ActiveMQ in Action: Common Problems and Solutions

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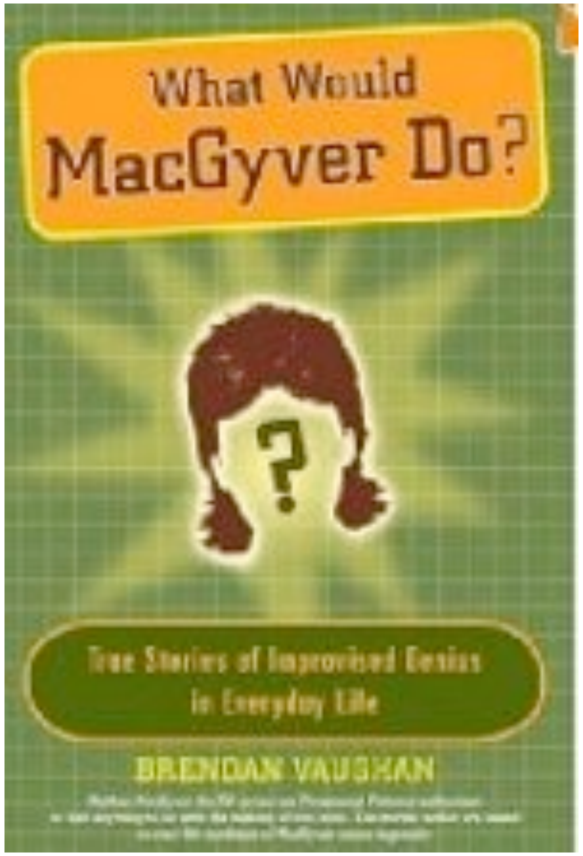
Common Questions

- Should I create my JMS clients from scratch?
- How do I manage connections efficiently?
- How do I consume only certain messages?
- Why is ActiveMQ locking up or freezing?
- Do I need a network of brokers?
- Should I use a master/slave configuration?

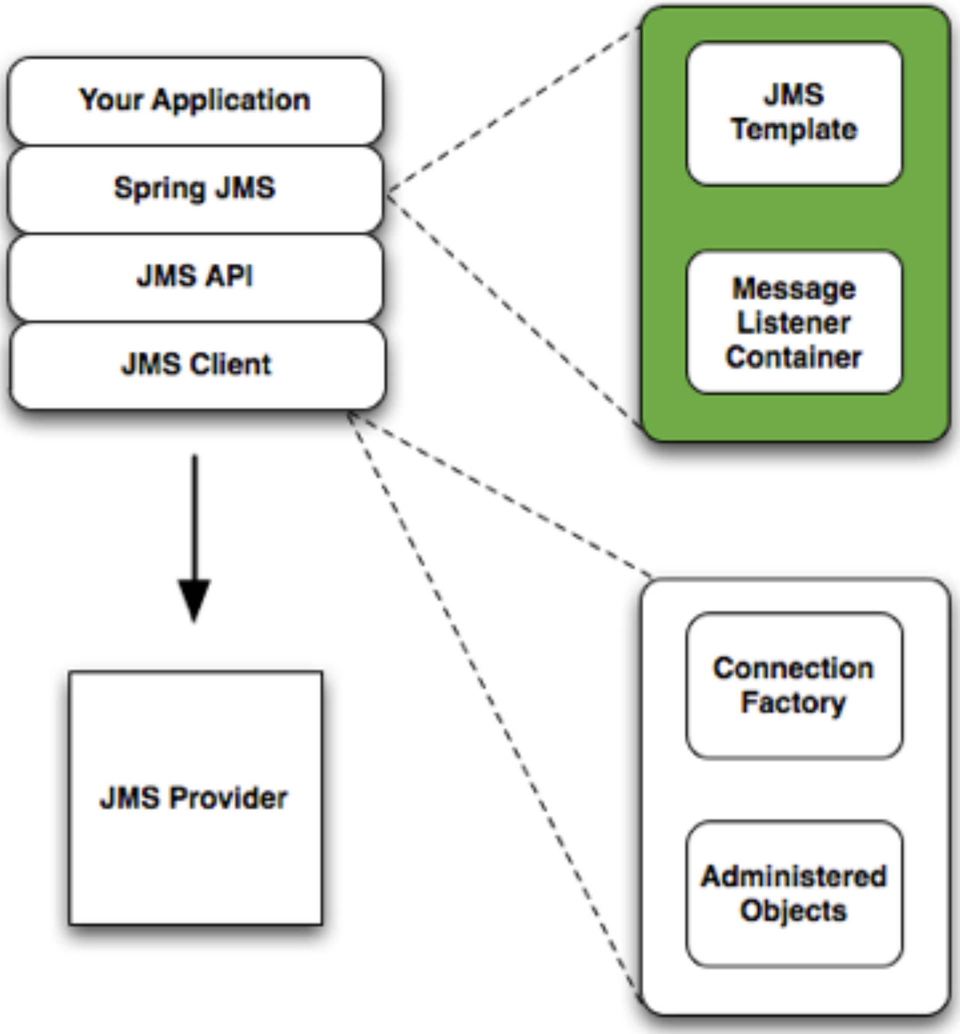
Should I create JMS clients from scratch?



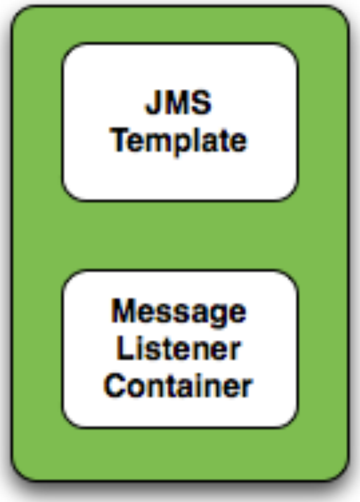
Should I create JMS clients from scratch?

- Question:
  - Would you create a HTTP client from scratch?
  - Would you create a SMTP client from scratch?
- Answer:
  - Sometimes, but mostly no
- **Solution:**
  - Use Spring JMS

Spring JMS

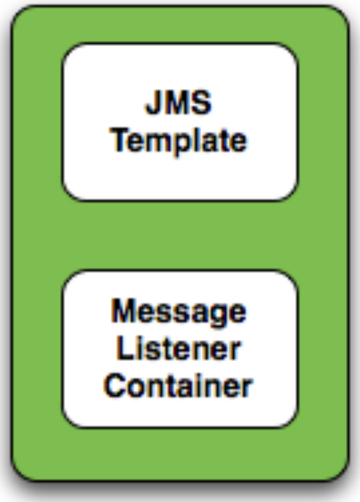

Your Application
Spring JMS
JMS API
JMS Client
JMS Provider
JMS Template
Message Listener Container
Connection Factory
Administered Objects

Spring JMS



- **JMS Template**
  - **Send and receive messages synchronously**
- Message Listener Container
  - Receive messages asynchronously
  - Message-Driven POJOs (MDPs)

Spring JMS



- JMS Template
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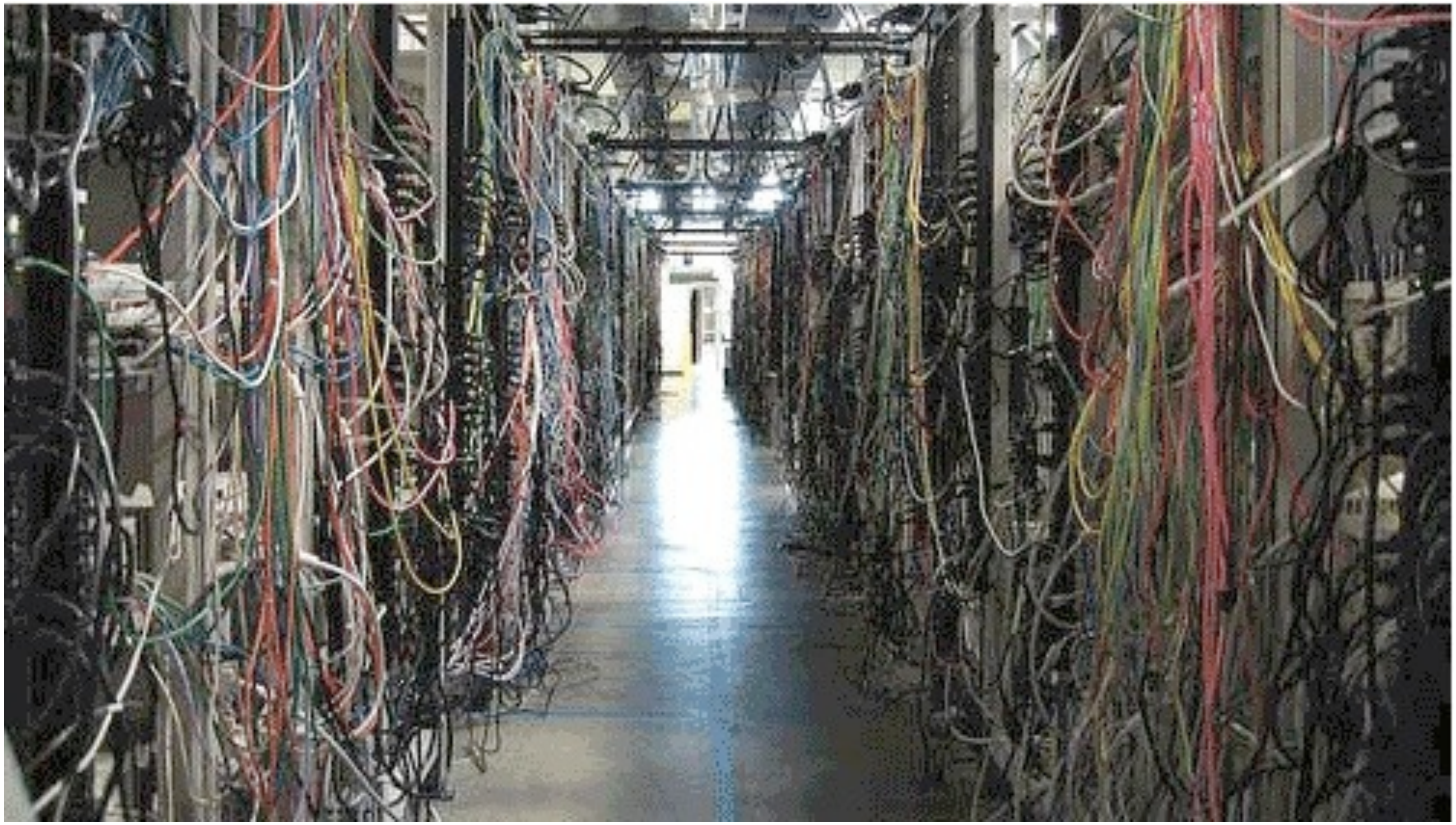
- **Message Listener Container**
  - **Receive messages asynchronously**
  - **Message-Driven POJOs (MDPs)**

How do I manage connections efficiently?



How do I manage connections efficiently?

- JMS connections are expensive to constantly create and destroy
- Create a group that never closes, i.e., pooling

- **Solutions:**
  - ActiveMQ PooledConnectionFactory
  - Spring CachingConnectionFactory

ActiveMQ PooledConnectionFactory

- Based on Apache Commons Pool
  - Generic object pooling framework from the ASF
- Highly configurable
  - Instantiate your own custom GenericObjectPool
- Could be improved
  - Upon hitting pool limit, grow the pool instead of blocking
  - Throw exception when the pool is exhausted
- Caches JMS Sessions and MessageProducers

Spring CachingConnectionFactory

- Based on Spring SingleConnectionFactory
  – Ignores calls to Connection.close()
- Caches JMS Sessions and MessageProducers
- By default only one session is cached
  – Increase the sessionCacheSize!
- Consumers are not closed until Session is closed
  – NOTE: Cache strategy uses the JMS selector as a key

How do I consume only certain messages?

ActiveMQ is not a database!

How do I consume only certain messages?

- ActiveMQ is for sending and receiving events
- ActiveMQ is NOT a message store

- **Solutions:**
  - Use message selectors
  - Correct application design

JMS Selectors

- Allows a client to filter messages from a destination
- Filters message headers only, not payload
- Conditional expressions using a subset of SQL
- Provide boolean evaluation of message headers

Literals	**Booleans TRUE/FALSE; numbers such as 5, -10, +34; numbers with decimal or scientific notation such as 43.3E7, +10.5239**
Identifiers	**A header field**
Operators	**AND, OR, LIKE, BETWEEN, =, <>, <, >, <=, =>, +, =, *, /, IS NULL, IS NOT NULL**

JMS Selector Examples

```
// Select messages with a header named symbol whose value is APPL
String selector = "symbol = ‘APPL’";

// Create a consumer that only receives messages about Apple Computer stock
MessageConsumer consumer =
        session.createConsumer(someDestination, selector);
```

```
// Select messages with a header named symbol whose value is APPL
// and with a header named price that is greater than the previous price
String selector = "symbol = ‘APPL’ AND price > " + getPreviousPrice();

// Create a consumer that only receives messages about Apple Computer stock
// that has increased in price
MessageConsumer consumer =
        session.createConsumer(someDestination, selector);
```

JMS Selectors

- Very powerful, but like a sharp knife
- Applied to every message on a destination
  - Can cause unnecessary overhead

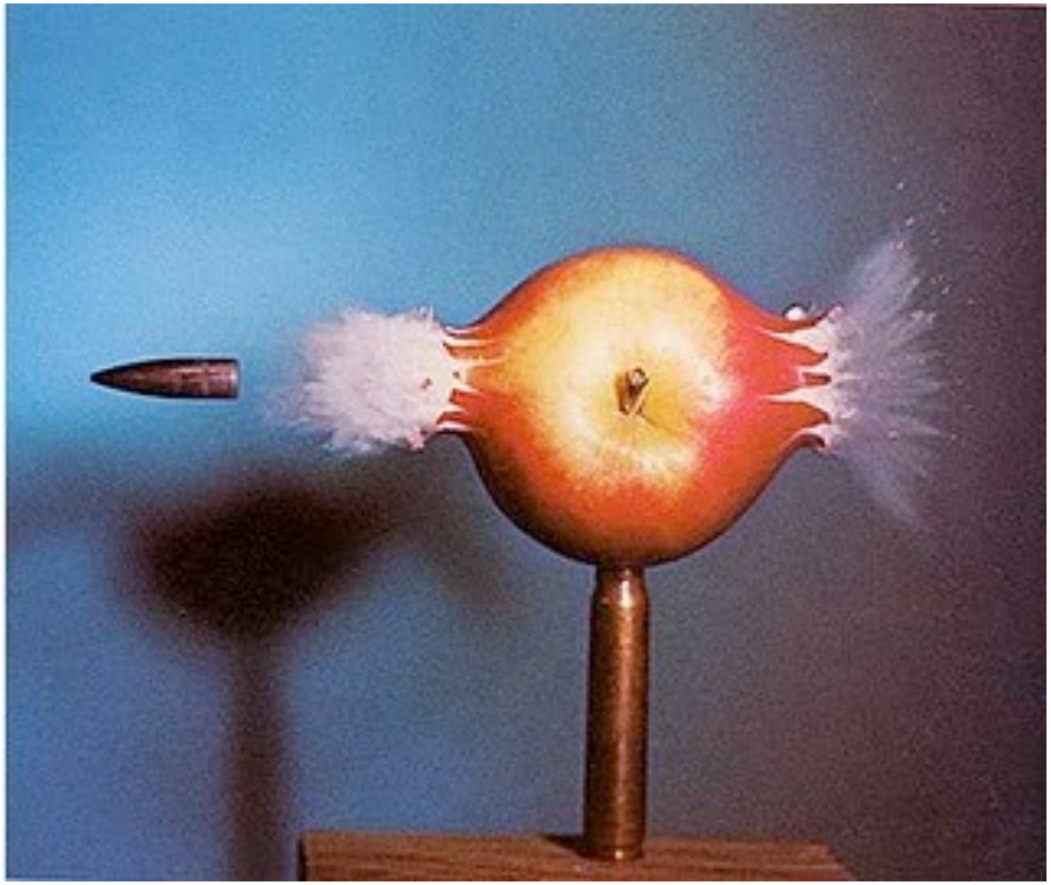
Correct Application Design

- ActiveMQ is for sending and receiving events
- ActiveMQ is NOT a message store

- Phase one, consume the messages
  - Lightweight processing
- Phase two, conduct further processing
  - Heavyweight processing

- I.e., a proper service-oriented architecture

Why is ActiveMQ is locking up or freezing?



Why is ActiveMQ is locking up or freezing?

- JVM memory
- Broker memory
- Prefetch limit
- Producer flow control
- Message cursors

JVM Memory

- ActiveMQ start script
  - As of 5.4.x JVM is given 256mb of memory (min and max)

- You may need to increase this!

Broker Memory

- ActiveMQ controls how much memory it can use
- Will not automatically use all the JVM memory
- Configurable but commented out by default

Broker Memory Example

```
<broker brokerName="myBroker” ...>
...
 <systemUsage>
  <systemUsage>
   <memoryUsage>
    <memoryUsage limit="64 mb” />
   </memoryUsage>
   <storeUsage>
    <storeUsage limit="100 gb" />
   </storeUsage>
   <tempUsage>
    <tempUsage limit="10 gb" />
   </tempUsage>
  </systemUsage>
 </systemUsage>
...
</broker>
```

Prefetch Limit

- Prevents a consumer from being flooded with messages
- Applied on a per client basis

- Incorrect prefetch limit + slow consumer =
  messages remain in a queue unconsumed

- Results in some consumers being starved of messages

- NOTE: Be careful with connection pools

Prefetch Limit Example

```
...
 <bean id="connectionFactory"
      class="org.apache.activemq.ActiveMQConnectionFactory"
      p:brokerURL="tcp://localhost:61616"
      p:prefetchPolicy-ref="prefetchPolicy"/>

 <bean id="prefetchPolicy"
      class="org.apache.activemq.ActiveMQPrefetchPolicy"
      p:queuePrefetch="1" />
...
```

Producer Flow Control

- Prevents producer from flooding broker
- If memory exceeds limit, a producer will be paused

- NOTE: This setting is enabled by default

Broker Memory Example

```
<broker brokerName="myBroker” ...>
...
<destinationPolicy>
  <policyMap>
    <policyEntries>
      <policyEntry topic=">" producerFlowControl="true"
        memoryLimit="10mb">
        <pendingSubscriberPolicy>
          <vmCursor />
        </pendingSubscriberPolicy>
      </policyEntry>
      <policyEntry queue=">" producerFlowControl="true"
        memoryLimit="10mb">
      </policyEntry>
    </policyEntries>
  </policyMap>
</destinationPolicy>
...
</broker>
```

Message Cursors

- Only so many messages can be held in memory
- Message cursors provide a configurable message paging

- Two types of cursors
  - VM cursors
    - Holds only message reference in memory
  - File cursors
    - Flushes both message and reference to disk

- http://activemq.apache.org/how-do-i-configure-activemq-to-hold-100s-of-millions-of-queue-messages-.html

Broker Memory Example

```
<broker brokerName="myBroker" ...>
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<destinationPolicy>
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      <policyEntry topic=">" producerFlowControl="true"
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        memoryLimit="10mb">
       <pendingQueuePolicy>
          <fileQueueCursor />
        </pendingQueuePolicy>
      </policyEntry>
    </policyEntries>
  </policyMap>
</destinationPolicy>
...
</broker>
```
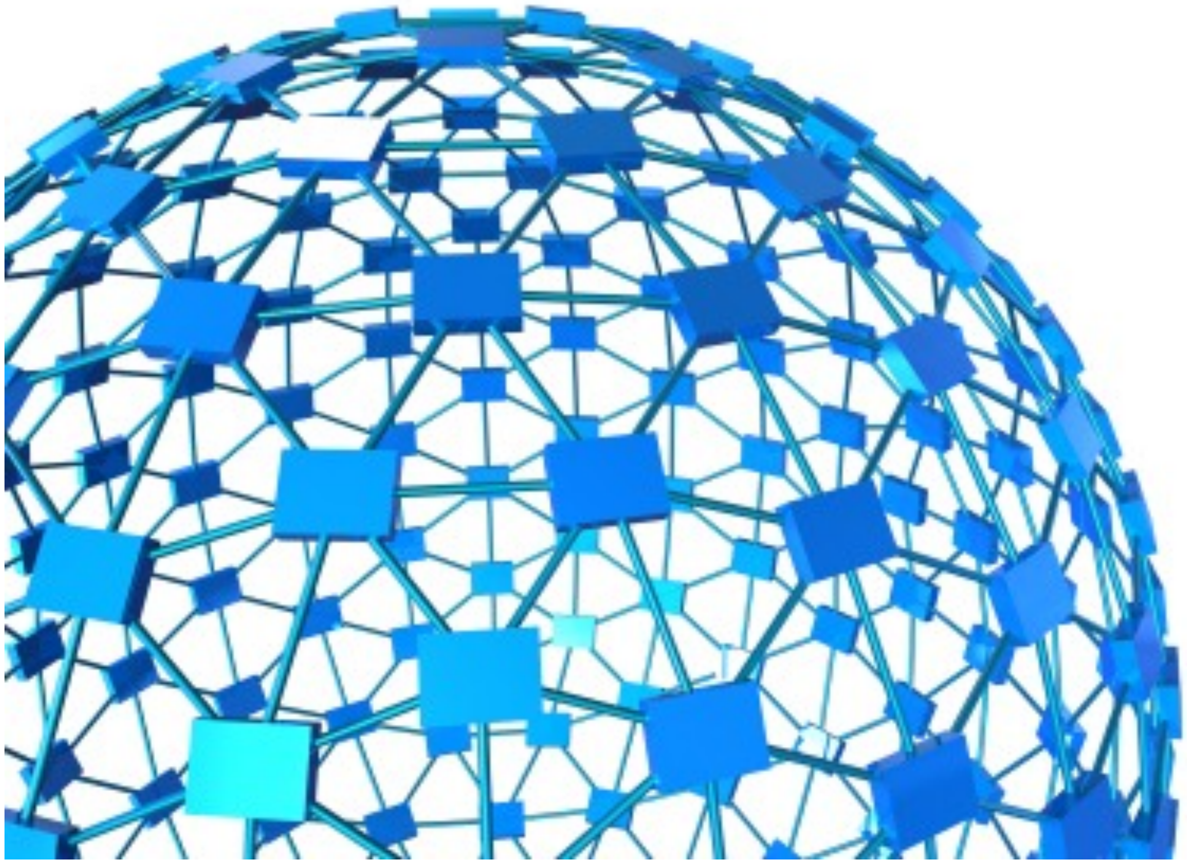
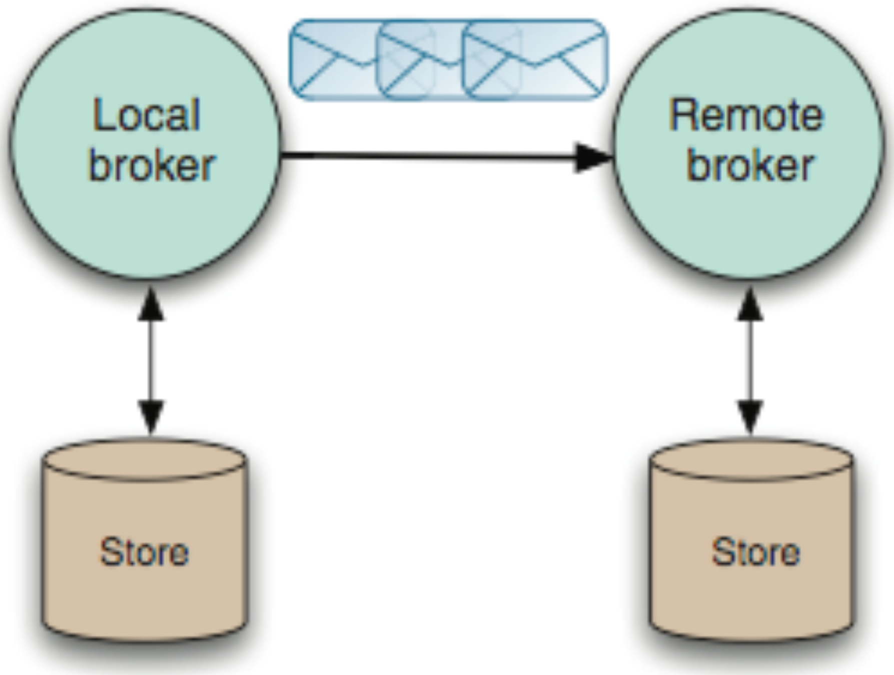

Do I need a network of brokers?



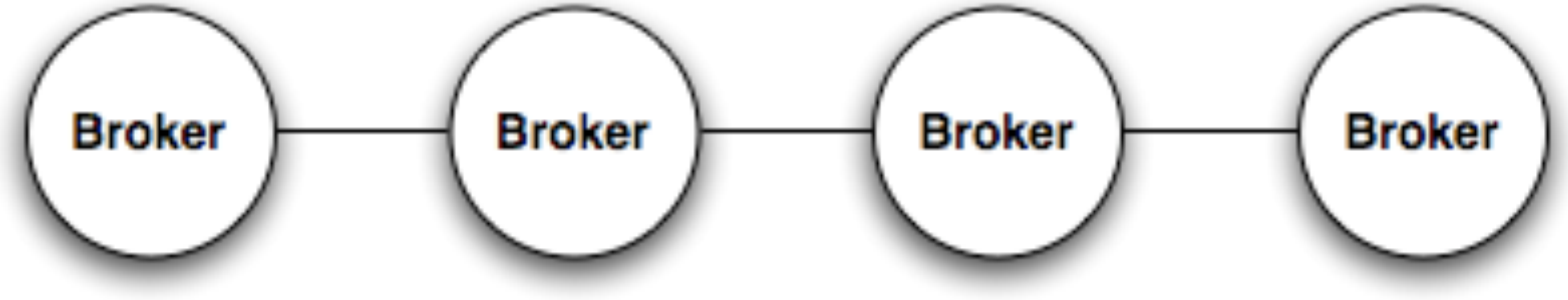
Do I need a network of brokers?

- What is a network of brokers?
  - Clustered ActiveMQ instances
- How are they clustered?
  - They pass messages between broker instances
  - Send a message to one broker, consume the message from a different broker
- Where might this be useful?
  - Situations where a centralized broker is not suitable
- How does this work?
  - Using store and forward

Store and Forward



Topology Example



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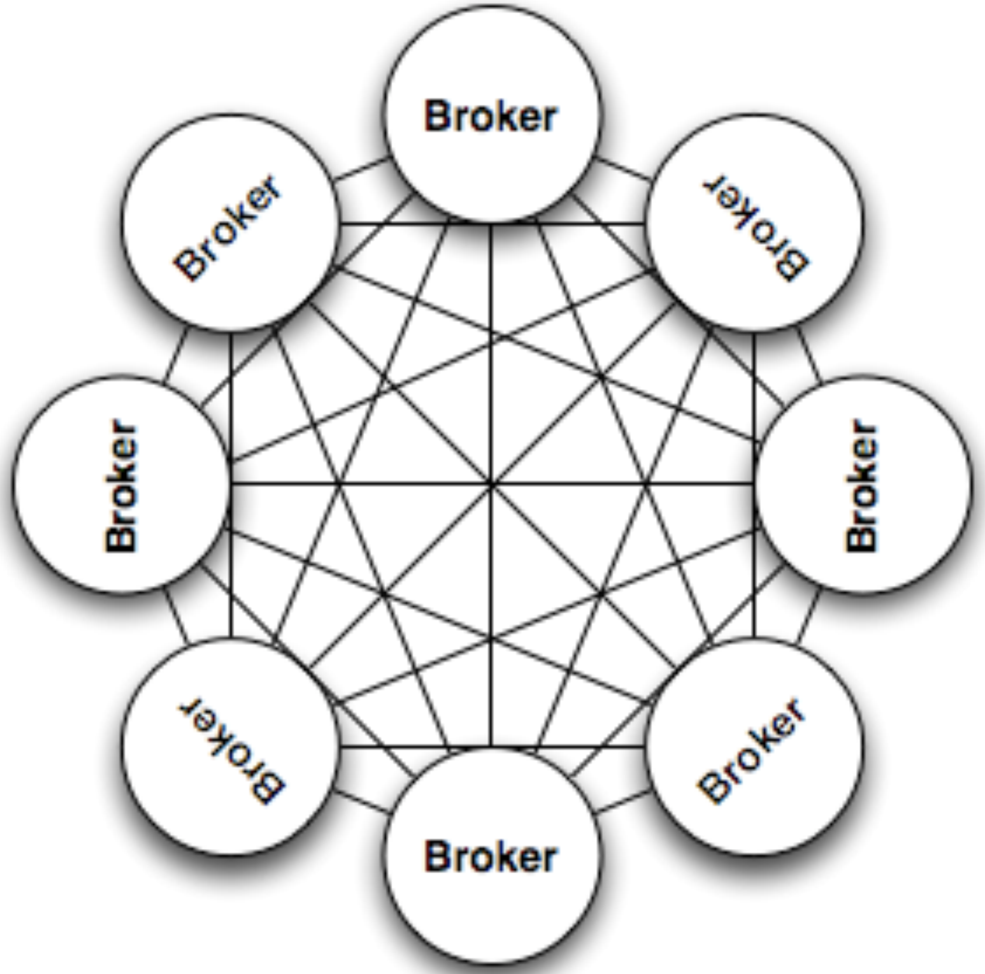

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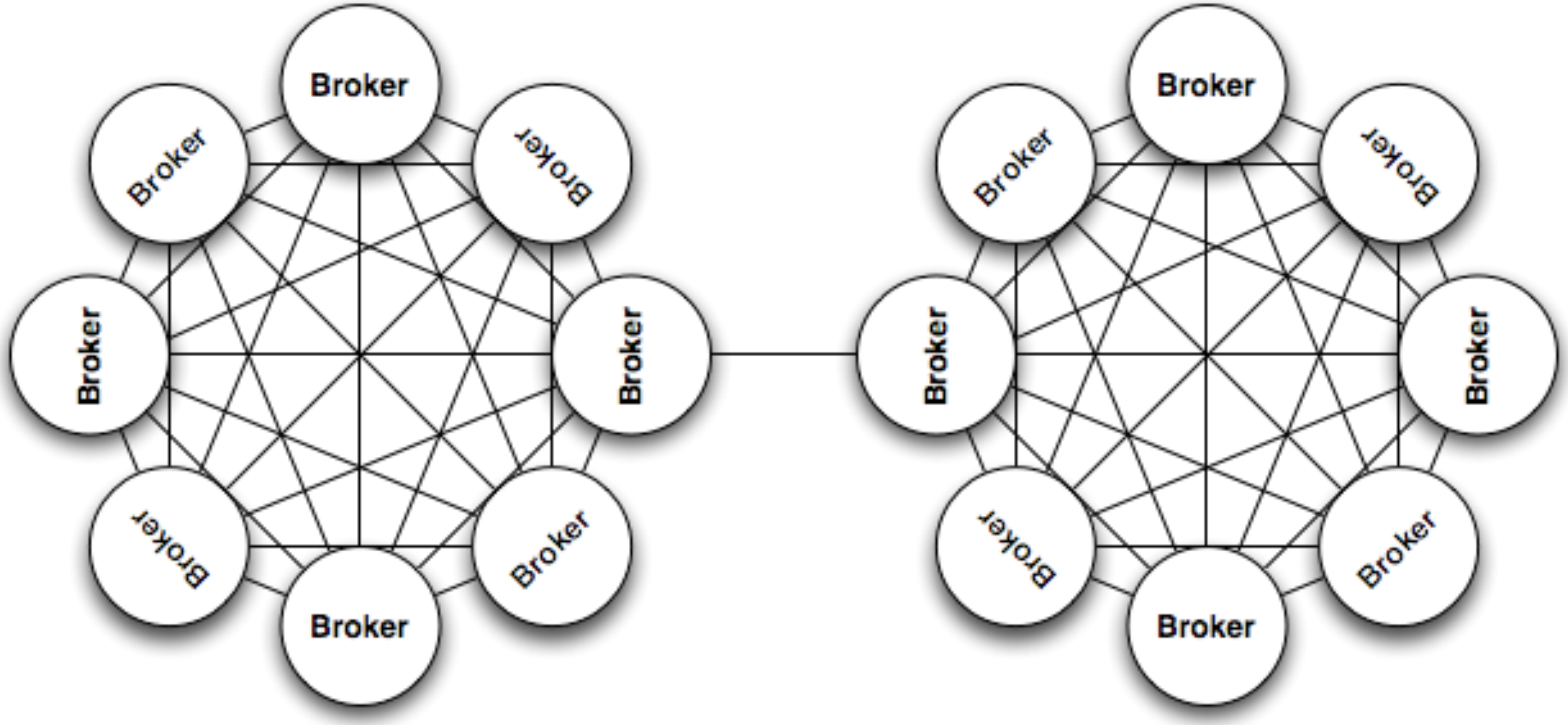

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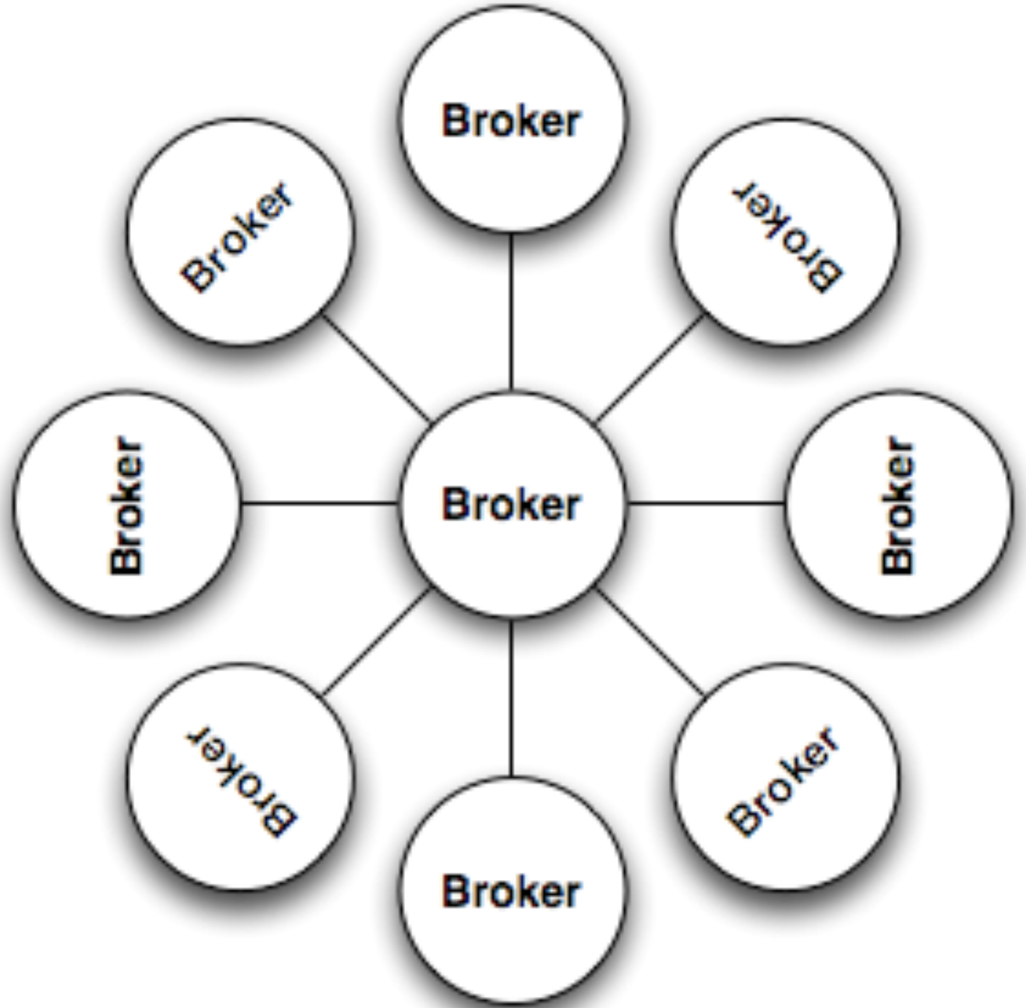

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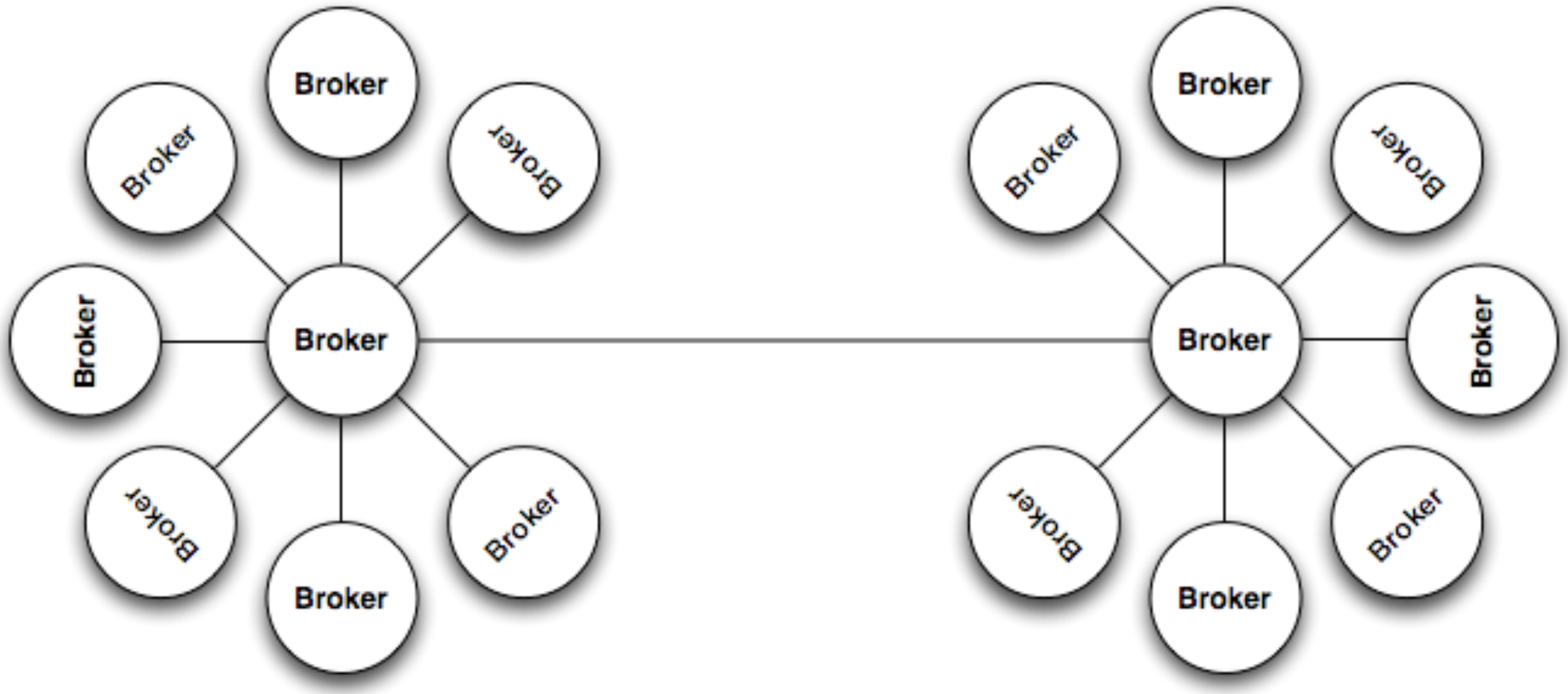

Should I use a master/slave config?

Should I use a master/slave config?

- What is a master/slave configuration?
  - It helps to provide high availability for ActiveMQ
- What does that mean?
  - ActiveMQ brokers are configured for warm failover
  - If one broker fails or becomes unreachable, another one takes over
- Where might this be useful?
  - In situations that need highly available message brokers
- How does this work?
  –

Types of Master/Slave

- Shared nothing master/slave
- Shared storage master/slave
  - Shared database
  - Shared file system

Shared Nothing Master/Slave

- Sometimes called pure master/slave
- Uses a fully replicated data store
  - Does not depend on database or file system
- Slave broker consumes all message states from the Master broker (messages, acks, tx states)
- Slave does not start any networking or transport connectors
- Master broker will only respond to client when a message exchange has been successfully passed to the slave broker

Shared Nothing Master/Slave

- If the master fails, the slave optionally has two modes of operation:
  1. Start up all it's network and transport connectors
     - All clients connected to failed Master resume on Slave
  2. Close down completely
     - Slave is simply used to duplicate state from Master

- Clients should use failover transport:

```
failover://(tcp://masterhost:61616, tcp://slavehost:61616)?randomize=false
```

Shared Database Master/Slave

- Uses tables in a relational database to store data
- No restriction on the number of brokers
- Simple configuration (JDBC URL)
- Clustered database mitigates single point of failure
- One master selected at random

- Clients should use failover transport:

```
failover://(tcp://masterhost:61616, tcp://slavehost:61616)?randomize=false
```

Shared File System Master/Slave

- Utilizes a directory on a shared file system to store data
- No restriction on number of brokers
- Simple configuration (point to the data dir)
- Shared file system mitigates single point of failure
- One master selected at random

- Clients should use failover transport:

```
failover://(tcp://masterhost:61616, tcp://slavehost:61616)?randomize=false
```

Thank You!

Q&A