Building a Distributed Data Ingestion System with RabbitMQ

Alvaro Videla - RabbitMQ

Конференция разработчиков
высоконагруженных систем

Alvaro Videla

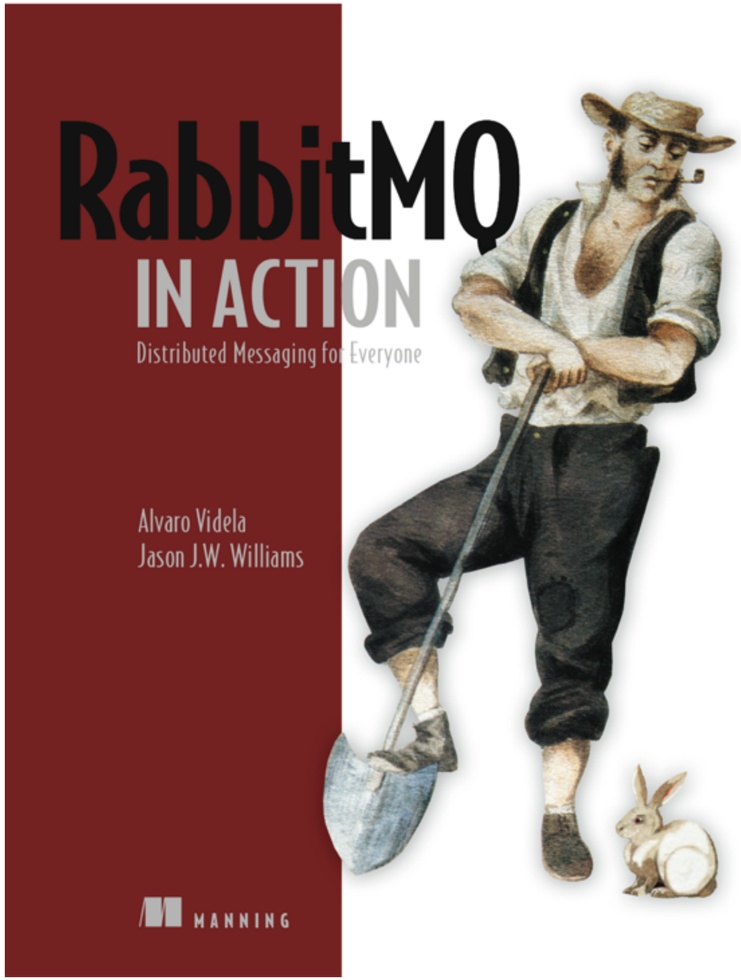
- Works at RabbitMQ
- Co-Author of RabbitMQ in Action
- Creator of the RabbitMQ Simulator
- Blogs about RabbitMQ Internals: http://videlalvaro.github.io/internals.html
- @old_sound — alvaro@rabbitmq.com — github.com/videlalvaro

About Me

Co-authored

RabbitMQ in Action

http://bit.ly/rabbitmq



About this Talk

- Exploratory Talk
- A ‘what could be done’ talk instead of ‘this is how you do it’

Agenda

- Intro to RabbitMQ
- The Problem
- Solution Proposal
- Improvements

https://twitter.com/spacemanaki/status/514590885523505153

What is RabbitMQ

Multi Protocol

http://bit.ly/rmq-protocols

Community Plugins

http://www.rabbitmq.com/community-plugins.html

Polyglot

Polyglot

- PHP

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- node.js

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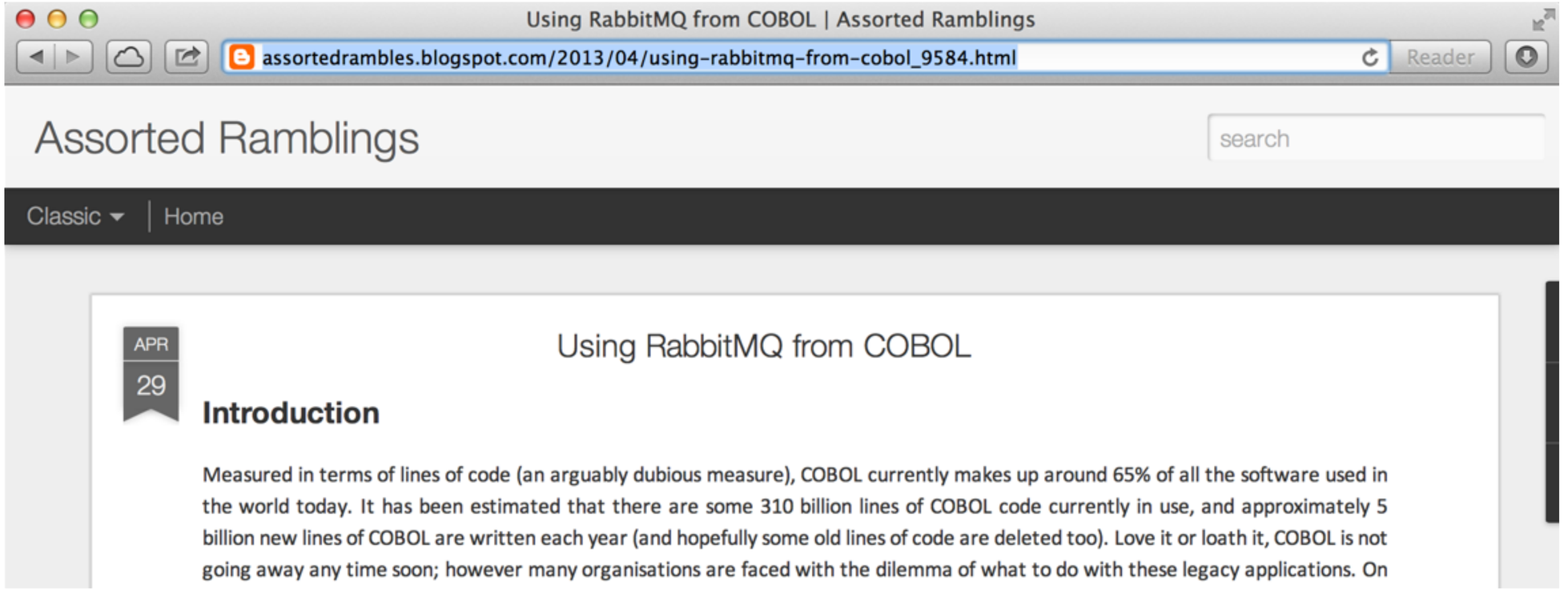
Polyglot



Even COBOL!!!11

Some users of RabbitMQ

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- Instagram

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The New York Times on RabbitMQ

This architecture - Fabrik - has dozens of RabbitMQ instances spread across 6 AWS zones in Oregon and Dublin.

Upon launch today, the system autoscaled to ~500,000 users. Connection times remained flat at ~200ms.

http://lists.rabbitmq.com/pipermail/rabbitmq-discuss/2014-January/032943.html

http://www.rabbitmq.com/download.html

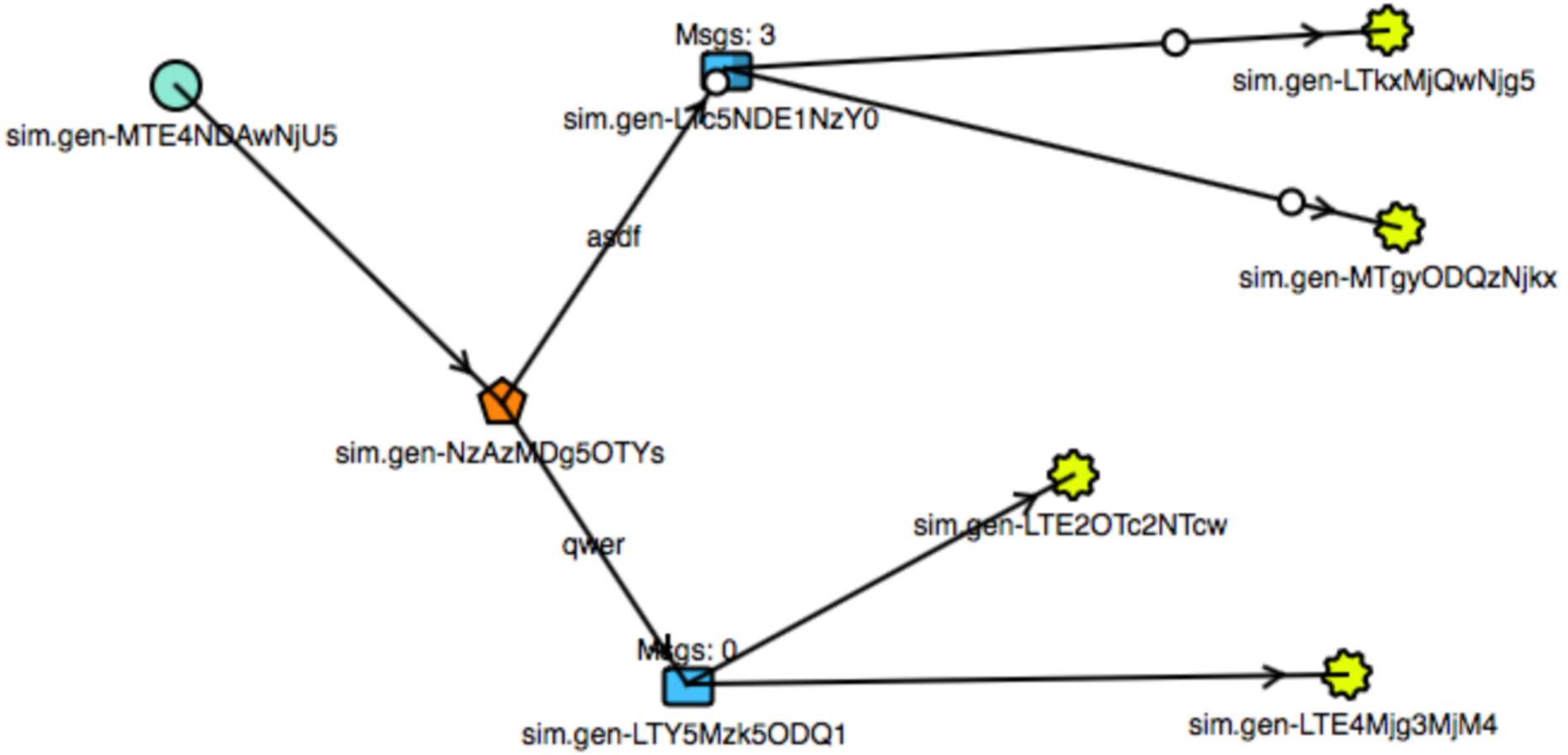
Unix - Mac - Windows

Messaging with RabbitMQ

https://github.com/RabbitMQSimulator/RabbitMQSimulator

http://tryrabbitmq.com

RabbitMQ Simulator



The Problem

Distributed Application

Data Producer

Obtain a Channel

```
{ok, Connection} =
        amqp_connection:start(#amqp_params_network{host = "localhost"}),

{ok, Channel} = amqp_connection:open_channel(Connection),
```

Data Producer

Declare an Exchange

```
amqp_channel:call(Channel, #'exchange.declare'{exchange = <<"events">>,
                                               type = <<"direct">>}),
```

Data Producer

Publish a message

```
amqp_channel:cast(Channel,
                  #'basic.publish'{
                        exchange = <<"events">>},
                  #amqp_msg{props = #'P_basic'{delivery_mode = 2},
                            payload = <<"Hello Federation">>}),
```

Data Consumer

Obtain a Channel

```
{ok, Connection} =
        amqp_connection:start(#amqp_params_network{host = "localhost"}),

{ok, Channel} = amqp_connection:open_channel(Connection),
```

Data Consumer

Declare Queue and bind it

```
amqp_channel:call(Channel, #'exchange.declare'{exchange = <<"events">>,
                                               type = <<"direct">>}),

#'queue.declare_ok'{queue = Queue} =
    amqp_channel:call(Channel, #'queue.declare'{exclusive = true}),

amqp_channel:call(Channel, #'queue.bind'{exchange = <<"events">>,
                                         queue = Queue}),
```

Data Consumer

Start a consumer

```
amqp_channel:subscribe(Channel, #'basic.consume'{queue = Queue,
                                                 no_ack = true}, self()),

receive
        #'basic.consume_ok'{} -> ok
end,

loop(Channel).
```

Data Consumer

Process messages

```
loop(Channel) ->
    receive
        {#'basic.deliver'{}, #amqp_msg{payload = Body}} ->
            io:format(" [x] ~p~n", [Body]),
            loop(Channel)
    end.
```

Distributed Application

Ad-hoc solution

A process that replicates data to the remote server

Possible issues

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- Remote server is offline

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  - Prevent unbounded local buffers

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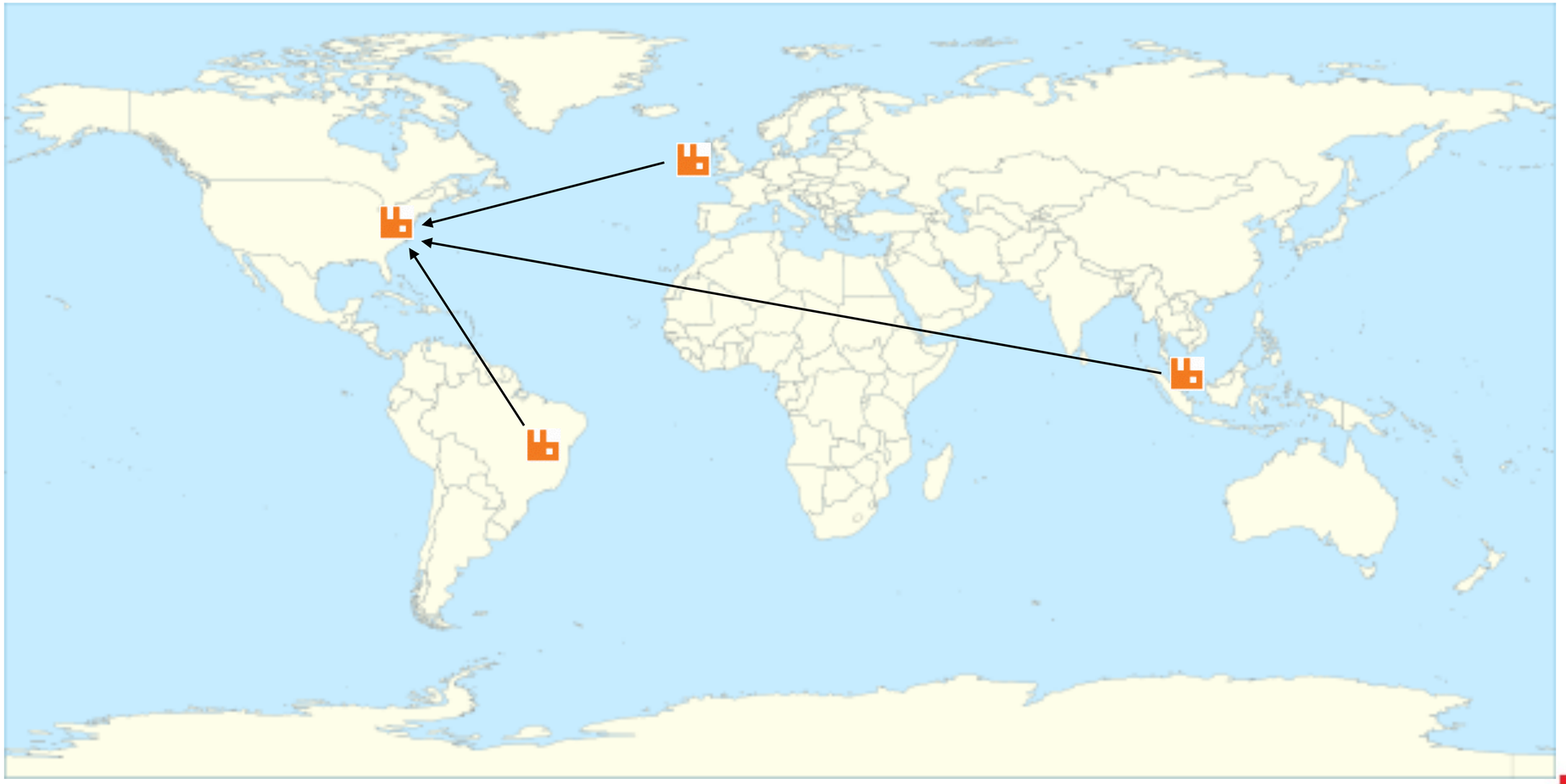
Possible issues

- Remote server is offline
  - Prevent unbounded local buffers
  - Prevent message loss
- Prevent unnecessary message replication
  - No need for those messages on remote server
  - Messages that became stale

Can we do better?

RabbitMQ Federation



RabbitMQ Federation

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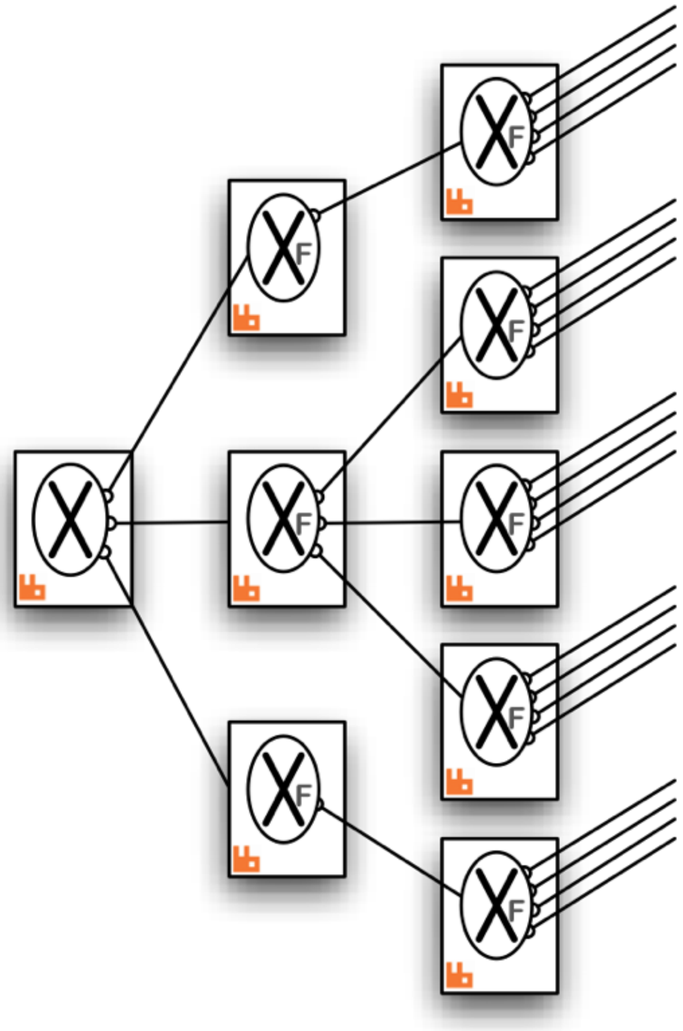
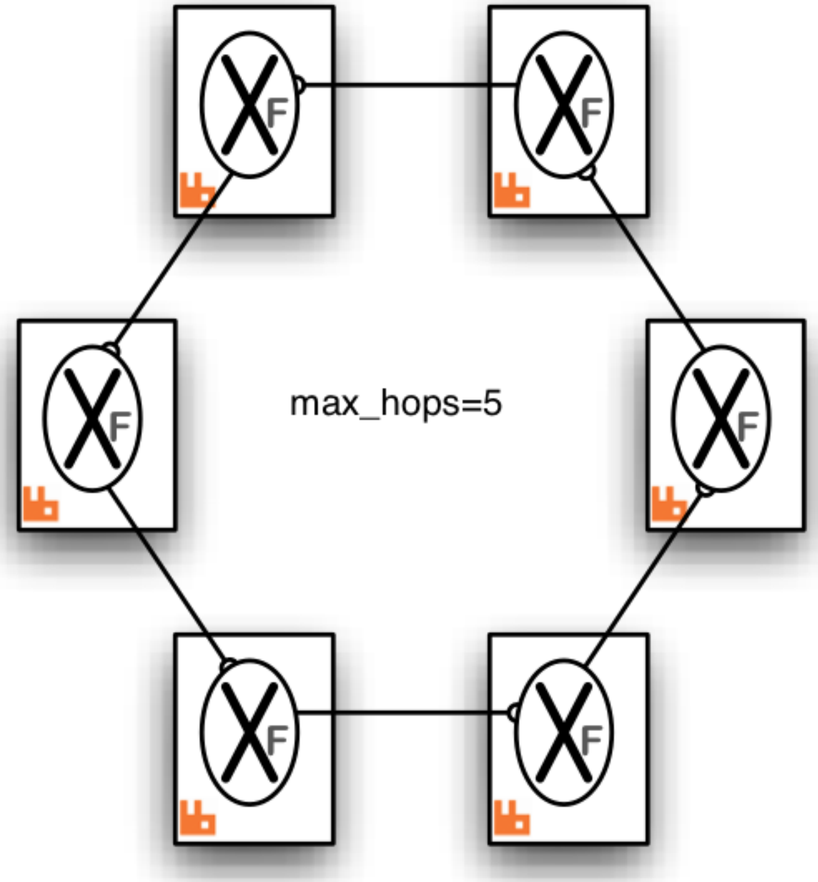
- Supports Network Partitions
- Specificity - not everything has to be federated

RabbitMQ Federation



max_hops=no of levels-1

RabbitMQ Federation



RabbitMQ Federation

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- It’s a RabbitMQ **Plugin**

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- Internally uses **Queues** and **Exchanges Decorators**

RabbitMQ Federation

- It’s a RabbitMQ **Plugin**
- Internally uses **Queues** and **Exchanges Decorators**
- Managed using **Parameters** and **Policies**

Enabling the Plugin

```
rabbitmq-plugins enable rabbitmq_federation
```

Enabling the Plugin

```
rabbitmq-plugins enable rabbitmq_federation

rabbitmq-plugins enable rabbitmq_federation_management
```

Federating an Exchange

```
rabbitmqctl set_parameter federation-upstream my-upstream \
'{"uri":"amqp://server-name","expires":3600000}'
```

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rabbitmqctl set_policy --apply-to exchanges federate-me "^amq\." \
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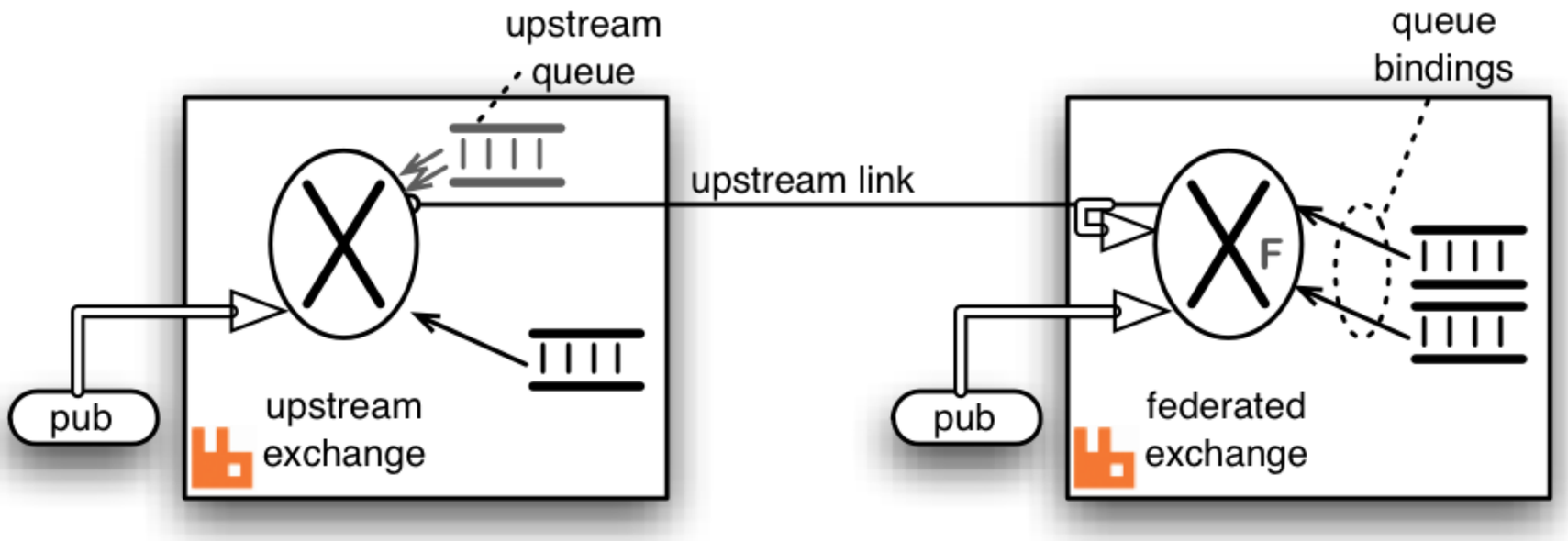
Federating an Exchange



Configuring Federation

Config Options

```
rabbitmqctl set_parameter federation-upstream \
name ‘json-object’
```

Config Options

```
rabbitmqctl set_parameter federation-upstream \
name ‘json-object’

json-object: {
   ‘uri’: ‘amqp://server-name/’,
   ‘prefetch-count’: 1000,
   ‘reconnect-delay’: 1,
   ‘ack-mode’: on-confirm
}
```

http://www.rabbitmq.com/federation-reference.html

Prevent unbound buffers

```
expires: N // ms.
message-ttl: N // ms.
```

Prevent message forwarding

```
max-hops: N
```

Speed vs No Message Loss

```
ack-mode: on-confirm
ack-mode: on-publish
ack-mode: no-ack
```

AMQP URI:

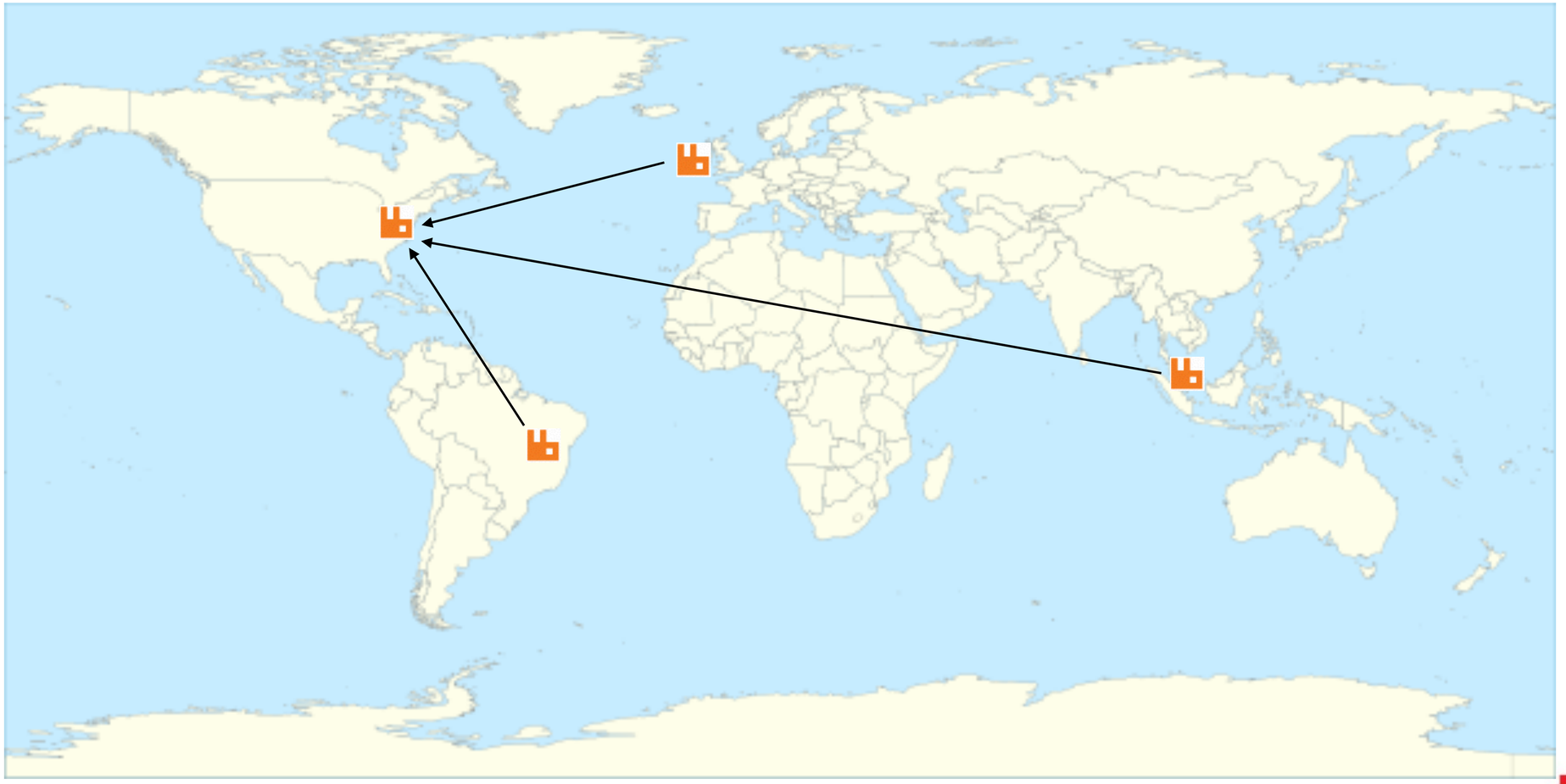
```
amqp://user:pass@host:10000/vhost
```

http://www.rabbitmq.com/uri-spec.html

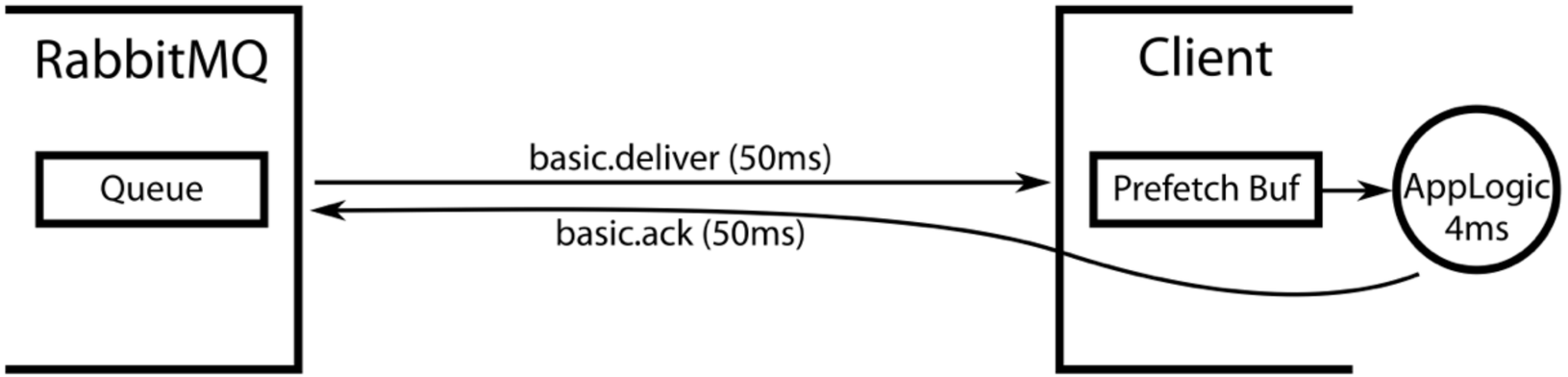
Config can be applied via

- CLI using **`rabbitmqctl`**
- HTTP API
- RabbitMQ Management Interface

RabbitMQ Federation

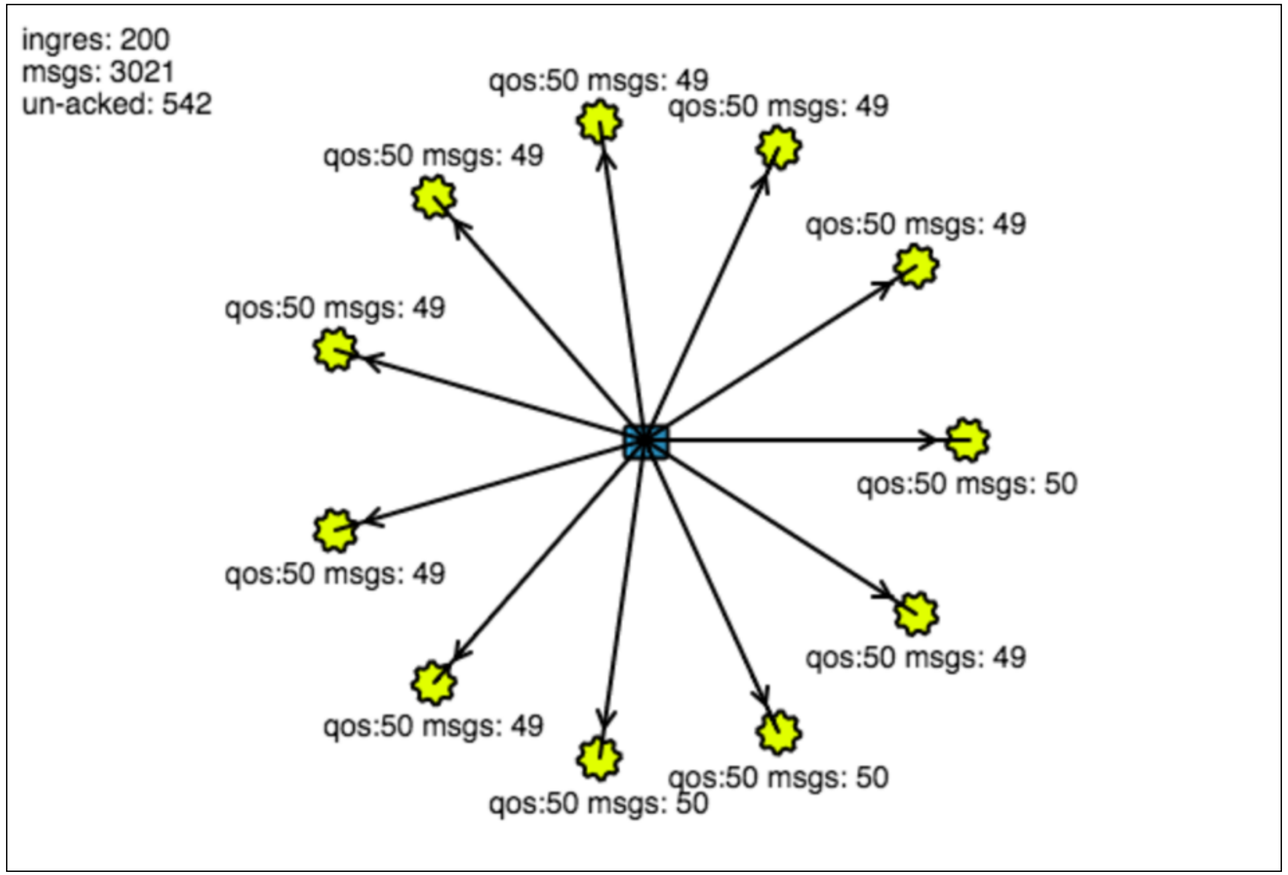


Some Queueing Theory



http://www.rabbitmq.com/blog/2012/05/11/some-queuing-theory-throughput-latency-and-bandwidth/

RabbitMQ BasicQos Simulator



Prevent Unbound Buffers

λ = mean arrival time

μ = mean service rate

if $\lambda > \mu$ what happens?

https://www.rabbitmq.com/blog/2014/01/23/preventing-unbounded-buffers-with-rabbitmq/

Prevent Unbound Buffers

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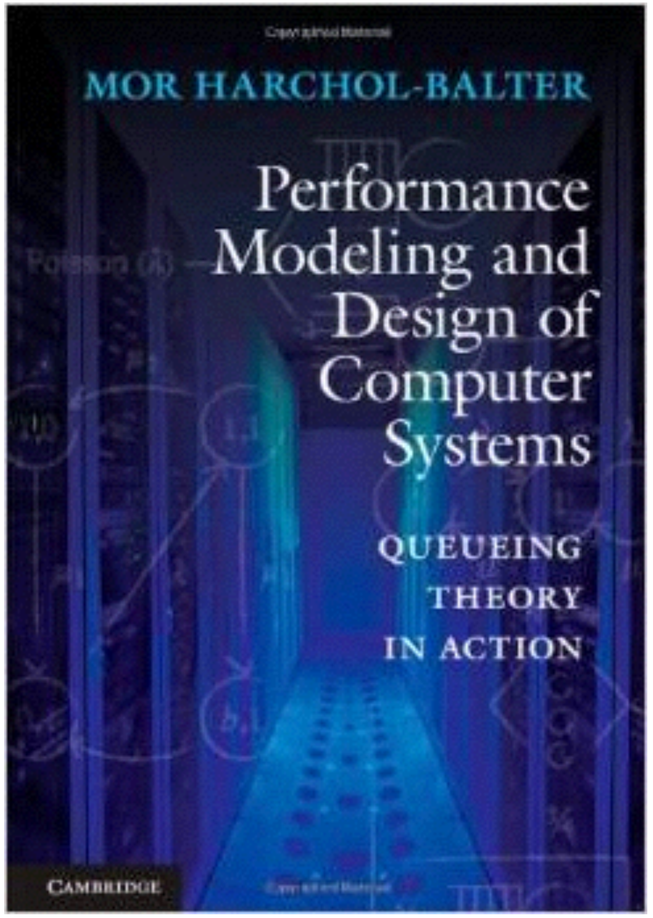
if $\lambda > \mu$ what happens?

Queue length goes to infinity over time.

https://www.rabbitmq.com/blog/2014/01/23/preventing-unbounded-buffers-with-rabbitmq/

Recommended Reading



Performance Modeling and Design of Computer Systems: Queueing Theory in Action

Scaling the Setup

The Problem

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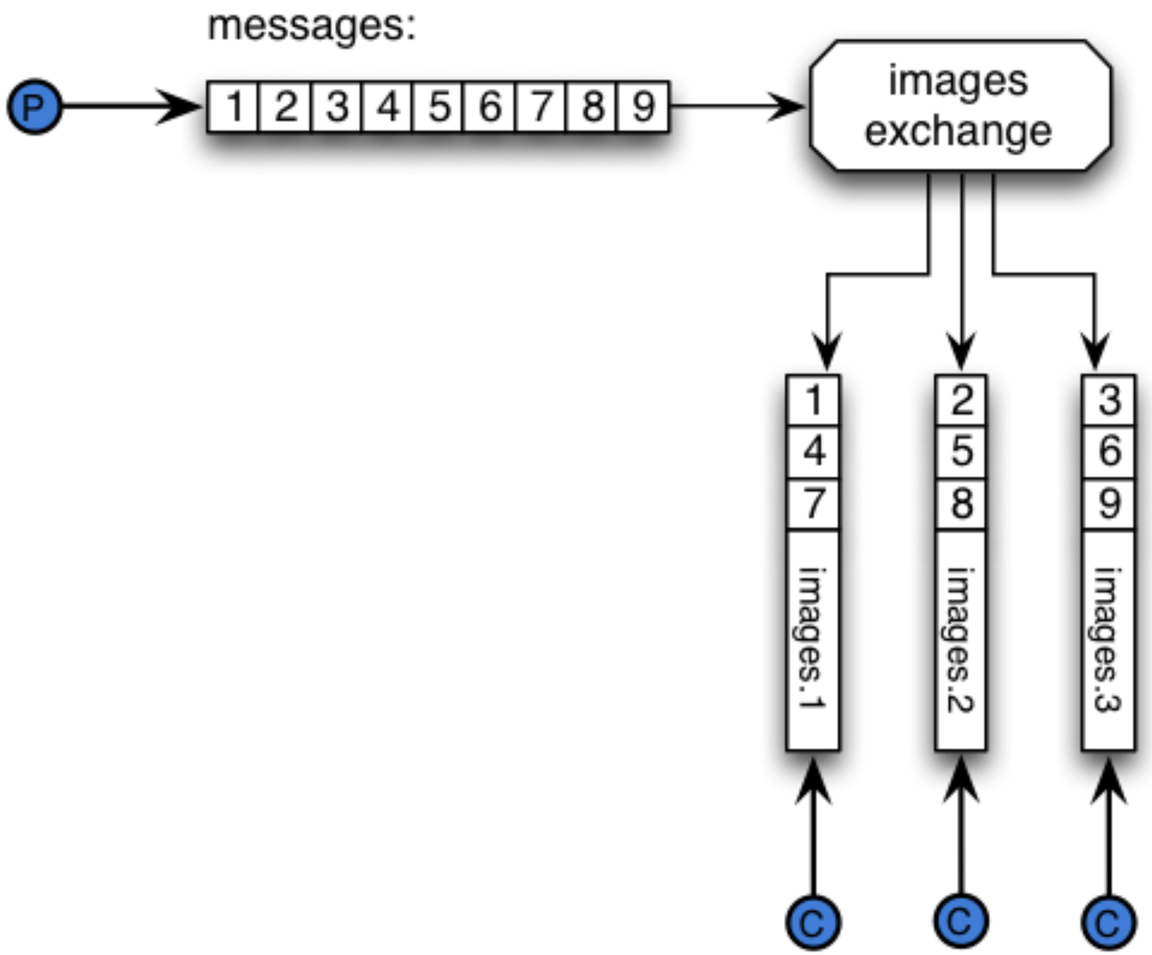
- Queues contents live in the node where the Queue was declared
- A cluster can access the queue from every connected node
- Queues are an Erlang process (tied to one core)
- Adding more nodes doesn’t really help

Enter Sharded Queues

Pieces of the Puzzle

- modulo hash exchange (consistent hash works as well)
- good ol' queues

Sharded Queues



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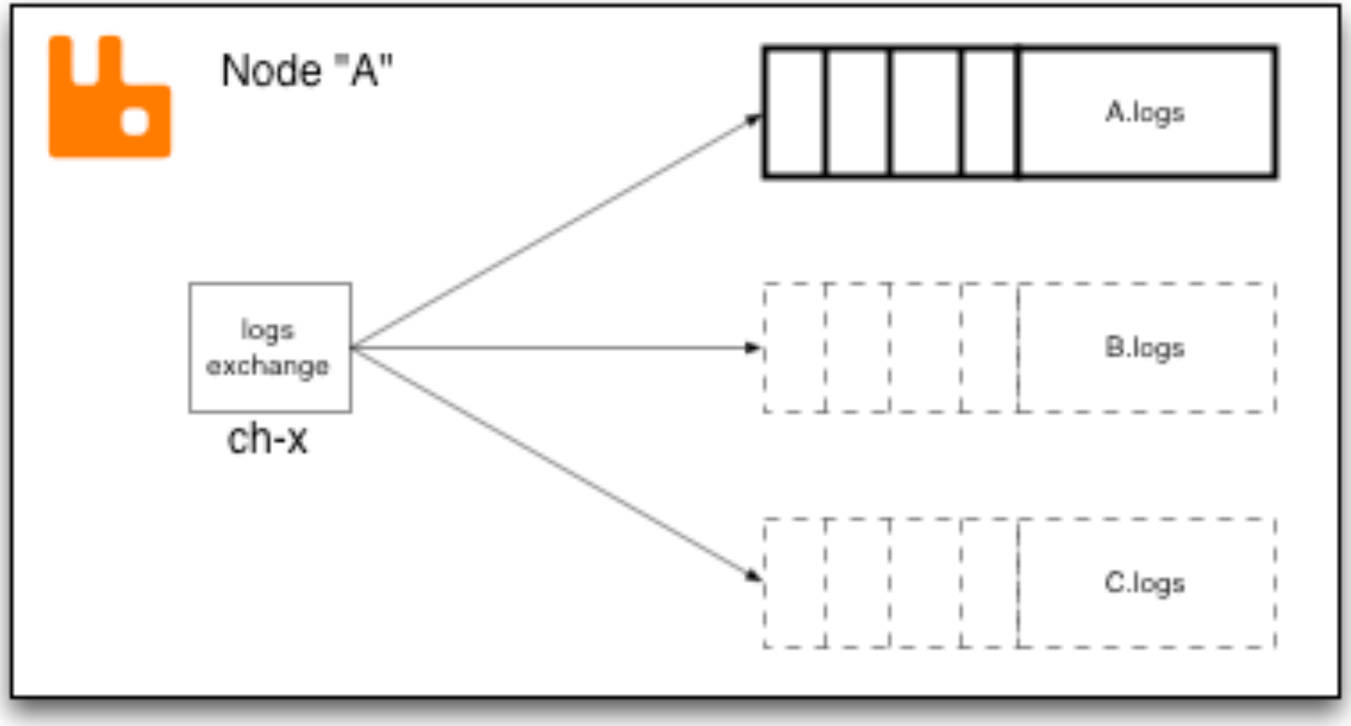

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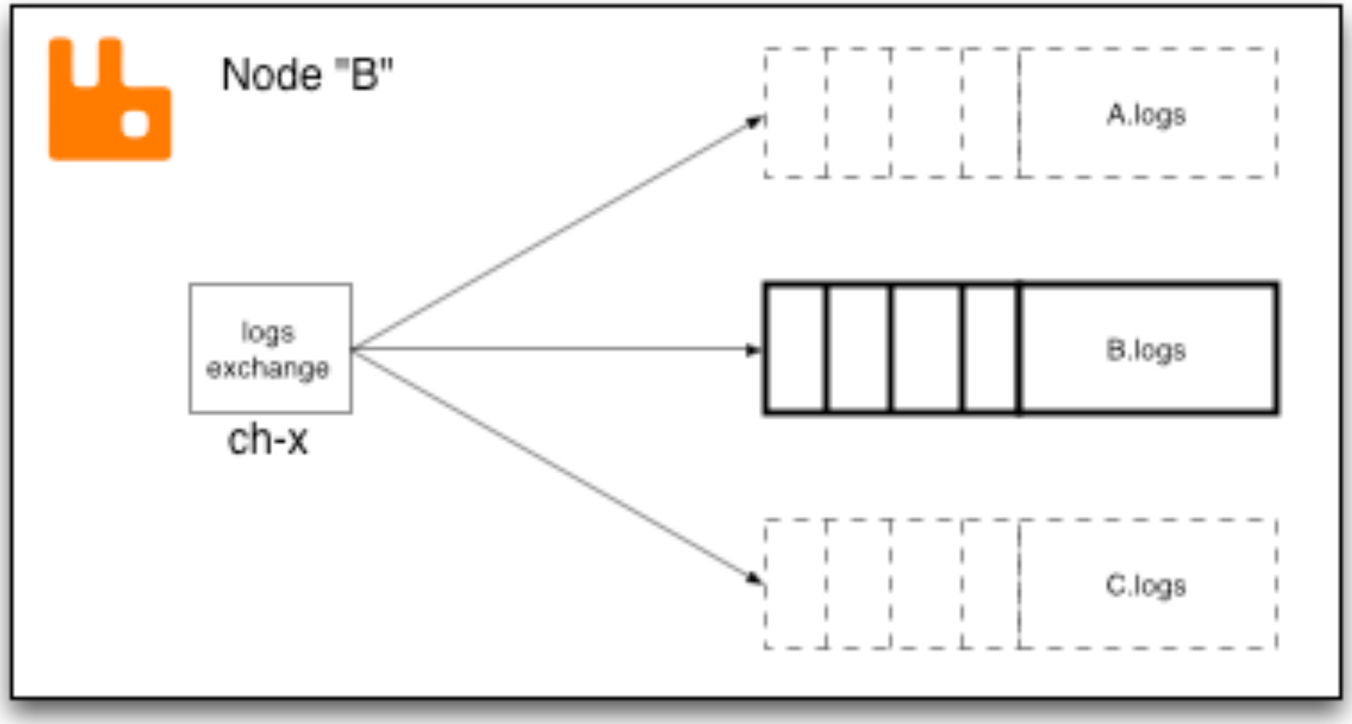
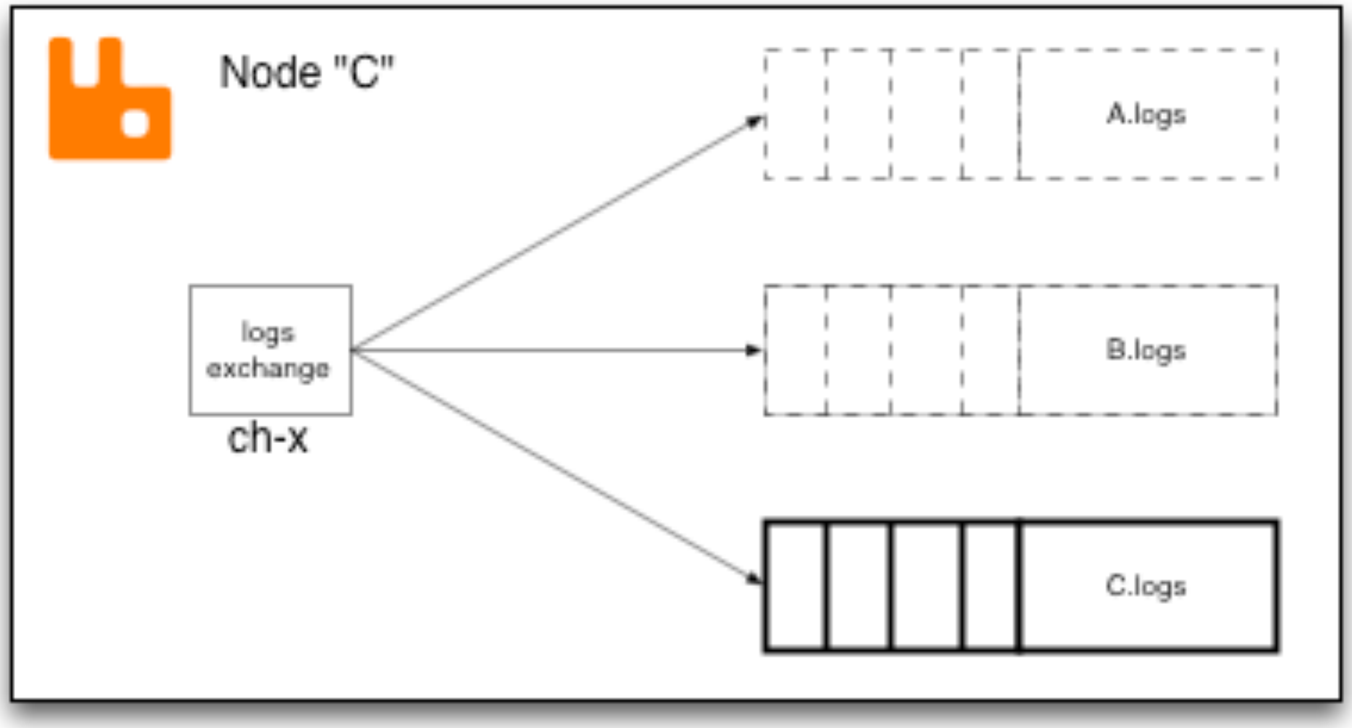


Sharded Queues



Sharded Queues

- Declare Queues with name: `nodename.queuename.index`

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Sharded Queues

- Declare Queues with name: `nodename.queuename.index`
- Bind the queues to a partitioner exchange
- Transparent to the consumer (virtual queue name)

We need more scale!

Federated Queues

Federated Queues

- Load-balance messages across federated queues

Federated Queues

- Load-balance messages across federated queues
- Only moves messages when needed

Federating a Queue

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- Ingest data using various protocols: AMQP, MQTT and STOMP
- Distribute that data globally using Federation
- Scale up using Sharding
- Load balance consumers with Federated Queues

Credits

world map: wikipedia.org

federation diagrams: rabbitmq.com

Questions?

highload++ 2014

Конференция разработчиков
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Thanks!

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highload++ 2014

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