Messaging for web and mobile with Apache ActiveMQ

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Bosanac Dejan?

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Agenda

- Challenges of web messaging
- REST vs Stomp
- Mobile messaging using MQTT
- In-browser messaging (Ajax vs Web Sockets)
- Striking the balance

Messaging For Web

Messaging for Web

- Connect from any web application backend (Ruby, PHP, Python, …)
- Connect directly from the browser (AJAX, Web Sockets)
- The main requirement is **simplicity**

What’s wrong with HTTP?

- Nothing at all!
- Ideal for simple request-reply communication
- Lacks semantics for publish-subscribe and point-to-point communication

Limitations

- Pull based protocol
- Easy simple producing
- There’s no concept of consumer or subscription
- There’s no concept of transactions

Pull Consuming

- HTTP techniques
  - Long polling
  - Comet
- Maintain a state
  - Session
  - ClientID

Push Consuming

- Web Hooks – http://webhooks.org
- Provide a callback (HTTP URL) to be called on event
- Trigger callback on every message

Camel HTTP component

```
<camelContext id="camel" xmlns="http://camel.apache.org/schema/
spring”>
    <route>
        <from uri="activemq:topic:events"/>
        <to uri="http://mysite.com/events"/>
    </route>
</camelContext>
```

- HawtIO – http://hawt.io
- Missing API for dynamically managing subscribers

STOMP

Stomp – what it is?

- http://stomp.github.com
- **S**imple **T**ext **O**rientated **M**essaging **P**rotocol
- HTTP for the messaging realm

Stomp – basics

- Very simple, so it’s easy to write clients and servers in practically any language
- A lot of client APIs in C, Java, Ruby, Pyhton, JS, PHP
- Implemented by ActiveMQ, Apollo, HornetQ, RabbitMQ

Stomp - Protocol

- Text based headers, similar to HTTP
- Can transport binary bodies
- Frame command for every messaging concept, like CONNECT, MESSAGE, SUBSCRIBE, ACK, etc.

```
MESSAGE
subscription:0
message-id:007
destination:/queue/a
content-type:text/plain

hello queue a^@
```

Stomp + ActiveMQ

- Available transports

```
<transportConnectors>
  <transportConnector name=”stomp" uri=”stomp://0.0.0.0:61613"/>
  <transportConnector name=”stomp+nio" uri=”stomp+nio://0.0.0.0:61614"/>
  <transportConnector name=”stomp+ssl" uri=”stomp+ssl://0.0.0.0:61615"/>
  <transportConnector name=”stomp+nio+ssl"
                     uri=”stomp+nio+ssl://0.0.0.0:61615"/>
</transportConnectors>
```

- NIO implementation for better scalability
- SSL for secure communication

Stomp Java Client

- StompJMS - https://github.com/fusesource/stompjms
- APIs:
  - JMS
  - Blocking
  - Future
  - Callback

```
Stomp stomp = new Stomp("localhost", 61613);
Future<FutureConnection> future = stomp.connectFuture();
FutureConnection connection = future.await();
```

```
CONNECT
host:localhost
accept-version:1.1

CONNECTED
heart-beat:0,0
session:ID:vidra.local-56933-1369046267671-2:1
server:ActiveMQ/5.9-SNAPSHOT
version:1.1
```

```
StompFrame frame = new StompFrame(SEND);
frame.addHeader(DESTINATION, StompFrame.encodeHeader("/queue/test"));
frame.addHeader(MESSAGE_ID, StompFrame.encodeHeader("test"));
frame.content(new Buffer("Important Message".getBytes("UTF-8")));
Future<Void> sendFuture = connection.send(frame);

sendFuture.await();
```

```
SEND
message-id:test
destination:/queue/test
content-length:17

Important Message
```

```
StompFrame disconnect = new StompFrame(DISCONNECT);
Future<Void> disconnectFuture = connection.send(disconnect);
disconnectFuture.await();
```

```
DISCONNECT
```

```
Stomp stomp = new Stomp("localhost", 61613);
Future<FutureConnection> future = stomp.connectFuture();
FutureConnection connection = future.await();
```

```
CONNECT
host:localhost
accept-version:1.1

CONNECTED
heart-beat:0,0
session:ID:vidra.local-56933-1369046267671-2:1
server:ActiveMQ/5.9-SNAPSHOT
version:1.1
```

```
Future<StompFrame> receiveFuture = connection.receive();

StompFrame frame = new StompFrame(SUBSCRIBE);
frame.addHeader(DESTINATION, StompFrame.encodeHeader("/queue/test"));

AsciiBuffer id = connection.nextId();
frame.addHeader(ID, id);
Future<StompFrame> response = connection.request(frame);
response.await();
```

```
SUBSCRIBE
receipt:2
destination:/queue/test
id:1
```

```
RECEIPT
receipt-id:2
```

```
StompFrame received = receiveFuture.await();
System.out.println(received.content());
```

```
MESSAGE
message-id:ID:vidra.local-56933-1369046267671-2:1:-1:1:1
destination:/queue/test
timestamp:1369046474700
expires:0
subscription:1
content-length:17
priority:4

Important Message
```

```
StompFrame unsubscribe = new StompFrame(UNSUBSCRIBE);
unsubscribe.addHeader(ID, id);
Future<Void> unsubscribeFuture = connection.send(unsubscribe);
unsubscribeFuture.await();
```

```
UNSUBSCRIBE
id:1
```

```
StompFrame disconnect = new StompFrame(DISCONNECT);
Future<Void> disconnectFuture = connection.send(disconnect);
disconnectFuture.await();
```

```
DISCONNECT
```

Advanced Stomp

- Ack modes
- Transactions
- Reliable messaging
- Protocol Negotiations
- Heart-beating

Stomp and ActiveMQ

- Queues and Topics
- Reliable Messaging
- Temporary destinations
- Durable topic subscribers
- Destination wildcards
- Message selectors

Stomp and ActiveMQ

- Message expiration
- Composite destinations
- Priority consumers
- Exclusive consumers

Messaging For Mobile
MQTT

Messaging for Mobile

- Different set of requirements
- Low bandwidth network
- Small footprint
- Low power usage

MQTT

- http://mqtt.org/ - **MQ T**elemetry **T**ransport
- IoT (Internet of Things) protocol
- Efficient binary protocol
- Developed by IBM for embedded devices telemetry

MQTT Features

- Low bandwidth
  - Smallest frame 2 bytes
- Unreliable networks
- Small footprint

MQTT for mobile

- Efficient battery usage - Power Profiliing: MQTT on Android - http://stephendnicholas.com/archives/219
- **Ideal for native mobile applications**
- Usecase: Facebook messanger
  - Phone-to-phone delivery in milliseconds, rather than seconds
  - Without killing battery life

MQTT

- Publish/subscribe protocol – topics only
- 3 QoS Options:
  - At Most Once – message loss might occur
  - At Least Once – duplicates might occur
  - Exactly Once – guaranteed delivery

MQTT + ActiveMQ

- Available transports

```
<transportConnectors>
  <transportConnector name=”mqtt"     uri=”mqtt://0.0.0.0:1883"/>
  <transportConnector name=”mqtt+nio" uri=”mqtt+nio://0.0.0.0:1884"/>
  <transportConnector name=”mqtt+ssl" uri=”mqtt+ssl://0.0.0.0:1885"/>
  <transportConnector name=”mqtt+nio+ssl"
                     uri=”mqtt+nio+ssl://0.0.0.0:1886"/>
</transportConnectors>
```

- NIO implementation for better scalability
- SSL for secure communication

MQTT client

- mqtt-client
  - https://github.com/fusesource/mqtt-client
- APIs:
  - Blocking
  - Callback
  - Future

MQTT Example

```
MQTT mqtt = new MQTT();
mqtt.setHost("localhost", 1883);
final CallbackConnection connection = mqtt.callbackConnection();
```

MQTT Example

```
connection.connect(new Callback<Void>() {

    public void onSuccess(Void value) {
        connection.publish("test",
            "Important Message!".getBytes(),
            QoS.AT_LEAST_ONCE,
            false,
            null
        );
    }

    public void onFailure(Throwable value) {
        connection.disconnect(null);
    }
});
```

MQTT Example

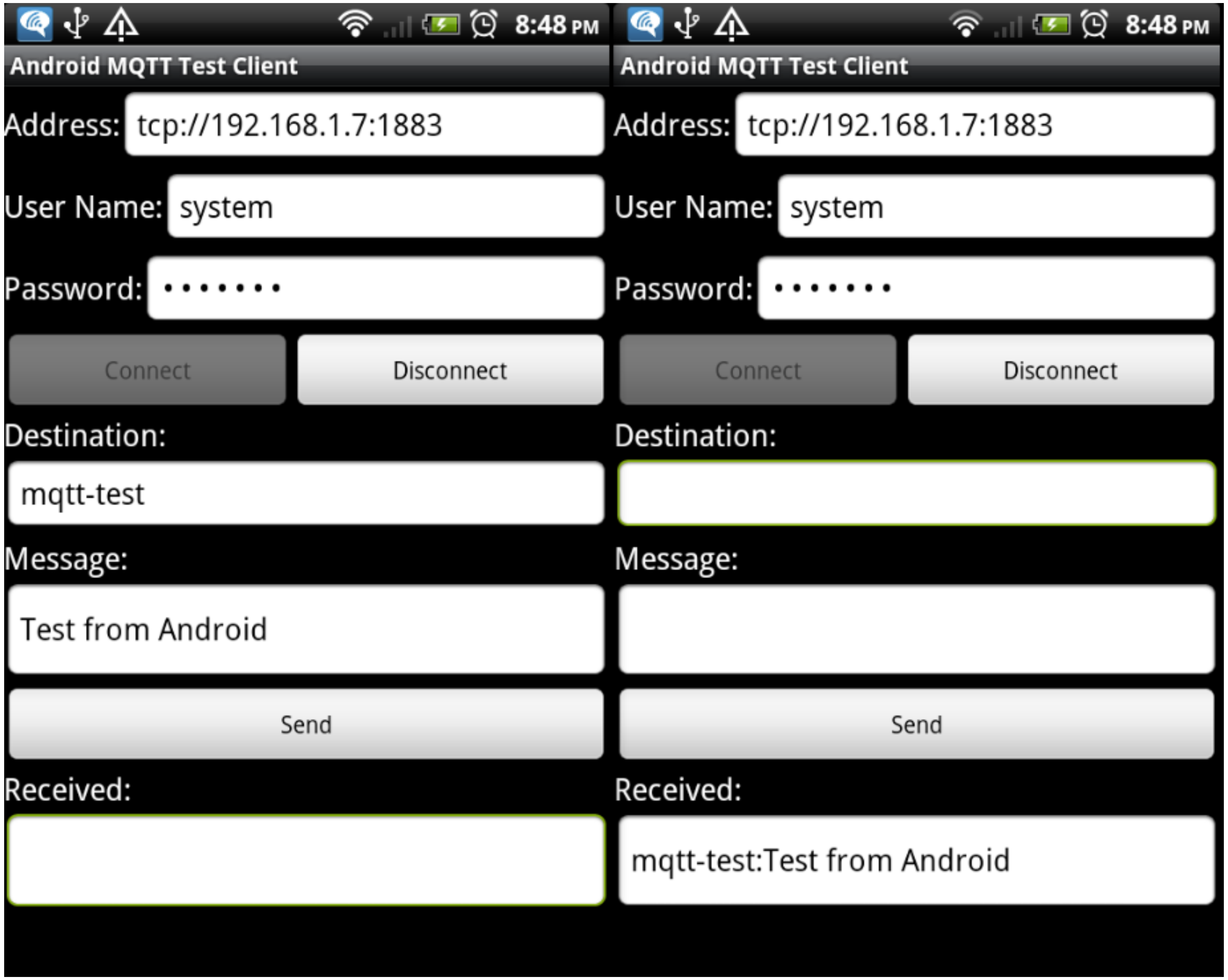
```
final Promise<Buffer> result = new Promise<Buffer>();

connection.listener(new Listener() {

    public void onConnected() {}

    public void onDisconnected() {}

    public void onPublish(UTF8Buffer topic, Buffer body,
                          Runnable ack) {
        result.onSuccess(body);
        ack.run();
    }

    public void onFailure(Throwable value) {
        result.onFailure(value);
        connection.disconnect(null);
    }
});

LOG.info("Received: " + result.await(5, TimeUnit.MINUTES));
```

MQTT Example

```
connection.connect(new Callback<Void>() {

    public void onSuccess(Void aVoid) {

        Topic[] topics = {
            new Topic(utf8("test"), QoS.AT_LEAST_ONCE)
        };
        connection.subscribe(topics, null);
    }

    public void onFailure(Throwable value) {
        connection.disconnect(null);
    }
});
```

MQTT Android Example

https://github.com/jsherman1/android-mqtt-demo/



Android MQTT Test Client

Address: tcp://192.168.1.7:1883

User Name: system

Password: ••••••••

Destination: mqtt-test

Message: Test from Android

Received:

Android MQTT Test Client

Address: tcp://192.168.1.7:1883

User Name: system

Password: ••••••••

Destination:

Message:

Received: mqtt-test:Test from Android

In-Browser Messaging

In-browser Messaging

- Use JavaScript to produce and consume messages directly from the browser
- We need to leverage existing web technologies like Ajax and Web Sockets
- We need a web server that’s able to communicate with the broker

Ajax

- Old-school way
- Comes bundled with ActiveMQ distribution

Ajax – explained

- Requires additional servlet as an intermediary between broker and clients
- POST to send messages
- Jetty continuations to receive messages

Ajax – Example

```
<script type="text/javascript" src="js/jquery-1.4.2.min.js"></
script>
<script type="text/javascript" src="js/amq_jquery_adapter.js"></
script>
<script type="text/javascript" src="js/amq.js"></script>
<script type="text/javascript">
  var amq = org.activemq.Amq;
  amq.init({
    uri: 'amq',
    logging: true,
    timeout: 20
  });
</script>
```

Ajax – Example

```
amq.sendMessage(”queue://TEST”, “Important Message!”);
```

```
var myHandler =
{
  rcvMessage: function(message)
  {
     console.log(“Received message: ” + message);
  }
};

amq.addListener(“myListener”, “queue://TEST”, myHandler.rcvMessage);
```

WebSocket

- Evolution over Ajax and Comet
- Defines a “socket” – permanent duplex connection – between browser and server
- Server and browser can exchange messages

WebSocket

- Fully standardized and part of HTML5 spec
  - Protocol – standardized by IETF
  - API – standardized by W3C
- Supported by most modern web servers and browsers

WebSocket Example

```
var connection = new WebSocket("ws://localhost:8161");

connection.onopen = function() {
      console.log("Connection opened!");
};

connection.onmessage = function(msg) {
      console.log("Received Message: " + msg.data);
};

connection.onerror = function(error) {
      console.log("Error occured: " + error);
}

connection.onclose = function(evt) {
      console.log("Connection closed!");
};

connection.send("Important Message!");
connection.close();
```

WebSocket + ActiveMQ

- WebSocket is a plain socket – like a raw TCP
- We need a protocol on top of it to use all concepts of messaging and connect to broker
- **WebSocket+Stomp ideal for standard web clients!**
- **WebSocket+MQTT ideal for mobile web clients!**

WebSocket + ActiveMQ

- New **ws** and **wss** transports

```
<transportConnectors>
  <transportConnector name="websocket" uri="ws://0.0.0.0:61613"/>
  <transportConnector name="secure_websocket" uri="wss://0.0.0.0:61614"/>
</transportConnectors>
```

- wss transport needs SSL context configuration

WebSocket + ActiveMQ

- Stomp supported since 5.4.0
- MQTT supported since 5.9.0
- You can use both over the same connector
- Connector detects the protocol when connection is initialized

stomp-websocket

- Client side library stomp-websocket
  - http://github.com/jmesnil/stomp-websocket
- Supports Stomp 1.1
- Not a “pure” Stomp as it requires WebSocket handshake

stomp-websocket Example

```
var client = Stomp.client("ws://localhost:61614");
var connected = false;
client.connect("admin", "admin", function() {
      connected = true;
      client.subscribe("/queue/test", function(message) {
            console.log("Received message " + message);
      }
});

if (connected) {
      client.send("/queue/test", {priority: 9}, "Important Message!");
}

if (connected) {
      client.disconnect();
}
```

MQTT WebSocket client

- Eclipse Paho JavaScript Client
  - http://www.eclipse.org/paho/
- Demo available at
  - http://localhost:8161/demo/mqtt

MQTT Websocket Example

```
var client = new Messaging.Client("localhost", "61614", "myClient");
var connected = false;

client.onConnect = function() {
      connected = true;
      client.subscribe("test");
}

client.onMessageArrived = function(message) {
      console.log("Received message " + message);
}

client.connect();

if (connected) {
      var message = new Messaging.Message("Important Message!");
      message.destination = "test";
      client.send(message);
}

if (connected) {
      client.disconnect();
}
```

Striking The Balance

Striking the Balance

- Lots of possibilities, how to choose right?
- Native mobile apps should consider MQTT
- Do you need live updates in your browser?
- WebSockets ideal for HTML5 apps with limited number of users that needs instant update
- For everyone else, there's backend messaging

Stomp pitfall

- Short-lived connections
- Every page view, open a new connection to the broker
- Puts heavy load on the broker
- Eliminates all advance messaging mechanisms – message prefetches, producer flow control, etc.

Stomp configuration

```
<destinationPolicy>
  <policyMap>
    <policyEntries>
      <policyEntry queue=">" producerFlowControl="false">
      </policyEntry>
    </policyEntries>
  </policyMap>
</destinationPolicy>


<transportConnectors>
  <transportConnector name="stomp+nio"
          uri="stomp+nio://0.0.0.0:61613?
transport.closeAsync=false"/>
</transportConnectors>
```

Conclusion

- Messaging is not the thing of the enterprise anymore
- Things want to get integrated
- We have technology to do that **TODAY**!

AMA

- Links
  - Stomp
    - http://stomp.github.com
    - https://github.com/fusesource/stompjms
  - MQTT
    - http://mqtt.org
    - https://github.com/fusesource/mqtt-client
- Blog: http://sensatic.net
- Twitter: http://twitter.com/dejanb