Messaging-as-a-Service

Building a scalable messaging service

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Who am I ?

@ppatierno

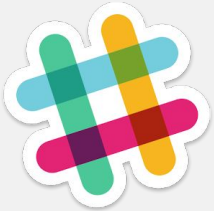
- Senior Software Engineer @ Red Hat
  - Messaging & IoT team
- Lead/Committer @ Eclipse Foundation
  - Hono, Paho and Vert.x projects
- Microsoft MVP
- Technologies and protocols “globetrotter”
- Hacking low constrained devices in spare time
- Blogger and speaker about distributed systems, messaging, IoT and embedded “world”

redhat.

Agenda

- Messaging … what ?
- Messaging … in the cloud
- EnMasse : the open source MaaS !
  - Architecture & Features
  - Scalability
  - Configuration
  - CI/CD pipeline
  - User experience
- Messaging & IoT

What is messaging **not**?



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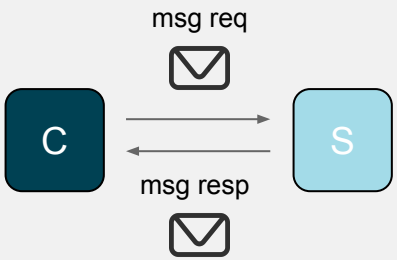
What is messaging?

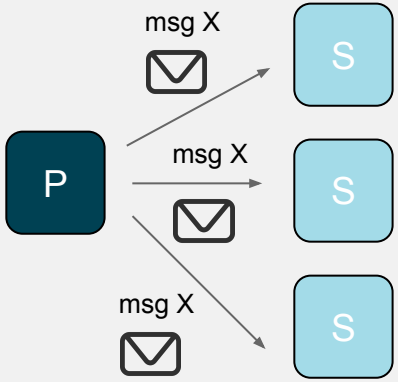
- It’s about *messages* exchange
  - **Internally** in distributed systems
  - **Externally** between systems
- Communication at the ***application*** level
- Messages go from ***sender/producer/publisher*** to ***receiver/consumer/subscriber***
  - **Asynchronously**
  - Time **decoupling**
  - … or **directly** and **synchronously**

Messaging patterns

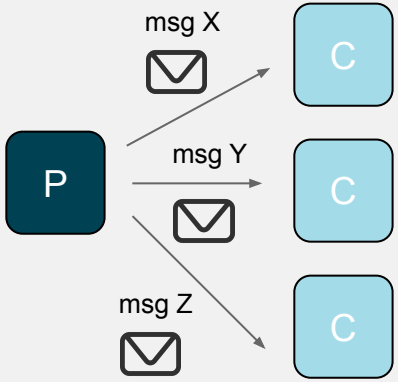
Request/Response



Publish/Subscribe



Competing Consumers



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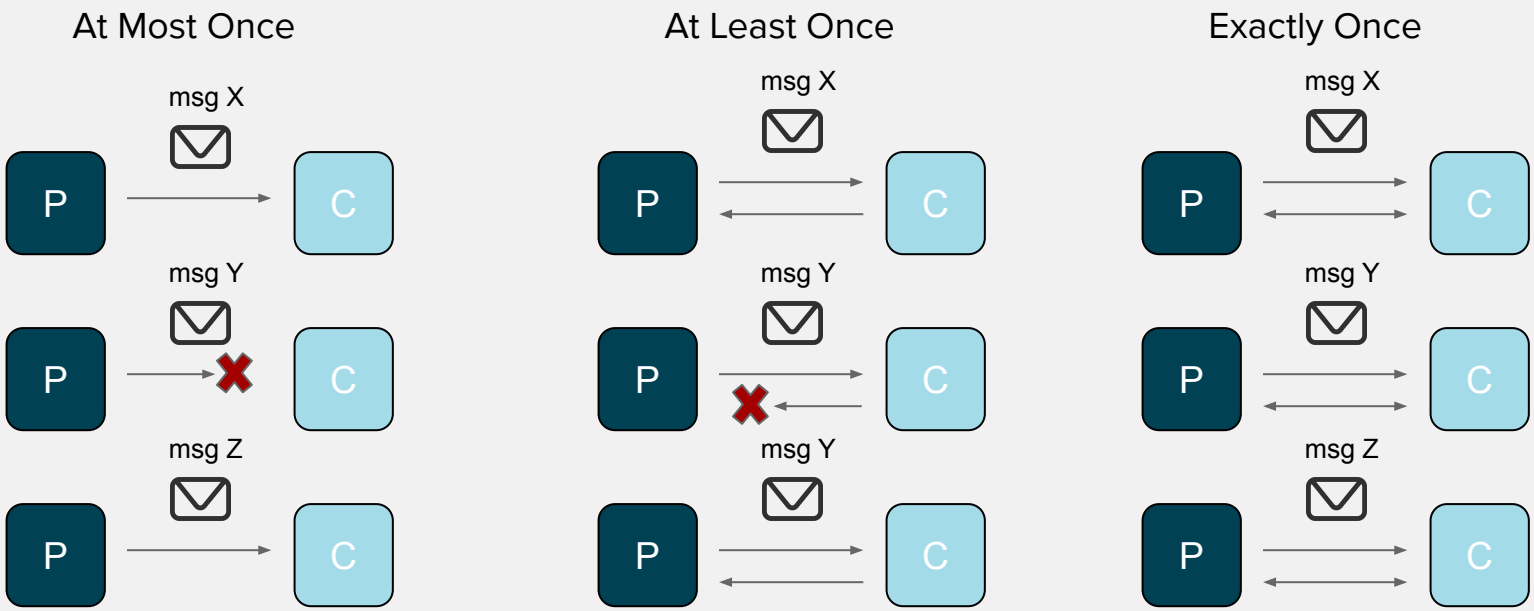
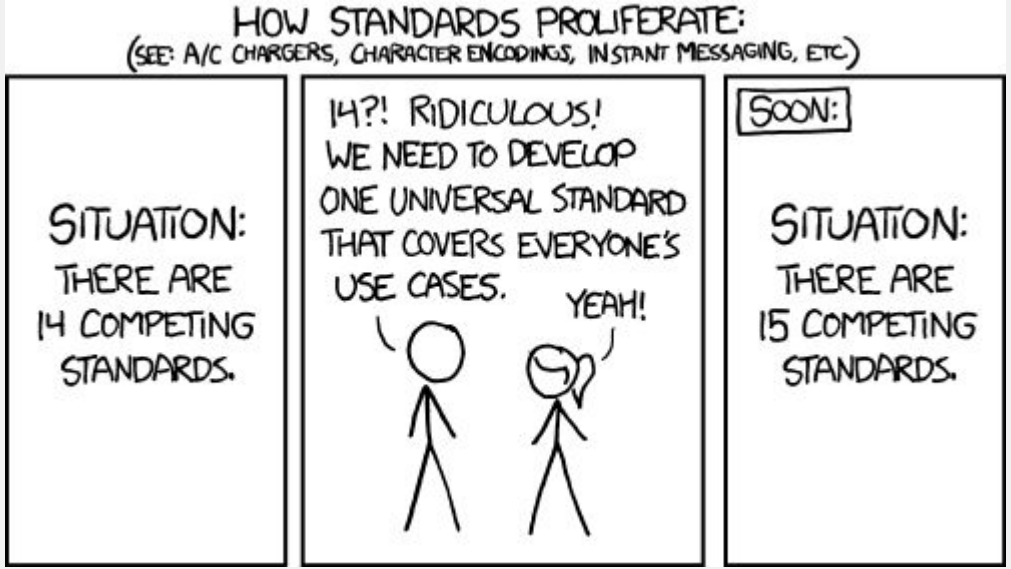
Quality of Service



Interoperability

Open standards



AMQP 1.0

HTTP

MQTT

STOMP

XMPP

CoAP

Messaging in the cloud

- Microsoft Azure
  - Service Bus
  - Event Hub
- Amazon Web Services
  - Simple Queue Service (SQS)
- Google
  - FireBase Cloud Messaging
- Confluent
  - Apache Kafka as a Service

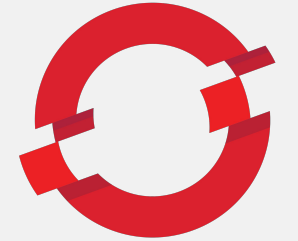
Cloud provider limitations

- They are not open source !
- Freedom of choice
  - On-premise or in the cloud
  - Ability to choose which cloud
  - Open Standards protocols allows users to choose client freely
- Migrating from one to the other can be complex

EnMasse

Messaging-as-a-Service

- Open source cloud messaging running on Kubernetes and OpenShift
- enmasse.io



EnMasse

Features

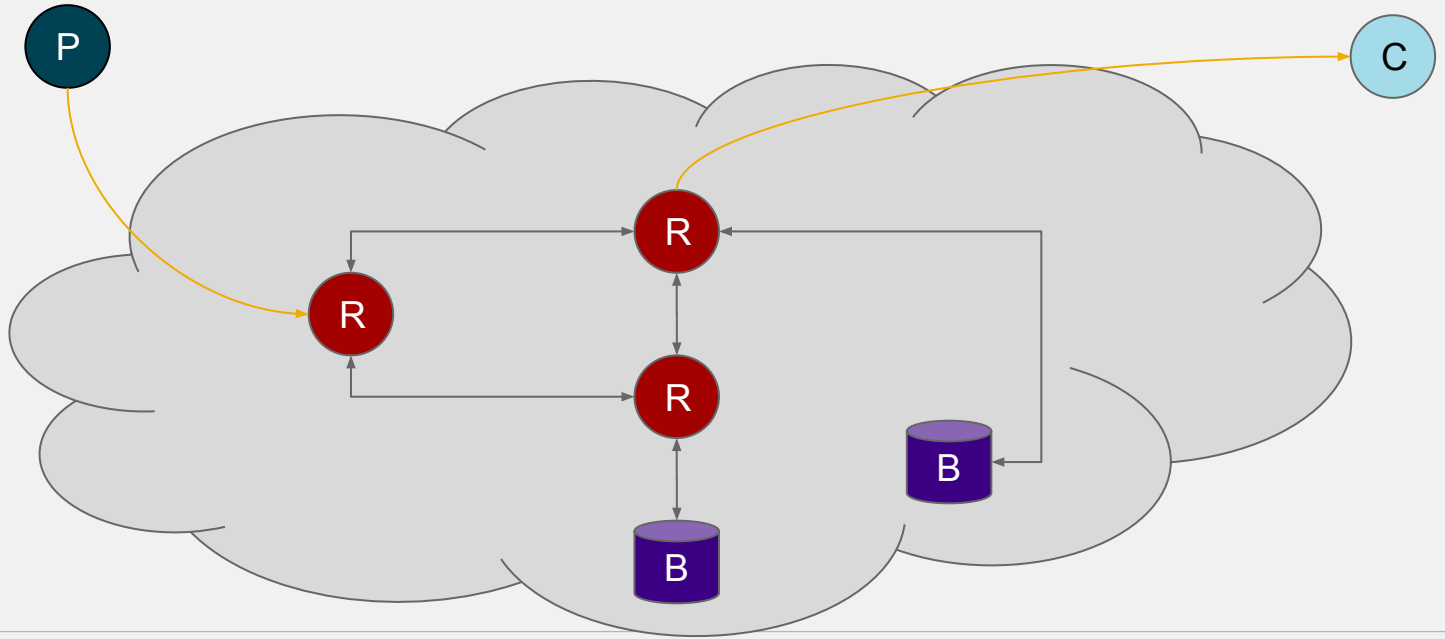
- Multiple communication patterns: **request/response**, **publish/subscribe** and **competing consumers**
- Support for **“store and forward”** and **direct** messaging mechanisms
- **Scale** and **elasticity** of message brokers
- **AMQP 1.0** and **MQTT** support
- Simple **setup**, **management** and **monitoring**
- **Multitenancy**: manage multiple independent instances
- Deploy **“on premise”** or in the **cloud**

EnMasse

Coming features

- Authentication and authorization
- Service broker API
- HTTP(S)
- Message grouping
- Distributed transactions
- Message ordering
- Multiple flavors
    - Apache Kafka
- …

Basic idea



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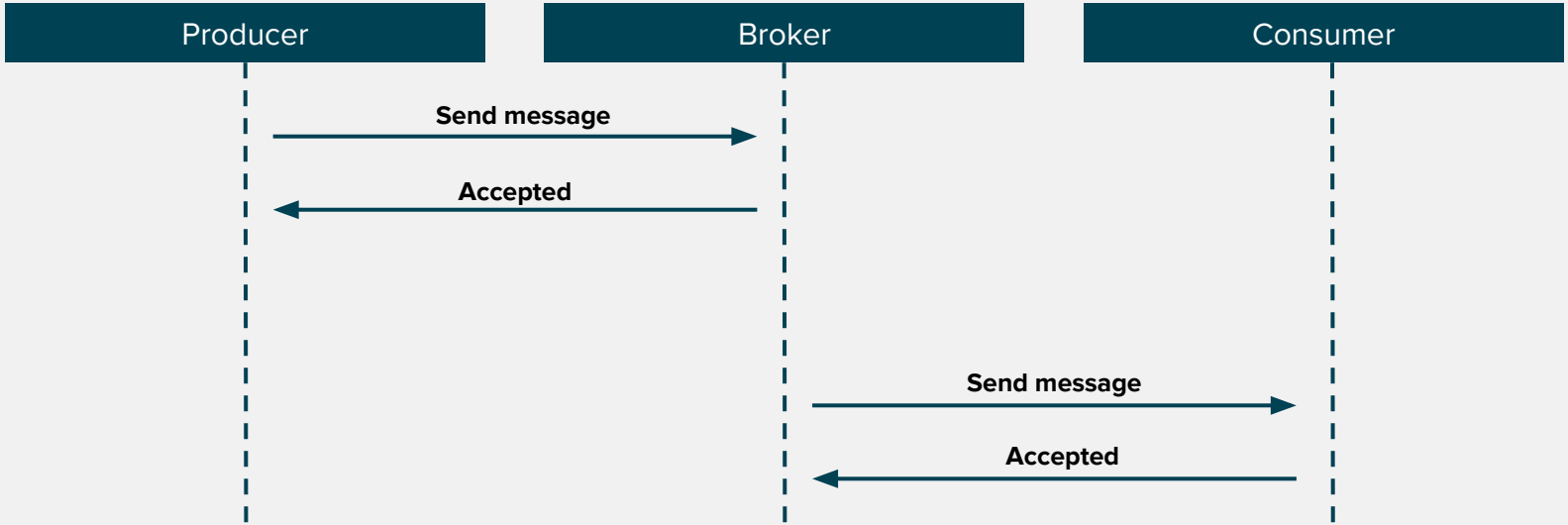
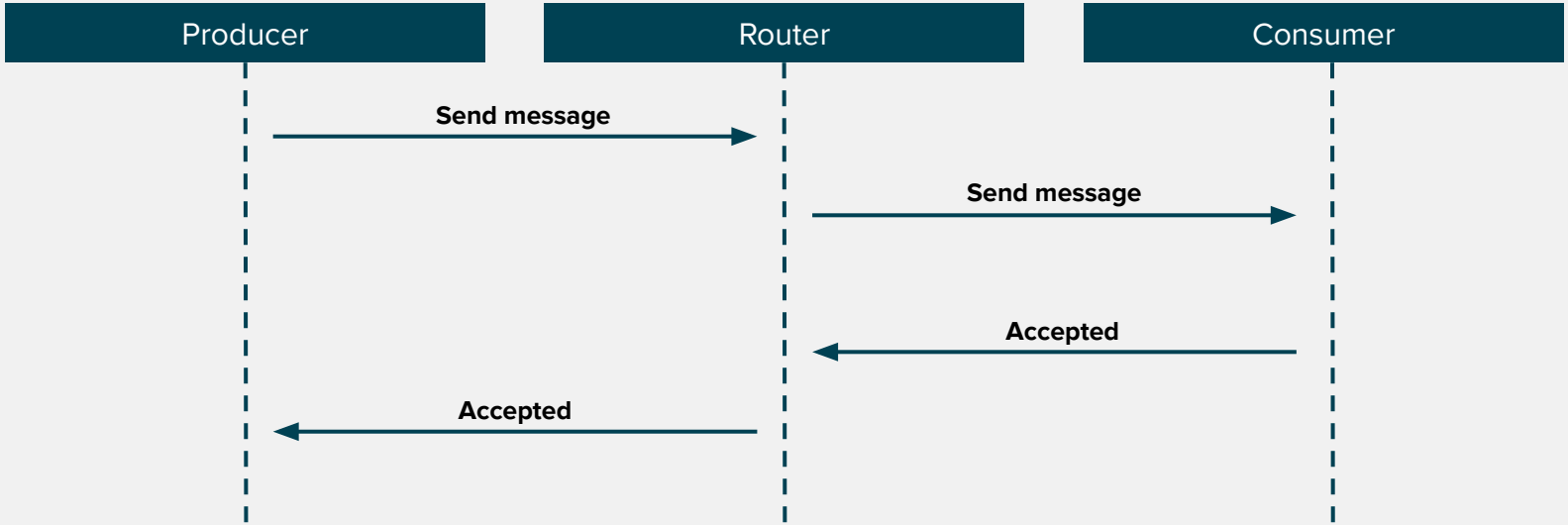
Routing vs “Broking”

Broker

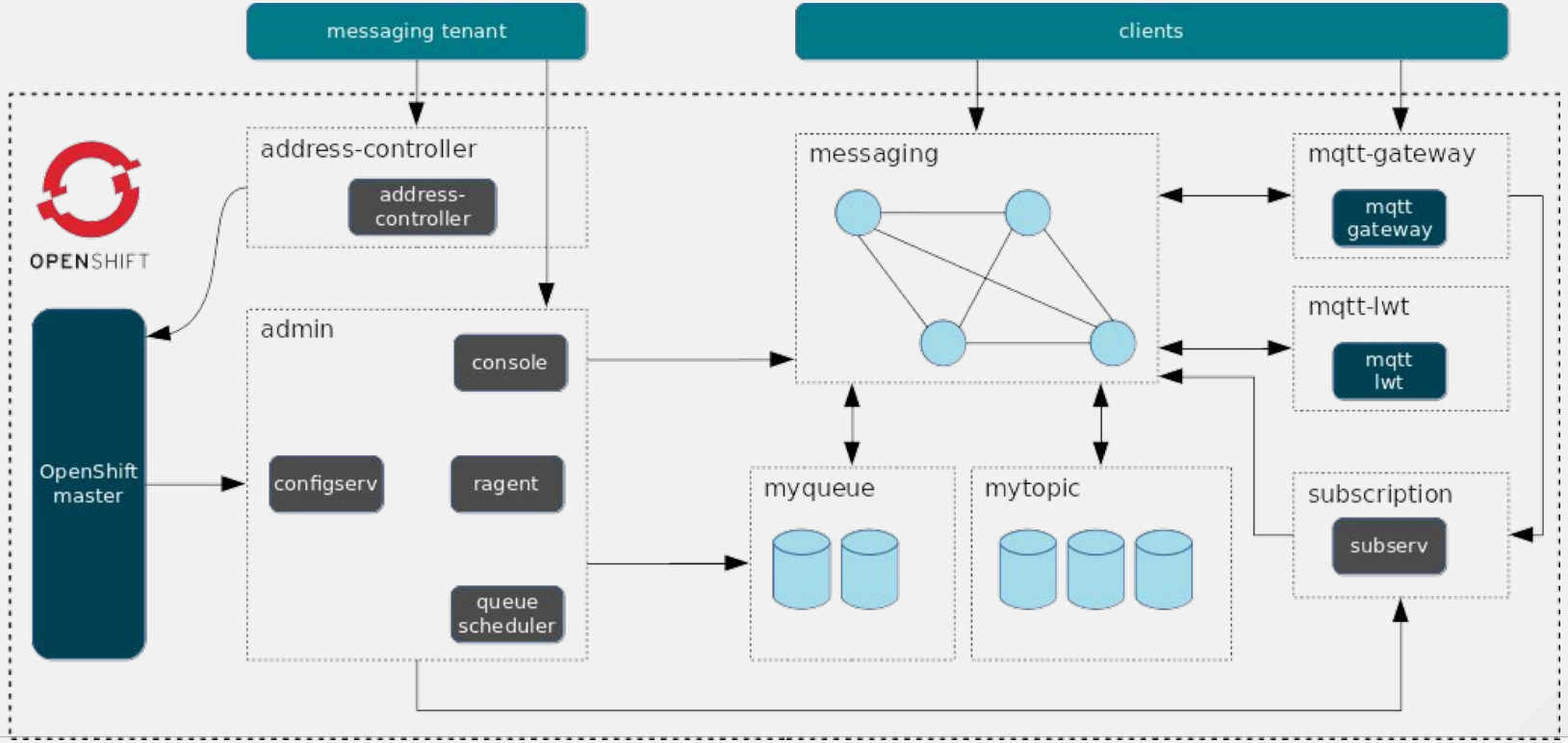


Routing vs “Broking”

Router



Architecture



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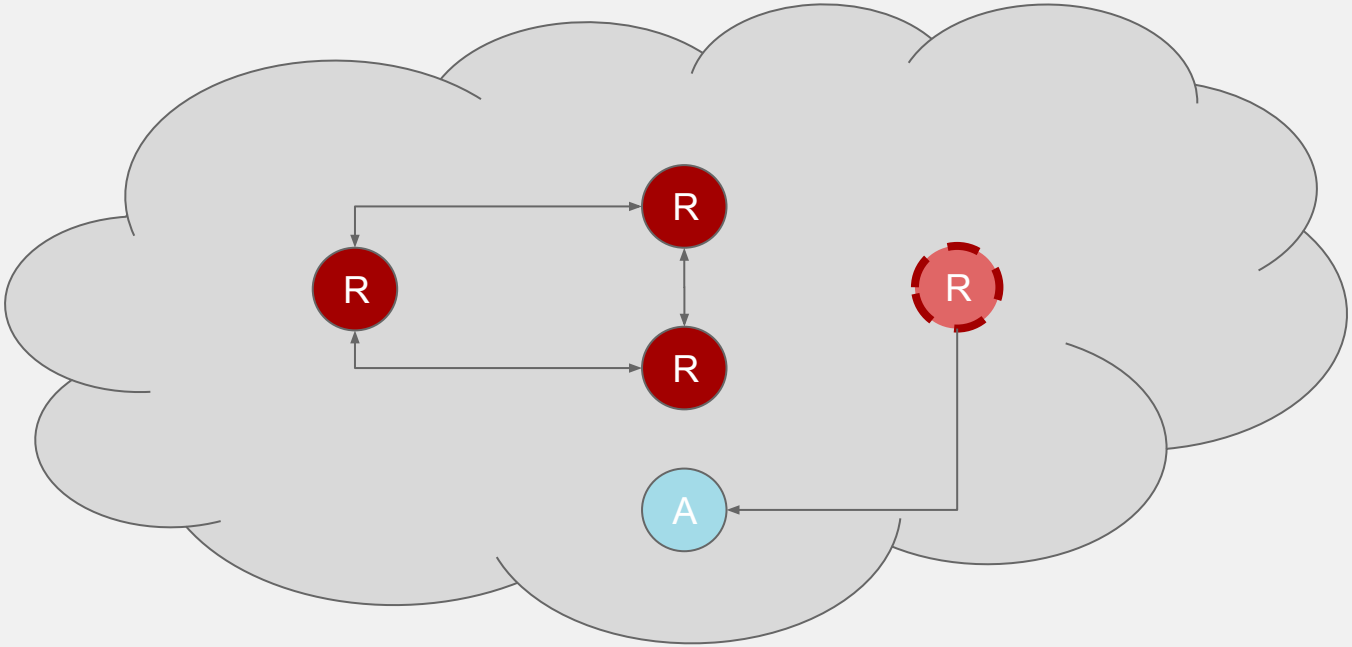
MQTT over AMQP

- **MQTT gateway**
  - Handles connections with remote MQTT clients
  - Bridges MQTT - AMQP protocols
- **MQTT lwt**
  - Provides the “will testament” feature
  - In charge to recover & send the “will” if client dies
- It brings **MQTT features over AMQP** so …
  - … “will testament” works for AMQP clients as well

Scaling (routers and brokers)

Scaling routers



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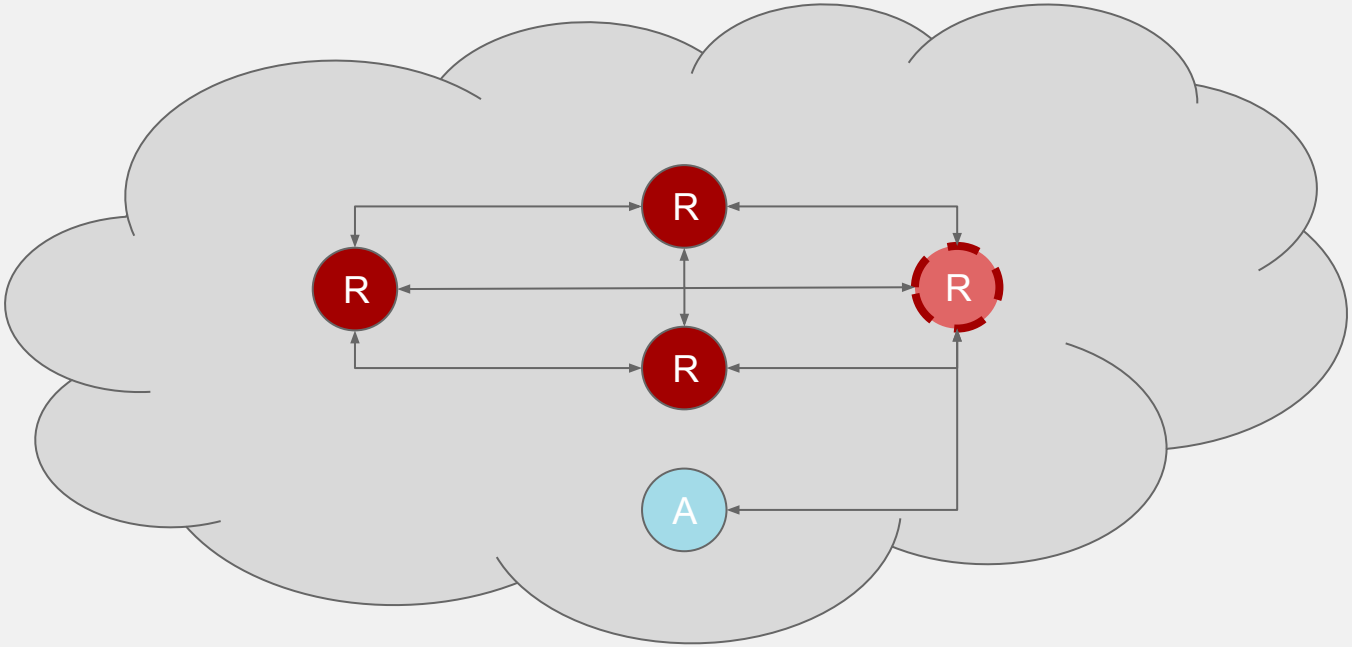
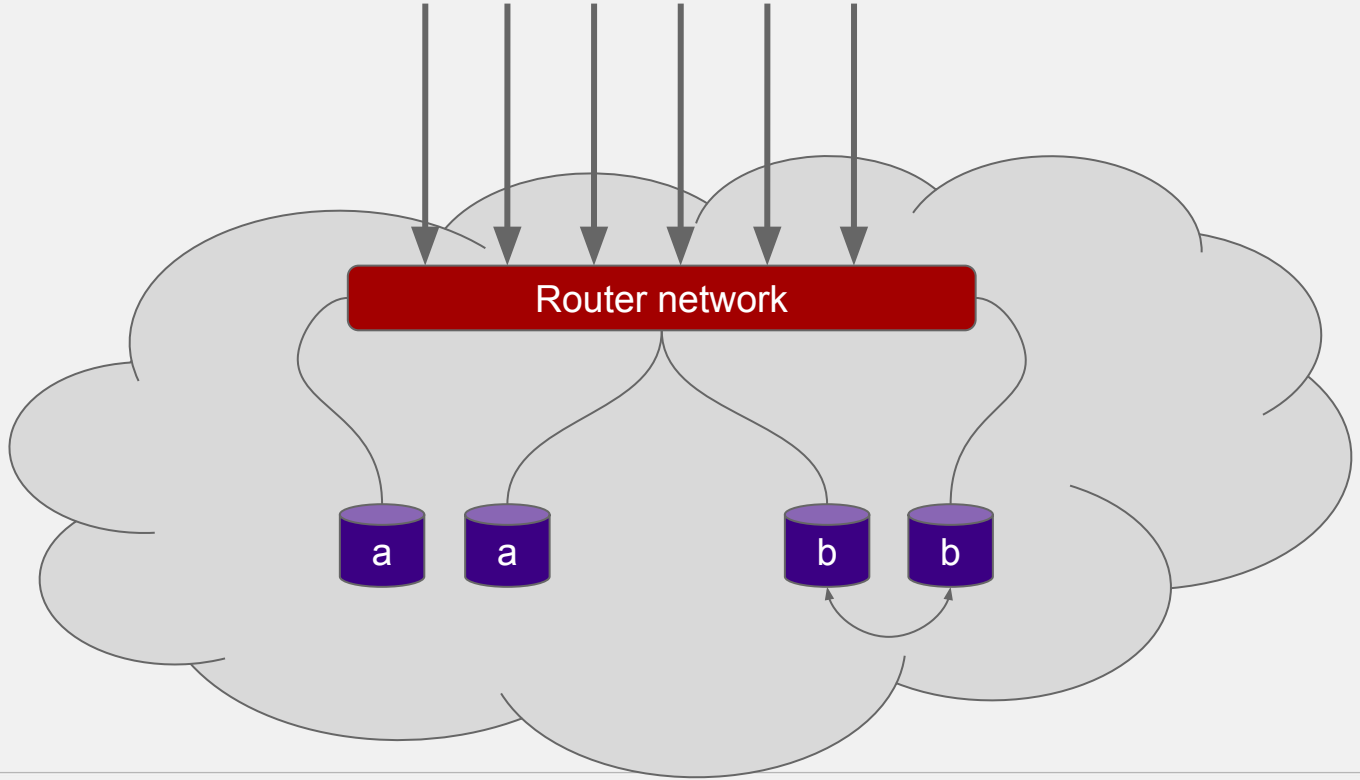
Scaling routers (#2)



Scaling brokers



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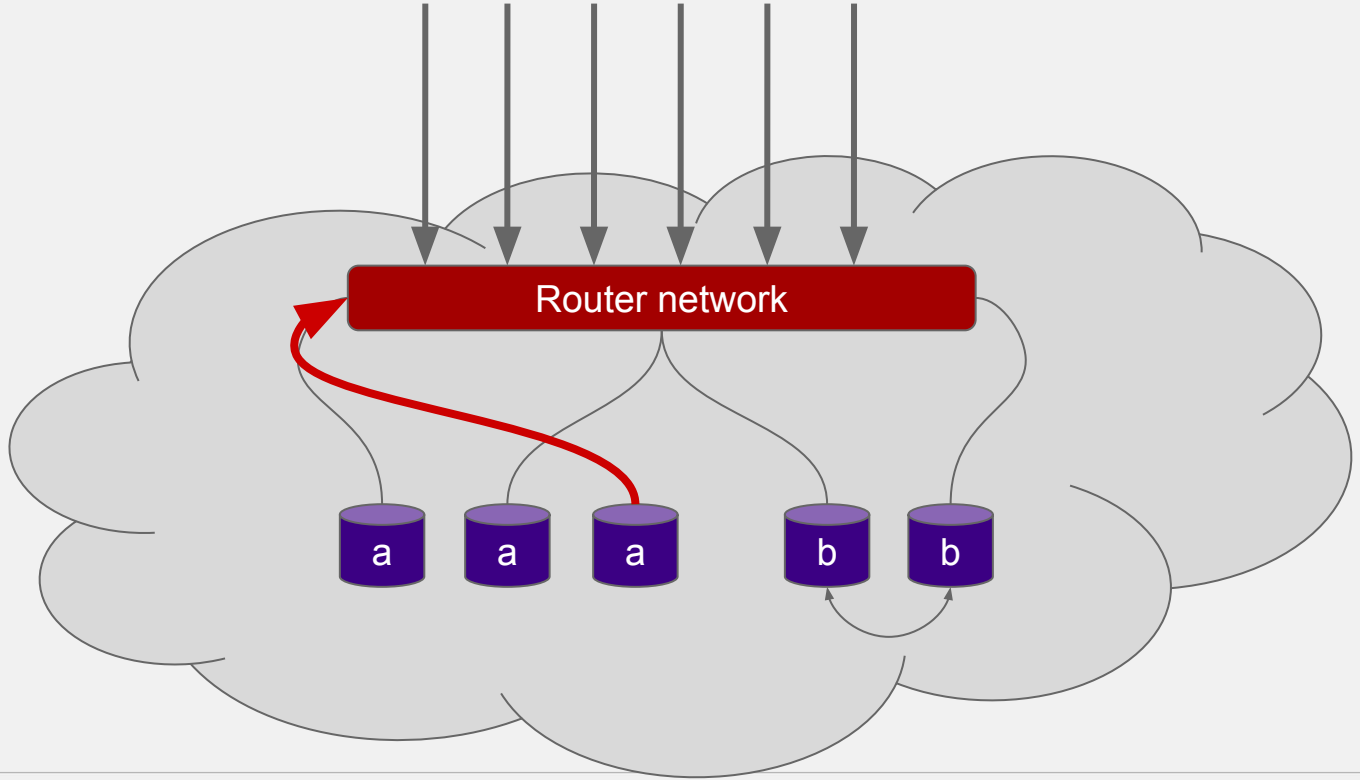
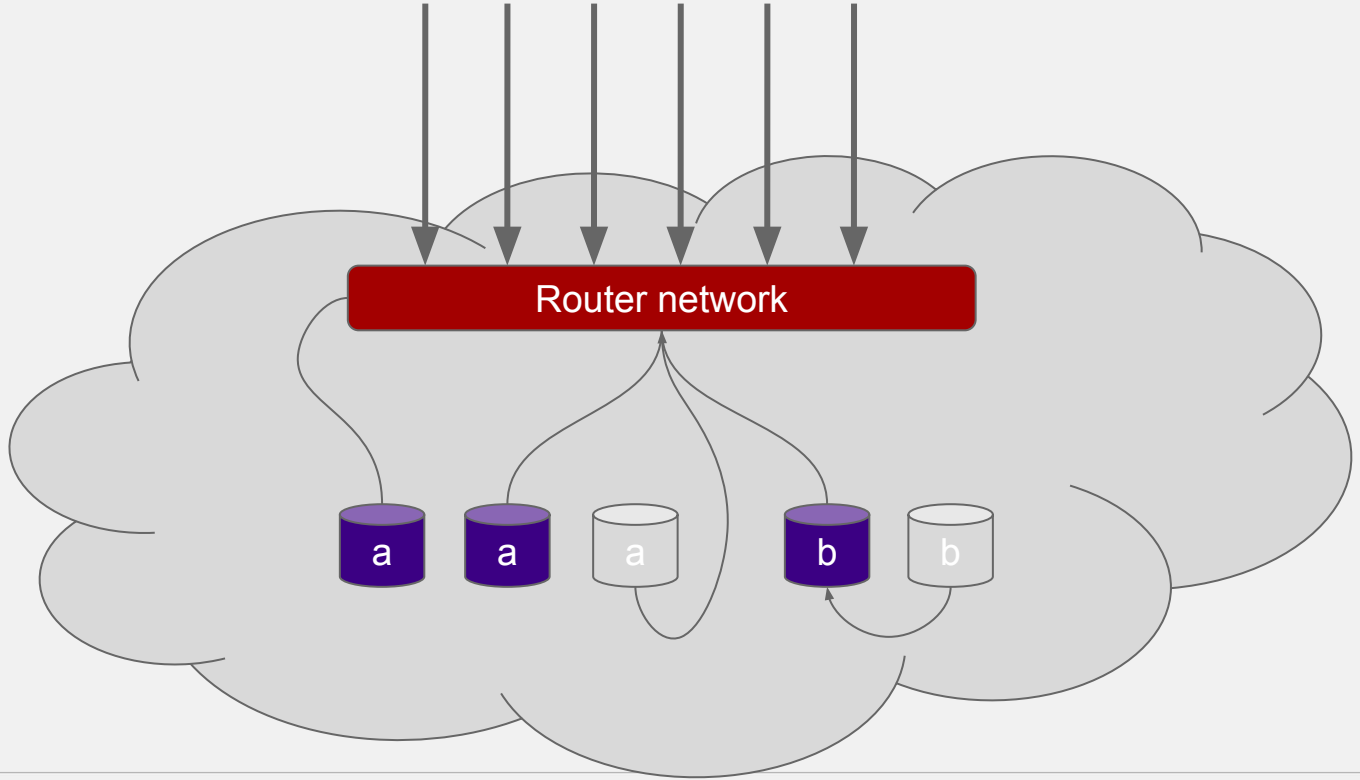
Adding brokers



Removing brokers



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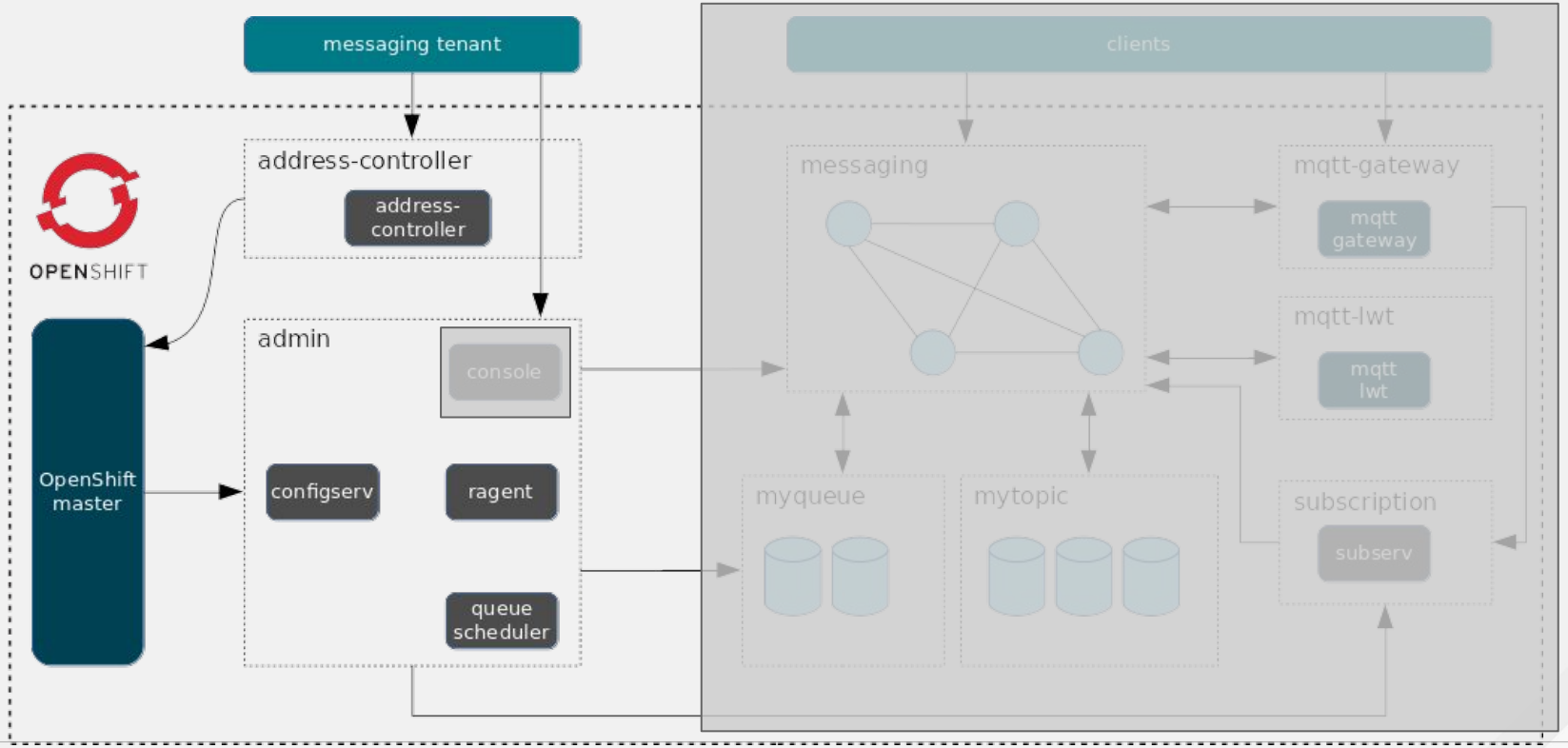
Configuration management

Configuration distribution



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Configuration interface

```
{
    "apiVersion": "v3",
    "kind": "Address",
    "metadata": {
        "name": "myqueue"
    },
    "spec": {
        "store_and_forward": true,
        "multicast": false,
        "flavor": "vanilla-queue"
    }
}
```

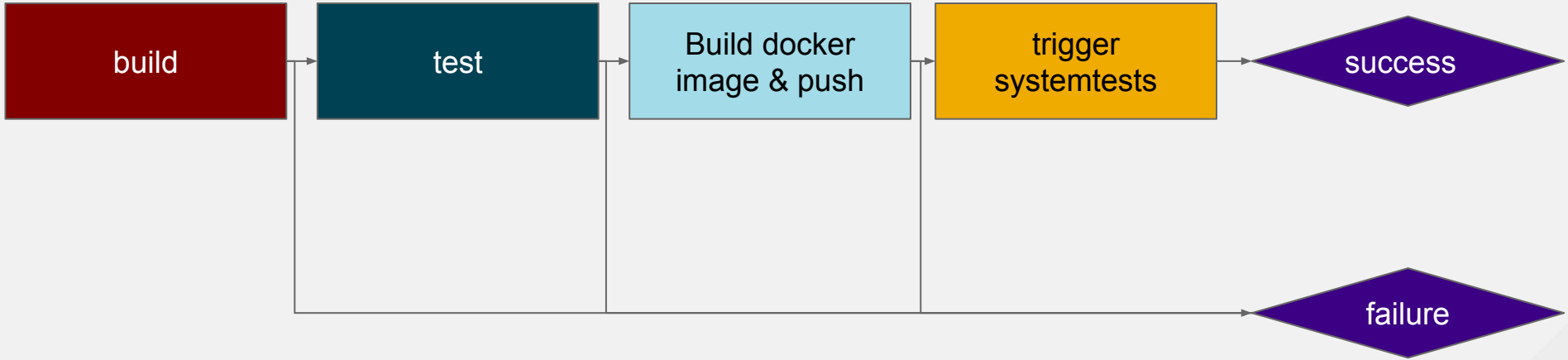
Configuration interface

```
{
    "apiVersion": "v3",
    "kind": "Flavor",
    "metadata": {
        "name": "vanilla-queue"
    },
    "spec": {
        "type": "queue",
        "Description": "Simple in-memory queue",
        "templateName": "queue-inmemory",
        "templateParameters": {}
    }
}
```

Continuous integration

Continuous integration

Component build pipeline



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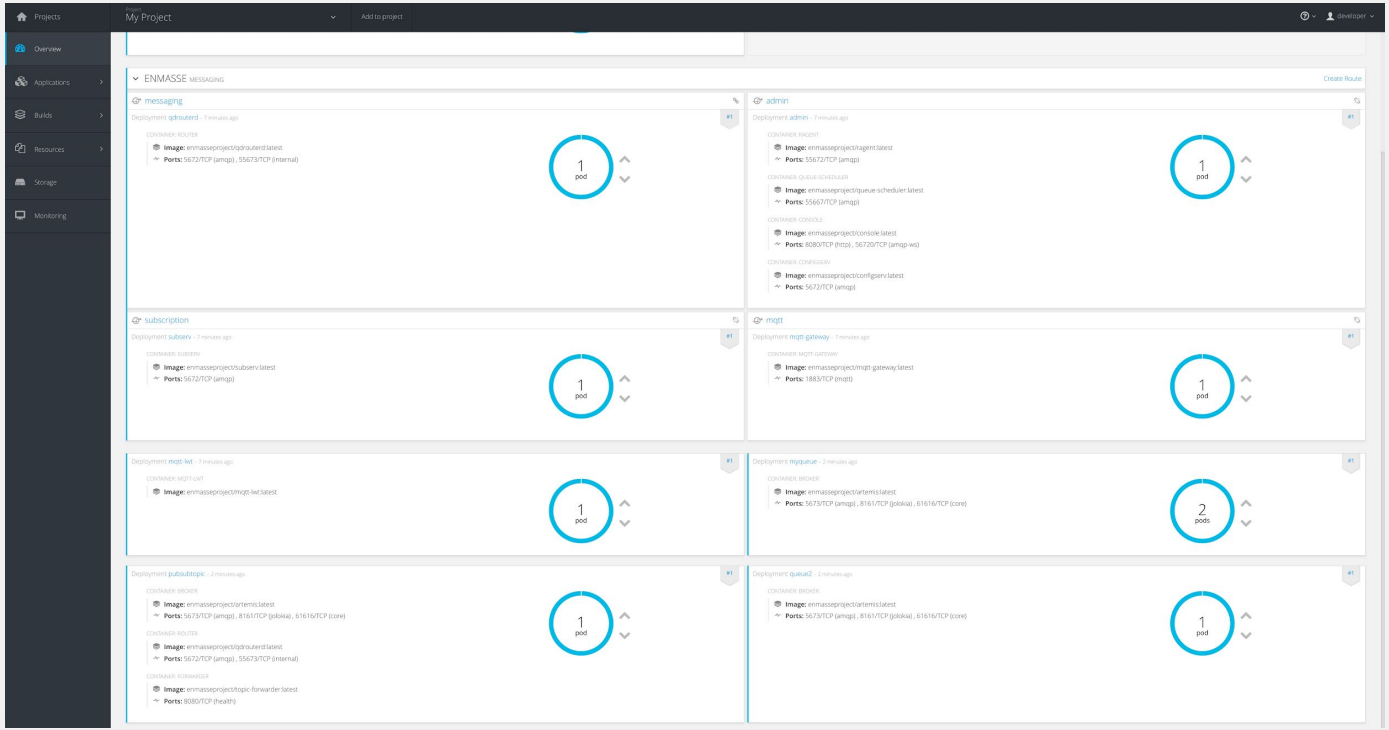
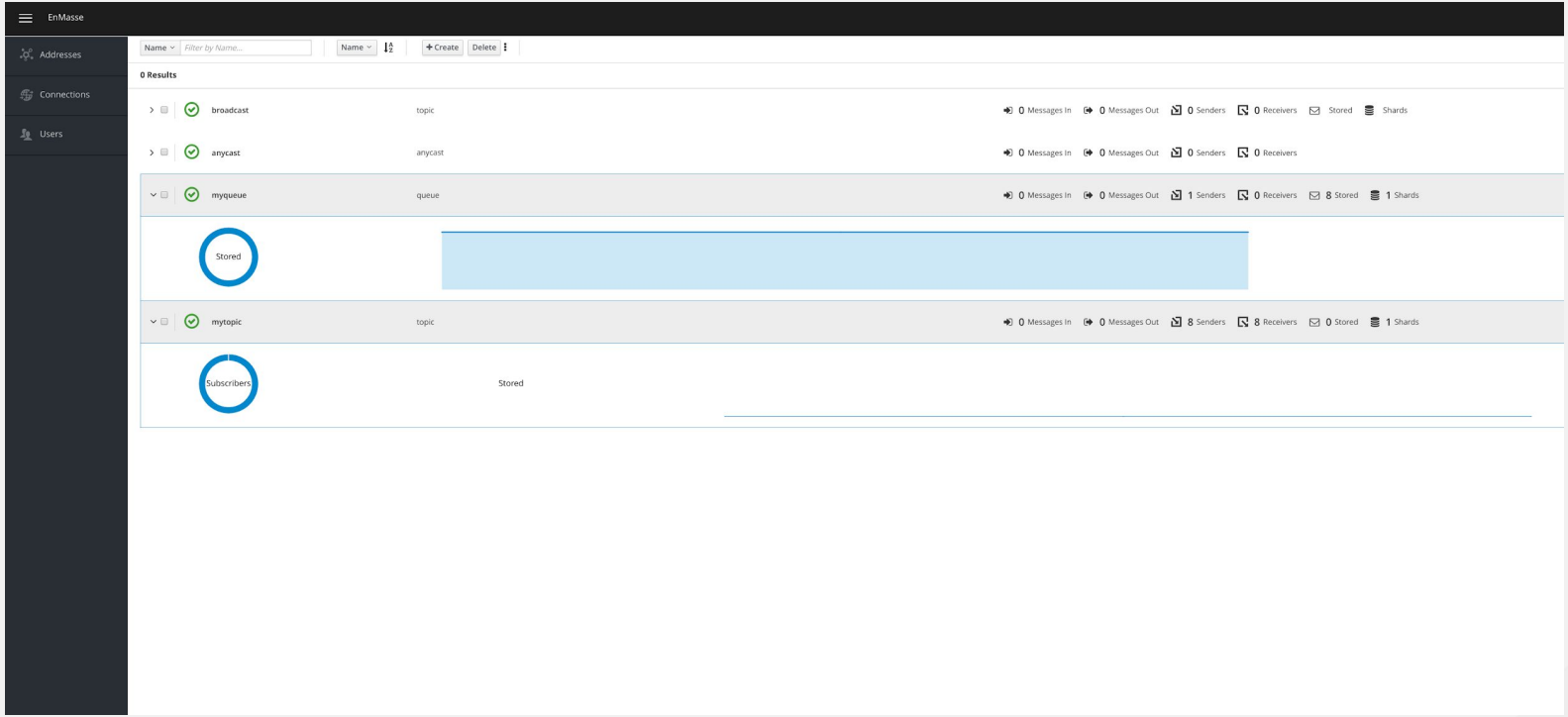
User interface

OpenShift console



Messaging console



Monitoring


enmasse
Zoom Out
Last 15 minutes
Refresh every 10s
Queue Depth
150
100
50
0
19:48
19:49
19:50
19:51
19:52
19:53
19:54
19:55
19:56
19:57
19:58
19:59
20:00
20:01
20:02
pod/3c6d28c5-13de-11e7-9578-507b9def37d9/custom/"myqueue"."myqueue"."myqueue-928437301-bk41n".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"7c372d87-bb1c-4ad0-87de-c1a0941f5004"."7c372d87-bb1c-4ad0-87de-c1a0941f5004"."mytopic-3603657105-y4za0".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."3a13e9d1-e3c4-415f-b975-a2d6a9b89452"."mytopic-3603657105-y4za0".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."b2775fe6-9714-4ac5-8d43-bf3f7ee5687b"."mytopic-3603657105-y4za0".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."c44f1f90-c3a6-4b47-a07c-6fbf3f1d43c6"."mytopic-3603657105-y4za0".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."d89a8cc5-69b9-4103-9403-daa563eb938a"."mytopic-3603657105-y4za0".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."e8134053-1321-4393-a1fd-cd1d3bd36319"."mytopic-3603657105-y4za0".queueDepth
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."edd9b4bd-37fd-4a34-b3de-0e0e35dd3a6b"."mytopic-3603657105-y4za0".queueDepth
Number of consumers
1.25
1.00
0.75
0.50
0.25
0
pod/3c6d28c5-13de-11e7-9578-507b9def37d9/custom/"myqueue"."myqueue"."myqueue-928437301-bk41n".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"7c372d87-bb1c-4ad0-87de-c1a0941f5004"."7c372d87-bb1c-4ad0-87de-c1a0941f5004"."mytopic-3603657105-y4za0".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."3a13e9d1-e3c4-415f-b975-a2d6a9b89452"."mytopic-3603657105-y4za0".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."b2775fe6-9714-4ac5-8d43-bf3f7ee5687b"."mytopic-3603657105-y4za0".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."c44f1f90-c3a6-4b47-a07c-6fbf3f1d43c6"."mytopic-3603657105-y4za0".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."d89a8cc5-69b9-4103-9403-daa563eb938a"."mytopic-3603657105-y4za0".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."e8134053-1321-4393-a1fd-cd1d3bd36319"."mytopic-3603657105-y4za0".numConsumers
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/"mytopic"."edd9b4bd-37fd-4a34-b3de-0e0e35dd3a6b"."mytopic-3603657105-y4za0".numConsumers
Broker Heap usage
240 Mil
220 Mil
200 Mil
180 Mil
160 Mil
140 Mil
pod/3c6d28c5-13de-11e7-9578-507b9def37d9/custom/broker.memoryHeapUsage
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/broker.memoryHeapUsage
ADD ROW

Messaging & IoT

“give me a **scalable messaging platform**, and I shall move the **Internet of Things** world” (Archimedes)

redhat.

IoT communication patterns

Telemetry

Inquiries

Commands

Notifications

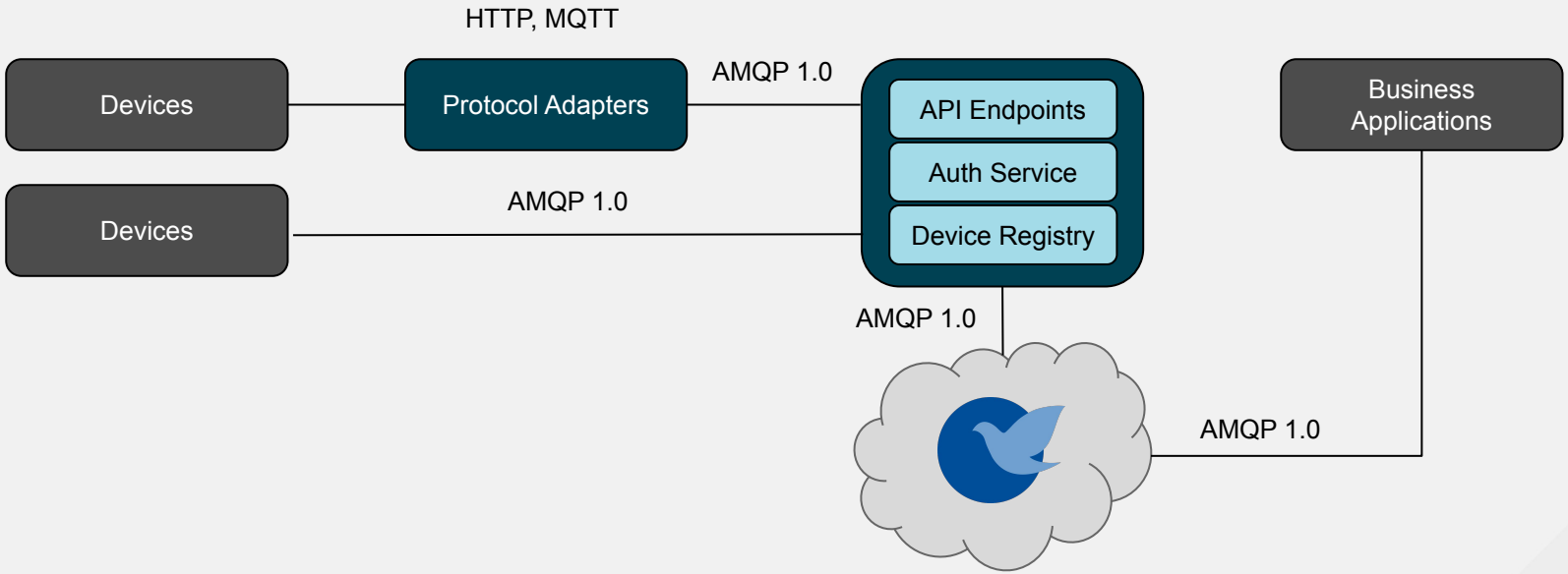
IoT communication patterns

Messaging patterns & protocols

- **Telemetry** & **Notifications** are about …
  - …. messaging **publish/subscribe**
- **Commands** & **Inquiries** are about …
  - … messaging **request/response**
- Different protocols (AMQP, MQTT, HTTP, …) implement them in different way
  - As built-in support …
  - … or on top of it at application level
  - Read more on *“Strengths And Weaknesses Of IoT Communication Patterns”* *

* DZone IoT Guide : https://dzone.com/guides/iot-applications-protocols-and-best-practices

Eclipse Hono



DEMO

Resources

- **EnMasse** : https://enmasseproject.github.io/
- **Qpid Dispatch Router** : http://qpid.apache.org/components/dispatch-router/
- **ActiveMQ Artemis** : https://activemq.apache.org/artemis/
- **Eclipse Hono** : https://www.eclipse.org/hono/
- **Demo** : https://github.com/ppatierno/devday-maas
- **My blog** : https://paolopatierno.wordpress.com/

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Thank you ! Questions ?

@ppatierno