MODULE *MQTTBase*

EXTENDS *TLC*, *FiniteSets*, *Sequences*, *Naturals*

CONSTANTS

CONNECT, *CONACK*, *PUBLISH*, *PUBACK*, *PUBREL*, *PUBREC*, *PUBCOMP*, *SUBSCRIBE*, *SU*

CONSTANTS

publishers,
subscribers,
broker,
topics,
maxQueueLen,
maxPubNum

VARIABLES

pc,
pub2q \ ∗ *qos2*
store,
active,
network,
topic_subscribers,
used_num */ID*

$vars \triangleq \langle pc, active, network, store, used\_num, topic\_subscribers \rangle$
$agent\_vars \triangleq \langle pc, active, store, used\_num, topic\_subscribers \rangle$
$clients \triangleq publishers \cup subscribers$
$agents \triangleq clients \cup \{broker\}$
$maxSubNum \triangleq Cardinality(topics)$

$PUBLISHERS \triangleq Permutations(publishers)$
$SUBSCRIBERS \triangleq Permutations(subscribers)$
$CLIENTS \triangleq PUBLISHERS \cup SUBSCRIBERS$

$msgs \triangleq$
$[from : clients, to : \{broker\}, type : \{CONNECT\}, payload : [clientId : clients]]$
$\cup [from : clients, to : \{broker\}, type : \{PINGREQ\}]$
$\cup [from : \{broker\}, to : clients, type : \{CONACK, PINGRESP\}, qos : \{NULL\}, topics : \{NULL\}, pac$
$\cup [from : publishers, to : \{broker\}, type : \{PUBLISH\}, qos : \{0, 1, 2\}, topic : topics, packetID : 1 .. maxP$
$\cup [from : publishers, to : \{broker\}, type : \{PUBREL\}, packetID : 1 .. maxPubNum]$
$\cup [from : subscribers, to : \{broker\}, type : \{UNSUBSCRIBE\}, topic : topics]$
$\cup [from : subscribers, to : \{broker\}, type : \{SUBSCRIBE\}, qos : \{0, 1, 2\}, topic : topics, pac$
$\cup [from : \{broker\}, to : publishers, type : \{PUBACK, PUBREC, PUBCOMP\}, packetID : 1 .. maxP$
$\cup [from : \{broker\}, to : subscribers, type : \{SUBACK\}, qos : \{0, 1, 2\}, topic : topics, packetID : 1 .. maxS$
$\cup [from : \{broker\}, to : subscribers, type : \{UNSUBACK\}, topic : topics]$
$\cup [from : \{broker\}, to : subscribers, type : \{PUBLISH\}, qos : \{0, 1, 2\}, topic : topics, packetID : maxPubN$
$\cup [from : \{broker\}, to : subscribers, type : \{PUBREL\}, packetID : maxPubNum + 1 .. maxPubNum * 2$
$\cup [from : subscribers, to : \{broker\}, type : \{PUBACK, PUBREC, PUBCOMP\}, packetID : maxPubNu$

$$\cup\, [from : clients,\ to : \{broker\},\ type : \{DISCONNECT\}]$$

$canSendTo(chan) \triangleq Len(network[chan]) < maxQueueLen$

$send(msg,\ chan) \triangleq [network \text{ EXCEPT } ![chan] = Append(@,\ msg)]$

$rcv(msg,\ chan) \triangleq [network \text{ EXCEPT } ![chan] = Tail(@)]$

$response(msg,\ from,\ to) \triangleq [network \text{ EXCEPT } ![to] = Append(@,\ msg),\ ![from] = Tail(@)]$