RabbitMQ tutorial - Topics

Topics

(using Spring AMQP)

INFO

Prerequisites

This tutorial assumes RabbitMQ is installed and running on `localhost` on the standard port (5672). In case you use a different host, port or credentials, connections settings would require adjusting.

Where to get help

If you're having trouble going through this tutorial you can contact us through GitHub Discussions or RabbitMQ community Discord.

In the previous tutorial we improved our messaging flexibility. Instead of using a `fanout` exchange only capable of dummy broadcasting, we used a `direct` one, and gained a possibility of selectively receiving the message based on the routing key.

Although using the `direct` exchange improved our system, it still has limitations - it can't do routing based on multiple criteria.

In our messaging system we might want to subscribe to not only queues based on the routing key, but also based on the source which produced the message. You might know this concept from the `syslog` unix tool, which routes logs based on both severity (info/warn/crit...) and facility (auth/cron/kern...). Our example is a little simpler than this.

That example would give us a lot of flexibility - we may want to listen to just critical errors coming from 'cron' but also all logs from 'kern'.

To implement that flexibility in our logging system we need to learn about a more complex `topic` exchange.

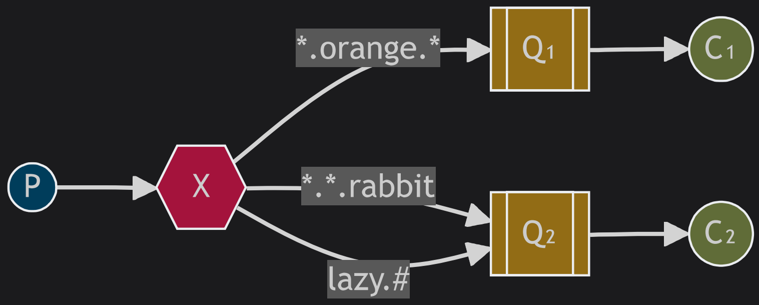
Topic exchange

Messages sent to a `topic` exchange can't have an arbitrary `routing_key` - it must be a list of words, delimited by dots. The words can be anything, but usually they specify some features connected to the message. A few valid routing key examples: "`stock.usd.nyse`", "`nyse.vmw`", "`quick.orange.rabbit`". There can be as many words in the routing key as you like, up to the limit of 255 bytes.

The binding key must also be in the same form. The logic behind the `topic` exchange is similar to a `direct` one - a message sent with a particular routing key will be delivered to all the queues that are bound with a matching binding key. However there are two important special cases for binding keys:

- `*` (star) can substitute for exactly one word.
- `#` (hash) can substitute for zero or more words.

It's easiest to explain this in an example:



In this example, we're going to send messages which all describe animals. The messages will be sent with a routing key that consists of three words (two dots). The first word in the routing key will describe speed, second a colour and third a species: "`<speed>.<colour>.<species>`".

We created three bindings: Q1 is bound with binding key "`*.orange.*`" and Q2 with "`*.*.rabbit`" and "`lazy.#`".

These bindings can be summarised as:

- Q1 is interested in all the orange animals.
- Q2 wants to hear everything about rabbits, and everything about lazy animals.

A message with a routing key set to "`quick.orange.rabbit`" will be delivered to both queues. Message "`lazy.orange.elephant`" also will go to both of them. On the other hand "`quick.orange.fox`" will only go to the first queue, and "`lazy.brown.fox`" only to the second.

"`lazy.pink.rabbit`" will be delivered to the second queue only once, even though it matches two bindings. "`quick.brown.fox`" doesn't match any binding so it will be discarded.

What happens if we break our contract and send a message with one or four words, like "`orange`" or "`quick.orange.new.rabbit`"? Well, these messages won't match any bindings and will be lost.

On the other hand "`lazy.orange.new.rabbit`", even though it has four words, will match the last binding and will be delivered to the second queue.

> **Topic exchange**
>
> Topic exchange is powerful and can behave like other exchanges.
>
> When a queue is bound with "`#`" (hash) binding key - it will receive all the messages, regardless of the routing key - like in `fanout` exchange.
>
> When special characters "`*`" (star) and "`#`" (hash) aren't used in bindings, the topic exchange will behave just like a `direct` one.

Putting it all together

We're going to use a `topic` exchange in our messaging system. We'll start off with a working assumption that the routing keys will take advantage of both wildcards and a hash tag.

The code is almost the same as in the previous tutorial.

First let's configure some profiles and beans in the `Tut5Config` class of the `tut5` package:

```
import org.springframework.amqp.core.*;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;
import org.springframework.context.annotation.Profile;

@Profile({"tut5","topics"})
@Configuration
public class Tut5Config {

        @Bean
        public TopicExchange topic() {
                return new TopicExchange("tut.topic");
        }

        @Profile("receiver")
        private static class ReceiverConfig {

                @Bean
                public Tut5Receiver receiver() {
                        return new Tut5Receiver();
                }

                @Bean
                public Queue autoDeleteQueue1() {
                        return new AnonymousQueue();
                }

                @Bean
                public Queue autoDeleteQueue2() {
                        return new AnonymousQueue();
                }

                @Bean
                public Binding binding1a(TopicExchange topic,
                    Queue autoDeleteQueue1) {
                        return BindingBuilder.bind(autoDeleteQueue1)
                            .to(topic)
                            .with("*.orange.*");
                }

                @Bean
                public Binding binding1b(TopicExchange topic,
                    Queue autoDeleteQueue1) {
                        return BindingBuilder.bind(autoDeleteQueue1)
                            .to(topic)
                            .with("*.*.rabbit");
                }

                @Bean
                public Binding binding2a(TopicExchange topic,
                    Queue autoDeleteQueue2) {
                        return BindingBuilder.bind(autoDeleteQueue2)
                            .to(topic)
                            .with("lazy.#");
                }

        }

        @Profile("sender")
        @Bean
        public Tut5Sender sender() {
                return new Tut5Sender();
        }

}
```

We setup our profiles for executing the topics as the choice of `tut5` or `topics`. We then created the bean for our `TopicExchange`. The `receiver` profile is the `ReceiverConfig` class defining our receiver, two `AnonymousQueue`s as in the previous tutorial and the bindings for the topics utilizing the topic syntax. We also create the `sender` profile as the creation of the `Tut5Sender` class.

The `Tut5Receiver` again uses the `@RabbitListener` annotation to receive messages from the respective topics.

```
import org.springframework.amqp.rabbit.annotation.RabbitListener;
import org.springframework.util.StopWatch;

public class Tut5Receiver {

        @RabbitListener(queues = "#{autoDeleteQueue1.name}")
        public void receive1(String in) throws InterruptedException {
                receive(in, 1);
        }

        @RabbitListener(queues = "#{autoDeleteQueue2.name}")
        public void receive2(String in) throws InterruptedException {
                receive(in, 2);
        }

        public void receive(String in, int receiver) throws
            InterruptedException {
                StopWatch watch = new StopWatch();
                watch.start();
                System.out.println("instance " + receiver + " [x] Received '"
                    + in + "'");
                doWork(in);
                watch.stop();
                System.out.println("instance " + receiver + " [x] Done in "
                    + watch.getTotalTimeSeconds() + "s");
        }

        private void doWork(String in) throws InterruptedException {
                for (char ch : in.toCharArray()) {
                        if (ch == '.') {
                                Thread.sleep(1000);
                        }
                }
        }
}
```

The code for `Tut5Sender.java`:

```
package org.springframework.amqp.tutorials.tut5;

import org.springframework.amqp.core.TopicExchange;
import org.springframework.amqp.rabbit.core.RabbitTemplate;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.scheduling.annotation.Scheduled;
import java.util.concurrent.atomic.AtomicInteger;

public class Tut5Sender {

        @Autowired
        private RabbitTemplate template;

        @Autowired
        private TopicExchange topic;

        AtomicInteger index = new AtomicInteger(0);

        AtomicInteger count = new AtomicInteger(0);

        private final String[] keys = {"quick.orange.rabbit",
"lazy.orange.elephant", "quick.orange.fox",
                        "lazy.brown.fox", "lazy.pink.rabbit",
"quick.brown.fox"};

        @Scheduled(fixedDelay = 1000, initialDelay = 500)
        public void send() {
                StringBuilder builder = new StringBuilder("Hello to ");
                if (this.index.incrementAndGet() == keys.length) {
                        this.index.set(0);
                }
                String key = keys[this.index.get()];
                builder.append(key).append(' ');
                builder.append(this.count.incrementAndGet());
                String message = builder.toString();
                template.convertAndSend(topic.getName(), key, message);
                System.out.println(" [x] Sent '" + message + "'");
        }
}
```

Compile and run the examples as described in Tutorial 1. Or if you have been following along through the tutorials you only need to do the following:

To build the project:

```
./mvnw clean package
```

To execute the sender and receiver with the correct profiles execute the jar with the correct parameters:

```
# shell 1
java -jar target/rabbitmq-tutorials.jar \
    --spring.profiles.active=topics,receiver \
    --tutorial.client.duration=60000
# shell 2
java -jar target/rabbitmq-tutorials.jar \
    --spring.profiles.active=topics,sender \
    --tutorial.client.duration=60000
```

The output from the sender will look something like:

```
Ready ... running for 60000ms
 [x] Sent 'Hello to lazy.orange.elephant 1'
 [x] Sent 'Hello to quick.orange.fox 2'
 [x] Sent 'Hello to lazy.brown.fox 3'
 [x] Sent 'Hello to lazy.pink.rabbit 4'
 [x] Sent 'Hello to quick.brown.fox 5'
 [x] Sent 'Hello to quick.orange.rabbit 6'
 [x] Sent 'Hello to lazy.orange.elephant 7'
 [x] Sent 'Hello to quick.orange.fox 8'
 [x] Sent 'Hello to lazy.brown.fox 9'
 [x] Sent 'Hello to lazy.pink.rabbit 10'
```

And the receiver will respond with the following output:

```
instance 1 [x] Received 'Hello to lazy.orange.elephant 1'
instance 2 [x] Received 'Hello to lazy.orange.elephant 1'
instance 2 [x] Done in 2.005s
instance 1 [x] Done in 2.005s
instance 1 [x] Received 'Hello to quick.orange.fox 2'
instance 2 [x] Received 'Hello to lazy.brown.fox 3'
instance 1 [x] Done in 2.003s
instance 2 [x] Done in 2.003s
instance 1 [x] Received 'Hello to lazy.pink.rabbit 4'
instance 2 [x] Received 'Hello to lazy.pink.rabbit 4'
instance 1 [x] Done in 2.006s
instance 2 [x] Done in 2.006s
```

Have fun playing with these programs. Note that the code doesn't make any assumption about the routing or binding keys, you may want to play with more than two routing key parameters.

(Full source code for Tut5Receiver.java source and Tut5Sender.java source. The configuration is in Tut5Config.java source.)

Next, find out how to do a round trip message as a remote procedure call in tutorial 6