Comet Web Applications

How to Scale Server-Side Event-Driven Scenarios

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About me

- Simone Bordet (sbordet@webtide.com)
- Senior Java Engineer at Webtide
  - Previously freelance, SimulaLabs, Hewlett-Packard
- Active in OpenSource and Java Communities
  - Jetty, Cometd, MX4J, Foxtrot, Livetribe, etc.
  - Co-Leader of Java User Group Torino, Italy
- Currently working on:
  - Comet server-side and client-side applications
    - Clients for browsers, J2ME and Android
  - Server-side asynchronous IO and protocols

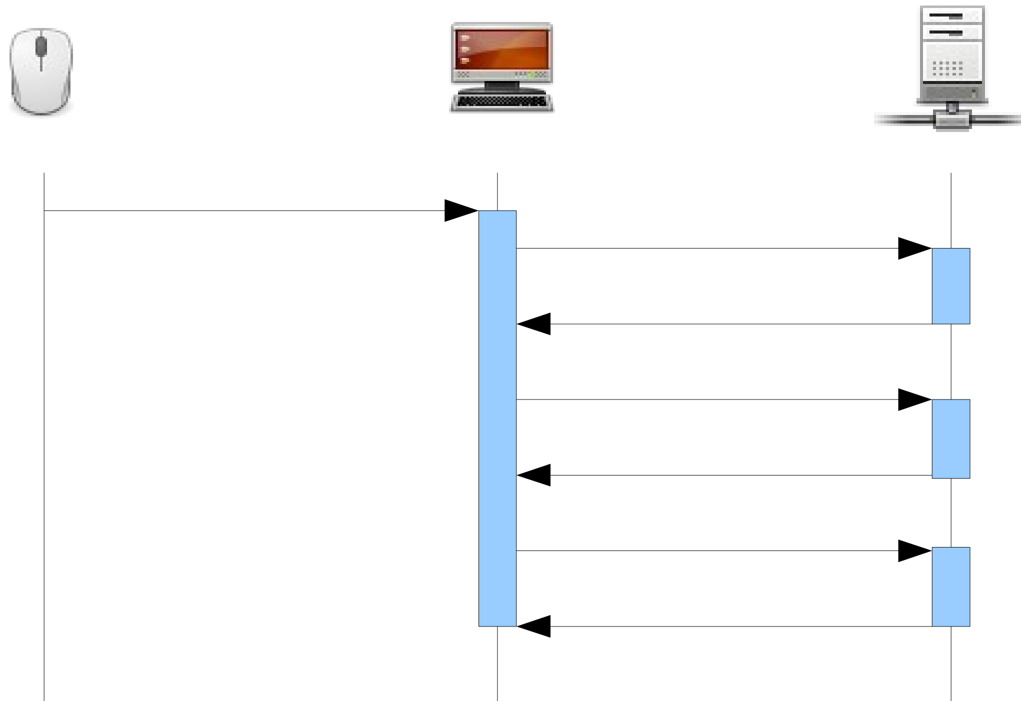
Agenda

- What are Comet web applications
- Impacts of Comet web applications
- The CometD project
- Demo
- Questions & Answers

What are Comet Web Applications

Web Apps History

Web Classic Interaction

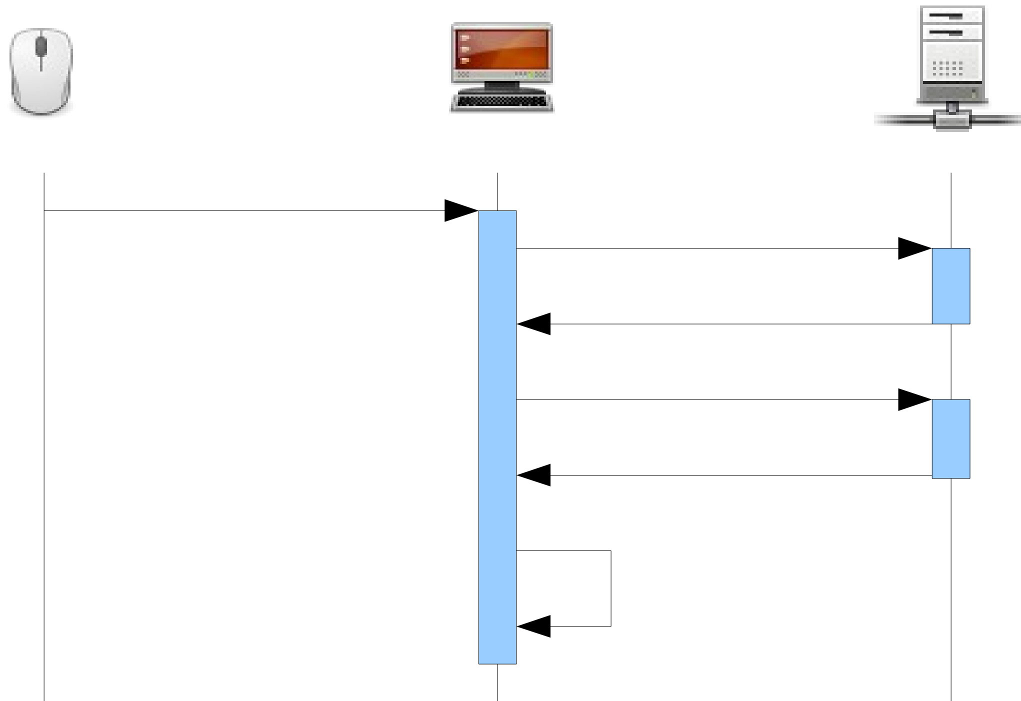


Web Apps History

- Web Classic Interaction
- Request Pattern
  - Bursts of requests for HTML, images, CSS, JS
- Navigation Mode
  - Full page based
- Interaction with Server
  - Reactive, changes happen on user click
  - Resources download

Web Apps History

- Web Dynamic HTML Interaction

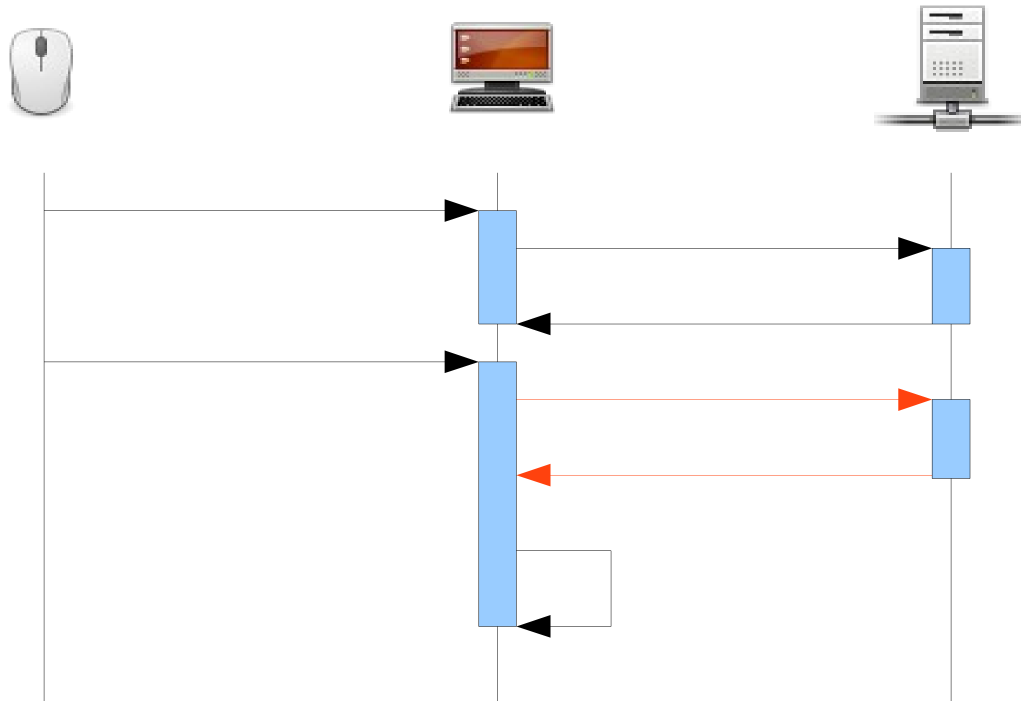


Web Apps History

- Web Dynamic HTML Interaction
- Request Pattern, Navigation Mode, Interaction with Server
  - Same as before
- Uses JavaScript
  - Input validation
  - DOM manipulation
  - Local UI effects

Web Apps History

- Web Classic + XMLHttpRequest



Web Apps History

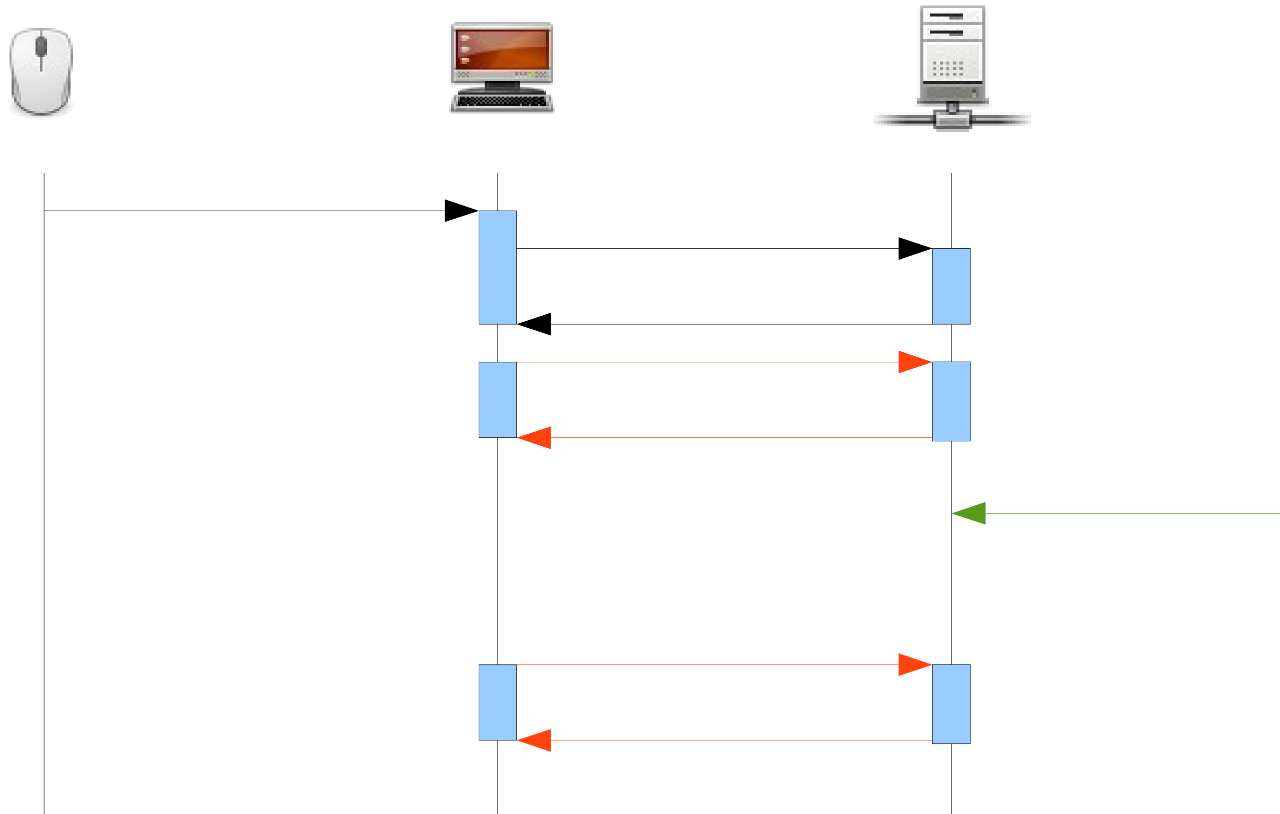
- Web Classic + XHR
- Request Pattern: changed
  - Bursts (for classic) + Concurrent (for XHR)
  - Requires synchronization in server code
- Navigation Mode: radically changed
  - Sometimes full page, most often single page with partial changes
- Interaction with Server: changed
  - Reactive as before
  - Data download

Server-side Events

- Heavy usage of client-side JavaScript and XHR changed the way we create and develop webapps
  - They become **rich**, and raise expectations
- Traditionally, web experience was driven by the client
  - Can webapps now be also driven by server-side events ?

Server-side Events

- Server-side Event-driven **Polling** Web Application

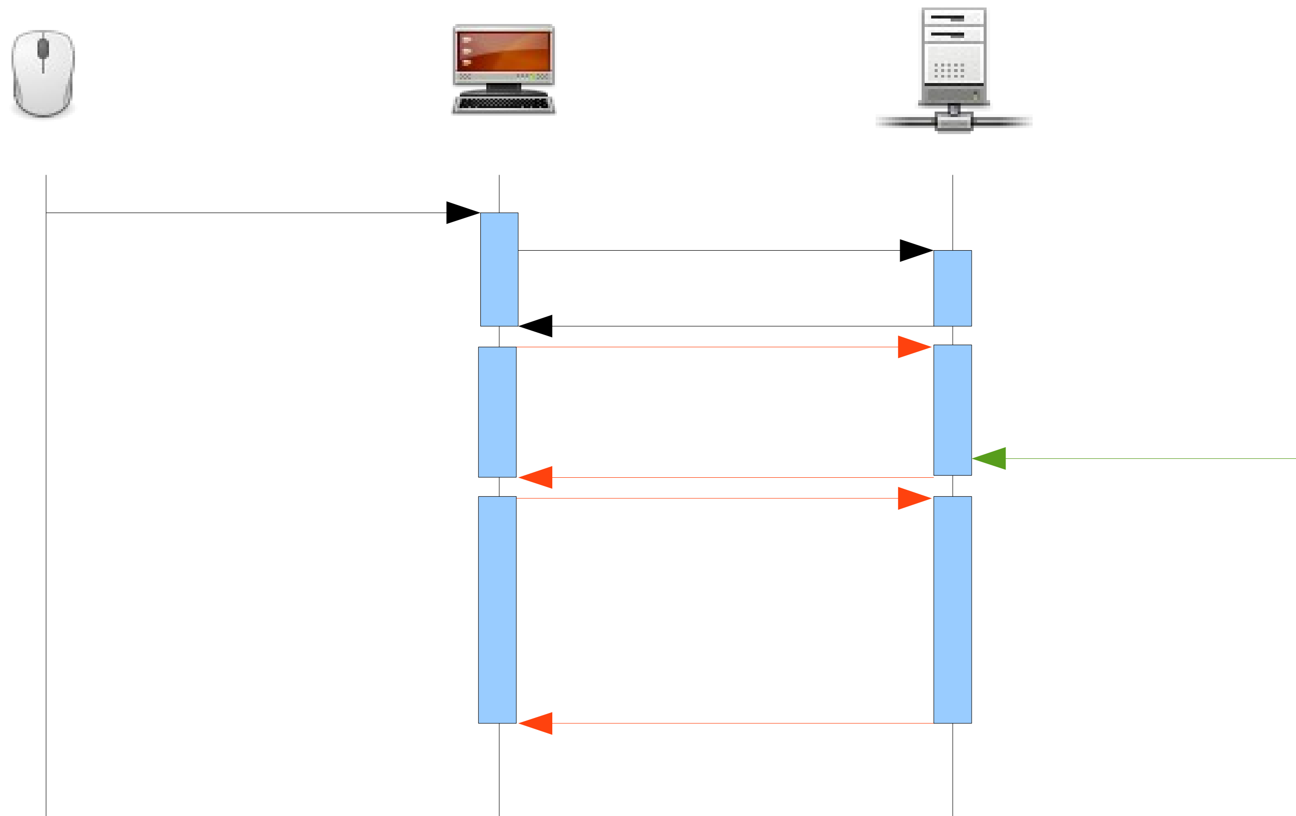


Server-side Events

- Polling Strategy for Server-side Events Notification
  - Simple to implement (“I can do that !”)
  - Sensible latency for event notifications
- Can look like a denial of service attack to the poor server
  - When poll interval is short to reduce event latency
  - When the number of clients is large
- We can do better !

Server-side Events

- Server-side Event-driven **Comet** Web Application



Server-side Events

- Comet Strategy for Server-side Events Notification
  - Difficult to implement right
  - Minimal latency for event notification
- One request (the “long poll”) is held by the server until:
  - A server-side events arrives
  - A timeout expires
  - The client disconnects

Impacts on the Server

Polling vs Comet

- What are the impacts of the polling and comet models on servers ?

- Polling
  - 1000 clients, each polling every 5 seconds
  - Assume 100 ms poll processing time
  - Yields 200 requests/s, 20 concurrent requests
  - 20 threads x 1 MB stack size = 20 MB
- Limits
  - Most likely, the server is CPU bound, then connection bound

Polling vs Comet

- Comet (Classic)
  - 1000 clients, long poll timeout 20 seconds
  - Yields 1000 concurrent requests !
  - 1000 x 1 MB stack size = 1 GB
- Limits
  - Most likely, the server is memory bound
  - Note that stack memory is outside Java heap

Polling vs Comet

- Comet has huge impacts on server-side
- You cannot just deploy your comet application in a normal configuration
- You cannot deploy your comet application behind Apache Httpd
  - Does not scale for the same reasons
- You need a new generation of servers

Jetty

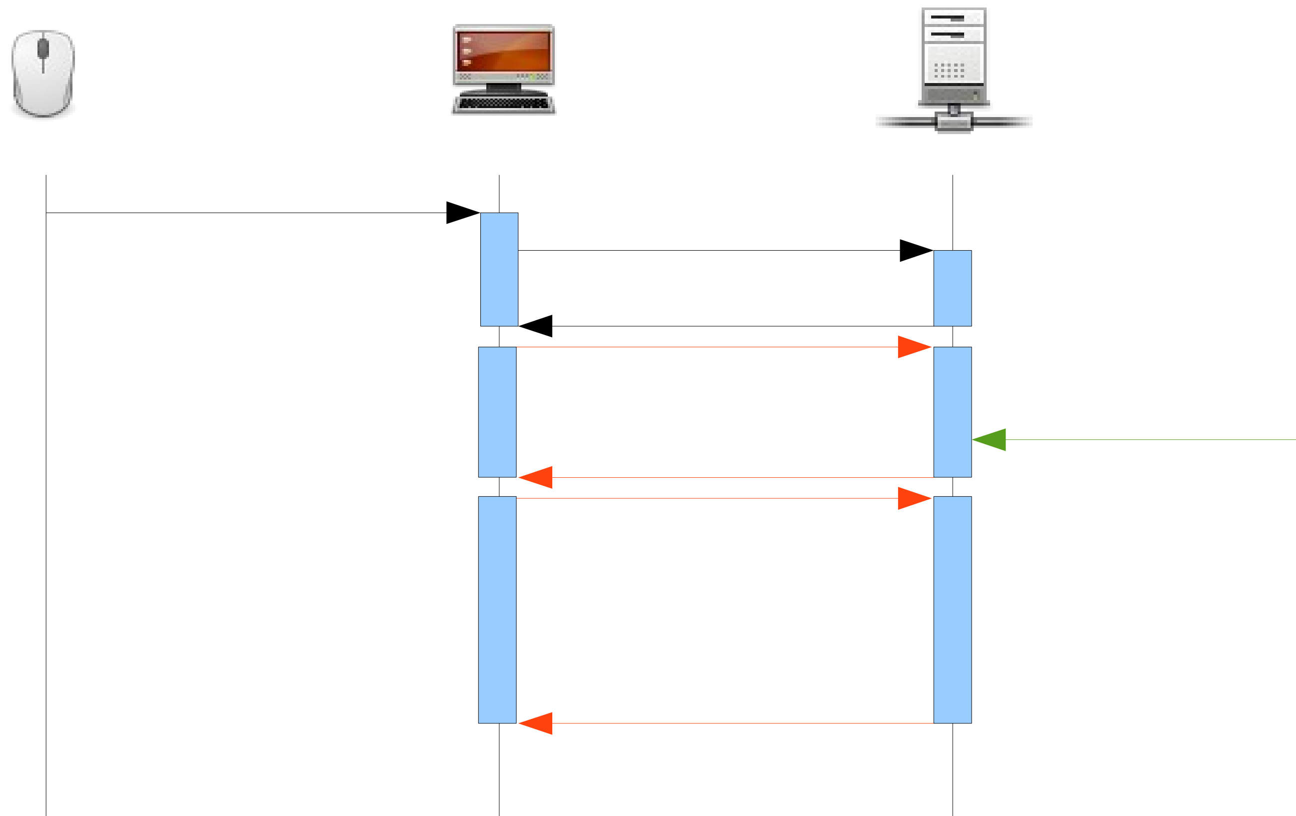
- Greg Wilkins was the first to explore these problems
- He created the **Jetty Continuations** which allow the Jetty server to scale Comet applications

- The continuation concept has been incorporated in the new Servlet 3.0 specification

- Jetty 6 and Jetty 7 successfully deployed Comet applications worldwide
- Jetty 8 will implement Servlet 3.0

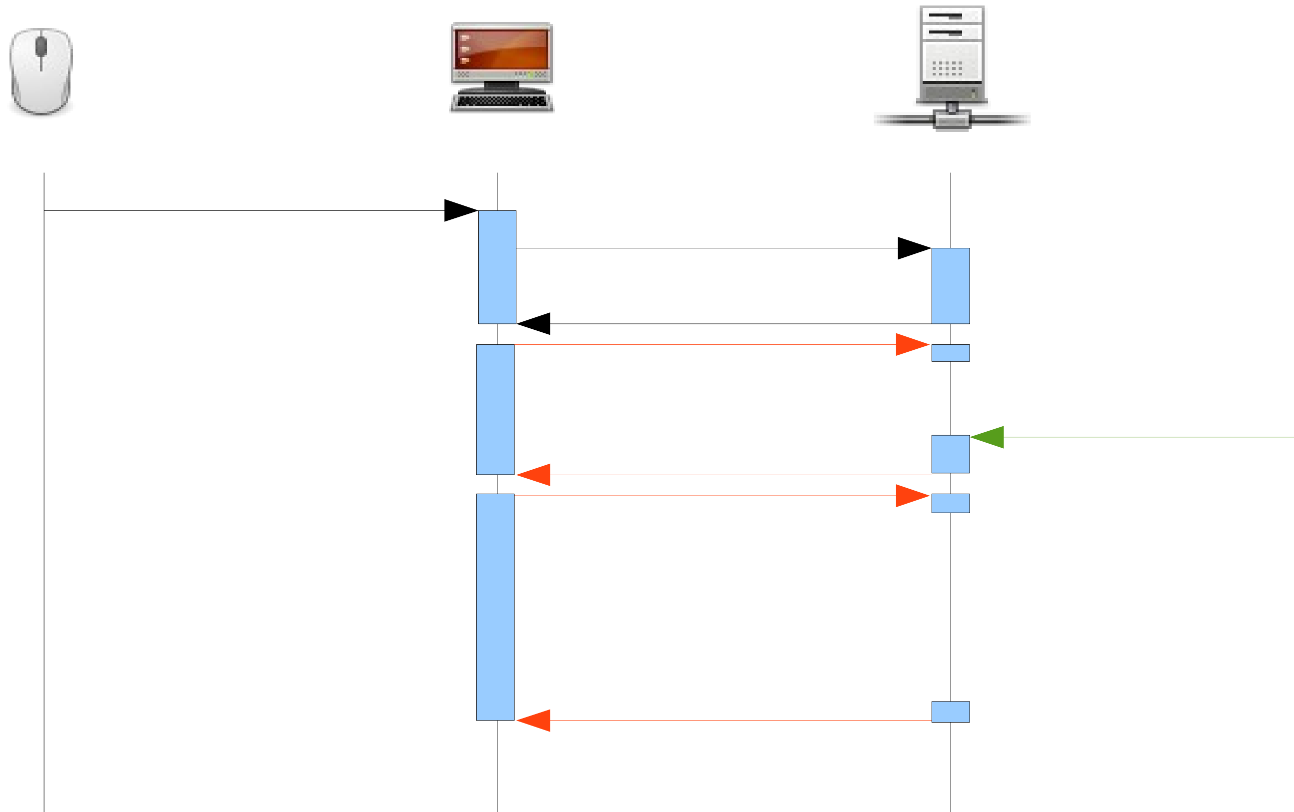
Comet Classic

- Server-side Event-driven **Comet** Web Application



Comet Continuation

- Server-side Event-driven **Comet** Web Application



Polling vs Comet

- Comet (Continuations)
  - 1000 clients, long poll timeout 20 seconds
  - Assume 160 ms processing time
    - Request is run twice
  - Yields 50 requests/s, 8 concurrent requests
  - 8 x 1 MB stack size = 8 MB

- Limits
  - Most likely, the server is connection bound, then CPU bound
  - Scales better than normal polling

Continuations

- With Comet, we have an asynchronous bidirectional web
  - Looks like messaging to me
- Writing server-side code based on continuations (or, in the future, with Servlet 3.0) is **difficult**
  - It really is, you don't want to do it
- Web applications should be easy to write
  - Can we abstract the gory details into a library ?

The CometD Project

The CometD Project

- We have now a scalable bidirectional web
- What do we need to write applications ?
- We don't want to care about long-polling the server, respecting possible constraints
  - In browsers, the same-origin policy and the two connection limit
- We want:
  - A clean way to publish data to the server
  - A clean way to receive data from the server
  - A clean way to “emit” server-side events to clients

The CometD Project

- There are a lot of other details to take care of
  - Authentication
  - Network Failures
    - With possible automatic retry
  - Message Batching
  - Message Acknowledgment
  - Etc.

- From these and other requirements and input, the CometD project was born

The CometD Project

- The CometD project delivers libraries that use the Comet technique (long poll) to transport **Bayeux messages**
- The Bayeux protocol specifies the format of the Bayeux messages
  - It is based on JSON
- Libraries are available in
  - JavaScript (client)
  - Java (client and server)
  - Perl & Python (less active)

Bayeux

- Bayeux is at its core a publish/subscribe messaging system
  - Very similar to JMS
- A Bayeux channel is a “topic” you may subscribe interest to
  - And you will be delivered messages published onto
- You can publish messages to a channel
  - The server automatically delivers the messages to all channel subscribers

Bayeux

```
var cometd = $.cometd;  // jQuery style

cometd.init('http://myserver/cometd');

cometd.subscribe('/my/channel', function(message)
{
    var data = message.data;
    // Do something with the data
});

cometd.publish('/my/channel', {
    userId: 1,
    chatText: 'hello!'
});

cometd.disconnect();
```

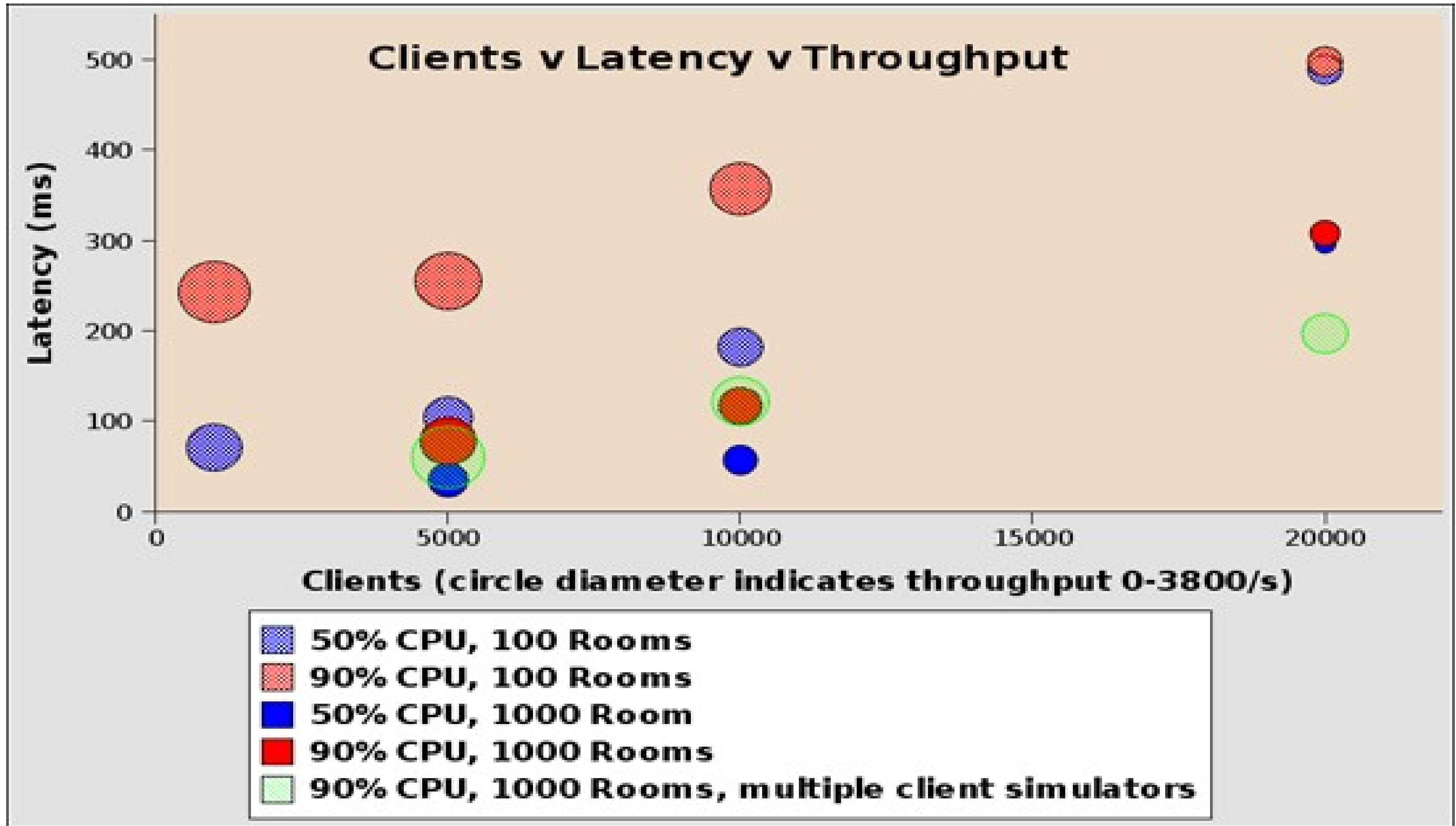
CometD JavaScript

- The JavaScript library features
  - Common code with bindings for Dojo and jQuery
  - Highly configurable
  - Message batching
  - Automatic reconnection
  - Pluggable transports
    - Long Polling and Callback Polling available
  - Supports Cross-Origin servers
  - Extensible
    - Many extensions already available

CometD Java

- The Java library features
  - Highly scalable (the client is based on Jetty asynchronous HTTP Client)
  - Message batching
  - Lazy messages
  - A variety of listeners to be notified of relevant events in client and server
  - Data filters to automatically convert data
  - Extensions
  - SecurityPolicy

Performance



DEMO

Questions & Answers