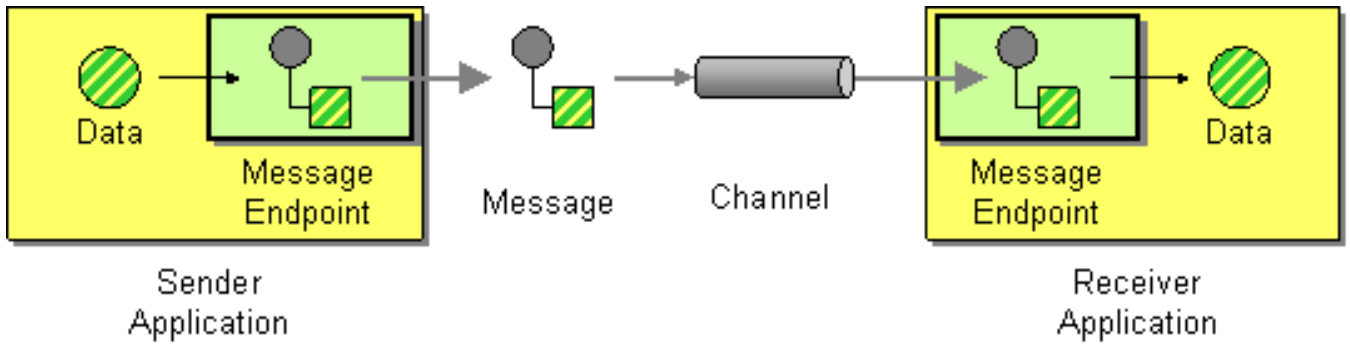
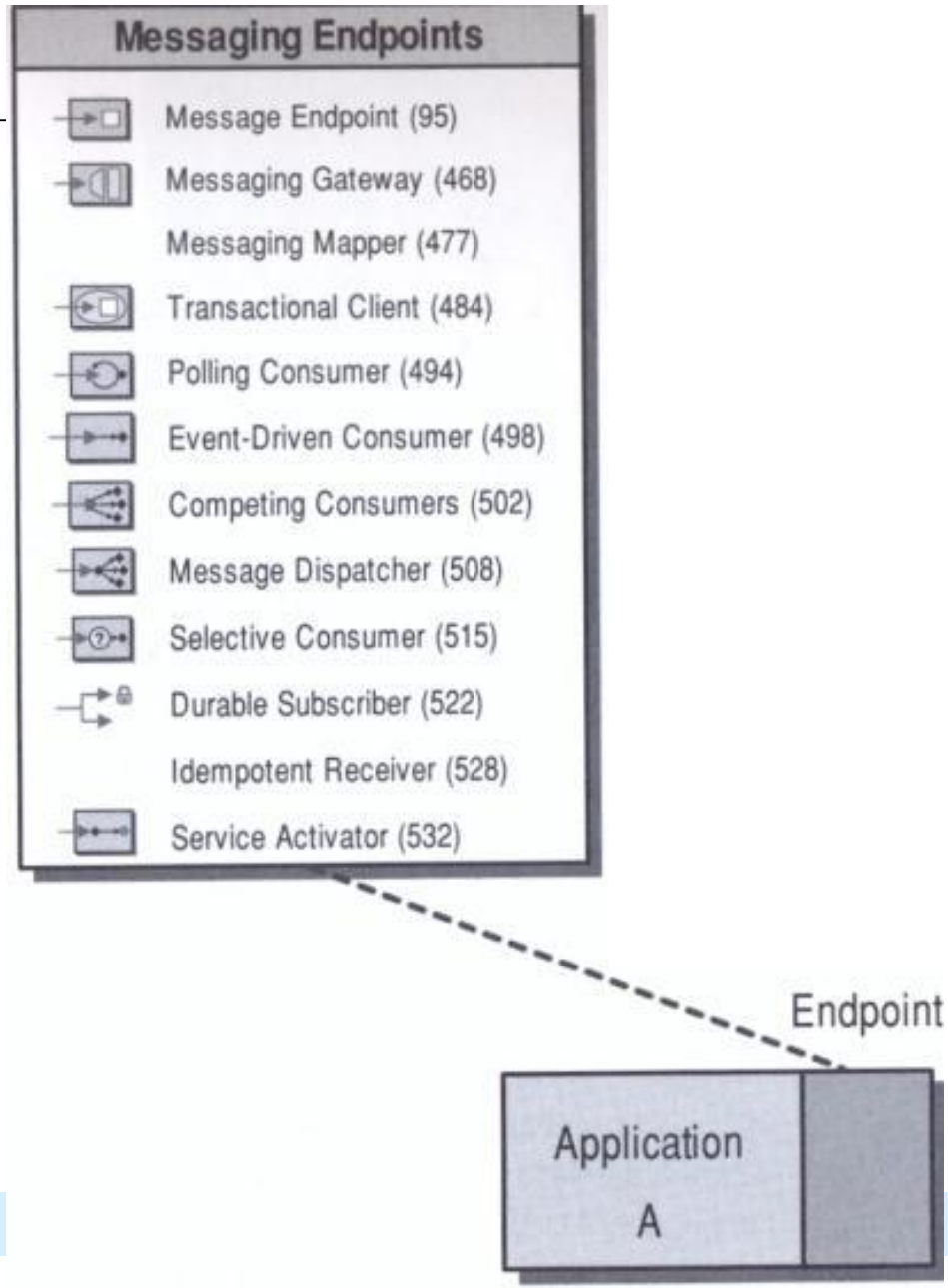
Message Endpoint

- How does an application connect to a messaging channel to send and receive messages?



- Use a *Message Endpoint*, i.e. a **client** of the messaging system that the application can use to send or receive messages.

Pattern Overview



Types of messaging clients

- Endpoint code you write yourself to a messaging API (e.g. MSMQ)
- Libraries and tools in commercial middleware packages

Two types of messaging endpoint patterns:

  - Patterns that relate to both Send and Receive
  - Patterns that relate to Message Consumption

Patterns for Both Send and Receive

- Encapsulate the messaging code
  - a thin layer of code performs the application's part of the integration *Messaging Gateway (468)*
- Data translation
  - *Messaging Mapper (477)* to convert data between the application format and the message format
- Externally-controlled transactions
  - *Transactional Client* (484) to control transactions externally

Message Consumer Patterns

- Synchronous or asynchronous consumer?
  - *Polling Consumer (494)*
  - *Event-Driven Consumer (498)*
- Message grab versus message assignment ?
  - *Competing Consumers (502)*
  - *Message Dispatcher (508)*
- Accept all messages or filter?
  - *Selective Consumer (515)*
- Subscribe while disconnected
  - *Durable Subscriber (522)*
- Idempotency
  - *Idempotent Receiver (528)*
- Synchronous or asynchronous service
  - *Service Activator (532)*

Message Consumer Challenge

Receiving messages is the tricky part!

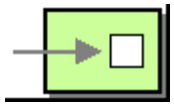
Throttling

Application ability to control the rate at which it consumes messages

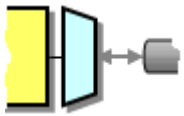
- Consumer can't control rate at which clients **send** requests
- Consumer can control the rate at which it **processes** those requests
  - Queue up
  - Concurrent message consumers

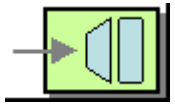
Endpoint Concepts in EIP book

- Often difficult to tell these concepts apart

Endpoint 

An **message endpoint** is a **specialized channel adapter** custom developed for, and integrated into the application.

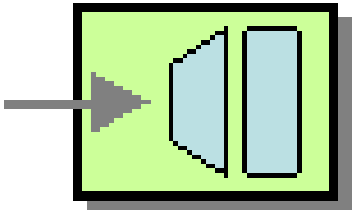
Adapter 

Gateway 

A **message endpoint** should be **designed** as a **message gateway** to encapsulate message code

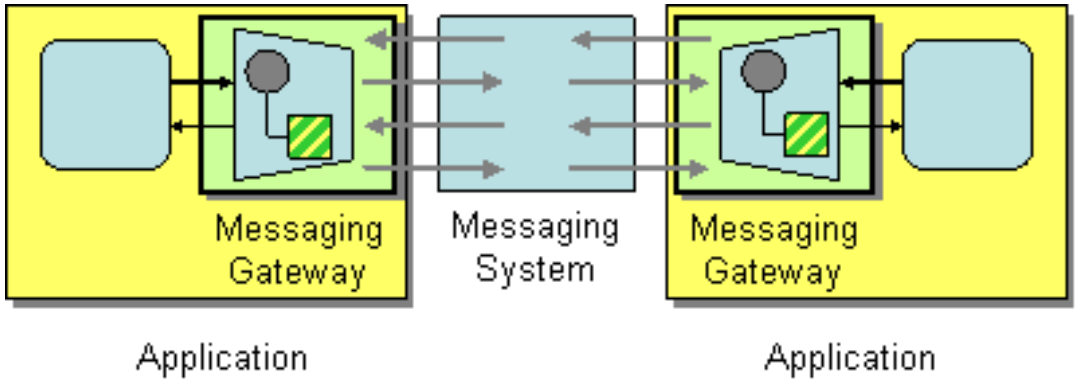
Send & Receive patterns

Messaging Gateway



Encapsulates messaging-specific code

Separates it from the rest of the application code

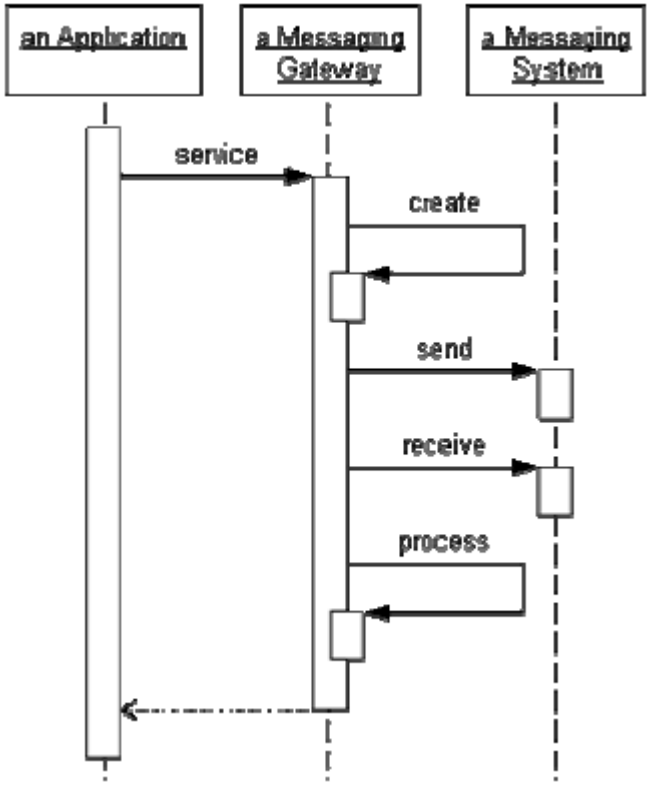


Only Messaging Gateway code knows about messaging →

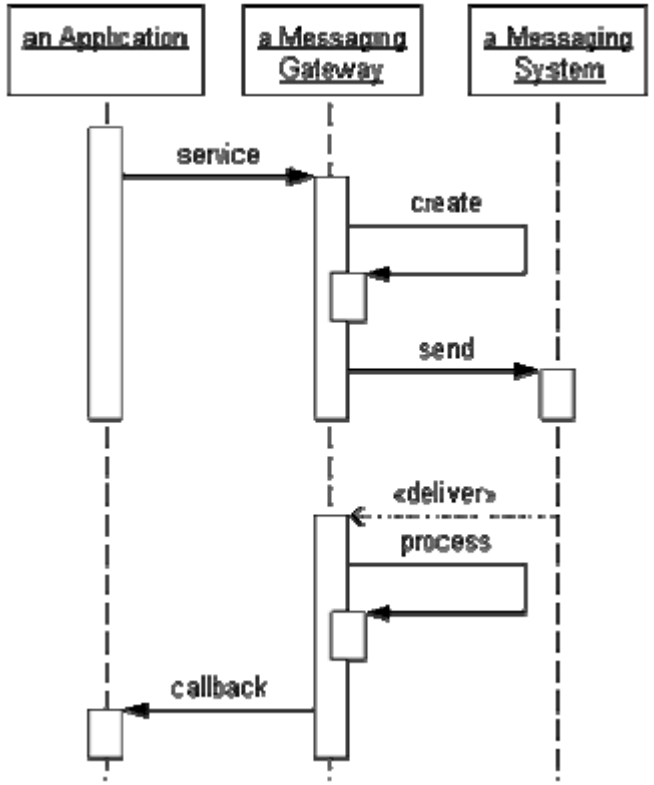
Makes it possible to swap out the gateway with a different implementation ☺

Gateway request-reply example

1.Blocking (Synchronous)



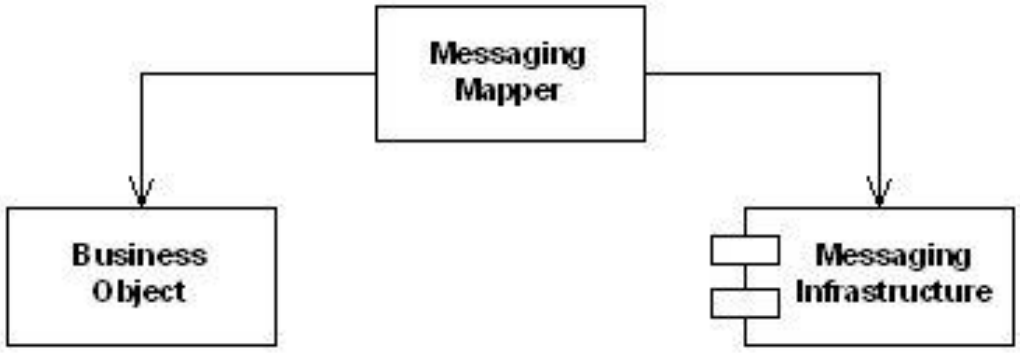
2.Event-Driven (Asynchronous)



Messaging Mapper (477)

- How to move data between domain objects and the messaging infrastructure while keeping the two independent of each other?

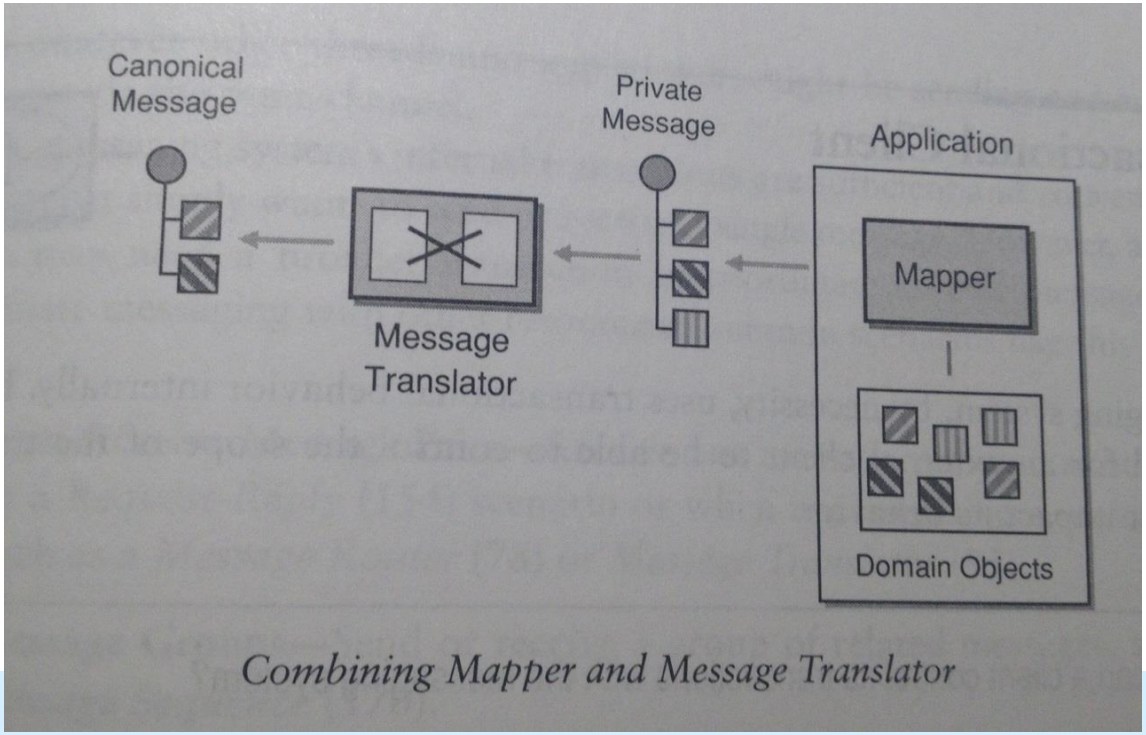
- Create a separate *Messaging Mapper* that contains the mapping logic between the messaging infrastructure and the domain objects. Neither the objects nor the infrastructure have knowledge of the Messaging Mapper's existence



Combining Mapper and Translator?

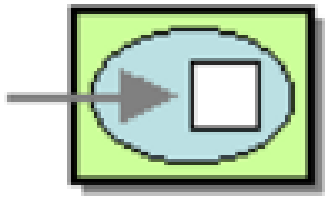
- Message Translator: Structural mappings inside messaging layer
- Messaging Mapper: Object references, data type conversion etc.

- Illustration of combination of these patterns (EIP p. 483)

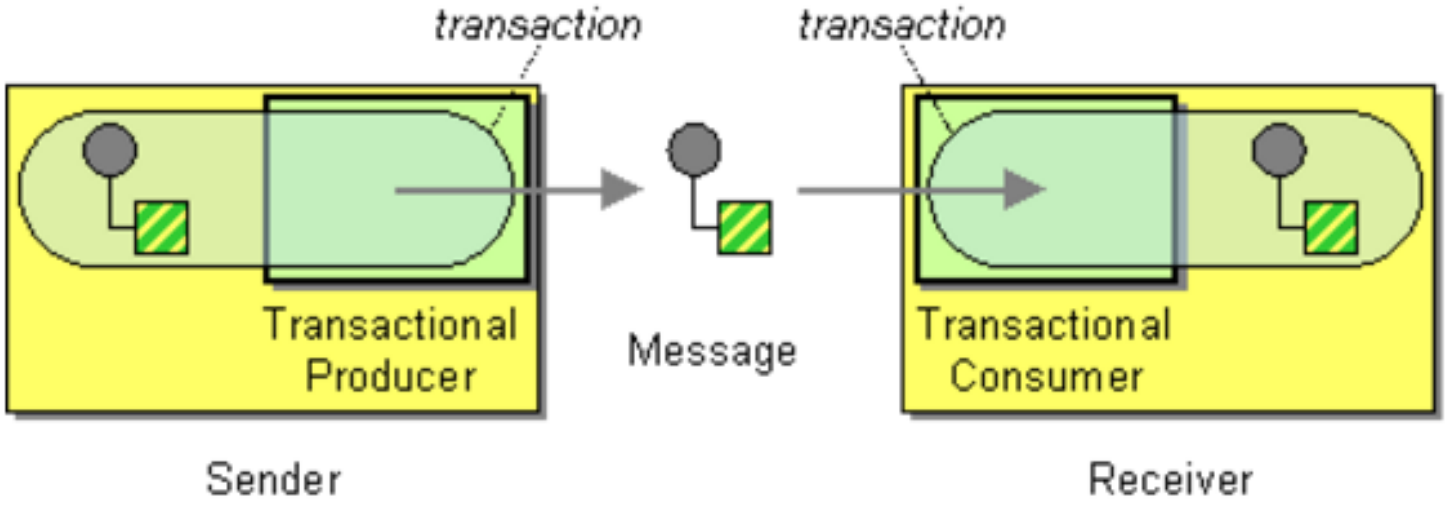


Combining Mapper and Message Translator

Transactional Client (484)



- Can a client control its transactions with the messaging system?



- **Sender**: the message isn't "really" added to the channel until the sender commits the transaction.
- **Receiver**: the message isn't "really" removed from the channel until the receiver commits the transaction.

RabbitMQ Example – receiver commit

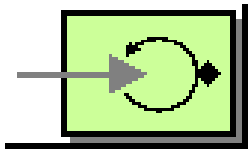
- RabbitMQ supports message *acknowledgements*
- Message acknowledgment is turned on by default
- We must explicitly turned them off with

autoAck=false flag

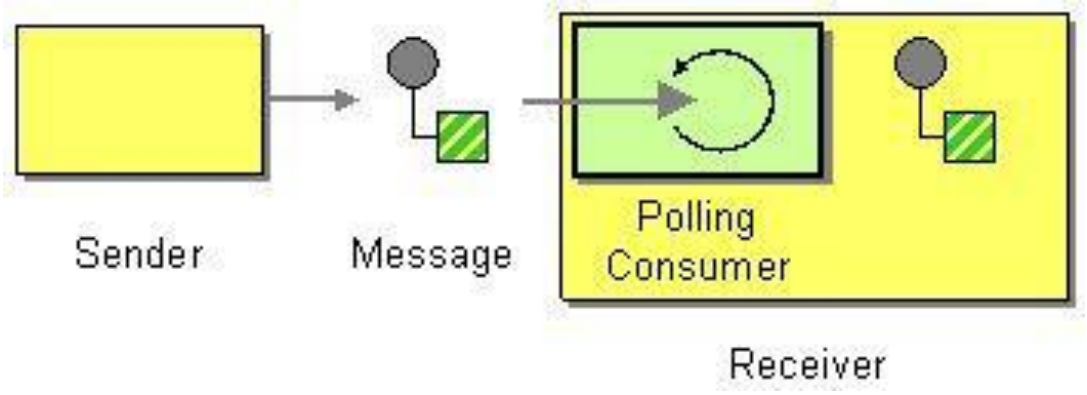
```
QueueingConsumer consumer = new QueueingConsumer(channel);
boolean autoAck = false;
channel.basicConsume("hello", autoAck, consumer);

while (true) {
  QueueingConsumer.Delivery delivery = consumer.nextDelivery();
  //...
  channel.basicAck(delivery.getEnvelope().getDeliveryTag(), false);
}
```

Consumer patterns

Polling Consumer (494)

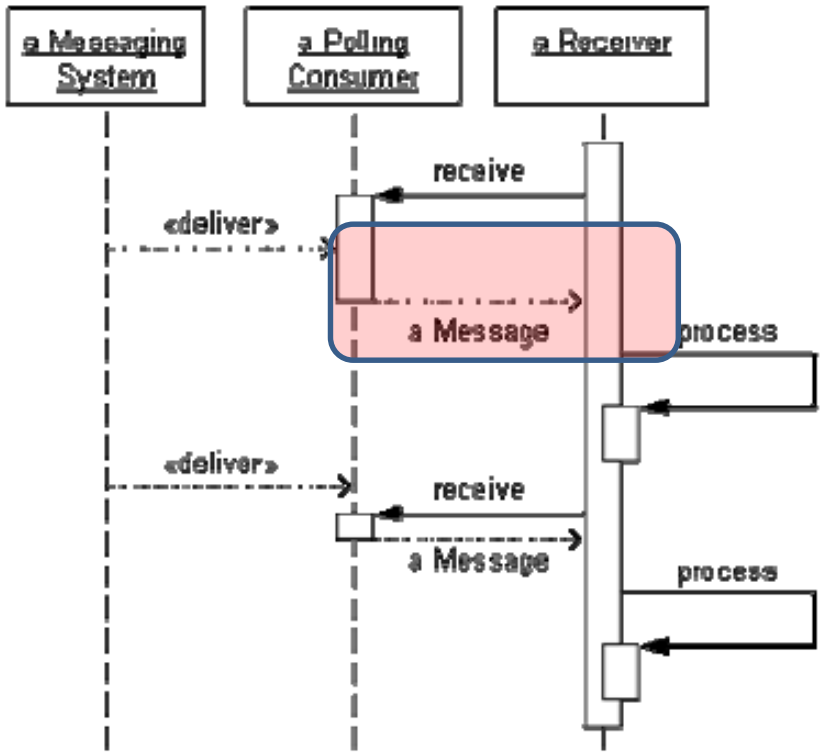


- A polling consumer **actively** checks for new messages
- A polling consumer won't poll for more messages until it has finished processing the current message, i.e. when it is ready!



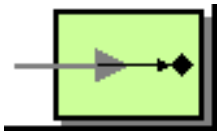
Polling Consumer Flow - Example

- Synchronous receiver **explicitly** requests messages
- **Blocks** until a message is delivered
- Can **control** how many messages are consumed concurrently (by limiting no. of threads that are polling
  - Extra messages queue up until receiver can process
- Poll how often?



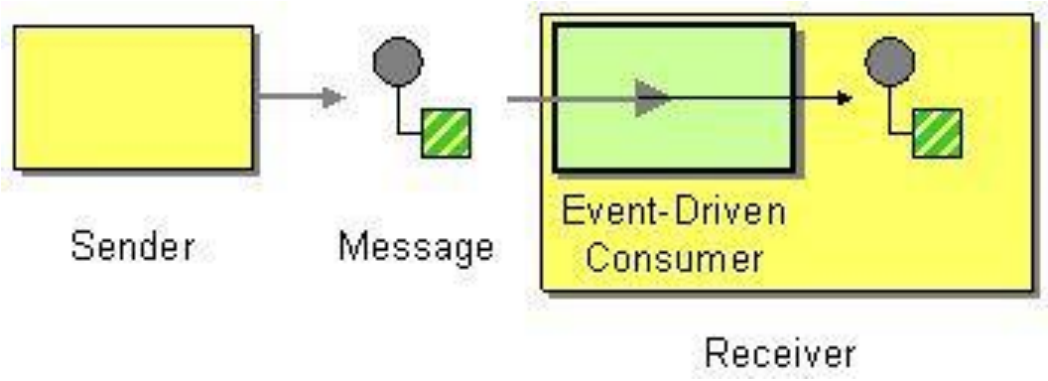
Polling Consumer Sequence

Event-Driven Consumer (498)



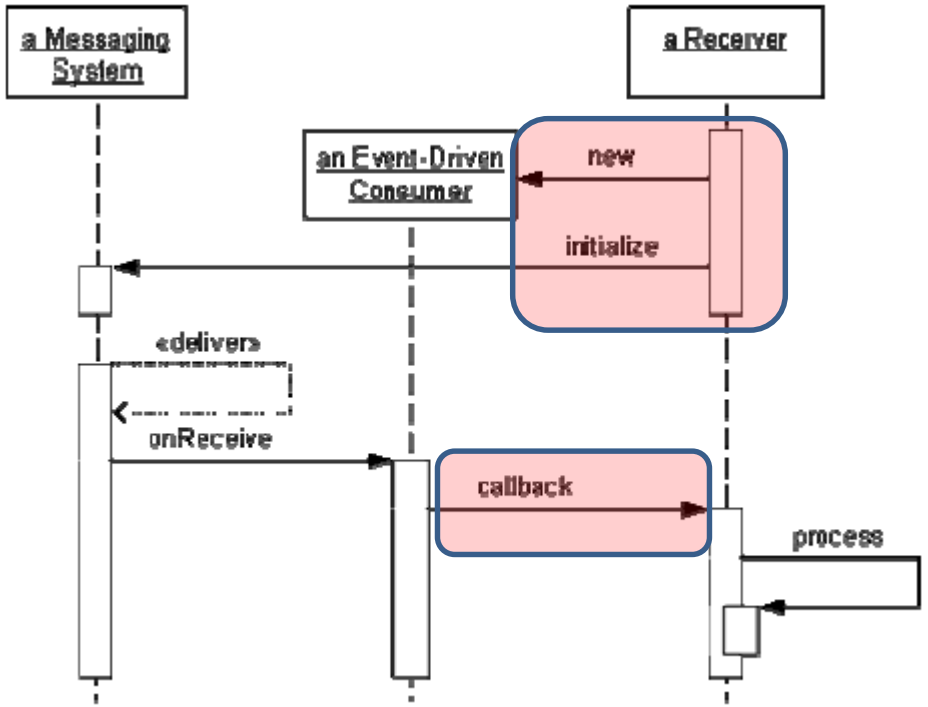
- An Event-Driven Consumer **listens** on a channel and **waits** for a client to send messages to it.

- When a message arrives, the consumer 'wakes up' and takes the message for processing



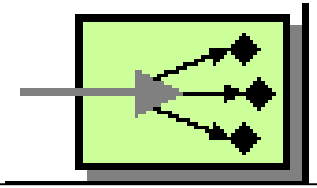
Event-Driven Consumer Flow - Example

- Asynchronous receiver is invoked by messaging system when a message arrives
- Consumer passes message to application through callback
- Consumer is idle between messages waiting to be invoked

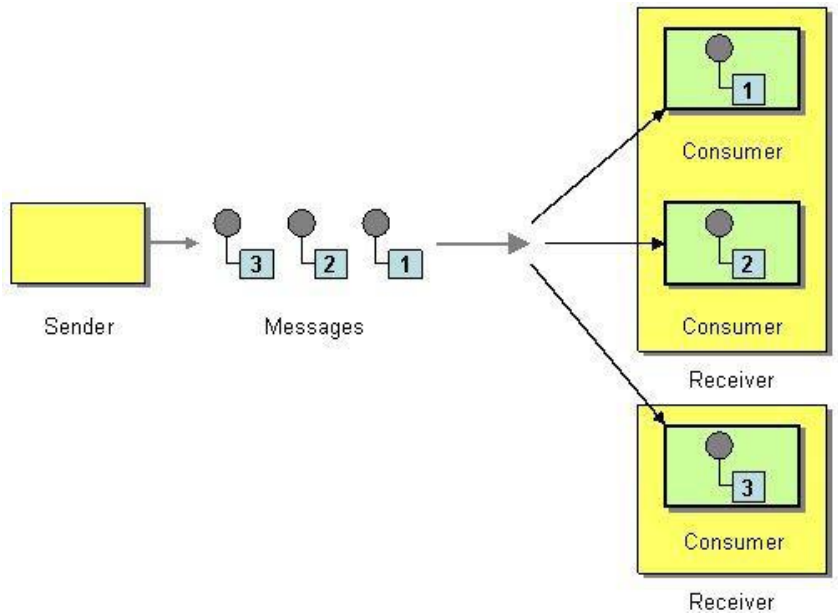


Event-Driven Consumer Sequence

Competing Consumers (502)

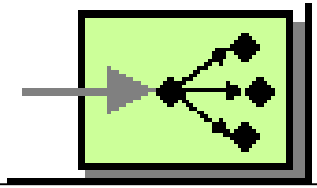


- **Concurrency** is handled by creating multiple Competing Consumers on a single channel
  - consumers process multiple messages concurrently
  - any of the consumers could potentially receive it (they compete)



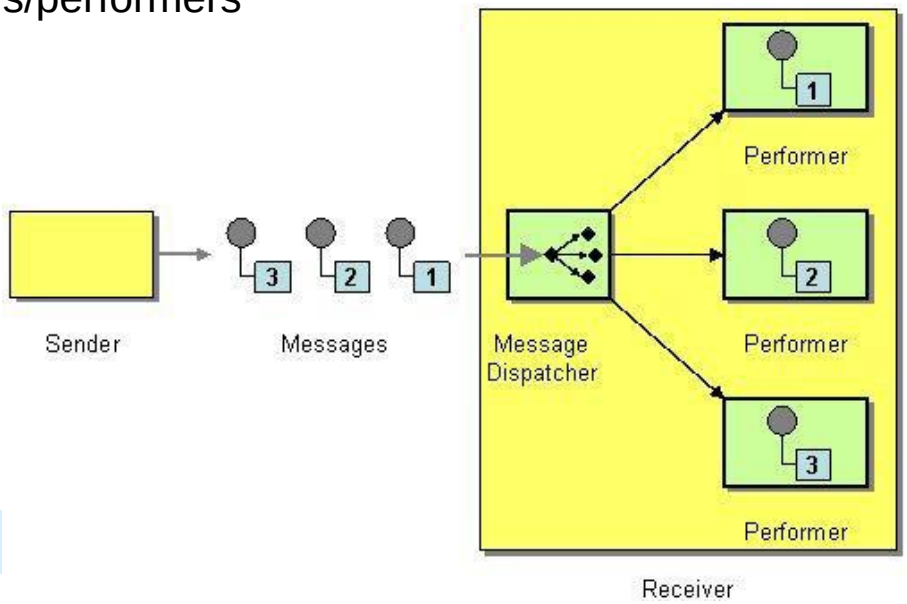
The messaging system's implementation determines which consumer actually receives the message

Message Dispatcher (508)



- Multiple consumers on a single channel can **coordinate** their own message processing with a message dispatching.

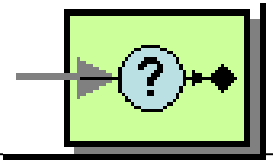
- A Message Dispatcher consumes messages from a channel and distribute them to performers
  - **The client implements the coordination itself**
  - An application can throttle message load by limiting the number of consumers/performers



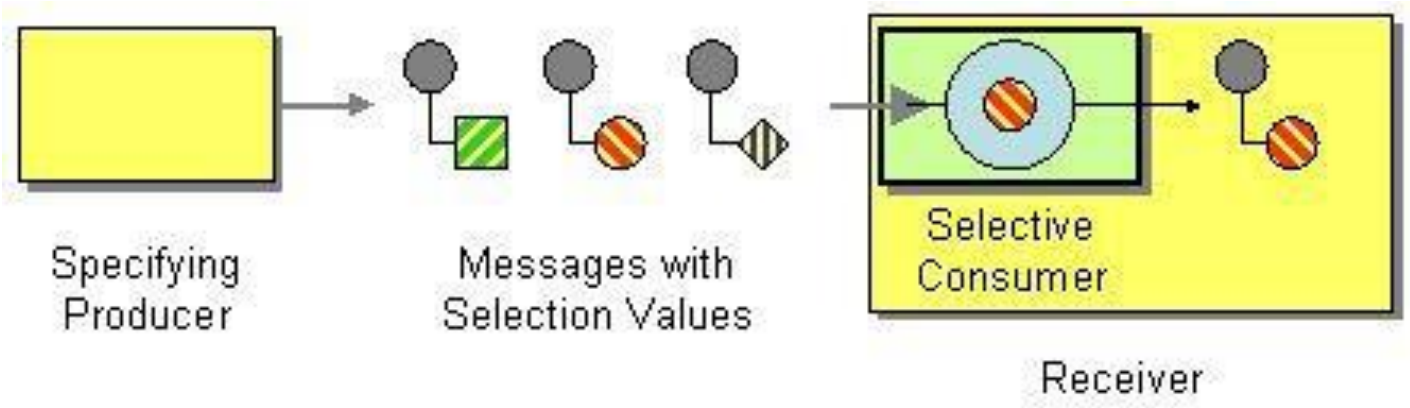
Message Dispatcher 2

- Consists of two parts:
  - **Dispatcher**: consumes messages from a channel and distributes each message to a performer
  - **Performer**: is given the message by the dispatcher and processes it.
- If the **performer** processes in its own **thread**, the dispatcher can receive and delegate other messages, so they can be consumed as fast as the dispatcher can receive and delegate them

Selective Consumer (515)



- How can a consumer **select** which messages to receive?
- A Selective Consumer **filters** the messages delivered by its channel so that it only receives the ones that match its criteria



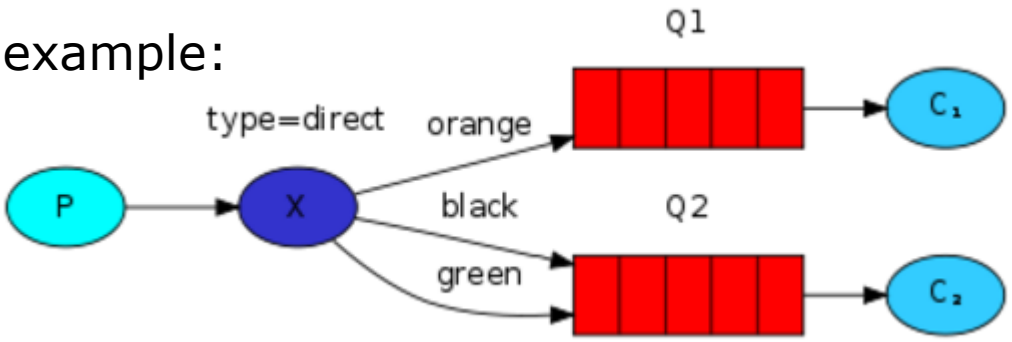
Selective Consumer Filtering Process

- Three parts to the filtering process:

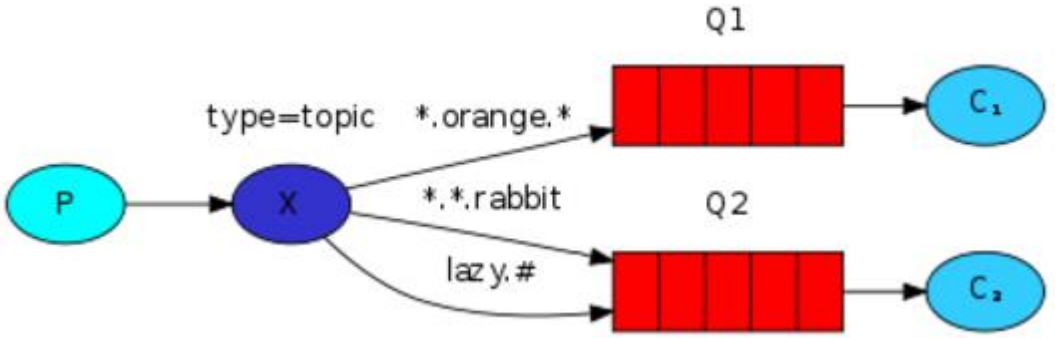
1. **Producer** specifies the message's selection value before sending
2. **Selection Value** is one or more values specified in the message
3. **Selective Consumer** receives messages that meet its selection criteria

RabbitMQ Filtering Examples

- **Direct exchange** example:

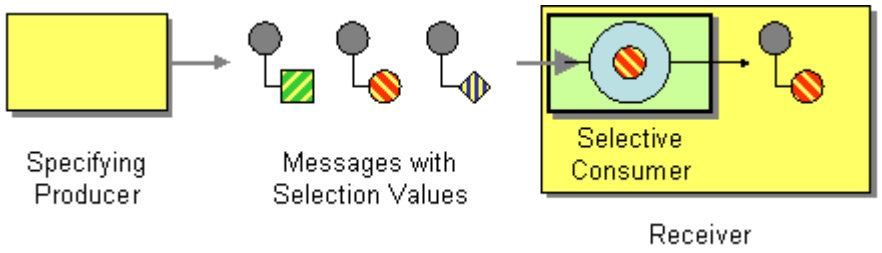


- **Topic exchange** example (more fine-grained routing key)

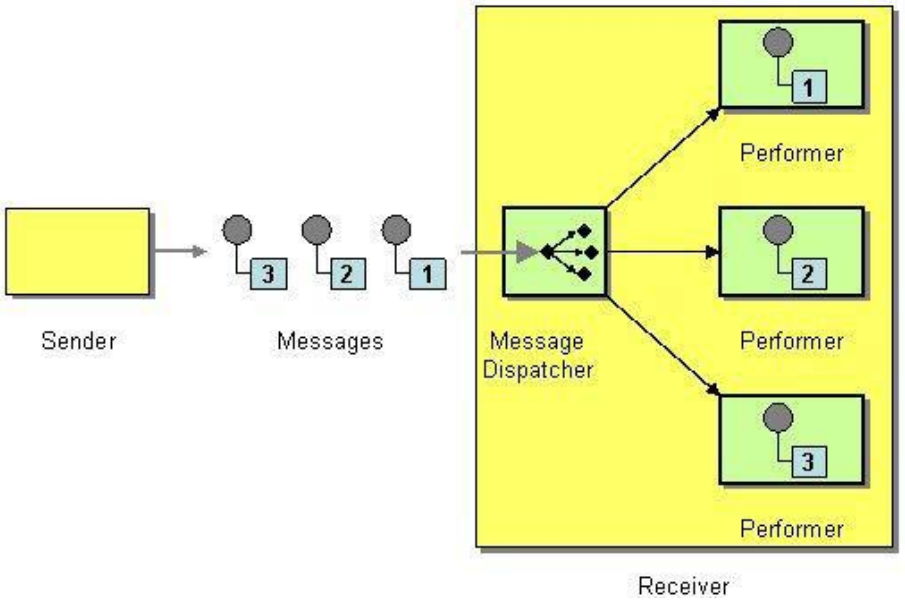


Selective Consumer vs. Message Dispatcher

You want msg. system to do dispatching (Selective Consumer)



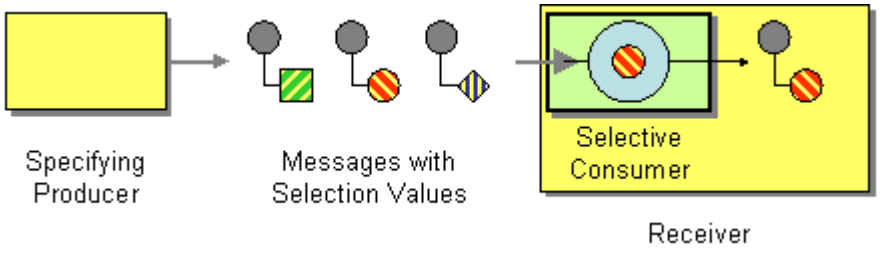
You want the app to do it itself (Message Dispatcher)



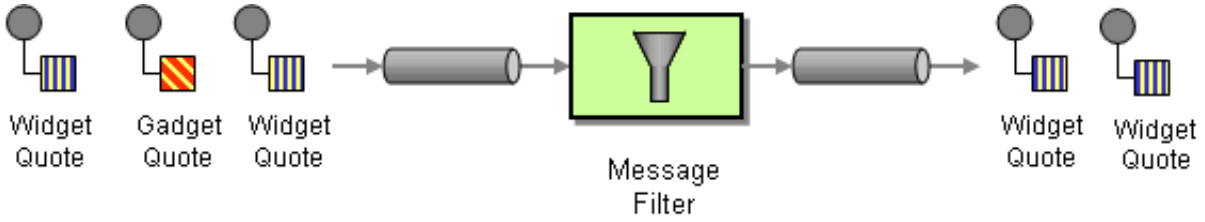
Selective Consumer vs. Message Filter

Same goal, but different ways

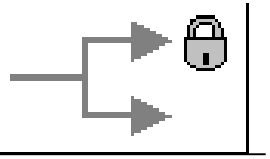
Selective consumer: filters the messages delivered by its channel so that it only receives the ones that match its criteria.



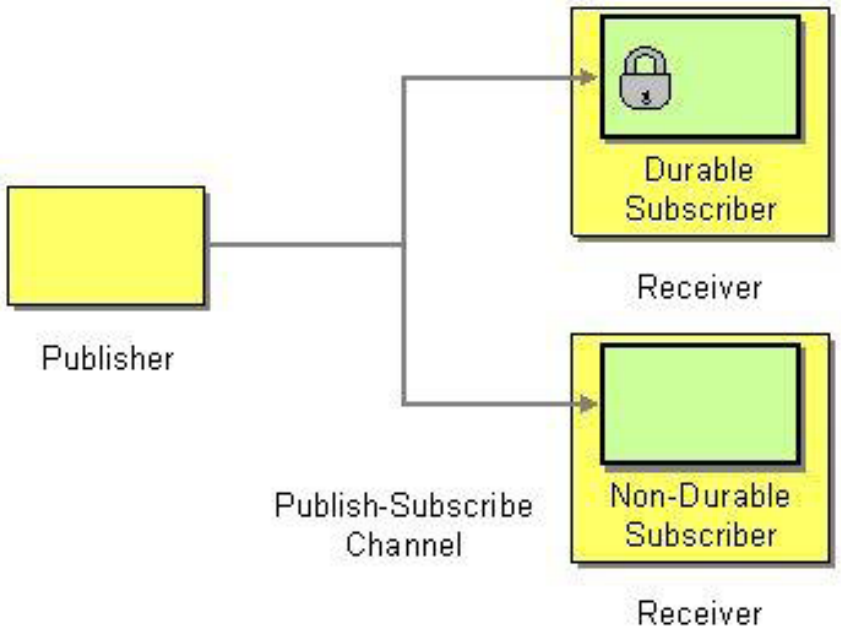
Message Filter: eliminates undesired messages from a channel based on a set of criteria.



Durable Subscriber (522)



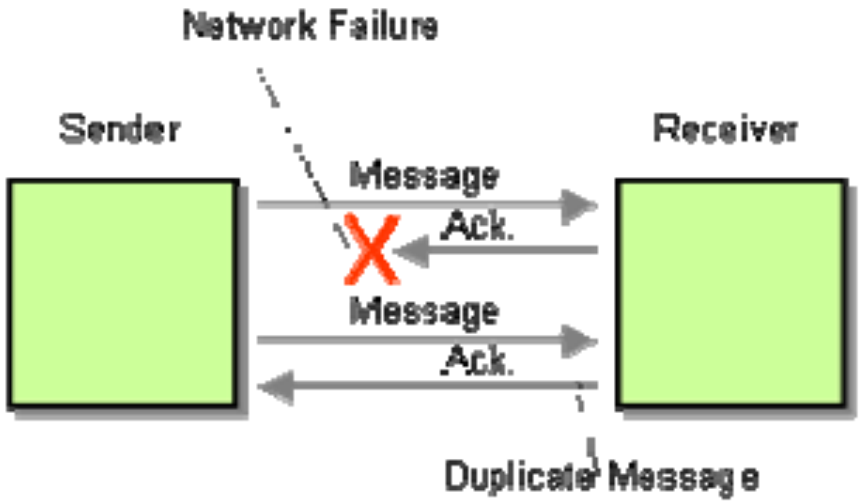
- **How to avoid missing messages while not listening for them?**
- Use a Durable Subscriber to make the messaging system save messages published while the subscriber is disconnected



Idempotent Receiver (528)

- **How to deal with duplicate messages?**

- Design a receiver to be an Idempotent Receiver, one that can safely receive the same message multiple times



Message duplication because of problem sending acknowledgement

Idempotent Receiver 2

Can be achieved through two primary means

- Explicit removal of duplicate messages
  - We must keep track of messages already received
  - How long to keep this history?
  - Must we persist it?

- Define message semantics to support idempotency
  - E.g. send the message so it does not impact the system,
  - Instead of
    - Add $10 to account 1234
  - Use
    - Set balance of account 1234 to $110