EMQ X Cloud Webinar

Ensure MQTT Security with TLS/SSL in EMQ X

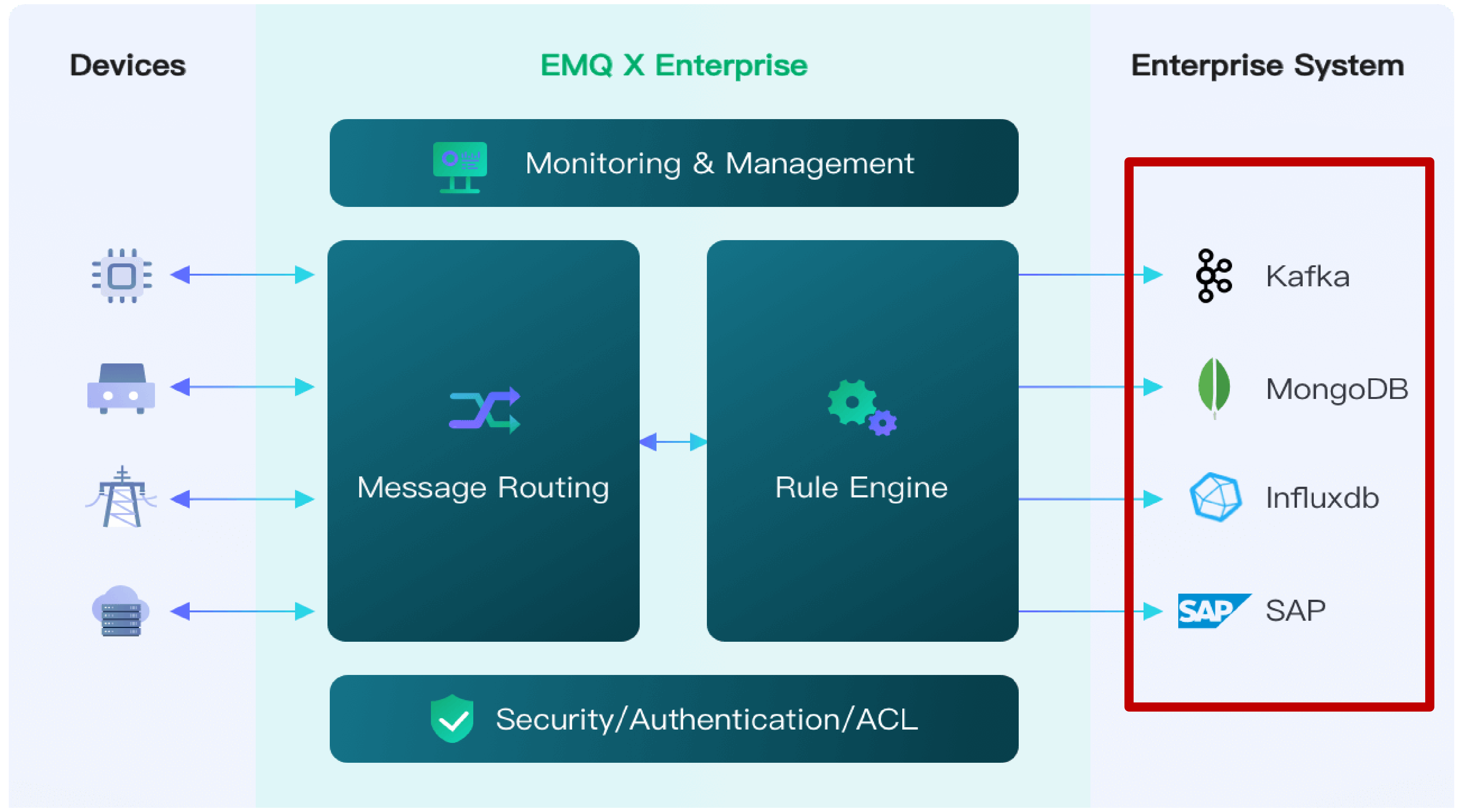
February 9th
9:00am EST / 3:00pm CET / 2:00pm UTC

Speaker:
Kary Ware, Sales Engineer @EMQ

Agenda

- Introduction to EMQ X Cloud and on-prem products
- Overview of SSL/TLS security
- How to verify certificates and certificate chains using openssl
- How to map certificate files to EMQ X listeners (cloud and on-prem)
- Example: Mapping Let's Encrypt certificates to EMQ X
- Demo: Generating self-signed certificates and mapping to EMQ X
  Separate tutorial video so you can try it yourselves.
- Summary and Q & A

Introduction to EMQ X Cloud and on-prem products



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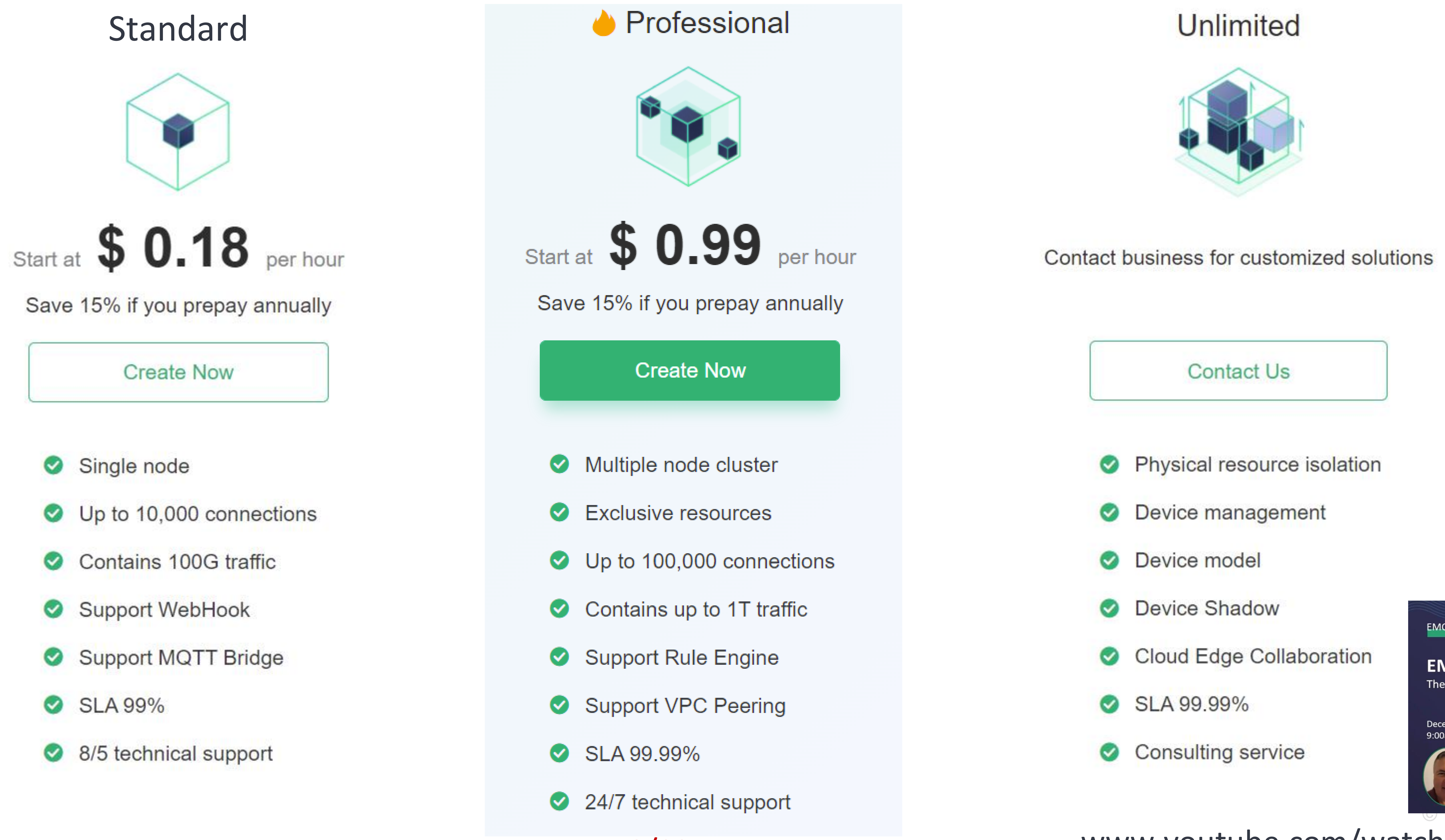
EMQ X Cloud

All plans offer high performance fully 100% MQTT compliant message brokers
Rule Engine: Process messages in real-time



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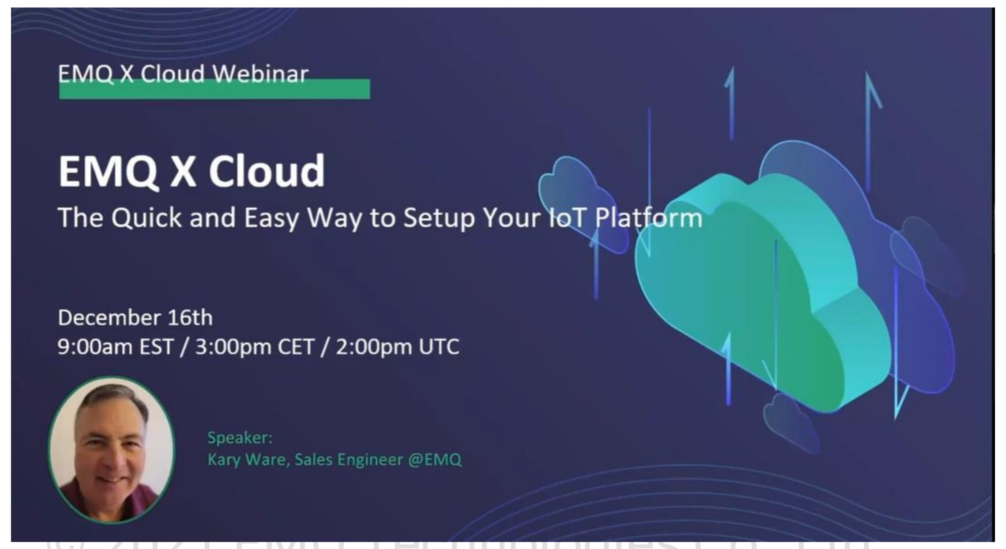
Create Now	Create Now	Contact Us
✓ Single node	✓ Multiple node cluster	✓ Physical resource isolation
✓ Up to 10,000 connections	✓ Exclusive resources	✓ Device management
✓ Contains 100G traffic	✓ Up to 100,000 connections	✓ Device model
✓ Support WebHook	✓ Contains up to 1T traffic	✓ Device Shadow
✓ Support MQTT Bridge	✓ Support Rule Engine	✓ Cloud Edge Collaboration
✓ SLA 99%	✓ Support VPC Peering	✓ SLA 99.99%
✓ 8/5 technical support	✓ SLA 99.99%	✓ Consulting service
	✓ 24/7 technical support	

TLS/SSL


EMQ X Cloud Webinar
EMQ X Cloud
The Quick and Easy Way to Setup Your IoT Platform
December 16th
9:00am EST / 3:00pm CET / 2:00pm UTC
Speaker:
Kary Ware, Sales Engineer @EMQ

www.youtube.com/watch?v=-ybaUlSiSdE

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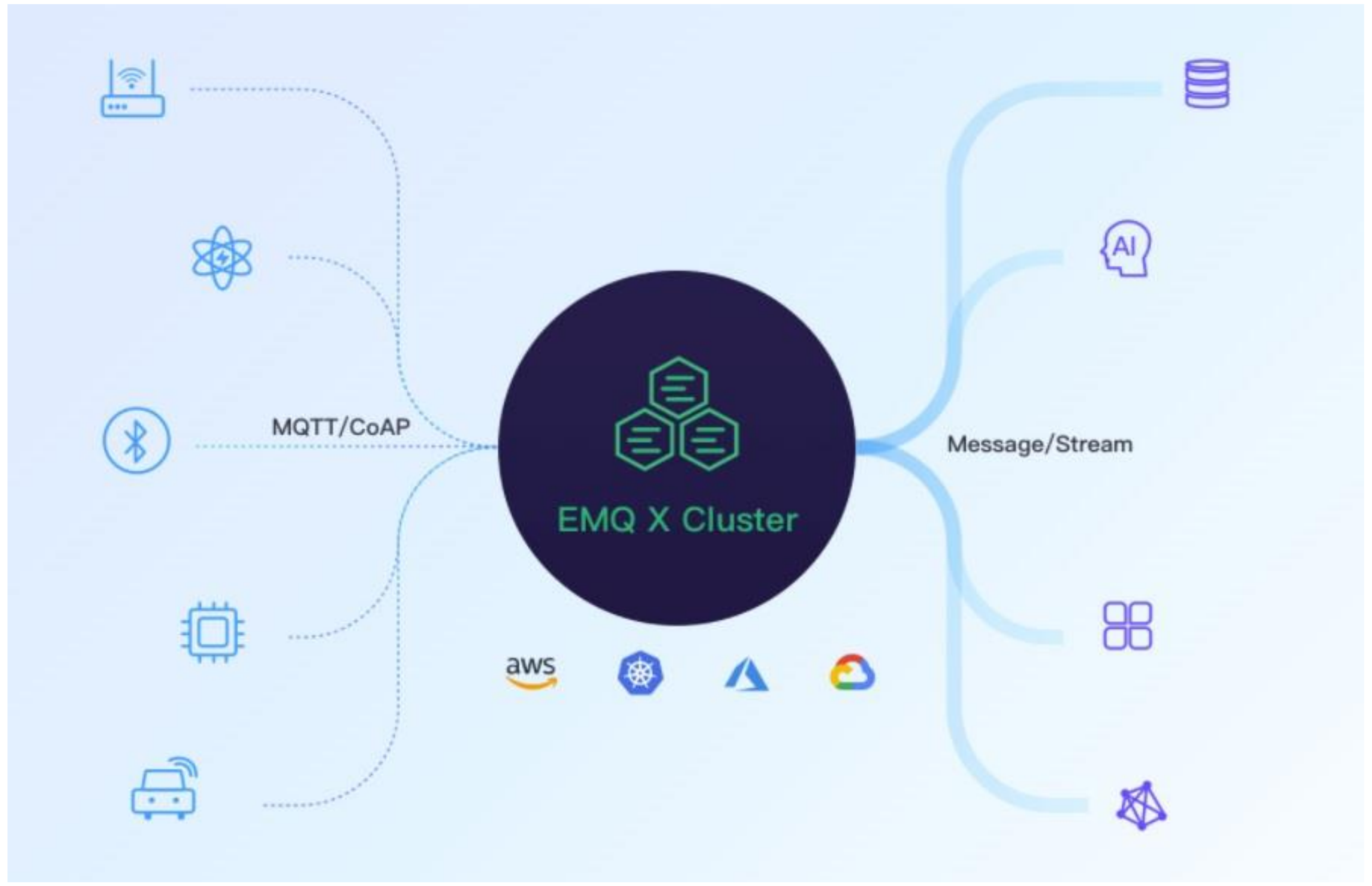
EMQ X on-prem

Both are high performance fully 100% MQTT compliant message brokers
Rule Engine: Process messages in real-time

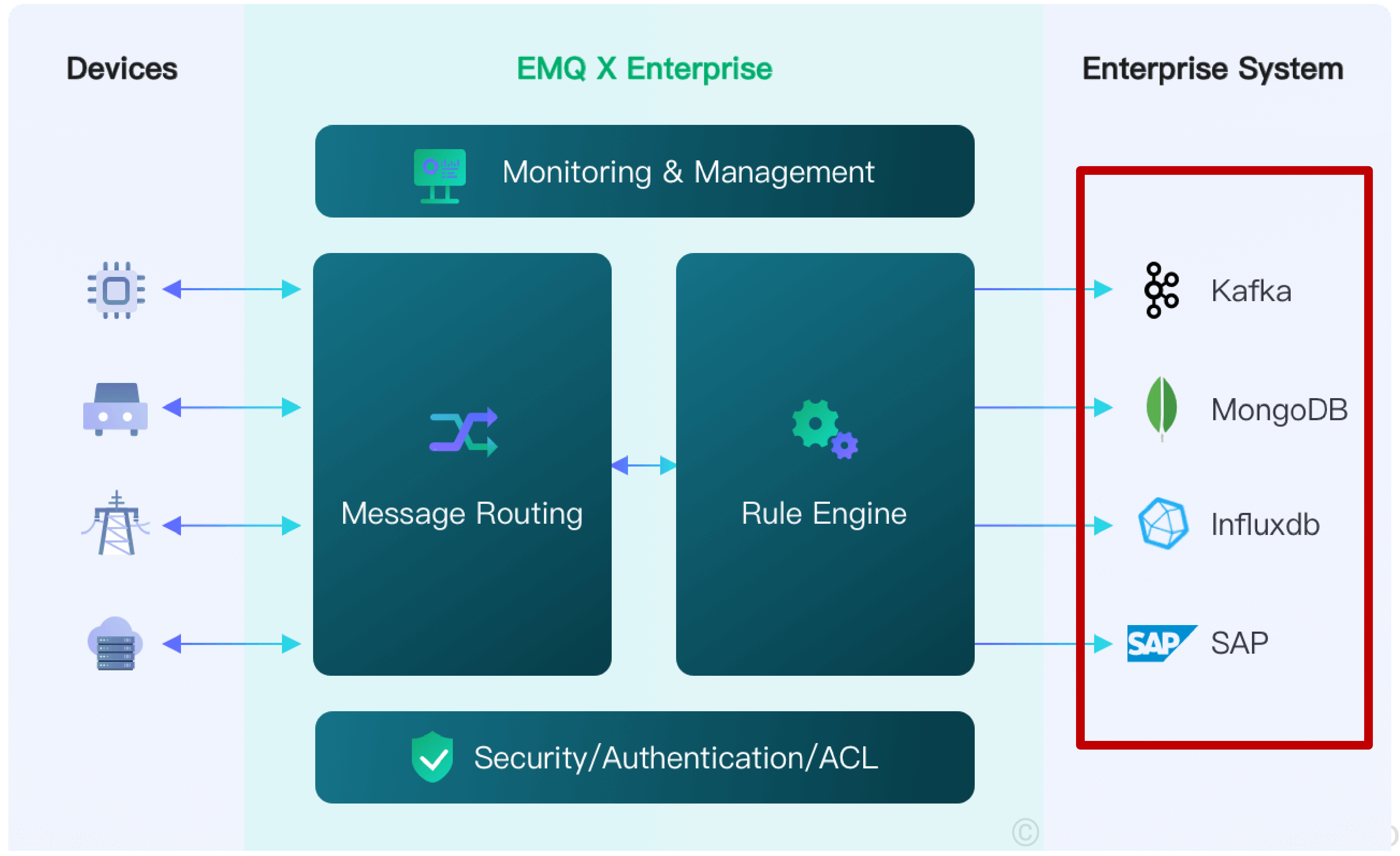
EMQ X Broker/Community Edition

- Open source
- High performance
- Real-time message processing
- 100K connections per node
- TLS/SSL Security



EMQ X Enterprise

- Based on Broker
- 1M connections per node
- Data persistence to many popular databases
- Kafka bridge



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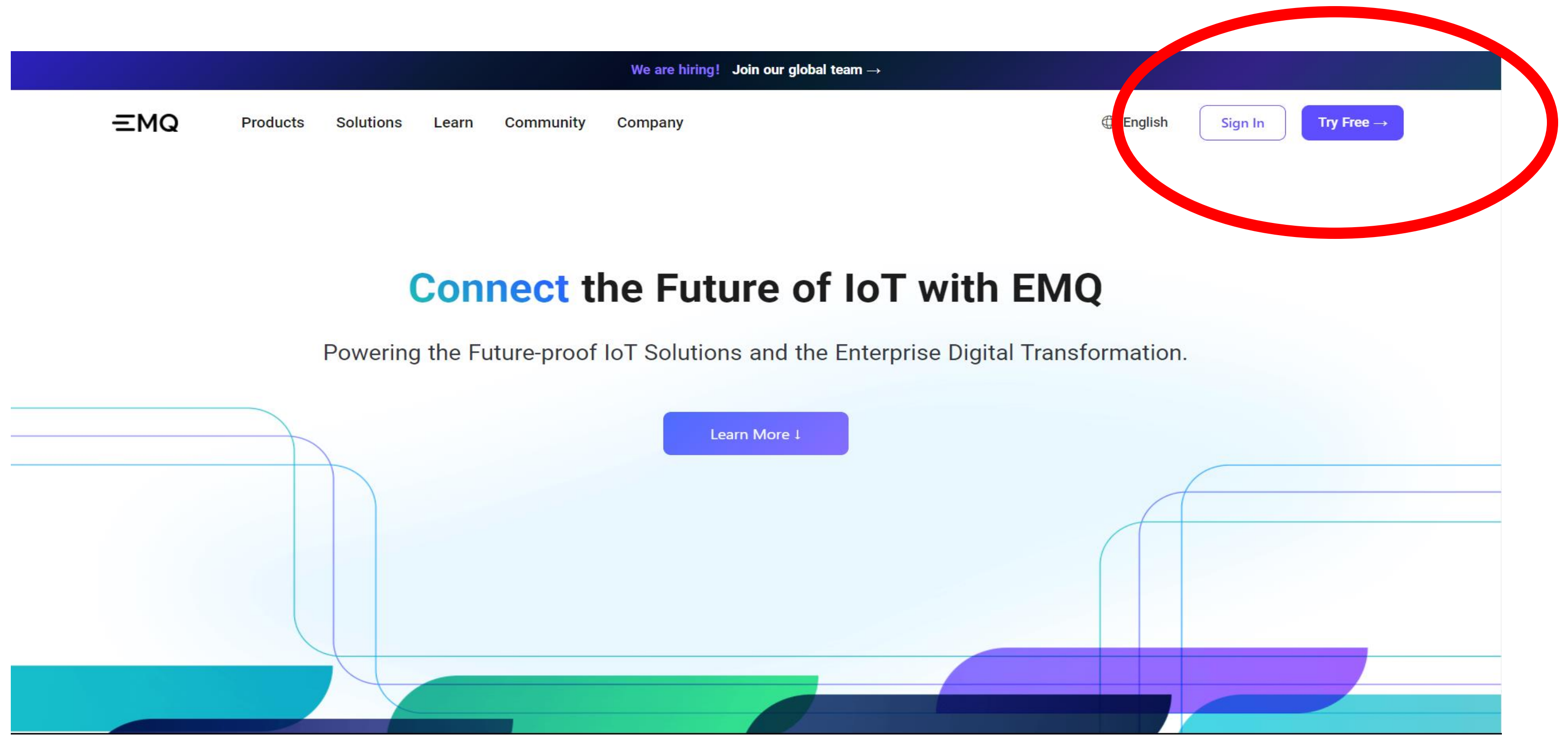
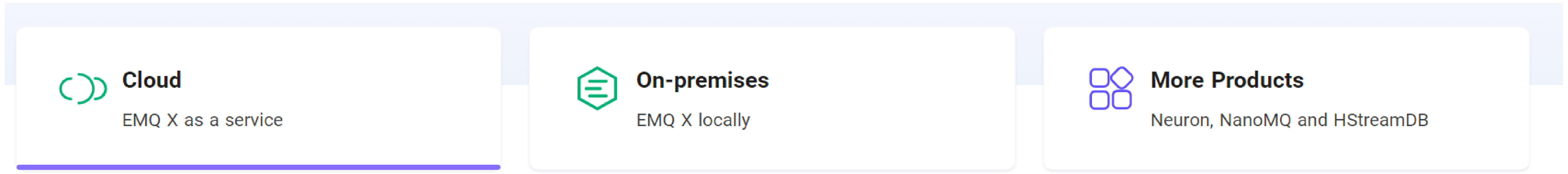
and click **Try Free**



Connect the Future of IoT with EMQ

Powering the Future-proof IoT Solutions and the Enterprise Digital Transformation.

Choose **Cloud** or On-Premises



Cloud
EMQ X as a service

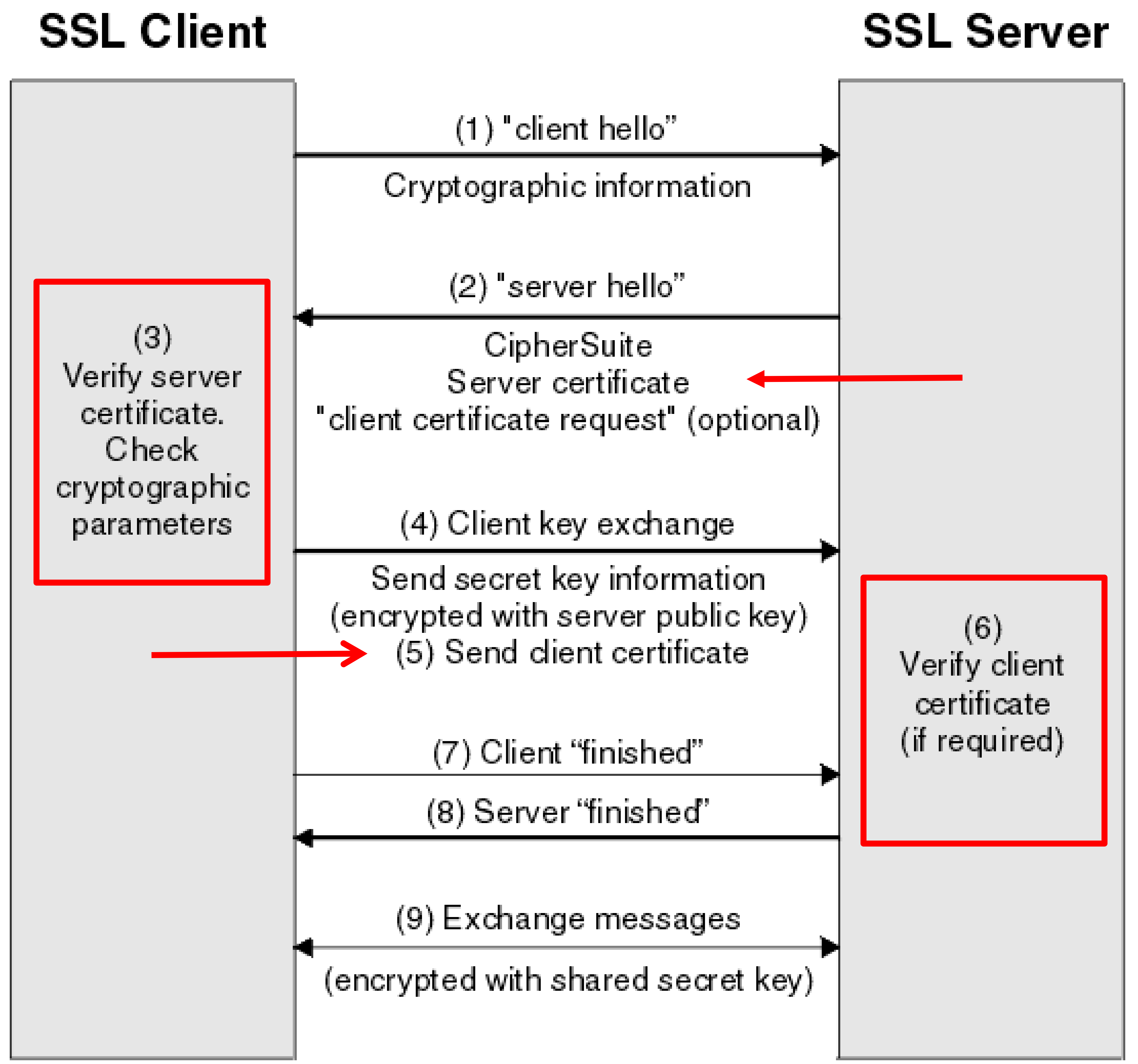
On-premises
EMQ X locally

More Products
Neuron, NanoMQ and HStreamDB

Follow the instructions

You don't need a credit card!

Overview of SSL/TLS security


SSL Client
SSL Server
(1) "client hello"
Cryptographic information
(2) "server hello"
CipherSuite
Server certificate
"client certificate request" (optional)
(3)
Verify server certificate.
Check cryptographic parameters
(4) Client key exchange
Send secret key information
(encrypted with server public key)
(5) Send client certificate
(6)
Verify client certificate
(if required)
(7) Client "finished"
(8) Server "finished"
(9) Exchange messages
(encrypted with shared secret key)

www.emqx.com/en/blog/emqx-server-ssl-tls-secure-connection-configuration-guide

Two main levels of security in MQTT and EMQ X

Username/password and client ID

- Client sends username/password and client ID in MQTT CONNECT packet.
- EMQ X broker validates client username/password or client ID

  using internal or external database such as MongoDB, MySQL, PostgreSQL, Redis
- This can be turned off for testing purposes

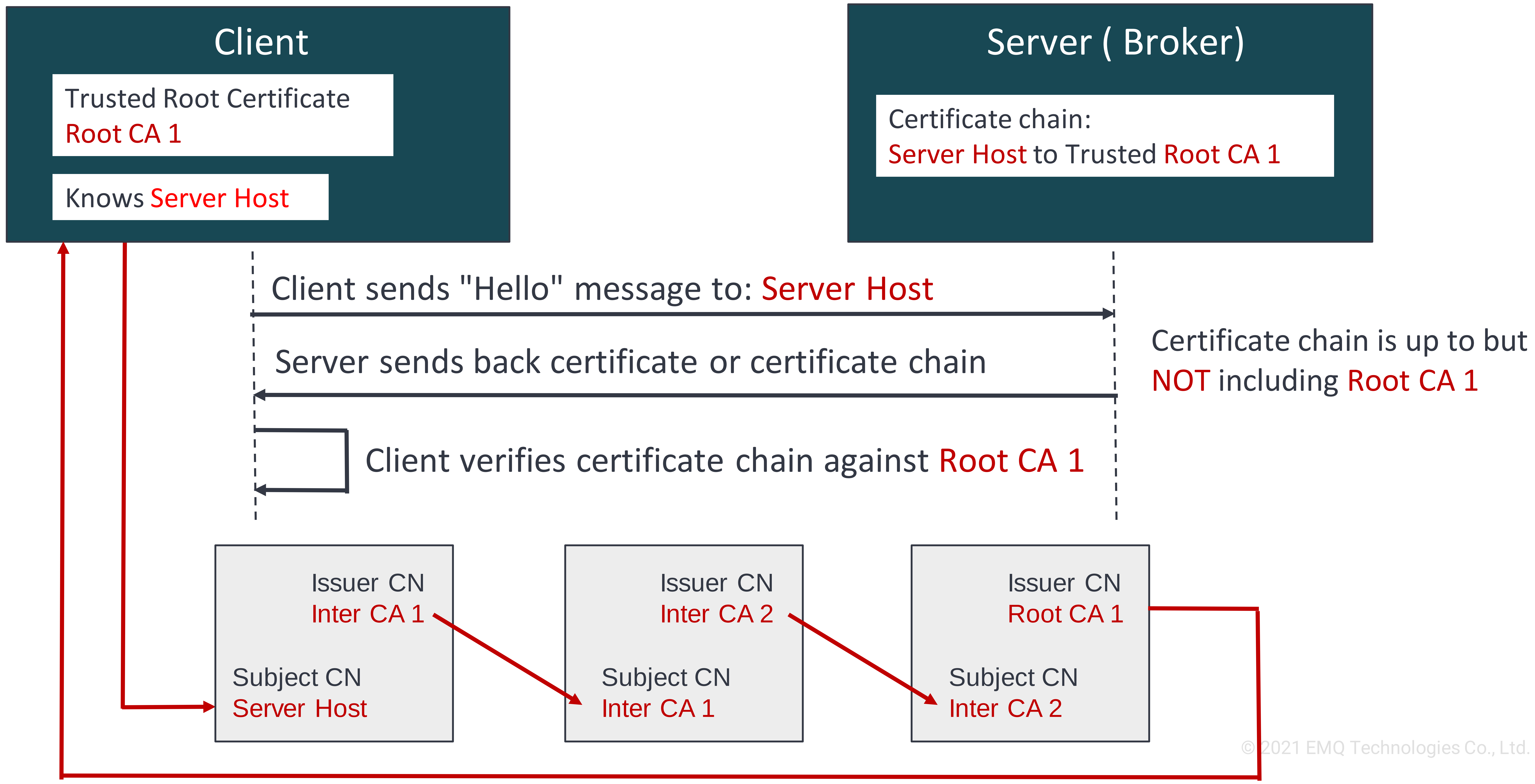
Transport Layer Security (TLS): encryption + authentication using trust certificates

- One-way TLS: Client verifies identity of the server
- Two-way TLS (mTLS): Server also verifies the identity of the client

TLS security and certificates are the focus of this webinar

One-way TLS example

Client verifies identity of the server (broker) using trusted certificate chain



Client

Trusted Root Certificate
Root CA 1

Knows Server Host

Server (Broker)

Certificate chain:
Server Host to Trusted Root CA 1

Client sends "Hello" message to: Server Host

Server sends back certificate or certificate chain

Client verifies certificate chain against Root CA 1

Certificate chain is up to but NOT including Root CA 1

Issuer CN	Subject CN
Inter CA 1	Server Host
Inter CA 2	Inter CA 1
Root CA 1	Inter CA 2

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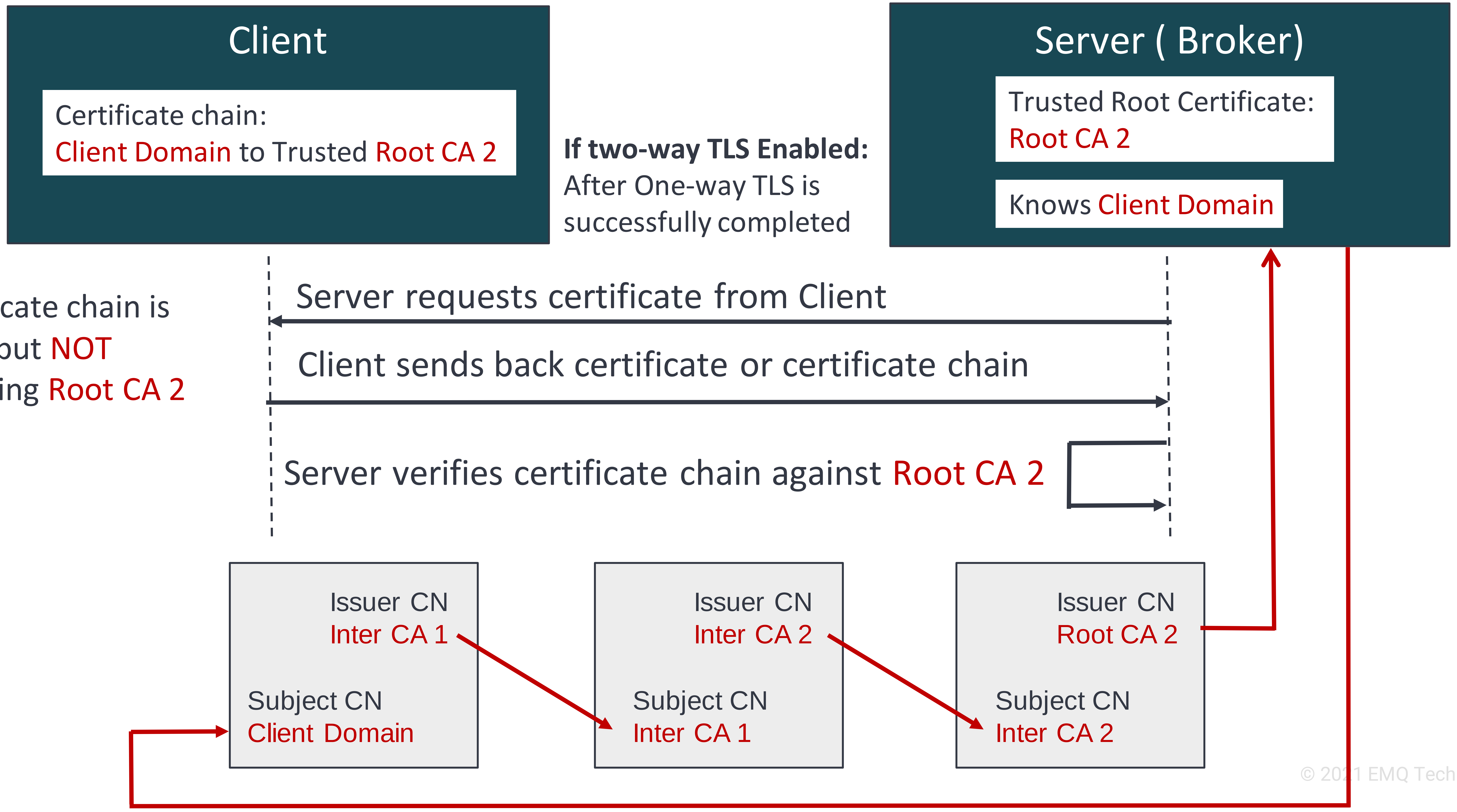
Two-way TLS example

Server also verifies identity of the client using trusted certificate chain



Client
Certificate chain:
Client Domain to Trusted Root CA 2
If two-way TLS Enabled:
After One-way TLS is successfully completed
Server (Broker)
Trusted Root Certificate:
Root CA 2
Knows Client Domain
Server requests certificate from Client
Client sends back certificate or certificate chain
Server verifies certificate chain against Root CA 2
Issuer CN
Inter CA 1
Subject CN
Client Domain
Issuer CN
Inter CA 2
Subject CN
Inter CA 1
Issuer CN
Root CA 2
Subject CN
Inter CA 2

Certificate chain is up to but NOT including Root CA 2

Setting up clients and server for TLS

You will need to provide the clients and server with the following information

Client

Trusted Root Certificate for the server
Example: Root CA 1

Client private key

Server (Broker)

Certificate chain: (Example)
Server Host to Trusted Root CA 1

Server private key

One-way TLS

If Two-way TLS enabled

Client

Certificate chain: (Example)
Client Domain to Trusted Root CA 2

Server (Broker)

Trusted Root Certificate for the client
Example: Root CA 2

EMQ X On Prem
Contains trusted CAs in a file: cacerts.pem

You provide this information through public key certificate files and private key files

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TLS certificate file examples

Trusted CA Let's Encrypt

cert.pem chain.pem fullchain.pem privkey.pem isrgrootx1.pem

Self-signed These will be generated in the demo and tutorial

ca.pem client-fullchain.pem client.key client.pem server-fullchain.pem server.key server.pem

Generated by EMQ X on-prem Self-signed

cacert.pem cert.pem client-cert.pem client-key.pem key.pem

Located in emqx/etc/certs directory

Next you will see how to examine and understand what these files contain.

How to verify certificates and certificate chains using openssl

Part 1

Part 1:
Examine the certificate files before they are mapped to the EMQ X broker

openssl.org

Part 2 will show how to test the certificates on the running broker

OpenSSL version should be at least 1.1.1

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Determine if a file is a certificate or key

OpenSSL Cryptography and SSL/TLS Toolkit

Display contents of file

```
cat file_name
```

Self signed files used in the demo

```
ca.pem   client-fullchain.pem   client.key  client.pem
server-fullchain.pem   server.key   server.pem
```

Example

```
cat server.pem
```

```
-----BEGIN CERTIFICATE-----
MIIDYzCCAkugAwIBAgIHFkIXcQaZEzANBgkqhki
G9w0BAQsFADBtMQswCQYDVQQG
EwJTRTESMBAGA1UECAwJU3....
```

```
cat server.key
```

```
-----BEGIN RSA PRIVATE KEY-----
MIIEpAIBAAKCAQEA+R7ZTkUUqHV8me6zRba3BS7yb
o0NNtAr1IUxM9G5wBsGnT0E
F1wOswpueIjEjmGHxFh6tpWlsc....
```

Display the number of certificates in the chain

```
cat server-fullchain.pem | grep -i begin
```

```
-----BEGIN CERTIFICATE-----
-----BEGIN CERTIFICATE-----
```

```
cat server-fullchain.pem | grep -ic begin
```

```
2
```

EMQ

Verify that certificate and key pair match

OpenSSL Cryptography and SSL/TLS Toolkit

Gets public key contained in private key and compares hash against public key certificate file

```
openssl pkey -in KEY_FILENAME -pubout -outform pem | sha256sum
openssl x509 -in CERT_FILENAME -pubkey -noout -outform pem | sha256sum
```

Example

```
openssl pkey -in server.key -pubout -outform pem | sha256sum
openssl x509 -in server.pem -pubkey -noout -outform pem | sha256sum
```

```
./verify.sh server
```

```
./key-cert-verify.sh server.key server.pem
```

```
key  - server.key:   a3d3fd1961aeeebf568a3e436926adaa494d51048e39771e306e1628fea009cc
cert - server.pem: a3d3fd1961aeeebf568a3e436926adaa494d51048e39771e306e1628fea009cc
Result: OK
```

```
./key-cert-verify.sh client.key server.pem
```

```
key  - client.key: 8f5cf72e1d3d27397ee7f74c9aeeece39173c0581bfb13d9eb0edf220d393772
cert - server.pem: a3d3fd1961aeeebf568a3e436926adaa494d51048e39771e306e1628fea009cc
Result: Fail - Not a valid certificate and private key pair
```

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Trace certificate chain in a file

Displays all the subjects and issuers in a certificate file

```
openssl crl2pkcs7 -nocrl -certfile CERT_FILENAME | openssl pkcs7 -print_certs -noout
```

Example

```
openssl crl2pkcs7 -nocrl -certfile server-fullchain.pem | openssl pkcs7 -print_certs -noout
```

```
./trace.sh server-fullchain.pem
```

subject=C = SE, ST = Stockholm, O = MyOrgName, OU = MyService, **CN** = localhost

issuer=C = SE, ST = Stockholm, O = MyOrgName, OU = MyIntermediateCA, **CN** = MyIntermediateCA-1

=

subject=C = SE, ST = Stockholm, O = MyOrgName, OU = MyIntermediateCA, **CN** = MyIntermediateCA-1

issuer=C = SE, ST = Stockholm, L = Stockholm, O = MyOrgName, OU = MyRootCA, **CN** = MyRootCA

Determine if a root CA is in EMQ X cacerts.pem file

Displays all the subjects and issuers in a certificate file

```
openssl crl2pkcs7 -nocrl -certfile cacerts.pem | openssl pkcs7 -print_certs -noout
```

```
./trace.sh cacerts.pem
```

/opt/emqx/lib/certifi-2.8.0/priv/**cacerts.pem**

```
subject=C = GR, O = Hellenic Academic and Research Institutions CA, CN = HARICA TLS RSA Root CA 2021

issuer=C = GR, O = Hellenic Academic and Research Institutions CA, CN = HARICA TLS RSA Root CA 2021


subject=C = GR, O = Hellenic Academic and Research Institutions CA, CN = HARICA TLS ECC Root CA 2021

issuer=C = GR, O = Hellenic Academic and Research Institutions CA, CN = HARICA TLS ECC Root CA 2021
```

```
./trace.sh /opt/emqx/lib/certifi-2.8.0/priv/cacerts.pem | grep "ISRG Root"
```

Root CA for Let's Encrypt

```
subject=C = US, O = Internet Security Research Group, CN = ISRG Root X1
issuer=C = US, O = Internet Security Research Group, CN = ISRG Root X1
```

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Show certificate file contents

OpenSSL
Cryptography and SSL/TLS Toolkit

Displays the contents of all certificates in a file

```
openssl crl2pkcs7 -nocrl -certfile CERT_FILENAME | openssl pkcs7 -print_certs -noout -text
```

Same as previous example but with **–text** option

Example

```
openssl crl2pkcs7 -nocrl -certfile server-fullchain.pem | openssl pkcs7 -print_certs -noout -text
```

```
./show.sh server-fullchain.pem
```

Result

```
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number: 6265117935573267 (0x16421771069913)
        Signature Algorithm: sha256WithRSAEncryption
        Issuer: C=SE, ST=Stockholm, O=MyOrgName, OU=MyIntermediateCA,
CN=MyIntermediateCA-1
        Validity
            Not Before: Jan 14 16:18:27 2022 GMT
            Not After : Jan 12 16:18:27 2032 GMT
        Subject: C=SE, ST=Stockholm, O=MyOrgName, OU=MyService, CN=localhost
        Subject Public Key Info:
            Public Key Algorithm: rsaEncryption
                RSA Public-Key: (2048 bit)
                Modulus:
                    00:f9:1e:d9:4e:45:14:a8:75:7c:99:ee:b3:45:b6:
   ....
```

Note:
This command works for files with one certificate but **NOT** with multiple certificates:

```
openssl x509 -text -noout  -in CERT_FILENAME
```

Usage examples....

Display X509 extensions

```
openssl crl2pkcs7 -nocrl -certfile server-fullchain.pem | openssl pkcs7 -print_certs -noout -text
| grep –iA 4  X509 --color
```

```
./show.sh server-fullchain.pem | grep -iA4 X509  --color
```

--colour works too

```
        X509v3 extensions:
            X509v3 Subject Alternative Name:
                DNS:s2da4b72-internet-facing-e....daf.elb.eu-west-1.amazonaws.com
    Signature Algorithm: sha256WithRSAEncryption
         89:74:3f:5d:78:15:85:20:4b:c2:8c:8b:c2:ea:4c:77:0e:e9:
         2d:11:29:9c:63:1d:4e:eb:0a:0d:6f:c1:a3:72:38:39:35:d3:
--
        X509v3 extensions:
            X509v3 Key Usage: critical
                Certificate Sign, CRL Sign
            X509v3 Basic Constraints: critical
                CA:TRUE
            X509v3 Subject Key Identifier:
                65:F1:3A:AA:67:67:A5:D7:DC:06:85:5E:A9:0E:3D:25:B7:AD:34:91
            X509v3 Authority Key Identifier:
                DirName:/C=SE/ST=Stockholm/L=Stockholm/O=MyOrgName/OU=MyRootCA/CN=MyRootCA
                serial:50:66:52:FC:DC:68:9A:98:73:34:D6:BC:06:BC:73:92:BA:F2:03:46


    Signature Algorithm: sha256WithRSAEncryption
```

← Subject Alternative Name

Display certificate validity

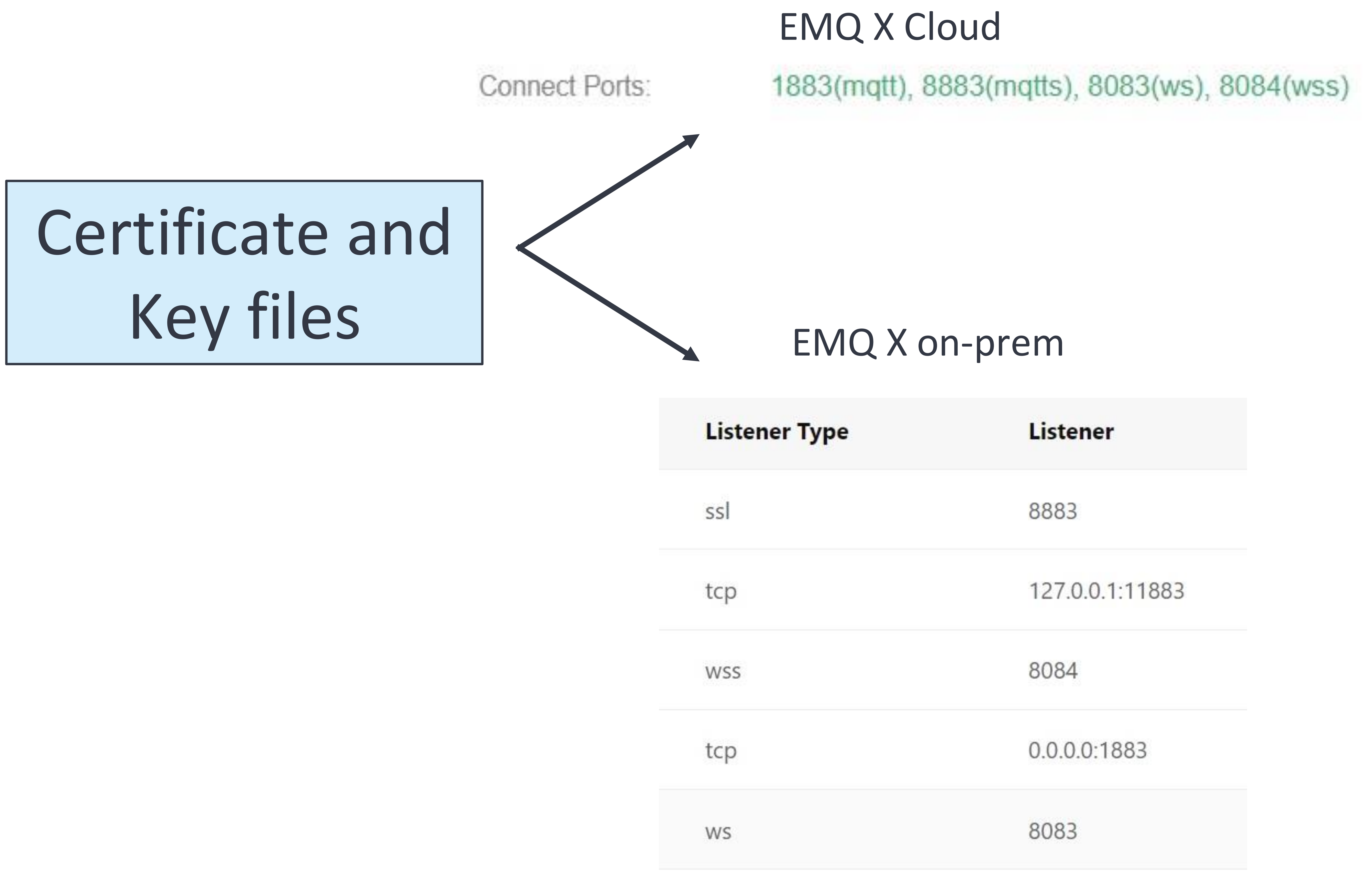
Display validity dates of all certificates in the file

```
openssl crl2pkcs7 -nocrl -certfile server-fullchain.pem | openssl pkcs7 -print_certs -noout -text | grep –iA 2 validity
```

```
./show.sh server-fullchain.pem | grep -iA2 validity  --color
```

```
        Validity
            Not Before: Jan 14 16:18:27 2022 GMT
            Not After : Jan 12 16:18:27 2032 GMT
--
        Validity
            Not Before: Jan 14 16:18:26 2022 GMT
            Not After : Jan 12 16:18:26 2032 GMT
```

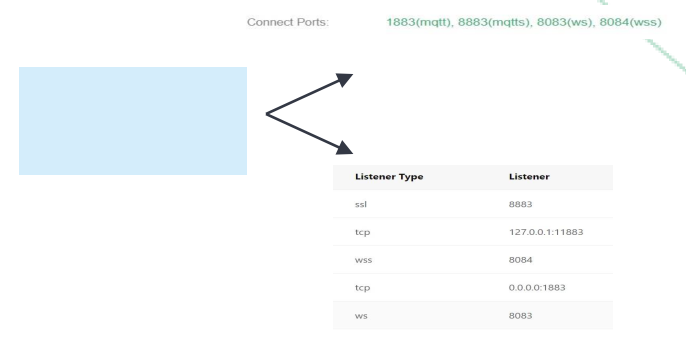
How to map certificate files to EMQ X listeners



Connect Ports: 1883(mqtt), 8883(mqtts), 8083(ws), 8084(wss)

Listener Type	Listener
ssl	8883
tcp	127.0.0.1:11883
wss	8084
tcp	0.0.0.0:1883
ws	8083

Client connections

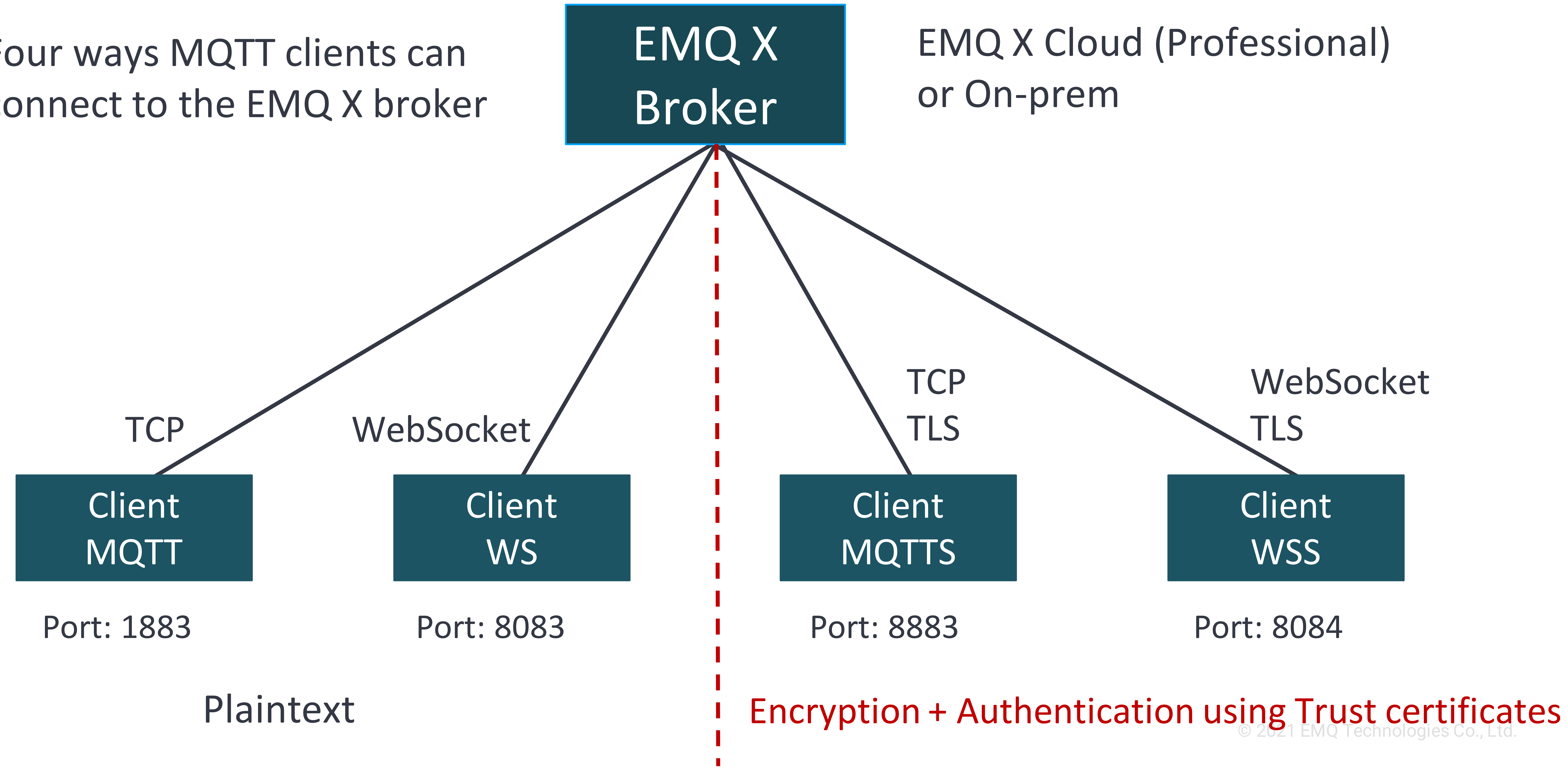


Connect Ports: 1883(mqtt), 8883(mqtts), 8083(ws), 8084(wss)

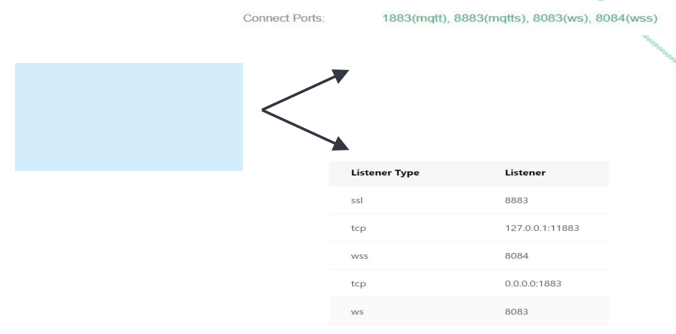
Listener Type	Listener
ssl	8883
tcp	127.0.0.1:11883
wss	8084
tcp	0.0.0.0:1883
ws	8083

Four ways MQTT clients can connect to the EMQ X broker

EMQ X Cloud (Professional) or On-prem



EMQ X dashboard (on-prem)



Connect Ports: 1883(mqtt), 8883(mqtts), 8083(ws), 8084(wss)

Listener Type	Listener
ssl	8883
tcp	127.0.0.1:11883
wss	8084
tcp	0.0.0.0:1883
ws	8083

Two ways to connect to the EMQ X dashboard

localhost:18083/#/monitor

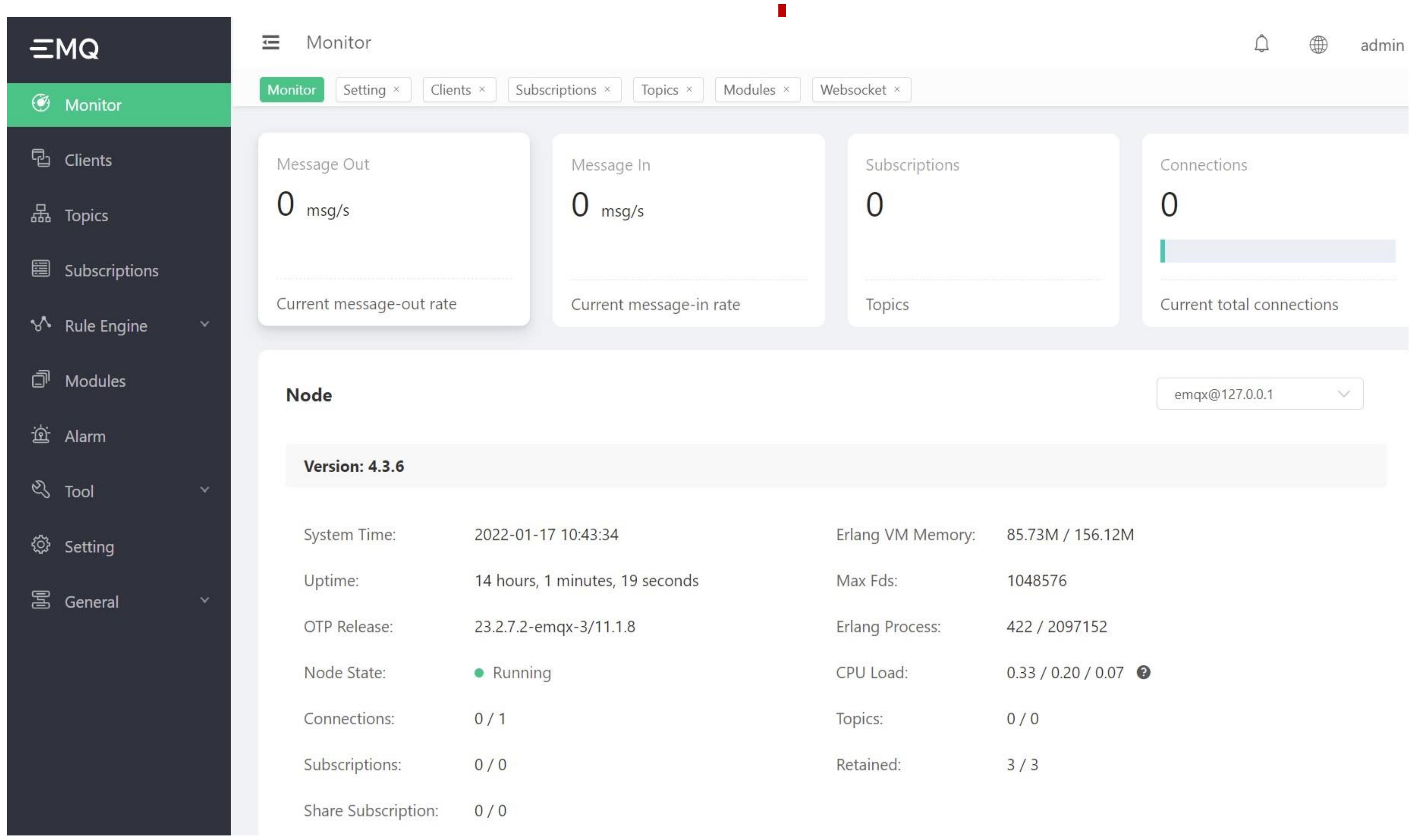
HTTP
Port: 18083

Plaintext

localhost:18084/#/monitor

HTTPS
Port: 18084

Encryption + Authentication using Trust certificates



Message Out
0 msg/s
Current message-out rate

Message In
0 msg/s
Current message-in rate

Subscriptions
0
Topics

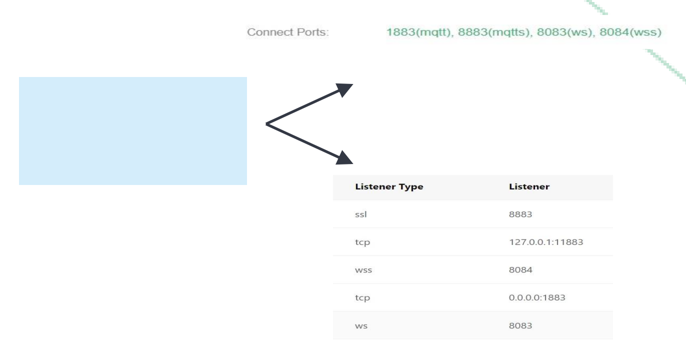
Connections
0
Current total connections

Node

emqx@127.0.0.1

Version: 4.3.6

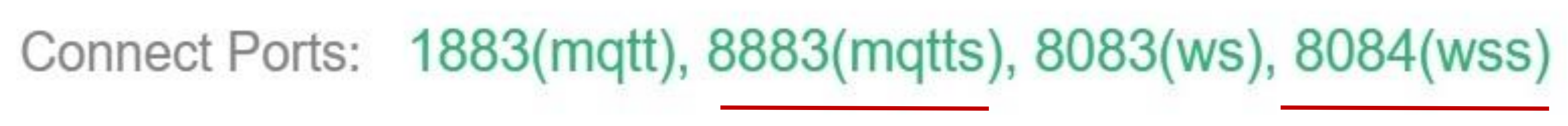
System Time:	2022-01-17 10:43:34	Erlang VM Memory:	85.73M / 156.12M
Uptime:	14 hours, 1 minutes, 19 seconds	Max Fds:	1048576
OTP Release:	23.2.7.2-emqx-3/11.1.8	Erlang Process:	422 / 2097152
Node State:	● Running	CPU Load:	0.33 / 0.20 / 0.07
Connections:	0 / 1	Topics:	0 / 0
Subscriptions:	0 / 0	Retained:	3 / 3
Share Subscription:	0 / 0		



Verifying EMQ X port listeners

EMQ X Cloud

Deployment > Overview > Connect Ports



Connect Ports: 1883(mqtt), 8883(mqtts), 8083(ws), 8084(wss)

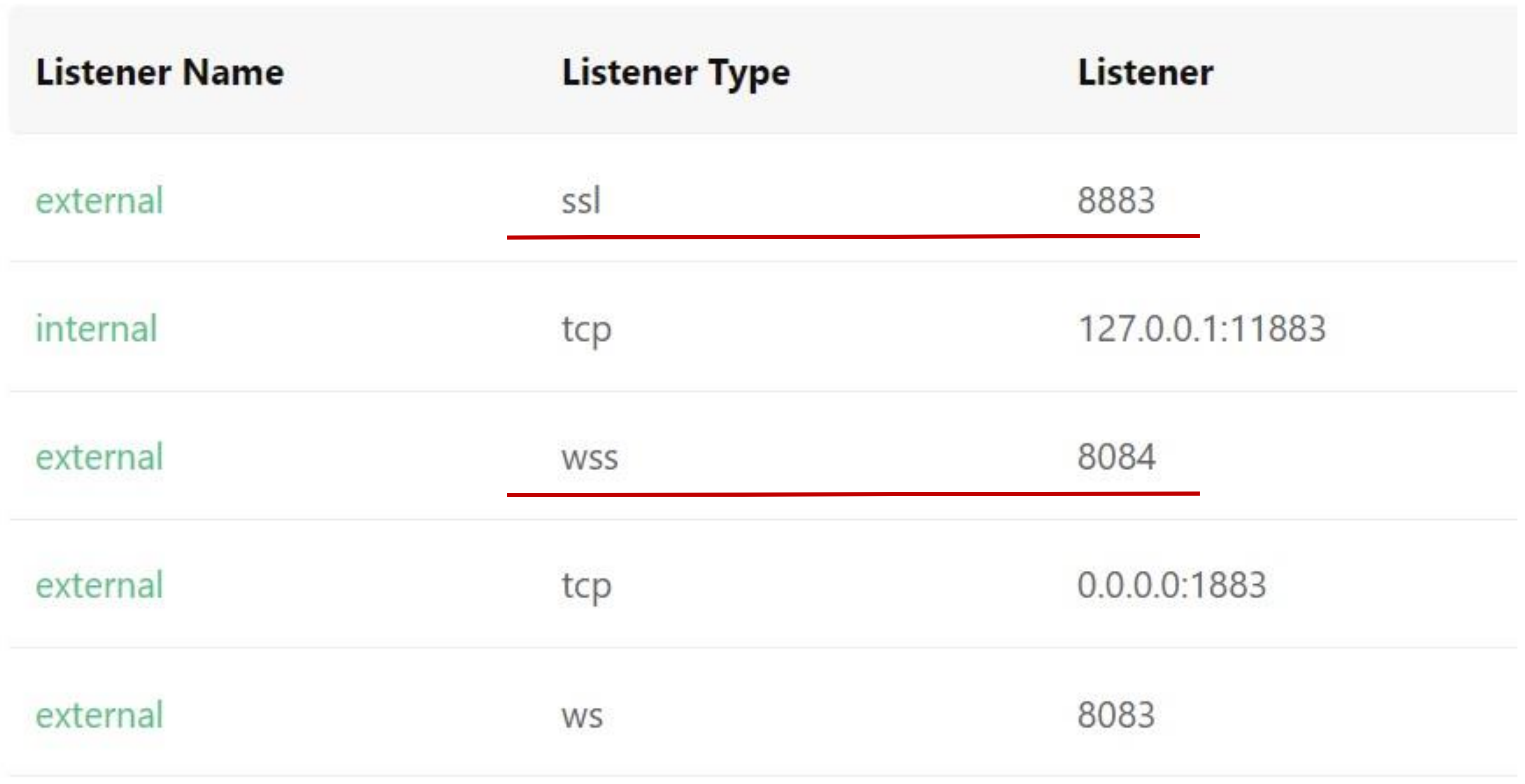
For MQTTS (SSL) and WSS to work properly:

The EMQ X broker needs to have

the correct certificate files.

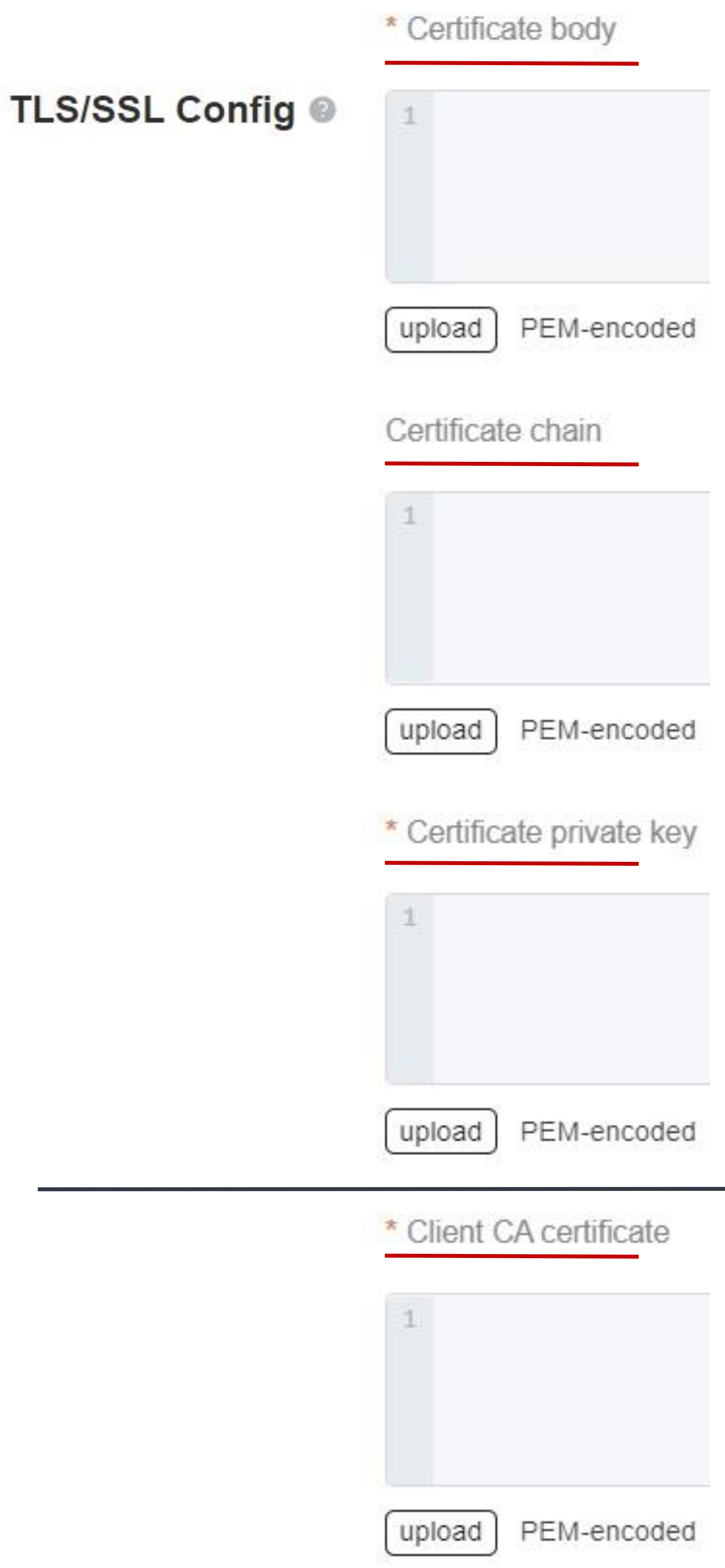
EMQ X on-prem

Dashboard > Settings > Listeners



Listener Name	Listener Type	Listener
external	ssl	8883
internal	tcp	127.0.0.1:11883
external	wss	8084
external	tcp	0.0.0.0:1883
external	ws	8083

Mapping of EMQ X Cloud certificate files



TLS/SSL Config

* Certificate body

upload PEM-encoded

Certificate chain

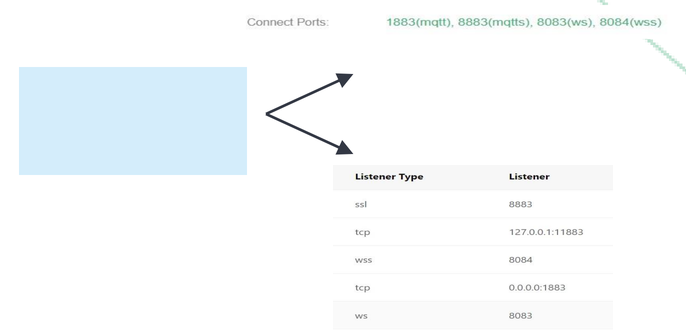
upload PEM-encoded

* Certificate private key

upload PEM-encoded

* Client CA certificate

upload PEM-encoded



Connect Ports: 1883(mqtt), 8883(mqtts), 8083(ws), 8084(wss)

Listener Type	Listener
ssl	8883
tcp	127.0.0.1:11883
wss	8084
tcp	0.0.0.0:1883
ws	8083

Maps to:

File containing the server (broker) certificate

Together they need to form a valid chain (Can overlap)

File containing all intermediate server CAs (if any), but **NOT** the root CA

File containing the server (broker) private key

For two-way TLS

File containing the **client** root CA

Example

server.pem

subject: ServerHost
issuer: MyInterCA-1

server-chain.pem

subject: MyInterCA-1
issuer: MyRootCA

server.key

Server Private Key

ca.pem

subject: MyRootCA
issuer: MyRootCA

https://docs.emqx.io/en/cloud/latest/deployments/tls_ssl.html#certificate-restrictions

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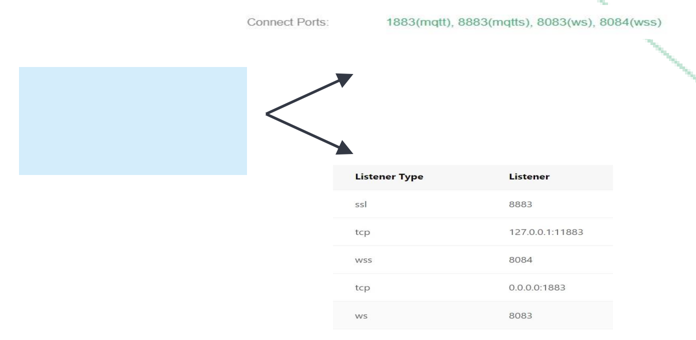
Main TLS parameter definitions EMQ X on-prem



EMQ X Parameter	Maps to:	Example
*.keyfile	File containing the server (broker) private key	server.key Server Private Key
*.certfile	File containing certificate chain from server, all (if any) intermediate CAs, but **NOT** the root CA	server-fullchain.pem subject: ServerHost issuer: MyInterCA-1 subject: MyInterCA-1 issuer: MyRootCA
*.cacertfile **For two-way TLS**	File containing root CAs for all clients. Needed only if the root CA is not included in the EMQ X cacerts.pem file	ca.pem subject: MyRootCA issuer: MyRootCA

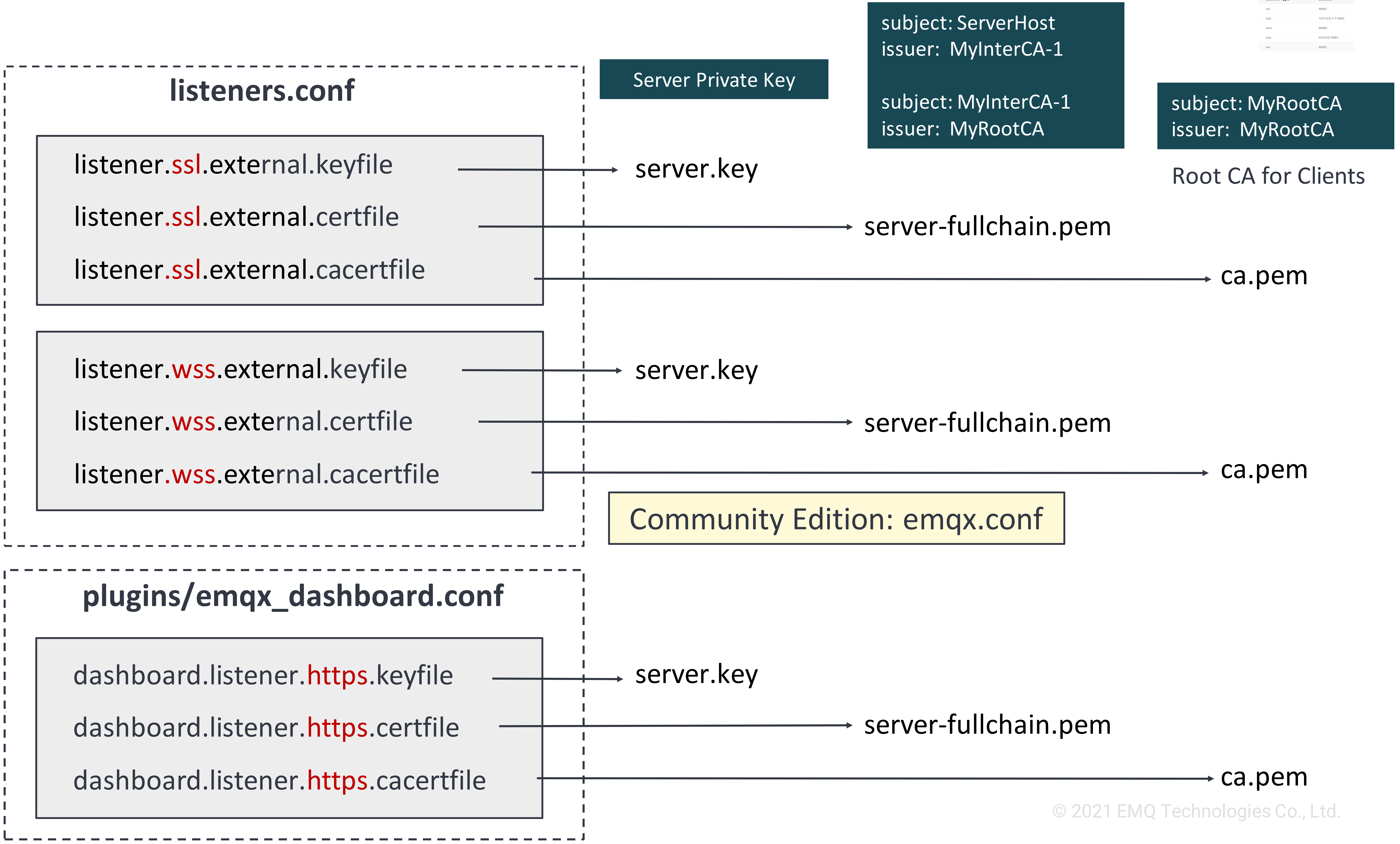
EMQ X on-prem configuration files example

Enterprise edition

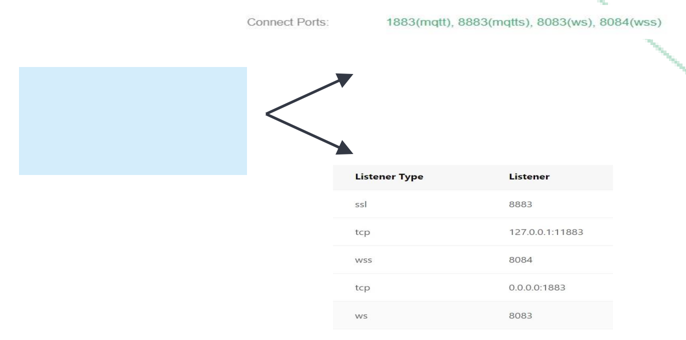
SSL (MQTTS) Configurations

WSS Configurations

HTPPS Configurations

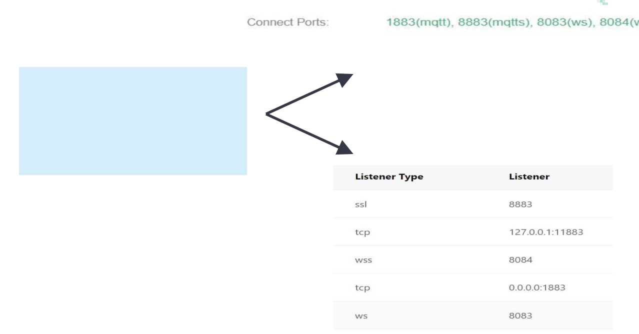


listeners.conf
listener.ssl.external.keyfile
listener.ssl.external.certfile
listener.ssl.external.cacertfile
listener.wss.external.keyfile
listener.wss.external.certfile
listener.wss.external.cacertfile
plugins/emqx_dashboard.conf
dashboard.listener.https.keyfile
dashboard.listener.https.certfile
dashboard.listener.https.cacertfile
Server Private Key
subject: ServerHost
issuer: MyInterCA-1
subject: MyInterCA-1
issuer: MyRootCA
subject: MyRootCA
issuer: MyRootCA
Root CA for Clients
server.key
server-fullchain.pem
ca.pem
server.key
server-fullchain.pem
ca.pem
Community Edition: emqx.conf
server.key
server-fullchain.pem
ca.pem



EMQ

Mapping EMQ X self-generated on-prem files


Connect Ports: 1883(mqtt), 8883(mqtts), 8083(ws), 8084(wss)

Listener Type	Listener
ssl	8883
tcp	127.0.0.1:11883
wss	8084
tcp	0.0.0.0:1883
ws	8083

Located in emqx/certs/ `cacert.pem  cert.pem  client-cert.pem  client-key.pem  key.pem`

No intermediate CAs

Root CA is same for both server and client

Server files

key.pem

Server Private Key

Maps to

cert.pem

subject: Server
issuer: RootCA

Maps to

cacert.pem

subject: RootCA
issuer: RootCA

Maps to

Root CA of client

EMQ X Parameters

listeners.conf
plugins/**emqx_dashboard.conf**

***.keyfile**

***.certfile**

Needed only for
Two-way TLS

***.cacertfile**

Files for Clients

client-key.pem

Client Private Key

cacert.pem

subject: RootCA
issuer: RootCA

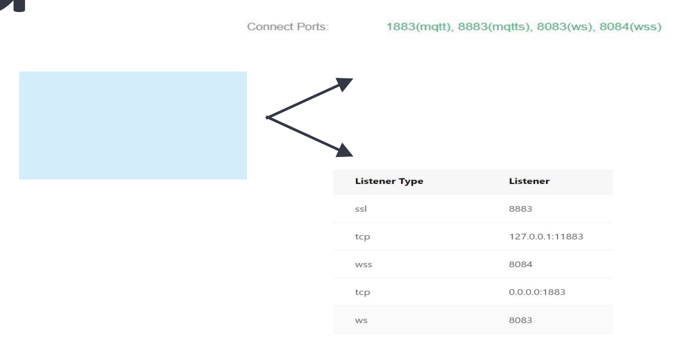
Root CA of server

Needed only for Two-way TLS

client-cert.pem

subject: Client
issuer: RootCA

Mapping EMQ X self-generated on-prem files EMQ X Cloud



cert.pem

subject: Server
issuer: RootCA

Maps to

emqx/certs/

```
cacert.pem  cert.pem  key.pem
client-cert.pem  client-key.pem
```

key.pem

Server Private Key

Maps to

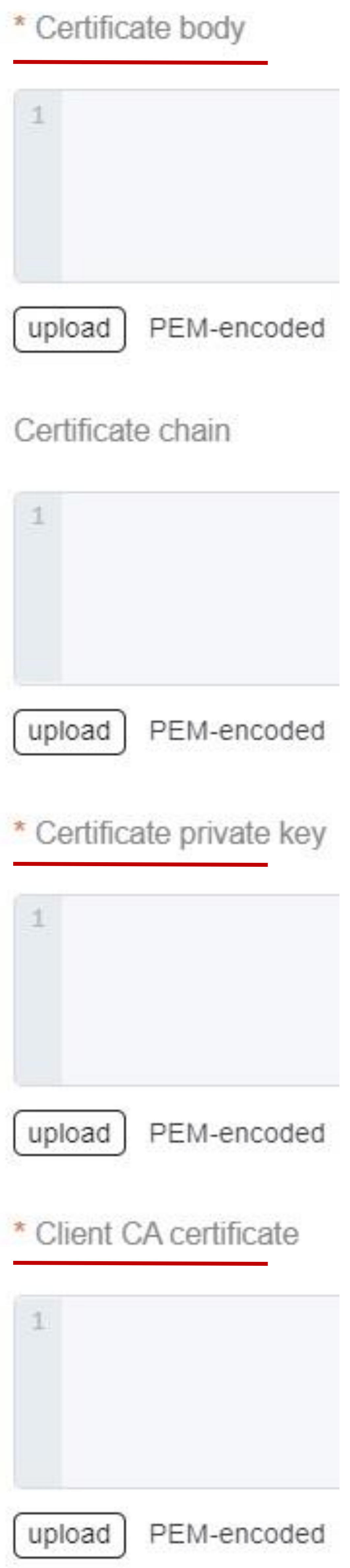
cacert.pem

subject: RootCA
issuer: RootCA

Two-Way TLS

Maps to

Root CA of client



* Certificate body

upload PEM-encoded

Certificate chain

upload PEM-encoded

* Certificate private key

upload PEM-encoded

* Client CA certificate

upload PEM-encoded

Files for Clients

client-key.pem

Client Private Key

cacert.pem

subject: RootCA
issuer: RootCA

Root CA of server

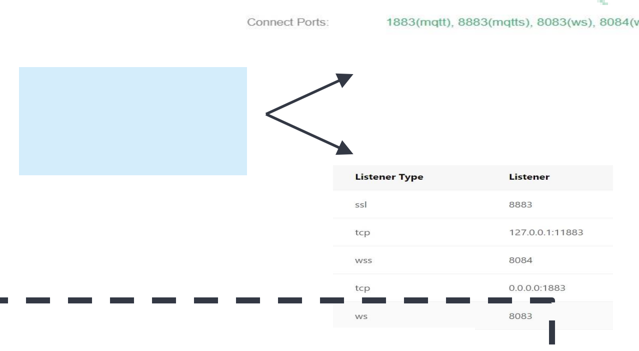
Needed only for Two-way TLS

client-cert.pem

subject: Client
issuer: RootCA

EMQ X Parameters

Configuring one-way TLS and two-way TLS



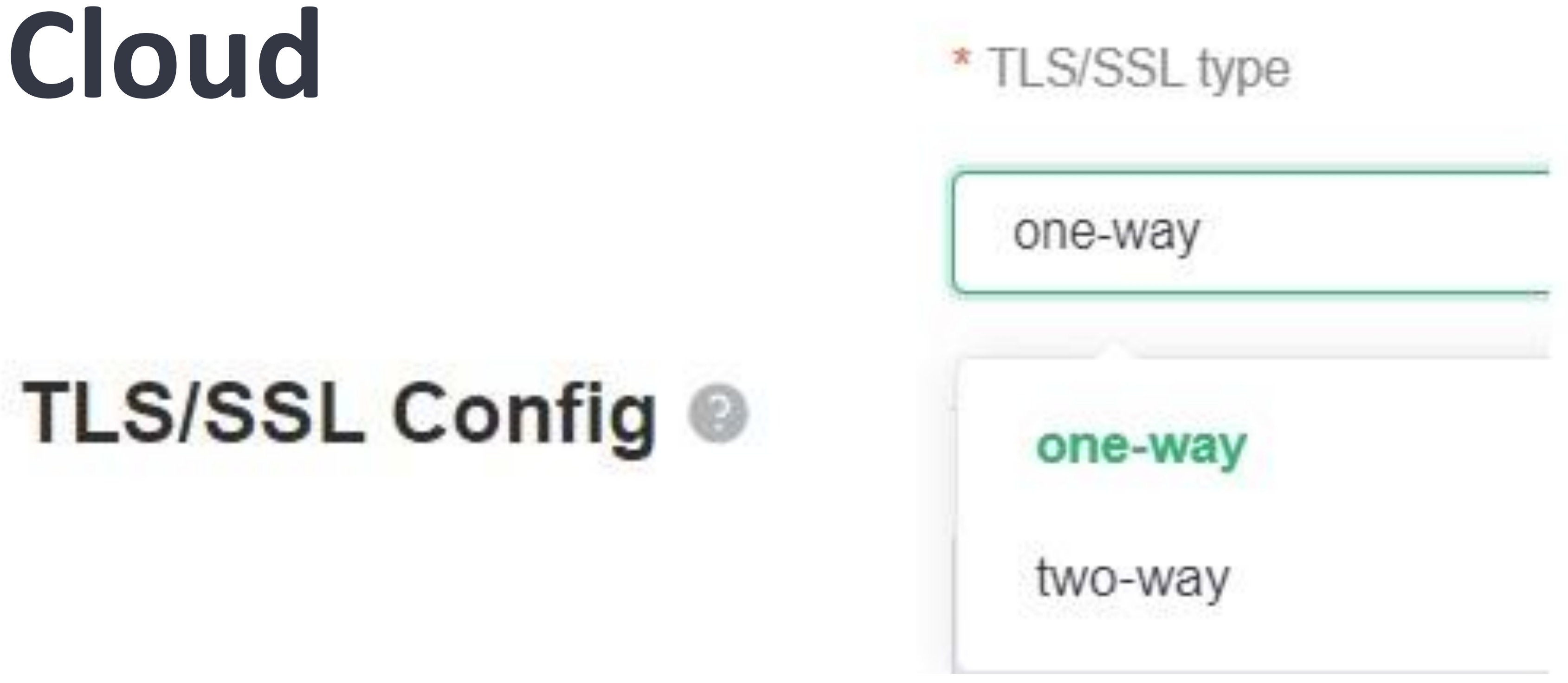
On-prem

For One-Way TLS: *.verify = verify_none

For Two-Way TLS: *.verify = verify_peer

*.fail_if_no_peer_cert = true

Cloud


TLS/SSL Config

* TLS/SSL type

one-way

File	Parameter	One-Way TLS	Two-Way TLS
listeners.conf/emqx.conf	listener.ssl.external.verify	verify_none	verify_peer
SSL	listener.ssl.external.fail_if_no_peer_cert		true
listeners.conf/emqx.conf	listener.wss.external.verify	verify_none	verify_peer
WSS	listener.wss.external.fail_if_no_peer_cert		true
emqx_dashboard.conf	listener.https.external.verify	verify_none	verify_peer
HTTPS	listener.https.external.fail_if_no_peer_cert		true

Example: Mapping Lets Encrypt certificates to EMQ X

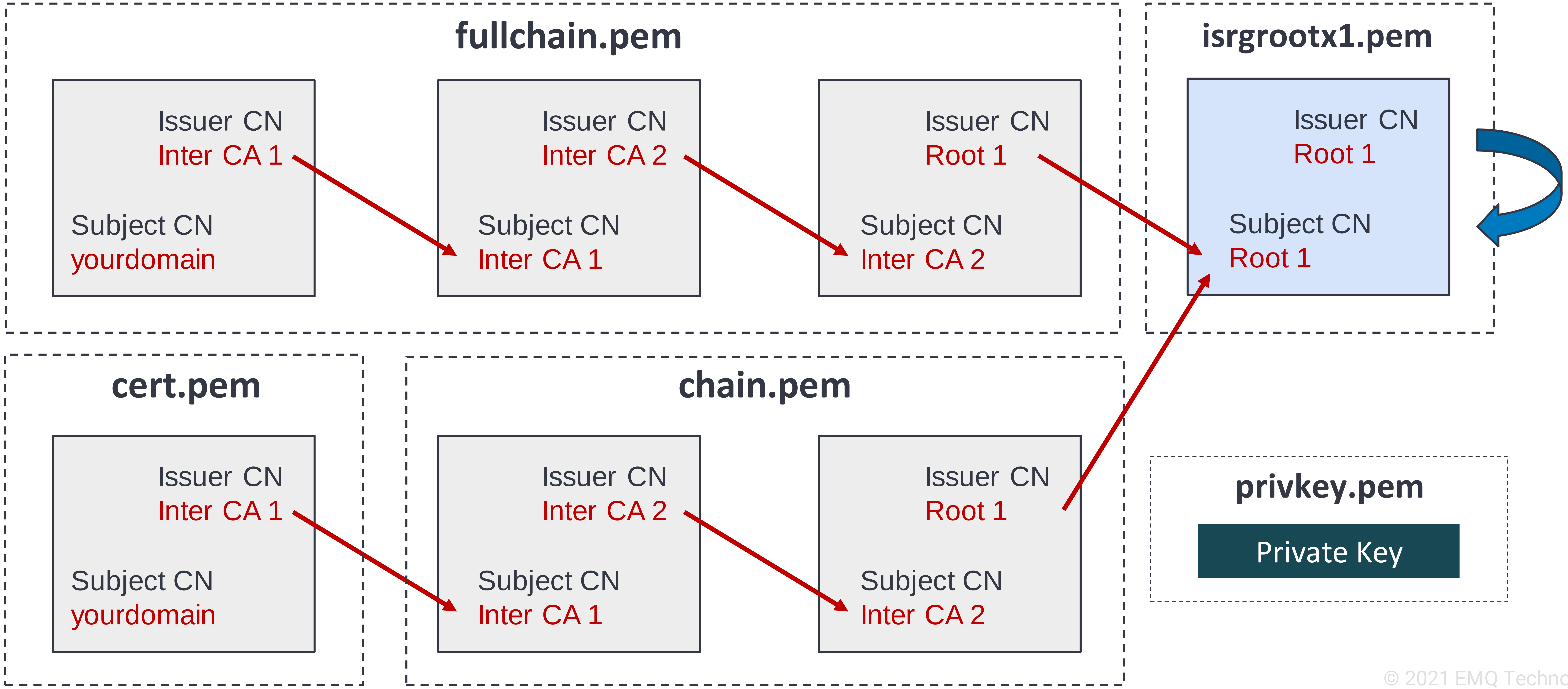
letsencrypt.org

Let's Encrypt files

Files located at: /etc/letsencrypt/live/**yourdomain**/ `cert.pem chain.pem fullchain.pem privkey.pem`

Root certificate file not included but can be downloaded manually

Root certificate is contained in EMQ X (on-prem) cacerts.pem file



Mapping Let's Encrypt files to EMQ X on-prem

cert.pem chain.pem fullchain.pem privkey.pem

privkey.pem

Server Private Key

Maps to

fullchain.pem

subject: yourdomain
issuer: R3

subject: R3
issuer: ISRG Root X1

subject: ISRG Root X1
issuer: DST Root CA X3

Maps to

EMQ X Parameters

listeners.conf
plugins/**emqx_dashboard.conf**

***.keyfile**

***.certfile**

One-Way TLS
Client needs to have either
ISRG Root X1
DST Root CA X3

Two-Way TLS
Clients need corresponding
fullchain.pem for client
privkey.pem for client

EMQ X cacerts.pem file contains both
ISRG Root X1
DST Root CA X3

ΞMQ

Mapping Let's Encrypt files to EMQ X Cloud

Let's Encrypt

cert.pem chain.pem fullchain.pem privkey.pem

cert.pem

subject: yourdomain
issuer: R3

Maps to

chain.pem or fullchain.pem

subject: R3
issuer: ISRG Root X1

subject: ISRG Root X1
issuer: DST Root CA X3

Maps to

privkey.pem

Server Private Key

Maps to

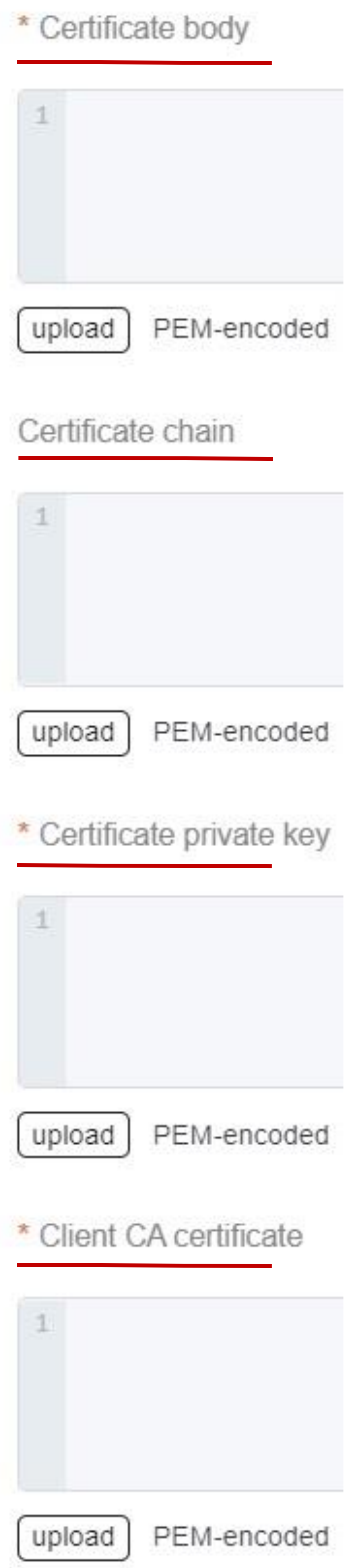
xxx.pem

subject: Client RootCA
issuer: Client RootCA

Root CA of client

Two-Way TLS

Maps to



* Certificate body

upload PEM-encoded

Certificate chain

upload PEM-encoded

* Certificate private key

upload PEM-encoded

* Client CA certificate

upload PEM-encoded

Files for Clients

One-Way TLS

Client needs to have either
- ISRG Root X1
- DST Root CA X3

Two-Way TLS

EMQ X contains both
- ISRG Root X1
- DST Root CA X3

How to verify certificates and certificate chains using openssl

Part 2

Part 2:
Verify that certificates are correct on the running broker.

OpenSSL
Cryptography and SSL/TLS Toolkit

openssl.org

OpenSSL version should be at least 1.1.1

openssl s_client

Connects to the running broker as a client using SSL/TLS
Useful for troubleshooting and verifying TLS certificates are correct

Example

```
openssl s_client  -CAfile CA_FILE  -connect HOST:PORT
```

For EMQ X, PORT can be **8883** (SSL), **8084** (WSS), **18084** (HTTPS)

```
openssl s_client  -CAfile ca.pem -connect localhost:8883
```

Prints out TLS connection messages

Verify the certificate chain on the server

```
openssl s_client  -CAfile ca.pem -connect localhost:8883 2>&1| grep -iA5 "certificate chain"
```

```
Certificate chain
0 s:C = SE, ST = Stockholm, O = MyOrgName, OU = MyService, CN = localhost
  i:C = SE, ST = Stockholm, O = MyOrgName, OU = MyIntermediateCA,  CN = MyIntermediateCA-1
1 s:C = SE, ST = Stockholm, O = MyOrgName, OU = MyIntermediateCA,  CN = MyIntermediateCA-1
  i:C = SE, ST = Stockholm, L = Stockholm, O = MyOrgName, OU = MyRootCA, CN = MyRootCA
```

```
grep  iAx
x = (num certs) x 2 + 1
```

s_client writes to both stdout and stderr
Use **2>&1** to force all output to stdout before piping to grep
Otherwise, the output will be: All of stderr plus grep of only stdout

openssl s_client verbose

To turn on verbose output

For EMQ X, PORT can be **8883** (SSL), **8084** (WSS), **18084** (HTTPS)

```
openssl s_client  -CAfile CA_FILE -verify_hostname HOST -tlsextdebug -state -debug -connect HOST:PORT
```

```
openssl s_client  -CAfile ca.pem -verify_hostname localhost -tlsextdebug -state -debug -connect localhost:8883
```

Can use the following scripts

	Port	EMQ X On-Prem	EMQ X Cloud
SSL	**8883**	`./sclient-ssl.sh`	`./sclient-ssl.sh cloud`
WSS	**8084**	`./sclient-wss.sh`	`./sclient-wss.sh cloud`
HTTPS	**18084**	`./sclient-https.sh`	`./sclient-https.sh cloud`

Then examine the output or grep to find some errors....

Common certificate errors

Certificate chain is broken

```
Cannot verify certificate chain
Verify return code: 20 (unable to get local issuer certificate)
```

Server hostname does not match certificate

```
Cannot verify hostname
Verification error: Hostname mismatch
```

Can grep for lines of interest

```
./sclient-wss.sh 2>&1 | grep -i -e err -e verif
```

grep –e option allows for multiple search terms

No certificates

```
SSL_connect:error in SSLv3/TLS write client hello
write:errno=104
Verification: OK
Verify return code: 0 (ok)
```

```
./sclient-wss.sh 2>&1 | grep -i "certificate chain"
```

Returns blank

Hands-on Tutorial

Overview

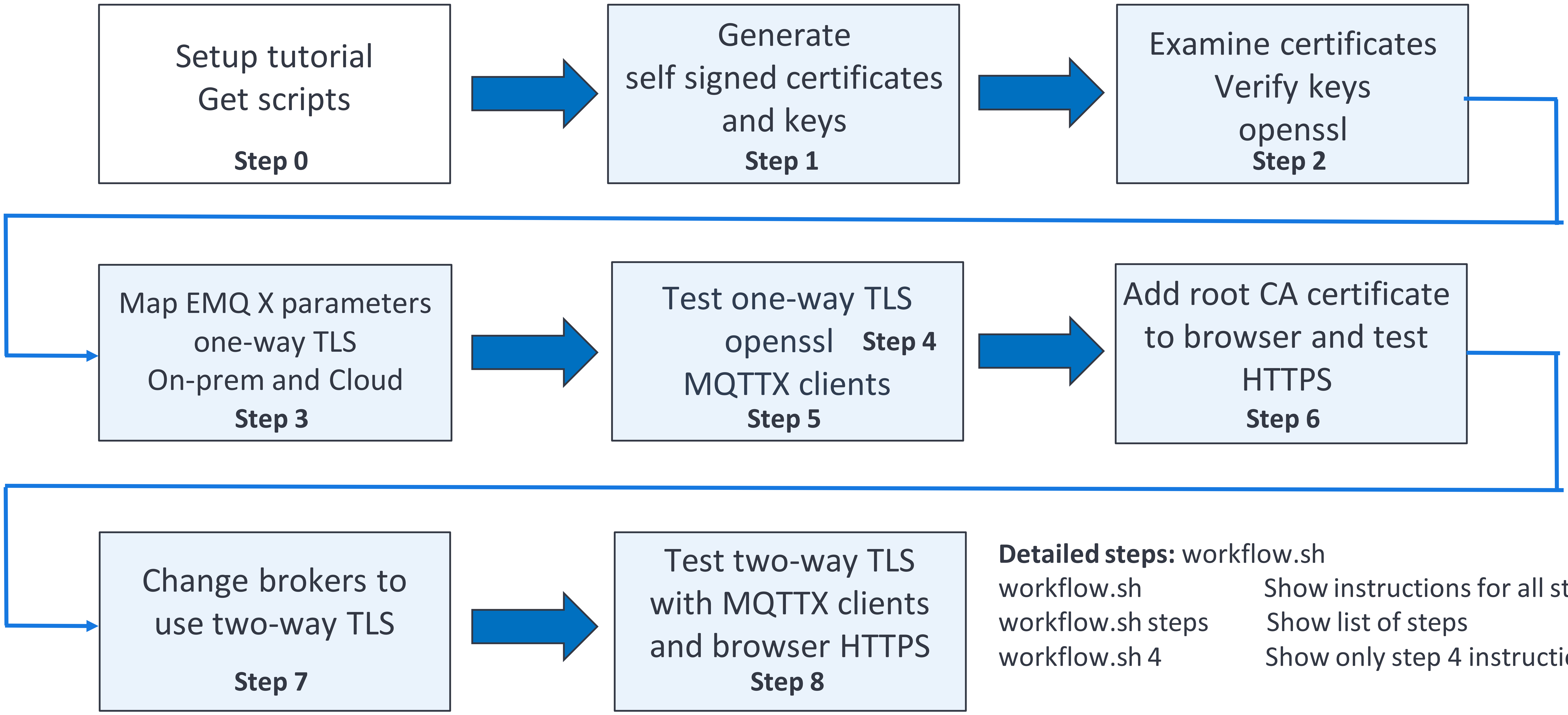
Generating self-signed certificates and mapping to EMQ X Cloud and on-prem

Verify that they work

One-way TLS and Two-way TLS

Separate Video

Tutorial Workflow



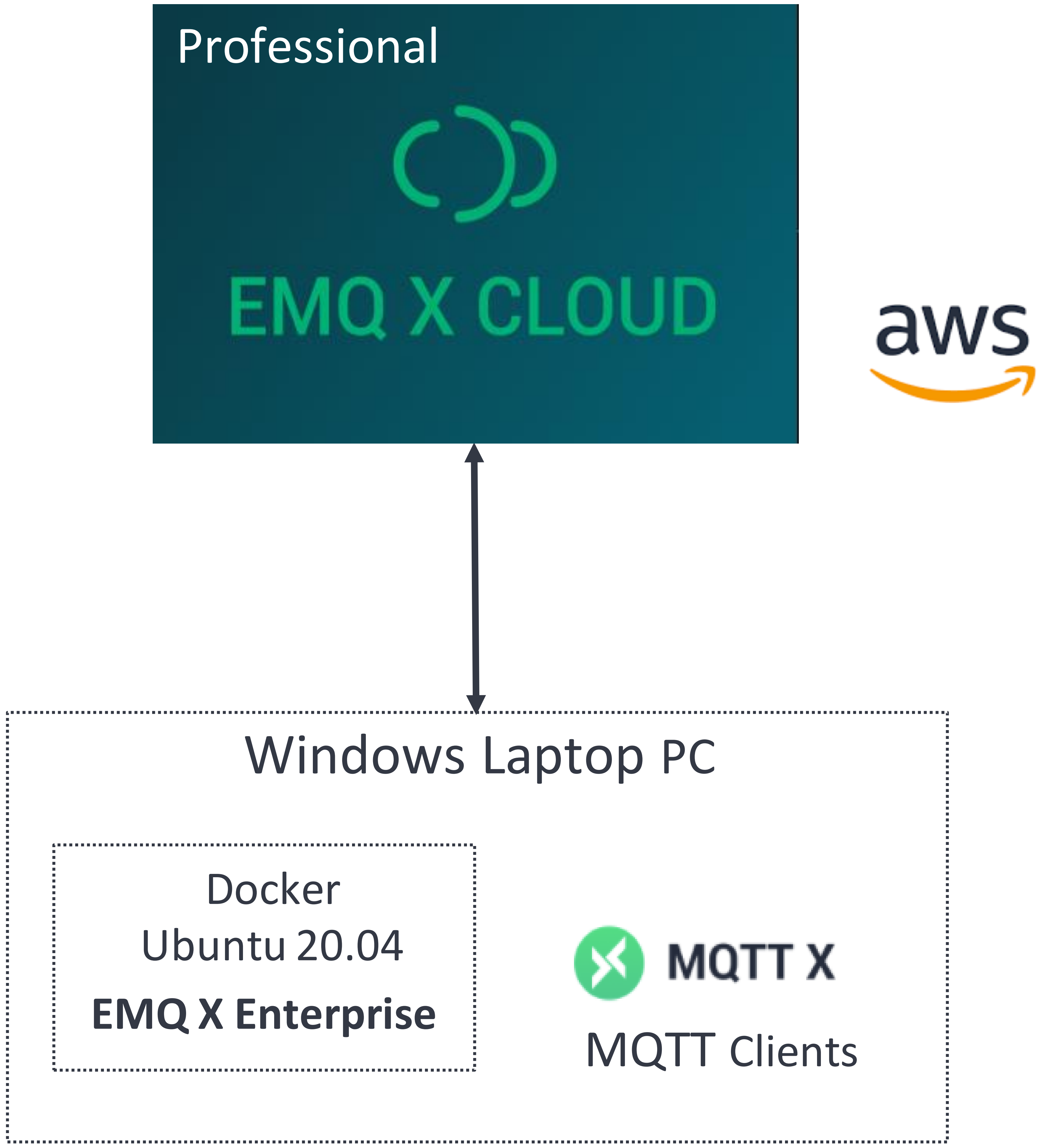
Detailed steps: workflow.sh

workflow.sh	Show instructions for all steps
workflow.sh steps	Show list of steps
workflow.sh 4	Show only step 4 instructions

ΞMQ

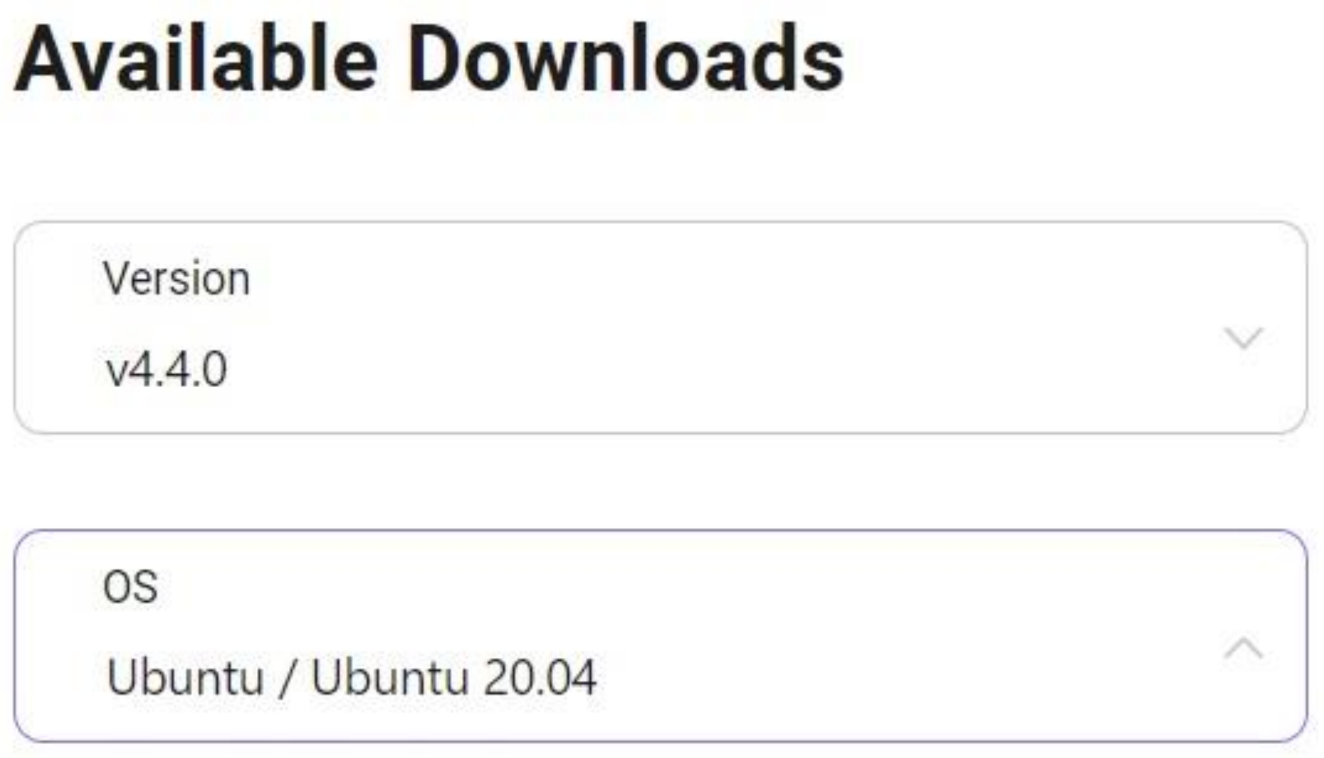
Demo and tutorial setup

Demo



You can also install EMQ X directly on Linux

Docker Ubuntu image
+
EMQ X Ubuntu install

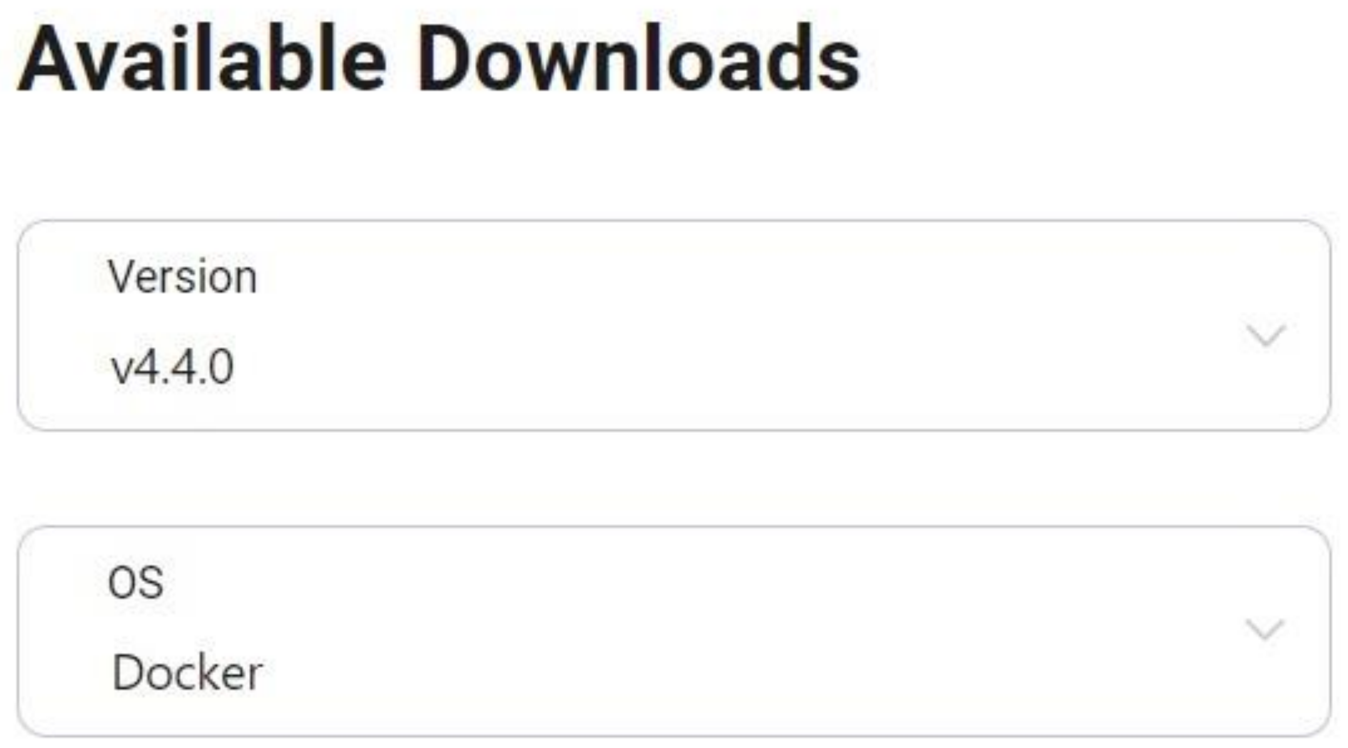


Available Downloads

Version
v4.4.0

OS
Ubuntu / Ubuntu 20.04

≠



Available Downloads

Version
v4.4.0

OS
Docker

EMQ X Docker Install

Alpine Linux
Smaller

Demo

Generate self-signed certificates
Map to EMQ X Cloud and on-prem
One-way TLS

Welcome to join EMQ X Community

Discord

https://discord.gg/C2zpUvPnRC

slack

https://slack-invite.emqx.io/

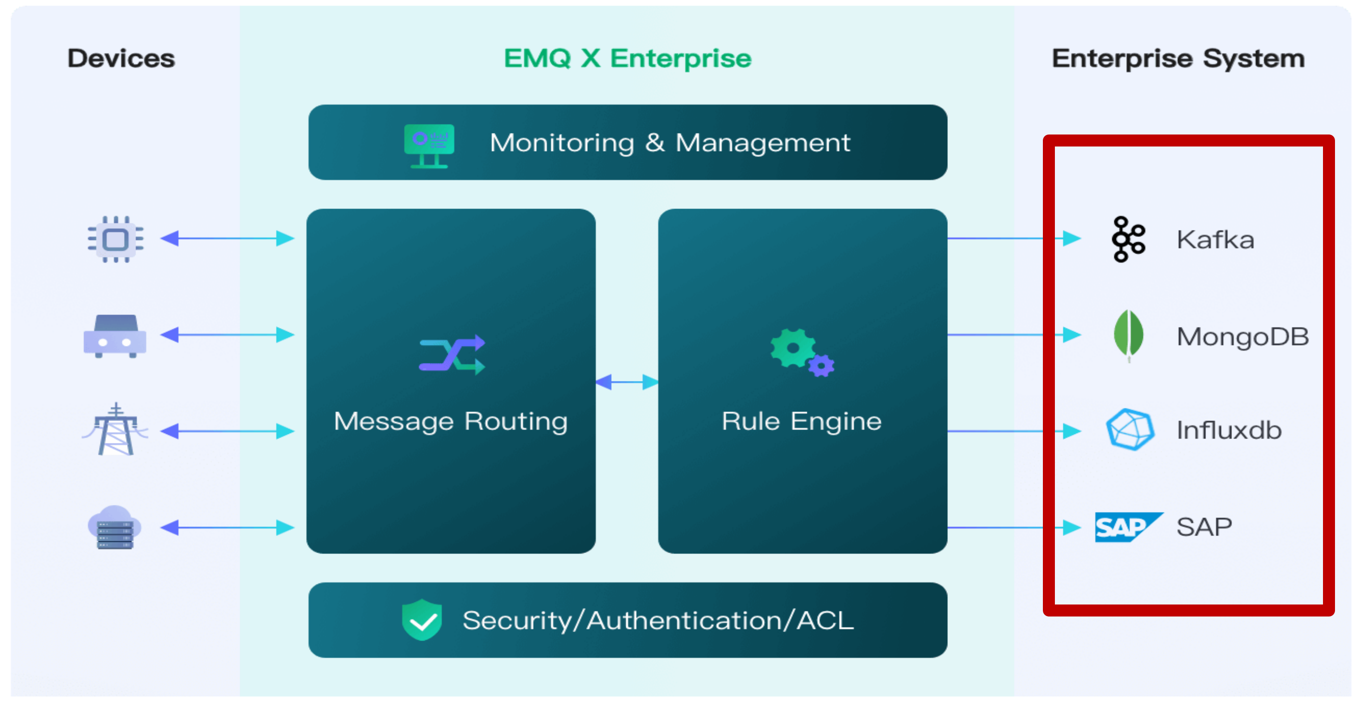
# Forum

https://github.com/emqx/emqx/discussions

Happy to discuss your favorite topics with YOU

Questions and Answers

Q & A



Sign up for your free trial today! www.emqx.com

Try Free →

And try out the demo yourself