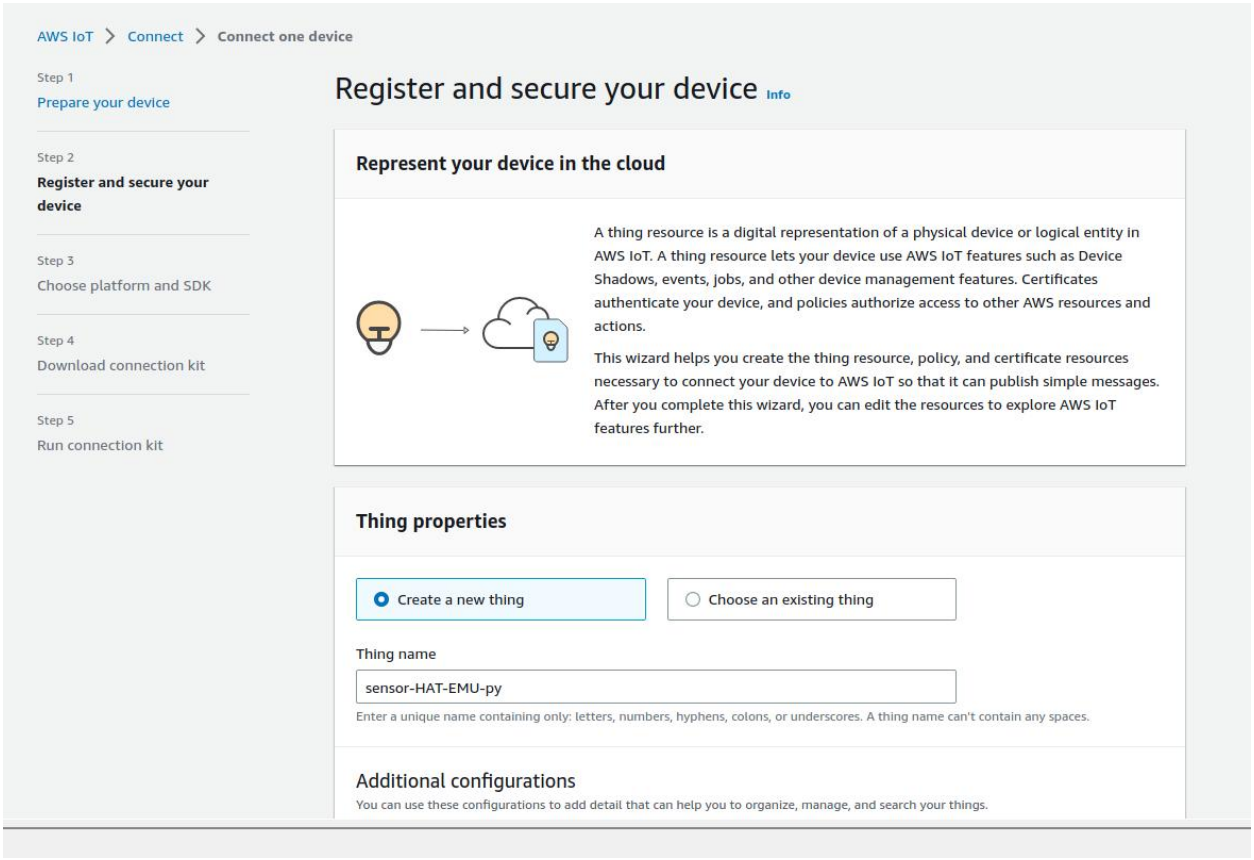
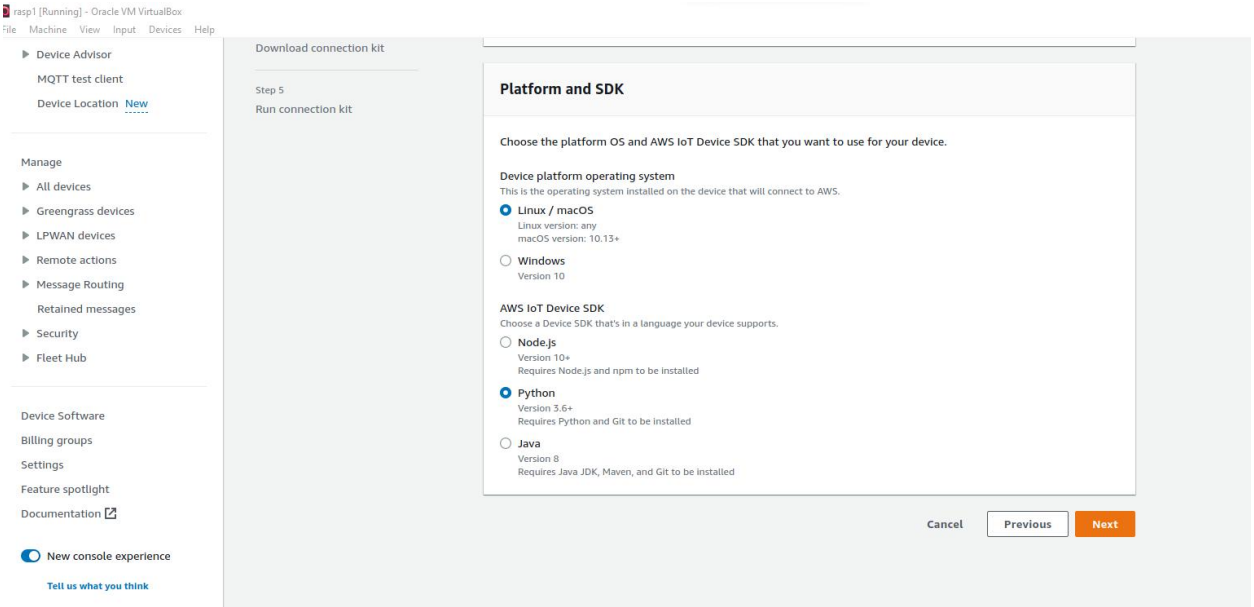
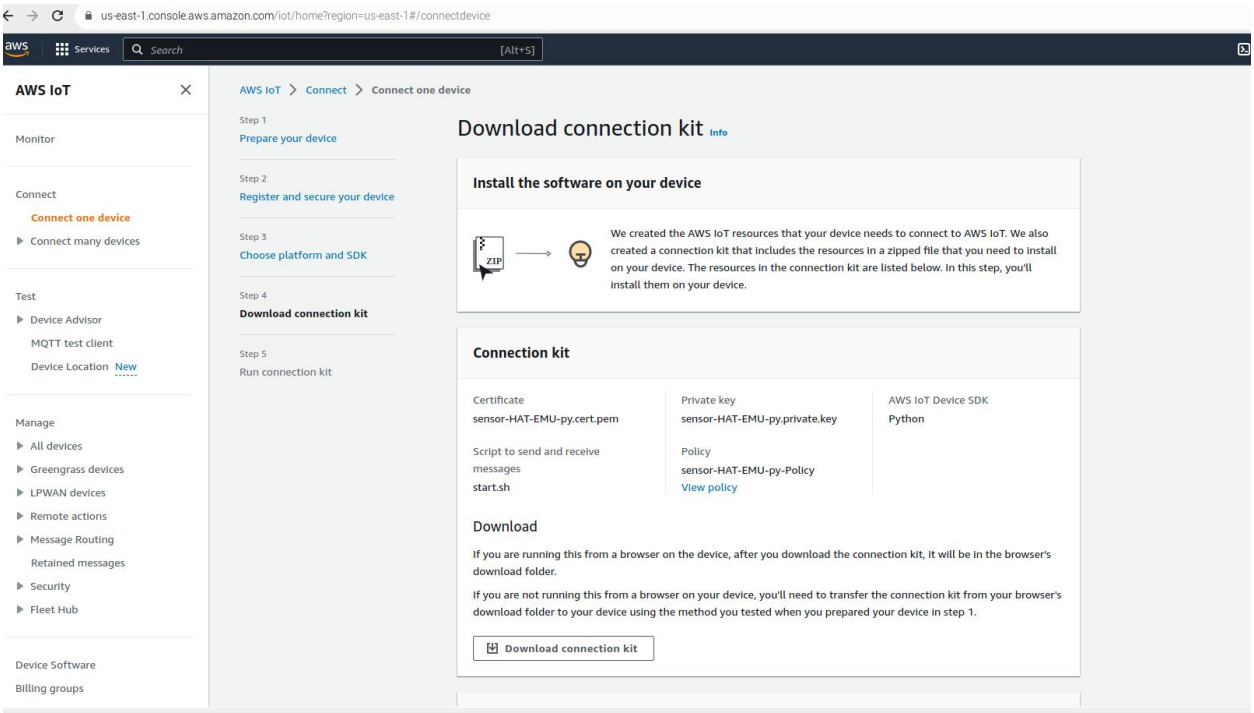
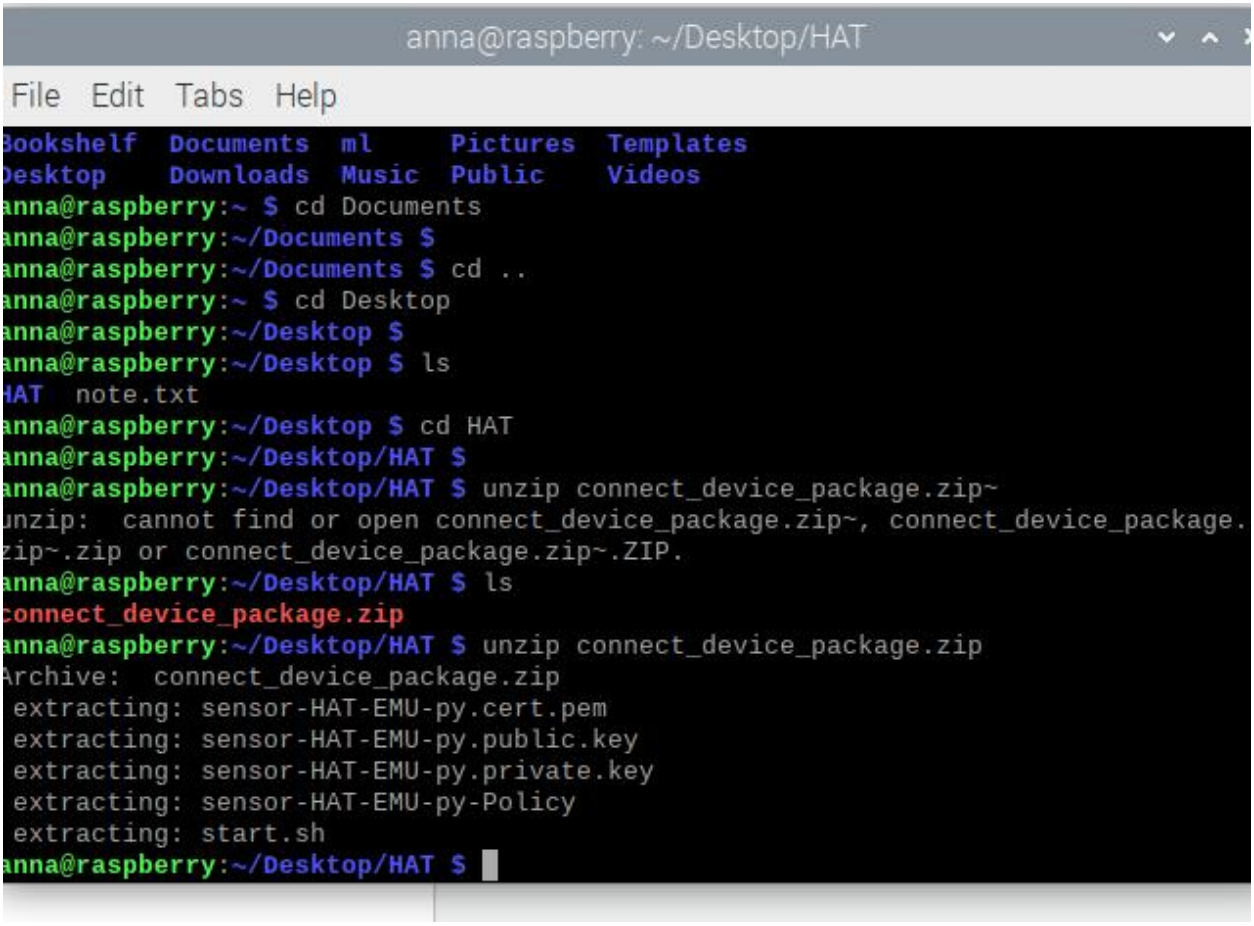
Part2 – Connecting Raspberry Pi emulator + VirtualBox + Sense HAT Emulator to AWS IOT Using Python
Step1. Walk through AWS IOT → Connect → Connect one device






us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/connectdevice
Services
Search
[Alt+S]
AWS IoT
Monitor
Connect
Connect one device
Connect many devices
Test
Device Advisor
MQTT test client
Device Location New
Manage
All devices
Greengrass devices
LPWAN devices
Remote actions
Message Routing
Retained messages
Security
Fleet Hub
Device Software
Billing groups
AWS IoT > Connect > Connect one device
Step 1
Prepare your device
Step 2
Register and secure your device
Step 3
Choose platform and SDK
Step 4
Download connection kit
Step 5
Run connection kit
Download connection kit Info
Install the software on your device
ZIP
We created the AWS IoT resources that your device needs to connect to AWS IoT. We also created a connection kit that includes the resources in a zipped file that you need to install on your device. The resources in the connection kit are listed below. In this step, you'll install them on your device.
Connection kit
Certificate
sensor-HAT-EMU-py.cert.pem
Private key
sensor-HAT-EMU-py.private.key
AWS IoT Device SDK
Python
Script to send and receive messages
start.sh
Policy
sensor-HAT-EMU-py-Policy
View policy
Download
If you are running this from a browser on the device, after you download the connection kit, it will be in the browser's download folder.
If you are not running this from a browser on your device, you'll need to transfer the connection kit from your browser's download folder to your device using the method you tested when you prepared your device in step 1.
Download connection kit


anna@raspberry: ~/Desktop/HAT
File Edit Tabs Help
Bookshelf Documents ml Pictures Templates
Desktop Downloads Music Public Videos
anna@raspberry:~ $ cd Documents
anna@raspberry:~/Documents $
anna@raspberry:~/Documents $ cd ..
anna@raspberry:~ $ cd Desktop
anna@raspberry:~/Desktop $
anna@raspberry:~/Desktop $ ls
HAT note.txt
anna@raspberry:~/Desktop $ cd HAT
anna@raspberry:~/Desktop/HAT $
anna@raspberry:~/Desktop/HAT $ unzip connect_device_package.zip~
unzip: cannot find or open connect_device_package.zip~, connect_device_package.zip~.zip or connect_device_package.zip~.ZIP.
anna@raspberry:~/Desktop/HAT $ ls
connect_device_package.zip
anna@raspberry:~/Desktop/HAT $ unzip connect_device_package.zip
Archive: connect_device_package.zip
extracting: sensor-HAT-EMU-py.cert.pem
extracting: sensor-HAT-EMU-py.public.key
extracting: sensor-HAT-EMU-py.private.key
extracting: sensor-HAT-EMU-py-Policy
extracting: start.sh
anna@raspberry:~/Desktop/HAT $

Step 2
Register and secure your device

Step 3
Choose platform and SDK

Step 4
Download connection kit

Step 5
Run connection kit

How to display messages from your device

Step 1: Add execution permissions
On the device, launch a terminal window to copy and paste the command to add execution permissions.

chmod +x start.sh Copy

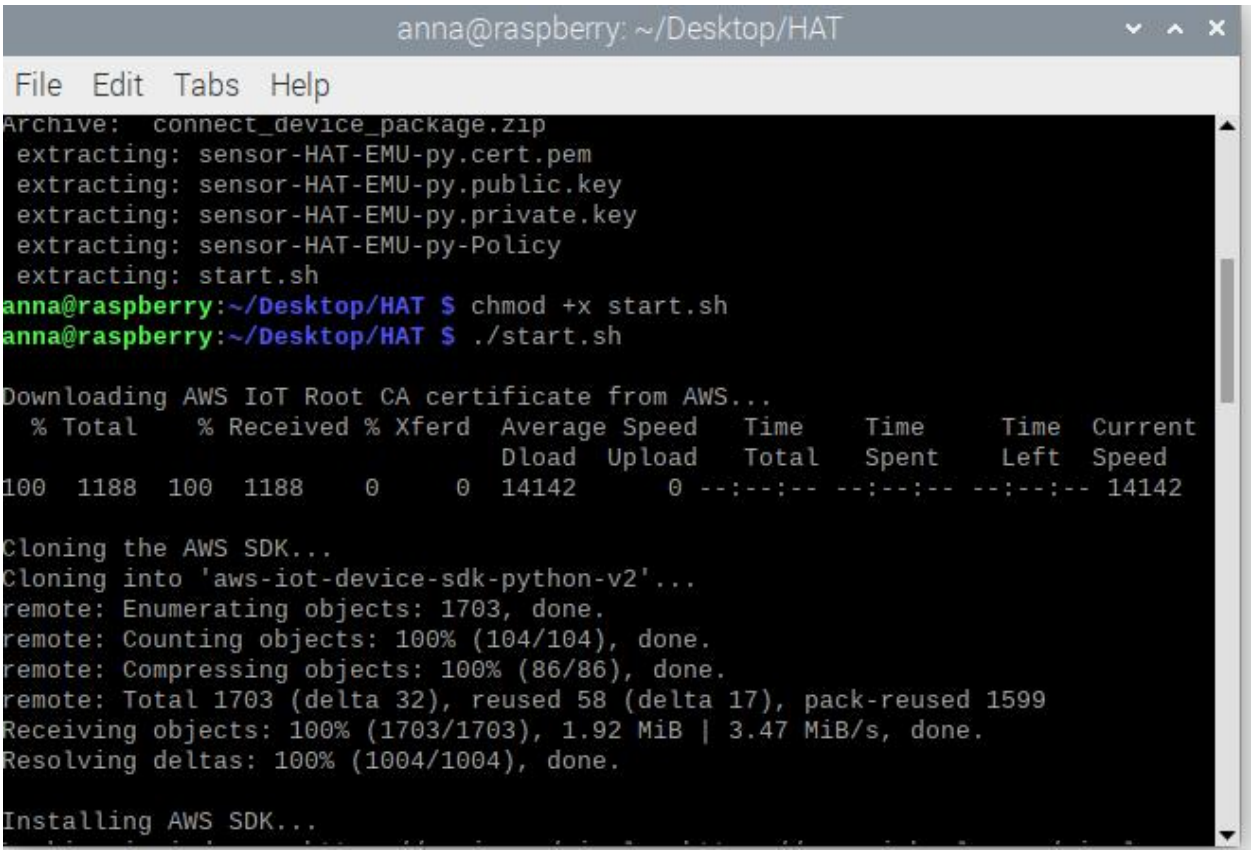
Step 2: Run the start script
On the device, copy and paste the command to the terminal window and run the start script.

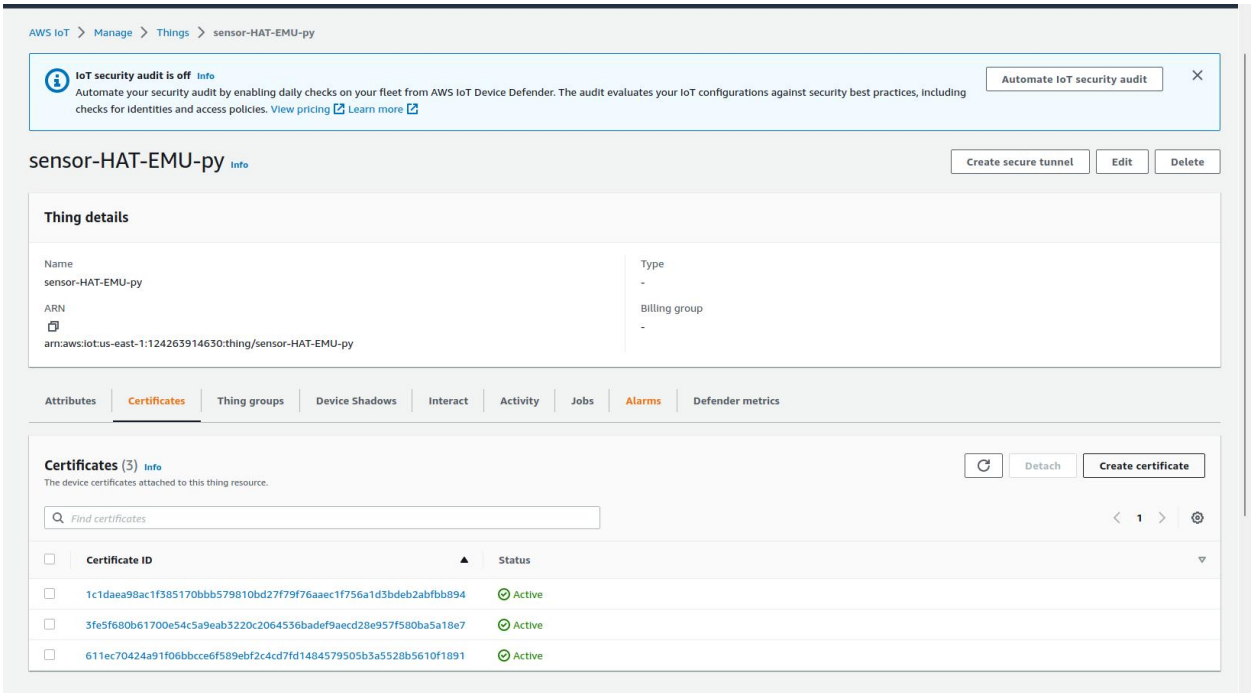
./start.sh Copy

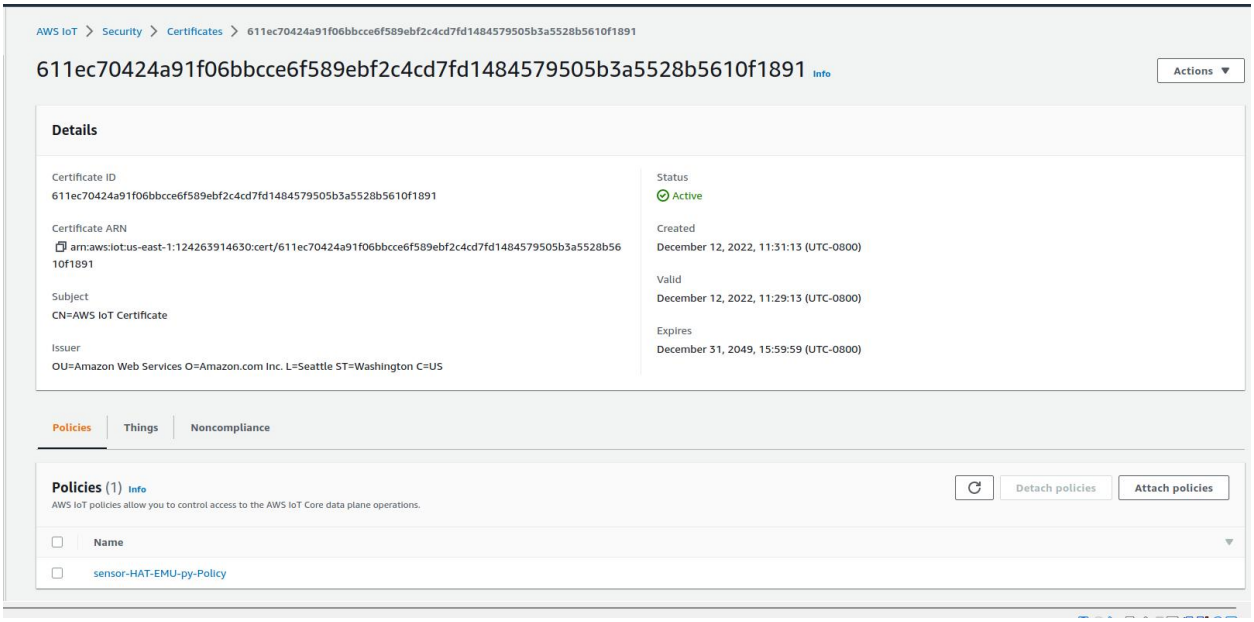
Step 3: Return to this screen to view your device's messages
After running the start script, return to this screen to see the messages between your device and AWS IoT. The messages from your device appear in the following list.

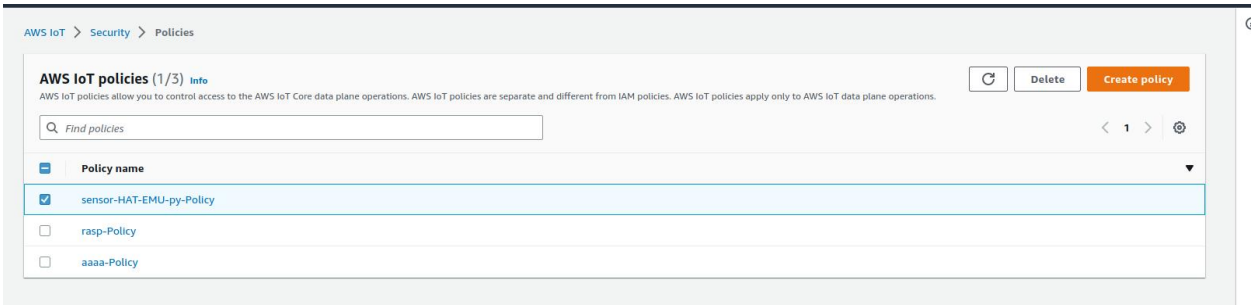
Subscriptions	sdk/test/Python	Pause	Clear
sdk/test/Python	Waiting for messages		

Cancel Previous Continue

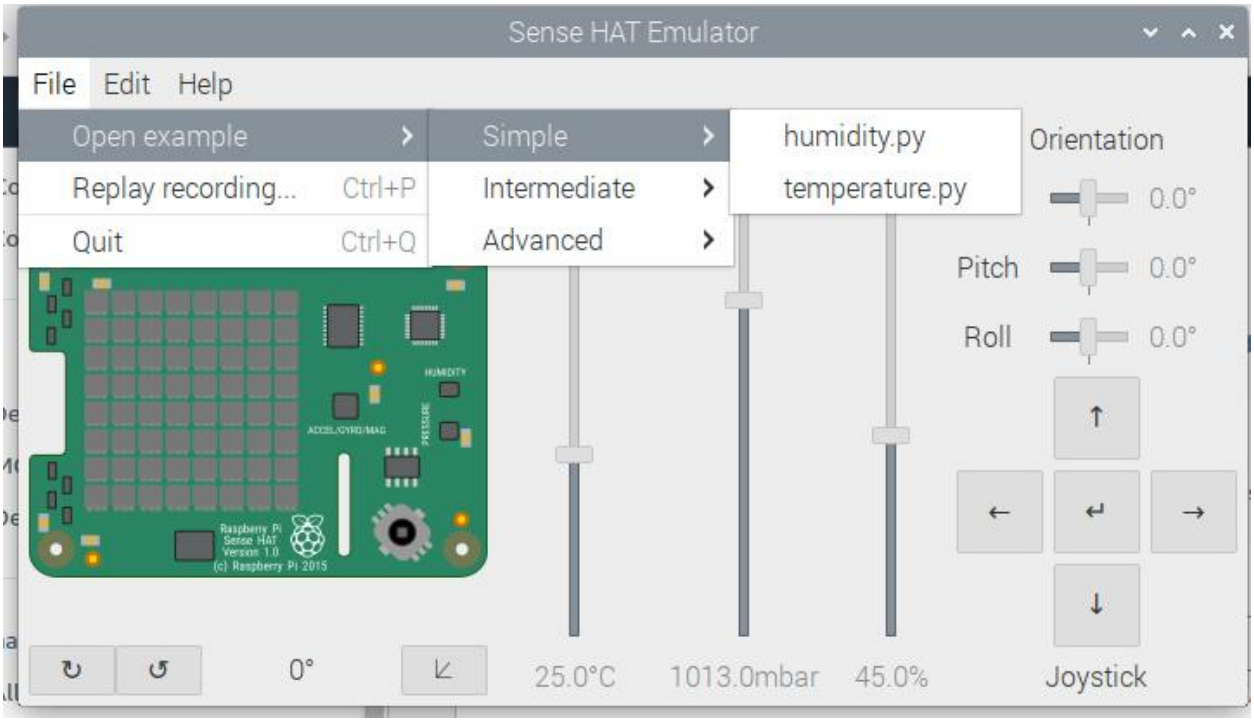

anna@raspberry: ~/Desktop/HAT
File Edit Tabs Help
Archive: connect_device_package.zip
extracting: sensor-HAT-EMU-py.cert.pem
extracting: sensor-HAT-EMU-py.public.key
extracting: sensor-HAT-EMU-py.private.key
extracting: sensor-HAT-EMU-py-Policy
extracting: start.sh
anna@raspberry:~/Desktop/HAT $ chmod +x start.sh
anna@raspberry:~/Desktop/HAT $ ./start.sh
Downloading AWS IoT Root CA certificate from AWS...
% Total % Received % Xferd Average Speed Time Time Time Current
Dload Upload Total Spent Left Speed
100 1188 100 1188 0 0 14142 0 --:--:-- --:--:-- --:--:-- 14142
Cloning the AWS SDK...
Cloning into 'aws-iot-device-sdk-python-v2'...
remote: Enumerating objects: 1703, done.
remote: Counting objects: 100% (104/104), done.
remote: Compressing objects: 100% (86/86), done.
remote: Total 1703 (delta 32), reused 58 (delta 17), pack-reused 1599
Receiving objects: 100% (1703/1703), 1.92 MiB | 3.47 MiB/s, done.
Resolving deltas: 100% (1004/1004), done.
Installing AWS SDK...


AWS IoT > Manage > Things > sensor-HAT-EMU-py
IoT security audit is off Info
Automate your security audit by enabling daily checks on your fleet from AWS IoT Device Defender. The audit evaluates your IoT configurations against security best practices, including checks for identities and access policies. View pricing Learn more
Automate IoT security audit
sensor-HAT-EMU-py Info
Create secure tunnel
Edit
Delete
Thing details
Name
sensor-HAT-EMU-py
Type
-
ARN
arn:aws:iot:us-east-1:124263914630:thing/sensor-HAT-EMU-py
Billing group
-
Attributes
Certificates
Thing groups
Device Shadows
Interact
Activity
Jobs
Alarms
Defender metrics
Certificates (3) Info
The device certificates attached to this thing resource.
Detach
Create certificate
Find certificates
Certificate ID
Status
1c1daea98ac1f385170bbb579810bd27f79f76aaec1f756a1d3bdeb2abfbb894
Active
3fe5f680b61700e54c5a9eab3220c2064536badef9aecd28e957f580ba5a18e7
Active
611ec70424a91f06bbcce6f589ebf2c4cd7fd1484579505b3a5528b5610f1891
Active


AWS IoT > Security > Certificates > 611ec70424a91f06bbcce6f589ebf2c4cd7fd1484579505b3a5528b5610f1891
611ec70424a91f06bbcce6f589ebf2c4cd7fd1484579505b3a5528b5610f1891 Info
Actions
Details
Certificate ID
611ec70424a91f06bbcce6f589ebf2c4cd7fd1484579505b3a5528b5610f1891
Certificate ARN
arn:aws:iot:us-east-1:124263914630:cert/611ec70424a91f06bbcce6f589ebf2c4cd7fd1484579505b3a5528b5610f1891
Subject
CN=AWS IoT Certificate
Issuer
OU=Amazon Web Services O=Amazon.com Inc. L=Seattle ST=Washington C=US
Status
Active
Created
December 12, 2022, 11:31:13 (UTC-0800)
Valid
December 12, 2022, 11:29:13 (UTC-0800)
Expires
December 31, 2049, 15:59:59 (UTC-0800)
Policies
Things
Noncompliance
Policies (1) Info
AWS IoT policies allow you to control access to the AWS IoT Core data plane operations.
Detach policies
Attach policies
Name
sensor-HAT-EMU-py-Policy



Testing with sample code:



Thonny - /home/anna/temperature-2022-12-12-12-11-02.py @ 15 : 1

New Load Save Run Debug Over Into Out Stop Zoom Quit Support

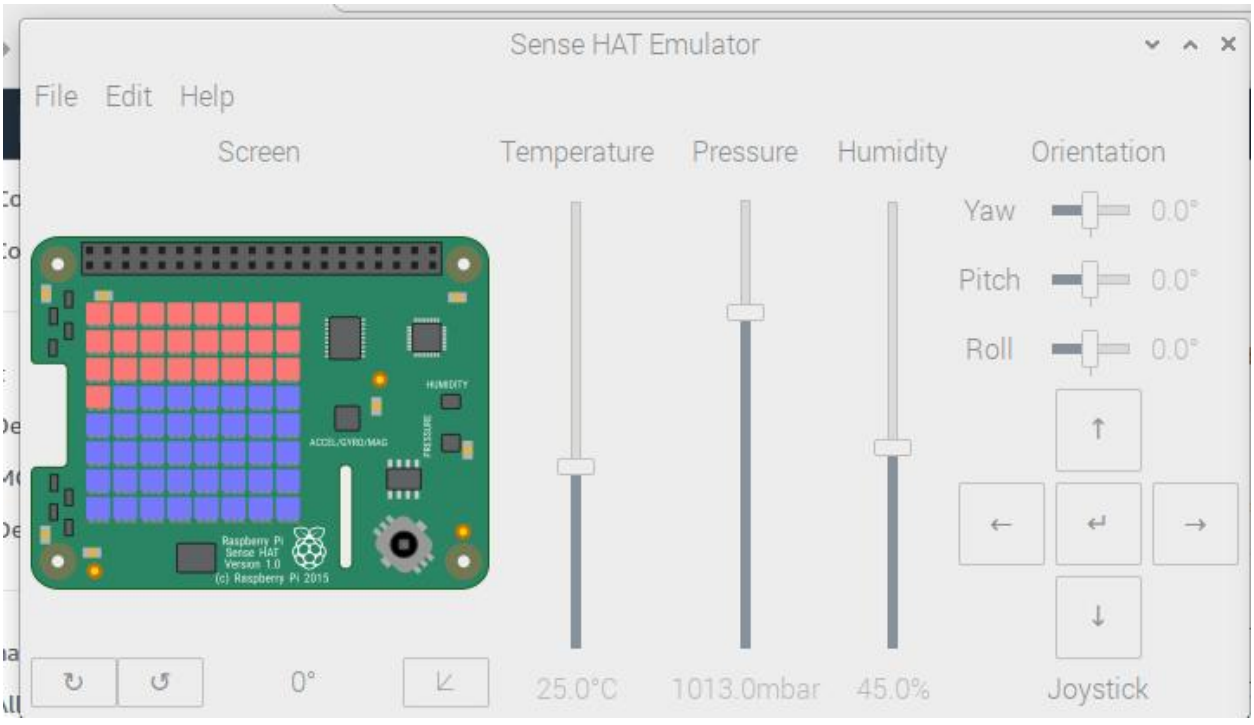
temperature-2022-12-12-12-11-02.py

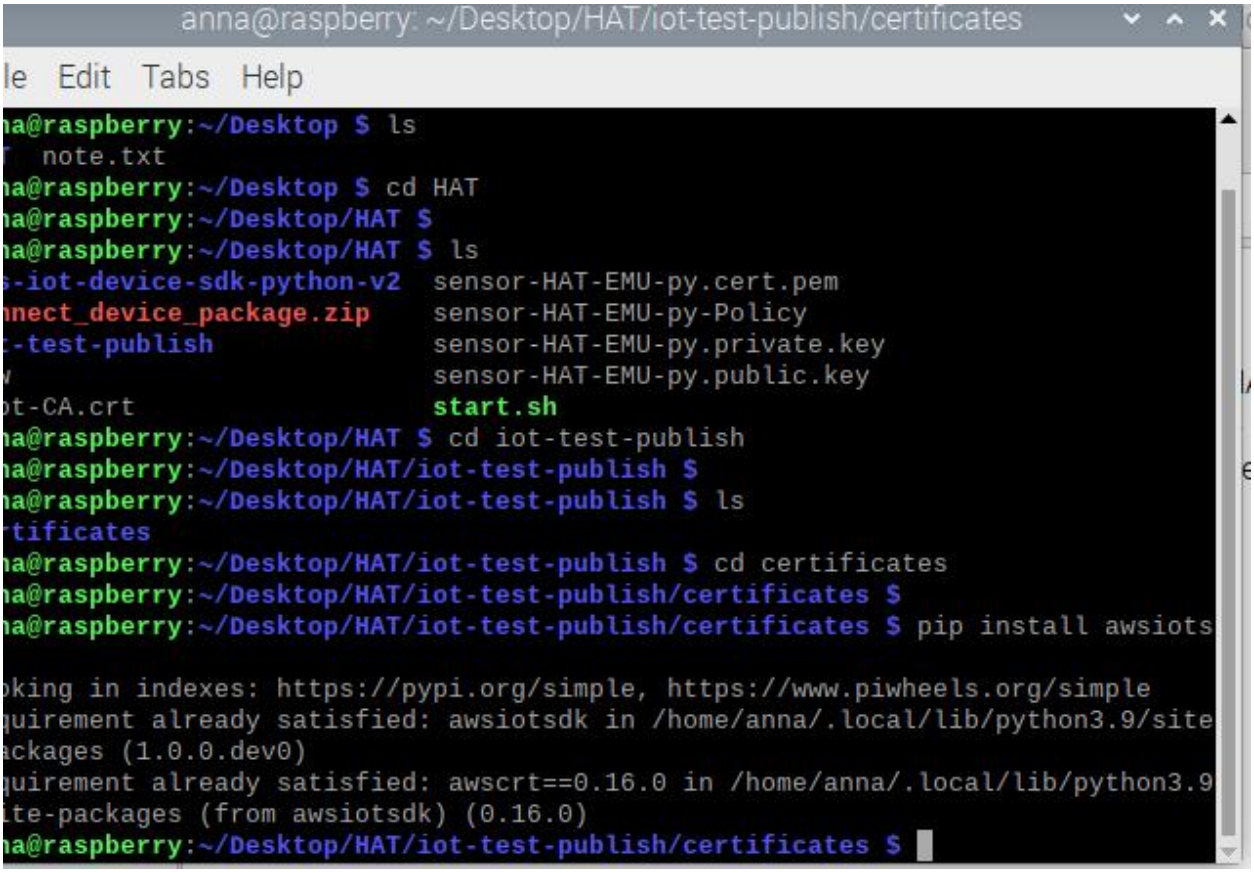
```
1  # This file has been written to your home directory for convenience. It is
2  # saved as "/home/anna/temperature-2022-12-12-12-11-02.py"
3
4  from sense_emu import SenseHat
5
6  sense = SenseHat()
7
8  red = (255, 0, 0)
9  blue = (0, 0, 255)
10
11 while True:
12     temp = sense.temp
13     pixels = [red if i < temp else blue for i in range(64)]
14     sense.set_pixels(pixels)
15
```

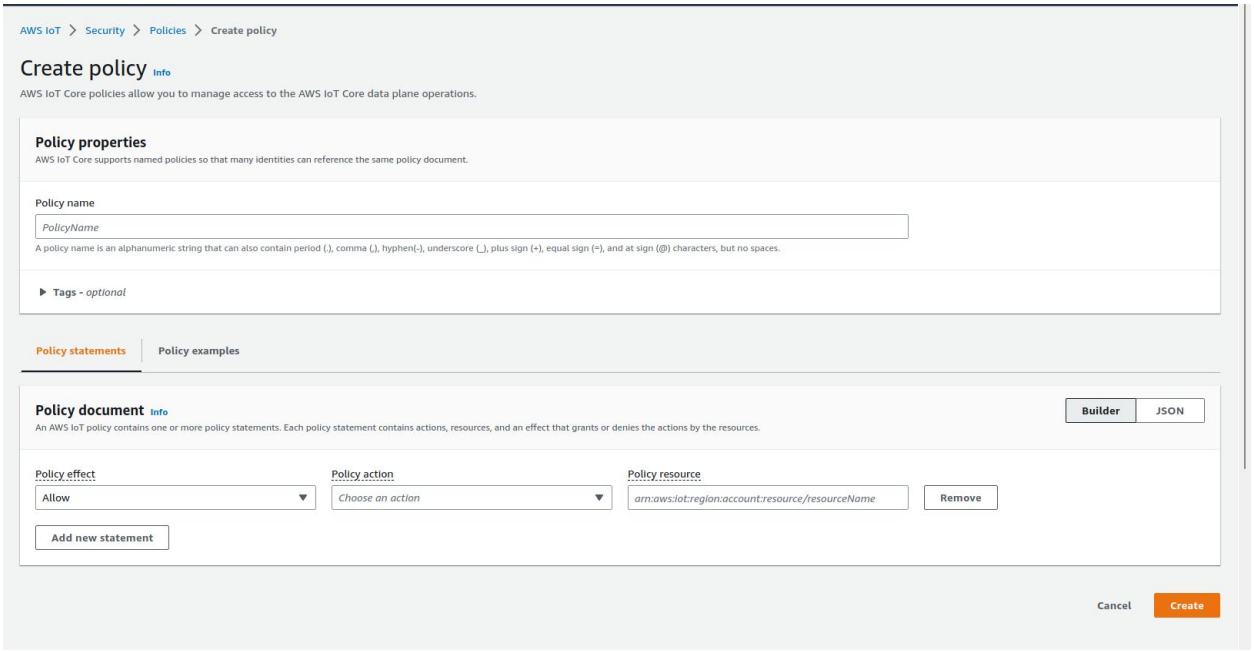
Shell

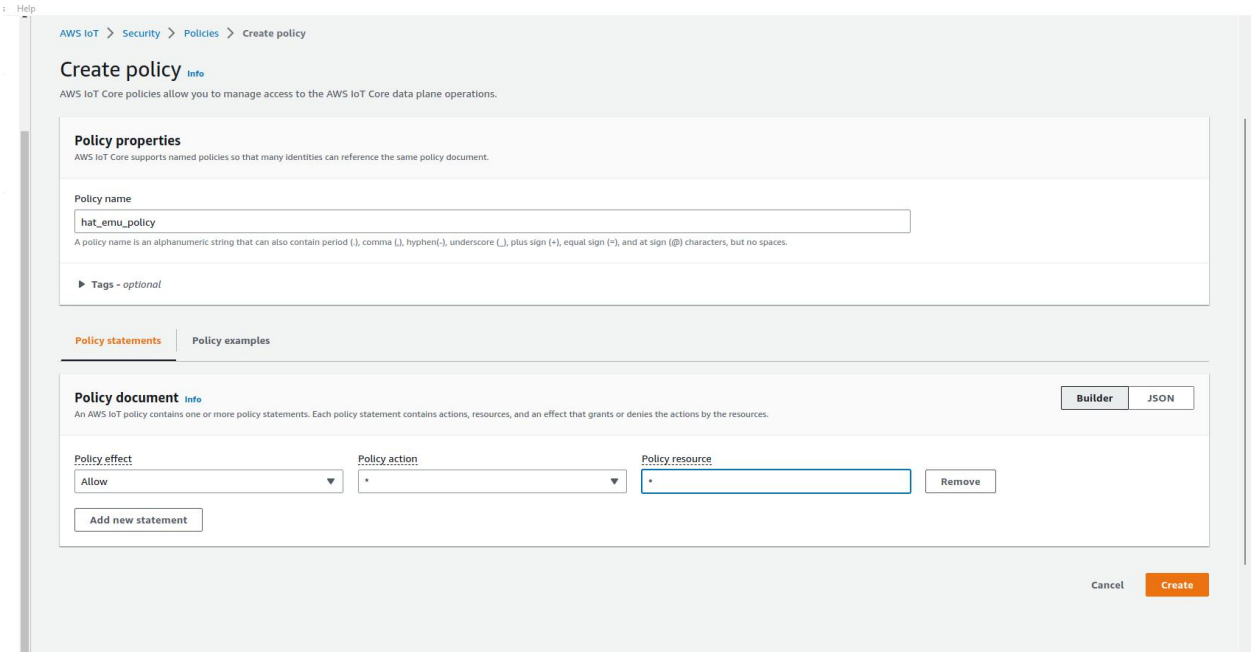
```
>>> %Run temperature-2022-12-12-12-11-02.py
```

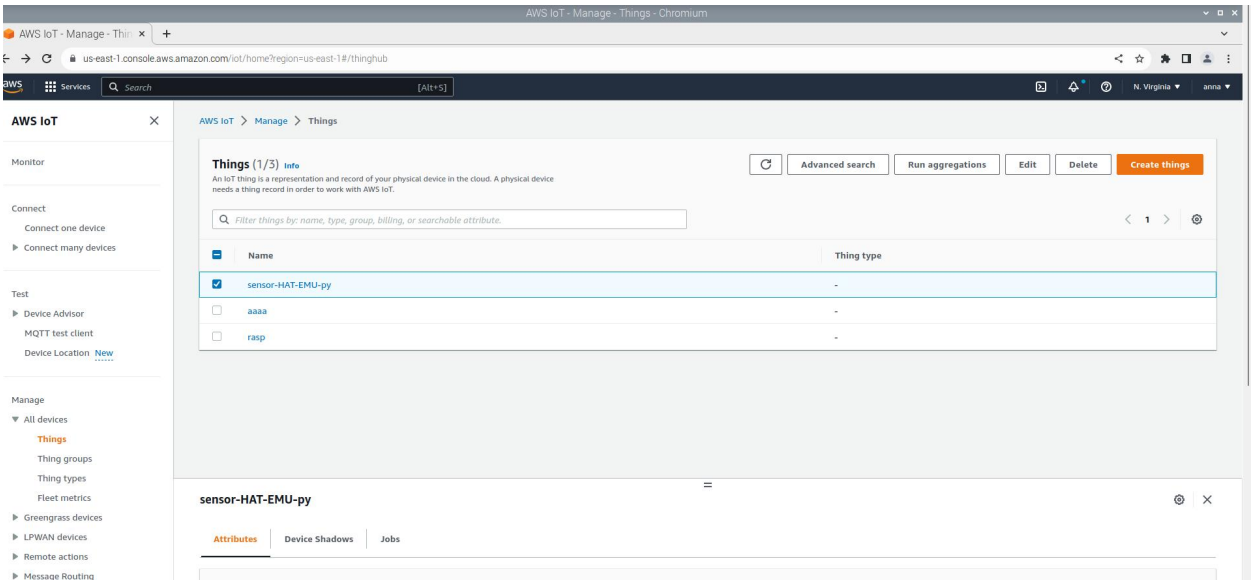
Local Python 3 • /usr/bin/pytho

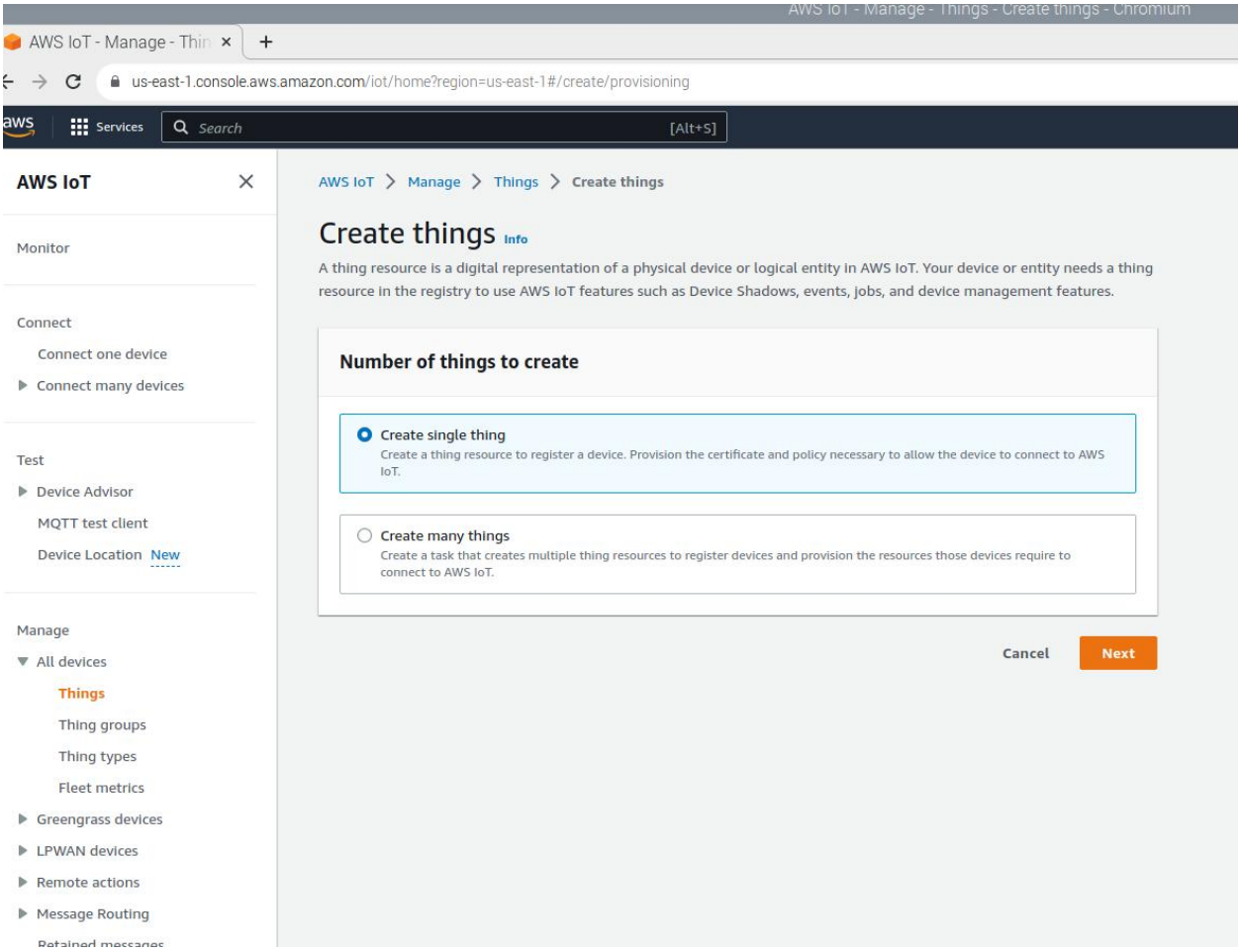



anna@raspberry: ~/Desktop/HAT/iot-test-publish/certificates
le Edit Tabs Help
na@raspberry:~/Desktop $ ls
note.txt
na@raspberry:~/Desktop $ cd HAT
na@raspberry:~/Desktop/HAT $
na@raspberry:~/Desktop/HAT $ ls
s-iot-device-sdk-python-v2
nnect_device_package.zip
t-test-publish
ot-CA.crt
sensor-HAT-EMU-py.cert.pem
sensor-HAT-EMU-py-Policy
sensor-HAT-EMU-py.private.key
sensor-HAT-EMU-py.public.key
start.sh
na@raspberry:~/Desktop/HAT $ cd iot-test-publish
na@raspberry:~/Desktop/HAT/iot-test-publish $
na@raspberry:~/Desktop/HAT/iot-test-publish $ ls
rtificates
na@raspberry:~/Desktop/HAT/iot-test-publish $ cd certificates
na@raspberry:~/Desktop/HAT/iot-test-publish/certificates $
na@raspberry:~/Desktop/HAT/iot-test-publish/certificates $ pip install awsiots
oking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
quirement already satisfied: awsiotsdk in /home/anna/.local/lib/python3.9/site
ackages (1.0.0.dev0)
quirement already satisfied: awscrt==0.16.0 in /home/anna/.local/lib/python3.9
ite-packages (from awsiotsdk) (0.16.0)
na@raspberry:~/Desktop/HAT/iot-test-publish/certificates $


AWS IoT > Security > Policies > Create policy
Create policy Info
AWS IoT Core policies allow you to manage access to the AWS IoT Core data plane operations.
Policy properties
AWS IoT Core supports named policies so that many identities can reference the same policy document.
Policy name
PolicyName
A policy name is an alphanumeric string that can also contain period (.), comma (,), hyphen(-), underscore (_), plus sign (+), equal sign (=), and at sign (@) characters, but no spaces.
Tags - optional
Policy statements
Policy examples
Policy document Info
An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.
Builder
JSON
Policy effect
Allow
Policy action
Choose an action
Policy resource
arn:aws:iot:region:account:resource/resourceName
Remove
Add new statement
Cancel
Create


Help
AWS IoT > Security > Policies > Create policy
Create policy Info
AWS IoT Core policies allow you to manage access to the AWS IoT Core data plane operations.
Policy properties
AWS IoT Core supports named policies so that many identities can reference the same policy document.
Policy name
hat_emu_policy
A policy name is an alphanumeric string that can also contain period (.), comma (,), hyphen(-), underscore (_), plus sign (+), equal sign (=), and at sign (@) characters, but no spaces.
Tags - optional
Policy statements
Policy examples
Policy document Info
An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.
Builder
JSON
Policy effect
Allow
Policy action
*
Policy resource
*
Remove
Add new statement
Cancel
Create


AWS IoT - Manage - Things - Chromium
us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/thinghub
Services
Search
[Alt+S]
N. Virginia
anna
AWS IoT
Monitor
Connect
Connect one device
Connect many devices
Test
Device Advisor
MQTT test client
Device Location New
Manage
All devices
Things
Thing groups
Thing types
Fleet metrics
Greengrass devices
LPWAN devices
Remote actions
Message Routing
AWS IoT > Manage > Things
Things (1/3) Info
An IoT thing is a representation and record of your physical device in the cloud. A physical device needs a thing record in order to work with AWS IoT.
Advanced search
Run aggregations
Edit
Delete
Create things
Filter things by: name, type, group, billing, or searchable attribute.
Name
Thing type
sensor-HAT-EMU-py
aaaa
rasp
sensor-HAT-EMU-py
Attributes
Device Shadows
Jobs


AWS IoT - Manage - Things - Create things - Chromium
AWS IoT - Manage - Thin
us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/create/provisioning
aws
Services
Search
[Alt+S]
AWS IoT
Monitor
Connect
Connect one device
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Device Advisor
MQTT test client
Device Location New
Manage
All devices
Things
Thing groups
Thing types
Fleet metrics
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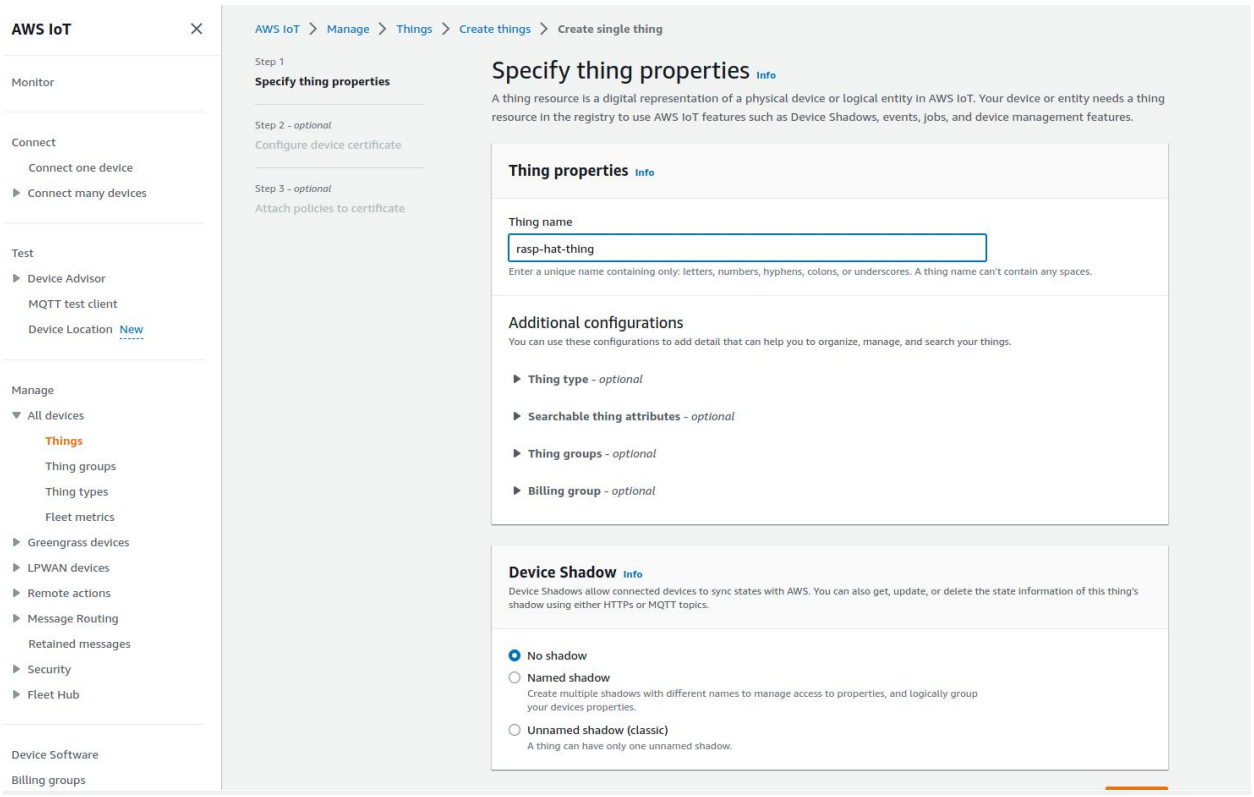
Remote actions
Message Routing
AWS IoT > Manage > Things > Create things
Create things Info
A thing resource is a digital representation of a physical device or logical entity in AWS IoT. Your device or entity needs a thing resource in the registry to use AWS IoT features such as Device Shadows, events, jobs, and device management features.
Number of things to create
Create single thing
Create a thing resource to register a device. Provision the certificate and policy necessary to allow the device to connect to AWS IoT.
Create many things
Create a task that creates multiple thing resources to register devices and provision the resources those devices require to connect to AWS IoT.
Cancel
Next


AWS IoT
Monitor
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Connect one device
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Thing types
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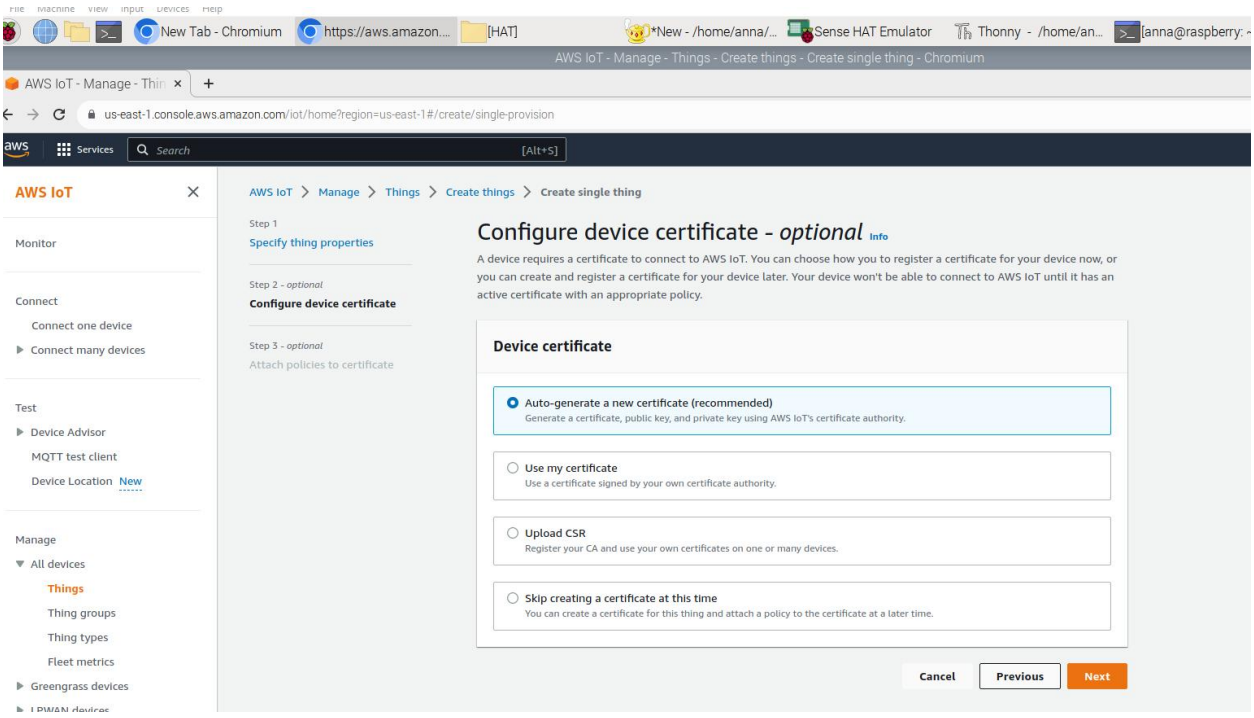
Greengrass devices
LPWAN devices
Remote actions
Message Routing
Retained messages
Security
Fleet Hub
Device Software
Billing groups
AWS IoT > Manage > Things > Create things > Create single thing
Step 1
Specify thing properties
Step 2 - optional
Configure device certificate
Step 3 - optional
Attach policies to certificate
Specify thing properties Info
A thing resource is a digital representation of a physical device or logical entity in AWS IoT. Your device or entity needs a thing resource in the registry to use AWS IoT features such as Device Shadows, events, jobs, and device management features.
Thing properties Info
Thing name
rasp-hat-thing
Enter a unique name containing only: letters, numbers, hyphens, colons, or underscores. A thing name can't contain any spaces.
Additional configurations
You can use these configurations to add detail that can help you to organize, manage, and search your things.
Thing type - optional
Searchable thing attributes - optional
Thing groups - optional
Billing group - optional
Device Shadow Info
Device Shadows allow connected devices to sync states with AWS. You can also get, update, or delete the state information of this thing's shadow using either HTTPs or MQTT topics.
No shadow
Named shadow
Create multiple shadows with different names to manage access to properties, and logically group your devices properties.
Unnamed shadow (classic)
A thing can have only one unnamed shadow.


New Tab - Chromium
https://aws.amazon....
[HAT]
*New - /home/anna/...
Sense HAT Emulator
Thonny - /home/an...
[anna@raspberry:
AWS IoT - Manage - Things - Create things - Create single thing - Chromium
AWS IoT - Manage - Thin
us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/create/single-provision
Services
Search
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AWS IoT
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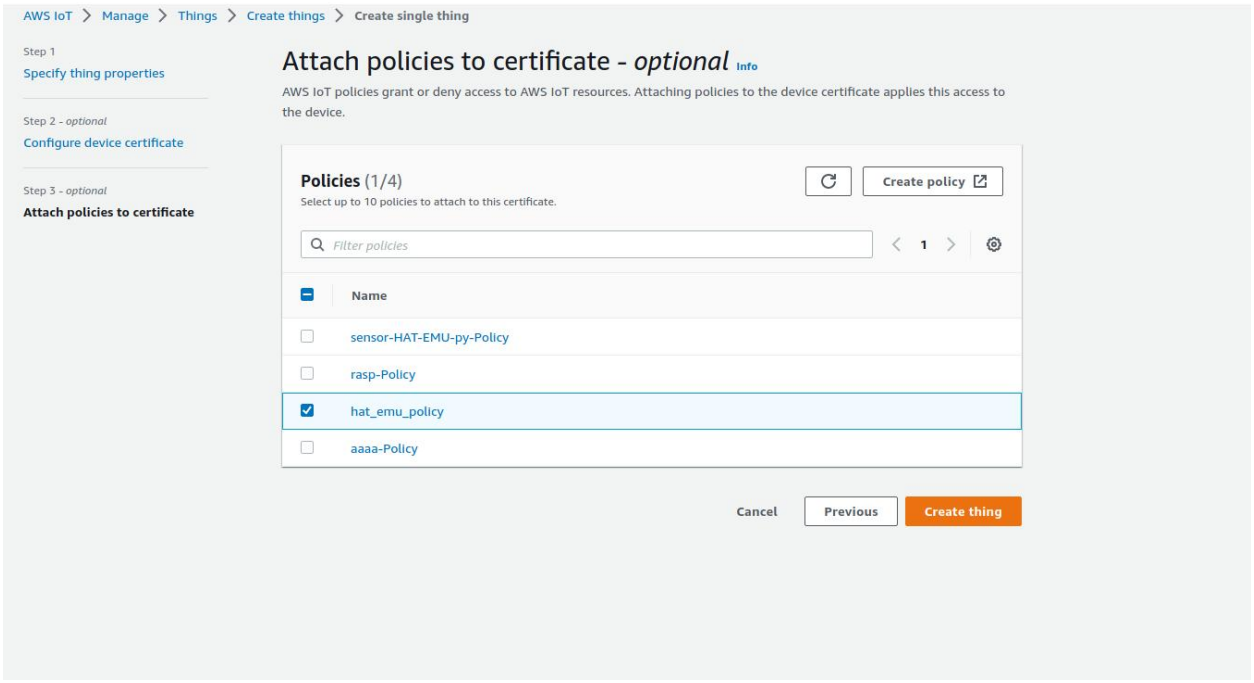
Greengrass devices
AWS IoT > Manage > Things > Create things > Create single thing
Step 1
Specify thing properties
Step 2 - optional
Configure device certificate
Step 3 - optional
Attach policies to certificate
Configure device certificate - optional Info
A device requires a certificate to connect to AWS IoT. You can choose how you to register a certificate for your device now, or you can create and register a certificate for your device later. Your device won't be able to connect to AWS IoT until it has an active certificate with an appropriate policy.
Device certificate
Auto-generate a new certificate (recommended)
Generate a certificate, public key, and private key using AWS IoT's certificate authority.
Use my certificate
Use a certificate signed by your own certificate authority.
Upload CSR
Register your CA and use your own certificates on one or many devices.
Skip creating a certificate at this time
You can create a certificate for this thing and attach a policy to the certificate at a later time.
Cancel
Previous
Next


AWS IoT > Manage > Things > Create things > Create single thing
Step 1
Specify thing properties
Step 2 - optional
Configure device certificate
Step 3 - optional
Attach policies to certificate
Attach policies to certificate - optional Info
AWS IoT policies grant or deny access to AWS IoT resources. Attaching policies to the device certificate applies this access to the device.
Policies (1/4)
Select up to 10 policies to attach to this certificate.
Create policy
Filter policies
1
Name
sensor-HAT-EMU-py-Policy
rasp-Policy
hat_emu_policy
aaaa-Policy
Cancel
Previous
Create thing

Download certificates and keys

Download certificate and key files to install on your device so that it can connect to AWS.

Device certificate

You can activate the certificate now, or later. The certificate must be active for a device to connect to AWS IoT.

Device certificate

f47dfbac4d2...te.pem.crt

Deactivate certificate | Download

Key files

The key files are unique to this certificate and can't be downloaded after you leave this page. Download them now and save them in a secure place.

⚠ This is the only time you can download the key files for this certificate.

Public key file

f47dfbac4d223d19728bf24...e7c91ef-public.pem.key

Download

Private key file

f47dfbac4d223d19728bf24...7c91ef-private.pem.key

Download

Root CA certificates

Download the root CA certificate file that corresponds to the type of data endpoint and cipher suite you're using. You can also download the root CA certificates later.

Amazon trust services endpoint

RSA 2048 bit key: Amazon Root CA 1

Download

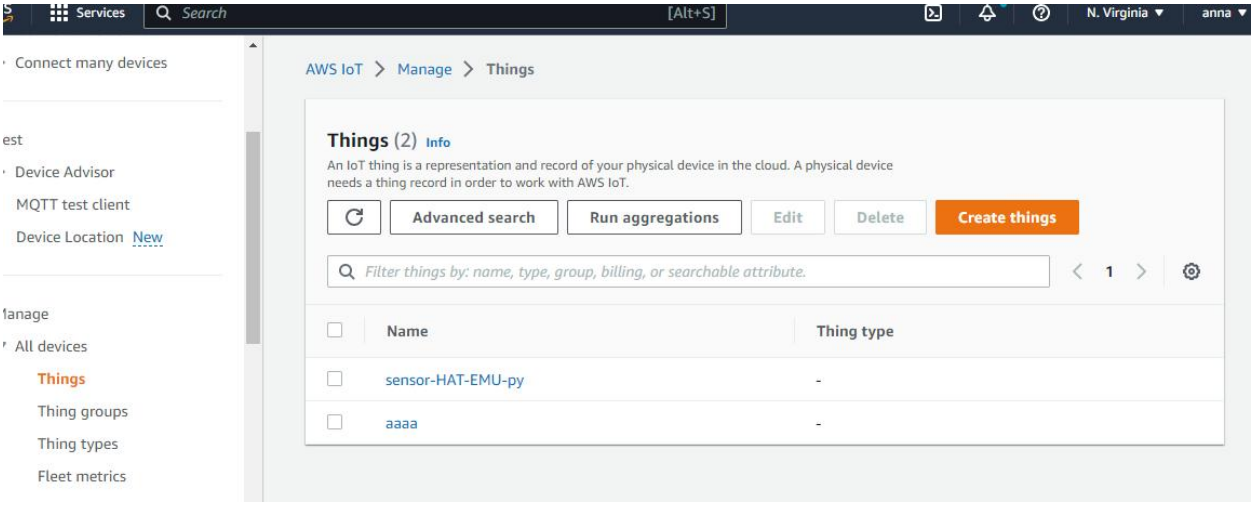
Amazon trust services endpoint

ECC 256 bit key: Amazon Root CA 3

Download

If you don't see the root CA certificate that you need here, AWS IoT supports additional root CA certificates. These root CA certificates and others are available in our developer guides. Learn more

Done


Services
Search
[Alt+S]
N. Virginia
anna
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Thing types
Fleet metrics
AWS IoT > Manage > Things
Things (2) Info
An IoT thing is a representation and record of your physical device in the cloud. A physical device needs a thing record in order to work with AWS IoT.
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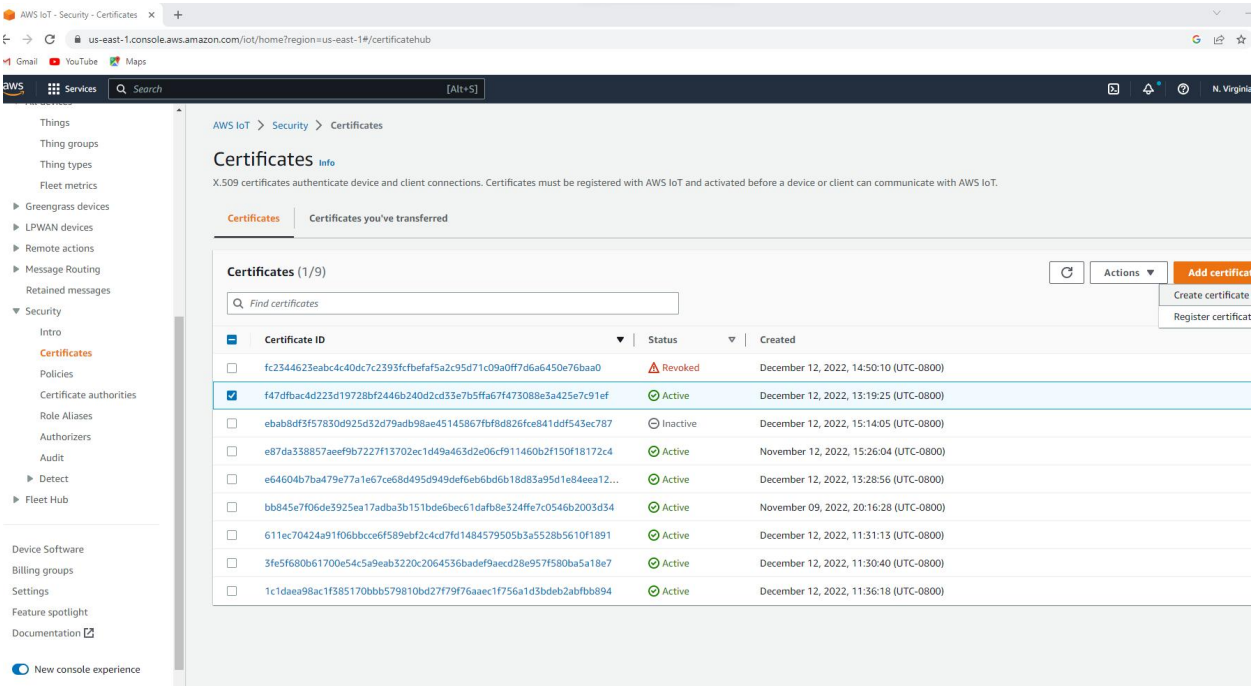
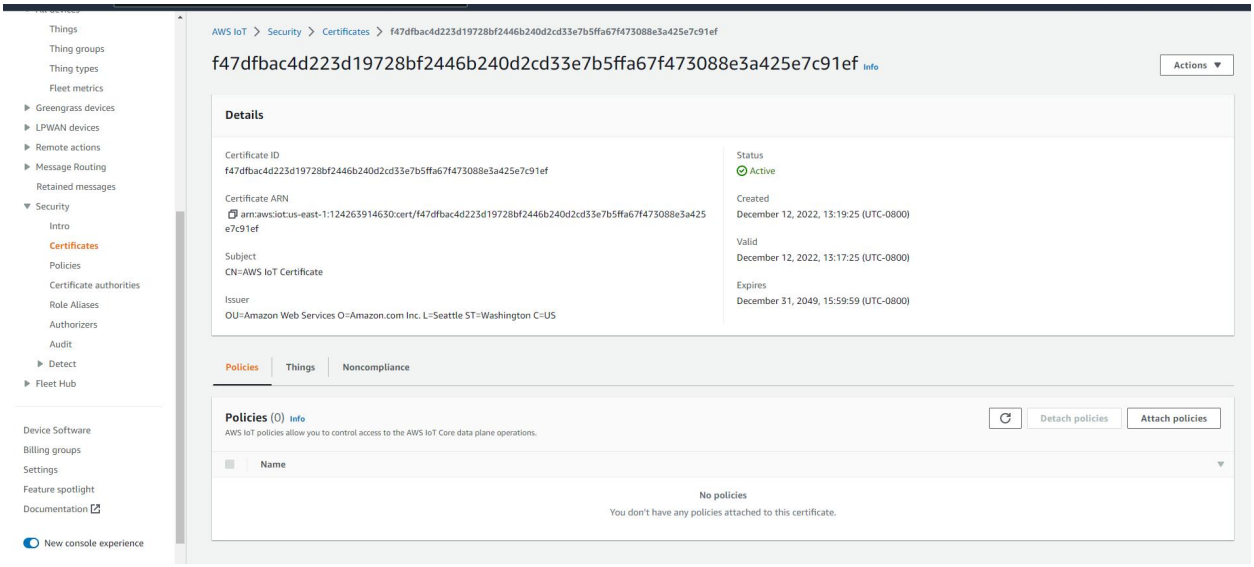
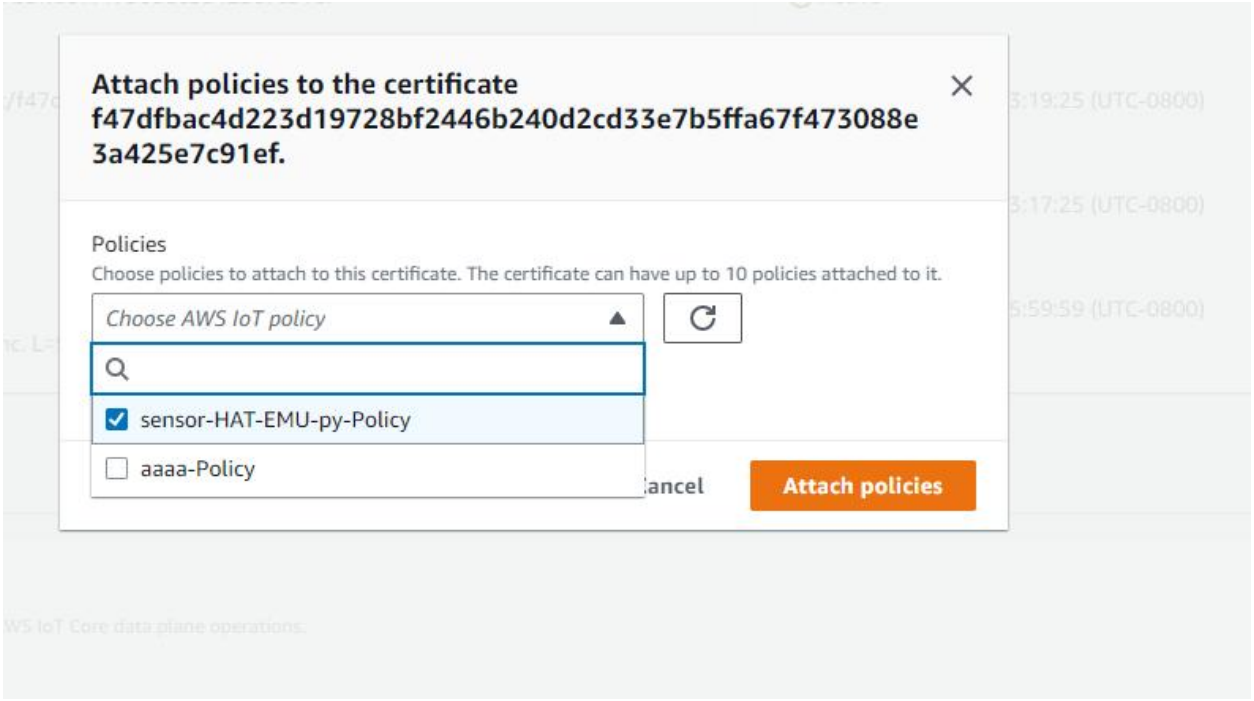
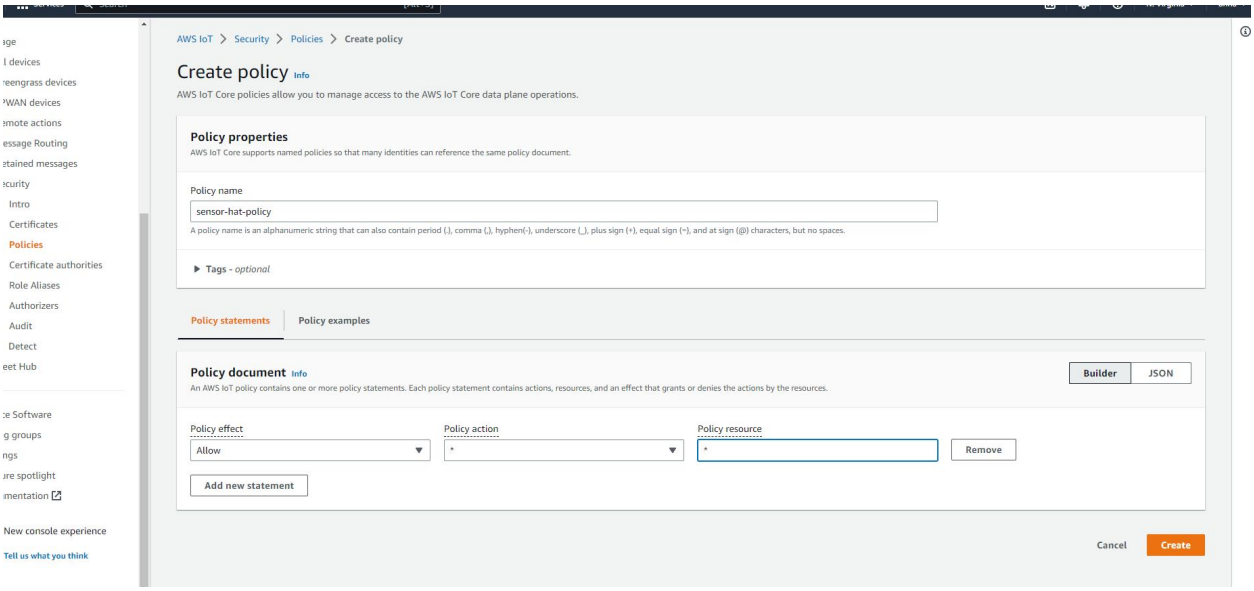
Run aggregations
Edit
Delete
Create things
Filter things by: name, type, group, billing, or searchable attribute.
1
Name
Thing type
sensor-HAT-EMU-py
-
aaaa
-


AWS IoT - Security - Certificates
us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/certificatehub
Gmail
YouTube
Maps
Services
Search
[Alt+S]
N. Virginia
Things
Thing groups
Thing types
Fleet metrics
Greengrass devices
LPWAN devices
Remote actions
Message Routing
Retained messages
Security
Intro
Certificates
Policies
Certificate authorities
Role Aliases
Authorizers
Audit
Detect
Fleet Hub
Device Software
Billing groups
Settings
Feature spotlight
Documentation
New console experience
AWS IoT > Security > Certificates
Certificates Info
X.509 certificates authenticate device and client connections. Certificates must be registered with AWS IoT and activated before a device or client can communicate with AWS IoT.
Certificates
Certificates you've transferred
Certificates (1/9)
Actions
Add certificat
Create certificate
Register certificat
Find certificates
Certificate ID
Status
Created
fc2344623eabc4c40dc7c2393fcfbefaf5a2c95d71c09a0ff7d6a6450e76baa0
Revoked
December 12, 2022, 14:50:10 (UTC-0800)
f47dfbac4d223d19728bf2446b240d2cd33e7b5ffa67f473088e3a425e7c91ef
Active
December 12, 2022, 13:19:25 (UTC-0800)
ebab8df3f57830d925d32d79adb98ae45145867fbf8d826fce841ddf543ec787
Inactive
December 12, 2022, 15:14:05 (UTC-0800)
e87da338857aeef9b7227f13702ec1d49a463d2e06cf911460b2f150f18172c4
Active
November 12, 2022, 15:26:04 (UTC-0800)
e64604b7ba479e77a1e67ce68d495d949def6eb6bd6b18d83a95d1e84eea12...
Active
December 12, 2022, 13:28:56 (UTC-0800)
bb845e7f06de3925ea17adba3b151bde6bec61dafb8e324ffe7c0546b2003d34
Active
November 09, 2022, 20:16:28 (UTC-0800)
611ec70424a91f06bbcce6f589ebf2c4cd7fd1484579505b3a5528b5610f1891
Active
December 12, 2022, 11:31:13 (UTC-0800)
3fe5f680b61700e54c5a9eab3220c2064536badef9aecd28e957f580ba5a18e7
Active
December 12, 2022, 11:30:40 (UTC-0800)
1c1daea98ac1f385170bbb579810bd27f79f76aaec1f756a1d3bdeb2abfbb894
Active
December 12, 2022, 11:36:18 (UTC-0800)


Things
Thing groups
Thing types
Fleet metrics
Greengrass devices
LPWAN devices
Remote actions
Message Routing
Retained messages
Security
Intro
Certificates
Policies
Certificate authorities
Role Aliases
Authorizers
Audit
Detect
Fleet Hub
Device Software
Billing groups
Settings
Feature spotlight
Documentation
New console experience
AWS IoT > Security > Certificates > f47dfbac4d223d19728bf2446b240d2cd33e7b5ffa67f473088e3a425e7c91ef
f47dfbac4d223d19728bf2446b240d2cd33e7b5ffa67f473088e3a425e7c91ef Info
Actions
Details
Certificate ID
f47dfbac4d223d19728bf2446b240d2cd33e7b5ffa67f473088e3a425e7c91ef
Certificate ARN
arn:aws:iot:us-east-1:124263914630:cert/f47dfbac4d223d19728bf2446b240d2cd33e7b5ffa67f473088e3a425e7c91ef
Subject
CN=AWS IoT Certificate
Issuer
OU=Amazon Web Services O=Amazon.com Inc. L=Seattle ST=Washington C=US
Status
Active
Created
December 12, 2022, 13:19:25 (UTC-0800)
Valid
December 12, 2022, 13:17:25 (UTC-0800)
Expires
December 31, 2049, 15:59:59 (UTC-0800)
Policies
Things
Noncompliance
Policies (0) Info
AWS IoT policies allow you to control access to the AWS IoT Core data plane operations.
Detach policies
Attach policies
Name
No policies
You don't have any policies attached to this certificate.


Attach policies to the certificate f47dfbac4d223d19728bf2446b240d2cd33e7b5ffa67f473088e3a425e7c91ef.
Policies
Choose policies to attach to this certificate. The certificate can have up to 10 policies attached to it.
Choose AWS IoT policy
sensor-HAT-EMU-py-Policy
aaaa-Policy
Attach policies


AWS IoT > Security > Policies > Create policy
Create policy Info
AWS IoT Core policies allow you to manage access to the AWS IoT Core data plane operations.
Policy properties
AWS IoT Core supports named policies so that many identities can reference the same policy document.
Policy name
sensor-hat-policy
A policy name is an alphanumeric string that can also contain period (.), comma (,), hyphen(-), underscore (_), plus sign (+), equal sign (=), and at sign (@) characters, but no spaces.
Tags - optional
Policy statements
Policy examples
Policy document Info
An AWS IoT policy contains one or more policy statements. Each policy statement contains actions, resources, and an effect that grants or denies the actions by the resources.
Builder
JSON
Policy effect
Allow
Policy action
*
Policy resource
*
Remove
Add new statement
Cancel
Create
Intro
Certificates
Policies
Certificate authorities
Role Aliases
Authorizers
Audit
Detect
New console experience
Tell us what you think