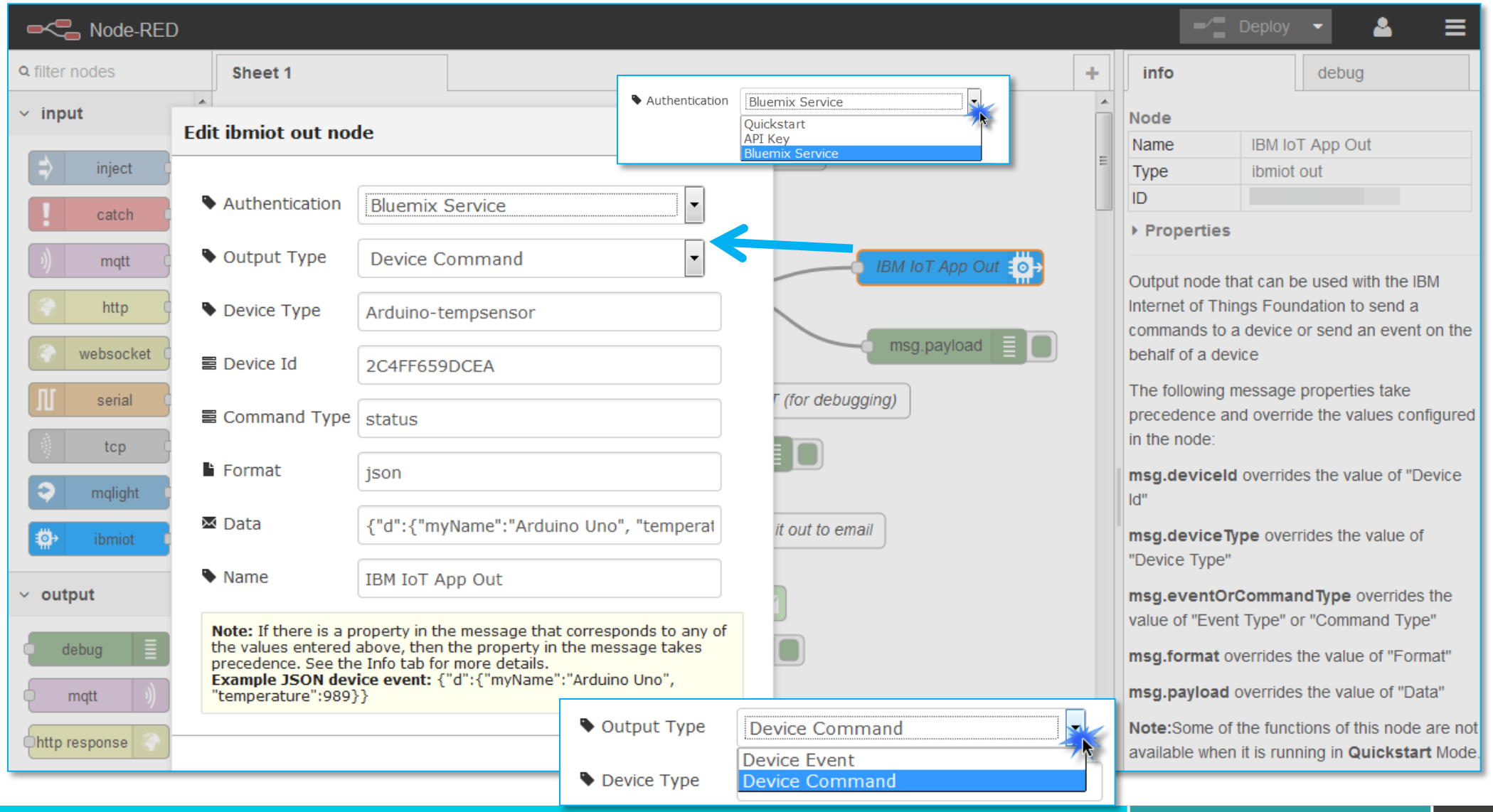
“IBM IoT-out Node” Used to Send Command to Device



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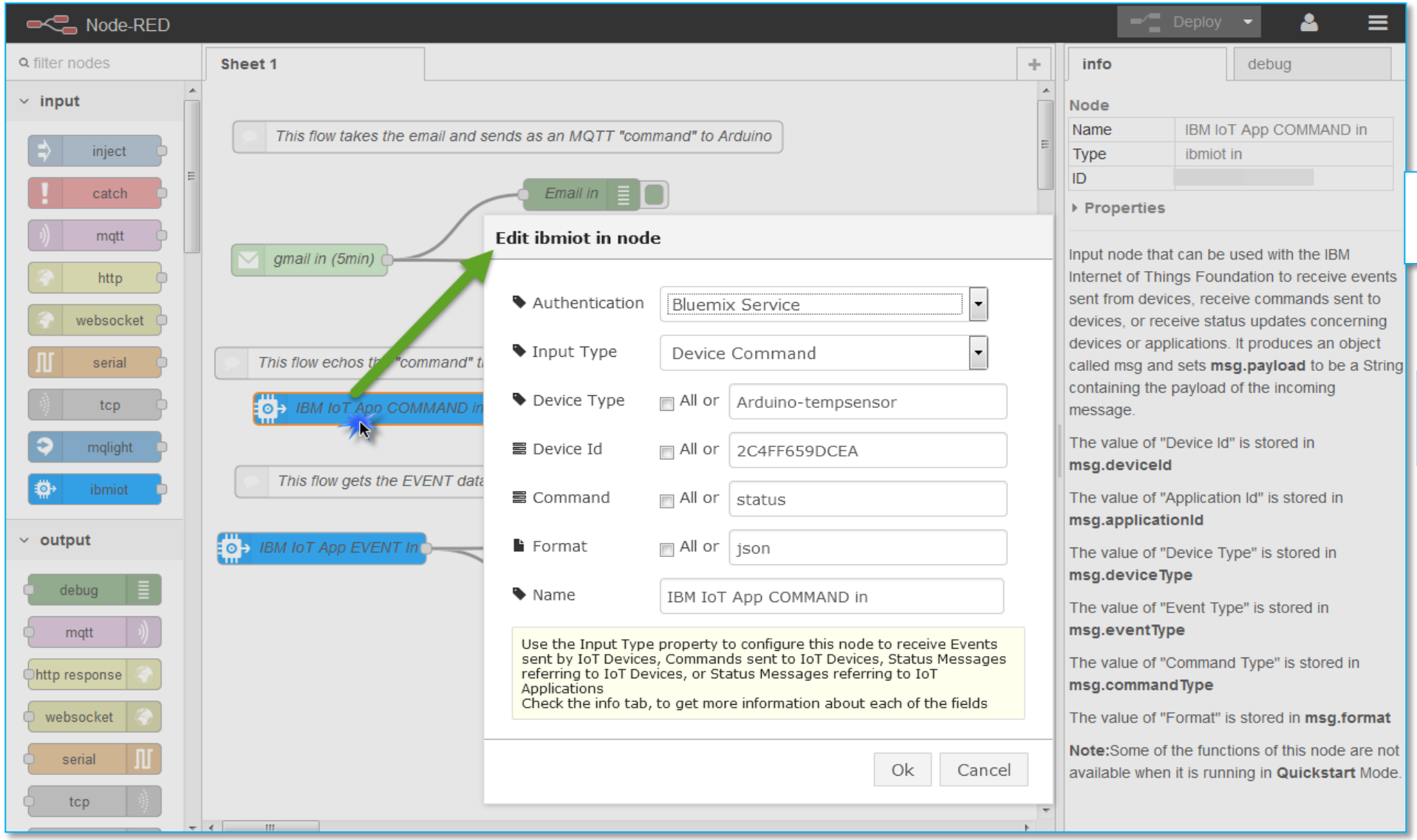
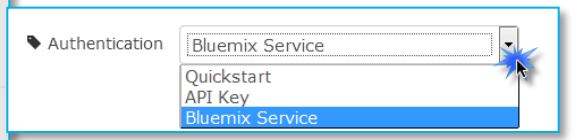
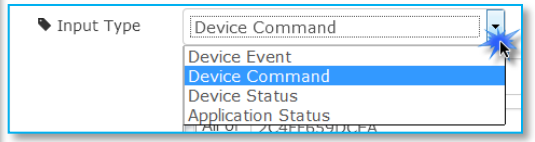
“IBM IoT-in Node” Used to Echo Command to Device







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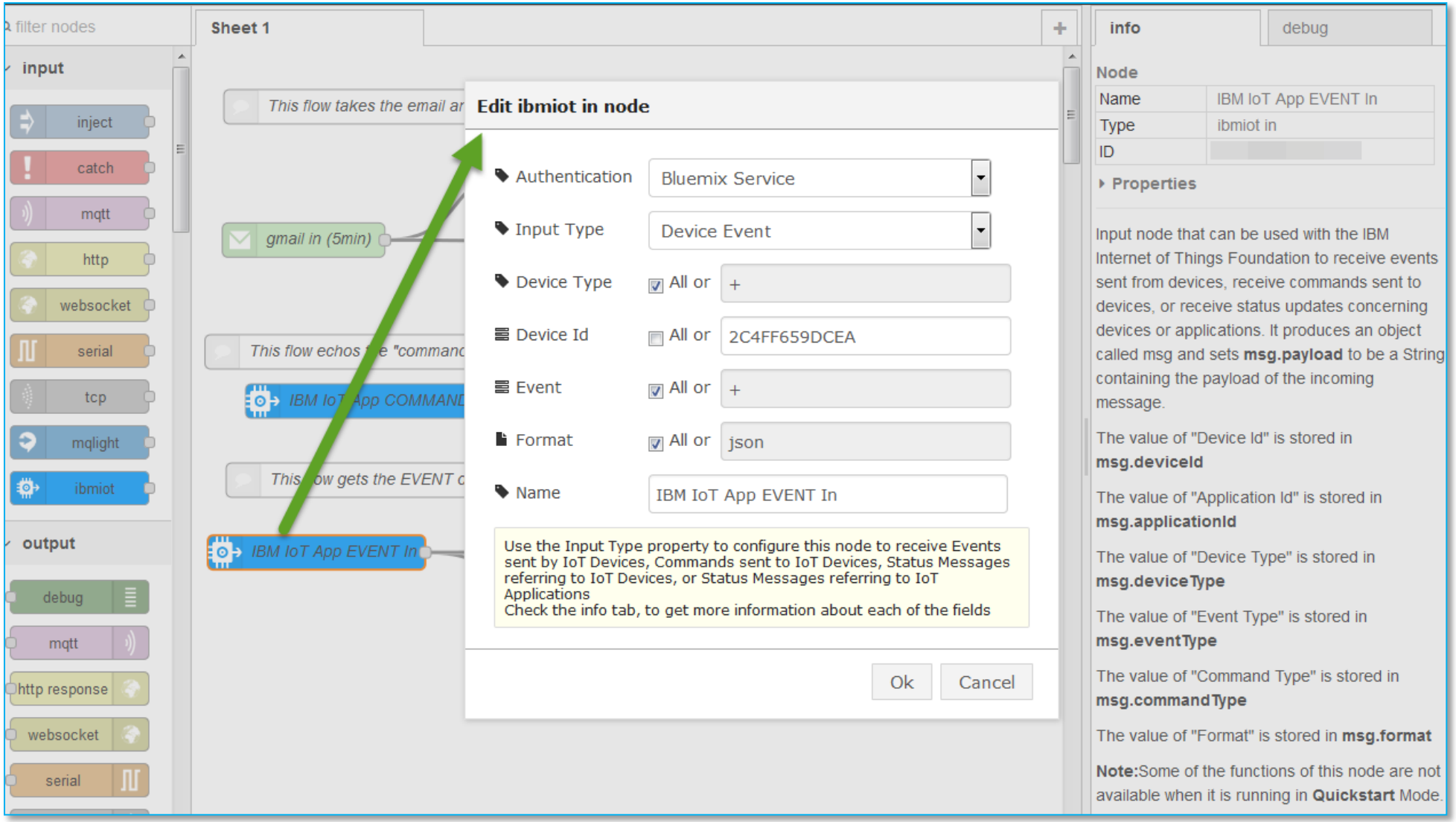
“IBM IoT-in Node” Used to Input Device Event



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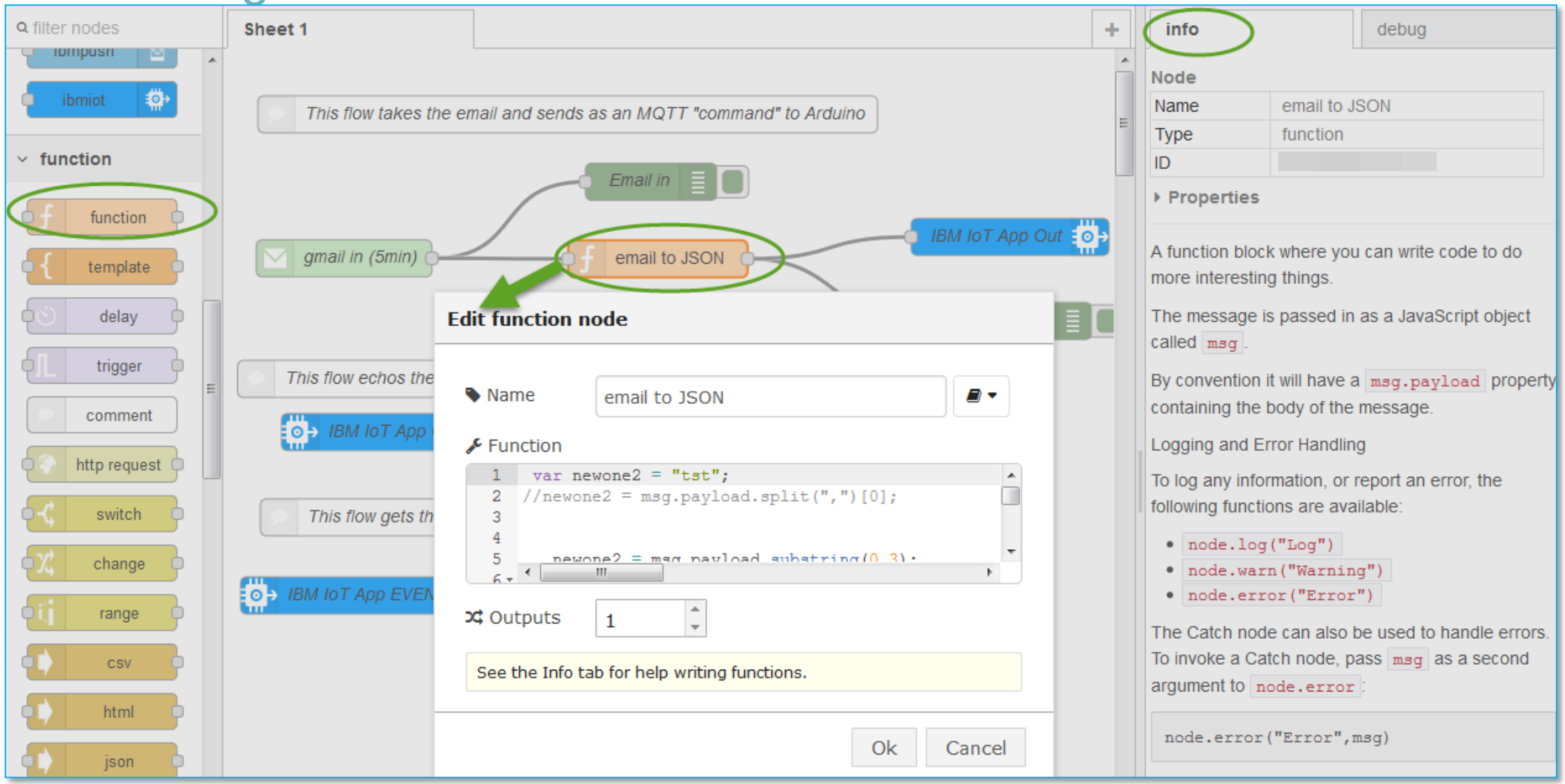
Converting eMail Command to JSON



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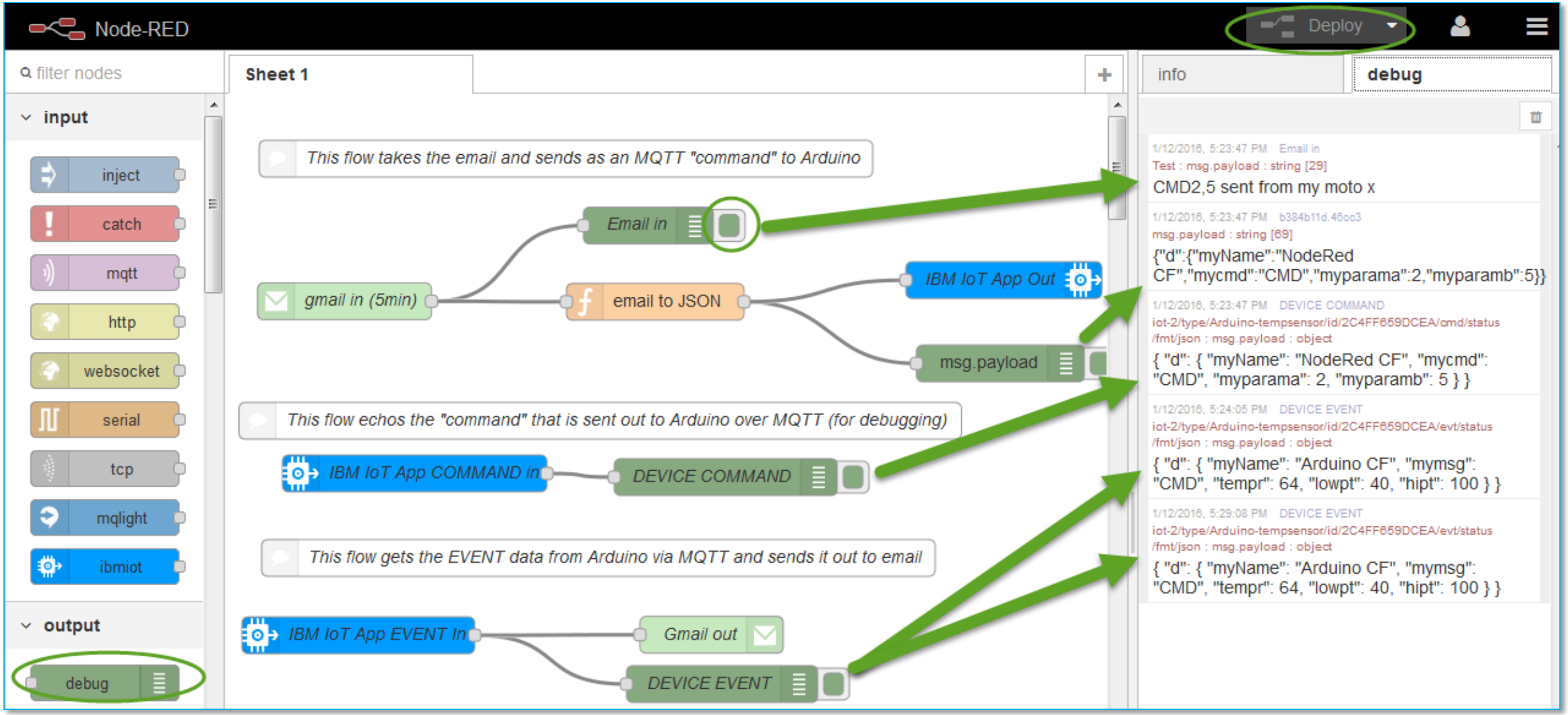
Debugging



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Insights for Weather

Insights for Weather

IBM

PUBLISH DATE
10/22/2015

AUTHOR
IBM

TYPE
Service

LOCATION
US South

VIEW DOCS

This service lets you integrate historical and real-time weather data from The Weather Company into your IBM Bluemix application. You can retrieve weather data for an area specified by a geolocation. The data allows you to forecast, detect, and visualize disruptive weather events that might affect decision making in your application.

- **Standard 1-Day Hourly**

  An hourly weather forecast for the next 24 hours starting from the current time, for a specified geolocation. This forecast includes the current conditions with appropriate units of measure for the location and in the language requested.

- **Standard 10-Day Daily**

  A daily forecast for each of the next 10 days starting from the current day, including forecasts for the daytime and nighttime segments. This forecast includes the forecast narrative text string of up to 256 characters with appropriate units of measure for the location and in the language requested.

- **Current observations**

  Observed weather data (temperature, wind direction and speed, humidity, pressure, dew point, visibility, and UV Index) that is collected from observation devices worldwide, plus a weather phrase and a matching weather icon.

- **Historical data**

  Observed weather data from site-based observation stations for a specified geolocation that includes current observations and up to 24 hours of past observations.

Begin composing your service with

Insights for Weather

LOG IN TO BLUEMIX

Don't have an account?

SIGN UP FOR A FREE TRIAL

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IoT Real-Time Insights

IoT Real-Time Insights

IBM

PUBLISH DATE
12/12/2015

AUTHOR
IBM

TYPE
Service

VIEW DOCS

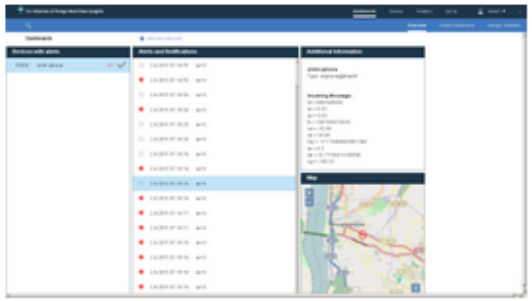
The IBM IoT Real-Time Insights services allows you to understand IoT data in context and monitor the conditions of your devices and operations. IoT Real-Time Insights works with Internet of Things Foundation to enrich and monitor data from you devices, visualize what's happening now, and respond to emerging conditions through automated actions.

- **Contextualize IoT data**

  Apply a virtual data model which combines IoT data with asset master data to put data in context and gain greater insight. For example, incoming data can be merged with master asset data from Maximo Asset Management for a complete view of your assets.

- **Apply rules and take automated action**

  Using the built in rules engine, monitor enriched data to detect when a device or process is not performing properly, and then automate the appropriate response to ensure that business operations are not disrupted. For example, you could automatically create a work order to track an issue in Maximo and respond with a service technician.



http://www.ng.bluemix.net/docs/services/iotrtinsights/index.html

Take aways

Let’s take a moment to think of one take-away you have from this presentation

Also, please submit a survey!

How to Contact me

Please reach out and Connect to me!
(tell me why you want to connect)

- Blog: http://www.henrywill4.com
- Twitter: @henrywill and @pmlessons
- International Project Management Group (Founded by Mr. Will): http://www.pmlessonslearned.com
- Blog post about this project
- http://henrywill4.blogspot.com/2016/02/cabin-fever-part-6-smart-temperature.html
- You'll find me updating that post with more info during this InterConnect 2016 conference

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For More In-depth discussion…

Stop by and see me at my “Ask Me Anything” Session

- IDA-6963 - Connecting Node-RED Flows to the IBM Watson IoT Platform for an IoT Device
- Wednesday Feb. 24, 12:00 PM to 2:00 PM
- Venue : Mandalay Bay Solution EXPO
- Room : dev@interconnect - Ask Me Anything Station 1

- Please also review the replay of my Breakout Session: “**IND-2119 :** A Primer to Programming an Internet of Things Device on IBM Bluemix”

Reference Slides are located after these Legal Slides

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laptop or conference kiosk.

Ask Me Anything:
Connecting Node-RED Flows to the IBM Watson IoT Platform for an IoT Device
IDA-6963

The Benefits of IBM IoTF

- Web Dashboard
- Cloud hosted
- Device Management: Reboot, update firmware, device diagonstics, bulk device addition and removal
- Responsive, Scalable Connectivity
- Secure communication (MQTT and TLS)
- Storage and access to data
- Ties to other Bluemix services (including Watson)

From https://internetofthings.ibmcloud.com/#/

IoT Game Using MQTT

Load this URL on your Mobile Device to play:

http://iotgame.mybluemix.net/

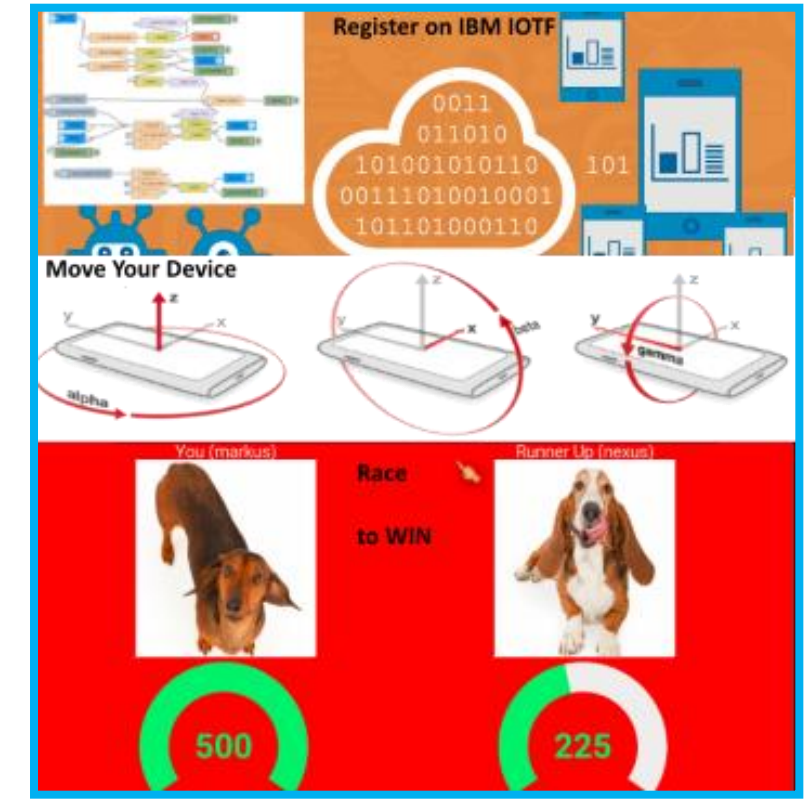
Dashboard:

http://decodenr.mybluemix.net/freeboard/#start-34807

Video about the technology:

https://www.youtube.com/watch?v=sTfmU-UwXmU

Thanks for Markus Van Kempen for this game



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IND-2119 A Primer: Programming an IoT Device on IBM Bluemix

Code Example

Code Example: Page 1

ESP8266_NodeMCU-2016-02-16-Henry-Will | Arduino 1.6.7

File Edit Sketch Tools Help

ESP8266_NodeMCU-2016-02-16-Henry-Will § | mydefs.h | myssid.h

```
/*
This code was taken from a Pubsub Example at:
https://github.com/knolleary/pubsubclient/tree/master/examples/mqtt_esp8266
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This code was modified by Henry Will under the same license 2016-02-16

 Basic ESP8266 MQTT example
 This sketch demonstrates the capabilities of the pubsub library in combination with the ESP8266 board/library.

 It connects to wifi and then to the IBM Bluemix IoT Foundation MQTT Server then:
  - publishes a JSON message to the topic every two seconds
  - subscribes to the command topic, printing out any messages it receives. NB - it assumes the received payloads are strings not binary
  - If the first character of the command topic is an 1, switch ON the ESP Led,
    else switch it off

 It will reconnect to the server if the connection is lost using a blocking
 reconnect function. See the 'mqtt_reconnect_nonblocking' example for how to
 achieve the same result without blocking the main loop.

 To install the ESP8266 board, (using Arduino 1.6.4+):
  - Add the following 3rd party board manager under "File -> Preferences -> Additional Boards Manager URLs":
       http://arduino.esp8266.com/stable/package_esp8266com_index.json
  - Open the "Tools -> Board -> Board Manager" and click install for the ESP8266"
  - Select your ESP8266 in "Tools -> Board"
- you will also need to add this USB driver for windows machines and reboot after installing it:
https://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx
And, you need to add the pubsub library from here:
https://github.com/knolleary/pubsubclient/tree/master/src

More info at my blog here:
http://henrywill4.blogspot.com/2016/02/the-esp8266-nodemcu-using-arduino-ide.html
*/
```

#ibminterconnect

Code Example: Page 2

```
42
43 #include <ESP8266WiFi.h>
44 #include <PubSubClient.h>
45
46 // Explicit Function Prototypes (to prevent compiler errors
47 void setup_wifi();
48 void callback(char* topic, byte* payload, unsigned int length);
49 void reconnect();
50
51
52 #include "mydefs.h"
53 //mydefs.h includes the following:
54 // Update these with values suitable for IoTF org
55 //const char* mqtt_server = "myorgid.messaging.internetofthings.ibmcloud.com"; // change myorgid to the one you have in IoTF
56 // char* myclient = "d:<<orgid>>:<<Deviceid>>";  // where <<orgid>> is the orgid (do not include << and >>) and
57 //    and DeviceID is the Device ID that was registered (don not include << >>)
58 // char* myclientpwd = "zzzzzzz";  // Authentication Token provided at time of registration fo this device
59 // for details, see https://docs.internetofthings.ibmcloud.com/devices/mqtt.html
60
61 #include "myssid.h"
62 //myssid.h includes the following:
63 // Update these with values suitable for your wifi network
64 //const char* ssid = "myssid";
65 //const char* password = "my pwd";
66
67
68 WiFiClient espClient;
69 PubSubClient client(espClient);
70 long lastMsg = 0;
71 char msg[50];
72 int value = 30;
73
```

Code Example: Page 3

```
73
74 void setup() {
75   pinMode(BUILTIN_LED, OUTPUT);     // Initialize the BUILTIN_LED pin as an output
76   Serial.begin(115200);
77   setup_wifi();
78
79   client.setServer(mqtt_server, 1883);
80   client.setCallback(callback);
81 }
82
83 void setup_wifi() {
84   delay(10);
85   // We start by connecting to a WiFi network
86   Serial.println();
87   Serial.print("Connecting to ");
88   Serial.println(ssid);
89
90   WiFi.begin(ssid, password);
91
92   while (WiFi.status() != WL_CONNECTED) {
93     delay(500);
94     Serial.print(".");
95   }
96
97   Serial.println("");
98   Serial.println("WiFi connected");
99   Serial.println("IP address: ");
100  Serial.println(WiFi.localIP());
101  delay(5000);
102
103 }
```

Code Example: Page 4

```
104
105 void callback(char* topic, byte* payload, unsigned int length) {
106   Serial.print("Message arrived [");
107   Serial.print(topic);
108   Serial.print("] ");
109   for (int i = 0; i < length; i++) {
110     Serial.print((char)payload[i]);
111   }
112   Serial.println();
113
114   // Switch on the LED if an 1 was received as first character
115   if ((char)payload[0] == '1') {
116     digitalWrite(BUILTIN_LED, LOW);   // Turn the LED on (Note that LOW is the voltage level
117     // but actually the LED is on; this is because
118     // it is acive low on the ESP-01)
119   } else {
120     digitalWrite(BUILTIN_LED, HIGH);  // Turn the LED off by making the voltage HIGH
121   }
122 }
123
124
125
126
```

Code Example: Page 5

```
127 void reconnect() {
128   // Loop until we're reconnected
129   while (!client.connected()) {
130     Serial.print("Attempting MQTT connection...");
131     // Attempt to connect
132 // see https://docs.internetofthings.ibmcloud.com/devices/mqtt.html
133     if (client.connect(myclient,"use-token-auth",myclientpwd)) {
134       Serial.println("connected");
135       // Once connected, resubscribe
136       client.subscribe("iot-2/cmd/status/fmt/json");
137     } else {
138       Serial.print("failed, rc=");
139 // Note: list of errors here: https://github.com/knolleary/pubsubclient/blob/master/src/PubSubClient.h
140       Serial.print(client.state());
141       Serial.println(" try again in 5 seconds");
142       // Wait 5 seconds before retrying
143       delay(5000);
144     }
145   }
146 }
```

Code Example: Page 6

```
147 void loop() {
148   if (!client.connected()) {
149     reconnect();
150   }
151   client.loop();
152 
153   long now = millis();
154   if (now - lastMsg > 2000) {
155     lastMsg = now;
156     ++value;
157     snprintf (msg, 75, "{\"d\":{\"myName\":\"ESPnodeMCU\",\"temp\":%ld}}", value);
158     Serial.print("Publish message: ");
159     Serial.println(msg);
160     client.publish("iot-2/evt/status/fmt/json", msg);
161   }
162 }
```

IND-2119 A Primer: Programming an IoT Device on IBM Bluemix

Reference Slides

Backup and Reference

- My blog post about the “Cabin Fever” project: http://henrywill4.blogspot.com/2015/09/cabin-fever-part-5-mqtt-and-ibm.html
  - And the most recent: http://henrywill4.blogspot.com/2016/02/cabin-fever-part-6-smart-temperature.html
- My Blog post about ESP 8266 NodeMCU http://henrywill4.blogspot.com/2016/02/the-esp8266-nodemcu-using-arduino-ide.html
- Bluemix: http://bluemix.net
- Getting started with IoTF
  - Great Video about how to get started with Bluemix and IoT using the temperature sensor https://www.youtube.com/watch?v=sCcFR92DA8w
  - This is the place to start (and has lots of links to help: Getting Started in IoT Foundation: https://www.ng.bluemix.net/docs/#services/IoT/index.html#gettingstartedtemplate
  - Docs (Info) about IoTF: http://iotf.readthedocs.org/en/latest/reference/concepts.html?cm_mc_uid=62867461194814392103270&cm_mc_sid_50200000=1441455248
- Stackoverflow (a great place to ask questions and get help): http://stackoverflow.com/questions/tagged/bluemix
- IoTF Recipes:
  - How they work (video): https://www.youtube.com/watch?v=wE6Yo8RWJlY
  - Where they are located: https://developer.ibm.com/iotfoundation/
  - Search for IoTF Recipes: https://developer.ibm.com/recipes/?post_type=tutorials&s=IoTF
  - Quickstart: https://quickstart.internetofthings.ibmcloud.com/#/

More Backup and Reference

- Creating Applications with Node-RED for Bluemix: https://www.ng.bluemix.net/docs/services/IoT/index.html#iot180
- Arduino IDE: https://www.arduino.cc/en/Main/Software
- MQTT:
  - MQTT: http://mqtt.org/
  - Paho Project (open-source client libraries for MQTT) http://www.eclipse.org/paho/
  - Arduino MQTT Library: http://pubsubclient.knolleary.net/
- Amazing Watson Rover Demo of what can be done with Watson on Bluemix and IoT: https://player.vimeo.com/video/130135196
- Node_RED: http://nodered.org/ and http://noderedguide.com/ and https://groups.google.com/forum/#!forum/node-red
- Email to SMS Text Messages: http://www.emailtextmessages.com/

Recipes and Code that I Found Helpful – page 1 of 2

- This article “One Wire Digital Temperature. DS18B20 + Arduino ” was helpful to learn how to get the temperature sensor to work: http://bildr.org/2011/07/ds18b20-arduino/
- This one shows how to connect to quickstart. There is a second part, use the link near top for “view more content in this series”: http://www.ibm.com/developerworks/cloud/library/cl-bluemix-arduino-iot1/index.html Note: the second part has a link to download the sample sketch (code). I like the way that this code’s “loop” will try to reconnect if it’s not connected (pull the internet connection out and plug it back in, you’ll see that it will reconnect)
- Note that the second part of that recipe includes a description of what the JSON format looks like http://www.ibm.com/developerworks/cloud/library/cl-bluemix-arduino-iot2/index.html
- This code README explains how to form the client ID (under the heading "Registered Flow from device and to device") https://github.com/ibm-messaging/iot-arduino/blob/master/README.md
- The Arduino example code located at this link gives an example of how to subscribe to MQTT and the commands from the “application” https://github.com/knolleary/pubsubclient/tree/master/examples/mqtt_publish_in_callback
- This recipe was helpful to see the difference between a quickstart (unregistered) and registered flow: https://developer.ibm.com/recipes/tutorials/connect-an-arduino-uno-device-to-the-ibm-internet-of-things-foundation/

Recipes and Code that I Found Helpful – page 2 of 2

- This IBM Redpaper “MQTT and Arduino Devices” and the code there was also found to be helpful (but, note that it only starts the internet connection in the startup and therefore it does not automatically reconnect if disconnected as in the receipe above): http://www.redbooks.ibm.com/redpapers/pdfs/redp4929.pdf
- The following questions posted by me were also very helpful
  - http://stackoverflow.com/questions/32961280/how-can-ibm-bluemix-node-red-iotout-node-be-set-up-correctly-to-send-command-to/32961307#32961307
  - http://stackoverflow.com/questions/33029450/how-can-i-convert-between-plain-text-in-json-in-node-red-function-node
- When writing the JS code in the Node-Red “function” node to convert email to JSON, I found the following websites helpful:
  - http://www.w3schools.com/jsref/jsref_obj_string.asp
  - http://stackoverflow.com/questions/4090518/string-to-int-use-parseint-or-number
  - http://nodejs.org
  - http://code.tutsplus.com/tutorials/nodejs-for-beginners--net-26314
  - developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/
- This recipe was helpful to learn how to bind the IoTF service to the application, register the device with IoTF, and get an API key. It also explains the format of the topics for publishing and subscribing: http://www.ibm.com/developerworks/cloud/library/cl-mqtt-bluemix-iot-node-red-app/index.html
- My blog post on Cabin Fever: http://henrywill4.blogspot.com/2015/09/cabin-fever-part-5-mqtt-and-ibm.html

Thank You

Ask Me Anything:
Connecting Node-RED Flows to the IBM Watson IoT Platform for an IoT Device
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