Spring RabbitMQ for High Load

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Who am I

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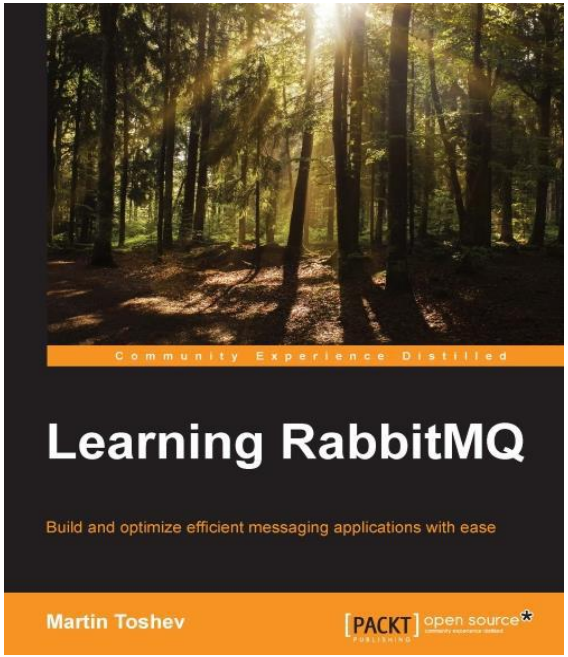

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Agenda

- Messaging Basics
- RabbitMQ Overview
- Spring RabbitMQ

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Messaging Basics

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Messaging

- Messaging provides a mechanism for loosely-coupled integration of systems

- The central unit of processing in a message is a message which typically contains a **body** and a **header**

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Use cases

- Offloading long-running tasks to worker nodes
- Distributing and processing high loads of data
- Aggregating logs and propagating events between systems
- Many others …

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Messaging protocols

- Messaging solutions implement different protocols for transferring of messages such as AMQP, XMPP, MQTT, STOMP, Kafka binary protocol and others

- The variety of protocols imply vendor lock-in

Messaging protocols comparison

	AMQP	MQTT	XMPP	STOMP	Kafka
goal	replacement of proprietary protocols	messaging for resource-constrained devices	instant messaging, adopted for wider use	message-oriented middleware	processing of large real-time data feeds
format	binary	binary	XML-based	text-based	binary
API	divided into classes (> 40 methods in RabbitMQ)	simple (5 basic operations with 2-3 packet types for each)	different XML items with multiple types	~ 10 basic commands	42 request types in latest version (Kafka 2.0.0)
reliability	publisher/subscriber acknowledgements, transactions	acknowledgements	Acknowledgments and resumptions (XEP-198)	Subscriber acknowledgements and transactions	Acknowledgements, transactional replication
security	SASL, TLS/SSL	no built-in TLS/SSL, header authentication	SASL, TLS/SSL	depending on message broker	SASL, TLS/SSL, ACLs
extensibility	extension points	none	extensible	depending on message broker	no extension mechanism defined

Messaging brokers

- A variety of messaging brokers can be a choice for applications …

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Common broker characteristics

- Secure message transfer, authentication and authorization of messaging endpoints
- Message routing and persistence
- Broker subscriptions

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RabbitMQ Overview

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RabbitMQ

- An open source message broker written in Erlang
- Implements the AMQP Protocol (Advanced Message Queueing Protocol)
- Has a pluggable architecture and provides extensions for other protocols such as HTTP, STOMP and MQTT

AMQP

- AMQP is a binary protocol that aims to standardize middleware communication
- Derives its origins from the financial industry
- Defines multiple connection channels inside a single TCP connection

AMQP characteristics

- The AMQP protocol defines:
  - **exchanges** – the message broker endpoints that receive messages
  - **queues** – the message broker endpoints that store messages from exchanges and are used by subscribers for retrieval of messages
  - **bindings** – rules that bind exchanges and queues

- The AMQP protocol is programmable – which means that the above entities can be created/modified/deleted by applications

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Message handling

- Each message can be published with a **routing key**
- Each binding between an exchange and a queue has a **binding key**
- Routing of messages is determined based on matching between the routing and binding keys

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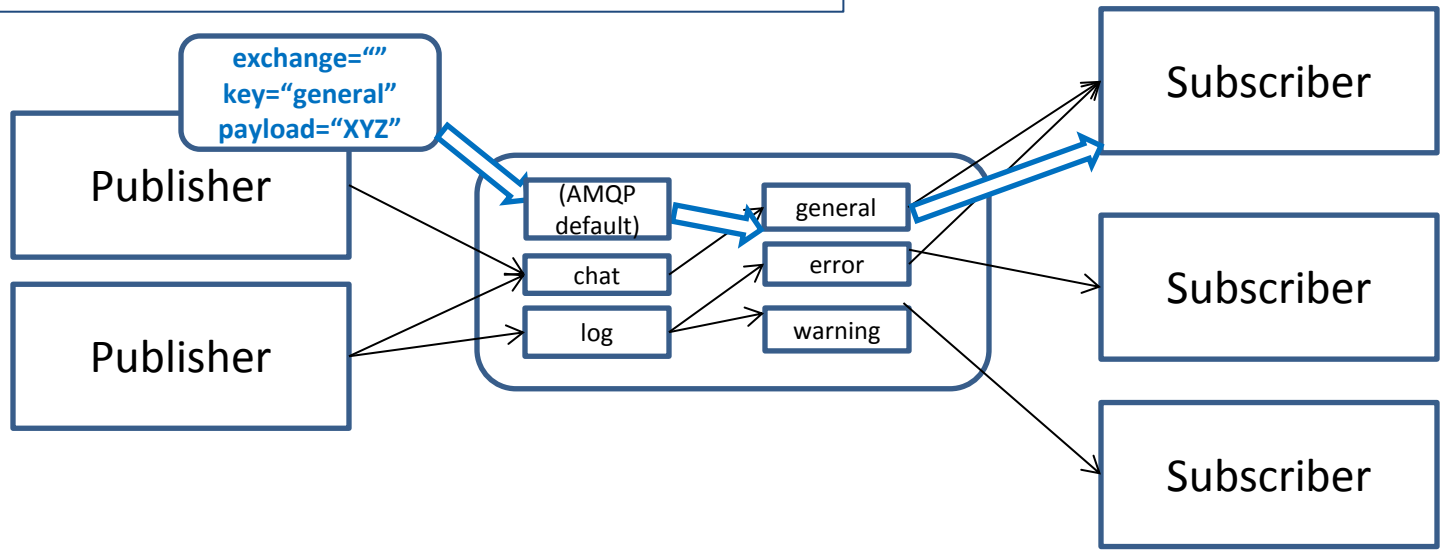
Message routing

- Different types of messaging patterns are implemented by means of different types of exchanges

- RabbitMQ provides the following types of exchanges:
  - direct/default
  - fanout
  - topic
  - headers

Default exchange

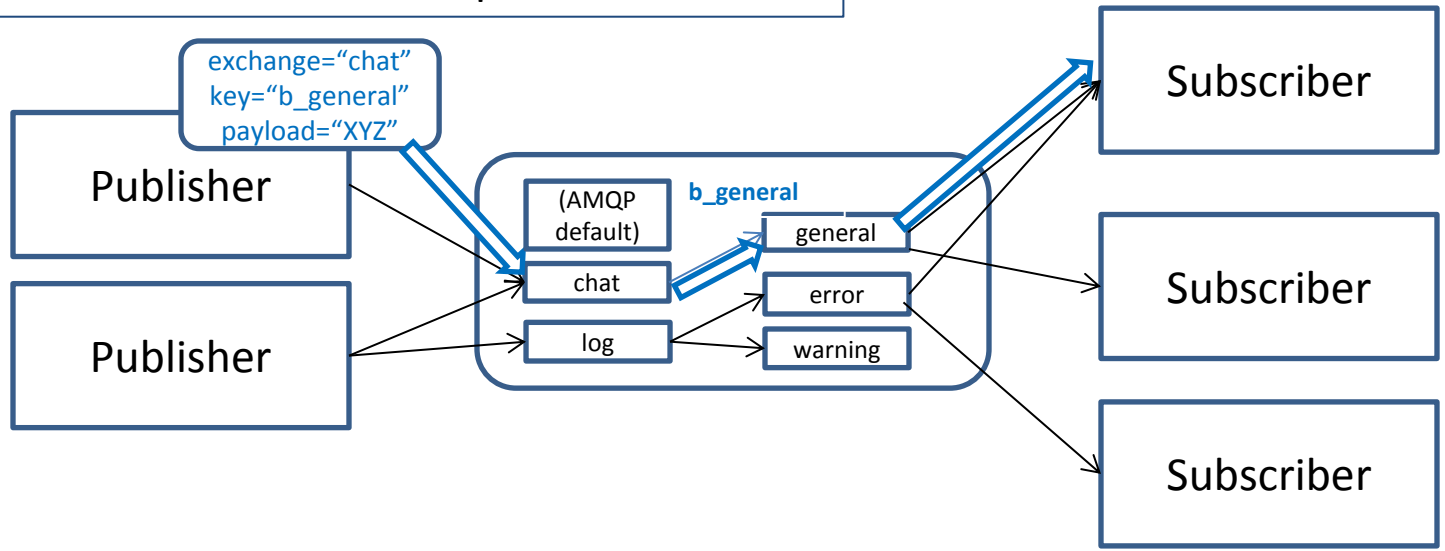
default exchange: suitable for point-to-point communication between endpoints



(AMQP default) *is a system exchange*

Direct exchange

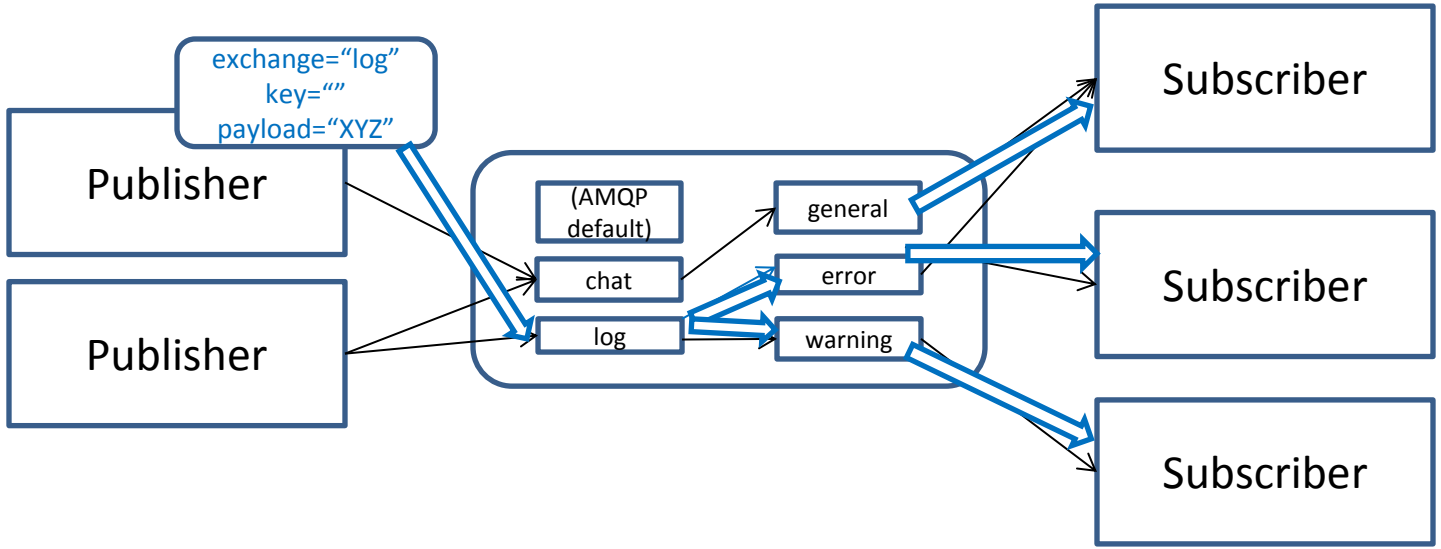
direct exchange: suitable for point-to-point communication between endpoints



***chat** is defined as a direct exchange upon creation*

Fanout exchange

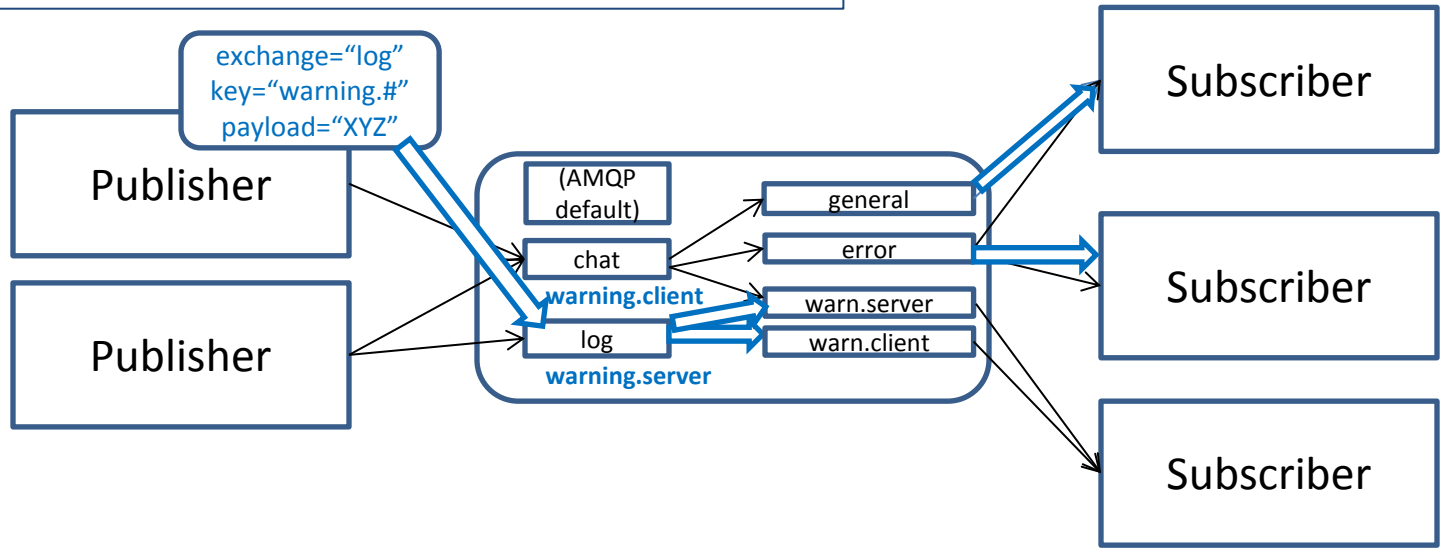
fanout exchange: suitable for broadcast type of communication between endpoints



log *is defined as a fanout exchange upon creation*

Topic exchange

topic exchange: suitable for multicast type of communication between endpoints



***log** is defined as a topic exchange upon creation*

RabbitMQ clustering

- Default clustering mechanism provides scalability in terms of queues rather than high availability

- Mirrored queues are an extension to the default clustering mechanism that can be used to establish high availability at the broker level

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RabbitMQ Overview
(demo)

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Spring RabbitMQ

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Spring RabbitMQ

- The Spring Framework provides support for RabbitMQ by means of:
  - The Spring AMQP framework
  - The Spring Integration framework
  - ~~The Spring XD framework~~ (discontinued as of July 2017)

Spring AMQP

- Provides RabbitMQ utilities such as:
  - the **RabbitAdmin** class for automatically declaring queues, exchanges and bindings
  - Listener containers for asynchronous processing of inbound messages
  - the **RabbitTemplate** class for sending and receiving messages

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Spring AMQP usage

- Utilities of the Spring AMQP framework can be used either directly in Java or preconfigured in the Spring configuration

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RabbitAdmin (plain Java)

```
CachingConnectionFactory factory = new
        CachingConnectionFactory("localhost");
Queue queue = new Queue("sample-queue");
TopicExchange exchange =
        new TopicExchange("sample-topic-exchange");
RabbitAdmin admin = new RabbitAdmin(factory);
admin.declareQueue(queue);
admin.declareExchange(exchange);
admin.declareBinding(BindingBuilder.bind(queue).to(exchange)
        .with("sample-key"));
factory.destroy();
```

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Container listener (plain Java)

```
CachingConnectionFactory factory =
        new CachingConnectionFactory(
"localhost");
SimpleMessageListenerContainer container =
        new SimpleMessageListenerContainer(factory);
Object listener = new Object() {
    public void handleMessage(String message) { … }};
MessageListenerAdapter adapter = new
        MessageListenerAdapter(listener);
container.setMessageListener(adapter);
container.setQueueNames("sample-queue");
container.start();
```

RabbitTemplate (plain Java)

```
CachingConnectionFactory factory =
        new CachingConnectionFactory("localhost");
RabbitTemplate template =
        new RabbitTemplate(factory);
template.convertAndSend("", "sample-queue",
         "sample-queue test message!");
```

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Spring-based configuration

- All of the above examples can be configured using Spring configuration
- Cleaner and decouples RabbitMQ configuration for the business logic

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RabbitTemplate (Spring configuration)

```
<rabbit:connection-factory
        id="connectionFactory"
        host="localhost" />

<rabbit:template id="amqpTemplate"
        connection-factory="connectionFactory"
        exchange=""
        routing-key="sample-queue-spring"/>
```

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Container listener (Spring configuration)

```
<rabbit:listener-container
       connection-factory="connectionFactory">
       <rabbit:listener ref="springListener"
              method="receiveMessage"
              queue-names="sample-queue-spring" />
</rabbit:listener-container>

<bean id="springListener"
class="ua.org.javaday.rabbitmq.spring.ListenerSpringExample"/>
```

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Container listener (Spring configuration)

```
public class ListenerSpringExample {
	public void receiveMessage(String message) {
		System.out.println("Message received: " +
			message);
	}
}
```

Container listener (Spring annotations)

```
public class ListenerSpringExample {
        @RabbitListener(queues = "sample-queue-spring")
        public void receiveMessage(String message) {
                System.out.println("Message received: " +
                        message);
        }
}
```

RabbitAdmin
(Spring configuration)

```
<rabbit:admin id="amqpAdmin"
        connection-factory="connectionFactory" />
```

Spring Boot

- If you don’t want to use xml-based configuration you can use Spring Boot …

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Spring Boot

```
@SpringBootApplication
public class AppConfiguration {

    @Bean
    public ConnectionFactory connectionFactory() {
        CachingConnectionFactory connectionFactory =
            new CachingConnectionFactory("localhost");
        return connectionFactory;
    }
    @Bean
    public AmqpAdmin amqpAdmin() {
        return new RabbitAdmin(connectionFactory());
    }
}
```

Spring Integration AMQP

- The Spring Integration Framework provides:
  - **Inbound-channel-adapter** for reading messages from a queue
  - **outbound-channel-adapter** for sending messages to an exchange

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Spring Integration AMQP

- The Spring Integration Framework provides:
  - **Inbound-gateway** for request-reply communication at the publisher
  - **outbound-gateway** for request-reply communication at the receiver

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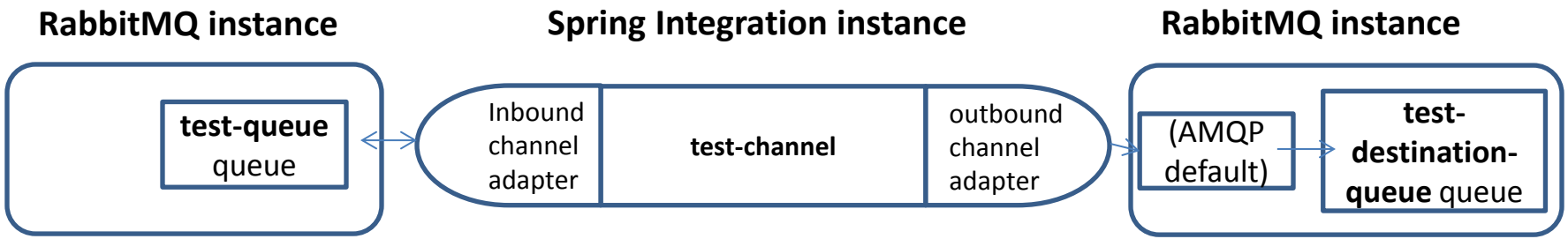
Spring Integration AMQP scenario

- Message replication with Spring integration:



Spring Integration AMQP scenario

```
<rabbit:connection-factory
        id="connectionFactory"
        host="localhost" />
<channel id="test-channel" />

<rabbit:queue name="test-queue" />
<rabbit:queue name="test-destination-queue" />

<rabbit:template id="amqpTemplate"
        connection-factory="connectionFactory"
        exchange=""
        routing-key="test-queue" />
```

Spring Integration AMQP scenario

```
<amqp:inbound-channel-adapter
        channel="test-channel"
        queue-names="test-queue"
        connection-factory="connectionFactory" />

<amqp:outbound-channel-adapter
        channel="test-channel"
        exchange-name=""
        routing-key="test-destination-queue"
        amqp-template="amqpTemplate" />
```

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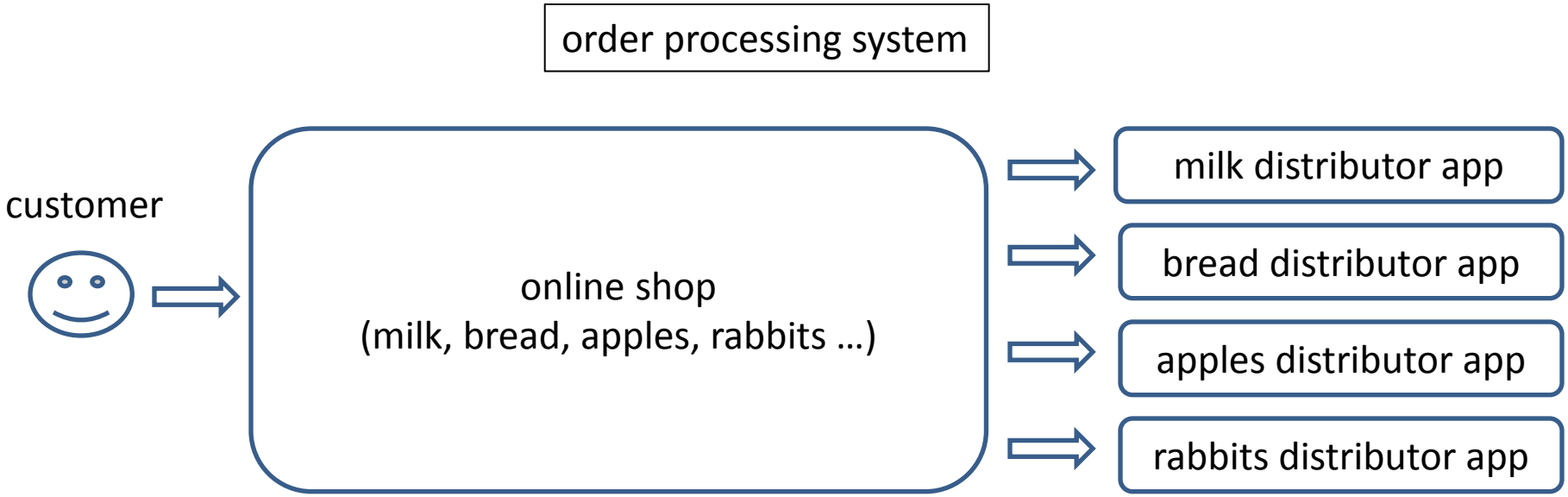
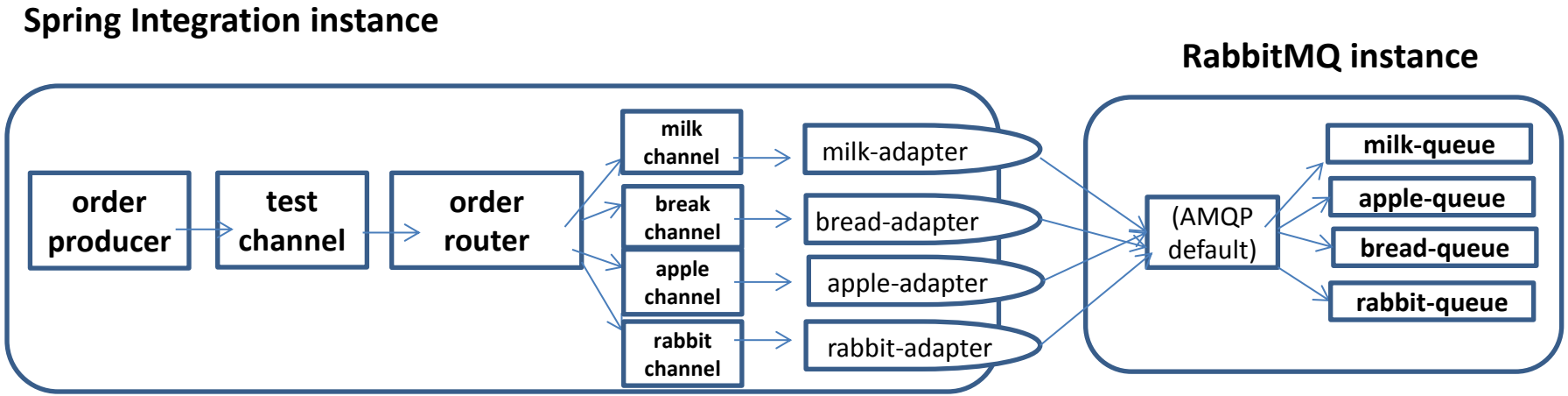
Yet another scenario



Implementation



Spring RabbitMQ

(demo)

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Summary

- The Spring Framework provides convenient utilities and adapters for integrating with RabbitMQ
- Favor them over the RabbitMQ Java library in Spring-based applications

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Thank you !

Q&A

demos: https://github.com/martinfmi/spring_rabbitmq_samples

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References

AMQP 0.9.1 specification
https://www.rabbitmq.com/resources/specs/amqp0-9-1.pdf

AMQP list of users
http://www.amqp.org/about/examples

RabbitMQ documentation
http://www.rabbitmq.com/documentation.html

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References

Choosing Your Messaging Protocol: AMQP, MQTT, or STOMP

http://blogs.vmware.com/vfabric/2013/02/choosing-your-messaging-protocol-amqp-mqtt-or-stomp.html

Spring AMQP reference

http://docs.spring.io/spring-amqp/reference/html/

Spring Integration AMQP

http://docs.spring.io/spring-integration/reference/html/amqp.html

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