Building a Distributed Data Ingestion System with RabbitMQ

Alvaro Videla - RabbitMQ

Alvaro Videla

- Developer Advocate at Pivotal / RabbitMQ
- Co-Author of RabbitMQ in Action
- Creator of the RabbitMQ Simulator
- Blogs about RabbitMQ Internals: http://videlalvaro.github.io/internals.html
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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

What is RabbitMQ

RabbitMQ

RabbitMQ

RabbitMQ

- Multi Protocol Messaging Server

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- Open Source (MPL)

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- Polyglot

RabbitMQ

- Multi Protocol Messaging Server
- Open Source (MPL)
- Polyglot
- Written in Erlang/OTP

Multi Protocol

http://bit.ly/rmq-protocols

Community Plugins

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

Polyglot

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Polyglot

- Java

Polyglot

- Java
- node.js

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- Java
- node.js
- Erlang

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Polyglot

- Java
- node.js
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- Haskell

Polyglot

Even COBOL!!!11

Some users of RabbitMQ

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- Instagram

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- Indeed.com

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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

A demo with the RabbitMQ Simulator

https://github.com/RabbitMQSimulator/RabbitMQSimulator

http://tryrabbitmq.com

RabbitMQ Simulator

The Problem

Distributed Application

Distributed Application

Data Producer

Obtain a Channel

```
ConnectionFactory factory = new ConnectionFactory();
factory.setHost("localhost");

Connection connection = factory.newConnection();

Channel channel = connection.createChannel();
```

Data Producer

Declare an Exchange

```
channel.exchangeDeclare(EXCHANGE_NAME, "direct", true);
```

Data Producer

Publish a message

```
String message = "Hello Federation!";
channel.basicPublish(EXCHANGE_NAME, "", null,
                                 message.getBytes());
```

Data Consumer

Obtain a Channel

```
ConnectionFactory factory = new ConnectionFactory();
factory.setHost("localhost");

Connection connection = factory.newConnection();

Channel channel = connection.createChannel();
```

Data Consumer

Declare Queue and bind it

```
channel.queueDeclare(QUEUE_NAME, true, false, false,
                     null);
channel.exchangeDeclare(EXCHANGE_NAME, "direct", true);
channel.queueBind(QUEUE_NAME, EXCHANGE_NAME, "");
```

Data Consumer

Start a consumer

```
QueueingConsumer consumer = new
QueueingConsumer(channel);
channel.basicConsume(QUEUE_NAME, false, consumer);
```

Data Consumer

Process messages

```
while (true) {
   QueueingConsumer.Delivery delivery =
      consumer.nextDelivery();

   String message = new String(delivery.getBody());
   System.out.println("Received '" + message + "'");

   channel.basicAck(
      delivery.getEnvelope().
      getDeliveryTag(), false);
}
```

Ad-hoc solution

A process that replicates data to the remote server

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

- Supports replication across different administrative domains
- Supports mix of Erlang and RabbitMQ versions
- Supports Network Partitions
- Specificity - not everything has to be federated

RabbitMQ Federation

RabbitMQ Federation

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RabbitMQ Federation

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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}'
```

Federating an Exchange

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

rabbitmqctl set_policy --apply-to exchanges federate-me "^amq\." \
'{"federation-upstream-set":"all"}'
```

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

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

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Pieces of the Puzzle

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

Sharded Queues

Sharded Queues

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Sharded Queues

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

Sharded Queues

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- Bind the queues to a consistent hash exchange

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
- Only moves messages when needed

Federating a Queue

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

Federating a Queue

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

rabbitmqctl set_policy --apply-to queues federate-me "^images\." \
'{"federation-upstream-set":"all"}'
```

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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?

Thanks

Alvaro Videla - @old_sound