1.– 4. September 2014
in Nürnberg

Herbstcampus

Wissenstransfer
par excellence

Avatar

Erweiterung der Java EE Plattform für JavaScript Fans

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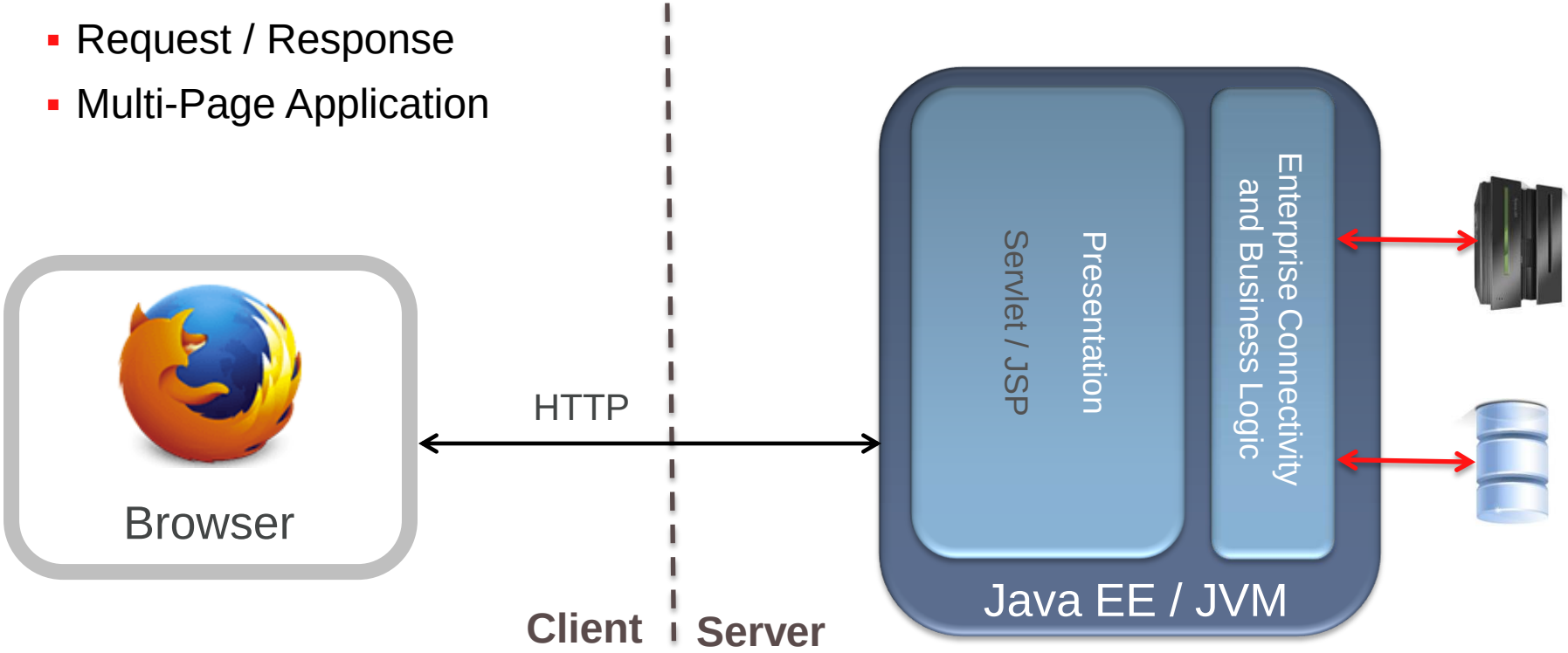
Agenda

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

Evolution of Web Application Architecture

A Java EE Perspective

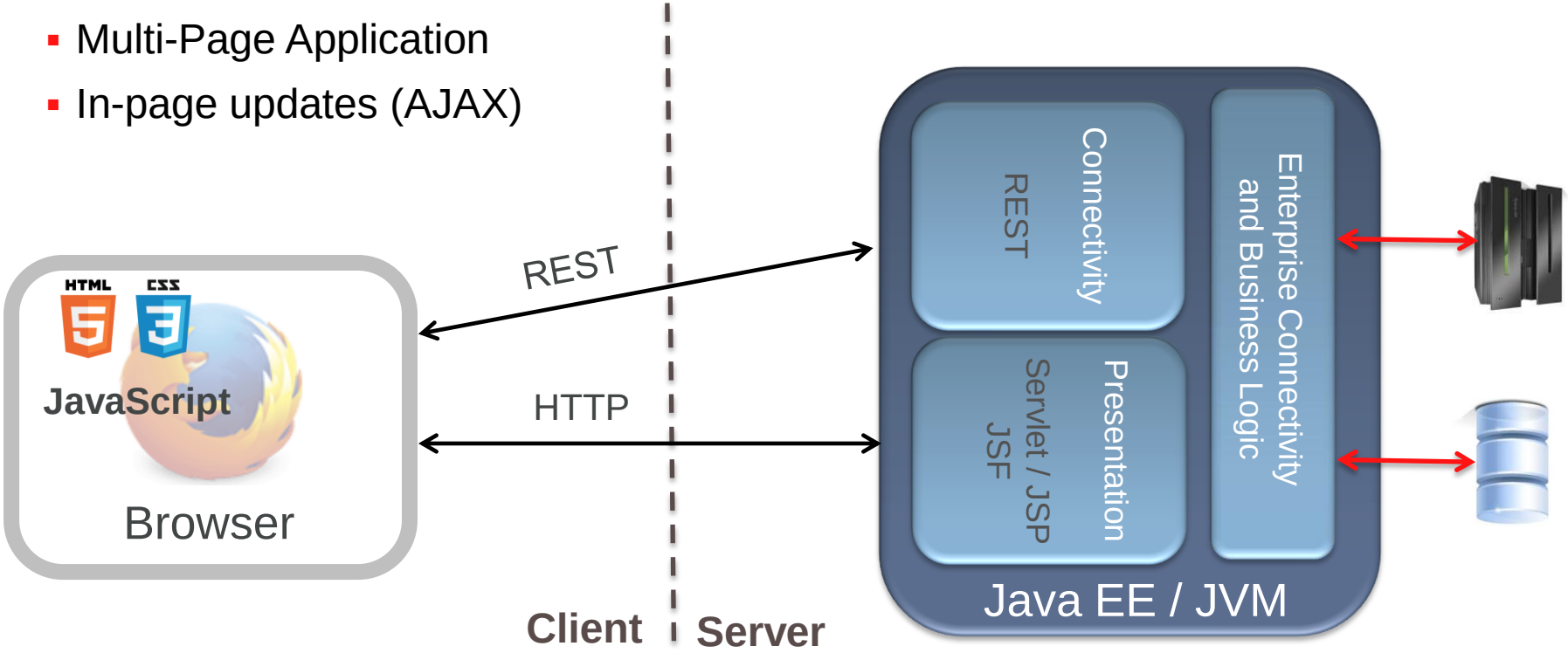
- Request / Response
- Multi-Page Application



Evolution of Web Application Architecture

A Java EE Perspective

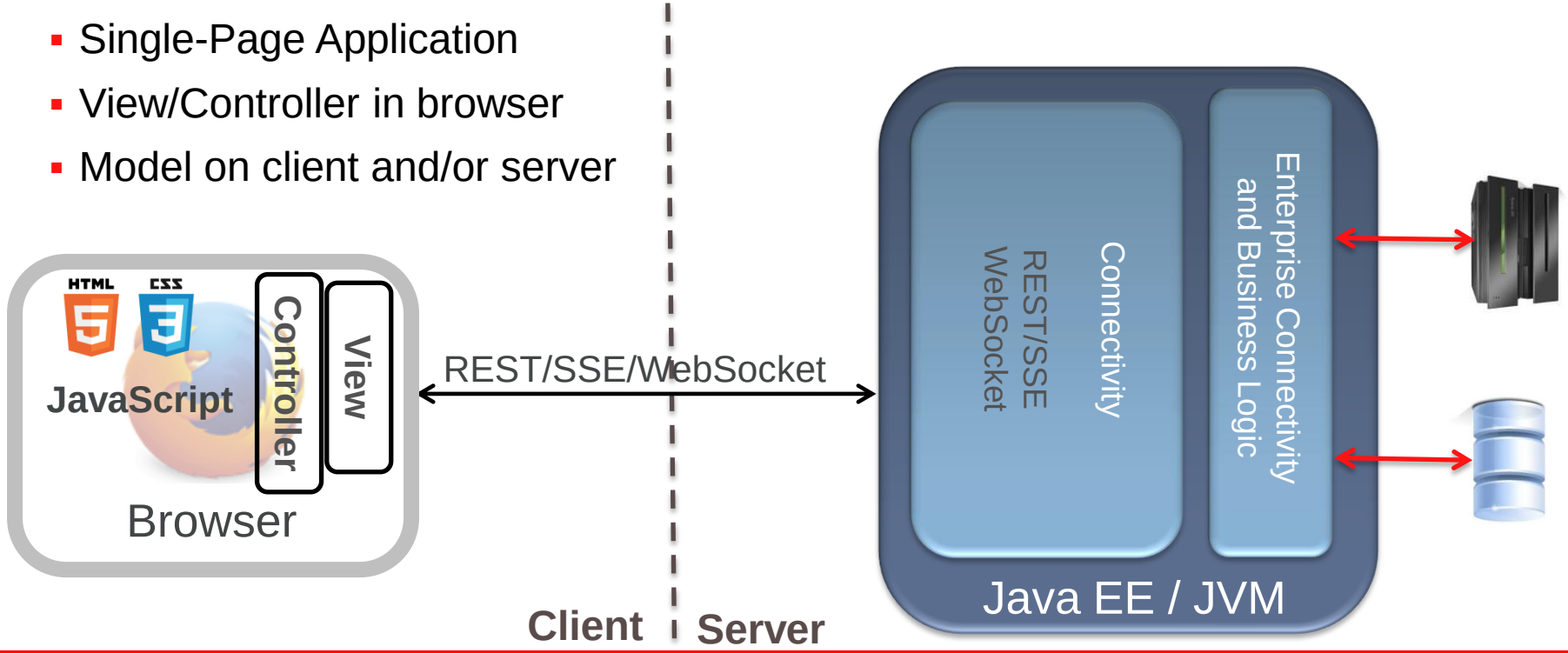
- Multi-Page Application
- In-page updates (AJAX)



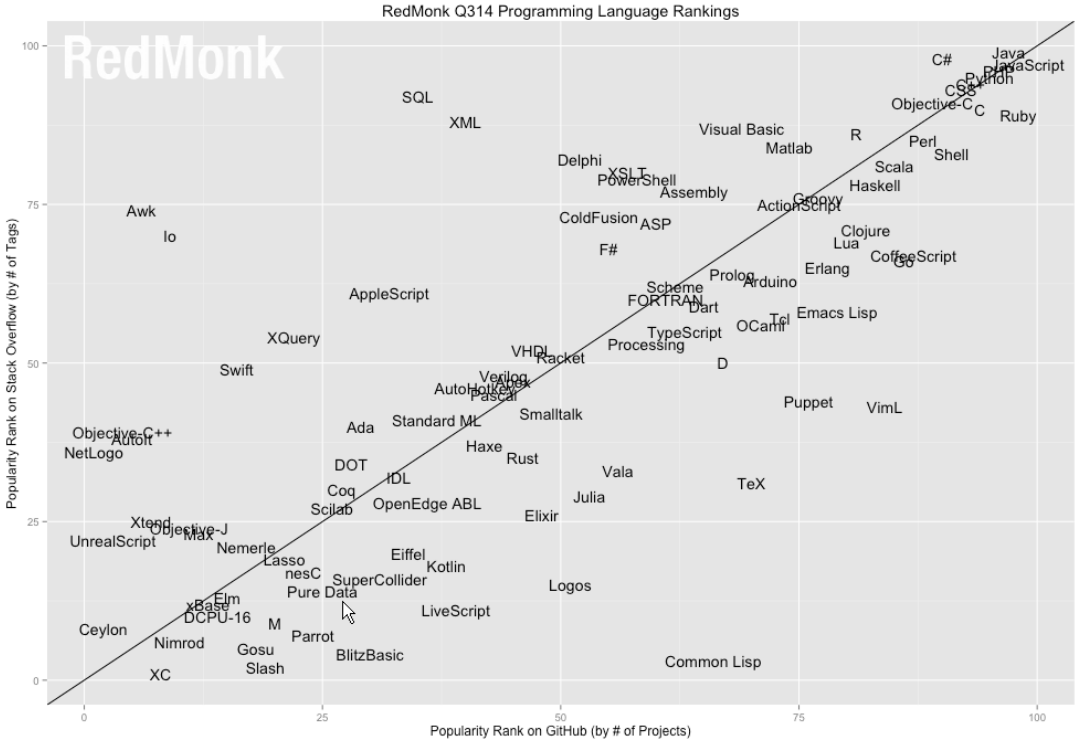
Modern Web Application Architecture

A Java EE Perspective

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



The Rise of JavaScript



http://redmonk.com/sogrady/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 80,000+ modules

Node.js Programming Model

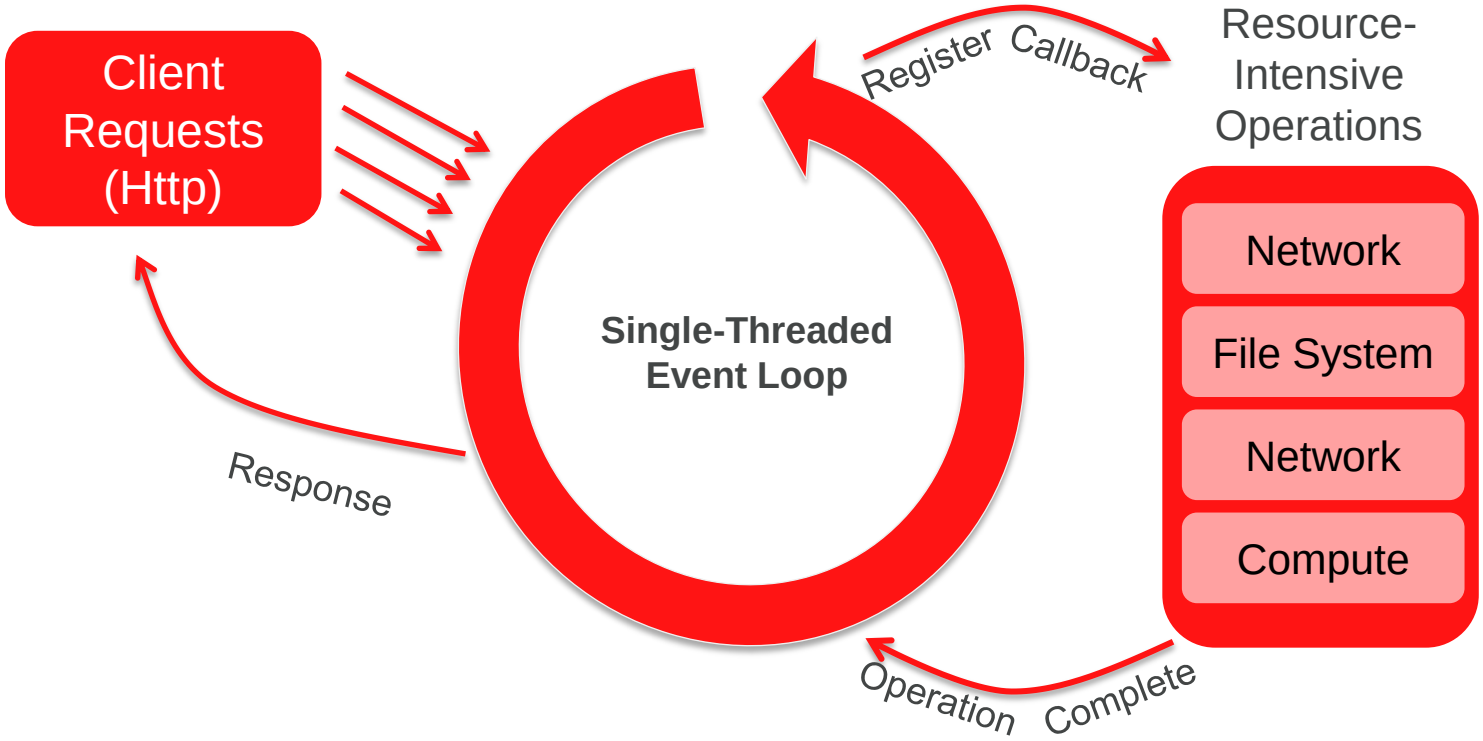
- Multi-threading is hard
  - Thousands of concurrent connections
  - Deal with deadlocks and race conditions
- Blocking on I/O is bad

- Single threaded Event-loop
  - Callback model
  - Non-blocking I/O calls
  - Heavily parallelized

Minimal Web Server Example :

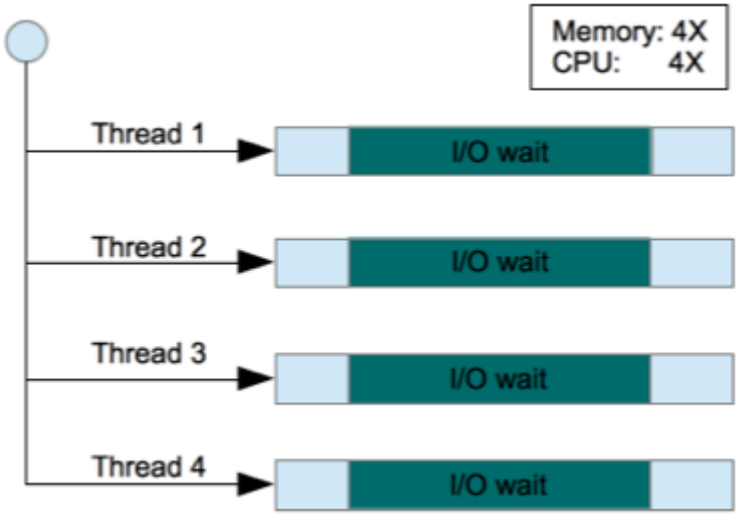
```
var http = require("http");

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

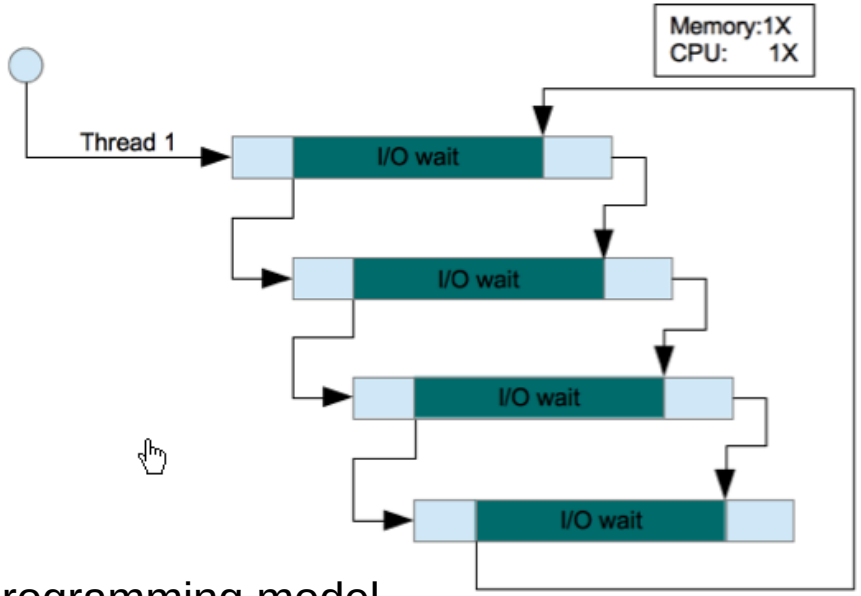
Node.js Event Loop



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/



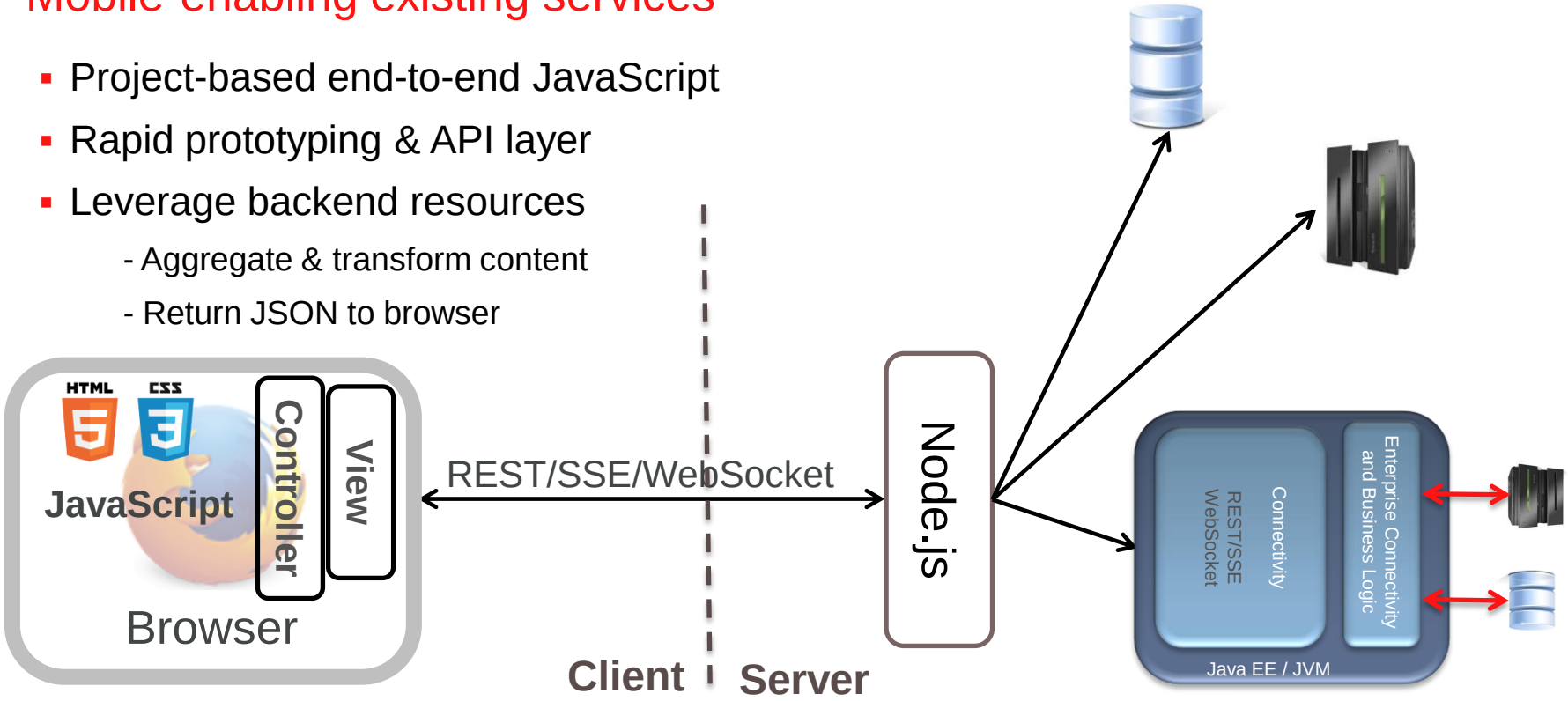


- Node.js, Vert.x are based on an async programming model
- Java EE introduces many new async API
  - Servlet, EJB, JAX-RS, Concurrency for Java EE, ...

Evolution of Web Application Architecture

Mobile-enabling existing services

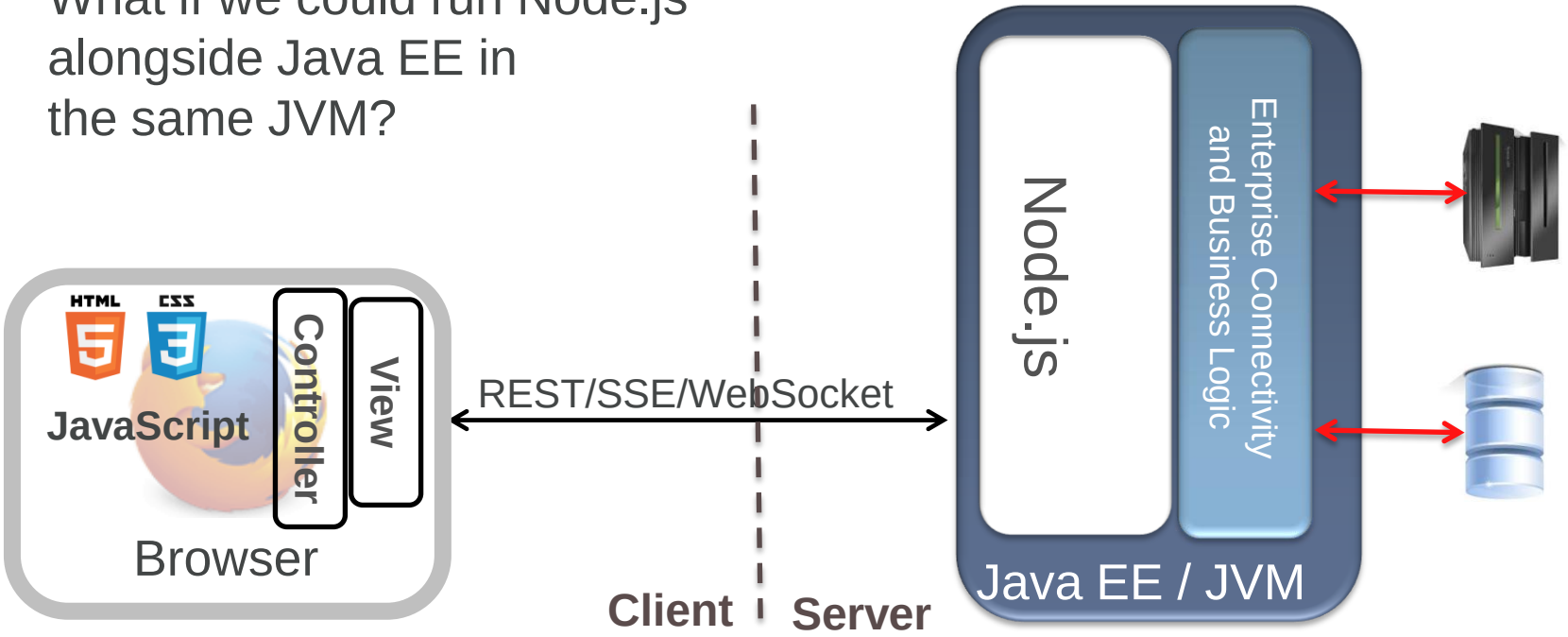
- Project-based end-to-end JavaScript
- Rapid prototyping & API layer
- Leverage backend resources
  - Aggregate & transform content
  - Return JSON to browser



Evolution of Web Application Architecture

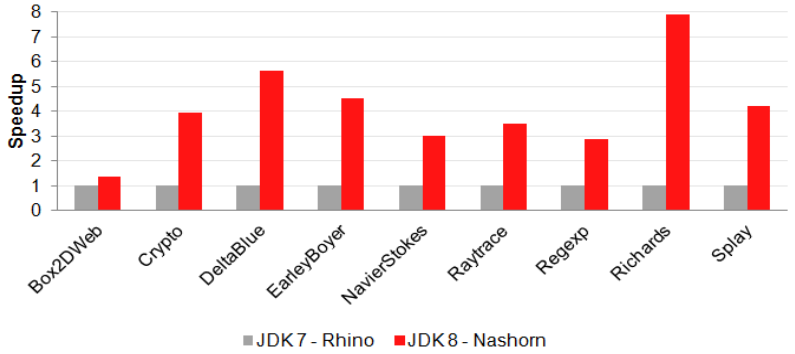
Mobile-enabling existing services

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)

```
var Button = javafx.scene.control.Button;

var button = new Button();
button.text = "Say 'Hello World'";
button.onAction = function() {
    print("Hello World!");
}
```

- New command-line tool **`jjs`** to run JavaScript
- Seamless Java ←→ JavaScript interoperability

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

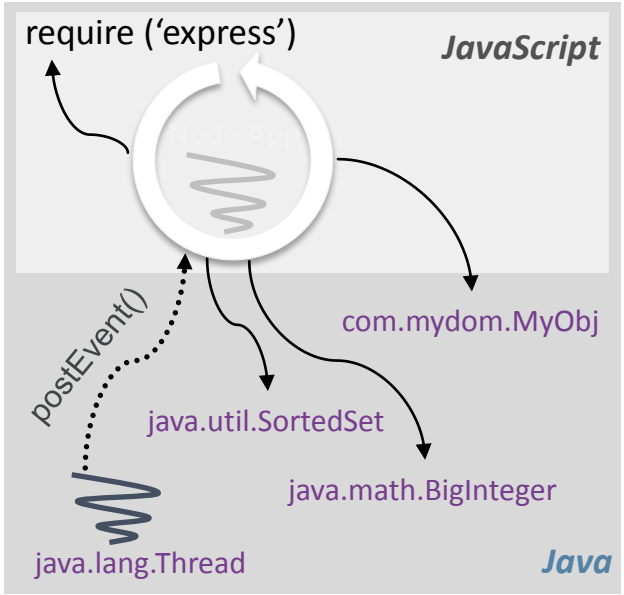
Avatar.js

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

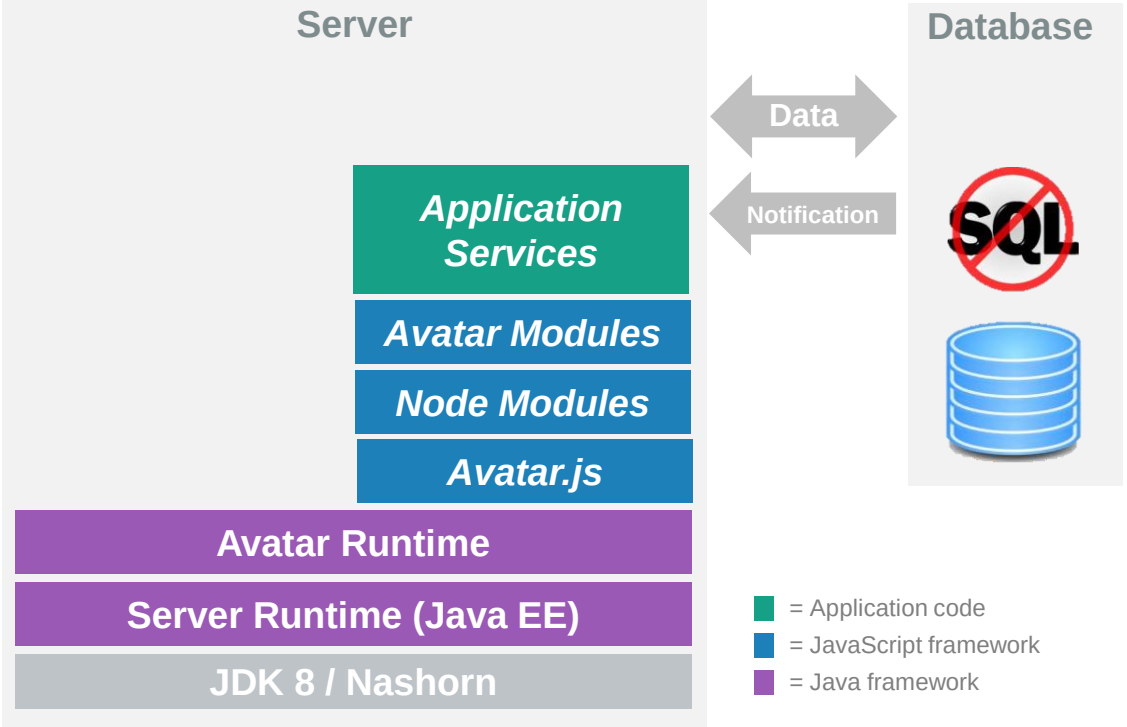
Project Avatar – the Backend

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, JPADataProvider, 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);
        };
   });
```

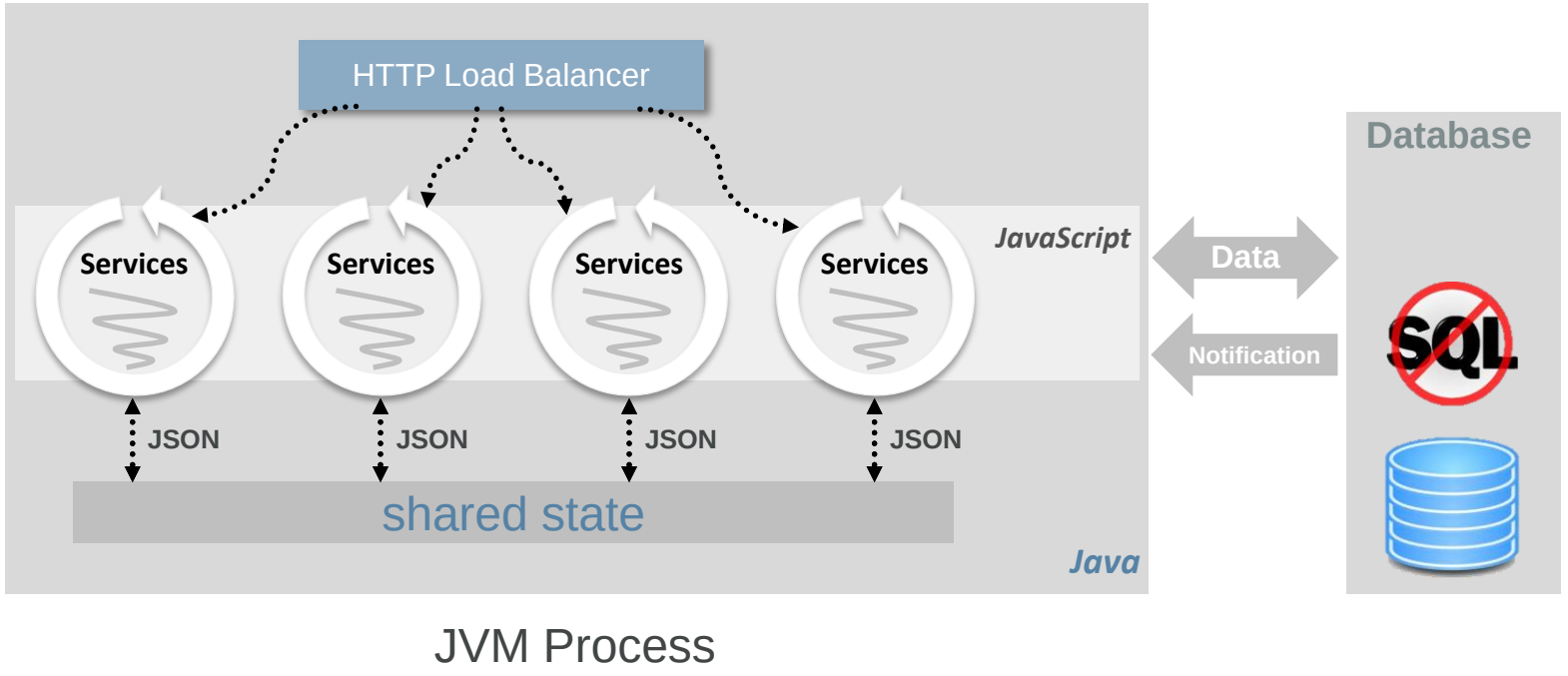
WebSocket Service Example

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



JVM Process

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
  - Many oportunities to leverage JPA features
- 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:  'gu3sslt'
      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)

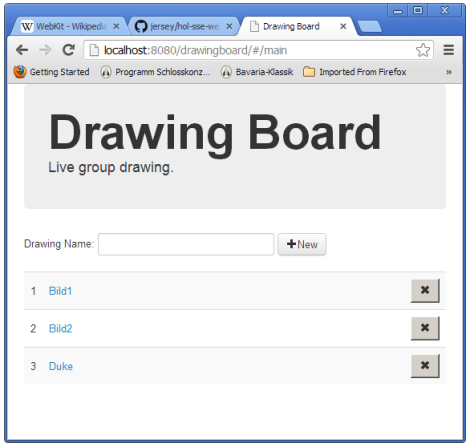
Demo

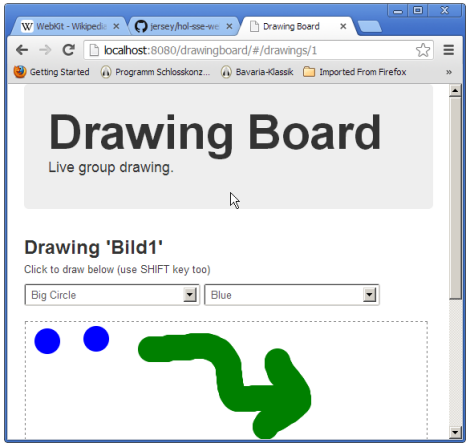
Porting of a HTML5 Applicaton to Avatar

- 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

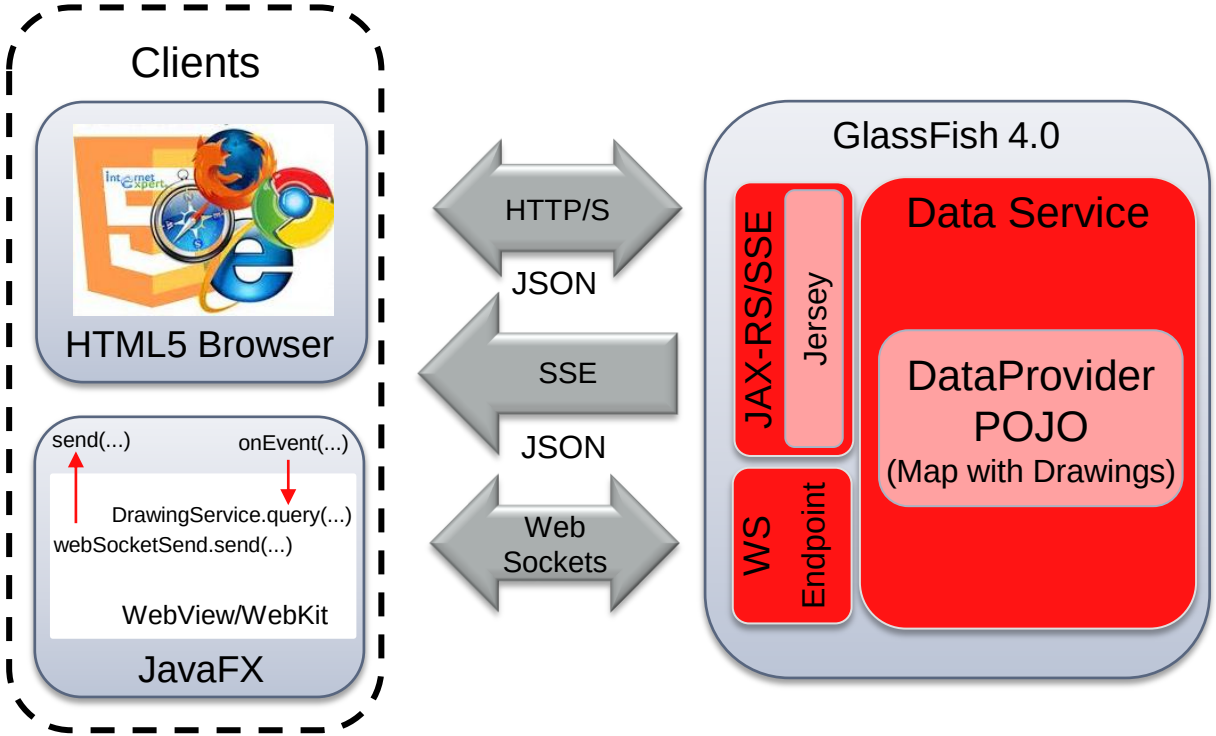




- Collaborative drawing
- Two-page application
  - List of drawings
  - Drawing
- Demonstrating
  - Server-side: JAX-RS, JSON, WebSocket, SSE Java API
  - Client-side: JAX-RS, WebSocket, SSE Java and JavaScript API
  - JavaFX hybrid Java/HTML5 application

Drawing Board HTML5 Demo

Thin Server Architecture



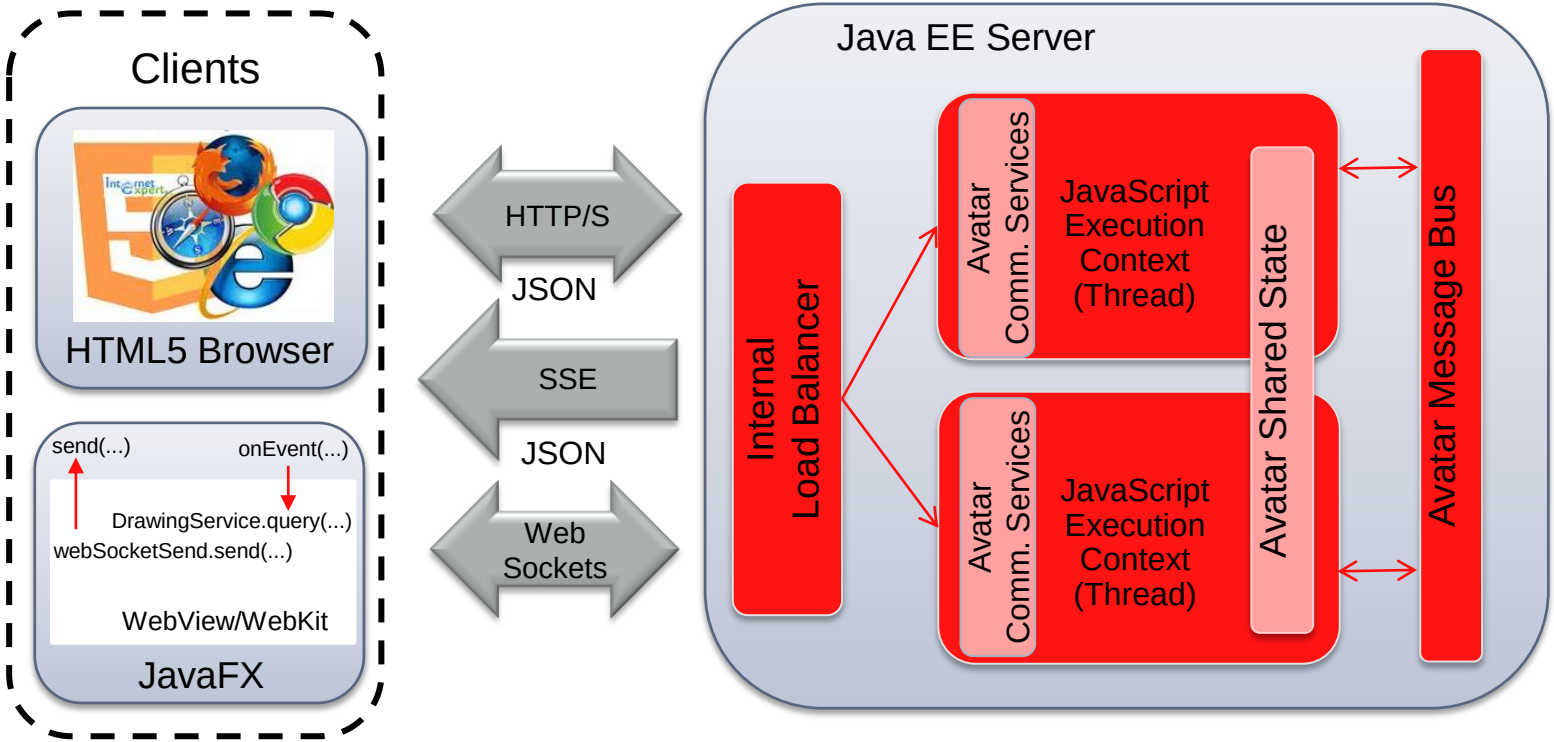
Drawing Board HTML5 Demo

Technology usage

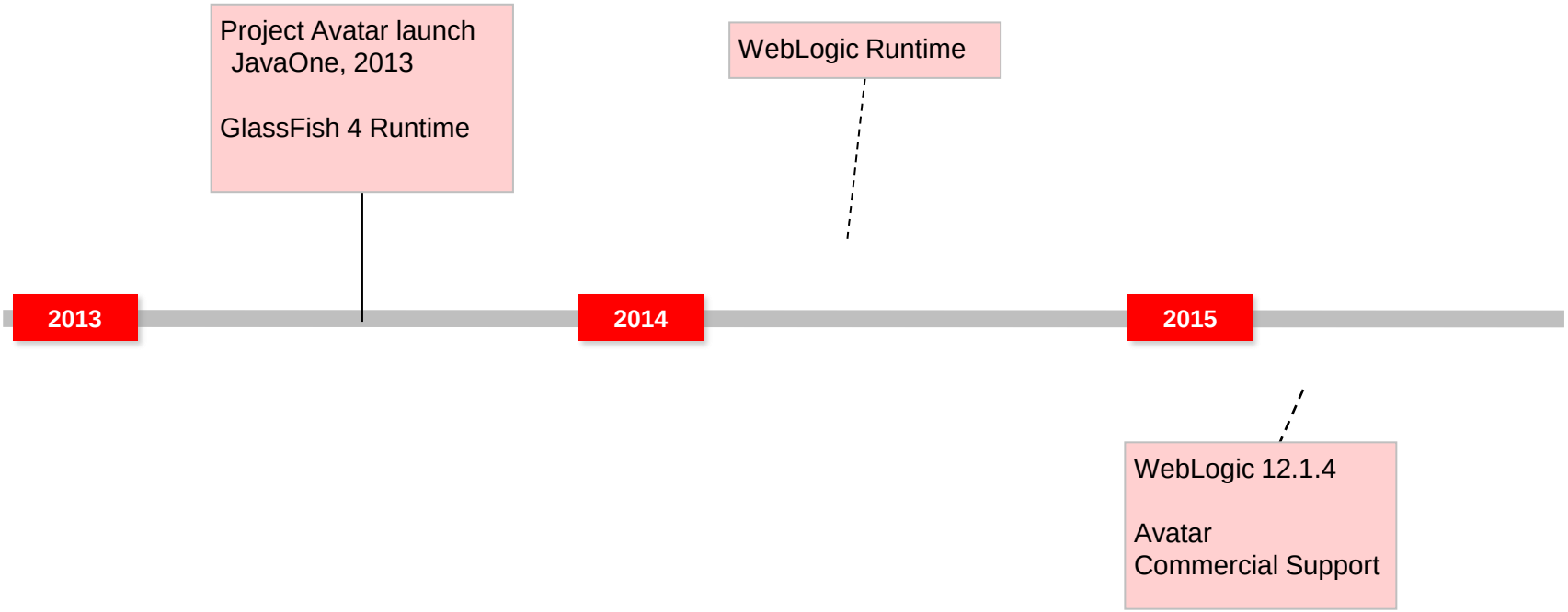
- JAX-RS: CRUD for drawings
- SSE: distributing the list of drawings to all connected clients
- WebSocket: distributing the updates of a drawing to all connected clients
- JSON: implementing of encoder/decoder of the WebSocket server endpoint
- Java – JavaScript bridge(WebEngine): modifying the AngularJS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



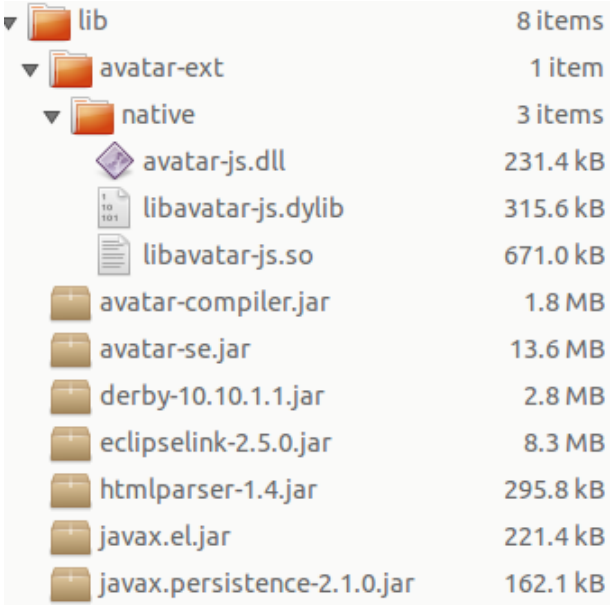
Avatar Roadmap



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



Java Community Questions on Avatar 1/2

http://blog.n-k.de/2014/07/avatarjs-project-avatar-feedback-from.html?m=1

- Why did you start Avatar.js and Avatar
  - To exploit new JVM capabilities and Nashorn
  - Synergy effects when running Java EE and Node.js apps on same JVM
- Who is your target group
  - Node.js developers wishing to access existing Java apps/libs or to take advantage of a rich Java appserver infrastructure
  - Java/JVM-based language developers wishing to use/integrate Node.js modules or Node.js single threaded non-blocking programming model
  - Java/JavaEE platform provider wishing to extend their offerings

Java Community Questions on Avatar 2/2

http://blog.n-k.de/2014/07/avatarjs-project-avatar-feedback-from.html?m=1

- Do you plan to invest more in Avatar
  - we are evaluating different scenarios and are going to invest in Avatar
- What about (more) documentation and more promotion
  - more to come at JavaOne 2014
- Why are there no real developing activites/commits since end of March
  - https://java.net/projects/avatar/sources/git/history? reveals a last modification on June 19 (but indeed a minor one)
  - We often evaluate/develop our products in closed source first

Summary

Server Side JavaScript on the JVM

- Invoke Java code
- Multi-threading and optimizations for better scalability
  - 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)

Vielen Dank!

Peter Doschkinow

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