

Workshop: Connecting IoT devices to the cloud with IBM Watson IoT and mbed Connector

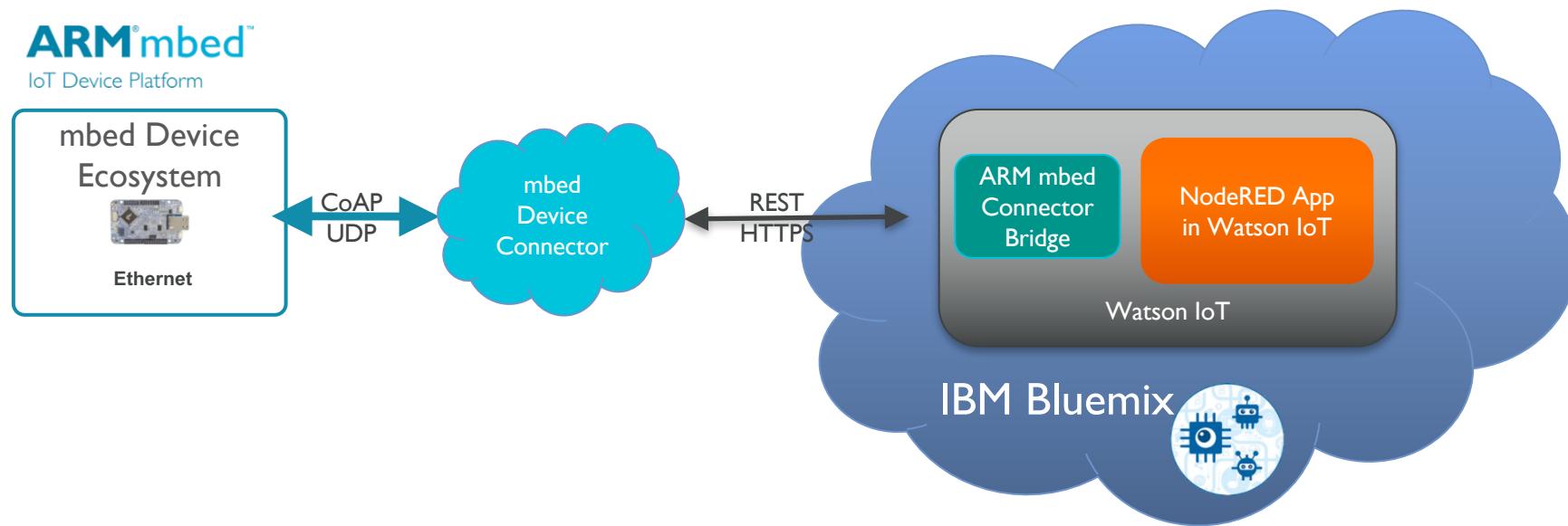
ARM

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Sept 25, 2017 – v1.6

What will we build in this Workshop?



- Connect your mbed device into Watson IoT through mbed Connector and Watson's Connector Bridge
 - Create a simple mbed device and connect it to mbed Device Connector
 - Watson IoT now has a fully integrated mbed Device Connector Bridge that links mbed Device Connector to Watson!!
 - Exploration of the device data telemetry using NodeRED flows within Watson IoT

Workshop: Let's get started!

- Create and setup your Bluemix account (should be completed prior to workshop)
- Install the necessary tools/drivers into your Windows/Mac/Linux PC (should be completed prior to workshop)
- Create mbed developer and Connector accounts (should be completed prior to workshop)
- Retrieve a set of provisioning credentials (security.h)
- Import our mbed sample project into the online IDE
- Update the sample project with the provisioning credentials (security.h)
- Compile, Install, Download, and Copy into the mbed device
- Connect a Serial Terminal (115200,8N1, proper mbed COM port chosen for Windows users...)
- Send the “Break” command to reset the mbed device
- See the device output on our Serial Terminal (PTSOOI method...)

NOTE: During the workshop, be sure to double-check your copy/paste operations...

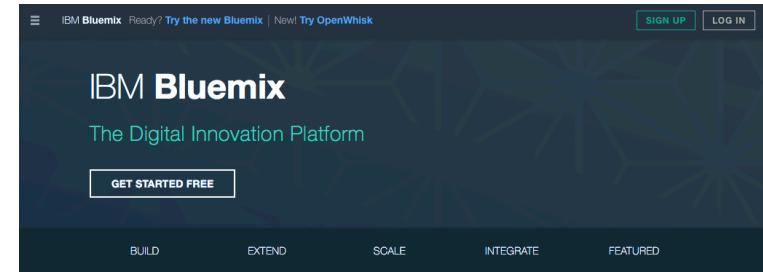
Quick Links: Visit https://github.com/ARMmbed/anson_workshop_mbed_connect_2016

- README.md has most of the links in the workshop...

Create our Bluemix Account

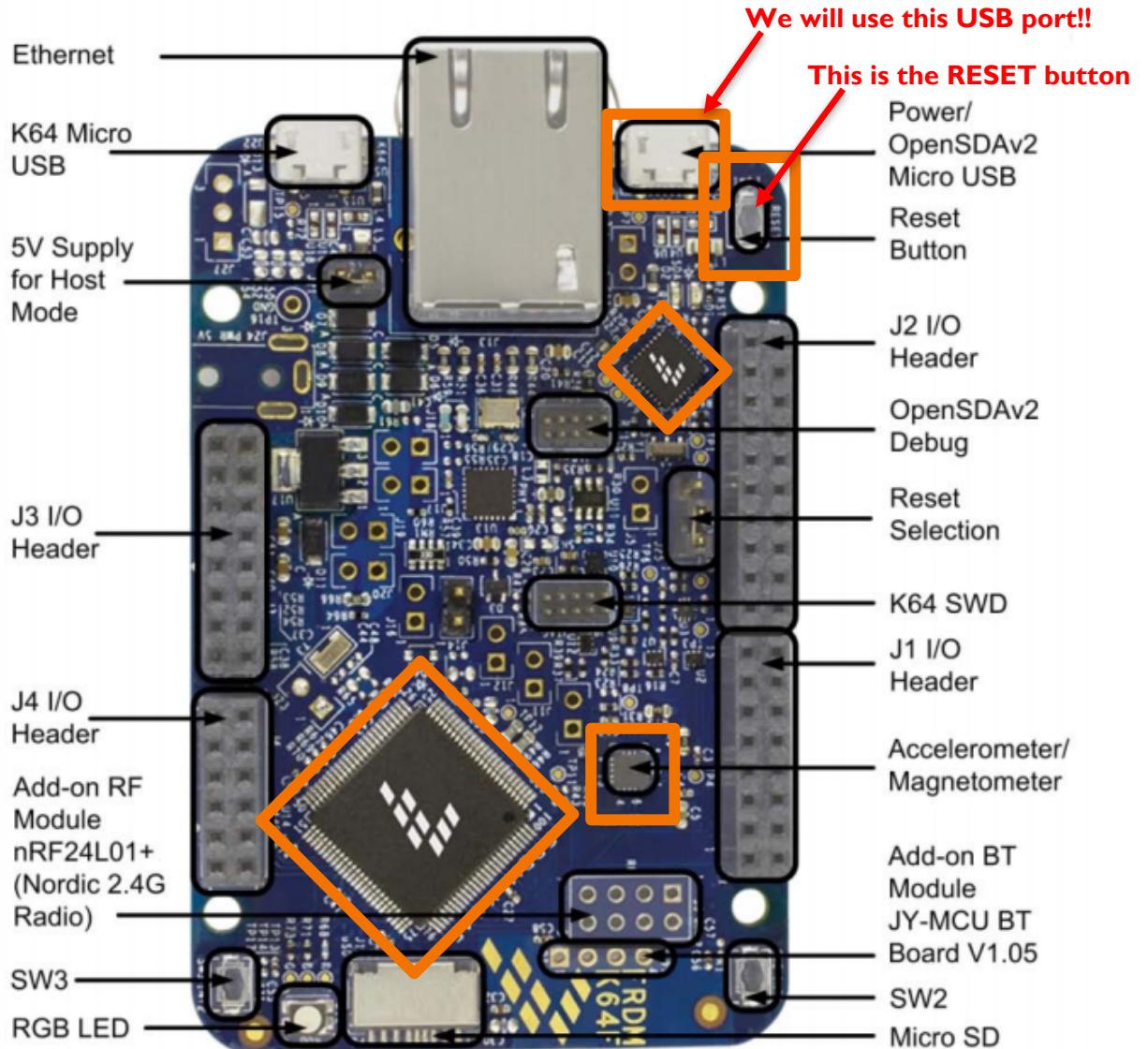
- Navigate to the Bluemix Dashboard:
<https://console.bluemix.net/>
- Press “Sign Up”
- Complete the sign-up process
- A confirmation email will be sent that must be acknowledged
- Log into your Bluemix account and establish your default organization and space

Prior to
Workshop

A screenshot of the 'Sign up for IBM Bluemix' registration page. The page has a dark blue header with the title 'Sign up for IBM Bluemix'. Below it, a subtext mentions a 30-day trial with free access to runtime and container memory. There are links for 'Already have an IBM ID?' and 'Log In'. The main form consists of several input fields: 'First Name*' and 'Email Address*', 'Last Name*' and 'Password*', 'Phone Number*' and 'Re-enter Password*', 'Company' and 'Security Question*', and 'Select your country or region' with a dropdown menu showing 'UNITED KINGDOM'. A checkbox at the bottom left allows users to stay informed via email or telephone. A 'CREATE ACCOUNT' button is located at the bottom right.

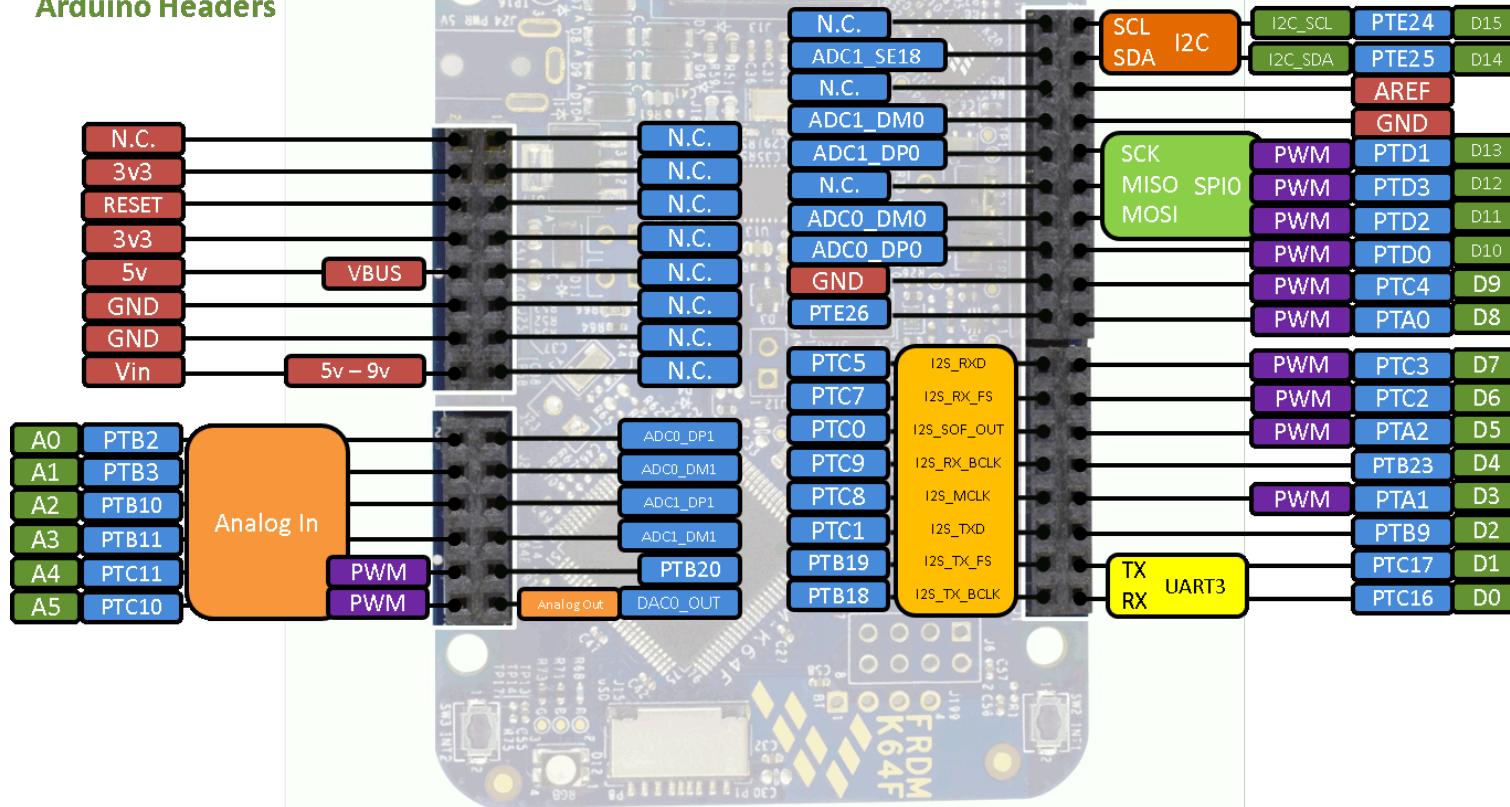
NXP- FRDM-K64F Overview

- **Freedom Development Platform**
 - Quick, simple development experience with rich features
 - Cortex-M4, 120MHz, 1MB Flash, 256KB SRAM
 - Easy access to MCU I/O
 - 3-axis **accelerometer**/3-axis **magnetometer**
 - RGB LED
 - Add-on **Bluetooth** Module
 - Built-in Ethernet/Add-on **Wireless** Module
 - Micro SD
- **Arduino shield compatible**
- Flash programming functionality
- Enabled by OpenSDA debug interface





freescale™
FRDM-K64F
Arduino Headers



Install the Necessary Tools

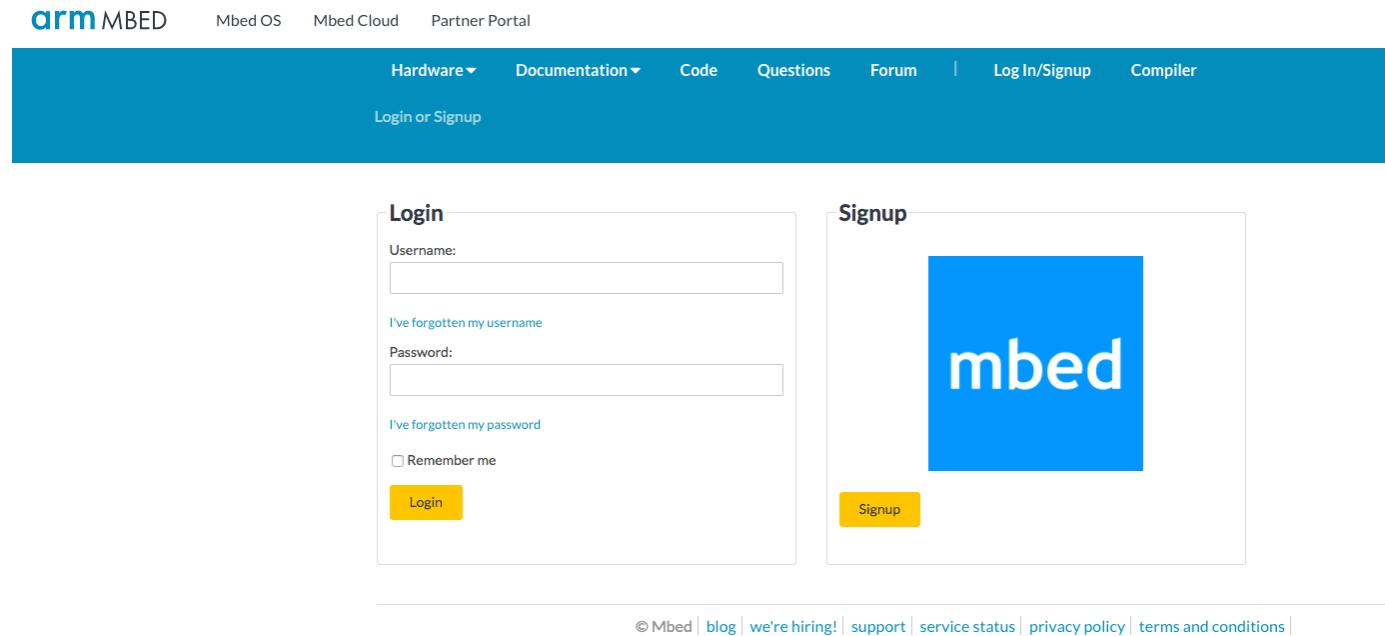
Prior to
Workshop

- **Windows**
 - **IMPORTANT:** Install the mbed USB Serial driver -
https://os.mbed.com/media/downloads/drivers/mbedWinSerial_16466.exe
 - Insert the USB cable and mbed device BEFORE running the Serial Driver installation...
 - the installer MUST see the device first
 - Serial Terminal: Putty - <http://www.putty.org/>
 - Option: Install CoolTerm - http://freeware.the-meiers.org/CoolTerm_Win.zip
 - Chrome and Firefox Browsers installed – **NOTE: IE will NOT WORK... Please use Chrome and/or Firefox**
- **Mac**
 - Serial Terminal: CoolTerm - http://freeware.the-meiers.org/CoolTerm_Mac.zip
 - Chrome and Firefox Browsers installed
- **Linux**
 - Serial Terminal: CoolTerm - http://freeware.the-meiers.org/CoolTerm_Linux.zip
 - Chrome and Firefox Browsers installed

Connect both your USB cable and Ethernet cable to the K64F and leave it there for now

Create Your mbed Account

- Navigate to: <https://os.mbed.com/account/login/?next=/>
- Create an Account

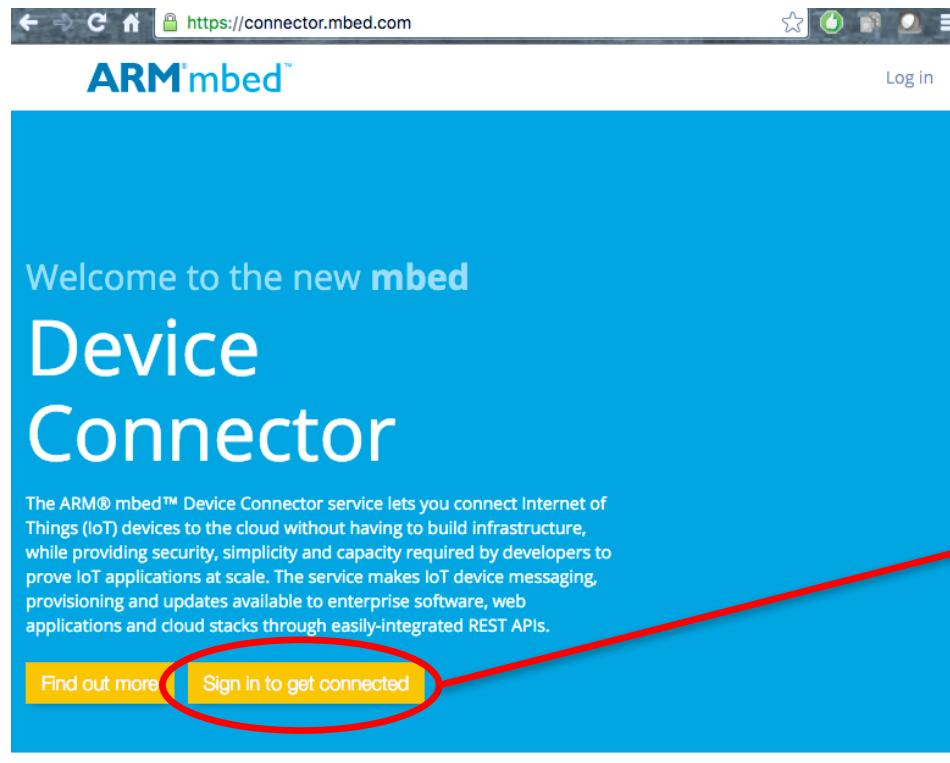


Prior to
Workshop

Create Your mbed Connector Account...

Prior to
Workshop

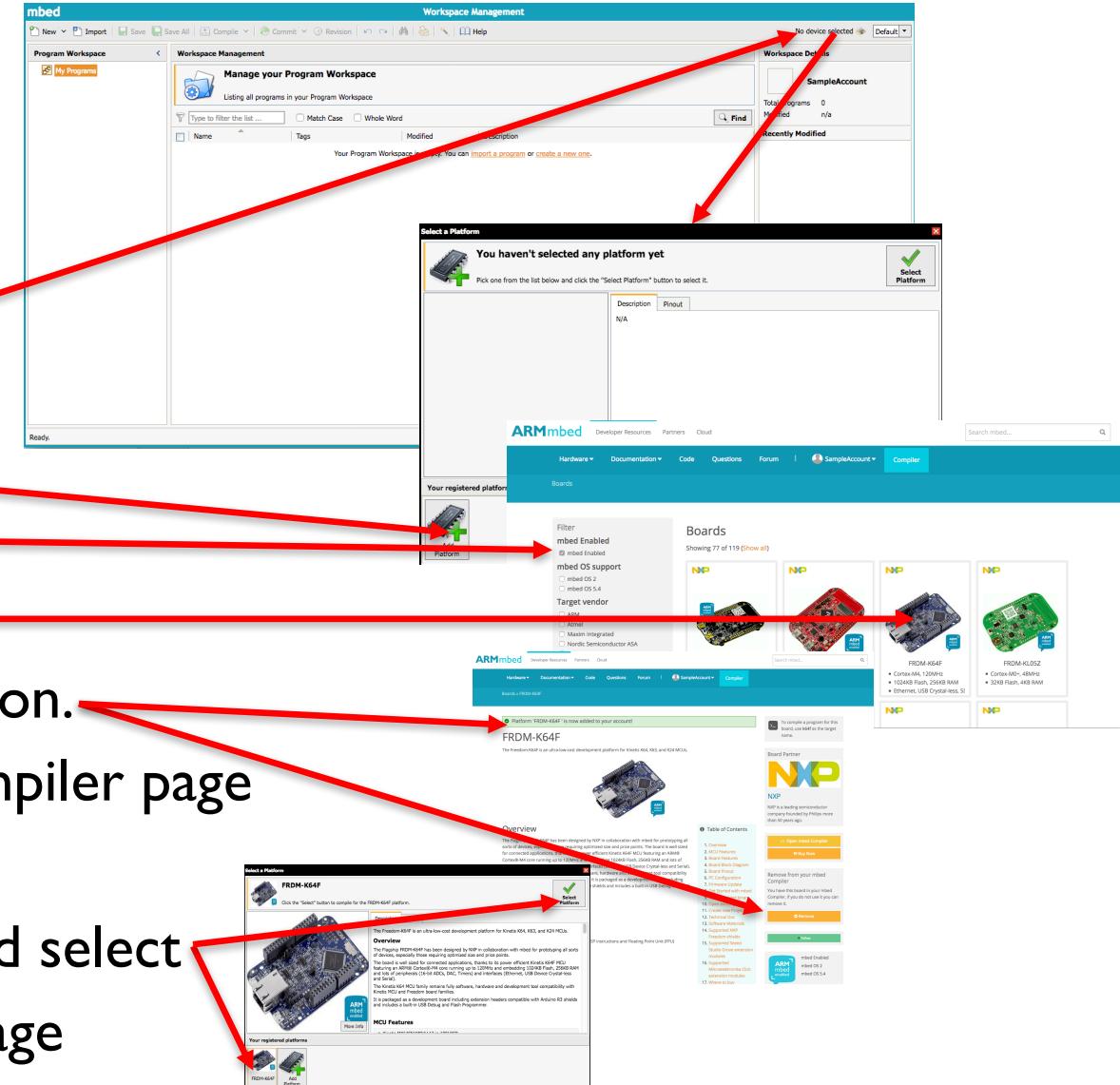
- Navigate to the mbed Connector Dashboard: <https://connector.mbed.com>
- Confirm that you can log into your mbed device Connector dashboard



The screenshot shows the mbed Device Connector Dashboard. At the top, it says "mbed Device Connector (Beta)" and "Dashboard". The dashboard is divided into several sections: "My environment" (Dashboard), "My devices" (Connected devices: 0 of 100, Security credentials), "Device Connector" (API Console: 7 of 10000 per hour transactions), and "My applications" (Access keys: 5 of 2). There are also links to "Learn how to develop my device application", "Access REST API documentation", and "Learn how to develop my web application".

Log into the Online IDE – Add the K64F Compile Target

- Go to <https://os.mbed.com/>



- Select the “Compiler” page
- Click on “No device selected”
- Click on “Add Device”
- Check “mbed Enabled”
- Click on the “FRDM-K64F”
- Click on “Add to Compiler”... note addition.
- Dismiss all windows... go back to the compiler page
- Click on “No device selected”
- Now, select the “FRDM-K64F” to add and select
- Dismiss and confirm on your compiler page

Log into the Online IDE - Import our K64F Project

- Go to <https://os.mbed.com/>

- Select the “Compiler” page

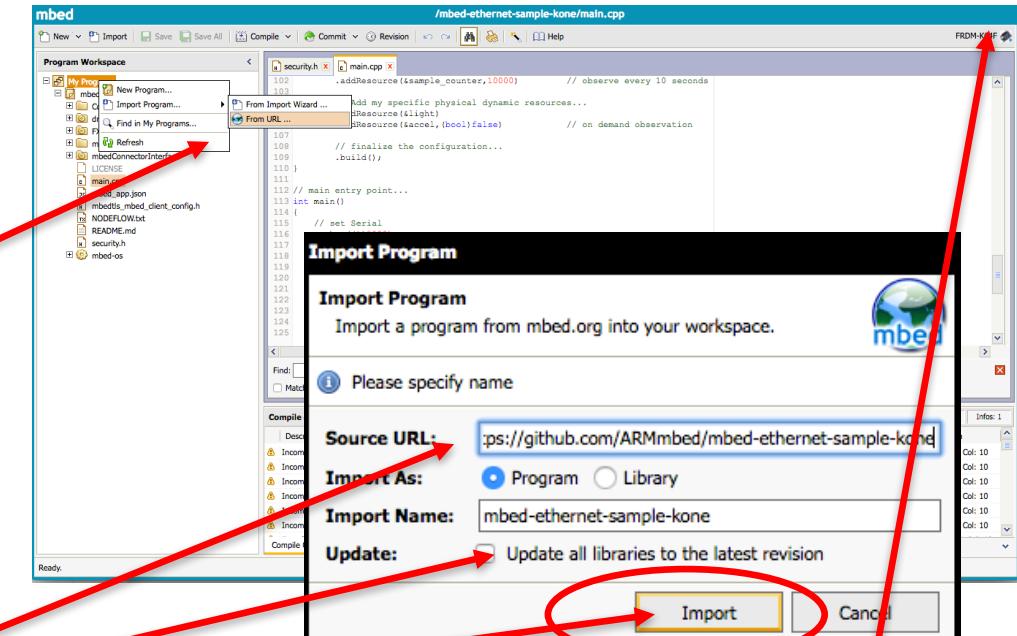
- Right-click on “My Programs” → “Import Program”

- Select “from URL...”

- Enter this URL (Leave the “Update all libraries...” **unchecked**)

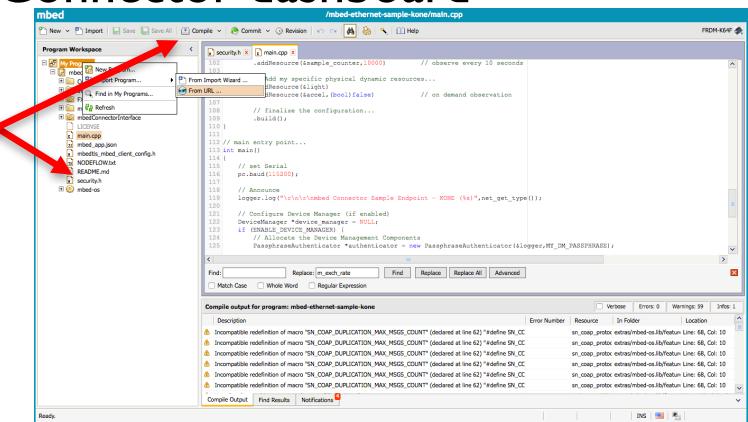
<https://github.com/ARMmbed/mbed-ethernet-sample-techcon2016/>

- Press “Import”, then ensure that “FRDM-K64F” is selected



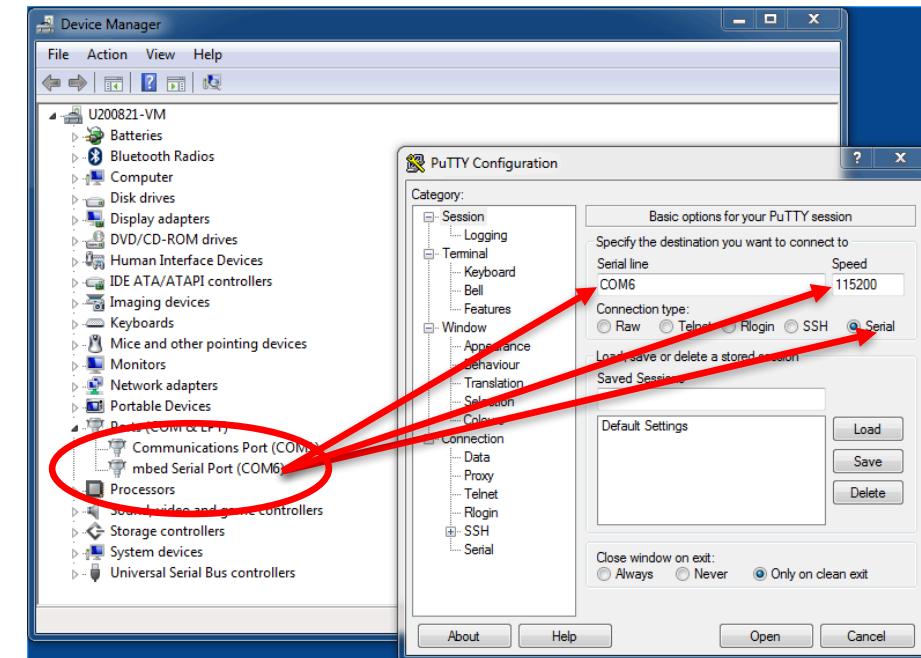
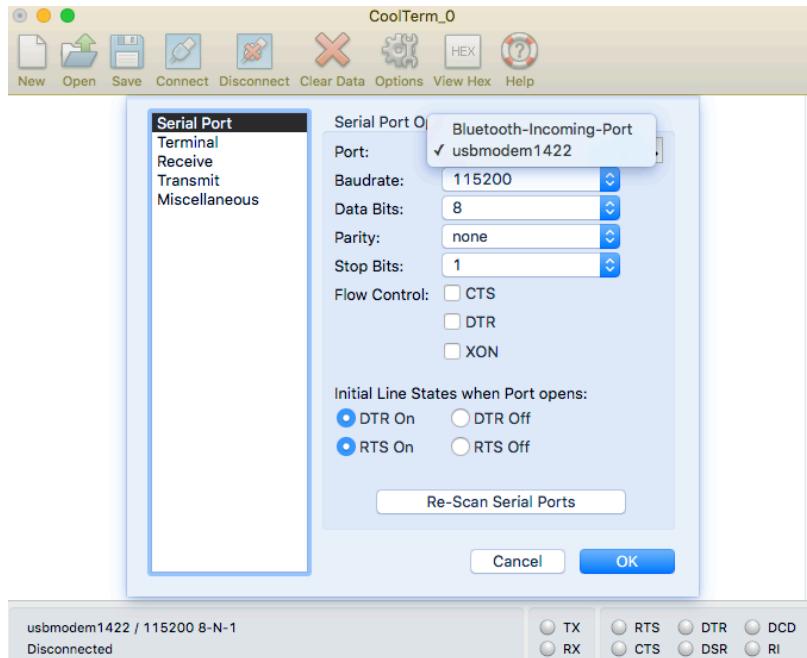
Set Provisioning Credentials in Your Endpoint Code

- Go back to the mbed Device Connector dashboard: <https://connector.mbed.com>
 - In the left sidebar, select “Security Credentials” → “Get My Security Credentials”
 - Copy all contents of security.h (**Record the MBED_ENDPOINT_NAME & MBED_DOMAIN values... used later!**)
- Now, go back to the Compiler page of your online IDE
- Replace security.h with the the new security.h that you copied from your Connector dashboard
- Save
 - Glance at main.cpp... a clean and simple mbed endpoint example
 - Exposes two CoAP resources: accelerometer and LED
- Select the project name and press the “Compile” button
- The endpoint code should compile up successfully
- The online IDE will deposit a “bin” file into your downloads directory
- Drag-n-Drop this bin file to your “MBED” flash drive (may also be called “DAPLINK”)
- K64F green LED will flicker for a bit, then stop, and dismount/remount...



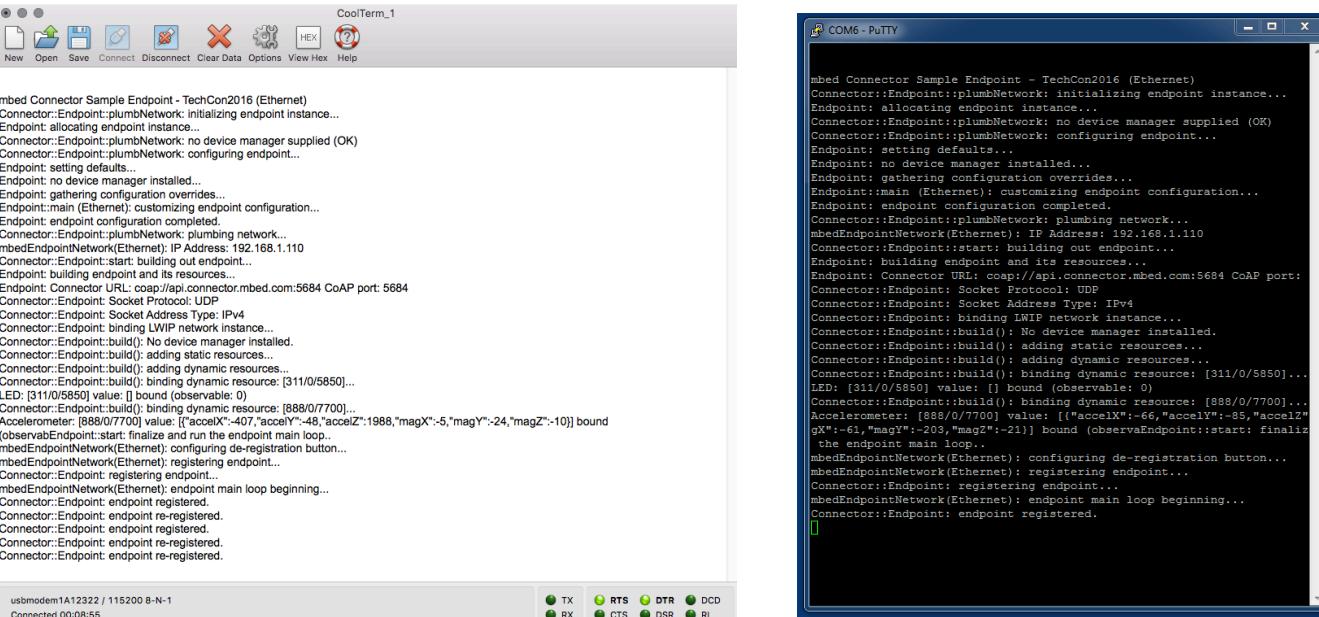
Running your Endpoint Code

- Bring up your Serial Terminal
 - CoolTerm for Windows, Mac, Linux: Select: “Options→”Re-scan serial ports”. Select the mbed one found.
 - For MAC, you may need to “authorize” the CoolTerm Application under your “System Preferences”-> “Security & Privacy”... you may have to allow apps to run from “any developer”, then authorize the launch of CoolTerm.
 - PuTTY for Windows : You must determine what COM port your mbed device is. Look in the Windows Device Manager FYI
- For the endpoint serial configuration, set the baud rate to 115200 baud, defaults for everything else: (8, N, one)
 - PuTTY for Windows: Ensure that you have “Serial” radio button selected...



Running your Endpoint Code...

- Connect your Serial Terminal to the K64F:
 - CoolTerm for Windows, Mac, Linux: Simply press the “Connect” button on the top part of the CoolTerm GUI
 - PuTTY for Windows: Press the “Open” button
- Send a “Break” command from the serial terminal (or press the RESET button on the K64F)
 - CoolTerm for Windows, Mac, Linux: “Connection” → “Send Break”
 - PuTTY for Windows: Right-click on top of Window, Select “Special Command” → “Break”
- Look at the output – you need to confirm that you see “endpoint registered” in the output:



The screenshots show the output of running endpoint code on a K64F board. The log messages include:

```
mbed Connector Sample Endpoint - TechCon2016 (Ethernet)
Connector::Endpoint::plumbNetwork: initializing endpoint instance...
Endpoint: allocating endpoint instance...
Connector::Endpoint::plumbNetwork: no device manager supplied (OK)
Connector::Endpoint::plumbNetwork: configuring endpoint...
Endpoint: setting defaults...
Endpoint: no device manager installed...
Endpoint: gathering configuration services...
Endpoint::main (Ethernet): customizing endpoint configuration...
Endpoint: endpoint configuration completed.
Connector::Endpoint::plumbNetwork: plumbing network...
mbedEndpointNetwork(Ethernet): IP Address: 192.168.1.110
Connector::Endpoint::start: building out endpoint...
Endpoint: building endpoint and its resources...
Endpoint: Connector URL: coap://api.connector.mbed.com:5684 CoAP port: 5684
Connector::Endpoint::Socket Protocol: UDP
Connector::Endpoint::Socket Address Type: IPv4
Connector::Endpoint::binding LWIP network instance...
Connector::Endpoint::build(): No device manager installed.
Connector::Endpoint::build(): adding static resources...
Connector::Endpoint::build(): adding dynamic resources...
Connector::Endpoint::bind dynamic resource: [311/0/5850]...
LED: [311/0/5850] value: [] bound (observable: 0)
Connector::Endpoint::bind dynamic resource: [888/0/7700]...
Accelerometer: [888/0/7700] value: [{"accelX": -407, "accelY": -48, "accelZ": 1988, "magX": -5, "magY": -24, "magZ": -10}] bound
(observeEndpoint::start: finalizing and run the endpoint main loop.
mbedEndpointNetwork(Ethernet): configuring de-registration button...
mbedEndpointNetwork(Ethernet): registering endpoint...
Connector::Endpoint::re-registered.
mbedEndpointNetwork(Ethernet): endpoint main loop beginning...
Connector::Endpoint::endpoint registered.
Connector::Endpoint::endpoint re-registered.
Connector::Endpoint::endpoint registered.
Connector::Endpoint::endpoint re-registered.
Connector::Endpoint::endpoint re-registered.
```

At the bottom of the CoolTerm window, there is a status bar with the text "usbmodem1A12322 / 115200 8-N-1" and "Connected 00:08:55". Below the status bar, there is a row of seven small circular indicators labeled TX, RTS, DTR, DCD, RX, CTS, DSR, and RI.

Status Check

So far we've completed the following

- Setup our accounts and PC with appropriate tools (prior to workshop)...
- Retrieved a set of provisioning credentials (security.h)
- Imported our mbed sample project into the online IDE
- Updated the sample project with the provisioning credentials (security.h)
- Compiled, Installed, Downloaded, and Copied into the mbed device
- Connected a Serial Terminal (115200,8NI, proper mbed COM port chosen for Windows users...)
- Sent the “Break” command to reset the mbed device
- Saw the device output on our Serial Terminal (PTSOOI method...)

Next, we will import and configure the Watson IoT mbed Connector Bridge...

Watson IoT mbed Connector Bridge Configuration

What we will do next...

- Create our own Watson IoT Instance within our Bluemix account
- Create our Watson IoT Application Credentials (used in the NodeRED application...)
- Create our sample Watson IoT NodeRED Application
- Bind the Watson NodeRED Application to our Watson IoT instance
- Create a mbed Connector API Token
- Acquire our mbed Connector MBED_DOMAIN value
- Configure the Watson IoT ARM mbed Connector Bridge

Create our Watson IoT Instance

- Go to the Bluemix dashboard & click:
(<https://console.bluemix.net>)
- Select “Services”, then “Internet of Things”
- Press “Get Started”
- Configure your Watson IoT Instance
 - Leave “unbound”
 - Select the “Free” plan
(scroll down...)
- Select “Create”

This will create your Watson IoT instance

The image consists of four screenshots illustrating the process of creating a Watson IoT instance:

- Bluemix Dashboard:** Shows the main dashboard with the "IBM Bluemix" logo at the top left. A red arrow points from the "Create" button in the list of services to the "Internet of Things" service entry.
- Services Catalog:** Shows the "Services" section of the catalog. A red arrow points from the "Internet of Things" service entry to its detailed page.
- Service Details:** Shows the "Internet of Things Platform" service details page. A red arrow points from the "Get Started" button to the "Leave unbound" dropdown menu under "Connect to".
- Final Step:** Shows the "Create" button highlighted in blue at the bottom right of the service details page.

Create Watson IoT Application Credentials

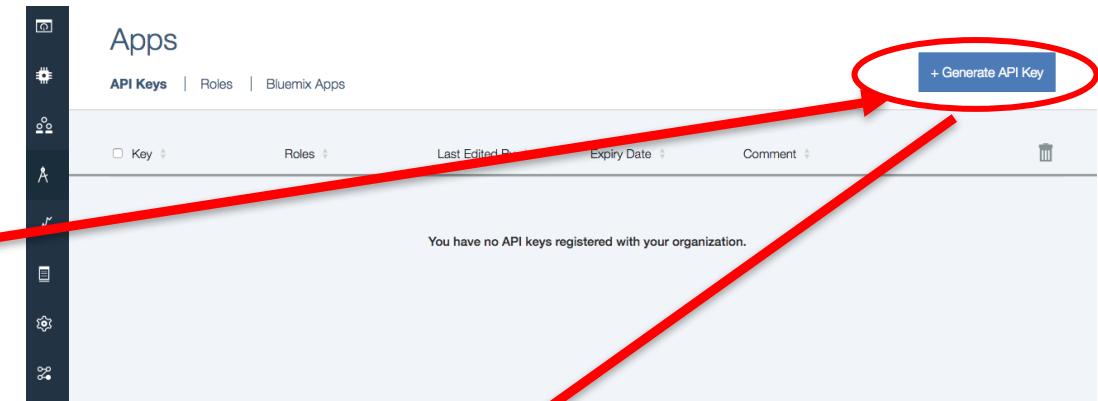
- Once your Watson IoT Instance is created, you should see the Watson IoT dashboard
- Launch the “Launch”
- Press “Apps”

The screenshot shows the IBM Bluemix Internet of Things dashboard for a instance named "my-watson-iot-instance". The dashboard has a header with "IBM Bluemix Internet of Things" and navigation tabs for "Manage", "Plan", and "Connections". Below the header is a section titled "Welcome to Watson IoT Platform" with a sub-section "Securely connect, control, and manage devices. Quickly build IoT applications that analyze data from the physical world." A prominent red arrow points to the "Launch" button, which is highlighted in blue. To the right of the "Launch" button are links for "Learn about Watson IoT Platform" and "Expand using step-by-step recipes".

The screenshot shows the Watson IoT Platform dashboard with a sidebar menu on the left. The menu items include "BOARDS", "DEVICES", "MEMBERS", "APPS" (which is highlighted with a red arrow), "USAGE", "RULES", "SECURITY", "SETTINGS", and "EXTENSIONS". The main area of the dashboard displays four cards: "DEVICE-CENTRIC ANALYTICS" (5 Cards, Owned by you), "USAGE OVERVIEW" (3 Cards, Owned by you), and "RULE-CENTRIC ANALYTICS" (6 Cards, Owned by you). A "Create New Board" button is located in the top right corner of the main dashboard area.

Create Watson IoT Application Credentials...

- Press “Generate API Key”



- Record the API Key

- Record the Authentication Token

- Press “Generate” after adding a comment

- Save these two values! You will need them later...

The dialog box is titled 'Generate API Key'. It contains fields for 'API Key' (a-b0522z-smaoymkkzn) and 'Authentication Token' (7Pkf_tv@K@cpO3(1k), both of which are circled in red). Below these fields is a note: 'Authentications tokens are non-recoverable. If you misplaced your token, you will need to re-register the API key to generate a new authentication token.' There are sections for 'Select API Role(s)', 'Standard Application', and a 'Comment' field containing 'My NodeRED Application Key'. At the bottom, there is a 'Set API key expiry' section with a date set to '10/13/2016'.

Creating our Sample Watson IoT NodeRED Application

Please DO NOT USE Internet Explorer for this task!

- Go back to our Bluemix Dashboard: <https://console.bluemix.net>

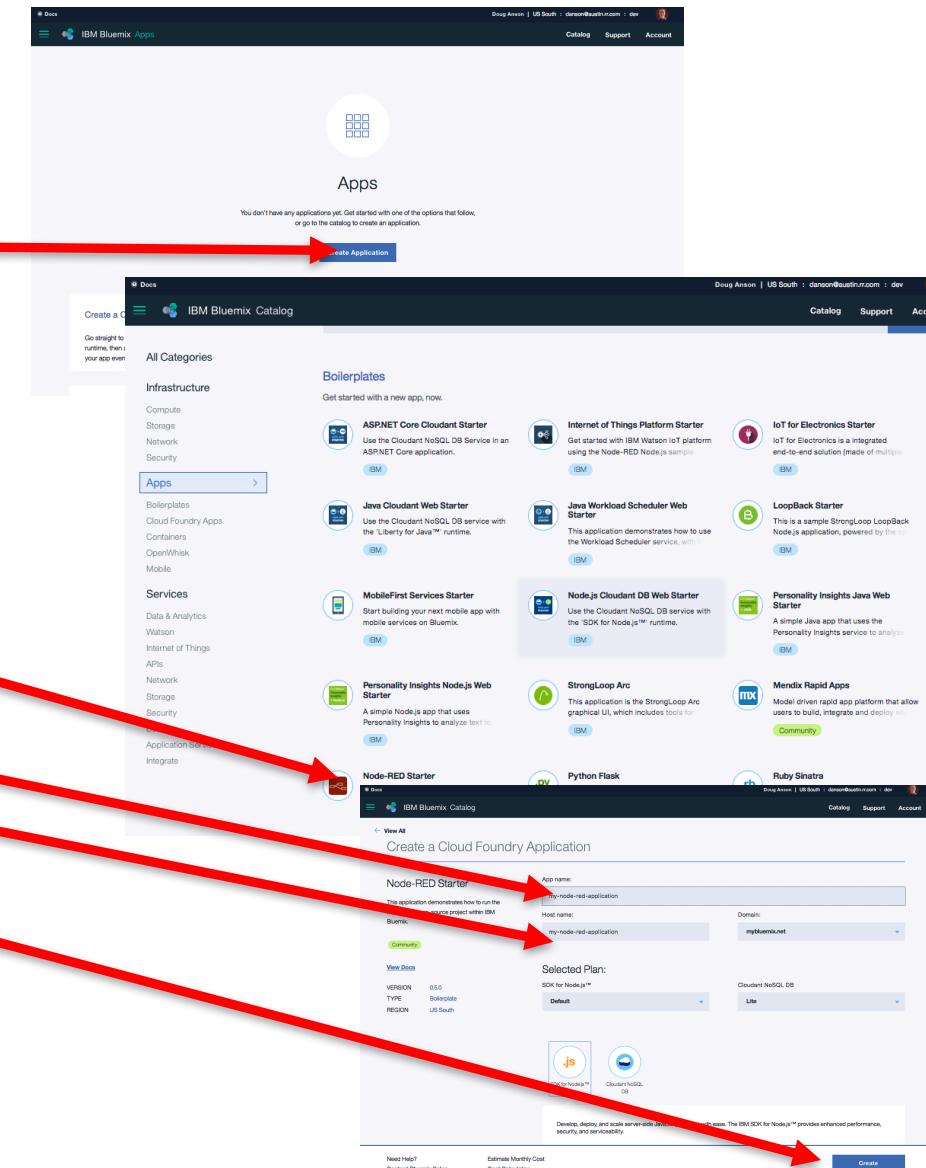
- Click on “Create Application”

- Select “NodeRED Starter”

- Enter an “App Name” (must be unique)
 - Make a note that your app URL is <app name>.mybluemix.net
 - Press “Create” to finalize creating the application

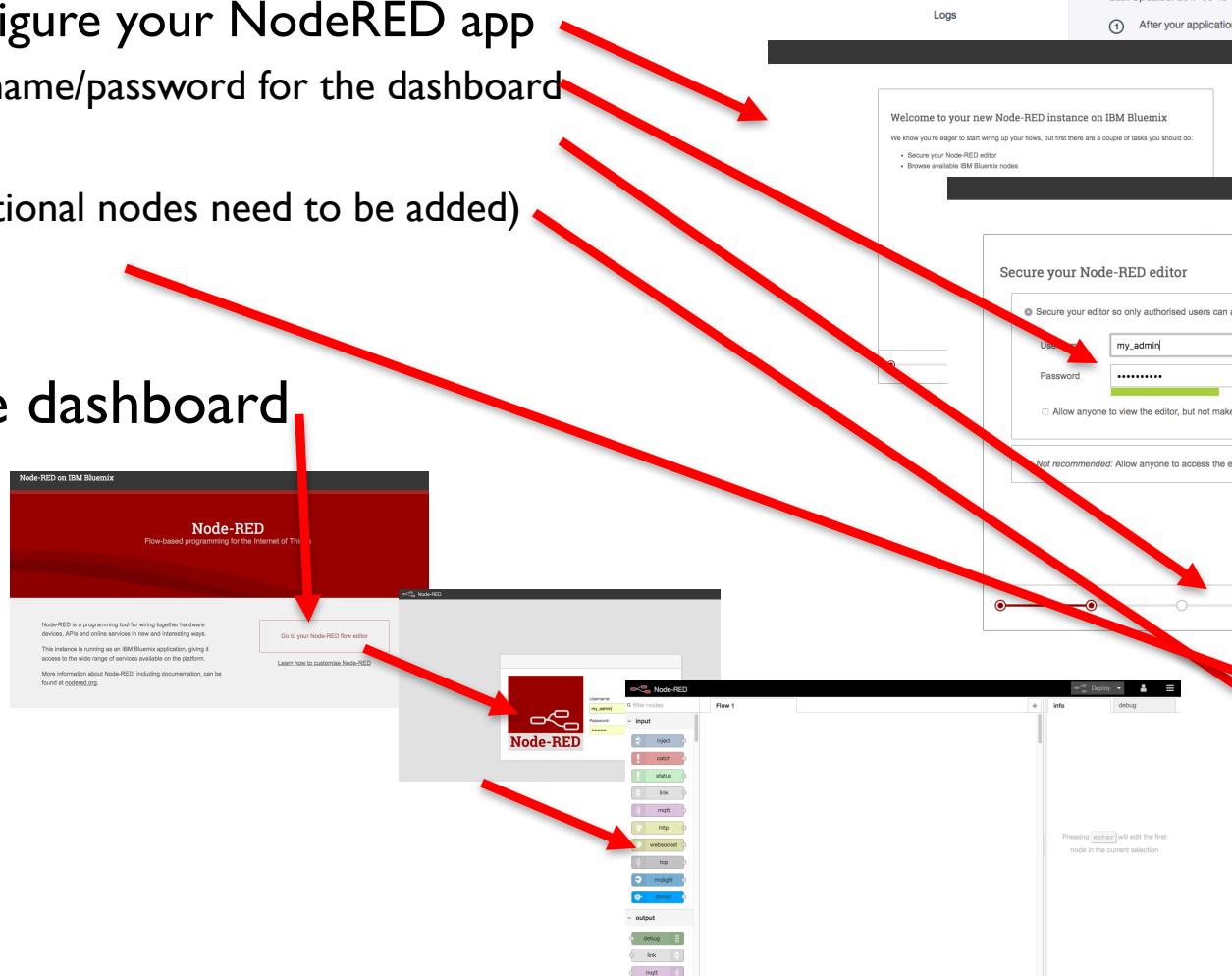
- Application will “Stage”... this will take a few minutes...

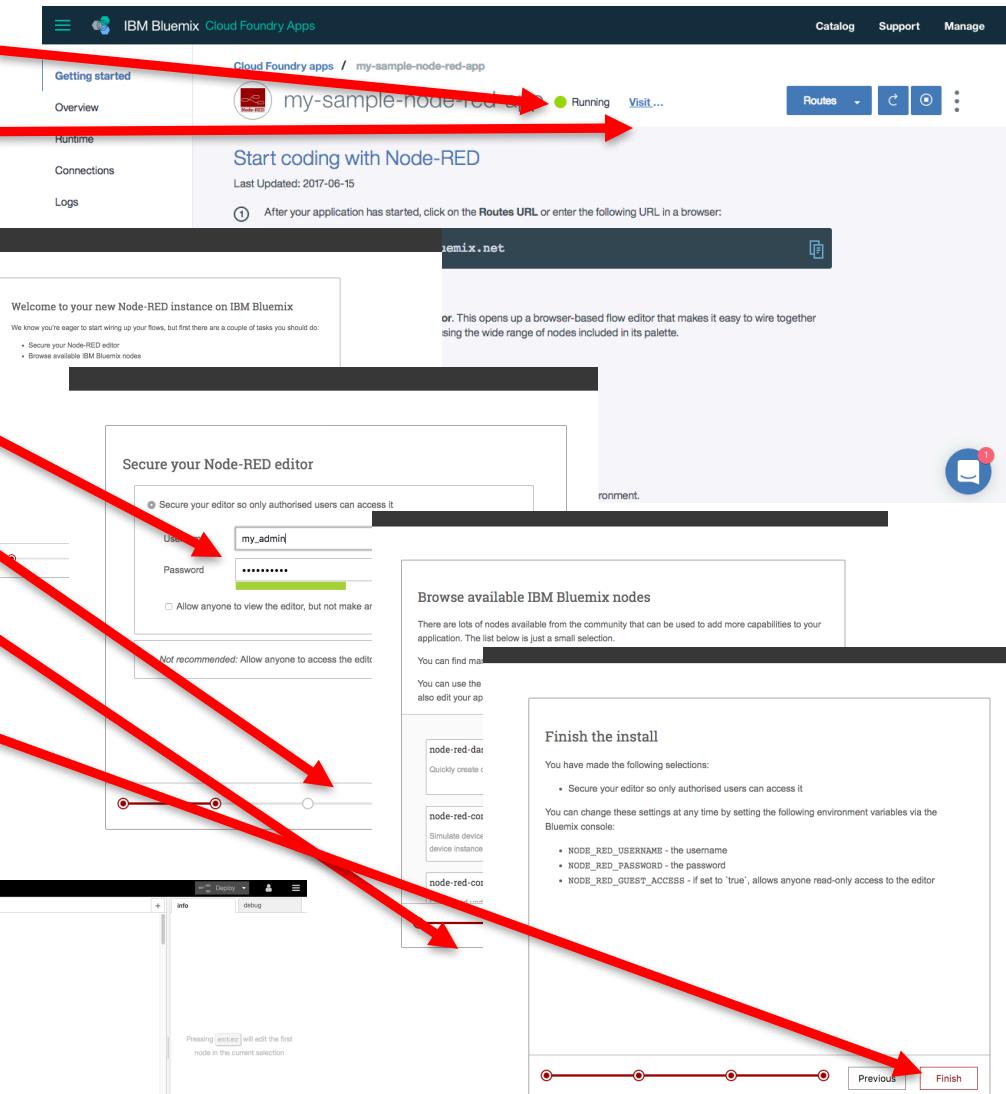
- Next we will configure the NodeRED application (next slide)



Configure Watson IoT NodeRED Application

Please DO NOT USE Internet Explorer for this task!

- Your NodeRED app should fully "stage" and report "running"
- Click on "Visit..." 
- Next, you must configure your NodeRED app
 - Create an admin username/password for the dashboard
 - Press "Next"
 - Press "Next" (no additional nodes need to be added)
 - Press "Finish"
- Now, login to the dashboard 



Bind the Watson NodeRED Application to our Watson IoT instance

Please DO NOT USE Internet Explorer for this task!

- Dashboard -> Apps, select your NodeRED app

IBM Bluemix Cloud Foundry Apps

Cloud Foundry apps / my-sample-node-red-app

my-sample-node-red-app • Running Visit...

Getting started Overview Runtime Connections Logs Monitoring API Management

Runtime

Node-RED 1 512 512

BUILDPACK Node-RED Starter INSTANCES All instances are running Health is 100% MB MEMORY PER INSTANCE TOTAL MB ALLOCATION 511 GB still available

Connections (1) my-sample-node-red-app-cloudantNoSQLDB Connect new Connect existing

Runtime cost \$0.00 \$0.00

- Press “Connect Existing”
- Click on your Watson IoT Instance
- Press “Connect”
- Your NodeRED application will “restage”... this will take awhile.
Wait for the “running” state:

IBM Bluemix Cloud Foundry Apps

Getting started Overview Runtime Connections Logs Monitoring API Management

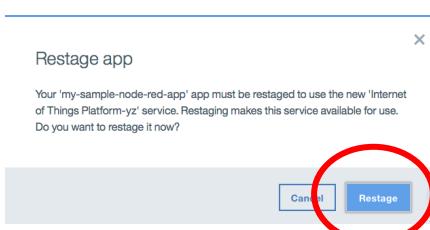
Connect existing service

Services

Internet of Things Platform-yz my-watson-node-red-app-cloud Visual Recognition-Id

Select compatible service to connect to my-sample-node-red-app

Connect



Note: keep this window open!!!

Create our mbed Connector Access/API Token

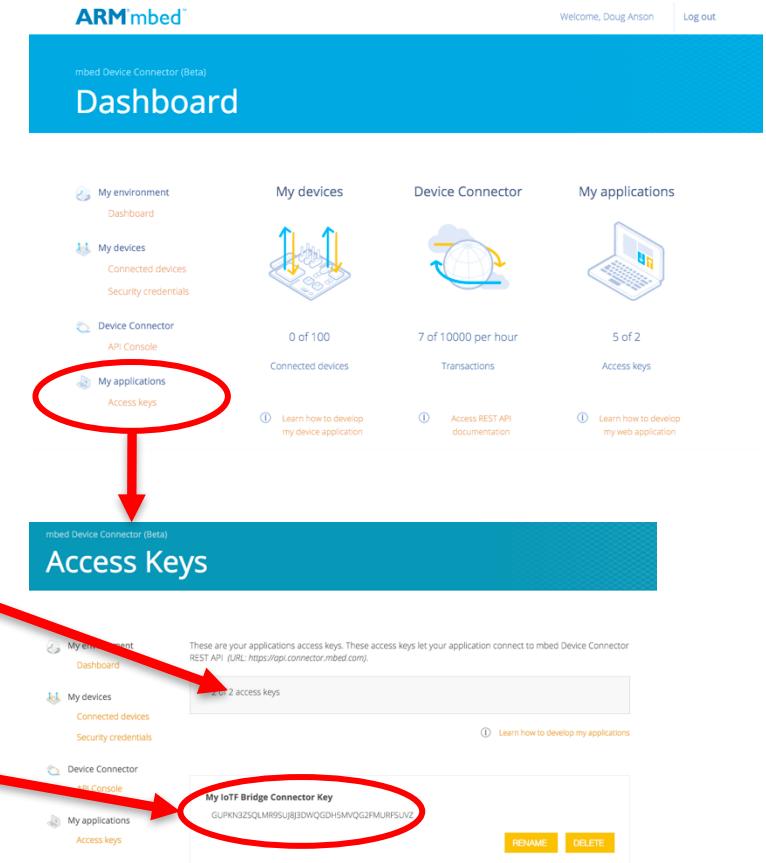
- Navigate to the mbed Connector Dashboard: <https://connector.mbed.com>

- Log in

- Select “Access Keys”... you will create a new token

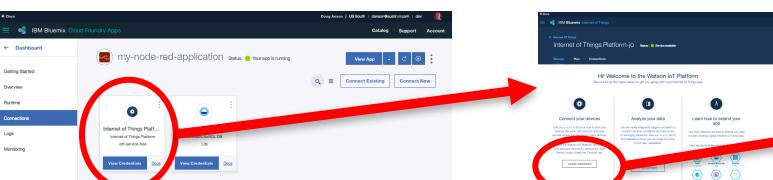
- Generate an API Token, give it a name

- Save the API Token

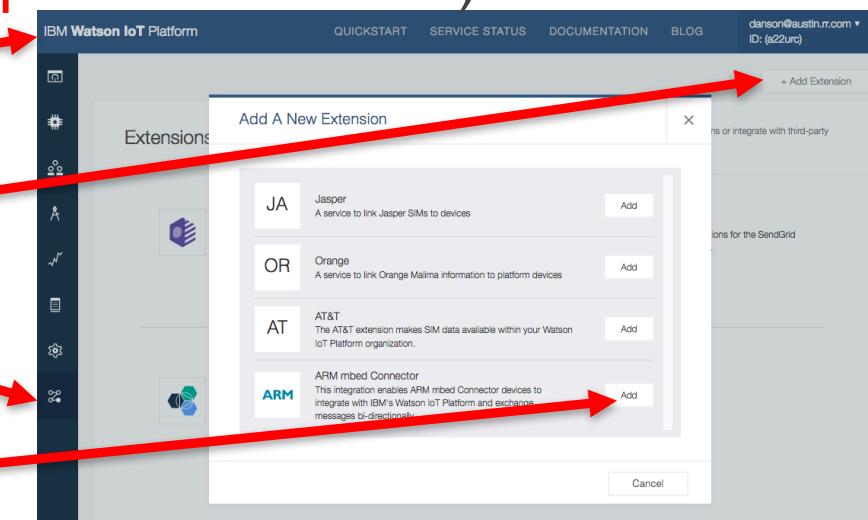


Configure the Watson IoT ARM mbed Connector Bridge

- Go back to the Watson IoT Dashboard (last window open on slide 21...)



- Select “Extensions” (bottom icon)
Select “Add Extension”



- Select “ARM mbed Connector”
(Press “add”, then “setup”)
- scroll down a bit...



- Paste your Connector API Token



- Press “Check Connection”



- If OK, press “Done”



- Keep this window open!!

Status Check

So far we've completed the following

- Created our own Watson IoT Instance within our Bluemix account
- Created our Watson IoT Application Credentials (used in the NodeRED application...)
- Created our sample Watson IoT NodeRED Application
- Bound the Watson IoT Application to our Watson IoT instance/service
- Created a mbed Connector API Token
- Acquired our mbed Connector MBED_DOMAIN value
- Configured the Watson IoT ARM mbed Connector Bridge

Next, we will Import our NodeRED flow sample and restart the Endpoint... We should then see device telemetry flowing from the device, through Connector, through the Bridge, and into Watson IoT!

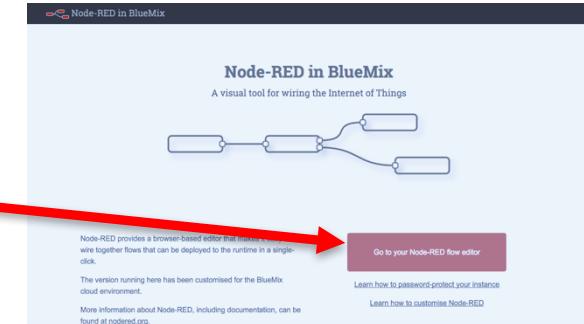
Importing the NodeRED Flow Example

Copy the Sample NodeRED Flow JSON

- Go back to your Online IDE workspace
- Go to your “mbed-ethernet-sample-techcon2016” project
- Double-click on NODEFLOW.txt
- Copy all of that file...

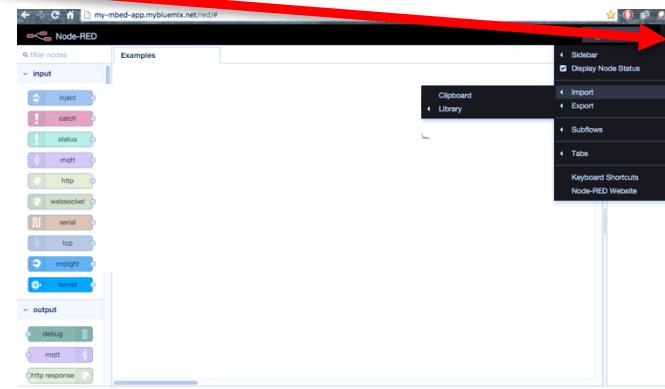
Import the NodeRED Flow

- Navigate to the URL that we recorded earlier for your Watson IoT NodeRED Application (i.e. `http://<app name>.mybluemix.net`)



- Select “go to your NodeRED flow editor”

- Select the menu (far right)



- Select “Import”

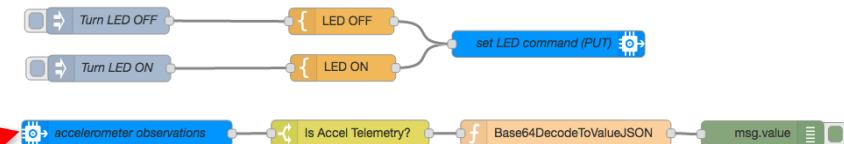
- Select “Clipboard”

- Paste the entire contents of the JSON code you copied in the previous slide into the “paste nodes here” window... then press “OK”.

- If you have trouble copy/pasting the NODEFLOW.txt file contents, try copying it from <https://github.com/ARMmbed/mbed-ethernet-sample-techcon2016> (NODEFLOW.txt is listed there...click & copy...)

Your new Watson IoT Application Node Flow: Configure it

- Configure your NodeRED flow input and output nodes (Blue) and link them to your Watson IoT instance



- Double click on the observation node
- Click on the “edit” button

Edit ibmiot in n

Delete Cancel Done

Authentication: API Key
API Key: MyWatsonIoT

Input Type: Device Telemetry
Device Type: All or mbed-endpoint

Device Id: All or 5516d813-7ede-4e16-b61d-8d646f

Event: All or notify

Format: All or json

QoS: 0

Name: accelerometer observations

Use the Input Type property to configure this node to receive Events sent by IoT Devices, Commands sent to IoT Devices, Status Messages referring to IoT Devices, or Status Messages referring to IoT Applications
Check the info tab, to get more information about each of the fields

- Provide a name
- Insert your Watson API Key from slide 20

Edit ibmiot config node * Ethernet

Name: MyWatsonIoT

API Key: a-uqttt4-28lb0hgffy

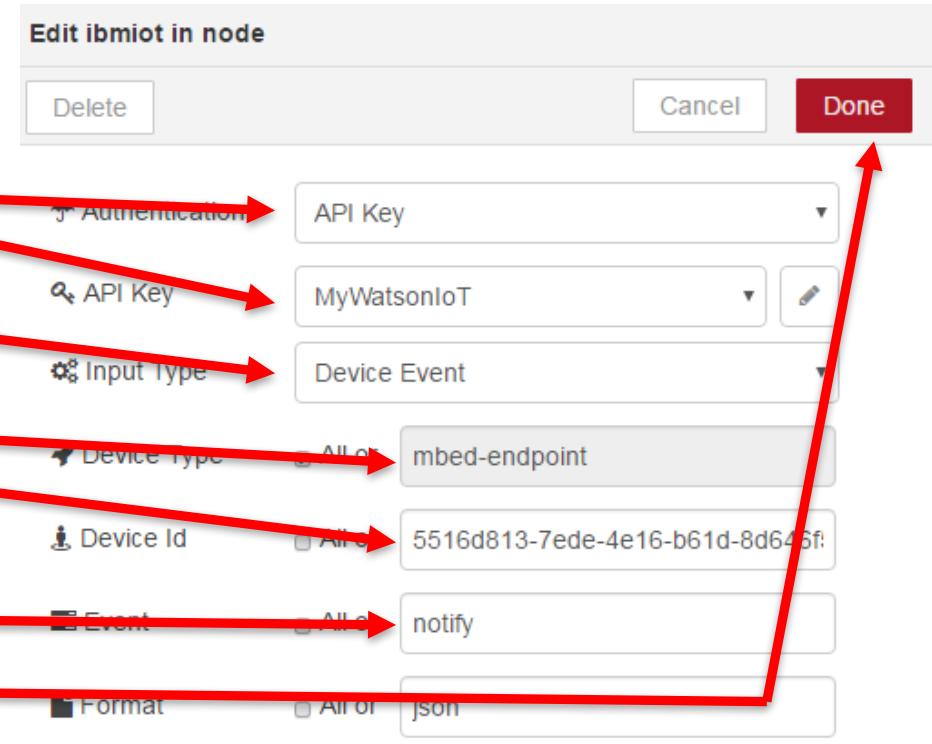
API Token:
5 nodes use this config

Delete Update Cancel

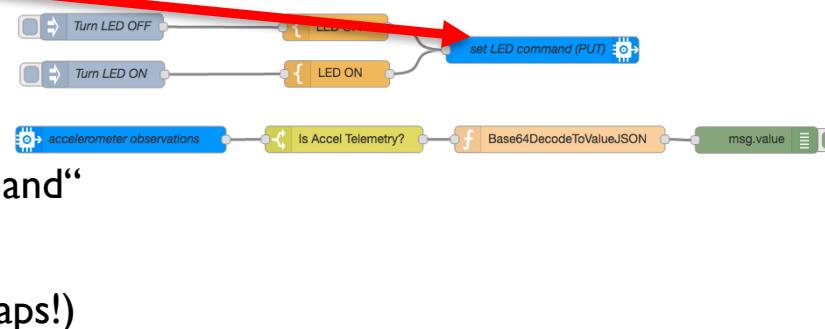
- Insert your Watson Auth Token from slide 20
- Press “Update” to save

Your new Watson IoT Application Node Flow: Configure it...

- Now, select the new linkage to your Watson IoT instance via the drop down here and that “API Key” is selected
- Input Type is “Device Event”
- You can filter by Device Type (found in main.cpp on your endpoint) or “all”
- Ensure you have your endpoint ID here... this comes from the security.h header (**MBED_ENDPOINT_NAME**)
- Event is “notify” (i.e. CoAP observations)
- Press “Done”

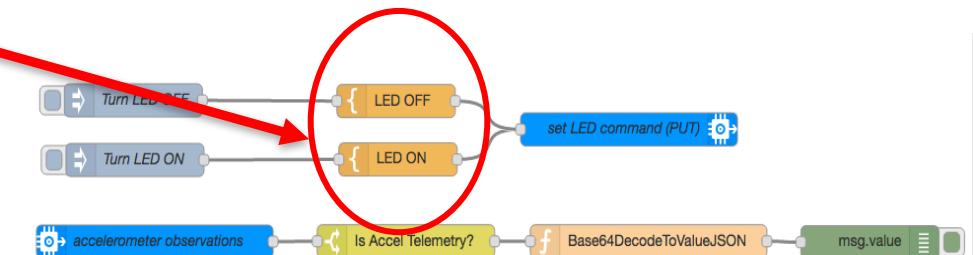


- Edit the blue PUT node
 - API Key Auth
 - Select same API Key
 - Output Type is “Device Command”
 - Device Type, Device ID
 - Command Type is “PUT” (all caps!)



Your new Watson IoT Application Node Flow: Configure it...

- Lastly, we have to look at the remaining “Orange” command builder nodes and update them as well
- For both LED OFF/ON nodes, select and note the JSON payload created. “deviceld” needs to be the value you have for your Endpoint (**MBED_ENDPOINT_NAME**)
 - “deviceld” will be on the right-hand side in the JSON structure... you have to scroll to the right to see it... You can also enlarge the edit window...
- Locate **MBED_ENDPOINT_NAME_Goes_Here** and replace it with your actual **MBED_ENDPOINT_NAME** value ... press “Done” when complete.
- FYI, Each LED ON/OFF has a Base64 encoded value
 - It’s a “1” for ON, “0” for OFF... each must be Base64 encoded
- Press the red “Deploy” button in the upper right hand side of your NodeRED console



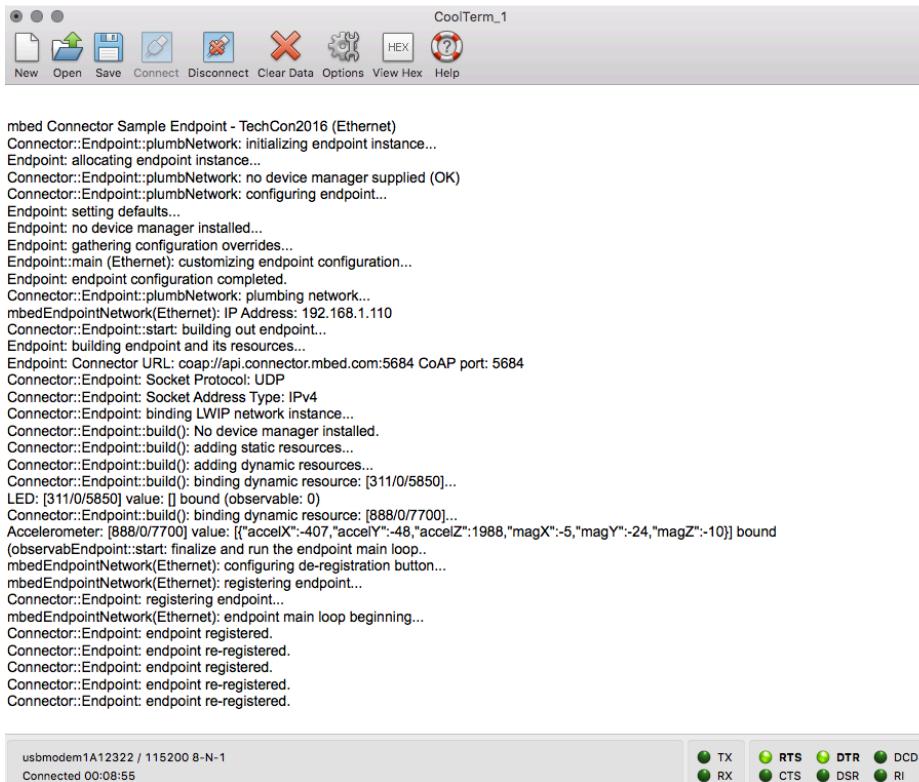
Putting it all Together

- Press the “reset” button on your mbed device (next to the USB port)
- On your NodeRED Editor, select the “debug” window

Lets check how things are working...

Putting it all Together: Check the Serial Terminal

- You should see output that looks something like this:
 - Make sure that you see a message like “endpoint registered”



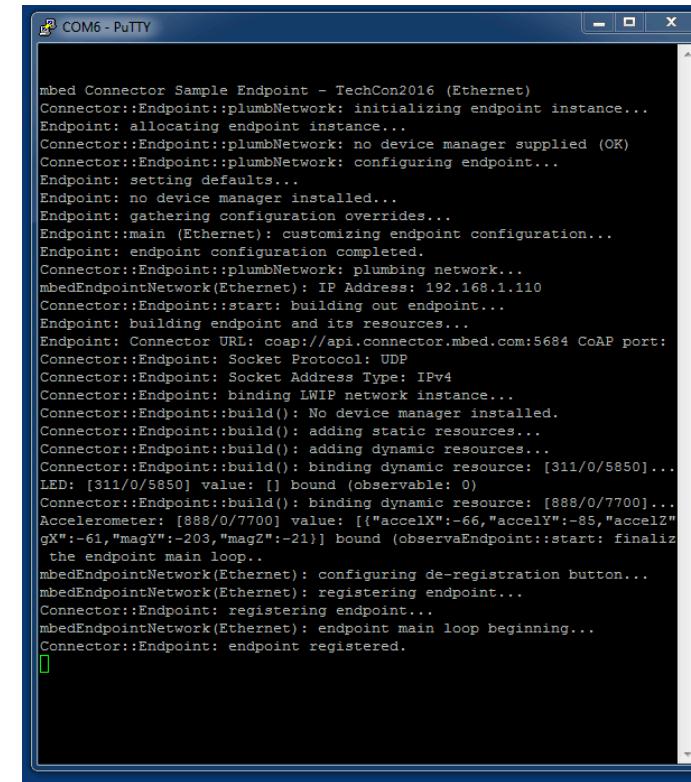
CoolTerm_1

New Open Save Connect Disconnect Clear Data Options View Hex Help

```
mbed Connector Sample Endpoint - TechCon2016 (Ethernet)
Connector::Endpoint::plumbNetwork: initializing endpoint instance...
Endpoint: allocating endpoint instance...
Connector::Endpoint::plumbNetwork: no device manager supplied (OK)
Connector::Endpoint::plumbNetwork: configuring endpoint...
Endpoint: setting defaults...
Endpoint: no device manager installed...
Endpoint: gathering configuration overrides...
Endpoint::main (Ethernet): customizing endpoint configuration...
Endpoint: endpoint configuration completed.
Connector::Endpoint::plumbNetwork: plumbing network...
mbedEndpointNetwork(Ethernet): IP Address: 192.168.1.110
Connector::Endpoint::start: building out endpoint...
Endpoint: building endpoint and its resources...
Endpoint: Connector URL: coap://api.connector.mbed.com:5684 CoAP port: 5684
Connector::Endpoint: Socket Protocol: UDP
Connector::Endpoint: Socket Address Type: IPv4
Connector::Endpoint: binding LWIP network instance...
Connector::Endpoint::build(): No device manager installed.
Connector::Endpoint::build(): adding static resources...
Connector::Endpoint::build(): adding dynamic resources...
Connector::Endpoint::build(): binding dynamic resource: [311/0/5850]...
LED: [311/0/5850] value: [] bound (observable: 0)
Connector::Endpoint::build(): binding dynamic resource: [888/0/7700]...
Accelerometer: [888/0/7700] value: [{"accelX": -407, "accelY": -48, "accelZ": 1988, "magX": -5, "magY": -24, "magZ": -10}] bound
(observaEndpoint::start: finalize and run the endpoint main loop..
mbedEndpointNetwork(Ethernet): configuring de-registration button...
mbedEndpointNetwork(Ethernet): registering endpoint...
Connector::Endpoint: registering endpoint...
mbedEndpointNetwork(Ethernet): endpoint main loop beginning...
Connector::Endpoint: endpoint registered.
Connector::Endpoint: endpoint re-registered.
Connector::Endpoint: endpoint registered.
Connector::Endpoint: endpoint re-registered.
Connector::Endpoint: endpoint re-registered.
```

usbmodem1A12322 / 115200 8-N-1
Connected 00:08:55

TX RTS DTR DCD
RX CTS DSR RI



COM6 - PuTTY

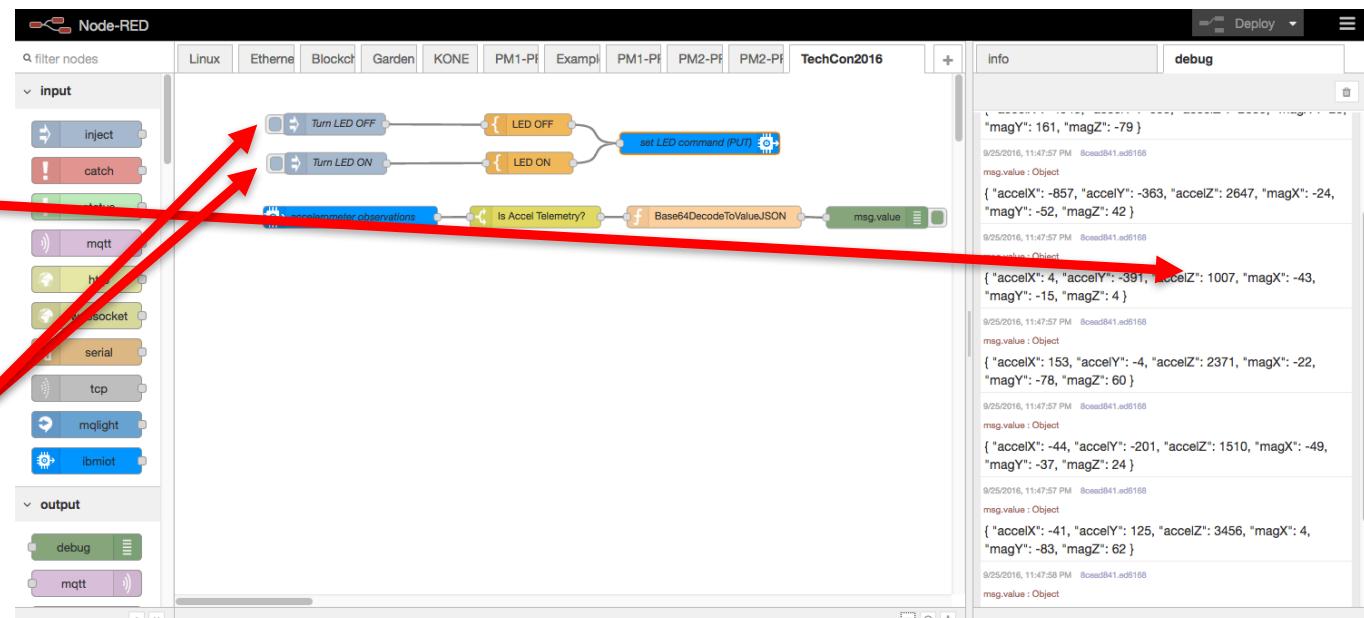
```
mbed Connector Sample Endpoint - TechCon2016 (Ethernet)
Connector::Endpoint::plumbNetwork: initializing endpoint instance...
Endpoint: allocating endpoint instance...
Connector::Endpoint::plumbNetwork: no device manager supplied (OK)
Connector::Endpoint::plumbNetwork: configuring endpoint...
Endpoint: setting defaults...
Endpoint: no device manager installed...
Endpoint: gathering configuration overrides...
Endpoint::main (Ethernet): customizing endpoint configuration...
Endpoint: endpoint configuration completed.
Connector::Endpoint::plumbNetwork: plumbing network...
mbedEndpointNetwork(Ethernet): IP Address: 192.168.1.110
Connector::Endpoint::start: building out endpoint...
Endpoint: building endpoint and its resources...
Endpoint: Connector URL: coap://api.connector.mbed.com:5684 CoAP port: 5684
Connector::Endpoint: Socket Protocol: UDP
Connector::Endpoint: Socket Address Type: IPv4
Connector::Endpoint: binding LWIP network instance...
Connector::Endpoint::build(): No device manager installed.
Connector::Endpoint::build(): adding static resources...
Connector::Endpoint::build(): adding dynamic resources...
Connector::Endpoint::build(): binding dynamic resource: [311/0/5850]...
LED: [311/0/5850] value: [] bound (observable: 0)
Connector::Endpoint::build(): binding dynamic resource: [888/0/7700]...
Accelerometer: [888/0/7700] value: [{"accelX": -66, "accelY": -85, "accelZ": -61, "magX": -203, "magY": -21}]] bound
(observaEndpoint::start: finalize and run the endpoint main loop..
mbedEndpointNetwork(Ethernet): configuring de-registration button...
mbedEndpointNetwork(Ethernet): registering endpoint...
Connector::Endpoint: registering endpoint...
mbedEndpointNetwork(Ethernet): endpoint main loop beginning...
Connector::Endpoint: endpoint registered.
```

Putting it all Together: NodeRED debug info...

- Navigate to your Watson IoT application and NodeRED flow editor

- Examine the debug window

- You should see output similar to this... telemetry in Watson IoT
 - Shake your K64F! That triggers events...
- You can toggle your LED On and off by clicking each of these... look in the serial terminal for output from the endpoint



Putting it all Together: Check Watson IoT Devices

- Go to the last window you had open from slide 19
 - Can also be reached by going to <https://console.bluemix.net/dashboard/services>
 - Select the “Internet of Things Platform” service in the list
 - Click the “Launch” button
- Select “Devices”
 - The bridge automatically creates Watson IoT devices for you

The image consists of five screenshots illustrating the workflow for creating Watson IoT devices:

- Screenshot 1:** IBM Bluemix Services dashboard showing the "All Services [3]" section. It lists "my-watson-iot-instance" (Internet of Things Platform, free plan), "my-watson-iot-endpoint-ibmcloud92f02" (Cloud Foundry App, free plan), and "Visual Recognition" (free plan). A red arrow points from this screen down to the "Devices" list in Screenshot 5.
- Screenshot 2:** IBM Bluemix Internet of Things instance management page for "my-watson-iot-instance". It shows basic information like "my-watson-iot-instance" and "my-watson-iot-endpoint-ibmcloud92f02". A red arrow points from this screen down to the "Watson IoT Platform" dashboard in Screenshot 3.
- Screenshot 3:** Watson IoT Platform documentation page. It features a "Welcome to Watson IoT Platform" banner and links for "QUICKSTART", "SERVICE STATUS", "DOCUMENTATION", and "BLOG". A red arrow points from this screen down to the "Extensions" page in Screenshot 4.
- Screenshot 4:** Watson IoT Platform extensions configuration page. It lists several integrations: "Single Sign On" (Status: Not Configured), "Email" (Status: Not Configured), "ARM imbed Connector" (Status: Configured), and "Historical Data Storage" (Status: Not Configured). A red arrow points from this screen down to the "Devices" list in Screenshot 5.
- Screenshot 5:** Watson IoT Platform devices list page. It shows a table with one row:

Device ID	Device Type	Class ID	Date Added	Location
cc69e7c5-c24f-43cf-8365-8d23bb01c707	mbed-endpoint	Device	Oct 31, 2016 3:58:23 PM	

A red oval highlights the "Device ID" column value "cc69e7c5-c24f-43cf-8365-8d23bb01c707".

Putting it all Together: Check Watson IoT Devices

- Select your device

The screenshot shows the Watson IoT Platform's Devices dashboard. A red arrow points from the 'Select your device' bullet point to the device list. The list displays one result: 'cc69e7c5-c24f-43cf-8365-8d23bb01c707'. This device is categorized as an 'mbed-endpoint' and is listed as a 'Device'. It was added on 'Oct 31, 2016 3:58:23 PM'. The dashboard includes standard filtering and search tools.

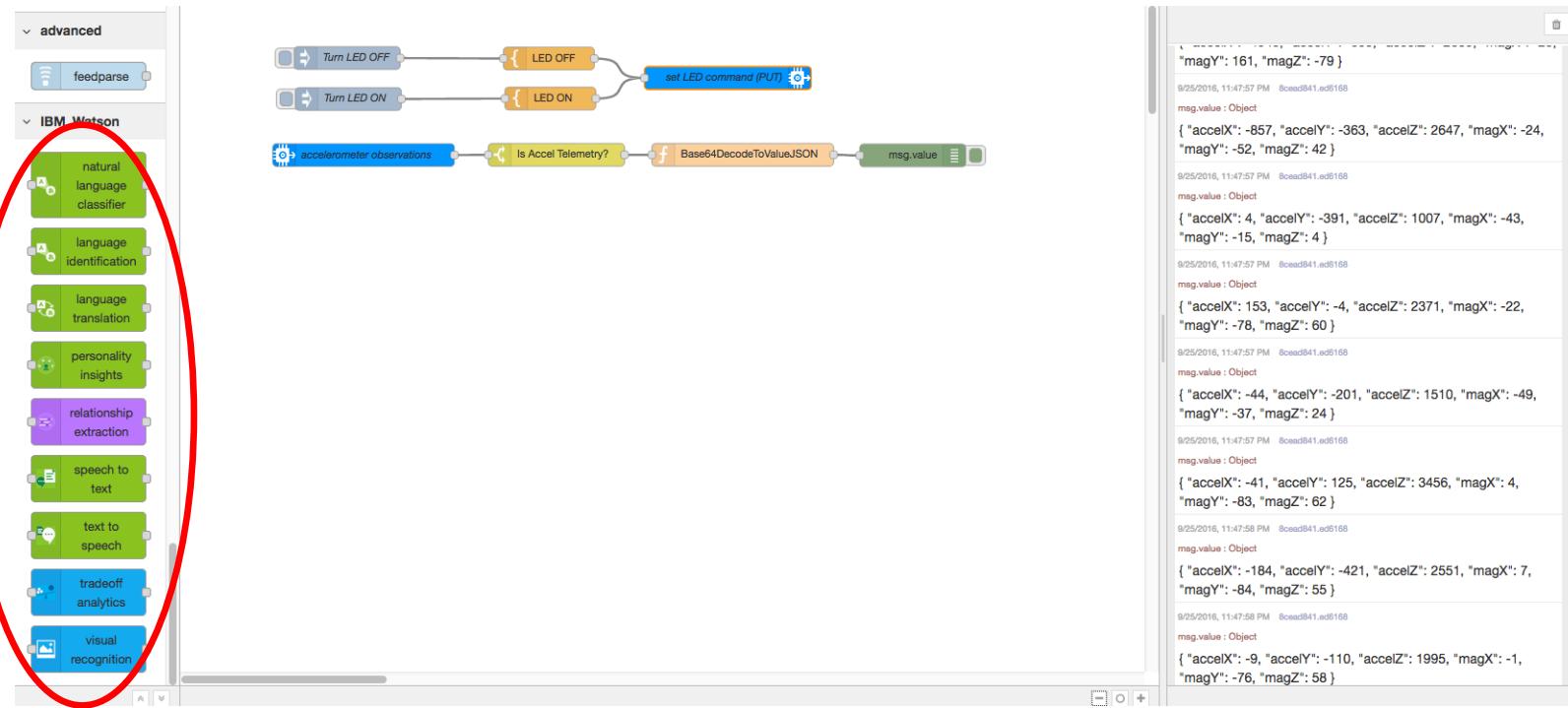
- You can watch CoAP
notify events occurring
via your bridge
(observations)

The screenshot shows the detailed view for the selected device ('cc69e7c5-c24f-43cf-8365-8d23bb01c707'). A red arrow points from the 'Recent Events' section to the event list. The 'Recent Events' table shows three entries, each with a timestamp, format (json), and a 'notify' message. The table also includes columns for 'Time Received' and 'Format'.

Time Received	Format	Message
Oct 12, 2016 1:19:51 PM	json	notify
Oct 12, 2016 1:19:52 PM	json	notify
Oct 12, 2016 1:19:53 PM	json	notify

Ah Ha!

This is SUPER COOL



- CONGRATS! You have now finished getting mbed device data into IBM Watson IoT.
- We can deliver mbed device data into Watson IoT analytics via our NodeRED flow!
- The bigger challenge remains... What can/do you do with your data telemetry?

Summary

We have completed the following – congratulations!

- Created our Bluemix mbed environments and PC tool setup
- Imported our mbed endpoint, customized, installed, and ran it
- Created our own Watson IoT Service Instance and NodeRED application
- Configured our Watson mbed Connector Bridge
- Imported a NodeRED flow and customized it
- Examined live telemetry and some bi-directional capabilities of our bridge

Great JOB! Thanks for your time.