aws 接入awsIOT平台的证书签发逻辑

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参考资料

- https://aws.amazon.com/cn/blogs/china/certification-vending-machine-intelligent-device-access-aws-iot-platform-solution/

IoT 设备与 AWS IoT Core 的 MQTT 通信使用**基于证书的 TLS 1.2双向认证体系**。所谓的双向认证，即意味着 IoT 设备端需安装 IoT 设备证书，并且，签发该证书所使用的 CA 证书需要被 IoT Core 授信，从而完成 IoT Core 对 IoT 设备端的认证。**并且IoT 设备也会验证 IoT Core 的身份**（aws的root_CA）

双向TLS验证模式就会要求设备上所使用的证书需要具备以下条件之一：

- IoT终端设备上所使用的证书为AWS IoT平台所签发的
- IoT终端设备上所使用的证书的CA证书预先导入了AWS IoT平台

因此存在两种方式获取设备认证

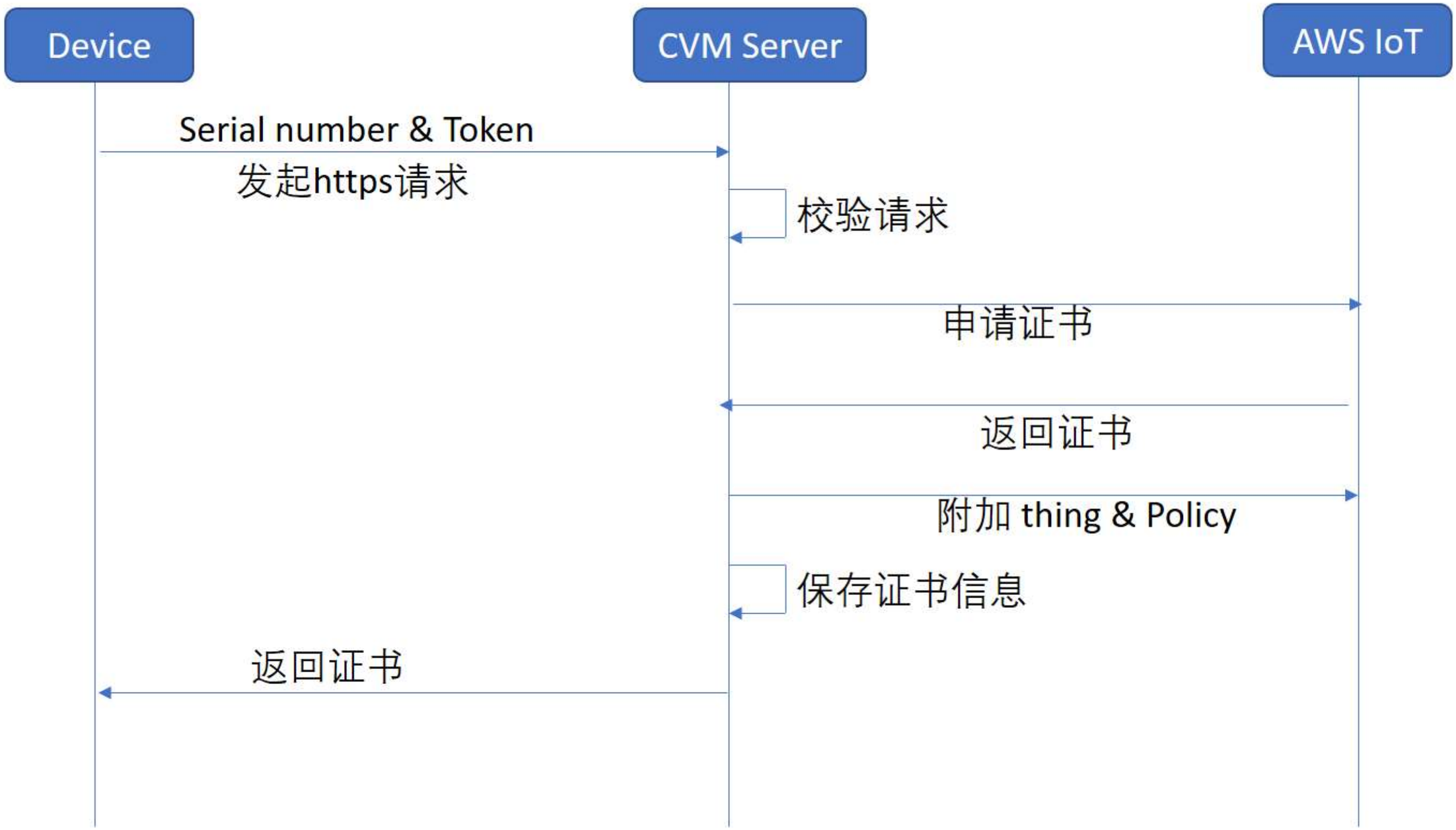
- 当用户希望使用从第三方机构购买或者自签发的 CA 证书，并将由该 CA 证书签发的设备证书的设备连接到 AWS IoT Core 时，可以利用即时注册功能来实现。
- 如果希望直接利用 AWS IoT CA 证书签发的设备证书对设备进行注册激活，参考 Certificate Vending Machine 方案。

Certification Vending方案

- https://aws.amazon.com/cn/blogs/china/certification-vending-machine-intelligent-device-access-aws-iot-platform-solution/

生产出厂的IoT设备，可能在生产过程中没有预装IoT证书，又希望这些设备连接至AWS IoT平台

- 主要目的是让设备自行向IoT平台申请CA签发的授信证书，并且通过AWS IoT管理平台控制证书权限



cvs需要客户自行实现

自签证书方案

自签证书JITR

- https://aws.amazon.com/cn/blogs/china/aws-iot-series-1/

签发ca和私钥

```
mkdir cert
cd cert
openssl genrsa -out CA_Private.key 2048
openssl req -x509 -new -nodes -key CA_Private.key -sha256 -days 3650 -out CA_Certificate.pem
```

为了安全AWS IOT Core 提供了相应的审核流程**确保你同时持有 CA 证书和对应的私钥**，先获取认证码

```
aws iot get-registration-code
{
    "registrationCode": "c0700df329cedx68def0c7385c83709b4da075"
}
```

生成另一个私钥和csr，在csr中填入认证码

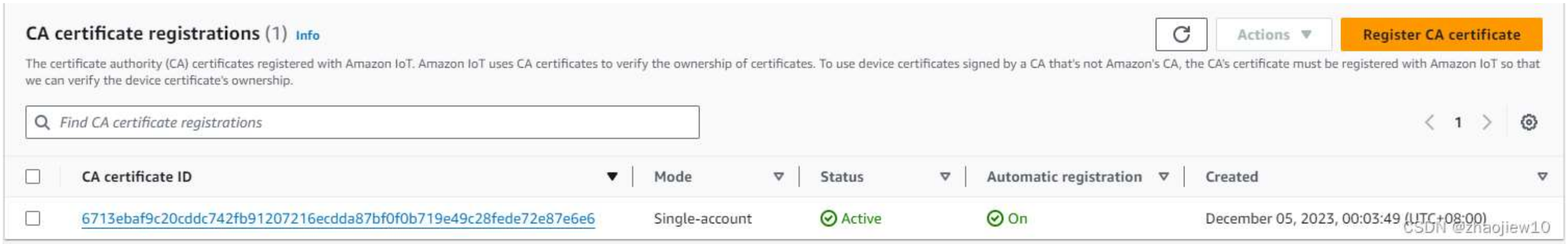
```
openssl genrsa -out Verification_Private.key 2048
openssl req -new -key Verification_Private.key -out Verification.csr

# Organization Name (eg, company) []:
# Organizational Unit Name (eg, section)
# Common Name (e.g. server FQDN or YOUR name) []: XXXXXREGISTRATIONCODEXXXXX
```

使用ca和私钥，生成中间证书（确保ca和私钥的正确性）

```
openssl x509 -req -in Verification.csr -CA CA_Certificate.pem -CAkey CA_Private.key -CAcreateserial -out Verification.crt -days 3650 -sha256
```

导入ca和中间证书

```
aws iot register-ca-certificate --ca-certificate file://CA_Certificate.pem --verification-certificate file://Verification.crt --set-as-active --allow-auto-registration
{
    "certificateArn": "arn:aws-cn:iot:cn-north-1:037047667284:cacert/6713ebaf9c20cddc742fb91207216ecdda87bf0f0b719e49c28fede72e87e6e6",
    "certificateId": "6713ebaf9c20cddc742fb91207216ecdda87bf0f0b719e49c28fede72e87e6e6"
}
```



生成设备私钥和csr

```
openssl genrsa -out Device.key 2048
openssl req -new -key Device.key -out Device_Certificate.csr
```

使用ca签发设备证书

```
openssl x509 -req -in Device_Certificate.csr -CA CA_Certificate.pem -CAkey CA_Private.key -CAcreateserial -out Device_Certificate.crt -days 3650 -sha256
```

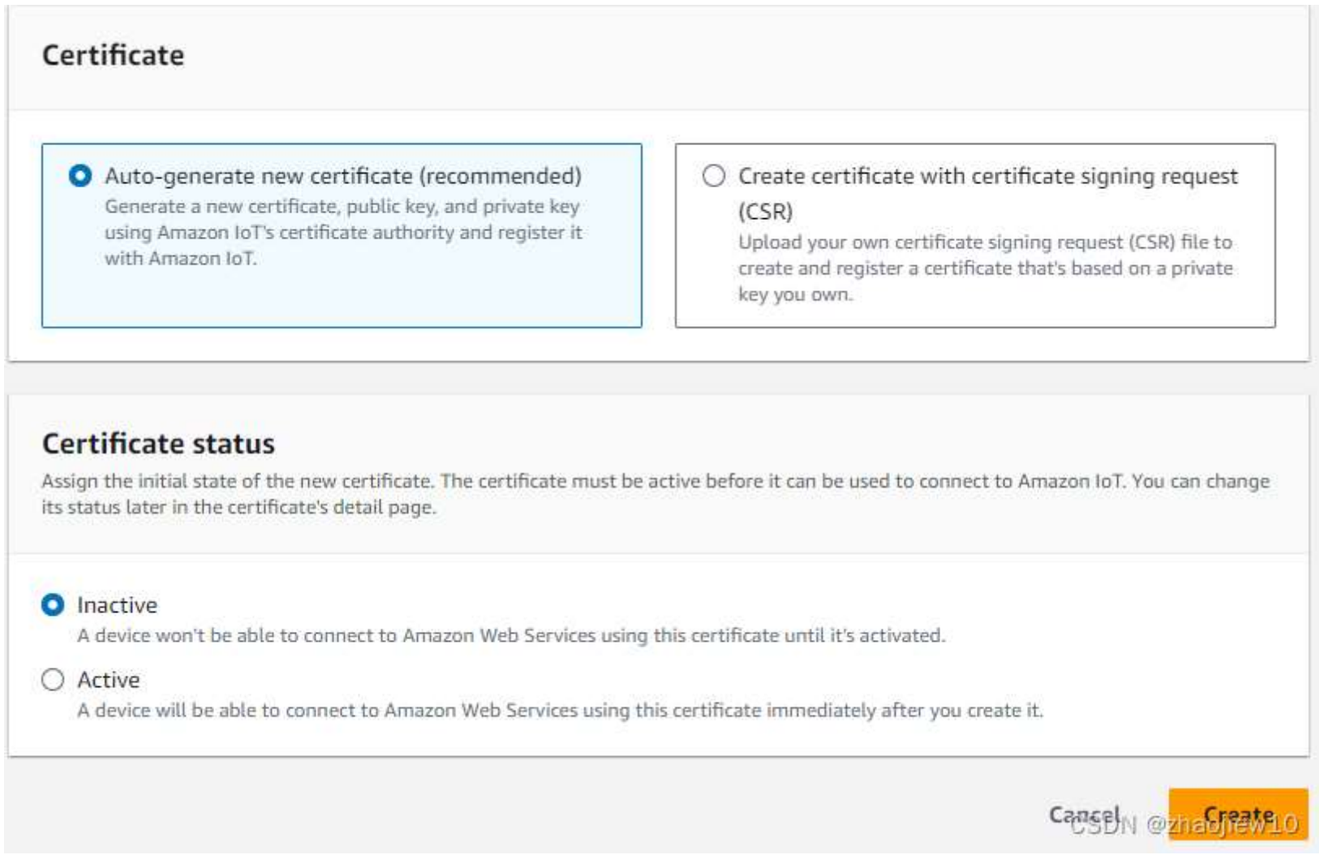
在设备上安装设备证书

！！！重要

- 此ca证书并非aws签发，因此显示在Certificate authorities中
- 外部设备使用该三方证书签发的设备证书访问iot会自动创建Certificates（并非ca certificates）
- 之后需要为该设备绑定策略授权

也可以在控制台直接生成上面的这些，区别在于自动生成的实际上是由aws ca签发的

- 可以直接签发，设备私钥和证书一起生成
- 或者创建设备私钥和csr后，使用aws ca签发



当 IoT 设备第一次连接 AWS IoT Core 时，如果它集成的设备证书是由已在 Core 上注册的 CA 证书签发而来，那么相应的设备证书会实现自动注册

- 注册后的默认状态为“PENDING_ACTIVATION”，意味着虽然设备证书已经成功注册，但是还处于等待激活的状态。同时，这个连接动作默认会发一条消息到 AWS IoT Core 的 MQTT Topic “$aws/events/certificates/registered/” 上，格式如下

```
{
    "certificateId": "<certificateID>",
    "caCertificateId": "<caCertificateId>",
    "timestamp": "<timestamp>",
    "certificateStatus": "PENDING_ACTIVATION",
    "awsAccountId": "<awsAccountId>",
    "certificateRegistrationTimestamp": "<certificateRegistrationTimestamp>"
}
```

- 可以通过iot规则触发lambda函数完成证书激活

通过lambda函数授权，主要逻辑如下

- 创建policy
- 附加在证书上

- 激活证书

```
var AWS = require('aws-sdk');

exports.handler = function (event, context, callback) {

  // 根据实际部署区域写入，在certificateARN一处也是。
  var region = "cn-north-1";
  var accountId = event.awsAccountId.toString().trim();
  var iot = new AWS.Iot({
    'region': region,
    apiVersion: '2015-05-28'
  });

  var certificateId = event.certificateId.toString().trim();

  //这里你可以替换成你想要的topic名称
  var topicName = `JITR/test`;
  var certificateARN = `arn:aws-cn:iot:${region}:${accountId}:cert/${certificateId}`;
  var policyName = `Policy_${certificateId}`;

  //定义Policy并赋予权限，允许IoT设备连接，发布，订阅和接受消息
  var policy = {
    "Version": "2012-10-17",
    "Statement": [
      {
        "Action": [
          "iot:Publish",
          "iot:Subscribe",
          "iot:Connect",
          "iot:Receive"
        ],
        "Effect": "Allow",
        "Resource": [
          "*"
        ]
      }
    ]
  };

  //创建Policy
  iot.createPolicy({
    policyDocument: JSON.stringify(policy),
    policyName: policyName
  }, (err, data) => {
    //Ignore if the policy already exists
```

```
    if (err && (!err.code || err.code !== 'ResourceAlreadyExistsException')) {
      console.log(err);
      callback(err, data);
      return;
    }
    console.log(data);

    //附加Policy到设备证书上
    iot.attachPrincipalPolicy({
      policyName: policyName,
      principal: certificateARN
    }, (err, data) => {
      //Ignore if the policy is already attached
      if (err && (!err.code || err.code !== 'ResourceAlreadyExistsException')) {
        console.log(err);
        callback(err, data);
        return;
      }
      console.log(data);

      //激活证书
      iot.updateCertificate({
        certificateId: certificateId,
        newStatus: 'ACTIVE'
      }, (err, data) => {
        if (err) {
          console.log(err, err.stack);
          callback(err, data);
        } else {
          console.log(data);
          callback(null, "Success, created, attached policy and activated the certificate " + certificateId);
        }
      });
    });
  });
}
```

在控制台订阅此ca

在ec2上下载mosquitto

```
sudo wget http://download.opensuse.org/repositories/home:/oojah:/mqtt/CentOS_CentOS-7/home:oojah:mqtt.repo -O /etc/yum.repos.d/mqtt.repo
sudo yum install mosquitto mosquitto-clients -y

# 如果上面的命令执行时报依赖缺少的错误，可以加上--skip-broken再执行一遍即可
sudo yum install mosquitto mosquitto-clients -y --skip-broken
```

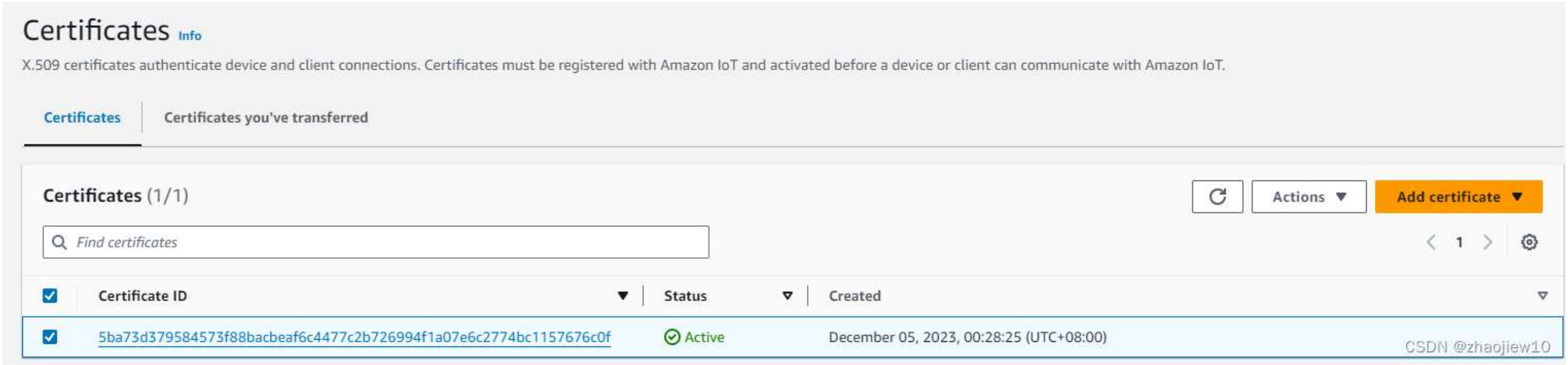
合并证书链

```
cd cert
cat Device_Certificate.crt CA_Certificate.pem > Device_CA_Certificate.crt
```

发布消息，连接会失败

```
mosquitto_pub --cafile root-CA.crt --cert Device_CA_Certificate.crt --key Device.key -h xxxxxxxxxxxxx.iot.cn-north-1.amazonaws.com.cn -p 8883 -q 1 -t JITR/test -i anyclientID --tls-ve
```

证书自动创建



关联admin权限（iot策略）后再次连接

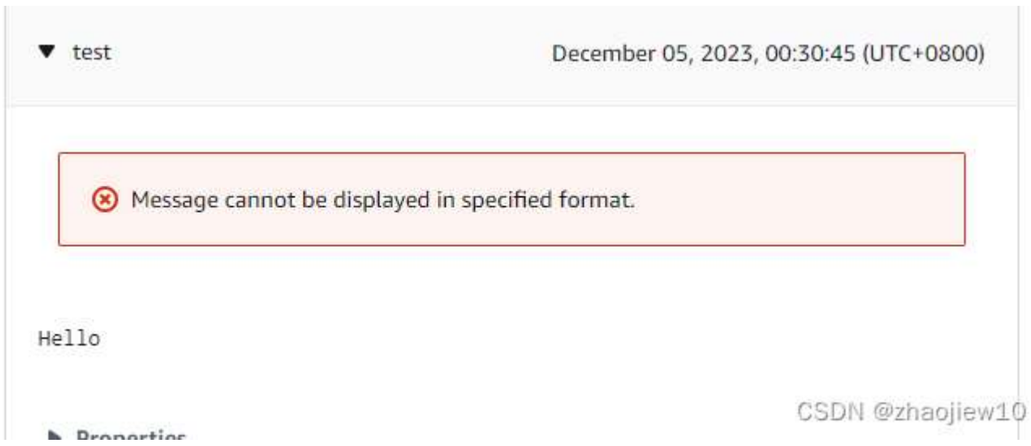
成功连接

```
/cert # mosquitto_pub --cafile AmazonRootCA1.pem --cert Device_CA_Certificate.crt --key Device.key -h a1zwdkk9p50qtr.ats.iot.cn-north-1.amazonaws.com.cn  -p 8883 -q 1 -t test
i D001 --tls-version tlsv1.2 -m "Hello" -d
Client D001 sending CONNECT
Client D001 received CONNACK (0)
Client D001 sending PUBLISH (d0, q1, r0, m1, 'test', ... (5 bytes))
Client D001 received PUBACK (Mid: 1, RC:0)
Client D001 sending DISCONNECT
```



```
#对于自动生成的证书
mosquitto_sub --cafile AmazonRootCA1.pem --cert 94505e987e73a5b0e380bb25a68bea19874d741b3907cdef0ba903eeef6d9049-certificate.pem.crt  --key 94505e987e73a5b
0e380bb25a68bea19874d741b3907cdef0ba903eeef6d9049-private.pem.key -h a1zwdkk9p50qtr.ats.iot.cn-north-1.amazonaws.com.cn  -p 8883 -q 0 -t sensor -d
```

控制台订阅test的topic，成功收到消息



创建thing的逻辑和上面几乎一致，只不过证书可以选择多种方式

使用mosquitto模拟连接后活动能够看到记录

- 可以看到连接记录和保活记录

```
# mosquitto_sub --cafile AmazonRootCA1.pem --cert Device_CA_Certificate.crt --key Device.key -h a1zwdkk9p50qtr.ats.iot.cn-north-1.amazonaws.com.cn  -p 8883 -q 1 -t sensor
s/switch/livingroom/open -i bubble --tls-version tlsv1.2  -d
Client bubble sending CONNECT
Client bubble received CONNACK (0)
Client bubble sending SUBSCRIBE (Mid: 1, Topic: sensors/switch/livingroom/open, QoS: 1, Options: 0x00)
Client bubble received SUBACK
Subscribed (mid: 1): 1
Client bubble sending PINGREQ
Client bubble received PINGRESP
```

- id为设备名称，用于区分不同的设备证书

Attributes | Certificates | Thing groups | Device Shadows | Activity | Packages and versions | Jobs | Alarms | Defender metrics

Activity (2) Info

Lists the most recent MQTT messages related to Device Shadow activity since you opened the thing details page. To see more messages related to this activity, choose the **MQTT test client** button.

Clear | MQTT test client

▼ Subscribed

December 05, 2023, 00:42:39 (UTC+08:00)

$aws/events/subscriptions/subscribed/bubble


```
{
  "clientId": "bubble",
  "timestamp": 1701708159322,
  "eventType": "subscribed",
  "sessionIdentifier": "8e6f0295-f132-4874-b3b0-eba2b2081457",
  "principalIdentifier": "5ba73d379584573f88bacbeaf6c4477c2b726994f1a07e6c2774bc1157676c0f",
  "topics": [
    "sensors/switch/livingroom/open"
  ]
}
```

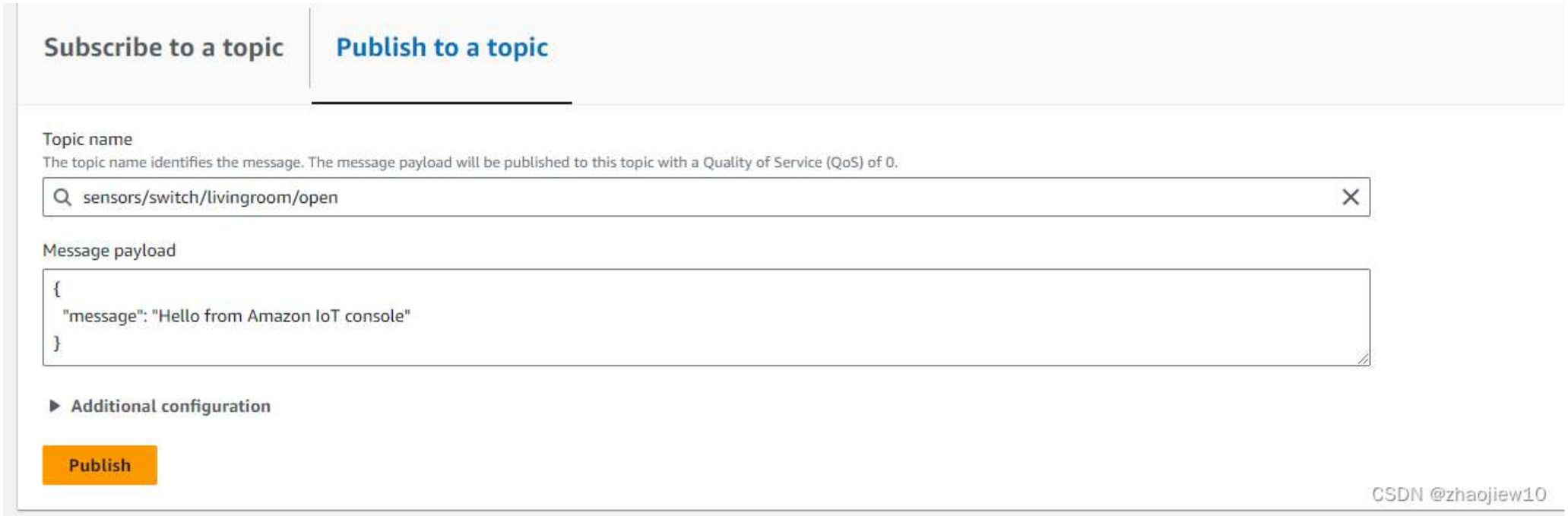

▼ Connected

December 05, 2023, 00:42:39 (UTC+08:00)

$aws/events/presence/connected/bubble


```
{
  "clientId": "bubble",
  "timestamp": 1701708159286,
  "eventType": "connected",
  "sessionIdentifier": "8e6f0295-f132-4874-b3b0-eba2b2081457",
```


测试发布消息



在mosquitto成功收到消息

```
Client bubble received PINGRESP
Client bubble received PUBLISH (d0, q0, r0, m0, 'sensors/switch/livingroom/open', ... (48 bytes))
{
  "message": "Hello from Amazon IoT console"
}
```


自签证书JITP

步骤类似，但是使用模板自动在iot上注册