



DELIVERING ARDUINO DATA TO THINGWORX

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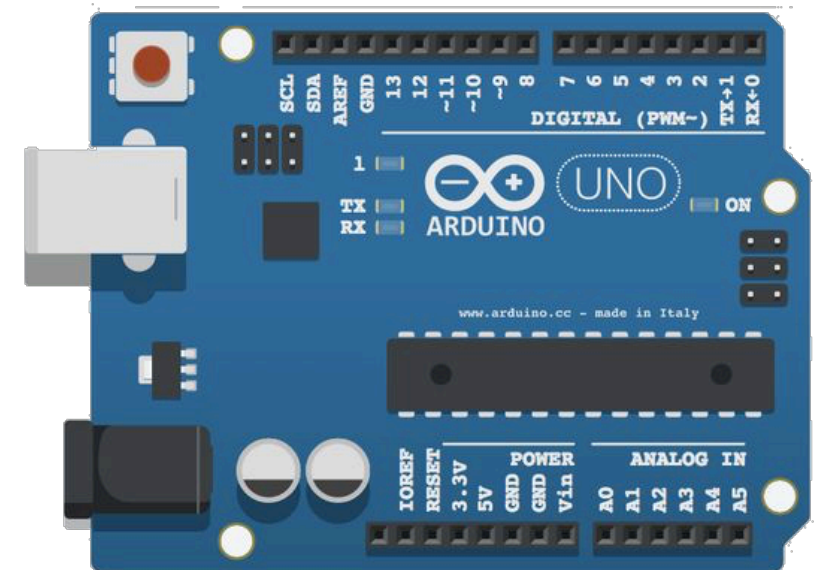
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THE ARDUINO PLATFORM



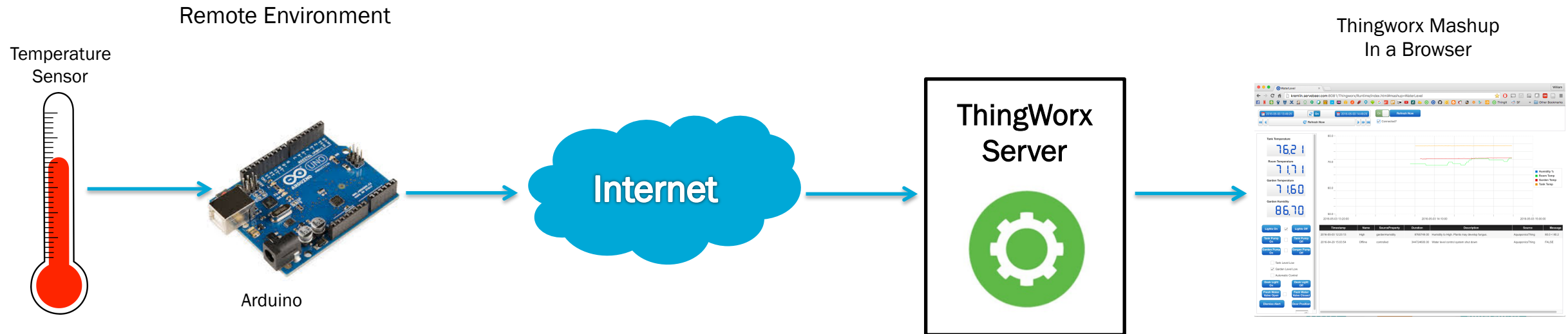
- Easy to use, low cost, microcontroller based platform open source platform
- Great for data acquisition, both analog and digital
- Easy to program
- A low resource platform not suitable for any ThingWorx “Always On” SDK
- Offers no network connectivity out of the box
- Supports Shields to easily add new hardware



EXAMPLE- REMOTE TEMPERATURE MEASUREMENT



- Report a remote temperature measurement to ThingWorx
- Do minimal protocol development work on the Arduino
- Provide a re-usable example for data delivery

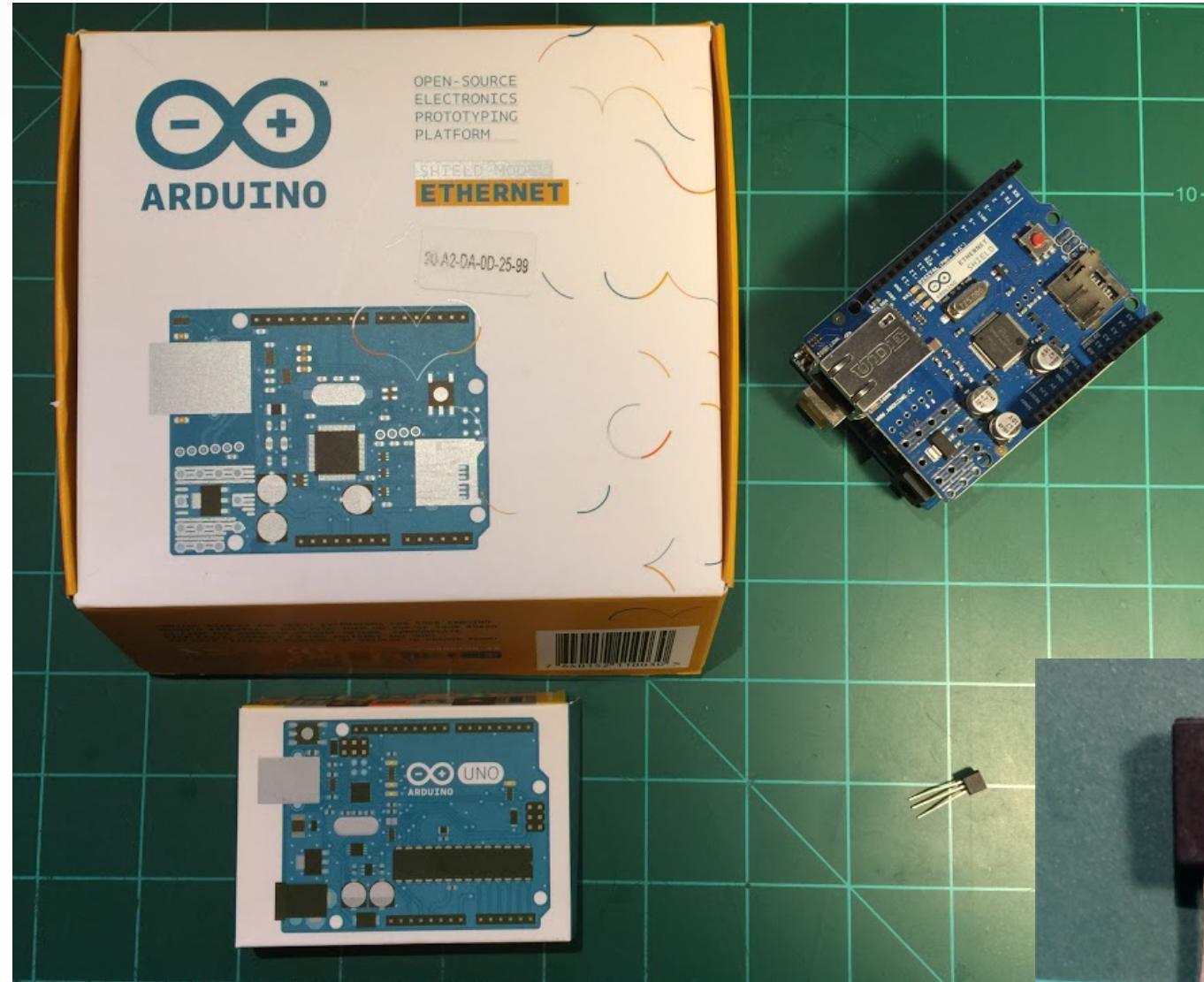


THE HARDWARE

- 1 Arduino Uno
- 1 Arduino Ethernet Shield
- Dallas Systems DS18B20 “One Wire” Temperature sensor
- 4.7 K Ω Resistor is required as a pull up

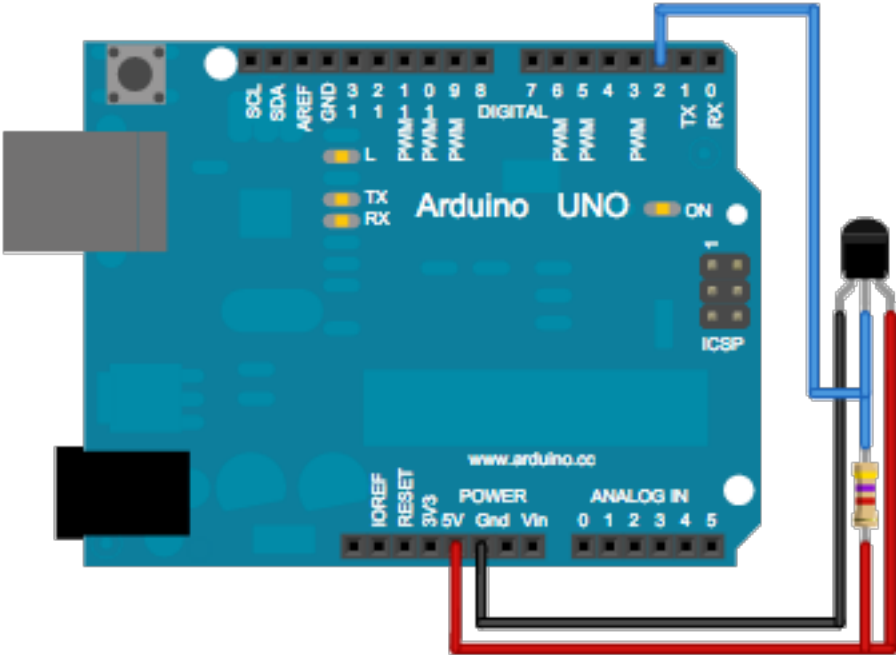


- The Java Ring used One Wire Protocol

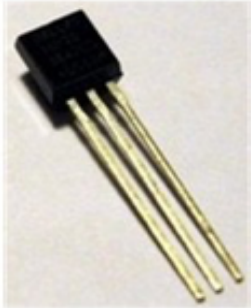
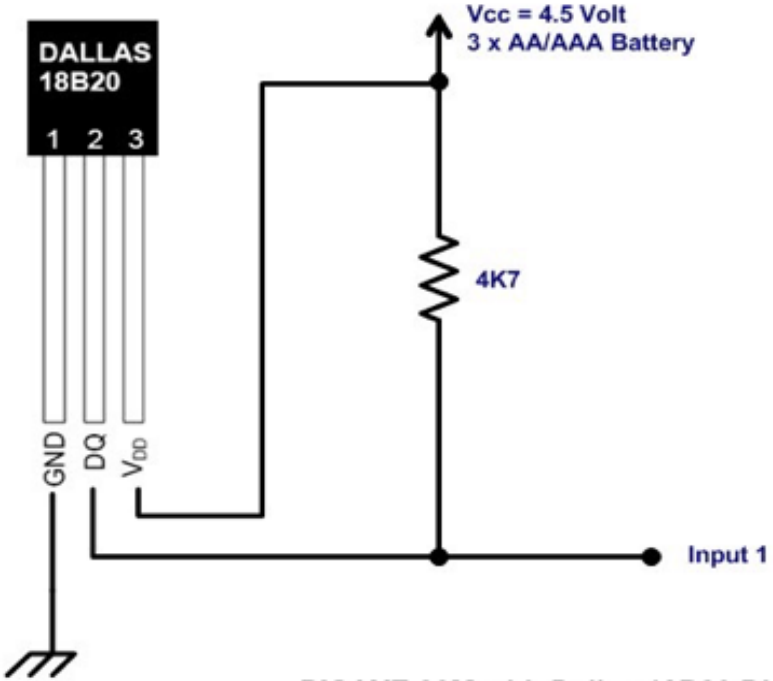


CONNECTING THE TEMPERATURE SENSOR

- Do not reverse +5V and GND on the 18B20!!!
- The sensor will overheat and burn out in seconds, Buy more than one just in case
- Multiple 18B20s can work on the same set of pins



<http://www.ermicro.com/blog>



(BOTTOM VIEW)

PICAXE 20M with Dallas 18B20 Digital Thermometer

WHY REST WHEN YOU CAN MQTT?

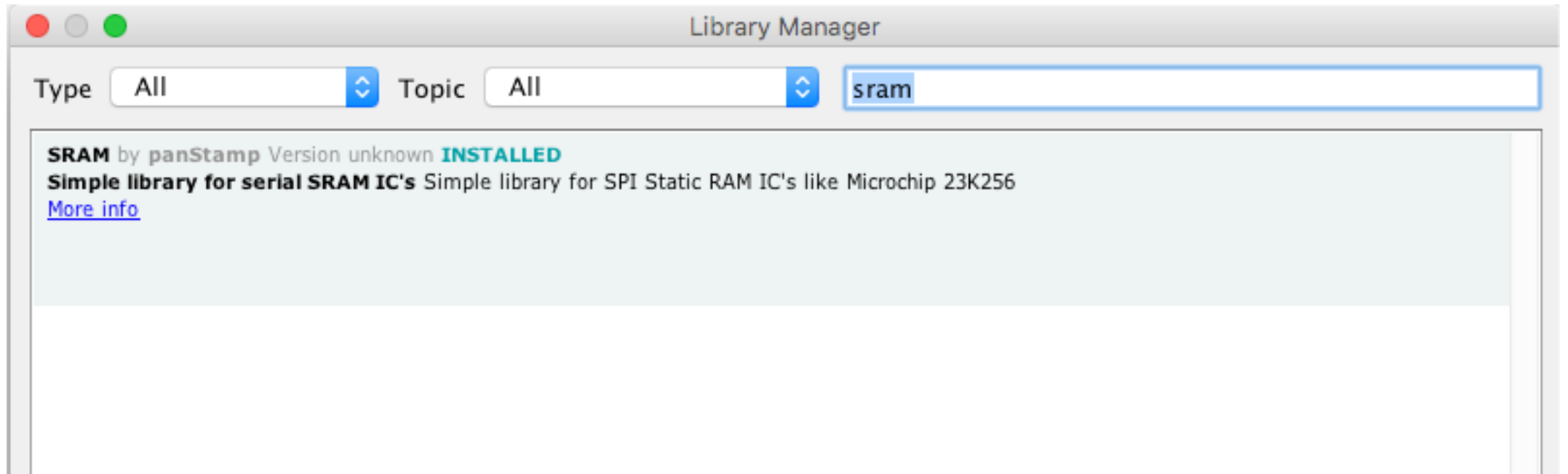
- HTTP REST (REpresentative State Transfer) works
 - You format the request and manage the actions (GET,PUT,POST)
 - Deduce the Thing URL
 - Uses port 80
- MQTT (Message Queue Telemetry Transport)
 - Light weight, efficient protocol – For small footprint systems
 - Publish, Subscribe Model
 - Requires a Server (Broker) in between Arduino and ThingWorx
 - Can be installed on your ThingWorx server host
- Mosquitto MQTT Server (<http://mosquitto.org/>)
 - Open Source, easy install
 - Requires port 1883 or 8883 open to pass through a firewall
 - Easy to Install
 - Comes with Windows Installer
 - Installs with “Brew” on OSX
 - <http://www.xappsoftware.com/wordpress/2014/10/30/install-mosquitto-on-mac-os-x/>



CONFIGURING YOUR ARDUINO IDE

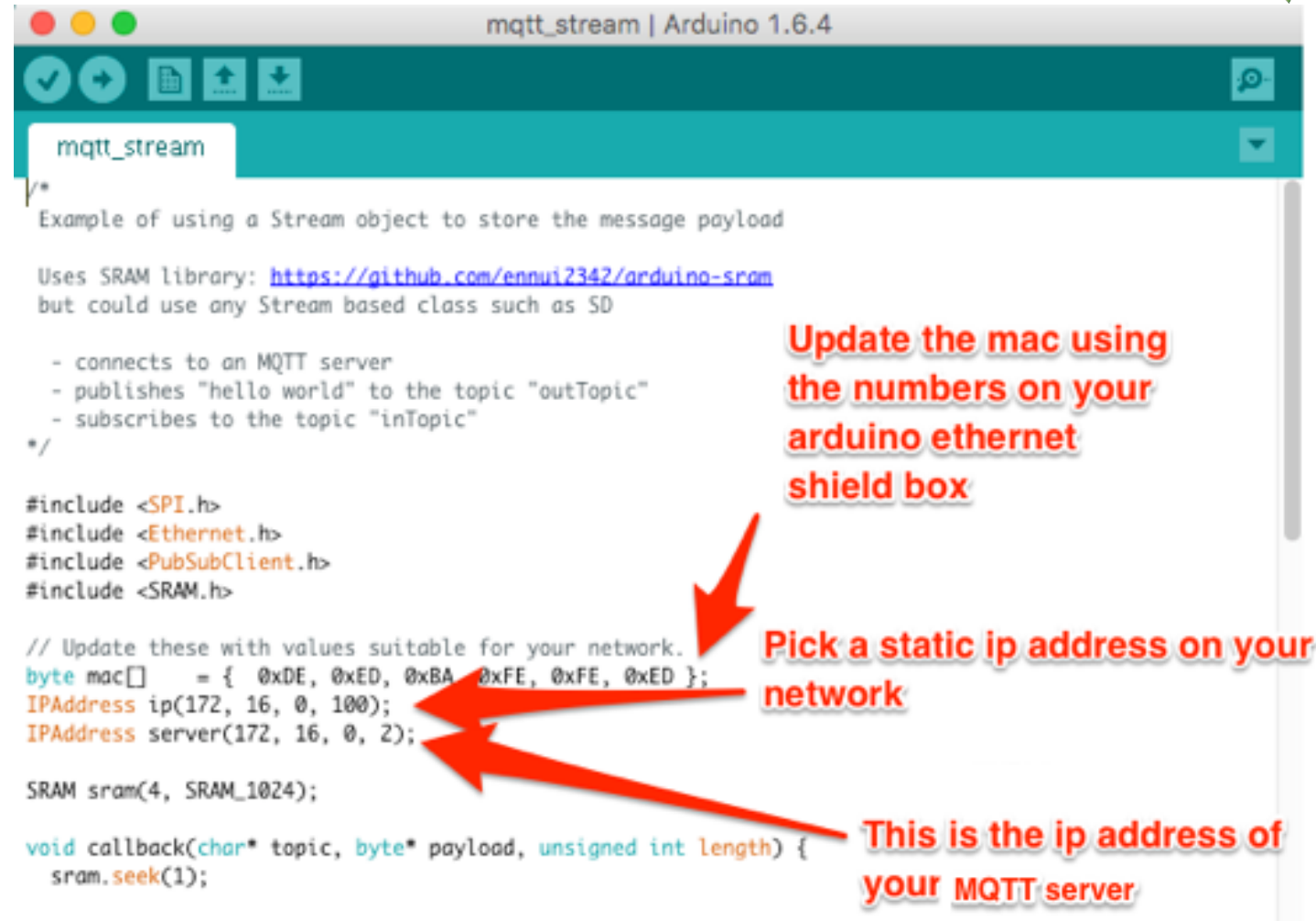


- Download and install the Arduino IDE - <https://www.arduino.cc/en/Main/Software>
- Install these libraries from Sketch>Include Libraries>Manage Libraries... Menu
 - Pubsub – MQTT Client Library
 - Sram – Simple Serial Library



RUNNING THE TEST SKETCH

- File>Examples>PubSub Client> mqtt_stream.ino
- Enter the MAC Address
- Choose a static IP for your Arduino
- Enter your server IP address
- Install your Ethernet Shield
- Attach your Arduino via USB
- Upload the Modified Sketch
- Connect Arduino to Network



```

mqtt_stream | Arduino 1.6.4
mqtt_stream
/*
  Example of using a Stream object to store the message payload

  Uses SRAM library: https://github.com/ennui2342/arduino-sram
  but could use any Stream based class such as SD

  - connects to an MQTT server
  - publishes "hello world" to the topic "outTopic"
  - subscribes to the topic "inTopic"
  */

#include <SPI.h>
#include <Ethernet.h>
#include <PubSubClient.h>
#include <SRAM.h>

// Update these with values suitable for your network.
byte mac[] = { 0xDE, 0xED, 0xBA, 0xFE, 0xFE, 0xED };
IPAddress ip(172, 16, 0, 100);
IPAddress server(172, 16, 0, 2);

SRAM sram(4, SRAM_1024);

void callback(char* topic, byte* payload, unsigned int length) {
  sram.seek(1);
  }
  
```

Update the mac using the numbers on your arduino ethernet shield box

Pick a static ip address on your network

This is the ip address of your MQTT server

TESTING OUT YOUR CONNECTION – HELLO WORLD



- Test sketch creates an output topic called “outTopic” containing “Hello World”
- Creates an input topic call “inTopic”
- Use the Mosquitto command line client to subscribe to your topic
- Run:
 - `mosquitto_sub -h 127.0.0.1 -t outTopic`
- -h is the server, 127.0.0.1 assumes you are running this command on the same host
- See “Hello World” in appear in your console when you turn your Arduino on.
- MQTT Topics can be organized by topic level



SENDING TEMPERATURE DATA



- The DS18x20_MQTT.ino sketch is the modified DS18x20 example
 - http://www.pjrc.com/teensy/td_libs_OneWire.html (Docs)
 - https://community.thingworx.com/servlet/JiveServlet/download/38-6087/DS18x20_MQTT.zip (Code)
- Make the same changes MAC Address and IP in this sketch.
- Note the topic changes
- OutTopic has been replaced with /Thingworx/DS18Thing/F and /Thingworx/DS18Thing/C
- To Report Temp readings

```
if (cfg == 0x00) raw = raw & ~1; // 9 bit resolution, 93.75 ms
else if (cfg == 0x20) raw = raw & ~3; // 10 bit res, 187.5 ms
else if (cfg == 0x40) raw = raw & ~1; // 11 bit res, 375 ms
//// default is 12 bit resolution, 750 ms conversion time
}
celsius = (float)raw / 16.0;
fahrenheit = celsius * 1.8 + 32.0;
Serial.print(" Temperature = ");
Serial.print(celsius);
Serial.print(" Celsius, ");
Serial.print(fahrenheit);
Serial.println(" Fahrenheit");
char tempString[100];
String(fahrenheit).toCharArray(tempString, sizeof(tempString));
client.publish("/Thingworx/DS18Thing/F", tempString);
String(celsius).toCharArray(tempString, sizeof(tempString));
client.publish("/Thingworx/DS18Thing/C", tempString);
client.loop();
}
```

These topics map to Thingworx properties

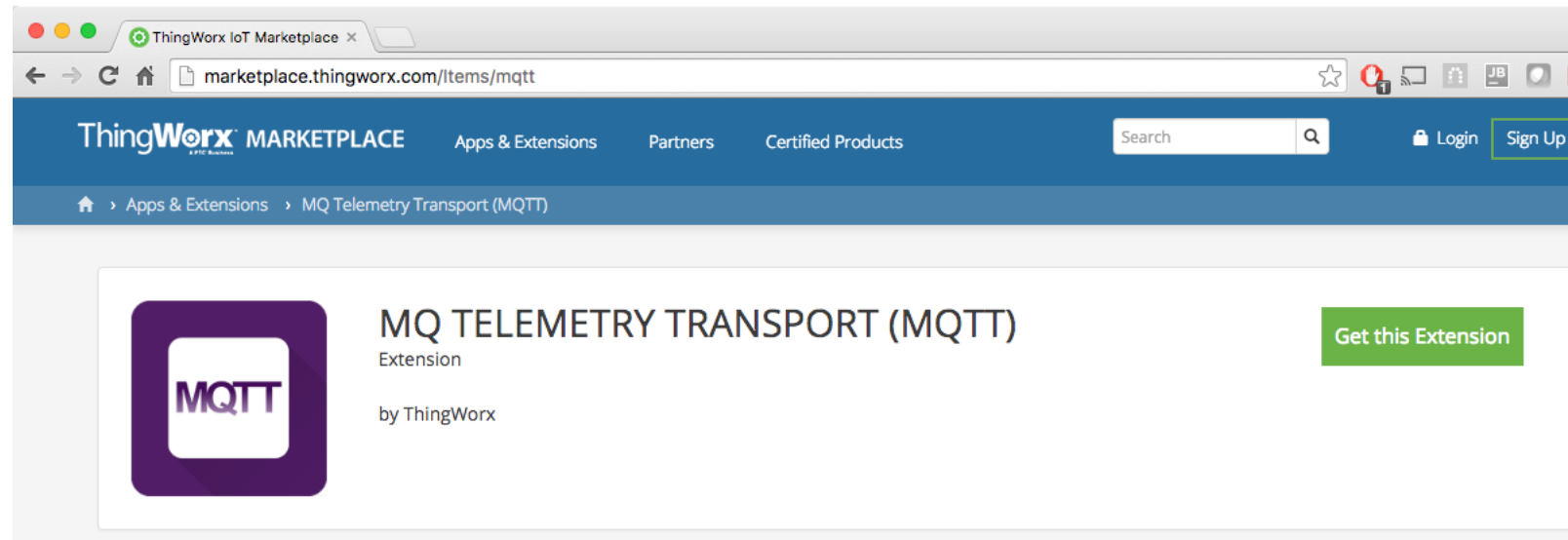


INSTALLING THE THINGWORX MQTT EXTENSION



- Download and install the MQTT extension on your server from the ThingWorx Marketplace at:
 - <http://marketplace.thingworx.com/Items/mqtt>

- After you do, confirm that you have the ThingTemplates shown below



<input type="checkbox"/>		MQTTSubscriber	MQTT subscriber interface	ThingTemplate
<input type="checkbox"/>		MQTTConnection	MQTT connection interface	ThingTemplate
<input type="checkbox"/>		MQTT	MQTT interface	ThingTemplate

CREATING YOUR THING TO RECEIVE YOUR DATA



- Create a new Thing based on the MQTT ThingTemplate
- We will use the automatic mapping feature so your Thing name must match the MQTT Topic name “DS18Thing”

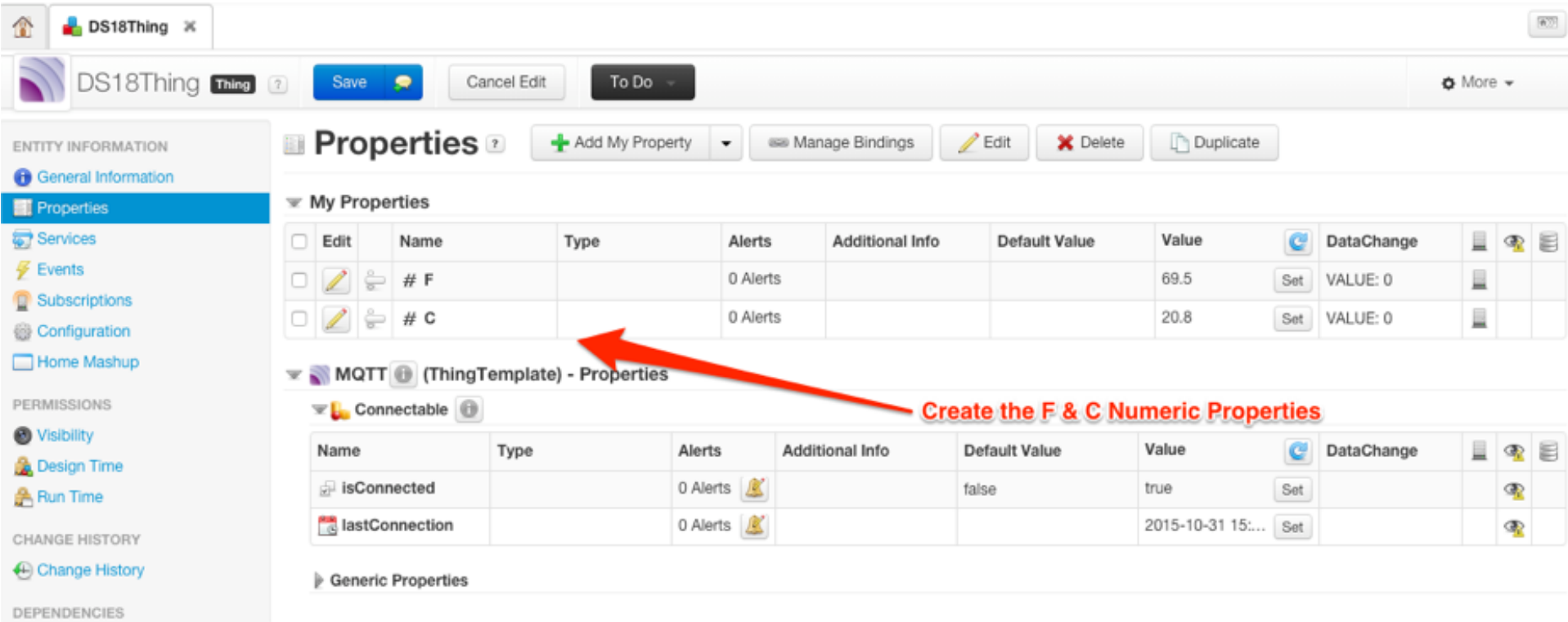
The screenshot shows the ThingWorx web interface. At the top, there's a search bar and navigation options like '+ New Entity' and 'Import'. Below that, a breadcrumb trail shows 'New Thing - 1'. The main content area is titled 'General Information' and contains several fields: 'Name' is set to 'DS18Thing', 'Description' is empty, 'Tags' has a search box, 'Thing Template' is set to 'MQTT', and 'Implemented Shapes' has another search box. On the left, a sidebar lists 'ENTITY INFORMATION' (General Information, Properties, Services, Events, Subscriptions, Configuration, Home Mashup) and 'PERMISSIONS' (Visibility, Design Time, Run Time).

ENTITY INFORMATION	
General Information	
Properties	
Services	
Events	
Subscriptions	
Configuration	
Home Mashup	
PERMISSIONS	
Visibility	
Design Time	
Run Time	

General Information	
Name	DS18Thing
Description	
Tags	Search ModelTags or +
Thing Template	MQTT
Implemented Shapes	Search ThingShapes or +

GIVE YOUR THING PROPERTIES

- Since our MQTT topics are /Thingworx/DS18Thing/F and /Thingworx/DS18Thing/C
- DS18Thing needs matching NUMERIC properties F & C
- Add Them and Save



Properties

My Properties

	Edit	Name	Type	Alerts	Additional Info	Default Value	Value	DataChange			
<input type="checkbox"/>		# F		0 Alerts			69.5	Set	VALUE: 0		
<input type="checkbox"/>		# C		0 Alerts			20.8	Set	VALUE: 0		

MQTT (ThingTemplate) - Properties

Connectable

Name	Type	Alerts	Additional Info	Default Value	Value	DataChange			
isConnected		0 Alerts		false	true	Set			
lastConnection		0 Alerts			2015-10-31 15:...	Set			

Generic Properties

Create the F & C Numeric Properties

CONFIGURE YOUR THING



- Your MQTT Based Thing must know what MQTT server to get its topics from
- Use the “Configuration” section to add its IP address

Configuration for MQTTThing

Connection Settings

Name	Value
password	<input type="password"/> Change Password
connectTimeout	<input type="text" value="10000"/>
serverName	<input type="text" value="192.168.1.101"/> Your Mosquitto MQTT Server IP Address
retryInterval	<input type="text" value="30000"/>
serverPort	<input type="text" value="1883"/>
userId	<input type="text"/>
timeout	<input type="text" value="5000"/>
useSSL	<input type="checkbox"/>

AUTOMATING PROPERTY MAPPING

- Scroll Down
- Enable Automapping

Automapping Settings

Name	Value
format	<input type="text" value="/Thingworx/{t}/{p}"/>
enabled	<input checked="" type="checkbox"/> Check this!

- Under properties Hit refresh and confirm that the isConnected property is now true and you are connected!

MQTT (ThingTemplate) - Properties

Connectable

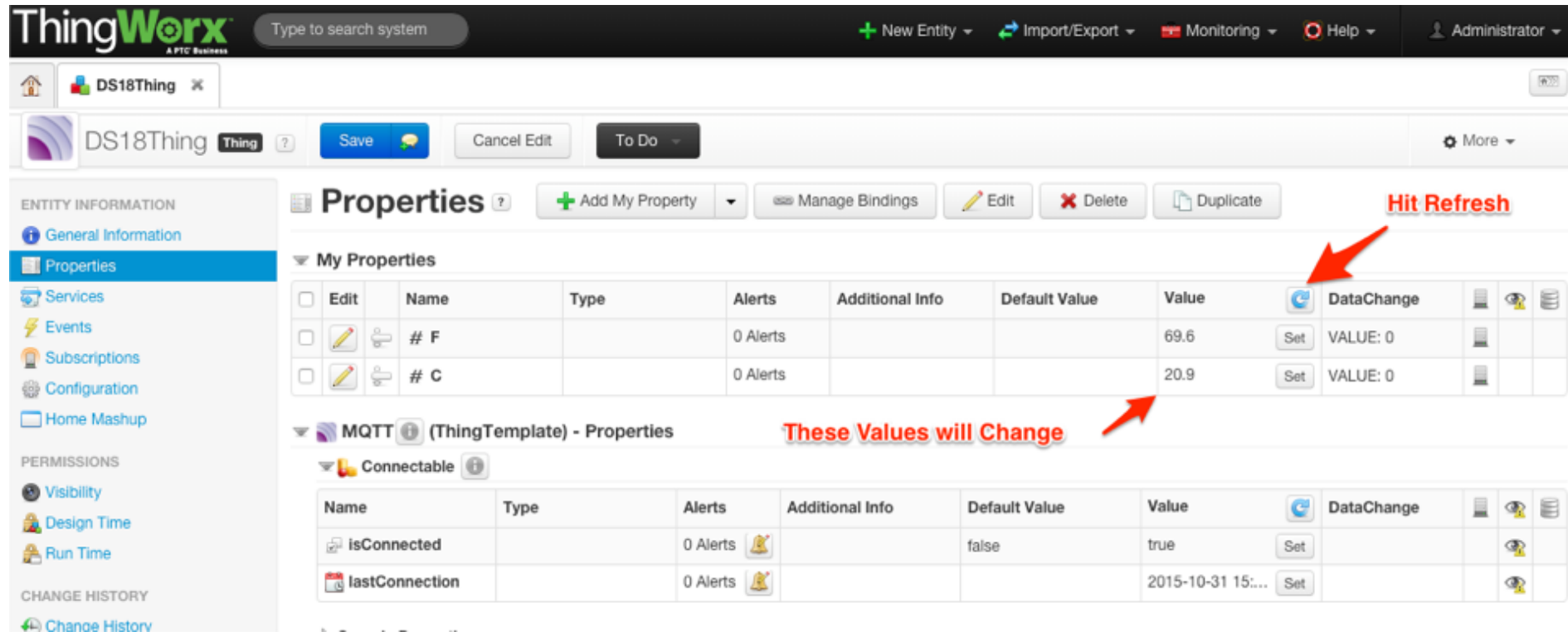
Hit Refresh

Name	Type	Alerts	Additional Info	Default Value	Value	Buttons	Date
isConnected		0 Alerts		false	true	Set	
lastConnection		0 Alerts			2015-10-31 15:...	Set	

Success!

WATCH THE DATA ROLL IN

- Once your connection is established, touch the sensor
- Hitting the refresh button will allow you to observe the temperature changes



ThingWorx A PTC Business

Type to search system

+ New Entity Import/Export Monitoring Help Administrator

DS18Thing x

DS18Thing Thing Save Cancel Edit To Do More

ENTITY INFORMATION

- General Information
- Properties**
- Services
- Events
- Subscriptions
- Configuration
- Home Mashup

PERMISSIONS

- Visibility
- Design Time
- Run Time

CHANGE HISTORY

- Change History

Properties Add My Property Manage Bindings Edit Delete Duplicate

My Properties

	Edit	Name	Type	Alerts	Additional Info	Default Value	Value	DataChange				
<input type="checkbox"/>		# F		0 Alerts			69.6	Set	VALUE: 0			
<input type="checkbox"/>		# C		0 Alerts			20.9	Set	VALUE: 0			

MQTT (ThingTemplate) - Properties These Values will Change

Connectable

Name	Type	Alerts	Additional Info	Default Value	Value	DataChange			
isConnected		0 Alerts		false	true	Set			
lastConnection		0 Alerts			2015-10-31 15:...	Set			

Hit Refresh

CONCLUSIONS

- MQTT Data Delivery:
 - Allows you to not have to worry about protocol specific details
 - Is easy to implement on an Arduino
 - Is lightweight and compact over the wire
 - Great for low resource platforms
 - Requires a MQTT Server
 - Integrates easily into ThingWorx

QUESTIONS?

IT'S A QUESTION PARTY!



MY FAVORITE!

The image features several colorful geometric shapes, including triangles and lines in shades of blue, green, yellow, and purple, scattered across the background. A large, multi-colored geometric shape is prominent on the right side. The text 'LIVE WORX 16' is centered, with 'LIVE' in a thin, outlined font and 'WORX 16' in a bold, solid black font. A small 'TM' trademark symbol is positioned to the right of the '16'.

LIVE
WORX 16™

TAKE A FRESH LOOK AT THINGS

liveworx.com