

# Table of Contents

- 1 Introduction ..... 9
  - 1.1 Organization of MQTT ..... 9
  - 1.2 Terminology ..... 9
  - 1.3 Normative references ..... 10
  - 1.4 Non normative references ..... 11
  - 1.5 Data representations ..... 13
    - 1.5.1 Bits ..... 13
    - 1.5.2 Integer data values ..... 13
    - 1.5.3 UTF-8 encoded strings ..... 13
  - 1.6 Editing conventions ..... 15
- 2 MQTT Control Packet format ..... 16
  - 2.1 Structure of an MQTT Control Packet ..... 16
  - 2.2 Fixed header ..... 16
    - 2.2.1 MQTT Control Packet type ..... 16
    - 2.2.2 Flags ..... 17
    - 2.2.3 Remaining Length ..... 18
  - 2.3 Variable header ..... 19
    - 2.3.1 Packet Identifier ..... 20
  - 2.4 Payload ..... 21
- 3 MQTT Control Packets ..... 23
  - 3.1 CONNECT – Client requests a connection to a Server ..... 23
    - 3.1.1 Fixed header ..... 23
    - 3.1.2 Variable header ..... 23
    - 3.1.3 Payload ..... 29
    - 3.1.4 Response ..... 30
  - 3.2 CONNACK – Acknowledge connection request ..... 31
    - 3.2.1 Fixed header ..... 31
    - 3.2.2 Variable header ..... 31
    - 3.2.3 Payload ..... 33
  - 3.3 PUBLISH – Publish message ..... 33
    - 3.3.1 Fixed header ..... 33
    - 3.3.2 Variable header ..... 35
    - 3.3.3 Payload ..... 36
    - 3.3.4 Response ..... 36
    - 3.3.5 Actions ..... 36
  - 3.4 PUBACK – Publish acknowledgement ..... 37
    - 3.4.1 Fixed header ..... 37
    - 3.4.2 Variable header ..... 37
    - 3.4.3 Payload ..... 37
    - 3.4.4 Actions ..... 37
  - 3.5 PUBREC – Publish received (QoS 2 publish received, part 1) ..... 37
    - 3.5.1 Fixed header ..... 38
    - 3.5.2 Variable header ..... 38

3.5.3 Payload.....	38
3.5.4 Actions.....	38
3.6 PUBREL – Publish release (QoS 2 publish received, part 2).....	38
3.6.1 Fixed header.....	38
3.6.2 Variable header .....	39
3.6.3 Payload.....	39
3.6.4 Actions.....	39
3.7 PUBCOMP – Publish complete (QoS 2 publish received, part 3).....	39
3.7.1 Fixed header.....	39
3.7.2 Variable header .....	40
3.7.3 Payload.....	40
3.7.4 Actions.....	40
3.8 SUBSCRIBE - Subscribe to topics .....	40
3.8.1 Fixed header.....	40
3.8.2 Variable header .....	40
3.8.3 Payload.....	41
3.8.4 Response .....	42
3.9 SUBACK – Subscribe acknowledgement.....	43
3.9.1 Fixed header.....	44
3.9.2 Variable header .....	44
3.9.3 Payload.....	44
3.10 UNSUBSCRIBE – Unsubscribe from topics .....	45
3.10.1 Fixed header.....	45
3.10.2 Variable header .....	45
3.10.3 Payload.....	46
3.10.4 Response .....	46
3.11 UNSUBACK – Unsubscribe acknowledgement.....	47
3.11.1 Fixed header.....	47
3.11.2 Variable header .....	47
3.11.3 Payload.....	48
3.12 PINGREQ – PING request .....	48
3.12.1 Fixed header.....	48
3.12.2 Variable header .....	48
3.12.3 Payload.....	48
3.12.4 Response .....	48
3.13 PINGRESP – PING response .....	48
3.13.1 Fixed header.....	48
3.13.2 Variable header .....	49
3.13.3 Payload.....	49
3.14 DISCONNECT – Disconnect notification.....	49
3.14.1 Fixed header.....	49
3.14.2 Variable header .....	49
3.14.3 Payload.....	49
3.14.4 Response .....	49
4 Operational behavior .....	51

4.1	Storing state.....	51
4.1.1	Non normative example .....	51
4.2	Network Connections.....	52
4.3	Quality of Service levels and protocol flows .....	52
4.3.1	QoS 0: At most once delivery.....	52
4.3.2	QoS 1: At least once delivery .....	53
4.3.3	QoS 2: Exactly once delivery .....	54
4.4	Message delivery retry.....	55
4.5	Message receipt .....	56
4.6	Message ordering .....	56
4.7	Topic Names and Topic Filters .....	57
4.7.1	Topic wildcards.....	57
4.7.2	Topics beginning with \$.....	58
4.7.3	Topic semantic and usage .....	58
4.8	Handling errors .....	59
5	Security.....	60
5.1	Introduction .....	60
5.2	MQTT solutions: security and certification.....	60
5.3	Lightweight cryptography and constrained devices.....	61
5.4	Implementation notes .....	61
5.4.1	Authentication of Clients by the Server .....	61
5.4.2	Authorization of Clients by the Server .....	61
5.4.3	Authentication of the Server by the Client.....	61
5.4.4	Integrity of Application Messages and Control Packets.....	62
5.4.5	Privacy of Application Messages and Control Packets.....	62
5.4.6	Non-repudiation of message transmission.....	62
5.4.7	Detecting compromise of Clients and Servers .....	62
5.4.8	Detecting abnormal behaviors.....	63
5.4.9	Other security considerations.....	63
5.4.10	Use of SOCKS .....	64
5.4.11	Security profiles .....	64
6	Using WebSocket as a network transport.....	65
6.1	IANA Considerations .....	65
7	Conformance .....	66
7.1	Conformance Targets .....	66
7.1.1	MQTT Server.....	66
7.1.2	MQTT Client .....	66
Appendix A.	Acknowledgements (non normative).....	68
Appendix B.	Mandatory normative statements (non normative) .....	70
Appendix C.	Revision history (non normative) .....	80

## Table of Figures and Tables

Figure 1.1 Structure of UTF-8 encoded strings .....	13
Figure 1.2 UTF-8 encoded string non normative example.....	14
Figure 2.1 – Structure of an MQTT Control Packet.....	16
Figure 2.2 - Fixed header format.....	16
Table 2.1 - Control packet types .....	16
Table 2.2 - Flag Bits .....	17
Table 2.4 Size of Remaining Length field.....	18
Figure 2.3 - Packet Identifier bytes.....	20
Table 2.5 - Control Packets that contain a Packet Identifier.....	20
Table 2.6 - Control Packets that contain a Payload .....	21
Figure 3.1 – CONNECT Packet fixed header.....	23
Figure 3.2 - Protocol Name bytes.....	23
Figure 3.3 - Protocol Level byte .....	24
Figure 3.4 - Connect Flag bits.....	24
Figure 3.5 Keep Alive bytes .....	27
Figure 3.6 - Variable header non normative example .....	28
Figure 3.7 - Password bytes .....	30
Figure 3.8 – CONNACK Packet fixed header .....	31
Figure 3.9 – CONNACK Packet variable header.....	31
Table 3.1 – Connect Return code values .....	32
Figure 3.10 – PUBLISH Packet fixed header .....	33
Table 3.2 - QoS definitions.....	34
Table 3.3 - Publish Packet non normative example .....	35
Figure 3.11 - Publish Packet variable header non normative example .....	35
Table 3.4 - Expected Publish Packet response.....	36
Figure 3.12 - PUBACK Packet fixed header .....	37
Figure 3.13 – PUBACK Packet variable header.....	37
Figure 3.14 – PUBREC Packet fixed header .....	38
Figure 3.15 – PUBREC Packet variable header .....	38
Figure 3.16 – PUBREL Packet fixed header .....	38
Figure 3.17 – PUBREL Packet variable header .....	39
Figure 3.18 – PUBCOMP Packet fixed header .....	39
Figure 3.19 – PUBCOMP Packet variable header .....	40
Figure 3.20 – SUBSCRIBE Packet fixed header.....	40
Figure 3.21 - Variable header with a Packet Identifier of 10, Non normative example.....	41
Figure 3.22 – SUBSCRIBE Packet payload format.....	41
Table 3.5 - Payload non normative example.....	42
Figure 3.23 - Payload byte format non normative example.....	42
Figure 3.24 – SUBACK Packet fixed header.....	44
Figure 3.25 – SUBACK Packet variable header.....	44
Figure 3.26 – SUBACK Packet payload format.....	44
Table 3.6 - Payload non normative example.....	45
Figure 3.27 - Payload byte format non normative example.....	45
Figure 3.28 – UNSUBSCRIBE Packet Fixed header .....	45
Figure 3.29 – UNSUBSCRIBE Packet variable header.....	45
Table 3.7 - Payload non normative example.....	46
Figure 3.30 - Payload byte format non normative example.....	46

Figure 3.31 – UNSUBACK Packet fixed header.....	47
Figure 3.32 – UNSUBACK Packet variable header.....	47
Figure 3.33 – PINGREQ Packet fixed header.....	48
Figure 3.34 – PINGRESP Packet fixed header.....	48
Figure 3.35 – DISCONNECT Packet fixed header.....	49
Figure 4.1 – QoS 0 protocol flow diagram, non normative example.....	52
Figure 4.2 – QoS 1 protocol flow diagram, non normative example.....	53
Figure 4.3 – QoS 2 protocol flow diagram, non normative example.....	54
Figure 6.1 - IANA WebSocket Identifier .....	65