

*****Draft*****

**Ultibo virtual MQTT Broker
connection with nano-rp2040-connect
with a goal to use a pico_w instead
11/27/22**

*****Draft*****

Required: QEMU 6.2.0 compiled from source. qemu-6.2.0-rpios-32bit.img or qemu-6.2.0-rpios-64bit.img. Openocd is also compiled from source installed-openocd050322-610f137.img installed-openocd082722-228ede-64bit.img. Lazarus IDE (Ultibo-Edition) is installed using <https://github.com/develone/Tools/blob/master/Installer/Core/Linux/ultiboinstaller.sh>
The MQTT will run on a Raspberry Pi OS 32 or 64 bit system.
Arduino IDE was installed on a 32 bit Raspberry Pi OS.

nano-rp2040-connect configuration.

```
const char broker[] = "192.168.1.229"; // QEMU pi4-27 Address of the MQTT
server
int    port    = 9883;
```

```
const char topic[] = "update/memo";
```

```
mqttClient.setId("nano-rp2040-connect");
```

```
mqttClient.setUsernamePassword("testuser", "password123");
```

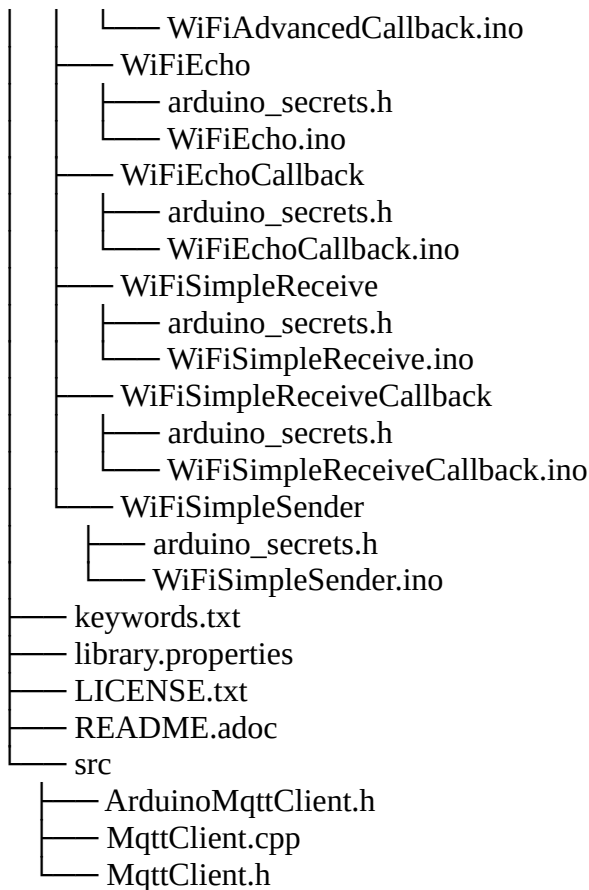
```
while (!mqttClient.connect(broker, port)) {
    .
    .
    .
}
```

Since the MQTT Broker is running in a virtual system the mqtt-port is 9883 instead of 1883

Goal: To use a pico_w instead of nano-rp2040-connect to connect to MQTT Broker running virtually on Raspberry Pi 4B. The code for mqtt broker was written by Ultibo user <https://github.com/pjde/ultibo-mqtt> which was added to https://github.com/develone/Ultibo_Projects/tree/master/Pauls-ultibo-mqtt

Status: Two files are used on the nano-rp2040-connect arduino_secrets.h & mqtt.ino plus

```
libraries/ArduinoMqttClient/
├── examples
│   └── WiFiAdvancedCallback
│       └── arduino_secrets.h
```



8 directories, 19 files

The current pico_w code is found at https://github.com/develone/pico_w-mqtt_example
This code compile links and executes but does not connect like nano-rp2040-connect.

pico_w configuration.

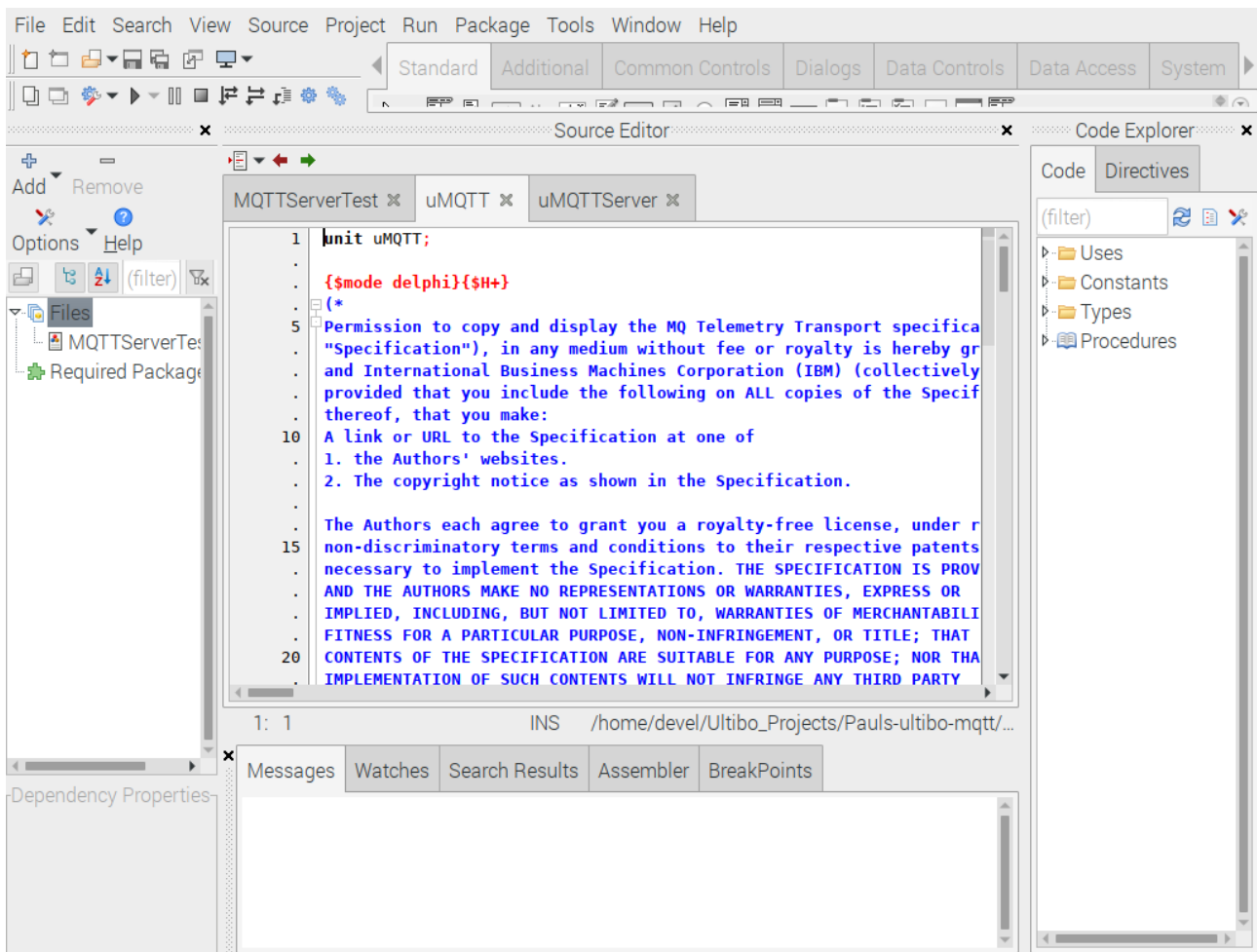
```
u16_t mqtt_port = 9883;
```

```
#define LWIP_MQTT_EXAMPLE_IPADDR_INIT = IPADDR4_INIT(PP_HTONL(0xc0a801e5))
```

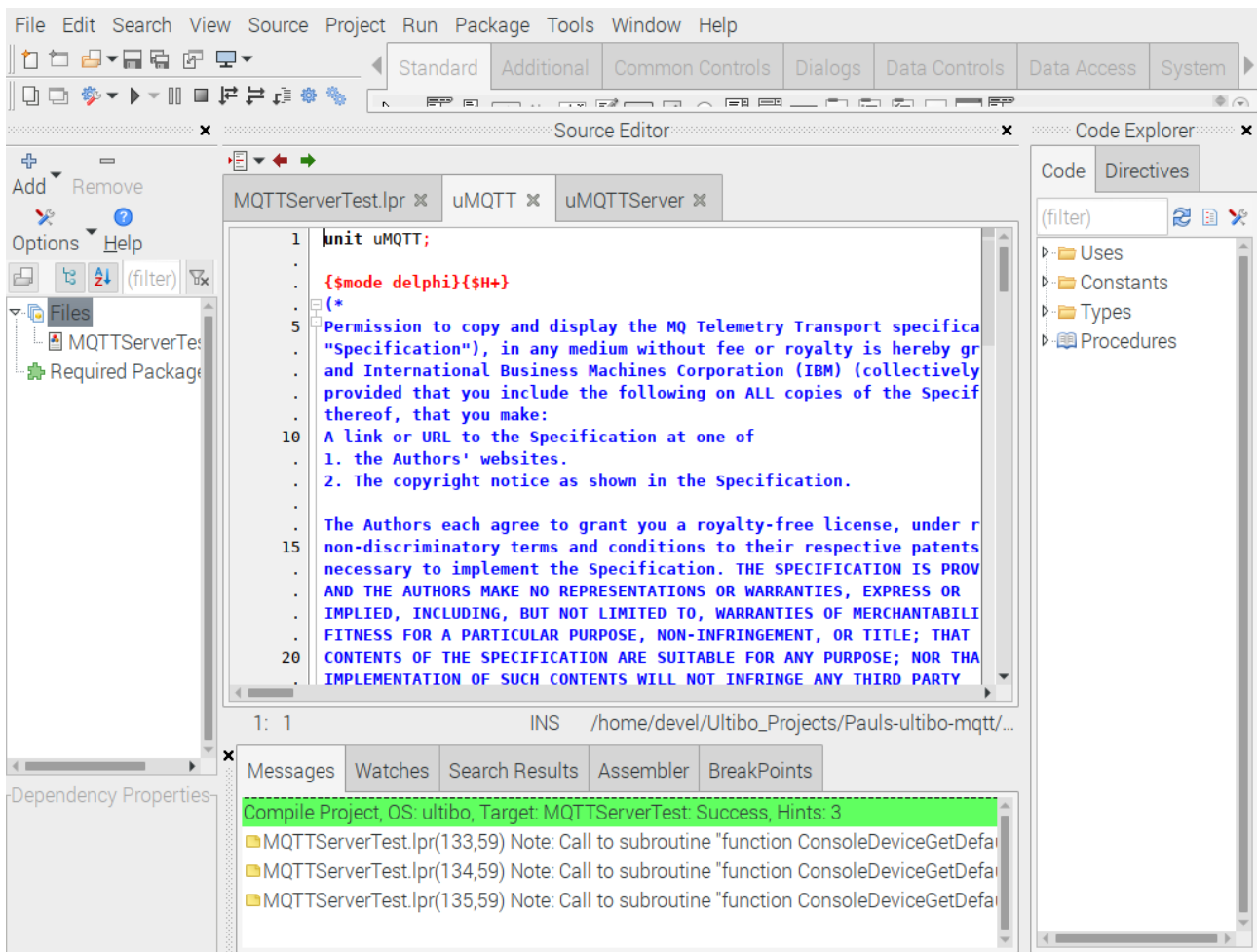
The following command is used to set the path for openocd & qemu.

. Ultibo_Projects/picoultibo.sh

```
export ULTIBO1=/home/devel/ultibo/core
export ULTIBO2=/home/devel/qemu-6.2.0-rpios/bin
export PICO=/home/devel/local/openocd/bin
export PICOTOOL=/home/devel/picotool/build/
export PATH=$ULTIBO1:$ULTIBO2:$PICO:$PICOTOOL:$PATH
echo $PATH
```



From the main menu Run/Compile will generate a “kernel.bin” when the green bar appears.



The script `startqemu.sh` will bring up the MQTT broker.

```
#!/bin/bash
```

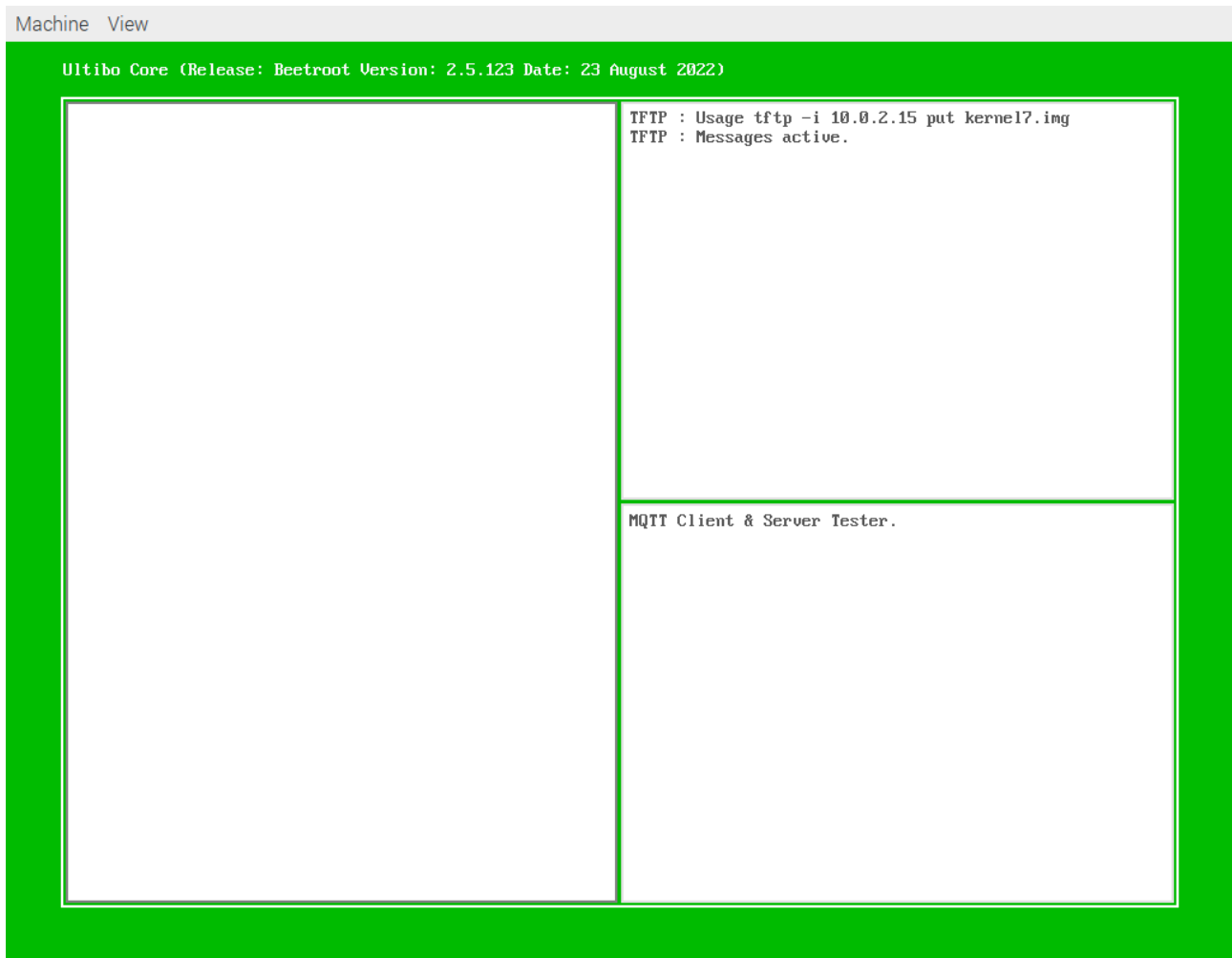
```
qemu-system-arm -machine versatilepb -cpu cortex-a8 -kernel kernel.bin \
```

```
-net
```

```
user,hostfwd=tcp::5080-:80,hostfwd=tcp::5023-:23,hostfwd=tcp::9883-:1883,hostfwd=udp::5069-:6
```

```
9,hostfwd=tcp::6050-:5050 -net nic \
```

```
-drive file=disk.img,if=sd,format=raw
```



When a 5 is depressed in the left panel currently the nano-rp2040-connect and begin sending messages. The nano-rp2040 will connect to the mqtt broker as client “nano-rp2040-connect” user “testuser” password “password123” and start sending messages on topic “update/memo”.

cat /dev/ttyACM0
Sent MQTT message.

Received a message with topic 'update/memo', length 10 bytes:

BUTTON 399

Sent MQTT message.

Received a message with topic 'update/memo', length 10 bytes:

BUTTON 400

Sent MQTT message.

Received a message with topic 'update/memo', length 10 bytes:

BUTTON 401

Sent MQTT message.

Received a message with topic 'update/memo', length 10 bytes:

BUTTON 402

Sent MQTT message.

Received a message with topic 'update/memo', length 10 bytes:

BUTTON 403

Machine View

Ultibo Core (Release: Beetroot Version: 2.5.123 Date: 23 August 2022)

timer 3 triggered Thread Created Connect Check User testuser pass password123 Clean YES Accepted. Is Broker NO Subscription "update/memo" @ AT_MOST_ONCE Subscriptions changed... Publishing -- Was Retained NO Publishing to Client nano-rp2040-connect "update/memo" Publishing -- Was Retained NO Publishing to Client nano-rp2040-connect "update/memo" Publishing -- Was Retained NO Publishing to Client nano-rp2040-connect "update/memo" Publishing -- Was Retained NO Publishing to Client nano-rp2040-connect "update/memo" Publishing -- Was Retained NO Publishing to Client nano-rp2040-connect "update/memo" Publishing -- Was Retained NO Publishing to Client nano-rp2040-connect "update/memo"	TFTP : Usage tftp -i 10.0.2.15 put kernel7.img TFTP : Messages active.
	MQTT Client & Server Tester.

The nano-rp2040-connect

No.	Time	Source	Destination	Protocol	Length	Info
44	8.124826065	2600:1700:69f0:42c0...	2606:4700::6810:f9f9	TCP	86	51778 → 443 [ACK] Seq=79 Ack=79 Win=501 Len=0 TSval=13746216 TSecr=171493955
45	8.768900632	HUMAX_c7:5e:51	Broadcast	0x7373	121	Ethernet II
46	8.959921033	HUMAX_c7:5e:51	Spanning-tree-(for-...	STP	60	Conf. Root = 0/0/cc:ab:2c:c7:5e:51 Cost = 0 Port = 0x8002
47	9.255556446	Espressi_01:8f:48	Broadcast	ARP	60	Who has 192.168.1.229? Tell 192.168.1.179
48	9.255593094	Raspberr_1a:8a:d8	Espressi_01:8f:48	ARP	42	192.168.1.229 is at e4:5f:01:1a:8a:d8
49	9.261391934	192.168.1.179	192.168.1.229	TCP	60	57487 → 9883 [SYN] Seq=0 Win=5744 Len=0 MSS=1436
50	9.261442934	192.168.1.229	192.168.1.179	TCP	58	9883 → 57487 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460
51	9.264319474	192.168.1.179	192.168.1.229	TCP	60	57487 → 9883 [ACK] Seq=1 Ack=1 Win=5744 Len=0
52	9.266614540	192.168.1.179	192.168.1.229	TCP	110	57487 → 9883 [PSH, ACK] Seq=1 Ack=1 Win=5744 Len=56
53	9.266654114	192.168.1.229	192.168.1.179	TCP	54	9883 → 57487 [ACK] Seq=1 Ack=57 Win=64184 Len=0
54	9.536578343	192.168.1.229	192.168.1.179	TCP	58	9883 → 57487 [PSH, ACK] Seq=1 Ack=57 Win=64184 Len=4
55	9.574076520	192.168.1.179	192.168.1.229	TCP	72	57487 → 9883 [PSH, ACK] Seq=57 Ack=5 Win=5740 Len=18
▶ Frame 49: 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface eth0, id 0 ▶ Ethernet II, Src: Espressi_01:8f:48 (30:c6:f7:01:8f:48), Dst: Raspberr_1a:8a:d8 (e4:5f:01:1a:8a:d8) ▶ Internet Protocol Version 4, Src: 192.168.1.179, Dst: 192.168.1.229 ▶ Transmission Control Protocol, Src Port: 57487, Dst Port: 9883, Seq: 0, Len: 0						
0000	e4 5f 01 1a 8a d8 30 c6	f7 01 8f 48 00 00 45 00	... 0 ... H ... E ...			
0010	00 2c 00 03 00 00 ff 06	36 e0 c0 a8 01 b3 c0 a8	... 6 ...			
0020	01 e5 e0 8f 26 9b 00 00	19 6d 00 00 00 00 60 02	... & ... m ...			
0030	16 70 dc 4d 00 00 02 04	85 9c 00 00	... p ... M ...			

This when the connection information is sent from the nano-rp2040-connect to the mqtt broker.

No.	Time	Source	Destination	Protocol	Length	Info
44	8.124826065	2600:1700:69f0:42c0...	2606:4700::6810:f9f9	TCP	86	51778 → 443 [ACK] Seq=79 Ack=79 Win=501 Len=0 TSval=13746216 TSecr=171493955
45	8.768900632	HUMAX_c7:5e:51	Broadcast	0x7373	121	Ethernet II
46	8.959921033	HUMAX_c7:5e:51	Spanning-tree-(for-...	STP	60	Conf. Root = 0/0/cc:ab:2c:c7:5e:51 Cost = 0 Port = 0x8002
47	9.255556446	Espressi_01:8f:48	Broadcast	ARP	60	Who has 192.168.1.229? Tell 192.168.1.179
48	9.255593094	Raspberr_1a:8a:d8	Espressi_01:8f:48	ARP	42	192.168.1.229 is at e4:5f:01:1a:8a:d8
49	9.261391934	192.168.1.179	192.168.1.229	TCP	60	57487 → 9883 [SYN] Seq=0 Win=5744 Len=0 MSS=1436
50	9.261442934	192.168.1.229	192.168.1.179	TCP	58	9883 → 57487 [SYN, ACK] Seq=0 Ack=1 Win=64240 Len=0 MSS=1460
51	9.264319474	192.168.1.179	192.168.1.229	TCP	60	57487 → 9883 [ACK] Seq=1 Ack=1 Win=5744 Len=0
52	9.266614540	192.168.1.179	192.168.1.229	TCP	110	57487 → 9883 [PSH, ACK] Seq=1 Ack=1 Win=5744 Len=56
53	9.266654114	192.168.1.229	192.168.1.179	TCP	54	9883 → 57487 [ACK] Seq=1 Ack=57 Win=64184 Len=0
54	9.536578343	192.168.1.229	192.168.1.179	TCP	58	9883 → 57487 [PSH, ACK] Seq=1 Ack=57 Win=64184 Len=4
55	9.574076520	192.168.1.179	192.168.1.229	TCP	72	57487 → 9883 [PSH, ACK] Seq=57 Ack=5 Win=5740 Len=18
▶ Frame 52: 110 bytes on wire (880 bits), 110 bytes captured (880 bits) on interface eth0, id 0 ▶ Ethernet II, Src: Espressi_01:8f:48 (30:c6:f7:01:8f:48), Dst: Raspberr_1a:8a:d8 (e4:5f:01:1a:8a:d8) ▶ Internet Protocol Version 4, Src: 192.168.1.179, Dst: 192.168.1.229 ▶ Transmission Control Protocol, Src Port: 57487, Dst Port: 9883, Seq: 1, Ack: 1, Len: 56 ▶ Data (56 bytes)						
0000	e4 5f 01 1a 8a d8 30 c6	f7 01 8f 48 00 00 45 00	... 0 ... H ... E ...			
0010	00 60 00 05 00 00 ff 06	36 aa c0 a8 01 b3 c0 a8	... 6 ...			
0020	01 e5 e0 8f 26 9b 00 00	19 6e 47 af d8 88 50 18	... & ... nG ... P ...			
0030	16 70 e8 6c 00 00 10 36	00 04 4d 51 54 54 04 c2	... p ... 6 ... MQTT ...			
0040	00 3c 00 13 6e 61 6e 6f	2d 72 70 32 30 34 30 2d	... < ... nano ...			
0050	63 6f 6e 6e 65 63 74 00	00 74 65 73 74 75 73 65	... connect ... testuse ...			
0060	72 00 0b 70 61 73 73 77	6f 72 64 31 32 33	... r ... passw ord123			

The nano-rp2040-connect begins sending updates to topic “update/memo” to mqtt broker.

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/>

No.	Time	Source	Destination	Protocol	Length	Info
1108	33.556159433	2600:1700:69f0:42c0...	2600:1700:69f0:42c0...	TCP	86	58202 → 22 [ACK] Seq=1 Ack=465 Win=501 Len=0 TSval=4018516150 TSecr=4264266404
1109	33.559053476	192.168.1.175	192.168.1.229	TCP	97	60639 → 9883 [PSH, ACK] Seq=1 Ack=1 Win=11680 Len=43
1110	33.559237659	192.168.1.229	192.168.1.175	TCP	54	9883 → 60639 [ACK] Seq=1 Ack=44 Win=64197 Len=0
1111	33.564924633	HUMAX_c7:5e:51	Spanning-tree-(for-... STP	60	Conf: Root = 0/0/cc:ab:2:c7:5e:51 Cost = 0 Port = 0x8002	
1112	33.829020574	192.168.1.229	192.168.1.179	TCP	78	9883 → 58060 [PSH, ACK] Seq=665 Ack=666 Win=64074 Len=24
1113	33.997029937	192.168.1.229	192.168.1.175	TCP	58	9883 → 60639 [PSH, ACK] Seq=1 Ack=44 Win=64197 Len=4
1114	34.009245544	28:cd:c1:08:17:1f	Broadcast	ARP	60	Who has 192.168.1.254? Tell 192.168.1.175
1115	34.032903841	HUMAX_c7:5e:51	Broadcast	0x7373	121	Ethernet II
1116	34.168675983	192.168.1.179	192.168.1.229	TCP	60	58060 → 9883 [ACK] Seq=666 Ack=689 Win=5024 Len=0
1117	34.223985155	2600:1700:69f0:42c0...	2600:1700:69f0:42c0...	SSH	138	Server: Encrypted packet (len=52)
1118	34.224026970	2600:1700:69f0:42c0...	2600:1700:69f0:42c0...	TCP	86	58202 → 22 [ACK] Seq=1 Ack=517 Win=501 Len=0 TSval=4018516818 TSecr=4264267072
1119	34.224654476	192.168.1.175	192.168.1.229	TCP	RR	60639 → 9883 [PSH, ACK] Seq=44 Ack=5 Win=11676 Len=34

▶ Frame 1109: 97 bytes on wire (776 bits), 97 bytes captured (776 bits) on interface eth0, id 0
 ▶ Ethernet II, Src: 28:cd:c1:08:17:1f (28:cd:c1:08:17:1f), Dst: Raspberr_1a:8a:d8 (e4:5f:01:1a:8a:d8)
 ▶ Internet Protocol Version 4, Src: 192.168.1.175, Dst: 192.168.1.229
 ▶ Transmission Control Protocol, Src Port: 60639, Dst Port: 9883, Seq: 1, Ack: 1, Len: 43
 ▶ Data (43 bytes)

```

0000  e4 5f 01 1a 8a d8 28 cd c1 08 17 1f 08 00 45 00  .-----( .-----E-
0010  00 53 00 04 00 00 ff 06 36 bc c0 a8 01 af c0 a8  .S-----6-----
0020  01 e5 ec df 26 9b 00 00 19 6e d5 e5 05 0f 50 18  ....&...n...oP-
0030  2d a0 15 e2 00 00 10 29 00 04 4d 51 54 54 04 c2  -.....-MQTT-
0040  00 64 00 06 70 69 63 6f 5f 77 00 08 74 65 73 74  .d.pico_w_test
0050  75 73 65 72 00 0b 70 61 73 73 77 6f 72 64 31 32  user pa sswor12
0060  33                                           3
  
```

wireshark_eth04RE6V1.pcapng Packets: 1220 · Displayed: 1220 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

Starting FreeRTOS on core 0:

Connecting to WiFi...

Connected.

Connecting to WiFi...

Connected.

mqtt_port = 9883 &mqtt_port 0x20000598

mqtt_ip = 0xe501a8c0 &mqtt_ip = 0x20000594

IPADDR_LOOPBACK = 0x7f000001

mqtt_client 0x20001bac &mqtt_client 0x20000f40

mqtt_set_inpub_callback 0x10001249

mqtt_client_connect 0x10001261

Ready, running iperf server at 192.168.1.175

MQTT client "pico_w" connection cb: status 0

MQTT client "pico_w" request cb: err 0

MQTT client "pico_w" request cb: err 0