Challenge 2: CoAP and MQTT Traffic Analysis

The goal of this challenge is to analyze the CoAP and MQTT traffic given a log.

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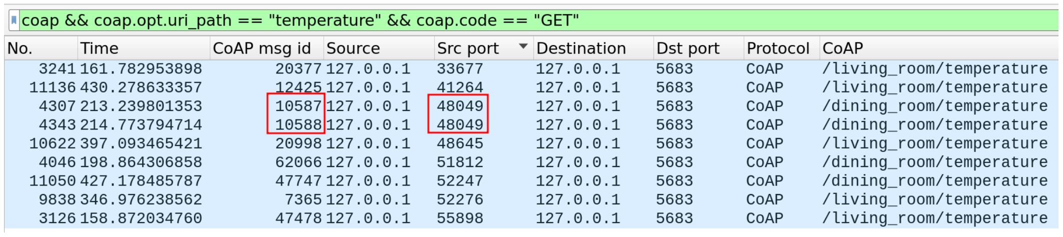
Questions

The questions to be answered are:

1. a. How many different CoAP clients sent a GET request to a temperature resource (../temperature)?
   b. For each of the clients found in 1a, write the MID of the longest CoAP response (any response) received by the client
2. a. How many CoAP POST requests directed to the "coap.me" server did NOT produce a successful result?
   b. How many requests from 2a are directed to a "weird" resource? (resources like /weirdXX)?
3. a. How many MQTT Publish messages with qos=2 are RECEIVED by the clients running in the machine capturing the traffic?
   b. How many clients are involved in the messages found in 3a?
   c. What are the MQTT Message identifiers (ID) of the subscribe requests that let the client receive the messages found in 3a?
4. a. How many MQTT clients sent a subscribe message to a public broker using at least one wildcard?
   b. Considering clients found in 4a, how many of them WOULD receive a publish message directed to the topic: "metaverse/facility4/area0/light"
5. a. How many MQTT ACK messages in total are received by clients who connected to brokers specifying a client identifier shorter than 15 bytes and using MQTT version 3.1.1?
6. a. How many MQTT subscribe requests with message ID=1 are directed to the HiveMQ broker?
   b. How many publish messages are received by the clients thanks to the subscribe requests found in 6a
7. a. How many MQTT-SN (on port 1885) publish messages sent after the hour 3.59PM (Milan Time) are directed to topic 6?
   b. Explain possible reasons why messages in 7a are not handled by the server

Answers

1. a. `coap && coap.opt.uri_path == "temperature" && coap.code == "GET"`
   8 different clients sent a GET request to a temperature resource.
   There are 9 different packets, but 2 messages (with ids 10587 and 10588) have the same Source Port (48049). We assume a different port for each client, so there are 8 different clients.



coap && coap.opt.uri_path == "temperature" && coap.code == "GET"

No.	Time	CoAP msg id	Source	Src port	Destination	Dst port	Protocol	CoAP
3241	161.782953898	20377	127.0.0.1	33677	127.0.0.1	5683	CoAP	/living_room/temperature
11136	430.278633357	12425	127.0.0.1	41264	127.0.0.1	5683	CoAP	/living_room/temperature
4307	213.239801353	10587	127.0.0.1	48049	127.0.0.1	5683	CoAP	/dining_room/temperature
4343	214.773794714	10588	127.0.0.1	48049	127.0.0.1	5683	CoAP	/dining_room/temperature
10622	397.093465421	20998	127.0.0.1	48645	127.0.0.1	5683	CoAP	/living_room/temperature
4046	198.864306858	62066	127.0.0.1	51812	127.0.0.1	5683	CoAP	/dining_room/temperature
11050	427.178485787	47747	127.0.0.1	52247	127.0.0.1	5683	CoAP	/dining_room/temperature
9838	346.976238562	7365	127.0.0.1	52276	127.0.0.1	5683	CoAP	/living_room/temperature
3126	158.872034760	47478	127.0.0.1	55898	127.0.0.1	5683	CoAP	/living_room/temperature

b. `udp.srcport == 5683 && udp.dstport == <Client Port>`
By filtering all CoAP messages for each of the client and by sorting with respect to length, the longest responses are:

1. Client Port: 55898, MID: 25
2. Client Port: 33677, MID: 26
3. Client Port: 51812, MID: 29
4. Client Port: 48049, MID: 10589
5. Client Port: 52276, MID: 7365
6. Client Port: 48645, MID: 63
7. Client Port: 52247, MID: 47747
8. Client Port: 41264, MID: 12426

2. a. There are 18 POST requests directed to "coap.me" which ended in failure (see `scripts/2.a.py`)

   b. There are 8 POST requests directed to a weird resource of "coap.me" which ended in failure (see `scripts/2.b.py`)

3. a. `mqtt && mqtt.msgtype == 3 && mqtt.qos == 2 && (ip.dst_host == "127.0.0.1" || ip.dst_host == "10.0.2.15") && tcp.srcport == 1883`
   The number or received messages is 2.
   The destination address must be either internal or the public one and the src port must be the broker one (aka the service), so 1883.

   b. The number of involved clients is 1 based on the previous assumption.

   c. `mqtt && mqtt.msgtype == 8 && mqtt.topic contains "hospital" && ip.dst_host == "3.65.168.153" && tcp.srcport == 59385`
   We are looking for these topics:
   - `hospital/facility2/section0` (3.65.168.153) (dst port 59385)
   - `hospital/facility2/room4/temperature` (3.65.168.153) (dst port 59385) For both of them, the subscription topic is `hospital/#` with a MID of 15

4. a. `mqtt && mqtt.msgtype == 8 && ip.dst_host != "127.0.0.1" && (mqtt.topic contains "+" || mqtt.topic contains "#")`
   The number of clients is 4.
   By sorting the messages with respect to the source port, there are 4 different clients which used at least one wildcard to subscribe to a topic on a public broker:
   1. Client Port: 59385;
   2. Client Port: 38887;
   3. Client Port: 37419;
   4. Client Port: 36707.

   b. 2 of the 4 clients would receive the message (see `script/4.b.py`):
   1. Client Port: 59385 -> `metaverse/facility4/+/light`
   2. Client Port: 37419 -> `metaverse/+/area0/light`

5. a. `mqtt && mqtt.msgtype == 1 && mqtt.clientid_len <= 15 && mqtt.ver == 4`
   There are 2 clients which connected to brokers with a client identifier with length less (or equal) to 15 bytes and with MQTT version of 3.1.1.
   `mqtt && (mqtt.msgtype == 2 || mqtt.msgtype == 9 || mqtt.msgtype == 4) && (tcp.dstport == 43949 || tcp.dstport == 44887)` This query displays all the ACKs that the two clients received, including connect ACK, subscribe ACK and publish ACK.
   The total number of received ACKs is 20.

6. a. `dns && dns.resp.name contains "hivemq"`
   This query reveals all the dns responses about hivemq broker. The host has two IP addresses: 3.66.35.116 and 3.65.168.153.
   `mqtt && mqtt.msgtype == 8 && (ip.dst_host == "3.66.35.116" || ip.dst_host == "3.65.168.153") && mqtt.msgid == 1`
   The number of messages is 3. This query looks for messages with MID = 1 of MQTT directed to the hivemq broker.

   b. `mqtt && mqtt.msgtype == 3 && tcp.dstport == CLIENT_PORT`
   the query used inside the `scripts/6.b.py` allows to check all the publish messages received by a certain client. By checking the topics with the ones found in the answer 6.a, it results that 0 messages have been received by those clients with the highlighted subscribe requests.

7. a. `mqttsn && frame.time >= "Jan 27, 2024 15:59:00" && mqttsn.topic.id == 6 && mqttsn.msg.type == 12`
   The number of messages is 3.
   All of them receives back and ICMP message with a "port unreachable" error.

   b. The ICMP response means that there is not a process running on `127.0.0.1:1885`.
   Either the MQTT-SN server is offline or it is on a different port.