

Introduction of MQTT

A Popular Protocol for IoT



What You Will Learn...

#MQTT #ARDUINO

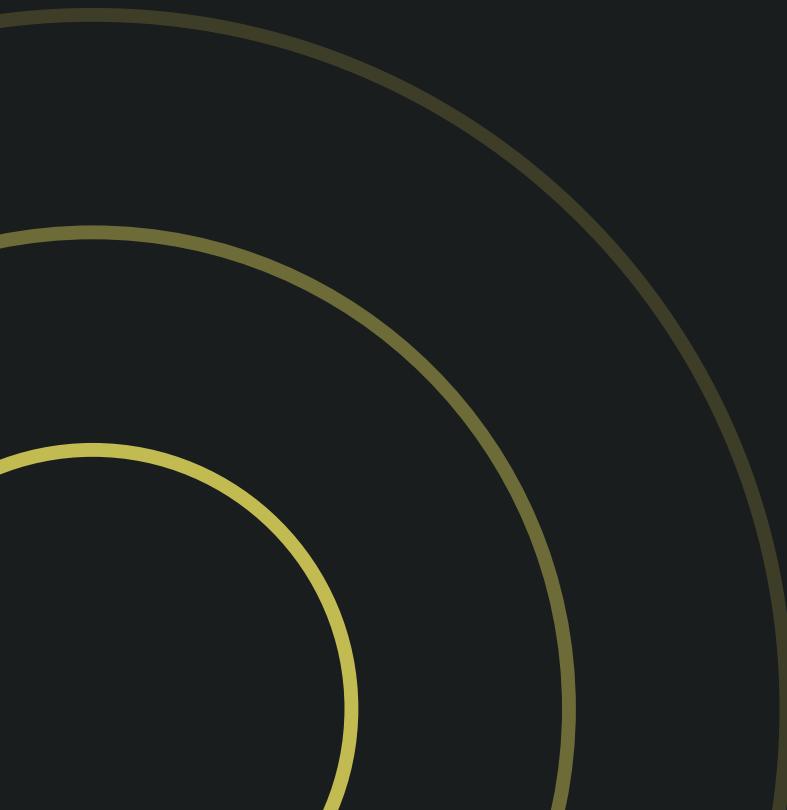
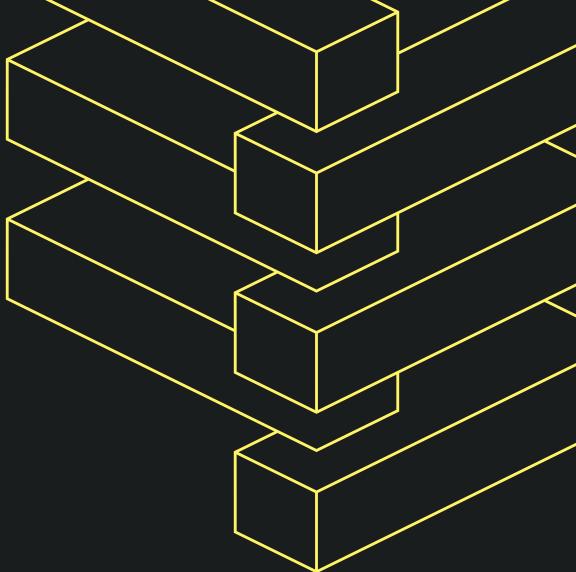


Hint

In this course, we take Arduino to process data from sensor and as MQTT publisher. So, you must know the basic of Arduino as prerequisites before you start this course.

01. What is MQTT?
02. How Does MQTT Work
03. Popular Open Source Broker
04. How to Deploy MQTT Broker
05. Simple Implementation

What is MQTT?



What is MQTT?

MQTT (Message Queuing Telemetry Transport) is a lightweight, open, and simple messaging protocol.



How Does MQTT Work?

Following broker-based architecture

All messages are routed and distributed by the MQTT broker.
Each client does not need to establish a direct connection.

Working with publish/subscribe pattern

Clients are categorized into publishers and subscribers.
Publishers send messages, while subscribers receive messages.

Routing messages based on topic

The hierarchy in MQTT topics is established using slashes (/),
resembling the structure of URL paths.

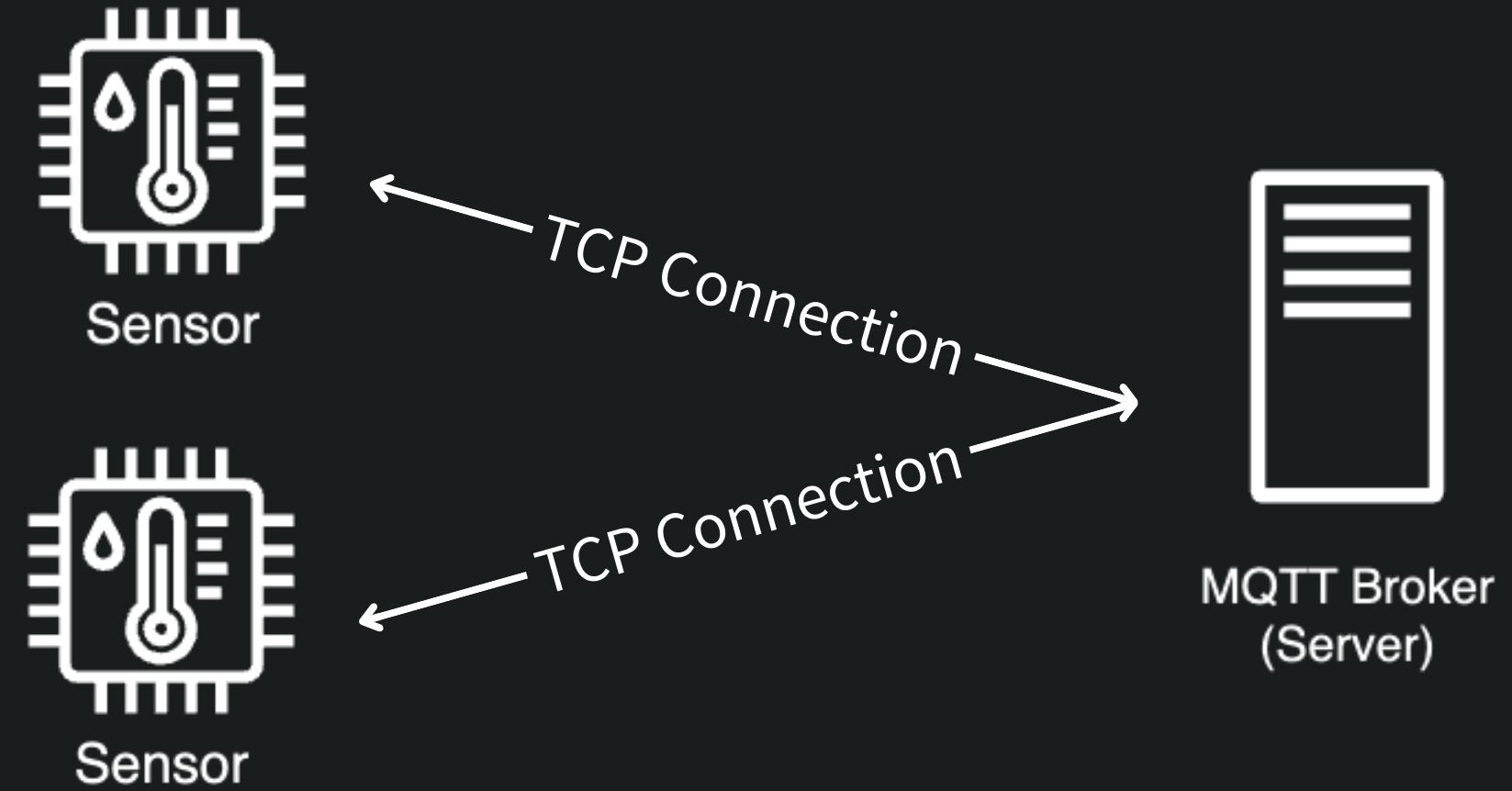


Publish/Subscribe pattern

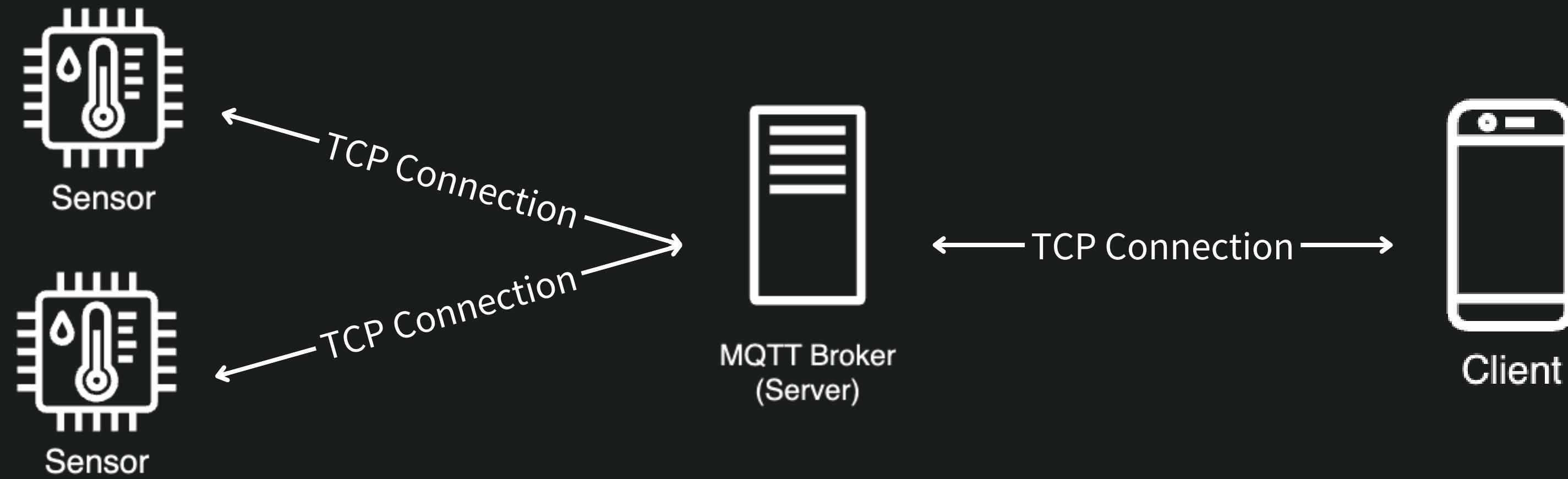


MQTT Broker
(Server)

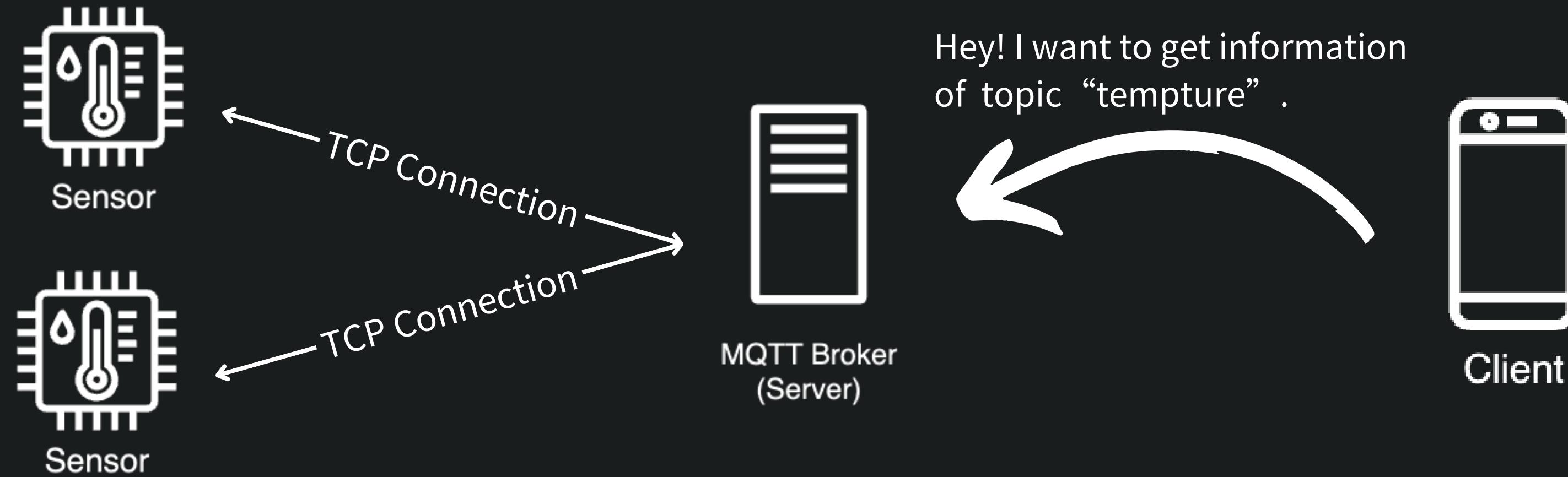
Publish/Subscribe pattern



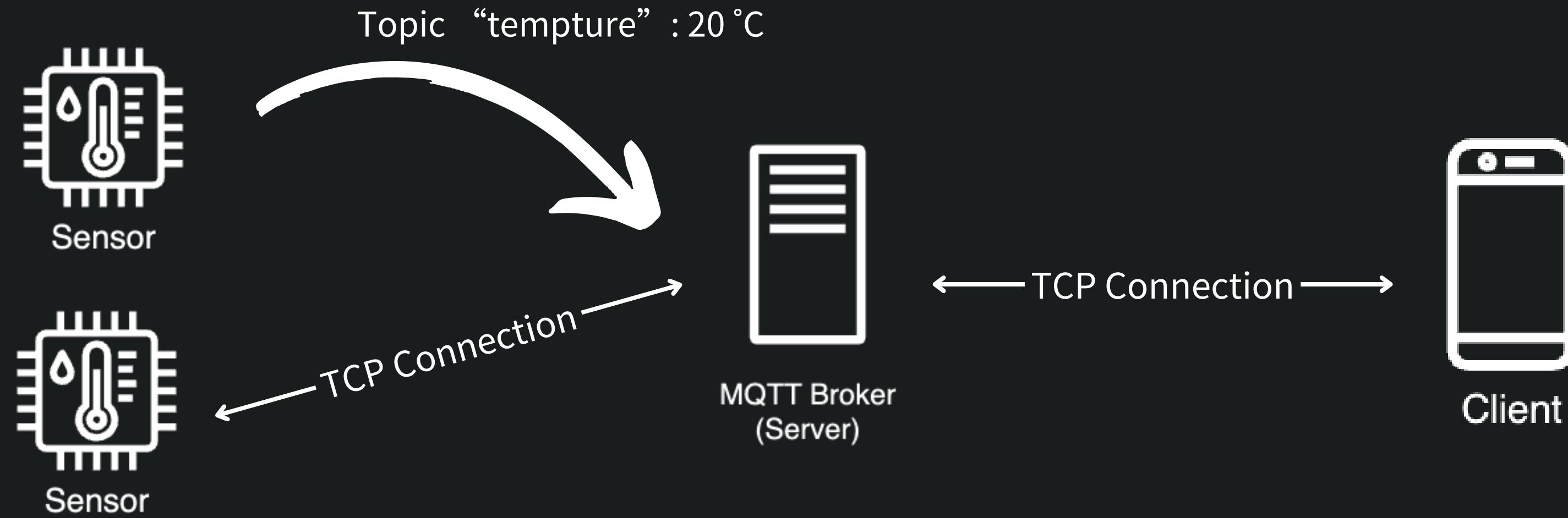
Publish/Subscribe pattern



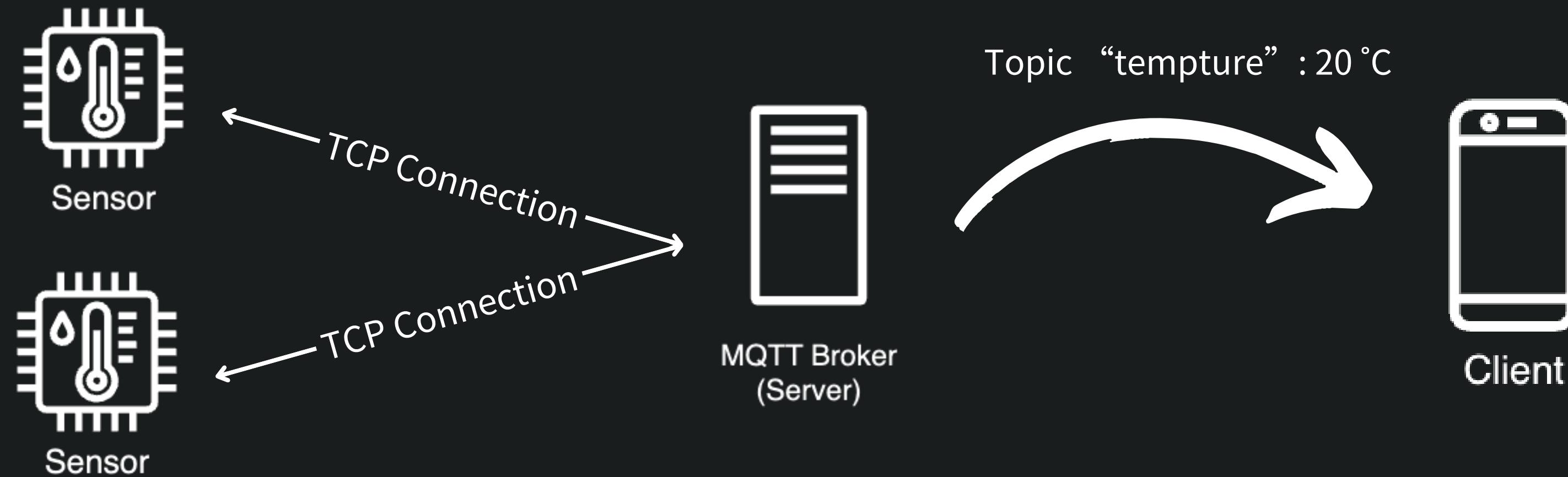
Publish/Subscribe pattern



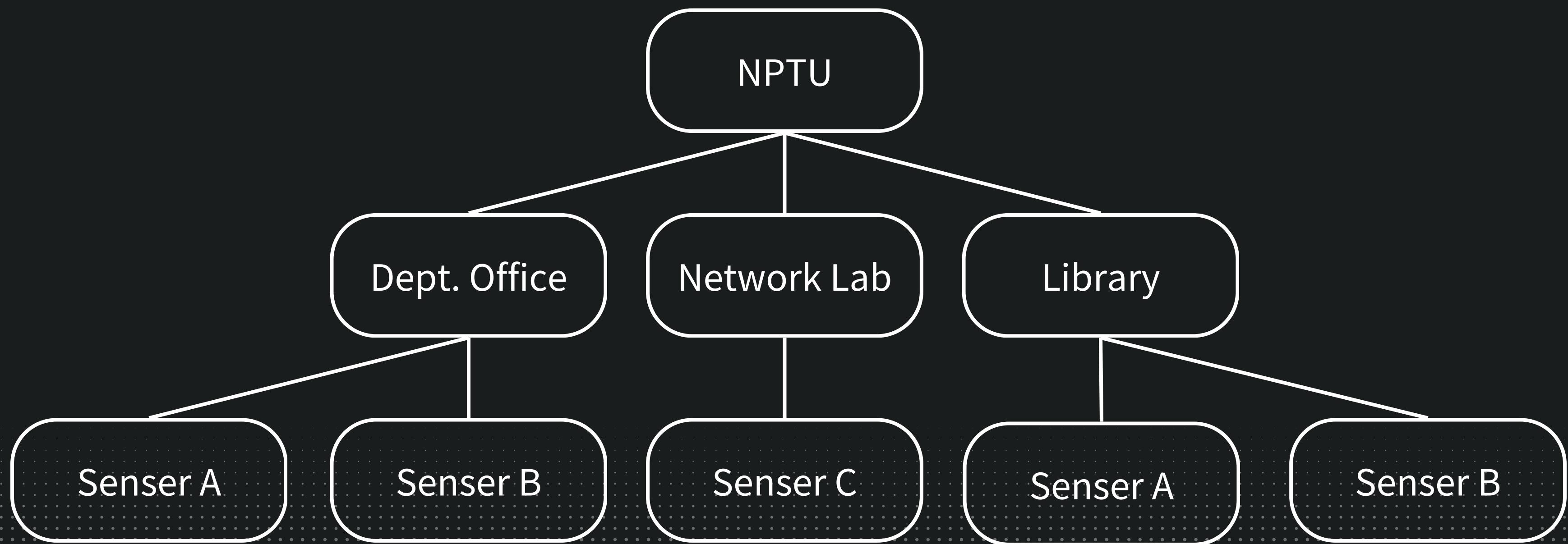
Publish/Subscribe pattern



Publish/Subscribe pattern

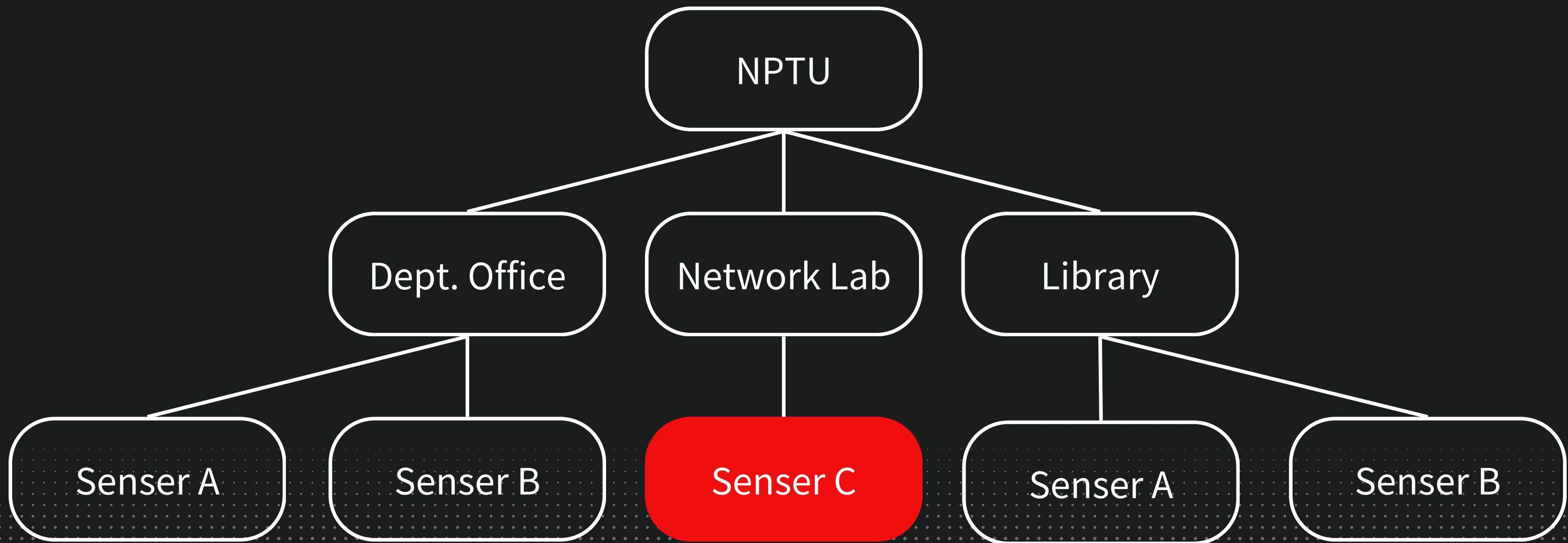


Topic based routing



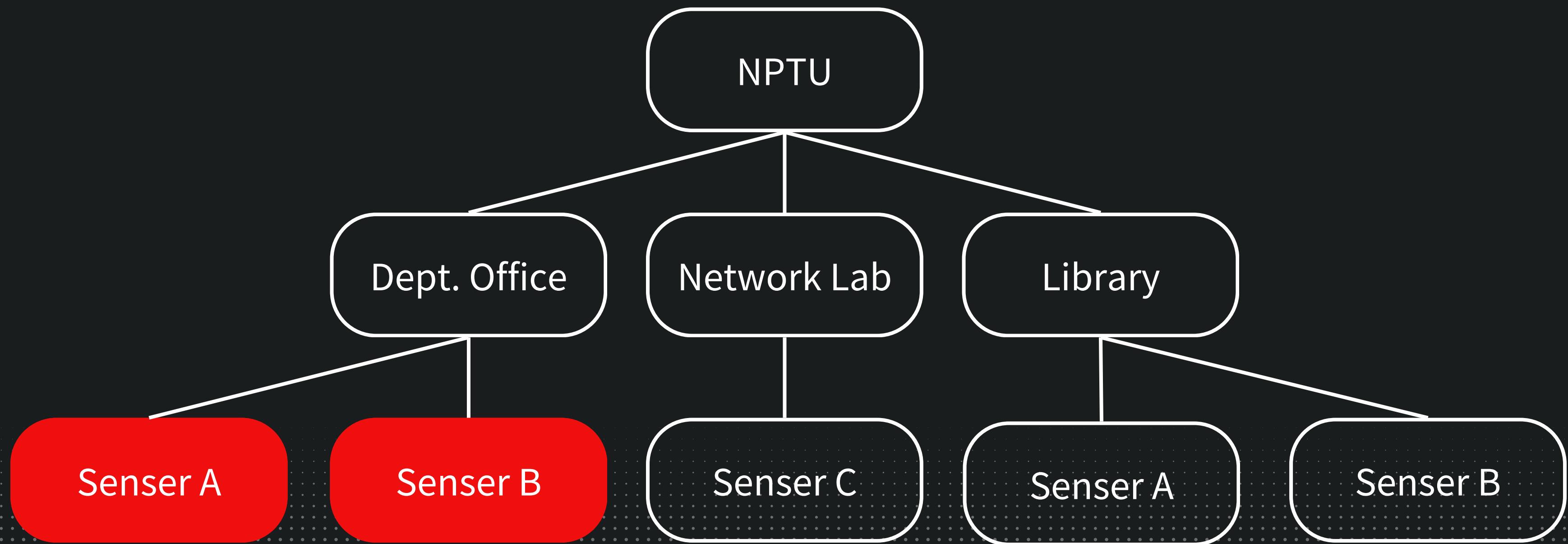
Topic based routing

NPTU/Network Lab/Senser C



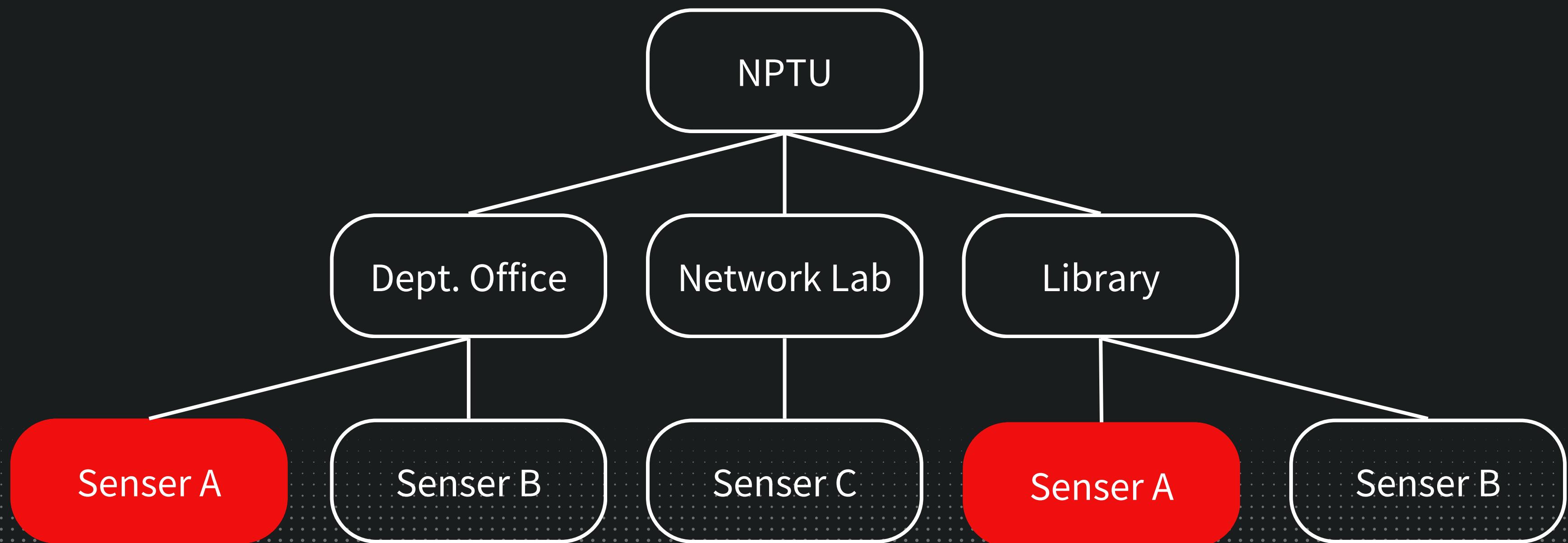
Topic based routing

NPTU/Dept. Office/#



Topic based routing

NPTU/+/Senser A



Popular Open Source Broker

Mosquitto

<https://mosquitto.org>



EMQX

<https://www.emqx.io>



RabbitMQ

<https://www.rabbitmq.com/>



HiveMQ

<https://www.hivemq.com/>



Deploy MQTT Broker

<https://mosquitto.com>

Ubuntu

```
~ sudo apt update  
~ sudo apt install -y mosquitto
```

MacOS

```
~ brew install mosquitto
```



Windows

Follow the link:

<https://mosquitto.org/download/#windows>, and
download the installer.



moqutto -h

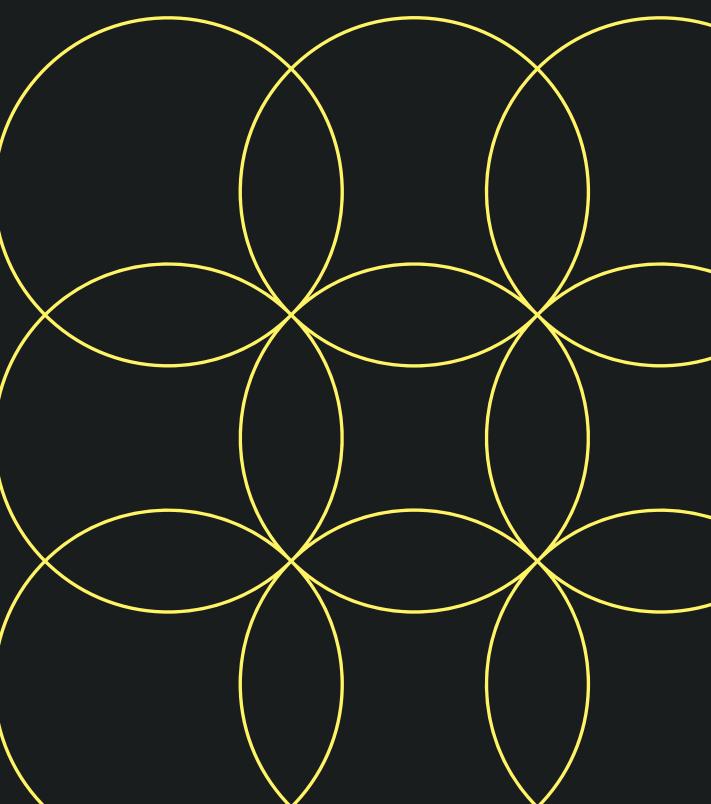
Show help page.

moqutto -c [config file]

Specify the broker config file.

moqutto -d

Put the broker into the background after starting.

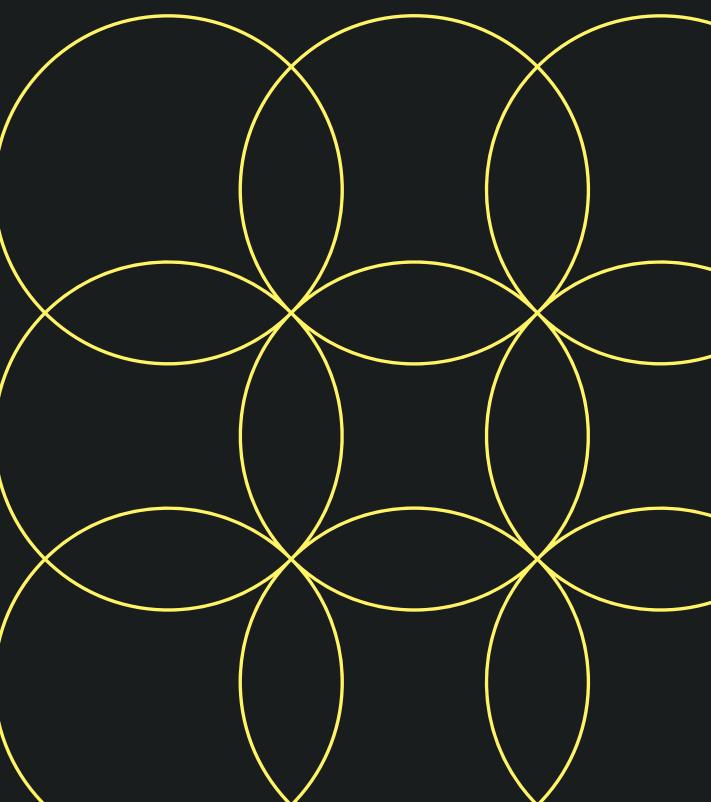


moqutto -p [port]

Start the broker listening on the specified port.

moqutto -v

Verbose mode - enable all logging types.



MQTT Client

Publisher

https://github.com/nptucs-networklab/mqtt-course/blob/main/example/MQTT_client/mqtt_publisher.py

Subscriber

https://github.com/nptucs-networklab/mqtt-course/blob/main/example/MQTT_client/mqtt_publisher.py

Tool - MQTTX

<https://mqtx.app/>



Connect to other broker...

Can not connect? Why?

Listeners

The network ports that mosquito listens on can be controlled using listeners. The default listener options can be overridden and further listeners can be created.

General Options

`bind_address address`

This option is deprecated and will be removed in a future version. Use the `listener` instead.

Listen for incoming network connections on the specified IP address/hostname only. This is useful to restrict access to certain network interfaces. To restrict access to mosquito to the local host only, use "bind_address localhost". This only applies to the default listener. Use the `listener` option to control other listeners.

It is recommended to use an explicit `listener` rather than rely on the implicit default listener options like this.

Not reloaded on reload signal.

```
allow_anonymous [ true | false ]
```

Boolean value that determines whether clients that connect without providing a username are allowed to connect. If set to `false` then another means of connection should be created to control authenticated client access.

Defaults to `false`, unless no listeners are defined in the configuration file, in which case it set to `true`, but connections are only allowed from the local machine.

If `per_listener_settings` is `true`, this option applies to the current listener being configured only. If `per_listener_settings` is `false`, this option applies to all listeners.

Important

In version 1.6.x and earlier, this option defaulted to `true` unless there was another security option set.

Add the following
line in configure file.

```
1 allow_anonymous true  
2 listener 1883
```

Work?

Did you checkout the packet?

Wireshark

You can filter the packets using the specified filter.

The screenshot shows the Wireshark interface with a dark theme. The title bar reads "mqtt.pcapng". The toolbar contains various icons for file operations, search, and selection. The main window has a green header bar with the filter "mqtt && ip.addr==139.162.125.227". The table below lists network traffic:

No.	Time	Source	Destination	Protocol	Length	Info
52	2.436979	172.31.1.102	139.162.125.227	MQTT	80	Connect Command
58	2.479598	139.162.125.227	172.31.1.102	MQTT	70	Connect Ack
60	2.479997	172.31.1.102	139.162.125.227	MQTT	79	Subscribe Request (id=1)
61	2.524686	139.162.125.227	172.31.1.102	MQTT	71	Subscribe Ack (id=1)
211	4.568874	172.31.1.102	139.162.125.227	MQTT	80	Connect Command
215	4.635779	139.162.125.227	172.31.1.102	MQTT	70	Connect Ack
216	4.635939	172.31.1.102	139.162.125.227	MQTT	92	Publish Message [mqtt/pac
217	4.677682	139.162.125.227	172.31.1.102	MQTT	92	Publish Message [mqtt/pac
630	14.574170	172.31.1.102	139.162.125.227	MQTT	92	Publish Message [mqtt/pac
631	14.625475	139.162.125.227	172.31.1.102	MQTT	92	Publish Message [mqtt/pac

MQTT Publish Packet

What is the topic?

What is the message?

Wireshark · Packet 216 · mqtt.pcapng

Frame 216: 32 bytes on wire (256 bits), 32 bytes captured (256 bits) on link
> Ethernet II, Src: Apple_09:de:d5 (50:ed:3c:09:de:d5), Dst: Cisco_79:ac:40 (00:0c:29:79:ac:40)
> Internet Protocol Version 4, Src: 172.31.1.102, Dst: 139.162.125.227
> Transmission Control Protocol, Src Port: 65331, Dst Port: 1883, Seq: 15, Ack: 16, Len: 24
MQ Telemetry Transport Protocol, Publish Message
Header Flags: 0x30, Message Type: Publish Message, QoS Level: At most once
Msg Len: 24
Topic Length: 11
Topic: mqtt/packet
Message: 48656c6c6f2c206d717474

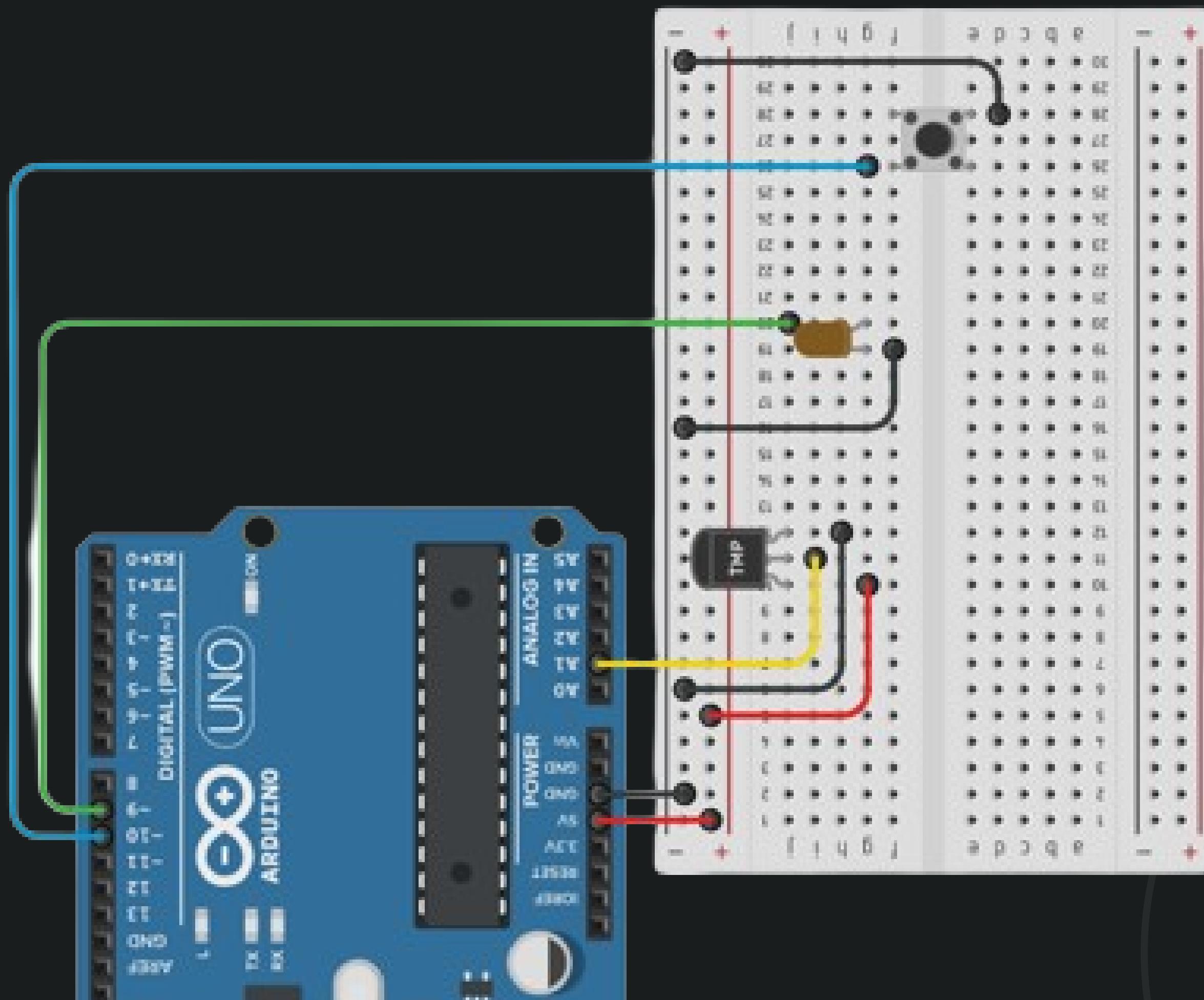
Hex	Dec	ASCII
0000	58 97 bd 79 ac 40 50 ed 3c 09 de d5 08 00 45 00	X y @P < E
0010	00 4e 00 00 40 00 40 06 83 9f ac 1f 01 66 8b a2	N @ @ f ..
0020	7d e3 ff 33 07 5b ea bd 04 3d 88 94 3b cc 80 18	} 3 [.. = .. ; ..
0030	08 06 2e 40 00 00 01 01 08 0a 33 64 fa 59 45 f1	.. @ 3d YE ..
0040	f9 43 30 18 00 0b 6d 71 74 74 2f 70 61 63 6b 65	.C0 .. mq tt/packe
0050	74 48 65 6c 6c 6f 2c 20 6d 71 74 74	tHello, mqtt

Show packet bytes

Help Close

Arduino as MQTT Client

Simple Implementation



Open Arduino IDE and Programming

[Source Code](#)

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