



## What is Quarkus?

Quarkus is a Kubernetes Native Java stack tailored for GraalVM & OpenJDK HotSpot, crafted from the best of breed Java libraries and standards. Also focused on developer experience, making things just work with little to no configuration and allowing to do live coding.

Cheat-sheet tested with **Quarkus 0.15.0**.

## Getting Started

Quarkus comes with a Maven archetype to scaffold a very simple starting project.

```
mvn io.quarkus:quarkus-maven-plugin:0.15.0:create \
  -DprojectId=org.acme \
  -DprojectArtifactId=getting-started \
  -DclassName="org.acme.quickstart.GreetingResource" \
  -Dpath="/hello"
```

This creates a simple JAX-RS resource called `GreetingResource`.

```
@Path("/hello")
public class GreetingResource {

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

## Extensions

Quarkus comes with extensions to integrate with some libraries such as JSON-B, Camel or MicroProfile spec. To list all available extensions just run:

```
./mvnw quarkus:list-extensions
```

And to register the extensions into build tool:

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

**Tip** `extensions` property supports CSV format to register more than one extension at once.

## Application Lifecycle

You can be notified when the application starts/stops by observing `StartupEvent` and `ShutdownEvent` events.

```
@ApplicationScoped
public class ApplicationLifecycle {
    void onStart(@Observes StartupEvent event) {}
    void onStop(@Observes ShutdownEvent event) {}
}
```

## Adding Configuration Parameters

To add configuration to your application, Quarkus relies on `MicroProfile Config spec` (<https://github.com/eclipse/microprofile-config>).

```
@ConfigProperty(name = "greetings.message")
String message;

@ConfigProperty(name = "greetings.message",
                defaultValue = "Hello")
String messageWithDefault;

@ConfigProperty(name = "greetings.message")
Optional<String> optionalMessage;
```

Properties can be set as:

- Environment variables.
- System properties.
- Resources  
`src/main/resources/application.properties`.
- External config directory under the current working directory:  
`config/application.properties`.

```
greetings.message = Hello World
```

## Injection

Quarkus is based on CDI 2.0 to implement injection of code. It is not fully supported and only a subset of the specification is implemented (<https://quarkus.io/guides/cdi-reference>).

```
@ApplicationScoped
public class GreetingService {

    public String message(String message) {
        return message.toUpperCase();
    }
}
```

Scope annotation is mandatory to make the bean discoverable by CDI.

```
@Inject
GreetingService greetingService;
```

Quarkus is designed with Substrate VM in mind. For **Important** this reason, we encourage you to use *package-private* scope instead of *private*.

## JSON Marshalling/Unmarshalling

To work with `JSON-B` you need to add a dependency:

```
./mvnw quarkus:add-extension
-Dextensions="io.quarkus:quarkus-resteasy-jsonb"
```

Any POJO is marshaled/unmarshalled automatically.

```
public class Sauce {
    private String name;
    private long scovilleHeatUnits;

    // getter/setters
}
```

JSON equivalent:

```
{
    "name": "Blair's Ultra Death",
    "scovilleHeatUnits": 1100000
}
```

In a `POST` endpoint example:

```
@POST
@Consumes(MediaType.APPLICATION_JSON)
public Response create(Sauce sauce) {
    // Create Sauce
    return Response.created(URI.create(sauce.getId()))
        .build();
}
```

## Validator

Quarkus uses **Hibernate Validator** to validate input/output of REST services and business services using Bean validation spec.

```
./mvnw quarkus:add-extension
-Dextensions="io.quarkus:quarkus-hibernate-validator"
```

Annotate POJO objects with validator annotations such as: @NotNull, @Digits, @NotBlank, @Min, @Max, ...

```
public class Sauce {

    @NotBlank(message = "Name may not be blank")
    private String name;
    @Min(0)
    private long scovilleHeatUnits;

    // getter/setters
}
```

To validate that an object is valid you need to annotate where is used with @Valid annotation:

```
public Response create(@Valid Sauce sauce) {}
```

**Tip** If a validation error is triggered, a violation report is generated and serialized as JSON. If you want to manipulate the output, you need to catch in the code the `ConstraintViolationException` exception.

### Create Your Custom Constraints

First you need to create the custom annotation:

```
@Target({ METHOD, FIELD, ANNOTATION_TYPE, CONSTRUCTOR,
          PARAMETER, TYPE_USE })
@Retention(RUNTIME)
@Documented
@Constraint(validatedBy = { NotExpiredValidator.class})
public @interface NotExpired {

    String message() default "Sauce must not be expired";
    Class<?>[] groups() default { };
    Class<? extends Payload>[] payload() default { };

}
```

You need to implement the validator logic in a class that implements `ConstraintValidator`.

```
public class NotExpiredValidator
    implements ConstraintValidator<NotExpired, LocalDate>
{

    @Override
    public boolean isValid(LocalDate value,
                          ConstraintValidatorContext ctx) {

        if ( value == null ) {
            return true;
        }
        LocalDate today = LocalDate.now();
        return ChronoUnit.YEARS.between(today, value) > 0;
    }
}
```

And use it normally:

```
@NotExpired
@JsonbDateFormat(value = "yyyy-MM-dd")
private LocalDate expired;
```

### Manual Validation

You can call the validation process manually instead of relaying to @Valid by injecting `Validator` class.

```
@Inject
Validator validator;
```

And use it:

```
Set<ConstraintViolation<Sauce>> violations =
    validator.validate(sauce);
```

## Logging

You can configure how Quarkus logs:

```
quarkus.log.console.enable=true
quarkus.log.console.level=DEBUG
quarkus.log.console.color=false
quarkus.log.category."com.lordofthejars".level=DEBUG
```

Prefix is `quarkus.log`.

| Property                         | Default   | Description                        |
|----------------------------------|---|------------------------------------|
| console.enable                   | true  | Console logging enabled.           |
| console.format                   | %d{yyyy-MM-dd HH:mm:ss,SSS} %-5p [%c{3.}] (%t) %s%n           | Format pattern to use for logging. |
| console.level                    | INFO  | Minimum log level.                 |
| console.color                    | INFO  | Allow color rendering.             |
| file.enable                      | false   | File logging enabled.              |
| file.format                      | %d{yyyy-MM-dd HH:mm:ss,SSS} %h %N[%i] %-5p [%c{3.}] (%t) %s%n | Format pattern to use for logging. |
| file.level                       | ALL   | Minimum log level.                 |
| file.path                        | quarkus.log   | The path to log file.              |
| category."<category-name>".level | INFO  | Minimum level category.            |
| level                            | INFO  | Default minimum level.             |

## Rest Client

Quarkus implements **MicroProfile Rest Client** spec:

```
./mvnw quarkus:add-extension
-Dextensions="io.quarkus:quarkus-smallrye-rest-client"
```

To get content from <http://worldclockapi.com/api/json/cet/now> you need to create a service interface:

```
@Path("/api")
@RegisterRestClient
public interface WorldClockService {

    @GET @Path("/json/cet/now")
    @Produces(MediaType.APPLICATION_JSON)
    WorldClock getNow();

    @GET
    @Path("/json/{where}/now")
    @Produces(MediaType.APPLICATION_JSON)
    WorldClock getSauce(@BeanParam
                        WorldClockOptions worldClockOptions);

}
```

```
public class WorldClockOptions {
    @HeaderParam("Authorization")
    String auth;

    @PathParam("where")
    String where;
}
```

And configure the hostname at `application.properties`:

```
org.acme.quickstart.WorldClockService/mp-rest/url=
http://worldclockapi.com
```

Injecting the client:

```
@Inject
@RestClient
WorldClockService worldClockService;
```

If invocation happens within a JAX-RS resource class, you can propagate headers from incoming request to the outgoing request by using next configuartion property.

```
org.eclipse.microprofile.rest.client.propagateHeaders=
Authorization,MyCustomHeader
```

**Tip** You can still use the JAX-RS client without any problem `ClientBuilder.newClient().target(...)`

You can customize the headers passed by implementing `MicroProfile ClientHeadersFactory` annotation:

```
@RegisterForReflection
public class BaggageHeadersFactory
    implements ClientHeadersFactory {

    @Override
    public MultivaluedMap<String, String> update(
        MultivaluedMap<String, String> incomingHeaders,
        MultivaluedMap<String, String> outgoingHeaders) {}

}
```

And registering it in the client using `RegisterClientHeaders` annotation.

```
@RegisterClientHeaders(BaggageHeadersFactory.class)
@RegisterRestClient
public interface WorldClockService {}
```

Or statically set:

```
@GET
@ClientHeaderParam(name="X-Log-Level", value="ERROR")
Response getNow();
```

### Asynchronous

A method on client interface can return a `CompletionStage` class to be executed asynchronously.

```
@GET @Path("/json/cet/now")
@Produces(MediaType.APPLICATION_JSON)
CompletionStage<WorldClock> getNow();
```

## Testing

Quarkus archetype adds test dependencies with JUnit 5 and Rest-Assured library to test REST endpoints.

To package and run the application for testing:

```
@QuarkusTest
public class GreetingResourceTest {

    @Test
    public void testHelloEndpoint() {
        given()
            .when().get("/hello")
            .then()
                .statusCode(200)
                .body(is("hello"));
    }

}
```

Test port can be modified by using `quarkus.http.test-port` configuration property.

You can also inject the URL where Quarkus is started:

```
@TestHTTPResource("index.html")
URL url;
```

If you need to provide an alternative implementation of a service (for testing purposes) you can do it by using CDI `@Alternative` annotation using it in the test service placed at `src/test/java`:

```
@Alternative
@Priority(1)
@ApplicationScoped
public class MockExternalService extends ExternalService {}
```

**Important** This does not work when using native image testing.

To test native executables you can annotate the test with `@SubstrateTest`.

Persistence

Quarkus works with JPA(Hibernate) as persistence solution. But also provides an Active Record pattern implementation under Panache project.

To use database access you need to add Quarkus JDBC drivers instead of the original ones. At this time H2, MariaDB, MSSQL and PostgreSQL drivers are supported.

```
./mvnw quarkus:add-extension
-Dextensions="io.quarkus:quarkus-hibernate-orm-panache,
io.quarkus:quarkus-jdbc-mariadb"
```

```
@Entity
public class Developer extends PanacheEntity {

    // id field is implicit

    public String name;
}
```

And configuration in src/main/resources/application.properties:

```
quarkus.datasource.url=jdbc:mariadb://localhost:3306/mydb
quarkus.datasource.driver=org.mariadb.jdbc.Driver
quarkus.datasource.username=developer
quarkus.datasource.password=developer
quarkus.hibernate-orm.database.generation=update
```

Database operations:

```
// Insert
Developer developer = new Developer();
developer.name = "Alex";
developer.persist();

// Find All
Developer.findAll().list();

// Find By Query
Developer.find("name", "Alex").firstResult();

// Delete
Developer developer = new Developer();
developer.id = 1;
developer.delete();

// Delete By Query
long numberOfDeleted = Developer.delete("name", "Alex");
```

Remember to annotate methods with @Transactional annotation to make changes persisted in the database.

If queries start with the keyword from then they are treated as HQL query, if not then next short form is supported:

- order by which expands to from EntityName order by ...
- <columnName> which expands to from EntityName where <columnName>=?
- <query> which is expanded to from EntityName where <query>

Static Methods

| Field     | Parameters   | Return  |
|-----------|--|---|
| findById  | Object   | Returns object or null if not found.  |
| find      | String, [Object..., Map<String, Object>, Parameters]       | Lists of entities meeting given query with parameters set.  |
| find      | String, Sort, [Object..., Map<String, Object>, Parameters] | Lists of entities meeting given query with parameters set sorted by Sort attribute/s.                   |
| findAll   |  | Finds all entities.   |
| findAll   | Sort   | Finds all entities sorted by Sort attribute/s.  |
| stream    | String, [Object..., Map<String, Object>, Parameters]       | java.util.stream.Stream of entities meeting given query with parameters set.                            |
| stream    | String, Sort, [Object..., Map<String, Object>, Parameters] | java.util.stream.Stream of entities meeting given query with parameters set sorted by Sort attribute/s. |
| streamAll |  | java.util.stream.Stream of all entities.  |

| Field     | Parameters   | Return  |
|-----------|--|---|
| streamAll | Sort   | java.util.stream.Stream of all entities sorted by Sort attribute/s. |
| count     |  | `Number of entities.  |
| count     | String, [Object..., Map<String, Object>, Parameters] | Number of entities meeting given query with parameters set.         |
| deleteAll |  | Number of deleted entities.   |
| delete    | String, [Object..., Map<String, Object>, Parameters] | Number of deleted entities meeting given query with parameters set. |
| persist   | [Iterable, Steram, Object...]                        |   |

Panache also supports DAO pattern by providing **Tip** PanacheRepository<TYPE> interface to be implemented by your repository class.

Flyway

Quarkus integrates with Flyway to help you on database schema migrations.

```
./mvnw quarkus:add-extension
-Dextensions="io.quarkus:quarkus-flyway"
```

Then place migration files to the migrations folder (classpath:db/migration).

You can inject org.flywaydb.core.Flyway to programmatically execute the migration.

```
@Inject
Flyway flyway;

flyway.migrate();
```



Or can be automatically executed by setting `migrate-at-start` property to `true`.

```
quarkus.flyway.migrate-at-start=true
```

List of Flyway parameters

`quarkus.` as prefix is skipped in the next table.

| Parameter   | Default                             | Description   |
|---|-------------------------------------|---|
| <code>flyway.migrate-at-start</code>                | <code>false</code>                  | Flyway migration automatically.   |
| <code>flyway.locations</code>                       | <code>classpath:db/migration</code> | CSV locations to scan recursively for migrations. Supported prefixes <code>classpath</code> and <code>filesystem</code> . |
| <code>flyway.connect-retries</code>                 | <code>0</code>                      | The maximum number of retries when attempting to connect.   |
| <code>flyway.schemas</code>                         | <code>none</code>                   | CSV case-sensitive list of schemas managed.   |
| <code>flyway.table</code>                           | <code>flyway_schema_history</code>  | The name of Flyway's schema history table.  |
| <code>flyway.sql-migration-prefix</code>            | <code>V</code>                      | Prefix for versioned SQL migrations.  |
| <code>flyway.repeatable-sql-migration-prefix</code> | <code>R</code>                      | Prefix for repeatable SQL migrations.   |

Reactive Programming

Quarkus implements MicroProfile Reactive spec and uses `RXJava2` to provide reactive programming model.

```
./mvnw quarkus:add-extension
-Dextensions="
  io.quarkus:quarkus-smallrye-reactive-streams-operators"
```

Asynchronous HTTP endpoint is implemented by returning `Java CompletionStage`. You can create this class either manually or using MicroProfile Reactive Streams spec:

```
@GET
@Path("/reactive")
@Produces(MediaType.TEXT_PLAIN)
public CompletionStage<String> getHello() {
    return ReactiveStreams.of("h", "e", "l", "l", "o")
        .map(String::toUpperCase)
        .toList()
        .run()
        .thenApply(list -> list.toString());
}
```

Creating streams is also easy, you just need to return `Publisher` object.

```
@GET
@Path("/stream")
@Produces(MediaType.SERVER_SENT_EVENTS)
public Publisher<String> publishers() {
    return Flowable
        .interval(500, TimeUnit.MILLISECONDS)
        .map(s -> atomicInteger.getAndIncrement())
        .map(i -> Integer.toString(i));
}
```

Reactive Messaging

Quarkus relies on MicroProfile Reactive Messaging spec (<https://github.com/eclipse/microprofile-reactive-messaging>) to implement reactive messaging streams.

```
mvn quarkus:add-extension
-Dextensions="
  io.quarkus:quarkus-smallrye-reactive-messaging"
```

You can just start using in-memory streams by using `@Incoming` to produce data and `@Outgoing` to consume data.

Produce every 5 seconds one piece of data.

```
@ApplicationScoped
public class ProducerData {

    @Outgoing("my-in-memory")
    public Flowable<Integer> generate() {
        return Flowable.interval(5, TimeUnit.SECONDS)
            .map(tick -> random.nextInt(100));
    }
}
```

Consumes generated data from `my-in-memory` stream.

```
@ApplicationScoped
public class ConsumerData {
    @Incoming("my-in-memory")
    public void randomNumber(int randomNumber) {
        System.out.println("Received " + randomNumber);
    }
}
```

You can also inject an stream as a field:

```
@Inject
@Stream("my-in-memory") Publisher<Integer> randomNumbers;
```

Possible return types:

Kafka

To integrate with Kafka you need to add next extensions:

```
mvn quarkus:add-extension
-Dextensions="
  io.quarkus:quarkus-smallrye-reactive-messaging-kafka,
  io.quarkus:quarkus-vertx"
```

Then `@Outgoing`, `@Incoming` or `@Stream` can be used.

Kafka configuration schema: `smallrye.messaging.[sink|source].{stream-name}.<property>=<value>`

```
smallrye.messaging.source.prices.type=
  io.smallrye.reactive.messaging.kafka.Kafka
smallrye.messaging.source.prices.topic=
  prices
smallrye.messaging.source.prices.bootstrap.servers=
  localhost:9092
smallrye.messaging.source.prices.key.deserializer=
  org.apache.kafka.common.serialization.StringDeserializer
smallrye.messaging.source.prices.value.deserializer=
  org.apache.kafka.common.serialization.IntegerDeserializer
smallrye.messaging.source.prices.group.id=
  my-group-id
```

A complete list of supported properties are in [Kafka](#) site. For producer and for consumer

**Important** If the stream is not configured then it is assumed to be an in-memory stream.

## Reactive PostgreSQL Client

You can use Reactive PostgreSQL to execute queries to PostreSQL database in a reactive way, instead of using JDBC way.

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

Database configuration is the same as shown in Persistence section, but URL is different as it is not a *jdbc*.

```
quarkus.datasource.url=
    vertx-reactive:postgresql://host:5431/db
```

Then you can inject `io.reactiveverse.axle.pgclient.PgPool` class.

```
@Inject
PgPool client;

CompletionStage<JsonArray> =
    client.query("SELECT * FROM table")
    .thenApply(pgRowSet -> {
        JsonArray jsonArray = new JsonArray();
        PgIterator iterator = pgRowSet.iterator();
        return jsonArray;
    })
```

## JWT

Quarkus implements MicroProfile JWT RBAC spec.

```
mvn quarkus:add-extension
-Dextensions="io.quarkus:quarkus-smallrye-jwt"
```

Minimum JWT required claims: typ, alg, kid, iss, sub, exp, iat, jti, upn, groups.

You can inject token by using `JsonWebToken` or a claim individually by using `@Claim`.

```
@Inject
JsonWebToken jwt;

@Inject
@Claim(standard = Claims.preferred_username)
String name;

@Inject
@Claim("groups")
Set<String> groups;
```

Set of supported types: `String`, `Set<String>`, `Long`, `Boolean`, `javax.json.JsonValue`, `Optional`, `org.eclipse.microprofile.jwt.ClaimValue`.

And configuration in `src/main/resources/application.properties`:

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

Configuration options:

| Parameter                           | Default     | Description                                |
|-------------------------------------|-------------|--|
| quarkus.smallrye-jwt.enabled        | true        | Determine if the jwt extension is enabled. |
| quarkus.smallrye-jwt.realm-name     | Quarkus-JWT | Name to use for security realm.            |
| quarkus.smallrye-jwt.auth-mechanism | MP-JWT      | Authentication mechanism.                  |

| Parameter                        | Default | Description  |
|----------------------------------|---------|--|
| mp.jwt.verify.publickey          | none    | Public Key text itself to be supplied as a string. |
| mp.jwt.verify.publickey.location | none    | Relative path or URL of a public key.              |
| mp.jwt.verify.issuer             | none    | iss accepted as valid.                             |

Supported public key formats:

- PKCS#8 PEM
- JWK
- JWKS
- JWK Base64 URL
- JWKS Base64 URL

To send a token to server-side you should use `Authorization` header: `curl -H "Authorization: Bearer eyJraWQiOi..."`.

To inject claim values, the bean must be `@RequestScoped` CDI scoped. If you need to inject claim values in scope with a lifetime greater than `@RequestScoped` then you need to use `javax.enterprise.inject.Instance` interface.

```
@Inject
@Claim(standard = Claims.iat)
private Instance<Long> providerIAT;
```

## RBAC

JWT `groups` claim is directly mapped to roles to be used in security annotations.

```
@RolesAllowed("Subscriber")
```

## Keycloak

Quarkus can use Keycloak to protect resources using bearer token issued by Keycloak server.

```
mvn quarkus:add-extension
-Dextensions="io.quarkus:quarkus-keycloak"
```

You can get token information by injecting `KeycloakSecurityContext` object.

```
@Inject
KeycloakSecurityContext keycloakSecurityContext;
```

You can also protect resources with security annotations.

```
@GET
@RolesAllowed("admin")
```

Configure application to Keycloak service in `application.properties` file.

```
quarkus.keycloak.realm=quarkus
quarkus.keycloak.auth-server-url=http://localhost:8180/auth
quarkus.keycloak.resource=backend-service
quarkus.keycloak.bearer-only=true
quarkus.keycloak.credentials.secret=secret
quarkus.keycloak.policy-enforcer.enable=true
quarkus.keycloak.policy-enforcer.enforcement-mode=PERMISSIVE
```

You can see all possible Configuration parameters here.

**Tip** you can also use `src/main/resources/keycloak.json` standard Keycloak configuration file.

## Fault Tolerance

Quarkus uses <https://github.com/eclipse/microprofile-fault-tolerance>[MicroProfile Fault Tolerance spec:

```
./mvnw quarkus:add-extension
-Dextensions="io.quarkus:quarkus-smallrye-fault-tolerance"
```

MicroProfile Fault Tolerance spec uses CDI interceptor and it can be used in several elements such as CDI bean, JAX-RS resource or MicroProfile Rest Client.

To do automatic **retries** on a method:

```
@Path("/api")
@RegisterRestClient
public interface WorldClockService {

    @GET @Path("/json/cet/now")
    @Produces(MediaType.APPLICATION_JSON)
    @Retry(maxRetries = 2)
    WorldClock getNow();

}
```

You can set fallback code in case of an error by using `@Fallback` annotation:

```
@Retry(maxRetries = 1)
@Fallback(fallbackMethod = "fallbackMethod")
WorldClock getNow() {}

public String fallbackMethod() {
    return "It could beworse";
}
```

`fallbackMethod` must have the same parameters and return type as the annotated method.

You can also set logic into a class that implements `FallbackHandler` interface:

```
public class RecoverFallback
    implements FallbackHandler<String> {
    @Override
    public String handle(ExecutionContext context) {
        return "It could be worse";
    }
}
```

And set it in the annotation as value `@Fallback(RecoverFallback.class)`.

In case you want to use **circuit breaker** pattern:

```
@CircuitBreaker(requestVolumeThreshold = 4,
                failureRatio=0.75,
                delay = 1000)
WorldClock getNow() {}
```

If 3 (4 x 0.75) failures occur among the rolling window of 4 consecutive invocations then the circuit is opened for 1000 ms and then be back to half open. If the invocation succeeds then the circuit is back to closed again.

You can use **bulkahead** pattern to limit the number of concurrent access to the same resource. If the operation is synchronous it uses a semaphore approach, if it is asynchronous a thread-pool one. When a request cannot be processed `BulkheadException` is thrown. It can be used together with any other fault tolerance annotation.

```
@Bulkhead(5)
@Retry(maxRetries = 4,
        delay = 1000,
        retryOn = BulkheadException.class)
WorldClock getNow() {}
```

Fault tolerance annotations:

| Annotation      | Properties   |
|-----------------|--|
| @Timeout        | unit   |
| @Retry          | maxRetries, delay, delayUnit, maxDuration, durationUnit, jitter, jitterDelayUnit, retryOn, abortOn |
| @Fallback       | fallbackMethod   |
| @Bulkhead       | waitingTaskQueue (only valid in asynchronous)  |
| @CircuitBreaker | failOn, delay, delayUnit, requestVolumeThreshold, failureRatio, successThreshold                   |
| @Asynchronous   |  |

You can override annotation parameters via configuration file using `property [classname/methodname/]annotation/parameter:`

```
org.acme.quickstart.WorldClock/getNow/Retry/maxDuration=30
# Class scope
org.acme.quickstart.WorldClock/Retry/maxDuration=3000
# Global
Retry/maxDuration=3000
```

You can also enable/disable policies using special parameter enabled.

```
org.acme.quickstart.WorldClock/getNow/Retry/enabled=false
# Disable everything except fallback
MP_Fault_Tolerance_NonFallback_Enabled=false
```

MicroProfile Fault Tolerance integrats with MicroProfile **Tip** Metrics spec. You can disable it by setting `MP_Fault_Tolerance_Metrics_Enabled` to `false`.

Observability

Health Checks

Quarkus relies on MicroProfile Health spec to provide health checks.

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

By just adding this extension, an endpoint is registered to `/health` providing a default health check.

```
{
  "outcome": "UP",
  "checks": [
  ]
}
```

To create a custom health check you need to implement the `HealthCheck` interface and annotate it with `@Health` annotation.

```
@Health
public class DatabaseHealthCheck implements HealthCheck {
    @Override
    public HealthCheckResponse call() {
        HealthCheckResponseBuilder responseBuilder =
            HealthCheckResponse.named("Database conn");

        try {
            checkDatabaseConnection();
            responseBuilder.withData("connection", true);
            responseBuilder.up();
        } catch (IOException e) {
            // cannot access the database
            responseBuilder.down()
                .withData("error", e.getMessage());
        }
        return responseBuilder.build();
    }
}
```

Builds the next output:

```
{
  "outcome": "UP",
  "checks": [
    {
      "name": "Database connection",
      "state": "UP",
      "data": {
        "connection": true
      }
    }
  ]
}
```

Metrics

Quarkus can utilize the MicroProfile Metrics spec to provide metrics support.

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

The metrics can be read with JSON or the OpenMetrics format. An endpoint is registered automatically at `/metrics` providing default metrics.

MicroProfile Metrics annotations:

| Annotation | Description                               |
|------------|---|
| @Timed     | Method, constructor, or class as timed.   |
| @Metered   | Method, constructor, or class as metered. |

| Annotation | Description   |
|------------|---|
| @Counted   | Method, constructor, or class as counted.           |
| @Gauge     | Method or field as a gauge.                         |
| @Metric    | Requesting that a metric be injected or registered. |

```
@GET
//...
@Timed(name = "checksTimer",
    description = "A measure of how long it takes
        to perform a hello.",
    unit = MetricUnits.MILLISECONDS)
public String hello() {}
```

@Gauge annotation returning a measure as a gauge.

```
@Gauge(name = "hottestSauce", unit = MetricUnits.NONE,
    description = "Hottest Sauce so far.")
public Long hottestSauce() {}
```

Injecting a histogram using @Metric.

```
@Inject
@Metric(name = "histogram")
Histogram historgram;
```

Tracing

Quarkus can utilize the MicroProfile OpenTracing spec to provide tracing support.

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

By default, requests sent to any endpoint are traced without any code changes being required.

This extension includes OpenTracing support and Jaeger tracer.

Jaeger tracer configuration:

```
quarkus.jaeger.service-name=myservice
quarkus.jaeger.sampler-type=const
quarkus.jaeger.sampler-param=1
quarkus.jaeger.endpoint=http://localhost:14268/api/traces
```



@Traced annotation can be set to disable tracing at class or method level.

Tracer class can be injected into the class.

```
@Inject
Tracer tracer;

tracer.activeSpan().setBaggageItem("key", "value");
```

Cloud

Native

You can build a native image by using GraalVM. The common use case is creating a Docker image so you can execute the next commands:

```
./mvnw package -Pnative -Dnative-image.docker-build=true

docker build -f src/main/docker/Dockerfile.native
               -t quarkus/getting-started .
docker run -i --rm -p 8080:8080 quarkus/getting-started
```

To configure native application, you can create a config directory at the same place as the native file and place an application.properties file inside. config/application.properties.

Kubernetes

Quarks can use ap4k to generate Kubernetes resources.

```
./mvnw quarkus:add-extensions
      -Dextensions="io.quarkus:quarkus-kubernetes"
```

Running ./mvnw package the Kubernetes resources are created at target/wiring-classes/META-INF/kubernetes/ directory.

| Property                 | Default              | Description          |
|--------------------------|----------------------|----------------------|
| quarkus.kubernetes.group | Current username     | Set Docker Username. |
| quarkus.application.name | Current project name | Project name         |

Amazon Lambda

Quarkus integrates with Amazon Lambda.

```
./mvnw quarkus:add-extension
      -Dextensions="io.quarkus:quarkus-amazon-lambda"
```

And `com.amazonaws.services.lambda.runtime.RequestHandler` then implement `interface`.

```
public class TestLambda
    implements RequestHandler<MyInput, MyOutput> {
    @Override
    public MyInput handleRequest(MyOutput input,
                                Context context) {

        // ...
    }
}
```

Test

You can write tests for Amazon lambdas:


```
<dependency>
  <groupId>io.quarkus</groupId>
  <artifactId>quarkus-test-amazon-lambda</artifactId>
  <scope>test</scope>
</dependency>
```

```
@Test
public void testLambda() {
    MyInput in = new MyInput();
    in.setGreeting("Hello");
    in.setName("Stu");
    MyOutput out = LambdaClient.invoke(MyOutput.class, in);
}
```

Resources

- <https://quarkus.io/guides/>
- <https://www.youtube.com/user/lordofthejars>

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