

# Quarkus - Using JWT RBAC

This guide explains how your Quarkus application can utilize MicroProfile JWT (MP JWT) to verify [JSON Web Tokens](#), represent them as MP JWT [org.eclipse.microprofile.jwt.JsonWebToken](#) and provide secured access to the Quarkus HTTP endpoints using Bearer Token Authorization and [Role-Based Access Control](#).



Quarkus OpenId Connect extension also supports Bearer Token Authorization and uses [smallrye-jwt](#) to represent the bearer tokens as [JsonWebToken](#), please read the [Using OpenID Connect to Protect Service Applications](#) guide for more information. OpenId Connect extension has to be used if the Quarkus application needs to authenticate the users using OIDC Authorization Code Flow, please read [Using OpenID Connect to Protect Web Applications](#) guide for more information.

## Solution

We recommend that you follow the instructions in the next sections and create the application step by step. However, you can skip right to the completed example.

Clone the Git repository: `git clone https://github.com/quarkusio/quarkus-quickstarts.git`, or download an [archive](#).

The solution is located in the [security-jwt-quickstart](#) directory.

## Creating the Maven project

First, we need a new project. Create a new project with the following command:

```
mvn io.quarkus:quarkus-maven-plugin:1.7.3.Final:create \
  -DprojectId=org.acme \
  -DprojectArtifactId=security-jwt-quickstart \
  -DclassName="org.acme.security.jwt.TokenSecuredResource" \
  -Dpath="/secured" \
  -Dextensions="resteasy-jsonb, jwt"
cd security-jwt-quickstart
```

This command generates the Maven project with a REST endpoint and imports the [smallrye-jwt](#) extension, which includes the MicroProfile JWT RBAC support.

If you already have your Quarkus project configured, you can add the [smallrye-jwt](#) extension to your project by running the following command in your project base directory:

```
./mvnw quarkus:add-extension -Dextensions="smallrye-jwt"
```

This will add the following to your `pom.xml`:

```
<dependency>
  <groupId>io.quarkus</groupId>
  <artifactId>quarkus-smallrye-jwt</artifactId>
</dependency>
```

## Examine the JAX-RS resource

Open the `src/main/java/org/acme/security/jwt/TokenSecuredResource.java` file and see the following content:

*Basic REST Endpoint*

```
package org.acme.security.jwt;

import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;

@Path("/secured")
public class TokenSecuredResource {

    @GET
    @Produces(MediaType.TEXT_PLAIN)
    public String hello() {
        return "hello";
    }
}
```

This is a basic REST endpoint that does not have any of the SmallRye JWT specific features, so let's add some.

*REST Endpoint V1*

```
package org.acme.security.jwt;

import java.security.Principal;

import javax.annotation.security.PermitAll;
import javax.enterprise.context.RequestScoped;
import javax.inject.Inject;
import javax.ws.rs.GET;
```

```

import javax.ws.rs.InternalServerErrorException;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.Context;
import javax.ws.rs.core.MediaType;
import javax.ws.rs.core.SecurityContext;

import org.eclipse.microprofile.jwt.JsonWebToken;

@Path("/secured")
@RequestScoped ❶
public class TokenSecuredResource {

    @Inject
    JsonWebToken jwt; ❷

    @GET()
    @Path("permit-all")
    @PermitAll ❸
    @Produces(MediaType.TEXT_PLAIN)
    public String hello(@Context SecurityContext ctx) {
        return getResponseString(ctx); ❹
    }

    private String getResponseString(SecurityContext ctx) {
        String name;
        if (ctx.getUserPrincipal() == null) { ❺
            name = "anonymous";
        } else if
(!ctx.getUserPrincipal().getName().equals(jwt.getName())) { ❻
            throw new InternalServerErrorException("Principal and
JsonWebToken names do not match");
        } else {
            name = ctx.getUserPrincipal().getName(); ❼
        }
        return String.format("hello + %s,"
            + " isHttps: %s,"
            + " authScheme: %s,"
            + " hasJWT: %s",
            name, ctx.isSecure(), ctx.getAuthenticationScheme(),
hasJwt()); ❽
    }

    private boolean hasJwt() {
        return jwt.getClaimNames() != null;
    }
}

```

❶ Add a **RequestScoped** as Quarkus uses a default scoping of **ApplicationScoped** and this will

produce undesirable behavior since JWT claims are naturally request scoped.

- ② Here we inject the `JsonWebToken` interface, an extension of the `java.security.Principal` interface that provides access to the claims associated with the current authenticated token.
- ③ `@PermitAll` is a JSR 250 common security annotation that indicates that the given endpoint is accessible by any caller, authenticated or not.
- ④ Here we inject the JAX-RS `SecurityContext` to inspect the security state of the call and use a `getResponseString()` function to populate a response string.
- ⑤ Here we check if the call is insecured by checking the request user/caller `Principal` against null.
- ⑥ Here we check that the `Principal` and `JsonWebToken` have the same name since `JsonWebToken` does represent the current `Principal`.
- ⑦ Here we get the `Principal` name.
- ⑧ The reply we build up makes use of the caller name, the `isSecure()` and `getAuthenticationScheme()` states of the request `SecurityContext`, and whether a non-null `JsonWebToken` was injected.

## Run the application

Now we are ready to run our application. Use:

```
./mvnw compile quarkus:dev
```

and you should see output similar to:

#### *quarkus:dev Output*

```
$ ./mvnw compile quarkus:dev
[INFO] Scanning for projects...
[INFO]
[INFO] -----< org.acme:security-jwt-quickstart
>-----
[INFO] Building security-jwt-quickstart 1.0-SNAPSHOT
[INFO] -----[ jar
]-----
...
Listening for transport dt_socket at address: 5005
2020-07-15 16:09:50,883 INFO [io.quarkus] (Quarkus Main Thread)
security-jwt-quickstart 1.0-SNAPSHOT on JVM (powered by Quarkus
999-SNAPSHOT) started in 1.073s. Listening on: http://0.0.0.0:8080
2020-07-15 16:09:50,885 INFO [io.quarkus] (Quarkus Main Thread)
Profile dev activated. Live Coding activated.
2020-07-15 16:09:50,885 INFO [io.quarkus] (Quarkus Main Thread)
Installed features: [cdi, mutiny, resteasy, resteasy-jsonb,
security, smallrye-context-propagation, smallrye-jwt, vertx, vertx-
web]
```

Now that the REST endpoint is running, we can access it using a command line tool like curl:

*curl command for /secured/permit-all*

```
$ curl http://127.0.0.1:8080/secured/permit-all; echo
hello + anonymous, isHttps: false, authScheme: null, hasJWT: false
```

We have not provided any JWT in our request, so we would not expect that there is any security state seen by the endpoint, and the response is consistent with that:

- user name is anonymous
- isHttps is false as https is not used
- authScheme is null
- hasJWT is false

Use Ctrl-C to stop the Quarkus server.

So now let's actually secure something. Take a look at the new endpoint method `helloRolesAllowed` in the following:

*REST Endpoint V2*

```
package org.acme.security.jwt;

import javax.annotation.security.PermitAll;
```

```

import javax.annotation.security.RolesAllowed;
import javax.enterprise.context.RequestScoped;
import javax.inject.Inject;
import javax.ws.rs.GET;
import javax.ws.rs.InternalServerErrorException;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.Context;
import javax.ws.rs.core.MediaType;
import javax.ws.rs.core.SecurityContext;

import org.eclipse.microprofile.jwt.JsonWebToken;

@Path("/secured")
@RequestScoped
public class TokenSecuredResource {

    @Inject
    JsonWebToken jwt; ①

    @GET
    @Path("permit-all")
    @PermitAll
    @Produces(MediaType.TEXT_PLAIN)
    public String hello(@Context SecurityContext ctx) {
        return getResponseString(ctx);
    }

    @GET
    @Path("roles-allowed") ②
    @RolesAllowed({ "User", "Admin" }) ③
    @Produces(MediaType.TEXT_PLAIN)
    public String helloRolesAllowed(@Context SecurityContext ctx) {
        return getResponseString(ctx) + ", birthdate: " +
jwt.getClaim("birthdate").toString(); ④
    }

    private String getResponseString(SecurityContext ctx) {
        String name;
        if (ctx.getUserPrincipal() == null) {
            name = "anonymous";
        } else if
(!ctx.getUserPrincipal().getName().equals(jwt.getName())) {
            throw new InternalServerErrorException("Principal and
JsonWebToken names do not match");
        } else {
            name = ctx.getUserPrincipal().getName();
        }
        return String.format("hello + %s,"

```

```

        + " isHttps: %s,"
        + " authScheme: %s,"
        + " hasJWT: %s",
        name, ctx.isSecure(), ctx.getAuthenticationScheme(),
hasJwt());
    }

    private boolean hasJwt() {
        return jwt.getClaimNames() != null;
    }
}

```

- ① Here we inject `JsonWebToken`
- ② This new endpoint will be located at `/secured/roles-allowed`
- ③ `@RolesAllowed` is a JSR 250 common security annotation that indicates that the given endpoint is accessible by a caller if they have either a "User" or "Admin" role assigned.
- ④ Here we build the reply the same way as in the `hello` method but also add a value of the JWT `birthdate` claim by directly calling the injected `JsonWebToken`.

After you make this addition to your `TokenSecuredResource`, rerun the `./mvnw compile quarkus:dev` command, and then try `curl -v http://127.0.0.1:8080/secured/roles-allowed; echo` to attempt to access the new endpoint. Your output should be:

*curl command for /secured/roles-allowed*

```

$ curl -v http://127.0.0.1:8080/secured/roles-allowed; echo
* Trying 127.0.0.1...
* TCP_NODELAY set
* Connected to 127.0.0.1 (127.0.0.1) port 8080 (#0)
> GET /secured/roles-allowed HTTP/1.1
> Host: 127.0.0.1:8080
> User-Agent: curl/7.54.0
> Accept: */*
>
< HTTP/1.1 401 Unauthorized
< Connection: keep-alive
< Content-Type: text/html; charset=UTF-8
< Content-Length: 14
< Date: Sun, 03 Mar 2019 16:32:34 GMT
<
* Connection #0 to host 127.0.0.1 left intact
Not authorized

```

Excellent, we have not provided any JWT in the request, so we should not be able to access the endpoint, and we were not. Instead we received an HTTP 401 Unauthorized error. We need to obtain and pass in a valid JWT to access that endpoint. There are two steps to this, 1) configuring our SmallRye JWT extension with information on how to validate a JWT, and 2) generating a matching

JWT with the appropriate claims.

## Configuring the SmallRye JWT Extension Security Information

Create a `security-jwt-quickstart/src/main/resources/application.properties` with the following content:

*application.properties for TokenSecuredResource*

```
mp.jwt.verify.publickey.location=META-INF/resources/publicKey.pem  
①  
mp.jwt.verify.issuer=https://quarkus.io/using-jwt-rbac ②
```

① We are setting public key location to point to a classpath `publicKey.pem` resource location. We will add this key in part B, [Adding a Public Key](#).

② We are setting the issuer to the URL string <https://quarkus.io/using-jwt-rbac>.

## Adding a Public Key

The [JWT specification](#) defines various levels of security of JWTs that one can use. The MicroProfile JWT RBAC specification requires that JWTs that are signed with the RSA-256 signature algorithm. This in turn requires a RSA public key pair. On the REST endpoint server side, you need to configure the location of the RSA public key to use to verify the JWT sent along with requests. The `mp.jwt.verify.publickey.location=publicKey.pem` setting configured previously expects that the public key is available on the classpath as `publicKey.pem`. To accomplish this, copy the following content to a `security-jwt-quickstart/src/main/resources/META-INF/resources/publicKey.pem` file.



Adding `publicKey.pem` to `resources/META-INF/resources` ensures that it is available in the native image without having to provide a GraalVM resource file.

*RSA Public Key PEM Content*

```
-----BEGIN PUBLIC KEY-----  
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAlivFI8qB4D0y2jy0CfEq  
Fyy46R0o7S8TKpsx5xbHKoU1VWg6QkQm+ntyIv1p4kE1sPEQ073+HY8+Bzs75XwR  
TYL1BmR1w8J5hmjVWjc6R2BTBGAYRPFRRhor3kpM6ni2SPmNNhurEAHw7TaqszP5e  
UF/F9+KEBWkwVta+PZ37bwqSE4sCb1soZFrVz/UT/LF4tYpuVYt3YbqToZ3pZ0Z9  
AX2o1GCG3xw0jkc4x0W7ezbQZdC9iftPxVHR8ir0ijJRRjcPDtA6vPKpzL16CyYn  
sIYPd991twxTHjr3npfv/3Lw50bAkbt4HeLFxTx4f1EoZLK0/g0bAoV2uqBhka9x  
nQIDAQAB  
-----END PUBLIC KEY-----
```



# Generating a JWT

Often one obtains a JWT from an identity manager like [Keycloak](#), but for this quickstart we will generate our own using the JWT generation API provided by `smallrye-jwt` (see [Generate JWT tokens with SmallRye JWT](#) for more information).

Take the code from the following listing and place into `security-jwt-quickstart/src/main/java/org/acme/security/jwt/GenerateToken.java`:

*GenerateToken main Driver Class*

```
package org.acme.security.jwt;

import java.util.Arrays;
import java.util.HashSet;

import org.eclipse.microprofile.jwt.Claims;

import io.smallrye.jwt.build.Jwt;

public class GenerateToken {
    /**
     * Generate JWT token
     */
    public static void main(String[] args) {
        String token =
            Jwt.issuer("https://quarkus.io/using-jwt-rbac") ①
                .upn("jdoe@quarkus.io") ②
                .groups(new HashSet<>(Arrays.asList("User", "Admin")))
                .claim(Claims.birthdate.name(), "2001-07-13") ④
                .sign();
        System.out.println(token);
    }
}
```

- ① The `iss` claim is the issuer of the JWT. This needs to match the server side `mp.jwt.verify.issuer` in order for the token to be accepted as valid.
- ② The `upn` claim is defined by the MicroProfile JWT RBAC spec as preferred claim to use for the `Principal` seen via the container security APIs.
- ③ The `group` claim provides the groups and top-level roles associated with the JWT bearer.
- ④ The `birthday` claim. It can be considered to be a sensitive claim so you may want to consider encrypting the claims, see [Generate JWT tokens with SmallRye JWT](#).

Note for this code to work we need the content of the RSA private key that corresponds to the public key we have in the TokenSecuredResource application. Take the following PEM content and place it into `security-jwt-quickstart/src/main/resources/META-INF/resources/privateKey.pem`:

```

-----BEGIN PRIVATE KEY-----
MIIEvQIBADANBgkqhkiG9w0BAQEFAASCBAcwggSjAgEAAoIBAQCWK8UjyoHgPTLa
PLQJ8SoXLLjpHSjtLxMqzmHnFscqhTVVaDpCRcb6e3Ii/WniQTWw8RA7vf4djz4H
OzvlfBFNgvUGZHXDwnmGaNvaNzpHYFMEYBhE8VGGiveSkzqeLZI+Y02G6sQAfDtN
qqzM/15QX8X34oQFaTBW1r49nftvCpITiWJvWyhkWtXP9RP8sXi1im5Vi3dhup0h
nelk5n0BfajUYIbfHA60RzjHRbt7NtBl0L2J+0/FUdHyKs6KM1FGNw800Dq88qnM
uXoLJiewhg9332W3DFMe0veel+//cvDnRsCRtPg4sXFPHh+UShkso7+DRsChXa6
oGGQD3GdAgMBAAECggEAAjftSZwMHwvIXIDZB+yP+pemg4ryt84iMlbofclQV8hv
6TsI4UGwcbKxFOm5VSYxbN0isb80qasb929gixsyBjsQ8284bhPJR7r0q8h1C+jY
URA6S4pk8d/LmFakXwG9Tz6YP0p3Jziuh48lzkFTk0xW2Dp4SLwtAptZY/+ZXyJ6
96QXDrZKSSM99Jh9s7a0ST66WoxSS0UC51ak+Keb0KJ1jz4bIJ2C3r4rYlSu4hHB
Y73GfkWORTQuyUDa9yD0em0/z0nr6pp+pBSXPLHADsqvZiIhxD/00Xk5I6/zVHB3
zuoQqLERk0WvA8FXz2o8AYwcQRY2g30eX9kU4uDQAQKBgQDmf7KGImUGitsEPepF
KH5yLWYWqghHx6wfV+fdbBxoqn9WlwcQ7JbynIiVx8MX8/1lCCe8v41ypu/eLtP
iY1ev2IKdrUSTvYRSsFigRkuPHUo1ajsGHQd+ucTDf58mn7kRLW1JGMeGxo/t32B
m96Af6AiPWPEJuVfgGV0iwg+HQBKbQCmyPzL9M2rhYZn1AozRUguvlpMJHU2DpqS
34Q+7x2Ghf7MgBUhqE0t3FA0xEC7IYBwHmeY0vFR8ZkVRKNF4gbnF9RtLdz0DMEG
5qsMnvJUSQbNB1yVjUCnDAteLqiFRlQ/k0LgYkjKDY7Lfcizl9uJRl00SYeX/qG2
tRW09t0pgQKBgBSGkpM3RN/MRayfBtmZvYjvVwH3yjkI2GbHA1jj1g6IebLB9SnfL
WbXJErCj1U+wvoPf5hfBc7m+jRgD3Eo86YXibQyZfY5pFIh9q7L15CQ15hj4zc4Y
b16sFR+xQ1Q9Pcd+BuBWmSz5J0E/qcF869dthgkGhnfVLt/0QzqZluZRAoGAXQ09
nT0TkmKIvlza5Af/YbTqEpq8m1BDhTYXPlWCD4+qvMWpBII1rSSBtftgcgca9XLB
MXmRmbqtQeRtg4u7dishZVh1MeP7vbHsNLppUQT90l6lFPsd2xUpJDc6BkFat62d
Xjr3iWNPC9E9nhPPdCNBv7reX7q81obpeXFMXgECgYEAmk2Qlus30V0tfoNRqNpe
Mb0teduf2+h3xaI1XDIzPVtZF35ELY/RkAHlmWRT4PCdR0zXDIdE67L6XdJyecSt
Fd0UH8z5qUraVVeBfVJqf/oGsXc4+ex1ZKUTbY0wqY1y9E39yvB3MaTmZFuuqk8
f3cg+fr8aou7pr9SHhJlZCU=
-----END PRIVATE KEY-----

```

We will use a `smallrye.jwt.sign.key-location` property to point to this private signing key.

Now we can generate a JWT to use with `TokenSecuredResource` endpoint. To do this, run the following command:

```
$ mvn exec:java
-Dexec.mainClass=org.acme.security.jwt.GenerateToken
-Dexec.classpathScope=test -Dsmallrye.jwt.sign.key
-location=privateKey.pem

eyJraWQiOiJcL3ByaXZhdGVlZXkucGVtIiwidHlwIjoiSldUIiwiaWF0IjoiYWMiYWxnIjoiUlMyNTYifQ.eyJzdWIiOiJqZG9lLXVzaW5nLWp3dC1yYmFjIiwiaXYXVkIjoibmctand0LXJiYWMiLCJlcG4iOiJqZG9lQHFIYXJrdXMuaW8iLCJjaXJOaGRhdGUiOiIyMDAxLTA3LTEzIiwiaXYXV0aF90aW11IjoxNTUxNjc2LJCpc3MiOiJodHRwczpcL1wvcXVhcmt1cy5pb1wvdXNpbmctand0LXJiYWMiLCJyb2xlTWFWcwGluz3MiOmsiZ3JvdXAyIjoir3JvdXAyTWFWcwGVkUm9sZSIImdyb3VwMSI6Ikdyb3VwMU1hcHB1ZFJvbGUifSwiZ3JvdXBzIjpjbikvjaG9lciIsIlRlc3RlciiIsIlN1YnNjcmlzZXIiLCJncm91cDIiXSwicHJlZmVycmVkX3VzZXJuYW11IjoiamRvZSIImV4cCI6MTU1MTY1OTk3NiwiawWF0IjoxNTUxNjc2LJCqdGkiOiJhLTEyMyJ9.09tx_wNNS4qdpFhxEd1e7v4aBNWz1FCqOUV8qmXd7dW9xmM4hA5T0-ZREk3ApMrL7_rnX8z81qGPio_R8IfHDyNaI1SLD56gVX-NaOLS20jfcB03z0WJPKR_BoZkYACtMoqlWgIwIRC-wJKUU025dHZiNL0FW04PjwuCz8hpZYXIurScfFhXKrDX1fh3jDhTs0EFfu67ACd85f3BdX9pe-ayKSVLh_RSbTbBPeyoYPE59FW7H5-i8IE-Gqu838Hz0i38ksEJFI25eR-AJ6_PSUD0_-TV3NjXhf3bfIET4VSaIZcpibekoJg0cQm-4ApPEcPLdgTejYHA-mupb8hSwg
```

The JWT string is the Base64 URL encoded string that has 3 parts separated by '.' characters. First part - JWT headers, second part - JWT claims, third part - JWT signature.

## Finally, Secured Access to /secured/roles-allowed

Now let's use this to make a secured request to the `/secured/roles-allowed` endpoint. Make sure you have the Quarkus server running using the `./mvnw compile quarkus:dev` command, and then run the following command, making sure to use your version of the generated JWT from the previous step:

```
curl -H "Authorization: Bearer eyJraWQiOiJcL3ByaXZhdGVkucG9tIiwiaWF0IjoiU1MyNTYifQ.eyJzdWIiOiJqZG9lLVVzaW5nLWp3dC1yYmFjIiwiaXYVkIjoibmctand0LXJiYWMiLCJlcG4iOiJqZG9lQHFIYXJrdXMuaW8iLCJjaXJOaGRhdGUiOiIyMDAxLTAAEzIiwiaXYXN0aF90aWw1IjoxNTUxNjUyMDkxLCApc3M0IjodHRwc2pcL1wvcXVhcmt1cy5pb1wvdXNpbmctand0LXJiYWMiLCJyb2x1TWFWcGluz3MiOnsiZ3JvdxAYIjoir3JvdXAyTWFwcGVkUm9sZSIsImdyb3VwMSi6Ikdyb3VwMU1hcHB1ZFJvbGUifSwiZ3JvdXBzIjpjbikvJaG9lciIsIlRlc3RlciiIsIlN1YnNjcmlilXIiLCJncm91cDIiXSwicXVycmVkaXZ3VzZXJuYWI1IjoiamRvZSIImV4cCI6MTU1MTY1MjM5MSwiaWF0IjoxNTUxNjUyMDkxLCAqdGkiOiJhLTEyMyJ9.aPA4Rlc4kw7n_0ZZRRk25xZydJy_J_3BRR8ryYL yHT01o68_aNWWQCgpnAuOW64svPhPnLYYnQzK- l2vHX34B64JySyBD4y_vRObgmdwh_SEufBAWZV7mkG3Y4mTKT3_4EWNu4VH92IhdnkGI4GJB6yHAezlQIE6EdS0a4Nq8Gp4uPGqHsUZTJR3uIW0TbnshFBm47-oVM3ZUrBz57JKtr0e9jv0HjPQWyvbzx1HuxZd6eA8ow8xzvooKXFxoSFcmnxotd3wag vYQ9ysBa89bgzL-lhjWtusumFDUVYwfqADE7oSOD4Vtc1gq8svznBQ-YpfTHfb9QEcofMlpyjNA" http://127.0.0.1:8080/secured/roles-allowed; echo
```

### *curl Command for /secured/roles-allowed With JWT*

```
$ curl -H "Authorization: Bearer eyJraWQ..."
http://127.0.0.1:8080/secured/roles-allowed; echo
hello + jdoe@quarkus.io, isHttps: false, authScheme: MP-JWT,
hasJWT: true, birthdate: 2001-07-13
```

Success! We now have:

- a non-anonymous caller name of `jdoe@quarkus.io`
- an authentication scheme of Bearer
- a non-null JsonWebToken
- birthdate claim value

## Using the JsonWebToken and Claim Injection

Now that we can generate a JWT to access our secured REST endpoints, let's see what more we can do with the `JsonWebToken` interface and the JWT claims. The `org.eclipse.microprofile.jwt.JsonWebToken` interface extends the `java.security.Principal` interface, and is in fact the type of the object that is returned by the `javax.ws.rs.core.SecurityContext#getUserPrincipal()` call we used previously. This means that code that does not use CDI but does have access to the REST container `SecurityContext` can get hold of the caller `JsonWebToken` interface by casting the `SecurityContext#getUserPrincipal()`.

The `JsonWebToken` interface defines methods for accessing claims in the underlying JWT. It provides accessors for common claims that are required by the MicroProfile JWT RBAC specification as well as

arbitrary claims that may exist in the JWT.

All the JWT claims can also be injected. Let's expand our `TokenSecuredResource` with another endpoint `/secured/roles-allowed-admin` which uses the injected `birthdate` claim (as opposed to getting it from `JsonWebToken`):

```
package org.acme.security.jwt;

import javax.annotation.security.PermitAll;
import javax.annotation.security.RolesAllowed;
import javax.enterprise.context.RequestScoped;
import javax.inject.Inject;
import javax.ws.rs.GET;
import javax.ws.rs.InternalServerErrorException;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.Context;
import javax.ws.rs.core.MediaType;
import javax.ws.rs.core.SecurityContext;

import org.eclipse.microprofile.jwt.Claim;
import org.eclipse.microprofile.jwt.Claims;
import org.eclipse.microprofile.jwt.JsonWebToken;

@Path("/secured")
@RequestScoped
public class TokenSecuredResource {

    @Inject
    JsonWebToken jwt;
    @Inject
    @Claim(standard = Claims.birthdate)
    String birthdate; ①

    @GET
    @Path("permit-all")
    @PermitAll
    @Produces(MediaType.TEXT_PLAIN)
    public String hello(@Context SecurityContext ctx) {
        return getResponseString(ctx);
    }

    @GET
    @Path("roles-allowed")
    @RolesAllowed({ "User", "Admin" })
    @Produces(MediaType.TEXT_PLAIN)
    public String helloRolesAllowed(@Context SecurityContext ctx) {
        return getResponseString(ctx) + ", birthdate: " +
            jwt.getClaim("birthdate").toString();
    }
}
```

```

    }

    @GET
    @Path("roles-allowed-admin")
    @RolesAllowed("Admin")
    @Produces(MediaType.TEXT_PLAIN)
    public String helloRolesAllowedAdmin(@Context SecurityContext
    ctx) {
        return getResponseString(ctx) + ", birthdate: " +
    birthdate; ❷
    }

    private String getResponseString(SecurityContext ctx) {
        String name;
        if (ctx.getUserPrincipal() == null) {
            name = "anonymous";
        } else if
    (!ctx.getUserPrincipal().getName().equals(jwt.getName())) {
            throw new InternalServerErrorException("Principal and
    JsonWebToken names do not match");
        } else {
            name = ctx.getUserPrincipal().getName();
        }
        return String.format("hello + %s,"
            + " isHttps: %s,"
            + " authScheme: %s,"
            + " hasJWT: %s",
            name, ctx.isSecure(), ctx.getAuthenticationScheme(),
    hasJwt());
    }

    private boolean hasJwt() {
        return jwt.getClaimNames() != null;
    }
}

```

❶ Here we use the injected **birthday** claim.

❷ Here we use the injected **birthday** claim to build the final reply.

Now generate the token again and run:

```
$ curl -H "Authorization: Bearer eyJraWQ..."
http://127.0.0.1:8080/secured/roles-allowed-admin; echo
hello + jdoe@quarkus.io, isHttps: false, authScheme: MP-JWT,
hasJWT: true, birthdate: 2001-07-13
```

You can also generate the native executable with `./mvnw clean package -Pnative`. Native Executable Example

```
Scotts-iMacPro:security-jwt-quickstart starksm$ ./mvnw clean
package -Pnative
[INFO] Scanning for projects...
...
[security-jwt-quickstart-runner:25602]    universe:      493.17 ms
[security-jwt-quickstart-runner:25602]    (parse):      660.41 ms
[security-jwt-quickstart-runner:25602]    (inline):    1,431.10 ms
[security-jwt-quickstart-runner:25602]    (compile):   7,301.78 ms
[security-jwt-quickstart-runner:25602]    compile:    10,542.16 ms
[security-jwt-quickstart-runner:25602]    image:      2,797.62 ms
[security-jwt-quickstart-runner:25602]    write:      988.24 ms
[security-jwt-quickstart-runner:25602]    [total]:    43,778.16 ms
[INFO]
-----
[INFO] BUILD SUCCESS
[INFO]
-----
[INFO] Total time: 51.500 s
[INFO] Finished at: 2019-03-28T14:30:56-07:00
[INFO]
-----

Scotts-iMacPro:security-jwt-quickstart starksm$ ./target/security-
jwt-quickstart-runner
2019-03-28 14:31:37,315 INFO [io.quarkus] (main) Quarkus 0.12.0
started in 0.006s. Listening on: http://[::]:8080
2019-03-28 14:31:37,316 INFO [io.quarkus] (main) Installed
features: [cdi, resteasy, resteasy-jsonb, security, smallrye-jwt]
```


## Explore the Solution



The solution repository located in the `security-jwt-quickstart` directory contains all of the versions we have worked through in this quickstart guide as well as some additional endpoints that illustrate subresources with injection of `JsonWebTokens` and their claims into those using the CDI APIs. We suggest that you check out the quickstart solutions and explore the `security-jwt-quickstart` directory to learn more about the SmallRye JWT extension features.

## Configuration Reference



# Quarkus configuration

 Configuration property fixed at build time - All other configuration properties are overridable at runtime

Configuration property	Type	Default
 <code>quarkus.smallrye-jwt.enabled</code> The MP-JWT configuration object	boolean	<code>true</code>
 <code>quarkus.smallrye-jwt.rsa-sig-provider</code> The name of the <code>java.security.Provider</code> that supports SHA256withRSA signatures	string	<code>SunRsaSign</code>

## MicroProfile JWT configuration

Property Name	Default	Description
<code>mp.jwt.verify.publickey</code>	<code>none</code>	The <code>mp.jwt.verify.publickey</code> config property allows the Public Key text itself to be supplied as a string. The Public Key will be parsed from the supplied string in the order defined in section <a href="#">Supported Public Key Formats</a> .
<code>mp.jwt.verify.publickey.location</code>	<code>none</code>	Config property allows for an external or internal location of Public Key to be specified. The value may be a relative path or a URL. If the value points to an HTTPS based JWK set then, for it to work in native mode, the <code>quarkus.ssl.native</code> property must also be set to <code>true</code> , see <a href="#">Using SSL With Native Executables</a> for more details.
<code>mp.jwt.verify.issuer</code>	<code>none</code>	Config property specifies the value of the <code>iss</code> (issuer) claim of the JWT that the server will accept as valid.

## Supported Public Key Formats

Public Keys may be formatted in any of the following formats, specified in order of precedence:

- Public Key Cryptography Standards #8 (PKCS#8) PEM
- JSON Web Key (JWK)
- JSON Web Key Set (JWKS)
- JSON Web Key (JWK) Base64 URL encoded

- JSON Web Key Set (JWKS) Base64 URL encoded

## Additional SmallRye JWT configuration

SmallRye JWT provides more properties which can be used to customize the token processing:

Property Name	Default	Description
<code>smallrye.jwt.verify.algorithm</code>	<code>RS256</code>	Signature algorithm. Set it to <code>ES256</code> to support the Elliptic Curve signature algorithm.
<code>smallrye.jwt.verify.key-format</code>	<code>ANY</code>	Set this property to a specific key format such as <code>PEM_KEY</code> , <code>PEM_CERTIFICATE</code> , <code>JWK</code> or <code>JWK_BASE64URL</code> to optimize the way the verification key is loaded.
<code>smallrye.jwt.verify.relax-key-validation</code>	<code>false</code>	Relax the validation of the verification keys, setting this property to <code>true</code> will allow public RSA keys with the length less than 2048 bit.
<code>smallrye.jwt.token.header</code>	<code>Authorization</code>	Set this property if another header such as <code>Cookie</code> is used to pass the token.
<code>smallrye.jwt.token.cookie</code>	<code>none</code>	Name of the cookie containing a token. This property will be effective only if <code>smallrye.jwt.token.header</code> is set to <code>Cookie</code> .
<code>smallrye.jwt.always-check-authorization</code>	<code>false</code>	Set this property to true for Authorization header be checked even if the <code>smallrye.jwt.token.header</code> is set to <code>Cookie</code> but no cookie with a <code>smallrye.jwt.token.cookie</code> name exists.
<code>smallrye.jwt.token.schemes</code>	<code>Bearer</code>	Comma-separated list containing an alternative single or multiple schemes, for example, <code>DPoP</code> .
<code>smallrye.jwt.token.kid</code>	<code>none</code>	Key identifier. If it is set then the verification JWK key as well every JWT token must have a matching <code>kid</code> header.
<code>smallrye.jwt.time-to-live</code>	<code>none</code>	The maximum number of seconds that a JWT may be issued for use. Effectively, the difference between the expiration date of the JWT and the issued at date must not exceed this value.
<code>smallrye.jwt.require.named-principal</code>	<code>false</code>	If an application relies on <code>java.security.Principal</code> returning a name then a token must have a <code>upn</code> or <code>preferred_username</code> or <code>sub</code> claim set. Setting this property will result in SmallRye JWT throwing an exception if none of these claims is available for the application code to reliably deal with a non-null <code>Principal</code> name.

Property Name	Default	Description
<code>smallrye.jwt.path.sub</code>	<code>none</code>	Path to the claim containing the subject name. It starts from the top level JSON object and can contain multiple segments where each segment represents a JSON object name only, example: <code>realms/subject</code> . This property can be used if a token has no 'sub' claim but has the subject set in a different claim. Use double quotes with the namespace qualified claims.
<code>smallrye.jwt.claims.sub</code>	<code>none</code>	This property can be used to set a default sub claim value when the current token has no standard or custom <code>sub</code> claim available. Effectively this property can be used to customize <code>java.security.Principal</code> name if no <code>upn</code> or <code>preferred_username</code> or <code>sub</code> claim is set.
<code>smallrye.jwt.path.groups</code>	<code>none</code>	Path to the claim containing the groups. It starts from the top level JSON object and can contain multiple segments where each segment represents a JSON object name only, example: <code>realm/groups</code> . This property can be used if a token has no 'groups' claim but has the groups set in a different claim. Use double quotes with the namespace qualified claims.
<code>smallrye.jwt.groups-separator</code>	<code>' '</code>	Separator for splitting a string which may contain multiple group values. It will only be used if the <code>smallrye.jwt.path.groups</code> property points to a custom claim whose value is a string. The default value is a single space because a standard OAuth2 <code>scope</code> claim may contain a space separated sequence.
<code>smallrye.jwt.claims.groups</code>	<code>none</code>	This property can be used to set a default groups claim value when the current token has no standard or custom groups claim available.
<code>smallrye.jwt.jwks.refresh-interval</code>	<code>60</code>	JWK cache refresh interval in minutes. It will be ignored unless the <code>mp.jwt.verify.publickey.location</code> points to the HTTPS URL based JWK set and no HTTP <code>Cache-Control</code> response header with a positive <code>max-age</code> parameter value is returned from a JWK HTTPS endpoint.

Property Name	Default	Description
<code>smallrye.jwt.jwks.forced-refresh-interval</code>	30	Forced JWK cache refresh interval in minutes which is used to restrict the frequency of the forced refresh attempts which may happen when the token verification fails due to the cache having no JWK key with a kid property matching the current token's kid header. It will be ignored unless the <code>mp.jwt.verify.publickey.location</code> points to the HTTPS URL based JWK set.
<code>smallrye.jwt.expiration.grace</code>	60	Expiration grace in seconds. By default an expired token will still be accepted if the current time is no more than 1 min after the token expiry time.
<code>smallrye.jwt.verify.aud</code>	none	Comma separated list of the audiences that a token <code>aud</code> claim may contain.
<code>smallrye.jwt.required.claims</code>	none	Comma separated list of the claims that a token must contain.
<code>smallrye.jwt.decrypt.key-location</code>	none	Config property allows for an external or internal location of Private Decryption Key to be specified.
<code>smallrye.jwt.decrypt.algorithm</code>	RSA_OAEP	Decryption algorithm.
<code>smallrye.jwt.token.decryption.kid</code>	none	Decryption Key identifier. If it is set then the decryption JWK key as well every JWT token must have a matching <code>kid</code> header.

## Create JsonWebToken with JWTParser

If the JWT token can not be injected, for example, if it is embedded in the service request payload or the service endpoint acquires it out of band, then one can use `JWTParser`:

```
import org.eclipse.microprofile.jwt.JsonWebToken;
import io.smallrye.jwt.auth.principal.JWTParser;
...
@Inject JWTParser parser;

String token = getTokenFromOidcServer();

// Parse and verify the token
JsonWebToken jwt = parser.parse(token);
```

You can also use it to customize the way the token is verified or decrypted. For example, one can supply a local `SecretKey`:

```

import javax.crypto.SecretKey;
import javax.ws.rs.GET;
import javax.ws.rs.core.NewCookie;
import javax.ws.rs.core.Response;
import org.eclipse.microprofile.jwt.JsonWebToken;
import io.smallrye.jwt.auth.principal.JWTParser;
import io.smallrye.jwt.build.Jwt;

@Path("/secured")
public class SecuredResource {
    @Inject JWTParser parser;
    private SecretKey key = createSecretKey();

    @GET
    @Produces("text/plain")
    public Response getUsername(@CookieParam("jwt") String jwtCookie)
    {
        Response response = null;
        if (jwtCookie == null) {
            String newJwtCookie = Jwt.upn("Alice").sign(key);
            // or newJwtCookie = Jwt.upn("alice").encrypt(key);
            return Response.ok("Alice").cookie(new NewCookie("jwt",
newJwtCookie)).build();
        } else {
            // All mp.jwt and smallrye.jwt properties are still
effective, only the verification key is customized.
            JsonWebToken jwt = parser.verify(jwtCookie, key);
            // or jwt = parser.decrypt(jwtCookie, key);
            return Response.ok(jwt.getName()).build();
        }
    }
}

```

## Token Decryption

If your application needs to accept the tokens with the encrypted claims or with the encrypted inner signed claims then all you have to do is to set `smallrye.jwt.decrypt.key-location` pointing to the decryption key.

If this is the only key property which is set then the incoming token is expected to contain the encrypted claims only. If either `mp.jwt.verify.publickey` or `mp.jwt.verify.publickey.location` verification properties are also set then the incoming token is expected to contain the encrypted inner-signed token.

See [Generate JWT tokens with SmallRye JWT](#) and learn how to generate the encrypted or inner-signed and then encrypted tokens fast.

# How to check the errors in the logs

Set

```
quarkus.log.category."io.quarkus.smallrye.jwt.runtime.auth.MpJwtValidator"  
.level=TRACE
```

 to see more details about the token verification or decryption errors.

## Generate JWT tokens with SmallRye JWT

JWT claims can be signed or encrypted or signed first and the nested JWT token encrypted. Signing the claims is used most often to secure the claims. What is known today as a JWT token is typically produced by signing the claims in a JSON format using the steps described in the [JSON Web Signature](#) specification. However, when the claims are sensitive, their confidentiality can be guaranteed by following the steps described in the [JSON Web Encryption](#) specification to produce a JWT token with the encrypted claims. Finally both the confidentiality and integrity of the claims can be further enforced by signing them first and then encrypting the nested JWT token.

SmallRye JWT provides an API for securing the JWT claims using all of these options.

## Create JwtClaimsBuilder and set the claims

The first step is to initialize a `JwtClaimsBuilder` using one of the options below and add some claims to it:

```

import java.util.Collections;
import javax.json.Json;
import javax.json.JsonObject;
import io.smallrye.jwt.build.Jwt;
import io.smallrye.jwt.build.JwtClaimsBuilder;
import org.eclipse.microprofile.jwt.JsonWebToken;

...
// Create an empty builder and add some claims
JwtClaimsBuilder builder1 = Jwt.claims();
builder1.claim("customClaim", "custom-
value").issuer("https://issuer.org");
// Or start typing the claims immediately:
// JwtClaimsBuilder builder1 = Jwt.upn("Alice");

// Builder created from the existing claims
JwtClaimsBuilder builder2 = Jwt.claims("/tokenClaims.json");

// Builder created from a map of claims
JwtClaimsBuilder builder3 =
Jwt.claims(Collections.singletonMap("customClaim", "custom-
value"));

// Builder created from JsonObject
JsonObject userName = Json.createObjectBuilder().add("username",
"Alice").build();
JsonObject userAddress = Json.createObjectBuilder().add("city",
"someCity").add("street", "someStreet").build();
JsonObject json = Json.createObjectBuilder(userName).add("address",
userAddress).build();
JwtClaimsBuilder builder4 = Jwt.claims(json);

// Builder created from JsonWebToken
@Inject JsonWebToken token;
JwtClaimsBuilder builder5 = Jwt.claims(token);

```

The API is fluent so the builder initialization can be done as part of the fluent API sequence.

The builder will also set **iat** (issued at) to the current time, **exp** (expires at) to 5 minutes away from the current time (it can be customized with the **smallrye.jwt.new-token.lifespan** property) and **jti** (unique token identifier) claims if they have not already been set. One can also configure **smallrye.jwt.new-token.issuer** property and skip setting the issuer directly with the builder API.

The next step is to decide how to secure the claims.

## Sign the claims

The claims can be signed immediately or after the **JSON Web Signature** headers have been set:

```
import io.smallrye.jwt.build.Jwt;
...

// Sign the claims using the private key loaded from the location
// set with a 'smallrye.jwt.sign.key-location' property.
// No 'jws()' transition is necessary.
String jwt1 = Jwt.claims("/tokenClaims.json").sign();

// Set the headers and sign the claims with an RSA private key
// loaded in the code (the implementation of this method is omitted).
// Note a 'jws()' transition to a 'JwtSignatureBuilder'.
String jwt2 =
    Jwt.claims("/tokenClaims.json").jws().keyId("kid1").header("custom-
    header", "custom-value").sign(getPrivateKey());
```

Note the **alg** (algorithm) header is set to **RS256** by default.

## Encrypt the claims

The claims can be encrypted immediately or after the **JSON Web Encryption** headers have been set the same way as they can be signed. The only minor difference is that encrypting the claims always requires a **jwe()** **JwtEncryptionBuilder** transition:

```
import io.smallrye.jwt.build.Jwt;
...

// Encrypt the claims using the public key loaded from the location
// set with a 'smallrye.jwt.encrypt.key-location' property.
String jwt1 = Jwt.claims("/tokenClaims.json").jwe().encrypt();

// Set the headers and encrypt the claims with an RSA public key
// loaded in the code (the implementation of this method is omitted).
String jwt2 = Jwt.claims("/tokenClaims.json").jwe().header("custom-
    header", "custom-value").encrypt(getPublicKey());
```

Note the **alg** (key management algorithm) header is set to **RSA-OAEP-256** (it will be changed to **RSA-OAEP** in a future version of smallrye-jwt) and the **enc** (content encryption header) is set to **A256GCM** by default.

## Sign the claims and encrypt the nested JWT token

The claims can be signed and then the nested JWT token encrypted by combining the sign and encrypt



steps.

```
import io.smallrye.jwt.build.Jwt;
...

// Sign the claims and encrypt the nested token using the private
// and public keys loaded from the locations set with the
// 'smallrye.jwt.sign.key-location' and 'smallrye.jwt.encrypt.key-
// location' properties respectively.
String jwt = Jwt.claims("/tokenClaims.json").innerSign().encrypt();
```

## Fast JWT Generation

If `smallrye.jwt.sign.key-location` or/and `smallrye.jwt.encrypt.key-location` properties are set then one can secure the existing claims (resources, maps, JsonObjects) with a single call:

```
// More compact than Jwt.claims("/claims.json").sign();
Jwt.sign("/claims.json");

// More compact than Jwt.claims("/claims.json").jwe().encrypt();
Jwt.encrypt("/claims.json");

// More compact than
Jwt.claims("/claims.json").innerSign().encrypt();
Jwt.signAndEncrypt("/claims.json");
```

As mentioned above, `iat`, `exp`, `jti` and `iss` claims will be added if needed.

## SmallRye JWT Builder configuration

Smallrye JWT supports the following properties which can be used to customize the way claims are signed and encrypted:

Property Name	Default	Description
<code>smallrye.jwt.sign.key-location</code>	<code>none</code>	Location of a private key which will be used to sign the claims when either a no-argument <code>sign()</code> or <code>innerSign()</code> method is called.
<code>smallrye.jwt.encrypt.key-location</code>	<code>none</code>	Location of a public key which will be used to encrypt the claims or inner JWT when a no-argument <code>encrypt()</code> method is called.
<code>smallrye.jwt.new-token.lifespan</code>	<code>300</code>	Token lifespan in seconds which will be used to calculate an exp (expiry) claim value if this claim has not already been set.

Property Name	Default	Description
<code>smallrye.jwt.new-token.issuer</code>	<code>none</code>	Token issuer which can be used to set an iss (issuer) claim value if this claim has not already been set.

## References

- [MP JWT 1.1.1 HTML](#)
- [MP JWT 1.1.1 PDF](#)
- [SmallRye JWT](#)
- [JSON Web Token](#)
- [JSON Web Signature](#)
- [JSON Web Encryption](#)
- [JSON Web Algorithms](#)
- [Quarkus Security](#)