ADD-01
RabbitMQ: Messaging in the Cloud

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INTRODUCTION AND PLAN

Coming up in the next hour...
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- Messaging, messaging, messaging: What does it all mean?
Coming up in the next hour. . .

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- What is this angular mutant orange Rabbit thing, and why is it dropping AMQP all over the carpet?
COMING UP IN THE NEXT HOUR . . .

▶ Messaging, messaging, messaging: What does it all mean?
▶ What is this angular mutant orange Rabbit thing, and why is it dropping AMQP all over the carpet?
▶ How many balloons does it take to keep a Rabbit in a cloud?
COMING UP IN THE NEXT HOUR... 

- Messaging, messaging, messaging: What does it all mean?
- What is this angular mutant orange Rabbit thing, and why is it dropping AMQP all over the carpet?
- How many balloons does it take to keep a Rabbit in a cloud?
- Prizes! Prizes! Prizes!
**Why do you care?**

**Messaging is becoming ever more important because:**

- Scalability issues demand greater flexibility from application developers
- Traditional synchronous programming models fair poorly at large scale
- Cloud computing permits greater dynamic scaling than ever seen before, but applications need to be written well to take advantage of this
- Messaging enables scaling by decoupling components and adding flexibility
Several cloud infrastructures have been built using RabbitMQ as the nervous system of the cloud.

RabbitMQ is easily installed and used by clients on existing clouds such as Amazon EC2.

RabbitMQ is available as an additional component on Heroku.

RabbitMQ is going to become available in more clouds in the future, e.g. Social, Nebula, VMforce.

RabbitMQ is just as easy to use to solve problems in clouds as it is to solve problems on the ground.
What is Messaging?
What is Messaging?
What is a Banana?
What can I use Messaging for?
What can I use Messaging for?
What can I use a Banana for?
What is messaging?

What can I use a Messaging protocol for?
Decoupling

Producer → RabbitMQ → Consumer

E.g. website passing orders to a credit-card charging engine

It’s got to be good for something, right?
Decoupling

E.g. website passing orders to a credit-card charging engine
Bidirectional Decoupling

E.g. remote procedure call
Bidirectional Decoupling

E.g. remote procedure call
Pipelining and Decoupling

Producer → Consumer

Consumer → Producer

E.g. combining messages with records in a database
Pipelining and Decoupling

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E.g. combining messages with records in a database
Pipelining and Decoupling

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Work-distribution and Decoupling

Both duplication and round-robin. Duplication can be used for logging messages at certain points in the system. Round-robin can be used for horizontal scaling.
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Work-distribution and Decoupling

Both duplication and round-robin. Duplication can be used for logging messages at certain points in the system. Round-robin can be used for horizontal scaling.
Work aggregation, distribution and Decoupling
Other things message brokers can typically do

- Store-and-forward of messages
- Absorbing spikes of activity (again, decoupling)
- Routing to different consumers based on message properties
USE CASES FOR MESSAGING PROTOCOLS

OTHER THINGS MESSAGE BROKERS CAN TYPICALLY DO

- Store-and-forward of messages
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GENERAL CONCLUSION

- Messaging protocols as a means of decoupling events is an extremely common and pervasive task
- There is an enormous range of applications and problems to which using a messaging protocol is an effective solution
AMQP: Advanced Message Queueing Protocol
AMQP IS ESPECIALLY NICE BECAUSE... 

- All resources are dynamically created and destroyed by clients as they need them – no static preconfiguration
- A clean and simple model: just three key nouns to learn
- Open standard, developed by the AMQP Working Group (we’re members)
- Lots of client libraries available in many languages, for free
AMQP is especially nice because... 

- All resources are dynamically created and destroyed by clients as they need them – no static preconfiguration
- A clean and simple model: just three key nouns to learn
- Open standard, developed by the AMQP Working Group (we’re members)
- Lots of client libraries available in many languages, for free
- An excellent, freely available, open source broker implementation, called RabbitMQ...
Create an exchange,…

"my_exchange"

`type = fanout`
...create a queue,...

X

"my_exchange"
type = fanout

"my_queue"
…add a binding,…

```
"my_exchange"
type = fanout
```

```
"my_queue"
```
...all inside a broker.

```
X
"my_exchange"
  type = fanout

"my_queue"
```
Publish a message, …
...it sits in a queue.

"my_exchange"
type = fanout

"my_queue"
Publish another message, …

```
msg 2
```

```
"my_exchange"
type = fanout
"my_queue"
msg 2
```
Publish another message, ...it also goes to the queue.

```
"my_exchange"
type = fanout
"my_queue"
```
Consuming from the queue retrieves the messages in order.
Consuming from the queue retrieves the messages in order.

```
"my_exchange"
type = fanout

"my_queue"

msg

msg 2
```
Consuming from the queue retrieves the messages in order.

"my_exchange"
type = fanout
"my_queue"
msg 2
Publish many messages,…
...and they are distributed amongst several consumers on the same queue.

```
x
"my_exchange"
type = fanout
"my_queue"
```

- D
- A
- E
- B
- F
- C
We can create a second queue and bind it to the same exchange.
Messages go to every queue bound to a \textit{fanout} exchange ...
Messages go to *every* queue bound to a *fanout* exchange ...
Messages go to every queue bound to a fanout exchange... and the queues can be consumed from at different rates.
Messages go to every queue bound to a fanout exchange... and the queues can be consumed from at different rates.
AMQP 101

Advanced != Complicated

Messages go to every queue bound to a fanout exchange... and the queues can be consumed from at different rates.

```
X

"my_exchange"
type = fanout

"my_queue_2"

"my_queue"

C

"my_queue"

C
```

...and the
We replace “my_exchange” with a *direct* exchange.
The routing key of a published message selects which queues the message goes to.
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The routing key of a published message selects which queues the message goes to.

```
X
"my_exchange"
type = direct
bk: Binding Key

"my_queue"
bk = "vodka"
rk: Routing Key

"my_queue_2"
bk = "beer"
```

A
B
Messages with no matching bindings are discarded.
Messages with no matching bindings are discarded.
Topic exchanges permit wildcards in the binding key.

- `*` matches any 1 element.
- `#` matches zero or more elements.

```
"my_queue"
"my_queue_2"
"my_exchange"
```

type = topic

```
bk = "a.*.c"
bk = "#.e"
```

rk: Routing Key

bk: Binding Key
*Topic* exchanges permit wildcards in the binding key. Keys are `.=`-separated lists, e.g. “stocks.nyse.vmw”

* matches any 1 element.

# matches zero or more elements.

```
"my_queue"
"my_queue_2"
"my_exchange"
type = topic
bk = "a:*:c"
bk = "#:e"
bk: Binding Key
rk: Routing Key
```
**Topic** exchanges permit wildcards in the binding key. Keys are \( . \)-separated lists, e.g. “stocks.nyse.vmw”
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```
E rk = "b.e"
F rk = "e"
```

```
"my_exchange"
type = topic
```

```
"my_queue"
"my_queue_2"
```

```
bk = "a.*.c"
bk = "#.e"
```

rk: Routing Key  bk: Binding Key
**AMQP 101**

**ADVANCED != COMPLICATED**

*Topic* exchanges permit wildcards in the binding key. Keys are .-separated lists, e.g. “stocks.nyse.vmw”

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---

**Diagram:**

- **type = topic**
  - **bk = “a.*.c”**
    - **“my_exchange”**
    - **bk = “#.e”**
      - **“my_queue_2”**
  - **bk = “#.e”**
    - **“my_queue”**

**rk:** Routing Key

**bk:** Binding Key
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Other key elements of AMQP

- Errors can be raised for messages that do not get routed to any queues
- Messages can be consumed so that the broker does not forget about the message until the client explicitly acknowledges the message
- Messages can be published with a property indicating whether the message should be written to disk
- Transactions: making publication and acknowledgement of several messages atomic
- Flow control: e.g. used to stop publishers from overwhelming the broker in extreme situations
AN OPEN Protocol is a good thing because it... 

- Makes it easier to have multiple implementations that interoperate at the wire-level
- Avoids vendor lock-in: easy to rip out and replace individual components with alternative implementations
- Allows third-parties to write client libraries for other languages
- Decouples flag-day upgrades for both client libraries and broker
- Allows third-party traffic analysis tools to inspect and decode interactions between the clients and brokers
- Promotes similarities in APIs presented by different client libraries
RabbitMQ, AMQP & Messaging

- RabbitMQ consists of the broker (server) and several clients (Java, .Net, plus others)
- They speak the AMQP protocol to each other
- Anyone can write (and many have) other clients which also speak AMQP and work with RabbitMQ
RabbitMQ, AMQP & Messaging

- RabbitMQ consists of the *broker* (server) and several clients (Java, .Net, plus others)
- They speak the AMQP *protocol* to each other
- Anyone can write (and many have) other clients which also speak AMQP and work with RabbitMQ
- RabbitMQ is freely available and open source, licensed under the Mozilla Public License v1.1
- It’s already in many popular Linux distributions (Ubuntu, Debian, Fedora, Gentoo) and can be easily installed on OS X both through MacPorts and Homebrew
The broker is written in Erlang: an excellent programming language and platform for the task
A mere 17k lines of code in the broker
Supports clustering for increased scalability
Supports several extension points via plugins which are frequently used to extend RabbitMQ, e.g. STOMP, XMPP adaptors; The Shovel; additional exchange types…
Can work with Pacemaker and associated tools to provide various forms of High Availability
RabbitMQ Features

- A single queue can run up around 30,000 messages per second, depending on payload, clients, and properties of the messages.
- But several queues together can achieve much higher throughput, and still keep the queues empty.
- RabbitMQ 2.0 gains the ability to send messages to disk to free up memory, thus allowing queue depths to grow, bounded only by disk space, not RAM. Queues of 10s of millions of items are easily accommodated.
- Adding extension to RabbitMQ based on feedback from our users, e.g. queue expiry, queue-message TTL, publisher acknowledgements.
RabbitMQ is a leading implementation of AMQP, and has wide adoption from a large community across a large number of languages and problem domains.

Website and downloads available at http://www.rabbitmq.com/

On Ubuntu and Debian, just an `apt-get install rabbitmq-server` away. Similarly easy for Fedora and many other Linux distributions.

For OS X, it’s in MacPorts.

Full easy-to-install Windows bundles available from the website.
“All our messages are incredibly important and must never ever be lost under any circumstances”.
“All our messages are incredibly important and must never ever be lost under any circumstances”.

Fact: There are always moments at which the message is at a single point of failure.
“We need guaranteed exactly-once delivery – I want to send 1 message, and know it gets delivered to exactly one consumer, once”.
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Fact: Provably impossible. Depends on definition of guarantee: you can achieve a high probability of no duplicates and no message loss.
Thank you

Questions?