KEYFACTOR

# PQC Lab Quick Start Guide

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Try out Post-Quantum Cryptography (PQC) using the PQC Lab on Azure which provides a free sandbox environment where you can generate your own quantum-safe certificates using EJBCA.

The PQC Lab Test Drive launches a pre-built, functional Public Key Infrastructure (PKI) with a configured EJBCA Enterprise instance, allowing you to run EJBCA with fully configured PQC certificate authorities (CAs) and profiles, as well as pre-configured and enabled enrollment protocols.

Follow this guide to generate PQC certificates using the NIST candidate algorithm Dilithium over enrollment protocols such as EST, ACME, and the REST API.

This guide shows you how to:

- Launch the Keyfactor Test Drive Instance
- Access EJBCA
- Generate PQC certificates using different enrollment protocols: EST, ACME, and REST API
- View issued certificates

# Prerequisites

Before you begin, you need a valid Microsoft Account to launch the PQC Lab Test Drive on the Azure Marketplace.

In addition, to use the EJBCA Client CLI, you need Java installed.

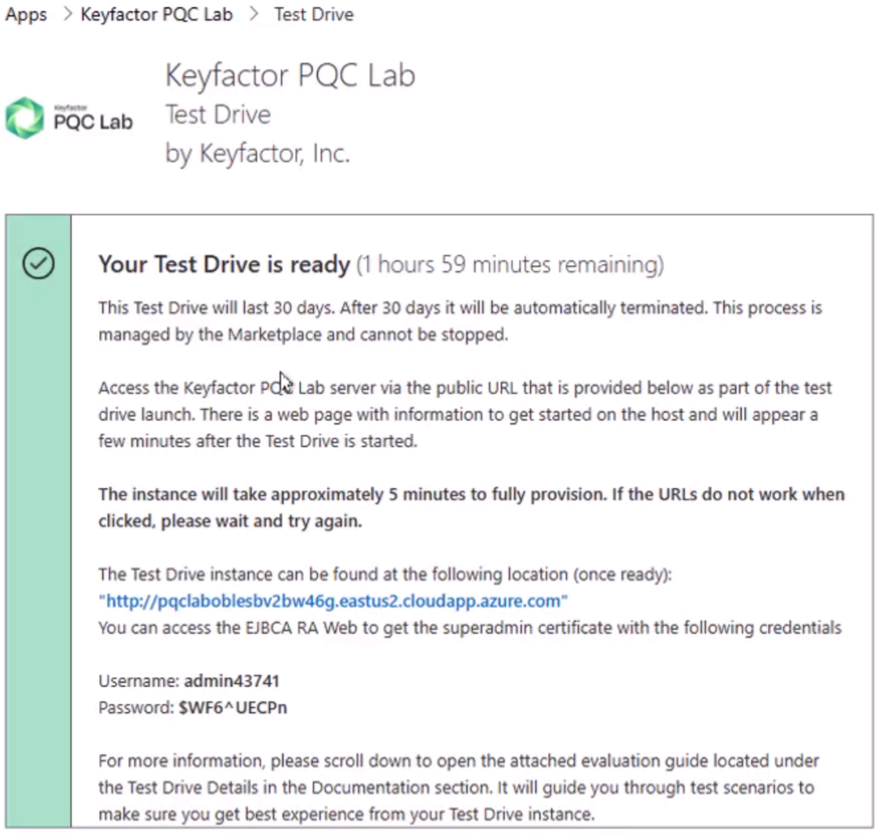
This 30-day trial includes the components EJBCA Enterprise, MariaDB, and WildFly version 26.1.3. Azure automatically terminates the instance after 30 days so do not put any data on this host that you want to retain. You can export your configurations before the 30-day period using the EJBCA user interface.

⚠ The PQC Lab Test Drive is designed as a demonstration instance and is not a production-grade server.

# Launch the Keyfactor Test Drive Instance

Navigate to Keyfactor PQC Lab on the Azure Marketplace and click **Test Drive**.

During the Test Drive launch, you are provided with the location and credentials to access all the Keyfactor resources on the instance. The values are generated specifically for your instance and will expire in 30 days. Make a secure note of the credentials as you will use the username and password to retrieve the EJBCA administrator certificate.



Apps > Keyfactor PQC Lab > Test Drive

Keyfactor PQC Lab
Test Drive
by Keyfactor, Inc.

**Your Test Drive is ready** (1 hours 59 minutes remaining)

This Test Drive will last 30 days. After 30 days it will be automatically terminated. This process is managed by the Marketplace and cannot be stopped.

Access the Keyfactor PQC Lab server via the public URL that is provided below as part of the test drive launch. There is a web page with information to get started on the host and will appear a few minutes after the Test Drive is started.

**The instance will take approximately 5 minutes to fully provision. If the URLs do not work when clicked, please wait and try again.**

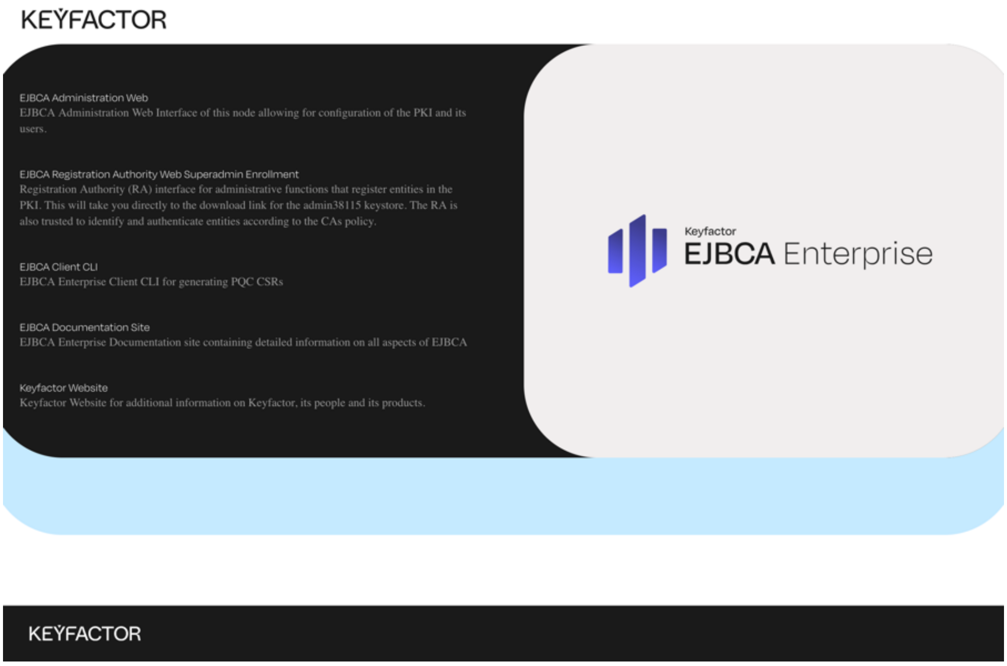
The Test Drive instance can be found at the following location (once ready):
"http://pqclaboblesbv2bw46g.eastus2.cloudapp.azure.com"
You can access the EJBCA RA Web to get the superadmin certificate with the following credentials

Username: **admin43741**
Password: **$WF6^UECPn**

For more information, please scroll down to open the attached evaluation guide located under the Test Drive Details in the Documentation section. It will guide you through test scenarios to make sure you get best experience from your Test Drive instance.

The instance will take approximately 30 minutes to complete.

Once completed, you will be brought to the complete Test Drive start page with some useful links.



EJBCA Administration Web
EJBCA Administration Web Interface of this node allowing for configuration of the PKI and its users.

EJBCA Registration Authority Web Superadmin Enrollment
Registration Authority (RA) interface for administrative functions that register entities in the PKI. This will take you directly to the download link for the admin38115 keystore. The RA is also trusted to identify and authenticate entities according to the CAs policy.

EJBCA Client CLI
EJBCA Enterprise Client CLI for generating PQC CSRs

EJBCA Documentation Site
EJBCA Enterprise Documentation site containing detailed information on all aspects of EJBCA

Keyfactor Website
Keyfactor Website for additional information on Keyfactor, its people and its products.

Once ready, use the provided Test Drive instance URL and the username and password to access the EJBCA RA user interface and retrieve the administrator (superadmin) certificate.

Follow this tutorial video that walks you through the step-by-step process of issuing PQC certificates using standard protocols and APIs like REST, EST, and ACME:

Getting Started with PQC Lab: How to set up a post-quantum PKI lab environment in just minutes

# Access EJBCA

To access EJBCA, the credentials need to be retrieved from the server and installed in your browser. We recommend using Mozilla Firefox as it has self-enrollment capabilities and its own keystore separate from the operating system.

## Step 1 - Download the EJBCA administrator certificate

Access the EJBCA RA interface to retrieve the administrator (Superadmin) certificate, using the username and password provided by the test drive in the Azure Marketplace.

To download the certificate:

1. In your browser, navigate to the EJBCA RA interface.
   ℹ If you selected the EJBCA Registration Authority Web Superadmin Enrollment link on the start page, the username will be populated for you. The enrollment code is the password that was supplied to you during the Azure Test Drive provisioning process.
2. A browser warning is shown if you have not added the Management CA to the list of trusted roots in your certificate store. Click through the security warning, and accept the risk and continue.
3. To enroll, select **Enroll** > **Use Username** and specify the following:
    - **Username:** Enter the Administrator username that was provided to you in the Azure marketplace when you launched the instance.
    - **Enrollment code:** Enter the Administrator password that was provided to you in the Azure marketplace when you launched the instance.
    - Click **Check**.
    - For **Key algorithm**, select **RSA 2048 bits** to limit the type of keys to be used.
    - Click **Download PKCS#12** to download and save the keystore.

The P12 file is now downloaded to your download directory.

## Step 2 - Import certificate into browser

Next, add the downloaded P12 keystore to your browser's certificate store.

The procedure for importing a certificate may vary depending on the web browser you are using. This example describes how to import a certificate to Mozilla Firefox.

To import the certificate in your browser:

1. Open the Firefox application menu and click **Settings**.
2. Go to **Privacy & Security** and in the **Security** section, click **View Certificates**.
3. On the **Your Certificates** tab, select **Import**.
4. Browse to the downloaded P12 file, select the file, and click **OK**.
5. Enter the password you specified as the enrollment code in the previous step, and click **Sign in**.
6. Click **OK** to close the Firefox Certificate Manager.

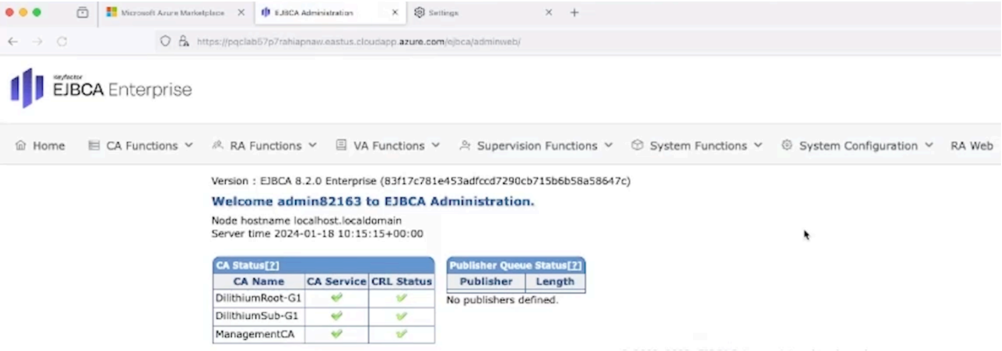
The administrator certificate is now imported and installed in your browser.

## Step 3 - Access EJBCA

To access EJBCA using the certificate you just installed:

1. On the Test Drive start page, click the **EJBCA Administration Web** or point your browser to https://<localhost>/ejbca/adminweb/ to access EJBCA using the imported certificate.
2. When prompted with a request for your browser to use the imported certificate, click **OK** to access EJBCA with the certificate.

EJBCA opens displaying the administration page.



Version : EJBCA 8.2.0 Enterprise (83f17c781e453adfccd7290cb715b6b58a58647c)

Welcome admin82163 to EJBCA Administration.

Node hostname localhost.localdomain
Server time 2024-01-18 10:15:15+00:00

CA Status[?]

| CA Name | CA Service | CRL Status |
|---|---|---|
| DilithiumRoot-G1 | ✓ | ✓ |
| DilithiumSub-G1 | ✓ | ✓ |
| ManagementCA | ✓ | ✓ |

Publisher Queue Status[?]

| Publisher | Length |
|---|---|

No publishers defined.

Along with the Management CA, a Dilithium Root CA (trust anchor) and a Dilithium Subordinate CA are listed among the certificate authorities.

# Download EJBCA Client CLI

Download the EJBCA Enterprise Client CLI that will allow you to generate PQC Certificate Signing Requests (CSRs) with Dilithium.

1. Navigate to the Test Drive instance start page.
2. Click **EJBCA Client CLI** to download the EJBCA CLI file.
3. In your terminal, in the downloads directory, unzip the EJBCA Client CLI ZIP file.

# Issue PQC certificates

The following provides steps to enroll for a certificate using the enrollment protocols ACME, EST, and EJBCA REST API.

## EST

To generate a CSR and enroll for a certificate using the Enrollment over Secure Transport (EST) protocol with basic authentication, follow these steps:

1. Open a terminal window and change to the unzipped EJBCA Client CLI directory.
2. Create a new directory for the EST enrollment:

```
$ mkdir est && cd est
```

3. Generate a CSR:

```
$ ../ejbca-cli/ejbca.sh gencsr --keyalg DILITHIUM3 --subjectdn
"C=ZZ,O=Keyfactor PQC Lab,OU=Devices,CN=pqc-EstTestDevice01"
```

4. Convert the CSR to DER encoding:

```
$ openssl req -inform PEM -outform DER -in certificateSigningRequest.csr -out
pqc-estTestDevice01.csr
```

5. Download the Dilithium CA certificate:

```
$ curl -k https://<EJBCA FQDN>/.well-known/est/pcqra/cacerts -o cacerts.p7
```

6. Base64 encode the CSR:

```
$ openssl base64 -in pqc-estTestDevice01.csr -out pqc-estTestDevice01.b64 -e
```

7. Enroll for a certificate using the EST protocol with basic authentication:

```
$ curl -kv --user "pqcclient:foo123" --data @pqc-estTestDevice01.b64 -o pqc-
estTestDevice01-p7.b64 -H "Content-Type: application/pkcs10" -H "Content-
Transfer-Encoding: base64" https://<EJBCA FQDN>/.well-known/est/pcqra/
simpleenroll
```

8. Convert the response into a PEM encoded certificate:

```
$openssl base64 -in pqc-estTestDevice01-p7.b64 -out pqc-estTestDevice01-p7.der
-d
openssl pkcs7 -inform DER -in pqc-estTestDevice01-p7.der -print_certs -out pqc-
estTestDevice01-cert.pem
```

9. Review the certificate with OpenSSL:

```
$ openssl x509 -noout -text -in pqc-estTestDevice01-cert.pem
```

10. Change back to the root of the EJBCA CLI directory:

```
$ cd ../
```

## ACME

To generate a CSR and enroll for a certificate using the Automatic Certificate Management Environment (ACME) protocol and the ACME Certbot client, follow these steps:

1. Create a new directory for the ACME enrollment:

```
$ mkdir acme && cd acme
```

2. Generate a CSR:

```
$ ../ejbca-cli/ejbca.sh gencsr --keyalg DILITHIUM3 --subjectdn
"C=ZZ,O=Keyfactor PQC Lab,OU=Devices,CN=<DNS RESOLVABLE FQDN>" --subjectaltname
"dNSName=<DNS RESOLVABLE FQDN>"
```

3. Copy the CSR to a host that has an ACME client such as Certbot installed using SCP.
4. SSH to the ACME host.
5. Enroll for a certificate using the ACME certbot client:

```
$sudo certbot certonly --standalone --server https://<EJBCA FQDN>/ejbca/acme/
pqcdilithium/directory --agree-tos --email your.email@yourdomain.com --no-eff-
email --no-verify-ssl --csr pqc.csr
```

6. Parse the certificate with OpenSSL:

```
$ openssl x509 -noout -text -in 0000_cert.pem
```

7. Logout of the remote session.
8. Change back to the root of the EJBCA CLI directory.

```
$ cd ../
```

## REST API

To generate a CSR and enroll for a certificate using the EJBCA REST API and the REST API enrollment script, follow these steps:

1. Create a new directory for the REST API enrollment:

   ```
   $ mkdir rest && cd rest
   ```

2. Download the REST API enrollment script:

   ```
   $ curl -LO https://github.com/Keyfactor/keyfactorcommunity/blob/main/apps-
   integration/ejbca-rest-api/pkcs10Enroll.sh
   ```

3. Download the Management CA certificate from the EJBCA instance:

   ```
   $ curl -k https://<EJBCA FQDN>/ejbca/ra/cert\?
   caid\=-1782614762\&chain\=false\&format\=pem -o ManagementCA.pem
   ```

4. Generate a CSR:

   ```
   $ ../ejbca-cli/ejbca.sh gencsr --keyalg DILITHIUM3 --subjectdn
   "C=ZZ,O=Keyfactor PQC Lab,OU=Devices,CN=pqc-RestTestDevice01"
   ```

5. Enroll for a certificate using the pkcs10Enroll.sh script:

   ```
   $ ./pkcs10Enroll.sh -c certificateSigningRequest.csr -P ../admin82163.p12 \
   -s foo123 -H <EJBCA FQDN> -u pqc-RestTestDevice01 \
   -p "dilithiumDeviceAuthentication-1y" -e "pqcDeviceAuth" -n DilithiumSub-G1
   ```

6. Parse the certificate with OpenSSL:

   ```
   $ openssl x509 -text -noout -in pqc-RestTestDevice01.crt
   ```

7. Change back to the root of the EJBCA CLI directory:

   ```
   cd ../
   ```

You have now obtained Dilithium certificates out of the enrollment protocols ACME, EST, and EJBCA REST API.

# View issued certificates

To view the PQC certificates you have issued, do the following:

1. Navigate to the Test Drive start page.
2. Click the **EJBCA Administration Web** link.
3. On the EJBCA administration page, click the menu option **RA Web**.
4. Click **Search** > **Certificates** and enter PQC in the search field.
5. The issued PQC certificates are listed in the overview.

You can display detailed information about the certificates by clicking **View**.

## Next steps

This tutorial has demonstrated how you can use the PQC Lab on Azure to try post-quantum cryptography and generate your own quantum-safe certificates with EJBCA.

To explore other tools and resources and get ready for the quantum leap, go to the Keyfactor PQC Lab webpage.