

\*\*\*\*\*Draft\*\*\*\*\*

**Ultibo virtual MQTT Broker  
connection with nano-rp2040-connect  
with a goal to use a pico\_w instead  
11/28/22**

\*\*\*\*\*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");
```

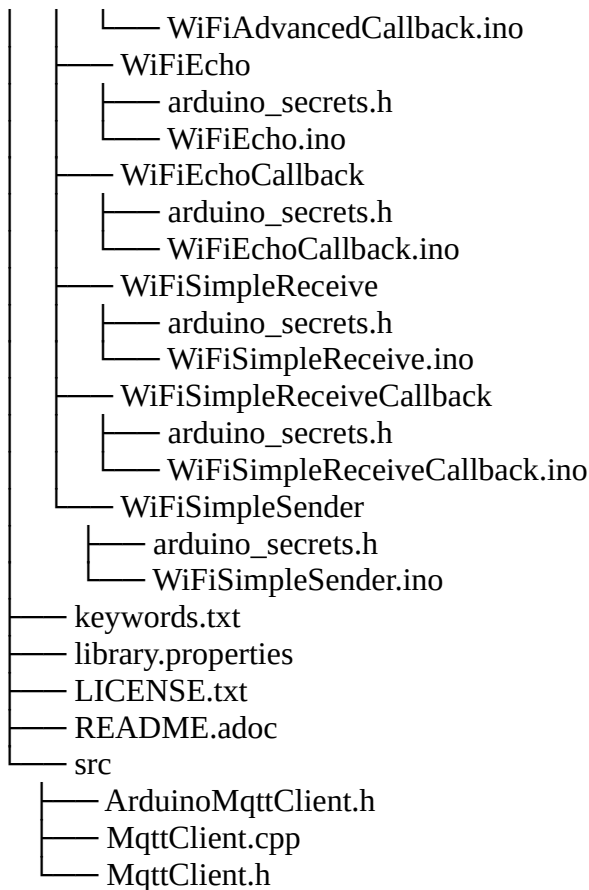
```
while (!mqttClient.connect(broker, port)) {
    .
    .
    .
}
```

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](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](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.

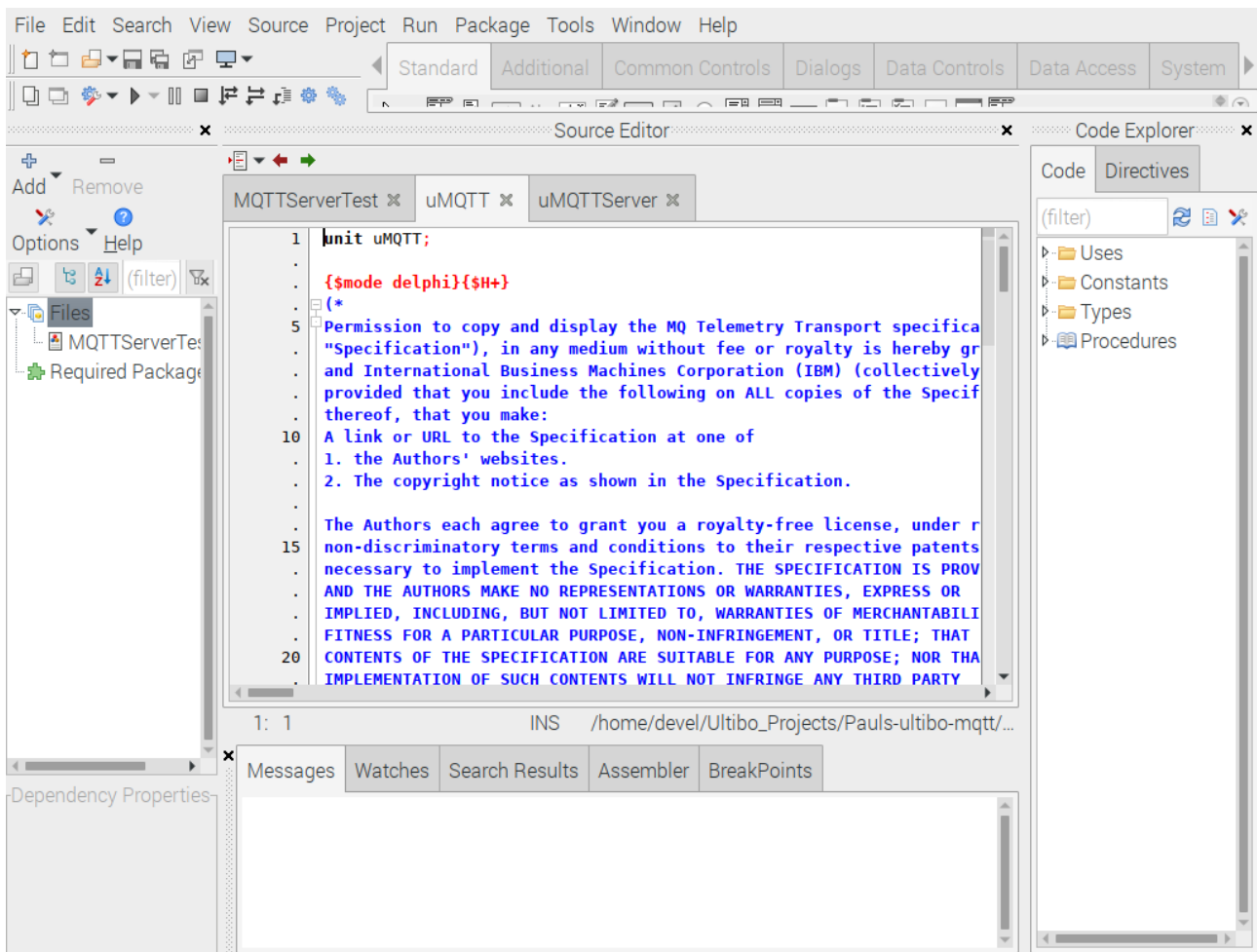
```
u16_t mqtt_port = 9883;
```

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

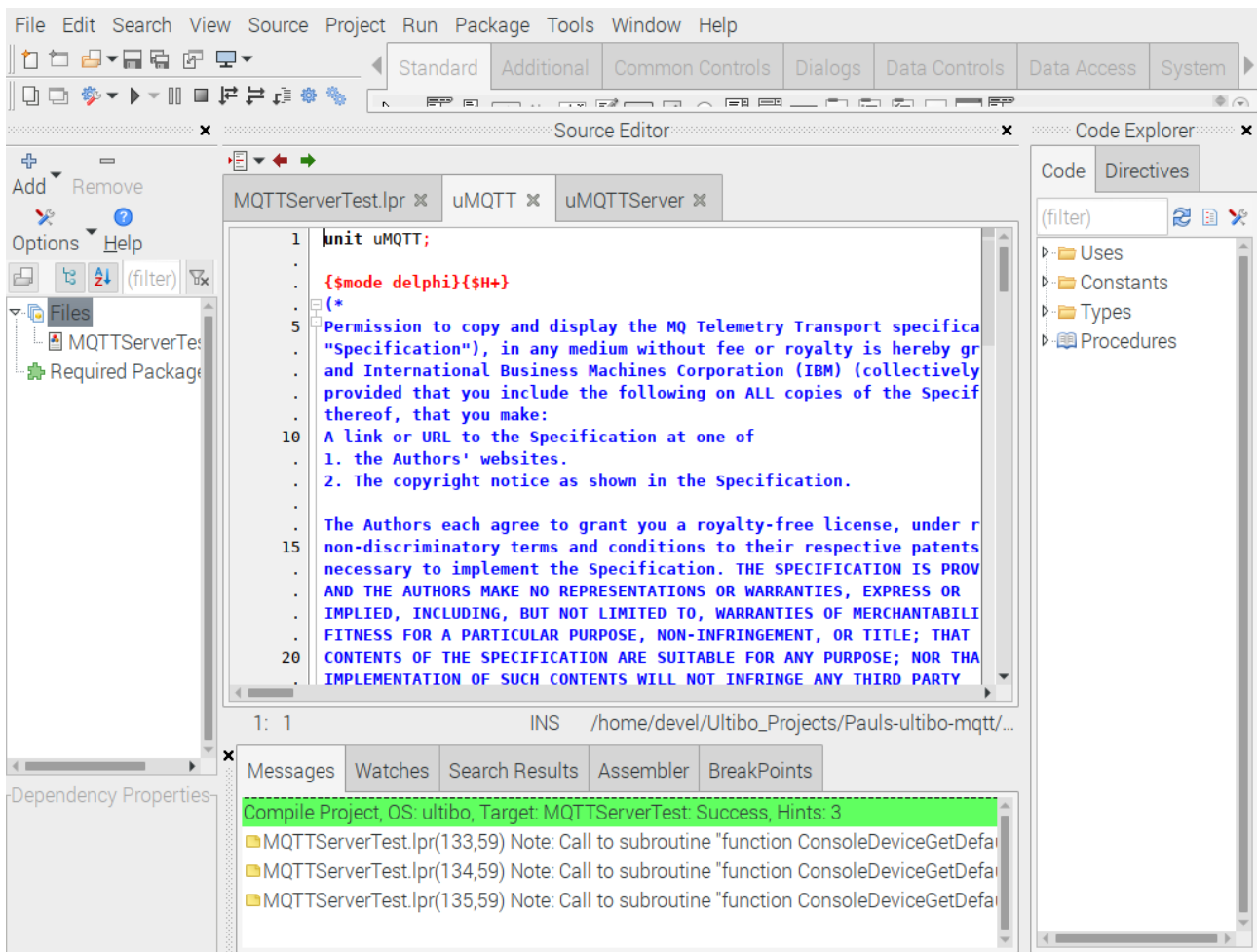
The following command is used to set the path for openocd & qemu.

### **. 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
```

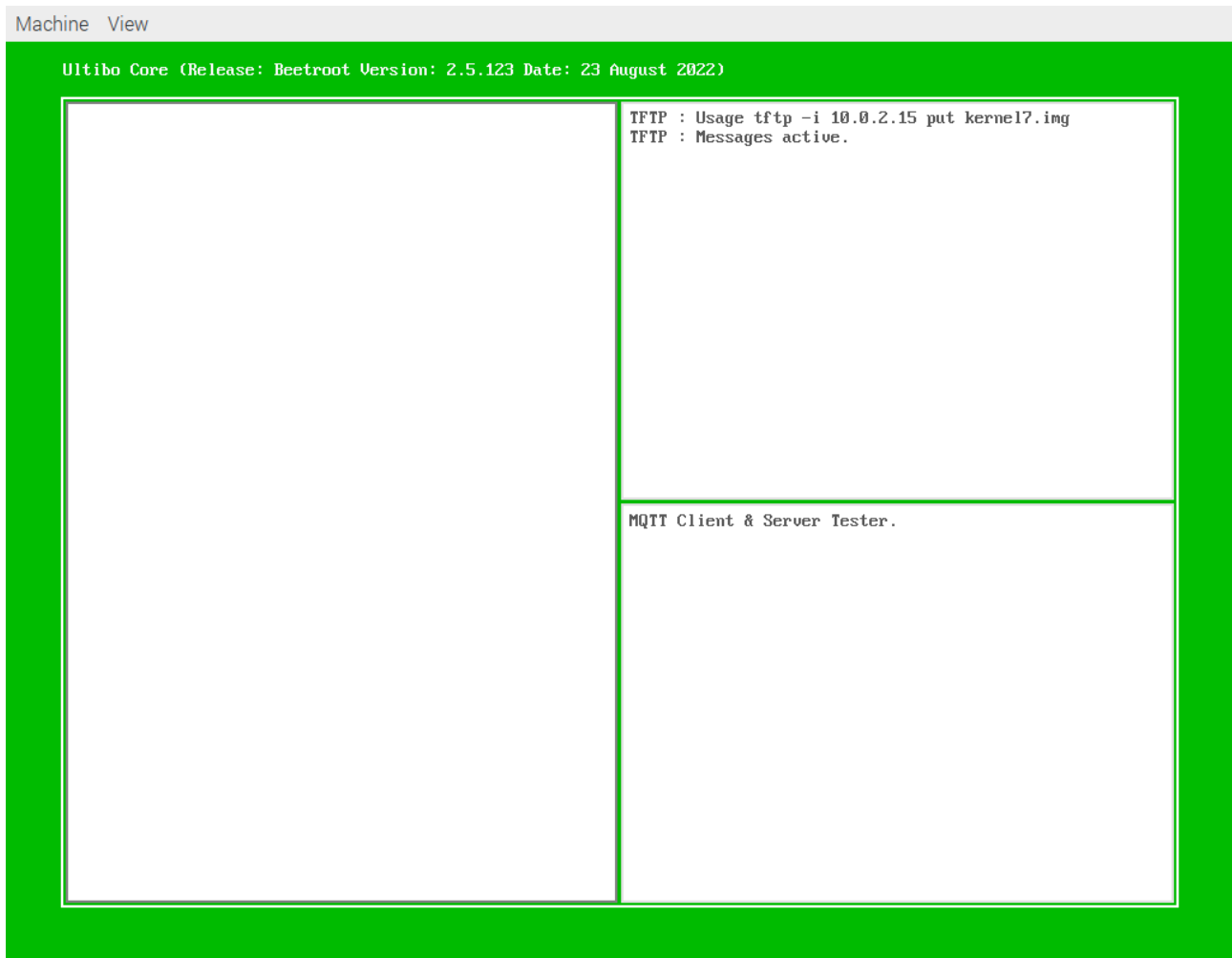
```
qemu-system-arm -machine versatilepb -cpu cortex-a8 -kernel kernel.bin \
```

```
-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

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

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

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	8.768906632	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	9.574076528	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 08 00 45 00  ...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...

```

wireshark\_eth0R2YKWI.pcapng Packets: 83 · Displayed: 83 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

This when the connection information is sent from the nano-rp2040-connect to the 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
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	8.768906632	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	9.574076528	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 08 00 45 00  ...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  ...&...P...
0030  16 70 e8 6c 00 00 10 36 00 04 4d 51 54 54 04 c2  ...p.l...6...MQTT-
0040  00 3c 00 13 6e 61 6e 6f 2d 72 70 32 30 34 30 2d  ...<...nano-rp2040-
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

```

Ready to load or capture Packets: 83 · Displayed: 83 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

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
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	8.958921033	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

Frame 55: 72 bytes on wire (576 bits), 72 bytes captured (576 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: 57, Ack: 5, Len: 18  
 Data (18 bytes)

```

0000  e4 5f 01 1a 8a d8 30 c6 f7 01 8f 48 08 00 45 00  ..H..E-
0010  00 3a 00 06 00 00 ff 06 36 cf c0 a8 01 b3 c0 a8  ....6.....
0020  01 e5 e0 8f 26 9b 00 00 19 a6 47 af d8 8c 50 18  ...&...G...P-
0030  16 6c ff 29 00 00 82 10 00 01 00 0b 75 70 64 61  .L).....upda
0040  74 65 2f 6d 65 6d 6f 00                te/memo
  
```

Packets: 83 · Displayed: 83 (100.0%) · Dropped: 0 (0.0%) · Profile: Default

pico\_w connects with MQTT Broker

```

File Edit Tabs Help

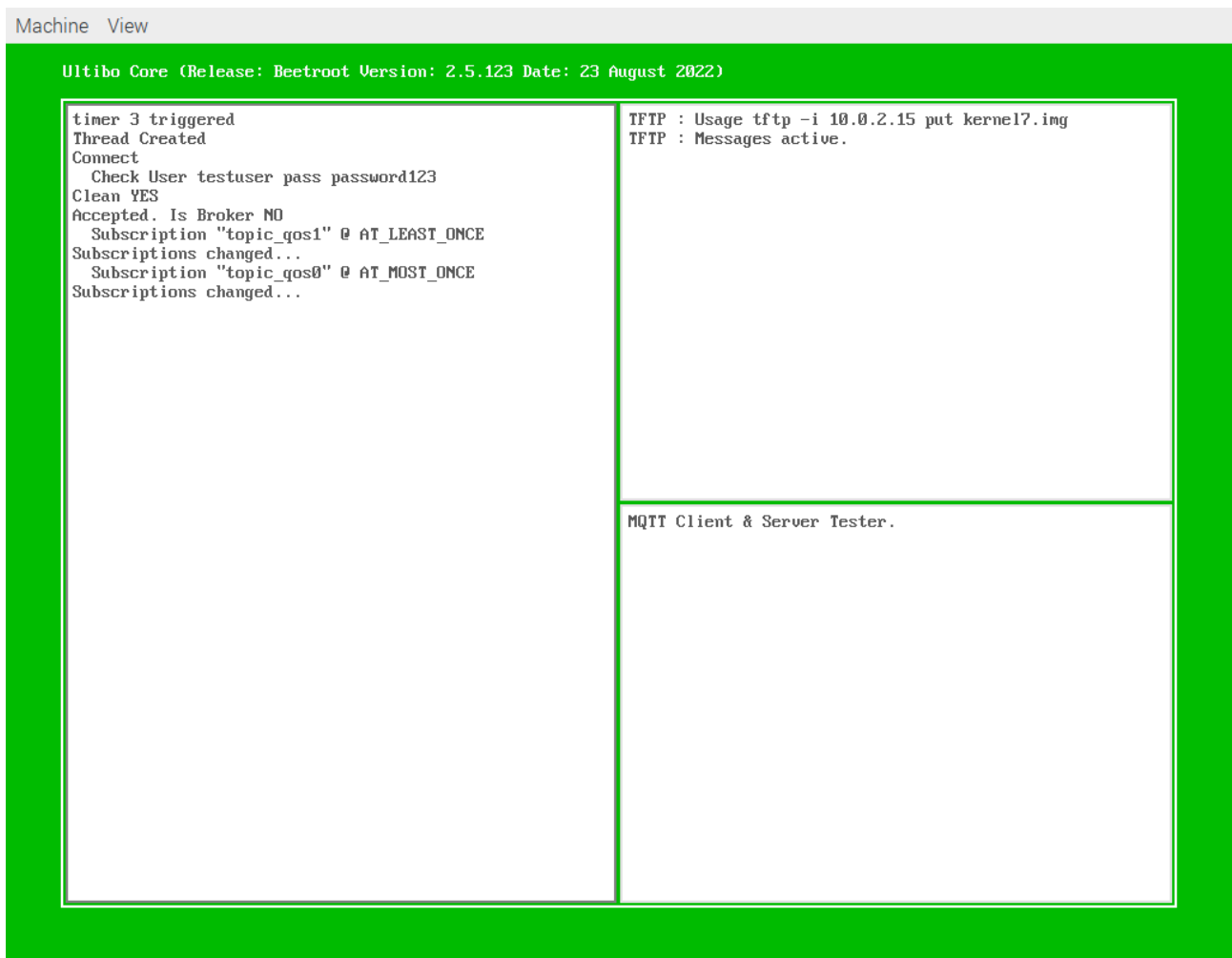
Connected.
mqtt_port = 9883 &mqtt_port 0x20000598
mqtt_ip = 0xe501a8c0 &mqtt_ip = 0x20000594
IPADDR_LOOPBACK = 0x7f000001
mqtt_client 0x20001bac &mqtt_client 0x20000f40
mqtt_set_inpub_callback 0x10001249
mqtt_client_connect 0x10001261

Ready, running iperf server at 192.168.1.175
MQTT client "pico_w" connection cb: status 256
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

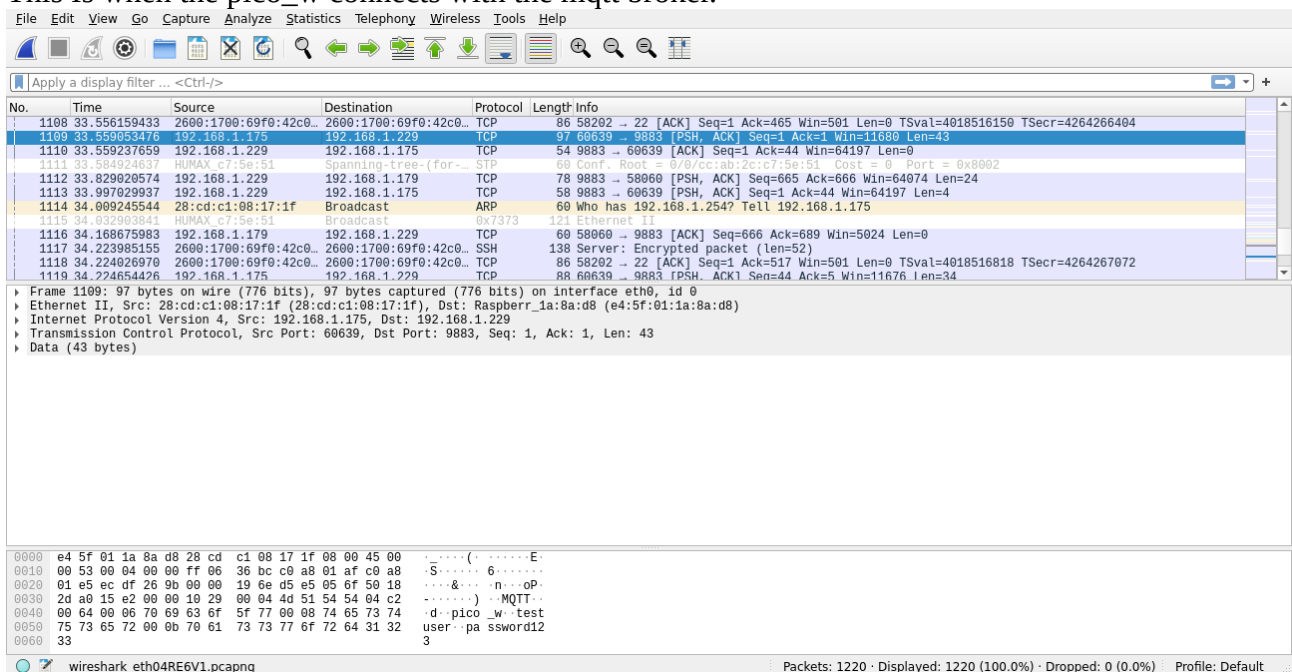
Ready, running iperf server at 192.168.1.175
MQTT client "pico_w" connection cb: status 0
MQTT client "pico_w" request cb: err 0
MQTT client "pico_w" request cb: err 0
  
```

pico\_w connects with MQTT Broker





This Is when the pico\_w connects with the mqtt broker.



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