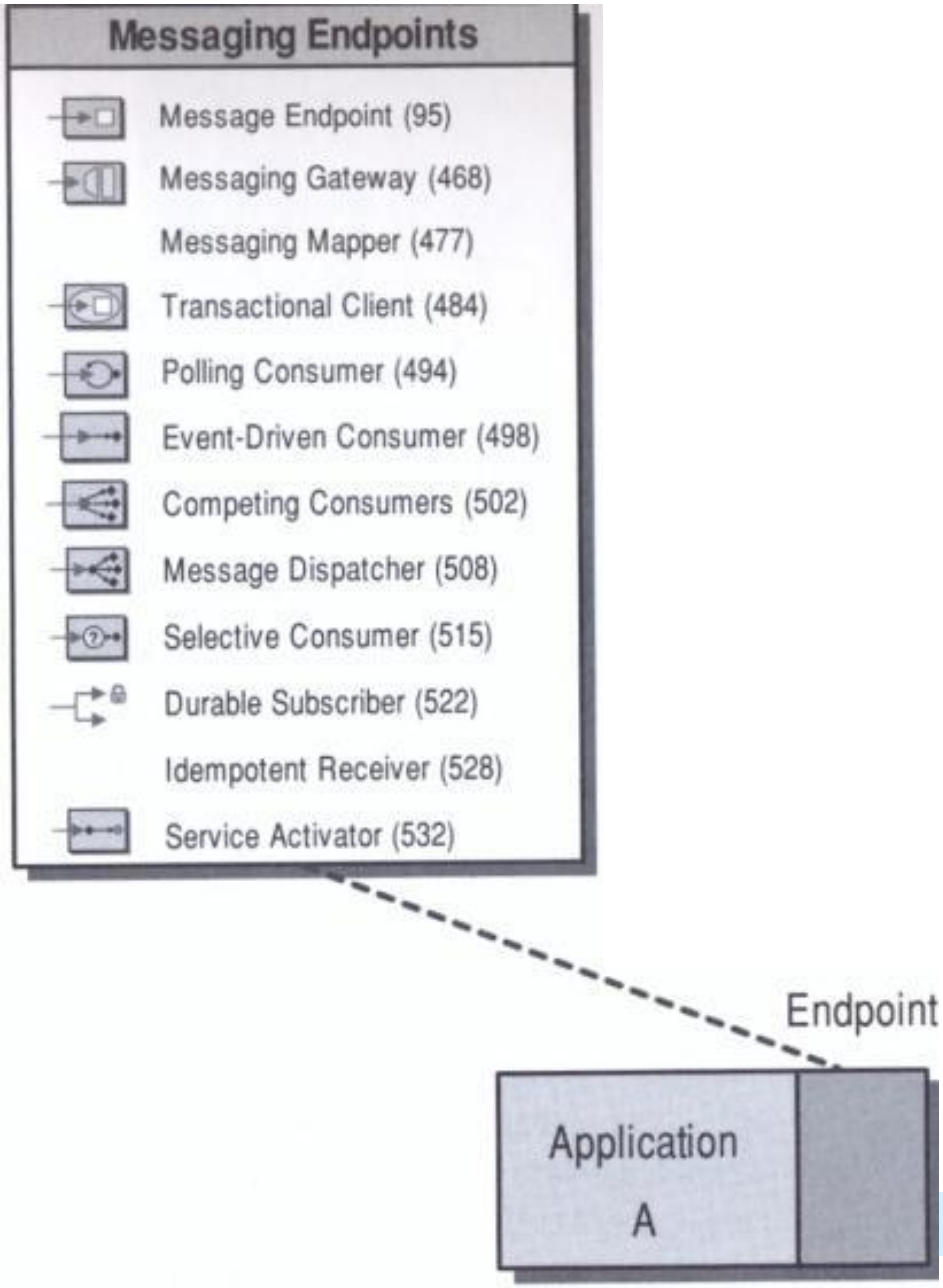
Pattern Overview



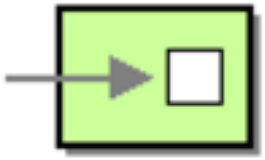
How to connect to messaging endpoint?

An application connects to a messaging system through …

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

We will look at 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

Some pattern alternatives

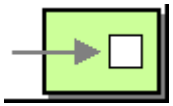
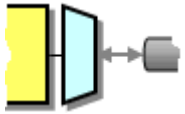
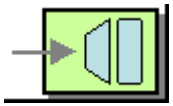
- Synchronous or asynchronous consumer?
  - *Polling Consumer (494)*
  - *Event-Driven Consumer (498)*
- Message grab versus message assignment ?
  - *Competing Consumers (502)*
  - *Message Dispatcher (508)*
- Accept all messages or filter?
  - *Selective Consumer (515)*
- Subscribe while disconnected
  - *Durable Subscriber (522)*
- Idem potency
  - *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

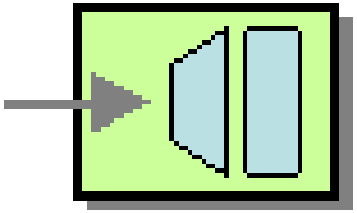
Endpoint Concepts in EIP book

- Often difficult to tell these concepts apart:
  - Endpoint 
  - Adapter 
  - Gateway 

- An **message endpoint** is a **specialized channel adapter** custom developed for, and integrated into its application.
- A **message endpoint** should be **designed** as a **message gateway** to encapsulate message code

Send & Receive patterns

Messaging Gateway

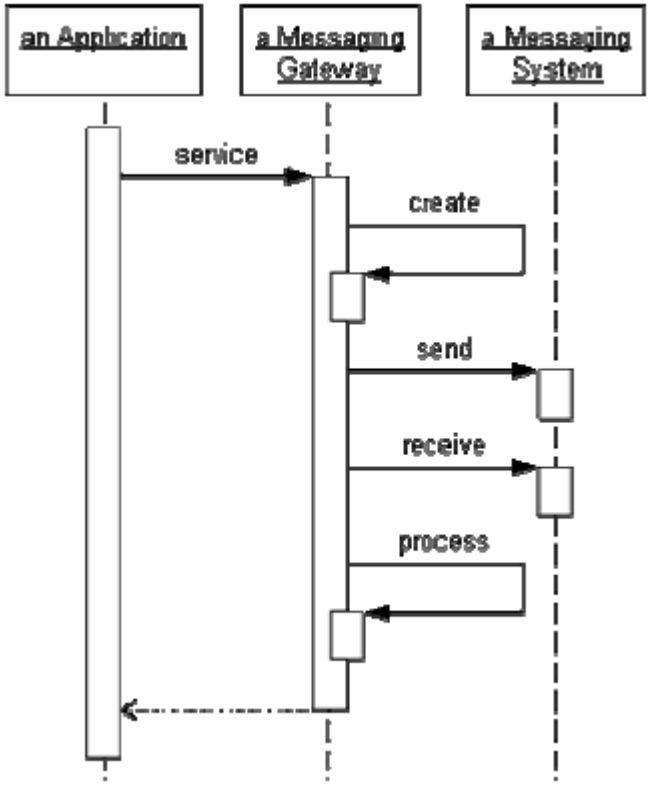


- Encapsulates messaging-specific code
- Separates it from the rest of the application code
- Only Messaging Gateway code knows about the messaging

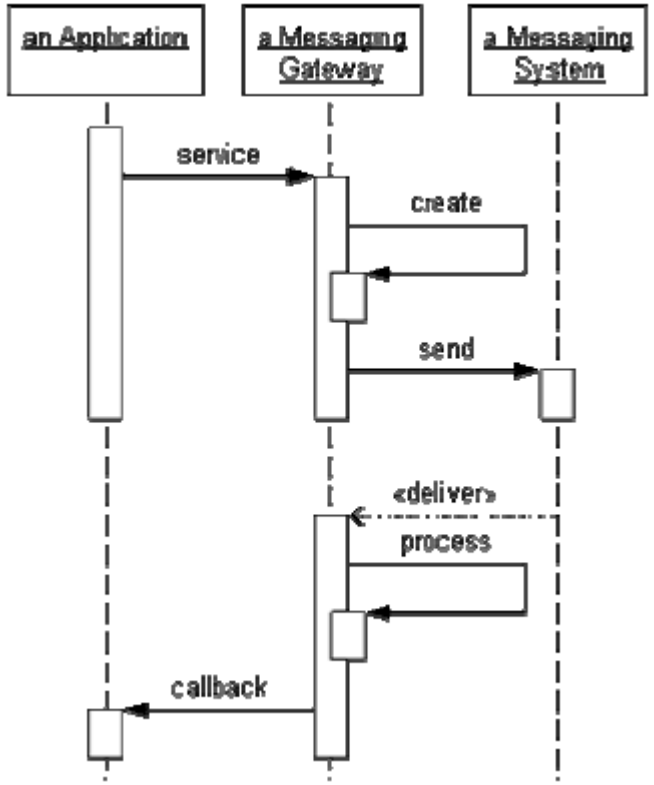
Possible to swap out the gateway with a different implementation ☺

Gateway request-reply example

1.Blocking (Synchronous)



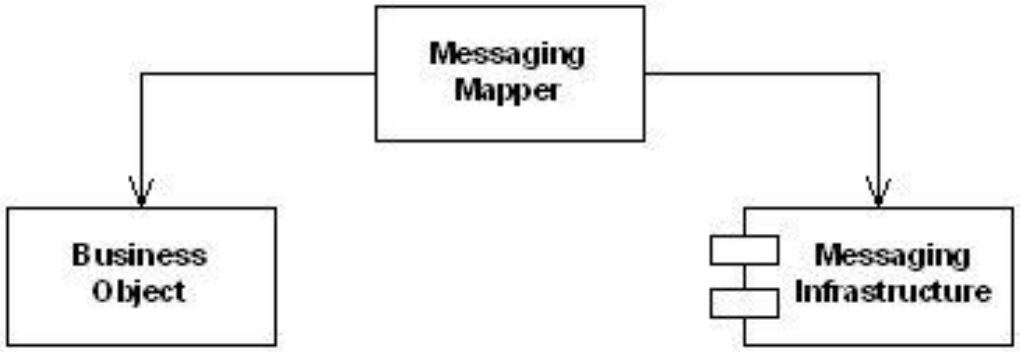
2.Event-Driven (Asynchronous)



Messaging Mapper (477)

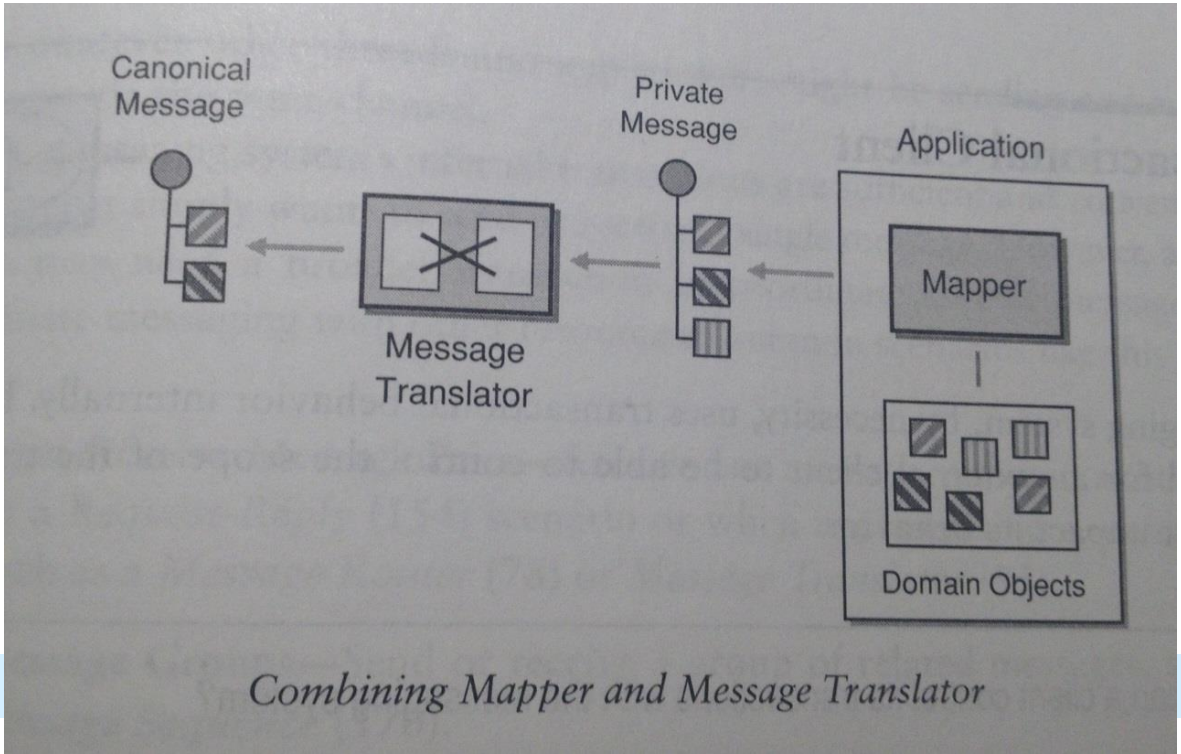
- How to move data between domain objects and the messaging infrastructure while keeping the two independent of each other?

- 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



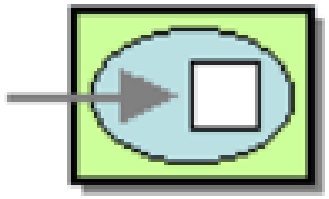
Difference between Mapper and Translator?

- Message Translator: Structural mappings inside messaging layer
- Messaging Mapper: Object references, data type conversion etc. inside application
- Example of combination of the patterns (EIP p. 483):

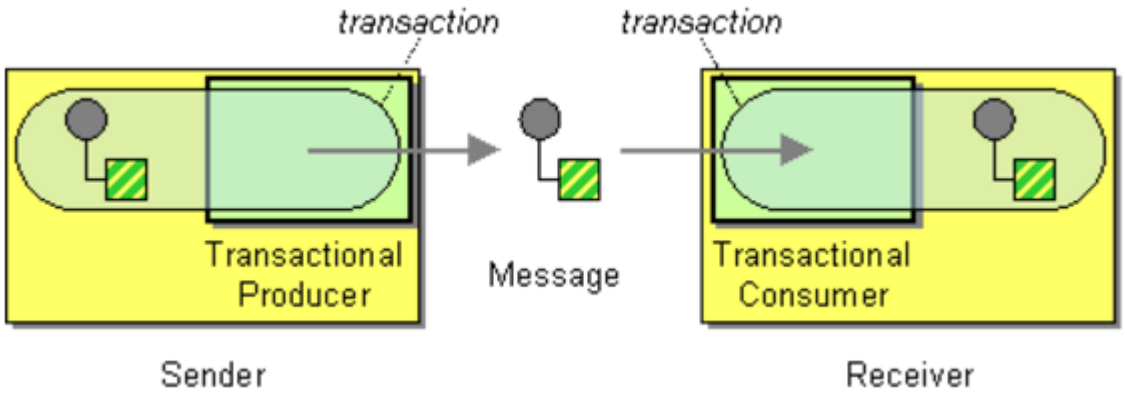


Combining Mapper and Message Translator

Transactional Client (484)



- How can a client control its transactions with the messaging system?



- With a sender, the message isn't "really" added to the channel until the sender commits the transaction.
- With a receiver, the message isn't "really" removed from the channel until the receiver commits the transaction.

RabbitMQ Example

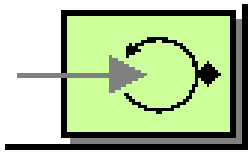
- RabbitMQ supports message *acknowledgements*
- A client makes itself transactional by sending an ack(nowledgement) to tell RabbitMQ that a message has been received, processed and RabbitMQ is free to delete it

- Message acknowledgments are turned on by default.
- We must explicitly turned them off via the autoAck=true flag

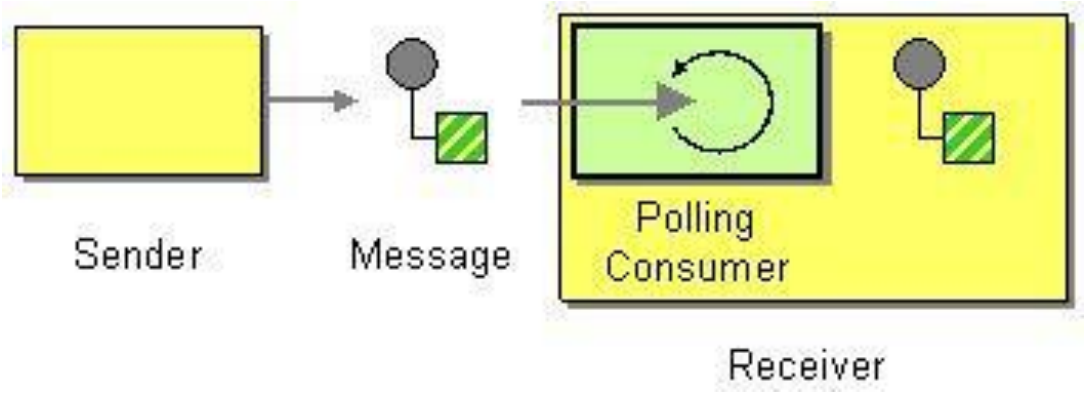
```
QueueingConsumer consumer = new QueueingConsumer(channel);
boolean autoAck = false;
channel.basicConsume("hello", autoAck, consumer);

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

Consumer patterns

Polling Consumer (494)

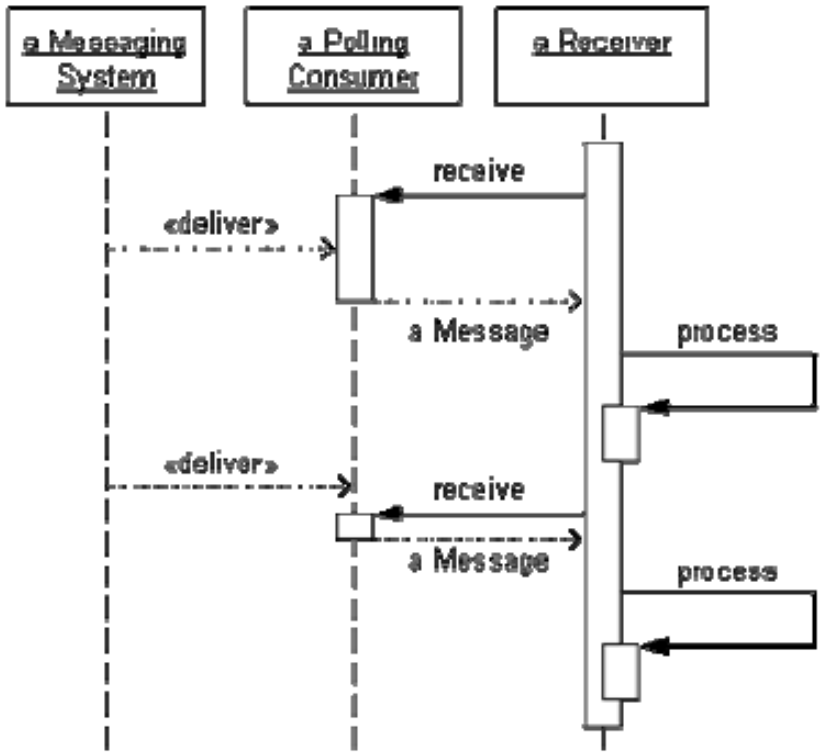


- A polling consumer actively checks for new messages to consume
- A polling consumer won't poll for more messages until it has finished processing the current message, i.e. when it is ready!



Polling Consumer Flow - Example

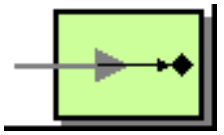
- Synchronous receiver receives messages by explicitly requesting them
- `receive` method blocks until a message is delivered
- Application can control how many messages are consumed concurrently (by limiting no. of threads that are polling
- Extra messages queue up until receiver can process



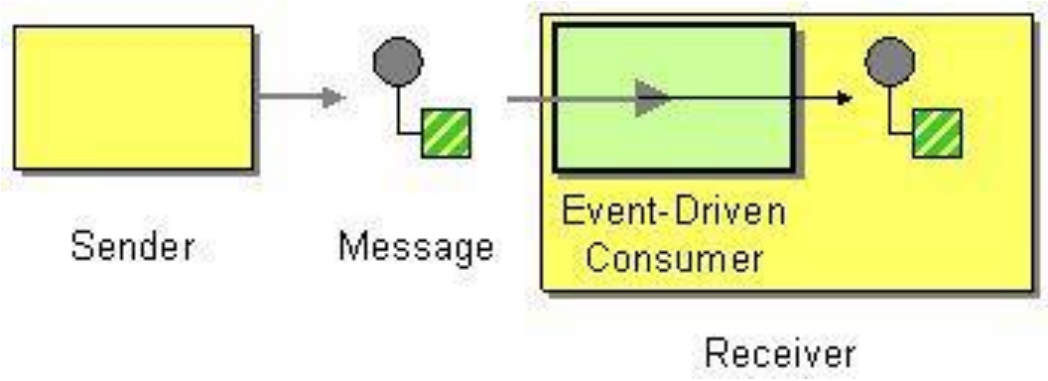
Polling Consumer Sequence

How the consumer gets the message from messaging system is implementation specific

Event-Driven Consumer (498)

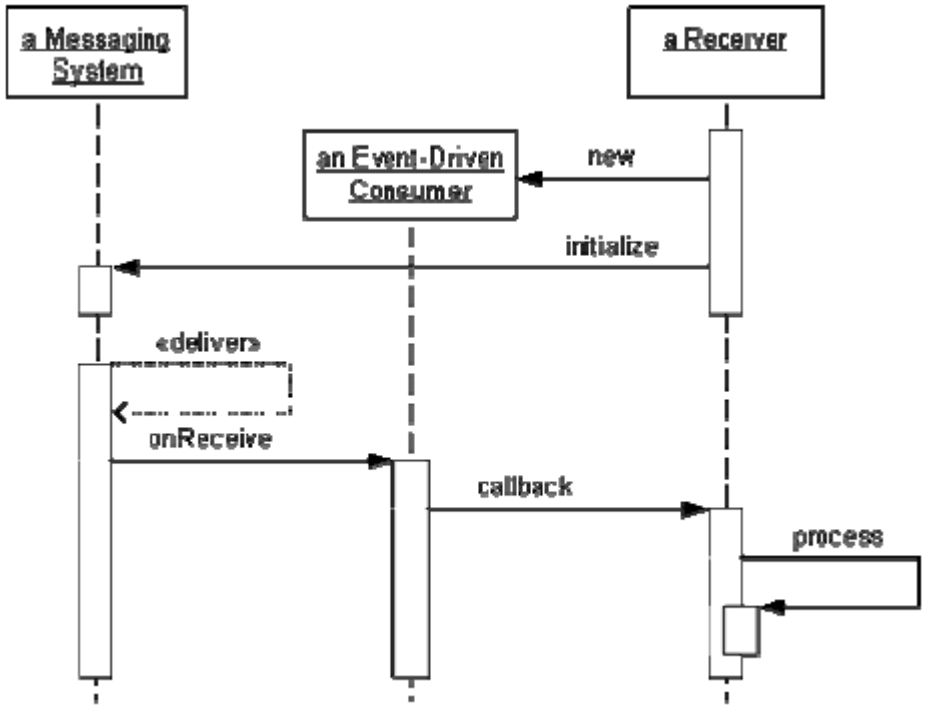


- An Event-Driven Consumer listens on a channel and waits for a client to send messages to it.
- When a message arrives, the consumer 'wakes up' and takes the message for processing



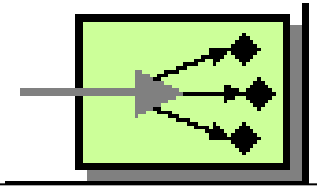
Event-Driven Consumer Flow - Example

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

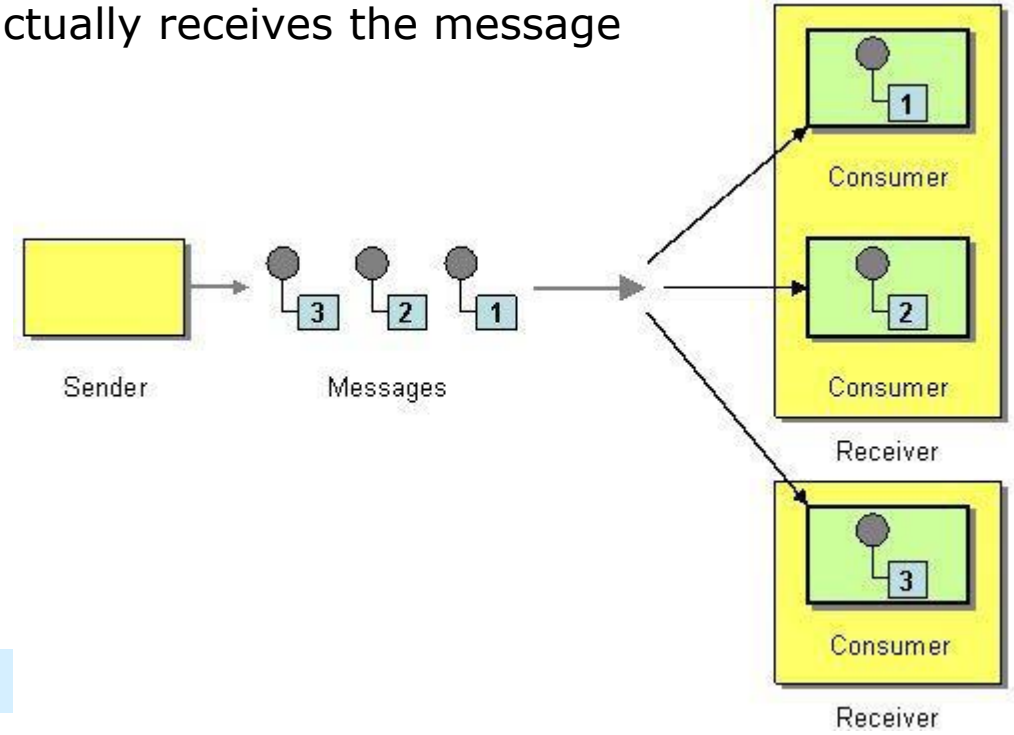


Event-Driven Consumer Sequence

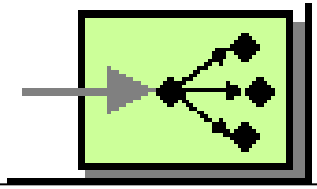
Competing Consumers (502)



- Creating multiple Competing Consumers on a single channel make the consumers process multiple messages concurrently
  - When the channel delivers a message, any of the consumers could potentially receive it
  - In effect the consumers compete to be the receiver
  - The messaging system's implementation determines which consumer actually receives the message

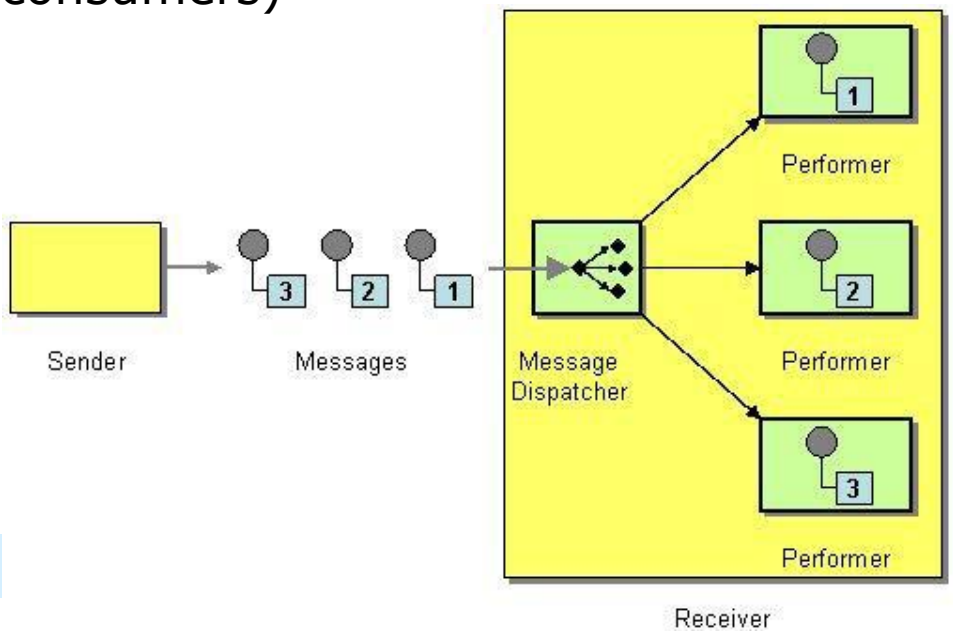


Message Dispatcher (508)



- How can multiple consumers on a single channel coordinate their own message processing?

- A Message Dispatcher will consume messages from a channel and distribute them to performers
- The client implements the coordination itself (as opposed to competing consumers)

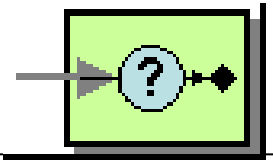


Message Dispatcher 2

- 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.

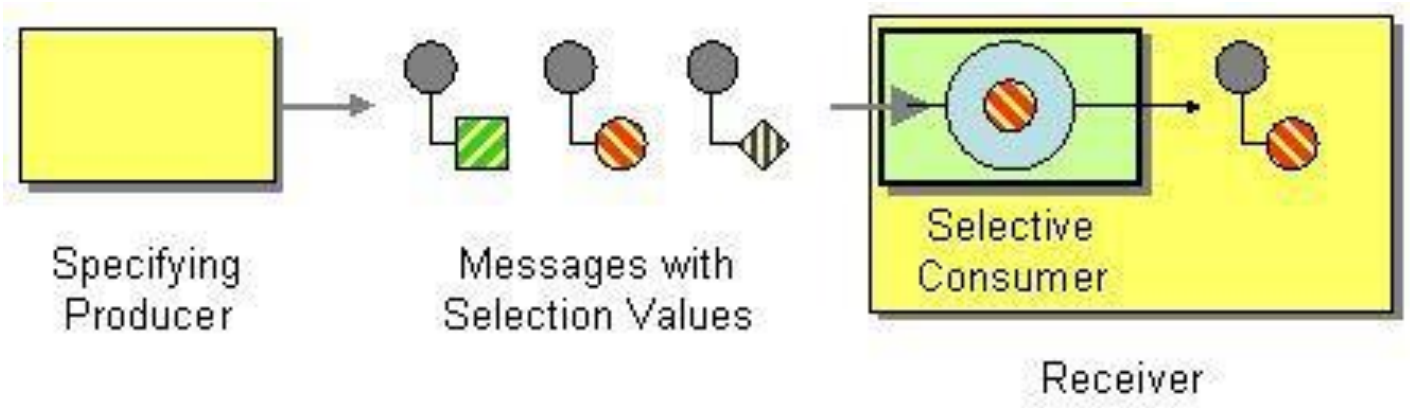
- If the performer processes in its own thread, the dispatcher can receive and delegate other messages, so they can be consumed as fast as the dispatcher can receive and delegate them

Selective Consumer (515)



- How can a message consumer select which messages it wishes to receive?

- Make the consumer a Selective Consumer, one that 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:

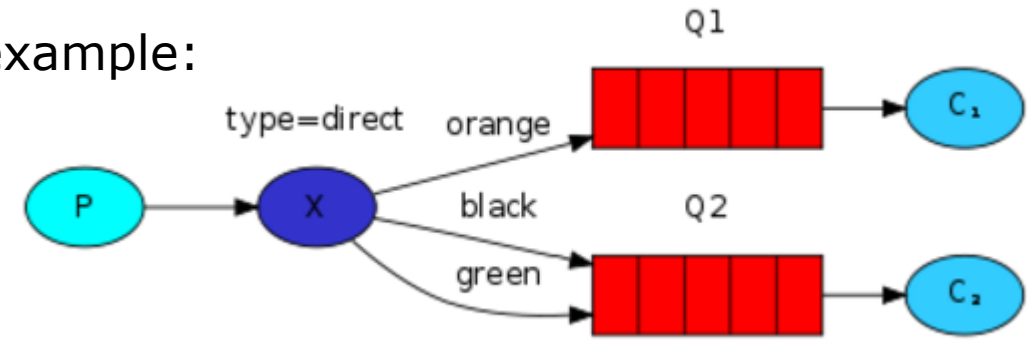
1. **Specifying Producer**. Specifies the message's selection value before sending it

2. **Selection Value**. One or more values specified in the message that allow a consumer to make the selection

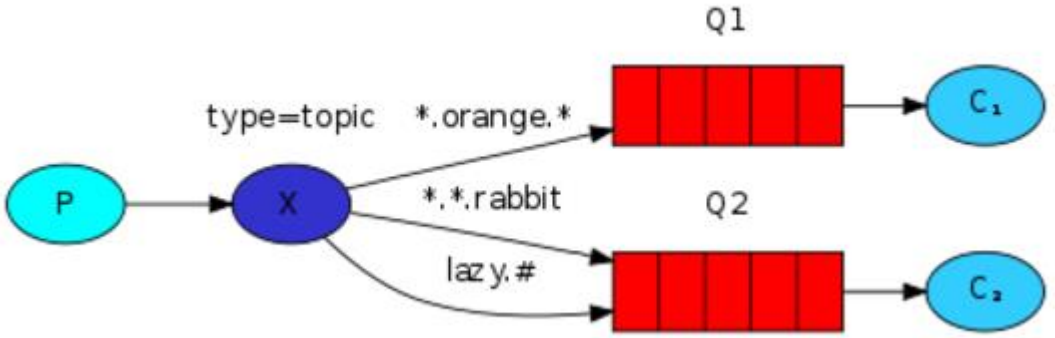
3. **Selective Consumer**. Receives messages that meet its selection criteria

RabbitMQ Exchange Examples

- Direct exchange example:



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

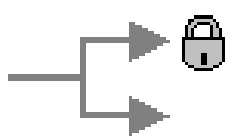


Selective Consumer - Alternatives

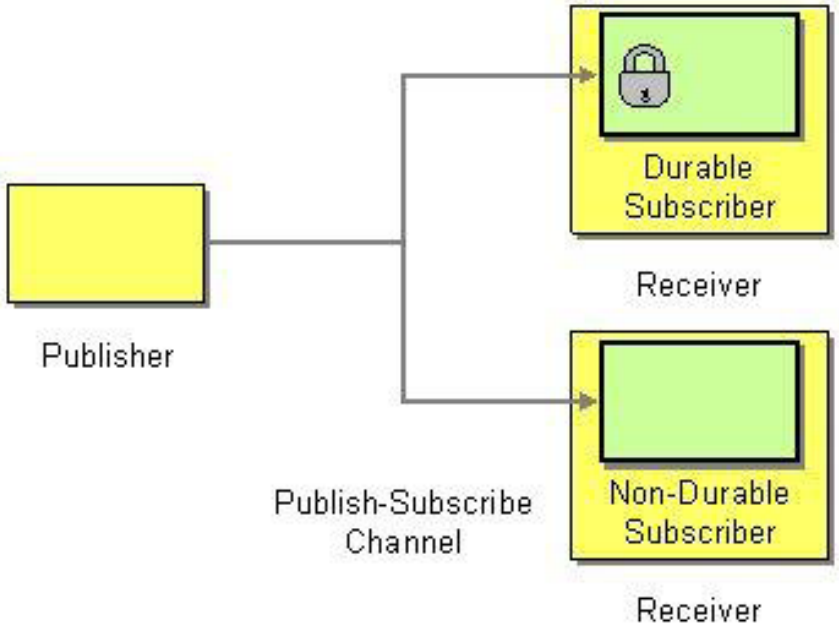
- Selective consumer vs. Message Dispatcher?
  - You want msg. system to do dispatching (Selective Consumer)
  - You want to do it yourself (Message Dispatcher)

- Selective consumer vs. Message Filter?
  - Same goal, but different ways
    - Selective consumer: all messages are delivered to the receivers, but each receiver ignores unwanted messages. It allows unwanted messages to be available to other receivers
    - Message Filter: Sits between sender channel and receiver channel and only transfers desired messages to the receiver's channel. Undesired messages are eliminated from channel

Durable Subscriber (522)



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

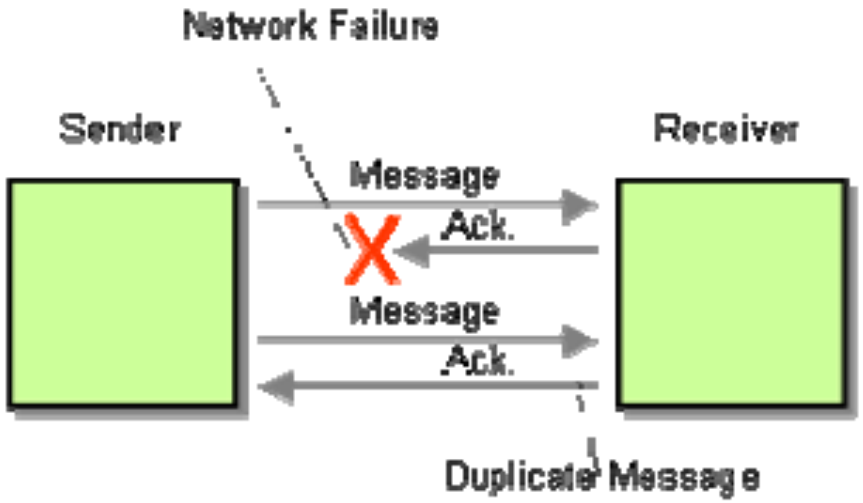


Durable Subscriber 2

- Message system saves messages for an inactive subscriber
- Delivers these saved messages when the subscriber reconnects
- Subscriber will not loose any messages even though it disconnected
- A connected subscriber acts the same whether its subscription is durable or non-durable
- The difference is in how the messaging system behaves when the subscriber is disconnected

Idempotent Receiver (528)

- **How can a message receiver 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. resend the message so it does not impact the system,
  - Instead of
    - Add $10 to account 1234
  - Use
    - Set balance of account 1234 to $110