VolantMQ/volantmq [891 stars]

注：我们已向厂商通报此安全问题及修复建议

0x01 攻击场景与测试

考虑IoT应用的共享场景，即智能家居系统使用 MQTT 协议进行物联网设备和用户管理，其中有两个用户角色。管理员，也就是房主
可以授权其他普通用户（例如，Airbnb 客人）访问他的智能家居设备的权利。普通用户的访问权限可能会被撤销和到期。我们
认为管理员和设备是良性的，而客人可能是恶意的，会尽可能地去试图未授权访问设备（越权或是维持被撤销的权限）。

- **攻击场景**

> 首先，攻击者登记入住，因此目前攻击者拥有主题“A”的“写权限”。
>
> 1. 攻击者向主题“A”发布一条“retained 消息”。
>
> 2. 攻击者的权限被管理员或设备所有者撤销。
>
> 3. 任何设备、受害者订阅主题“A”时，都会收到攻击者发布的这条有害retained 消息。

- **漏洞危害**

攻击者可以在退房前留下一条恶意的retained message，在其退房后，所有重新或新订阅这个主题“A”的设备都会收到这条消息。

0x02 漏洞测试步骤

- **测试环境**

VolantMQ: 0.4.0

mqtt client: 任意客户端即可 (paho.mqtt)

访问控制插件: 官方插件http auth（由于golang更新已不再支持plugin模块，因此这个插件目前无法使用），也可修改VolantMQ内置的auth测试插件 (见附录 `auth.go`, 替换cmd/volantmq/auth.go)，由于漏洞的原理为broker的permission check位置不当 (或没有进行足够的检查)，而无关于permission check本身的正确与否，因此无论权限检查插件使用何种机制 (使用http请求授权服务器、使用database存储ACL等)，漏洞本身都是存在的。

配置测试用户：

admin: 拥有所有权限

user1(attacker): 拥有publish权限

配置文件如下：

```
version: v0.0.1
system:
  log:
    console:
      level: info # available levels: debug, info, warn, error, dpanic, panic, fatal
  http:
    defaultPort: 8080
plugins:
  enabled:
    - auth_http
  config:
    auth:                   # plugin type
      - name: internal
        backend: simpleAuth
        config:
          users:
            admin: "d74ff0ee8da3b9806b18c877dbf29bbde50b5bd8e4dad7a3a725000feb82e8f1" # pass
            user1: "e6c3da5b206634d7f3f3586d747ffdb36b5c675757b380c6a5fe5c570c714349" # pass1
auth:
  anonymous: false
  order:
    - internal
mqtt:
  version:
    - v3.1.1
    - v5.0
  keepAlive:
    period: 60               # KeepAlive The number of seconds to keep the connection live if there's no data.
    # Default is 60 seconds
    force: false             # Force connection to use server keep alive interval (MQTT 5.0 only)
    # Default is false
  options:
    connectTimeout: 5        # The number of seconds to wait for the CONNECT message before disconnecting.
    # If not set then default to 2 seconds.
    offlineQoS0: true        # OfflineQoS0 tell server to either persist (true) or ignore (false) QoS 0 messages for non-clean sessions
    # If not set than default is false
    sessionPreempt: true     # Either allow or deny replacing of existing session if there new client with same clientID
    # If not set than default is false
    retainAvailable: true    # don't set to use default
    subsOverlap: true        # tells server how to handle overlapping subscriptions from within one client
      # if true server will send only one publish with max subscribed QoS even there are n subscriptions
      # if false server will send as many publishes as amount of subscriptions matching publish topic exists
    # Default is false
    subsId: true             # don't set to use default
    subsShared: false        # don't set to use default
    subsWildcard: true       # don't set to use default
    receiveMax: 65530        # don't set to use default
    maxPacketSize: 268435455 # don't set to use default
    maxTopicAlias: 65535     # don't set to use default
    maxQoS: 2
listeners:
  defaultAddr: "0.0.0.0" # default 127.0.0.1
  mqtt:
    tcp:
      1883:
        auth:
        tls:
    ws:
      8883:
```

若使用http auth或是附录中的`auth.go`，则仅需简单写一个http服务 (见附录`app.py`)，在broker请求/acl页面获取用户是否拥有进行敏感操作的权限时，回复"allow" (代表拥有权限)/"xxxxx"即可。

```python
from flask import Flask, request, render_template, session, jsonify
from flask_cors import CORS, cross_origin
import json
import time as mytime
from datetime import *

app = Flask(__name__)
cors = CORS(app)


@app.route('/acl', methods=['GET'])
def Start():
    user = request.args.get('user')
    resp = "deny"
    if(user == "admin"):
        resp = "allow"
    elif(user == "user1"):
        resp = "allow"
    return resp


if __name__ == '__main__':
    app.run(host='0.0.0.0', debug=True, port=80)
```

- **测试步骤**

1. 攻击者随后向主题“A”发布“retained 消息”。

```
$ mosquitto_pub -u user1 -P pass1 -t "test" -m "bad message" --retain
```

2. 攻击者的权限被管理员或设备所有者撤销。

若使用 auth.go 进行访问控制，则可手动控制auth server的访问控制配置来进行测试，例如当撤销attacker全新啊时，修改web服务代码 app.py 中的回复为 deny ：

```
from flask import Flask, request, render_template, session, jsonify
from flask_cors import CORS, cross_origin
import json
import time as mytime
from datetime import *

app = Flask(__name__)
cors = CORS(app)


@app.route('/acl', methods=['GET'])
def Start():
    user = request.args.get('user')
    resp = "deny"
    if(user == "admin"):
        resp = "allow"
    elif(user == "user1"):
        resp = "deny"
    return resp
```

3. 任何设备、受害者订阅主题“A”时，都会收到攻击者发布的这条有害retained 消息。

```
$ mosquitto_sub -u admin-user -P admin-password -t "test" -c
```

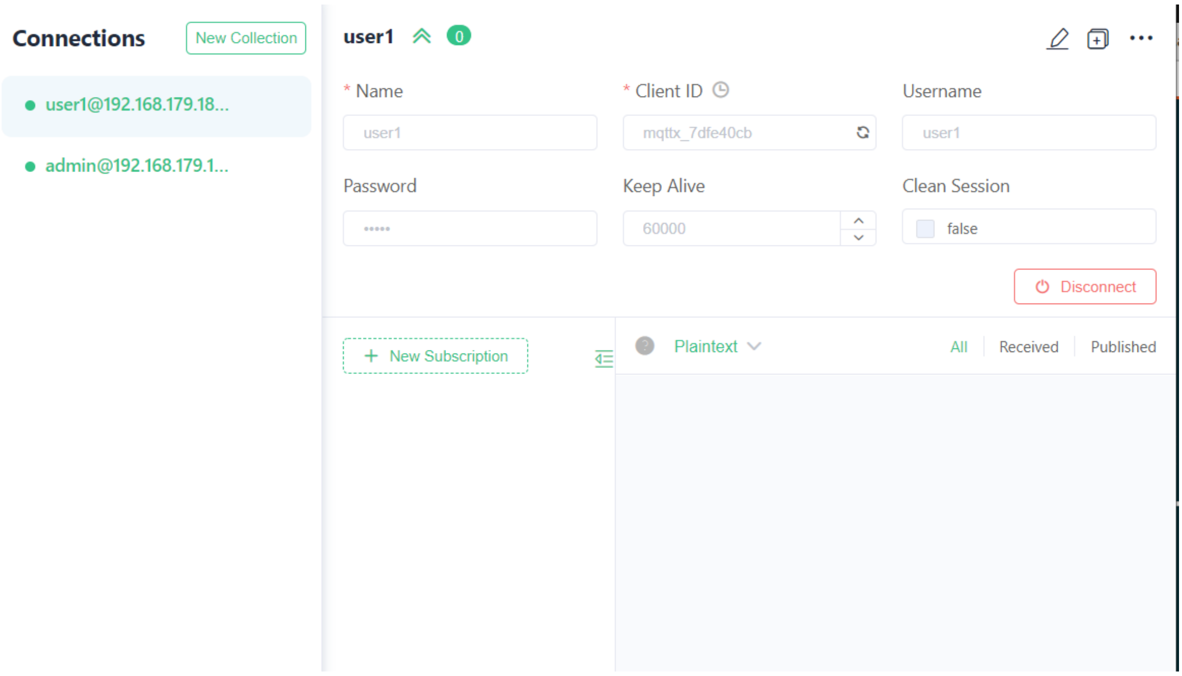
0x03 漏洞效果

测试前配置

测试用的账号：admin和user1

目前user1拥有 test topic的发布权限

```
#app.py
@app.route('/acl', methods=['GET'])
def Start():
    user = request.args.get('user')
    resp = "deny"
    if(user == "admin"):
        resp = "allow"
    elif(user == "user1"):
        resp = "allow"
    return resp
```



Name: user1

Client ID: mqttx_7dfe40cb

Username: user1

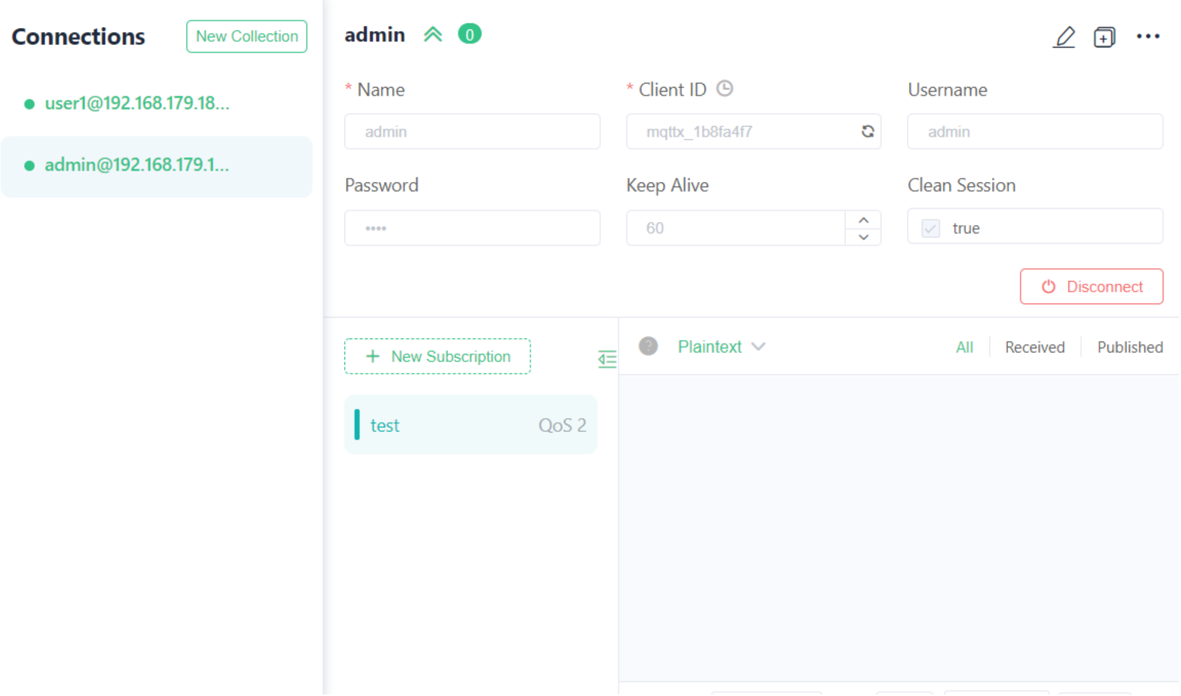
Password: •••••

Keep Alive: 60000

Clean Session: □ false

测试流程

1. 使用MQTTX客户端，先使用admin用户连接broker，并订阅test主题：



Name: admin

Client ID: mqttx_1b8fa4f7

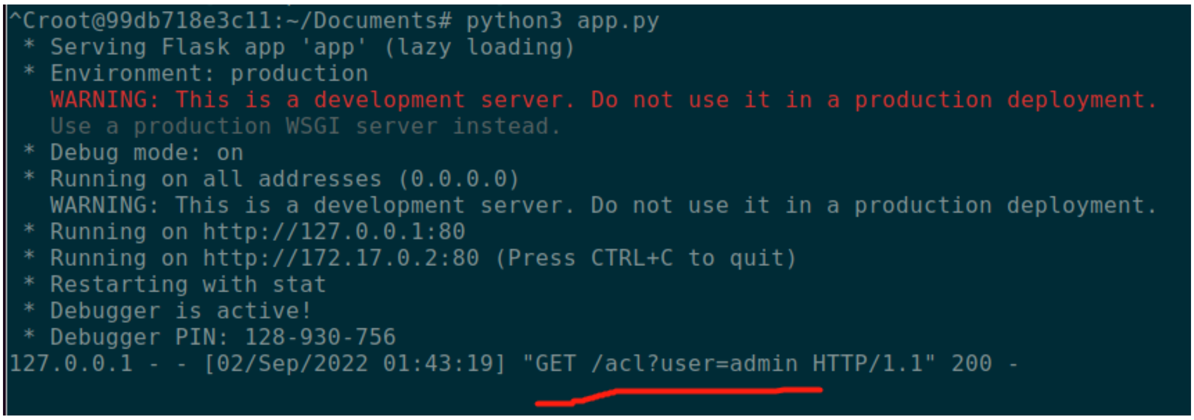
Username: admin

Password: ••••

Keep Alive: 60

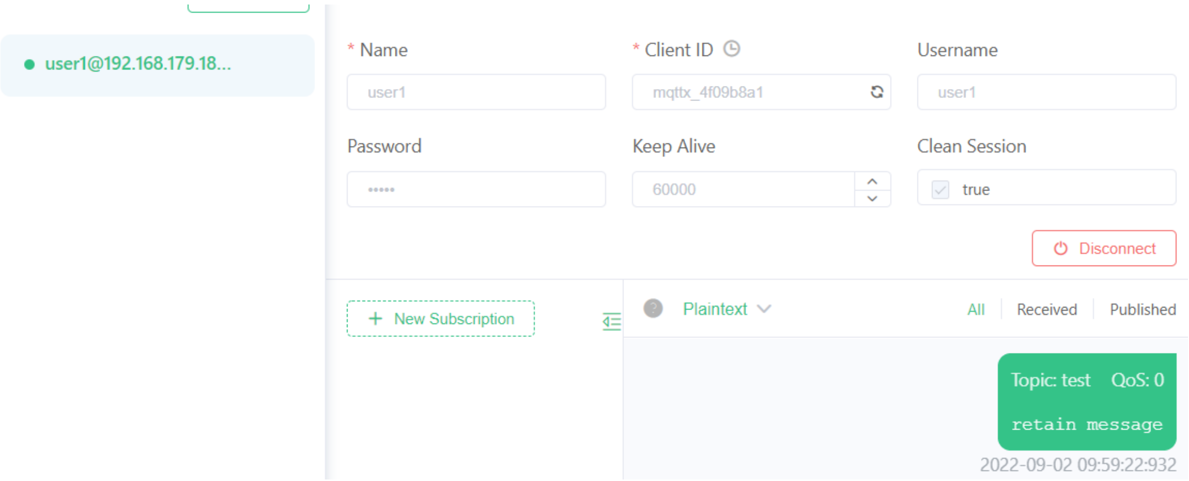
Clean Session: ☑ true

test QoS 2



```
^Croot@99db718e3c11:~/Documents# python3 app.py
 * Serving Flask app 'app' (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production deployment.
   Use a production WSGI server instead.
 * Debug mode: on
 * Running on all addresses (0.0.0.0)
   WARNING: This is a development server. Do not use it in a production deployment.
 * Running on http://127.0.0.1:80
 * Running on http://172.17.0.2:80 (Press CTRL+C to quit)
 * Restarting with stat
 * Debugger is active!
 * Debugger PIN: 128-930-756
127.0.0.1 - - [02/Sep/2022 01:43:19] "GET /acl?user=admin HTTP/1.1" 200 -
```

2. 攻击者连接broker，并且攻击者向主题“test”发布“retained 消息”。



● user1@192.168.179.18...

* Name: user1

* Client ID: mqttx_4f09b8a1

Username: user1

Password: •••••

Keep Alive: 60000

Clean Session: ☑ true

Topic: test QoS: 0

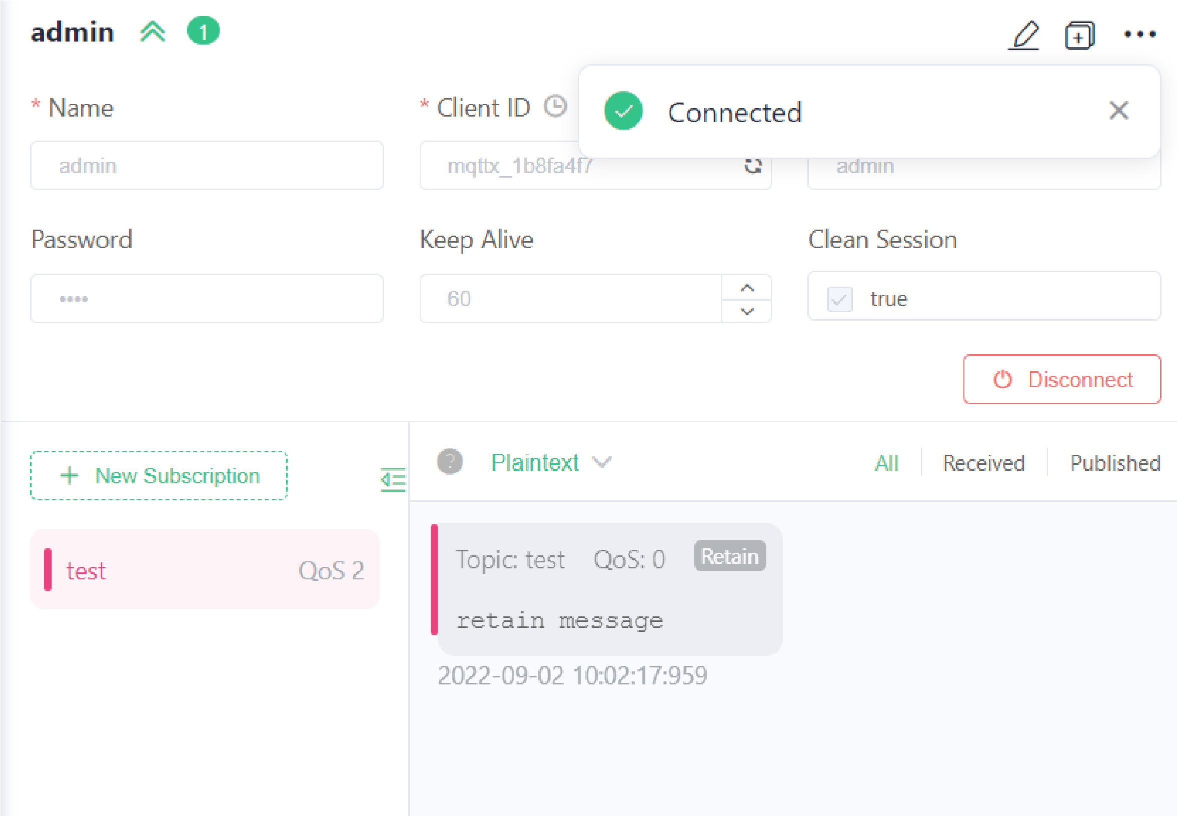
retain message

2022-09-02 09:59:22:932

3. 攻击者的权限被管理员或设备所有者撤销。

```
#app.py
@app.route('/acl', methods=['GET'])
def Start():
    user = request.args.get('user')
    resp = "deny"
    if(user == "admin"):
        resp = "allow"
    elif(user == "user1"):
        resp = "deny"
    return resp
```

4. 任何设备、受害者订阅主题“test”时，都会收到攻击者发布的这条有害retained 消息。



admin 1

Connected

* Name: admin

* Client ID: mqttx_1b8fa4f7

admin

Password: ••••

Keep Alive: 60

Clean Session: ☑ true

Disconnect

+ New Subscription

test QoS 2

Plaintext

All | Received | Published

Topic: test QoS: 0 Retain

```
retain message
```

2022-09-02 10:02:17:959