MQTT v3.1.1 server for QoS = 0 (at most once delivery)

Source code at:
https://github.com/giovannioliveira/MQTT-broker

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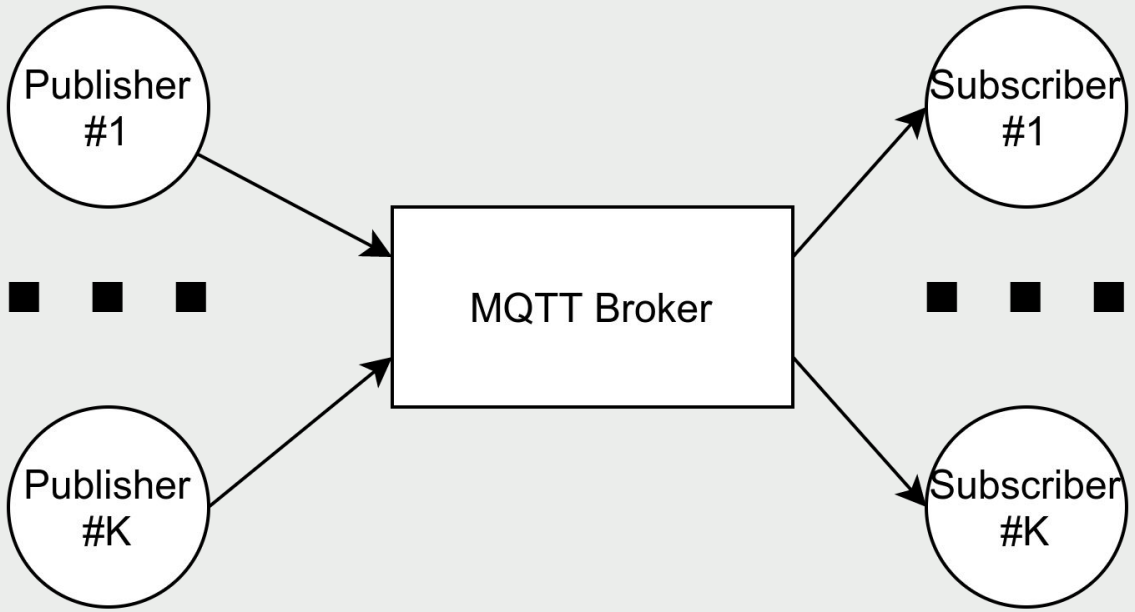
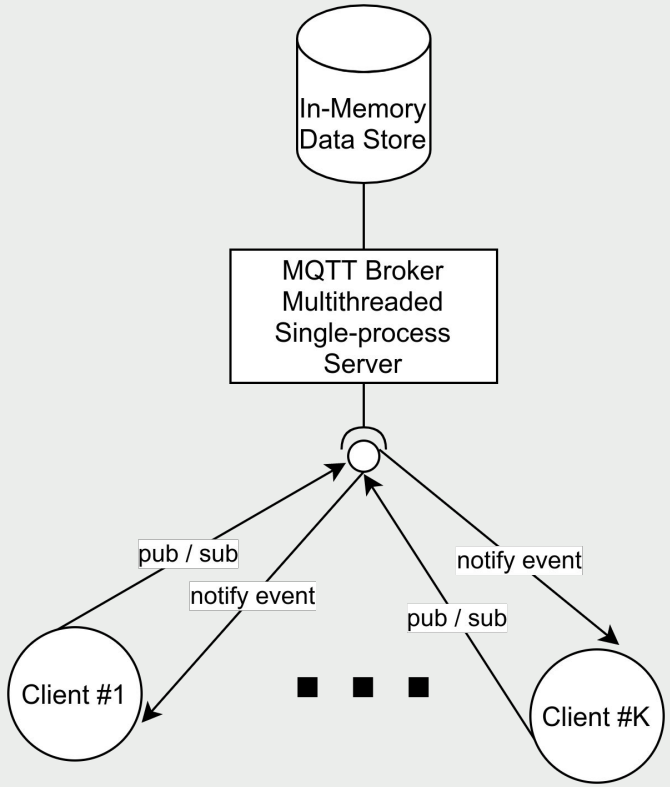
MQTT Protocol Generic View



1) Subscriber #i connects to MQTT broker;
2) Subscriber #i subscribes to topic “foo-bar”;
3) Publisher #j connects to MQTT broker;
4) Publisher #j publishes message “lorem ipsum” in topic “foo-bar”;
5) For each node subscribed to topic “foo-bar”, MQTT broker sends message “lorem ipsum” (which includes Subscriber #i).

Proposed Solution Architecture

- Programming Language:
  C (std. C99);
- Tested Compiler/Platform:
  GNU GCC / Linux x64
- Build automation tool:
  Cmake 3.16.3
- Concurrency Technology:
  Multi-threading, Single-Process;
- Data store:
  In-memory (volatile);
- Service Port:
  Configurable (executable arg.);
- Maximum clients:
  In-source (define MAXCLIENTS).



Features:

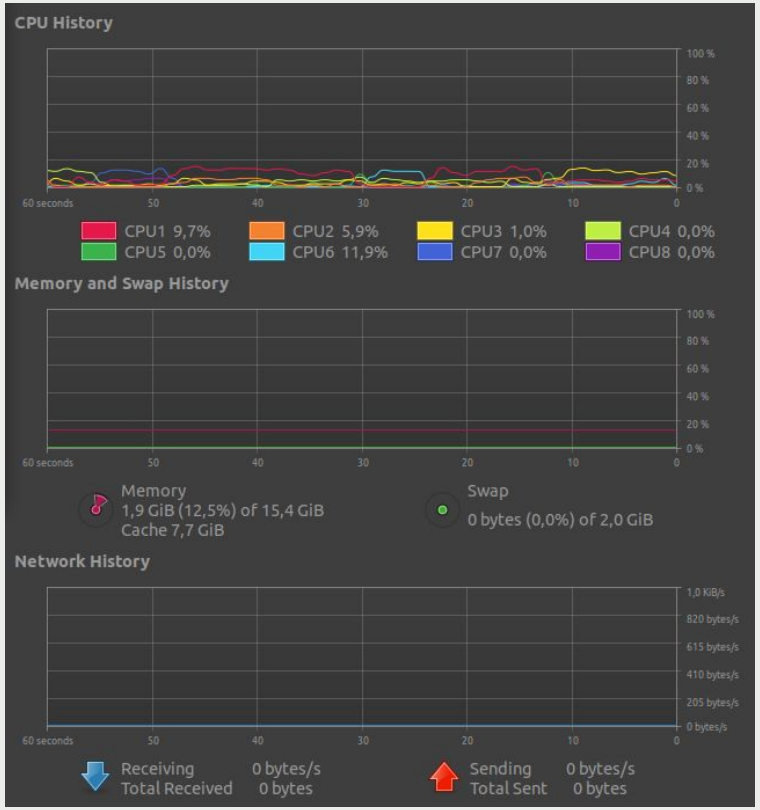
- Each client can be simultaneously listening to multiple topics and publishing to any topic;
- Connection state control and esource release on unexpected connection close;
- Packet type is checked against flag code to skip corrupted or non-MQTT packages.

Proposed Data Structure

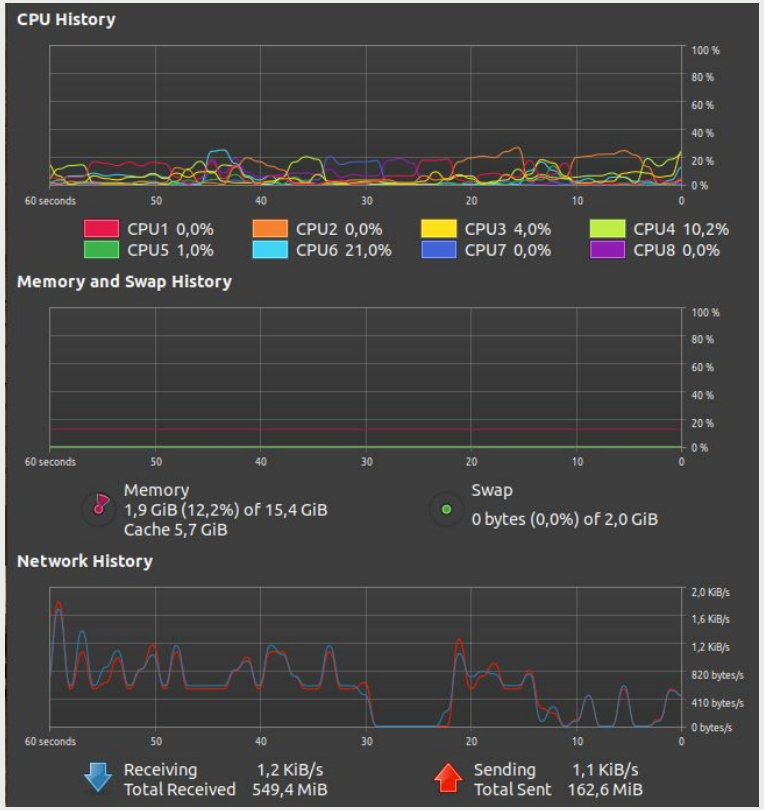
```
typedef struct {
    int connfd;
    pthread_t thread;
    char *id;
    enum connection_statuses connstat;
    simple_set subscriptions;
} thread_t;
```

- Each connection is stored into a reusable slot represented by a struct called "**thread_t**", where:
  - **connfd** is the file description of the connection between client and broker;
  - **thread** is the OS-thread that is created to handle the single-client communication;
  - ***id** is a string with the identifier provided by the node at connection time;
  - **connection_statuses** is an enum to represent MQTT connection statuses (so far, CONNECTED and DISCONNECTED);
  - **subscriptions** is a set structure used to store subscriptions (topic names) of associated client. Set is imported from [4].

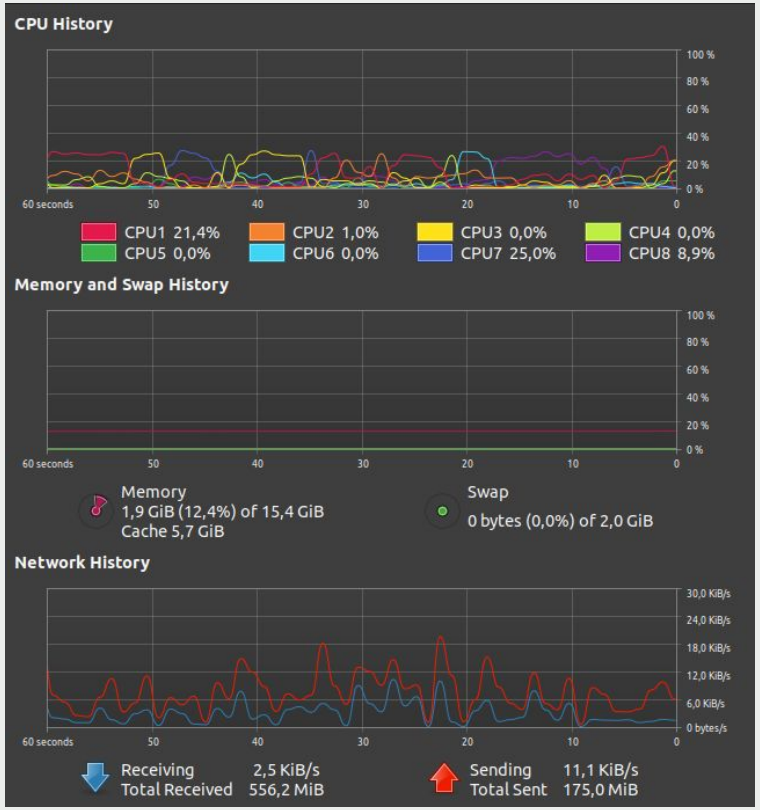
Performance Benchmarks on LAN



Case: Server-only listening to new connections



Case: Server listening to 2 clients (1 publisher, 1 subscriber)

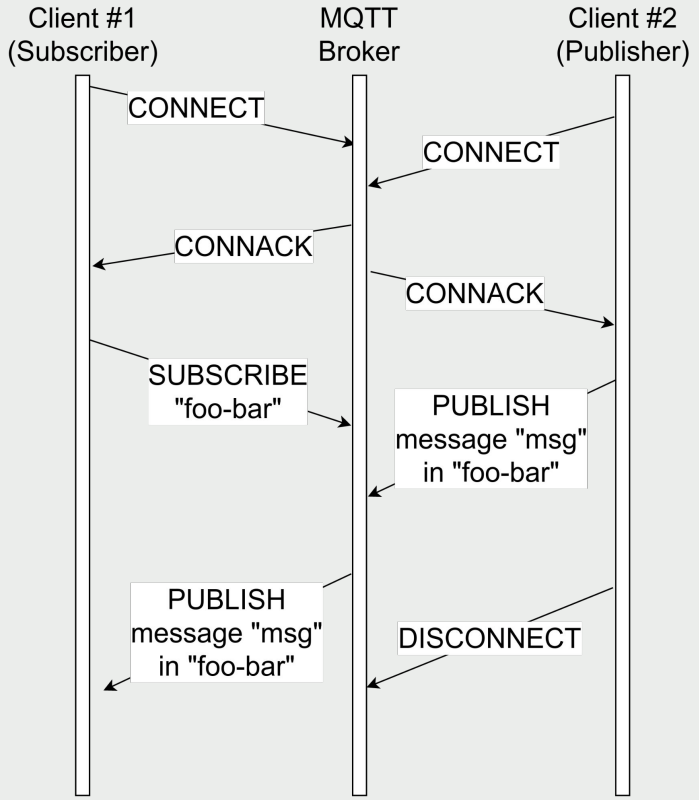


Case: Server listening to 100 clients (50 publishers, 50 subscribers)

* Tests performed on Ubuntu Desktop 20.04.3 LTS; Intel® Core™ i7-10510U CPU @ 1.80GHz × 8; 15,4 GiB of RAM; Wireless Network 802.11b; Link Speed: 144 Mb/s (2,4 GHz).

Supported Command Reference

- **CONNECT**: Client sends to Broker at connection initiation;
- **CONNACK**: Broker sends to Client at successful CONNECT request;
- **SUBSCRIBE**: Client sends to Broker to subscribe to one or more topics;
- **PUBLISH**: Client sends to Broker to publish a message into a single topic;
- **PINGREQ**: Client sends to Broker to check connection health;
- **PINGRESP**: Broker sends to Client to respond PINGREQ request;
- **DISCONNECT**: Client sends to Broker to close MQTT connection gracefully.



References

[1] Standard, O. A. S. I. S. "MQTT version 3.1. 1." URL http://docs. oasis-open. org/mqtt/mqtt/v3 1 (2014).

[2] Ritchie, Dennis M., Brian W. Kernighan, and Michael E. Lesk. The C programming language. Englewood Cliffs: Prentice Hall, 1988.

[3] https://edisciplinas.usp.br/pluginfile.php/6485438/mod_assign/introattachment/0/mac5910-servidor-exemplo-ep1.c

[4] https://github.com/barrust/set