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Server-Side JavaScript auf der JVM

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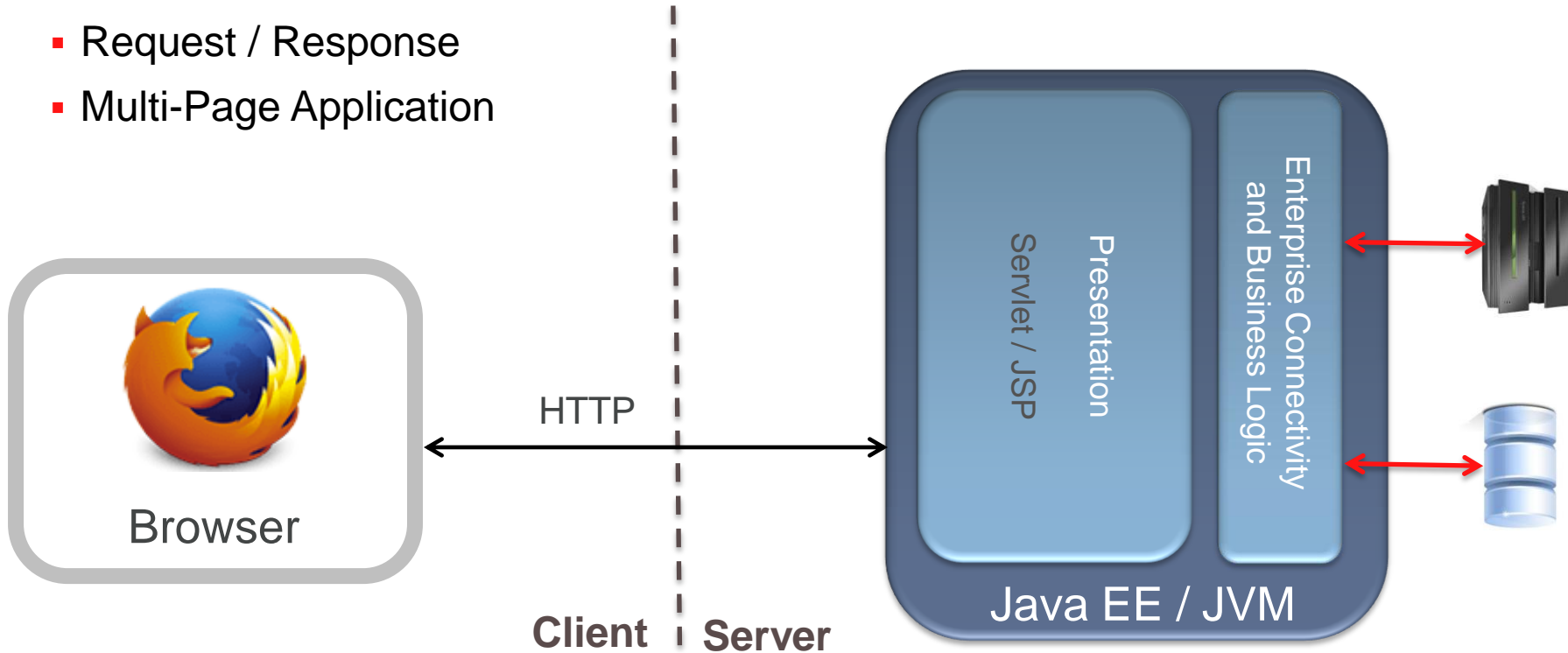
Agenda

- Web Application Architecture
- JavaScript and Node.js on the JVM
- Project Avatar – Advanced JavaScript Services
- Avatar Client Framework
- Summary

Evolution of Web Application Architecture

A Java EE Perspective

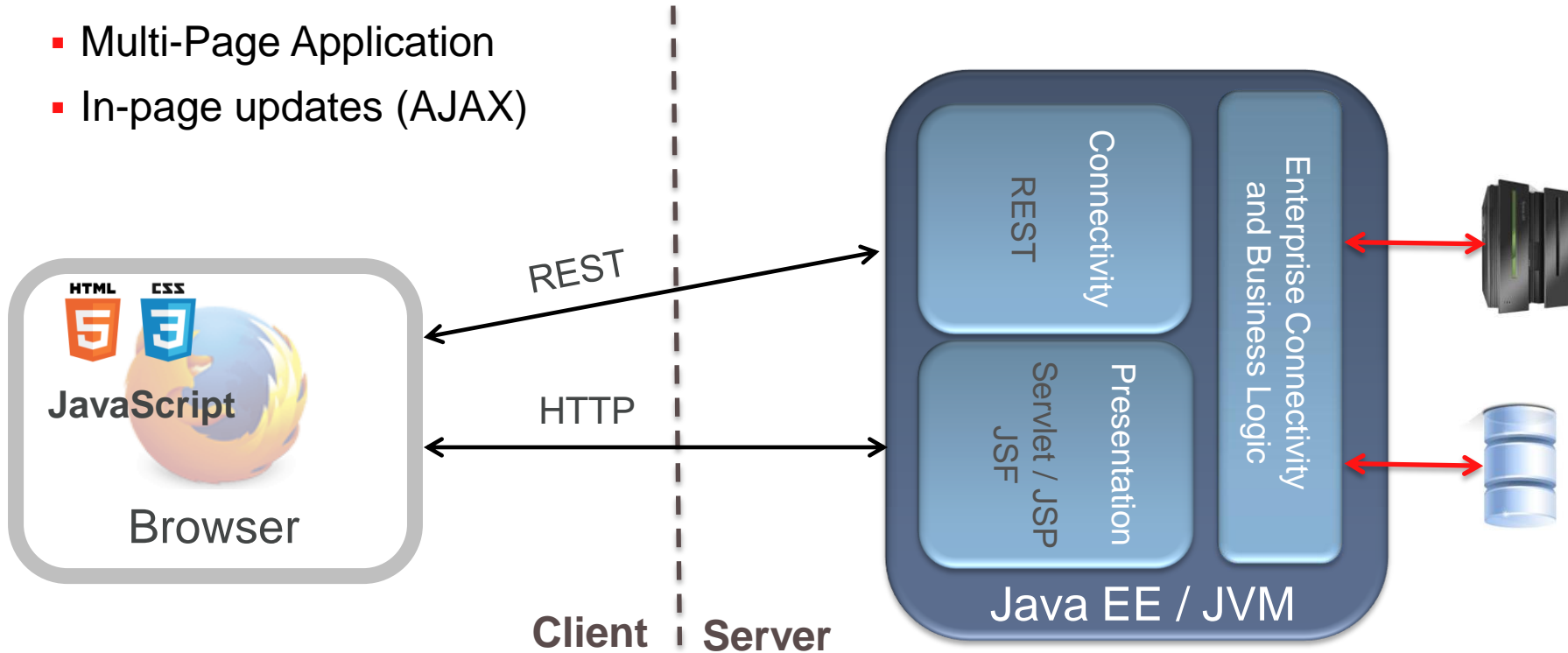
- Request / Response
- Multi-Page Application



Evolution of Web Application Architecture

A Java EE Perspective

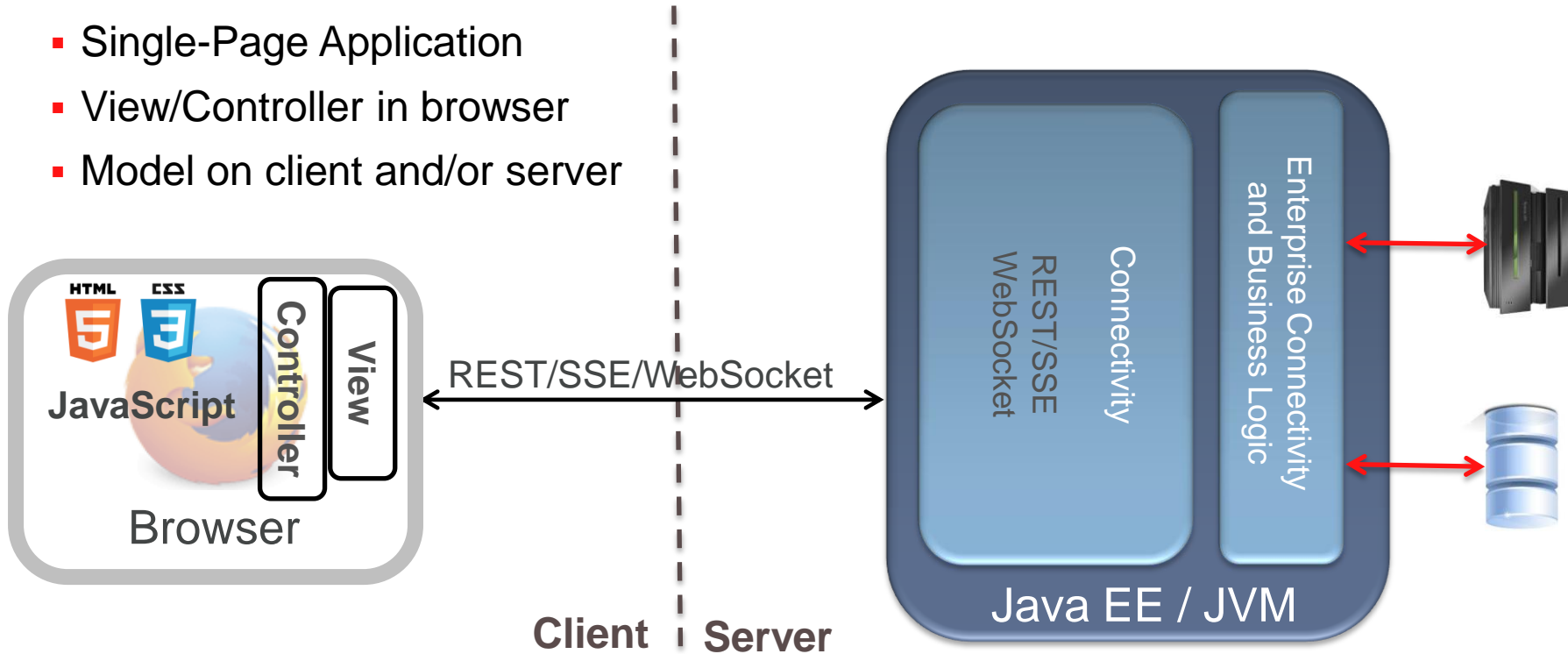
- Multi-Page Application
- In-page updates (AJAX)



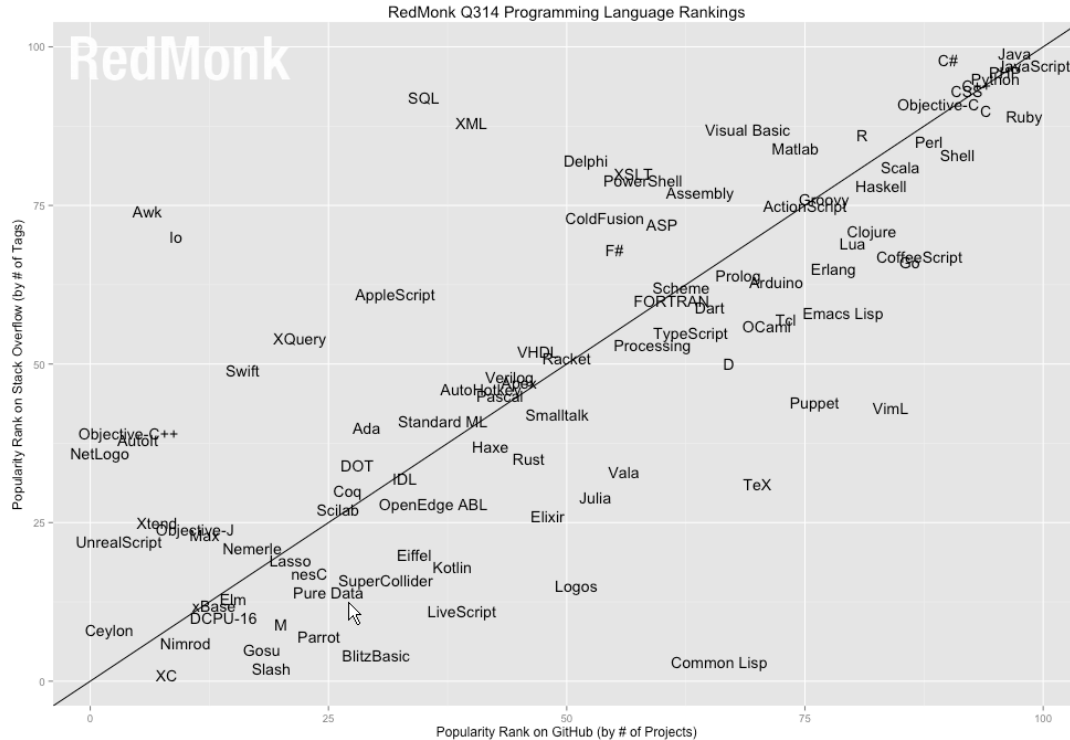
Modern Web Application Architecture

A Java EE Perspective

- Single-Page Application
- View/Controller in browser
- Model on client and/or server



The Rise of JavaScript



<http://redmonk.com/sograzy/2014/06/13/language-rankings-6-14/>

Java EE 7 – The Latest in Enterprise Java



- More annotated POJOs
- Less boilerplate code
- Cohesive integrated platform

- WebSockets
- JSON
- Servlet 3.1 NIO
- REST

- Batch
- Concurrency
- Simplified JMS

Node.js

<http://www.nodejs.org>



- Platform built on Chrome's JavaScript runtime V8 for easily building fast, scalable network applications (Ryan Dahl , 2009)
 - perfect for DIRTy(Data Intensive Real-Time) apps
- Uses event-driven non-blocking I/O model
 - The async programming model is harder to develop to, but it allows scalability and high levels of concurrency
- Melting pot community
 - Java, .NET, Browser, PHP, etc ...
 - Very successful, second-most-watched project on GitHub with 60,000+ modules

Node.js Programming Model

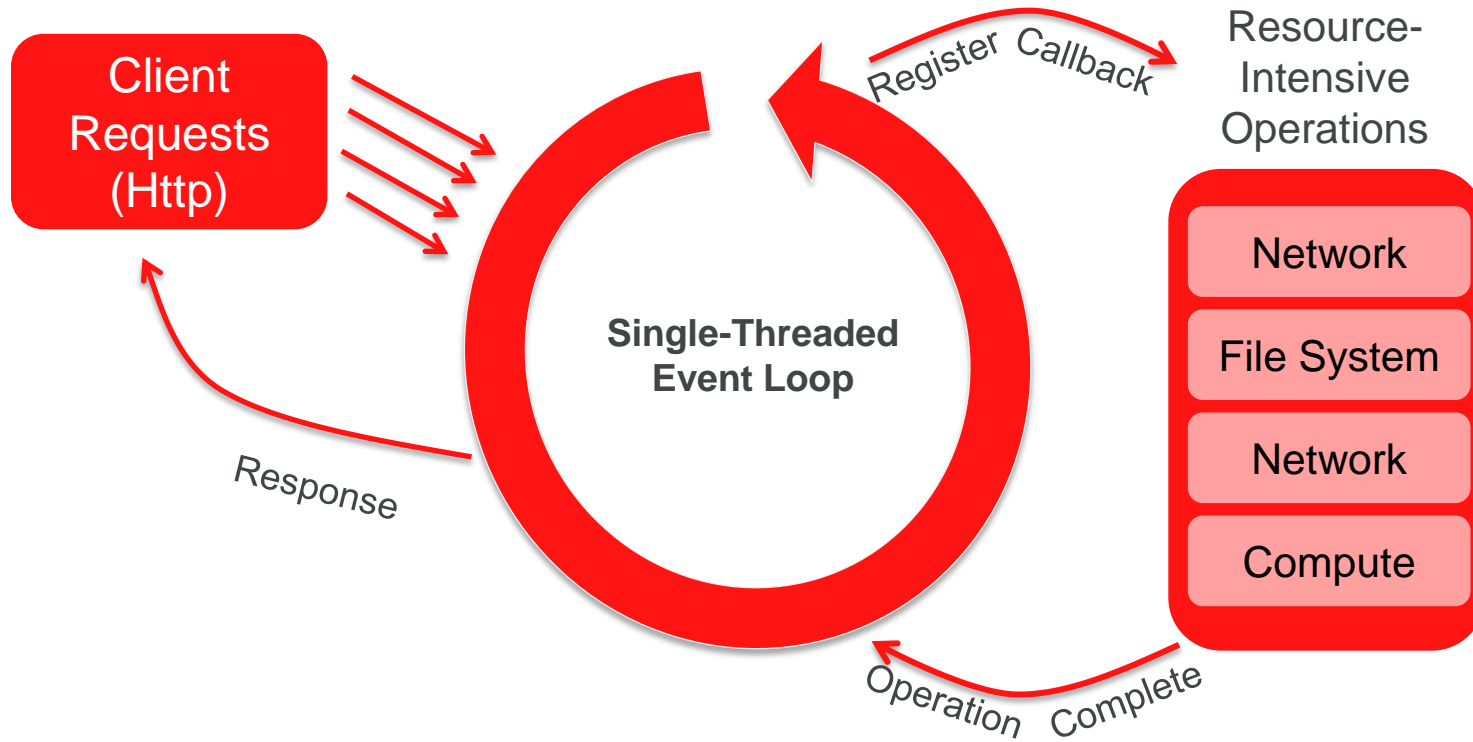
- Multi-threading is hard
 - Thousands of concurrent connections
 - Deal with deadlocks and race conditions
- Blocking on I/O is bad
- Single threaded Event-loop
 - Callback model
 - Non-blocking I/O calls
 - Heavily parallelized

Minimal Web Server Example :

```
var http = require("http");

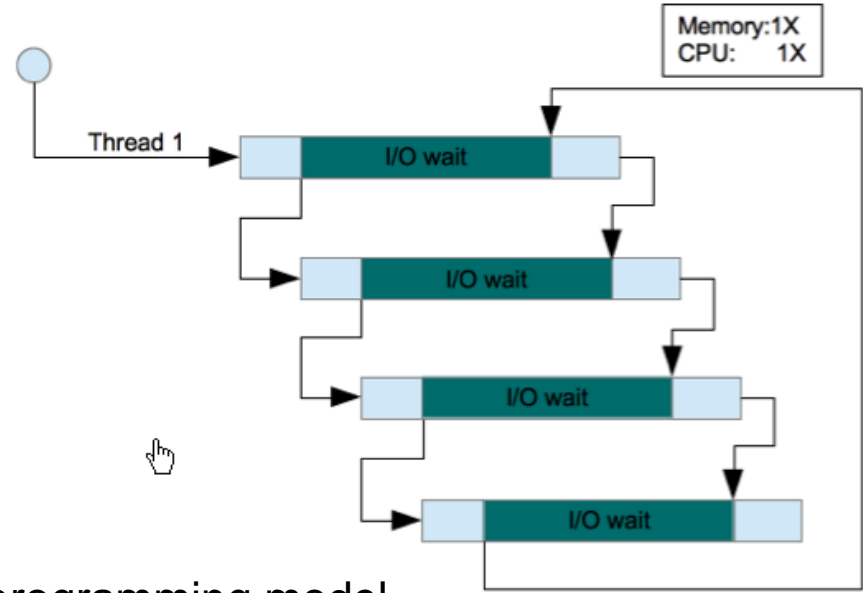
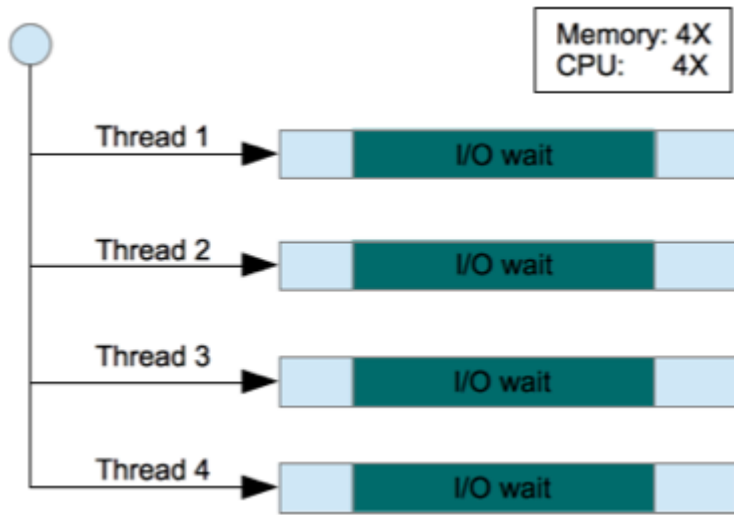
http.createServer(function(request, response) {
  response.writeHead(200, {"Content-Type": "text/plain"});
  response.write("Hello World");
  response.end();
}).listen(8080);
```

Node.js Event Loop



Ressource Utilization: sync vs. async I/O

<http://bijoor.me/2013/06/09/java-ee-threads-vs-node-js-which-is-better-for-concurrent-data-processing-operations/>

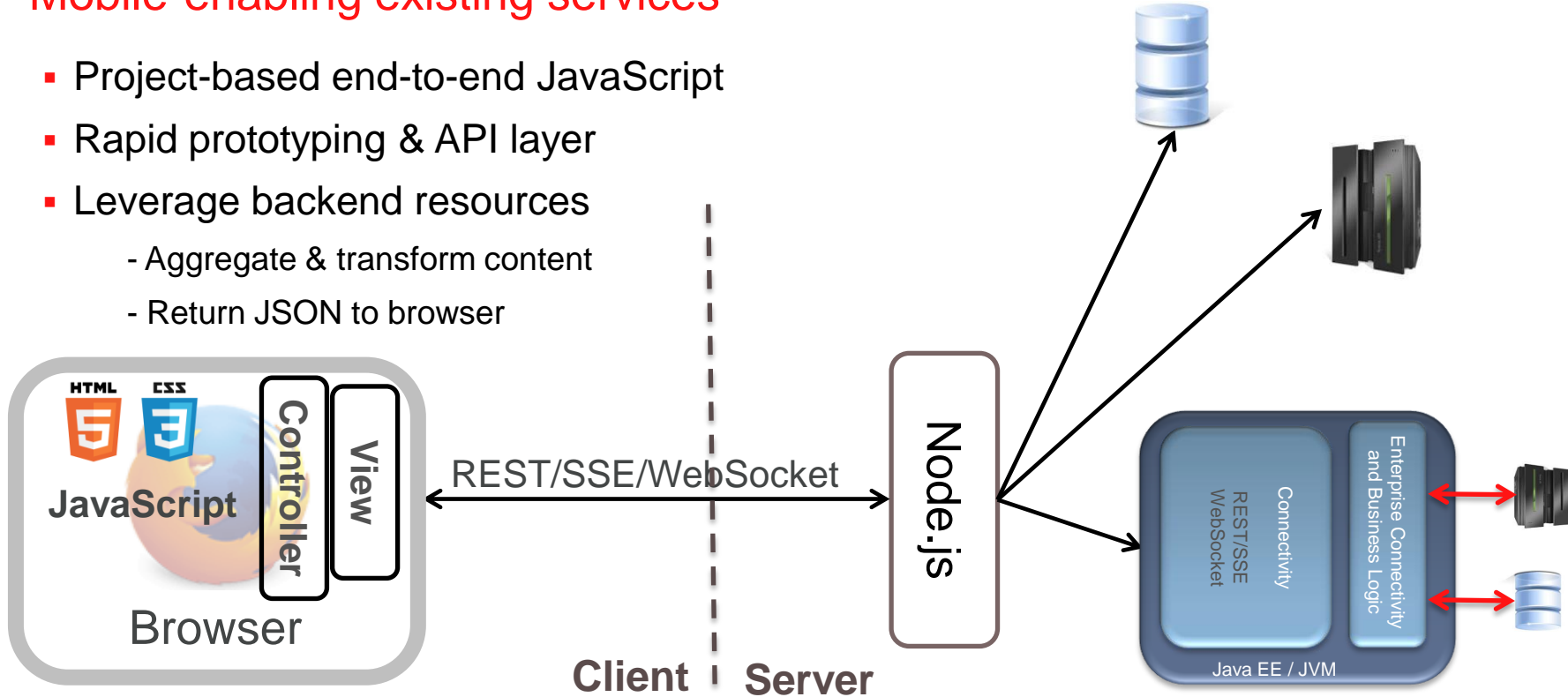


- Node.js, Vert.x are based on an async programming model
- Java EE introduces many new async API
 - Servlet, EJB, JAX-RS, Concurrency for Java EE, ...

Evolution of Web Application Architecture

Mobile-enabling existing services

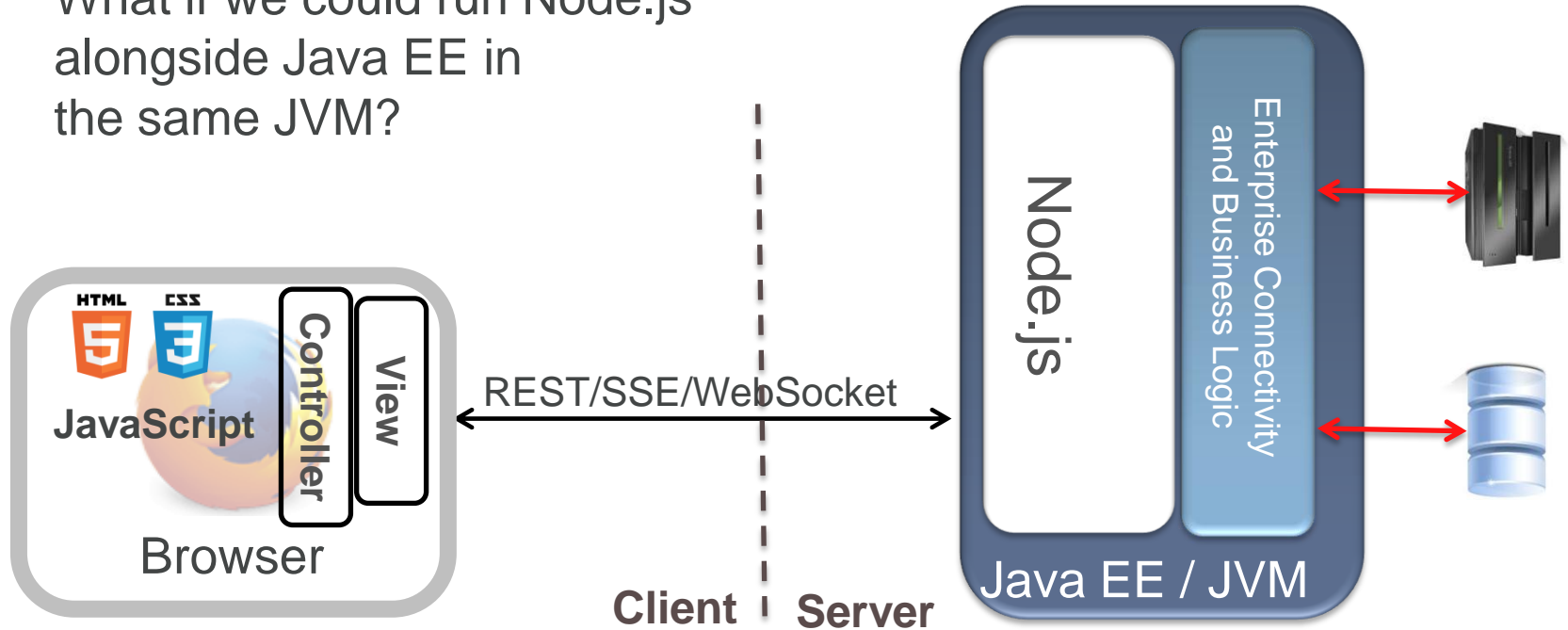
- Project-based end-to-end JavaScript
- Rapid prototyping & API layer
- Leverage backend resources
 - Aggregate & transform content
 - Return JSON to browser



Evolution of Web Application Architecture

Mobile-enabling existing services

What if we could run Node.js alongside Java EE in the same JVM?

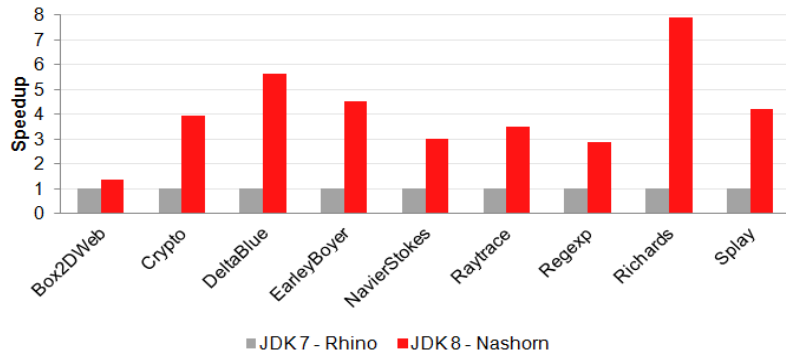


Project Nashorn

JavaScript on the JVM

- ECMAScript 5.1 compliant
- Bundled with JDK 8
 - Replaces Rhino in earlier JVMs
 - Faster (2x – 10x)
- New command-line tool `jjc` to run JavaScript
- Seamless Java \leftrightarrow JavaScript interoperability

<http://download.java.net/jdk8/docs/technotes/guides/scripting/nashorn/index.html>



```
var Button = javafx.scene.control.Button;  
  
var button = new Button();  
button.text = "Say 'Hello World'";  
button.setOnAction() {  
    print("Hello World!");  
}
```

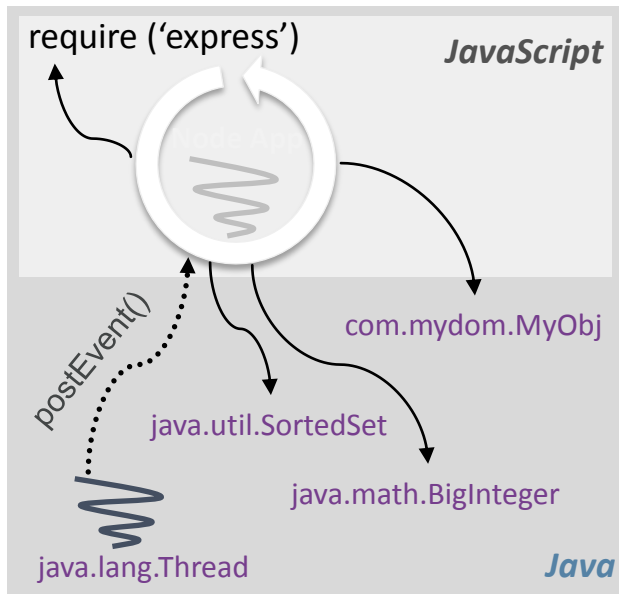

Avatar.js

Node.js on the JVM

- Platform for server side JavaScript applications
- Requires Nashorn (JDK 8)
- 95% Node.js compatibility
 - Use popular packages (Express, async, commander, etc)
 - Uses same portability libraries as Node.js
 - Java bindings for libuv and http-parser
 - Limitation: No Chrome v8 native APIs
- Avatar.js Advantages
 - Leverage JVM, Java frameworks and libraries, Security manager

Avatar.js = Node.js + Java

Leverage Java, including Threads



JVM Process

- Node.js Programming Model
 - Code in JavaScript
 - Single event loop / thread
 - Require (import) Node modules
- Invoke Java code
 - Java types and libraries
 - `new java.lang.Thread();`
 - `new com.mydom.MyObj()`

Demo

Pictures web app with Node.js and Avatar.js

Nodyn

<http://nodyn.io>

- Node.js compatible open-source framework by RedHat
 - compatibility achieved by implementing process.binding(C/C++ dependencies in newer Node.js code) in Java
- Components
 - DynJS: JavaScript runtime (for now slower than Nashorn)
 - Netty: asynchronous event-driven network application framework
 - Vert.x
- No distribution available yet
- Similar to avatar.js

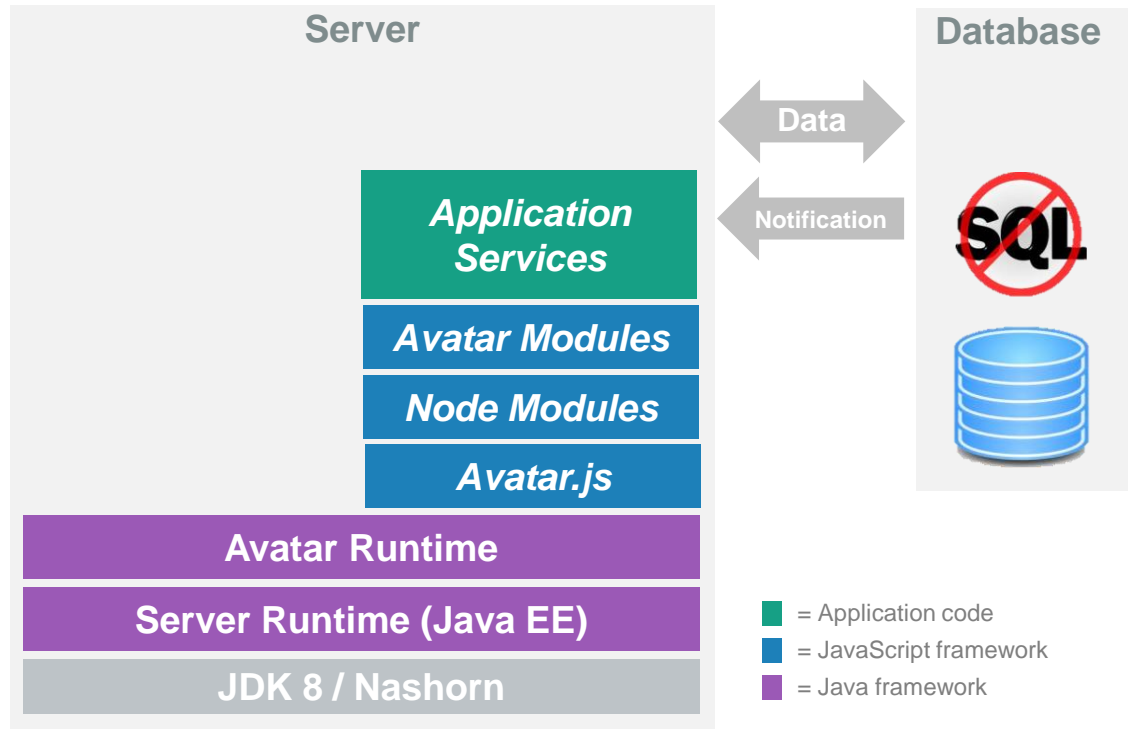
Project Avatar – the Backend

A Server Side JavaScript Services Framework

- Similar in spirit to Servlets, but focused on REST, WebSocket, Server Sent Event (SSE) endpoints
- Use familiar Node.js event-driven programming model and modules
- Layers on Avatar.js NodeJS-compatible runtime
- Adds integrated enterprise features

Avatar Architecture - Server

Server side



Project Avatar – Backend Features

Leveraging the JVM and Java EE in the Node.js programming model

- Out-of-the-box support for REST, WebSocket, SSE communications
- Multi-threading, lightweight message passing, shared state
- HTTP listener / load-balancer is managed by framework (unlike Node)
- Model Store – Object Relational Mapping
- DataProvider API
 - Simple key-value based collection abstraction
 - FileDataProvider, JPADDataProvider, NoSqlDataProvider
- Messaging integration with JMS on Java EE container
 - Through configuration of SSE- and WebSocket communication types

WebSocket Service Example

```
// Load avatar module
var avatar = require('org/glassfish/avatar');

// Register service instance
avatar.registerSocketService(
  {url: 'websocket/chat'},
  function() {
    this.data = {transcript : ""};

    this.onMessage = function (peer, message) {
      this.data.transcript += message;
      this.data.transcript += '\n';
      peer.getContext().sendAll(this.data);
    };
  });
```


WebSocket Service Example

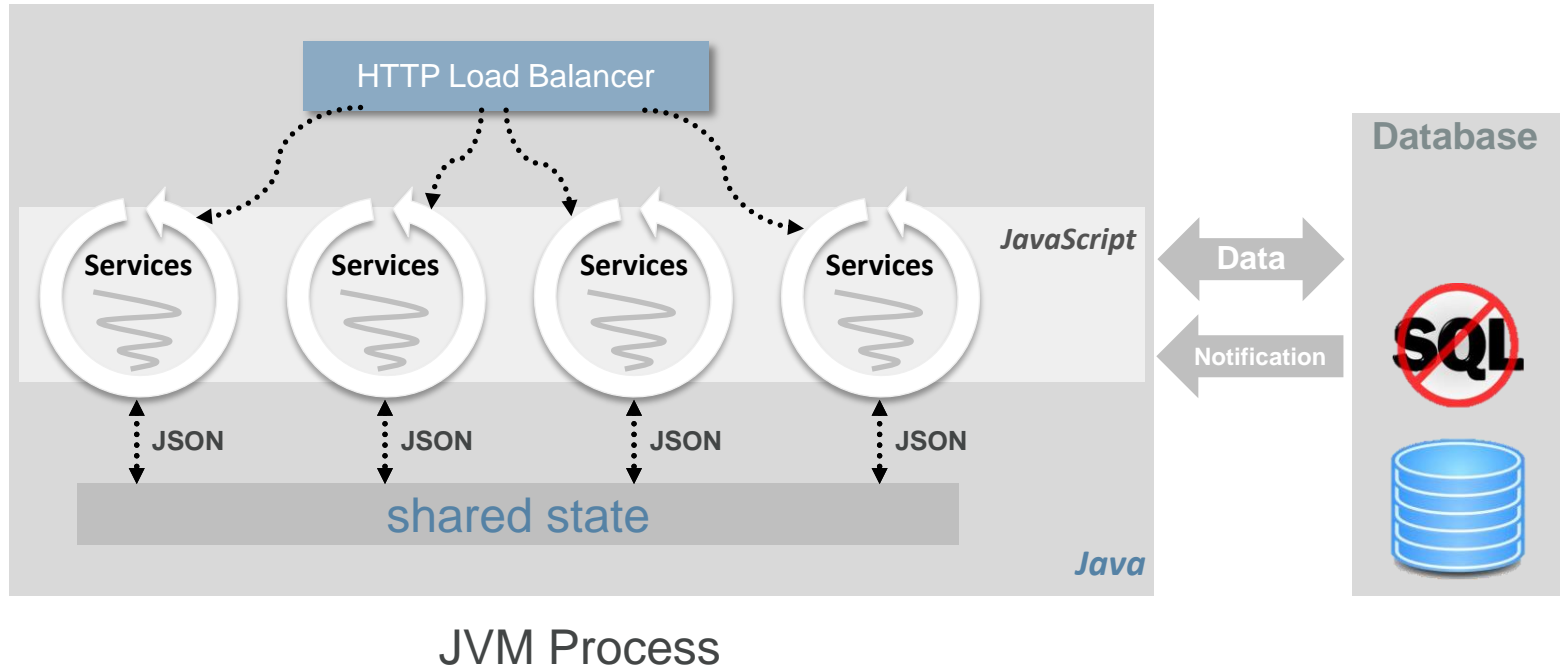
With JMS integration

```
// Load avatar module
var avatar = require('org/glassfish/avatar');

// Register service instance
avatar.registerSocketService({
  url: "/websockets/jmschat/{chatroom}",
  jms: {
    connectionFactoryName: "jms/AvatarConnectionFactory",
    destinationName: "jms/AvatarTopic",
    messageSelector: "chatroom=#{this.chatroom}",
    messageProperties: {
      chatroom: "#{this.chatroom}"
    }
  }
},
function() { this.onMessage(peer, message) { ... };
```

Avatar Services Scalability

Multi-core, state sharing, data storage



Shared State

Lightweight inter-thread communication

- Two Models
 - MessageBus
 - Publish/subscribe message passing
 - Shared State
 - Simple map API
 - Application-scoped instance
 - Session-scoped instance
 - Named
 - Leased, with configurable timeout
- Provide required serialization, concurrency, and caching

State Sharing Example

```
var avatar = require('org/glassfish/avatar');  
var threads = require('org/glassfish/avatar/threads');  
var appname = avatar.application.name;  
var bus = avatar.application.bus;
```

```
// Listen for messages on the 'hello' topic  
bus.on('echo', function(msg) {  
    print(appname + ' got ' + msg);  
});
```

```
// Start a background thread which publishes to the 'echo' topic  
new threads.Thread('background', 'monitor.js').start();
```

```
// or publish to the same topic in this thread  
setTimeout(function() bus.publish('echo', { x : 'x', y : 'y' }), 3000);
```

Model-Store Framework

- JavaScript ORM library
- Pure JavaScript API that
 - Supports relational and non-relational databases
 - Integration with other Avatar services
- Similar to pure Node.js libraries
 - Sequelize, JugglingDB, Mongoose

Model-Store API

Model and Database setup

```
var Product = avatar.newModel({  
  "name": {  
    type: "string",  
    primary: true  
  },  
  "price": "number",  
  "quantity": "integer"  
});
```

```
var store = avatar.newStore('mysql', {  
  host: 'localhost',  
  port: 3306,  
  database: 'test',  
  username: 'root',  
  password: 'gu3ssl1t'  
  createDb: true,  
  dropTables: true  
});
```

Model-Store Example

Creating and Storing an Object

```
// Binds Product model with store
Product.bind(store);

// Insert a new product into the db
store.connect(function() {
  Product.create({
    name: 'Widget',
    price: 1.00,
    quantity: 2
  }, function(err, w1) {
    console.log(JSON.stringify(w1));
    store.disconnect(function() {
      // done
    });
  });
});
```

- Bind model to data store
- Connect to store
 - Creates Product table if required
 - Callback adds product to table

Model-Store API

- Models can have relationships with other models
 - 1:1, 1:n, M,N
- Data Stores
 - Relational
 - Tested: Oracle DB, MySQL, Derby (Embedded, Network)
 - Non-tested: Any other JDBC driver
 - Non-relational
 - Oracle NoSQL, MongoDB (in progress)

Demo

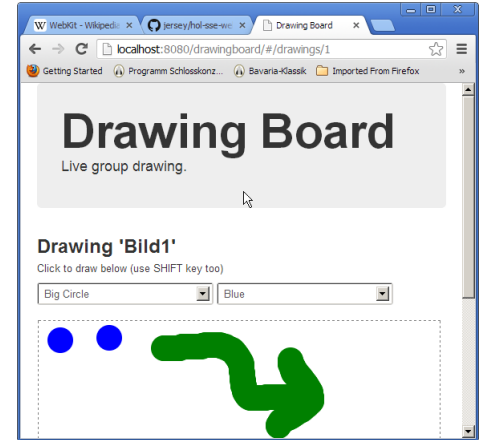
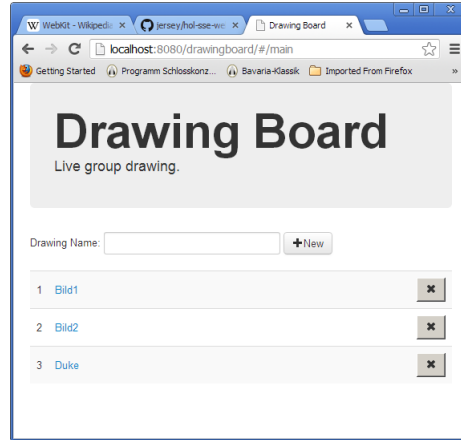
Porting of a HTML5 Application to Avatar

- Client implementation in AngularJS
- Server implemented with Java EE 7, then ported to use Avatar services
- Focus on the server side
- Demonstrate usage of Avatar Services
 - built-in support for REST/WebSocket/SSE communication patterns
 - Shared state
 - Message bus
- Running on GlassFish 4.x or WebLogic 12.1.3

Drawing Board HTML5 Demo

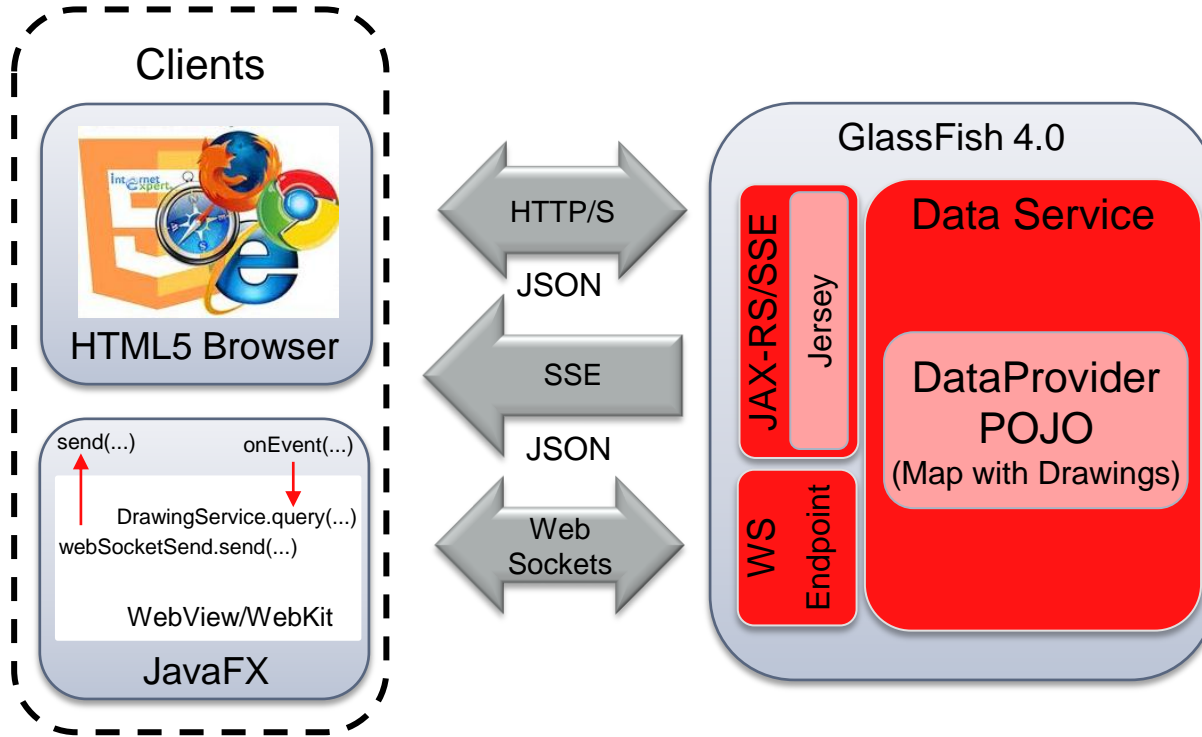
<http://github.com/doschkinow/hol-sse-websocket/solutions/exercise5>

- Collaborative drawing
- Two-page application
 - List of drawings
 - Drawing
- Demonstrating
 - Server-side: JAX-RS, JSON, WebSocket, SSE Java API
 - Client-side: JAX-RS, WebSocket, SSE Java and JavaScript API
 - JavaFX **hybrid** Java/HTML5 application



Drawing Board HTML5 Demo

Thin Server Architecture



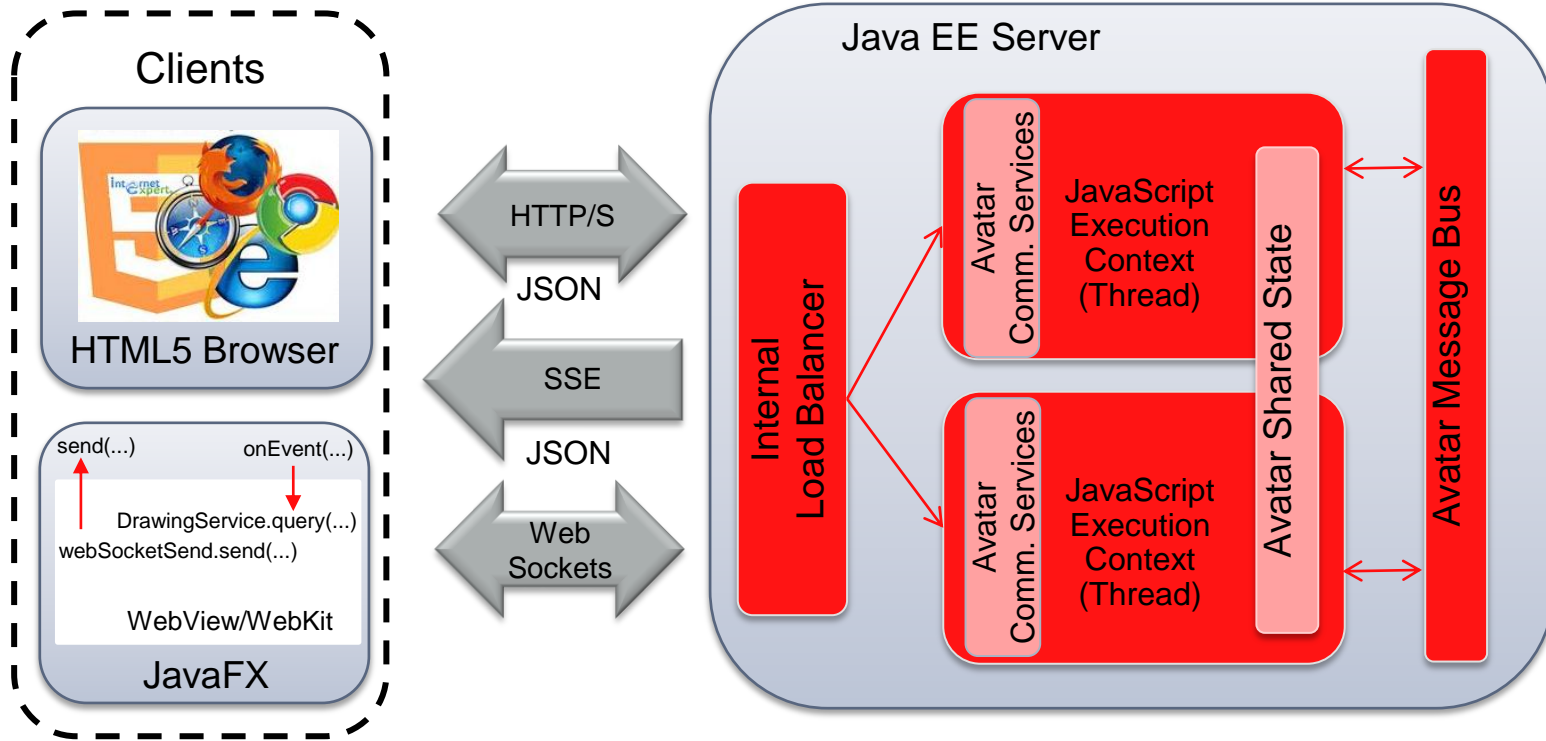
Drawing Board HTML5 Demo

Technology usage

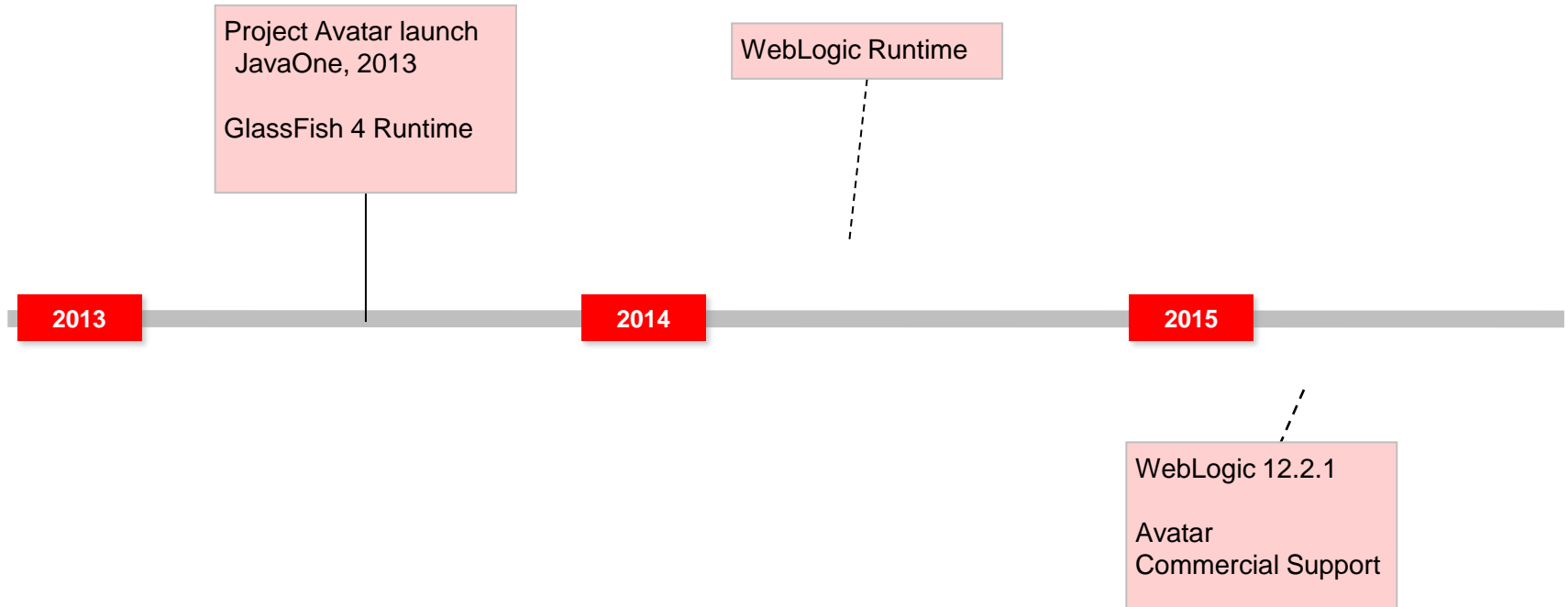
- JAX-RS: CRUD for drawings
- SSE: distributing the list of drawings to all connected clients
- WebSocket: distributing the updates of a drawing to all connected clients
- JSON: implementing of encoder/decoder of the WebSocket server endpoint
- Java – JavaScript bridge(WebEngine): modifying the AngularJS client by replacing the WebSocket/SSE JavaScript client communication with a Java implementation in the JavaFX client

Drawing Board HTML5 Demo

Using Avatar Services (<http://github.com/doschkinow/hol-sse-websocket/solutions/exercise7>)



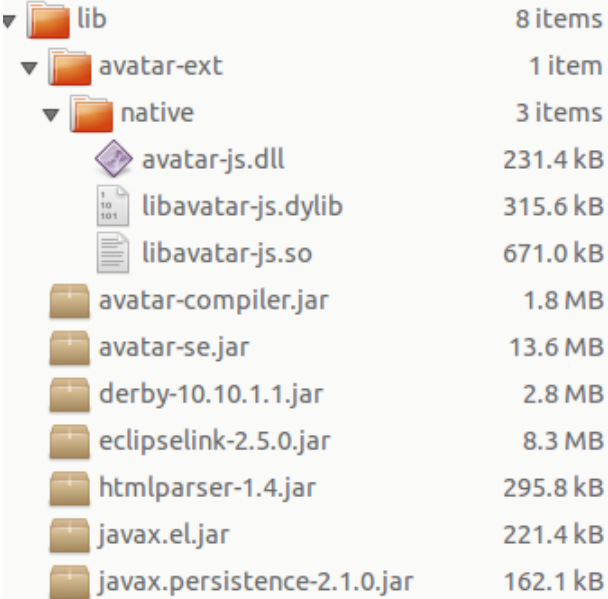
Avatar Roadmap



Avatar-SE

Lightweight implementation on Java SE

- Internal project
 - Seeking to deliver a very lightweight implementation
- Zip-distribution, based on Grizzly as protocol engine
 - Includes JPA and JavaDB
- Running the Avatar examples application
 - `java -jar lib/avatar-se.jar start avatar-se-1.0-
ea/Project-Avatar-examples/hangman`



lib	8 items
avatar-ext	1 item
native	3 items
avatar-js.dll	231.4 kB
libavatar-js.dylib	315.6 kB
libavatar-js.so	671.0 kB
avatar-compiler.jar	1.8 MB
avatar-se.jar	13.6 MB
derby-10.10.1.1.jar	2.8 MB
eclipselink-2.5.0.jar	8.3 MB
htmlparser-1.4.jar	295.8 kB
javax.el.jar	221.4 kB
javax.persistence-2.1.0.jar	162.1 kB

Summary

Server Side JavaScript on the JVM

- Invoke Java code
- Multi-threading optimizations
 - Share state across threads, JVMs
 - Built-in load balancing across threads
- Leverage Java EE services
- Deploy on existing Java EE infrastructure
 - Leverage appserver features (clustering, lifecycle management)

Hardware and Software

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