Messaging Patterns

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About Me

- Developer at Liip AG
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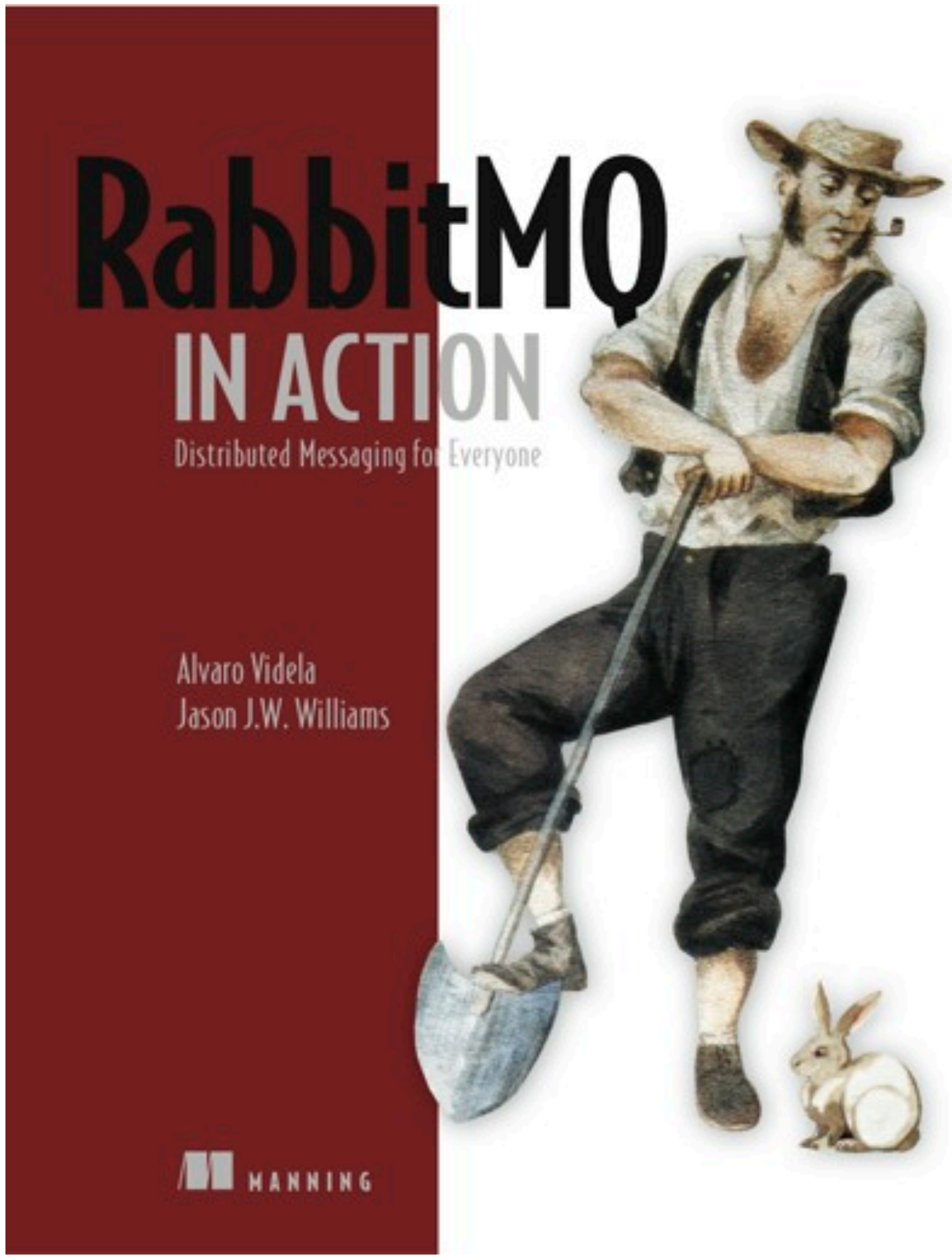
About Me

Co-authoring

RabbitMQ in Action

http://bit.ly/rabbitmq

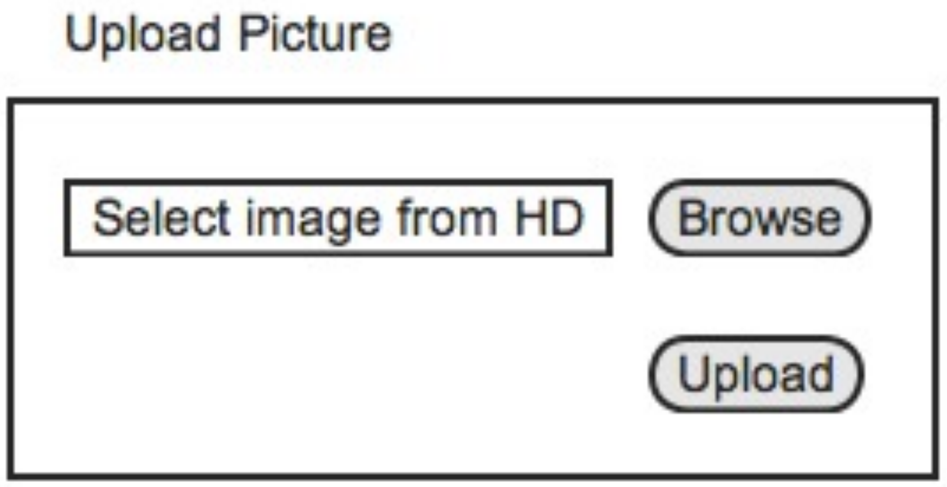


Why Do I need Messaging?

An Example

Implement a Photo Gallery

Two Parts:


Upload Picture
Select image from HD
Browse
Upload

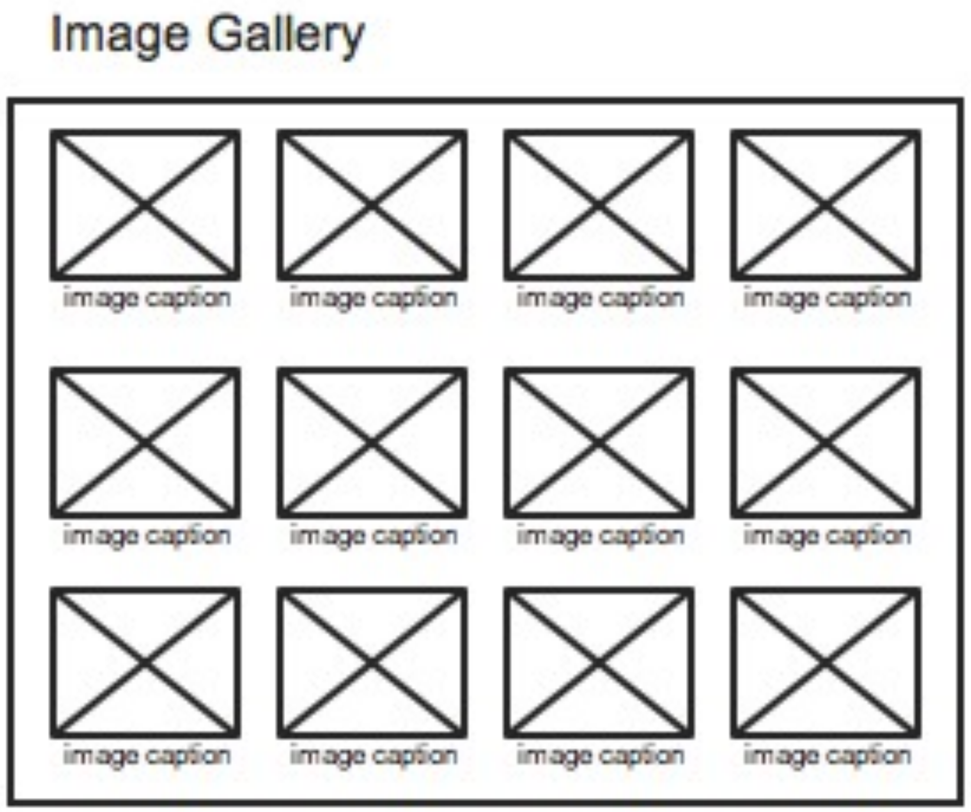


Image Gallery
image caption

Pretty Simple

‘Till new requirements arrive

The Product Owner

Can we also notify the user friends when she uploads a new image?

Can we also notify the user friends when she uploads a new image?

I forgot to mention we need it for tomorrow…

The Social Media Guru

We need to give badges to users for each picture upload

We need to give badges to users for each picture upload

and post uploads to Twitter

The Sysadmin

Dumb! You're delivering full size images! The bandwidth bill has tripled!

Dumb! You're delivering full size images! The bandwidth bill has tripled!

We need this fixed for yesterday!

The Developer in the other team

I need to call your PHP stuff but from Python

I need to call your PHP stuff but from Python

And also Java starting next week

The User

I don’t want to wait till your app resizes my image!

You

FML!

Let’s see the code evolution

First Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  image_handler:do_upload(ReqData:get_file()),
  ok.
```

Second Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  resize_image(Image),
  ok.
```

Third Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  resize_image(Image),
  notify_friends(ReqData:get_user()),
  ok.
```

Fourth Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  resize_image(Image),
  notify_friends(ReqData:get_user()),
  add_points_to_user(ReqData:get_user()),
  ok.
```

Final Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  resize_image(Image),
  notify_friends(ReqData:get_user()),
  add_points_to_user(ReqData:get_user()),
  tweet_new_image(User, Image),
  ok.
```

Can our code scale to new requirements?

What if

What if

- We need to speed up image conversion

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- We need to speed up image conversion
- User notification has to be sent by email

What if

- We need to speed up image conversion
- User notification has to be sent by email
- Stop tweeting about new images

What if

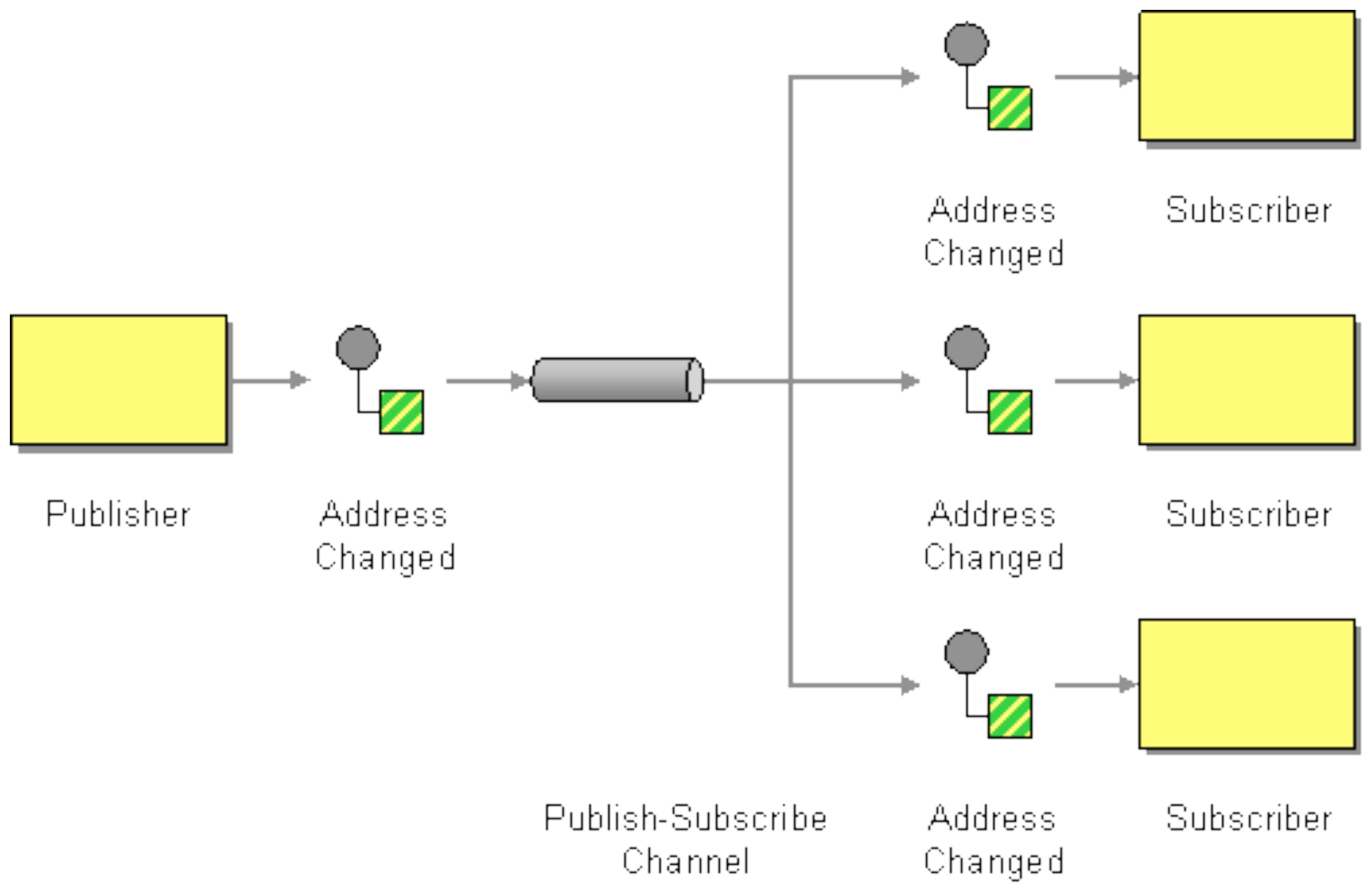
- We need to speed up image conversion
- User notification has to be sent by email
- Stop tweeting about new images
- Resize in different formats

Can we do better?

Sure.
Using messaging

Design

Publish / Subscribe Pattern



First Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  Msg = #msg{user = ReqData:get_user(), image = Image},
  publish_message('new_image', Msg).
```

First Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  Msg = #msg{user = ReqData:get_user(), image = Image},
  publish_message('new_image', Msg).

%% friends notifier
on('new_image', Msg) ->
  notify_friends(Msg.user, Msg.image).
```

First Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  Msg = #msg{user = ReqData:get_user(), image = Image},
  publish_message('new_image', Msg).

%% friends notifier
on('new_image', Msg) ->
  notify_friends(Msg.user, Msg.image).

%% points manager
on('new_image', Msg) ->
  add_points(Msg.user, 'new_image').
```

First Implementation:

```
%% image_controller
handle('PUT', "/user/image", ReqData) ->
  {ok, Image} = image_handler:do_upload(ReqData:get_file()),
  Msg = #msg{user = ReqData:get_user(), image = Image},
  publish_message('new_image', Msg).

%% friends notifier
on('new_image', Msg) ->
  notify_friends(Msg.user, Msg.image).

%% points manager
on('new_image', Msg) ->
  add_points(Msg.user, 'new_image').

%% resizer
on('new_image', Msg) ->
  resize_image(Msg.image).
```

Second Implementation:

Second Implementation:

```
%% there’s none.
```

Messaging

Messaging

- Share data across processes

Messaging

- Share data across processes
- Processes can be part of different apps

Messaging

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- Processes can be part of different apps
- Apps can live in different machines

Messaging

- Share data across processes
- Processes can be part of different apps
- Apps can live in different machines
- Communication is Asynchronous

Main Concepts

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- Messages are sent by **Producers**

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- Messages are delivered to **Consumers**

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- Messages are sent by **Producers**
- Messages are delivered to **Consumers**
- Messages goes through a **Channel**

Messaging and RabbitMQ

What is RabbitMQ?

RabbitMQ

- Enterprise Messaging System
- Open Source MPL
- Written in Erlang/OTP
- Commercial Support
- Messaging via AMQP

Features

- Reliable and High Scalable
- Easy To install
- Easy To Cluster
- Runs on: Windows, Solaris, Linux, OSX
- AMQP 0.8 - 0.9.1

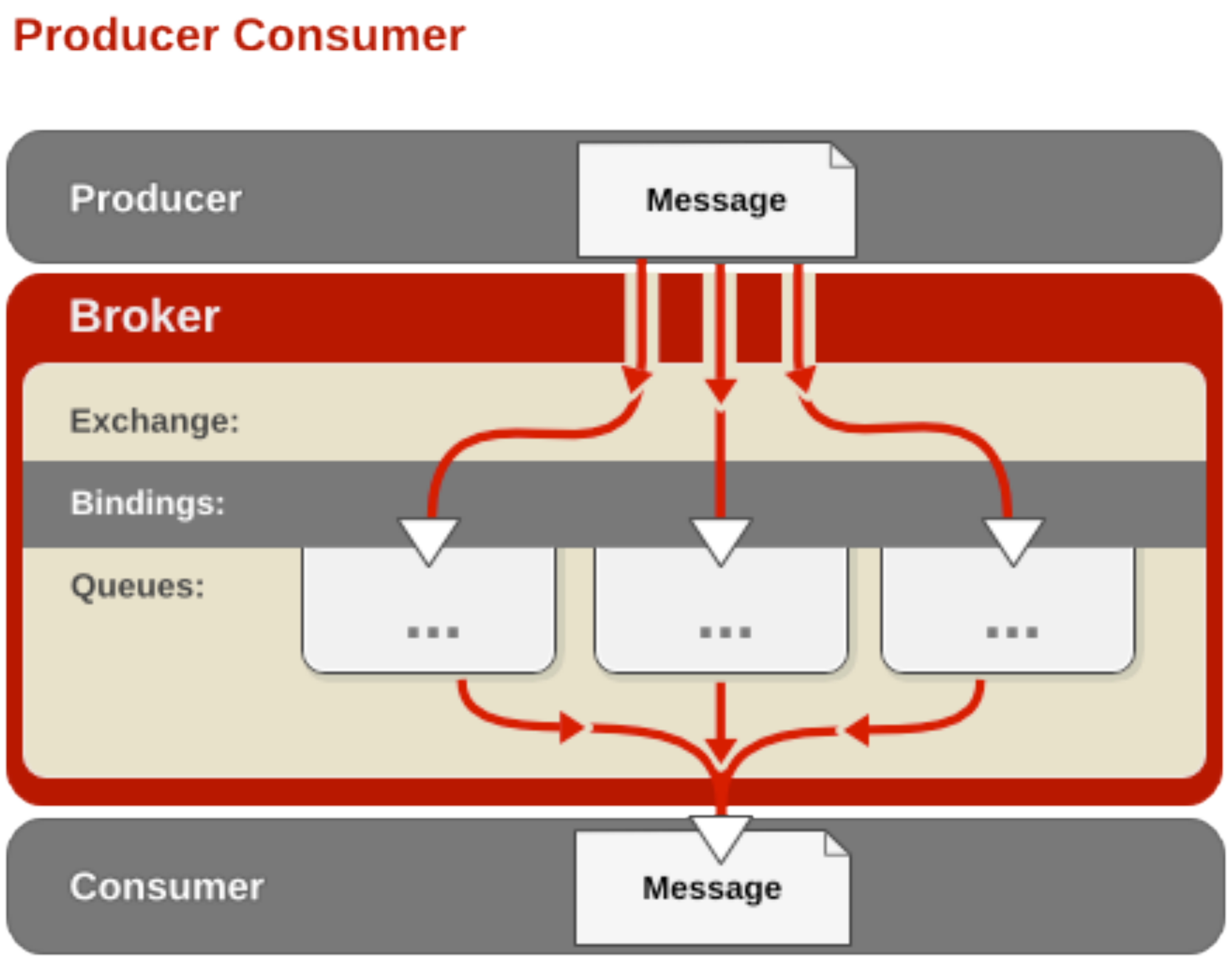
Client Libraries

- Java
- .NET/C#
- Erlang
- Ruby, Python, PHP, Perl, AS3, Lisp, Scala, Clojure, Haskell

AMQP

- Advanced Message Queuing Protocol
- Suits Interoperability
- Completely Open Protocol
- Binary Protocol

Message Flow



http://www.redhat.com/docs/en-US/Red_Hat_Enterprise_MRG/1.0/html/Messaging_Tutorial/chap-Messaging_Tutorial-Initial_Concepts.html

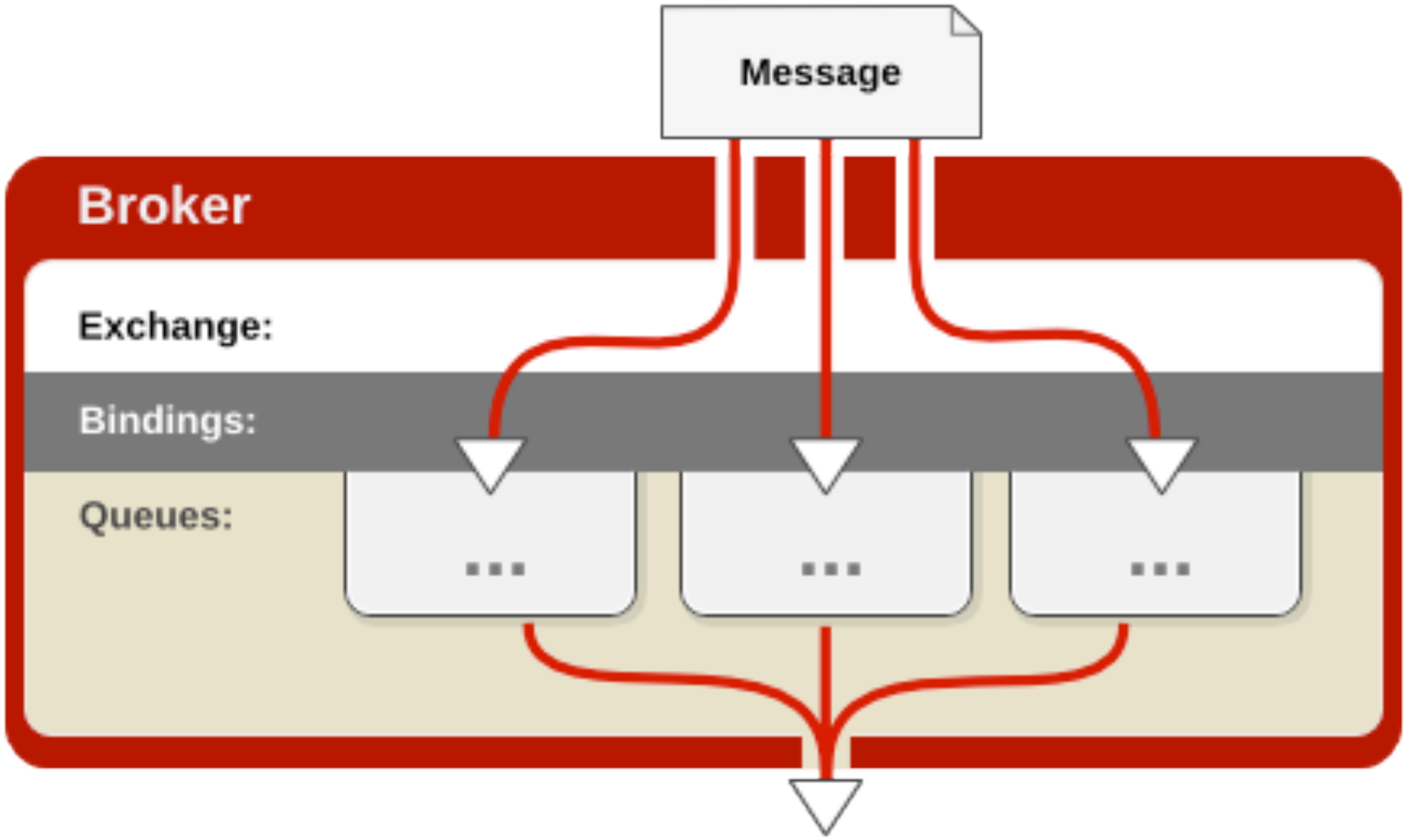
AMQP Model

- Exchanges
- Message Queues
- Bindings
- Rules for binding them

Exchange Types

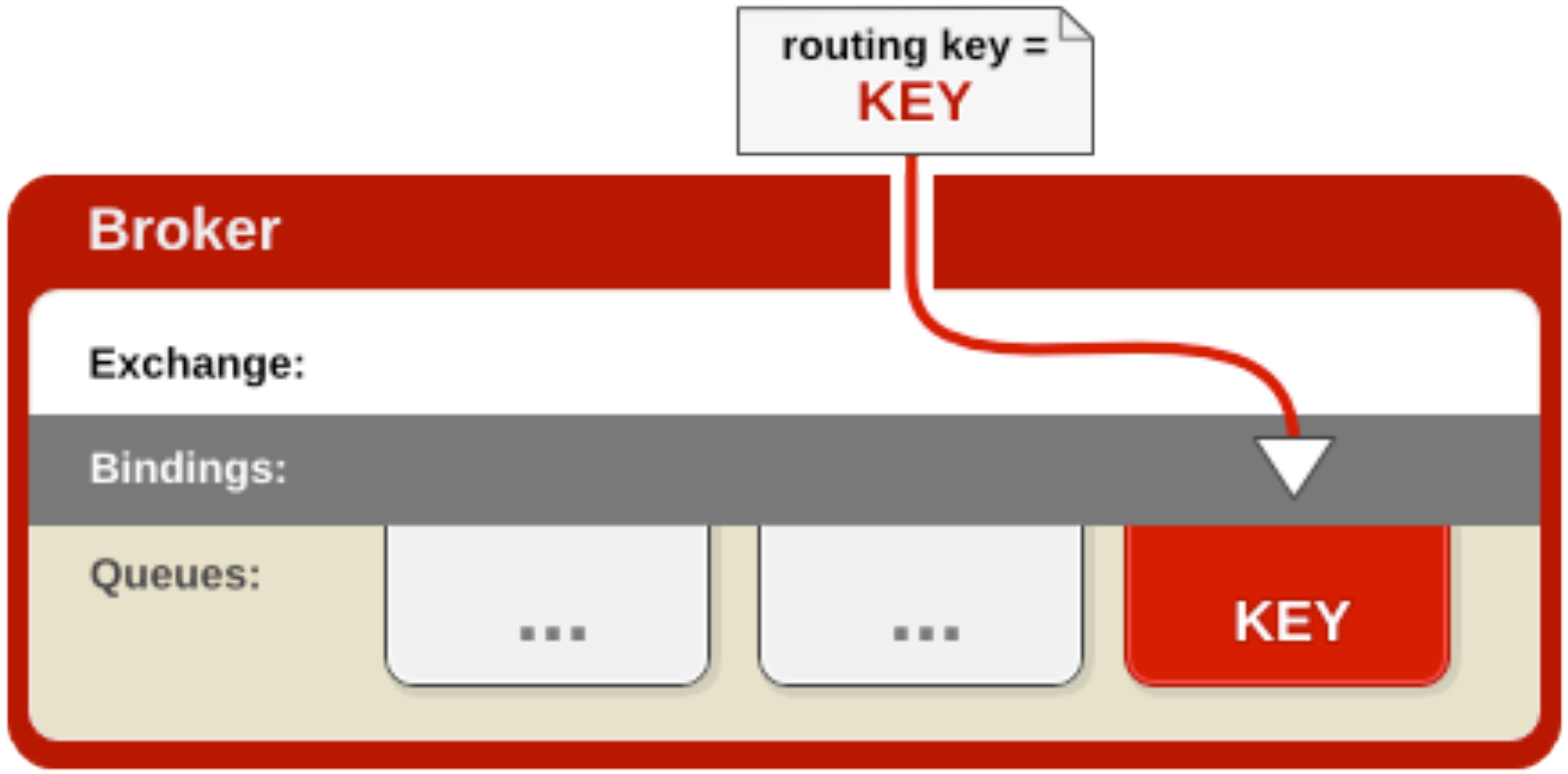
- Fanout
- Direct
- Topic

Fanout Exchange

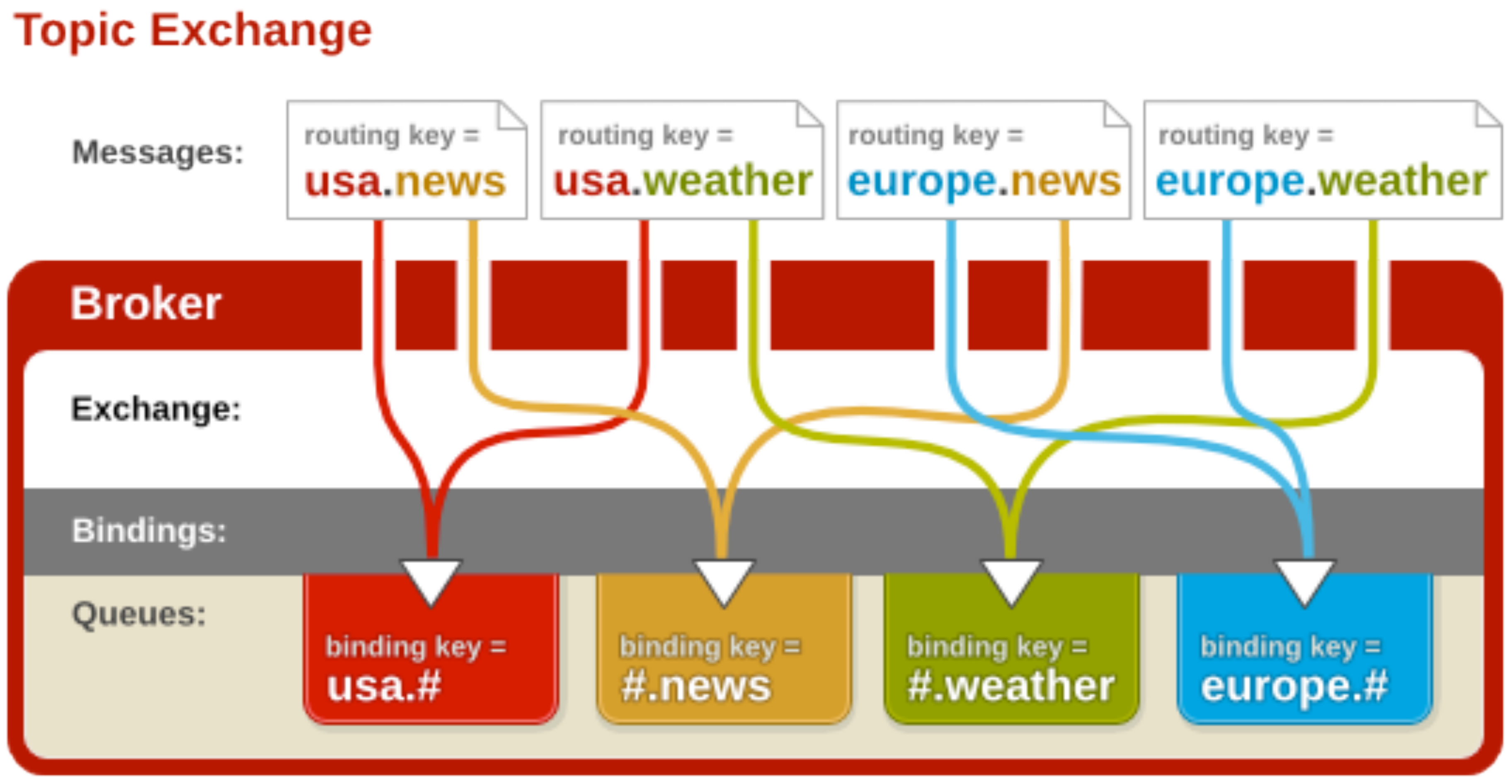


http://www.redhat.com/docs/en-US/Red_Hat_Enterprise_MRG/1.0/html/Messaging_Tutorial/sect-Messaging_Tutorial-Initial_Concepts-Fanout_Exchange.html

Direct Exchange



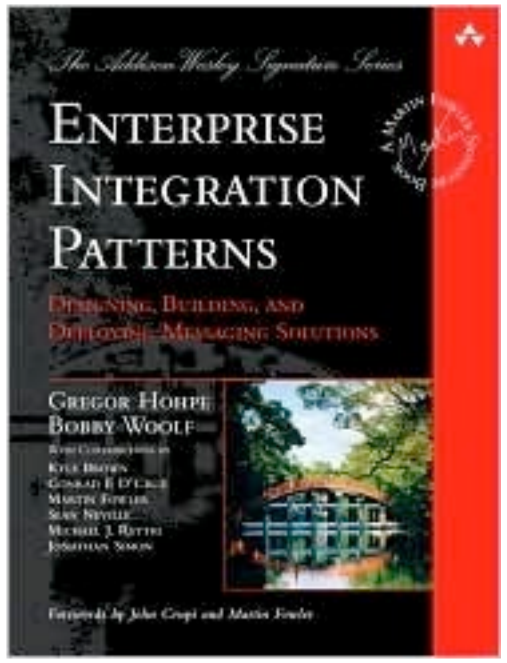
http://www.redhat.com/docs/en-US/Red_Hat_Enterprise_MRG/1.0/html/Messaging_Tutorial/sect-Messaging_Tutorial-Initial_Concepts-Direct_Exchange.html



http://www.redhat.com/docs/en-US/Red_Hat_Enterprise_MRG/1.0/html/Messaging_Tutorial/sect-Messaging_Tutorial-Initial_Concepts-Topic_Exchange.html

Messaging Patterns

There are many messaging patterns


The Addison-Wesley Signature Series
Enterprise Integration Patterns
Designing, Building, and Deploying Messaging Solutions
Gregor Hohpe
Bobby Woolf

http://www.eaipatterns.com/

Basic Patterns

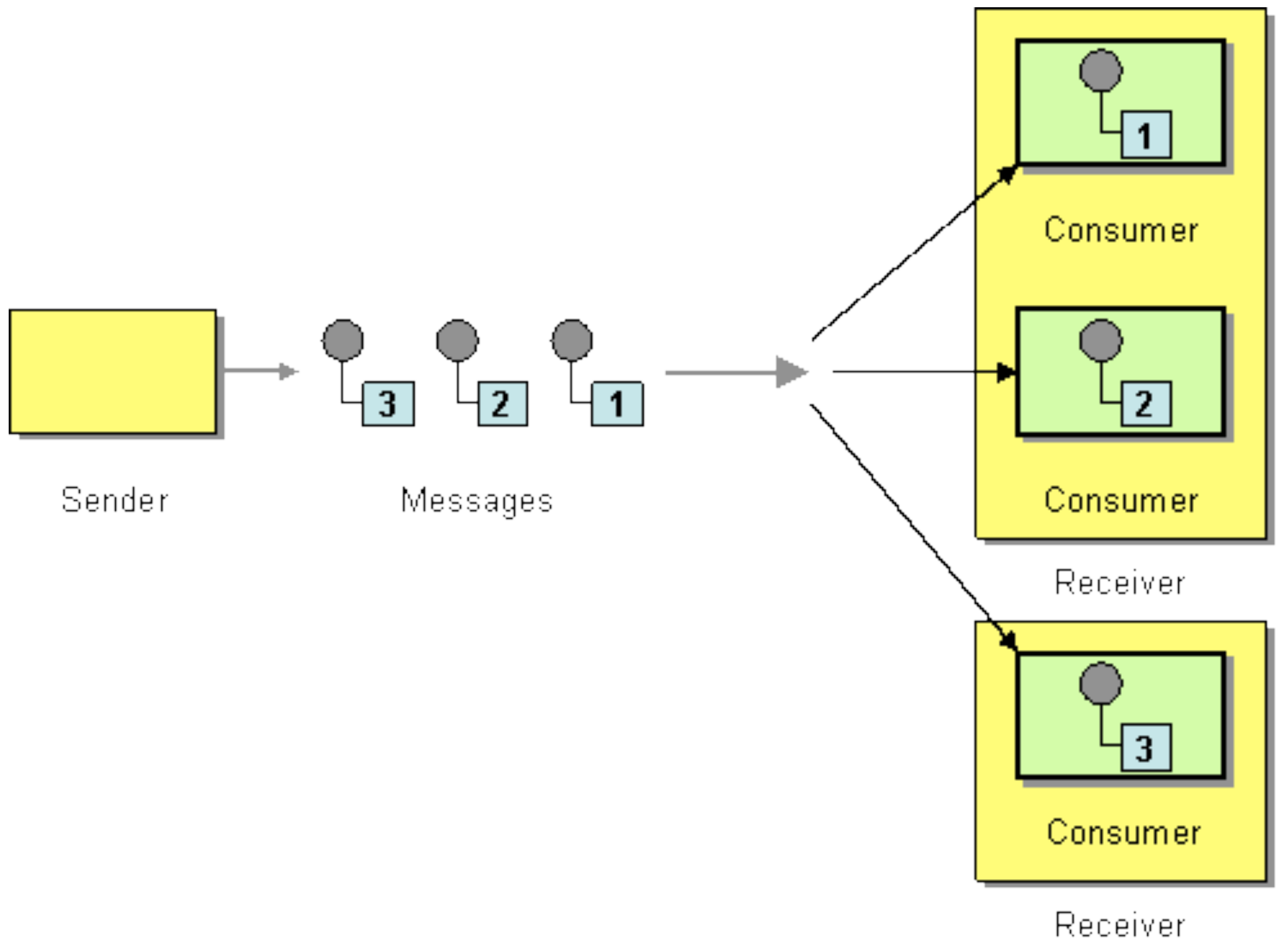
Competing Consumers

How can a messaging client process multiple messages concurrently?

Competing Consumers

Create multiple *Competing Consumers* on a single channel so that the consumers can process multiple messages concurrently.

Competing Consumers



Publisher Code

```erlang
init(Exchange, Queue) ->
    #'exchange.declare'{exchange = Exchange,
                        type = <<"direct">>,
                        durable = true},
    #'queue.declare'{queue = Queue, durable = false},
   #'queue.bind'{queue = Queue, exchange = Exchange}.



publish_msg(Exchange, Payload) ->
    Props = #'P_basic'{content_type = <<"application/json">>,
                       delivery_mode = 2}, %% persistent
    publish(Exchange, #amqp_msg{props = Props, payload = Payload}).
```

Consumer Code

```erlang
init_consumer(Exchange, Queue) ->
    init(Exchange, Queue),
    #'basic.consume'{ticket = 0, queue = Queue}.


on(#'basic.deliver'{delivery_tag = DeliveryTag},
   #amqp_msg{} = Msg) ->
      do_something_with_msg(Msg),
      #'basic.ack'{delivery_tag = DeliveryTag}.
```

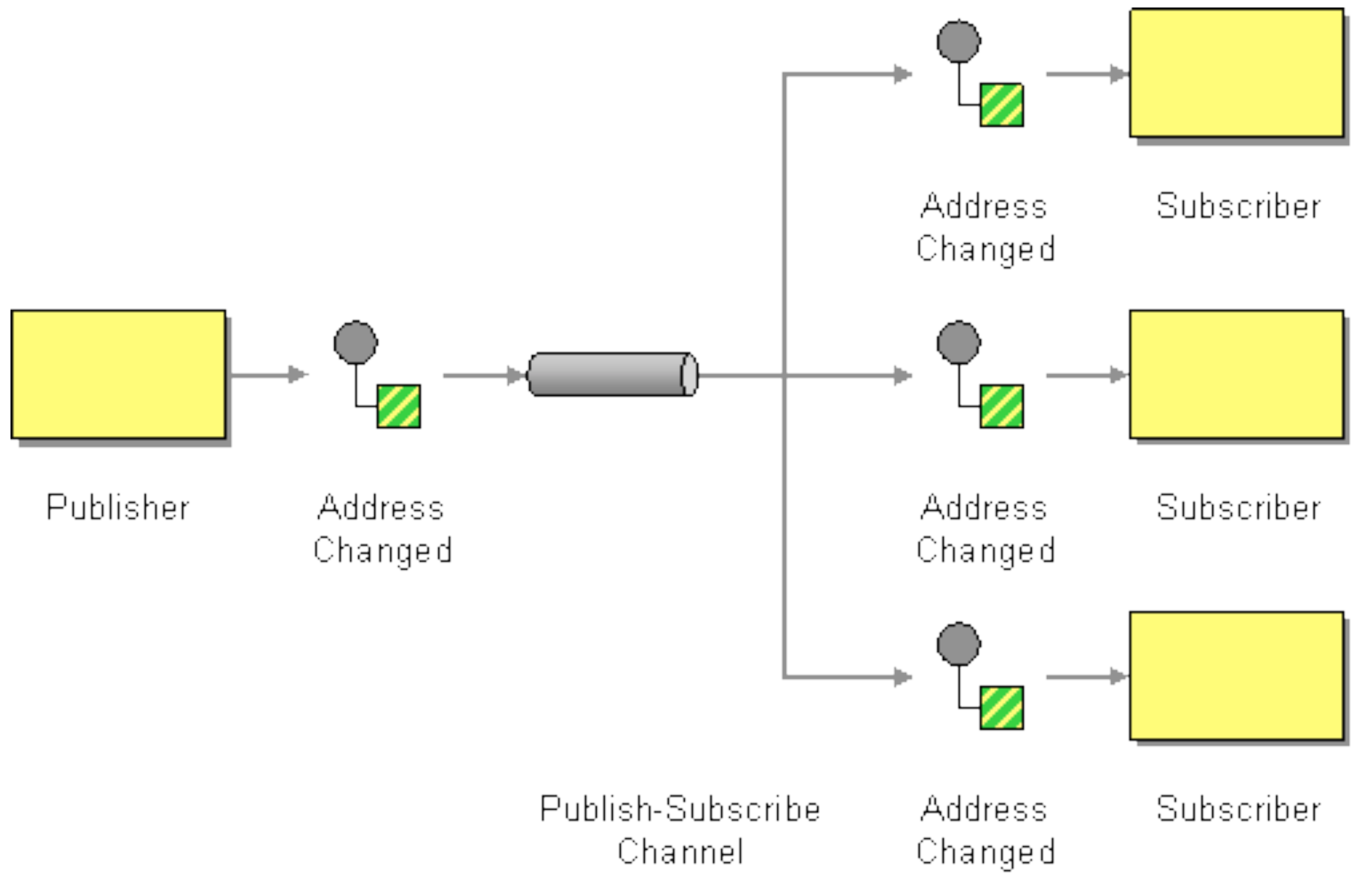
Publish/Subscribe

How can the sender broadcast an event to all interested receivers?

Publish/Subscribe

Send the event on a *Publish-Subscribe Channel*, which delivers a copy of a particular event to each receiver.

Publish/Subscribe



Publisher Code

```
init(Exchange, Queue) ->
    #'exchange.declare'{exchange = Exchange,
                        type = <<"fanout">>, %% different type
                        durable = true}
    %% same as before ...



publish_msg(Exchange, Payload) ->
    Props = #'P_basic'{content_type = <<"application/json">>,
                       delivery_mode = 2}, %% persistent
    publish(Exchange, #amqp_msg{props = Props, payload = Payload}).
```

Consumer Code A

```
init_consumer(Exchange, ResizeImageQueue) ->
    init(Exchange, ResizeImageQueue),
    #'basic.consume'{queue = ResizeImageQueue}.


on(#'basic.deliver'{delivery_tag = DeliveryTag},
   #amqp_msg{} = Msg) ->
      resize_message(Msg),
      #'basic.ack'{delivery_tag = DeliveryTag}.
```

Consumer Code B

```
init_consumer(Exchange, NotifyFriendsQueue) ->
    init(Exchange, NotifyFriendsQueue),
    #'basic.consume'{queue = NotifyFriendsQueue}.


on(#'basic.deliver'{delivery_tag = DeliveryTag},
   #amqp_msg{} = Msg) ->
      notify_friends(Msg),
      #'basic.ack'{delivery_tag = DeliveryTag}.
```

Consumer Code C

```
init_consumer(Exchange, LogImageUpload) ->
    init(Exchange, LogImageUpload),
    #'basic.consume'{queue = LogImageUpload}.


on(#'basic.deliver'{delivery_tag = DeliveryTag},
   #amqp_msg{} = Msg) ->
      log_image_upload(Msg),
      #'basic.ack'{delivery_tag = DeliveryTag}.
```

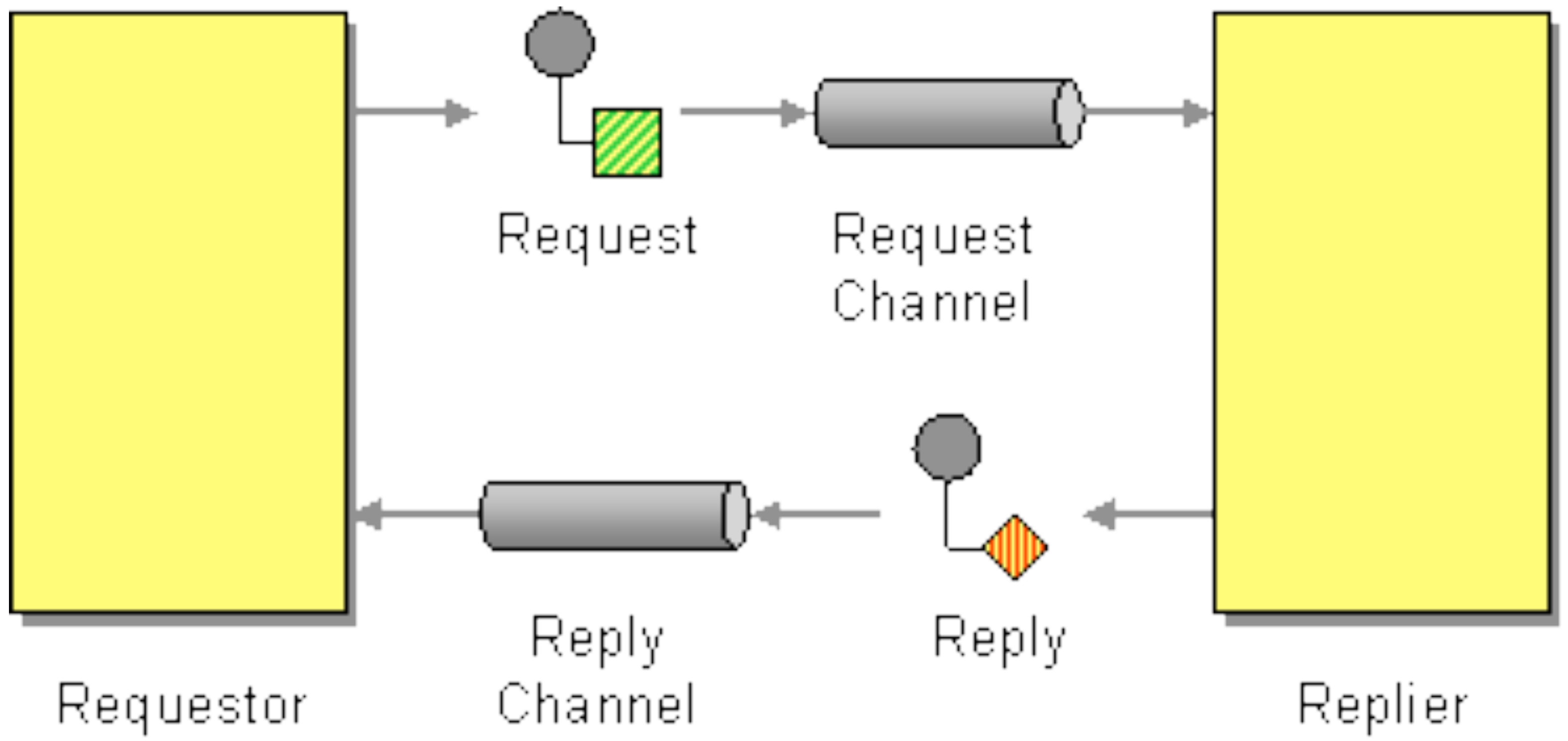
Request/Reply

When an application sends a message, how can it get a response from the receiver?

Request/Reply

Send a pair of *Request-Reply* messages, each on its own channel.

Request/Reply



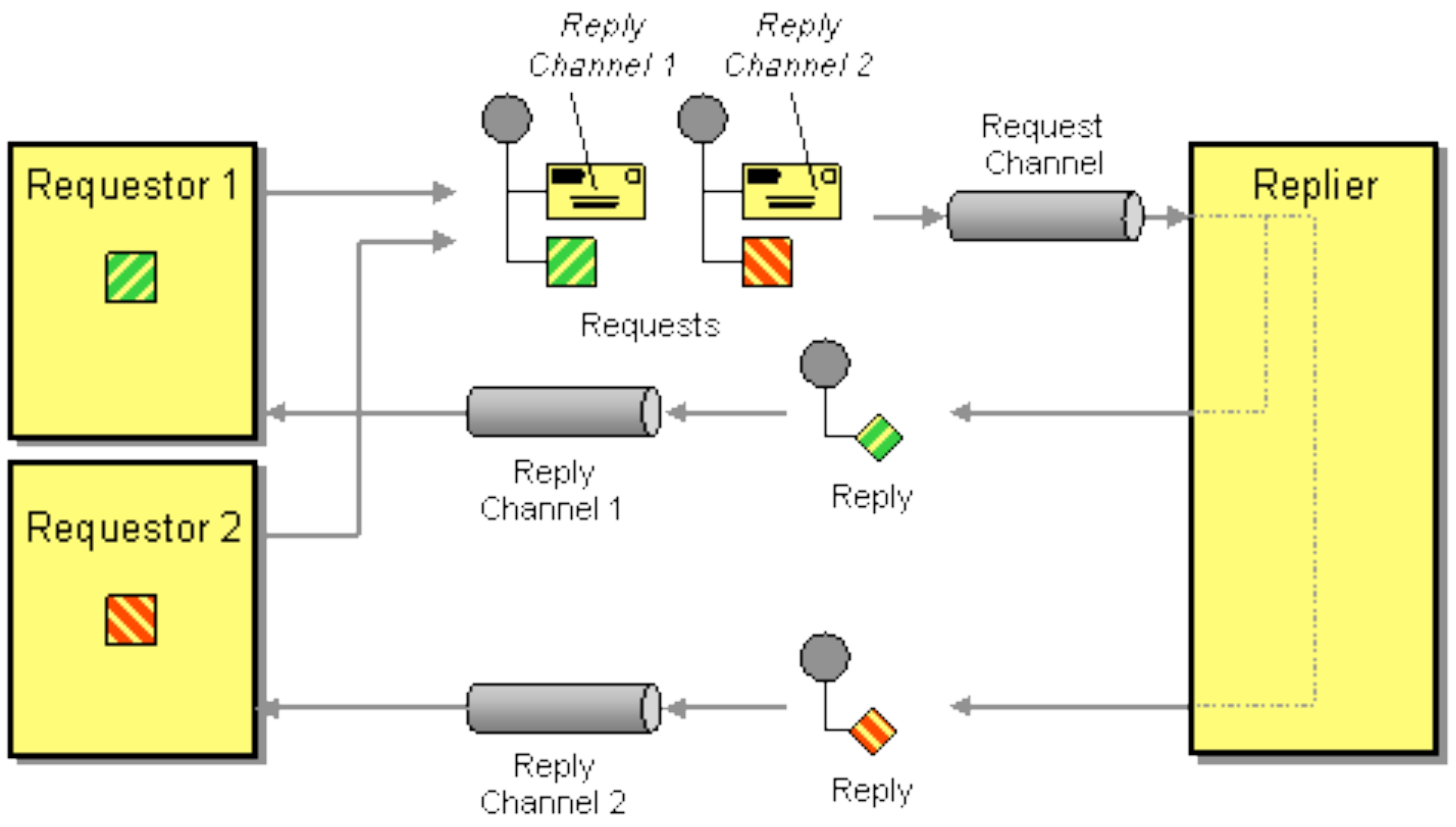
Return Address

How does a replier know where to send the reply?

Return Address

The request message should contain a *Return Address* that indicates where to send the reply message.

Return Address



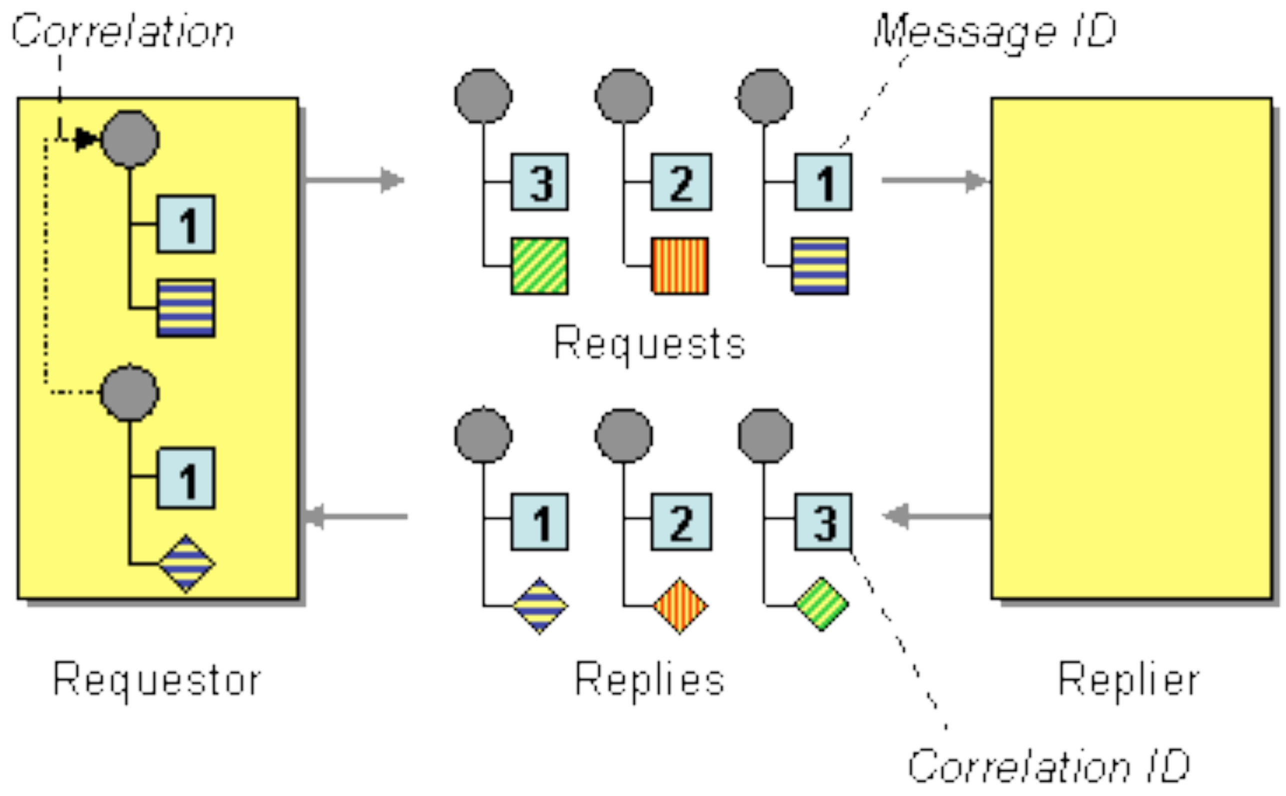
Correlation Identifier

How does a requestor that has received a reply know which request this is the reply for?

Correlation Identifier

Each reply message should contain a *Correlation Identifier*, a unique identifier that indicates which request message this reply is for.

Correlation Identifier



Putting it all together

RPC Client

```
init() ->
    #'queue.declare_ok'{queue = SelfQueue} =
        #'queue.declare'{exclusive = true, auto_delete = true},
    #'basic.consume'{queue = SelfQueue, no_ack = true},
    SelfQueue.
```

RPC Client

```
init() ->
    #'queue.declare_ok'{queue = SelfQueue} =
        #'queue.declare'{exclusive = true, auto_delete = true},
    #'basic.consume'{queue = SelfQueue, no_ack = true},
    SelfQueue.

request(Payload, RequestId) ->
    Props = #'P_basic'{correlation_id = RequestId,
                       reply_to = SelfQueue},
    publish(ServerExchange, #amqp_msg{props = Props,
                                      payload = Payload}).
```

RPC Client

```
init() ->
    #'queue.declare_ok'{queue = SelfQueue} =
        #'queue.declare'{exclusive = true, auto_delete = true},
    #'basic.consume'{queue = SelfQueue, no_ack = true},
    SelfQueue.


request(Payload, RequestId) ->
    Props = #'P_basic'{correlation_id = RequestId,
                       reply_to = SelfQueue},
    publish(ServerExchange, #amqp_msg{props = Props,
                                      payload = Payload}).


on(#'basic.deliver'{},
   #amqp_msg{props = Props, payload = Payload}) ->
    CorrelationId = Props.correlation_id,
    do_something_with_reply(Payload).
```

RPC Server

```
on(#'basic.deliver'{},
   #amqp_msg{props = Props, payload = Payload}) ->

    CorrelationId = Props.correlation_id,

    ReplyTo = Props.reply_to,

    Reply = process_request(Payload),

    NewProps = #'P_basic'{correlation_id = CorrelationId},

    publish("", %% anonymous exchange
            #amqp_msg{props = NewProps,
                      payload = Reply},
            ReplyTo). %% routing key
```

Advanced Patterns

Control Bus

How can we effectively administer a messaging system that is distributed across multiple platforms and a wide geographic area?

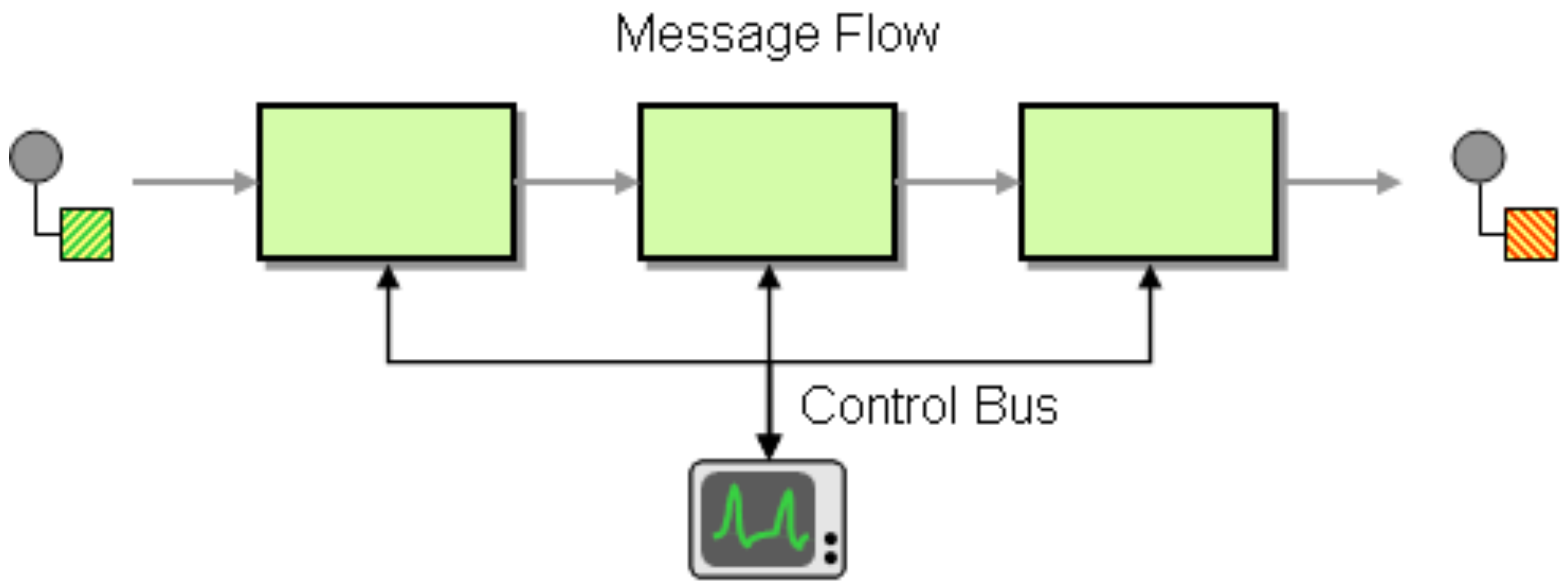
Control Bus

Use a *Control Bus* to manage an enterprise integration system.

Control Bus

- Send Configuration Messages
- Start/Stop Services
- Inject Test Messages
- Collect Statistics

Control Bus



Control Bus

Make Services

“Control Bus” Enabled

Detour

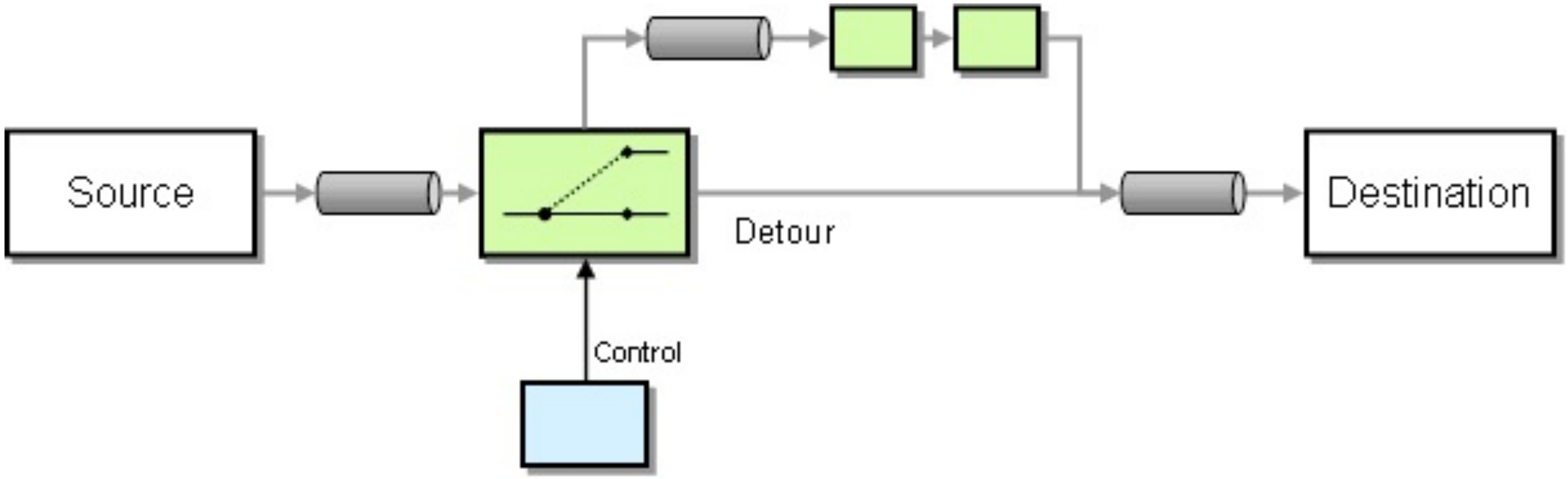
How can you route a message through intermediate steps to perform validation, testing or debugging functions?

Detour

Construct a *Detour* with a context-based router controlled via the *Control Bus*.

In one state the router routes incoming messages through additional steps while in the other it routes messages directly to the destination channel.

Detour



Wire Tap

How do you inspect messages that travel on a point-to-point channel?

Wire Tap

Insert a simple Recipient List into the channel that publishes each incoming message to the main channel and a secondary channel.

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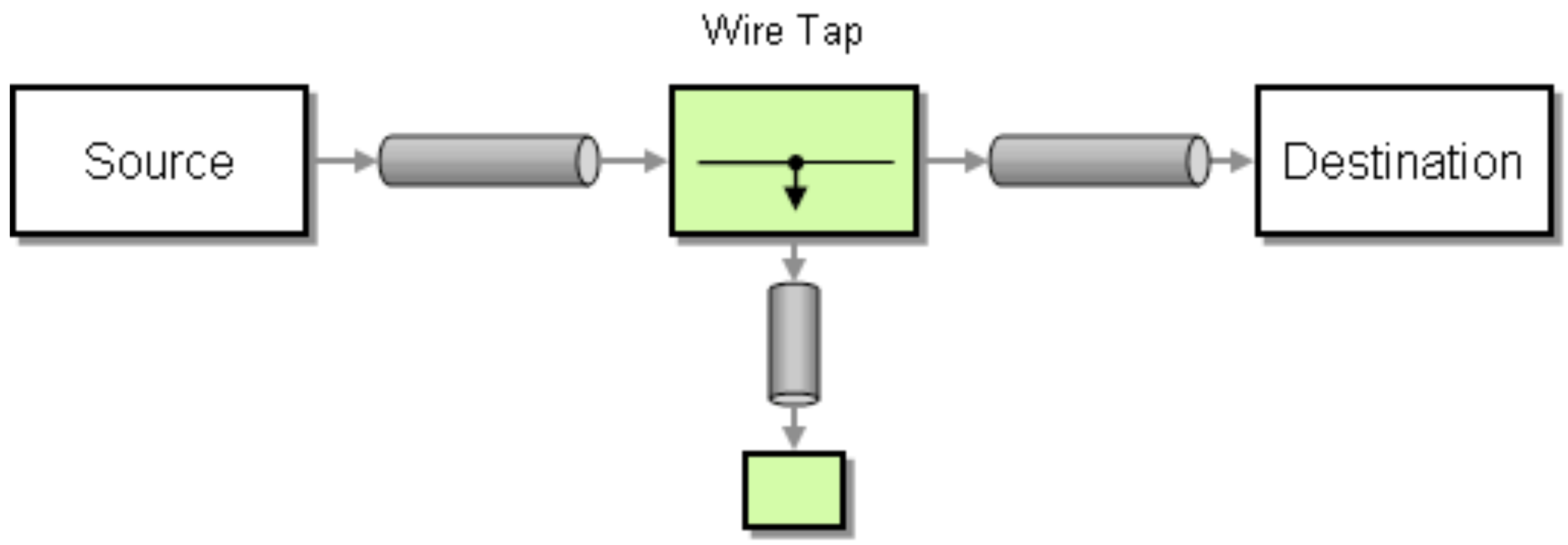
Wire Tap



Smart Proxy

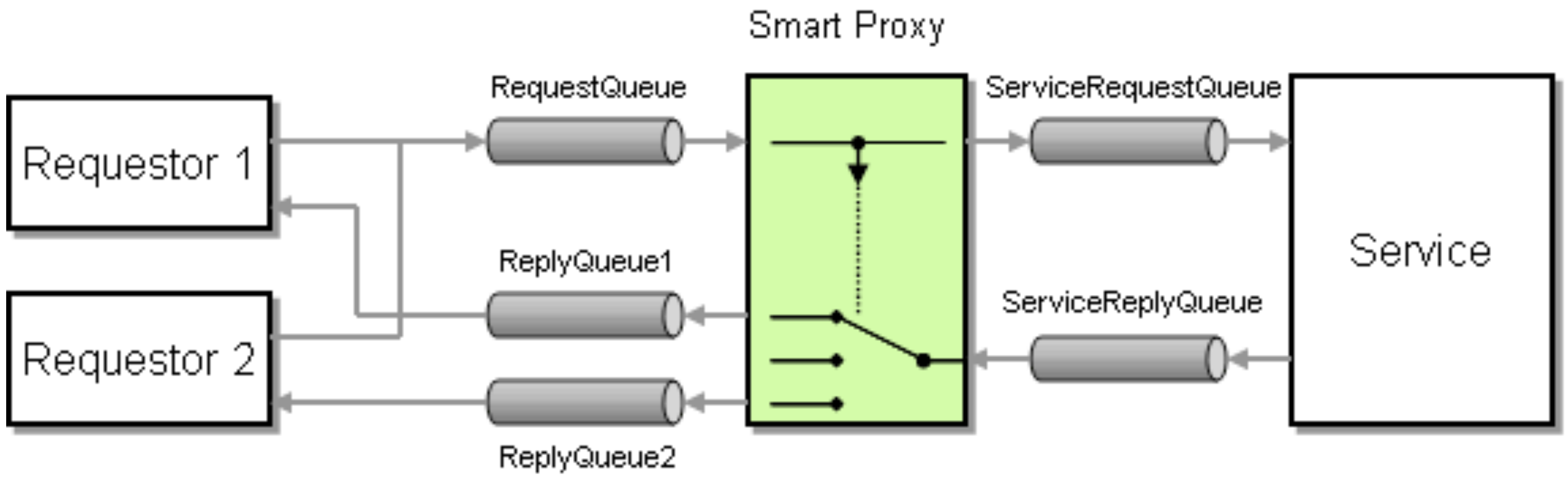
How can you track messages on a service that publishes reply messages to the Return Address specified by the requestor?

Smart Proxy

Use a *Smart Proxy* to store the Return Address supplied by the original requestor and replace it with the address of the *Smart Proxy*.

When the service sends the reply message route it to the original Return Address.

Smart Proxy


Smart Proxy
RequestQueue
ServiceRequestQueue
Requestor 1
Service
ReplyQueue1
ServiceReplyQueue
Requestor 2
ReplyQueue2

Credits

Pattern graphics and description taken from:
http://www.eaipatterns.com/

Thanks!

@old_sound

http://vimeo.com/user1169087

http://www.slideshare.net/old_sound