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Paho MQTT C Client - MQTT Client Library Encyclopedia



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Category: MQTT • MQTT Client • MQTT Client Library

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Paho MQTT C Client	
Language	С
License	EPL and EDL
Website	eclipse.org/paho/clients/c
API Style	Blocking and non-blocking

Description

The Paho C client libraries started life back in 2007, when I first started writing a small MQTT server, RSMB (Really Small Message Broker). I thought I would reuse as much of the internal code of RSMB as I could, to save myself some time. As it turned out, I probably didn't save as much time as I expected, because in some ways writing a client library for MQTT is more complex than writing a server. RSMB is single-threaded, which I mainly retained in the design of these client libraries, for better or worse.

I started writing RSMB in C++, but the template support in gcc at the time did not work well, so I switched to standard ANSI C. That's why the client libraries are C too. It seemed to me at the time that Linux was likely to take over the world for embedded systems, with Windows CE maybe getting a look in. That's why I wrote these libraries with Linux (and some other forms of Unix) and Windows in mind, rather than being any more portable. And that's why the Paho embedded client libraries now exist - for all those other embedded operating systems that are now popular!

In 2008, there weren't too many MQTT client libraries to learn from, so for the first steps I followed the IBM Java client of the time. I thought it was better to copy an existing model to make it easier for the MQTT application programmer to

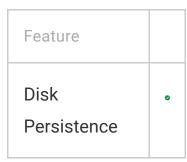
transfer knowledge from one to the other. As a result the synchronous client was born, just called MQTTClient. This has the following design points:

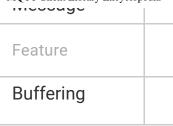
- threading: no background thread, or just one, regardless of how many connections are created
- 2. blocking MQTT calls, to simplify application programming
- 3. an inflight window for QoS 1 and 2 messages of 1 or 10 only, to limit the amount of damage that can be inflicted on a server
- 4. internal tracing and memory tracking, for serviceability and elimination of memory leaks

Features

Feature	
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QoS 0	
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QoS 2	
Authentication	
Throttling	
Offline	
Message	





Usage

Installation

On Linux (or Unix) the simplest method is to clone the repo and install:

```
git clone https://git.eclipse.org/r/paho/ord
make
sudo make install
```

Pre-built libraries for MacOS and Windows are available on the **Paho downloads page**.

Unzip to a location of your choice.

First we have to include the header file.

```
1 #include "MQTTClient.h"
```

Now we can create a client object.

```
1   MQTTClient client;
2   rc = MQTTClient_create(&client, url, client)
```

Where the url is of the form host:port, and clientid is a string. The fourth parameter

specifies the disk persistence required.

MQTTCLIENT_PERSISTENCE_NONE says that no persistence is required.

MQTTCLIENT_PERSISTENCE_DEFAULT asks for the supplied, default disk persistence to be used. This stores all inflight message data to disk, and means that the application can end, restart, and recreate the client object with the same clientid and url. Any inflight message data will be read from disk and restored so that the application can continue where its previous incarnation left off.

Next we can optionally set some callback functions.

At a minimum, we must have a messageArrived

callback, which will be called whenever an MQTT

publish message arrives.

There is also a **connectionLost callback** which will be called whenever the connection to the server has been broken unexpectedly. That is, we have called connect previously, it has succeeded, we have not called disconnect, and now the connection has been broken. Often we simply want to reconnect in the **connectionLost callback**. The final callback function is **deliveryComplete**, which is called when an MQTT publish exchange finishes. The MQTTClient_publish call blocks, but only until the publish packet is written to the socket.

For OoS 0 this is the end of the story For OoS 1 and

2, the MQTT packet exchange continues. When the final acknowledgement is received from the server, deliveryComplete is called. context is a pointer which is passed to the callbacks and can contain any useful information, such as the client object for which this callback is being made.

For this synchronous client, you do have the option of not setting any callbacks. In that case, no background thread will be started. Under these circumstances, the application, on a regular basis, must call

```
1 rc = MQTTClient_receive(client, topicName,
```

to receive messages, or

```
1 MQTTClient_yield();
```

to allow any necessary MQTT background processing to take place. This mode was intended specifically when the application wanted no threads to be created.

Application Setup - MQTTAsync

The application setup for the asynchronous client library is very similar to the synchronous library.

Header file:

```
#include "MQTTAsync.h"
```

client object creation:

```
1  MQTTAsync client;
2  rc = MQTTAsync_create(&client, url, clientic)
```

and setting the callbacks:

```
1 rc = MQTTAsync_setCallbacks(client, context
```

There is no non-threaded mode for the async client, background threads will always be created and the arrival of MQTT publications will be notified by the messageArrived callback.

Connect

To connect to a server, we create a connect options structure and call connect:

```
MQTTClient_connectOptions conn_opts = MQTTClient_connectOptions conn_opts = MQTTClient_conn_opts.keepAliveInterval = 10;
conn_opts.cleansession = 1;
rc = MQTTClient_connect(client, conn_opts);
```

which will block until the MQTT connect is complete, or has failed. Similarly, for the async client:

```
MQTTAsync_connectOptions conn_opts = MQTTAsy
conn_opts.keepAliveInterval = 10;
conn_opts.cleansession = 1;
conn_opts.onSuccess = onConnect;
conn_opts.onFailure = onConnectFailure;
```

```
conn_opts.context = client;
rc = MQTTAsync_connect(client, &conn_opts);
```

except that we add two pointers to callback functions. The connect call will not block, success or failure will be notified by the invocation of one or other of the callback functions. For the other connect examples, I'll just show the synchronous client, but the pattern is the same for the async client. A typical pattern for the async client is to make all MQTT calls in callback functions: a subscribe or publish call can be made in the success callback for connect, for instance.

Connect with LWT

```
MQTTClient_willOptions will_opts = MQTTClien
MQTTClient_connectOptions conn_opts = MQTTClien
conn_opts.keepAliveInterval = 10;
conn_opts.cleansession = 1;
conn_opts.will = will_opts;
will_opts.topicName = "will topic";
will_opts.message = "will message";
rc = MQTTClient_connect(client, conn_opts);
```

Connect with Username and Password

```
MQTTClient_connectOptions conn_opts = MQTTClient_connectOptions conn_opts = MQTTClient_conn_opts.keepAliveInterval = 10;
conn_opts.cleansession = 1;
conn_opts.username = "username";
conn_opts.password = "password";
rc = MQTTClient_connect(client, conn_opts);
```

Publish

Publish looks like the following, for the synchronous client:

```
char* payload = "a payload";
int payloadlen = strlen(payload);
int qos = 1;
int retained = 0;
MQTTClient_deliveryToken dt;
rc = MQTTClient_publish(client, topicName, ]
```

There is also another version of the call which takes a message structure:

```
MQTTClient_message msg = MQTTClient_message
msg.payload = "a payload";
msg.payloadlen = strlen(payload);
msg.qos = 1;
msg.retained = 0;
MQTTClient_deliveryToken dt;
rc = MQTTClient_publishMessage(client, topic
```

The delivery token can be used in a waitForCompletion call, to synchronize on the completion of the MQTT packet exchange. The async calls for publish look very similar, except I renamed publish to send, and topic to destination.

This was to be compatible with the JavaScript Paho client, because the asynchronous programming models are very similar. It seemed like a good idea at the time!

```
MQTTAsync_responseOptions response;
response.onSuccess = onPublish;
response.onFailure = onPublishFailure;
response.context = client;
rc = MQTTAsync_sendMessage(client, destinat)
```

Again, the biggest change is the addition of the success and failure callbacks.

Subscribe

The subscribe call is straightforward:

```
const char* topic = "mytopic";
int qos = 2;
rc = MQTTClient_subscribe(client, topic, qos)
```

and for the async client:

```
MQTTAsync_responseOptions opts = MQTTAsync_:
opts.onSuccess = onSubscribe;
opts.onFailure = onSubscribeFailure;
opts.context = client;
rc = MQTTAsync_subscribe(client, topic, qos
```

Unsubscribe

The unsubscribe call is also straightforward:

```
const char* topic = "mytopic";
rc = MQTTClient_unsubscribe(client, topic);
```

and for the async client:

```
MQTTAsync_responseOptions opts = MQTTAsync_:
opts.onSuccess = onUnsubscribe;
opts.onFailure = onUnsubscribeFailure;
opts.context = client;
rc = MQTTAsync_unsubscribe(client, topic, &c.)
```

Disconnect

There is a timeout parameter in milliseconds on the disconnect call, which allows outstanding MQTT packet exchanges to complete.

```
1  int timeout = 100;
2  MQTTClient_disconnect(client, timeout);
```

or:

```
MQTTAsync_disconnectOptions opts = MQTTAsync
opts.onSuccess = onDisconnect;
opts.context = client;
rc = MQTTAsync_disconnect(client, &opts);
```

When you've finished with a client object, call destroy to free up the memory:

```
1 MQTTClient_destroy(&client);
```

or:

```
1 MQTTAsync_destroy(&client);
```

Receiving Messages

A typical message arrived callback function might look like this:

```
int messageArrived(void *context, char *to)
1
2
3
        printf("Message arrived\n");
4
        printf(" topic: %s\n", topicName);
5
        printf("
                  message: .*s\n", message.pag
6
7
        MQTTClient freeMessage(&message);
        MQTTClient free(topicName);
8
9
        return 1;
10
    }
```

Note the calls to free memory, and the return value:

1 means that the message was received properly, 0
means it wasn't. The messageArrived
callback will be invoked again for the same
message if you return 0.

Using TLS / SSL

To use TLS, you need to add the SSL options data to the connect options:

```
1   MQTTClient_SSLOptions ssl_opts = MQTTClient
2   ssl_opts.enableServerCertAuth = 0;
3   conn_opts.ssl = &ssl_opts;
```

The TLS implementation uses OpenSSL, so the configuration parameters are the same:

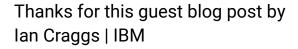
```
/** The file in PEM format containing the
 1
 2
    const char* trustStore;
 3
    /** The file in PEM format containing the |
 4
 5
    * the client's private key.
    */
 6
 7
    const char* keyStore;
 9
    /** If not included in the sslKeyStore, th.
    * the client's private key.
10
    */
11
12
    const char* privateKey;
13
    /** The password to load the client's priva
14
    const char* privateKeyPassword;
15
    /**
16
17
    * The list of cipher suites that the clien
    * full explanation of the cipher list form
18
19
    * http://www.openssl.org/docs/apps/ciphers
2.0
    * If this setting is ommitted, its default
21
    * those offering no encryption- will be con
    * This setting can be used to set an SSL and
22
23
    */
24
    const char* enabledCipherSuites;
25
    /** True/False option to enable verification
26
27
    int enableServerCertAuth;
```

Example application

Sample application for the Paho C clients are in the samples directory of the **github repository** and in the download packages.



About Ian Craggs



lan Craggs works for IBM, and has been involved with MQTT for more than 10 years. He wrote the IBM MQTT server Really Small Message Broker which became the inspiration for the Eclipse Mosquitto project. He contributed C client libraries to the Eclipse Paho project at its onset and is now the project leader.

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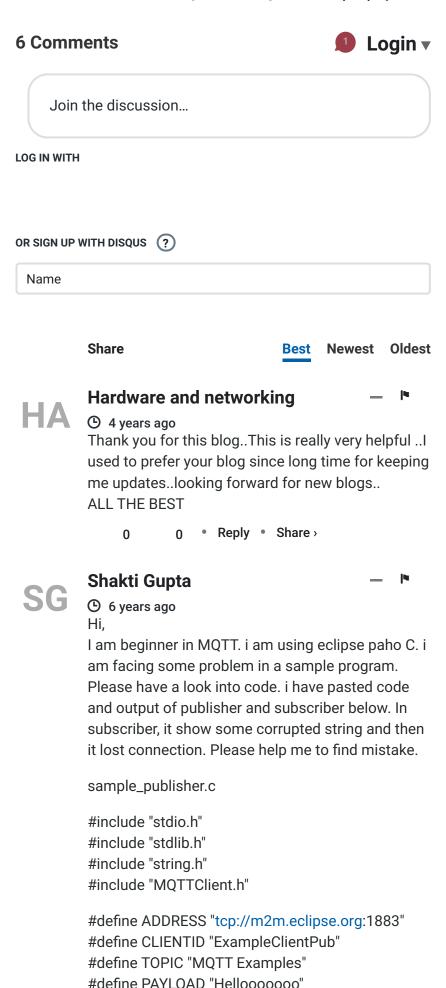
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```
#define QOS 1
#define TIMEOUT 10000L
int main(int argc, char* argv[])
MQTTClient client;
MQTTClient_connectOptions conn_opts =
MQTTClient_connectOptions_initializer;
MQTTClient_message pubmsg =
MQTTClient_message_initializer;
MQTTClient_deliveryToken token;
int rc;
int status;
char* str="HELLO";
MQTTClient_create(&client, ADDRESS, CLIENTID,
MQTTCLIENT_PERSISTENCE_NONE, NULL);
conn_opts.keepAliveInterval = 20;
conn_opts.cleansession = 1;
if ((rc = MQTTClient_connect(client, &conn_opts))
!= MQTTCLIENT_SUCCESS)
printf("Failed to connect, return code %d\n", rc);
exit(-1);
}
pubmsq.payload = (void*)str;
pubmsq.payloadlen = strlen(str);
pubmsq.qos = QOS;
pubmsq.retained = 0;
printf("lenght is %d", pubmsg.payloadlen);
status=MQTTClient_publishMessage(client, TOPIC,
&pubmsq, &token);
printf("status is %d \n",status);
printf("Waiting for up to %d seconds for publication
of %s\n"
"on topic %s for client with ClientID: %s\n",
(int)(TIMEOUT/1000), PAYLOAD, TOPIC, CLIENTID);
rc = MQTTClient_waitForCompletion(client, token,
TIMEOUT);
printf("Message with delivery token %d delivered\n",
token);
MQTTClient_disconnect(client, 10000);
MQTTClient_destroy(&client);
return rc;
}
```

```
./sample_publish
lenght is 5status is 0
Waiting for up to 10 seconds for publication of
Hellooooooo
on topic MQTT Examples for client with ClientID:
ExampleClientPub
Message with delivery token 1 delivered
Sample_subscribe.c
/*
* sample_subscribe.c
* Created on: 22-Sep-2016
* Author: shakti
*/
#include "stdio.h"
#include "stdlib.h"
#include "string.h"
#include "MQTTClient.h"
#include "sample_subscribe.h"
#define ADDRESS "tcp://m2m.eclipse.org:1883"
#define CLIENTID "ExampleClientPub"
#define TOPIC "MOTT Examples"
#define PAYLOAD "Hellooooooo"
#define QOS 1
#define TIMEOUT 10000L
int main(int argc, char* argv[])
MQTTClient client;
MQTTClient_connectOptions conn_opts =
MQTTClient_connectOptions_initializer;
int rc;
int ch:
//a. Create an instance of MQTT client
MQTTClient_create(&client, ADDRESS,
CLIENTID, MQTTCLIENT_PERSISTENCE_NONE,
NULL);
//b. Prepare connection options
conn_opts.keepAliveInterval = 20;
conn_opts.cleansession = 1;
MQTTClient_setCallbacks(client, NULL, connlost,
msgarrvd, delivered);
//c. Connect to broker with the connection options
```

```
if ((rc = MQTTClient_connect(client, &conn_opts))
!= MQTTCLIENT_SUCCESS)
{
printf("Failed to connect, return code %d\n", rc);
exit(-1);
}
//d. Subscribe interested topics.
printf("Subscribing to topic %s\nfor client %s using
QoS%d\n\n"
"Press Q to quit\n\n", TOPIC, CLIENTID, QOS);
MQTTClient_subscribe(client, TOPIC, QOS);
do
{
ch = getchar();
} while(ch!='Q' && ch != 'q');
//MQTTClient_setCallbacks(client, NULL, connlost,
msgarrvd, delivered);
//e. Disconnect to broker
MQTTClient_disconnect(client, 10000);
//f. Release resources
MQTTClient_destroy(&client);
return rc;
}
Sample_subscribe.h
#ifndef SAMPLES_SAMPLE_SUBSCRIBE_H_
#define SAMPLES_SAMPLE_SUBSCRIBE_H_
volatile MQTTClient_deliveryToken deliveredtoken;
void delivered(void *context,
MQTTClient_deliveryToken dt)
printf("Message with token value %d delivery
confirmed\n", dt);
deliveredtoken = dt;
}
int msgarrvd(void *context, char *topicName, int
topicLen, MQTTClient_message* message)
{
int i;
char* payloadptr;
printf("Message arrived\n");
printf(" topic: %s\n", topicName);
printf(" message: ");
printf("address of message is %u \n",message);
payloadptr = (char*)message->payload;
```

```
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```

```
printf("11111 \n");
printf("message is.... %s",payloadptr);
for(i=0; ipayloadlen; i++)
{
printf("2222 \n");
putchar(*payloadptr++);
printf("33333 \n");
}
putchar('\n');
if(message!=NULL)
{
printf("555 \n");
MQTTClient_freeMessage(&message);
printf("666 \n");
}
//free(topicName);
printf("4444 \n");
return 1;
}
void connlost(void *context, char *cause)
{
printf("\nConnection lost\n");
printf(" cause: %s\n", cause);
#endif /* SAMPLES_SAMPLE_SUBSCRIBE_H_ */
Output of sample_subscribe
./sample_subscribe
Subscribing to topic MQTT Examples
for client ExampleClientPub using QoS1
Press Q to quit
Message arrived
topic: MQTT Examples
message: address of message is 2281704372
message is.... crashedket.c2222
c33333
2222
r33333
2222
a33333
2222
s33333
```

2222

h33333

2222

e33333

2222

d33333

555

666

4444

Connection lost

cause (null)

Thank You. Shakti Gupta

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Himanshu

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O 7 years ago

Ηi,

Do we have a MQTT Client Library in c programming for Windows CE 6.0

Regards, Himanshu

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TΗ

The HiveMQ Team → - I

Himanshu

© 7 years ago

I believe the Paho embedded C library (http://www.hivemq.com/blog/... can be integrated with Windows CE. The best way to check this would to reach out to the Paho folks via the mailing list at https://dev.eclipse.org/mai..., they're always very helpful.

Hope this helps, Dominik from the HiveMQ Team

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Wouter

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