Lab 4: Smart Home Monitoring using OM2M, Node-RED, and Wyliodrin

物聯網技術與應用(英) IoT/M2M Technologies and Applications

國立交通大學資訊工程系
Department of Computer Science
National Chiao Tung University

November 30, 2018

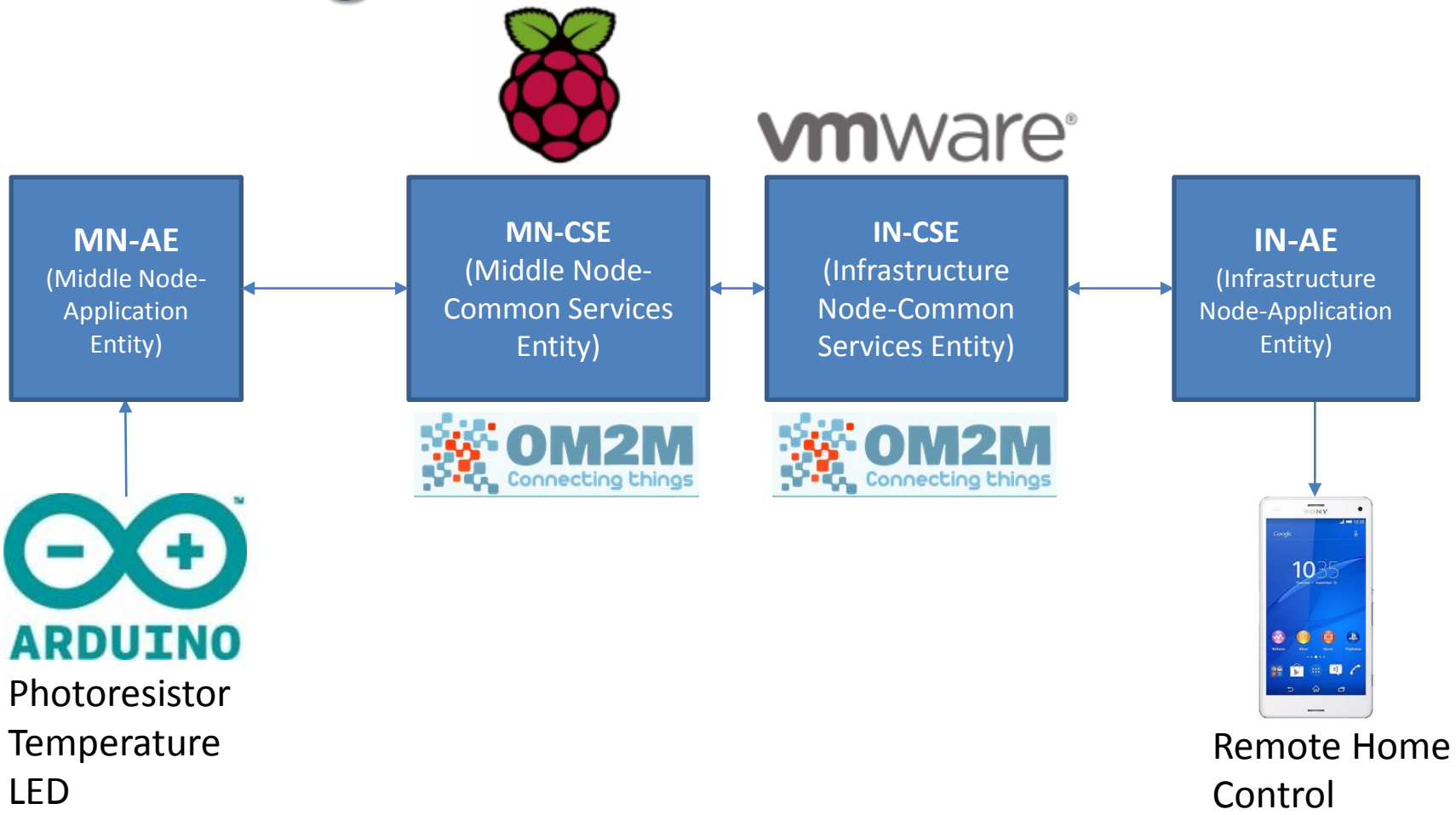
Outline

- High Level Architecture.
- Configuring IN-CSE (VM) and MN-CSE (Raspbery Pi). *(Checkpoint 1)*
- Creating a Middle Node-Application Entity (MN-AE) with HTTP Server Capabilities using Node-Red. *(Checkpoint 2)*
- Sending Smart Home Data from Raspberry Pi to MN-AE using Node-Red. *(Checkpoint 3)*
- Subscribing to Smart Home Data and Extracting Sensor Values using Node-Red. *(Checkpoint 4)*

Attention!

Please, start your virtual machine, connect your Raspberry Pi to the power source now, and connect your Arduino to your Raspberry Pi as you did in Lab 2.

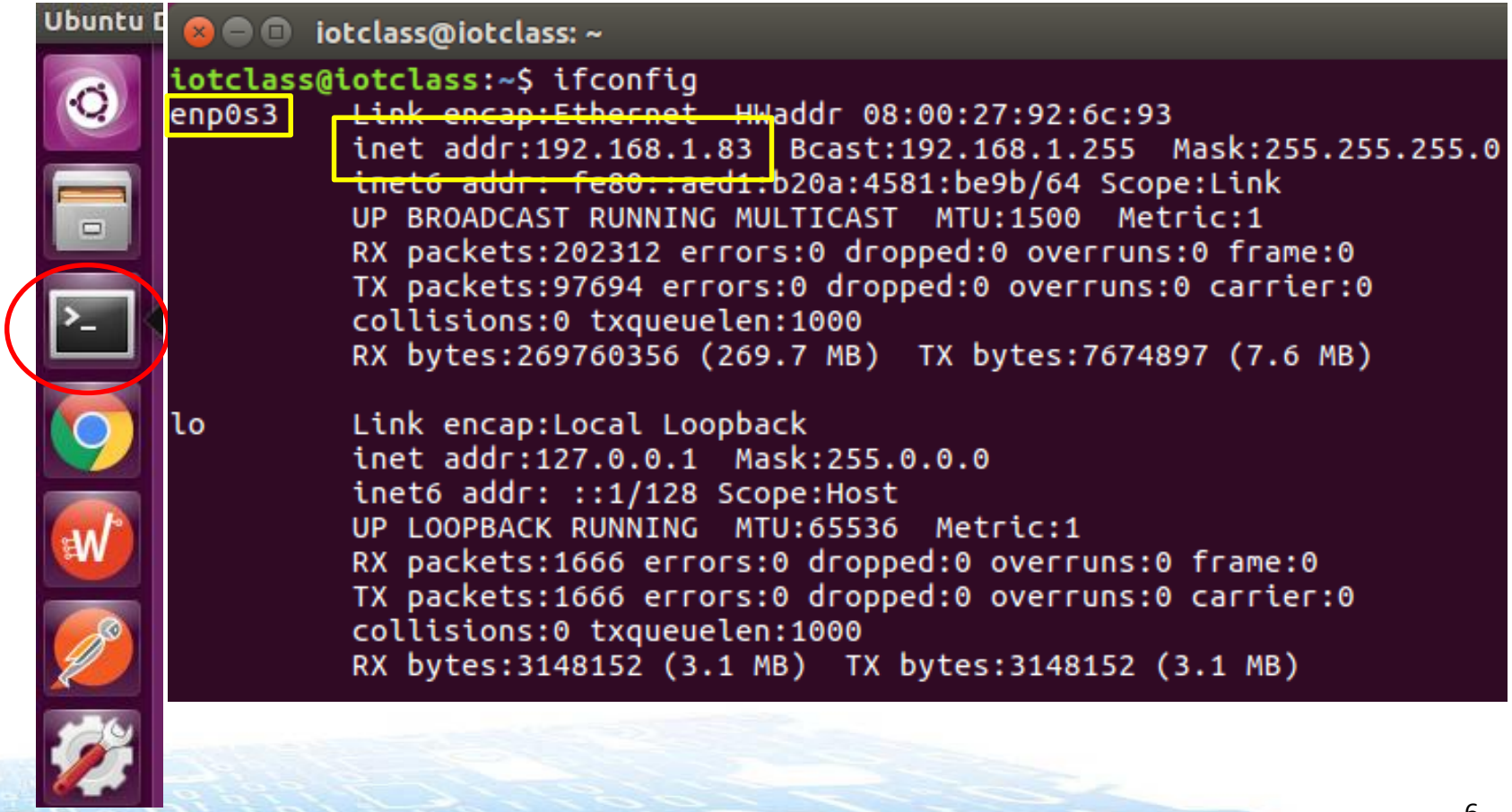
High Level Architecture



CONFIGURING IN-CSE

Finding out your VM IP Address

1. Open a terminal window (Click on the icon shown below).
2. Execute “ifconfig”.
3. **YOUR.VM.IP.ADDRESS** is under the first network interface information.



Changing IN-CSE Configuration (1)

1. In another terminal window, execute:
2. cd om2m/in-cse/configuration/
3. nano config.ini

```
iotclass@ubuntu: ~/om2m/in-cse/configuration
iotclass@ubuntu:~$ cd om2m/in-cse/configuration/
iotclass@ubuntu:~/om2m/in-cse/configuration$ nano config.ini
iotclass@ubuntu:~/om2m/in-cse/configuration$
```

Changing IN-CSE Configuration (2)

4. Set org.eclipse.om2m.**caseBaseAddress**=**YOUR.VM.IP.ADRESS**
5. Save the changes (Press CTRL + X, then press Y, finally press ENTER).

iotclass@iotclass: ~/om2m/IN-CSE/configuration

```
  GNU nano 2.5.3                File: config.ini

#This configuration file was written by: org.eclipse.equinox.internal.framework$
#Fri Jul 08 10:21:12 CEST 2016
log4j.configuration=file\:./log4j.configuration
org.eclipse.equinox.http.jetty.http.port=8080
org.eclipse.om2m.dbReset=false
org.eclipse.om2m.cseBaseContext=/
org.eclipse.om2m.globalContext=
osgi.bundles=reference\:file\:javax.servlet_3.1.0.v20140303-1611.jar@4,referenc$
org.eclipse.om2m.cseBaseProtocol.default=http
org.eclipse.om2m.cseBaseName=in-name
org.eclipse.om2m.cseBaseAddress=192.168.1.83
eclipse.p2.profile=DefaultProfile
org.eclipse.om2m.dbUrl=jdbc\:h2\:./database/indb
osgi.framework.extensions=
org.eclipse.om2m.webInterfaceContext=/webpage
osgi.bundles.defaultStartLevel=4
org.eclipse.om2m.dbUser=om2m
osgi.framework=file\:plugins/org.eclipse.osgi_3.10.2.v20150203-1939.jar
org.eclipse.om2m.guestRequestingEntity=guest\:guest
                              [ Read 29 lines ]
^G Get Help   ^O Write Out  ^W Where Is   ^K Cut Text   ^J Justify    ^C Cur Pos
^X Exit       ^R Read File  ^\ Replace    ^U Uncut Text ^T To Spell   ^_ Go To Line
```

Line 11. YOUR.VM.IP.ADRESS

Start OM2M IN-CSE

- Enter the following commands:

  $ cd ..

  $ ./start.sh

```
iotclass@ubuntu: ~/om2m/in-cse
iotclass@ubuntu:~/om2m/in-cse/configuration$ cd ..
iotclass@ubuntu:~/om2m/in-cse$ ./start.sh
```

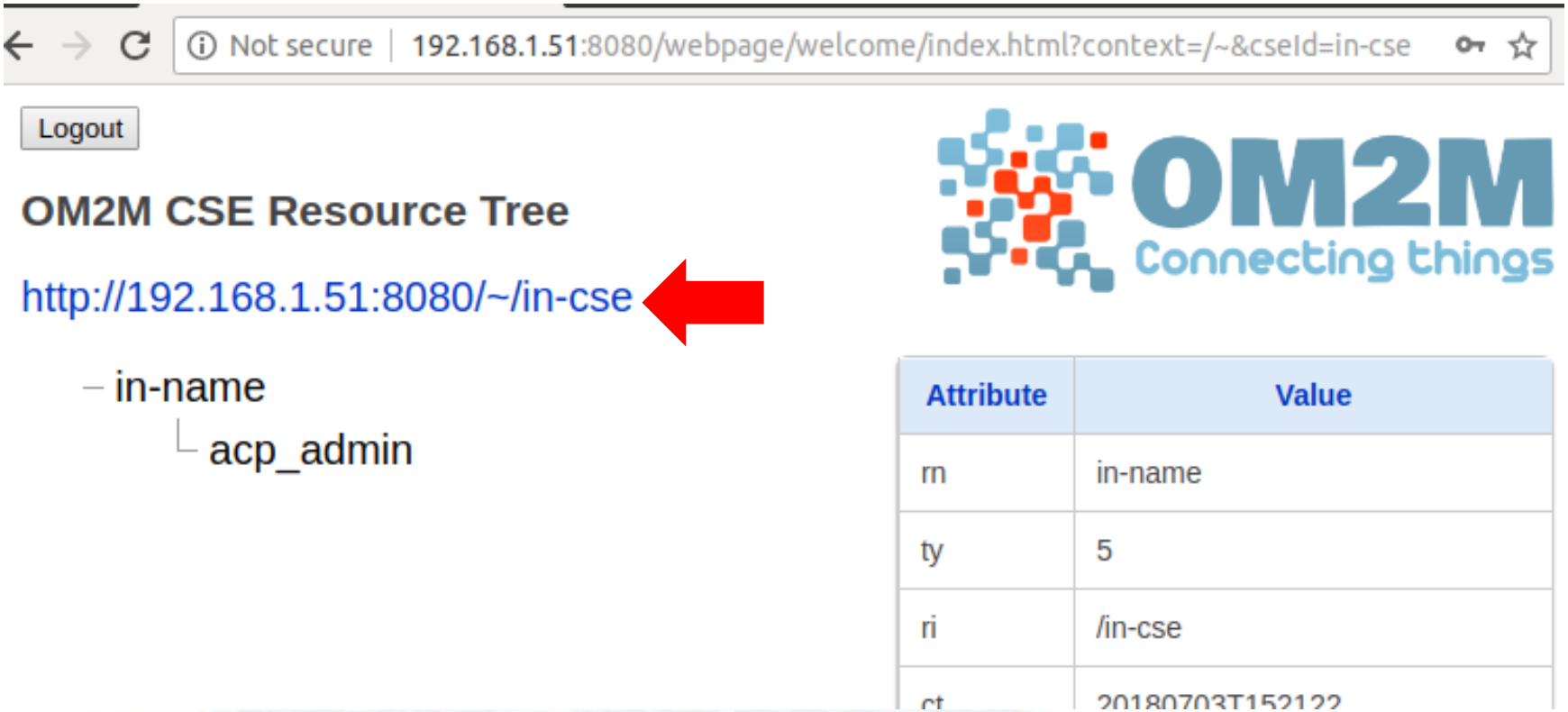
- After starting it successfully, you will see “CSE Started” in your terminal.

```
Registering Database (JPA-EL) Service
[INFO] - org.eclipse.om2m.core.Activator
DataBase persistence service discovered
[INFO] - org.eclipse.om2m.core.thread.CoreExecutor
Creating thread pool with corePoolSize=5 & maximumSize=50
[INFO] - org.eclipse.om2m.core.CSEInitializer
Initializating the cseBase
[INFO] - org.eclipse.om2m.core.CSEInitializer
cseBase already initialized
[INFO] - org.eclipse.om2m.core.Activator
Registering CseService...
[INFO] - org.eclipse.om2m.binding.http.Activator
CseService discovered
[INFO] - org.eclipse.om2m.binding.coap.Activator
CSE Service discovered
[INFO] - org.eclipse.om2m.core.Activator
CSE Started
```

Verify your IN-CSE

Browse to http://**YOUR.VM.IP.ADRESS**:8080/webpage.

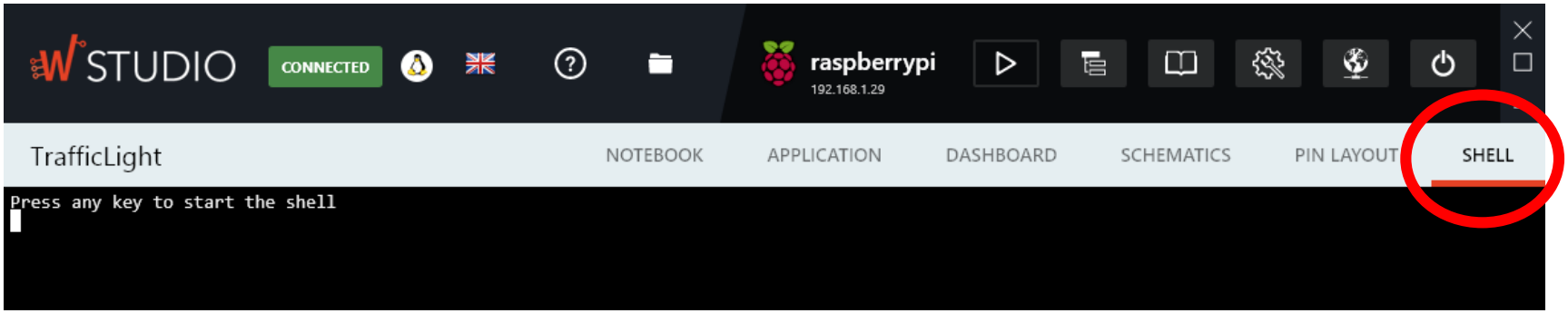
Notice that your IN-CSE is using an IP address now instead of Localhost.



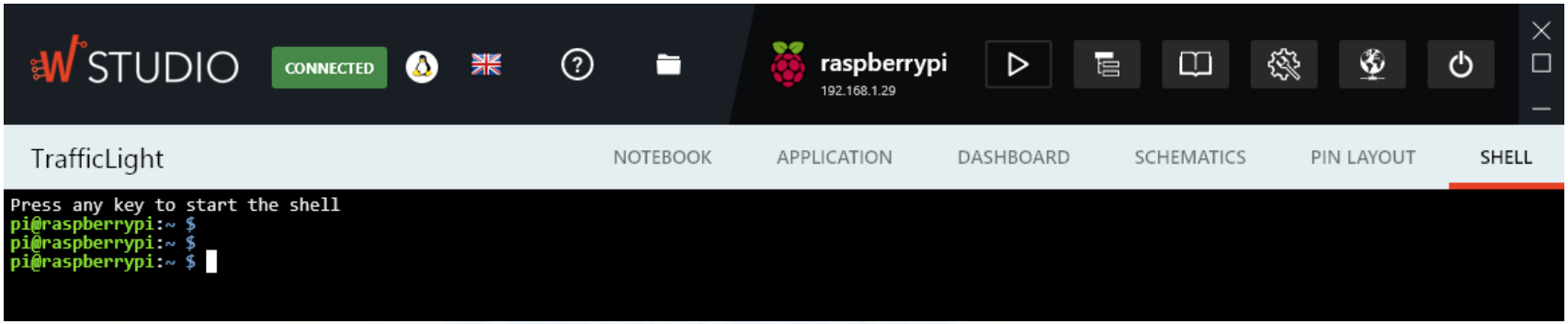
CONFIGURING MN-CSE

Changing MN-CSE Configuration (1)

1. Open a new terminal window and launch Wyliodrin Studio. ($ ./wyliodrin.AppImage)
2. Connect to your Raspberry Pi.
3. Click on the “Shell” tab.

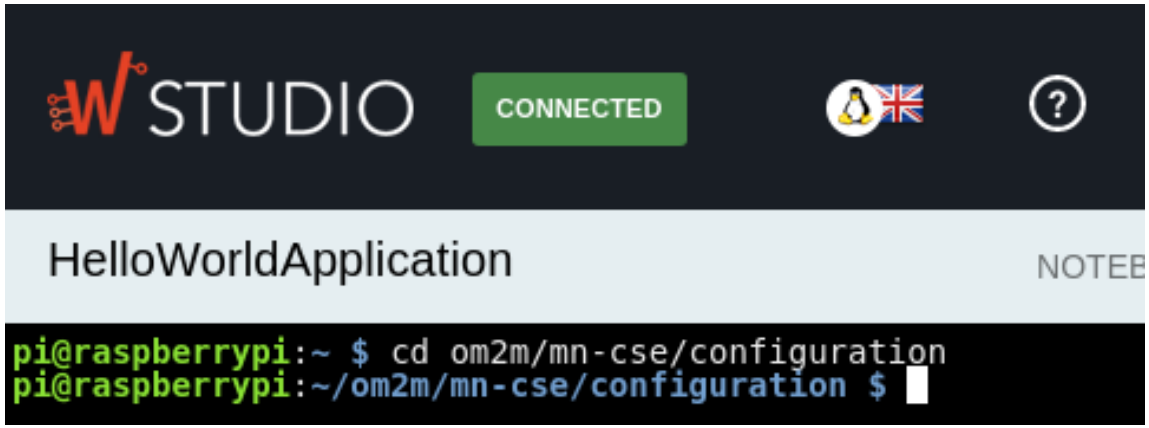


4. Press ENTER.

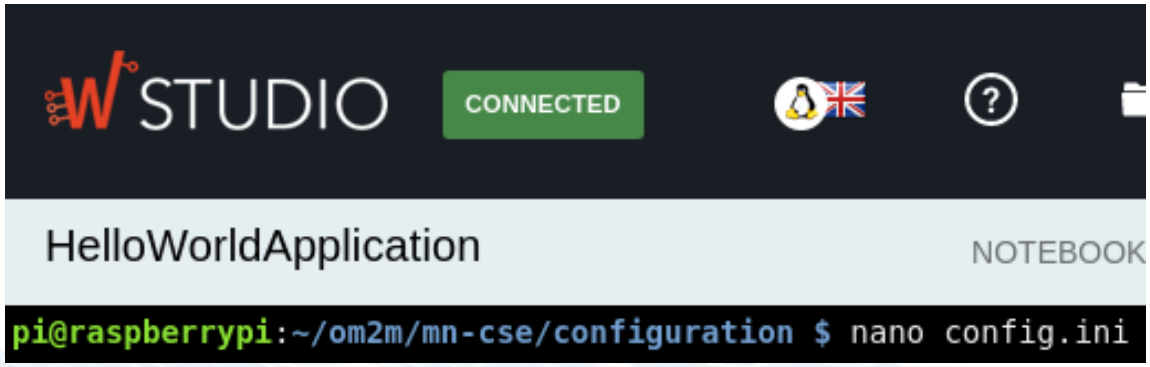


Changing MN-CSE Configuration (2)

4. Execute the following commands:
5. cd om2m/mn-cse/configuration



6. nano config.ini



Changing MN-CSE Configuration (3)

7. Set org.eclipse.om2m.**cseBaseName**=mn-name-pi
8. Set org.eclipse.om2m.**cseBaseAddress**=YOUR.RASPBERRY.IP.ADDRESS
9. Set org.eclipse.om2m.**cseBaseId**=mn-cse-pi
10. Set org.eclipse.om2m.**remoteCseAddress**=YOUR.VM.IP.ADRESS
11. Save the changes (Press CTRL + X, then press Y, finally press ENTER).

```
org.eclipse.om2m.remoteCsePort=8080
org.eclipse.om2m.cseBaseContext=/
org.eclipse.om2m.globalContext=
osgi.bundles=reference\:file\:javax.servlet_3.1.0.v20140303-1611.jar@4,reference\:file\:javax.xml_1.
org.eclipse.om2m.cseBaseProtocol.default=http
org.eclipse.om2m.cseBaseName=mn-name
org.eclipse.om2m.cseBaseAddress=127.0.0.1
eclipse.p2.profile=DefaultProfile
org.eclipse.om2m.dbUrl=jdbc\:h2\:./database/mndb
osgi.framework.extensions=
org.eclipse.om2m.webInterfaceContext=/webpage
osgi.bundles.defaultStartLevel=4
org.eclipse.om2m.dbUser=om2m
org.eclipse.om2m.maxNrOfInstances=1000
osgi.framework=file\:plugins/org.eclipse.osgi_3.10.2.v20150203-1939.jar
org.eclipse.om2m.guestRequestingEntity=guest\:guest
org.eclipse.om2m.remoteCseName=in-name
org.eclipse.om2m.cseBaseId=mn-cse
org.eclipse.om2m.remoteCseContext=/
org.eclipse.om2m.dbDriver=org.h2.Driver
org.eclipse.om2m.remoteCseAddress=127.0.0.1
org.eclipse.om2m.adminRequestingEntity=admin\:admin
org.eclipse.om2m.cseType=MN
org.apache.commons.logging.Log=org.apache.commons.logging.impl.Log4JLogger
org.eclipse.om2m.cseAuthentication=true
eclipse.p2.data.area=@config.dir/../p2
org.eclipse.om2m.coap.port=5684
org.eclipse.om2m.dbPassword=om2m
```

Line 13. mn-name-pi

Line 14. YOUR.RASPBERRY.IP.ADDRESS

Line 25. mn-cse-pi

Line 29. YOUR.VM.IP.ADRESS

Starting MN-CSE on Raspberry

12. Execute “cd ..”.
13. Execute “./start.sh”.

…

…

This process will take a few minutes, it is normal due to the computational capacity of Pi. In the end, you should see a message “Successfully registered to in-cse” as shown below.

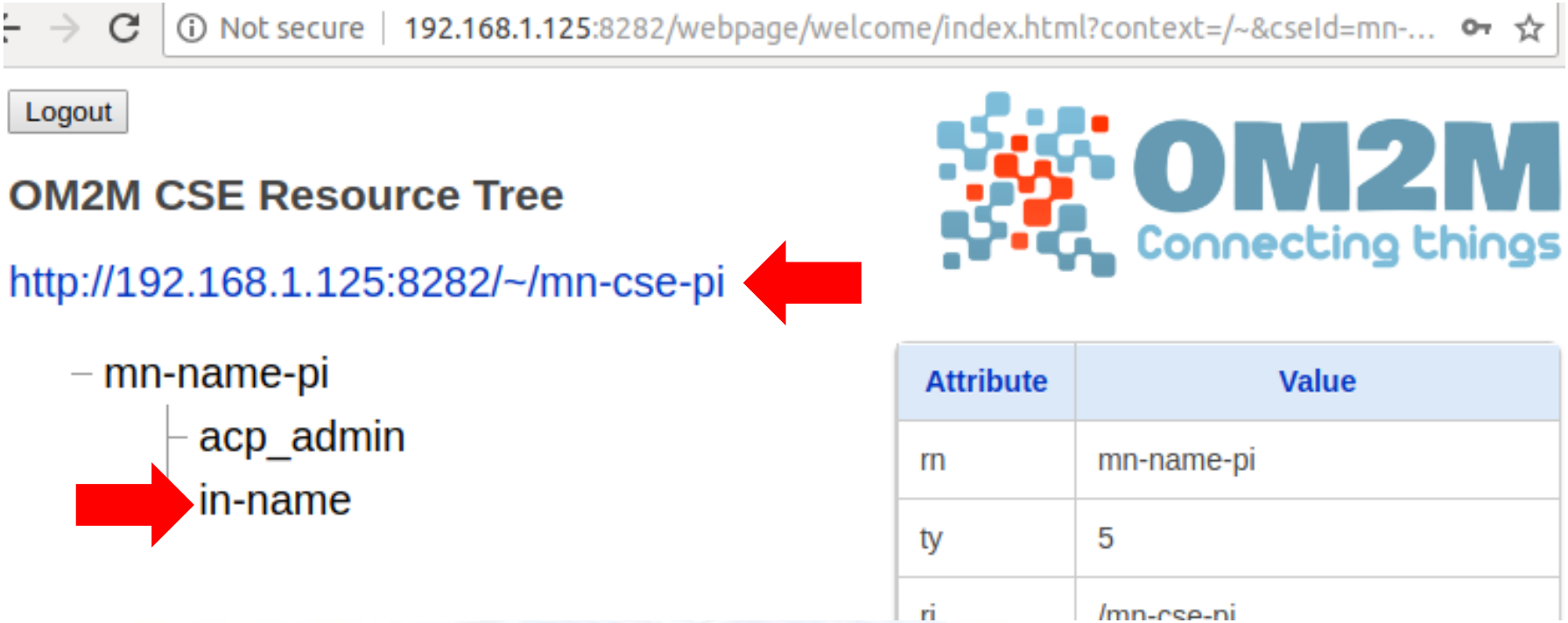
```
]
[INFO] - org.eclipse.om2m.core.CSEInitializer
Successfully registered to in-cse
[INFO] - org.eclipse.om2m.core.remotecse.RemoteCseService
addRemoteCseAndPublish(cseId=/mn-cse-pi/csr-809637383, name=in-name)
[INFO] - org.eclipse.om2m.core.remotecse.RemoteCseService
post Event to inform about RemoteCSE creation (cseId=in-cse, cseName=in-name)
```

Verify your MN-CSE

Browse to http://**YOUR.RASPBERRY.IP.ADDRESS**:8282/webpage.

Notice that your MN-CSE is using an IP address now instead of Localhost.

Also notice the registration of “in-name” which corresponds to the IN-CSE.



CHECKPOINT 1!

CREATING MN-AE AND WEB SERVICE

Launching Node-Red

Use a new terminal to launch Node-Red:

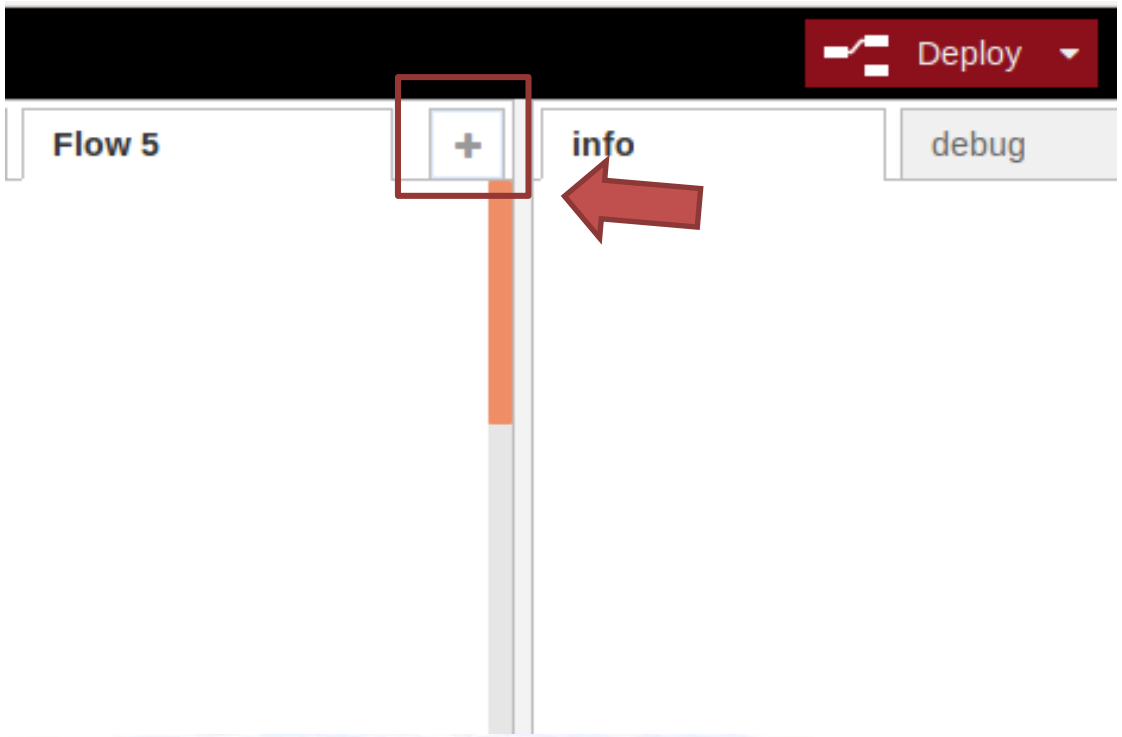
$ *node-red*

```
ubuntu@ubuntu-VirtualBox: ~
ubuntu@ubuntu-VirtualBox:~$ node-red


Welcome to Node-RED
===================

2 Aug 20:11:59 - [info] Node-RED version: v0.11.1
2 Aug 20:11:59 - [info] Node.js  version: v0.12.7
2 Aug 20:11:59 - [info] Loading palette nodes
2 Aug 20:12:03 - [warn] ---------------------------------------
2 Aug 20:12:03 - [warn] Failed to register 1 node type
2 Aug 20:12:03 - [warn] Run with -v for details
2 Aug 20:12:03 - [warn] ---------------------------------------
2 Aug 20:12:03 - [info] Settings file  : /usr/local/lib/node_modules/node-red/se
ttings.js
2 Aug 20:12:03 - [info] User directory : /home/ubuntu/.node-red
2 Aug 20:12:03 - [info] Flows file : /home/ubuntu/.node-red/flows_ubuntu-Virtual
Box.json
2 Aug 20:12:03 - [info] Server now running at http://127.0.0.1:1880/
2 Aug 20:12:03 - [info] Starting flows
2 Aug 20:12:03 - [info] Started flows
```

Before creating new flows in Node-Red (1)

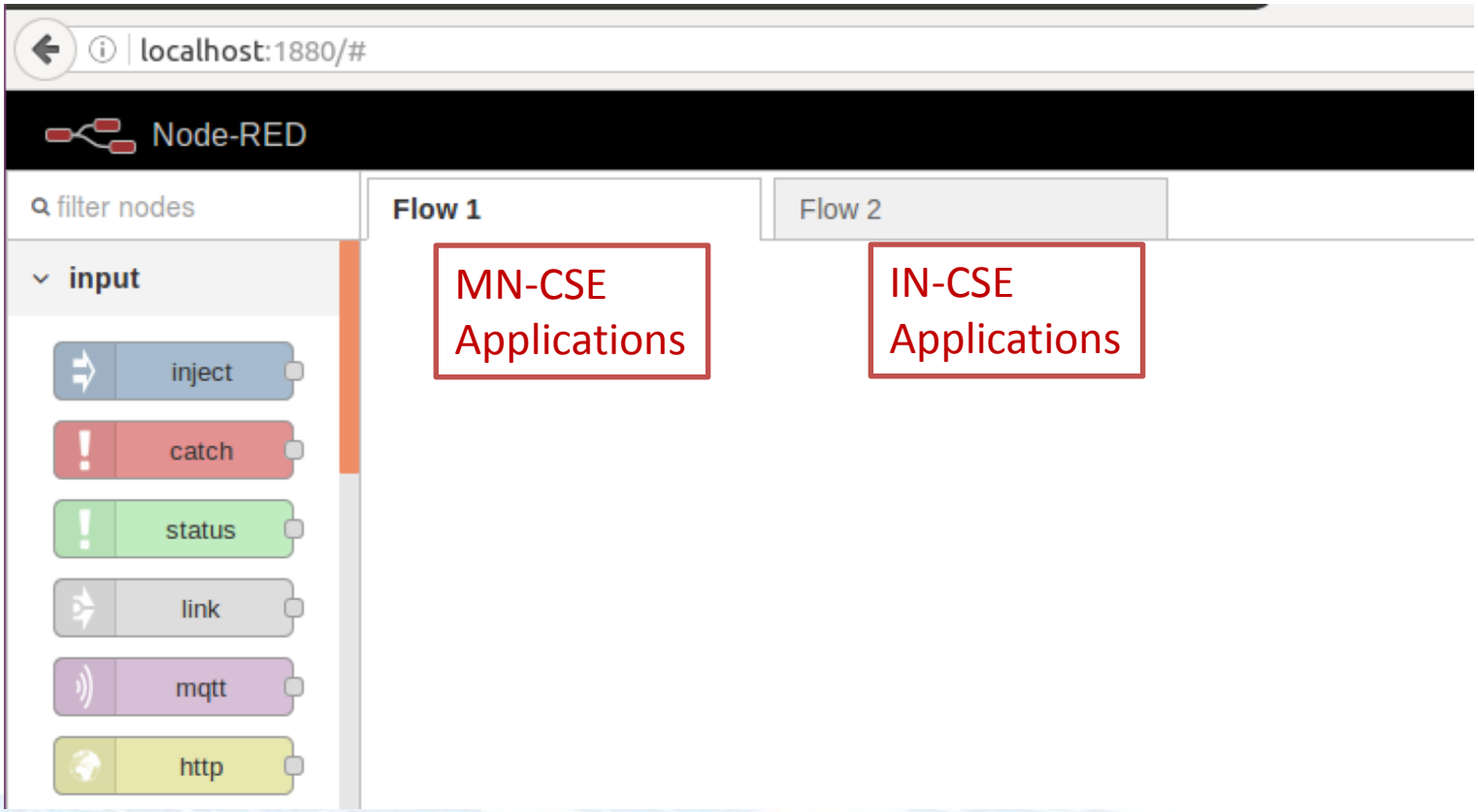
Open http://localhost:1880 in a browser.

Add a new workspace.



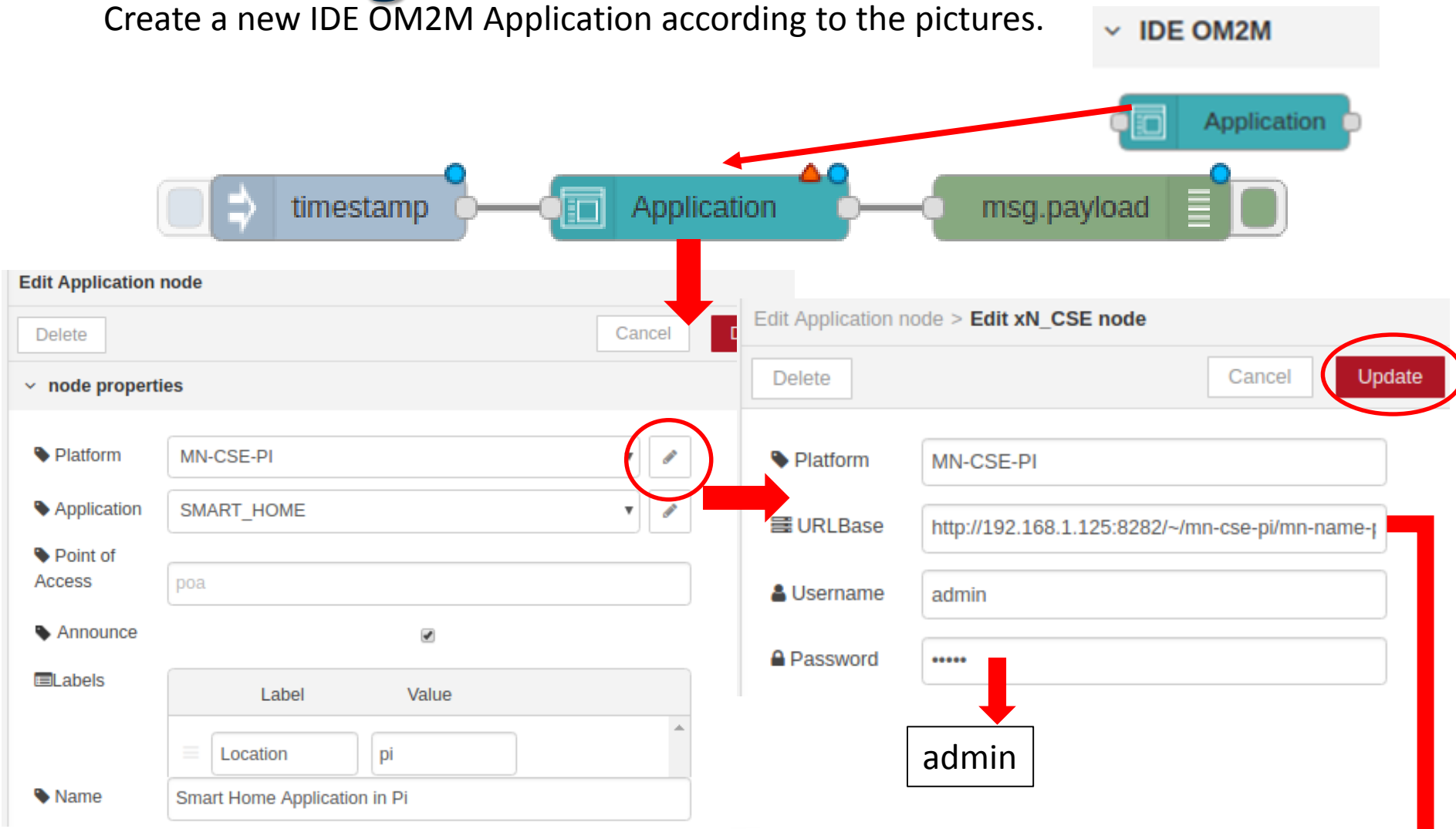
Before creating new flows in Node-Red (2)

We suggest you to use different workspaces for different applications.
For example, one workspace for MN-CSE and another one for IN-CSE applications.



Creating a MN-AE with Node-RED

Create a new IDE OM2M Application according to the pictures.

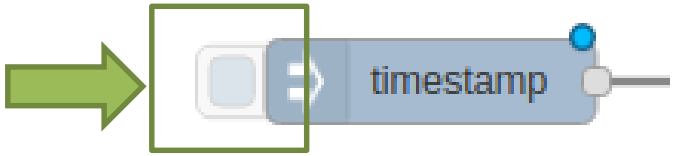


URLBase = http://**YOUR.RASPBERRY.IP.ADDRESS**:8282/~/mn-cse-pi/mn-name-pi

Reminder:
Deploy and Trigger the Flows

Remember to push the Deploy button in Node-Red every time you made changes.

After successfully deploying, trigger you new flows.



Creating a MN-AE with Node-RED

Deploy the flows in Node-Red and trigger the flow.

Verify that your application has been creating by accessing OM2M GUI.

Not secure | 192.168.1.125:8282/webpage/welcome/index.html?context=/~&cseId=mn-...

Logout

OM2M CSE Resource Tree

http://192.168.1.125:8282/~/mn-cse-pi/CAE958638652

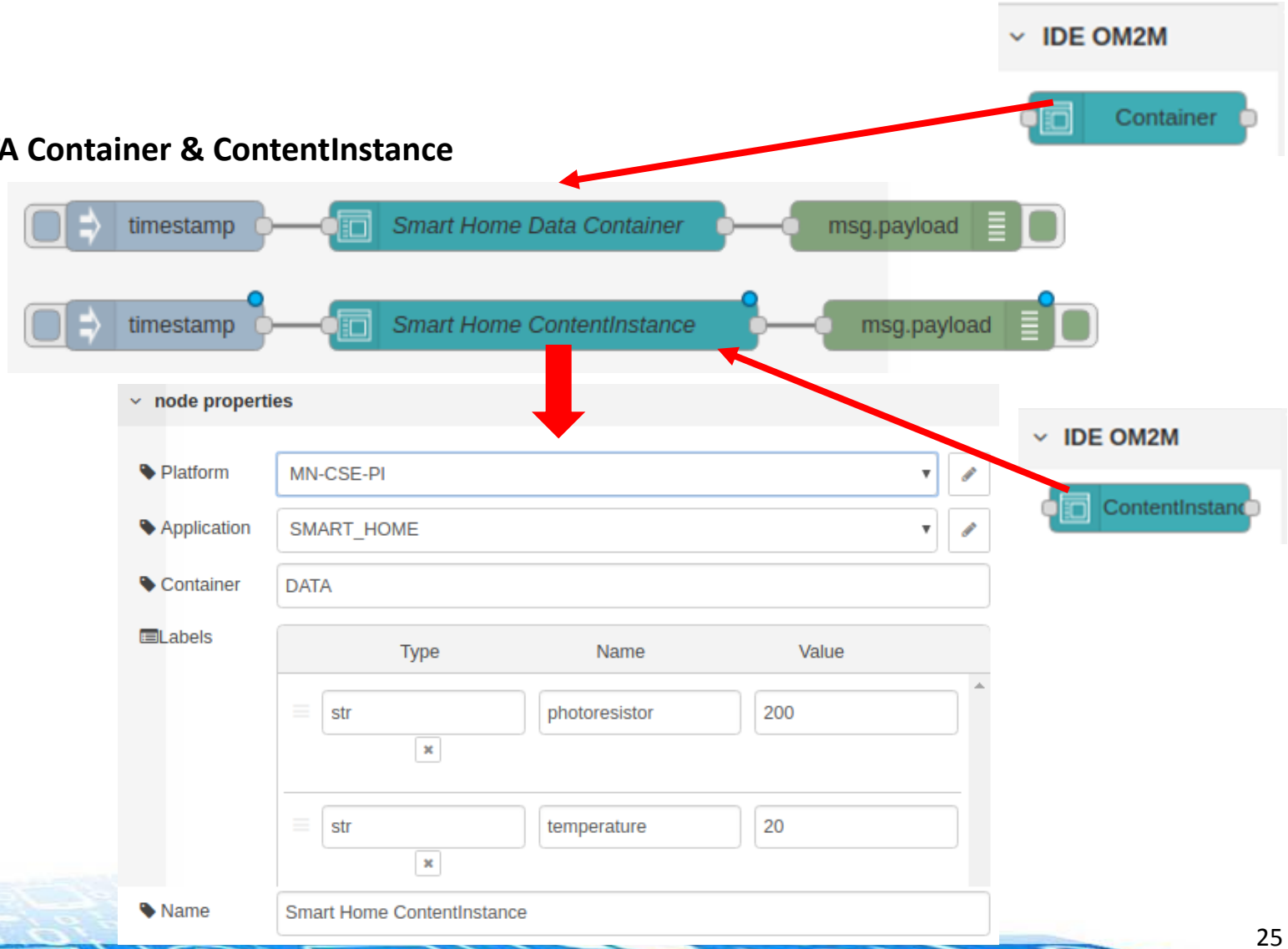
- mn-name-pi
  - acp_admin
  - SMART_HOME
  - in-name

Attribute	Value
rn	SMART_HOME
ty	2
ri	/mn-cse-pi/CAE958638652
pi	/mn-cse-pi
ct	20180703T094547
lt	20180703T094547

Creating a MN-AE with Node-RED

Create the following resources under your “SMART_HOME” application.

DATA Container & ContentInstance



Creating a MN-AE with Node-RED

Deploy the flows in Node-Red and trigger the flows.
Verify that your DATA container and ContentInstance have been created.

Logout

OM2M CSE Resource Tree

http://192.168.1.125:8282/~/mn-cse-pi/cin-239932425

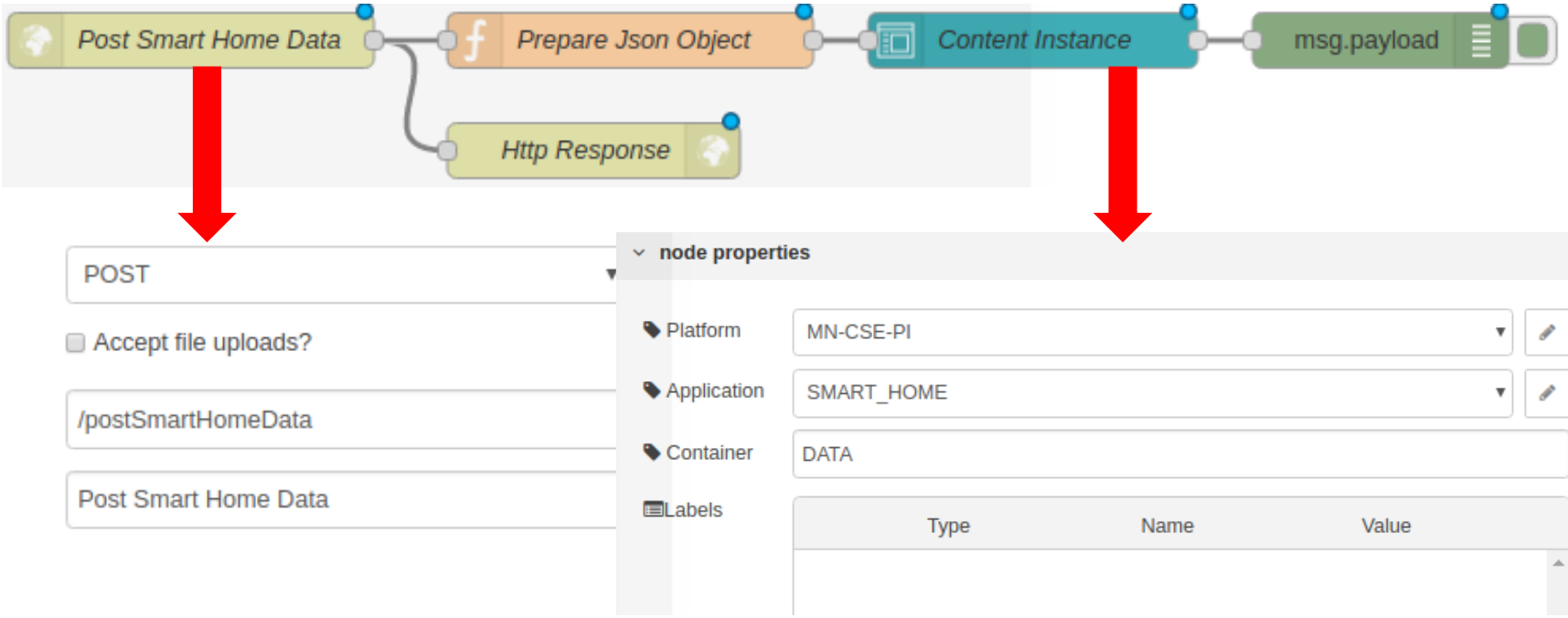
- mn-name-pi
  - acp_admin
  - SMART_HOME
    - DATA
      - cin_239932425
  - in-name

Attribute	Value
rn	cin_239932425
ty	4
ri	/mn-cse-pi/cin-239932425
pi	/mn-cse-pi/cnt-224633082
ct	20180703T112557
lt	20180703T112557
st	0
cnf	message
cs	126
con	

Attribute	Value
photoresistor	200
temperature	20

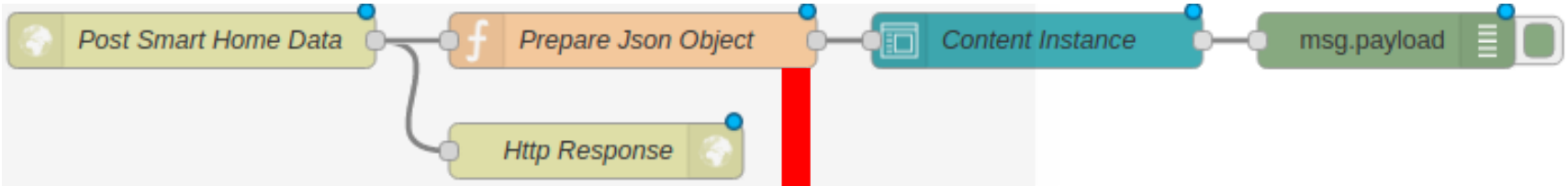
Creating a MN-AE with Node-RED

Create a “postSmartHomeData” webservice to receive data from real sensors.



Creating a MN-AE with Node-RED

Create a “postSmartHomeData” webservice to receive data from real sensors.



Name

Prepare Json Object

Function

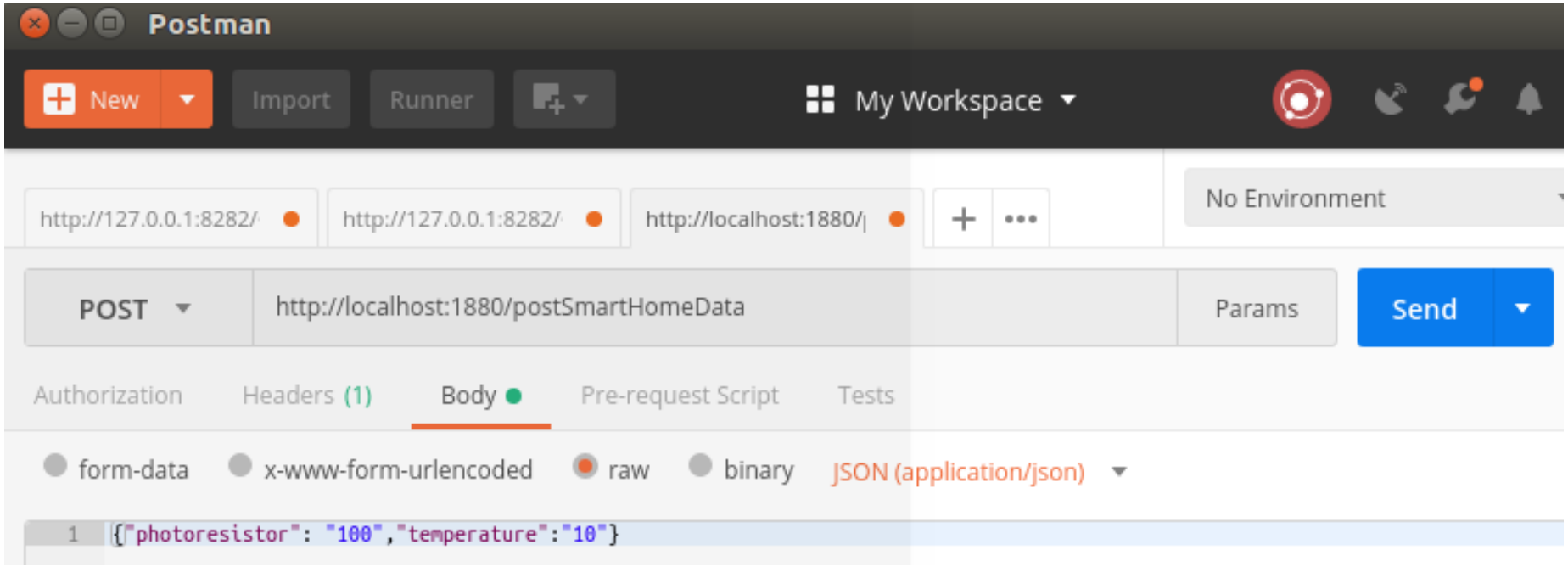
```
var data = [{
    type:'str',
    label:'photoresistor',
    value: msg.payload.photoresistor
},
{
    type:'str',
    label:'temperature',
    value: msg.payload.temperature
}];
msg.externalInput = JSON.stringify(data);
return msg;
```

CODE (Copy & Paste in Node Red)

```
var data = [{
    type:'str',
    label:'photoresistor',
    value: msg.payload.photoresistor
},
{
    type:'str',
    label:'temperature',
    value: msg.payload.temperature
}];
msg.externalInput =
JSON.stringify(data);
return msg;
```

Creating a MN-AE with Node-RED

Deploy the flows in Node-Red.
Use Postman to verify your webservice works correctly.



Creating a MN-AE with Node-RED

Check the OM2M GUI.

Logout

OM2M CSE Resource Tree

http://192.168.1.125:8282/~/mn-cse-pi/cin-9528

- mn-name-pi
  - acp_admin
  - SMART_HOME
    - DATA
      - cin_239932425
      - cin_952835110
  - in-name

Attribute	Value
rn	cin_952835110
ty	4
ri	/mn-cse-pi/cin-952835110
pi	/mn-cse-pi/cnt-224633082
ct	20180703T114156
lt	20180703T114156
st	0
cnf	message
cs	126
con	

Attribute	Value
photoresistor	100
temperature	10

CHECKPOINT 2!

SENDING SMART HOME DATA FROM PI

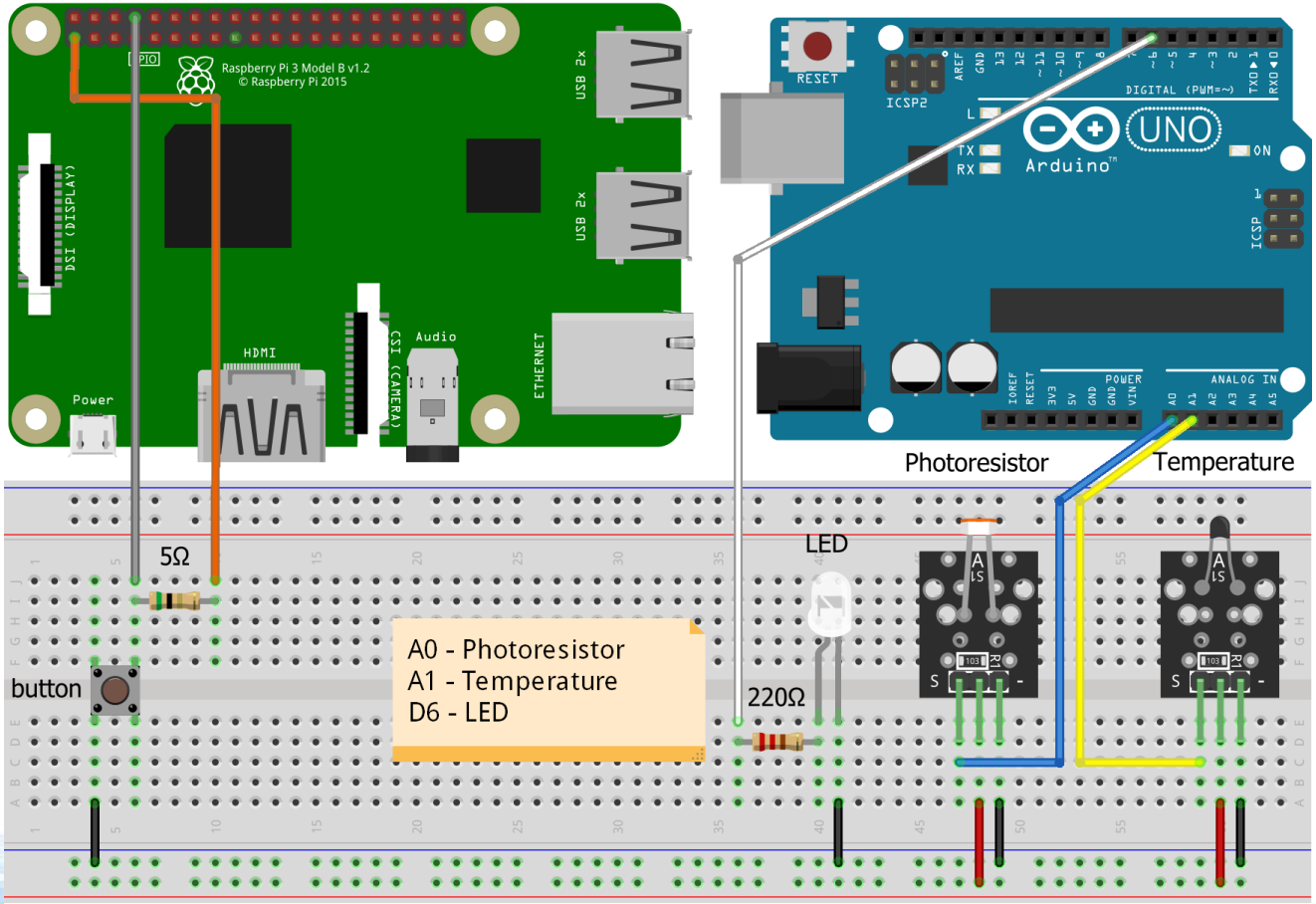
Attention!!

We are going to use the applications created in Labs 1 and 2, and apply some modifications on them.

Make sure your Pi, Arduino, and the Wyliodrin applications from Labs 1 and 2 are ready!

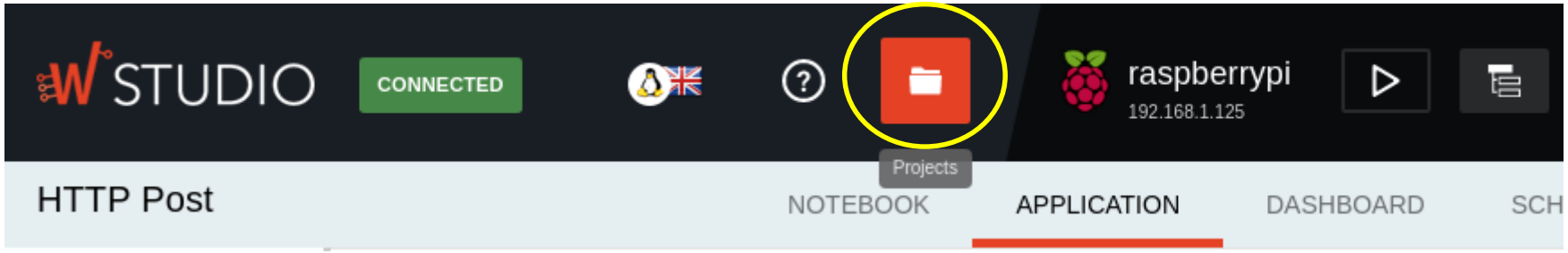
Schematics (Lab 1 + Lab 2)

- Connect all the modules and component according to the schema.
- **Connect Arduino to Raspberry with Arduino USB-cable as you did in Lab 2.**
- **Connect 5V and GND (Ground) to your breadboard as you did in Labs 0, 1, and 2 (Not shown in the diagram!).**
- Ask TA if you are not sure how to connect the components.

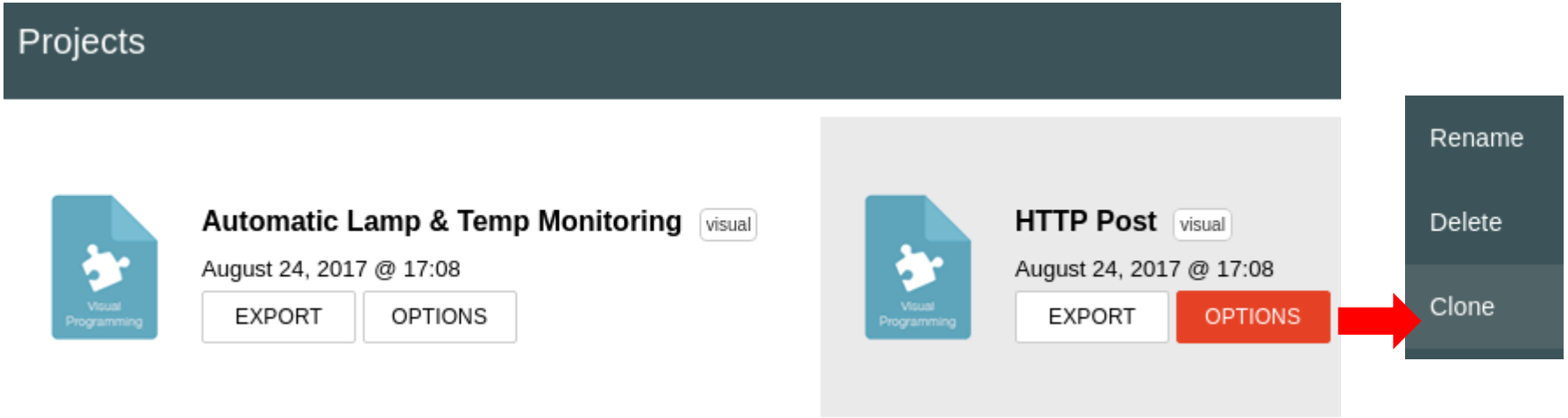


Clone HTTP Post App (1)

- Use Wyliodrin to clone your previous “HTTP Post” application. Click on “Projects”.

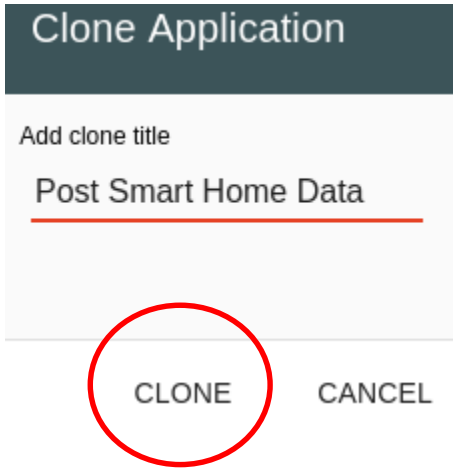


- In the Projects window, click on “Options” -> “Clone”.

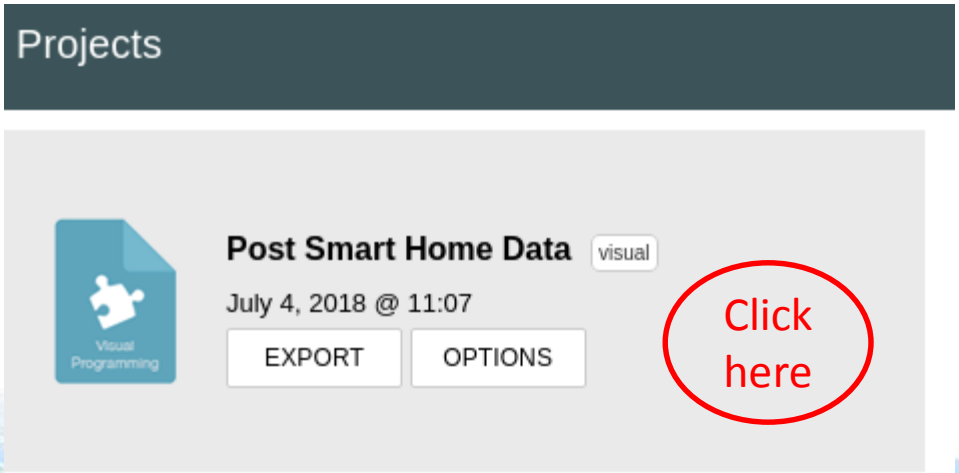


Clone HTTP Post App (2)

- Change the application name to “Post Smart Home Data”. Click on “clone”.

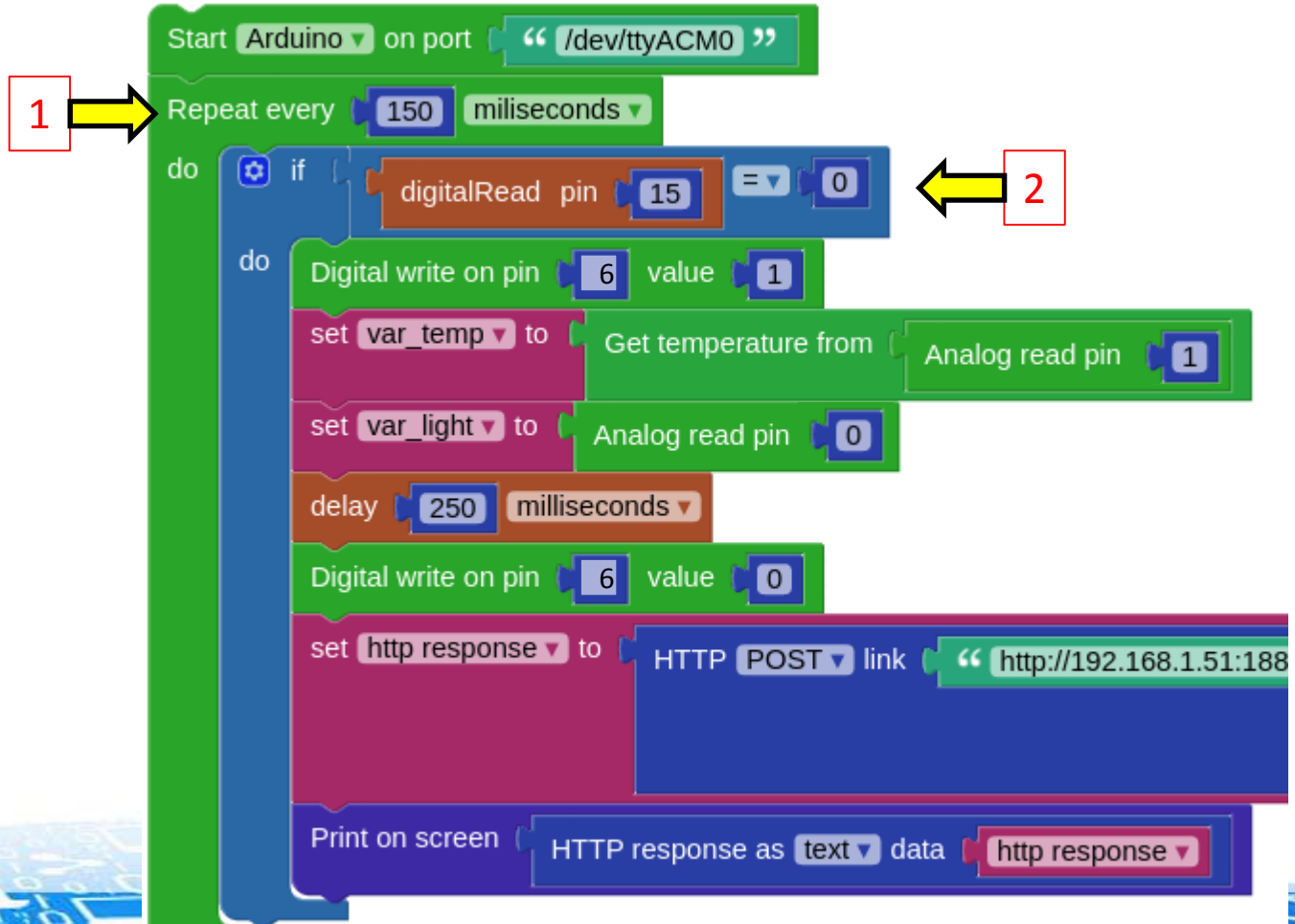


- Open the application.



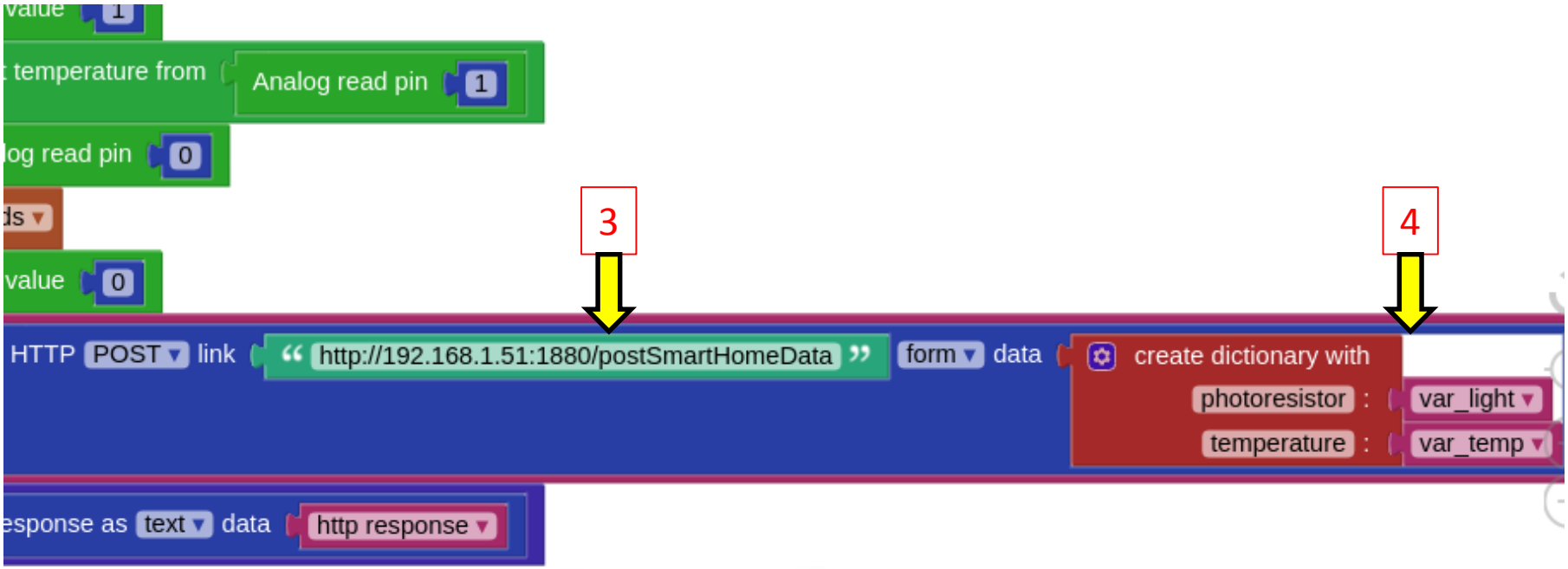
Modify the blocks (1)

1. Change time to 150 milliseconds.
2. Use the switch button to trigger the action (Put previous blocks inside the IF block).



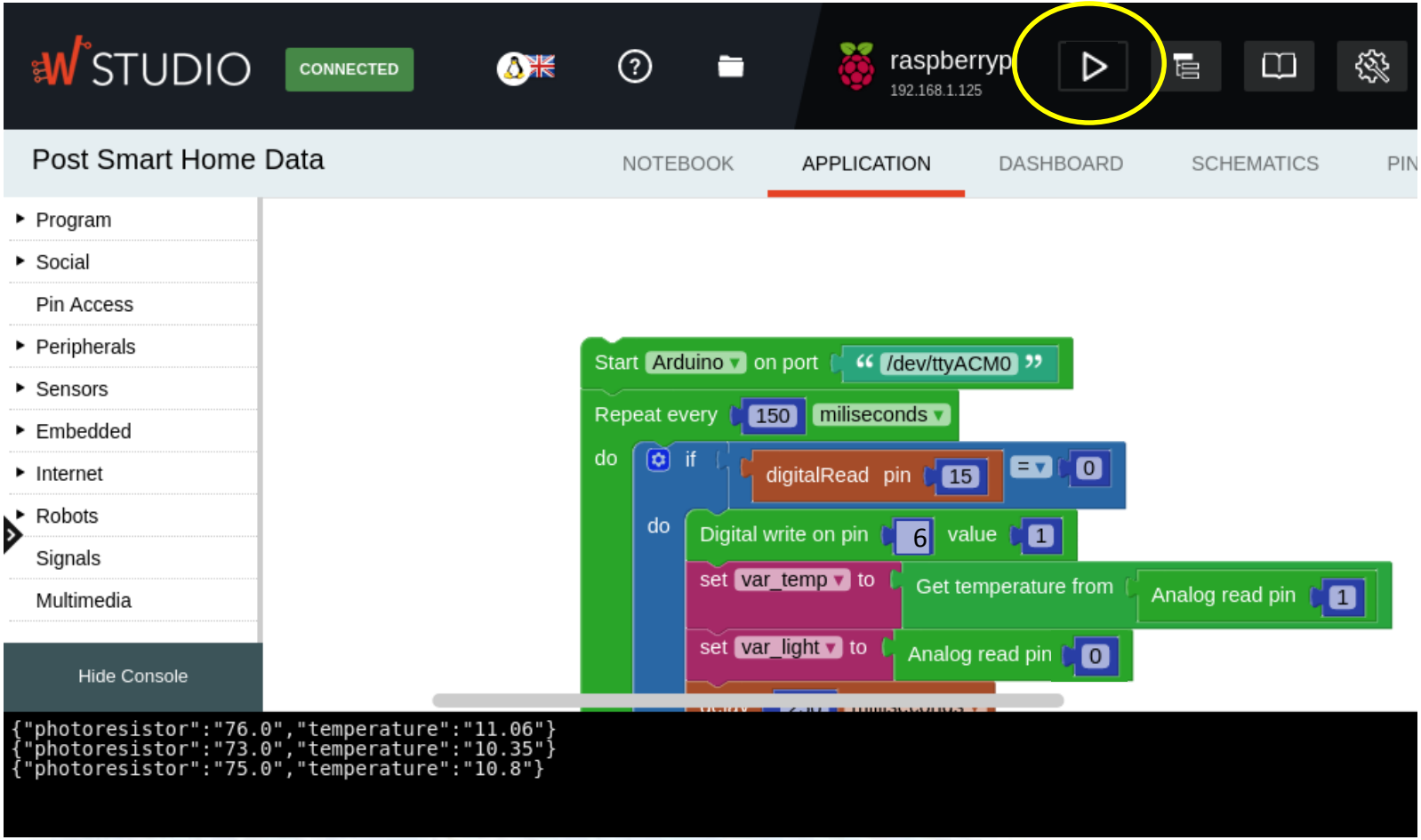
Modify the blocks (2)

3. Set “link” to: http://**YOUR.VM.IP.ADRESS**:1880/postSmartHomeData.
4. Change dictionary to send “photoresistor”: var_light, “temperature”: var_temp.
5. Run your application now!



Run the application

Push the switch button in your breadboard several times.



Verify the data is received

Use the OM2M GUI to check if the data is saved correctly.

http://localhost:8080/~/mn-cse-pi/cin-911179417

- mn-name-pi
  - acp_admin
  - SMART_HOME
    - DATA
      - cin_535384691
      - cin_710437371
      - cin_588005961
      - cin_526274670
      - cin_181429149
      - cin_58870277
      - cin_710611188
      - cin_22856444
      - cin_624882041
      - cin_191592019
      - cin_345602423

Attribute	Value
rn	cin_911179417
ty	4
ri	/mn-cse-pi/cin-911179417
pi	/mn-cse-pi/cnt-103641824
ct	20180704T091831
lt	20180704T091831
st	0
cnf	message
cs	129
con	

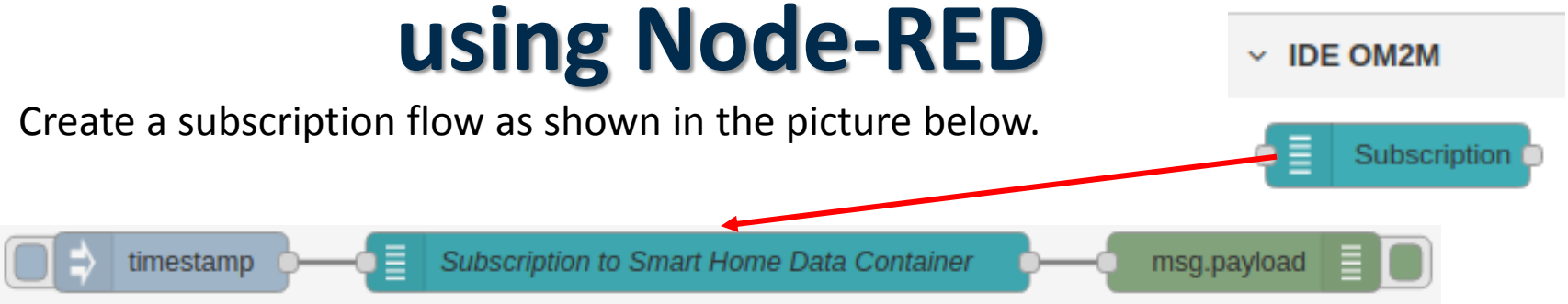
Attribute	Value
photoresistor	75.0
temperature	10.8

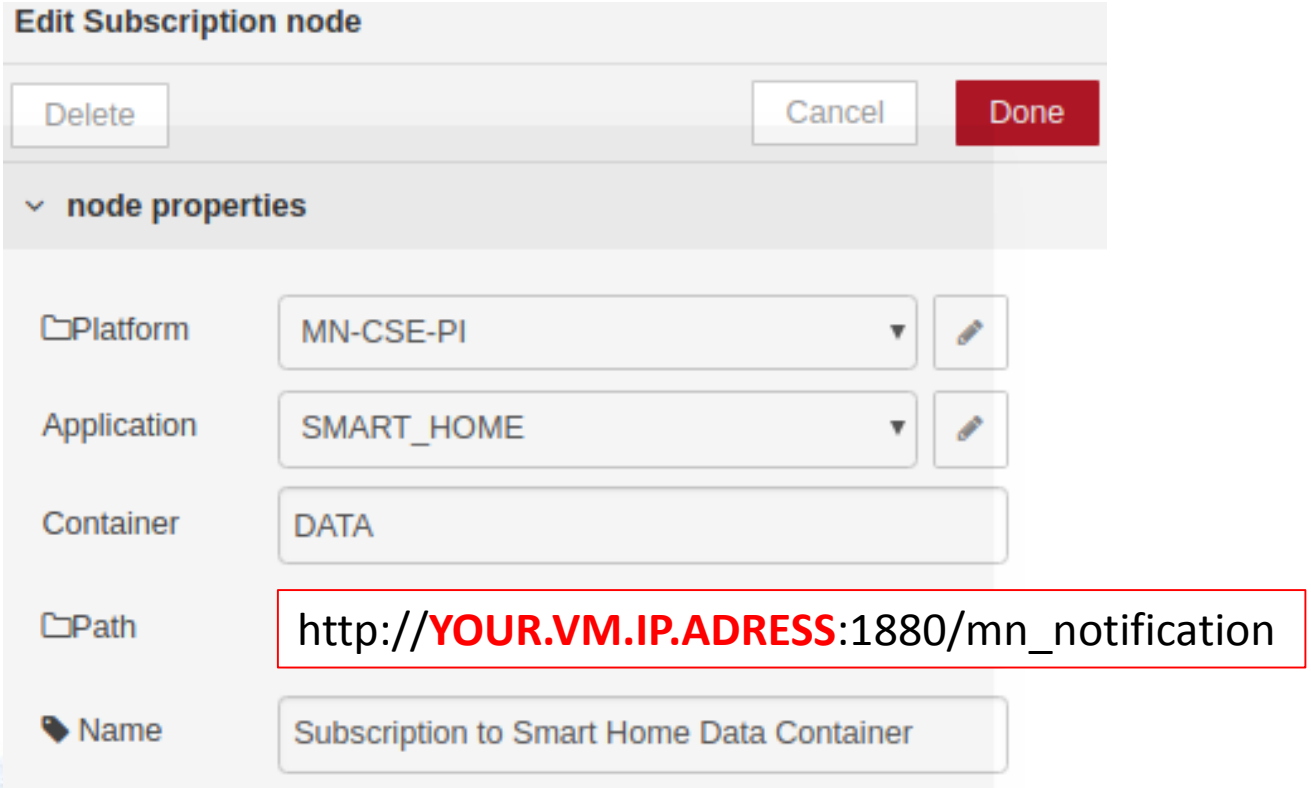
CHECKPOINT 3!

SUBSCRIBING TO SMART HOME DATA

Creating a subscription to a MN-AE using Node-RED

Create a subscription flow as shown in the picture below.





Creating a subscription to a MN-AE using Node-RED

Deploy the flow and trigger it. Verify the subscription object was created using the OM2M GUI.

OM2M CSE Resource Tree

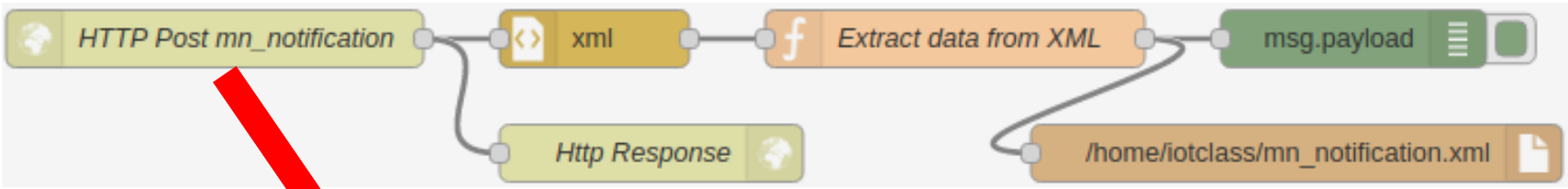
http://localhost:8080/~/mn-cse-pi/cin-324109828

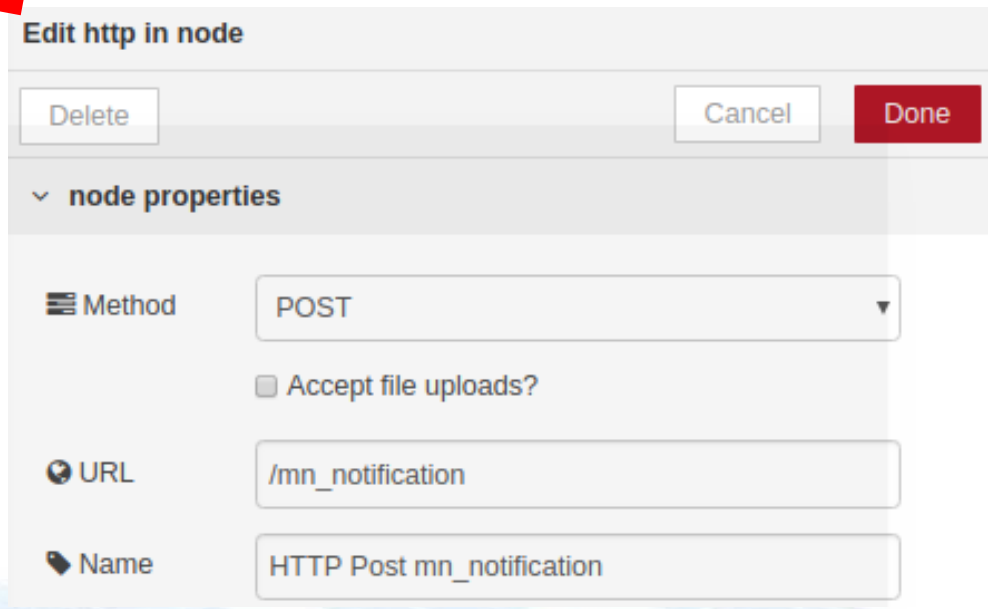
- mn-name-pi
  - acp_admin
  - SMART_HOME
    - DATA
      - cin_535384691
      - SUBSCRIPTION
  - in-name

Attribute	Value
rn	SUBSCRIPTION
ty	23
ri	/mn-cse-pi/sub-395011938
pi	/mn-cse-pi/cnt-103641824
ct	20180704T075839
lt	20180704T075839
acpi	AccessControlPolicyIDs: /mn-cse-pi/acp-766302963
nu	• http://192.168.1.51:1880/mn_notification
nct	2

Creating a subscription to a MN-AE using Node-RED

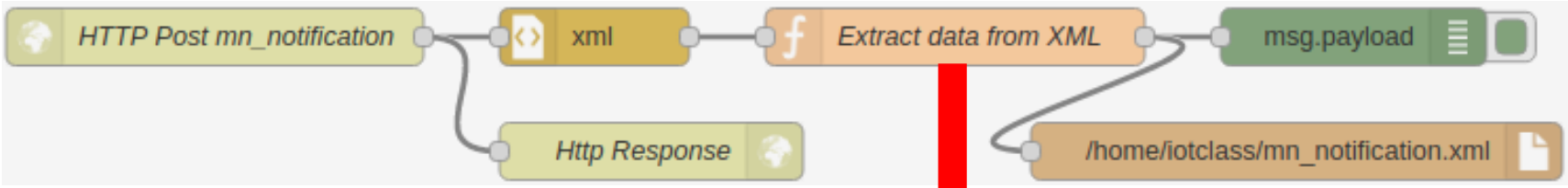
Create a web service to receive the notification.

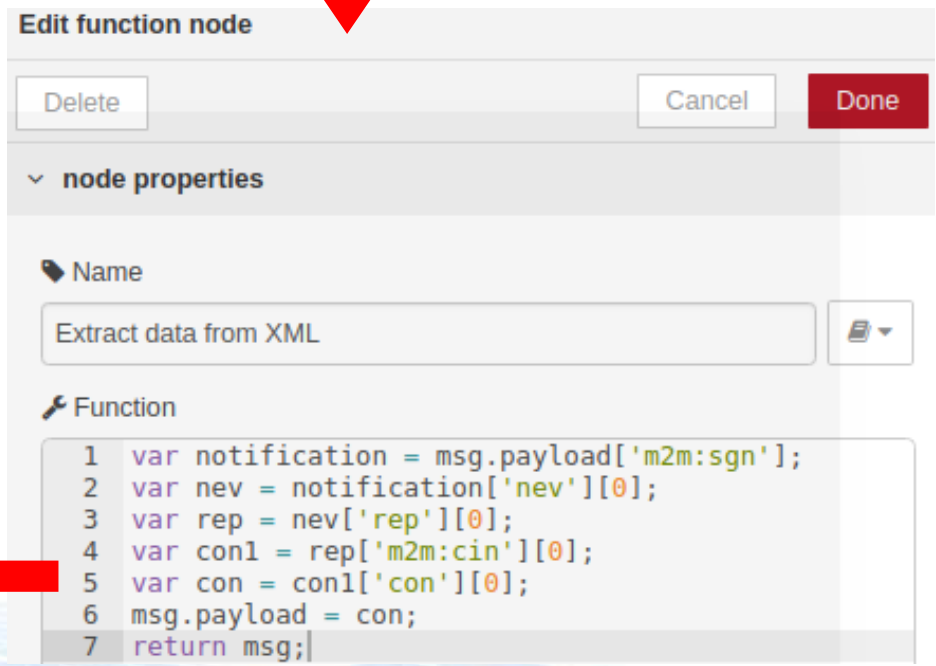




Creating a subscription to a MN-AE using Node-RED

Create a web service to receive the notification.



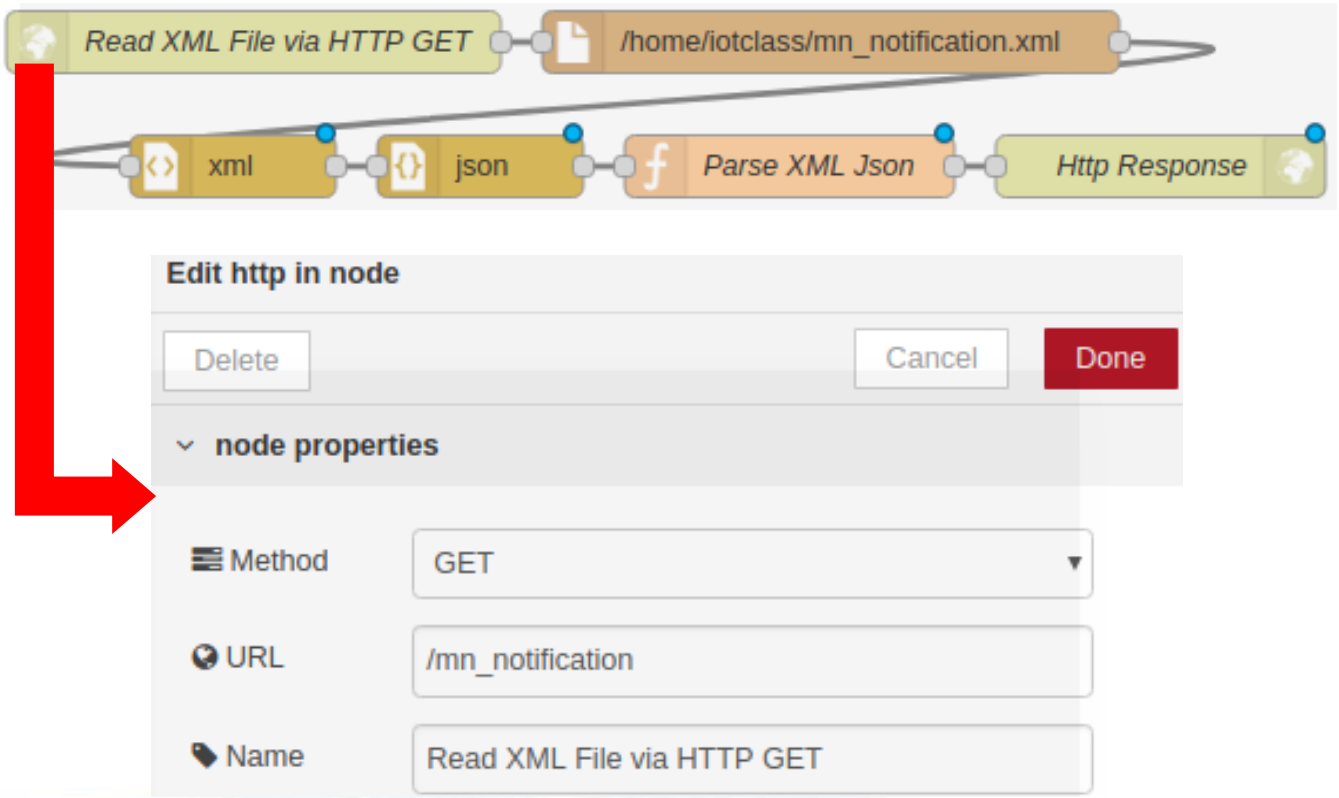


CODE (Copy & Paste in Node Red)

```
var notification =
msg.payload['m2m:sgn'];
var nev = notification['nev'][0];
var rep = nev['rep'][0];
var con1 = rep['m2m:cin'][0];
var con = con1['con'][0];
msg.payload = con;
return msg;
```

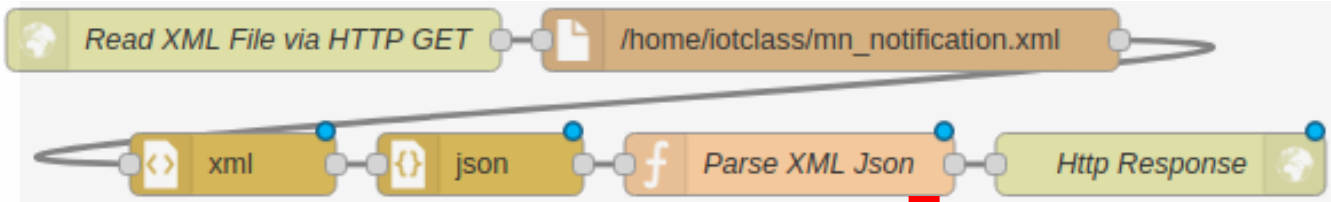
Creating a subscription to a MN-AE using Node-RED

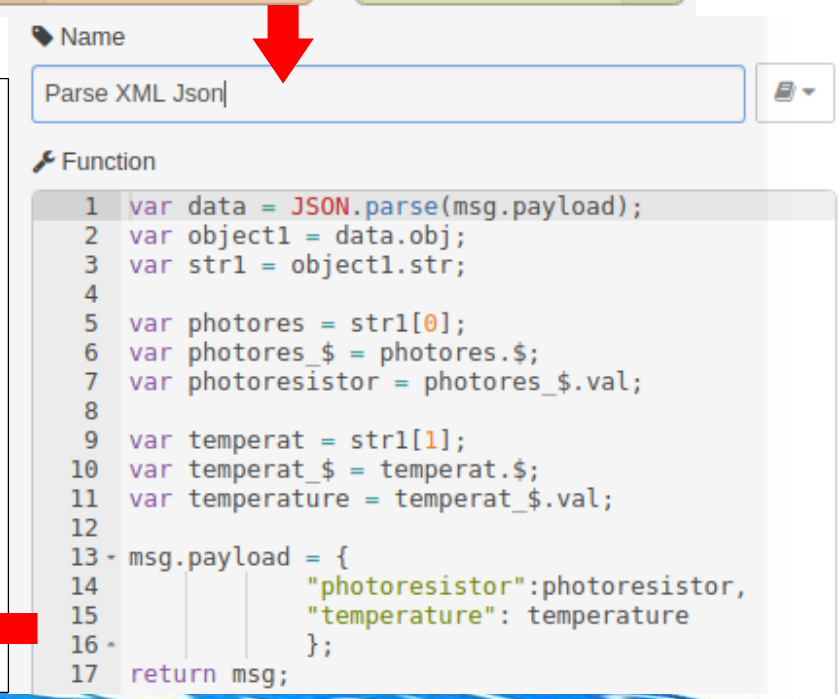
Create an additional HTTP GET Web Service to extract the values of photoresistor and temperature from the notification message.



Creating a subscription to a MN-AE using Node-RED

Create an additional HTTP GET Web Service to extract the values of photoresistor and temperature from the notification message.





CODE (Copy & Paste in Node Red)

```
var data = JSON.parse(msg.payload);
var object1 = data.obj;
var str1 = object1.str;
var photores = str1[0];
var photores_$ = photores.$;
var photoresistor = photores_$.val;
var temperat = str1[1];
var temperat_$ = temperat.$;
var temperature = temperat_$.val;
msg.payload = {
            "photoresistor":photoresistor,
            "temperature": temperature
            };
return msg;
```

Creating a subscription to a MN-AE using Node-RED

Deploy all the flows.

Push the switch button in your breadboard.

Open the url of the Read XML web service.
http://**YOUR.VM.IP.ADDRESS**:1880/mn_notification


```
{"photoresistor":"75.0","temperature":"10.8"}
```

CHECKPOINT 4!