Eclipse Hono and all things IoT messaging

IoT Day Grenoble 2018

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Who am I

Dejan Bosanac

Software Engineer @ Red Hat

- Messaging and IoT

Open source committer

- Eclipse Hono
- Eclipse Kapua
- Apache ActiveMQ

Eclipse Hono provides a **uniform API** for interacting with **millions of devices** connected to the cloud via **arbitrary protocols**.

Eclipse Hono

Connect. Command. Control.

- An Eclipse Foundation IoT project ...
  - Bosch and Red Hat as main contributors
- https://www.eclipse.org/hono/

Eclipse Hono

Connect. Command. Control.

- Open source IoT connectivity platform running on …
  - Kubernetes
  - OpenShift
  - Docker Swarm
- On-premise & in the cloud
- Provided by a set of Docker containers

Eclipse Hono

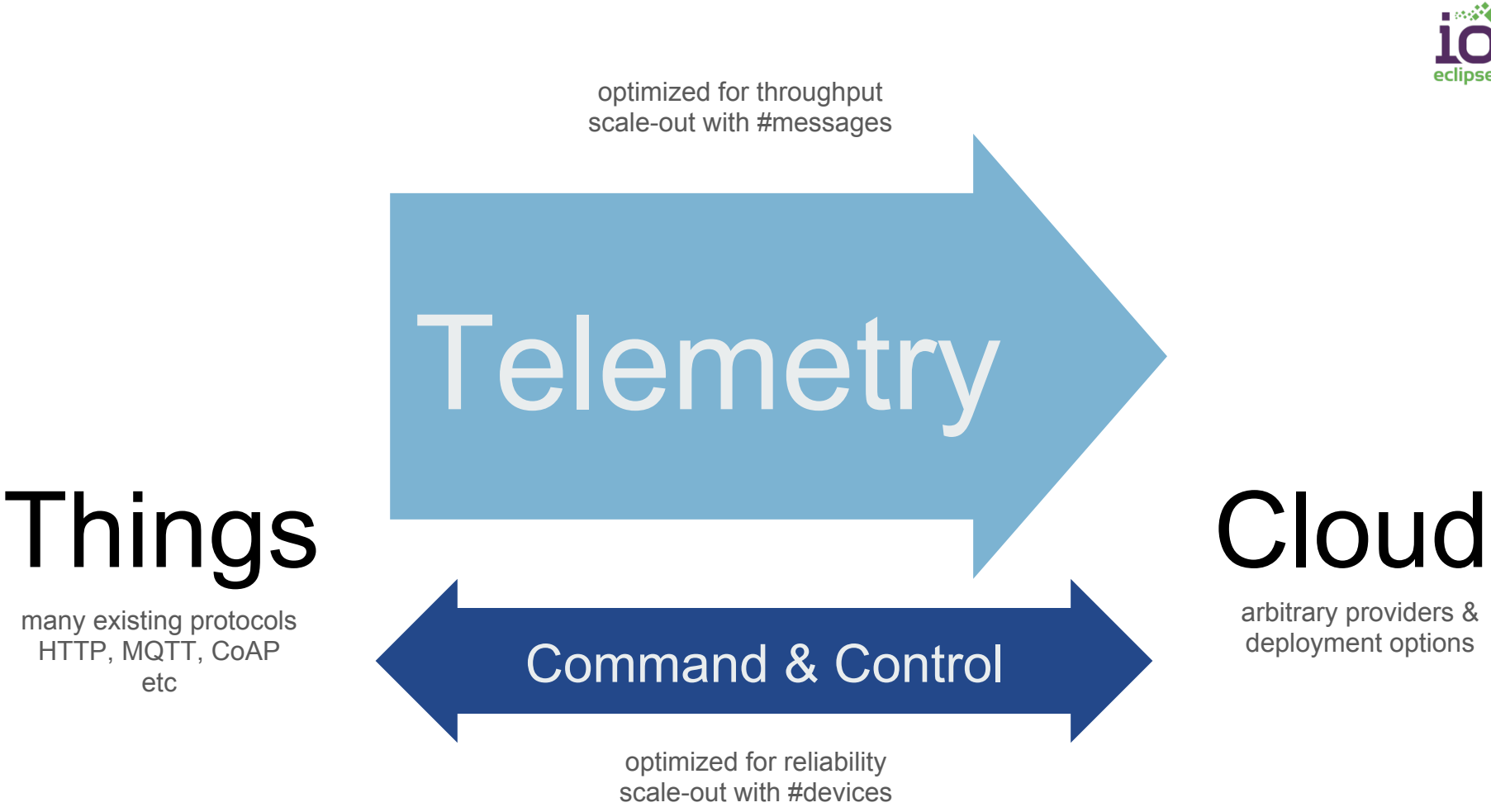
Goals

- Tailored general messaging for IoT solutions
- Provide standard APIs for interacting with devices
- Support for arbitrary protocols (MQTT, AMQP 1.0, HTTP, …)
- Support different underlying messaging infrastructures
  - AMQP 1.0 based
  - JMS
  - Apache Kafka
  - RabbitMQ

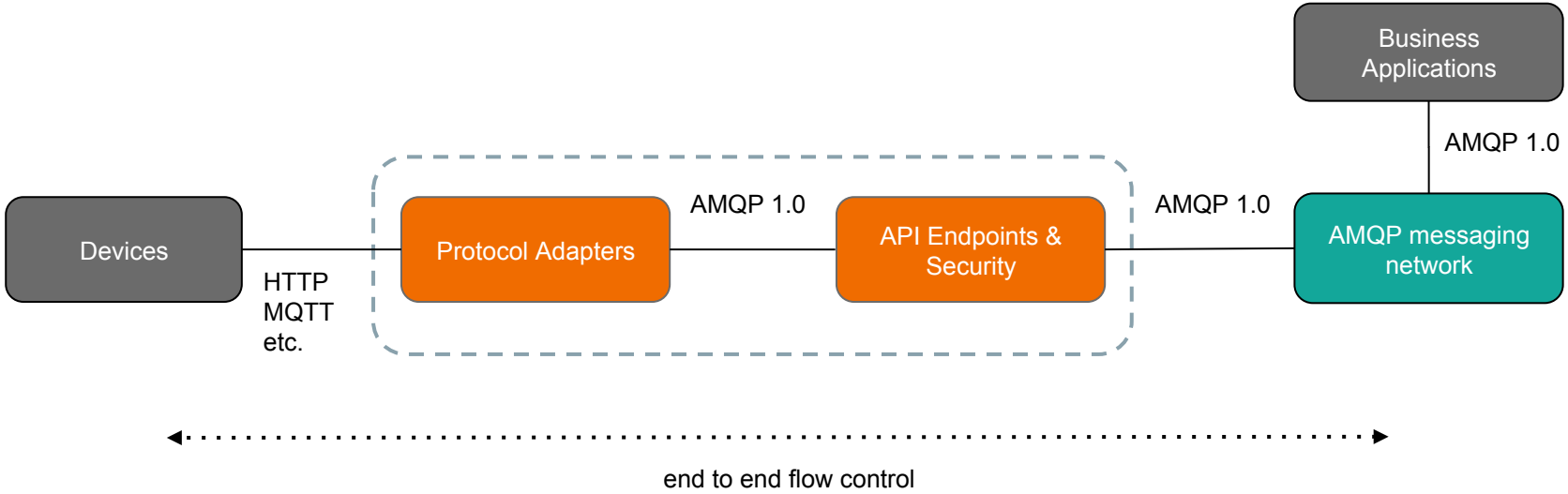
Eclipse Hono

Features

- Scalability
- Multi-tenancy
- Device-based security
- Multi-protocol support


optimized for throughput
scale-out with #messages
Telemetry
Things
many existing protocols
HTTP, MQTT, CoAP
etc
Cloud
arbitrary providers &
deployment options
Command & Control
optimized for reliability
scale-out with #devices

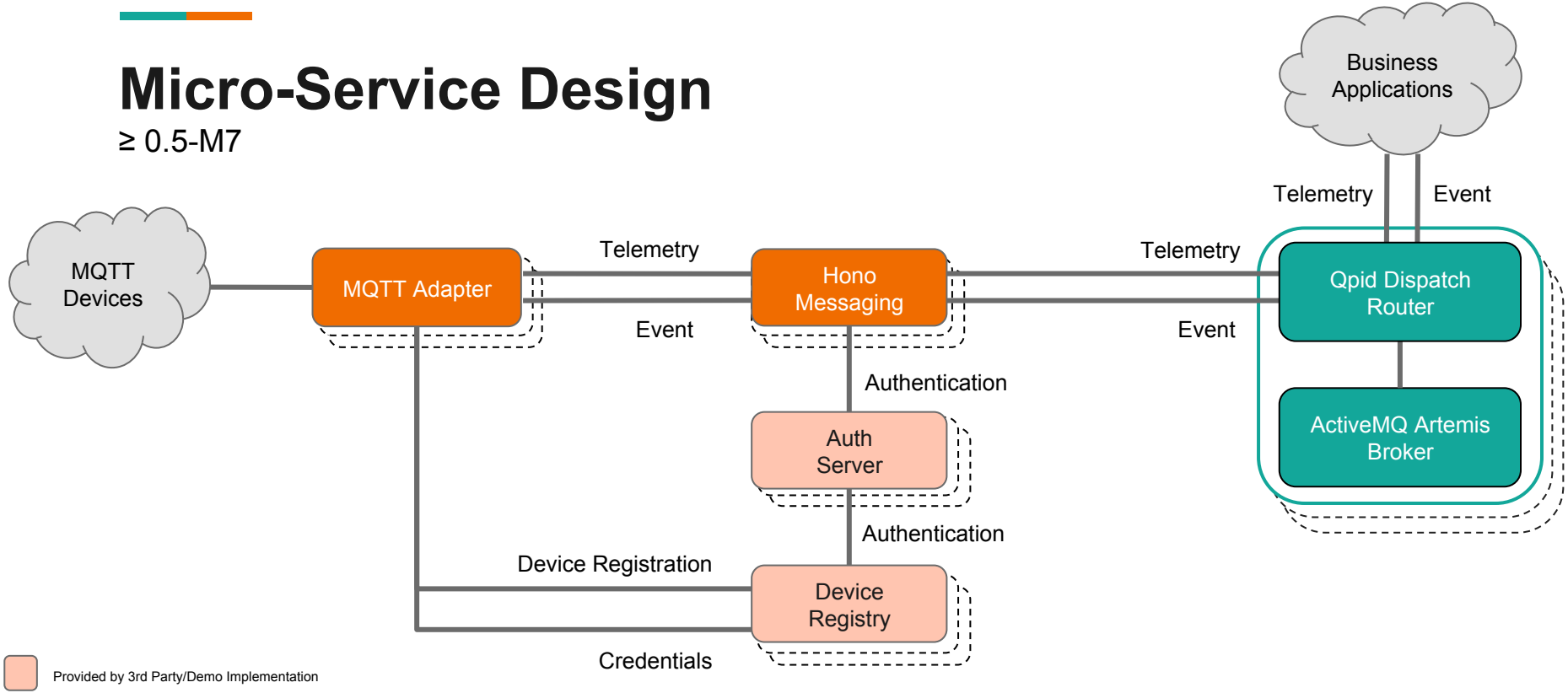
Building Blocks



Hono

Micro-Service Design

≥ 0.5-M7



Eclipse Hono

Telemetry & Event

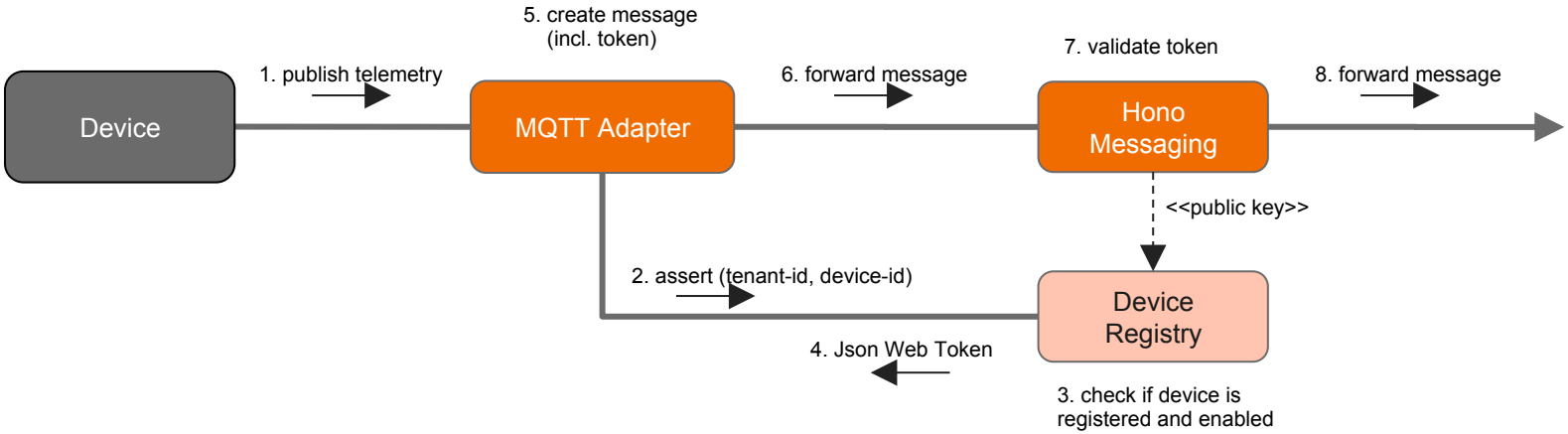
- used by devices to **send data/event downstream**
- leverages on **“direct messaging”** …
  - Telemetry
  - Devices can send data only if consumers are online
  - No broker involved
- … **“store and forward”**
  - Event
  - Broker for storing event with a “ttl” eventually
- consumers receive data published by devices belonging to a particular tenant

Eclipse Hono

Device Registration

- used to make Hono **aware of devices** that will connect to the service
- solutions/consumers may use the API to get information about devices
- operations
  - register, deregister, get information, assertion
- for every message sent by a device …
  - a **registration assertion** (JWT) is attached by the protocol adapter
  - it’s verified by messaging before sending the message downstream
  - a disabled device will have such check fails

Registration Assertion



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Credentials

- handle authentication for devices on protocol adapters
- used by **protocol adapters** to retrieve credentials used to authenticate devices connecting to the adapter (MQTT, HTTP, …)
- different types of credentials
  - psk, hashed password, public key, …
- operations
  - add, get, update, remove
- Where an **identity management system** is already in place (i.e. Keycloak) …
  - needs for having a “facade” from this API to such a system

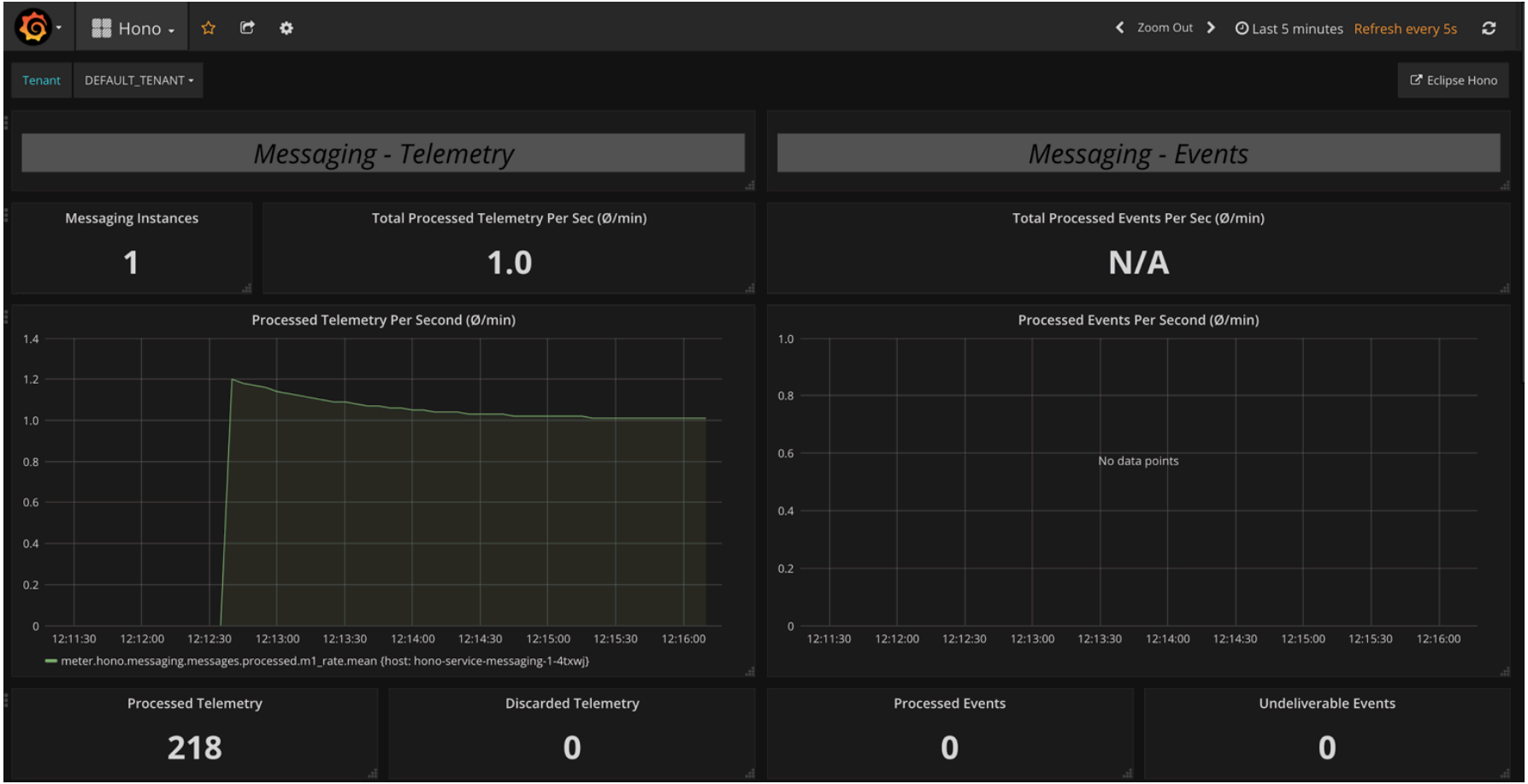
Eclipse Hono

Authentication

- handle authentication between components (protocol adapters, messaging, …)
- used by clients/components for getting a **token** asserting …
  - subject's identity
  - granted authorities
- other services will use such a token to make authorization decisions on a client's request to read or write from/to a resource or to invoke a certain operation
  - i.e. messaging checks if an adapter can write telemetry data
- Where an **identity management system** is already in place (i.e. Keycloak) …
  - needs for having a "facade" from this API to such a system

Features Hono 0.5

- Uniform APIs for consuming telemetry data and events
- MQTT, HTTP protocol adapters
- Device-level Authentication
- Tenant based Security Model
- Horizontal Scalability


Hono
Zoom Out
Last 5 minutes
Refresh every 5s
Tenant
DEFAULT_TENANT
Eclipse Hono
Messaging - Telemetry
Messaging - Events
Messaging Instances
1
Total Processed Telemetry Per Sec (Ø/min)
1.0
Total Processed Events Per Sec (Ø/min)
N/A
Processed Telemetry Per Second (Ø/min)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
12:11:30
12:12:00
12:12:30
12:13:00
12:13:30
12:14:00
12:14:30
12:15:00
12:15:30
12:16:00
meter.hono.messaging.messages.processed.m1_rate.mean {host: hono-service-messaging-1-4txwj}
Processed Events Per Second (Ø/min)
No data points
Processed Telemetry
218
Discarded Telemetry
0
Processed Events
0
Undeliverable Events
0

Future

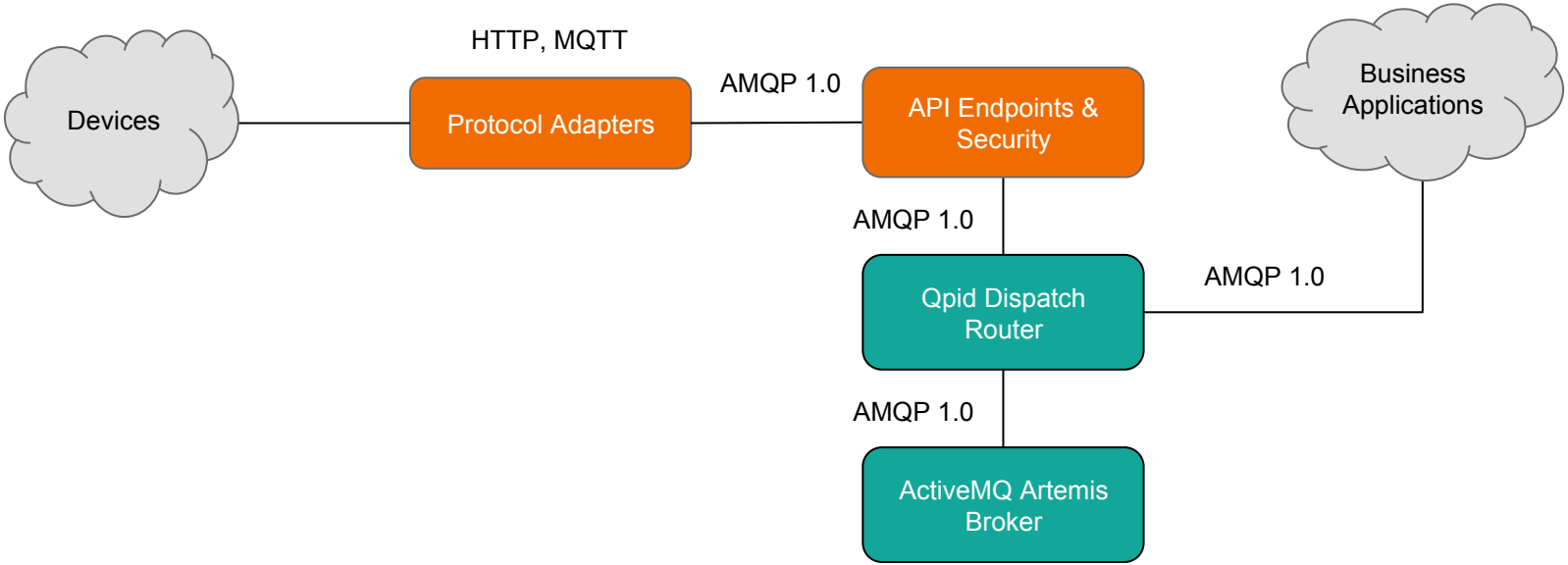
- Performance and scalability testing and tuning
- Continue improving OpenShift and EnMasse integrations
- Command and control API
- Tenant API

Eclipse Hono

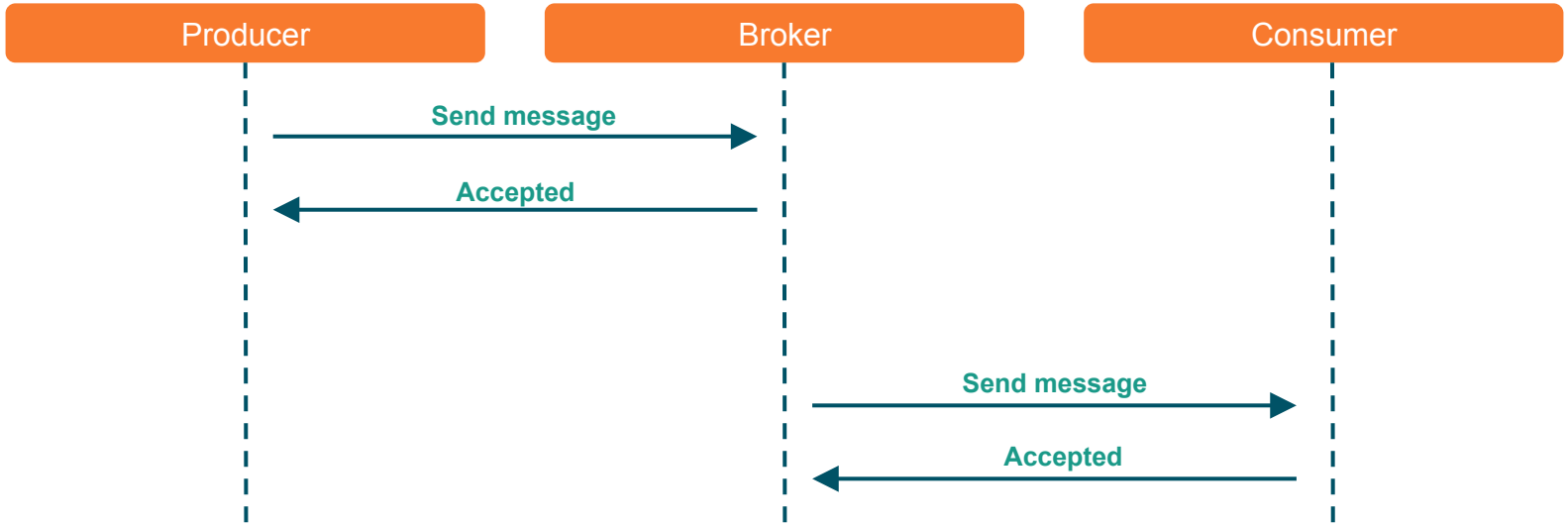
Command & Control

- used by applications to **send commands to devices**
- command execution can be “just in time” or “deferred”
    - **just in time** : command already executed, the response from device contains the result
    - **deferred** : command not executed yet, the response from device specifies it’s accepted; for long running operations the result will be provided later

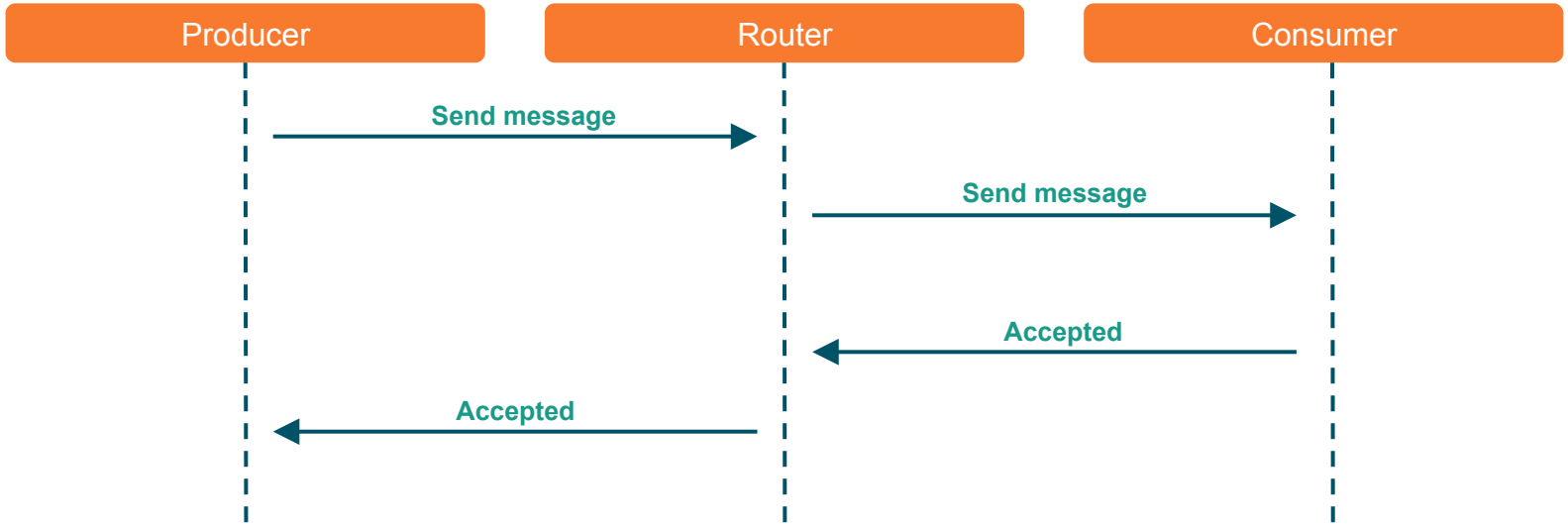
Simple deployment



Routing vs Brokering



Routing vs Brokering

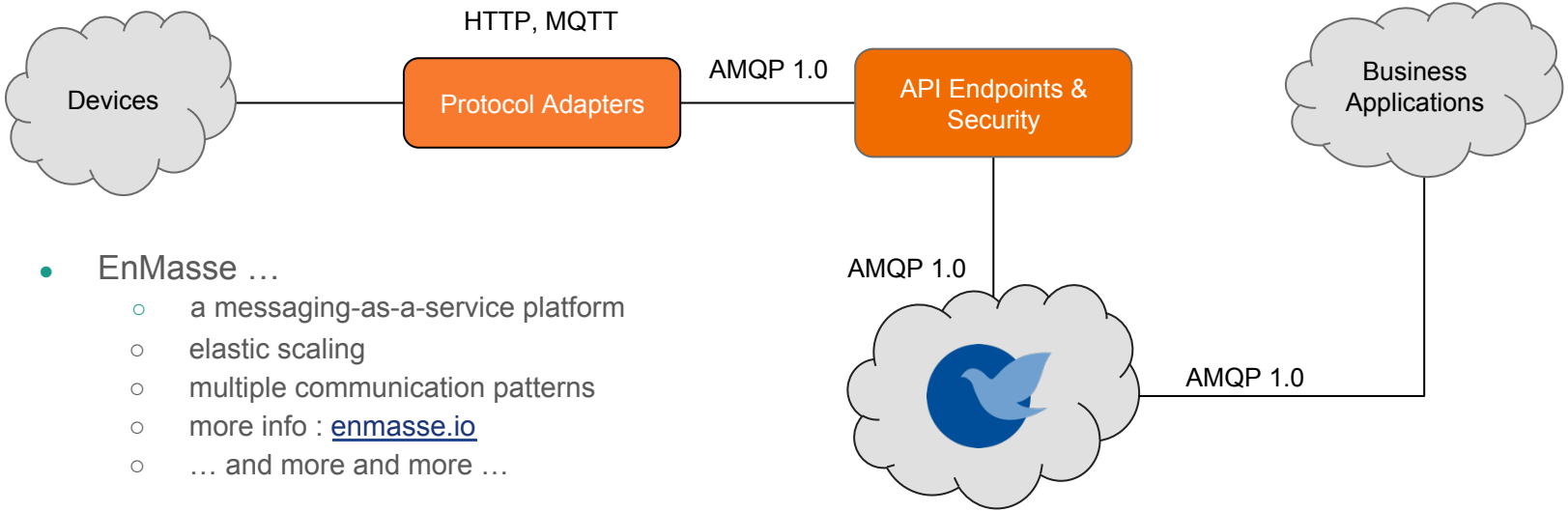


Addressing semantics

- Store and Forward
  - Queue
  - Topic

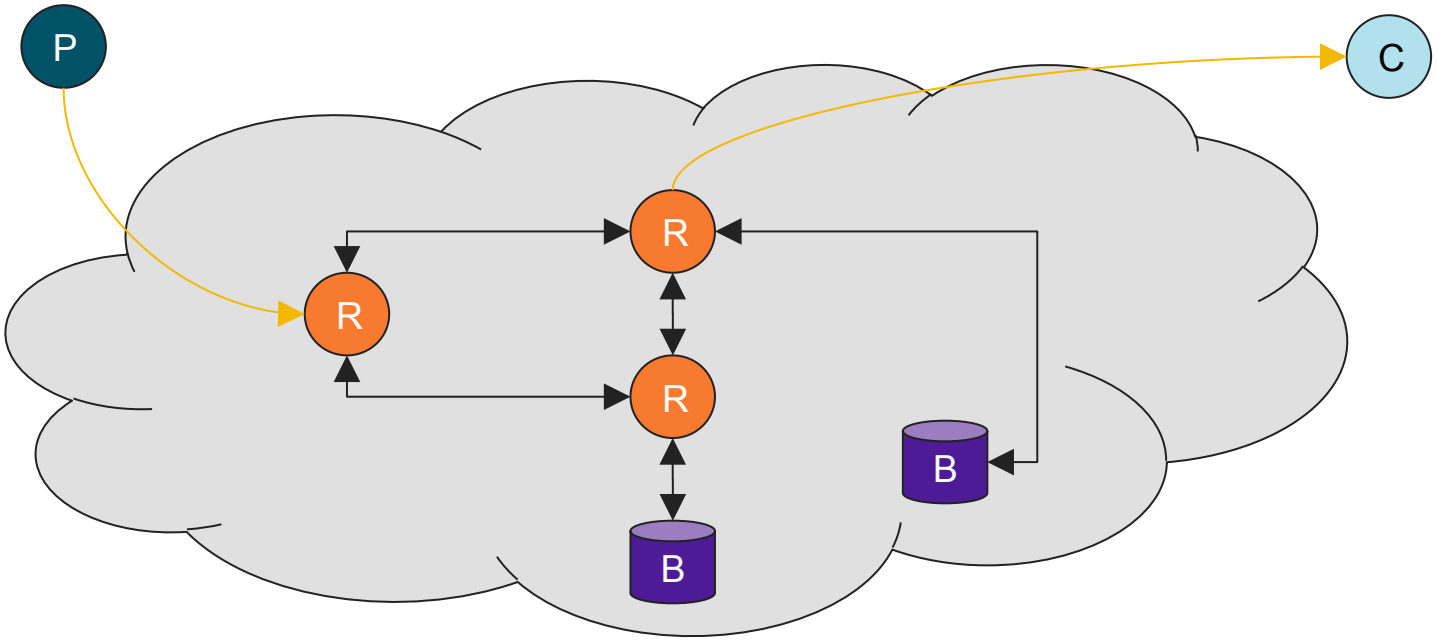
- Direct
  - Anycast
  - Multicast (Broadcast)

Scalable deployment



- EnMasse …
  - a messaging-as-a-service platform
  - elastic scaling
  - multiple communication patterns
  - more info : enmasse.io
  - … and more and more …

Basic idea

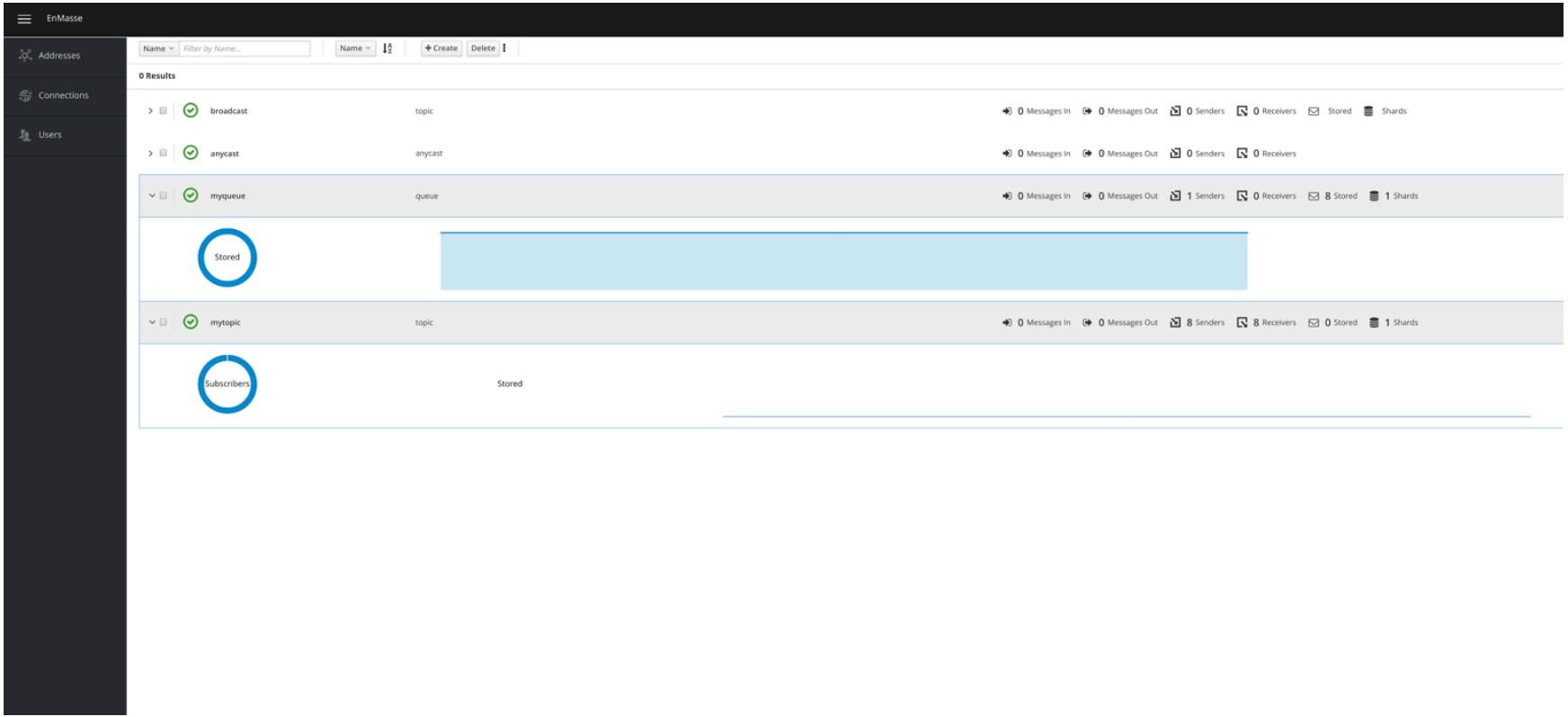


Messaging-as-a-Service

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

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**

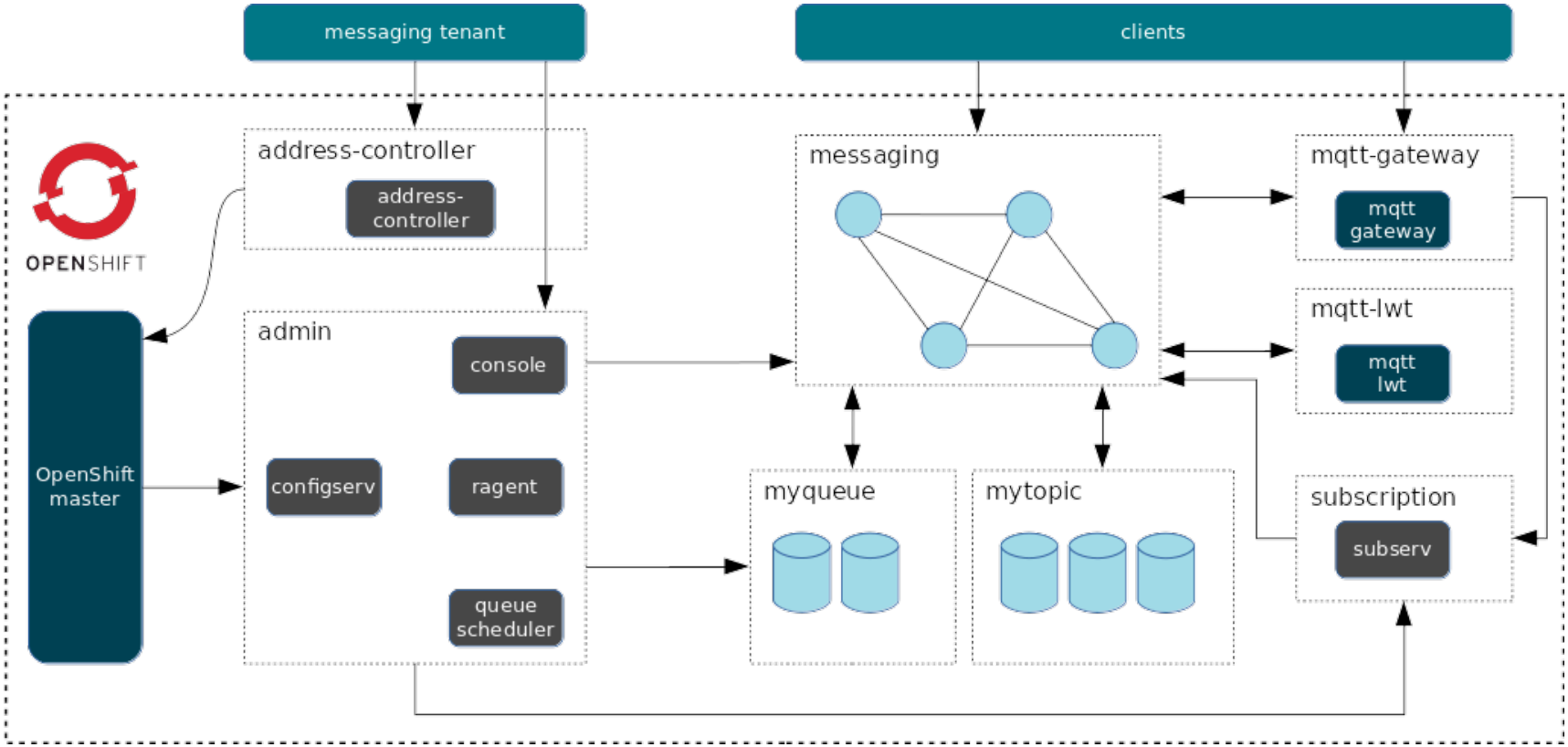

EnMasse
Addresses
Connections
Users
Name
Filter by Name...
Name
+ Create
Delete
0 Results
broadcast
topic
0 Messages In
0 Messages Out
0 Senders
0 Receivers
Stored
Shards
anycast
anycast
0 Messages In
0 Messages Out
0 Senders
0 Receivers
myqueue
queue
0 Messages In
0 Messages Out
1 Senders
0 Receivers
8 Stored
1 Shards
Stored
mytopic
topic
0 Messages In
0 Messages Out
8 Senders
8 Receivers
0 Stored
1 Shards
Subscribers
Stored

Address types

- Queue
  - store-and-forward = true
  - multicast = false
- Topic
  - store-and-forward = true
  - multicast = true
- Anycast
  - store-and-forward = false
  - multicast = false
- Broadcast
  - store-and-forward = false
  - multicast = true

Flavor examples

- Persistence
  - In memory
  - Persisted
- Scaling
  - Single broker
  - Pooled
- HA


messaging tenant
clients
OPENSHIFT
address-controller
address-controller
messaging
mqtt-gateway
mqtt gateway
mqtt-lwt
mqtt lwt
admin
console
OpenShift master
configserv
ragent
queue scheduler
myqueue
mytopic
subscription
subserv


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
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".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
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/broker.memoryHeapUsage
pod/3c7d2c21-13de-11e7-9578-507b9def37d9/custom/broker.memoryHeapUsage
+ ADD ROW

Future

In progress/TODO

- Authentication and authorization
- Service broker API
- HTTP(S)
- Broker address space
  - Message grouping
  - Distributed transactions
  - Message ordering
- Multiple flavors
  - Apache Kafka?
- ...

Resources

- Eclipse Hono - https://www.eclipse.org/hono
- EnMasse - http://enmasse.io
- ActiveMQ Artemis - https://activemq.apache.org/artemis/
- Qpid Dispatch Router - http://qpid.apache.org/components/dispatch-router/

Thank you ! Questions ?