Spring Cloud Contract Reference Documentation

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Legal

2.2.0.BUILD-SNAPSHOT

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Chapter 1. Spring Cloud Contract Documentation

This section provides a brief overview of Spring Cloud Contract reference documentation. It serves as a map for the rest of the document.

1.1. About the Documentation

The Spring Cloud Contract reference guide is available as

- Multi-page HTML
- Single-page HTML
- PDF

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1.2. Getting Help

If you have trouble with Spring Cloud Contract, we would like to help.

- Try the How-to documents. They provide solutions to the most common questions.
- Learn the Spring Cloud Contract basics. If you are starting out with Spring Cloud Contract, try one of the guides.
- Ask a question. We monitor stackoverflow.com for questions tagged with `spring-cloud-contract`.
- Report bugs with Spring Cloud Contract at github.com/spring-cloud/spring-cloud-contract/issues.
- Chat with us at Spring Cloud Contract Gitter

All of Spring Cloud Contract is open source, including the documentation. If you find problems with the docs or if you want to improve them, please get involved.

1.3. First Steps

If you are getting started with Spring Cloud Contract or 'Spring' in general, start with the following topics:

- **From scratch:** Overview | Three-second Tour | First application
- **Tutorial:** Introduction | Consumer, Part 1 | Producer | Consumer, Part 2

1.4. Working with Spring Cloud Contract

Ready to actually start using Spring Cloud Contract? We have you covered:

- **Provider contract testing:**
  - Provider contract testing with stubs in Nexus or Artifactory
  - Provider contract testing with stubs in Git
  - Provider contract testing with stubs in Artifactory for a non-Spring application
  - Provider contract testing with stubs in Artifactory in non JVM world
  - Provider contract testing with REST Docs and stubs in Nexus / Artifactory
- **Consumer-Driven contract testing:**
  - Consumer Driven Contracts with contracts on the producer side
  - Consumer Driven Contracts with contracts in external repo
  - Consumer Driven Contracts with contracts on the producer side, pushed to git

We talk about **Provider Contracts** when it is the producer of the API that defines the contracts and publishes it for all its consumers to use. This approach is useful for producers that cannot directly collaborate with their consumers — for example, when there are too many consumers or the consumers are external (do not work within the same company).

We use the term, **Consumer-Driven Contracts**, to refer to workflows where the consumers of an API play a vital role in the process of creating the contracts. We recommended this approach, because it is easy to implement when both producer and consumer teams work for the same organizations and the number of consumers is not extremely large.

1.5. Learning about Spring Cloud Contract Features

Need more details about Spring Cloud Contract's core features? The following content is for you:

- **Core Features:** Contract DSL | Contracts for HTTP | Contracts for Messaging
- **Integrations:** JAX-RS | Context Paths | RESTDocs Pact
- **Modules:** Stub Runner | WireMock
- **Build Tools:** Contract Verifier - Maven | Contract Verifier - Gradle | Docker

1.6. Advanced Topics

Finally, we have a few topics for more advanced users:

- **Customizing the DSL:** DSL Customization | Common JAR | Test Dependency | Plugin Dependency | Referencing the DSL
- **Customizing WireMock:** Extensions | Configuration
- **Customizing Spring Cloud Contract:** Pluggable Architecture | Contract Converter | Test Generator | Stub Generator | Stub Runner | Stub Downloader

Chapter 2. Getting Started

If you are getting started with Spring Cloud Contract, or Spring in general, start by reading this section. It answers the basic “what?”, “how?” and “why?” questions. It includes an introduction to Spring Cloud Contract, along with installation instructions. We then walk you through building your first Spring Cloud Contract application, discussing some core principles as we go.

2.1. Introducing Spring Cloud Contract

Spring Cloud Contract moves TDD to the level of software architecture. It lets you perform consumer-driven and producer-driven contract testing.

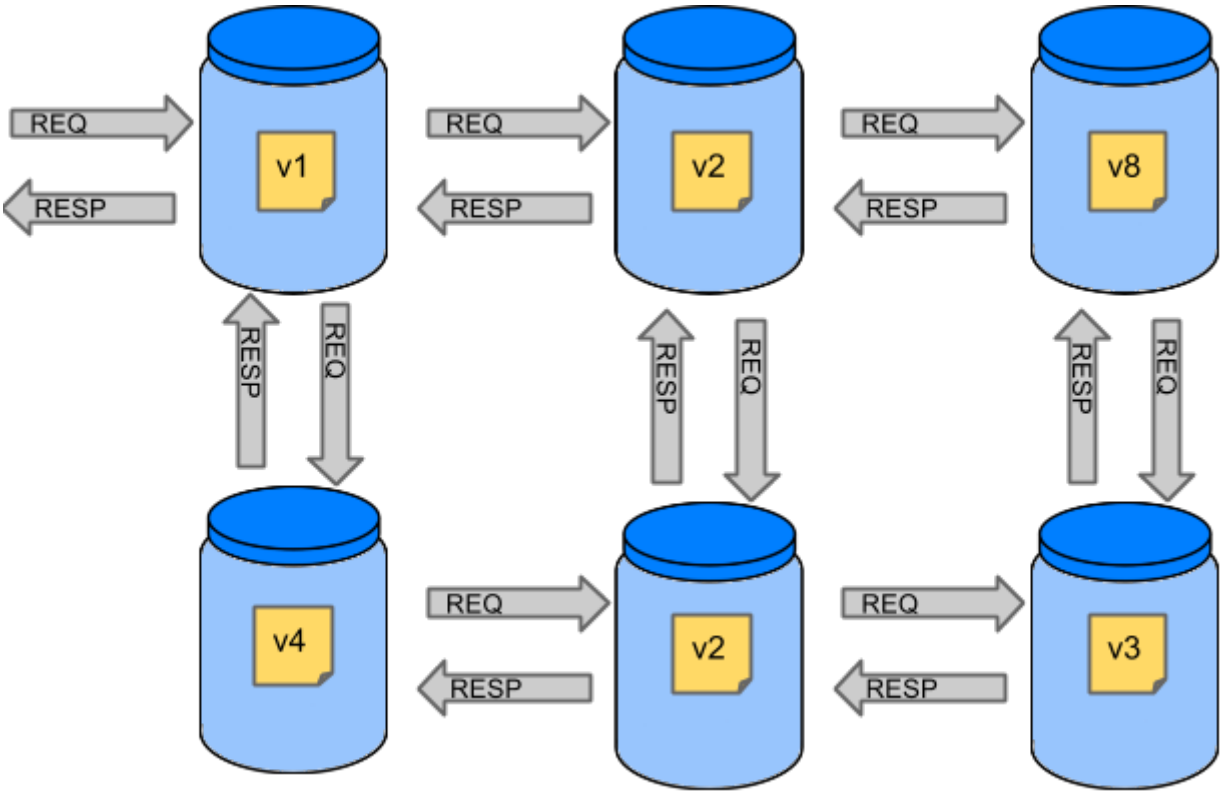
2.1.1. History

Before becoming Spring Cloud Contract, this project was called Accurest. It was created by Marcin Grzejszczak and Jakub Kubrynski from (Codearte).

The `0.1.0` release took place on 26 Jan 2015 and it became stable with `1.0.0` release on 29 Feb 2016.

Why Do You Need It?

Assume that we have a system that consists of multiple microservices, as the following image shows:



Testing Issues

If we want to test the application in the top left corner of the image in the preceding section to determine whether it can communicate with other services, we could do one of two things:

- Deploy all microservices and perform end-to-end tests.
- Mock other microservices in unit and integration tests.

Both have their advantages but also a lot of disadvantages.

Deploy all microservices and perform end to end tests

Advantages:

- Simulates production.
- Tests real communication between services.

Disadvantages:

- To test one microservice, we have to deploy six microservices, a couple of databases, and other items.
- The environment where the tests run is locked for a single suite of tests (nobody else would be able to run the tests in the meantime).
- They take a long time to run.
- The feedback comes very late in the process.
- They are extremely hard to debug.

Mock other microservices in unit and integration tests

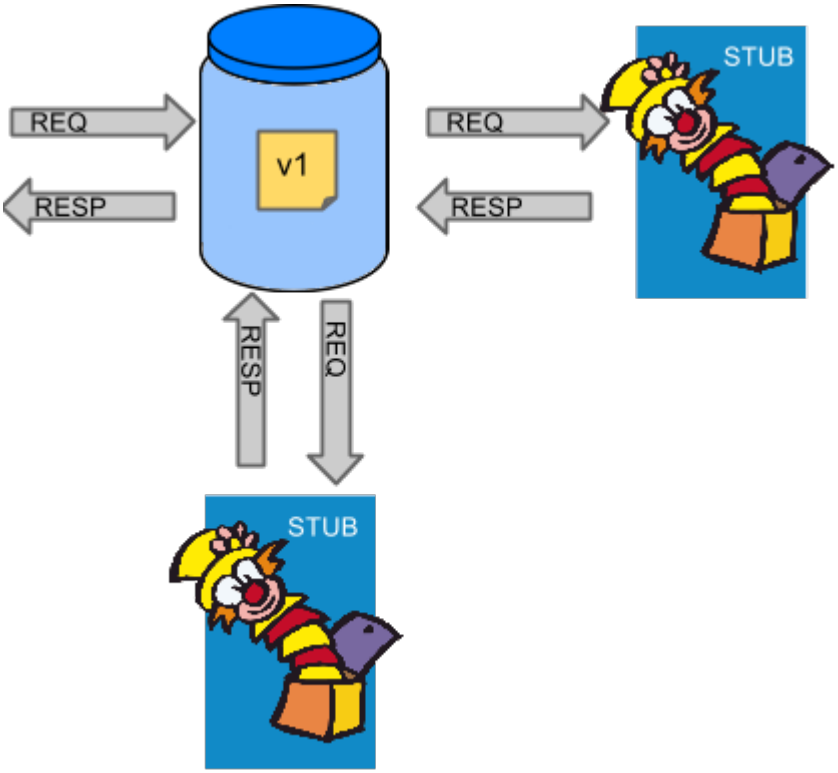
Advantages:

- They provide very fast feedback.
- They have no infrastructure requirements.

Disadvantages:

- The implementor of the service creates stubs that might have nothing to do with reality.
- You can go to production with passing tests and failing production.

To solve the aforementioned issues, Spring Cloud Contract was created. The main idea is to give you very fast feedback, without the need to set up the whole world of microservices. If you work on stubs, then the only applications you need are those that your application directly uses. The following image shows the relationship of stubs to an application:



Spring Cloud Contract gives you the certainty that the stubs that you use were created by the service that you call. Also, if you can use them, it means that they were tested against the producer's side. In short, you can trust those stubs.

2.1.2. Purposes

The main purposes of Spring Cloud Contract are:

- To ensure that HTTP and Messaging stubs (used when developing the client) do exactly what the actual server-side implementation does.
- To promote the ATDD (acceptance test-driven developement) method and the microservices architectural style.
- To provide a way to publish changes in contracts that are immediately visible on both sides.
- To generate boilerplate test code to be used on the server side.

By default, Spring Cloud Contract integrates with Wiremock as the HTTP server stub.

Spring Cloud Contract's purpose is NOT to start writing business features in the contracts. Assume that we have a business use case of fraud check. If a user can be a fraud for 100 different reasons, we would assume that you would create two contracts, one for the positive case and one for the negative case. Contract tests are used to test contracts between applications and not to simulate full behavior.

2.1.3. What Is a Contract?

As consumers of services, we need to define what exactly we want to achieve. We need to formulate our expectations. That is why we write contracts. In other words, a contract is an agreement on how the API or message communication should look. Consider the following example:

Assume that you want to send a request that contains the ID of a client company and the amount it wants to borrow from us. You also want to send it to the `/fraudcheck` URL via the `PUT` method. The following listing shows a contract to check whether a client should be marked as a fraud in both Groovy and YAML:

groovy

```
/*
 * Copyright 2013-2019 the original author or authors.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      https://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

package contracts

org.springframework.cloud.contract.spec.Contract.make {
    request { // (1)
        method 'PUT' // (2)
        url '/fraudcheck' // (3)
        body([ // (4)
               "client.id": $(regex('[0-9]{10}')),
               loanAmount : 99999
        ])
        headers { // (5)
            contentType('application/json')
        }
    }
    response { // (6)
        status OK() // (7)
        body([ // (8)
               fraudCheckStatus  : "FRAUD",
               "rejection.reason": "Amount too high"
        ])
        headers { // (9)
            contentType('application/json')
        }
    }
}

/*
```

```
From the Consumer perspective, when shooting a request in the integration test:

(1) - If the consumer sends a request
(2) - With the "PUT" method
(3) - to the URL "/fraudcheck"
(4) - with the JSON body that
 * has a field `client.id` that matches a regular expression `[0-9]{10}`
 * has a field `loanAmount` that is equal to `99999`
(5) - with header `Content-Type` equal to `application/json`
(6) - then the response will be sent with
(7) - status equal `200`
(8) - and JSON body equal to
 { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
(9) - with header `Content-Type` equal to `application/json`

From the Producer perspective, in the autogenerated producer-side test:

(1) - A request will be sent to the producer
(2) - With the "PUT" method
(3) - to the URL "/fraudcheck"
(4) - with the JSON body that
 * has a field `client.id` that will have a generated value that matches a regular
expression `[0-9]{10}`
 * has a field `loanAmount` that is equal to `99999`
(5) - with header `Content-Type` equal to `application/json`
(6) - then the test will assert if the response has been sent with
(7) - status equal `200`
(8) - and JSON body equal to
 { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
(9) - with header `Content-Type` matching `application/json.*`
 */
```

yaml

```
request: # (1)
  method: PUT # (2)
  url: /yamlfraudcheck # (3)
  body: # (4)
    "client.id": 1234567890
    loanAmount: 99999
  headers: # (5)
    Content-Type: application/json
  matchers:
    body:
      - path: $.['client.id'] # (6)
        type: by_regex
        value: "[0-9]{10}"
response: # (7)
  status: 200 # (8)
  body:  # (9)
    fraudCheckStatus: "FRAUD"
```

```
    "rejection.reason": "Amount too high"
  headers: # (10)
    Content-Type: application/json


#From the Consumer perspective, when shooting a request in the integration test:
#
#(1) - If the consumer sends a request
#(2) - With the "PUT" method
#(3) - to the URL "/yamlfraudcheck"
#(4) - with the JSON body that
# * has a field `client.id`
# * has a field `loanAmount` that is equal to `99999`
#(5) - with header `Content-Type` equal to `application/json`
#(6) - and a `client.id` json entry matches the regular expression `[0-9]{10}`
#(7) - then the response will be sent with
#(8) - status equal `200`
#(9) - and JSON body equal to
# { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
#(10) - with header `Content-Type` equal to `application/json`
#
#From the Producer perspective, in the autogenerated producer-side test:
#
#(1) - A request will be sent to the producer
#(2) - With the "PUT" method
#(3) - to the URL "/yamlfraudcheck"
#(4) - with the JSON body that
# * has a field `client.id` `1234567890`
# * has a field `loanAmount` that is equal to `99999`
#(5) - with header `Content-Type` equal to `application/json`
#(7) - then the test will assert if the response has been sent with
#(8) - status equal `200`
#(9) - and JSON body equal to
# { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
#(10) - with header `Content-Type` equal to `application/json`
```

2.2. A Three-second Tour

This very brief tour walks through using Spring Cloud Contract. It consists of the following topics:

- On the Producer Side
- On the Consumer Side

You can find a somewhat longer tour here.

The following UML diagram shows the relationship of the parts within Spring Cloud Contract:

[getting started three second] | *getting-started-three-second.png*

2.2.1. On the Producer Side

To start working with Spring Cloud Contract, you can add files with REST or messaging contracts expressed in either Groovy DSL or YAML to the contracts directory, which is set by the `contractsDslDir` property. By default, it is `$rootDir/src/test/resources/contracts`.

Then you can add the Spring Cloud Contract Verifier dependency and plugin to your build file, as the following example shows:

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-verifier</artifactId>
    <scope>test</scope>
</dependency>
```

The following listing shows how to add the plugin, which should go in the build/plugins portion of the file:

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
</plugin>
```

Running `./mvnw clean install` automatically generates tests that verify the application compliance with the added contracts. By default, the tests get generated under `org.springframework.cloud.contract.verifier.tests.`.

As the implementation of the functionalities described by the contracts is not yet present, the tests fail.

To make them pass, you must add the correct implementation of either handling HTTP requests or messages. Also, you must add a base test class for auto-generated tests to the project. This class is extended by all the auto-generated tests, and it should contain all the setup information necessary to run them (for example `RestAssuredMockMvc` controller setup or messaging test setup).

The following example, from `pom.xml`, shows how to specify the base test class:

```
<build>
        <plugins>
            <plugin>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-contract-maven-plugin</artifactId>
                <version>2.1.2.RELEASE</version>
                <extensions>true</extensions>
                <configuration>

<baseClassForTests>com.example.contractTest.BaseTestClass</baseClassForTests> ①
                </configuration>
            </plugin>
            <plugin>
                <groupId>org.springframework.boot</groupId>
                <artifactId>spring-boot-maven-plugin</artifactId>
            </plugin>
        </plugins>
    </build>
```

① The `baseClassForTests` element lets you specify your base test class. It must be a child of a `configuration` element within `spring-cloud-contract-maven-plugin`.

Once the implementation and the test base class are in place, the tests pass, and both the application and the stub artifacts are built and installed in the local Maven repository. You can now merge the changes, and you can publish both the application and the stub artifacts in an online repository.

2.2.2. On the Consumer Side

You can use `Spring Cloud Contract Stub Runner` in the integration tests to get a running WireMock instance or messaging route that simulates the actual service.

To do so, add the dependency to `Spring Cloud Contract Stub Runner`, as the following example shows:

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-stub-runner</artifactId>
    <scope>test</scope>
</dependency>
```

You can get the Producer-side stubs installed in your Maven repository in either of two ways:

- By checking out the Producer side repository and adding contracts and generating the stubs by running the following commands:

```
$ cd local-http-server-repo
$ ./mvnw clean install -DskipTests
```

The tests are being skipped because the producer-side contract implementation is not in place yet, so the automatically-generated contract tests fail.

- By getting already-existing producer service stubs from a remote repository. To do so, pass the stub artifact IDs and artifact repository URL as `Spring Cloud Contract Stub Runner` properties, as the following example shows:

```
stubrunner:
  ids: 'com.example:http-server-dsl:+:stubs:8080'
  repositoryRoot: https://repo.spring.io/libs-snapshot
```

Now you can annotate your test class with `@AutoConfigureStubRunner`. In the annotation, provide the `group-id` and `artifact-id` values for `Spring Cloud Contract Stub Runner` to run the collaborators' stubs for you, as the following example shows:

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment=WebEnvironment.NONE)
@AutoConfigureStubRunner(ids = {"com.example:http-server-dsl:+:stubs:6565"},
        stubsMode = StubRunnerProperties.StubsMode.LOCAL)
public class LoanApplicationServiceTests {
```

Use the `REMOTE stubsMode` when downloading stubs from an online repository and `LOCAL` for offline work.

Now, in your integration test, you can receive stubbed versions of HTTP responses or messages that are expected to be emitted by the collaborator service.

2.3. Developing Your First Spring Cloud Contract-based Application

This brief tour walks through using Spring Cloud Contract. It consists of the following topics:

- On the Producer Side
- On the Consumer Side

You can find an even more brief tour here.

For the sake of this example, the `Stub Storage` is Nexus/Artifactory.

The following UML diagram shows the relationship of the parts of Spring Cloud Contract:

[Getting started first application] | *getting-started-three-second.png*

2.3.1. On the Producer Side

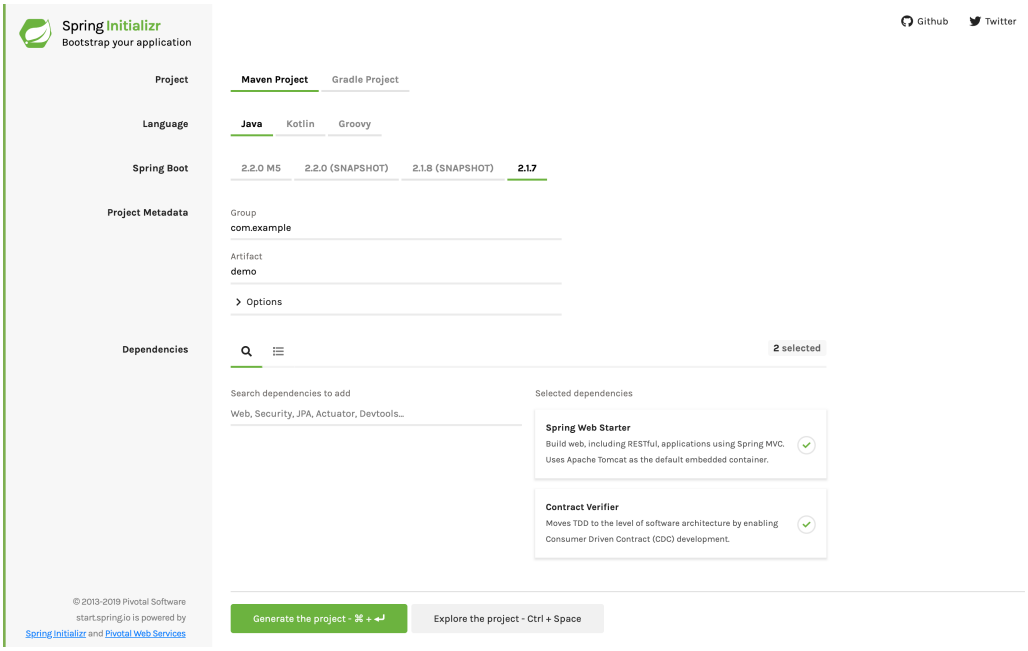
To start working with `Spring Cloud Contract`, you can add Spring Cloud Contract Verifier dependency and plugin to your build file, as the following example shows:

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-verifier</artifactId>
    <scope>test</scope>
</dependency>
```

The following listing shows how to add the plugin, which should go in the build/plugins portion of the file:

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
</plugin>
```

The easiest way to get started is to go to the Spring Initializr and add “Web” and “Contract Verifier” as dependencies. Doing so pulls in the previously mentioned dependencies and everything else you need in the `pom.xml` file (except for setting the base test class, which we cover later in this section). The following image shows the settings to use in the Spring Initializr:



Now you can add files with `REST/` messaging contracts expressed in either Groovy DSL or YAML to the contracts directory, which is set by the `contractsDslDir` property. By default, it is `$rootDir/src/test/resources/contracts`. Note that the file name does not matter. You can organize your contracts within this directory with whatever naming scheme you like.

For the HTTP stubs, a contract defines what kind of response should be returned for a given request (taking into account the HTTP methods, URLs, headers, status codes, and so on). The following example shows an HTTP stub contract in both Groovy and YAML:

groovy

```
package contracts

org.springframework.cloud.contract.spec.Contract.make {
    request {
        method 'PUT'
        url '/fraudcheck'
        body([
               "client.id": $(regex('[0-9]{10}')),
               loanAmount: 99999
        ])
        headers {
            contentType('application/json')
        }
    }
    response {
        status OK()
        body([
               fraudCheckStatus: "FRAUD",
               "rejection.reason": "Amount too high"
        ])
        headers {
            contentType('application/json')
        }
    }
}
```

yaml

```
request:
  method: PUT
  url: /fraudcheck
  body:
    "client.id": 1234567890
    loanAmount: 99999
  headers:
    Content-Type: application/json
  matchers:
    body:
      - path: $.['client.id']
        type: by_regex
        value: "[0-9]{10}"
response:
  status: 200
  body:
    fraudCheckStatus: "FRAUD"
    "rejection.reason": "Amount too high"
  headers:
    Content-Type: application/json;charset=UTF-8
```

If you need to use messaging, you can define:

- The input and output messages (taking into account from and where it was sent, the message body, and the header).
- The methods that should be called after the message is received.
- The methods that, when called, should trigger a message.

The following example shows a Camel messaging contract:

groovy

```
def contractDsl = Contract.make {
    name "foo"
    label 'some_label'
    input {
        messageFrom('jms:delete')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
        assertThat('bookWasDeleted()')
    }
}
```

yaml

```
label: some_label
input:
  messageFrom: jms:delete
  messageBody:
    bookName: 'foo'
  messageHeaders:
    sample: header
  assertThat: bookWasDeleted()
```

Running `./mvnw clean install` automatically generates tests that verify the application compliance with the added contracts. By default, the generated tests are under `org.springframework.cloud.contract.verifier.tests.`.

The generated tests may differ, depending on which framework and test type you have setup in your plugin.

In the next listing, you can find:

- The default test mode for HTTP contracts in `MockMvc`

- A JAX-RS client with the `JAXRS` test mode
- A `WebTestClient`-based test (this is particularly recommended while working with Reactive, `WebFlux`-based applications) set with the `WEBTESTCLIENT` test mode
- A Spock-based test with the `testFramework` property set to `SPOCK`

You need only one of these test frameworks. MockMvc is the default. To use one of the other frameworks, add its library to your classpath.

The following listing shows samples for all frameworks:

mockmvc

```
@Test
public void validate_shouldMarkClientAsFraud() throws Exception {
    // given:
        MockMvcRequestSpecification request = given()
                .header("Content-Type", "application/vnd.fraud.v1+json")
                .body("{\"client.id\":\"1234567890\",\"loanAmount\":99999}");

    // when:
        ResponseOptions response = given().spec(request)
                .put("/fraudcheck");

    // then:
        assertThat(response.statusCode()).isEqualTo(200);
        assertThat(response.header("Content-
Type")).matches("application/vnd.fraud.v1.json.*");
    // and:
        DocumentContext parsedJson =
JsonPath.parse(response.getBody().asString());
        assertThatJson(parsedJson).field("['fraudCheckStatus']").matches("[A-
Z]{5}");
        assertThatJson(parsedJson).field("['rejection.reason']").isEqualTo("Amount
too high");
}
```

jaxrs

```
@SuppressWarnings("rawtypes")
public class FooTest {
  WebTarget webTarget;

  @Test
  public void validate_() throws Exception {

    // when:
      Response response = webTarget
              .path("/users")
              .queryParam("limit", "10")
              .queryParam("offset", "20")
              .queryParam("filter", "email")
              .queryParam("sort", "name")
              .queryParam("search", "55")
              .queryParam("age", "99")
              .queryParam("name", "Denis.Stepanov")
              .queryParam("email", "bob@email.com")
              .request()
              .build("GET")
              .invoke();
      String responseAsString = response.readEntity(String.class);

    // then:
      assertThat(response.getStatus()).isEqualTo(200);

    // and:
      DocumentContext parsedJson = JsonPath.parse(responseAsString);
      assertThatJson(parsedJson).field("['property1']").isEqualTo("a");
  }

}
```

webtestclient

```
@Test
    public void validate_shouldRejectABeerIfTooYoung() throws Exception {
        // given:
            WebTestClientRequestSpecification request = given()
                    .header("Content-Type", "application/json")
                    .body("{\"age\":10}");

        // when:
            WebTestClientResponse response = given().spec(request)
                    .post("/check");

        // then:
            assertThat(response.statusCode()).isEqualTo(200);
            assertThat(response.header("Content-
Type")).matches("application/json.*");
        // and:
            DocumentContext parsedJson =
JsonPath.parse(response.getBody().asString());
            assertThatJson(parsedJson).field("['status']").isEqualTo("NOT_OK");
    }
```

spock

```
given:
     ContractVerifierMessage inputMessage = contractVerifierMessaging.create(
        \'\'\'{"bookName":"foo"}\'\'\',
        ['sample': 'header']
    )

when:
     contractVerifierMessaging.send(inputMessage, 'jms:delete')

then:
     noExceptionThrown()
     bookWasDeleted()
```

As the implementation of the functionalities described by the contracts is not yet present, the tests fail.

To make them pass, you must add the correct implementation of handling either HTTP requests or messages. Also, you must add a base test class for auto-generated tests to the project. This class is extended by all the auto-generated tests and should contain all the setup necessary information needed to run them (for example, `RestAssuredMockMvc` controller setup or messaging test setup).

The following example, from `pom.xml`, shows how to specify the base test class:

```
<build>
        <plugins>
            <plugin>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-contract-maven-plugin</artifactId>
                <version>2.1.2.RELEASE</version>
                <extensions>true</extensions>
                <configuration>

<baseClassForTests>com.example.contractTest.BaseTestClass</baseClassForTests> ①
                </configuration>
            </plugin>
            <plugin>
                <groupId>org.springframework.boot</groupId>
                <artifactId>spring-boot-maven-plugin</artifactId>
            </plugin>
        </plugins>
    </build>
```

① The `baseClassForTests` element lets you specify your base test class. It must be a child of a `configuration` element within `spring-cloud-contract-maven-plugin`.

The following example shows a minimal (but functional) base test class:

```
package com.example.contractTest;

import org.junit.Before;

import io.restassured.module.mockmvc.RestAssuredMockMvc;

public class BaseTestClass {

    @Before
    public void setup() {
        RestAssuredMockMvc.standaloneSetup(new FraudController());
    }
}
```

This minimal class really is all you need to get your tests to work. It serves as a starting place to which the automatically generated tests attach.

Now we can move on to the implementation. For that, we first need a data class, which we then use in our controller. The following listing shows the data class:

```
package com.example.Test;

import com.fasterxml.jackson.annotation.JsonProperty;

public class LoanRequest {

    @JsonProperty("client.id")
    private String clientId;

    private Long loanAmount;

    public String getClientId() {
        return clientId;
    }

    public void setClientId(String clientId) {
        this.clientId = clientId;
    }

    public Long getLoanAmount() {
        return loanAmount;
    }

    public void setLoanRequestAmount(Long loanAmount) {
        this.loanAmount = loanAmount;
    }
}
```

The preceding class provides an object in which we can store the parameters. Because the client ID in the contract is called `client.id`, we need to use the `@JsonProperty("client.id")` parameter to map it to the `clientId` field.

Now we can move along to the controller, which the following listing shows:

```
package com.example.docTest;

import org.springframework.web.bind.annotation.PutMapping;
import org.springframework.web.bind.annotation.RequestBody;
import org.springframework.web.bind.annotation.RestController;

@RestController
public class FraudController {

    @PutMapping(value = "/fraudcheck", consumes="application/json",
produces="application/json")
    public String check(@RequestBody LoanRequest loanRequest) { ①

        if (loanRequest.getLoanAmount() > 10000) { ②
            return "{fraudCheckStatus: FRAUD, rejection.reason: Amount too high}";
③
        } else {
            return "{fraudCheckStatus: OK, acceptance.reason: Amount OK}"; ④
        }
    }
}
```

① We map the incoming parameters to a `LoanRequest` object.

② We check the requested loan amount to see if it is too much.

③ If it is too much, we return the JSON (created with a simple string here) that the test expects.

④ If we had a test to catch when the amount is allowable, we could match it to this output.

The `FraudController` is about as simple as things get. You can do much more, including logging, validating the client ID, and so on.

Once the implementation and the test base class are in place, the tests pass, and both the application and the stub artifacts are built and installed in the local Maven repository Information about installing the stubs jar to the local repository appears in the logs, as the following example shows:

```
[INFO] --- spring-cloud-contract-maven-plugin:1.0.0.BUILD-SNAPSHOT:generateStubs
(default-generateStubs) @ http-server ---
[INFO] Building jar: /some/path/http-server/target/http-server-0.0.1-SNAPSHOT-
stubs.jar
[INFO]
[INFO] --- maven-jar-plugin:2.6:jar (default-jar) @ http-server ---
[INFO] Building jar: /some/path/http-server/target/http-server-0.0.1-SNAPSHOT.jar
[INFO]
[INFO] --- spring-boot-maven-plugin:1.5.5.BUILD-SNAPSHOT:repackage (default) @
http-server ---
[INFO]
[INFO] --- maven-install-plugin:2.5.2:install (default-install) @ http-server ---
[INFO] Installing /some/path/http-server/target/http-server-0.0.1-SNAPSHOT.jar to
/path/to/your/.m2/repository/com/example/http-server/0.0.1-SNAPSHOT/http-server-
0.0.1-SNAPSHOT.jar
[INFO] Installing /some/path/http-server/pom.xml to
/path/to/your/.m2/repository/com/example/http-server/0.0.1-SNAPSHOT/http-server-
0.0.1-SNAPSHOT.pom
[INFO] Installing /some/path/http-server/target/http-server-0.0.1-SNAPSHOT-
stubs.jar to /path/to/your/.m2/repository/com/example/http-server/0.0.1-
SNAPSHOT/http-server-0.0.1-SNAPSHOT-stubs.jar
```

You can now merge the changes and publish both the application and the stub artifacts in an online repository.

2.3.2. On the Consumer Side

You can use Spring Cloud Contract Stub Runner in the integration tests to get a running WireMock instance or messaging route that simulates the actual service.

To get started, add the dependency to `Spring Cloud Contract Stub Runner`, as follows:

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-stub-runner</artifactId>
    <scope>test</scope>
</dependency>
```

You can get the Producer-side stubs installed in your Maven repository in either of two ways:

- By checking out the Producer side repository and adding contracts and generating the stubs by running the following commands:

```
$ cd local-http-server-repo
$ ./mvnw clean install -DskipTests
```

The tests are skipped because the Producer-side contract implementation is not yet in place, so the automatically-generated contract tests fail.

- Getting already existing producer service stubs from a remote repository. To do so, pass the stub artifact IDs and artifact repository URl as `Spring Cloud Contract Stub Runner` properties, as the following example shows:

```
stubrunner:
  ids: 'com.example:http-server-dsl:+:stubs:8080'
  repositoryRoot: https://repo.spring.io/libs-snapshot
```

Now you can annotate your test class with `@AutoConfigureStubRunner`. In the annotation, provide the `group-id` and `artifact-id` for `Spring Cloud Contract Stub Runner` to run the collaborators' stubs for you, as the following example shows:

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment=WebEnvironment.NONE)
@AutoConfigureStubRunner(ids = {"com.example:http-server-dsl:+:stubs:6565"},
        stubsMode = StubRunnerProperties.StubsMode.LOCAL)
public class LoanApplicationServiceTests {
```

Use the `REMOTE stubsMode` when downloading stubs from an online repository and `LOCAL` for offline work.

In your integration test, you can receive stubbed versions of HTTP responses or messages that are expected to be emitted by the collaborator service. You can see entries similar to the following in the build logs:

```
2016-07-19 14:22:25.403  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Desired version is + - will try to
resolve the latest version
2016-07-19 14:22:25.438  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Resolved version is 0.0.1-SNAPSHOT
2016-07-19 14:22:25.439  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Resolving artifact com.example:http-
server:jar:stubs:0.0.1-SNAPSHOT using remote repositories []
2016-07-19 14:22:25.451  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Resolved artifact com.example:http-
server:jar:stubs:0.0.1-SNAPSHOT to /path/to/your/.m2/repository/com/example/http-
server/0.0.1-SNAPSHOT/http-server-0.0.1-SNAPSHOT-stubs.jar
2016-07-19 14:22:25.465  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Unpacking stub from JAR [URI:
file:/path/to/your/.m2/repository/com/example/http-server/0.0.1-SNAPSHOT/http-
server-0.0.1-SNAPSHOT-stubs.jar]
2016-07-19 14:22:25.475  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Unpacked file to
[/var/folders/0p/xwq47sq106x1_g3dtv6qfm940000gq/T/contracts100276532569594265]
2016-07-19 14:22:27.737  INFO 41050 --- [           main]
o.s.c.c.stubrunner.StubRunnerExecutor    : All stubs are now running RunningStubs
[namesAndPorts={com.example:http-server:0.0.1-SNAPSHOT:stubs=8080}]
```

2.4. Step-by-step Guide to Consumer Driven Contracts (CDC) with Contracts on the Producer Side

Consider an example of fraud detection and the loan issuance process. The business scenario is such that we want to issue loans to people but do not want them to steal from us. The current implementation of our system grants loans to everybody.

Assume that `Loan Issuance` is a client to the `Fraud Detection` server. In the current sprint, we must develop a new feature: if a client wants to borrow too much money, we mark the client as a fraud.

Technical remarks

- Fraud Detection has an `artifact-id` of `http-server`
- Loan Issuance has an artifact-id of `http-client`
- Both have a `group-id` of `com.example`
- For the sake of this example the `Stub Storage` is Nexus/Artifactory

Social remarks

- Both the client and the server development teams need to communicate directly and discuss changes while going through the process
- CDC is all about communication

The server-side code is available here and the client code is available here.

In this case, the producer owns the contracts. Physically, all of the contracts are in the producer's repository.

2.4.1. Technical Note

If you use the SNAPSHOT, Milestone, or Release Candidate versions you need to add the following section to your build:

Maven

```
<repositories>
    <repository>
        <id>spring-snapshots</id>
        <name>Spring Snapshots</name>
        <url>https://repo.spring.io/snapshot</url>
        <snapshots>
            <enabled>true</enabled>
        </snapshots>
    </repository>
    <repository>
        <id>spring-milestones</id>
        <name>Spring Milestones</name>
        <url>https://repo.spring.io/milestone</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </repository>
    <repository>
        <id>spring-releases</id>
        <name>Spring Releases</name>
        <url>https://repo.spring.io/release</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </repository>
</repositories>
<pluginRepositories>
    <pluginRepository>
        <id>spring-snapshots</id>
        <name>Spring Snapshots</name>
        <url>https://repo.spring.io/snapshot</url>
        <snapshots>
            <enabled>true</enabled>
        </snapshots>
    </pluginRepository>
    <pluginRepository>
        <id>spring-milestones</id>
        <name>Spring Milestones</name>
```

```
        <url>https://repo.spring.io/milestone</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </pluginRepository>
    <pluginRepository>
        <id>spring-releases</id>
        <name>Spring Releases</name>
        <url>https://repo.spring.io/release</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </pluginRepository>
</pluginRepositories>
```

Gradle

```
repositories {
    mavenCentral()
    mavenLocal()
    maven { url "https://repo.spring.io/snapshot" }
    maven { url "https://repo.spring.io/milestone" }
    maven { url "https://repo.spring.io/release" }
}
```

For simplicity, we use the following acronyms:

- Loan Issuance (LI): The HTTP client
- Fraud Detection (FD): The HTTP server
- Spring Cloud Contract (SCC)

2.4.2. The Consumer Side (Loan Issuance)

As a developer of the Loan Issuance service (a consumer of the Fraud Detection server), you might do the following steps:

1. Start doing TDD by writing a test for your feature.
2. Write the missing implementation.
3. Clone the Fraud Detection service repository locally.
4. Define the contract locally in the repo of the fraud detection service.
5. Add the Spring Cloud Contract (SCC) plugin.
6. Run the integration tests.
7. File a pull request.
8. Create an initial implementation.

9. Take over the pull request.
10. Write the missing implementation.
11. Deploy your app.
12. Work online.

We start with the loan issuance flow, which the following UML diagram shows:

[getting started cdc client] | *getting-started-cdc-client.png*

Start Doing TDD by Writing a Test for Your Feature

The following listing shows a test that we might use to check whether a loan amount is too large:

```
@Test
public void shouldBeRejectedDueToAbnormalLoanAmount() {
    // given:
    LoanApplication application = new LoanApplication(new Client("1234567890"),
            99999);
    // when:
    LoanApplicationResult loanApplication = service.loanApplication(application);
    // then:
    assertThat(loanApplication.getLoanApplicationStatus())
            .isEqualTo(LoanApplicationStatus.LOAN_APPLICATION_REJECTED);
    assertThat(loanApplication.getRejectionReason()).isEqualTo("Amount too high");
}
```

Assume that you have written a test of your new feature. If a loan application for a big amount is received, the system should reject that loan application with some description.

Write the Missing Implementation

At some point in time, you need to send a request to the Fraud Detection service. Assume that you need to send the request containing the ID of the client and the amount the client wants to borrow. You want to send it to the `/fraudcheck` URL by using the `PUT` method. To do so, you might use code similar to the following:

```
ResponseEntity<FraudServiceResponse> response = restTemplate.exchange(
        "http://localhost:" + port + "/fraudcheck", HttpMethod.PUT,
        new HttpEntity<>(request, httpHeaders), FraudServiceResponse.class);
```

For simplicity, the port of the Fraud Detection service is set to `8080`, and the application runs on `8090`.

If you start the test at this point, it breaks, because no service currently runs on port `8080`.

Clone the Fraud Detection service repository locally

You can start by playing around with the server side contract. To do so, you must first clone it, by running the following command:

```
$ git clone https://your-git-server.com/server-side.git local-http-server-repo
```

Define the Contract Locally in the Repository of the Fraud Detection Service

As a consumer, you need to define what exactly you want to achieve. You need to formulate your expectations. To do so, write the following contract:

Place the contract in the `src/test/resources/contracts/fraud` folder. The `fraud` folder is important because the producer's test base class name references that folder.

The following example shows our contract, in both Groovy and YAML:

groovy

```
/*
 * Copyright 2013-2019 the original author or authors.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      https://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

package contracts

org.springframework.cloud.contract.spec.Contract.make {
    request { // (1)
        method 'PUT' // (2)
        url '/fraudcheck' // (3)
        body([ // (4)
```

```
                "client.id": $(regex('[0-9]{10}')),
                loanAmount : 99999
        ])
        headers { // (5)
            contentType('application/json')
        }
    }
    response { // (6)
        status OK() // (7)
        body([ // (8)
                fraudCheckStatus  : "FRAUD",
                "rejection.reason": "Amount too high"
        ])
        headers { // (9)
            contentType('application/json')
        }
    }
}

/*
From the Consumer perspective, when shooting a request in the integration test:

(1) - If the consumer sends a request
(2) - With the "PUT" method
(3) - to the URL "/fraudcheck"
(4) - with the JSON body that
 * has a field `client.id` that matches a regular expression `[0-9]{10}`
 * has a field `loanAmount` that is equal to `99999`
(5) - with header `Content-Type` equal to `application/json`
(6) - then the response will be sent with
(7) - status equal `200`
(8) - and JSON body equal to
 { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
(9) - with header `Content-Type` equal to `application/json`

From the Producer perspective, in the autogenerated producer-side test:

(1) - A request will be sent to the producer
(2) - With the "PUT" method
(3) - to the URL "/fraudcheck"
(4) - with the JSON body that
 * has a field `client.id` that will have a generated value that matches a regular
expression `[0-9]{10}`
 * has a field `loanAmount` that is equal to `99999`
(5) - with header `Content-Type` equal to `application/json`
(6) - then the test will assert if the response has been sent with
(7) - status equal `200`
(8) - and JSON body equal to
 { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
(9) - with header `Content-Type` matching `application/json.*`
 */
```

yaml

```
request: # (1)
  method: PUT # (2)
  url: /yamlfraudcheck # (3)
  body: # (4)
    "client.id": 1234567890
    loanAmount: 99999
  headers: # (5)
    Content-Type: application/json
  matchers:
    body:
      - path: $.['client.id'] # (6)
        type: by_regex
        value: "[0-9]{10}"
response: # (7)
  status: 200 # (8)
  body:  # (9)
    fraudCheckStatus: "FRAUD"
    "rejection.reason": "Amount too high"
  headers: # (10)
    Content-Type: application/json


#From the Consumer perspective, when shooting a request in the integration test:
#
#(1) - If the consumer sends a request
#(2) - With the "PUT" method
#(3) - to the URL "/yamlfraudcheck"
#(4) - with the JSON body that
# * has a field `client.id`
# * has a field `loanAmount` that is equal to `99999`
#(5) - with header `Content-Type` equal to `application/json`
#(6) - and a `client.id` json entry matches the regular expression `[0-9]{10}`
#(7) - then the response will be sent with
#(8) - status equal `200`
#(9) - and JSON body equal to
# { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
#(10) - with header `Content-Type` equal to `application/json`
#
#From the Producer perspective, in the autogenerated producer-side test:
#
#(1) - A request will be sent to the producer
#(2) - With the "PUT" method
#(3) - to the URL "/yamlfraudcheck"
#(4) - with the JSON body that
# * has a field `client.id` `1234567890`
# * has a field `loanAmount` that is equal to `99999`
#(5) - with header `Content-Type` equal to `application/json`
#(7) - then the test will assert if the response has been sent with
#(8) - status equal `200`
```

```
#(9) - and JSON body equal to
# { "fraudCheckStatus": "FRAUD", "rejectionReason": "Amount too high" }
#(10) - with header `Content-Type` equal to `application/json`
```

The YML contract is quite straightforward. However, when you take a look at the Contract written with a statically typed Groovy DSL, you might wonder what the `value(client(…), server(…))` parts are. By using this notation, Spring Cloud Contract lets you define parts of a JSON block, a URL, or other structure that is dynamic. In case of an identifier or a timestamp, you need not hardcode a value. You want to allow some different ranges of values. To enable ranges of values, you can set regular expressions that match those values for the consumer side. You can provide the body by means of either a map notation or String with interpolations. We highly recommend using the map notation.

You must understand the map notation in order to set up contracts. See the Groovy docs regarding JSON.

The previously shown contract is an agreement between two sides that:

- If an HTTP request is sent with all of
  - A `PUT` method on the `/fraudcheck` endpoint
  - A JSON body with a `client.id` that matches the regular expression `[0-9]{10}` and `loanAmount` equal to `99999`,
  - A `Content-Type` header with a value of `application/vnd.fraud.v1+json`
- Then an HTTP response is sent to the consumer that
  - Has status `200`
  - Contains a JSON body with the `fraudCheckStatus` field containing a value of `FRAUD` and the `rejectionReason` field having a value of `Amount too high`
  - Has a `Content-Type` header with a value of `application/vnd.fraud.v1+json`

Once you are ready to check the API in practice in the integration tests, you need to install the stubs locally.

Add the Spring Cloud Contract Verifier Plugin

We can add either a Maven or a Gradle plugin. In this example, we show how to add Maven. First, we add the `Spring Cloud Contract` BOM, as the following example shows:

```
<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-dependencies</artifactId>
            <version>${spring-cloud-release.version}</version>
            <type>pom</type>
            <scope>import</scope>
        </dependency>
    </dependencies>
</dependencyManagement>
```

Next, add the `Spring Cloud Contract Verifier` Maven plugin, as the following example shows:

```
            <plugin>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-contract-maven-plugin</artifactId>
                <version>${spring-cloud-contract.version}</version>
                <extensions>true</extensions>
                <configuration>

<packageWithBaseClasses>com.example.fraud</packageWithBaseClasses>
<!--                    <convertToYaml>true</convertToYaml>-->
                </configuration>
                <!-- if additional dependencies are needed e.g. for Pact -->
                <dependencies>
                    <dependency>
                        <groupId>org.springframework.cloud</groupId>
                        <artifactId>spring-cloud-contract-pact</artifactId>
                        <version>${spring-cloud-contract.version}</version>
                    </dependency>
                </dependencies>
            </plugin>
```

Since the plugin was added, you get the `Spring Cloud Contract Verifier` features, which, from the provided contracts:

- Generate and run tests
- Produce and install stubs

You do not want to generate tests, since you, as the consumer, want only to play with the stubs. You need to skip the test generation and execution. To do so, run the following commands:

```
$ cd local-http-server-repo
$ ./mvnw clean install -DskipTests
```

Once you run those commands, you should you see something like the following content in the logs:

```
[INFO] --- spring-cloud-contract-maven-plugin:1.0.0.BUILD-SNAPSHOT:generateStubs
(default-generateStubs) @ http-server ---
[INFO] Building jar: /some/path/http-server/target/http-server-0.0.1-SNAPSHOT-
stubs.jar
[INFO]
[INFO] --- maven-jar-plugin:2.6:jar (default-jar) @ http-server ---
[INFO] Building jar: /some/path/http-server/target/http-server-0.0.1-SNAPSHOT.jar
[INFO]
[INFO] --- spring-boot-maven-plugin:1.5.5.BUILD-SNAPSHOT:repackage (default) @
http-server ---
[INFO]
[INFO] --- maven-install-plugin:2.5.2:install (default-install) @ http-server ---
[INFO] Installing /some/path/http-server/target/http-server-0.0.1-SNAPSHOT.jar to
/path/to/your/.m2/repository/com/example/http-server/0.0.1-SNAPSHOT/http-server-
0.0.1-SNAPSHOT.jar
[INFO] Installing /some/path/http-server/pom.xml to
/path/to/your/.m2/repository/com/example/http-server/0.0.1-SNAPSHOT/http-server-
0.0.1-SNAPSHOT.pom
[INFO] Installing /some/path/http-server/target/http-server-0.0.1-SNAPSHOT-
stubs.jar to /path/to/your/.m2/repository/com/example/http-server/0.0.1-
SNAPSHOT/http-server-0.0.1-SNAPSHOT-stubs.jar
```

The following line is extremely important:

```
[INFO] Installing /some/path/http-server/target/http-server-0.0.1-SNAPSHOT-
stubs.jar to /path/to/your/.m2/repository/com/example/http-server/0.0.1-
SNAPSHOT/http-server-0.0.1-SNAPSHOT-stubs.jar
```

It confirms that the stubs of the `http-server` have been installed in the local repository.

Running the Integration Tests

In order to profit from the Spring Cloud Contract Stub Runner functionality of automatic stub downloading, you must do the following in your consumer side project (`Loan Application service`):

1. Add the `Spring Cloud Contract` BOM, as follows:

```
<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-dependencies</artifactId>
            <version>${spring-cloud-release-train.version}</version>
            <type>pom</type>
            <scope>import</scope>
        </dependency>
    </dependencies>
</dependencyManagement>
```

2. Add the dependency to `Spring Cloud Contract Stub Runner`, as follows:

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-stub-runner</artifactId>
    <scope>test</scope>
</dependency>
```

3. Annotate your test class with `@AutoConfigureStubRunner`. In the annotation, provide the `group-id` and `artifact-id` for the Stub Runner to download the stubs of your collaborators. (Optional step) Because you are playing with the collaborators offline, you can also provide the offline work switch (`StubRunnerProperties.StubsMode.LOCAL`).

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment = WebEnvironment.NONE)
@AutoConfigureStubRunner(ids = {
        "com.example:http-server-dsl:+:stubs" }, stubsMode =
StubRunnerProperties.StubsMode.LOCAL)
public class LoanApplicationServiceTests {
```

Now, when you run your tests, you see something like the following output in the logs:

```
2016-07-19 14:22:25.403  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Desired version is + - will try to
resolve the latest version
2016-07-19 14:22:25.438  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Resolved version is 0.0.1-SNAPSHOT
2016-07-19 14:22:25.439  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Resolving artifact com.example:http-
server:jar:stubs:0.0.1-SNAPSHOT using remote repositories []
2016-07-19 14:22:25.451  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Resolved artifact com.example:http-
server:jar:stubs:0.0.1-SNAPSHOT to /path/to/your/.m2/repository/com/example/http-
server/0.0.1-SNAPSHOT/http-server-0.0.1-SNAPSHOT-stubs.jar
2016-07-19 14:22:25.465  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Unpacking stub from JAR [URI:
file:/path/to/your/.m2/repository/com/example/http-server/0.0.1-SNAPSHOT/http-
server-0.0.1-SNAPSHOT-stubs.jar]
2016-07-19 14:22:25.475  INFO 41050 --- [           main]
o.s.c.c.stubrunner.AetherStubDownloader  : Unpacked file to
[/var/folders/0p/xwq47sq106x1_g3dtv6qfm940000gq/T/contracts100276532569594265]
2016-07-19 14:22:27.737  INFO 41050 --- [           main]
o.s.c.c.stubrunner.StubRunnerExecutor    : All stubs are now running RunningStubs
[namesAndPorts={com.example:http-server:0.0.1-SNAPSHOT:stubs=8080}]
```

This output means that Stub Runner has found your stubs and started a server for your application with a group ID of `com.example` and an artifact ID of `http-server` with version `0.0.1-SNAPSHOT` of the stubs and with the `stubs` classifier on port `8080`.

Filing a Pull Request

What you have done until now is an iterative process. You can play around with the contract, install it locally, and work on the consumer side until the contract works as you wish.

Once you are satisfied with the results and the test passes, you can publish a pull request to the server side. Currently, the consumer side work is done.

2.4.3. The Producer Side (Fraud Detection server)

As a developer of the Fraud Detection server (a server to the Loan Issuance service), you might want to do the following

- Take over the pull request
- Write the missing implementation
- Deploy the application

The following UML diagram shows the fraud detection flow:

[getting started cdc server] | *getting-started-cdc-server.png*

Taking over the Pull Request

As a reminder, the following listing shows the initial implementation:

```
@RequestMapping(value = "/fraudcheck", method = PUT)
public FraudCheckResult fraudCheck(@RequestBody FraudCheck fraudCheck) {
return new FraudCheckResult(FraudCheckStatus.OK, NO_REASON);
}
```

Then you can run the following commands:

```
$ git checkout -b contract-change-pr master
$ git pull https://your-git-server.com/server-side-fork.git contract-change-pr
```

You must add the dependencies needed by the autogenerated tests, as follows:

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-verifier</artifactId>
    <scope>test</scope>
</dependency>
```

In the configuration of the Maven plugin, you must pass the `packageWithBaseClasses` property, as follows:

```
            <plugin>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-contract-maven-plugin</artifactId>
                <version>${spring-cloud-contract.version}</version>
                <extensions>true</extensions>
                <configuration>

<packageWithBaseClasses>com.example.fraud</packageWithBaseClasses>
<!--                    <convertToYaml>true</convertToYaml>-->
                </configuration>
                <!-- if additional dependencies are needed e.g. for Pact -->
                <dependencies>
                    <dependency>
                        <groupId>org.springframework.cloud</groupId>
                        <artifactId>spring-cloud-contract-pact</artifactId>
                        <version>${spring-cloud-contract.version}</version>
                    </dependency>
                </dependencies>
            </plugin>
```

This example uses “convention-based” naming by setting the `packageWithBaseClasses` property. Doing so means that the two last packages combine to make the name of the base test class. In our case, the contracts were placed under `src/test/resources/contracts/fraud`. Since you do not have two packages starting from the `contracts` folder, pick only one, which should be `fraud`. Add the `Base` suffix and capitalize `fraud`. That gives you the `FraudBase` test class name.

All the generated tests extend that class. Over there, you can set up your Spring Context or whatever is necessary. In this case, you should use Rest Assured MVC to start the server side `FraudDetectionController`. The following listing shows the `FraudBase` class:

```
/*
 * Copyright 2013-2019 the original author or authors.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      https://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

package com.example.fraud;

import io.restassured.module.mockmvc.RestAssuredMockMvc;
import org.junit.Before;

public class FraudBase {

    @Before
    public void setup() {
        RestAssuredMockMvc.standaloneSetup(new FraudDetectionController(),
                new FraudStatsController(stubbedStatsProvider()));
    }

    private StatsProvider stubbedStatsProvider() {
        return fraudType -> {
            switch (fraudType) {
            case DRUNKS:
                return 100;
            case ALL:
                return 200;
            }
            return 0;
        };
    }

    public void assertThatRejectionReasonIsNull(Object rejectionReason) {
        assert rejectionReason == null;
    }

}
```

Now, if you run the `./mvnw clean install`, you get something like the following output:

```
Results :

Tests in error:
  ContractVerifierTest.validate_shouldMarkClientAsFraud:32 » IllegalState
Parsed...
```

This error occurs because you have a new contract from which a test was generated and it failed since you have not implemented the feature. The auto-generated test would look like the following test method:

```
@Test
public void validate_shouldMarkClientAsFraud() throws Exception {
    // given:
        MockMvcRequestSpecification request = given()
                .header("Content-Type", "application/vnd.fraud.v1+json")
                .body("{\"client.id\":\"1234567890\",\"loanAmount\":99999}");

    // when:
        ResponseOptions response = given().spec(request)
                .put("/fraudcheck");

    // then:
        assertThat(response.statusCode()).isEqualTo(200);
        assertThat(response.header("Content-
Type")).matches("application/vnd.fraud.v1.json.*");
    // and:
        DocumentContext parsedJson =
JsonPath.parse(response.getBody().asString());
        assertThatJson(parsedJson).field("['fraudCheckStatus']").matches("[A-
Z]{5}");
        assertThatJson(parsedJson).field("['rejection.reason']").isEqualTo("Amount
too high");
}
```

If you used the Groovy DSL, you can see that all of the `producer()` parts of the Contract that were present in the `value(consumer(…), producer(…))` blocks got injected into the test. In case of using YAML, the same applied for the `matchers` sections of the `response`.

Note that, on the producer side, you are also doing TDD. The expectations are expressed in the form of a test. This test sends a request to our own application with the URL, headers, and body defined in the contract. It is also expecting precisely defined values in the response. In other words, you have the `red` part of `red`, `green`, and `refactor`. It is time to convert the `red` into the `green`.

Write the Missing Implementation

Because you know the expected input and expected output, you can write the missing implementation as follows:

```
@RequestMapping(value = "/fraudcheck", method = PUT)
public FraudCheckResult fraudCheck(@RequestBody FraudCheck fraudCheck) {
if (amountGreaterThanThreshold(fraudCheck)) {
    return new FraudCheckResult(FraudCheckStatus.FRAUD, AMOUNT_TOO_HIGH);
}
return new FraudCheckResult(FraudCheckStatus.OK, NO_REASON);
}
```

When you run `./mvnw clean install` again, the tests pass. Since the `Spring Cloud Contract Verifier` plugin adds the tests to the `generated-test-sources`, you can actually run those tests from your IDE.

Deploying Your Application

Once you finish your work, you can deploy your changes. To do so, you must first merge the branch by running the following commands:

```
$ git checkout master
$ git merge --no-ff contract-change-pr
$ git push origin master
```

Your CI might run something a command such as `./mvnw clean deploy`, which would publish both the application and the stub artifacts.

2.4.4. Consumer Side (Loan Issuance), Final Step

As a developer of the loan issuance service (a consumer of the Fraud Detection server), I want to:

- Merge our feature branch to `master`
- Switch to online mode of working

The following UML diagram shows the final state of the process:

[getting started cdc client final] | *getting-started-cdc-client-final.png*

Merging a Branch to Master

The following commands show one way to merge a branch into master with Git:

```
$ git checkout master
$ git merge --no-ff contract-change-pr
```

Working Online

Now you can disable the offline work for Spring Cloud Contract Stub Runner and indicate where the repository with your stubs is located. At this moment, the stubs of the server side are automatically downloaded from Nexus/Artifactory. You can set the value of `stubsMode` to `REMOTE`. The following code shows an example of achieving the same thing by changing the properties:

```
stubrunner:
  ids: 'com.example:http-server-dsl:+:stubs:8080'
  repositoryRoot: https://repo.spring.io/libs-snapshot
```

That's it. You have finished the tutorial.

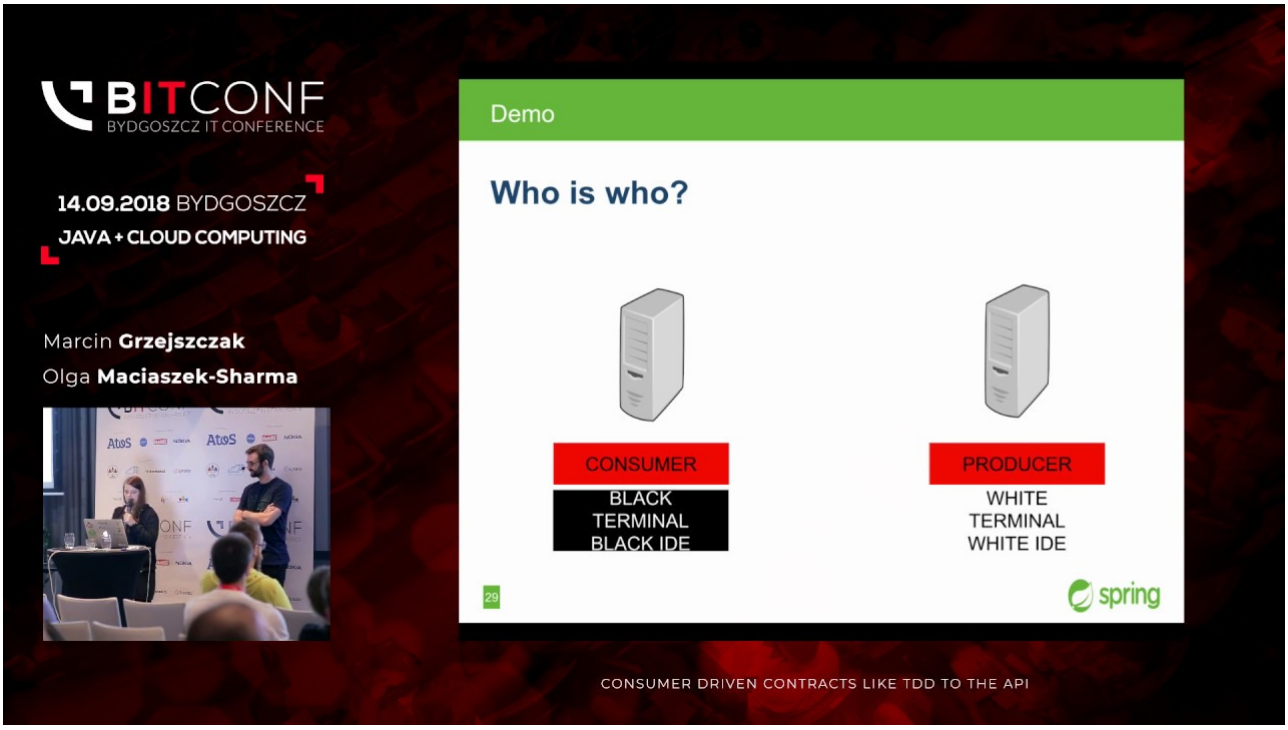
2.5. Next Steps

Hopefully, this section provided some of the Spring Cloud Contract basics and got you on your way to writing your own applications. If you are a task-oriented type of developer, you might want to jump over to spring.io and check out some of the getting started guides that solve specific "How do I do that with Spring?" problems. We also have Spring Cloud Contract-specific "how-to" reference documentation.

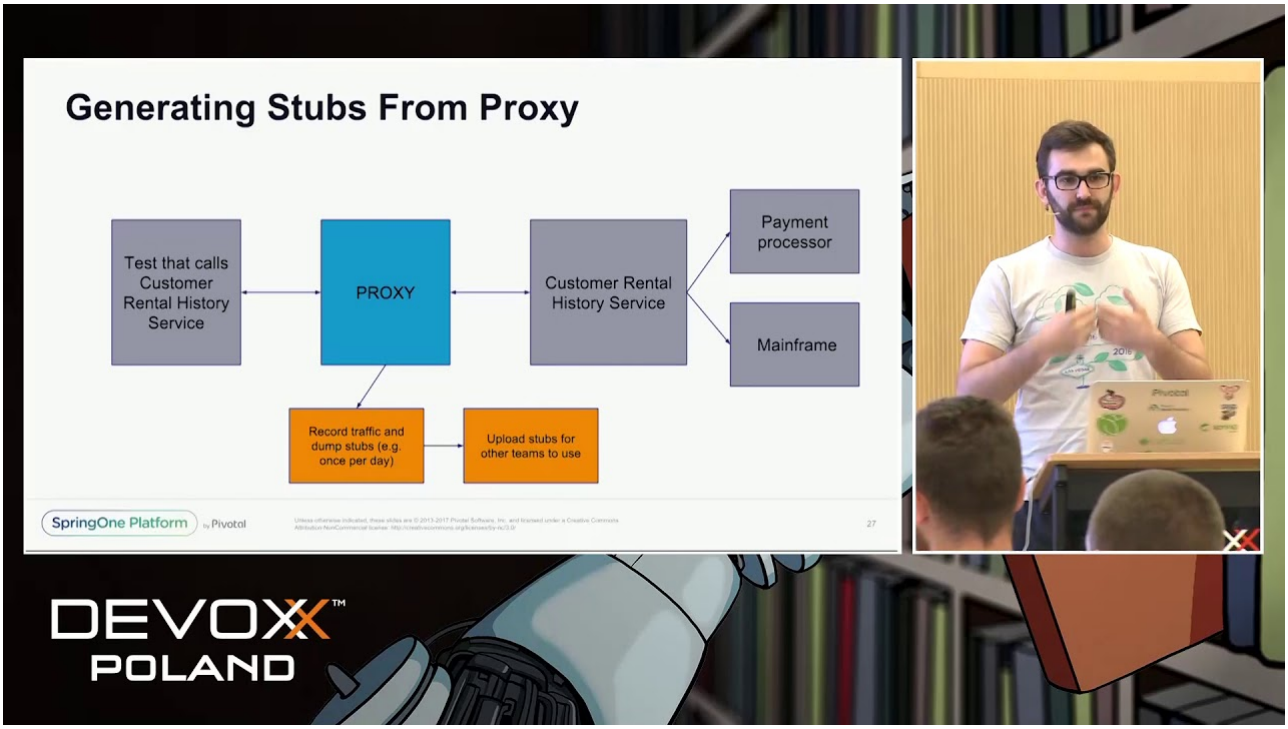
Otherwise, the next logical step is to read Using Spring Cloud Contract. If you are really impatient, you could also jump ahead and read about Spring Cloud Contract features.

In addition to that you can check out the following videos:

- "Consumer Driven Contracts and Your Microservice Architecture" by Olga Maciaszek-Sharma and Marcin Grzejszczak



- "Contract Tests in the Enterprise" by Marcin Grzejszczak



- "Why Contract Tests Matter?" by Marcin Grzejszczak

You can find the default project samples at samples.

You can find the Spring Cloud Contract workshops here.

Chapter 3. Using Spring Cloud Contract

This section goes into more detail about how you should use Spring Cloud Contract. It covers topics such as flows of how to work with Spring Cloud Contract. We also cover some Spring Cloud Contract best practices.

If you are starting out with Spring Cloud Contract, you should probably read the Getting Started guide before diving into this section.

3.1. Provider Contract Testing with Stubs in Nexus or Artifactory

You can check the Developing Your First Spring Cloud Contract based application link to see the provider contract testing with stubs in the Nexus or Artifactory flow.

You can also check the workshop page for a step-by-step instruction on how to do this flow.

3.2. Provider Contract Testing with Stubs in Git

In this flow, we perform the provider contract testing (the producer has no knowledge of how consumers use their API). The stubs are uploaded to a separate repository (they are not uploaded to Artifactory or Nexus).

3.2.1. Prerequisites

Before testing provider contracts with stubs in git, you must provide a git repository that contains all the stubs for each producer. For an example of such a project, see this samples or this sample. As a result of pushing stubs there, the repository has the following structure:

```
$ tree .
└── META-INF
    └── folder.with.group.id.as.its.name
        └── folder-with-artifact-id
            └── folder-with-version
                ├── contractA.groovy
                ├── contractB.yml
                └── contractC.groovy
```

You must also provide consumer code that has Spring Cloud Contract Stub Runner set up. For an example of such a project, see this sample and search for a `BeerControllerGitTest` test. You must also provide producer code that has Spring Cloud Contract set up, together with a plugin. For an example of such a project, see this sample.

3.2.2. The Flow

The flow looks exactly as the one presented in Developing Your First Spring Cloud Contract based application, but the `Stub Storage` implementation is a git repository.

You can read more about setting up a git repository and setting consumer and producer side in the How To page of the documentation.

3.2.3. Consumer setup

In order to fetch the stubs from a git repository instead of Nexus or Artifactory, you need to use the `git` protocol in the URL of the `repositoryRoot` property in Stub Runner. The following example shows how to set it up:

Annotation

```
@AutoConfigureStubRunner(
stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        repositoryRoot = "git://git@github.com:spring-cloud-samples/spring-cloud-
contract-nodejs-contracts-git.git",
        ids = "com.example:artifact-id:0.0.1")
```

JUnit 4 Rule

```
@Rule
    public StubRunnerRule rule = new StubRunnerRule()
            .downloadStub("com.example","artifact-id", "0.0.1")
            .repoRoot("git://git@github.com:spring-cloud-samples/spring-cloud-
contract-nodejs-contracts-git.git")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE);
```

JUnit 5 Extension

```
@RegisterExtension
    public StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
            .downloadStub("com.example","artifact-id", "0.0.1")
            .repoRoot("git://git@github.com:spring-cloud-samples/spring-cloud-
contract-nodejs-contracts-git.git")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE);
```

3.2.4. Setting up the Producer

In order to push the stubs to a git repository instead of Nexus or Artifactory, you need to use the `git` protocol in the URL of the plugin setup. Also you need to explicitly tell the plugin to push the stubs at the end of the build process. The following example shows how to do so:

maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <!-- Base class mappings etc. -->

        <!-- We want to pick contracts from a Git repository -->
        <contractsRepositoryUrl>git://git://git@github.com:spring-cloud-
samples/spring-cloud-contract-nodejs-contracts-git.git</contractsRepositoryUrl>

        <!-- We reuse the contract dependency section to set up the path
        to the folder that contains the contract definitions. In our case the
        path will be /groupId/artifactId/version/contracts -->
        <contractDependency>
            <groupId>${project.groupId}</groupId>
            <artifactId>${project.artifactId}</artifactId>
            <version>${project.version}</version>
        </contractDependency>

        <!-- The contracts mode can't be classpath -->
        <contractsMode>REMOTE</contractsMode>
    </configuration>
    <executions>
        <execution>
            <phase>package</phase>
            <goals>
                <!-- By default we will not push the stubs back to SCM,
                you have to explicitly add it as a goal -->
                <goal>pushStubsToScm</goal>
            </goals>
        </execution>
    </executions>
</plugin>
```

gradle

```
contracts {
    // We want to pick contracts from a Git repository
    contractDependency {
        stringNotation = "${project.group}:${project.name}:${project.version}"
    }
    /*
    We reuse the contract dependency section to set up the path
    to the folder that contains the contract definitions. In our case the
    path will be /groupId/artifactId/version/contracts
     */
    contractRepository {
        repositoryUrl = "git://git://git@github.com:spring-cloud-samples/spring-
cloud-contract-nodejs-contracts-git.git"
    }
    // The mode can't be classpath
    contractsMode = "REMOTE"
    // Base class mappings etc.
}

/*
In this scenario we want to publish stubs to SCM whenever
the `publish` task is executed
*/
publish.dependsOn("publishStubsToScm")
```

You can read more about setting up a git repository in the How To page of the documentation.

3.3. Consumer Driven Contracts with Contracts on the Producer Side

See Step-by-step Guide to Consumer Driven Contracts (CDC) with Contracts on the Producer Side to see the Consumer Driven Contracts with contracts on the producer side flow.

3.4. Consumer Driven Contracts with Contracts in an External Repository

In this flow, we perform Consumer Driven Contract testing. The contract definitions are stored in a separate repository.

See the workshop page for step-by-step instructions on how to do this flow.

3.4.1. Prerequisites

To use consumer-driven contracts with the contracts held in an external repository, you need to set up a git repository that:

- Contains all the contract definitions for each producer.
- Can package the contract definitions in a JAR.
- For each contract producer, contains a way (for example, `pom.xml`) to install stubs locally through the Spring Cloud Contract Plugin (SCC Plugin)

For more information, see the How To section, where we describe how to set up such a repository For an example of such a project, see this sample.

You also need consumer code that has Spring Cloud Contract Stub Runner set up. For an example of such a project, see this sample. You also need producer code that has Spring Cloud Contract set up, together with a plugin. For an example of such a project, see this sample. The stub storage is Nexus or Artifactory

At a high level, the flow looks as follows:

1. The consumer works with the contract definitions from the separate repository
2. Once the consumer's work is done, a branch with working code is done on the consumer side and a pull request is made to the separate repository that holds the contract definitions.
3. The producer takes over the pull request to the separate repository with contract definitions and installs the JAR with all contracts locally.
4. The producer generates tests from the locally stored JAR and writes the missing implementation to make the tests pass.
5. Once the producer's work is done, the pull request to the repository that holds the contract definitions is merged.
6. After the CI tool builds the repository with the contract definitions and the JAR with contract definitions gets uploaded to Nexus or Artifactory, the producer can merge its branch.
7. Finally, the consumer can switch to working online to fetch stubs of the producer from a remote location, and the branch can be merged to master.

3.4.2. Consumer Flow

The consumer:

1. Writes a test that would send a request to the producer.

   The test fails due to no server being present.

2. Clones the repository that holds the contract definitions.
3. Set up the requirements as contracts under the folder with the consumer name as a subfolder of the producer.

   For example, for a producer named `producer` and a consumer named `consumer`, the contracts would be stored under `src/main/resources/contracts/producer/consumer/`)

4. Once the contracts are defined, installs the producer stubs to local storage, as the following example shows:

```
$ cd src/main/resource/contracts/producer
$ ./mvnw clean install
```

5. Sets up Spring Cloud Contract (SCC) Stub Runner in the consumer tests, to:
    - Fetch the producer stubs from local storage.
    - Work in the stubs-per-consumer mode (this enables consumer driven contracts mode).

      The SCC Stub Runner:

    - Fetches the producer stubs.
    - Runs an in-memory HTTP server stub with the producer stubs.
    - Now your test communicates with the HTTP server stub and your tests pass
    - Create a pull request to the repository with contract definitions, with the new contracts for the producer
    - Branch your consumer code, until the producer team has merged their code

The following UML diagram shows the consumer flow:

[flow overview consumer cdc external consumer] | *flow-overview-consumer-cdc-external-*

consumer.png

3.4.3. Producer Flow

The producer:

1. Takes over the pull request to the repository with contract definitions. You can do it from the command line, as follows

```
$ git checkout -b the_branch_with_pull_request master
git pull https://github.com/user_id/project_name.git
the_branch_with_pull_request
```

2. Installs the contract definitions, as follows

```
$ ./mvnw clean install
```

3. Sets up the plugin to fetch the contract definitions from a JAR instead of from `src/test/resources/contracts`, as follows:

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <!-- We want to use the JAR with contracts with the following
coordinates -->
        <contractDependency>
            <groupId>com.example</groupId>
            <artifactId>beer-contracts</artifactId>
        </contractDependency>
        <!-- The JAR with contracts should be taken from Maven local -->
        <contractsMode>LOCAL</contractsMode>
        <!-- ... additional configuration -->
    </configuration>
</plugin>
```

Gradle

```
contracts {
    // We want to use the JAR with contracts with the following coordinates
    // group id `com.example`, artifact id `beer-contracts`, LATEST version and
NO classifier
    contractDependency {
        stringNotation = 'com.example:beer-contracts:+:'
    }
    // The JAR with contracts should be taken from Maven local
    contractsMode = "LOCAL"
    // Additional configuration
}
```

4. Runs the build to generate tests and stubs, as follows:

Maven

```
./mvnw clean install
```

Gradle

```
./gradlew clean build
```

5. Writes the missing implementation, to make the tests pass.

6. Merges the pull request to the repository with contract definitions, as follows:

```
$ git commit -am "Finished the implementation to make the contract tests pass"
$ git checkout master
$ git merge --no-ff the_branch_with_pull_request
$ git push origin master
```

7. The CI system builds the project with the contract definitions and uploads the JAR with the contract definitions to Nexus or Artifactory.
8. Switches to working remotely.
9. Sets up the plugin so that the contract definitions are no longer taken from the local storage but from a remote location, as follows:

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <!-- We want to use the JAR with contracts with the following
coordinates -->
        <contractDependency>
            <groupId>com.example</groupId>
            <artifactId>beer-contracts</artifactId>
        </contractDependency>
        <!-- The JAR with contracts should be taken from a remote location -->
        <contractsMode>REMOTE</contractsMode>
        <!-- ... additional configuration -->
    </configuration>
</plugin>
```

Gradle

```
contracts {
    // We want to use the JAR with contracts with the following coordinates
    // group id `com.example`, artifact id `beer-contracts`, LATEST version and
NO classifier
    contractDependency {
        stringNotation = 'com.example:beer-contracts:+:'
    }
    // The JAR with contracts should be taken from a remote location
    contractsMode = "REMOTE"
    // Additional configuration
}
```

10. Merges the producer code with the new implementation.
11. The CI system:
    - Builds the project
    - Generates tests, stubs, and the stub JAR
    - Uploads the artifact with the application and the stubs to Nexus or Artifactory.

The following UML diagram shows the producer process:

[flow overview consumer cdc external producer] | *flow-overview-consumer-cdc-external-*

producer.png

3.5. Consumer Driven Contracts with Contracts on the Producer Side, Pushed to Git

You can check Step-by-step Guide to Consumer Driven Contracts (CDC) with contracts laying on the producer side to see the consumer driven contracts with contracts on the producer side flow.

The stub storage implementation is a git repository. We describe its setup in the Provider Contract Testing with Stubs in Git section.

You can read more about setting up a git repository for the consumer and producer sides in the How To page of the documentation.

3.6. Provider Contract Testing with Stubs in Artifactory for a non-Spring Application

3.6.1. The Flow

You can check Developing Your First Spring Cloud Contract based application to see the flow for provider contract testing with stubs in Nexus or Artifactory.

3.6.2. Setting up the Consumer

For the consumer side, you can use a JUnit rule. That way, you need not start a Spring context. The follwoing listing shows such a rule (in JUnit4 and JUnit 5);

JUnit 4 Rule

```
@Rule
    public StubRunnerRule rule = new StubRunnerRule()
            .downloadStub("com.example","artifact-id", "0.0.1")
            .repoRoot("git://git@github.com:spring-cloud-samples/spring-cloud-
contract-nodejs-contracts-git.git")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE);
```

JUnit 5 Extension

```
@Rule
    public StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
            .downloadStub("com.example","artifact-id", "0.0.1")
            .repoRoot("git://git@github.com:spring-cloud-samples/spring-cloud-
contract-nodejs-contracts-git.git")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE);
```

3.6.3. Setting up the Producer

By default, the Spring Cloud Contract Plugin uses Rest Assured's `MockMvc` setup for the generated tests. Since non-Spring applications do not use `MockMvc`, you can change the `testMode` to `EXPLICIT` to send a real request to an application bound at a specific port.

In this example, we use a framework called Javalin to start a non-Spring HTTP server.

Assume that we have the following application:

```
package com.example.demo;

import io.javalin.Javalin;

public class DemoApplication {

    public static void main(String[] args) {
        new DemoApplication().run(7000);
    }

    public Javalin start(int port) {
        return Javalin.create().start(port);
    }

    public Javalin registerGet(Javalin app) {
        return app.get("/", ctx -> ctx.result("Hello World"));
    }

    public Javalin run(int port) {
        return registerGet(start(port));
    }

}
```

Given that application, we can set up the plugin to use the `EXPLICIT` mode (that is, to send out requests to a real port), as follows:

maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <baseClassForTests>com.example.demo.BaseClass</baseClassForTests>
        <!-- This will setup the EXPLICIT mode for the tests -->
        <testMode>EXPLICIT</testMode>
    </configuration>
</plugin>
```

gradle

```
contracts {
    // This will setup the EXPLICIT mode for the tests
    testMode = "EXPLICIT"
    baseClassForTests = "com.example.demo.BaseClass"
}
```

The base class might resemble the following:

```
import io.javalin.Javalin;
import io.restassured.RestAssured;
import org.junit.After;
import org.junit.Before;
import org.springframework.util.SocketUtils;

public class BaseClass {

    Javalin app;

    @Before
    public void setup() {
        // pick a random port
        int port = SocketUtils.findAvailableTcpPort();
        // start the application at a random port
        this.app = start(port);
        // tell Rest Assured where the started application is
        RestAssured.baseURI = "http://localhost:" + port;
    }

    @After
    public void close() {
        // stop the server after each test
        this.app.stop();
    }

    private Javalin start(int port) {
        // reuse the production logic to start a server
        return new DemoApplication().run(port);
    }
}
```

With such a setup:

- We have setup the Spring Cloud Contract plugin to use the `EXPLICIT` mode to send real requests instead of mocked ones.
- We have defined a base class that:
  - Starts the HTTP server on a random port for each test.
  - Sets Rest Assured to send requests to that port.
  - Closes the HTTP server after each test.

3.7. Provider Contract Testing with Stubs in Artifactory in a non-JVM World

In this flow, we assume that:

- The API Producer and API Consumer are non-JVM applications.
- The contract definitions are written in YAML.
- The Stub Storage is Artifactory or Nexus.
- Spring Cloud Contract Docker (SCC Docker) and Spring Cloud Contract Stub Runner Docker (SCC Stub Runner Docker) images are used.

You can read more about how to use Spring Cloud Contract with Docker in this page.

Here, you can read a blog post about how to use Spring Cloud Contract in a polyglot world.

Here, you can find a sample of a NodeJS application that uses Spring Cloud Contract both as a producer and a consumer.

3.7.1. Producer Flow

At a high level, the producer:

1. Writes contract definitions (for example, in YAML).
2. Sets up the build tool to:
    a. Start the application with mocked services on a given port.

       If mocking is not possible, you can setup the infrastructure and define tests in a stateful way.

    b. Run the Spring Cloud Contract Docker image and pass the port of a running application as an environment variable.

The SCC Docker image: * Generates the tests from the attached volume. * Runs the tests against the running application.

Upon test completion, stubs get uploaded to a stub storage site (such as Artifactory or Git).

The following UML diagram shows the producer flow:

[flows provider non jvm producer] | *flows-provider-non-jvm-producer.png*

3.7.2. Consumer Flow

At a high level, the consumer:

1. Sets up the build tool to:
    - Start the Spring Cloud Contract Stub Runner Docker image and start the stubs.

      The environment variables configure:

    - The stubs to fetch.
    - The location of the repositories.

      Note that:

    - To use the local storage, you can also attach it as a volume.
    - The ports at which the stubs are running need to be exposed.
2. Run the application tests against the running stubs.

The following UML diagram shows the consumer flow:

[flows provider non jvm consumer] | *flows-provider-non-jvm-consumer.png*

3.8. Provider Contract Testing with REST Docs and Stubs in Nexus or Artifactory

In this flow, we do not use a Spring Cloud Contract plugin to generate tests and stubs. We write Spring RESTDocs and, from them, we automatically generate stubs. Finally, we set up our builds to package the stubs and upload them to the stub storage site — in our case, Nexus or Artifactory.

See the workshop page for a step-by-step instruction on how to use this flow.

3.8.1. Producer Flow

As a producer, we:

1. We write RESTDocs tests of our API.
2. We add Spring Cloud Contract Stub Runner starter to our build (`spring-cloud-starter-contract-stub-runner`), as follows

maven

```
<dependencies>
    <dependency>
        <groupId>org.springframework.cloud</groupId>
        <artifactId>spring-cloud-starter-contract-stub-runner</artifactId>
        <scope>test</scope>
    </dependency>
</dependencies>

<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-dependencies</artifactId>
            <version>${spring-cloud.version}</version>
            <type>pom</type>
            <scope>import</scope>
        </dependency>
    </dependencies>
</dependencyManagement>
```

gradle

```
dependencies {
    testImplementation 'org.springframework.cloud:spring-cloud-starter-
contract-stub-runner'
}

dependencyManagement {
    imports {
        mavenBom "org.springframework.cloud:spring-cloud-
dependencies:${springCloudVersion}"
    }
}
```

3. We set up the build tool to package our stubs, as follows:

maven

```
<!-- pom.xml -->
<plugins>
    <plugin>
        <groupId>org.apache.maven.plugins</groupId>
        <artifactId>maven-assembly-plugin</artifactId>
        <executions>
            <execution>
                <id>stub</id>
                <phase>prepare-package</phase>
                <goals>
                    <goal>single</goal>
                </goals>
                <inherited>false</inherited>
                <configuration>
                    <attach>true</attach>
                    <descriptors>
                        ${basedir}/src/assembly/stub.xml
                    </descriptors>
                </configuration>
            </execution>
        </executions>
    </plugin>
</plugins>

<!-- src/assembly/stub.xml -->
<assembly
    xmlns="http://maven.apache.org/plugins/maven-assembly-
plugin/assembly/1.1.3"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/plugins/maven-assembly-
plugin/assembly/1.1.3 http://maven.apache.org/xsd/assembly-1.1.3.xsd">
    <id>stubs</id>
    <formats>
        <format>jar</format>
    </formats>
    <includeBaseDirectory>false</includeBaseDirectory>
    <fileSets>
        <fileSet>
            <directory>${project.build.directory}/generated-
snippets/stubs</directory>
            <outputDirectory>META-
INF/${project.groupId}/${project.artifactId}/${project.version}/mappings</outpu
tDirectory>
            <includes>
                <include>**/*</include>
            </includes>
        </fileSet>
    </fileSets>
</assembly>
```

gradle

```
task stubsJar(type: Jar) {
    classifier = "stubs"
    into("META-
INF/${project.group}/${project.name}/${project.version}/mappings") {
        include('**/*.*')
        from("${project.buildDir}/generated-snippets/stubs")
    }
}
// we need the tests to pass to build the stub jar
stubsJar.dependsOn(test)
bootJar.dependsOn(stubsJar)
```

Now, when we run the tests, stubs are automatically published and packaged.

The following UML diagram shows the producer flow:

[flows provider rest docs producer] | *flows-provider-rest-docs-producer.png*

3.8.2. Consumer Flow

Since the consumer flow is not affected by the tool used to generate the stubs, you can check Developing Your First Spring Cloud Contract based application to see the flow for consumer side of the provider contract testing with stubs in Nexus or Artifactory.

3.9. What to Read Next

You should now understand how you can use Spring Cloud Contract and some best practices that you should follow. You can now go on to learn about specific Spring Cloud Contract features, or you could skip ahead and read about the advanced features of Spring Cloud Contract.

Chapter 4. Spring Cloud Contract Features

This section dives into the details of Spring Cloud Contract. Here you can learn about the key features that you may want to use and customize. If you have not already done so, you might want to read the "Getting Started" and "Using Spring Cloud Contract" sections, so that you have a good grounding of the basics.

4.1. Contract DSL

Spring Cloud Contract supports the DSLs written in the following languages:

- Groovy
- YAML
- Java
- Kotlin

Spring Cloud Contract supports defining multiple contracts in a single file.

The following example shows a contract definition:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method 'PUT'
        url '/api/12'
        headers {
            header 'Content-Type':
'application/vnd.org.springframework.cloud.contract.verifier.twitter-places-
analyzer.v1+json'
        }
        body '''\
    [{
        "created_at": "Sat Jul 26 09:38:57 +0000 2014",
        "id": 492967299297845248,
        "id_str": "492967299297845248",
        "text": "Gonna see you at Warsaw",
        "place":
        {
            "attributes":{},
            "bounding_box":
            {
                "coordinates":
                    [[
                        [-77.119759,38.791645],
                        [-76.909393,38.791645],
                        [-76.909393,38.995548],
                        [-77.119759,38.995548]
                    ]],
                "type":"Polygon"
            },
            "country":"United States",
            "country_code":"US",
            "full_name":"Washington, DC",
            "id":"01fbe706f872cb32",
            "name":"Washington",
            "place_type":"city",
            "url": "https://api.twitter.com/1/geo/id/01fbe706f872cb32.json"
        }
    }]
'''
    }
    response {
        status OK()
    }
}
```

yml

```
description: Some description
name: some name
priority: 8
ignored: true
request:
  url: /foo
  queryParameters:
    a: b
    b: c
  method: PUT
  headers:
    foo: bar
    fooReq: baz
  body:
    foo: bar
  matchers:
    body:
      - path: $.foo
        type: by_regex
        value: bar
    headers:
      - key: foo
        regex: bar
response:
  status: 200
  headers:
    foo2: bar
    foo3: foo33
    fooRes: baz
  body:
    foo2: bar
    foo3: baz
    nullValue: null
  matchers:
    body:
      - path: $.foo2
        type: by_regex
        value: bar
      - path: $.foo3
        type: by_command
        value: executeMe($it)
      - path: $.nullValue
        type: by_null
        value: null
    headers:
      - key: foo2
        regex: bar
      - key: foo3
        command: andMeToo($it)
```

java

```
import java.util.Collection;
import java.util.Collections;
import java.util.function.Supplier;

import org.springframework.cloud.contract.spec.Contract;
import org.springframework.cloud.contract.verifier.util.ContractVerifierUtil;

class contract_rest implements Supplier<Collection<Contract>> {

    @Override
    public Collection<Contract> get() {
        return Collections.singletonList(Contract.make(c -> {
            c.description("Some description");
            c.name("some name");
            c.priority(8);
            c.ignored();
            c.request(r -> {
                r.url("/foo", u -> {
                    u.queryParameters(q -> {
                        q.parameter("a", "b");
                        q.parameter("b", "c");
                    });
                });
                r.method(r.PUT());
                r.headers(h -> {
                    h.header("foo", r.value(r.client(r.regex("bar")),
r.server("bar")));
                    h.header("fooReq", "baz");
                });
                r.body(ContractVerifierUtil.map().entry("foo", "bar"));
                r.bodyMatchers(m -> {
                    m.jsonPath("$.foo", m.byRegex("bar"));
                });
            });
            c.response(r -> {
                r.fixedDelayMilliseconds(1000);
                r.status(r.OK());
                r.headers(h -> {
                    h.header("foo2", r.value(r.server(r.regex("bar")),
r.client("bar")));
                    h.header("foo3", r.value(r.server(r.execute("andMeToo($it)")),
                            r.client("foo33")));
                    h.header("fooRes", "baz");
                });
                r.body(ContractVerifierUtil.map().entry("foo2", "bar")
                        .entry("foo3", "baz").entry("nullValue", null));
                r.bodyMatchers(m -> {
                    m.jsonPath("$.foo2", m.byRegex("bar"));
                    m.jsonPath("$.foo3", m.byCommand("executeMe($it)"));
```

```
                    m.jsonPath("$.nullValue", m.byNull());
                });
            });
        }));
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract
import org.springframework.cloud.contract.spec.withQueryParameters

contract {
    name = "some name"
    description = "Some description"
    priority = 8
    ignored = true
    request {
        url = url("/foo") withQueryParameters  {
            parameter("a", "b")
            parameter("b", "c")
        }
        method = PUT
        headers {
            header("foo", value(client(regex("bar")), server("bar")))
            header("fooReq", "baz")
        }
        body = body(mapOf("foo" to "bar"))
        bodyMatchers {
            jsonPath("$.foo", byRegex("bar"))
        }
    }
    response {
        delay = fixedMilliseconds(1000)
        status = OK
        headers {
            header("foo2", value(server(regex("bar")), client("bar")))
            header("foo3", value(server(execute("andMeToo(\$it)")),
client("foo33")))
            header("fooRes", "baz")
        }
        body = body(mapOf(
                "foo" to "bar",
                "foo3" to "baz",
                "nullValue" to null
        ))
        bodyMatchers {
            jsonPath("$.foo2", byRegex("bar"))
            jsonPath("$.foo3", byCommand("executeMe(\$it)"))
            jsonPath("$.nullValue", byNull)
        }
    }
}
```

You can compile contracts to stubs mapping by using the following standalone Maven command:

```
mvn org.springframework.cloud:spring-cloud-contract-maven-
plugin:convert
```

4.1.1. Contract DSL in Groovy

If you are not familiar with Groovy, do not worry - you can use Java syntax in the Groovy DSL files as well.

If you decide to write the contract in Groovy, do not be alarmed if you have not used Groovy before. Knowledge of the language is not really needed, as the Contract DSL uses only a tiny subset of it (only literals, method calls, and closures). Also, the DSL is statically typed, to make it programmer-readable without any knowledge of the DSL itself.

Remember that, inside the Groovy contract file, you have to provide the fully qualified name to the `Contract` class and `make` static imports, such as `org.springframework.cloud.spec.Contract.make { ⋯ }`. You can also provide an import to the `Contract` class (`import org.springframework.cloud.spec.Contract`) and then call `Contract.make { ⋯ }`.

4.1.2. Contract DSL in Java

To write a contract definition in Java, you need to create a class, that implements either the `Supplier<Contract>` interface for a single contract or `Supplier<Collection<Contract>>` for multiple contracts.

You can also write the contract definitions under `src/test/java` (e.g. `src/test/java/contracts`) so that you don't have to modify the classpath of your project. In this case you'll have to provide a new location of contract definitions to your Spring Cloud Contract plugin.

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <contractsDirectory>src/test/java/contracts</contractsDirectory>
    </configuration>
</plugin>
```

Gradle

```
contracts {
    contractsDslDir = new File(project.rootDir, "src/test/java/contracts")
}
```

4.1.3. Contract DSL in Kotlin

To get started with writing contracts in Kotlin you would need to start with a (newly created) Kotlin Script file (.kts). Just like the with the Java DSL you can put your contracts in any directory of your choice. The Maven and Gradle plugins will look at the `src/test/resources/contracts` directory by default.

You need to explicitly pass the the `spring-cloud-contract-spec-kotlin` dependency to your project plugin setup.

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <!-- some config -->
    </configuration>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-contract-spec-kotlin</artifactId>
            <version>${spring-cloud-contract.version}</version>
        </dependency>
    </dependencies>
</plugin>

<dependencies>
        <!-- Remember to add this for the DSL support in the IDE and on the
consumer side -->
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-contract-spec-kotlin</artifactId>
            <scope>test</scope>
        </dependency>
</dependencies>
```

Gradle

```
buildscript {
    repositories {
        // ...
    }
    dependencies {
        classpath "org.springframework.cloud:spring-cloud-contract-gradle-
plugin:${scContractVersion}"
        // remember to add this:
        classpath "org.springframework.cloud:spring-cloud-contract-spec-
kotlin:${scContractVersion}"
    }
}

dependencies {
    // ...

    // Remember to add this for the DSL support in the IDE and on the consumer
side
    testImplementation "org.springframework.cloud:spring-cloud-contract-spec-
kotlin"
}
```

Remember that, inside the Kotlin Script file, you have to provide the fully qualified name to the `ContractDSL` class. Generally you would use its contract function like this: `org.springframework.cloud.contract.spec.ContractDsl.contract { ⋯ }`. You can also provide an import to the `contract` function (`import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract`) and then call `contract { ⋯ }`.

4.1.4. Limitations

The support for verifying the size of JSON arrays is experimental. If you want to turn it on, set the value of the following system property to `true`: `spring.cloud.contract.verifier.assert.size`. By default, this feature is set to `false`. You can also set the `assertJsonSize` property in the plugin configuration.

Because JSON structure can have any form, it can be impossible to parse it properly when using the Groovy DSL and the `value(consumer(⋯), producer(⋯))` notation in `GString`. That is why you should use the Groovy Map notation.

4.1.5. Common Top-Level Elements

The following sections describe the most common top-level elements:

- Description

- Name
- Ignoring Contracts
- Contracts in Progress
- Passing Values from Files

Description

You can add a `description` to your contract. The description is arbitrary text. The following code shows an example:

groovy

```
            org.springframework.cloud.contract.spec.Contract.make {
                description('''
given:
    An input
when:
    Sth happens
then:
    Output
''')
            }
```

yml

```
description: Some description
name: some name
priority: 8
ignored: true
request:
  url: /foo
  queryParameters:
    a: b
    b: c
  method: PUT
  headers:
    foo: bar
    fooReq: baz
  body:
    foo: bar
  matchers:
    body:
      - path: $.foo
        type: by_regex
        value: bar
    headers:
      - key: foo
        regex: bar
response:
  status: 200
  headers:
    foo2: bar
    foo3: foo33
    fooRes: baz
  body:
    foo2: bar
    foo3: baz
    nullValue: null
  matchers:
    body:
      - path: $.foo2
        type: by_regex
        value: bar
      - path: $.foo3
        type: by_command
        value: executeMe($it)
      - path: $.nullValue
        type: by_null
        value: null
    headers:
      - key: foo2
        regex: bar
      - key: foo3
        command: andMeToo($it)
```

java

```
Contract.make(c -> {
    c.description("Some description");
}));
```

kotlin

```
contract {
    description = """
given:
    An input
when:
    Sth happens
then:
    Output
"""
}
```

Name

You can provide a name for your contract. Assume that you provided the following name: `should register a user`. If you do so, the name of the autogenerated test is `validate_should_register_a_user`. Also, the name of the stub in a WireMock stub is `should_register_a_user.json`.

You must ensure that the name does not contain any characters that make the generated test not compile. Also, remember that, if you provide the same name for multiple contracts, your autogenerated tests fail to compile and your generated stubs override each other.

The following example shows how to add a name to a contract:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    name("some_special_name")
}
```

yml

```
name: some name
```

java

```
Contract.make(c -> {
    c.name("some name");
}));
```

kotlin

```
contract {
    name = "some_special_name"
}
```

Ignoring Contracts

If you want to ignore a contract, you can either set a value for ignored contracts in the plugin configuration or set the `ignored` property on the contract itself. The following example shows how to do so:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    ignored()
}
```

yml

```
ignored: true
```

java

```
Contract.make(c -> {
    c.ignored();
}));
```

kotlin

```
contract {
    ignored = true
}
```

Contracts in Progress

A contract in progress will not generate tests on the producer side, but will allow generation of stubs.

Use this feature with caution as it may lead to false positives. You generate stubs for your consumers to use without actually having the implementation in place!

If you want to set a contract in progress the following example shows how to do so:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    inProgress()
}
```

yml

```
inProgress: true
```

java

```
Contract.make(c -> {
    c.inProgress();
}));
```

kotlin

```
contract {
    inProgress = true
}
```

You can set the value of the `failOnInProgress` Spring Cloud Contract plugin property to ensure that your build will break when at least one contract in progress remains in your sources.

Passing Values from Files

Starting with version `1.2.0`, you can pass values from files. Assume that you have the following resources in your project:

```
└─── src
    └─── test
        └─── resources
            └─── contracts
                ├─── readFromFile.groovy
                ├─── request.json
                └─── response.json
```

Further assume that your contract is as follows:

groovy

```
/*
 * Copyright 2013-2019 the original author or authors.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      https://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

import org.springframework.cloud.contract.spec.Contract

Contract.make {
    request {
        method('PUT')
        headers {
            contentType(applicationJson())
        }
        body(file("request.json"))
        url("/1")
    }
    response {
        status OK()
        body(file("response.json"))
        headers {
            contentType(applicationJson())
        }
    }
}
```

yml

```
request:
  method: GET
  url: /foo
  bodyFromFile: request.json
response:
  status: 200
  bodyFromFile: response.json
```

java

```
import java.util.Collection;
import java.util.Collections;
import java.util.function.Supplier;

import org.springframework.cloud.contract.spec.Contract;

class contract_rest_from_file implements Supplier<Collection<Contract>> {

    @Override
    public Collection<Contract> get() {
        return Collections.singletonList(Contract.make(c -> {
            c.request(r -> {
                r.url("/foo");
                r.method(r.GET());
                r.body(r.file("request.json"));
            });
            c.response(r -> {
                r.status(r.OK());
                r.body(r.file("response.json"));
            });
        }));
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        url = url("/1")
        method = PUT
        headers {
            contentType = APPLICATION_JSON
        }
        body = bodyFromFile("request.json")
    }
    response {
        status = OK
        body = bodyFromFile("response.json")
        headers {
            contentType = APPLICATION_JSON
        }
    }
}
```

Further assume that the JSON files is as follows:

request.json

```
{
  "status": "REQUEST"
}
```

response.json

```
{
  "status": "RESPONSE"
}
```

When test or stub generation takes place, the contents of the `request.json` and `response.json` files are passed to the body of a request or a response. The name of the file needs to be a file with location relative to the folder in which the contract lays.

If you need to pass the contents of a file in binary form, you can use the `fileAsBytes` method in the coded DSL or a `bodyFromFileAsBytes` field in YAML.

The following example shows how to pass the contents of binary files:

groovy

```
import org.springframework.cloud.contract.spec.Contract

Contract.make {
    request {
        url("/1")
        method(PUT())
        headers {
            contentType(applicationOctetStream())
        }
        body(fileAsBytes("request.pdf"))
    }
    response {
        status 200
        body(fileAsBytes("response.pdf"))
        headers {
            contentType(applicationOctetStream())
        }
    }
}
```

yml

```
request:
  url: /1
  method: PUT
  headers:
    Content-Type: application/octet-stream
  bodyFromFileAsBytes: request.pdf
response:
  status: 200
  bodyFromFileAsBytes: response.pdf
  headers:
    Content-Type: application/octet-stream
```

java

```
import java.util.Collection;
import java.util.Collections;
import java.util.function.Supplier;

import org.springframework.cloud.contract.spec.Contract;

class contract_rest_from_pdf implements Supplier<Collection<Contract>> {

    @Override
    public Collection<Contract> get() {
        return Collections.singletonList(Contract.make(c -> {
            c.request(r -> {
                r.url("/1");
                r.method(r.PUT());
                r.body(r.fileAsBytes("request.pdf"));
                r.headers(h -> {
                    h.contentType(h.applicationOctetStream());
                });
            });
            c.response(r -> {
                r.status(r.OK());
                r.body(r.fileAsBytes("response.pdf"));
                r.headers(h -> {
                    h.contentType(h.applicationOctetStream());
                });
            });
        }));
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        url = url("/1")
        method = PUT
        headers {
            contentType = APPLICATION_OCTET_STREAM
        }
        body = bodyFromFileAsBytes("contracts/request.pdf")
    }
    response {
        status = OK
        body = bodyFromFileAsBytes("contracts/response.pdf")
        headers {
            contentType = APPLICATION_OCTET_STREAM
        }
    }
}
```

You should use this approach whenever you want to work with binary payloads, both for HTTP and messaging.

4.2. Contracts for HTTP

Spring Cloud Contract lets you verify applications that use REST or HTTP as a means of communication. Spring Cloud Contract verifies that, for a request that matches the criteria from the `request` part of the contract, the server provides a response that is in keeping with the `response` part of the contract. Subsequently, the contracts are used to generate WireMock stubs that, for any request matching the provided criteria, provide a suitable response.

4.2.1. HTTP Top-Level Elements

You can call the following methods in the top-level closure of a contract definition:

- `request`: Mandatory
- `response` : Mandatory
- `priority`: Optional

The following example shows how to define an HTTP request contract:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    // Definition of HTTP request part of the contract
    // (this can be a valid request or invalid depending
    // on type of contract being specified).
    request {
        method GET()
        url "/foo"
        //...
    }

    // Definition of HTTP response part of the contract
    // (a service implementing this contract should respond
    // with following response after receiving request
    // specified in "request" part above).
    response {
        status 200
        //...
    }

    // Contract priority, which can be used for overriding
    // contracts (1 is highest). Priority is optional.
    priority 1
}
```

yml

```
priority: 8
request:
...
response:
...
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    // Definition of HTTP request part of the contract
    // (this can be a valid request or invalid depending
    // on type of contract being specified).
    c.request(r -> {
        r.method(r.GET());
        r.url("/foo");
        // ...
    });

    // Definition of HTTP response part of the contract
    // (a service implementing this contract should respond
    // with following response after receiving request
    // specified in "request" part above).
    c.response(r -> {
        r.status(200);
        // ...
    });

    // Contract priority, which can be used for overriding
    // contracts (1 is highest). Priority is optional.
    c.priority(1);
});
```

kotlin

```
contract {
    // Definition of HTTP request part of the contract
    // (this can be a valid request or invalid depending
    // on type of contract being specified).
    request {
        method = GET
        url = url("/foo")
        // ...
    }

    // Definition of HTTP response part of the contract
    // (a service implementing this contract should respond
    // with following response after receiving request
    // specified in "request" part above).
    response {
        status = OK
        // ...
    }

    // Contract priority, which can be used for overriding
    // contracts (1 is highest). Priority is optional.
    priority = 1
}
```

If you want to make your contract have a higher priority, you need to pass a lower number to the `priority` tag or method. For example, a `priority` with a value of `5` has higher priority than a `priority` with a value of `10`.

4.2.2. HTTP Request

The HTTP protocol requires only the method and the URL to be specified in a request. The same information is mandatory in request definition of the contract.

The following example shows a contract for a request:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        // HTTP request method (GET/POST/PUT/DELETE).
        method 'GET'

        // Path component of request URL is specified as follows.
        urlPath('/users')
    }

    response {
        //...
        status 200
    }
}
```

yml

```
method: PUT
url: /foo
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        // HTTP request method (GET/POST/PUT/DELETE).
        r.method("GET");

        // Path component of request URL is specified as follows.
        r.urlPath("/users");
    });

    c.response(r -> {
        // ...
        r.status(200);
    });
});
```

kotlin

```
contract {
    request {
        // HTTP request method (GET/POST/PUT/DELETE).
        method = method("GET")

        // Path component of request URL is specified as follows.
        urlPath = path("/users")
    }
    response {
        // ...
        status = code(200)
    }
}
```

You can specify an absolute rather than a relative `url`, but using `urlPath` is the recommended way, as doing so makes the tests be host-independent.

The following example uses `url`:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method 'GET'

        // Specifying `url` and `urlPath` in one contract is illegal.
        url('http://localhost:8888/users')
    }

    response {
        //...
        status 200
    }
}
```

yml

```
request:
  method: PUT
  urlPath: /foo
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        r.method("GET");

        // Specifying `url` and `urlPath` in one contract is illegal.
        r.url("http://localhost:8888/users");
    });

    c.response(r -> {
        // ...
        r.status(200);
    });
});
```

kotlin

```
contract {
    request {
        method = GET

        // Specifying `url` and `urlPath` in one contract is illegal.
        url("http://localhost:8888/users")
    }
    response {
        // ...
        status = OK
    }
}
```

`request` may contain query parameters, as the following example (which uses `urlPath`) shows:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        //...
        method GET()

        urlPath('/users') {

            // Each parameter is specified in form
            // `''paramName' : paramValue` where parameter value
            // may be a simple literal or one of matcher functions,
            // all of which are used in this example.
            queryParameters {

                // If a simple literal is used as value
                // default matcher function is used (equalTo)
                parameter 'limit': 100

                // `equalTo` function simply compares passed value
                // using identity operator (==).
                parameter 'filter': equalTo("email")

                // `containing` function matches strings
                // that contains passed substring.
                parameter 'gender': value(consumer(containing("[mf]")),
producer('mf'))

                // `matching` function tests parameter
                // against passed regular expression.
                parameter 'offset': value(consumer(matching("[0-9]+")),
producer(123))

                // `notMatching` functions tests if parameter
                // does not match passed regular expression.
                parameter 'loginStartsWith':
value(consumer(notMatching(".{0,2}")), producer(3))
            }
        }

        //...
    }

    response {
        //...
        status 200
    }
}
```

yml

```
request:
...
queryParameters:
  a: b
  b: c
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        // ...
        r.method(r.GET());

        r.urlPath("/users", u -> {

            // Each parameter is specified in form
            // `'paramName' : paramValue` where parameter value
            // may be a simple literal or one of matcher functions,
            // all of which are used in this example.
            u.queryParameters(q -> {

                // If a simple literal is used as value
                // default matcher function is used (equalTo)
                q.parameter("limit", 100);

                // `equalTo` function simply compares passed value
                // using identity operator (==).
                q.parameter("filter", r.equalTo("email"));

                // `containing` function matches strings
                // that contains passed substring.
                q.parameter("gender",
                        r.value(r.consumer(r.containing("[mf]")),
                                r.producer("mf")));

                // `matching` function tests parameter
                // against passed regular expression.
                q.parameter("offset",
                        r.value(r.consumer(r.matching("[0-9]+")),
                                r.producer(123)));

                // `notMatching` functions tests if parameter
                // does not match passed regular expression.
                q.parameter("loginStartsWith",
                        r.value(r.consumer(r.notMatching(".{0,2}")),
                                r.producer(3)));
            });
        });

        // ...
    });

    c.response(r -> {
        // ...
        r.status(200);
    });
});
```

kotlin

```
contract {
    request {
        // ...
        method = GET

        // Each parameter is specified in form
        // `'paramName' : paramValue` where parameter value
        // may be a simple literal or one of matcher functions,
        // all of which are used in this example.
        urlPath = path("/users") withQueryParameters {
            // If a simple literal is used as value
            // default matcher function is used (equalTo)
            parameter("limit", 100)

            // `equalTo` function simply compares passed value
            // using identity operator (==).
            parameter("filter", equalTo("email"))

            // `containing` function matches strings
            // that contains passed substring.
            parameter("gender", value(consumer(containing("[mf]")),
producer("mf")))

            // `matching` function tests parameter
            // against passed regular expression.
            parameter("offset", value(consumer(matching("[0-9]+")),
producer(123)))

            // `notMatching` functions tests if parameter
            // does not match passed regular expression.
            parameter("loginStartsWith", value(consumer(notMatching(".{0,2}")),
producer(3)))
        }

        // ...
    }
    response {
        // ...
        status = code(200)
    }
}
```

`request` can contain additional request headers, as the following example shows:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        //...
        method GET()
        url "/foo"

        // Each header is added in form `'Header-Name' : 'Header-Value'`.
        // there are also some helper methods
        headers {
            header 'key': 'value'
            contentType(applicationJson())
        }

        //...
    }

    response {
        //...
        status 200
    }
}
```

yml

```
request:
...
headers:
  foo: bar
  fooReq: baz
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        // ...
        r.method(r.GET());
        r.url("/foo");

        // Each header is added in form `'Header-Name' : 'Header-Value'`.
        // there are also some helper methods
        r.headers(h -> {
            h.header("key", "value");
            h.contentType(h.applicationJson());
        });

        // ...
    });

    c.response(r -> {
        // ...
        r.status(200);
    });
});
```

kotlin

```
contract {
    request {
        // ...
        method = GET
        url = url("/foo")

        // Each header is added in form `'Header-Name' : 'Header-Value'`.
        // there are also some helper variables
        headers {
            header("key", "value")
            contentType = APPLICATION_JSON
        }

        // ...
    }
    response {
        // ...
        status = OK
    }
}
```

`request` may contain additional request cookies, as the following example shows:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        //...
        method GET()
        url "/foo"

        // Each Cookies is added in form ``'Cookie-Key' : 'Cookie-Value'`.
        // there are also some helper methods
        cookies {
            cookie 'key': 'value'
            cookie('another_key', 'another_value')
        }

        //...
    }

    response {
        //...
        status 200
    }
}
```

yml

```
request:
...
cookies:
  foo: bar
  fooReq: baz
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        // ...
        r.method(r.GET());
        r.url("/foo");

        // Each Cookies is added in form ``'Cookie-Key' : 'Cookie-Value'``.
        // there are also some helper methods
        r.cookies(ck -> {
            ck.cookie("key", "value");
            ck.cookie("another_key", "another_value");
        });

        // ...
    });

    c.response(r -> {
        // ...
        r.status(200);
    });
});
```

kotlin

```
contract {
    request {
        // ...
        method = GET
        url = url("/foo")

        // Each Cookies is added in form ``'Cookie-Key' : 'Cookie-Value'``.
        // there are also some helper methods
        cookies {
            cookie("key", "value")
            cookie("another_key", "another_value")
        }

        // ...
    }

    response {
        // ...
        status = code(200)
    }
}
```

`request` may contain a request body, as the following example shows:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        //...
        method GET()
        url "/foo"

        // Currently only JSON format of request body is supported.
        // Format will be determined from a header or body's content.
        body '''{ "login" : "john", "name": "John The Contract" }'''
    }

    response {
        //...
        status 200
    }
}
```

yml

```
request:
...
body:
  foo: bar
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        // ...
        r.method(r.GET());
        r.url("/foo");

        // Currently only JSON format of request body is supported.
        // Format will be determined from a header or body's content.
        r.body("{ \"login\" : \"john\", \"name\": \"John The Contract\" }");
    });

    c.response(r -> {
        // ...
        r.status(200);
    });
});
```

kotlin

```
contract {
    request {
        // ...
        method = GET
        url = url("/foo")

        // Currently only JSON format of request body is supported.
        // Format will be determined from a header or body's content.
        body = body("{ \"login\" : \"john\", \"name\": \"John The Contract\" }")
    }
    response {
        // ...
        status = OK
    }
}
```

`request` can contain multipart elements. To include multipart elements, use the `multipart` method/section, as the following examples show:

groovy

```
org.springframework.cloud.contract.spec.Contract contractDsl =
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method 'PUT'
        url '/multipart'
        headers {
            contentType('multipart/form-data;boundary=AaB03x')
        }
        multipart(
                // key (parameter name), value (parameter value) pair
                formParameter: $(c(regex('".+"')), p('"formParameterValue"')),
                someBooleanParameter: $(c(regex(anyBoolean())), p('true')),
                // a named parameter (e.g. with `file` name) that represents file
with
                // `name` and `content`. You can also call `named("fileName",
"fileContent")`
                file: named(
                        // name of the file
                        name: $(c(regex(nonEmpty())), p('filename.csv')),
                        // content of the file
                        content: $(c(regex(nonEmpty())), p('file content')),
                        // content type for the part
                        contentType: $(c(regex(nonEmpty())),
p('application/json')))
        )
    }
```

```
    response {
        status OK()
    }
}
org.springframework.cloud.contract.spec.Contract contractDsl =
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method "PUT"
        url "/multipart"
        headers {
            contentType('multipart/form-data;boundary=AaB03x')
        }
        multipart(
                file: named(
                        name: value(stub(regex('.+')), test('file')),
                        content: value(stub(regex('.+')), test([100, 117, 100, 97]
as byte[]))
                )
        )
    }
    response {
        status 200
    }
}
```

yml

```
request:
  method: PUT
  url: /multipart
  headers:
    Content-Type: multipart/form-data;boundary=AaB03x
  multipart:
    params:
      # key (parameter name), value (parameter value) pair
      formParameter: '"formParameterValue"'
      someBooleanParameter: true
    named:
      - paramName: file
        fileName: filename.csv
        fileContent: file content
  matchers:
    multipart:
      params:
        - key: formParameter
          regex: ".+"
        - key: someBooleanParameter
          predefined: any_boolean
      named:
        - paramName: file
          fileName:
            predefined: non_empty
          fileContent:
            predefined: non_empty
response:
  status: 200
```

java

```
import java.util.Collection;
import java.util.Collections;
import java.util.HashMap;
import java.util.Map;
import java.util.function.Supplier;

import org.springframework.cloud.contract.spec.Contract;
import org.springframework.cloud.contract.spec.internal.DslProperty;
import org.springframework.cloud.contract.spec.internal.Request;
import org.springframework.cloud.contract.verifier.util.ContractVerifierUtil;

class contract_multipart implements Supplier<Collection<Contract>> {

    private static Map<String, DslProperty> namedProps(Request r) {
        Map<String, DslProperty> map = new HashMap<>();
        // name of the file
```

```
        map.put("name", r.$(r.c(r.regex(r.nonEmpty())), r.p("filename.csv")));
        // content of the file
        map.put("content", r.$(r.c(r.regex(r.nonEmpty())), r.p("file content")));
        // content type for the part
        map.put("contentType", r.$(r.c(r.regex(r.nonEmpty())),
r.p("application/json")));
        return map;
    }

    @Override
    public Collection<Contract> get() {
        return Collections.singletonList(Contract.make(c -> {
            c.request(r -> {
                r.method("PUT");
                r.url("/multipart");
                r.headers(h -> {
                    h.contentType("multipart/form-data;boundary=AaB03x");
                });
                r.multipart(ContractVerifierUtil.map()
                        // key (parameter name), value (parameter value) pair
                        .entry("formParameter",
                                r.$(r.c(r.regex("\".+\"")),
                                        r.p("\"formParameterValue\"")))
                        .entry("someBooleanParameter",
                                r.$(r.c(r.regex(r.anyBoolean())), r.p("true")))
                        // a named parameter (e.g. with `file` name) that
represents file
                        // with
                        // `name` and `content`. You can also call
`named("fileName",
                        // "fileContent")`
                        .entry("file", r.named(namedProps(r))));
            });
            c.response(r -> {
                r.status(r.OK());
            });
        }));
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        method = PUT
        url = url("/multipart")
        multipart {
            field("formParameter", value(consumer(regex("\".+\"")),
producer("\"formParameterValue\"")))
            field("someBooleanParameter", value(consumer(anyBoolean),
producer("true")))
            field("file",
                named(
                    // name of the file
                    value(consumer(regex(nonEmpty)), producer("filename.csv")),
                    // content of the file
                    value(consumer(regex(nonEmpty)), producer("file content")),
                    // content type for the part
                    value(consumer(regex(nonEmpty)), producer("application/json"))
                )
            )
        }
        headers {
            contentType = "multipart/form-data;boundary=AaB03x"
        }
    }
    response {
        status = OK
    }
}
```

In the preceding example, we define parameters in either of two ways:

Coded DSL

- Directly, by using the map notation, where the value can be a dynamic property (such as `formParameter: $(consumer(…), producer(…))`).
- By using the `named(…)` method that lets you set a named parameter. A named parameter can set a `name` and `content`. You can call it either by using a method with two arguments, such as `named("fileName", "fileContent")`, or by using a map notation, such as `named(name: "fileName", content: "fileContent")`.

YAML

- The multipart parameters are set in the `multipart.params` section.
- The named parameters (the `fileName` and `fileContent` for a given parameter name) can be set in the `multipart.named` section. That section contains the `paramName` (the name of the parameter), `fileName` (the name of the file), `fileContent` (the content of the file) fields.

- The dynamic bits can be set via the `matchers.multipart` section.
  - For parameters, use the `params` section, which can accept `regex` or a `predefined` regular expression.
  - for named params, use the `named` section where first you define the parameter name with `paramName`. Then you can pass the parametrization of either `fileName` or `fileContent` in a `regex` or in a `predefined` regular expression.

From the contract in the preceding example, the generated test and stubs look as follows:

Test

```
// given:
  MockMvcRequestSpecification request = given()
    .header("Content-Type", "multipart/form-data;boundary=AaB03x")
    .param("formParameter", "\"formParameterValue\"")
    .param("someBooleanParameter", "true")
    .multiPart("file", "filename.csv", "file content".getBytes());

 // when:
  ResponseOptions response = given().spec(request)
    .put("/multipart");

 // then:
  assertThat(response.statusCode()).isEqualTo(200);
```

Stub

```
            '''
{
  "request" : {
    "url" : "/multipart",
    "method" : "PUT",
    "headers" : {
      "Content-Type" : {
        "matches" : "multipart/form-data;boundary=AaB03x.*"
      }
    },
    "bodyPatterns" : [ {
        "matches" : ".*--(.*)\\r\\nContent-Disposition: form-data;
name=\\"formParameter\\"\\r\\n(Content-Type: .*\\r\\n)?(Content-Transfer-Encoding:
.*\\r\\n)?(Content-Length: \\\\d+\\r\\n)?\\r\\n\\".+\\"\\r\\n--\\\\1.*"
    }, {
        "matches" : ".*--(.*)\\r\\nContent-Disposition: form-data;
name=\\"someBooleanParameter\\"\\r\\n(Content-Type: .*\\r\\n)?(Content-Transfer-
Encoding: .*\\r\\n)?(Content-Length: \\\\d+\\r\\n)?\\r\\n(true|false)\\r\\n--
\\\\1.*"
    }, {
      "matches" : ".*--(.*)\\r\\nContent-Disposition: form-data; name=\\"file\\";
filename=\\"[\\\\S\\\\s]+\\"\\r\\n(Content-Type: .*\\r\\n)?(Content-Transfer-
Encoding: .*\\r\\n)?(Content-Length: \\\\d+\\r\\n)?\\r\\n[\\\\S\\\\s]+\\r\\n--
\\\\1.*"
    } ]
  },
  "response" : {
    "status" : 200,
    "transformers" : [ "response-template", "foo-transformer" ]
  }
}
    '''
```

4.2.3. HTTP Response

The response must contain an HTTP status code and may contain other information. The following code shows an example:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        //...
        method GET()
        url "/foo"
    }
    response {
        // Status code sent by the server
        // in response to request specified above.
        status OK()
    }
}
```

yml

```
response:
...
status: 200
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        // ...
        r.method(r.GET());
        r.url("/foo");
    });
    c.response(r -> {
        // Status code sent by the server
        // in response to request specified above.
        r.status(r.OK());
    });
});
```

kotlin

```
contract {
    request {
        // ...
        method = GET
        url =url("/foo")
    }
    response {
        // Status code sent by the server
        // in response to request specified above.
        status = OK
    }
}
```

Besides status, the response may contain headers, cookies, and a body, which are specified the same way as in the request (see HTTP Request).

In the Groovy DSL, you can reference the `org.springframework.cloud.contract.spec.internal.HttpStatus` methods to provide a meaningful status instead of a digit. For example, you can call `OK()` for a status `200` or `BAD_REQUEST()` for `400`.

4.2.4. Dynamic properties

The contract can contain some dynamic properties: timestamps, IDs, and so on. You do not want to force the consumers to stub their clocks to always return the same value of time so that it gets matched by the stub.

For the Groovy DSL, you can provide the dynamic parts in your contracts in two ways: pass them directly in the body or set them in a separate section called `bodyMatchers`.

Before 2.0.0, these were set by using `testMatchers` and `stubMatchers`. See the migration guide for more information.

For YAML, you can use only the `matchers` section.

Entries inside the `matchers` must reference existing elements of the payload. For more information check this issue.

Dynamic Properties inside the Body

This section is valid only for the Coded DSL (Groovy, Java etc.). Check out the Dynamic Properties in the Matchers Sections section for YAML examples of a similar feature.

You can set the properties inside the body either with the `value` method or, if you use the Groovy

map notation, with `$()`. The following example shows how to set dynamic properties with the value method:

value

```
value(consumer(...), producer(...))
value(c(...), p(...))
value(stub(...), test(...))
value(client(...), server(...))
```

$

```
$(consumer(...), producer(...))
$(c(...), p(...))
$(stub(...), test(...))
$(client(...), server(...))
```

Both approaches work equally well. The `stub` and `client` methods are aliases over the `consumer` method. Subsequent sections take a closer look at what you can do with those values.

Regular Expressions

This section is valid only for Groovy DSL. Check out the Dynamic Properties in the Matchers Sections section for YAML examples of a similar feature.

You can use regular expressions to write your requests in the contract DSL. Doing so is particularly useful when you want to indicate that a given response should be provided for requests that follow a given pattern. Also, you can use regular expressions when you need to use patterns and not exact values both for your tests and your server-side tests.

Make sure that regex matches a whole region of a sequence, as, internally, a call to `Pattern.matches()` is called. For instance, `abc` does not match `aabc`, but `.abc` does. There are several additional known limitations as well.

The following example shows how to use regular expressions to write a request:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method('GET')
        url $(consumer(~/\/[0-9]{2}/), producer('/12'))
    }
    response {
        status OK()
        body(
                id: $(anyNumber()),
                surname: $(
                        consumer('Kowalsky'),
                        producer(regex('[a-zA-Z]+'))
                ),
                name: 'Jan',
                created: $(consumer('2014-02-02 12:23:43'),
producer(execute('currentDate(it)'))),
                correlationId: value(consumer('5d1f9fef-e0dc-4f3d-a7e4-
72d2220dd827'),
                        producer(regex('[a-fA-F0-9]{8}-[a-fA-F0-9]{4}-[a-fA-F0-
9]{4}-[a-fA-F0-9]{4}-[a-fA-F0-9]{12}'))
                )
        )
        headers {
            header 'Content-Type': 'text/plain'
        }
    }
}
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.request(r -> {
        r.method("GET");
        r.url(r.$(r.consumer(r.regex("\\/[0-9]{2}")), r.producer("/12")));
    });
    c.response(r -> {
        r.status(r.OK());
        r.body(ContractVerifierUtil.map().entry("id", r.$(r.anyNumber()))
                .entry("surname", r.$(r.consumer("Kowalsky"),
                        r.producer(r.regex("[a-zA-Z]+")))));
        r.headers(h -> {
            h.header("Content-Type", "text/plain");
        });
    });
});
```

kotlin

```
contract {
    request {
        method = method("GET")
        url = url(v(consumer(regex("\\/[0-9]{2}")), producer("/12")))
    }
    response {
        status = OK
        body(mapOf(
                "id" to v(anyNumber),
                "surname" to v(consumer("Kowalsky"), producer(regex("[a-zA-Z]+")))
        ))
        headers {
            header("Content-Type", "text/plain")
        }
    }
}
```

You can also provide only one side of the communication with a regular expression. If you do so, then the contract engine automatically provides the generated string that matches the provided regular expression. The following code shows an example for Groovy:

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method 'PUT'
        url value(consumer(regex('/foo/[0-9]{5}')))
        body([
                requestElement: $(consumer(regex('[0-9]{5}')))
        ])
        headers {
            header('header',
$(consumer(regex('application\\/vnd\\.fraud\\.v1\\+json;.*'))))
        }
    }
    response {
        status OK()
        body([
                responseElement: $(producer(regex('[0-9]{7}')))
        ])
        headers {
            contentType("application/vnd.fraud.v1+json")
        }
    }
}
```

In the preceding example, the opposite side of the communication has the respective data generated for request and response.

Spring Cloud Contract comes with a series of predefined regular expressions that you can use in your contracts, as the following example shows:

```
public static RegexProperty onlyAlphaUnicode() {
    return new RegexProperty(ONLY_ALPHA_UNICODE).asString();
}

public static RegexProperty alphaNumeric() {
    return new RegexProperty(ALPHA_NUMERIC).asString();
}

public static RegexProperty number() {
    return new RegexProperty(NUMBER).asDouble();
}

public static RegexProperty positiveInt() {
    return new RegexProperty(POSITIVE_INT).asInteger();
}

public static RegexProperty anyBoolean() {
    return new RegexProperty(TRUE_OR_FALSE).asBooleanType();
}

public static RegexProperty anInteger() {
    return new RegexProperty(INTEGER).asInteger();
}

public static RegexProperty aDouble() {
    return new RegexProperty(DOUBLE).asDouble();
}

public static RegexProperty ipAddress() {
    return new RegexProperty(IP_ADDRESS).asString();
}

public static RegexProperty hostname() {
    return new RegexProperty(HOSTNAME_PATTERN).asString();
}

public static RegexProperty email() {
    return new RegexProperty(EMAIL).asString();
}

public static RegexProperty url() {
    return new RegexProperty(URL).asString();
}

public static RegexProperty httpsUrl() {
    return new RegexProperty(HTTPS_URL).asString();
}
```

```
public static RegexProperty uuid() {
    return new RegexProperty(UUID).asString();
}

public static RegexProperty isoDate() {
    return new RegexProperty(ANY_DATE).asString();
}

public static RegexProperty isoDateTime() {
    return new RegexProperty(ANY_DATE_TIME).asString();
}

public static RegexProperty isoTime() {
    return new RegexProperty(ANY_TIME).asString();
}

public static RegexProperty iso8601WithOffset() {
    return new RegexProperty(ISO8601_WITH_OFFSET).asString();
}

public static RegexProperty nonEmpty() {
    return new RegexProperty(NON_EMPTY).asString();
}

public static RegexProperty nonBlank() {
    return new RegexProperty(NON_BLANK).asString();
}
```

In your contract, you can use it as follows (example for the Groovy DSL):

```
Contract dslWithOptionalsInString = Contract.make {
    priority 1
    request {
        method POST()
        url '/users/password'
        headers {
            contentType(applicationJson())
        }
        body(
                email: $(consumer(optional(regex(email()))), producer('abc@abc.com')),
                callback_url: $(consumer(regex(hostname())),
producer('http://partners.com'))
        )
    }
    response {
        status 404
        headers {
            contentType(applicationJson())
        }
        body(
                code: value(consumer("123123"), producer(optional("123123"))),
                message: "User not found by email = [${value(producer(regex(email())),
consumer('not.existing@user.com'))}]"
        )
    }
}
```

To make matters even simpler, you can use a set of predefined objects that automatically assume that you want a regular expression to be passed. All of those methods start with the `any` prefix, as follows:

```
T anyAlphaUnicode();

T anyAlphaNumeric();

T anyNumber();

T anyInteger();

T anyPositiveInt();

T anyDouble();

T anyHex();

T aBoolean();

T anyIpAddress();

T anyHostname();

T anyEmail();

T anyUrl();

T anyHttpsUrl();

T anyUuid();

T anyDate();

T anyDateTime();

T anyTime();

T anyIso8601WithOffset();

T anyNonBlankString();

T anyNonEmptyString();

T anyOf(String... values);
```

The following example shows how you can reference those methods:

groovy

```
Contract contractDsl = Contract.make {
    name "foo"
    label 'trigger_event'
    input {
        triggeredBy('toString()')
    }
    outputMessage {
        sentTo 'topic.rateablequote'
        body([
                alpha            : $(anyAlphaUnicode()),
                number           : $(anyNumber()),
                anInteger        : $(anyInteger()),
                positiveInt      : $(anyPositiveInt()),
                aDouble          : $(anyDouble()),
                aBoolean         : $(aBoolean()),
                ip               : $(anyIpAddress()),
                hostname         : $(anyHostname()),
                email            : $(anyEmail()),
                url              : $(anyUrl()),
                httpsUrl         : $(anyHttpsUrl()),
                uuid             : $(anyUuid()),
                date             : $(anyDate()),
                dateTime         : $(anyDateTime()),
                time             : $(anyTime()),
                iso8601WithOffset: $(anyIso8601WithOffset()),
                nonBlankString   : $(anyNonBlankString()),
                nonEmptyString   : $(anyNonEmptyString()),
                anyOf            : $(anyOf('foo', 'bar'))
        ])
    }
}
```

kotlin

```
contract {
    name = "foo"
    label = "trigger_event"
    input {
        triggeredBy = "toString()"
    }
    outputMessage {
        sentTo = sentTo("topic.rateablequote")
        body(mapOf(
                "alpha" to v(anyAlphaUnicode),
                "number" to v(anyNumber),
                "anInteger" to v(anyInteger),
                "positiveInt" to v(anyPositiveInt),
                "aDouble" to v(anyDouble),
                "aBoolean" to v(aBoolean),
                "ip" to v(anyIpAddress),
                "hostname" to v(anyAlphaUnicode),
                "email" to v(anyEmail),
                "url" to v(anyUrl),
                "httpsUrl" to v(anyHttpsUrl),
                "uuid" to v(anyUuid),
                "date" to v(anyDate),
                "dateTime" to v(anyDateTime),
                "time" to v(anyTime),
                "iso8601WithOffset" to v(anyIso8601WithOffset),
                "nonBlankString" to v(anyNonBlankString),
                "nonEmptyString" to v(anyNonEmptyString),
                "anyOf" to v(anyOf('foo', 'bar'))
        ))
        headers {
            header("Content-Type", "text/plain")
        }
    }
}
```

Limitations

Due to certain limitations of the `Xeger` library that generates a string out of a regex, do not use the `$` and `^` signs in your regex if you rely on automatic generation. See Issue 899.

Do not use a `LocalDate` instance as a value for `$` (for example, `$(consumer(LocalDate.now()))`). It causes a `java.lang.StackOverflowError`. Use `$(consumer(LocalDate.now().toString()))` instead. See Issue 900.

Passing Optional Parameters

This section is valid only for Groovy DSL. Check out the Dynamic Properties in the Matchers Sections section for YAML examples of a similar feature.

You can provide optional parameters in your contract. However, you can provide optional parameters only for the following:

- The STUB side of the Request
- The TEST side of the Response

The following example shows how to provide optional parameters:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    priority 1
    name "optionals"
    request {
        method 'POST'
        url '/users/password'
        headers {
            contentType(applicationJson())
        }
        body(
                email: $(consumer(optional(regex(email())))),
producer('abc@abc.com')),
                callback_url: $(consumer(regex(hostname()))),
producer('https://partners.com'))
        )
    }
    response {
        status 404
        headers {
            header 'Content-Type': 'application/json'
        }
        body(
                code: value(consumer("123123"), producer(optional("123123")))
        )
    }
}
```

java

```
org.springframework.cloud.contract.spec.Contract.make(c -> {
    c.priority(1);
    c.name("optionals");
    c.request(r -> {
        r.method("POST");
        r.url("/users/password");
        r.headers(h -> {
            h.contentType(h.applicationJson());
        });
        r.body(ContractVerifierUtil.map()
                .entry("email",
                        r.$(r.consumer(r.optional(r.regex(r.email()))),
                                r.producer("abc@abc.com")))
                .entry("callback_url", r.$(r.consumer(r.regex(r.hostname())),
                        r.producer("https://partners.com"))));
    });
    c.response(r -> {
        r.status(404);
        r.headers(h -> {
            h.header("Content-Type", "application/json");
        });
        r.body(ContractVerifierUtil.map().entry("code", r.value(
                r.consumer("123123"), r.producer(r.optional("123123")))));
    });
});
```

kotlin

```
contract { c ->
    priority = 1
    name = "optionals"
    request {
        method = POST
        url = url("/users/password")
        headers {
            contentType = APPLICATION_JSON
        }
        body = body(mapOf(
                "email" to v(consumer(optional(regex(email))),
producer("abc@abc.com")),
                "callback_url" to v(consumer(regex(hostname)),
producer("https://partners.com"))
        ))
    }
    response {
        status = NOT_FOUND
        headers {
            header("Content-Type", "application/json")
        }
        body(mapOf(
                "code" to value(consumer("123123"), producer(optional("123123")))
        ))
    }
}
```

By wrapping a part of the body with the `optional()` method, you create a regular expression that must be present 0 or more times.

If you use Spock, the following test would be generated from the previous example:

groovy

```
                    """\
package com.example

import com.jayway.jsonpath.DocumentContext
import com.jayway.jsonpath.JsonPath
import spock.lang.Specification
import io.restassured.module.mockmvc.specification.MockMvcRequestSpecification
import io.restassured.response.ResponseOptions

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson
import static io.restassured.module.mockmvc.RestAssuredMockMvc.*

@SuppressWarnings("rawtypes")
class FooSpec extends Specification {

\tdef validate_optionals() throws Exception {
\t\tgiven:
\t\t\tMockMvcRequestSpecification request = given()
\t\t\t\t\t.header("Content-Type", "application/json")
\t\t\t\t\t.body('''{"email":"abc@abc.com","callback_url":"https://partners.com"}''
')

\t\twhen:
\t\t\tResponseOptions response = given().spec(request)
\t\t\t\t\t.post("/users/password")

\t\tthen:
\t\t\tresponse.statusCode() == 404
\t\t\tresponse.header("Content-Type") == 'application/json'

\t\tand:
\t\t\tDocumentContext parsedJson = JsonPath.parse(response.body.asString())
\t\t\tassertThatJson(parsedJson).field("['code']").matches("(123123)?")
\t}

}
"""
```

The following stub would also be generated:

```
                    '''
{
  "request" : {
    "url" : "/users/password",
    "method" : "POST",
    "bodyPatterns" : [ {
      "matchesJsonPath" : "$[?(@.['email'] =~ /([a-zA-Z0-9._%+-]+@[a-zA-Z0-9.-
]+\\\\.[a-zA-Z]{2,6})?/)]"
    }, {
      "matchesJsonPath" : "$[?(@.['callback_url'] =~
/((http[s]?|ftp):\\\\/)\\\\/?([^:\\\\/\\\\s]+)(:[0-9]{1,5})?/)]"
    } ],
    "headers" : {
      "Content-Type" : {
        "equalTo" : "application/json"
      }
    }
  },
  "response" : {
    "status" : 404,
    "body" : "{\\"code\\":\\"123123\\",\\"message\\":\\"User not found by email ==
[not.existing@user.com]\\"}",
    "headers" : {
      "Content-Type" : "application/json"
    }
  },
  "priority" : 1
}
'''
```

Executing Custom Methods on the Server Side

This section is valid only for Groovy DSL. Check out the Dynamic Properties in the Matchers Sections section for YAML examples of a similar feature.

You can define a method call that runs on the server side during the test. Such a method can be added to the class defined as `baseClassForTests` in the configuration. The following code shows an example of the contract portion of the test case:

groovy

```
method GET()
```

java

```
r.method(r.GET());
```

kotlin

```
method = GET
```

The following code shows the base class portion of the test case:

```
abstract class BaseMockMvcSpec extends Specification {

    def setup() {
        RestAssuredMockMvc.standaloneSetup(new PairIdController())
    }

    void isProperCorrelationId(Integer correlationId) {
        assert correlationId == 123456
    }

    void isEmpty(String value) {
        assert value == null
    }

}
```

You cannot use both a `String` and `execute` to perform concatenation. For example, calling `header('Authorization', 'Bearer ' + execute('authToken()'))` leads to improper results. Instead, call `header('Authorization', execute('authToken()'))` and ensure that the `authToken()` method returns everything you need.

The type of the object read from the JSON can be one of the following, depending on the JSON path:

- `String`: If you point to a `String` value in the JSON.
- `JSONArray`: If you point to a `List` in the JSON.
- `Map`: If you point to a `Map` in the JSON.
- `Number`: If you point to `Integer`, `Double`, and other numeric type in the JSON.
- `Boolean`: If you point to a `Boolean` in the JSON.

In the request part of the contract, you can specify that the `body` should be taken from a method.

You must provide both the consumer and the producer side. The `execute` part is applied for the whole body, not for parts of it.

The following example shows how to read an object from JSON:

```
Contract contractDsl = Contract.make {
    request {
        method 'GET'
        url '/something'
        body(
                $(c('foo'), p(execute('hashCode()')))
        )
    }
    response {
        status OK()
    }
}
```

The preceding example results in calling the `hashCode()` method in the request body. It should resemble the following code:

```
// given:
 MockMvcRequestSpecification request = given()
   .body(hashCode());

// when:
 ResponseOptions response = given().spec(request)
   .get("/something");

// then:
 assertThat(response.statusCode()).isEqualTo(200);
```

Referencing the Request from the Response

The best situation is to provide fixed values, but sometimes you need to reference a request in your response.

If you write contracts in the Groovy DSL, you can use the `fromRequest()` method, which lets you reference a bunch of elements from the HTTP request. You can use the following options:

- `fromRequest().url()`: Returns the request URL and query parameters.
- `fromRequest().query(String key)`: Returns the first query parameter with a given name.
- `fromRequest().query(String key, int index)`: Returns the nth query parameter with a given name.
- `fromRequest().path()`: Returns the full path.
- `fromRequest().path(int index)`: Returns the nth path element.

- `fromRequest().header(String key)`: Returns the first header with a given name.
- `fromRequest().header(String key, int index)`: Returns the nth header with a given name.
- `fromRequest().body()`: Returns the full request body.
- `fromRequest().body(String jsonPath)`: Returns the element from the request that matches the JSON Path.

If you use the YAML contract definition or the Java one, you have to use the Handlebars `{{{ }}}` notation with custom Spring Cloud Contract functions to achieve this. In that case, you can use the following options:

- `{{{ request.url }}}`: Returns the request URL and query parameters.
- `{{{ request.query.key.[index] }}}`: Returns the nth query parameter with a given name. For example, for a key of `thing`, the first entry is `{{{ request.query.thing.[0] }}}`
- `{{{ request.path }}}`: Returns the full path.
- `{{{ request.path.[index] }}}`: Returns the nth path element. For example, the first entry is `{{{ request.path.[0] }}}`
- `{{{ request.headers.key }}}`: Returns the first header with a given name.
- `{{{ request.headers.key.[index] }}}`: Returns the nth header with a given name.
- `{{{ request.body }}}`: Returns the full request body.
- `{{{ jsonpath this 'your.json.path' }}}`: Returns the element from the request that matches the JSON Path. For example, for a JSON path of `$.here`, use `{{{ jsonpath this '$.here' }}}`

Consider the following contract:

groovy

```
Contract contractDsl = Contract.make {
    request {
        method 'GET'
        url('/api/v1/xxxx') {
            queryParameters {
                parameter('foo', 'bar')
                parameter('foo', 'bar2')
            }
        }
        headers {
            header(authorization(), 'secret')
            header(authorization(), 'secret2')
        }
        body(foo: 'bar', baz: 5)
    }
    response {
        status OK()
        headers {
            header(authorization(), "foo ${fromRequest().header(authorization())}
```

```
bar")
        }
        body(
                url: fromRequest().url(),
                path: fromRequest().path(),
                pathIndex: fromRequest().path(1),
                param: fromRequest().query('foo'),
                paramIndex: fromRequest().query('foo', 1),
                authorization: fromRequest().header('Authorization'),
                authorization2: fromRequest().header('Authorization', 1),
                fullBody: fromRequest().body(),
                responseFoo: fromRequest().body('$.foo'),
                responseBaz: fromRequest().body('$.baz'),
                responseBaz2: "Bla bla ${fromRequest().body('$.foo')} bla bla",
                rawUrl: fromRequest().rawUrl(),
                rawPath: fromRequest().rawPath(),
                rawPathIndex: fromRequest().rawPath(1),
                rawParam: fromRequest().rawQuery('foo'),
                rawParamIndex: fromRequest().rawQuery('foo', 1),
                rawAuthorization: fromRequest().rawHeader('Authorization'),
                rawAuthorization2: fromRequest().rawHeader('Authorization', 1),
                rawResponseFoo: fromRequest().rawBody('$.foo'),
                rawResponseBaz: fromRequest().rawBody('$.baz'),
                rawResponseBaz2: "Bla bla ${fromRequest().rawBody('$.foo')} bla
bla"
        )
    }
}
Contract contractDsl = Contract.make {
    request {
        method 'GET'
        url('/api/v1/xxxx') {
            queryParameters {
                parameter('foo', 'bar')
                parameter('foo', 'bar2')
            }
        }
        headers {
            header(authorization(), 'secret')
            header(authorization(), 'secret2')
        }
        body(foo: "bar", baz: 5)
    }
    response {
        status OK()
        headers {
            contentType(applicationJson())
        }
        body('''
                {
                    "responseFoo": "{{{ jsonPath request.body '$.foo' }}}",
```

```
                    "responseBaz": {{{ jsonPath request.body '$.baz' }}},
                    "responseBaz2": "Bla bla {{{ jsonPath request.body '$.foo' }}}
bla bla"
                }
        '''.toString())
    }
}
```

yml

```
request:
  method: GET
  url: /api/v1/xxxx
  queryParameters:
    foo:
      - bar
      - bar2
  headers:
    Authorization:
      - secret
      - secret2
  body:
    foo: bar
    baz: 5
response:
  status: 200
  headers:
    Authorization: "foo {{{ request.headers.Authorization.0 }}} bar"
  body:
    url: "{{{ request.url }}}"
    path: "{{{ request.path }}}"
    pathIndex: "{{{ request.path.1 }}}"
    param: "{{{ request.query.foo }}}"
    paramIndex: "{{{ request.query.foo.1 }}}"
    authorization: "{{{ request.headers.Authorization.0 }}}"
    authorization2: "{{{ request.headers.Authorization.1 }}"
    fullBody: "{{{ request.body }}}"
    responseFoo: "{{{ jsonpath this '$.foo' }}}"
    responseBaz: "{{{ jsonpath this '$.baz' }}}"
    responseBaz2: "Bla bla {{{ jsonpath this '$.foo' }}} bla bla"
```

java

```
package contracts.beer.rest;

import java.util.function.Supplier;

import org.springframework.cloud.contract.spec.Contract;

import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.map;

class shouldReturnStatsForAUser implements Supplier<Contract> {

    @Override
    public Contract get() {
        return Contract.make(c -> {
            c.request(r -> {
                r.method("POST");
                r.url("/stats");
                r.body(map().entry("name", r.anyAlphaUnicode()));
                r.headers(h -> {
                    h.contentType(h.applicationJson());
                });
            });
            c.response(r -> {
                r.status(r.OK());
                r.body(map()
                        .entry("text",
                                "Dear {{{jsonPath request.body '$.name'}}} thanks
for your interested in drinking beer")
                        .entry("quantity", r.$(r.c(5), r.p(r.anyNumber()))));
                r.headers(h -> {
                    h.contentType(h.applicationJson());
                });
            });
        });
    }

}
```

kotlin

```
package contracts.beer.rest

import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        method = method("POST")
        url = url("/stats")
        body(mapOf(
            "name" to anyAlphaUnicode
        ))
        headers {
            contentType = APPLICATION_JSON
        }
    }
    response {
        status = OK
        body(mapOf(
            "text" to "Don't worry ${fromRequest().body("$.name")} thanks for your
interested in drinking beer",
            "quantity" to v(c(5), p(anyNumber))
        ))
        headers {
            contentType = fromRequest().header(CONTENT_TYPE)
        }
    }
}
```

Running a JUnit test generation leads to a test that resembles the following example:

```
// given:
 MockMvcRequestSpecification request = given()
   .header("Authorization", "secret")
   .header("Authorization", "secret2")
   .body("{\"foo\":\"bar\",\"baz\":5}");

// when:
 ResponseOptions response = given().spec(request)
   .queryParam("foo","bar")
   .queryParam("foo","bar2")
   .get("/api/v1/xxxx");

// then:
 assertThat(response.statusCode()).isEqualTo(200);
 assertThat(response.header("Authorization")).isEqualTo("foo secret bar");
// and:
 DocumentContext parsedJson = JsonPath.parse(response.getBody().asString());
 assertThatJson(parsedJson).field("['fullBody']").isEqualTo("{\"foo\":\"bar\",\"baz\":
5}");
 assertThatJson(parsedJson).field("['authorization']").isEqualTo("secret");
 assertThatJson(parsedJson).field("['authorization2']").isEqualTo("secret2");
 assertThatJson(parsedJson).field("['path']").isEqualTo("/api/v1/xxxx");
 assertThatJson(parsedJson).field("['param']").isEqualTo("bar");
 assertThatJson(parsedJson).field("['paramIndex']").isEqualTo("bar2");
 assertThatJson(parsedJson).field("['pathIndex']").isEqualTo("v1");
 assertThatJson(parsedJson).field("['responseBaz']").isEqualTo(5);
 assertThatJson(parsedJson).field("['responseFoo']").isEqualTo("bar");
 assertThatJson(parsedJson).field("['url']").isEqualTo("/api/v1/xxxx?foo=bar&foo=bar2"
);
 assertThatJson(parsedJson).field("['responseBaz2']").isEqualTo("Bla bla bar bla
bla");
```

As you can see, elements from the request have been properly referenced in the response.

The generated WireMock stub should resemble the following example:

```
{
  "request" : {
    "urlPath" : "/api/v1/xxxx",
    "method" : "POST",
    "headers" : {
      "Authorization" : {
        "equalTo" : "secret2"
      }
    },
    "queryParameters" : {
      "foo" : {
        "equalTo" : "bar2"
      }
    },
    "bodyPatterns" : [ {
      "matchesJsonPath" : "$[?(@.['baz'] == 5)]"
    }, {
      "matchesJsonPath" : "$[?(@.['foo'] == 'bar')]"
    } ]
  },
  "response" : {
    "status" : 200,
    "body" :
"{\"authorization\":\"{{{request.headers.Authorization.[0]}}}\",\"path\":\"{{{request.
path}}}\",\"responseBaz\":{{{jsonpath this '$.baz'}}}
,\"param\":\"{{{request.query.foo.[0]}}}\",\"pathIndex\":\"{{{request.path.[1]}}}\",\"
responseBaz2\":\"Bla bla {{{jsonpath this '$.foo'}}} bla
bla\",\"responseFoo\":\"{{{jsonpath this
'$.foo'}}}\",\"authorization2\":\"{{{request.headers.Authorization.[1]}}}\",\"fullBody
\":\"{{{escapejsonbody}}}\",\"url\":\"{{{request.url}}}\",\"paramIndex\":\"{{{request.
query.foo.[1]}}}\"}",
    "headers" : {
      "Authorization" : "{{{request.headers.Authorization.[0]}}};foo"
    },
    "transformers" : [ "response-template" ]
  }
}
```

Sending a request such as the one presented in the `request` part of the contract results in sending the following response body:

```
{
  "url" : "/api/v1/xxxx?foo=bar&foo=bar2",
  "path" : "/api/v1/xxxx",
  "pathIndex" : "v1",
  "param" : "bar",
  "paramIndex" : "bar2",
  "authorization" : "secret",
  "authorization2" : "secret2",
  "fullBody" : "{\"foo\":\"bar\",\"baz\":5}",
  "responseFoo" : "bar",
  "responseBaz" : 5,
  "responseBaz2" : "Bla bla bar bla bla"
}
```

This feature works only with WireMock versions greater than or equal to 2.5.1. The Spring Cloud Contract Verifier uses WireMock's `response-template` response transformer. It uses Handlebars to convert the Mustache `{{{ }}}` templates into proper values. Additionally, it registers two helper functions:

- `escapejsonbody`: Escapes the request body in a format that can be embedded in a JSON.
- `jsonpath`: For a given parameter, find an object in the request body.

Dynamic Properties in the Matchers Sections

If you work with Pact, the following discussion may seem familiar. Quite a few users are used to having a separation between the body and setting the dynamic parts of a contract.

You can use the `bodyMatchers` section for two reasons:

- Define the dynamic values that should end up in a stub. You can set it in the `request` or `inputMessage` part of your contract.
- Verify the result of your test. This section is present in the `response` or `outputMessage` side of the contract.

Currently, Spring Cloud Contract Verifier supports only JSON path-based matchers with the following matching possibilities:

Coded DSL

- For the stubs (in tests on the consumer's side):
  - `byEquality()`: The value taken from the consumer's request in the provided JSON path must be equal to the value provided in the contract.
  - `byRegex(…)`: The value taken from the consumer's request in the provided JSON path must match the regex. You can also pass the type of the expected matched value (for example, `asString()`, `asLong()`, and so on).
  - `byDate()`: The value taken from the consumer's request in the provided JSON path must match the regex for an ISO Date value.

- `byTimestamp()`: The value taken from the consumer's request in the provided JSON path must match the regex for an ISO DateTime value.
- `byTime()`: The value taken from the consumer's request in the provided JSON path must match the regex for an ISO Time value.

- For the verification (in generated tests on the Producer's side):
  - `byEquality()`: The value taken from the producer's response in the provided JSON path must be equal to the provided value in the contract.
  - `byRegex(…)`: The value taken from the producer's response in the provided JSON path must match the regex.
  - `byDate()`: The value taken from the producer's response in the provided JSON path must match the regex for an ISO Date value.
  - `byTimestamp()`: The value taken from the producer's response in the provided JSON path must match the regex for an ISO DateTime value.
  - `byTime()`: The value taken from the producer's response in the provided JSON path must match the regex for an ISO Time value.
  - `byType()`: The value taken from the producer's response in the provided JSON path needs to be of the same type as the type defined in the body of the response in the contract. `byType` can take a closure, in which you can set `minOccurrence` and `maxOccurrence`. For the request side, you should use the closure to assert size of the collection. That way, you can assert the size of the flattened collection. To check the size of an unflattened collection, use a custom method with the `byCommand(…) testMatcher`.
  - `byCommand(…)`: The value taken from the producer's response in the provided JSON path is passed as an input to the custom method that you provide. For example, `byCommand('thing($it)')` results in calling a `thing` method to which the value matching the JSON Path gets passed. The type of the object read from the JSON can be one of the following, depending on the JSON path:
    - `String`: If you point to a `String` value.
    - `JSONArray`: If you point to a `List`.
    - `Map`: If you point to a `Map`.
    - `Number`: If you point to `Integer`, `Double`, or another kind of number.
    - `Boolean`: If you point to a `Boolean`.
  - `byNull()`: The value taken from the response in the provided JSON path must be null.

YAML

See the Groovy section for detailed explanation of what the types mean.

For YAML, the structure of a matcher resembles the following example:

```
- path: $.thing1
  type: by_regex
  value: thing2
  regexType: as_string
```

Alternatively, if you want to use one of the predefined regular expressions `[only_alpha_unicode, number, any_boolean, ip_address, hostname, email, url, uuid, iso_date, iso_date_time, iso_time, iso_8601_with_offset, non_empty, non_blank]`, you can use something similar to the following example:

```
- path: $.thing1
  type: by_regex
  predefined: only_alpha_unicode
```

The following list shows the allowed list of `type` values:

- For `stubMatchers`:
  - `by_equality`
  - `by_regex`
  - `by_date`
  - `by_timestamp`
  - `by_time`
  - `by_type`
    - Two additional fields (`minOccurrence` and `maxOccurrence`) are accepted.
- For `testMatchers`:
  - `by_equality`
  - `by_regex`
  - `by_date`
  - `by_timestamp`
  - `by_time`
  - `by_type`
    - Two additional fields (`minOccurrence` and `maxOccurrence`) are accepted.
  - `by_command`
  - `by_null`

You can also define which type the regular expression corresponds to in the `regexType` field. The following list shows the allowed regular expression types:

- `as_integer`
- `as_double`
- `as_float`
- `as_long`
- `as_short`

- as_boolean
- as_string

Consider the following example:

groovy

```
Contract contractDsl = Contract.make {
    request {
        method 'GET'
        urlPath '/get'
        body([
                duck                : 123,
                alpha               : 'abc',
                number              : 123,
                aBoolean            : true,
                date                : '2017-01-01',
                dateTime            : '2017-01-01T01:23:45',
                time                : '01:02:34',
                valueWithoutAMatcher: 'foo',
                valueWithTypeMatch  : 'string',
                key                 : [
                        'complex.key': 'foo'
                ]
        ])
        bodyMatchers {
            jsonPath('$.duck', byRegex("[0-9]{3}").asInteger())
            jsonPath('$.duck', byEquality())
            jsonPath('$.alpha', byRegex(onlyAlphaUnicode()).asString())
            jsonPath('$.alpha', byEquality())
            jsonPath('$.number', byRegex(number()).asInteger())
            jsonPath('$.aBoolean', byRegex(anyBoolean()).asBooleanType())
            jsonPath('$.date', byDate())
            jsonPath('$.dateTime', byTimestamp())
            jsonPath('$.time', byTime())
            jsonPath("\$.['key'].['complex.key']", byEquality())
        }
        headers {
            contentType(applicationJson())
        }
    }
    response {
        status OK()
        body([
                duck                : 123,
                alpha               : 'abc',
                number              : 123,
                positiveInteger     : 1234567890,
                negativeInteger     : -1234567890,
                positiveDecimalNumber: 123.4567890,
```

```
            negativeDecimalNumber: -123.4567890,
            aBoolean             : true,
            date                 : '2017-01-01',
            dateTime             : '2017-01-01T01:23:45',
            time                 : "01:02:34",
            valueWithoutAMatcher : 'foo',
            valueWithTypeMatch   : 'string',
            valueWithMin         : [
                    1, 2, 3
            ],
            valueWithMax         : [
                    1, 2, 3
            ],
            valueWithMinMax      : [
                    1, 2, 3
            ],
            valueWithMinEmpty    : [],
            valueWithMaxEmpty    : [],
            key                  : [
                    'complex.key': 'foo'
            ],
            nullValue            : null
    ])
    bodyMatchers {
        // asserts the jsonpath value against manual regex
        jsonPath('$.duck', byRegex("[0-9]{3}").asInteger())
        // asserts the jsonpath value against the provided value
        jsonPath('$.duck', byEquality())
        // asserts the jsonpath value against some default regex
        jsonPath('$.alpha', byRegex(onlyAlphaUnicode()).asString())
        jsonPath('$.alpha', byEquality())
        jsonPath('$.number', byRegex(number()).asInteger())
        jsonPath('$.positiveInteger', byRegex(anInteger()).asInteger())
        jsonPath('$.negativeInteger', byRegex(anInteger()).asInteger())
        jsonPath('$.positiveDecimalNumber', byRegex(aDouble()).asDouble())
        jsonPath('$.negativeDecimalNumber', byRegex(aDouble()).asDouble())
        jsonPath('$.aBoolean', byRegex(anyBoolean()).asBooleanType())
        // asserts vs inbuilt time related regex
        jsonPath('$.date', byDate())
        jsonPath('$.dateTime', byTimestamp())
        jsonPath('$.time', byTime())
        // asserts that the resulting type is the same as in response body
        jsonPath('$.valueWithTypeMatch', byType())
        jsonPath('$.valueWithMin', byType {
            // results in verification of size of array (min 1)
            minOccurrence(1)
        })
        jsonPath('$.valueWithMax', byType {
            // results in verification of size of array (max 3)
            maxOccurrence(3)
        })
```

```
            jsonPath('$.valueWithMinMax', byType {
                // results in verification of size of array (min 1 & max 3)
                minOccurrence(1)
                maxOccurrence(3)
            })
            jsonPath('$.valueWithMinEmpty', byType {
                // results in verification of size of array (min 0)
                minOccurrence(0)
            })
            jsonPath('$.valueWithMaxEmpty', byType {
                // results in verification of size of array (max 0)
                maxOccurrence(0)
            })
            // will execute a method `assertThatValueIsANumber`
            jsonPath('$.duck', byCommand('assertThatValueIsANumber($it)'))
            jsonPath("\$.['key'].['complex.key']", byEquality())
            jsonPath('$.nullValue', byNull())
        }
        headers {
            contentType(applicationJson())
            header('Some-Header', $(c('someValue'), p(regex('[a-zA-Z]{9}'))))
        }
    }
}
```

yml

```
request:
  method: GET
  urlPath: /get/1
  headers:
    Content-Type: application/json
  cookies:
    foo: 2
    bar: 3
  queryParameters:
    limit: 10
    offset: 20
    filter: 'email'
    sort: name
    search: 55
    age: 99
    name: John.Doe
    email: 'bob@email.com'
  body:
    duck: 123
    alpha: "abc"
    number: 123
    aBoolean: true
    date: "2017-01-01"
    dateTime: "2017-01-01T01:23:45"
```

```
    time: "01:02:34"
    valueWithoutAMatcher: "foo"
    valueWithTypeMatch: "string"
    key:
      "complex.key": 'foo'
    nullValue: null
    valueWithMin:
      - 1
      - 2
      - 3
    valueWithMax:
      - 1
      - 2
      - 3
    valueWithMinMax:
      - 1
      - 2
      - 3
    valueWithMinEmpty: []
    valueWithMaxEmpty: []
  matchers:
    url:
      regex: /get/[0-9]
      # predefined:
      # execute a method
      #command: 'equals($it)'
    queryParameters:
      - key: limit
        type: equal_to
        value: 20
      - key: offset
        type: containing
        value: 20
      - key: sort
        type: equal_to
        value: name
      - key: search
        type: not_matching
        value: '^[0-9]{2}$'
      - key: age
        type: not_matching
        value: '^\\w*$'
      - key: name
        type: matching
        value: 'John.*'
      - key: hello
        type: absent
    cookies:
      - key: foo
        regex: '[0-9]'
      - key: bar
```

```
        command: 'equals($it)'
    headers:
      - key: Content-Type
        regex: "application/json.*"
    body:
      - path: $.duck
        type: by_regex
        value: "[0-9]{3}"
      - path: $.duck
        type: by_equality
      - path: $.alpha
        type: by_regex
        predefined: only_alpha_unicode
      - path: $.alpha
        type: by_equality
      - path: $.number
        type: by_regex
        predefined: number
      - path: $.aBoolean
        type: by_regex
        predefined: any_boolean
      - path: $.date
        type: by_date
      - path: $.dateTime
        type: by_timestamp
      - path: $.time
        type: by_time
      - path: "$.['key'].['complex.key']"
        type: by_equality
      - path: $.nullvalue
        type: by_null
      - path: $.valueWithMin
        type: by_type
        minOccurrence: 1
      - path: $.valueWithMax
        type: by_type
        maxOccurrence: 3
      - path: $.valueWithMinMax
        type: by_type
        minOccurrence: 1
        maxOccurrence: 3
response:
  status: 200
  cookies:
    foo: 1
    bar: 2
  body:
    duck: 123
    alpha: "abc"
    number: 123
    aBoolean: true
```

```
    date: "2017-01-01"
    dateTime: "2017-01-01T01:23:45"
    time: "01:02:34"
    valueWithoutAMatcher: "foo"
    valueWithTypeMatch: "string"
    valueWithMin:
      - 1
      - 2
      - 3
    valueWithMax:
      - 1
      - 2
      - 3
    valueWithMinMax:
      - 1
      - 2
      - 3
    valueWithMinEmpty: []
    valueWithMaxEmpty: []
    key:
      'complex.key': 'foo'
    nulValue: null
  matchers:
    headers:
      - key: Content-Type
        regex: "application/json.*"
    cookies:
      - key: foo
        regex: '[0-9]'
      - key: bar
        command: 'equals($it)'
    body:
      - path: $.duck
        type: by_regex
        value: "[0-9]{3}"
      - path: $.duck
        type: by_equality
      - path: $.alpha
        type: by_regex
        predefined: only_alpha_unicode
      - path: $.alpha
        type: by_equality
      - path: $.number
        type: by_regex
        predefined: number
      - path: $.aBoolean
        type: by_regex
        predefined: any_boolean
      - path: $.date
        type: by_date
      - path: $.dateTime
```

```
        type: by_timestamp
      - path: $.time
        type: by_time
      - path: $.valueWithTypeMatch
        type: by_type
      - path: $.valueWithMin
        type: by_type
        minOccurrence: 1
      - path: $.valueWithMax
        type: by_type
        maxOccurrence: 3
      - path: $.valueWithMinMax
        type: by_type
        minOccurrence: 1
        maxOccurrence: 3
      - path: $.valueWithMinEmpty
        type: by_type
        minOccurrence: 0
      - path: $.valueWithMaxEmpty
        type: by_type
        maxOccurrence: 0
      - path: $.duck
        type: by_command
        value: assertThatValueIsANumber($it)
      - path: $.nullValue
        type: by_null
        value: null
  headers:
    Content-Type: application/json
```

In the preceding example, you can see the dynamic portions of the contract in the `matchers` sections. For the request part, you can see that, for all fields but `valueWithoutAMatcher`, the values of the regular expressions that the stub should contain are explicitly set. For the `valueWithoutAMatcher`, the verification takes place in the same way as without the use of matchers. In that case, the test performs an equality check.

For the response side in the `bodyMatchers` section, we define the dynamic parts in a similar manner. The only difference is that the `byType` matchers are also present. The verifier engine checks four fields to verify whether the response from the test has a value for which the JSON path matches the given field, is of the same type as the one defined in the response body, and passes the following check (based on the method being called):

- For `$.valueWithTypeMatch`, the engine checks whether the type is the same.
- For `$.valueWithMin`, the engine checks the type and asserts whether the size is greater than or equal to the minimum occurrence.
- For `$.valueWithMax`, the engine checks the type and asserts whether the size is smaller than or equal to the maximum occurrence.
- For `$.valueWithMinMax`, the engine checks the type and asserts whether the size is between the

minimum and maximum occurrence.

The resulting test resembles the following example (note that an `and` section separates the autogenerated assertions and the assertion from matchers):

```
// given:
 MockMvcRequestSpecification request = given()
   .header("Content-Type", "application/json")

.body("{\"duck\":123,\"alpha\":\"abc\",\"number\":123,\"aBoolean\":true,\"date\":\"201
7-01-01\",\"dateTime\":\"2017-01-
01T01:23:45\",\"time\":\"01:02:34\",\"valueWithoutAMatcher\":\"foo\",\"valueWithTypeMa
tch\":\"string\",\"key\":{\"complex.key\":\"foo\"}}");

// when:
 ResponseOptions response = given().spec(request)
   .get("/get");

// then:
 assertThat(response.statusCode()).isEqualTo(200);
 assertThat(response.header("Content-Type")).matches("application/json.*");
// and:
 DocumentContext parsedJson = JsonPath.parse(response.getBody().asString());
 assertThatJson(parsedJson).field("['valueWithoutAMatcher']").isEqualTo("foo");
// and:
 assertThat(parsedJson.read("$.duck", String.class)).matches("[0-9]{3}");
 assertThat(parsedJson.read("$.duck", Integer.class)).isEqualTo(123);
 assertThat(parsedJson.read("$.alpha", String.class)).matches("[\\p{L}]*");
 assertThat(parsedJson.read("$.alpha", String.class)).isEqualTo("abc");
 assertThat(parsedJson.read("$.number", String.class)).matches("-
?(\\d*\\.\\d+|\\d+)");
 assertThat(parsedJson.read("$.aBoolean", String.class)).matches("(true|false)");
 assertThat(parsedJson.read("$.date", String.class)).matches("(\\d\\d\\d\\d)-(0[1-
9]|1[012])-(0[1-9]|[12][0-9]|3[01])");
 assertThat(parsedJson.read("$.dateTime", String.class)).matches("([0-9]{4})-(1[0-
2]|0[1-9])-(3[01]|0[1-9]|[12][0-9])T(2[0-3]|[01][0-9]):([0-5][0-9]):([0-5][0-9])");
 assertThat(parsedJson.read("$.time", String.class)).matches("(2[0-3]|[01][0-9]):([0-
5][0-9]):([0-5][0-9])");
 assertThat((Object)
parsedJson.read("$.valueWithTypeMatch")).isInstanceOf(java.lang.String.class);
 assertThat((Object)
parsedJson.read("$.valueWithMin")).isInstanceOf(java.util.List.class);
 assertThat((java.lang.Iterable) parsedJson.read("$.valueWithMin",
java.util.Collection.class)).as("$.valueWithMin").hasSizeGreaterThanOrEqualTo(1);
 assertThat((Object)
parsedJson.read("$.valueWithMax")).isInstanceOf(java.util.List.class);
 assertThat((java.lang.Iterable) parsedJson.read("$.valueWithMax",
java.util.Collection.class)).as("$.valueWithMax").hasSizeLessThanOrEqualTo(3);
 assertThat((Object)
parsedJson.read("$.valueWithMinMax")).isInstanceOf(java.util.List.class);
```

```
 assertThat((java.lang.Iterable) parsedJson.read("$.valueWithMinMax",
java.util.Collection.class)).as("$.valueWithMinMax").hasSizeBetween(1, 3);
 assertThat((Object)
parsedJson.read("$.valueWithMinEmpty")).isInstanceOf(java.util.List.class);
 assertThat((java.lang.Iterable) parsedJson.read("$.valueWithMinEmpty",
java.util.Collection.class)).as("$.valueWithMinEmpty").hasSizeGreaterThanOrEqualTo(0);
 assertThat((Object)
parsedJson.read("$.valueWithMaxEmpty")).isInstanceOf(java.util.List.class);
 assertThat((java.lang.Iterable) parsedJson.read("$.valueWithMaxEmpty",
java.util.Collection.class)).as("$.valueWithMaxEmpty").hasSizeLessThanOrEqualTo(0);
 assertThatValueIsANumber(parsedJson.read("$.duck"));
 assertThat(parsedJson.read("$.['key'].['complex.key']",
String.class)).isEqualTo("foo");
```

Notice that, for the `byCommand` method, the example calls the `assertThatValueIsANumber`. This method must be defined in the test base class or be statically imported to your tests. Notice that the `byCommand` call was converted to `assertThatValueIsANumber(parsedJson.read("$.duck"));`. That means that the engine took the method name and passed the proper JSON path as a parameter to it.

The resulting WireMock stub is in the following example:

```
                    '''
{
  "request" : {
    "urlPath" : "/get",
    "method" : "POST",
    "headers" : {
      "Content-Type" : {
        "matches" : "application/json.*"
      }
    },
    "bodyPatterns" : [ {
      "matchesJsonPath" : "$.['list'].['some'].['nested'][?(@.['anothervalue'] == 4)]"
    }, {
      "matchesJsonPath" : "$[?(@.['valueWithoutAMatcher'] == 'foo')]"
    }, {
      "matchesJsonPath" : "$[?(@.['valueWithTypeMatch'] == 'string')]"
    }, {
      "matchesJsonPath" : "$.['list'].['someother'].['nested'][?(@.['json'] == 'with
value')]"
    }, {
      "matchesJsonPath" : "$.['list'].['someother'].['nested'][?(@.['anothervalue'] ==
4)]"
    }, {
      "matchesJsonPath" : "$[?(@.duck =~ /([0-9]{3})/)]"
    }, {
      "matchesJsonPath" : "$[?(@.duck == 123)]"
    }, {
```

```
      "matchesJsonPath" : "$[?(@.alpha =~ /([\\\\p{L}]*)/)]"
    }, {
      "matchesJsonPath" : "$[?(@.alpha == 'abc')]"
    }, {
      "matchesJsonPath" : "$[?(@.number =~ /(-?(\\\\d*\\\\.\\\\d+|\\\\d+))/)]"
    }, {
      "matchesJsonPath" : "$[?(@.aBoolean =~ /((true|false))/)]"
    }, {
      "matchesJsonPath" : "$[?(@.date =~ /((\\\\d\\\\d\\\\d\\\\d)-(0[1-9]|1[012])-
(0[1-9]|[12][0-9]|3[01]))/)]"
    }, {
      "matchesJsonPath" : "$[?(@.dateTime =~ /(([0-9]{4})-(1[0-2]|0[1-9])-(3[01]|0[1-
9]|[12][0-9])T(2[0-3]|[01][0-9]):([0-5][0-9]):([0-5][0-9]))/)]"
    }, {
      "matchesJsonPath" : "$[?(@.time =~ /((2[0-3]|[01][0-9]):([0-5][0-9]):([0-5][0-
9]))/)]"
    }, {
      "matchesJsonPath" : "$.list.some.nested[?(@.json =~ /(.*)/)]"
    }, {
      "matchesJsonPath" : "$[?(@.valueWithMin.size() >= 1)]"
    }, {
      "matchesJsonPath" : "$[?(@.valueWithMax.size() <= 3)]"
    }, {
      "matchesJsonPath" : "$[?(@.valueWithMinMax.size() >= 1 &&
@.valueWithMinMax.size() <= 3)]"
    }, {
      "matchesJsonPath" : "$[?(@.valueWithOccurrence.size() >= 4 &&
@.valueWithOccurrence.size() <= 4)]"
    } ]
  },
  "response" : {
    "status" : 200,
    "body" : "{\\"date\\":\\"2017-01-01\\",\\"dateTime\\":\\"2017-01-
01T01:23:45\\",\\"aBoolean\\":true,\\"valueWithMax\\":[1,2,3],\\"valueWithOccurrence\\
":[1,2,3,4],\\"number\\":123,\\"duck\\":123,\\"alpha\\":\\"abc\\",\\"valueWithMin\\":[
1,2,3],\\"time\\":\\"01:02:34\\",\\"valueWithTypeMatch\\":\\"string\\",\\"valueWithMin
Max\\":[1,2,3],\\"valueWithoutAMatcher\\":\\"foo\\"}",
    "headers" : {
      "Content-Type" : "application/json"
    },
    "transformers" : [ "response-template" ]
  }
}
'''
```

If you use a `matcher`, the part of the request and response that the `matcher` addresses with the JSON Path gets removed from the assertion. In the case of verifying a collection, you must create matchers for **all** the elements of the collection.

Consider the following example:

```
Contract.make {
    request {
        method 'GET'
        url("/foo")
    }
    response {
        status OK()
        body(events: [[
                                operation          : 'EXPORT',
                                eventId            : '16f1ed75-0bcc-4f0d-a04d-
3121798faf99',
                                status             : 'OK'
                        ], [
                                operation          : 'INPUT_PROCESSING',
                                eventId            : '3bb4ac82-6652-462f-b6d1-
75e424a0024a',
                                status             : 'OK'
                        ]
                ]
        )
        bodyMatchers {
            jsonPath('$.events[0].operation', byRegex('.+'))
            jsonPath('$.events[0].eventId', byRegex('^([a-fA-F0-9]{8}-[a-fA-F0-9]{4}-
[a-fA-F0-9]{4}-[a-fA-F0-9]{4}-[a-fA-F0-9]{12})$'))
            jsonPath('$.events[0].status', byRegex('.+'))
        }
    }
}
```

The preceding code leads to creating the following test (the code block shows only the assertion section):

```
and:
    DocumentContext parsedJson = JsonPath.parse(response.body.asString())

assertThatJson(parsedJson).array("['events']").contains("['eventId']").isEqualTo("16f1
ed75-0bcc-4f0d-a04d-3121798faf99")

assertThatJson(parsedJson).array("['events']").contains("['operation']").isEqualTo("EX
PORT")

assertThatJson(parsedJson).array("['events']").contains("['operation']").isEqualTo("IN
PUT_PROCESSING")

assertThatJson(parsedJson).array("['events']").contains("['eventId']").isEqualTo("3bb4
ac82-6652-462f-b6d1-75e424a0024a")

assertThatJson(parsedJson).array("['events']").contains("['status']").isEqualTo("OK")
and:
    assertThat(parsedJson.read("\$.events[0].operation", String.class)).matches(".+")
    assertThat(parsedJson.read("\$.events[0].eventId", String.class)).matches("^([a-
fA-F0-9]{8}-[a-fA-F0-9]{4}-[a-fA-F0-9]{4}-[a-fA-F0-9]{4}-[a-fA-F0-9]{12})\$")
    assertThat(parsedJson.read("\$.events[0].status", String.class)).matches(".+")
```

As you can see, the assertion is malformed. Only the first element of the array got asserted. In order to fix this, you should apply the assertion to the whole `$.events` collection and assert it with the `byCommand(…)` method.

4.2.5. Asynchronous Support

If you use asynchronous communication on the server side (your controllers are returning `Callable`, `DeferredResult`, and so on), then, inside your contract, you must provide an `async()` method in the `response` section. The following code shows an example:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method GET()
        url '/get'
    }
    response {
        status OK()
        body 'Passed'
        async()
    }
}
```

yml

```
response:
    async: true
```

java

```
class contract implements Supplier<Collection<Contract>> {

    @Override
    public Collection<Contract> get() {
        return Collections.singletonList(Contract.make(c -> {
            c.request(r -> {
                // ...
            });
            c.response(r -> {
                r.async();
                // ...
            });
        }));
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        // ...
    }
    response {
        async = true
        // ...
    }
}
```

You can also use the `fixedDelayMilliseconds` method or property to add delay to your stubs. The following example shows how to do so:

groovy

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method GET()
        url '/get'
    }
    response {
        status 200
        body 'Passed'
        fixedDelayMilliseconds 1000
    }
}
```

yml

```
response:
    fixedDelayMilliseconds: 1000
```

java

```
class contract implements Supplier<Collection<Contract>> {

    @Override
    public Collection<Contract> get() {
        return Collections.singletonList(Contract.make(c -> {
            c.request(r -> {
                // ...
            });
            c.response(r -> {
                r.fixedDelayMilliseconds(1000);
                // ...
            });
        }));
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        // ...
    }
    response {
        delay = fixedMilliseconds(1000)
        // ...
    }
}
```

4.2.6. XML Support for HTTP

For HTTP contracts, we also support using XML in the request and response body. The XML body has to be passed within the `body` element as a `String` or `GString`. Also, body matchers can be provided for both the request and the response. In place of the `jsonPath(…)` method, the `org.springframework.cloud.contract.spec.internal.BodyMatchers.xPath` method should be used, with the desired `xPath` provided as the first argument and the appropriate `MatchingType` as second. All the body matchers apart from `byType()` are supported.

The following example shows a Groovy DSL contract with XML in the response body:

groovy

```
                    Contract.make {
                        request {
                            method GET()
                            urlPath '/get'
                            headers {
                                contentType(applicationXml())
                            }
                        }
                        response {
                            status(OK())
                            headers {
                                contentType(applicationXml())
                            }
                            body """
<test>
<duck type='xtype'>123</duck>
<alpha>abc</alpha>
<list>
<elem>abc</elem>
<elem>def</elem>
<elem>ghi</elem>
</list>
<number>123</number>
<aBoolean>true</aBoolean>
<date>2017-01-01</date>
<dateTime>2017-01-01T01:23:45</dateTime>
<time>01:02:34</time>
<valueWithoutAMatcher>foo</valueWithoutAMatcher>
<key><complex>foo</complex></key>
</test>"""
                            bodyMatchers {
                                xPath('/test/duck/text()', byRegex("[0-9]{3}"))
                                xPath('/test/duck/text()',
byCommand('equals($it)'))
                                xPath('/test/duck/xxx', byNull())
                                xPath('/test/duck/text()', byEquality())
                                xPath('/test/alpha/text()',
byRegex(onlyAlphaUnicode()))
                                xPath('/test/alpha/text()', byEquality())
                                xPath('/test/number/text()', byRegex(number()))
                                xPath('/test/date/text()', byDate())
                                xPath('/test/dateTime/text()', byTimestamp())
                                xPath('/test/time/text()', byTime())
                                xPath('/test/*/complex/text()', byEquality())
                                xPath('/test/duck/@type', byEquality())
                            }
                        }
                    }
```

yml

```
include::/opt/jenkins/data/workspace/spring-cloud-contract-master-ci/spring-cloud-
contract-verifier/src/test/resources/yml/contract_rest_xml.yml
```

java

```
import java.util.function.Supplier;

import org.springframework.cloud.contract.spec.Contract;

class contract_xml implements Supplier<Contract> {

    @Override
    public Contract get() {
        return Contract.make(c -> {
            c.request(r -> {
                r.method(r.GET());
                r.urlPath("/get");
                r.headers(h -> {
                    h.contentType(h.applicationXml());
                });
            });
            c.response(r -> {
                r.status(r.OK());
                r.headers(h -> {
                    h.contentType(h.applicationXml());
                });
                r.body("<test>\n" + "<duck type='xtype'>123</duck>\n"
                        + "<alpha>abc</alpha>\n" + "<list>\n" +
"<elem>abc</elem>\n"
                        + "<elem>def</elem>\n" + "<elem>ghi</elem>\n" +
"</list>\n"
                        + "<number>123</number>\n" + "<aBoolean>true</aBoolean>\n"
                        + "<date>2017-01-01</date>\n"
                        + "<dateTime>2017-01-01T01:23:45</dateTime>\n"
                        + "<time>01:02:34</time>\n"
                        + "<valueWithoutAMatcher>foo</valueWithoutAMatcher>\n"
                        + "<key><complex>foo</complex></key>\n" + "</test>");
                r.bodyMatchers(m -> {
                    m.xPath("/test/duck/text()", m.byRegex("[0-9]{3}"));
                    m.xPath("/test/duck/text()", m.byCommand("equals($it)"));
                    m.xPath("/test/duck/xxx", m.byNull());
                    m.xPath("/test/duck/text()", m.byEquality());
                    m.xPath("/test/alpha/text()",
m.byRegex(r.onlyAlphaUnicode()));
                    m.xPath("/test/alpha/text()", m.byEquality());
                    m.xPath("/test/number/text()", m.byRegex(r.number()));
                    m.xPath("/test/date/text()", m.byDate());
                    m.xPath("/test/dateTime/text()", m.byTimestamp());
```

```
                    m.xPath("/test/time/text()", m.byTime());
                    m.xPath("/test/*/complex/text()", m.byEquality());
                    m.xPath("/test/duck/@type", m.byEquality());
                });
            });
        });
    };

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

contract {
    request {
        method = GET
        urlPath = path("/get")
        headers {
            contentType = APPLICATION_XML
        }
    }
    response {
        status = OK
        headers {
            contentType =APPLICATION_XML
        }
        body = body("<test>\n" + "<duck type='xtype'>123</duck>\n"
                + "<alpha>abc</alpha>\n" + "<list>\n" + "<elem>abc</elem>\n"
                + "<elem>def</elem>\n" + "<elem>ghi</elem>\n" + "</list>\n"
                + "<number>123</number>\n" + "<aBoolean>true</aBoolean>\n"
                + "<date>2017-01-01</date>\n"
                + "<dateTime>2017-01-01T01:23:45</dateTime>\n"
                + "<time>01:02:34</time>\n"
                + "<valueWithoutAMatcher>foo</valueWithoutAMatcher>\n"
                + "<key><complex>foo</complex></key>\n" + "</test>")
        bodyMatchers {
            xPath("/test/duck/text()", byRegex("[0-9]{3}"))
            xPath("/test/duck/text()", byCommand("equals(\$it)"))
            xPath("/test/duck/xxx", byNull)
            xPath("/test/duck/text()", byEquality)
            xPath("/test/alpha/text()", byRegex(onlyAlphaUnicode))
            xPath("/test/alpha/text()", byEquality)
            xPath("/test/number/text()", byRegex(number))
            xPath("/test/date/text()", byDate)
            xPath("/test/dateTime/text()", byTimestamp)
            xPath("/test/time/text()", byTime)
            xPath("/test/*/complex/text()", byEquality)
            xPath("/test/duck/@type", byEquality)
        }
    }
}
```

The following example shows an automatically generated test for XML in the response body:

```
@Test
public void validate_xmlMatches() throws Exception {
    // given:
    MockMvcRequestSpecification request = given()
                .header("Content-Type", "application/xml");

    // when:
    ResponseOptions response = given().spec(request).get("/get");

    // then:
    assertThat(response.statusCode()).isEqualTo(200);
    // and:
    DocumentBuilder documentBuilder = DocumentBuilderFactory.newInstance()
                    .newDocumentBuilder();
    Document parsedXml = documentBuilder.parse(new InputSource(
                new StringReader(response.getBody().asString())));
    // and:
    assertThat(valueFromXPath(parsedXml, "/test/list/elem/text()")).isEqualTo("abc");

assertThat(valueFromXPath(parsedXml,"/test/list/elem[2]/text()")).isEqualTo("def");
    assertThat(valueFromXPath(parsedXml, "/test/duck/text()")).matches("[0-9]{3}");
    assertThat(nodeFromXPath(parsedXml, "/test/duck/xxx")).isNull();
    assertThat(valueFromXPath(parsedXml, "/test/alpha/text()")).matches("[\\p{L}]*");
    assertThat(valueFromXPath(parsedXml, "/test/*/complex/text()")).isEqualTo("foo");
    assertThat(valueFromXPath(parsedXml, "/test/duck/@type")).isEqualTo("xtype");
    }
```

4.2.7. Multiple Contracts in One File

You can define multiple contracts in one file. Such a contract might resemble the following example:

groovy

```
import org.springframework.cloud.contract.spec.Contract

[
    Contract.make {
        name("should post a user")
        request {
            method 'POST'
            url('/users/1')
        }
        response {
            status OK()
        }
    },
    Contract.make {
        request {
            method 'POST'
            url('/users/2')
        }
        response {
            status OK()
        }
    }
]
```

yml

```
---
name: should post a user
request:
  method: POST
  url: /users/1
response:
  status: 200
---
request:
  method: POST
  url: /users/2
response:
  status: 200
---
request:
  method: POST
  url: /users/3
response:
  status: 200
```

java

```
class contract implements Supplier<Collection<Contract>> {

    @Override
    public Collection<Contract> get() {
        return Arrays.asList(
            Contract.make(c -> {
                c.name("should post a user");
                // ...
            }), Contract.make(c -> {
                // ...
            }), Contract.make(c -> {
                // ...
            })
        );
    }

}
```

kotlin

```
import org.springframework.cloud.contract.spec.ContractDsl.Companion.contract

arrayOf(
    contract {
        name("should post a user")
        // ...
    },
    contract {
        // ...
    },
    contract {
        // ...
    }
)
```

In the preceding example, one contract has the `name` field and the other does not. This leads to generation of two tests that look more or less like the following:

```
package org.springframework.cloud.contract.verifier.tests.com.hello;

import com.example.TestBase;
import com.jayway.jsonpath.DocumentContext;
import com.jayway.jsonpath.JsonPath;
import
com.jayway.restassured.module.mockmvc.specification.MockMvcRequestSpecification;
import com.jayway.restassured.response.ResponseOptions;
import org.junit.Test;

import static com.jayway.restassured.module.mockmvc.RestAssuredMockMvc.*;
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson;
import static org.assertj.core.api.Assertions.assertThat;

public class V1Test extends TestBase {

    @Test
    public void validate_should_post_a_user() throws Exception {
        // given:
            MockMvcRequestSpecification request = given();

        // when:
            ResponseOptions response = given().spec(request)
                    .post("/users/1");

        // then:
            assertThat(response.statusCode()).isEqualTo(200);
    }

    @Test
    public void validate_withList_1() throws Exception {
        // given:
            MockMvcRequestSpecification request = given();

        // when:
            ResponseOptions response = given().spec(request)
                    .post("/users/2");

        // then:
            assertThat(response.statusCode()).isEqualTo(200);
    }

}
```

Notice that, for the contract that has the `name` field, the generated test method is named `validate_should_post_a_user`. The one that does not have the `name` field is called `validate_withList_1`. It corresponds to the name of the file `WithList.groovy` and the index of the contract in the list.

The generated stubs are shown in the following example:

```
should post a user.json
1_WithList.json
```

The first file got the `name` parameter from the contract. The second got the name of the contract file (`WithList.groovy`) prefixed with the index (in this case, the contract had an index of `1` in the list of contracts in the file).

It is much better to name your contracts, because doing so makes your tests far more meaningful.

4.2.8. Stateful Contracts

Stateful contracts (known also as scenarios) are contract definitions that should be read in order. This might be useful in the following situations:

- You want to execute the contract in a precisely defined order, since you use Spring Cloud Contract to test your stateful application

We really discourage you from doing that, since contract tests should be stateless.

- You want the same endpoint to return different results for the same request.

To create stateful contracts (or scenarios), you need to use the proper naming convention while creating your contracts. The convention requires including an order number followed by an underscore. This works regardless of whether you work with YAML or Groovy. The following listing shows an example:

```
my_contracts_dir\
  scenario1\
    1_login.groovy
    2_showCart.groovy
    3_logout.groovy
```

Such a tree causes Spring Cloud Contract Verifier to generate WireMock's scenario with a name of `scenario1` and the three following steps:

1. login, marked as `Started` pointing to…
2. showCart, marked as `Step1` pointing to…
3. logout, marked as `Step2` (which closes the scenario).

You can find more details about WireMock scenarios at https://wiremock.org/docs/stateful-behaviour/.

4.3. Integrations

4.3.1. JAX-RS

The Spring Cloud Contract supports the JAX-RS 2 Client API. The base class needs to define `protected WebTarget webTarget` and server initialization. The only option for testing JAX-RS API is to start a web server. Also, a request with a body needs to have a content type be set. Otherwise, the default of `application/octet-stream` gets used.

In order to use JAX-RS mode, use the following settings:

```
testMode == 'JAXRSCLIENT'
```

The following example shows a generated test API:

```
                    """\
package com.example;

import com.jayway.jsonpath.DocumentContext;
import com.jayway.jsonpath.JsonPath;
import org.junit.Test;
import org.junit.Rule;
import javax.ws.rs.client.Entity;
import javax.ws.rs.core.Response;

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertions.as
sertThat;
import static org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*;
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson;
import static javax.ws.rs.client.Entity.*;

@SuppressWarnings("rawtypes")
public class FooTest {
\tWebTarget webTarget;

\t@Test
\tpublic void validate_() throws Exception {

\t\t// when:
\t\t\tResponse response = webTarget
\t\t\t\t\t\t.path("/users")
\t\t\t\t\t\t.queryParam("limit", "10")
\t\t\t\t\t\t.queryParam("offset", "20")
\t\t\t\t\t\t.queryParam("filter", "email")
\t\t\t\t\t\t.queryParam("sort", "name")
\t\t\t\t\t\t.queryParam("search", "55")
\t\t\t\t\t\t.queryParam("age", "99")
```

```
\t\t\t\t\t\t\t.queryParam("name", "Denis.Stepanov")
\t\t\t\t\t\t\t.queryParam("email", "bob@email.com")
\t\t\t\t\t\t\t.request()
\t\t\t\t\t\t\t.build("GET")
\t\t\t\t\t\t\t.invoke();
\t\t\tString responseAsString = response.readEntity(String.class);

\t\t// then:
\t\t\tassertThat(response.getStatus()).isEqualTo(200);

\t\t// and:
\t\t\tDocumentContext parsedJson = JsonPath.parse(responseAsString);
\t\t\tassertThatJson(parsedJson).field("['property1']").isEqualTo("a");
\t}

}

"""
```

4.3.2. WebFlux with WebTestClient

You can work with WebFlux by using WebTestClient. The following listing shows how to configure WebTestClient as the test mode:

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <testMode>WEBTESTCLIENT</testMode>
    </configuration>
</plugin>
```

Gradle

```
contracts {
        testMode = 'WEBTESTCLIENT'
}
```

The following example shows how to set up a WebTestClient base class and RestAssured for WebFlux:

```
import io.restassured.module.webtestclient.RestAssuredWebTestClient;
import org.junit.Before;

public abstract class BeerRestBase {

    @Before
    public void setup() {
        RestAssuredWebTestClient.standaloneSetup(
        new ProducerController(personToCheck -> personToCheck.age >= 20));
    }
}
}
```

The `WebTestClient` mode is faster than the `EXPLICIT` mode.

4.3.3. WebFlux with Explicit Mode

You can also use WebFlux with the explicit mode in your generated tests to work with WebFlux. The following example shows how to configure using explicit mode:

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <testMode>EXPLICIT</testMode>
    </configuration>
</plugin>
```

Gradle

```
contracts {
        testMode = 'EXPLICIT'
}
```

The following example shows how to set up a base class and RestAssured for Web Flux:

```
@RunWith(SpringRunner.class)
@SpringBootTest(classes = BeerRestBase.Config.class,
        webEnvironment = SpringBootTest.WebEnvironment.RANDOM_PORT,
        properties = "server.port=0")
public abstract class BeerRestBase {

    // your tests go here

    // in this config class you define all controllers and mocked services
@Configuration
@EnableAutoConfiguration
static class Config {

    @Bean
    PersonCheckingService personCheckingService()  {
        return personToCheck -> personToCheck.age >= 20;
    }

    @Bean
    ProducerController producerController() {
        return new ProducerController(personCheckingService());
    }
}

}
```

4.3.4. Working with Context Paths

Spring Cloud Contract supports context paths.

The only change needed to fully support context paths is the switch on the producer side. Also, the autogenerated tests must use explicit mode. The consumer side remains untouched. In order for the generated test to pass, you must use explicit mode. The following example shows how to set the test mode to `EXPLICIT`:

Maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <testMode>EXPLICIT</testMode>
    </configuration>
</plugin>
```

Gradle

```
contracts {
        testMode = 'EXPLICIT'
}
```

That way, you generate a test that does not use MockMvc. It means that you generate real requests and you need to set up your generated test's base class to work on a real socket.

Consider the following contract:

```
org.springframework.cloud.contract.spec.Contract.make {
    request {
        method 'GET'
        url '/my-context-path/url'
    }
    response {
        status OK()
    }
}
```

The following example shows how to set up a base class and RestAssured:

```
import io.restassured.RestAssured;
import org.junit.Before;
import org.springframework.boot.web.server.LocalServerPort;
import org.springframework.boot.test.context.SpringBootTest;

@SpringBootTest(classes = ContextPathTestingBaseClass.class, webEnvironment =
SpringBootTest.WebEnvironment.RANDOM_PORT)
class ContextPathTestingBaseClass {

    @LocalServerPort int port;

    @Before
    public void setup() {
        RestAssured.baseURI = "http://localhost";
        RestAssured.port = this.port;
    }
}
```

If you do it this way:

- All of your requests in the autogenerated tests are sent to the real endpoint with your context path included (for example, `/my-context-path/url`).
- Your contracts reflect that you have a context path. Your generated stubs also have that information (for example, in the stubs, you have to call `/my-context-path/url`).

4.3.5. Working with REST Docs

You can use Spring REST Docs to generate documentation (for example, in Asciidoc format) for an HTTP API with Spring MockMvc, `WebTestClient`, or RestAssured. At the same time that you generate documentation for your API, you can also generate WireMock stubs by using Spring Cloud Contract WireMock. To do so, write your normal REST Docs test cases and use `@AutoConfigureRestDocs` to have stubs be automatically generated in the REST Docs output directory.

[rest docs] | *rest-docs.png*

The following example uses `MockMvc`:

```
@RunWith(SpringRunner.class)
@SpringBootTest
@AutoConfigureRestDocs(outputDir = "target/snippets")
@AutoConfigureMockMvc
public class ApplicationTests {

    @Autowired
    private MockMvc mockMvc;

    @Test
    public void contextLoads() throws Exception {
        mockMvc.perform(get("/resource"))
                .andExpect(content().string("Hello World"))
                .andDo(document("resource"));
    }
}
```

This test generates a WireMock stub at `target/snippets/stubs/resource.json`. It matches all `GET` requests to the `/resource` path. The same example with `WebTestClient` (used for testing Spring WebFlux applications) would be as follows:

```
@RunWith(SpringRunner.class)
@SpringBootTest
@AutoConfigureRestDocs(outputDir = "target/snippets")
@AutoConfigureWebTestClient
public class ApplicationTests {

    @Autowired
    private WebTestClient client;

    @Test
    public void contextLoads() throws Exception {
        client.get().uri("/resource").exchange()
                .expectBody(String.class).isEqualTo("Hello World")
                .consumeWith(document("resource"));
    }
}
```

Without any additional configuration, these tests create a stub with a request matcher for the HTTP method and all headers except `host` and `content-length`. To match the request more precisely (for example, to match the body of a POST or PUT), we need to explicitly create a request matcher. Doing so has two effects:

- Creating a stub that matches only in the way you specify.
- Asserting that the request in the test case also matches the same conditions.

The main entry point for this feature is `WireMockRestDocs.verify()`, which can be used as a substitute for the `document()` convenience method, as the following example shows:

```
import static
org.springframework.cloud.contract.wiremock.restdocs.WireMockRestDocs.verify;

@RunWith(SpringRunner.class)
@SpringBootTest
@AutoConfigureRestDocs(outputDir = "target/snippets")
@AutoConfigureMockMvc
public class ApplicationTests {

    @Autowired
    private MockMvc mockMvc;

    @Test
    public void contextLoads() throws Exception {
        mockMvc.perform(post("/resource")
                .content("{\"id\":\"123456\",\"message\":\"Hello World\"}"))
                .andExpect(status().isOk())
                .andDo(verify().jsonPath("$.id")
                        .stub("resource"));
    }
}
```

The preceding contract specifies that any valid POST with an `id` field receives the response defined in this test. You can chain together calls to `.jsonPath()` to add additional matchers. If JSON Path is unfamiliar, the JayWay documentation can help you get up to speed. The `WebTestClient` version of this test has a similar `verify()` static helper that you insert in the same place.

Instead of the `jsonPath` and `contentType` convenience methods, you can also use the WireMock APIs to verify that the request matches the created stub, as the following example shows:

```
@Test
public void contextLoads() throws Exception {
    mockMvc.perform(post("/resource")
            .content("{\"id\":\"123456\",\"message\":\"Hello World\"}"))
            .andExpect(status().isOk())
            .andDo(verify()
                    .wiremock(WireMock.post(
                        urlPathEquals("/resource"))
                        .withRequestBody(matchingJsonPath("$.id"))
                    .stub("post-resource"));
}
```

The WireMock API is rich. You can match headers, query parameters, and the request body by regex as well as by JSON path. You can use these features to create stubs with a wider range of parameters. The preceding example generates a stub resembling the following example:

post-resource.json

```
{
  "request" : {
    "url" : "/resource",
    "method" : "POST",
    "bodyPatterns" : [ {
      "matchesJsonPath" : "$.id"
    }]
  },
  "response" : {
    "status" : 200,
    "body" : "Hello World",
    "headers" : {
      "X-Application-Context" : "application:-1",
      "Content-Type" : "text/plain"
    }
  }
}
```

You can use either the `wiremock()` method or the `jsonPath()` and `contentType()` methods to create request matchers, but you cannot use both approaches.

On the consumer side, you can make the `resource.json` generated earlier in this section available on the classpath (by Publishing Stubs as JARs, for example). After that, you can create a stub that uses WireMock in a number of different ways, including by using `@AutoConfigureWireMock(stubs="classpath:resource.json")`, as described earlier in this document.

Generating Contracts with REST Docs

You can also generate Spring Cloud Contract DSL files and documentation with Spring REST Docs. If you do so in combination with Spring Cloud WireMock, you get both the contracts and the stubs.

Why would you want to use this feature? Some people in the community asked questions about a situation in which they would like to move to DSL-based contract definition, but they already have a lot of Spring MVC tests. Using this feature lets you generate the contract files that you can later modify and move to folders (defined in your configuration) so that the plugin finds them.

You might wonder why this functionality is in the WireMock module. The functionality is there because it makes sense to generate both the contracts and the stubs.

Consider the following test:

```
        this.mockMvc
                .perform(post("/foo").accept(MediaType.APPLICATION_PDF)
                        .accept(MediaType.APPLICATION_JSON)
                        .contentType(MediaType.APPLICATION_JSON)
                        .content("{\"foo\": 23, \"bar\" : \"baz\" }"))
                .andExpect(status().isOk()).andExpect(content().string("bar"))
                // first WireMock
                .andDo(WireMockRestDocs.verify().jsonPath("$[?(@.foo >= 20)]")
                        .jsonPath("$[?(@.bar in ['baz','bazz','bazzz'])]")
                        .contentType(MediaType.valueOf("application/json"))
                        .stub("shouldGrantABeerIfOldEnough"))
                // then Contract DSL documentation
                .andDo(document("index",
SpringCloudContractRestDocs.dslContract()));
```

The preceding test creates the stub presented in the previous section, generating both the contract and a documentation file.

The contract is called `index.groovy` and might resemble the following example:

```
import org.springframework.cloud.contract.spec.Contract

Contract.make {
    request {
        method 'POST'
        url '/foo'
        body('''
            {"foo": 23 }
        ''')
        headers {
            header('''Accept''', '''application/json''')
            header('''Content-Type''', '''application/json''')
        }
    }
    response {
        status OK()
        body('''
        bar
        ''')
        headers {
            header('''Content-Type''', '''application/json;charset=UTF-8''')
            header('''Content-Length''', '''3''')
        }
        bodyMatchers {
            jsonPath('$[?(@.foo >= 20)]', byType())
        }
    }
}
```

The generated document (formatted in Asciidoc in this case) contains a formatted contract. The location of this file would be `index/dsl-contract.adoc`.

4.4. Messaging

Spring Cloud Contract lets you verify applications that use messaging as a means of communication. All of the integrations shown in this document work with Spring, but you can also create one of your own and use that.

4.4.1. Messaging DSL Top-Level Elements

The DSL for messaging looks a little bit different than the one that focuses on HTTP. The following sections explain the differences:

- Output Triggered by a Method
- Output Triggered by a Message
- Consumer/Producer

- Common

Output Triggered by a Method

The output message can be triggered by calling a method (such as a `Scheduler` when a contract was started and a message was sent), as shown in the following example:

groovy

```
def dsl = Contract.make {
    // Human readable description
    description 'Some description'
    // Label by means of which the output message can be triggered
    label 'some_label'
    // input to the contract
    input {
        // the contract will be triggered by a method
        triggeredBy('bookReturnedTriggered()')
    }
    // output message of the contract
    outputMessage {
        // destination to which the output message will be sent
        sentTo('output')
        // the body of the output message
        body('''{ "bookName" : "foo" }''')
        // the headers of the output message
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

yml

```
# Human readable description
description: Some description
# Label by means of which the output message can be triggered
label: some_label
input:
  # the contract will be triggered by a method
  triggeredBy: bookReturnedTriggered()
# output message of the contract
outputMessage:
  # destination to which the output message will be sent
  sentTo: output
  # the body of the output message
  body:
    bookName: foo
  # the headers of the output message
  headers:
    BOOK-NAME: foo
```

In the previous example case, the output message is sent to `output` if a method called `bookReturnedTriggered` is executed. On the message publisher's side, we generate a test that calls that method to trigger the message. On the consumer side, you can use the `some_label` to trigger the

message.

Output Triggered by a Message

The output message can be triggered by receiving a message, as shown in the following example:

groovy

```
def dsl = Contract.make {
    description 'Some Description'
    label 'some_label'
    // input is a message
    input {
        // the message was received from this destination
        messageFrom('input')
        // has the following body
        messageBody([
                bookName: 'foo'
        ])
        // and the following headers
        messageHeaders {
            header('sample', 'header')
        }
    }
    outputMessage {
        sentTo('output')
        body([
                bookName: 'foo'
        ])
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

yml

```
# Human readable description
description: Some description
# Label by means of which the output message can be triggered
label: some_label
# input is a message
input:
  messageFrom: input
  # has the following body
  messageBody:
    bookName: 'foo'
  # and the following headers
  messageHeaders:
    sample: 'header'
# output message of the contract
outputMessage:
  # destination to which the output message will be sent
  sentTo: output
  # the body of the output message
  body:
    bookName: foo
  # the headers of the output message
  headers:
    BOOK-NAME: foo
```

In the preceding example, the output message is sent to `output` if a proper message is received on the `input` destination. On the message publisher's side, the engine generates a test that sends the input message to the defined destination. On the consumer side, you can either send a message to the input destination or use a label (`some_label` in the example) to trigger the message.

Consumer/Producer

This section is valid only for Groovy DSL.

In HTTP, you have a notion of `client/stub and `server/test` notation. You can also use those paradigms in messaging. In addition, Spring Cloud Contract Verifier also provides the `consumer` and `producer` methods, as presented in the following example (note that you can use either `$` or `value` methods to provide `consumer` and `producer` parts):

```
                    Contract.make {
                name "foo"
                        label 'some_label'
                        input {
                            messageFrom value(consumer('jms:output'),
producer('jms:input'))
                            messageBody([
                                    bookName: 'foo'
                            ])
                            messageHeaders {
                                header('sample', 'header')
                            }
                        }
                        outputMessage {
                            sentTo $(consumer('jms:input'), producer('jms:output'))
                            body([
                                    bookName: 'foo'
                            ])
                        }
                    }
```

Common

In the `input` or `outputMessage` section, you can call `assertThat` with the name of a `method` (for example, `assertThatMessageIsOnTheQueue()`) that you have defined in the base class or in a static import. Spring Cloud Contract runs that method in the generated test.

4.4.2. Integrations

You can use one of the following four integration configurations:

- Apache Camel
- Spring Integration
- Spring Cloud Stream
- Spring AMQP
- Spring JMS (requires embedded broker)
- Spring Kafka (requires embedded broker)

Since we use Spring Boot, if you have added one of these libraries to the classpath, all the messaging configuration is automatically set up.

Remember to put `@AutoConfigureMessageVerifier` on the base class of your generated tests. Otherwise, the messaging part of Spring Cloud Contract does not work.

If you want to use Spring Cloud Stream, remember to add a dependency on `org.springframework.cloud:spring-cloud-stream-test-support`, as follows:

Maven

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-stream-test-support</artifactId>
    <scope>test</scope>
</dependency>
```

Gradle

```
testCompile "org.springframework.cloud:spring-cloud-stream-test-
support"
```

Manual Integration Testing

The main interface used by the tests is `org.springframework.cloud.contract.verifier.messaging.MessageVerifier`. It defines how to send and receive messages. You can create your own implementation to achieve the same goal.

In a test, you can inject a `ContractVerifierMessageExchange` to send and receive messages that follow the contract. Then add `@AutoConfigureMessageVerifier` to your test. The following example shows how to do so:

```
@RunWith(SpringTestRunner.class)
@SpringBootTest
@AutoConfigureMessageVerifier
public static class MessagingContractTests {

  @Autowired
  private MessageVerifier verifier;
  ...
}
```

If your tests require stubs as well, then `@AutoConfigureStubRunner` includes the messaging configuration, so you only need the one annotation.

4.4.3. Producer Side Messaging Test Generation

Having the `input` or `outputMessage` sections in your DSL results in creation of tests on the publisher's side. By default, JUnit 4 tests are created. However, there is also a possibility to create JUnit 5, TestNG, or Spock tests.

There are three main scenarios that we should take into consideration:

- Scenario 1: There is no input message that produces an output message. The output message is triggered by a component inside the application (for example, a scheduler).
- Scenario 2: The input message triggers an output message.
- Scenario 3: The input message is consumed, and there is no output message.

The destination passed to `messageFrom` or `sentTo` can have different meanings for different messaging implementations. For Stream and Integration, it is first resolved as a `destination` of a channel. Then, if there is no such `destination` it is resolved as a channel name. For Camel, that's a certain component (for example, `jms`).

Scenario 1: No Input Message

Consider the following contract:

groovy

```
def contractDsl = Contract.make {
    name "foo"
    label 'some_label'
    input {
        triggeredBy('bookReturnedTriggered()')
    }
    outputMessage {
        sentTo('activemq:output')
        body('''{ "bookName" : "foo" }''')
        headers {
            header('BOOK-NAME', 'foo')
            messagingContentType(applicationJson())
        }
    }
}
```

yml

```
label: some_label
input:
  triggeredBy: bookReturnedTriggered
outputMessage:
  sentTo: activemq:output
  body:
    bookName: foo
  headers:
    BOOK-NAME: foo
    contentType: application/json
```

For the preceding example, the following test would be created:

JUnit

```
                    '''\
package com.example;

import com.jayway.jsonpath.DocumentContext;
import com.jayway.jsonpath.JsonPath;
import org.junit.Test;
import org.junit.Rule;
import javax.inject.Inject;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierObj
ectMapper;
import
```

```
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
sage;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
saging;

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat;
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*;
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson;
import static
org.springframework.cloud.contract.verifier.messaging.util.ContractVerifierMessagi
ngUtil.headers;
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.fileToBytes;

@SuppressWarnings("rawtypes")
public class FooTest {
\t@Inject ContractVerifierMessaging contractVerifierMessaging;
\t@Inject ContractVerifierObjectMapper contractVerifierObjectMapper;

\t@Test
\tpublic void validate_foo() throws Exception {
\t\t// when:
\t\t\tbookReturnedTriggered();

\t\t// then:
\t\t\tContractVerifierMessage response =
contractVerifierMessaging.receive("activemq:output");
\t\t\tassertThat(response).isNotNull();

\t\t// and:
\t\t\tassertThat(response.getHeader("BOOK-NAME")).isNotNull();
\t\t\tassertThat(response.getHeader("BOOK-NAME").toString()).isEqualTo("foo");
\t\t\tassertThat(response.getHeader("contentType")).isNotNull();
\t\t\tassertThat(response.getHeader("contentType").toString()).isEqualTo("applicat
ion/json");

\t\t// and:
\t\t\tDocumentContext parsedJson =
JsonPath.parse(contractVerifierObjectMapper.writeValueAsString(response.getPayload
()));
\t\t\tassertThatJson(parsedJson).field("['bookName']").isEqualTo("foo");
\t}

}

'''
```

Spock

```
                    '''\
package com.example

import com.jayway.jsonpath.DocumentContext
import com.jayway.jsonpath.JsonPath
import spock.lang.Specification
import javax.inject.Inject
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierObj
ectMapper
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
sage
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
saging

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson
import static
org.springframework.cloud.contract.verifier.messaging.util.ContractVerifierMessagi
ngUtil.headers
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.fileToBytes

@SuppressWarnings("rawtypes")
class FooSpec extends Specification {
\t@Inject ContractVerifierMessaging contractVerifierMessaging
\t@Inject ContractVerifierObjectMapper contractVerifierObjectMapper

\tdef validate_foo() throws Exception {
\t\twhen:
\t\t\tbookReturnedTriggered()

\t\tthen:
\t\t\tContractVerifierMessage response =
contractVerifierMessaging.receive("activemq:output")
\t\t\tresponse != null

\t\tand:
\t\t\tresponse.getHeader("BOOK-NAME") != null
\t\t\tresponse.getHeader("BOOK-NAME").toString() == 'foo'
\t\t\tresponse.getHeader("contentType") != null
\t\t\tresponse.getHeader("contentType").toString() == 'application/json'
```

```
\t\tand:
\t\t\tDocumentContext parsedJson =
JsonPath.parse(contractVerifierObjectMapper.writeValueAsString(response.getPayload
()))
\t\t\tassertThatJson(parsedJson).field("['bookName']").isEqualTo("foo")
\t}

}

'''
```

Scenario 2: Output Triggered by Input

Consider the following contract:

groovy

```
def contractDsl = Contract.make {
    name "foo"
    label 'some_label'
    input {
        messageFrom('jms:input')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
    }
    outputMessage {
        sentTo('jms:output')
        body([
                bookName: 'foo'
        ])
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

yml

```
label: some_label
input:
  messageFrom: jms:input
  messageBody:
    bookName: 'foo'
  messageHeaders:
    sample: header
outputMessage:
  sentTo: jms:output
  body:
    bookName: foo
  headers:
    BOOK-NAME: foo
```

For the preceding contract, the following test would be created:

JUnit

```
                    '''\
package com.example;
```

```
import com.jayway.jsonpath.DocumentContext;
import com.jayway.jsonpath.JsonPath;
import org.junit.Test;
import org.junit.Rule;
import javax.inject.Inject;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierObj
ectMapper;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
sage;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
saging;

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat;
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*;
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson;
import static
org.springframework.cloud.contract.verifier.messaging.util.ContractVerifierMessagi
ngUtil.headers;
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.fileToBytes;

@SuppressWarnings("rawtypes")
public class FooTest {
\t@Inject ContractVerifierMessaging contractVerifierMessaging;
\t@Inject ContractVerifierObjectMapper contractVerifierObjectMapper;

\t@Test
\tpublic void validate_foo() throws Exception {
\t\t// given:
\t\t\tContractVerifierMessage inputMessage = contractVerifierMessaging.create(
\t\t\t\t\t"{\\"bookName\\":\\"foo\\"}"
\t\t\t\t\t, headers()
\t\t\t\t\t\t.header("sample", "header")
\t\t\t);

\t\t// when:
\t\t\tcontractVerifierMessaging.send(inputMessage, "jms:input");

\t\t// then:
\t\t\tContractVerifierMessage response =
contractVerifierMessaging.receive("jms:output");
\t\t\tassertThat(response).isNotNull();

\t\t// and:
```

```
\t\t\tassertThat(response.getHeader("BOOK-NAME")).isNotNull();
\t\t\tassertThat(response.getHeader("BOOK-NAME").toString()).isEqualTo("foo");

\t\t// and:
\t\t\tDocumentContext parsedJson =
JsonPath.parse(contractVerifierObjectMapper.writeValueAsString(response.getPayload
()));
\t\t\tassertThatJson(parsedJson).field("['bookName']").isEqualTo("foo");
\t}

}

'''
```

Spock

```
                    """\
package com.example

import com.jayway.jsonpath.DocumentContext
import com.jayway.jsonpath.JsonPath
import spock.lang.Specification
import javax.inject.Inject
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierObj
ectMapper
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
sage
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
saging

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson
import static
org.springframework.cloud.contract.verifier.messaging.util.ContractVerifierMessagi
ngUtil.headers
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.fileToBytes

@SuppressWarnings("rawtypes")
class FooSpec extends Specification {
\t@Inject ContractVerifierMessaging contractVerifierMessaging
\t@Inject ContractVerifierObjectMapper contractVerifierObjectMapper

\tdef validate_foo() throws Exception {
```

```
\t\tgiven:
\t\t\tContractVerifierMessage inputMessage = contractVerifierMessaging.create(
\t\t\t\t\t'''{"bookName":"foo"}'''
\t\t\t\t\t\t, headers()
\t\t\t\t\t\t\t.header("sample", "header")
\t\t\t)

\t\twhen:
\t\t\tcontractVerifierMessaging.send(inputMessage, "jms:input")

\t\tthen:
\t\t\tContractVerifierMessage response =
contractVerifierMessaging.receive("jms:output")
\t\t\tresponse != null

\t\tand:
\t\t\tresponse.getHeader("BOOK-NAME") != null
\t\t\tresponse.getHeader("BOOK-NAME").toString() == 'foo'

\t\tand:
\t\t\tDocumentContext parsedJson =
JsonPath.parse(contractVerifierObjectMapper.writeValueAsString(response.getPayload
()))
\t\t\tassertThatJson(parsedJson).field("['bookName']").isEqualTo("foo")
\t}

}

"""
```

Scenario 3: No Output Message

Consider the following contract:

groovy

```
def contractDsl = Contract.make {
    name "foo"
    label 'some_label'
    input {
        messageFrom('jms:delete')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
        assertThat('bookWasDeleted()')
    }
}
```

yml

```
label: some_label
input:
  messageFrom: jms:delete
  messageBody:
    bookName: 'foo'
  messageHeaders:
    sample: header
  assertThat: bookWasDeleted()
```

For the preceding contract, the following test would be created:

JUnit

```
                    """\
package com.example;

import com.jayway.jsonpath.DocumentContext;
import com.jayway.jsonpath.JsonPath;
import org.junit.Test;
import org.junit.Rule;
import javax.inject.Inject;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierObj
ectMapper;
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
sage;
import
```

```
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
saging;

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat;
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*;
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson;
import static
org.springframework.cloud.contract.verifier.messaging.util.ContractVerifierMessagi
ngUtil.headers;
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.fileToBytes;

@SuppressWarnings("rawtypes")
public class FooTest {
\t@Inject ContractVerifierMessaging contractVerifierMessaging;
\t@Inject ContractVerifierObjectMapper contractVerifierObjectMapper;

\t@Test
\tpublic void validate_foo() throws Exception {
\t\t// given:
\t\t\tContractVerifierMessage inputMessage = contractVerifierMessaging.create(
\t\t\t\t\t"{\\"bookName\\":\\"foo\\"}"
\t\t\t\t\t, headers()
\t\t\t\t\t\t.header("sample", "header")
\t\t\t);

\t\t// when:
\t\t\tcontractVerifierMessaging.send(inputMessage, "jms:delete");
\t\t\tbookWasDeleted();

\t}

}

"""
```

Spock

```
                    """\
package com.example

import com.jayway.jsonpath.DocumentContext
import com.jayway.jsonpath.JsonPath
import spock.lang.Specification
import javax.inject.Inject
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierObj
ectMapper
```

```
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
sage
import
org.springframework.cloud.contract.verifier.messaging.internal.ContractVerifierMes
saging

import static
org.springframework.cloud.contract.verifier.assertion.SpringCloudContractAssertion
s.assertThat
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.*
import static com.toomuchcoding.jsonassert.JsonAssertion.assertThatJson
import static
org.springframework.cloud.contract.verifier.messaging.util.ContractVerifierMessagi
ngUtil.headers
import static
org.springframework.cloud.contract.verifier.util.ContractVerifierUtil.fileToBytes

@SuppressWarnings("rawtypes")
class FooSpec extends Specification {
\t@Inject ContractVerifierMessaging contractVerifierMessaging
\t@Inject ContractVerifierObjectMapper contractVerifierObjectMapper

\tdef validate_foo() throws Exception {
\t\tgiven:
\t\t\tContractVerifierMessage inputMessage = contractVerifierMessaging.create(
\t\t\t\t\t'''{"bookName":"foo"}'''
\t\t\t\t\t\t, headers()
\t\t\t\t\t\t\t.header("sample", "header")
\t\t\t)

\t\twhen:
\t\t\tcontractVerifierMessaging.send(inputMessage, "jms:delete")
\t\t\tbookWasDeleted()

\t\tthen:
\t\t\tnoExceptionThrown()
\t}

}
"""
```

4.4.4. Consumer Stub Generation

Unlike in the HTTP part, in messaging, we need to publish the contract definition inside the JAR with a stub. Then it is parsed on the consumer side, and proper stubbed routes are created.

If you have multiple frameworks on the classpath, Stub Runner needs to define which one should be used. Assume that you have AMQP, Spring Cloud Stream, and Spring Integration on the classpath and that you want to use Spring AMQP. Then you need to set `stubrunner.stream.enabled=false` and `stubrunner.integration.enabled=false`. That way, the only remaining framework is Spring AMQP.

Stub triggering

To trigger a message, use the `StubTrigger` interface, as the following example shows:

```
package org.springframework.cloud.contract.stubrunner;

import java.util.Collection;
import java.util.Map;

/**
 * Contract for triggering stub messages.
 *
 * @author Marcin Grzejszczak
 */
public interface StubTrigger {

    /**
     * Triggers an event by a given label for a given {@code groupid:artifactid}
notation.
     * You can use only {@code artifactId} too.
     *
     * Feature related to messaging.
     * @param ivyNotation ivy notation of a stub
     * @param labelName name of the label to trigger
     * @return true - if managed to run a trigger
     */
    boolean trigger(String ivyNotation, String labelName);

    /**
     * Triggers an event by a given label.
     *
     * Feature related to messaging.
     * @param labelName name of the label to trigger
     * @return true - if managed to run a trigger
     */
    boolean trigger(String labelName);

    /**
     * Triggers all possible events.
     *
     * Feature related to messaging.
     * @return true - if managed to run a trigger
     */
    boolean trigger();

    /**
     * Feature related to messaging.
     * @return a mapping of ivy notation of a dependency to all the labels it has.
     */
    Map<String, Collection<String>> labels();

}
```

For convenience, the `StubFinder` interface extends `StubTrigger`, so you only need one or the other in

your tests.

`StubTrigger` gives you the following options to trigger a message:

- Trigger by Label
- Trigger by Group and Artifact Ids
- Trigger by Artifact IDs
- Trigger All Messages

Trigger by Label

The following example shows how to trigger a message with a label:

```
stubFinder.trigger('return_book_1')
```

Trigger by Group and Artifact Ids

```
stubFinder.trigger('org.springframework.cloud.contract.verifier.stubs:streamService',
'return_book_1')
```

Trigger by Artifact IDs

The following example shows how to trigger a message from artifact IDs:

```
stubFinder.trigger('streamService', 'return_book_1')
```

Trigger All Messages

The following example shows how to trigger all messages:

```
stubFinder.trigger()
```

4.4.5. Consumer Side Messaging With Apache Camel

Spring Cloud Contract Stub Runner's messaging module gives you an easy way to integrate with Apache Camel. For the provided artifacts, it automatically downloads the stubs and registers the required routes.

Adding Apache Camel to the Project

You can have both Apache Camel and Spring Cloud Contract Stub Runner on the classpath. Remember to annotate your test class with `@AutoConfigureStubRunner`.

Disabling the Functionality

If you need to disable this functionality, set the `stubrunner.camel.enabled=false` property.

Examples

Assume that we have the following Maven repository with deployed stubs for the `camelService` application.

```
└─── .m2
    └─── repository
        └─── io
            └─── codearte
                └─── accurest
                    └─── stubs
                        └─── camelService
                            ├─── 0.0.1-SNAPSHOT
                            │    ├─── camelService-0.0.1-SNAPSHOT.pom
                            │    ├─── camelService-0.0.1-SNAPSHOT-stubs.jar
                            │    └─── maven-metadata-local.xml
                            └─── maven-metadata-local.xml
```

Further assume that the stubs contain the following structure:

```
├─── META-INF
│    └─── MANIFEST.MF
└─── repository
    ├─── accurest
    │    ├─── bookDeleted.groovy
    │    ├─── bookReturned1.groovy
    │    └─── bookReturned2.groovy
    └─── mappings
```

Now consider the following contracts (we number them 1 and 2):

```
Contract.make {
    label 'return_book_1'
    input {
        triggeredBy('bookReturnedTriggered()')
    }
    outputMessage {
        sentTo('jms:output')
        body('''{ "bookName" : "foo" }''')
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

```
Contract.make {
    label 'return_book_2'
    input {
        messageFrom('jms:input')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
    }
    outputMessage {
        sentTo('jms:output')
        body([
                bookName: 'foo'
        ])
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

Scenario 1 (No Input Message)

To trigger a message from the `return_book_1` label, we use the `StubTigger` interface, as follows:

```
stubFinder.trigger('return_book_1')
```

Next, we want to listen to the output of the message sent to `jms:output`:

```
Exchange receivedMessage = consumerTemplate.receive('jms:output', 5000)
```

The received message would then pass the following assertions:

```
receivedMessage != null
assertThatBodyContainsBookNameFoo(receivedMessage.in.body)
receivedMessage.in.headers.get('BOOK-NAME') == 'foo'
```

Scenario 2 (Output Triggered by Input)

Since the route is set for you, you can send a message to the `jms:output` destination.

```
producerTemplate.
        sendBodyAndHeaders('jms:input', new BookReturned('foo'), [sample:
'header'])
```

Next, we want to listen to the output of the message sent to `jms:output`, as follows:

```
Exchange receivedMessage = consumerTemplate.receive('jms:output', 5000)
```

The received message would pass the following assertions:

```
receivedMessage != null
assertThatBodyContainsBookNameFoo(receivedMessage.in.body)
receivedMessage.in.headers.get('BOOK-NAME') == 'foo'
```

Scenario 3 (Input with No Output)

Since the route is set for you, you can send a message to the `jms:output` destination, as follows:

```
producerTemplate.
        sendBodyAndHeaders('jms:delete', new BookReturned('foo'), [sample:
'header'])
```

4.4.6. Consumer Side Messaging with Spring Integration

Spring Cloud Contract Stub Runner's messaging module gives you an easy way to integrate with Spring Integration. For the provided artifacts, it automatically downloads the stubs and registers the required routes.

Adding the Runner to the Project

You can have both Spring Integration and Spring Cloud Contract Stub Runner on the classpath. Remember to annotate your test class with `@AutoConfigureStubRunner`.

Disabling the Functionality

If you need to disable this functionality, set the `stubrunner.integration.enabled=false` property.

Examples

Assume that you have the following Maven repository with deployed stubs for the `integrationService` application:

```
└── .m2
    └── repository
        └── io
            └── codearte
                └── accurest
                    └── stubs
                        └── integrationService
                            ├── 0.0.1-SNAPSHOT
                            │   ├── integrationService-0.0.1-SNAPSHOT.pom
                            │   ├── integrationService-0.0.1-SNAPSHOT-
stubs.jar
                            │   └── maven-metadata-local.xml
                            └── maven-metadata-local.xml
```

Further assume the stubs contain the following structure:

```
├── META-INF
│   └── MANIFEST.MF
└── repository
    ├── accurest
    │   ├── bookDeleted.groovy
    │   ├── bookReturned1.groovy
    │   └── bookReturned2.groovy
    └── mappings
```

Consider the following contracts (numbered 1 and 2):

```
Contract.make {
    label 'return_book_1'
    input {
        triggeredBy('bookReturnedTriggered()')
    }
    outputMessage {
        sentTo('output')
        body('''{ "bookName" : "foo" }''')
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

```
Contract.make {
    label 'return_book_2'
    input {
        messageFrom('input')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
    }
    outputMessage {
        sentTo('output')
        body([
                bookName: 'foo'
        ])
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

Now consider the following Spring Integration Route:

```
<?xml version="1.0" encoding="UTF-8"?>
<beans:beans xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xmlns:beans="http://www.springframework.org/schema/beans"
             xmlns="http://www.springframework.org/schema/integration"
             xsi:schemaLocation="http://www.springframework.org/schema/beans
            https://www.springframework.org/schema/beans/spring-beans.xsd
            http://www.springframework.org/schema/integration
            http://www.springframework.org/schema/integration/spring-
integration.xsd">


    <!-- REQUIRED FOR TESTING -->
    <bridge input-channel="output"
            output-channel="outputTest"/>

    <channel id="outputTest">
        <queue/>
    </channel>

</beans:beans>
```

These examples lend themselves to three scenarios:

1. Scenario 1 (No Input Message)
2. Scenario 2 (Output Triggered by Input)
3. Scenario 3 (Input with No Output)

Scenario 1 (No Input Message)

To trigger a message from the `return_book_1` label, use the `StubTigger` interface, as follows:

```
stubFinder.trigger('return_book_1')
```

The following listing shows how to listen to the output of the message sent to `jms:output`:

```
Message<?> receivedMessage = messaging.receive('outputTest')
```

The received message would pass the following assertions:

```
receivedMessage != null
assertJsons(receivedMessage.payload)
receivedMessage.headers.get('BOOK-NAME') == 'foo'
```

Scenario 2 (Output Triggered by Input)

Since the route is set for you, you can send a message to the `jms:output` destination, as follows:

```
messaging.send(new BookReturned('foo'), [sample: 'header'], 'input')
```

The following listing shows how to listen to the output of the message sent to `jms:output`:

```
Message<?> receivedMessage = messaging.receive('outputTest')
```

The received message passes the following assertions:

```
receivedMessage != null
assertJsons(receivedMessage.payload)
receivedMessage.headers.get('BOOK-NAME') == 'foo'
```

Scenario 3 (Input with No Output)

Since the route is set for you, you can send a message to the `jms:input` destination, as follows:

```
messaging.send(new BookReturned('foo'), [sample: 'header'], 'delete')
```

4.4.7. Consumer Side Messaging With Spring Cloud Stream

Spring Cloud Contract Stub Runner's messaging module gives you an easy way to integrate with Spring Stream. For the provided artifacts, it automatically downloads the stubs and registers the required routes.

If Stub Runner's integration with the Stream `messageFrom` or `sentTo` strings are resolved first as the `destination` of a channel and no such `destination` exists, the destination is resolved as a channel name.

If you want to use Spring Cloud Stream, remember to add a dependency on `org.springframework.cloud:spring-cloud-stream-test-support`, as follows:

Maven

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-stream-test-support</artifactId>
    <scope>test</scope>
</dependency>
```

Gradle

```
testCompile "org.springframework.cloud:spring-cloud-stream-test-
support"
```

Adding the Runner to the Project

You can have both Spring Cloud Stream and Spring Cloud Contract Stub Runner on the classpath. Remember to annotate your test class with `@AutoConfigureStubRunner`.

Disabling the Functionality

If you need to disable this functionality, set the `stubrunner.stream.enabled=false` property.

Examples

Assume that you have the following Maven repository with deployed stubs for the `streamService` application:

```
└─── .m2
    └─── repository
        └─── io
            └─── codearte
                └─── accurest
                    └─── stubs
                        └─── streamService
                            ├─── 0.0.1-SNAPSHOT
                            │    ├─── streamService-0.0.1-SNAPSHOT.pom
                            │    ├─── streamService-0.0.1-SNAPSHOT-stubs.jar
                            │    └─── maven-metadata-local.xml
                            └─── maven-metadata-local.xml
```

Further assume the stubs contain the following structure:

```
├──── META-INF
│    └──── MANIFEST.MF
└──── repository
    ├──── accurest
    │    ├──── bookDeleted.groovy
    │    ├──── bookReturned1.groovy
    │    └──── bookReturned2.groovy
    └──── mappings
```

Consider the following contracts (numbered 1 and 2):

```
Contract.make {
    label 'return_book_1'
    input { triggeredBy('bookReturnedTriggered()') }
    outputMessage {
        sentTo('returnBook')
        body('''{ "bookName" : "foo" }''')
        headers { header('BOOK-NAME', 'foo') }
    }
}
```

```
Contract.make {
    label 'return_book_2'
    input {
        messageFrom('bookStorage')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders { header('sample', 'header') }
    }
    outputMessage {
        sentTo('returnBook')
        body([
                bookName: 'foo'
        ])
        headers { header('BOOK-NAME', 'foo') }
    }
}
```

Now consider the following Spring configuration:

```
stubrunner.repositoryRoot: classpath:m2repo/repository/
stubrunner.ids:
org.springframework.cloud.contract.verifier.stubs:streamService:0.0.1-
SNAPSHOT:stubs
stubrunner.stubs-mode: remote
spring:
  cloud:
    stream:
      bindings:
        output:
          destination: returnBook
        input:
          destination: bookStorage

server:
  port: 0

debug: true
```

These examples lend themselves to three scenarios:

- Scenario 1 (No Input Message)
- Scenario 2 (Output Triggered by Input)
- Scenario 3 (Input with No Output)

Scenario 1 (No Input Message)

To trigger a message from the `return_book_1` label, use the `StubTrigger` interface as follows:

```
stubFinder.trigger('return_book_1')
```

The following example shows how to listen to the output of the message sent to a channel whose `destination` is `returnBook`:

```
Message<?> receivedMessage = messaging.receive('returnBook')
```

The received message passes the following assertions:

```
receivedMessage != null
assertJsons(receivedMessage.payload)
receivedMessage.headers.get('BOOK-NAME') == 'foo'
```

Scenario 2 (Output Triggered by Input)

Since the route is set for you, you can send a message to the `bookStorage destination`, as follows:

```
messaging.send(new BookReturned('foo'), [sample: 'header'], 'bookStorage')
```

The following example shows how to listen to the output of the message sent to `returnBook`:

```
Message<?> receivedMessage = messaging.receive('returnBook')
```

The received message passes the following assertions:

```
receivedMessage != null
assertJsons(receivedMessage.payload)
receivedMessage.headers.get('BOOK-NAME') == 'foo'
```

Scenario 3 (Input with No Output)

Since the route is set for you, you can send a message to the `jms:output` destination, as follows:

```
messaging.send(new BookReturned('foo'), [sample: 'header'], 'delete')
```

4.4.8. Consumer Side Messaging With Spring AMQP

Spring Cloud Contract Stub Runner's messaging module provides an easy way to integrate with Spring AMQP's Rabbit Template. For the provided artifacts, it automatically downloads the stubs and registers the required routes.

The integration tries to work standalone (that is, without interaction with a running RabbitMQ message broker). It expects a `RabbitTemplate` on the application context and uses it as a spring boot test named `@SpyBean`. As a result, it can use the Mockito spy functionality to verify and inspect messages sent by the application.

On the message consumer side, the stub runner considers all `@RabbitListener` annotated endpoints and all `SimpleMessageListenerContainer` objects on the application context.

As messages are usually sent to exchanges in AMQP, the message contract contains the exchange name as the destination. Message listeners on the other side are bound to queues. Bindings connect an exchange to a queue. If message contracts are triggered, the Spring AMQP stub runner integration looks for bindings on the application context that matches this exchange. Then it collects the queues from the Spring exchanges and tries to find message listeners bound to these queues. The message is triggered for all matching message listeners.

If you need to work with routing keys, you can pass them by using the `amqp_receivedRoutingKey` messaging header.

Adding the Runner to the Project

You can have both Spring AMQP and Spring Cloud Contract Stub Runner on the classpath and set the property `stubrunner.amqp.enabled=true`. Remember to annotate your test class with `@AutoConfigureStubRunner`.

If you already have Stream and Integration on the classpath, you need to disable them explicitly by setting the `stubrunner.stream.enabled=false` and `stubrunner.integration.enabled=false` properties.

Examples

Assume that you have the following Maven repository with a deployed stubs for the `spring-cloud-contract-amqp-test` application:

```
└── .m2
    └── repository
        └── com
            └── example
                └── spring-cloud-contract-amqp-test
                    ├── 0.4.0-SNAPSHOT
                    │   ├── spring-cloud-contract-amqp-test-0.4.0-SNAPSHOT.pom
                    │   ├── spring-cloud-contract-amqp-test-0.4.0-SNAPSHOT-
stubs.jar
                    │   └── maven-metadata-local.xml
                    └── maven-metadata-local.xml
```

Further assume that the stubs contain the following structure:

```
├──── META-INF
│    └──── MANIFEST.MF
└──── contracts
    └──── shouldProduceValidPersonData.groovy
```

Then consider the following contract:

```
Contract.make {
    // Human readable description
    description 'Should produce valid person data'
    // Label by means of which the output message can be triggered
    label 'contract-test.person.created.event'
    // input to the contract
    input {
        // the contract will be triggered by a method
        triggeredBy('createPerson()')
    }
    // output message of the contract
    outputMessage {
        // destination to which the output message will be sent
        sentTo 'contract-test.exchange'
        headers {
            header('contentType': 'application/json')
            header('__TypeId__':
'org.springframework.cloud.contract.stubrunner.messaging.amqp.Person')
        }
        // the body of the output message
        body([
                id  : $(consumer(9), producer(regex("[0-9]+"))),
                name: "me"
        ])
    }
}
```

Now consider the following Spring configuration:

```
stubrunner:
  repositoryRoot: classpath:m2repo/repository/
  ids: org.springframework.cloud.contract.verifier.stubs.amqp:spring-cloud-
contract-amqp-test:0.4.0-SNAPSHOT:stubs
  stubs-mode: remote
  amqp:
    enabled: true
server:
  port: 0
```

Triggering the Message

To trigger a message using the contract in the preceding section, use the `StubTrigger` interface as follows:

```
stubTrigger.trigger("contract-test.person.created.event")
```

The message has a destination of `contract-test.exchange`, so the Spring AMQP stub runner integration looks for bindings related to this exchange, as the following example shows:

```
@Bean
public Binding binding() {
    return BindingBuilder.bind(new Queue("test.queue"))
            .to(new DirectExchange("contract-test.exchange")).with("#");
}
```

The binding definition binds the queue called `test.queue`. As a result, the following listener definition is matched and invoked with the contract message:

```
@Bean
public SimpleMessageListenerContainer simpleMessageListenerContainer(
        ConnectionFactory connectionFactory,
        MessageListenerAdapter listenerAdapter) {
    SimpleMessageListenerContainer container = new
SimpleMessageListenerContainer();
    container.setConnectionFactory(connectionFactory);
    container.setQueueNames("test.queue");
    container.setMessageListener(listenerAdapter);

    return container;
}
```

Also, the following annotated listener matches and is invoked:

```
@RabbitListener(bindings = @QueueBinding(value = @Queue("test.queue"),
        exchange = @Exchange(value = "contract-test.exchange",
                ignoreDeclarationExceptions = "true")))
public void handlePerson(Person person) {
    this.person = person;
}
```

The message is directly handed over to the `onMessage` method of the `MessageListener` associated with the matching `SimpleMessageListenerContainer`.

Spring AMQP Test Configuration

In order to avoid Spring AMQP trying to connect to a running broker during our tests, we configure a mock `ConnectionFactory`.

To disable the mocked `ConnectionFactory`, set the following property: `stubrunner.amqp.mockConnection=false`, as follows:

```
stubrunner:
  amqp:
    mockConnection: false
```

4.4.9. Consumer Side Messaging With Spring JMS

Spring Cloud Contract Stub Runner's messaging module provides an easy way to integrate with Spring JMS.

The integration assumes that you have a running instance of a JMS broker (e.g. `activemq` embedded broker).

Adding the Runner to the Project

You need to have both Spring JMS and Spring Cloud Contract Stub Runner on the classpath. Remember to annotate your test class with `@AutoConfigureStubRunner`.

Examples

Assume that the stub structure looks as follows:

```
├── stubs
    ├── bookDeleted.groovy
    ├── bookReturned1.groovy
    └── bookReturned2.groovy
```

Further assume the following test configuration:

```
stubrunner:
  repository-root: stubs:classpath:/stubs/
  ids: my:stubs
  stubs-mode: remote
spring:
  activemq:
    send-timeout: 1000
  jms:
    template:
      receive-timeout: 1000
```

Now consider the following contracts (we number them 1 and 2):

```
Contract.make {
    label 'return_book_1'
    input {
        triggeredBy('bookReturnedTriggered()')
    }
    outputMessage {
        sentTo('output')
        body('''{ "bookName" : "foo" }''')
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

```
Contract.make {
    label 'return_book_2'
    input {
        messageFrom('input')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
    }
    outputMessage {
        sentTo('output')
        body([
                bookName: 'foo'
        ])
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

Scenario 1 (No Input Message)

To trigger a message from the `return_book_1` label, we use the `StubTigger` interface, as follows:

```
stubFinder.trigger('return_book_1')
```

Next, we want to listen to the output of the message sent to `output`:

```
TextMessage receivedMessage = (TextMessage) jmsTemplate.receive('output')
```

The received message would then pass the following assertions:

```
receivedMessage != null
assertThatBodyContainsBookNameFoo(receivedMessage.getText())
receivedMessage.getStringProperty('BOOK-NAME') == 'foo'
```

Scenario 2 (Output Triggered by Input)

Since the route is set for you, you can send a message to the `output` destination.

```
jmsTemplate.
        convertAndSend('input', new BookReturned('foo'), new
MessagePostProcessor() {
            @Override
            Message postProcessMessage(Message message) throws JMSException {
                message.setStringProperty("sample", "header")
                return message
            }
        })
```

Next, we want to listen to the output of the message sent to `output`, as follows:

```
TextMessage receivedMessage = (TextMessage) jmsTemplate.receive('output')
```

The received message would pass the following assertions:

```
receivedMessage != null
assertThatBodyContainsBookNameFoo(receivedMessage.getText())
receivedMessage.getStringProperty('BOOK-NAME') == 'foo'
```

Scenario 3 (Input with No Output)

Since the route is set for you, you can send a message to the `output` destination, as follows:

```
jmsTemplate.
        convertAndSend('delete', new BookReturned('foo'), new
MessagePostProcessor() {
            @Override
            Message postProcessMessage(Message message) throws JMSException {
                message.setStringProperty("sample", "header")
                return message
            }
        })
```

4.4.10. Consumer Side Messaging With Spring Kafka

Spring Cloud Contract Stub Runner's messaging module provides an easy way to integrate with Spring Kafka.

The integration assumes that you have a running instance of a embedded Kafka broker (via the `spring-kafka-test` dependency).

Adding the Runner to the Project

You need to have both Spring Kafka, Spring Kafka Test (to run the `@EmbeddedBroker`) and Spring Cloud Contract Stub Runner on the classpath. Remember to annotate your test class with `@AutoConfigureStubRunner`.

With Kafka integration, in order to poll for a single message we need to register a consumer upon Spring context startup. That may lead to a situation that, when you're on the consumer side, Stub Runner can register an additional consumer for the same group id and topic. That could lead to a situation that only one of the components would actually poll for the message. Since on the consumer side you have both the Spring Cloud Contract Stub Runner and Spring Cloud Contract Verifier classpath, we need to be able to switch off such behaviour. That's done automatically via the `stubrunner.kafka.initializer.enabled` flag, that will disable the Contact Verifier consumer registration. If your application is both the consumer and the producer of a kafka message, you might need to manually toggle that property to `false` in the base class of your generated tests.

Examples

Assume that the stub structure looks as follows:

```
├── stubs
    ├── bookDeleted.groovy
    ├── bookReturned1.groovy
    └── bookReturned2.groovy
```

Further assume the following test configuration (notice the `spring.kafka.bootstrap-servers`

pointing to the embedded broker's IP via `${spring.embedded.kafka.brokers}`):

```
stubrunner:
  repository-root: stubs:classpath:/stubs/
  ids: my:stubs
  stubs-mode: remote
spring:
  kafka:
    bootstrap-servers: ${spring.embedded.kafka.brokers}
    producer:
      properties:
        "value.serializer":
"org.springframework.kafka.support.serializer.JsonSerializer"
        "spring.json.trusted.packages": "*"
    consumer:
      properties:
        "value.deserializer":
"org.springframework.kafka.support.serializer.JsonDeserializer"
        "value.serializer":
"org.springframework.kafka.support.serializer.JsonSerializer"
        "spring.json.trusted.packages": "*"
      group-id: groupId
```

Now consider the following contracts (we number them 1 and 2):

```
Contract.make {
    label 'return_book_1'
    input {
        triggeredBy('bookReturnedTriggered()')
    }
    outputMessage {
        sentTo('output')
        body('''{ "bookName" : "foo" }''')
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

```
Contract.make {
    label 'return_book_2'
    input {
        messageFrom('input')
        messageBody([
                bookName: 'foo'
        ])
        messageHeaders {
            header('sample', 'header')
        }
    }
    outputMessage {
        sentTo('output')
        body([
                bookName: 'foo'
        ])
        headers {
            header('BOOK-NAME', 'foo')
        }
    }
}
```

Scenario 1 (No Input Message)

To trigger a message from the `return_book_1` label, we use the `StubTigger` interface, as follows:

```
stubFinder.trigger('return_book_1')
```

Next, we want to listen to the output of the message sent to `output`:

```
Message receivedMessage = receiveFromOutput()
```

The received message would then pass the following assertions:

```
assert receivedMessage != null
assert assertThatBodyContainsBookNameFoo(receivedMessage.getPayload())
assert receivedMessage.getHeaders().get('BOOK-NAME') == 'foo'
```

Scenario 2 (Output Triggered by Input)

Since the route is set for you, you can send a message to the `output` destination.

```
Message message = MessageBuilder.createMessage(new BookReturned('foo'), new
MessageHeaders([sample: "header",]))
kafkaTemplate.setDefaultTopic('input')
kafkaTemplate.send(message)
```

Next, we want to listen to the output of the message sent to `output`, as follows:

```
Message receivedMessage = receiveFromOutput()
```

The received message would pass the following assertions:

```
assert receivedMessage != null
assert assertThatBodyContainsBookNameFoo(receivedMessage.getPayload())
assert receivedMessage.getHeaders().get('BOOK-NAME') == 'foo'
```

Scenario 3 (Input with No Output)

Since the route is set for you, you can send a message to the `output` destination, as follows:

```
Message message = MessageBuilder.createMessage(new BookReturned('foo'), new
MessageHeaders([sample: "header",]))
kafkaTemplate.setDefaultTopic('delete')
kafkaTemplate.send(message)
```

4.5. Spring Cloud Contract Stub Runner

One of the issues that you might encounter while using Spring Cloud Contract Verifier is passing the generated WireMock JSON stubs from the server side to the client side (or to various clients). The same takes place in terms of client-side generation for messaging.

Copying the JSON files and setting the client side for messaging manually is out of the question. That is why we introduced Spring Cloud Contract Stub Runner. It can automatically download and run the stubs for you.

4.5.1. Snapshot Versions

You can add the additional snapshot repository to your `build.gradle` file to use snapshot versions, which are automatically uploaded after every successful build, as follows:

Maven

```
<repositories>
    <repository>
        <id>spring-snapshots</id>
        <name>Spring Snapshots</name>
        <url>https://repo.spring.io/snapshot</url>
        <snapshots>
            <enabled>true</enabled>
        </snapshots>
    </repository>
    <repository>
        <id>spring-milestones</id>
        <name>Spring Milestones</name>
        <url>https://repo.spring.io/milestone</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </repository>
    <repository>
        <id>spring-releases</id>
        <name>Spring Releases</name>
        <url>https://repo.spring.io/release</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
```

```
    </repository>
</repositories>
<pluginRepositories>
    <pluginRepository>
        <id>spring-snapshots</id>
        <name>Spring Snapshots</name>
        <url>https://repo.spring.io/snapshot</url>
        <snapshots>
            <enabled>true</enabled>
        </snapshots>
    </pluginRepository>
    <pluginRepository>
        <id>spring-milestones</id>
        <name>Spring Milestones</name>
        <url>https://repo.spring.io/milestone</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </pluginRepository>
    <pluginRepository>
        <id>spring-releases</id>
        <name>Spring Releases</name>
        <url>https://repo.spring.io/release</url>
        <snapshots>
            <enabled>false</enabled>
        </snapshots>
    </pluginRepository>
</pluginRepositories>
```

Gradle

```
/*
 We need to use the [buildscript {}] section when we have to modify
 the classpath for the plugins. If that's not the case this section
 can be skipped.

 If you don't need to modify the classpath (e.g. add a Pact dependency),
 then you can just set the [pluginManagement {}] section in [settings.gradle]
file.

 // settings.gradle
 pluginManagement {
    repositories {
        // for snapshots
        maven {url "https://repo.spring.io/snapshot"}
        // for milestones
        maven {url "https://repo.spring.io/milestone"}
        // for GA versions
        gradlePluginPortal()
    }
 }

 */
buildscript {
    repositories {
        mavenCentral()
        mavenLocal()
        maven { url "https://repo.spring.io/snapshot" }
        maven { url "https://repo.spring.io/milestone" }
        maven { url "https://repo.spring.io/release" }
    }
```

4.5.2. Publishing Stubs as JARs

The easiest approach to publishing stubs as jars is to centralize the way stubs are kept. For example, you can keep them as jars in a Maven repository.

For both Maven and Gradle, the setup comes ready to work. However, you can customize it if you want to.

The following example shows how to publish stubs as jars:

Maven

```
<!-- First disable the default jar setup in the properties section -->
<!-- we don't want the verifier to do a jar for us -->
<spring.cloud.contract.verifier.skip>true</spring.cloud.contract.verifier.skip>
```

```
<!-- Next add the assembly plugin to your build -->
<!-- we want the assembly plugin to generate the JAR -->
<plugin>
    <groupId>org.apache.maven.plugins</groupId>
    <artifactId>maven-assembly-plugin</artifactId>
    <executions>
        <execution>
            <id>stub</id>
            <phase>prepare-package</phase>
            <goals>
                <goal>single</goal>
            </goals>
            <inherited>false</inherited>
            <configuration>
                <attach>true</attach>
                <descriptors>
                    ${basedir}/src/assembly/stub.xml
                </descriptors>
            </configuration>
        </execution>
    </executions>
</plugin>

<!-- Finally setup your assembly. Below you can find the contents of
src/main/assembly/stub.xml -->
<assembly
    xmlns="http://maven.apache.org/plugins/maven-assembly-plugin/assembly/1.1.3"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/plugins/maven-assembly-
plugin/assembly/1.1.3 https://maven.apache.org/xsd/assembly-1.1.3.xsd">
    <id>stubs</id>
    <formats>
        <format>jar</format>
    </formats>
    <includeBaseDirectory>false</includeBaseDirectory>
    <fileSets>
        <fileSet>
            <directory>src/main/java</directory>
            <outputDirectory>/</outputDirectory>
            <includes>
                <include>**com/example/model/*.*</include>
            </includes>
        </fileSet>
        <fileSet>
            <directory>${project.build.directory}/classes</directory>
            <outputDirectory>/</outputDirectory>
            <includes>
                <include>**com/example/model/*.*</include>
            </includes>
        </fileSet>
```

```
        <fileSet>
            <directory>${project.build.directory}/snippets/stubs</directory>
            <outputDirectory>META-
INF/${project.groupId}/${project.artifactId}/${project.version}/mappings</outputDi
rectory>
            <includes>
                <include>**/*</include>
            </includes>
        </fileSet>
        <fileSet>
            <directory>${basedir}/src/test/resources/contracts</directory>
            <outputDirectory>META-
INF/${project.groupId}/${project.artifactId}/${project.version}/contracts</outputD
irectory>
            <includes>
                <include>**/*.groovy</include>
            </includes>
        </fileSet>
    </fileSets>
</assembly>
```

Gradle

```
ext {
    contractsDir = file("mappings")
    stubsOutputDirRoot = file("${project.buildDir}/production/${project.name}-
stubs/")
}

// Automatically added by plugin:
// copyContracts - copies contracts to the output folder from which JAR will be
created
// verifierStubsJar - JAR with a provided stub suffix
// the presented publication is also added by the plugin but you can modify it as
you wish

publishing {
    publications {
        stubs(MavenPublication) {
            artifactId "${project.name}-stubs"
            artifact verifierStubsJar
        }
    }
}
```

4.5.3. Stub Runner Core

The stub runner core runs stubs for service collaborators. Treating stubs as contracts of services lets you use stub-runner as an implementation of Consumer-driven Contracts.

Stub Runner lets you automatically download the stubs of the provided dependencies (or pick those from the classpath), start WireMock servers for them, and feed them with proper stub definitions. For messaging, special stub routes are defined.

Retrieving stubs

You can pick from the following options of acquiring stubs:

- Aether-based solution that downloads JARs with stubs from Artifactory or Nexus
- Classpath-scanning solution that searches the classpath with a pattern to retrieve stubs
- Writing your own implementation of the `org.springframework.cloud.contract.stubrunner.StubDownloaderBuilder` for full customization

The latter example is described in the Custom Stub Runner section.

Downloading Stubs

You can control the downloading of stubs with the `stubsMode` switch. It picks value from the `StubRunnerProperties.StubsMode` enumeration. You can use the following options:

- `StubRunnerProperties.StubsMode.CLASSPATH` (default value): Picks stubs from the classpath
- `StubRunnerProperties.StubsMode.LOCAL`: Picks stubs from a local storage (for example, `.m2`)
- `StubRunnerProperties.StubsMode.REMOTE`: Picks stubs from a remote location

The following example picks stubs from a local location:

```
@AutoConfigureStubRunner(repositoryRoot="https://foo.bar", ids =
"com.example:beer-api-producer:+:stubs:8095", stubsMode =
StubRunnerProperties.StubsMode.LOCAL)
```

Classpath scanning

If you set the `stubsMode` property to `StubRunnerProperties.StubsMode.CLASSPATH` (or set nothing since `CLASSPATH` is the default value), the classpath is scanned. Consider the following example:

```
@AutoConfigureStubRunner(ids = {
    "com.example:beer-api-producer:+:stubs:8095",
    "com.example.foo:bar:1.0.0:superstubs:8096"
})
```

You can add the dependencies to your classpath, as follows:

Maven

```
<dependency>
    <groupId>com.example</groupId>
    <artifactId>beer-api-producer-restdocs</artifactId>
    <classifier>stubs</classifier>
    <version>0.0.1-SNAPSHOT</version>
    <scope>test</scope>
    <exclusions>
        <exclusion>
            <groupId>*</groupId>
            <artifactId>*</artifactId>
        </exclusion>
    </exclusions>
</dependency>
<dependency>
    <groupId>com.example.thing1</groupId>
    <artifactId>thing2</artifactId>
    <classifier>superstubs</classifier>
    <version>1.0.0</version>
    <scope>test</scope>
    <exclusions>
        <exclusion>
            <groupId>*</groupId>
            <artifactId>*</artifactId>
        </exclusion>
    </exclusions>
</dependency>
```

Gradle

```
testCompile("com.example:beer-api-producer-restdocs:0.0.1-SNAPSHOT:stubs") {
    transitive = false
}
testCompile("com.example.thing1:thing2:1.0.0:superstubs") {
    transitive = false
}
```

Then the specified locations on your classpath get scanned. For `com.example:beer-api-producer-restdocs`, the following locations are scanned:

- /META-INF/com.example/beer-api-producer-restdocs/*/.*
- /contracts/com.example/beer-api-producer-restdocs/*/.*
- /mappings/com.example/beer-api-producer-restdocs/*/.*

For `com.example.thing1:thing2`, the following locations are scanned:

- /META-INF/com.example.thing1/thing2/*/.*
- /contracts/com.example.thing1/thing2/*/.*
- /mappings/com.example.thing1/thing2/*/.*

You have to explicitly provide the group and artifact IDs when you package the producer stubs.

To achieve proper stub packaging, the producer would set up the contracts as follows:

```
└── src
    └── test
        └── resources
            └── contracts
                └── com.example
                    └── beer-api-producer-restdocs
                        └── nested
                            └── contract3.groovy
```

By using the Maven `assembly` plugin or Gradle Jar task, you have to create the following structure in your stubs jar:

```
└── META-INF
    └── com.example
        └── beer-api-producer-restdocs
            └── 2.0.0
                ├── contracts
                │   └── nested
                │       └── contract2.groovy
                └── mappings
                    └── mapping.json
```

By maintaining this structure, the classpath gets scanned and you can profit from the messaging or HTTP stubs without the need to download artifacts.

Configuring HTTP Server Stubs

Stub Runner has a notion of a `HttpServerStub` that abstracts the underlying concrete implementation of the HTTP server (for example, WireMock is one of the implementations). Sometimes, you need to perform some additional tuning (which is concrete for the given implementation) of the stub servers. To do that, Stub Runner gives you the `httpServerStubConfigurer` property that is available in the annotation and the JUnit rule and is accessible through system properties, where you can provide your implementation of the `org.springframework.cloud.contract.stubrunner.HttpServerStubConfigurer` interface. The

implementations can alter the configuration files for the given HTTP server stub.

Spring Cloud Contract Stub Runner comes with an implementation that you can extend for WireMock: `org.springframework.cloud.contract.stubrunner.provider.wiremock.WireMockHttpServerStubConfigurer`. In the `configure` method, you can provide your own custom configuration for the given stub. The use case might be starting WireMock for the given artifact ID, on an HTTPS port. The following example shows how to do so:

Example 1. WireMockHttpServerStubConfigurer implementation

```
@CompileStatic
static class HttpsForFraudDetection extends WireMockHttpServerStubConfigurer {

    private static final Log log = LogFactory.getLog(HttpsForFraudDetection)

    @Override
    WireMockConfiguration configure(WireMockConfiguration httpStubConfiguration,
HttpServerStubConfiguration httpServerStubConfiguration) {
        if (httpServerStubConfiguration.stubConfiguration.artifactId ==
"fraudDetectionServer") {
            int httpsPort = SocketUtils.findAvailableTcpPort()
            log.info("Will set HTTPs port [" + httpsPort + "] for fraud detection
server")
            return httpStubConfiguration
                    .httpsPort(httpsPort)
        }
        return httpStubConfiguration
    }
}
```

You can then reuse it with the `@AutoConfigureStubRunner` annotation, as follows:

```
@AutoConfigureStubRunner(mappingsOutputFolder = "target/outputmappings/",
        httpServerStubConfigurer = HttpsForFraudDetection)
```

Whenever an HTTPS port is found, it takes precedence over the HTTP port.

Running stubs

This section describes how to run stubs. It contains the following topics:

- HTTP Stubs
- Viewing Registered Mappings
- Messaging Stubs

HTTP Stubs

Stubs are defined in JSON documents, whose syntax is defined in WireMock documentation

The following example defines a stub in JSON:

```
{
    "request": {
        "method": "GET",
        "url": "/ping"
    },
    "response": {
        "status": 200,
        "body": "pong",
        "headers": {
            "Content-Type": "text/plain"
        }
    }
}
```

Viewing Registered Mappings

Every stubbed collaborator exposes a list of defined mappings under the `__/admin/` endpoint.

You can also use the `mappingsOutputFolder` property to dump the mappings to files. For the annotation-based approach, it would resembling the following example:

```
@AutoConfigureStubRunner(ids="a.b.c:loanIssuance,a.b.c:fraudDetectionServer",
mappingsOutputFolder = "target/outputmappings/")
```

For the JUnit approach, it resembles the following example:

```
@ClassRule @Shared StubRunnerRule rule = new StubRunnerRule()
            .repoRoot("https://some_url")
            .downloadStub("a.b.c", "loanIssuance")
            .downloadStub("a.b.c:fraudDetectionServer")
            .withMappingsOutputFolder("target/outputmappings")
```

Then, if you check out the `target/outputmappings` folder, you would see the following structure;

```
.
├── fraudDetectionServer_13705
└── loanIssuance_12255
```

That means that there were two stubs registered. `fraudDetectionServer` was registered at port `13705` and `loanIssuance` at port `12255`. If we take a look at one of the files, we would see (for WireMock) the mappings available for the given server:

```
[{
  "id" : "f9152eb9-bf77-4c38-8289-90be7d10d0d7",
  "request" : {
    "url" : "/name",
    "method" : "GET"
  },
  "response" : {
    "status" : 200,
    "body" : "fraudDetectionServer"
  },
  "uuid" : "f9152eb9-bf77-4c38-8289-90be7d10d0d7"
},
...
]
```

Messaging Stubs

Depending on the provided Stub Runner dependency and the DSL, the messaging routes are automatically set up.

4.5.4. Stub Runner JUnit Rule and Stub Runner JUnit5 Extension

Stub Runner comes with a JUnit rule that lets you can download and run stubs for a given group and artifact ID, as the following example shows:

```
@ClassRule
public static StubRunnerRule rule = new StubRunnerRule().repoRoot(repoRoot())
        .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
        .downloadStub("org.springframework.cloud.contract.verifier.stubs",
                "loanIssuance")
        .downloadStub(

"org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer");

@BeforeClass
@AfterClass
public static void setupProps() {
    System.clearProperty("stubrunner.repository.root");
    System.clearProperty("stubrunner.classifier");
}
```

A `StubRunnerExtension` is also available for JUnit 5. `StubRunnerRule` and `StubRunnerExtension` work in a very similar fashion. After the rule or extension is executed, Stub Runner connects to your Maven repository and, for the given list of dependencies, tries to:

- Download them
- Cache them locally
- Unzip them to a temporary folder
- Start a WireMock server for each Maven dependency on a random port from the provided range of ports or the provided port
- Feed the WireMock server with all JSON files that are valid WireMock definitions
- Send messages (remember to pass an implementation of `MessageVerifier` interface)

Stub Runner uses the Eclipse Aether mechanism to download the Maven dependencies. Check their docs for more information.

Since the `StubRunnerRule` and `StubRunnerExtension` implement the `StubFinder` they let you find the started stubs, as the following example shows:

```
package org.springframework.cloud.contract.stubrunner;

import java.net.URL;
import java.util.Collection;
import java.util.Map;

import org.springframework.cloud.contract.spec.Contract;

/**
 * Contract for finding registered stubs.
```

```
 *
 * @author Marcin Grzejszczak
 */
public interface StubFinder extends StubTrigger {

    /**
     * For the given groupId and artifactId tries to find the matching URL of the
running
     * stub.
     * @param groupId - might be null. In that case a search only via artifactId
takes
     * place
     * @param artifactId - artifact id of the stub
     * @return URL of a running stub or throws exception if not found
     * @throws StubNotFoundException in case of not finding a stub
     */
    URL findStubUrl(String groupId, String artifactId) throws
StubNotFoundException;

    /**
     * For the given Ivy notation {@code
[groupId]:artifactId:[version]:[classifier]}
     * tries to find the matching URL of the running stub. You can also pass only
     * {@code artifactId}.
     * @param ivyNotation - Ivy representation of the Maven artifact
     * @return URL of a running stub or throws exception if not found
     * @throws StubNotFoundException in case of not finding a stub
     */
    URL findStubUrl(String ivyNotation) throws StubNotFoundException;

    /**
     * @return all running stubs
     */
    RunningStubs findAllRunningStubs();

    /**
     * @return the list of Contracts
     */
    Map<StubConfiguration, Collection<Contract>> getContracts();

}
```

The following examples provide more detail about using Stub Runner:

spock

```
@ClassRule
@Shared
StubRunnerRule rule = new StubRunnerRule()
        .stubsMode(StubRunnerProperties.StubsMode.REMOTE)

.repoRoot(StubRunnerRuleSpec.getResource("/m2repo/repository").toURI().toString())
        .downloadStub("org.springframework.cloud.contract.verifier.stubs",
"loanIssuance")

.downloadStub("org.springframework.cloud.contract.verifier.stubs:fraudDetectionSer
ver")
        .withMappingsOutputFolder("target/outputmappingsforrule")


def 'should start WireMock servers'() {
    expect: 'WireMocks are running'
        rule.findStubUrl('org.springframework.cloud.contract.verifier.stubs',
'loanIssuance') != null
        rule.findStubUrl('loanIssuance') != null
        rule.findStubUrl('loanIssuance') ==
rule.findStubUrl('org.springframework.cloud.contract.verifier.stubs',
'loanIssuance')

rule.findStubUrl('org.springframework.cloud.contract.verifier.stubs:fraudDetection
Server') != null
    and:
        rule.findAllRunningStubs().isPresent('loanIssuance')

rule.findAllRunningStubs().isPresent('org.springframework.cloud.contract.verifier.
stubs', 'fraudDetectionServer')

rule.findAllRunningStubs().isPresent('org.springframework.cloud.contract.verifier.
stubs:fraudDetectionServer')
    and: 'Stubs were registered'
        "${rule.findStubUrl('loanIssuance').toString()}/name".toURL().text ==
'loanIssuance'
        "${rule.findStubUrl('fraudDetectionServer').toString()}/name".toURL().text
== 'fraudDetectionServer'
}

def 'should output mappings to output folder'() {
    when:
        def url = rule.findStubUrl('fraudDetectionServer')
    then:
        new File("target/outputmappingsforrule",
"fraudDetectionServer_${url.port}").exists()
}
```

junit 4

```
@Test
public void should_start_wiremock_servers() throws Exception {
    // expect: 'WireMocks are running'
    then(rule.findStubUrl("org.springframework.cloud.contract.verifier.stubs",
            "loanIssuance")).isNotNull();
    then(rule.findStubUrl("loanIssuance")).isNotNull();
    then(rule.findStubUrl("loanIssuance")).isEqualTo(rule.findStubUrl(
            "org.springframework.cloud.contract.verifier.stubs", "loanIssuance"));
    then(rule.findStubUrl(

"org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer"))
                    .isNotNull();
    // and:
    then(rule.findAllRunningStubs().isPresent("loanIssuance")).isTrue();
    then(rule.findAllRunningStubs().isPresent(
            "org.springframework.cloud.contract.verifier.stubs",
            "fraudDetectionServer")).isTrue();
    then(rule.findAllRunningStubs().isPresent(

"org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer"))
                    .isTrue();
    // and: 'Stubs were registered'
    then(httpGet(rule.findStubUrl("loanIssuance").toString() + "/name"))
            .isEqualTo("loanIssuance");
    then(httpGet(rule.findStubUrl("fraudDetectionServer").toString() + "/name"))
            .isEqualTo("fraudDetectionServer");
}
```

junit 5

```
// Visible for Junit
@RegisterExtension
static StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
        .repoRoot(repoRoot()).stubsMode(StubRunnerProperties.StubsMode.REMOTE)
        .downloadStub("org.springframework.cloud.contract.verifier.stubs",
                "loanIssuance")
        .downloadStub(

"org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer")
        .withMappingsOutputFolder("target/outputmappingsforrule");

@BeforeAll
@AfterAll
static void setupProps() {
    System.clearProperty("stubrunner.repository.root");
    System.clearProperty("stubrunner.classifier");
}

private static String repoRoot() {
    try {
        return StubRunnerRuleJUnitTest.class.getResource("/m2repo/repository/")
                .toURI().toString();
    }
    catch (Exception e) {
        return "";
    }
}
```

See the Common Properties for JUnit and Spring for more information on how to apply global configuration of Stub Runner.

To use the JUnit rule or JUnit 5 extension together with messaging, you have to provide an implementation of the `MessageVerifier` interface to the rule builder (for example, `rule.messageVerifier(new MyMessageVerifier())`). If you do not do this, then, whenever you try to send a message, an exception is thrown.

Maven Settings

The stub downloader honors Maven settings for a different local repository folder. Authentication details for repositories and profiles are currently not taken into account, so you need to specify it by using the properties mentioned above.

Providing Fixed Ports

You can also run your stubs on fixed ports. You can do it in two different ways. One is to pass it in the properties, and the other is to use the fluent API of JUnit rule.

Fluent API

When using the `StubRunnerRule` or `StubRunnerExtension`, you can add a stub to download and then pass the port for the last downloaded stub. The following example shows how to do so:

```
@ClassRule
public static StubRunnerRule rule = new StubRunnerRule().repoRoot(repoRoot())
        .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
        .downloadStub("org.springframework.cloud.contract.verifier.stubs",
                "loanIssuance")
        .withPort(12345).downloadStub(

"org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer:12346");

@BeforeClass
@AfterClass
public static void setupProps() {
    System.clearProperty("stubrunner.repository.root");
    System.clearProperty("stubrunner.classifier");
}
```

For the preceding example, the following test is valid:

```
then(rule.findStubUrl("loanIssuance"))
        .isEqualTo(URI.create("http://localhost:12345").toURL());
then(rule.findStubUrl("fraudDetectionServer"))
        .isEqualTo(URI.create("http://localhost:12346").toURL());
```

Stub Runner with Spring

Stub Runner with Spring sets up Spring configuration of the Stub Runner project.

By providing a list of stubs inside your configuration file, Stub Runner automatically downloads and registers in WireMock the selected stubs.

If you want to find the URL of your stubbed dependency, you can autowire the `StubFinder` interface and use its methods, as follows:

```
@ContextConfiguration(classes = Config, loader = SpringBootContextLoader)
@SpringBootTest(properties = [" stubrunner.cloud.enabled=false",
        'foo=${stubrunner.runningstubs.fraudDetectionServer.port}',

'fooWithGroup=${stubrunner.runningstubs.org.springframework.cloud.contract.verifie
r.stubs.fraudDetectionServer.port}'])
```

```
@AutoConfigureStubRunner(mappingsOutputFolder = "target/outputmappings/",
        httpServerStubConfigurer = HttpsForFraudDetection)
@ActiveProfiles("test")
class StubRunnerConfigurationSpec extends Specification {

    @Autowired
    StubFinder stubFinder
    @Autowired
    Environment environment
    @StubRunnerPort("fraudDetectionServer")
    int fraudDetectionServerPort

@StubRunnerPort("org.springframework.cloud.contract.verifier.stubs:fraudDetectionS
erver")
    int fraudDetectionServerPortWithGroupId
    @Value('${foo}')
    Integer foo

    @BeforeClass
    @AfterClass
    void setupProps() {
        System.clearProperty("stubrunner.repository.root")
        System.clearProperty("stubrunner.classifier")
    }

    def 'should start WireMock servers'() {
        expect: 'WireMocks are running'

stubFinder.findStubUrl('org.springframework.cloud.contract.verifier.stubs',
'loanIssuance') != null
            stubFinder.findStubUrl('loanIssuance') != null
            stubFinder.findStubUrl('loanIssuance') ==
stubFinder.findStubUrl('org.springframework.cloud.contract.verifier.stubs',
'loanIssuance')
            stubFinder.findStubUrl('loanIssuance') ==
stubFinder.findStubUrl('org.springframework.cloud.contract.verifier.stubs:loanIssu
ance')

stubFinder.findStubUrl('org.springframework.cloud.contract.verifier.stubs:loanIssu
ance:0.0.1-SNAPSHOT') ==
stubFinder.findStubUrl('org.springframework.cloud.contract.verifier.stubs:loanIssu
ance:0.0.1-SNAPSHOT:stubs')

stubFinder.findStubUrl('org.springframework.cloud.contract.verifier.stubs:fraudDet
ectionServer') != null
        and:
            stubFinder.findAllRunningStubs().isPresent('loanIssuance')

stubFinder.findAllRunningStubs().isPresent('org.springframework.cloud.contract.ver
ifier.stubs', 'fraudDetectionServer')
```

```
stubFinder.findAllRunningStubs().isPresent('org.springframework.cloud.contract.ver
ifier.stubs:fraudDetectionServer')
        and: 'Stubs were registered'

"${stubFinder.findStubUrl('loanIssuance').toString()}/name".toURL().text ==
'loanIssuance'

"${stubFinder.findStubUrl('fraudDetectionServer').toString()}/name".toURL().text
== 'fraudDetectionServer'
        and: 'Fraud Detection is an HTTPS endpoint'

stubFinder.findStubUrl('fraudDetectionServer').toString().startsWith("https")
    }

    def 'should throw an exception when stub is not found'() {
        when:
            stubFinder.findStubUrl('nonExistingService')
        then:
            thrown(StubNotFoundException)
        when:
            stubFinder.findStubUrl('nonExistingGroupId', 'nonExistingArtifactId')
        then:
            thrown(StubNotFoundException)
    }

    def 'should register started servers as environment variables'() {
        expect:
            environment.getProperty("stubrunner.runningstubs.loanIssuance.port")
!= null
            stubFinder.findAllRunningStubs().getPort("loanIssuance") ==
(environment.getProperty("stubrunner.runningstubs.loanIssuance.port") as Integer)
        and:

environment.getProperty("stubrunner.runningstubs.fraudDetectionServer.port") !=
null
            stubFinder.findAllRunningStubs().getPort("fraudDetectionServer") ==
(environment.getProperty("stubrunner.runningstubs.fraudDetectionServer.port") as
Integer)
        and:

environment.getProperty("stubrunner.runningstubs.fraudDetectionServer.port") !=
null
            stubFinder.findAllRunningStubs().getPort("fraudDetectionServer") ==
(environment.getProperty("stubrunner.runningstubs.org.springframework.cloud.contra
ct.verifier.stubs.fraudDetectionServer.port") as Integer)
    }

    def 'should be able to interpolate a running stub in the passed test
property'() {
        given:
            int fraudPort =
```

```
stubFinder.findAllRunningStubs().getPort("fraudDetectionServer")
        expect:
            fraudPort > 0
            environment.getProperty("foo", Integer) == fraudPort
            environment.getProperty("fooWithGroup", Integer) == fraudPort
            foo == fraudPort
    }

    @Issue("#573")
    def 'should be able to retrieve the port of a running stub via an
annotation'() {
        given:
            int fraudPort =
stubFinder.findAllRunningStubs().getPort("fraudDetectionServer")
        expect:
            fraudPort > 0
            fraudDetectionServerPort == fraudPort
            fraudDetectionServerPortWithGroupId == fraudPort
    }

    def 'should dump all mappings to a file'() {
        when:
            def url = stubFinder.findStubUrl("fraudDetectionServer")
        then:
            new File("target/outputmappings/",
"fraudDetectionServer_${url.port}").exists()
    }

    @Configuration
    @EnableAutoConfiguration
    static class Config {}

    @CompileStatic
    static class HttpsForFraudDetection extends WireMockHttpServerStubConfigurer {

        private static final Log log = LogFactory.getLog(HttpsForFraudDetection)

        @Override
        WireMockConfiguration configure(WireMockConfiguration
httpStubConfiguration, HttpServerStubConfiguration httpServerStubConfiguration) {
            if (httpServerStubConfiguration.stubConfiguration.artifactId ==
"fraudDetectionServer") {
                int httpsPort = SocketUtils.findAvailableTcpPort()
                log.info("Will set HTTPs port [" + httpsPort + "] for fraud
detection server")
                return httpStubConfiguration
                        .httpsPort(httpsPort)
            }
            return httpStubConfiguration
        }
    }
```

```
}
```

Doing so depends on the following configuration file:

```
stubrunner:
  repositoryRoot: classpath:m2repo/repository/
  ids:
    - org.springframework.cloud.contract.verifier.stubs:loanIssuance
    - org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer
    - org.springframework.cloud.contract.verifier.stubs:bootService
  stubs-mode: remote
```

Instead of using the properties, you can also use the properties inside the `@AutoConfigureStubRunner`. The following example achieves the same result by setting values on the annotation:

```
@AutoConfigureStubRunner(
        ids = ["org.springframework.cloud.contract.verifier.stubs:loanIssuance",

"org.springframework.cloud.contract.verifier.stubs:fraudDetectionServer",
                "org.springframework.cloud.contract.verifier.stubs:bootService"],
        stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        repositoryRoot = "classpath:m2repo/repository/")
```

Stub Runner Spring registers environment variables in the following manner for every registered WireMock server. The following example shows Stub Runner IDs for `com.example:thing1` and `com.example:thing2`:

- `stubrunner.runningstubs.thing1.port`
- `stubrunner.runningstubs.com.example.thing1.port`
- `stubrunner.runningstubs.thing2.port`
- `stubrunner.runningstubs.com.example.thing2.port`

You can reference these values in your code.

You can also use the `@StubRunnerPort` annotation to inject the port of a running stub. The value of the annotation can be the `groupid:artifactid` or just the `artifactid`. The following example works shows Stub Runner IDs for `com.example:thing1` and `com.example:thing2`.

```
@StubRunnerPort("thing1")
int thing1Port;
@StubRunnerPort("com.example:thing2")
int thing2Port;
```

4.5.5. Stub Runner Spring Cloud

Stub Runner can integrate with Spring Cloud.

For real life examples, see:

- The producer app sample
- The consumer app sample

Stubbing Service Discovery

The most important feature of `Stub Runner Spring Cloud` is the fact that it stubs:

- `DiscoveryClient`
- `Ribbon ServerList`

That means that, regardless of whether you use Zookeeper, Consul, Eureka, or anything else, you do not need that in your tests. We are starting WireMock instances of your dependencies and we are telling your application, whenever you use `Feign`, to load a balanced `RestTemplate` or `DiscoveryClient` directly, to call those stubbed servers instead of calling the real Service Discovery tool.

For example, the following test passes:

```
def 'should make service discovery work'() {
    expect: 'WireMocks are running'
        "${stubFinder.findStubUrl('loanIssuance').toString()}/name".toURL().text
== 'loanIssuance'

"${stubFinder.findStubUrl('fraudDetectionServer').toString()}/name".toURL().text
== 'fraudDetectionServer'
    and: 'Stubs can be reached via load service discovery'
        restTemplate.getForObject('http://loanIssuance/name', String) ==
'loanIssuance'

restTemplate.getForObject('http://someNameThatShouldMapFraudDetectionServer/name',
String) == 'fraudDetectionServer'
}
```

Note that the preceding example requires the following configuration file:

```
stubrunner:
  idsToServiceIds:
    ivyNotation: someValueInsideYourCode
    fraudDetectionServer: someNameThatShouldMapFraudDetectionServer
```

Test Profiles and Service Discovery

In your integration tests, you typically do not want to call either a discovery service (such as Eureka) or Config Server. That is why you create an additional test configuration in which you want to disable these features.

Due to certain limitations of `spring-cloud-commons`, to achieve this, you have to disable these properties in a static block such as the following example (for Eureka):

```
    //Hack to work around https://github.com/spring-cloud/spring-cloud-
commons/issues/156
    static {
        System.setProperty("eureka.client.enabled", "false");
        System.setProperty("spring.cloud.config.failFast", "false");
    }
```

Additional Configuration

You can match the `artifactId` of the stub with the name of your application by using the `stubrunner.idsToServiceIds:` map. You can disable Stub Runner Ribbon support by setting `stubrunner.cloud.ribbon.enabled` to `false` You can disable Stub Runner support by setting `stubrunner.cloud.enabled` to `false`

By default, all service discovery is stubbed. This means that, regardless of whether you have an existing `DiscoveryClient`, its results are ignored. However, if you want to reuse it, you can set `stubrunner.cloud.delegate.enabled` to `true`, and then your existing `DiscoveryClient` results are merged with the stubbed ones.

The default Maven configuration used by Stub Runner can be tweaked either by setting the following system properties or by setting the corresponding environment variables:

- `maven.repo.local`: Path to the custom maven local repository location
- `org.apache.maven.user-settings`: Path to custom maven user settings location
- `org.apache.maven.global-settings`: Path to maven global settings location

4.5.6. Using the Stub Runner Boot Application

Spring Cloud Contract Stub Runner Boot is a Spring Boot application that exposes REST endpoints to trigger the messaging labels and to access WireMock servers.

One of the use cases is to run some smoke (end-to-end) tests on a deployed application. You can check out the Spring Cloud Pipelines project for more information.

Stub Runner Server

To use the Stub Runner Server, add the following dependency:

```
compile "org.springframework.cloud:spring-cloud-starter-stub-runner"
```

Then annotate a class with `@EnableStubRunnerServer`, build a fat jar, and it is ready to work.

For the properties, see the Stub Runner Spring section.

Stub Runner Server Fat Jar

You can download a standalone JAR from Maven (for example, for version 2.0.1.RELEASE) by running the following commands:

```
$ wget -O stub-runner.jar
'https://search.maven.org/remotecontent?filepath=org/springframework/cloud/spring-
cloud-contract-stub-runner-boot/2.0.1.RELEASE/spring-cloud-contract-stub-runner-
boot-2.0.1.RELEASE.jar'
$ java -jar stub-runner.jar --stubrunner.ids=... --stubrunner.repositoryRoot=...
```

Spring Cloud CLI

Starting from the `1.4.0.RELEASE` version of the Spring Cloud CLI project, you can start Stub Runner Boot by running `spring cloud stubrunner`.

In order to pass the configuration, you can create a `stubrunner.yml` file in the current working directory, in a subdirectory called `config`, or in `~/.spring-cloud`. The file could resemble the following example for running stubs installed locally:

Example 2. stubrunner.yml

```
stubrunner:
  stubsMode: LOCAL
  ids:
    - com.example:beer-api-producer:+:9876
```

Then you can call `spring cloud stubrunner` from your terminal window to start the Stub Runner server. It is available at port `8750`.

Endpoints

Stub Runner Boot offers two endpoints:

- HTTP
- Messaging

HTTP

For HTTP, Stub Runner Boot makes the following endpoints available:

- GET `/stubs`: Returns a list of all running stubs in `ivy:integer` notation
- GET `/stubs/{ivy}`: Returns a port for the given `ivy` notation (when calling the endpoint `ivy` can also be `artifactId` only)

Messaging

For Messaging, Stub Runner Boot makes the following endpoints available:

- GET `/triggers`: Returns a list of all running labels in `ivy : [ label1, label2 ⋯]` notation
- POST `/triggers/{label}`: Runs a trigger with `label`
- POST `/triggers/{ivy}/{label}`: Runs a trigger with a `label` for the given `ivy` notation (when calling the endpoint, `ivy` can also be `artifactId` only)

Example

The following example shows typical usage of Stub Runner Boot:

```
@ContextConfiguration(classes = StubRunnerBoot, loader = SpringBootContextLoader)
@SpringBootTest(properties = "spring.cloud.zookeeper.enabled=false")
@ActiveProfiles("test")
class StubRunnerBootSpec extends Specification {

    @Autowired
    StubRunning stubRunning

    def setup() {
        RestAssuredMockMvc.standaloneSetup(new HttpStubsController(stubRunning),
                new TriggerController(stubRunning))
    }

    def 'should return a list of running stub servers in "full ivy:port" notation'() {
        when:
            String response = RestAssuredMockMvc.get('/stubs').body.asString()
        then:
            def root = new JsonSlurper().parseText(response)
            root.'org.springframework.cloud.contract.verifier.stubs:bootService:0.0.1-
SNAPSHOT:stubs' instanceof Integer
    }

    def 'should return a port on which a [#stubId] stub is running'() {
        when:
            def response = RestAssuredMockMvc.get("/stubs/${stubId}")
        then:
            response.statusCode == 200
            Integer.valueOf(response.body.asString()) > 0
        where:
```

```
            stubId <<
['org.springframework.cloud.contract.verifier.stubs:bootService:+:stubs',

'org.springframework.cloud.contract.verifier.stubs:bootService:0.0.1-SNAPSHOT:stubs',

'org.springframework.cloud.contract.verifier.stubs:bootService:+',

'org.springframework.cloud.contract.verifier.stubs:bootService',
                        'bootService']
    }

    def 'should return 404 when missing stub was called'() {
        when:
            def response = RestAssuredMockMvc.get("/stubs/a:b:c:d")
        then:
            response.statusCode == 404
    }

    def 'should return a list of messaging labels that can be triggered when version
and classifier are passed'() {
        when:
            String response = RestAssuredMockMvc.get('/triggers').body.asString()
        then:
            def root = new JsonSlurper().parseText(response)
            root.'org.springframework.cloud.contract.verifier.stubs:bootService:0.0.1-
SNAPSHOT:stubs'?.containsAll(["delete_book", "return_book_1", "return_book_2"])
    }

    def 'should trigger a messaging label'() {
        given:
            StubRunning stubRunning = Mock()
            RestAssuredMockMvc.standaloneSetup(new HttpStubsController(stubRunning),
new TriggerController(stubRunning))
        when:
            def response = RestAssuredMockMvc.post("/triggers/delete_book")
        then:
            response.statusCode == 200
        and:
            1 * stubRunning.trigger('delete_book')
    }

    def 'should trigger a messaging label for a stub with [#stubId] ivy notation'() {
        given:
            StubRunning stubRunning = Mock()
            RestAssuredMockMvc.standaloneSetup(new HttpStubsController(stubRunning),
new TriggerController(stubRunning))
        when:
            def response = RestAssuredMockMvc.post("/triggers/$stubId/delete_book")
        then:
            response.statusCode == 200
        and:
```

```
            1 * stubRunning.trigger(stubId, 'delete_book')
        where:
            stubId <<
['org.springframework.cloud.contract.verifier.stubs:bootService:stubs',
'org.springframework.cloud.contract.verifier.stubs:bootService', 'bootService']
    }

    def 'should throw exception when trigger is missing'() {
        when:
            RestAssuredMockMvc.post("/triggers/missing_label")
        then:
            Exception e = thrown(Exception)
            e.message.contains("Exception occurred while trying to return
[missing_label] label.")
            e.message.contains("Available labels are")

e.message.contains("org.springframework.cloud.contract.verifier.stubs:loanIssuance:0.0
.1-SNAPSHOT:stubs=[]")

e.message.contains("org.springframework.cloud.contract.verifier.stubs:bootService:0.0.
1-SNAPSHOT:stubs=")
    }

}
```

Stub Runner Boot with Service Discovery

One way to use Stub Runner Boot is to use it as a feed of stubs for “smoke tests”. What does that mean? Assume that you do not want to deploy 50 microservices to a test environment in order to see whether your application works. You have already executed a suite of tests during the build process, but you would also like to ensure that the packaging of your application works. You can deploy your application to an environment, start it, and run a couple of tests on it to see whether it works. We can call those tests “smoke tests”, because their purpose is to check only a handful of testing scenarios.

The problem with this approach is thatm if you use microservices, you most likely also use a service discovery tool. Stub Runner Boot lets you solve this issue by starting the required stubs and registering them in a service discovery tool. Consider the following example of such a setup with Eureka (assume that Eureka is already running):

```
@SpringBootApplication
@EnableStubRunnerServer
@EnableEurekaClient
@AutoConfigureStubRunner
public class StubRunnerBootEurekaExample {

    public static void main(String[] args) {
        SpringApplication.run(StubRunnerBootEurekaExample.class, args);
    }

}
```

We want to start a Stub Runner Boot server (`@EnableStubRunnerServer`), enable the Eureka client (`@EnableEurekaClient`), and have the stub runner feature turned on (`@AutoConfigureStubRunner`).

Now assume that we want to start this application so that the stubs get automatically registered. We can do so by running the application with `java -jar ${SYSTEM_PROPS} stub-runner-boot-eureka-example.jar`, where `${SYSTEM_PROPS}` contains the following list of properties:

```
* -Dstubrunner.repositoryRoot=https://repo.spring.io/snapshot (1)
* -Dstubrunner.cloud.stubbed.discovery.enabled=false (2)
*
-Dstubrunner.ids=org.springframework.cloud.contract.verifier.stubs:loanIssuance,or
g.
*
springframework.cloud.contract.verifier.stubs:fraudDetectionServer,org.springframe
work.
* cloud.contract.verifier.stubs:bootService (3)
* -Dstubrunner.idsToServiceIds.fraudDetectionServer=
* someNameThatShouldMapFraudDetectionServer (4)
*
* (1) - we tell Stub Runner where all the stubs reside (2) - we don't want the
default
* behaviour where the discovery service is stubbed. That's why the stub
registration will
* be picked (3) - we provide a list of stubs to download (4) - we provide a list
of
```

That way, your deployed application can send requests to started WireMock servers through service discovery. Most likely, points 1 through 3 could be set by default in `application.yml`, because they are not likely to change. That way, you can provide only the list of stubs to download whenever you start the Stub Runner Boot.

4.5.7. Consumer-Driven Contracts: Stubs Per Consumer

There are cases in which two consumers of the same endpoint want to have two different responses.

This approach also lets you immediately know which consumer uses which part of your API. You can remove part of a response that your API produces and see which of your autogenerated tests fails. If none fails, you can safely delete that part of the response, because nobody uses it.

Consider the following example of a contract defined for the producer called `producer`, which has two consumers (`foo-consumer` and `bar-consumer`):

Consumer `foo-service`

```
request {
   url '/foo'
   method GET()
}
response {
    status OK()
    body(
       foo: "foo"
    }
}
```

Consumer `bar-service`

```
request {
   url '/bar'
   method GET()
}
response {
    status OK()
    body(
       bar: "bar"
    }
}
```

You cannot produce two different responses for the same request. That is why you can properly package the contracts and then profit from the `stubsPerConsumer` feature.

On the producer side, the consumers can have a folder that contains contracts related only to them. By setting the `stubrunner.stubs-per-consumer` flag to `true`, we no longer register all stubs but only those that correspond to the consumer application's name. In other words, we scan the path of every stub and, if it contains a subfolder with name of the consumer in the path, only then is it registered.

On the `foo` producer side the contracts would look like this

```
.
└── contracts
    ├── bar-consumer
    │   ├── bookReturnedForBar.groovy
    │   └── shouldCallBar.groovy
    └── foo-consumer
        ├── bookReturnedForFoo.groovy
        └── shouldCallFoo.groovy
```

The `bar-consumer` consumer can either set the `spring.application.name` or the `stubrunner.consumer-name` to `bar-consumer` Alternatively, you can set the test as follows:

```
@ContextConfiguration(classes = Config, loader = SpringBootContextLoader)
@SpringBootTest(properties = ["spring.application.name=bar-consumer"])
@AutoConfigureStubRunner(ids =
"org.springframework.cloud.contract.verifier.stubs:producerWithMultipleConsumers",
        repositoryRoot = "classpath:m2repo/repository/",
        stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        stubsPerConsumer = true)
class StubRunnerStubsPerConsumerSpec extends Specification {
...
}
```

Then only the stubs registered under a path that contains `bar-consumer` in its name (that is, those from the `src/test/resources/contracts/bar-consumer/some/contracts/⋯` folder) are allowed to be referenced.

You can also set the consumer name explicitly, as follows:

```
@ContextConfiguration(classes = Config, loader = SpringBootContextLoader)
@SpringBootTest
@AutoConfigureStubRunner(ids =
"org.springframework.cloud.contract.verifier.stubs:producerWithMultipleConsumers",
        repositoryRoot = "classpath:m2repo/repository/",
        consumerName = "foo-consumer",
        stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        stubsPerConsumer = true)
class StubRunnerStubsPerConsumerWithConsumerNameSpec extends Specification {
...
}
```

Then only the stubs registered under a path that contains the `foo-consumer` in its name (that is, those

from the `src/test/resources/contracts/foo-consumer/some/contracts/⋯` folder) are allowed to be referenced.

See issue 224 for more information about the reasons behind this change.

4.5.8. Fetching Stubs or Contract Definitions From A Location

Instead of picking the stubs or contract definitions from Artifactory / Nexus or Git, one can just want to point to a location on drive or classpath. This can be especially useful in a multimodule project, where one module wants to reuse stubs or contracts from another module without the need to actually install those in a local maven repository ot commit those changes to Git.

In order to achieve this it's enough to use the `stubs://` protocol when the repository root parameter is set either in Stub Runner or in a Spring Cloud Contract plugin.

In this example the `producer` project has been successfully built and stubs were generated under the `target/stubs` folder. As a consumer one can setup the Stub Runner to pick the stubs from that location using the `stubs://` protocol.

Annotation

```
@AutoConfigureStubRunner(
stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        repositoryRoot = "stubs://file://location/to/the/producer/target/stubs/",
        ids = "com.example:some-producer")
```

JUnit 4 Rule

```
@Rule
    public StubRunnerRule rule = new StubRunnerRule()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/producer/target/stubs/")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE);
```

JUnit 5 Extension

```
@RegisterExtension
    public StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/producer/target/stubs/")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE);
```

Contracts and stubs may be stored in a location, where each producer has its own, dedicated folder for contracts and stub mappings. Under that folder each consumer can have its own setup. To make Stub Runner find the dedicated folder from the provided ids one can pass a property `stubs.find-producer=true` or a system property `stubrunner.stubs.find-producer=true` .

```
└──── com.example ①
    ├──── some-artifact-id ②
    │    └──── 0.0.1
    │        ├──── contracts ③
    │        │    └──── shouldReturnStuffForArtifactId.groovy
    │        └──── mappings ④
    │            └──── shouldReturnStuffForArtifactId.json
    └──── some-other-artifact-id ⑤
        ├──── contracts
        │    └──── shouldReturnStuffForOtherArtifactId.groovy
        └──── mappings
            └──── shouldReturnStuffForOtherArtifactId.json
```

① group id of the consumers

② consumer with artifact id [some-artifact-id]

③ contracts for the consumer with artifact id [some-artifact-id]

④ mappings for the consumer with artifact id [some-artifact-id]

⑤ consumer with artifact id [some-other-artifact-id]

Annotation

```
@AutoConfigureStubRunner(
stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        repositoryRoot = "stubs://file://location/to/the/contracts/directory",
        ids = "com.example:some-producer",
        properties="stubs.find-producer=true")
```

JUnit 4 Rule

```
    static Map<String, String> contractProperties() {
        Map<String, String> map = new HashMap<>();
        map.put("stubs.find-producer", "true");
        return map;
    }

@Rule
    public StubRunnerRule rule = new StubRunnerRule()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/contracts/directory")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
            .properties(contractProperties());
```

JUnit 5 Extension

```
    static Map<String, String> contractProperties() {
        Map<String, String> map = new HashMap<>();
        map.put("stubs.find-producer", "true");
        return map;
    }

@RegisterExtension
    public StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/contracts/directory")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
            .properties(contractProperties());
```

4.5.9. Generating Stubs at Runtime

As a consumer, you might not want to wait for the producer to finish its implementation and then publish their stubs. A solution to this problem can be generation of stubs at runtime.

As a producer, when a contract is defined, you are required to make the generated tests pass in order for the stubs to be published. There are cases where you would like to unblock the consumers so that they can fetch the stubs before your tests are actually passing. In this case you should set such contracts as in progress. You can read more about this under the Contracts in Progress section.

That way your tests will not be generated, but the stubs will.

As a consumer, you can toggle a switch to generate stubs at runtime. Stub Runner will ignore all the existing stub mappings and will generate new ones for all the contract definitions. Another option is to pass the `stubrunner.generate-stubs` system property. Below you can find an example of such setup.

Annotation

```
@AutoConfigureStubRunner(
stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        repositoryRoot = "stubs://file://location/to/the/contracts",
        ids = "com.example:some-producer",
        generateStubs = true)
```

JUnit 4 Rule

```
@Rule
    public StubRunnerRule rule = new StubRunnerRule()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/contracts")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
            .withGenerateStubs(true);
```

JUnit 5 Extension

```
@RegisterExtension
    public StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/contracts")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
            .withGenerateStubs(true);
```

4.5.10. Fail On No Stubs

By default Stub Runner will fail if no stubs were found. In order to change that behaviour, just set to `false` the `failOnNoStubs` property in the annotation or call the `withFailOnNoStubs(false)` method on a JUnit Rule or Extension.

Annotation

```
@AutoConfigureStubRunner(
stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        repositoryRoot = "stubs://file://location/to/the/contracts",
        ids = "com.example:some-producer",
        failOnNoStubs = false)
```

JUnit 4 Rule

```
@Rule
    public StubRunnerRule rule = new StubRunnerRule()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/contracts")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
            .withFailOnNoStubs(false);
```

JUnit 5 Extension

```
@RegisterExtension
    public StubRunnerExtension stubRunnerExtension = new StubRunnerExtension()
            .downloadStub("com.example:some-producer")
            .repoRoot("stubs://file://location/to/the/contracts")
            .stubsMode(StubRunnerProperties.StubsMode.REMOTE)
            .withFailOnNoStubs(false);
```

4.5.11. Common Properties

This section briefly describes common properties, including:

- Common Properties for JUnit and Spring
- Stub Runner Stubs IDs

Common Properties for JUnit and Spring

You can set repetitive properties by using system properties or Spring configuration properties. The following table shows their names with their default values:

Property name	Default value	Description
stubrunner.minPort	10000	Minimum value of a port for a started WireMock with stubs.
stubrunner.maxPort	15000	Maximum value of a port for a started WireMock with stubs.
stubrunner.repositoryRoot		Maven repo URL. If blank, then call the local Maven repo.

Property name	Default value	Description
stubrunner.classifier	stubs	Default classifier for the stub artifacts.
stubrunner.stubsMode	CLASSPATH	The way you want to fetch and register the stubs
stubrunner.ids		Array of Ivy notation stubs to download.
stubrunner.username		Optional username to access the tool that stores the JARs with stubs.
stubrunner.password		Optional password to access the tool that stores the JARs with stubs.
stubrunner.stubsPerConsumer	`false`	Set to `true` if you want to use different stubs for each consumer instead of registering all stubs for every consumer.
stubrunner.consumerName		If you want to use a stub for each consumer and want to override the consumer name, change this value.

Stub Runner Stubs IDs

You can set the stubs to download in the `stubrunner.ids` system property. They use the following pattern:

```
groupId:artifactId:version:classifier:port
```

Note that `version`, `classifier`, and `port` are optional.

- If you do not provide the `port`, a random one is picked.
- If you do not provide the `classifier`, the default is used. (Note that you can pass an empty classifier this way: `groupId:artifactId:version:`).
- If you do not provide the `version`, then `+` is passed, and the latest one is downloaded.

`port` means the port of the WireMock server.

Starting with version 1.0.4, you can provide a range of versions that you would like the Stub Runner to take into consideration. You can read more about the Aether versioning ranges here.

4.6. Spring Cloud Contract WireMock

The Spring Cloud Contract WireMock modules let you use WireMock in a Spring Boot application. Check out the samples for more details.

If you have a Spring Boot application that uses Tomcat as an embedded server (which is the default with `spring-boot-starter-web`), you can add `spring-cloud-starter-contract-stub-runner` to your classpath and add `@AutoConfigureWireMock` to use Wiremock in your tests. Wiremock runs as a stub server, and you can register stub behavior by using a Java API or by using static JSON declarations as part of your test. The following code shows an example:

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment = WebEnvironment.RANDOM_PORT)
@AutoConfigureWireMock(port = 0)
public class WiremockForDocsTests {

    // A service that calls out over HTTP
    @Autowired
    private Service service;

    @Before
    public void setup() {
        this.service.setBase("http://localhost:"
                + this.environment.getProperty("wiremock.server.port"));
    }

    // Using the WireMock APIs in the normal way:
    @Test
    public void contextLoads() throws Exception {
        // Stubbing WireMock
        stubFor(get(urlEqualTo("/resource")).willReturn(aResponse()
                .withHeader("Content-Type", "text/plain").withBody("Hello
World!")));
        // We're asserting if WireMock responded properly
        assertThat(this.service.go()).isEqualTo("Hello World!");
    }

}
```

To start the stub server on a different port, use (for example), `@AutoConfigureWireMock(port=9999)`. For a random port, use a value of `0`. The stub server port can be bound in the test application context with the "wiremock.server.port" property. Using `@AutoConfigureWireMock` adds a bean of type `WiremockConfiguration` to your test application context, where it is cached between methods and classes having the same context. The same is true for Spring integration tests. Also, you can inject a bean of type `WireMockServer` into your test.

4.6.1. Registering Stubs Automatically

If you use `@AutoConfigureWireMock`, it registers WireMock JSON stubs from the file system or classpath (by default, from `file:src/test/resources/mappings`). You can customize the locations byusing the `stubs` attribute in the annotation, which can be an Ant-style resource pattern or a directory. In the case of a directory, `*/.json` is appended. The following code shows an example:

```
@RunWith(SpringRunner.class)
@SpringBootTest
@AutoConfigureWireMock(stubs="classpath:/stubs")
public class WiremockImportApplicationTests {

    @Autowired
    private Service service;

    @Test
    public void contextLoads() throws Exception {
        assertThat(this.service.go()).isEqualTo("Hello World!");
    }

}
```

Actually, WireMock always loads mappings from `src/test/resources/mappings` **as well as** the custom locations in the `stubs` attribute. To change this behavior, you can also specify a files root, as described in the next section of this document.

If you use Spring Cloud Contract's default stub jars, your stubs are stored in the `/META-INF/group-id/artifact-id/versions/mappings/` folder. If you want to register all stubs from that location, from all embedded JARs, you can use the following syntax:

```
@AutoConfigureWireMock(port = 0, stubs = "classpath*:/META-
INF/**/mappings/**/*.json")
```

4.6.2. Using Files to Specify the Stub Bodies

WireMock can read response bodies from files on the classpath or the file system. In the case of the file system, you can see in the JSON DSL that the response has a `bodyFileName` instead of a (literal) `body`. The files are resolved relative to a root directory (by default, `src/test/resources/__files`). To customize this location, you can set the `files` attribute in the `@AutoConfigureWireMock` annotation to the location of the parent directory (in other words, `__files` is a subdirectory). You can use Spring resource notation to refer to `file:⋯` or `classpath:⋯` locations. Generic URLs are not supported. A list of values can be given — in which case, WireMock resolves the first file that exists when it needs to find a response body.

When you configure the `files` root, it also affects the automatic loading of stubs, because they come from the root location in a subdirectory called `mappings`. The value of `files` has no effect on the stubs loaded explicitly from the `stubs` attribute.

4.6.3. Alternative: Using JUnit Rules

For a more conventional WireMock experience, you can use JUnit `@Rules` to start and stop the server. To do so, use the `WireMockSpring` convenience class to obtain an `Options` instance, as the following example shows:

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment = WebEnvironment.RANDOM_PORT)
public class WiremockForDocsClassRuleTests {

    // Start WireMock on some dynamic port
    // for some reason `dynamicPort()` is not working properly
    @ClassRule
    public static WireMockClassRule wiremock = new WireMockClassRule(
            WireMockSpring.options().dynamicPort());

    // A service that calls out over HTTP to wiremock's port
    @Autowired
    private Service service;

    @Before
    public void setup() {
        this.service.setBase("http://localhost:" + wiremock.port());
    }

    // Using the WireMock APIs in the normal way:
    @Test
    public void contextLoads() throws Exception {
        // Stubbing WireMock
        wiremock.stubFor(get(urlEqualTo("/resource")).willReturn(aResponse()
                .withHeader("Content-Type", "text/plain").withBody("Hello
World!")));
        // We're asserting if WireMock responded properly
        assertThat(this.service.go()).isEqualTo("Hello World!");
    }

}
```

The `@ClassRule` means that the server shuts down after all the methods in this class have been run.

4.6.4. Relaxed SSL Validation for Rest Template

WireMock lets you stub a “secure” server with an `https` URL protocol. If your application wants to

contact that stub server in an integration test, it will find that the SSL certificates are not valid (the usual problem with self-installed certificates). The best option is often to re-configure the client to use `http`. If that is not an option, you can ask Spring to configure an HTTP client that ignores SSL validation errors (do so only for tests, of course).

To make this work with minimum fuss, you need to use the Spring Boot `RestTemplateBuilder` in your application, as the following example shows:

```
@Bean
public RestTemplate restTemplate(RestTemplateBuilder builder) {
    return builder.build();
}
```

You need `RestTemplateBuilder` because the builder is passed through callbacks to initialize it, so the SSL validation can be set up in the client at that point. This happens automatically in your test if you use the `@AutoConfigureWireMock` annotation or the stub runner. If you use the JUnit `@Rule` approach, you need to add the `@AutoConfigureHttpClient` annotation as well, as the following example shows:

```
@RunWith(SpringRunner.class)
@SpringBootTest("app.baseUrl=https://localhost:6443")
@AutoConfigureHttpClient
public class WiremockHttpsServerApplicationTests {

    @ClassRule
    public static WireMockClassRule wiremock = new WireMockClassRule(
            WireMockSpring.options().httpsPort(6443));
...
}
```

If you use `spring-boot-starter-test`, you have the Apache HTTP client on the classpath, and it is selected by the `RestTemplateBuilder` and configured to ignore SSL errors. If you use the default `java.net` client, you do not need the annotation (but it does no harm). There is currently no support for other clients, but it may be added in future releases.

To disable the custom `RestTemplateBuilder`, set the `wiremock.rest-template-ssl-enabled` property to `false`.

4.6.5. WireMock and Spring MVC Mocks

Spring Cloud Contract provides a convenience class that can load JSON WireMock stubs into a Spring `MockRestServiceServer`. The following code shows an example:

```
@RunWith(SpringRunner.class)
@SpringBootTest(webEnvironment = WebEnvironment.NONE)
public class WiremockForDocsMockServerApplicationTests {

    @Autowired
    private RestTemplate restTemplate;

    @Autowired
    private Service service;

    @Test
    public void contextLoads() throws Exception {
        // will read stubs classpath
        MockRestServiceServer server =
WireMockRestServiceServer.with(this.restTemplate)

.baseUrl("https://example.org").stubs("classpath:/stubs/resource.json")
                .build();
        // We're asserting if WireMock responded properly
        assertThat(this.service.go()).isEqualTo("Hello World");
        server.verify();
    }

}
```

The `baseUrl` value is prepended to all mock calls, and the `stubs()` method takes a stub path resource pattern as an argument. In the preceding example, the stub defined at `/stubs/resource.json` is loaded into the mock server. If the `RestTemplate` is asked to visit `example.org/`, it gets the responses as being declared at that URL. More than one stub pattern can be specified, and each one can be a directory (for a recursive list of all `.json`), a fixed filename (as in the preceding example), or an Ant-style pattern. The JSON format is the normal WireMock format, which you can read about at the WireMock website.

Currently, the Spring Cloud Contract Verifier supports Tomcat, Jetty, and Undertow as Spring Boot embedded servers, and Wiremock itself has “native” support for a particular version of Jetty (currently 9.2). To use the native Jetty, you need to add the native Wiremock dependencies and exclude the Spring Boot container (if there is one).

4.7. Build Tools Integration

You can run test generation and stub execution in various ways. The most common ones are as follows:

- Maven
- Gradle
- Docker

4.8. What to Read Next

If you want to learn more about any of the classes discussed in this section, you can browse the source code directly. If you have specific questions, see the how-to section.

If you are comfortable with Spring Cloud Contract's core features, you can continue on and read about Spring Cloud Contract's advanced features.

Chapter 5. “How-to” Guides

This section provides answers to some common “how do I do that…” questions that often arise when using Spring Cloud Contract. Its coverage is not exhaustive, but it does cover quite a lot.

If you have a specific problem that we do not cover here, you might want to check out stackoverflow.com to see if someone has already provided an answer. Stack Overflow is also a great place to ask new questions (please use the `spring-cloud-contract` tag).

We are also more than happy to extend this section. If you want to add a “how-to”, send us a pull request.

5.1. Why use Spring Cloud Contract?

Spring Cloud Contract works great in a polyglot environment. This project has a lot of really interesting features. Quite a few of these features definitely make Spring Cloud Contract Verifier stand out on the market of Consumer Driven Contract (CDC) tooling. The most interesting features include the following:

- Ability to do CDC with messaging.
- Clear and easy to use, statically typed DSL.
- Ability to copy-paste your current JSON file to the contract and only edit its elements.
- Automatic generation of tests from the defined Contract.
- Stub Runner functionality: The stubs are automatically downloaded at runtime from Nexus/Artifactory.
- Spring Cloud integration: No discovery service is needed for integration tests.
- Spring Cloud Contract integrates with Pact and provides easy hooks to extend its functionality.
- Ability to add support for any language & framework through Docker.

5.2. How Can I Write Contracts in a Language Other than Groovy?

You can write a contract in YAML. See this section for more information.

We are working on allowing more ways of describing the contracts. You can check the github-issues for more information.

5.3. How Can I Provide Dynamic Values to a Contract?

One of the biggest challenges related to stubs is their reusability. Only if they can be widely used can they serve their purpose. The hard-coded values (such as dates and IDs) of request and response elements generally make that difficult. Consider the following JSON request:

```
{
    "time" : "2016-10-10 20:10:15",
    "id" : "9febab1c-6f36-4a0b-88d6-3b6a6d81cd4a",
    "body" : "foo"
}
```

Now consider the following JSON response:

```
{
    "time" : "2016-10-10 21:10:15",
    "id" : "c4231e1f-3ca9-48d3-b7e7-567d55f0d051",
    "body" : "bar"
}
```

Imagine the pain required to set the proper value of the `time` field (assume that this content is generated by the database) by changing the clock in the system or by providing stub implementations of data providers. The same is related to the field called `id`. You could create a stubbed implementation of UUID generator, but doing so makes little sense.

So, as a consumer, you want to send a request that matches any form of a time or any UUID. That way, your system works as usual, generating data without you having to stub out anything. Assume that, in case of the aforementioned JSON, the most important part is the `body` field. You can focus on that and provide matching for other fields. In other words, you would like the stub to work as follows:

```
{
    "time" : "SOMETHING THAT MATCHES TIME",
    "id" : "SOMETHING THAT MATCHES UUID",
    "body" : "foo"
}
```

As far as the response goes, as a consumer, you need a concrete value on which you can operate. Consequently, the following JSON is valid:

```
{
    "time" : "2016-10-10 21:10:15",
    "id" : "c4231e1f-3ca9-48d3-b7e7-567d55f0d051",
    "body" : "bar"
}
```

In the previous sections, we generated tests from contracts. So, from the producer's side, the situation looks much different. We parse the provided contract, and, in the test, we want to send a real request to your endpoints. So, for the case of a producer for the request, we cannot have any sort of matching. We need concrete values on which the producer's backend can work. Consequently, the following JSON would be valid:

```
{
    "time" : "2016-10-10 20:10:15",
    "id" : "9febab1c-6f36-4a0b-88d6-3b6a6d81cd4a",
    "body" : "foo"
}
```

On the other hand, from the point of view of the validity of the contract, the response does not necessarily have to contain concrete values for `time` or `id`. Suppose you generate those on the producer side. Again, you have to do a lot of stubbing to ensure that you always return the same values. That is why, from the producer's side you might want the following response:

```
{
    "time" : "SOMETHING THAT MATCHES TIME",
    "id" : "SOMETHING THAT MATCHES UUID",
    "body" : "bar"
}
```

How can you then provide a matcher for the consumer and a concrete value for the producer (and the opposite at some other time)? Spring Cloud Contract lets you provide a dynamic value. That means that it can differ for both sides of the communication.

You can read more about this in the Contract DSL section.

Read the Groovy docs related to JSON to understand how to properly structure the request and response bodies.

5.4. How to Do Stubs versioning?

This section covers version of the stubs, which you can handle in a number of different ways:

- API Versioning
- JAR versioning
- Development or Production Stubs

5.4.1. API Versioning

What does versioning really mean? If you refer to the API version, there are different approaches:

- Use hypermedia links and do not version your API by any means
- Pass the version through headers and URLs

We do not try to answer the question of which approach is better. You should pick whatever suits your needs and lets you generate business value.

Assume that you do version your API. In that case, you should provide as many contracts with as many versions as you support. You can create a subfolder for every version or append it to the contract name — whatever suits you best.

5.4.2. JAR versioning

If, by versioning, you mean the version of the JAR that contains the stubs, then there are essentially two main approaches.

Assume that you do continuous delivery and deployment, which means that you generate a new version of the jar each time you go through the pipeline and that the jar can go to production at any time. For example, your jar version looks like the following (because it got built on the 20.10.2016 at 20:15:21) :

```
1.0.0.20161020-201521-RELEASE
```

In that case your, generated stub jar should look like the following:

```
1.0.0.20161020-201521-RELEASE-stubs.jar
```

In this case, you should, inside your `application.yml` or `@AutoConfigureStubRunner` when referencing stubs, provide the latest version of the stubs. You can do that by passing the `+` sign. the following example shows how to do so:

```
@AutoConfigureStubRunner(ids = {"com.example:http-server-dsl:+:stubs:8080"})
```

If the versioning, however, is fixed (for example, `1.0.4.RELEASE` or `2.1.1`), you have to set the concrete value of the jar version. The following example shows how to do so for version 2.1.1:

```
@AutoConfigureStubRunner(ids = {"com.example:http-server-dsl:2.1.1:stubs:8080"})
```

5.4.3. Development or Production Stubs

You can manipulate the classifier to run the tests against current the development version of the stubs of other services or the ones that were deployed to production. If you alter your build to deploy the stubs with the `prod-stubs` classifier once you reach production deployment, you can run tests in one case with development stubs and one with production stubs.

The following example works for tests that use the development version of the stubs:

```
@AutoConfigureStubRunner(ids = {"com.example:http-server-dsl:+:stubs:8080"})
```

The following example works for tests that use the production version of stubs:

```
@AutoConfigureStubRunner(ids = {"com.example:http-server-dsl:+:prod-stubs:8080"})
```

You can also pass those values also in properties from your deployment pipeline.

5.5. How Can I use a Common Repository with Contracts Instead of Storing Them with the Producer?

Another way of storing contracts, rather than having them with the producer, is to keep them in a common place. This situation can be related to security issues (where the consumers cannot clone the producer's code). Also if you keep contracts in a single place, then you, as a producer, know how many consumers you have and which consumer you may break with your local changes.

5.5.1. Repo Structure

Assume that we have a producer with coordinates of `com.example:server` and three consumers: `client1`, `client2`, and `client3`. Then, in the repository with common contracts, you could have the following setup (which you can check out here). The following listing shows such a structure:

```
├──── com
│     └──── example
│         └──── server
│             ├──── client1
│             │     └──── expectation.groovy
│             ├──── client2
│             │     └──── expectation.groovy
│             ├──── client3
│             │     └──── expectation.groovy
│             └──── pom.xml
├──── mvnw
├──── mvnw.cmd
├──── pom.xml
└──── src
    └──── assembly
        └──── contracts.xml
```

As you can see under the slash-delimited `groupid/artifact id` folder (`com/example/server`) you have expectations of the three consumers (`client1`, `client2`, and `client3`). Expectations are the standard Groovy DSL contract files, as described throughout this documentation. This repository has to produce a JAR file that maps one-to-one to the contents of the repository.

The following example shows a `pom.xml` inside the `server` folder:

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xmlns="http://maven.apache.org/POM/4.0.0"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
https://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <groupId>com.example</groupId>
    <artifactId>server</artifactId>
    <version>0.0.1-SNAPSHOT</version>

    <name>Server Stubs</name>
    <description>POM used to install locally stubs for consumer side</description>

    <parent>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-parent</artifactId>
        <version>2.2.0.BUILD-SNAPSHOT</version>
        <relativePath/>
    </parent>

    <properties>
        <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
```

```
        <java.version>1.8</java.version>
        <spring-cloud-contract.version>2.2.0.BUILD-SNAPSHOT</spring-cloud-
contract.version>
        <spring-cloud-release.version>Hoxton.BUILD-SNAPSHOT</spring-cloud-
release.version>
        <excludeBuildFolders>true</excludeBuildFolders>
    </properties>

    <dependencyManagement>
        <dependencies>
            <dependency>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-dependencies</artifactId>
                <version>${spring-cloud-release.version}</version>
                <type>pom</type>
                <scope>import</scope>
            </dependency>
        </dependencies>
    </dependencyManagement>

    <build>
        <plugins>
            <plugin>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-contract-maven-plugin</artifactId>
                <version>${spring-cloud-contract.version}</version>
                <extensions>true</extensions>
                <configuration>
                    <!-- By default it would search under src/test/resources/ -->
                    <contractsDirectory>${project.basedir}</contractsDirectory>
                </configuration>
            </plugin>
        </plugins>
    </build>

    <repositories>
        <repository>
            <id>spring-snapshots</id>
            <name>Spring Snapshots</name>
            <url>https://repo.spring.io/snapshot</url>
            <snapshots>
                <enabled>true</enabled>
            </snapshots>
        </repository>
        <repository>
            <id>spring-milestones</id>
            <name>Spring Milestones</name>
            <url>https://repo.spring.io/milestone</url>
            <snapshots>
                <enabled>false</enabled>
            </snapshots>
```

```
        </repository>
        <repository>
            <id>spring-releases</id>
            <name>Spring Releases</name>
            <url>https://repo.spring.io/release</url>
            <snapshots>
                <enabled>false</enabled>
            </snapshots>
        </repository>
    </repositories>
    <pluginRepositories>
        <pluginRepository>
            <id>spring-snapshots</id>
            <name>Spring Snapshots</name>
            <url>https://repo.spring.io/snapshot</url>
            <snapshots>
                <enabled>true</enabled>
            </snapshots>
        </pluginRepository>
        <pluginRepository>
            <id>spring-milestones</id>
            <name>Spring Milestones</name>
            <url>https://repo.spring.io/milestone</url>
            <snapshots>
                <enabled>false</enabled>
            </snapshots>
        </pluginRepository>
        <pluginRepository>
            <id>spring-releases</id>
            <name>Spring Releases</name>
            <url>https://repo.spring.io/release</url>
            <snapshots>
                <enabled>false</enabled>
            </snapshots>
        </pluginRepository>
    </pluginRepositories>

</project>
```

There are no dependencies other than the Spring Cloud Contract Maven Plugin. Those pom files are necessary for the consumer side to run `mvn clean install -DskipTests` to locally install the stubs of the producer project.

The `pom.xml` in the root folder can look like the following:

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xmlns="http://maven.apache.org/POM/4.0.0"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
https://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>

    <groupId>com.example.standalone</groupId>
    <artifactId>contracts</artifactId>
    <version>0.0.1-SNAPSHOT</version>

    <name>Contracts</name>
    <description>Contains all the Spring Cloud Contracts, well, contracts. JAR
used by the
        producers to generate tests and stubs
    </description>

    <properties>
        <project.build.sourceEncoding>UTF-8</project.build.sourceEncoding>
    </properties>

    <build>
        <plugins>
            <plugin>
                <groupId>org.apache.maven.plugins</groupId>
                <artifactId>maven-assembly-plugin</artifactId>
                <executions>
                    <execution>
                        <id>contracts</id>
                        <phase>prepare-package</phase>
                        <goals>
                            <goal>single</goal>
                        </goals>
                        <configuration>
                            <attach>true</attach>

<descriptor>${basedir}/src/assembly/contracts.xml</descriptor>
                            <!-- If you want an explicit classifier remove the
following line -->
                            <appendAssemblyId>false</appendAssemblyId>
                        </configuration>
                    </execution>
                </executions>
            </plugin>
        </plugins>
    </build>

</project>
```

It uses the assembly plugin to build the JAR with all the contracts. The following example shows such a setup:

```
<assembly xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
          xmlns="http://maven.apache.org/plugins/maven-assembly-
plugin/assembly/1.1.3"
          xsi:schemaLocation="http://maven.apache.org/plugins/maven-assembly-
plugin/assembly/1.1.3 https://maven.apache.org/xsd/assembly-1.1.3.xsd">
    <id>project</id>
    <formats>
        <format>jar</format>
    </formats>
    <includeBaseDirectory>false</includeBaseDirectory>
    <fileSets>
        <fileSet>
            <directory>${project.basedir}</directory>
            <outputDirectory>/</outputDirectory>
            <useDefaultExcludes>true</useDefaultExcludes>
            <excludes>
                <exclude>**/${project.build.directory}/**</exclude>
                <exclude>mvnw</exclude>
                <exclude>mvnw.cmd</exclude>
                <exclude>.mvn/**</exclude>
                <exclude>src/**</exclude>
            </excludes>
        </fileSet>
    </fileSets>
</assembly>
```

5.5.2. Workflow

The workflow assumes that Spring Cloud Contract is set up both on the consumer and on the producer side. There is also the proper plugin setup in the common repository with contracts. The CI jobs are set for a common repository to build an artifact of all contracts and upload it to Nexus/Artifactory. The following image shows the UML for this workflow:

[how to common repo] | *how-to-common-repo.png*

5.5.3. Consumer

When the consumer wants to work on the contracts offline, instead of cloning the producer code, the consumer team clones the common repository, goes to the required producer's folder (for example, `com/example/server`) and runs `mvn clean install -DskipTests` to locally install the stubs converted from the contracts.

You need to have Maven installed locally

5.5.4. Producer

As a producer, you can to alter the Spring Cloud Contract Verifier to provide the URL and the dependency of the JAR that contains the contracts, as follows:

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <configuration>
        <contractsMode>REMOTE</contractsMode>
        <contractsRepositoryUrl>
            https://link/to/your/nexus/or/artifactory/or/sth
        </contractsRepositoryUrl>
        <contractDependency>
            <groupId>com.example.standalone</groupId>
            <artifactId>contracts</artifactId>
        </contractDependency>
    </configuration>
</plugin>
```

With this setup, the JAR with a groupid of `com.example.standalone` and artifactid `contracts` is downloaded from `link/to/your/nexus/or/artifactory/or/sth`. It is then unpacked in a local temporary folder, and the contracts present in `com/example/server` are picked as the ones used to generate the tests and the stubs. Due to this convention, the producer team can know which consumer teams will be broken when some incompatible changes are made.

The rest of the flow looks the same.

5.5.5. How Can I Define Messaging Contracts per Topic Rather than per Producer?

To avoid messaging contracts duplication in the common repository, when a few producers write messages to one topic, we could create a structure in which the REST contracts are placed in a folder per producer and messaging contracts are placed in the folder per topic.

For Maven Projects

To make it possible to work on the producer side, we should specify an inclusion pattern for filtering common repository jar files by messaging topics we are interested in. The `includedFiles` property of the Maven Spring Cloud Contract plugin lets us do so. Also, `contractsPath` need to be specified, since the default path would be the common repository `groupid/artifactid`. The following example shows a Maven plugin for Spring Cloud Contract:

```
<plugin>
   <groupId>org.springframework.cloud</groupId>
   <artifactId>spring-cloud-contract-maven-plugin</artifactId>
   <version>${spring-cloud-contract.version}</version>
   <configuration>
      <contractsMode>REMOTE</contractsMode>

<contractsRepositoryUrl>https://link/to/your/nexus/or/artifactory/or/sth</contract
sRepositoryUrl>
      <contractDependency>
         <groupId>com.example</groupId>
         <artifactId>common-repo-with-contracts</artifactId>
         <version>+</version>
      </contractDependency>
      <contractsPath>/</contractsPath>
      <baseClassMappings>
         <baseClassMapping>
            <contractPackageRegex>.*messaging.*</contractPackageRegex>
            <baseClassFQN>com.example.services.MessagingBase</baseClassFQN>
         </baseClassMapping>
         <baseClassMapping>
            <contractPackageRegex>.*rest.*</contractPackageRegex>
            <baseClassFQN>com.example.services.TestBase</baseClassFQN>
         </baseClassMapping>
      </baseClassMappings>
      <includedFiles>
         <includedFile>**/${project.artifactId}/**</includedFile>
         <includedFile>**/${first-topic}/**</includedFile>
         <includedFile>**/${second-topic}/**</includedFile>
      </includedFiles>
   </configuration>
</plugin>
```

Many of the values in the preceding Maven plugin can be changed. We included it for illustration purposes rather than trying to provide a “typical” example.

For Gradle Projects

To work with a Gradle project:

1. Add a custom configuration for the common repository dependency, as follows:

```
ext {
    conractsGroupId = "com.example"
    contractsArtifactId = "common-repo"
    contractsVersion = "1.2.3"
}

configurations {
    contracts {
        transitive = false
    }
}
```

2. Add the common repository dependency to your classpath, as follows:

```
dependencies {
    contracts "${conractsGroupId}:${contractsArtifactId}:${contractsVersion}"
    testCompile "${conractsGroupId}:${contractsArtifactId}:${contractsVersion}"
}
```

3. Download the dependency to an appropriate folder, as follows:

```
task getContracts(type: Copy) {
    from configurations.contracts
    into new File(project.buildDir, "downloadedContracts")
}
```

4. Unzip the JAR, as follows:

```
task unzipContracts(type: Copy) {
    def zipFile = new File(project.buildDir,
"downloadedContracts/${contractsArtifactId}-${contractsVersion}.jar")
    def outputDir = file("${buildDir}/unpackedContracts")

    from zipTree(zipFile)
    into outputDir
}
```

5. Cleanup unused contracts, as follows:

```
task deleteUnwantedContracts(type: Delete) {
    delete fileTree(dir: "${buildDir}/unpackedContracts",
        include: "**/*",
        excludes: [
            "**/${project.name}/**"",
            "**/${first-topic}/**",
            "**/${second-topic}/**"])
}
```

6. Create task dependencies, as follows:

```
unzipContracts.dependsOn("getContracts")
deleteUnwantedContracts.dependsOn("unzipContracts")
build.dependsOn("deleteUnwantedContracts")
```

7. Configure the plugin by specifying the directory that contains the contracts, by setting the `contractsDslDir` property, as follows:

```
contracts {
    contractsDslDir = new File("${buildDir}/unpackedContracts")
}
```

5.6. How Can I Use Git as the Storage for Contracts and Stubs?

In the polyglot world, there are languages that do not use binary storages, as Artifactory or Nexus do. Starting from Spring Cloud Contract version 2.0.0, we provide mechanisms to store contracts and stubs in a SCM (Source Control Management) repository. Currently, the only supported SCM is Git.

The repository would have to have the following setup (which you can checkout from here):

```
.
└── META-INF
    └── com.example
        └── beer-api-producer-git
            └── 0.0.1-SNAPSHOT
                ├── contracts
                │   └── beer-api-consumer
                │       ├── messaging
                │       │   ├── shouldSendAcceptedVerification.groovy
                │       │   └── shouldSendRejectedVerification.groovy
                │       └── rest
                │           ├── shouldGrantABeerIfOldEnough.groovy
                │           └── shouldRejectABeerIfTooYoung.groovy
                └── mappings
                    └── beer-api-consumer
                        └── rest
                            ├── shouldGrantABeerIfOldEnough.json
                            └── shouldRejectABeerIfTooYoung.json
```

Under the `META-INF` folder:

- We group applications by `groupId` (such as `com.example`).
- Each application is represented by its `artifactId` (for example, `beer-api-producer-git`).
- Next, each application is organized by its version (such as `0.0.1-SNAPSHOT`). Starting from Spring Cloud Contract version `2.1.0`, you can specify the versions as follows (assuming that your versions follow semantic versioning):
  - `+` or `latest`: To find the latest version of your stubs (assuming that the snapshots are always the latest artifact for a given revision number). That means:
    - If you have `1.0.0.RELEASE`, `2.0.0.BUILD-SNAPSHOT`, and `2.0.0.RELEASE`, we assume that the latest is `2.0.0.BUILD-SNAPSHOT`.
    - If you have `1.0.0.RELEASE` and `2.0.0.RELEASE`, we assume that the latest is `2.0.0.RELEASE`.
    - If you have a version called `latest` or `+`, we will pick that folder.
  - `release`: To find the latest release version of your stubs. That means:
    - If you have `1.0.0.RELEASE`, `2.0.0.BUILD-SNAPSHOT`, and `2.0.0.RELEASE` we assume that the latest is `2.0.0.RELEASE`.
    - If you have a version called `release`, we pick that folder.

Finally, there are two folders:

- `contracts`: The good practice is to store the contracts required by each consumer in the folder with the consumer name (such as `beer-api-consumer`). That way, you can use the `stubs-per-consumer` feature. Further directory structure is arbitrary.
- `mappings`: The Maven or Gradle Spring Cloud Contract plugins push the stub server mappings in

this folder. On the consumer side, Stub Runner scans this folder to start stub servers with stub definitions. The folder structure is a copy of the one created in the `contracts` subfolder.

5.6.1. Protocol Convention

To control the type and location of the source of contracts (whether binary storage or an SCM repository), you can use the protocol in the URL of the repository. Spring Cloud Contract iterates over registered protocol resolvers and tries to fetch the contracts (by using a plugin) or stubs (from Stub Runner).

For the SCM functionality, currently, we support the Git repository. To use it, in the property where the repository URL needs to be placed, you have to prefix the connection URL with `git://`. The following listing shows some examples:

```
git://file:///foo/bar
git://https://github.com/spring-cloud-samples/spring-cloud-contract-nodejs-contracts-git.git
git://git@github.com:spring-cloud-samples/spring-cloud-contract-nodejs-contracts-git.git
```

5.6.2. Producer

For the producer, to use the SCM (Source Control Management) approach, we can reuse the same mechanism we use for external contracts. We route Spring Cloud Contract to use the SCM implementation from the URL that starts with the `git://` protocol.

You have to manually add the `pushStubsToScm` goal in Maven or execute (bind) the `pushStubsToScm` task in Gradle. We do not push stubs to the `origin` of your git repository.

The following listing includes the relevant parts both Maven and Gradle build files:

maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <!-- Base class mappings etc. -->

        <!-- We want to pick contracts from a Git repository -->
        <contractsRepositoryUrl>git://https://github.com/spring-cloud-
samples/spring-cloud-contract-nodejs-contracts-git.git</contractsRepositoryUrl>

        <!-- We reuse the contract dependency section to set up the path
        to the folder that contains the contract definitions. In our case the
        path will be /groupId/artifactId/version/contracts -->
        <contractDependency>
            <groupId>${project.groupId}</groupId>
            <artifactId>${project.artifactId}</artifactId>
            <version>${project.version}</version>
        </contractDependency>

        <!-- The contracts mode can't be classpath -->
        <contractsMode>REMOTE</contractsMode>
    </configuration>
    <executions>
        <execution>
            <phase>package</phase>
            <goals>
                <!-- By default we will not push the stubs back to SCM,
                you have to explicitly add it as a goal -->
                <goal>pushStubsToScm</goal>
            </goals>
        </execution>
    </executions>
</plugin>
```

gradle

```
contracts {
    // We want to pick contracts from a Git repository
    contractDependency {
        stringNotation = "${project.group}:${project.name}:${project.version}"
    }
    /*
    We reuse the contract dependency section to set up the path
    to the folder that contains the contract definitions. In our case the
    path will be /groupId/artifactId/version/contracts
     */
    contractRepository {
        repositoryUrl = "git://https://github.com/spring-cloud-samples/spring-
cloud-contract-nodejs-contracts-git.git"
    }
    // The mode can't be classpath
    contractsMode = "REMOTE"
    // Base class mappings etc.
}

/*
In this scenario we want to publish stubs to SCM whenever
the `publish` task is executed
*/
publish.dependsOn("publishStubsToScm")
```

With such a setup:

- A git project is cloned to a temporary directory
- The SCM stub downloader goes to `META-INF/groupId/artifactId/version/contracts` folder to find contracts. For example, for `com.example:foo:1.0.0`, the path would be `META-INF/com.example/foo/1.0.0/contracts`.
- Tests are generated from the contracts.
- Stubs are created from the contracts.
- Once the tests pass, the stubs are committed in the cloned repository.
- Finally, a push is sent to that repo's `origin`.

5.6.3. Producer with Contracts Stored Locally

Another option to use the SCM as the destination for stubs and contracts is to store the contracts locally, with the producer, and only push the contracts and the stubs to SCM. The following listing shows the setup required to achieve this with Maven and Gradle:

maven

```
```

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <!-- In the default configuration, we want to use the contracts stored locally
-->
    <configuration>
        <baseClassMappings>
            <baseClassMapping>
                <contractPackageRegex>.*messaging.*</contractPackageRegex>
                <baseClassFQN>com.example.BeerMessagingBase</baseClassFQN>
            </baseClassMapping>
            <baseClassMapping>
                <contractPackageRegex>.*rest.*</contractPackageRegex>
                <baseClassFQN>com.example.BeerRestBase</baseClassFQN>
            </baseClassMapping>
        </baseClassMappings>
        <basePackageForTests>com.example</basePackageForTests>
    </configuration>
    <executions>
        <execution>
            <phase>package</phase>
            <goals>
                <!-- By default we will not push the stubs back to SCM,
                you have to explicitly add it as a goal -->
                <goal>pushStubsToScm</goal>
            </goals>
            <configuration>
                <!-- We want to pick contracts from a Git repository -->

<contractsRepositoryUrl>git://file://${env.ROOT}/target/contract_empty_git/
                </contractsRepositoryUrl>
                <!-- Example of URL via git protocol -->
                <!--<contractsRepositoryUrl>git://git@github.com:spring-cloud-
samples/spring-cloud-contract-samples.git</contractsRepositoryUrl>-->
                <!-- Example of URL via http protocol -->
                <!--<contractsRepositoryUrl>git://https://github.com/spring-cloud-
samples/spring-cloud-contract-samples.git</contractsRepositoryUrl>-->
                <!-- We reuse the contract dependency section to set up the path
                to the folder that contains the contract definitions. In our case
the
                path will be /groupId/artifactId/version/contracts -->
                <contractDependency>
                    <groupId>${project.groupId}</groupId>
                    <artifactId>${project.artifactId}</artifactId>
                    <version>${project.version}</version>
                </contractDependency>
                <!-- The mode can't be classpath -->
                <contractsMode>LOCAL</contractsMode>
            </configuration>
```

```
        </execution>
    </executions>
</plugin>
```

gradle

```
contracts {
        // Base package for generated tests
    basePackageForTests = "com.example"
    baseClassMappings {
        baseClassMapping(".*messaging.*", "com.example.BeerMessagingBase")
        baseClassMapping(".*rest.*", "com.example.BeerRestBase")
    }
}

/*
In this scenario we want to publish stubs to SCM whenever
the `publish` task is executed
*/
publishStubsToScm {
    // We want to modify the default set up of the plugin when publish stubs to
scm is called
    customize {
        // We want to pick contracts from a Git repository
        contractDependency {
            stringNotation = "${project.group}:${project.name}:${project.version}"
        }
        /*
        We reuse the contract dependency section to set up the path
        to the folder that contains the contract definitions. In our case the
        path will be /groupId/artifactId/version/contracts
         */
        contractRepository {
            repositoryUrl = "git://file://${new File(project.rootDir,
"../target")}/contract_empty_git/"
        }
        // The mode can't be classpath
        contractsMode = "LOCAL"
    }
}

publish.dependsOn("publishStubsToScm")
publishToMavenLocal.dependsOn("publishStubsToScm")
```

With such a setup:

- Contracts from the default `src/test/resources/contracts` directory are picked.
- Tests are generated from the contracts.

- Stubs are created from the contracts.
- Once the tests pass:
  - The git project is cloned to a temporary directory.
  - The stubs and contracts are committed in the cloned repository.
- Finally, a push is done to that repository's `origin`.

5.6.4. Keeping Contracts with the Producer and Stubs in an External Repository

You can also keep the contracts in the producer repository but keep the stubs in an external git repository. This is most useful when you want to use the base consumer-producer collaboration flow but cannot use an artifact repository to store the stubs.

To do so, use the usual producer setup and then add the `pushStubsToScm` goal and set `contractsRepositoryUrl` to the repository where you want to keep the stubs.

5.6.5. Consumer

On the consumer side, when passing the `repositoryRoot` parameter, either from the `@AutoConfigureStubRunner` annotation, the JUnit rule, JUnit 5 extension, or properties, you can pass the URL of the SCM repository, prefixed with the `git://` protocol. The following example shows how to do so:

```
@AutoConfigureStubRunner(
    stubsMode="REMOTE",
    repositoryRoot="git://https://github.com/spring-cloud-samples/spring-cloud-
contract-nodejs-contracts-git.git",
    ids="com.example:bookstore:0.0.1.RELEASE"
)
```

With such a setup:

- The git project is cloned to a temporary directory.
- The SCM stub downloader goes to thje `META-INF/groupId/artifactId/version/` folder to find stub definitions and contracts. For example, for `com.example:foo:1.0.0`, the path would be `META-INF/com.example/foo/1.0.0/`.
- Stub servers are started and fed with mappings.
- Messaging definitions are read and used in the messaging tests.

5.7. How Can I Use the Pact Broker?

When using Pact, you can use the Pact Broker to store and share Pact definitions. Starting from Spring Cloud Contract 2.0.0, you can fetch Pact files from the Pact Broker to generate tests and

stubs.

Pact follows the consumer contract convention. That means that the consumer creates the Pact definitions first and then shares the files with the Producer. Those expectations are generated from the Consumer's code and can break the Producer if the expectations are not met.

5.7.1. How to Work with Pact

Spring Cloud Contract includes support for the Pact representation of contracts up until version 4. Instead of using the DSL, you can use Pact files. In this section, we show how to add Pact support for your project. Note, however, that not all functionality is supported. Starting with version 3, you can combine multiple matchers for the same element; you can use matchers for the body, headers, request and path; and you can use value generators. Spring Cloud Contract currently only supports multiple matchers that are combined by using the `AND` rule logic. Next to that, the request and path matchers are skipped during the conversion. When using a date, time, or datetime value generator with a given format, the given format is skipped and the ISO format is used.

5.7.2. Pact Converter

In order to properly support the Spring Cloud Contract way of doing messaging with Pact, you have to provide some additional meta data entries.

To define the destination to which a message gets sent, you have to set a `metaData` entry in the Pact file with the `sentTo` key equal to the destination to which a message is to be sent (for example, `"metaData": { "sentTo": "activemq:output" }`).

5.7.3. Pact Contract

Spring Cloud Contract can read the Pact JSON definition. You can place the file in the `src/test/resources/contracts` folder. Remember to put the `spring-cloud-contract-pact` dependency to your classpath. The following example shows such a Pact contract:

```
{
  "provider": {
    "name": "Provider"
  },
  "consumer": {
    "name": "Consumer"
  },
  "interactions": [
    {
      "description": "",
      "request": {
        "method": "PUT",
        "path": "/pactfraudcheck",
        "headers": {
          "Content-Type": "application/json"
```

```
    },
    "body": {
      "clientId": "1234567890",
      "loanAmount": 99999
    },
    "generators": {
      "body": {
        "$.clientId": {
          "type": "Regex",
          "regex": "[0-9]{10}"
        }
      }
    },
    "matchingRules": {
      "header": {
        "Content-Type": {
          "matchers": [
            {
              "match": "regex",
              "regex": "application/json.*"
            }
          ],
          "combine": "AND"
        }
      },
      "body": {
        "$.clientId": {
          "matchers": [
            {
              "match": "regex",
              "regex": "[0-9]{10}"
            }
          ],
          "combine": "AND"
        }
      }
    }
  },
  "response": {
    "status": 200,
    "headers": {
      "Content-Type": "application/json"
    },
    "body": {
      "fraudCheckStatus": "FRAUD",
      "rejection.reason": "Amount too high"
    },
    "matchingRules": {
      "header": {
        "Content-Type": {
          "matchers": [
```

```
                {
                  "match": "regex",
                  "regex": "application/json.*"
                }
              ],
              "combine": "AND"
            }
          },
          "body": {
            "$.fraudCheckStatus": {
              "matchers": [
                {
                  "match": "regex",
                  "regex": "FRAUD"
                }
              ],
              "combine": "AND"
            }
          }
        }
      }
    ],
    "metadata": {
      "pact-specification": {
        "version": "3.0.0"
      },
      "pact-jvm": {
        "version": "3.5.13"
      }
    }
}
```

5.7.4. Pact for Producers

On the producer side, you must add two additional dependencies to your plugin configuration. One is the Spring Cloud Contract Pact support, and the other represents the current Pact version that you use. The following listing shows how to do so for both Maven and Gradle:

Maven

```
```

Gradle

```
// if additional dependencies are needed e.g. for Pact
classpath "org.springframework.cloud:spring-cloud-contract-
pact:${findProperty('verifierVersion') ?: verifierVersion}"
```

When you execute the build of your application, a test and stub is generated. The following example shows a test and stub that came from this process:

test

```
@Test
    public void validate_shouldMarkClientAsFraud() throws Exception {
        // given:
            MockMvcRequestSpecification request = given()
                    .header("Content-Type", "application/vnd.fraud.v1+json")
                    .body("{\"clientId\":\"1234567890\",\"loanAmount\":99999}");

        // when:
            ResponseOptions response = given().spec(request)
                    .put("/fraudcheck");

        // then:
            assertThat(response.statusCode()).isEqualTo(200);
            assertThat(response.header("Content-
Type")).matches("application/vnd\\.fraud\\.v1\\+json.*");
        // and:
            DocumentContext parsedJson =
JsonPath.parse(response.getBody().asString());

assertThatJson(parsedJson).field("['rejectionReason']").isEqualTo("Amount too
high");
        // and:
            assertThat(parsedJson.read("$.fraudCheckStatus",
String.class)).matches("FRAUD");
    }
```

stub

```
{
  "id" : "996ae5ae-6834-4db6-8fac-358ca187ab62",
  "uuid" : "996ae5ae-6834-4db6-8fac-358ca187ab62",
  "request" : {
    "url" : "/fraudcheck",
    "method" : "PUT",
    "headers" : {
      "Content-Type" : {
        "matches" : "application/vnd\\.fraud\\.v1\\+json.*"
      }
    },
    "bodyPatterns" : [ {
      "matchesJsonPath" : "$[?(@.['loanAmount'] = 99999)]"
    }, {
      "matchesJsonPath" : "$[?(@.clientId =~ /([0-9]{10})/)]"
    } ]
  },
  "response" : {
    "status" : 200,
    "body" : "{\"fraudCheckStatus\":\"FRAUD\",\"rejectionReason\":\"Amount too
high\"}",
    "headers" : {
      "Content-Type" : "application/vnd.fraud.v1+json;charset=UTF-8"
    },
    "transformers" : [ "response-template" ]
  },
}
```

5.7.5. Pact for Consumers

On the consumer side, you must add two additional dependencies to your project dependencies. One is the Spring Cloud Contract Pact support, and the other represents the current Pact version that you use. The following listing shows how to do so for both Maven and Gradle:

Maven

Gradle

5.7.6. Communicating with the Pact Broker

Whenever the `repositoryRoot` property starts with a Pact protocol (starts with `pact://`), the stub downloader tries to fetch the Pact contract definitions from the Pact Broker. Whatever is set after

`pact://` is parsed as the Pact Broker URL.

By setting environment variables, system properties, or properties set inside the plugin or contracts repository configuration, you can tweak the downloader's behavior. The following table describes the properties:

Table 1. Pact Stub Downloader properties

Name of a property	Default	Description
* `pactbroker.host` (plugin prop) * `stubrunner.properties.pactbroker.host` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_HOST` (env prop)	Host from URL passed to `repositoryRoot`	The URL of the Pact Broker.
* `pactbroker.port` (plugin prop) * `stubrunner.properties.pactbroker.port` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_PORT` (env prop)	Port from URL passed to `repositoryRoot`	The port of Pact Broker.
* `pactbroker.protocol` (plugin prop) * `stubrunner.properties.pactbroker.protocol` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_PROTOCOL` (env prop)	Protocol from URL passed to `repositoryRoot`	The protocol of Pact Broker.
* `pactbroker.tags` (plugin prop) * `stubrunner.properties.pactbroker.tags` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_TAGS` (env prop)	Version of the stub, or `latest` if version is `+`	The tags that should be used to fetch the stub.

* `pactbroker.auth.scheme` (plugin prop) * `stubrunner.properties.pactbroker.auth.scheme` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_AUTH_SCHEME` (env prop)	`Basic`	The kind of authentication that should be used to connect to the Pact Broker.
* `pactbroker.auth.username` (plugin prop) * `stubrunner.properties.pactbroker.auth.username` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_AUTH_USERNAME` (env prop)	The username passed to `contractsRepositoryUsername` (maven) or `contractRepository.username` (gradle)	The username to use when connecting to the Pact Broker.
* `pactbroker.auth.password` (plugin prop) * `stubrunner.properties.pactbroker.auth.password` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_AUTH_PASSWORD` (env prop)	The password passed to `contractsRepositoryPassword` (maven) or `contractRepository.password` (gradle)	The password to use when connecting to the Pact Broker.
* `pactbroker.provider-name-with-group-id` (plugin prop) * `stubrunner.properties.pactbroker.provider-name-with-group-id` (system prop) * `STUBRUNNER_PROPERTIES_PACTBROKER_PROVIDER_NAME_WITH_GROUP_ID` (env prop)	false	When `true`, the provider name is a combination of `groupId:artifactId`. If `false`, only `artifactId` is used.

5.7.7. Flow: Consumer Contract approach with Pact Broker | Consumer Side

The consumer uses the Pact framework to generate Pact files. The Pact files are sent to the Pact Broker. You can find an example of such a setup here.

5.7.8. Flow: Consumer Contract Approach with Pact Broker on the Producer Side

For the producer to use the Pact files from the Pact Broker, we can reuse the same mechanism we use for external contracts. We route Spring Cloud Contract to use the Pact implementation with the URL that contains the `pact://` protocol. You can pass the URL to the Pact Broker. You can find an example of such a setup here. The following listing shows the configuration details for both Maven and Gradle:

maven

```
<plugin>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-contract-maven-plugin</artifactId>
    <version>${spring-cloud-contract.version}</version>
    <extensions>true</extensions>
    <configuration>
        <!-- Base class mappings etc. -->

        <!-- We want to pick contracts from a Git repository -->

<contractsRepositoryUrl>pact://http://localhost:8085</contractsRepositoryUrl>

        <!-- We reuse the contract dependency section to set up the path
        to the folder that contains the contract definitions. In our case the
        path will be /groupId/artifactId/version/contracts -->
        <contractDependency>
            <groupId>${project.groupId}</groupId>
            <artifactId>${project.artifactId}</artifactId>
            <!-- When + is passed, a latest tag will be applied when fetching
pacts -->
            <version>+</version>
        </contractDependency>

        <!-- The contracts mode can't be classpath -->
        <contractsMode>REMOTE</contractsMode>
    </configuration>
    <!-- Don't forget to add spring-cloud-contract-pact to the classpath! -->
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-contract-pact</artifactId>
            <version>${spring-cloud-contract.version}</version>
        </dependency>
    </dependencies>
</plugin>
```

gradle

```
buildscript {
    repositories {
        //...
    }

    dependencies {
        // ...
        // Don't forget to add spring-cloud-contract-pact to the classpath!
        classpath "org.springframework.cloud:spring-cloud-contract-
pact:${contractVersion}"
    }
}

contracts {
    // When + is passed, a latest tag will be applied when fetching pacts
    contractDependency {
        stringNotation = "${project.group}:${project.name}:+"
    }
    contractRepository {
        repositoryUrl = "pact://http://localhost:8085"
    }
    // The mode can't be classpath
    contractsMode = "REMOTE"
    // Base class mappings etc.
}
```

With such a setup:

- Pact files are downloaded from the Pact Broker.
- Spring Cloud Contract converts the Pact files into tests and stubs.
- The JAR with the stubs gets automatically created, as usual.

5.7.9. Flow: Producer Contract approach with Pact on the Consumer Side

In the scenario where you do not want to do the consumer contract approach (for every single consumer, define the expectations) but you prefer to do producer contracts (the producer provides the contracts and publishes stubs), you can use Spring Cloud Contract with the Stub Runner option. You can find an example of such a setup here.

Remember to add the Stub Runner and Spring Cloud Contract Pact modules as test dependencies.

The following listing shows the configuration details for both Maven and Gradle:

maven

```
<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-dependencies</artifactId>
            <version>${spring-cloud.version}</version>
            <type>pom</type>
            <scope>import</scope>
        </dependency>
    </dependencies>
</dependencyManagement>

<!-- Don't forget to add spring-cloud-contract-pact to the classpath! -->
<dependencies>
    <!-- ... -->
    <dependency>
        <groupId>org.springframework.cloud</groupId>
        <artifactId>spring-cloud-starter-contract-stub-runner</artifactId>
        <scope>test</scope>
    </dependency>
    <dependency>
        <groupId>org.springframework.cloud</groupId>
        <artifactId>spring-cloud-contract-pact</artifactId>
        <scope>test</scope>
    </dependency>
</dependencies>
```

gradle

```
dependencyManagement {
    imports {
        mavenBom "org.springframework.cloud:spring-cloud-
dependencies:${springCloudVersion}"
    }
}

dependencies {
    //...
    testCompile("org.springframework.cloud:spring-cloud-starter-contract-stub-
runner")
    // Don't forget to add spring-cloud-contract-pact to the classpath!
    testCompile("org.springframework.cloud:spring-cloud-contract-pact")
}
```

Next, you can pass the URL of the Pact Broker to `repositoryRoot`, prefixed with `pact://` protocol (for example, `pact://http://localhost:8085`), as the following example shows:

```
@RunWith(SpringRunner.class)
@SpringBootTest
@AutoConfigureStubRunner(stubsMode = StubRunnerProperties.StubsMode.REMOTE,
        ids = "com.example:beer-api-producer-pact",
        repositoryRoot = "pact://http://localhost:8085")
public class BeerControllerTest {
    //Inject the port of the running stub
    @StubRunnerPort("beer-api-producer-pact") int producerPort;
    //...
}
```

With such a setup:

- Pact files are downloaded from the Pact Broker.
- Spring Cloud Contract converts the Pact files into stub definitions.
- The stub servers are started and fed with stubs.

5.8. How Can I Debug the Request/Response Being Sent by the Generated Tests Client?

The generated tests all boil down to RestAssured in some form or fashion. RestAssured relies on the Apache HttpClient. HttpClient has a facility called wire logging, which logs the entire request and response to HttpClient. Spring Boot has a logging common application property for doing this sort of thing. To use it, add this to your application properties, as follows:

```
logging.level.org.apache.http.wire=DEBUG
```

5.9. How Can I Debug the Mapping, Request, or Response Being Sent by WireMock?

Starting from version `1.2.0`, we turn on WireMock logging to `info` and set the WireMock notifier to being verbose. Now you can exactly know what request was received by the WireMock server and which matching response definition was picked.

To turn off this feature, set WireMock logging to `ERROR`, as follows:

```
logging.level.com.github.tomakehurst.wiremock=ERROR
```

5.10. How Can I See What Got Registered in the HTTP Server Stub?

You can use the `mappingsOutputFolder` property on `@AutoConfigureStubRunner`, `StubRunnerRule`, or `StubRunnerExtension`to dump all mappings per artifact ID. Also the port at which the given stub server was started is attached.

5.11. How Can I Reference Text from File?

In version 1.2.0, we added this ability. You can call a `file(…)` method in the DSL and provide a path relative to where the contract lies. If you use YAML, you can use the `bodyFromFile` property.

5.12. How Can I Generate Pact, YAML, or X files from Spring Cloud Contract Contracts?

Spring Cloud Contract comes with a `ToFileContractsTransformer` class that lets you dump contracts as files for the given `ContractConverter`. It contains a `static void main` method that lets you execute the transformer as an executable. It takes the following arguments:

- argument 1 : `FQN`: Fully qualified name of the `ContractConverter` (for example, `PactContractConverter`). **REQUIRED**.
- argument 2 : `path`: Path where the dumped files should be stored. **OPTIONAL** — defaults to `target/converted-contracts`.
- argument 3 : `path`: Path were the contracts should be searched for. **OPTIONAL** — defaults to `src/test/resources/contracts`.

After executing the transformer, the Spring Cloud Contract files are processed and, depending on the provided FQN of the `ContractTransformer`, the contracts are transformed to the required format and dumped to the provided folder.

The following example shows how to configure Pact integration for both Maven and Gradle:

maven

```
<plugin>
    <groupId>org.codehaus.mojo</groupId>
    <artifactId>exec-maven-plugin</artifactId>
    <version>1.6.0</version>
    <executions>
        <execution>
            <id>convert-dsl-to-pact</id>
            <phase>process-test-classes</phase>
            <configuration>
                <classpathScope>test</classpathScope>
                <mainClass>

org.springframework.cloud.contract.verifier.util.ToFileContractsTransformer
                </mainClass>
                <arguments>
                    <argument>

org.springframework.cloud.contract.verifier.spec.pact.PactContractConverter
                    </argument>
                    <argument>${project.basedir}/target/pacts</argument>
                    <argument>
                        ${project.basedir}/src/test/resources/contracts
                    </argument>
                </arguments>
            </configuration>
            <goals>
                <goal>java</goal>
            </goals>
        </execution>
    </executions>
</plugin>
```

gradle

```
task convertContracts(type: JavaExec) {
    main =
"org.springframework.cloud.contract.verifier.util.ToFileContractsTransformer"
    classpath = sourceSets.test.compileClasspath

args("org.springframework.cloud.contract.verifier.spec.pact.PactContractConverter"
,
            "${project.rootDir}/build/pacts",
"${project.rootDir}/src/test/resources/contracts")
}

test.dependsOn("convertContracts")
```

5.13. How Can I Work with Transitive Dependencies?

The Spring Cloud Contract plugins add the tasks that create the stubs jar for you. One problem that arises is that, when reusing the stubs, you can mistakenly import all of that stub's dependencies. When building a Maven artifact, even though you have a couple of different jars, all of them share one pom, as the following listing shows:

```
├─── producer-0.0.1.BUILD-20160903.075506-1-stubs.jar
├─── producer-0.0.1.BUILD-20160903.075506-1-stubs.jar.sha1
├─── producer-0.0.1.BUILD-20160903.075655-2-stubs.jar
├─── producer-0.0.1.BUILD-20160903.075655-2-stubs.jar.sha1
├─── producer-0.0.1.BUILD-SNAPSHOT.jar
├─── producer-0.0.1.BUILD-SNAPSHOT.pom
├─── producer-0.0.1.BUILD-SNAPSHOT-stubs.jar
├─── ...
└─── ...
```

There are three possibilities of working with those dependencies so as not to have any issues with transitive dependencies:

- Mark all application dependencies as optional
- Create a separate artifactid for the stubs
- Exclude dependencies on the consumer side

5.13.1. How Can I Mark All Application Dependencies as Optional?

If, in the `producer` application, you mark all of your dependencies as optional, when you include the `producer` stubs in another application (or when that dependency gets downloaded by Stub Runner) then, since all of the dependencies are optional, they do not get downloaded.

5.13.2. How can I Create a Separate `artifactid` for the Stubs?

If you create a separate `artifactid`, you can set it up in whatever way you wish. For example, you might decide to have no dependencies at all.

5.13.3. How can I Exclude Dependencies on the Consumer Side?

As a consumer, if you add the stub dependency to your classpath, you can explicitly exclude the unwanted dependencies.

5.14. How can I Generate Spring REST Docs Snippets from the Contracts?

When you want to include the requests and responses of your API by using Spring REST Docs, you only need to make some minor changes to your setup if you are using MockMvc and

RestAssuredMockMvc. To do so, include the following dependencies (if you have not already done so):

maven

```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-contract-verifier</artifactId>
    <scope>test</scope>
</dependency>
<dependency>
    <groupId>org.springframework.restdocs</groupId>
    <artifactId>spring-restdocs-mockmvc</artifactId>
    <optional>true</optional>
</dependency>
```

gradle

```
testCompile 'org.springframework.cloud:spring-cloud-starter-contract-verifier'
testCompile 'org.springframework.restdocs:spring-restdocs-mockmvc'
```

Next, you need to make some changes to your base class. The following examples use `WebAppContext` and the standalone option with RestAssured:

WebAppContext

```
package com.example.fraud;

import io.restassured.module.mockmvc.RestAssuredMockMvc;
import org.junit.Before;
import org.junit.Rule;
import org.junit.rules.TestName;
import org.junit.runner.RunWith;

import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.boot.test.context.SpringBootTest;
import org.springframework.restdocs.JUnitRestDocumentation;
import org.springframework.test.context.junit4.SpringRunner;
import org.springframework.test.web.servlet.setup.MockMvcBuilders;
import org.springframework.web.context.WebApplicationContext;

import static
org.springframework.restdocs.mockmvc.MockMvcRestDocumentation.document;
import static
org.springframework.restdocs.mockmvc.MockMvcRestDocumentation.documentationConfigu
ration;
```

```
@RunWith(SpringRunner.class)
@SpringBootTest(classes = Application.class)
public abstract class FraudBaseWithWebAppSetup {

    private static final String OUTPUT = "target/generated-snippets";

    @Rule
    public JUnitRestDocumentation restDocumentation = new
JUnitRestDocumentation(OUTPUT);

    @Rule
    public TestName testName = new TestName();

    @Autowired
    private WebApplicationContext context;

    @Before
    public void setup() {

RestAssuredMockMvc.mockMvc(MockMvcBuilders.webAppContextSetup(this.context)
                .apply(documentationConfiguration(this.restDocumentation))
                .alwaysDo(document(
                        getClass().getSimpleName() + "_" +
testName.getMethodName()))
                .build());
    }

    protected void assertThatRejectionReasonIsNull(Object rejectionReason) {
        assert rejectionReason == null;
    }

}
```

Standalone

```
package com.example.fraud;

import io.restassured.module.mockmvc.RestAssuredMockMvc;
import org.junit.Before;
import org.junit.Rule;
import org.junit.rules.TestName;

import org.springframework.restdocs.JUnitRestDocumentation;
import org.springframework.test.web.servlet.setup.MockMvcBuilders;

import static
org.springframework.restdocs.mockmvc.MockMvcRestDocumentation.document;
import static
org.springframework.restdocs.mockmvc.MockMvcRestDocumentation.documentationConfigu
ration;

public abstract class FraudBaseWithStandaloneSetup {

    private static final String OUTPUT = "target/generated-snippets";

    @Rule
    public JUnitRestDocumentation restDocumentation = new
JUnitRestDocumentation(OUTPUT);

    @Rule
    public TestName testName = new TestName();

    @Before
    public void setup() {
        RestAssuredMockMvc.standaloneSetup(MockMvcBuilders
                .standaloneSetup(new FraudDetectionController())
                .apply(documentationConfiguration(this.restDocumentation))
                .alwaysDo(document(
                        getClass().getSimpleName() + "_" +
testName.getMethodName())));
    }

}
```

You need not specify the output directory for the generated snippets (since version 1.2.0.RELEASE of Spring REST Docs).

5.15. How can I Use Stubs from a Location

If you want to fetch contracts or stubs from a given location without cloning a repo or fetching a JAR, just use the `stubs://` protocol when providing the repository root argument for Stub Runner or

the Spring Cloud Contract plugin. You can read more about this in this section of the documentation.

5.16. How can I Generate Stubs at Runtime

If you want to generate stubs at runtime for contracts, it's enough to switch the `generateStubs` property in the `@AutoConfigureStubRunner` annotation, or call the `withGenerateStubs(true)` method on the JUnit Rule or Extension. You can read more about this in this section of the documentation.

5.17. How can I Make The Build Pass if There Are No Contracts or Stubs

If you want Stub Runner not to fail if no stubs were found, it's enough to switch the `generateStubs` property in the `@AutoConfigureStubRunner` annotation, or call the `withFailOnNoStubs(false)` method on the JUnit Rule or Extension. You can read more about this in this section of the documentation.

If you want the plugins not to fail the build when no contracts were found, you can set the `failOnNoStubs` flag in Maven or call the `contractRepository { failOnNoStubs(false) }` Closure in Gradle.

5.18. How can I Mark that a Contract Is in Progress

If a contract is in progress, it means that the on the producer side tests will not be generated, but the stub will be. You can read more about this in this section of the documentation.

In a CI build, before going to production, you would like to ensure that no in progress contracts are there on the classpath. That's because you may lead to false positives. That's why, by default, in the Spring Cloud Contract plugin, we set the value of `failOnInProgress` to `true`. If you want to allow such contracts when tests are to be generated, just set the flag to `false`.

Appendix A: Common application properties

Various properties can be specified inside your `application.properties` file, inside your `application.yml` file, or as command line switches. This appendix provides a list of common Spring Cloud Contract properties and references to the underlying classes that consume them.

Property contributions can come from additional jar files on your classpath, so you should not consider this an exhaustive list. Also, you can define your own properties.

5.A.1. Default application properties

Name	Default	Description
stubrunner.amqp.enabled	false	Whether to enable support for Stub Runner and AMQP.

Name	Default	Description
stubrunner.amqp.mockCOnnection	true	Whether to enable support for Stub Runner and AMQP mocked connection factory.
stubrunner.classifier	stubs	The classifier to use by default in ivy co-ordinates for a stub.
stubrunner.cloud.consul.enabled	true	Whether to enable stubs registration in Consul.
stubrunner.cloud.delegate.enabled	true	Whether to enable DiscoveryClient's Stub Runner implementation.
stubrunner.cloud.enabled	true	Whether to enable Spring Cloud support for Stub Runner.
stubrunner.cloud.eureka.enabled	true	Whether to enable stubs registration in Eureka.
stubrunner.cloud.ribbon.enabled	true	Whether to enable Stub Runner's Ribbon integration.
stubrunner.cloud.stubbed.discovery.enabled	true	Whether Service Discovery should be stubbed for Stub Runner. If set to false, stubs will get registered in real service discovery.
stubrunner.cloud.zookeeper.enabled	true	Whether to enable stubs registration in Zookeeper.
stubrunner.consumer-name		You can override the default {@code spring.application.name} of this field by setting a value to this parameter.
stubrunner.delete-stubs-after-test	true	If set to {@code false} will NOT delete stubs from a temporary folder after running tests.
stubrunner.fail-on-no-stubs	true	When enabled, this flag will tell stub runner to throw an exception when no stubs / contracts were found.
stubrunner.generate-stubs	false	When enabled, this flag will tell stub runner to not load the generated stubs, but convert the found contracts at runtime to a stub format and run those stubs.

Name	Default	Description
stubrunner.http-server-stub-configurer		Configuration for an HTTP server stub.
stubrunner.ids	[]	The ids of the stubs to run in "ivy" notation ([groupId]:artifactId:[version]:[classifier][:port]). {@code groupId}, {@code classifier}, {@code version} and {@code port} can be optional.
stubrunner.ids-to-service-ids		Mapping of Ivy notation based ids to serviceIds inside your application. Example "a:b" → "myService" "artifactId" → "myOtherService"
stubrunner.integration.enabled	true	Whether to enable Stub Runner integration with Spring Integration.
stubrunner.jms.enabled	true	Whether to enable Stub Runner integration with Spring JMS.
stubrunner.kafka.enabled	true	Whether to enable Stub Runner integration with Spring Kafka.
stubrunner.kafka.initializer.enabled	true	Whether to allow Stub Runner to take care of polling for messages instead of the KafkaStubMessages component. The latter should be used only on the producer side.
stubrunner.mappings-output-folder		Dumps the mappings of each HTTP server to the selected folder.
stubrunner.max-port	15000	Max value of a port for the automatically started WireMock server.
stubrunner.min-port	10000	Min value of a port for the automatically started WireMock server.
stubrunner.password		Repository password.

Name	Default	Description
stubrunner.properties		Map of properties that can be passed to custom {@link org.springframework.cloud.contract.stubrunner.StubDownloaderBuilder}.
stubrunner.proxy-host		Repository proxy host.
stubrunner.proxy-port		Repository proxy port.
stubrunner.stream.enabled	true	Whether to enable Stub Runner integration with Spring Cloud Stream.
stubrunner.stubs-mode		Pick where the stubs should come from.
stubrunner.stubs-per-consumer	false	Should only stubs for this particular consumer get registered in HTTP server stub.
stubrunner.username		Repository username.
wiremock.placeholders.enabled	true	Flag to indicate that http URLs in generated wiremock stubs should be filtered to add or resolve a placeholder for a dynamic port.
wiremock.rest-template-ssl-enabled	false	
wiremock.server.files	[]	
wiremock.server.https-port	-1	
wiremock.server.https-port-dynamic	false	
wiremock.server.port	8080	
wiremock.server.port-dynamic	false	
wiremock.server.stubs	[]	

5.A.2. Additional application properties

The following properties can be passed as a system property (e.g. `stubrunner.properties.git.branch`) or via an environment variable (e.g. `STUBRUNNER_PROPERTIES_GIT_BRANCH`) or as a property inside stub runner's annotation or a JUnit Rule / Extension. In the latter case you can pass `git.branch` property name instead of the `stubrunner.properties.git.branch` one.

Table 2. Stubrunner Properties Options

Name	Default	Description
stubrunner.properties.pactbroker.provider-name-with-group-id	false	When using the Pact Broker based approach, you can automatically group id to the provider name.
stubrunner.properties.git.branch		When using the SCM based approach, you can customize the branch name to check out.
stubrunner.properties.git.commit-message	Updating project [$project] with stubs	When using the SCM based approach, you can customize the commit message for created stubs. The `$project` text will be replaced with the project name.
stubrunner.properties.git.no-of-attempts	10	When using the SCM based approach, you can customize number of retries to push the stubs to Git.
stubrunner.properties.git.username		When using the SCM based approach, you can pass the username to connect to the Git repository.
stubrunner.properties.git.password		When using the SCM based approach, you can pass the password to connect to the Git repository.
stubrunner.properties.git.wait-between-attempts	1000	When using the SCM based approach, you can customize waiting time in ms between trying to push the stubs to Git.
stubrunner.properties.stubs.find-producer	false	When using the Stubs protocol, you can toggle this flag to search for contracts via the `group id / artifact id` instead of taking the stubs directly from the provided folder.