mqTrains: Inexpensive Layout Control with WiFi using MQTT

by Speed Muller

(with help from David and Joel)

mqTrains - Inexpensive Layout Control with WiFi and MQTT

What are you going to see today?

- **mqTrains** - what is it, why and how
- Some inexpensive components
- A quick overview of MQTT
- Using mqTrains with JMRI
- Using mqTrains without JMRI

…by the 3 amiqToes!

(In no particular order)

Speed Muller, Dallas Texas (representing the Helix and below)

Joel Davidson, Austin Texas (representing Texas and beyond)

David McMorran (representing all of Down Undah)

*…and sneaking **Brad Anderson** in here, doing testing in the background…*

What is mqTrains ?

What is mqTrains ?

Started as Firmware for the Espressif ESP8266 microprocessors!

Primarily for ESP-01 or ESP-01S devices (*where footprint is fixed*).

Also works on other ESP8266 devices, but not ESP32 yet.

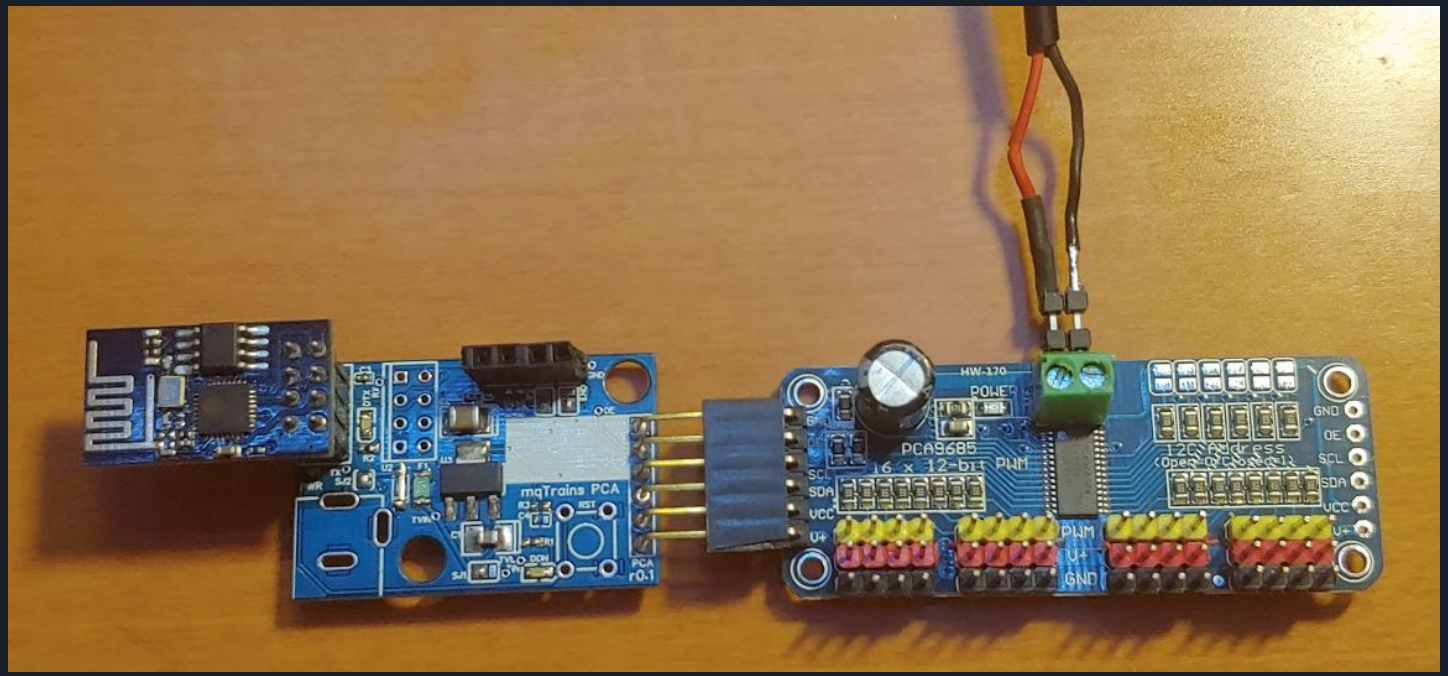
Hardware available everywhere: Amazon, AliExpress, Ebay and interface board designs now shared for you to build your own!

It can drive servo motors, can drive solenoid turnout motors,

control outputs like lights and signals **and** can monitor sensors.

Free to download, the code will become Open Source too

What is mqTrains ?



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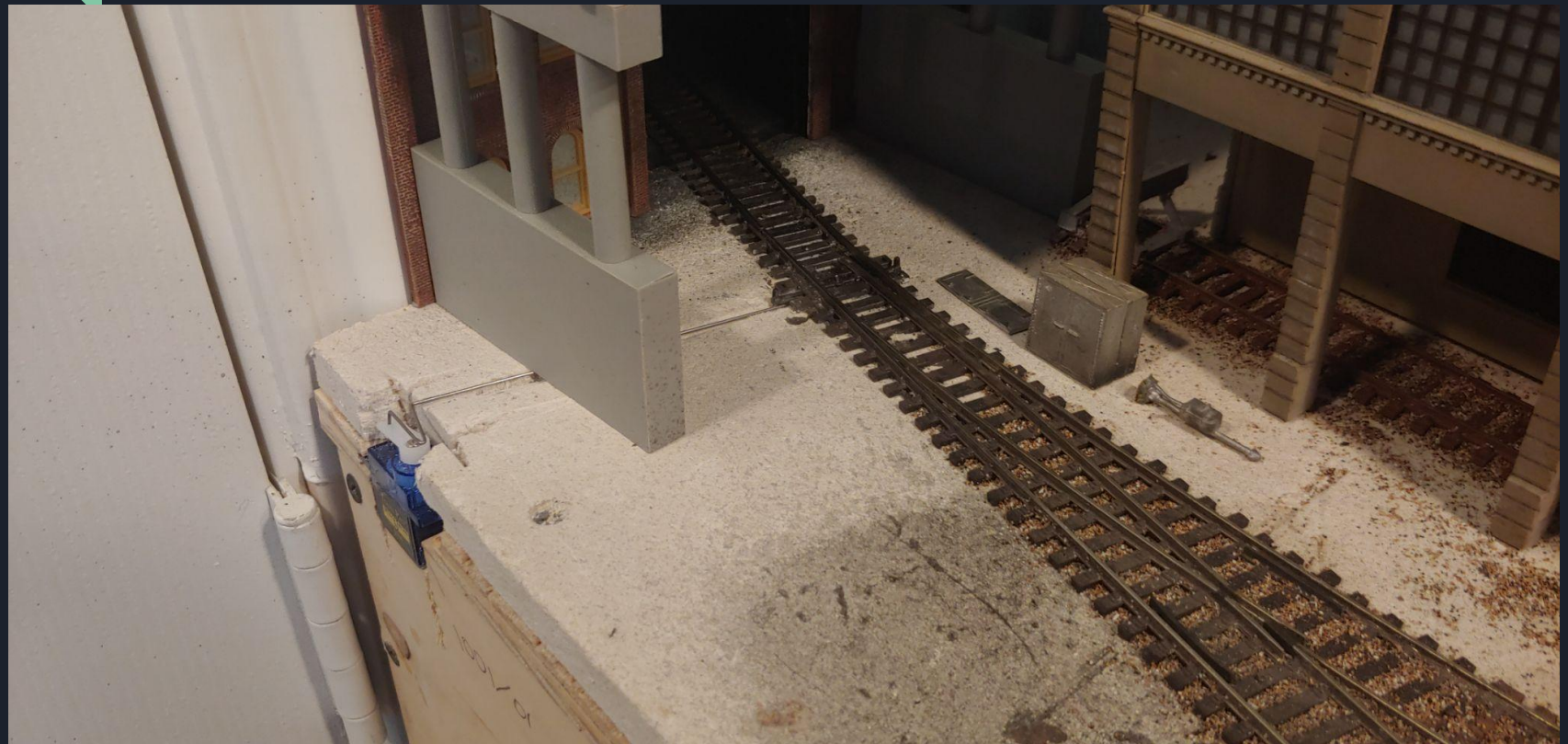

…but, why?

There are many inexpensive electronic components readily available…

Finding out **which** components to get is **simple** in most cases

Working out how to put them **together** is a bit **harder**

But, **writing code** for a device is **not for everyone**

The objective behind mqTrains is to make this technology **available to everyone** by having the programming done for you and ONLY showing you how to put things together

The motto: Less wires, less time, less cost!

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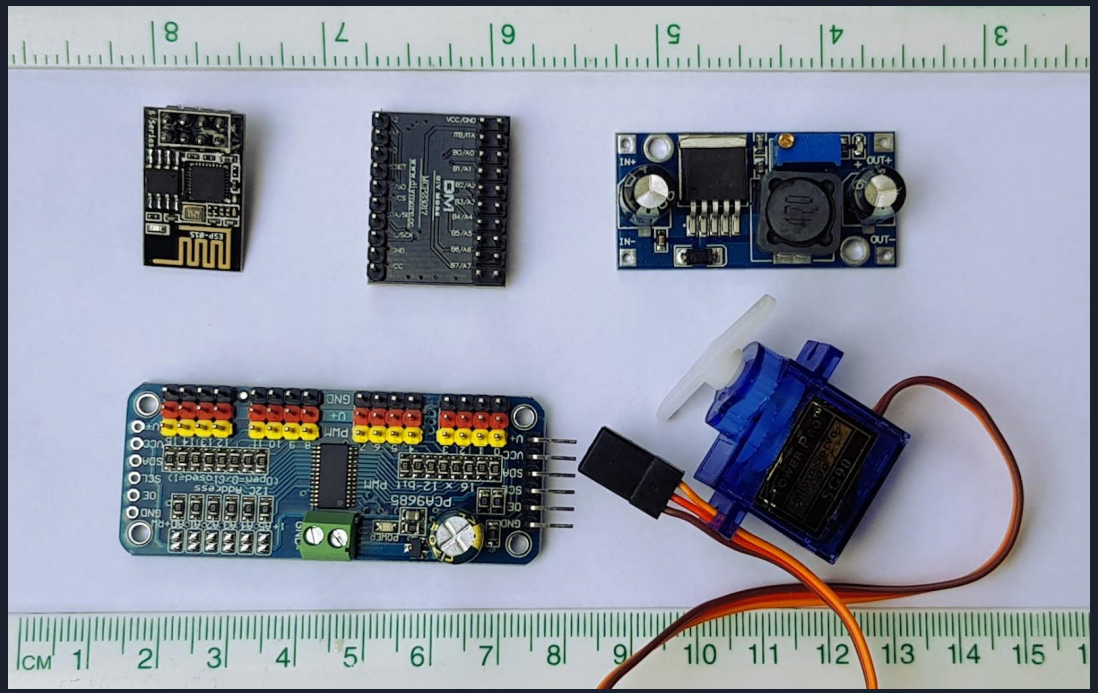
The motto: Less wires, less time, less cost!

(Speed also has a 3-foot rule: the “fix” to the problem should be within arms reach)

Inexpensive parts?



Approximate costs

ESP-01S	- $1.00
MCP23017	- $2.00
PCA9685	- $3.00
Buck Converter	- $0.50
9G Servo Motor	- $1.20

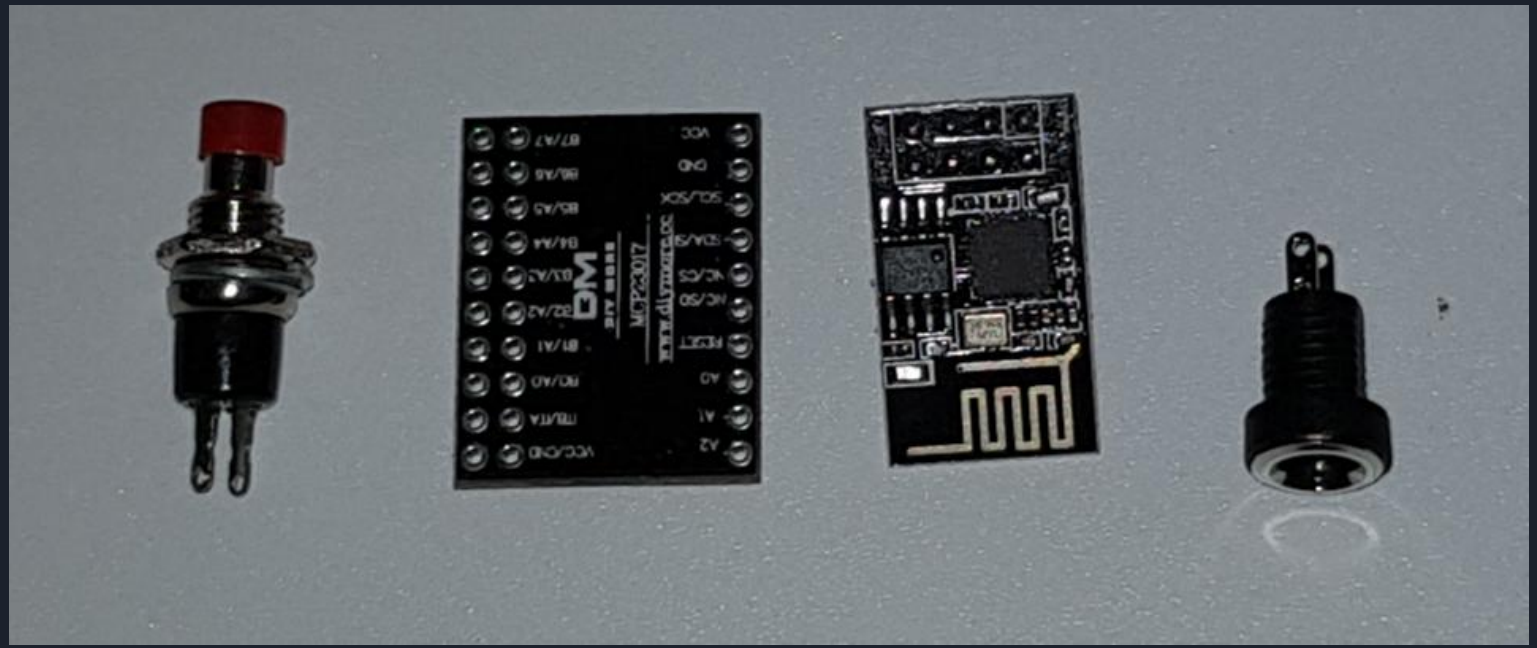
(and this can control 16 servos)

*1 + 3 + 0.50 + (16 * 1.20) = $23.70*

mqTrains

IOs...

Push-button, MCP23017, ESP-01 and an LED (16 I/Os)



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WiFi? All you need is 802.11n

- Not Internet, just WiFi!
- The team tested 22 nodes (ESPs) with both a
  - WRT54G (802.11b/g circa 2002), and
  - DIR-655 (802.11b/g/n circa 2007)

  Sending 20,000 MQTT messages in 24 hours
- Cost of a WiFi router that can do 802.11n?

  Linksys N600 @ $29.99?

(The TxNamib currently runs 42 nodes on a Ubiquiti UniFi AC Pro, planning to use 30 more!)

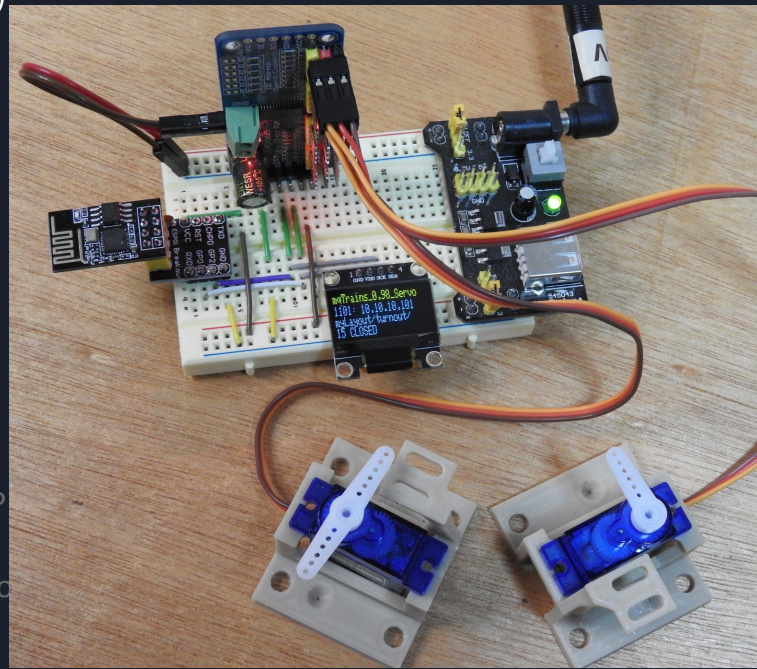
How to set it up! Very simple!!!

- Connect your Windows, Linux, Mac or Raspberry Pi computing device to a WiFi access point / router
  - WiFi or Wired
- Install mosquitto or any other MQTT Server (broker)
  - Linux or Pi: sudo apt-get install mosquitto
  - Mac: brew install mosquitto
  - Windows: https://mosquitto.org/download/
    - Configure Windows firewall to allow mosquitto
- Find your mosquitto computer's IP address
  - Linux, Mac or Pi: ifconfig
  - Windows: ipconfig

How to set it up! Very simple!!!

Nodes:

- Connect all the parts (*also need to program the ESP-01, instructions provided*)
- Power up!
- Connect with wireless device (phone, tablet, laptop or WiFi enabled PC)
    - SSID: mqtrains-0001
    - Key: mqtrains
- Use browser to go to 2.2.2.1
- Select Quick Start
- Change Serial Number (####) to something unique, like 0002
- Set MQTT Server IP address (port is by default 1883)
- Enter your WiFi SSID and Key (the latter will never be shown again)
- Save and Reboot
- If you have an OLED LCD or Serial Port connected, or you are monitoring your
  you will see the IP address of the module on your network. Else use the DHCP
  router's config page.
- Go to the new IP address with browser and configure the servos, I/O, signals c



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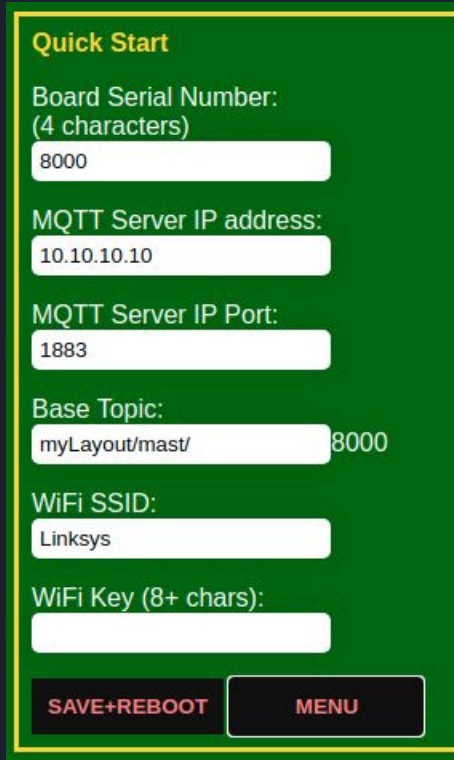
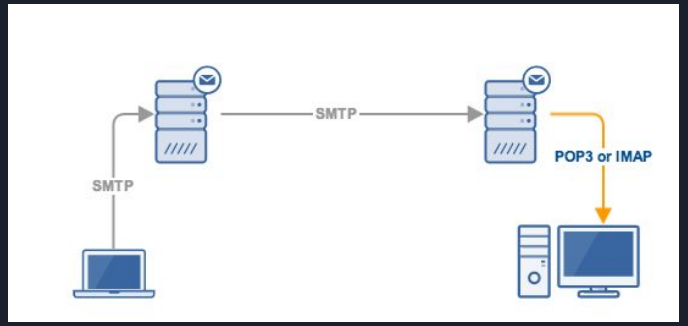


What is MQTT ?

You know these:



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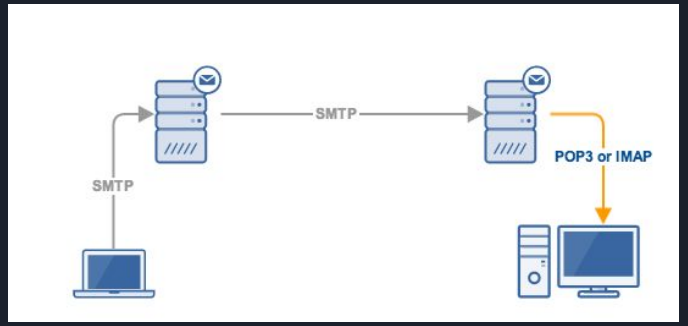
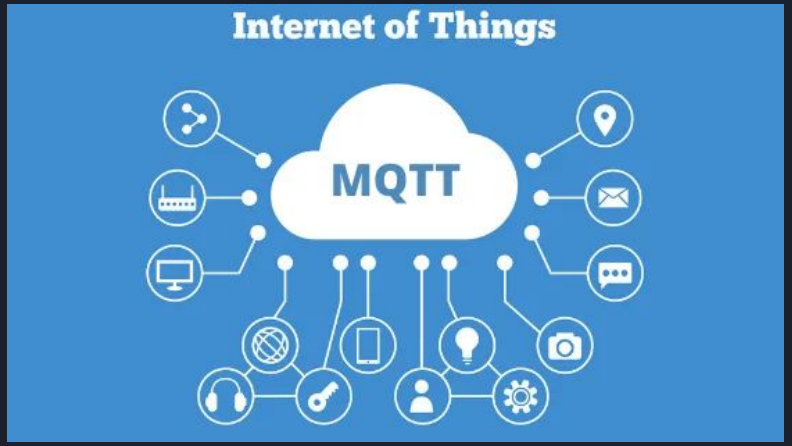


Just add another one:



MQTT - the messenger

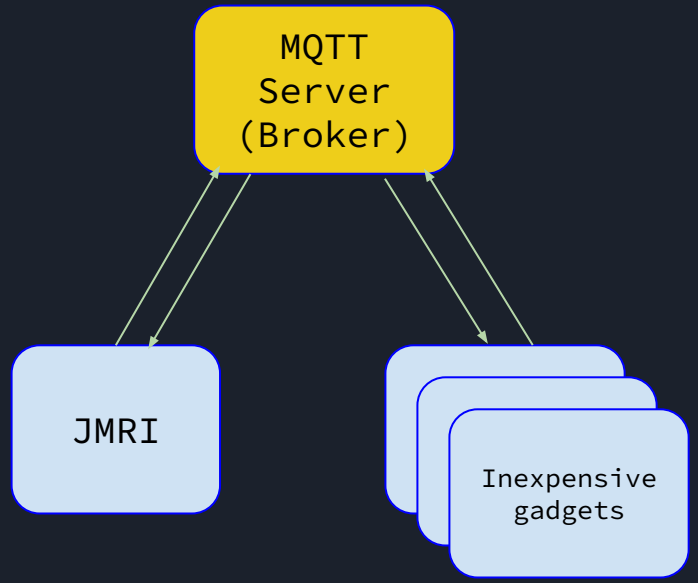
MQTT is a messaging protocol (often used in home automation systems among other uses, IOT sounds familiar)

It uses a Broker (now called a Server, a piece of software) through which all messages are sent

Clients connect to the Server to send (Publish) and receive messages (as Subscribed to)

Publishing is posting a message to the server

Subscribing is saying, give all messages I care about, to me.



Messages travel using **TCP/IP** (WiFi or wired)

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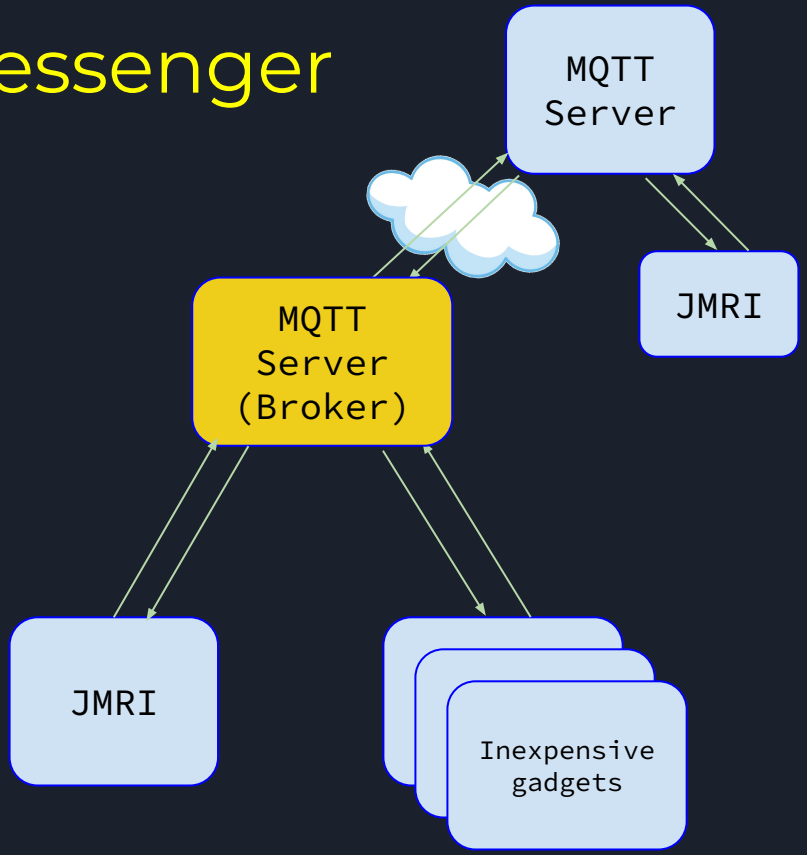
The MQTT Server can be "bridged" to another: Now TxNamib's remote dispatcher gets the same messages



Messages travel using **TCP/IP** (WiFi or wired)

MQTT - the messages

Messages look like this for a Turnout using MQTT in JMRI:

Topic: myLayout/turnout/0201/01 JMRI system name: MT0201/01

Payload: **Thrown** The 'State' being set in the JMRI Turnouts Table

Signal Mast messages:

Topic: myLayout/mast/8000/01 JMRI system name: IF$mqm:basic:...($8000/01)

Payload: **Approach; Lit; Unheld** The 'State', Lit and Held being set in the JMRI Signal Masts Table

I/O, or Sensors and Lights, same thing.

mqTrains with JMRI

Two, maybe three, awesome NMRAx clinics with more detailed steps by David McMorran, 2020/09/26, 2021/04/24 and 2021/06/11

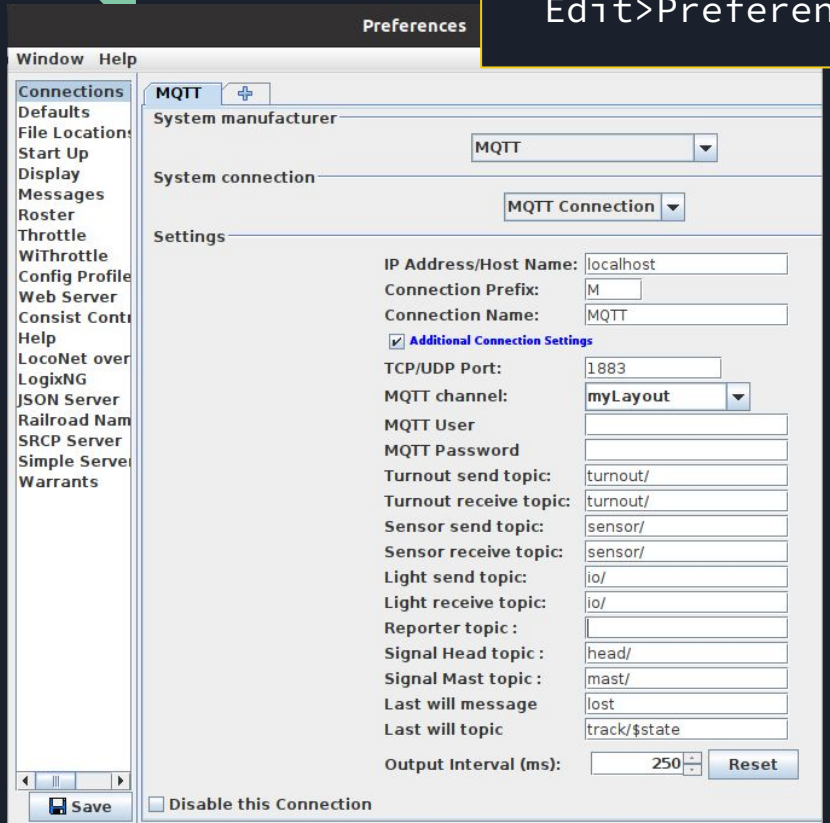
Subscribe to NMRA.org on YouTube and search for NMRAx on the dates shown

Or go to…

https://www.TxNamib.com/nmrax-links

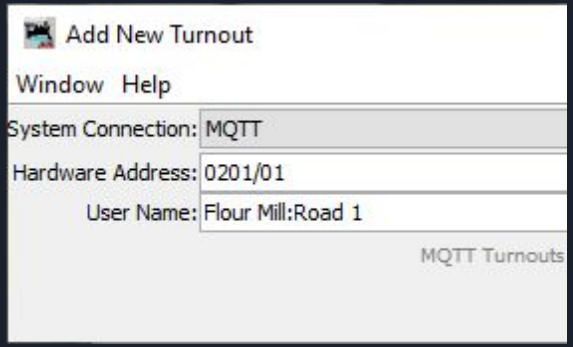
Setting up MQTT in JMRI

Edit>Preferences>Connections

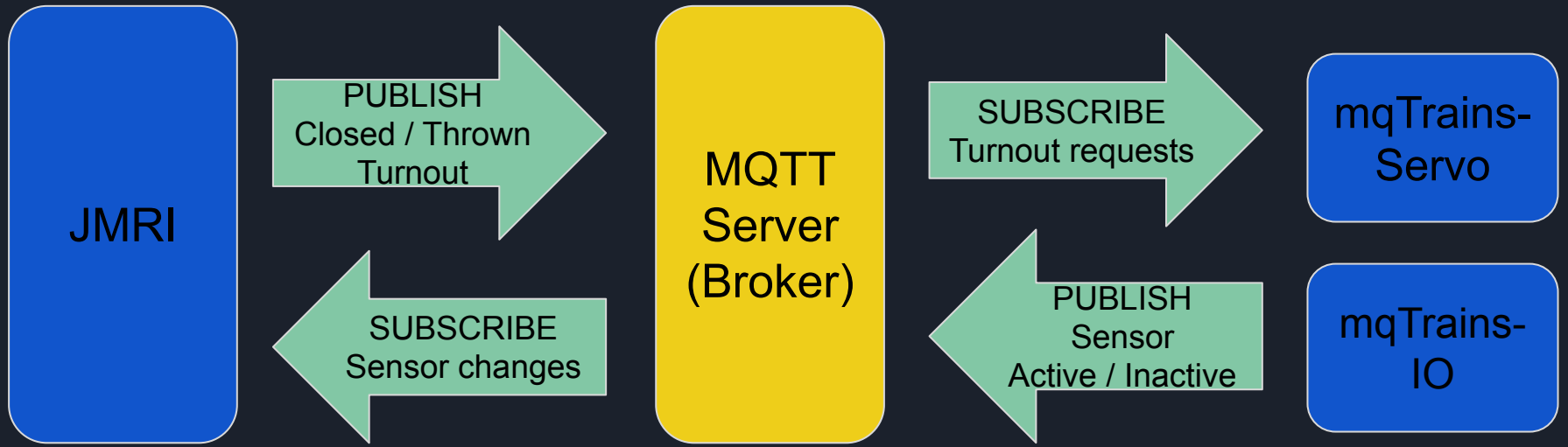


Topic: myLayout/turnout/0201/01

Tools>Tables>Turnouts>Add

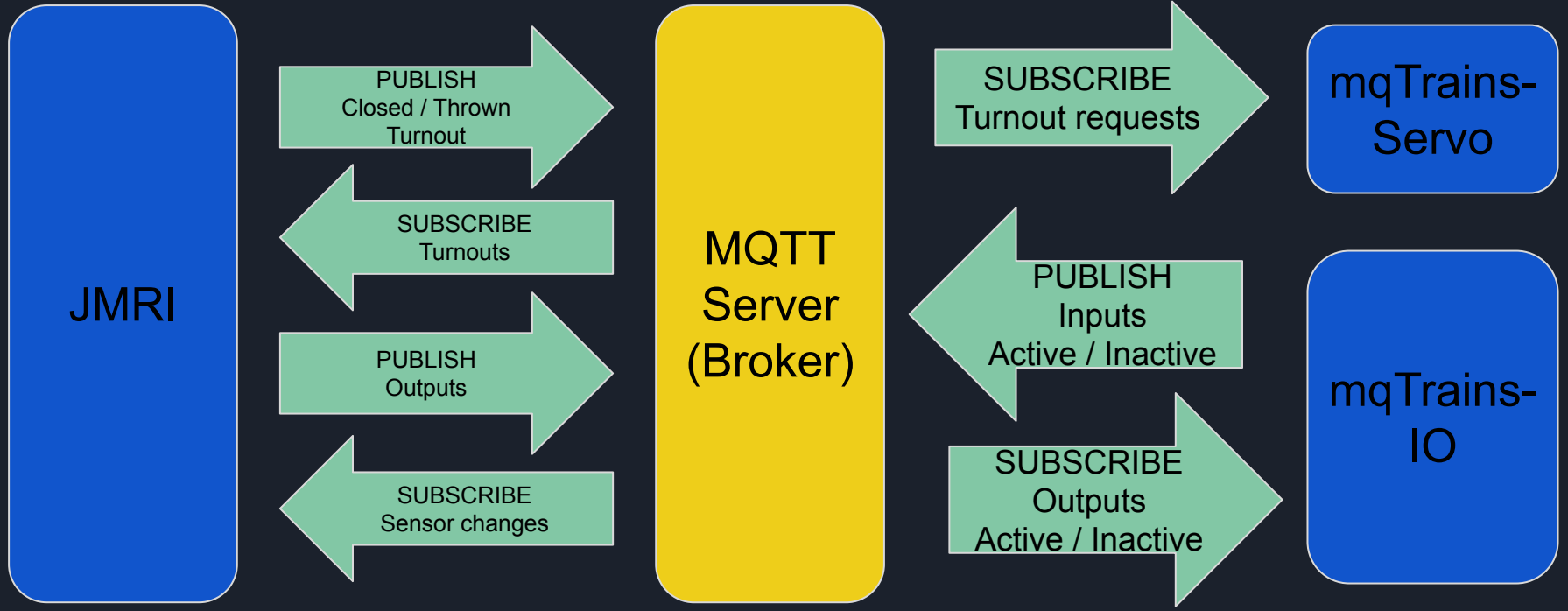


MQTT messages with JMRI



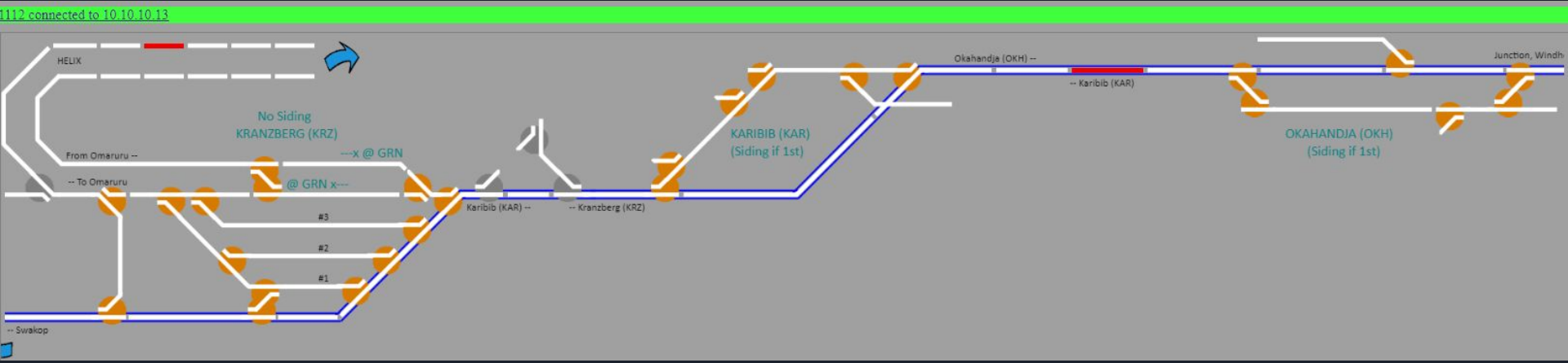
Messages transit over TCP/IP (WiFi or wired)

MQTT messages with JMRI



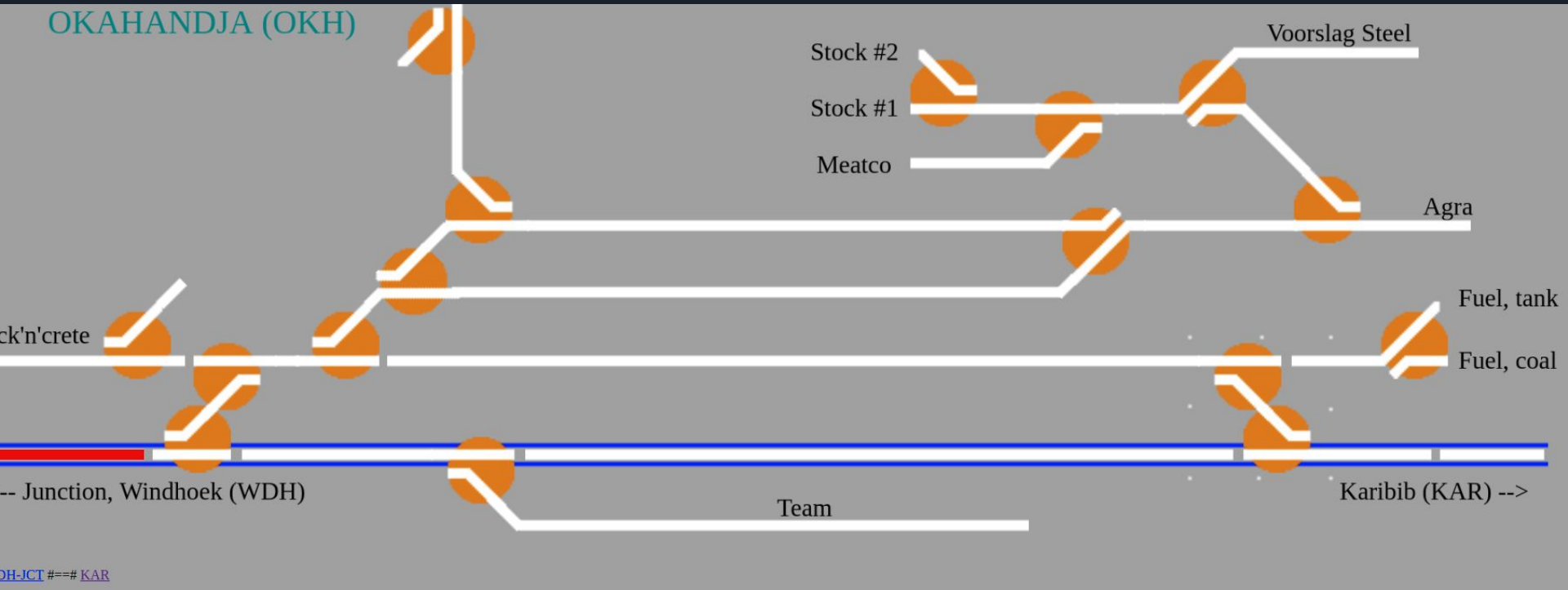
mqTrains w/Javascript (like in a web page)

mqTrains with Javascript (dispatcher view)



mqTrains with Javascript (local control)

mqTrains with Javascript (any good browser)



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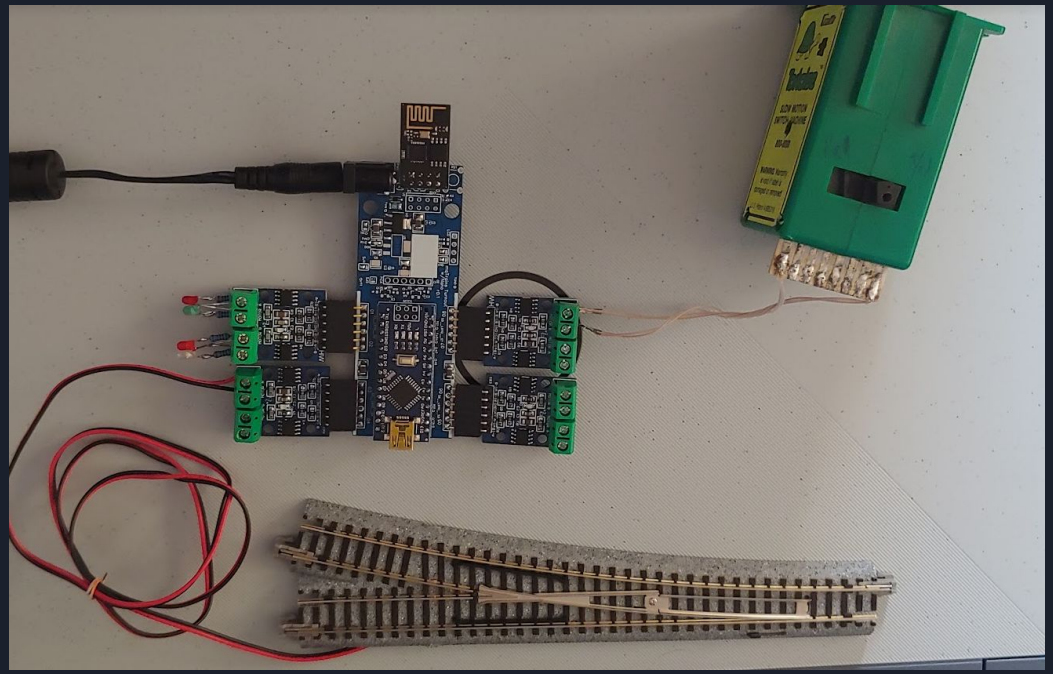
A few more examples...

mqTrains Turnout:
Solenoids and Stall motors (4 x L9110S boards, 8 turnouts)

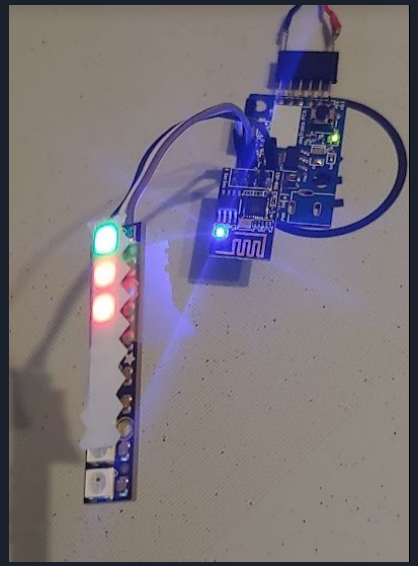


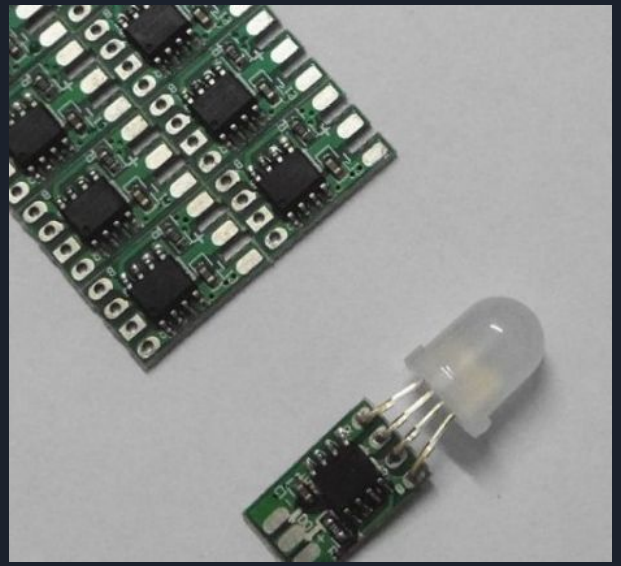
A few more examples...

mqTrains Signal Masts:

Just an ESP-01(s) and Pixels:

- NeoPixels,
- WS2811/12/12b or
- SK6812





Where do I start?

Buy an ESP8266 Starter Kit and then mqTrains.com!

mqTrains

Any questions ?

The only bad question is the one you did not ask!