

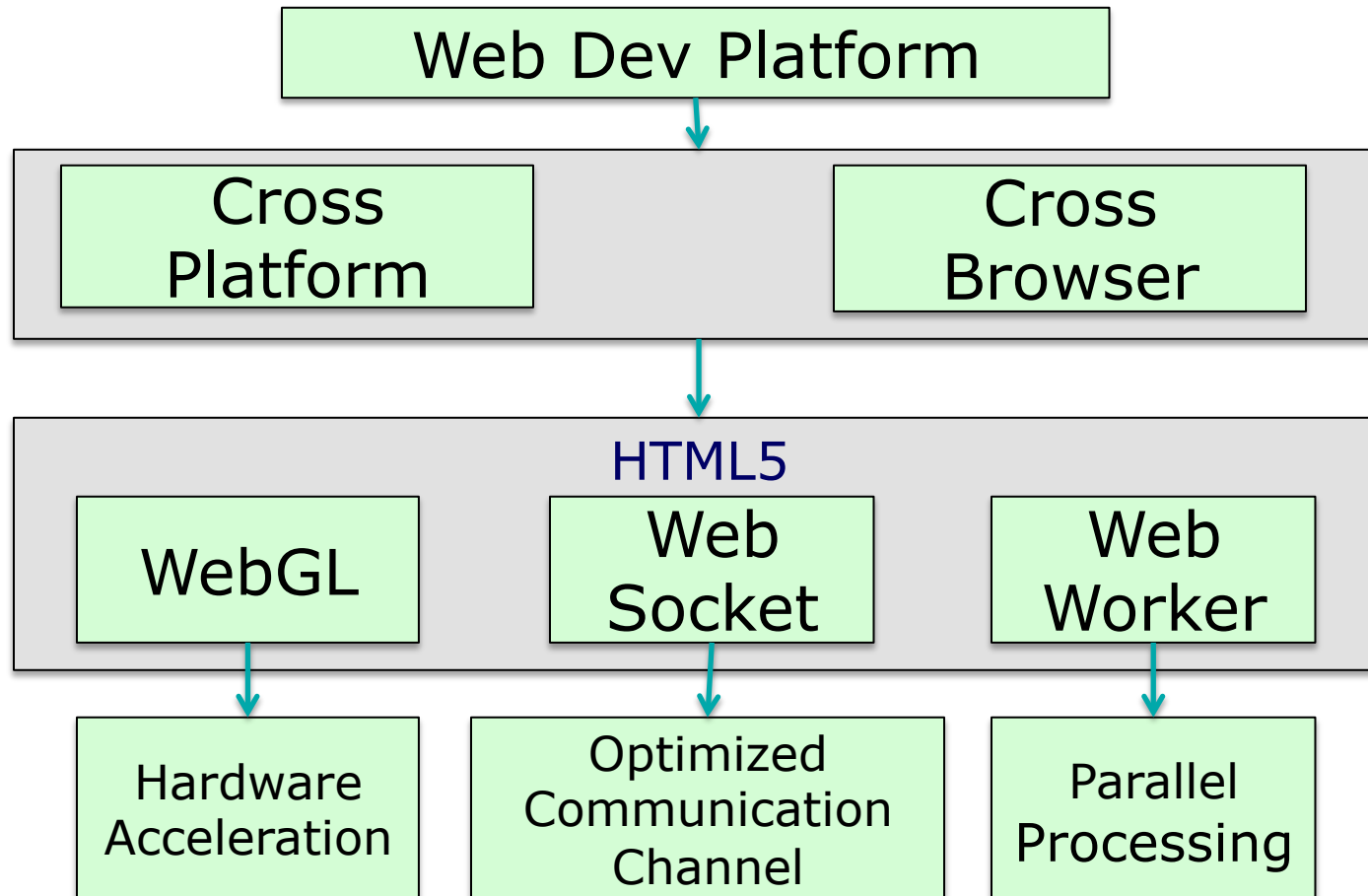


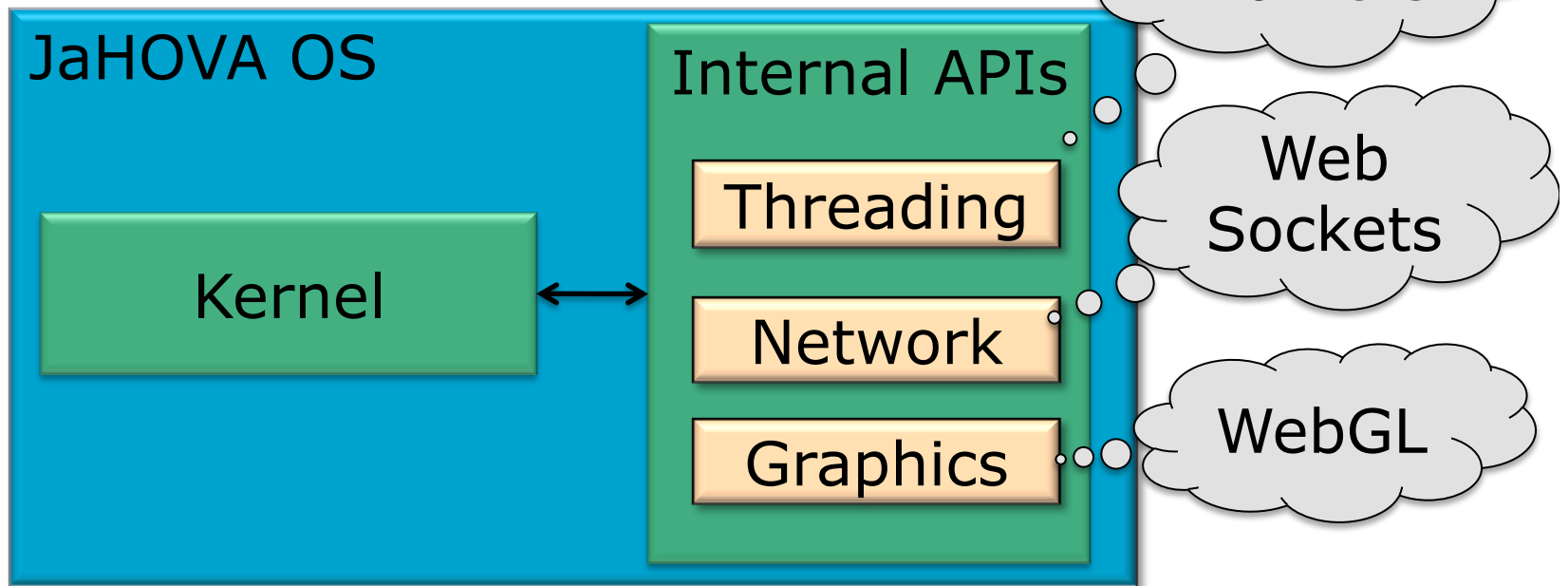
Building a Multi-threaded Web-Based Game Engine Using HTML5/CSS3 and JavaScript

Corey Clark PhD
Daniel Montgomery

GAME DEVELOPERS CONFERENCE
SAN FRANCISCO, CA
MARCH 5-9, 2012
EXPO DATES: MARCH 7-9

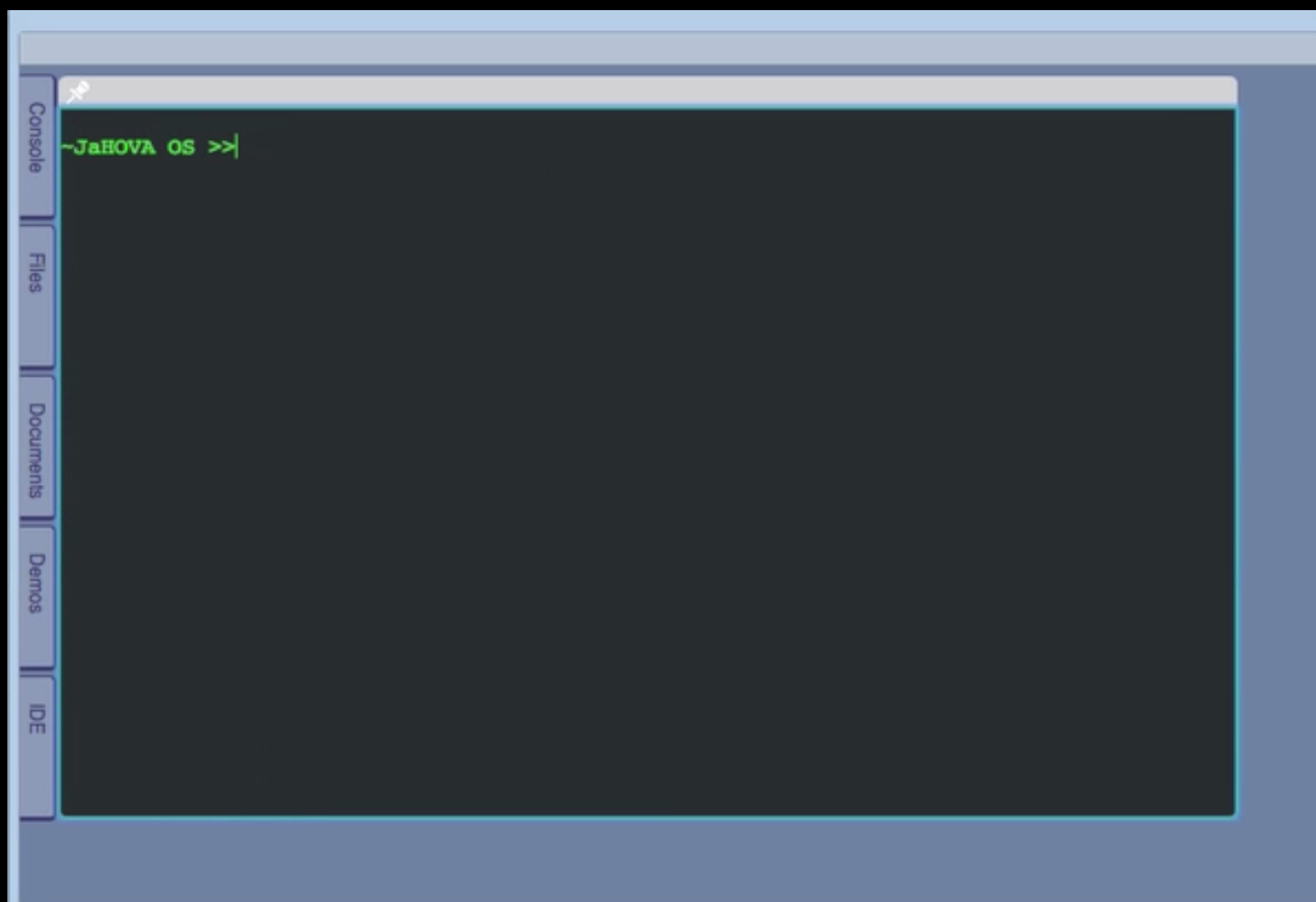
2012



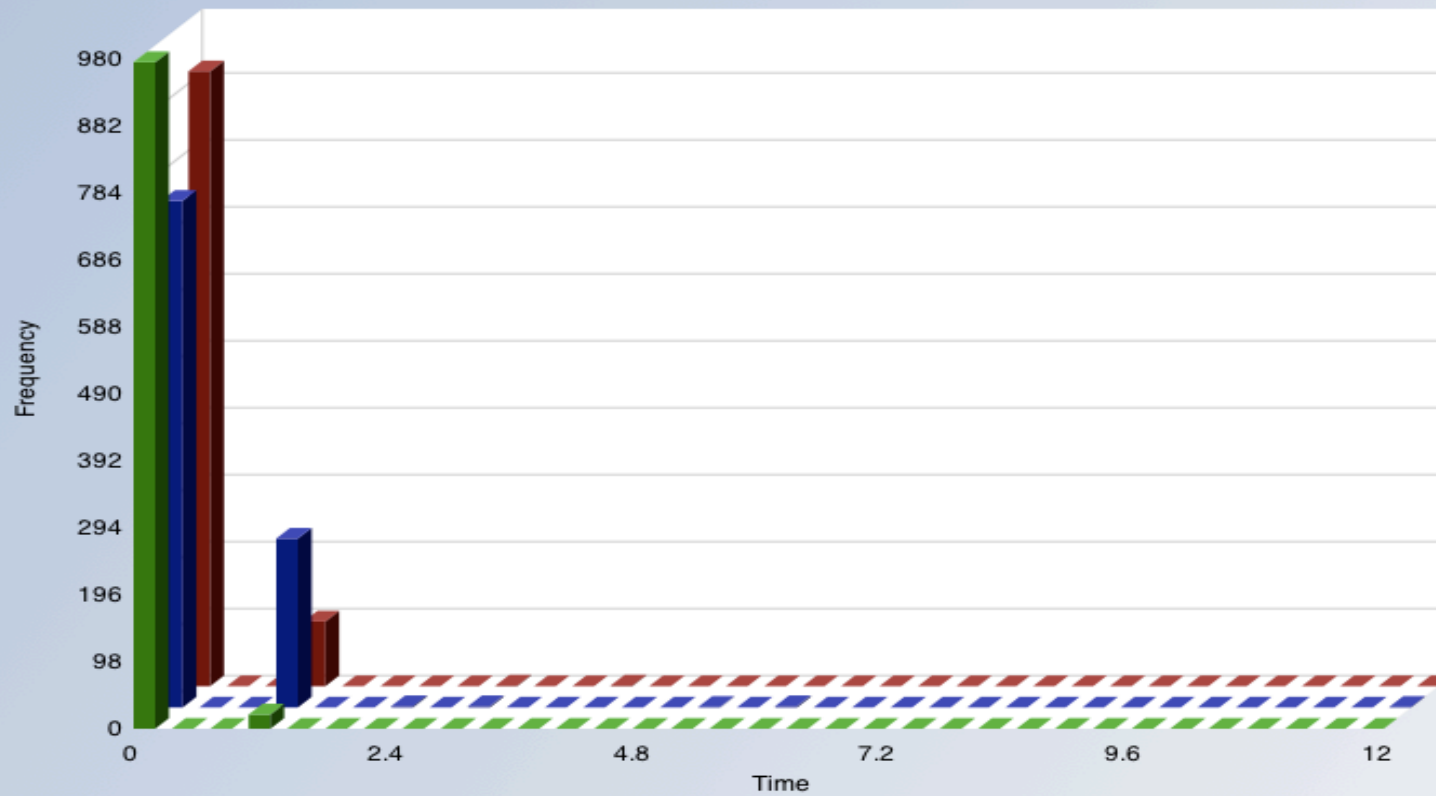


Web Workers and Multithreading

- Parallel Execution
 - Communicates through Message
 - Executes in Isolated Thread
- No Access To
 - DOM, Window
 - Document, Parent
 - No Shared Memory
 - But You Do Have...
 - XHR / WebSockets
 - Navigator, Location
 - setTimeout/setInterval
 - App Cache, importScript



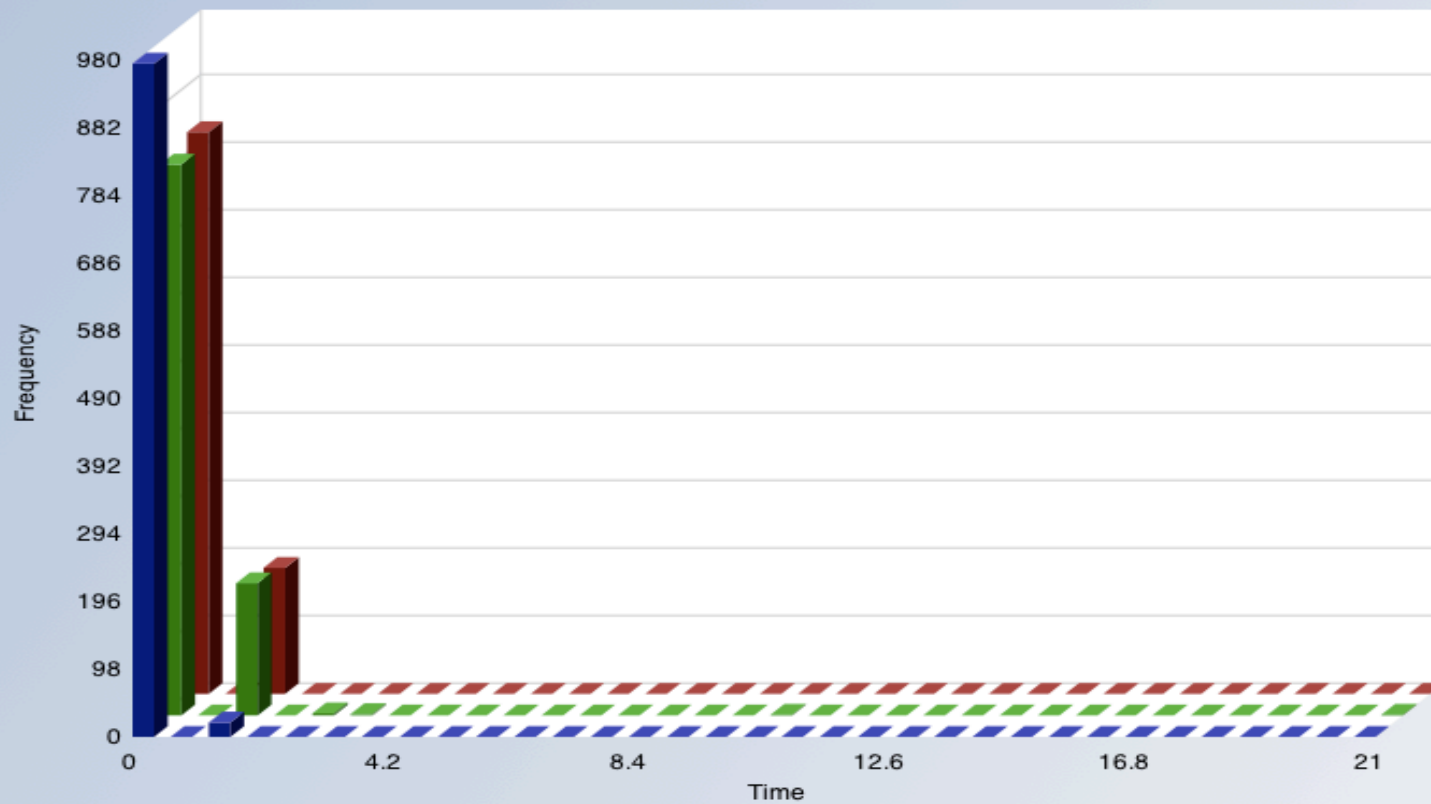
Time To Create Second Worker



Statistics	
Min:	0.00
Max:	1.00
N:	1000
Mean:	0.02
Stdev:	0.14

Legend	
Chrome	
Firefox	
Safari	

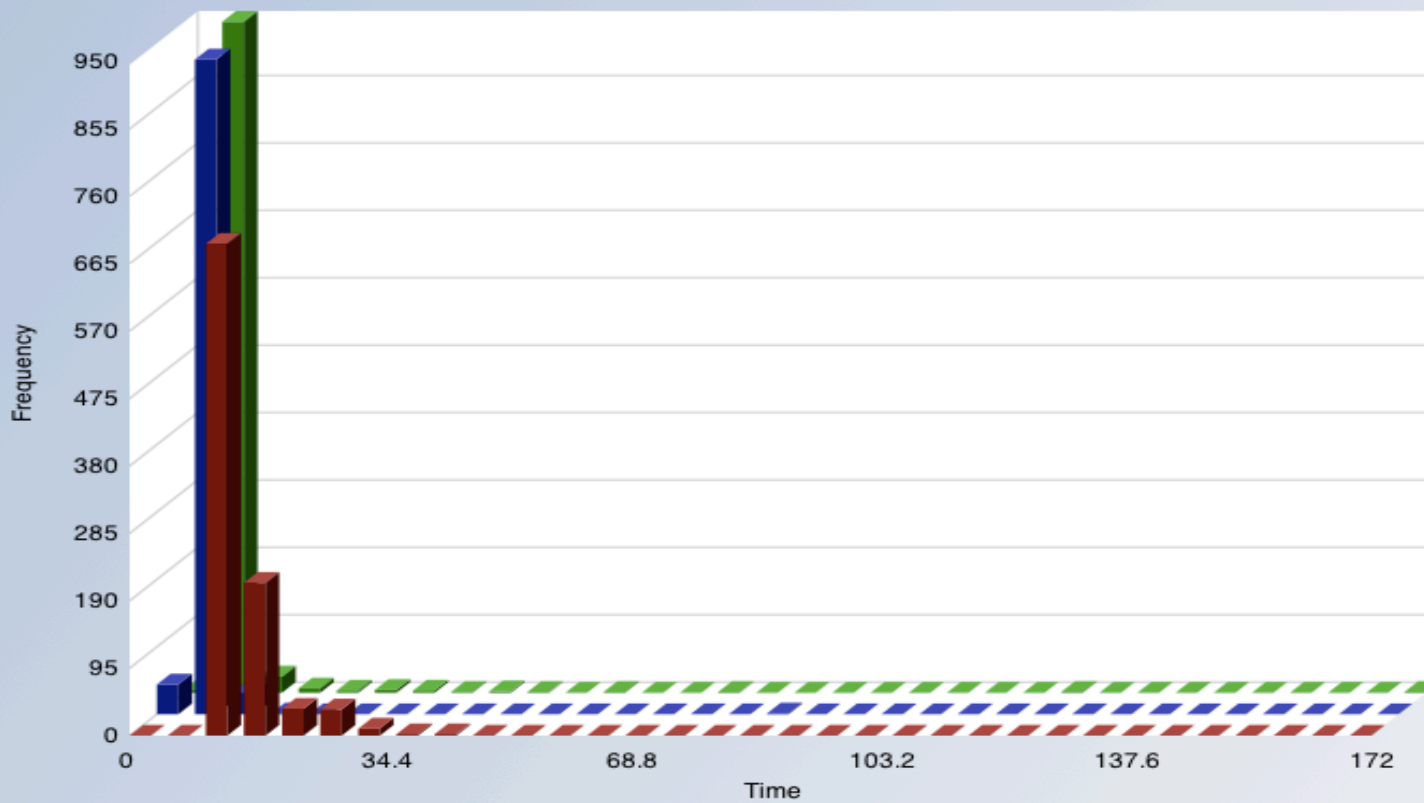
Time To Send Small Message



Statistics	
Min:	0.00
Max:	1.00
N:	999
Mean:	0.02
Stdev:	0.14

Legend	
Chrome	
Firefox	
Safari	

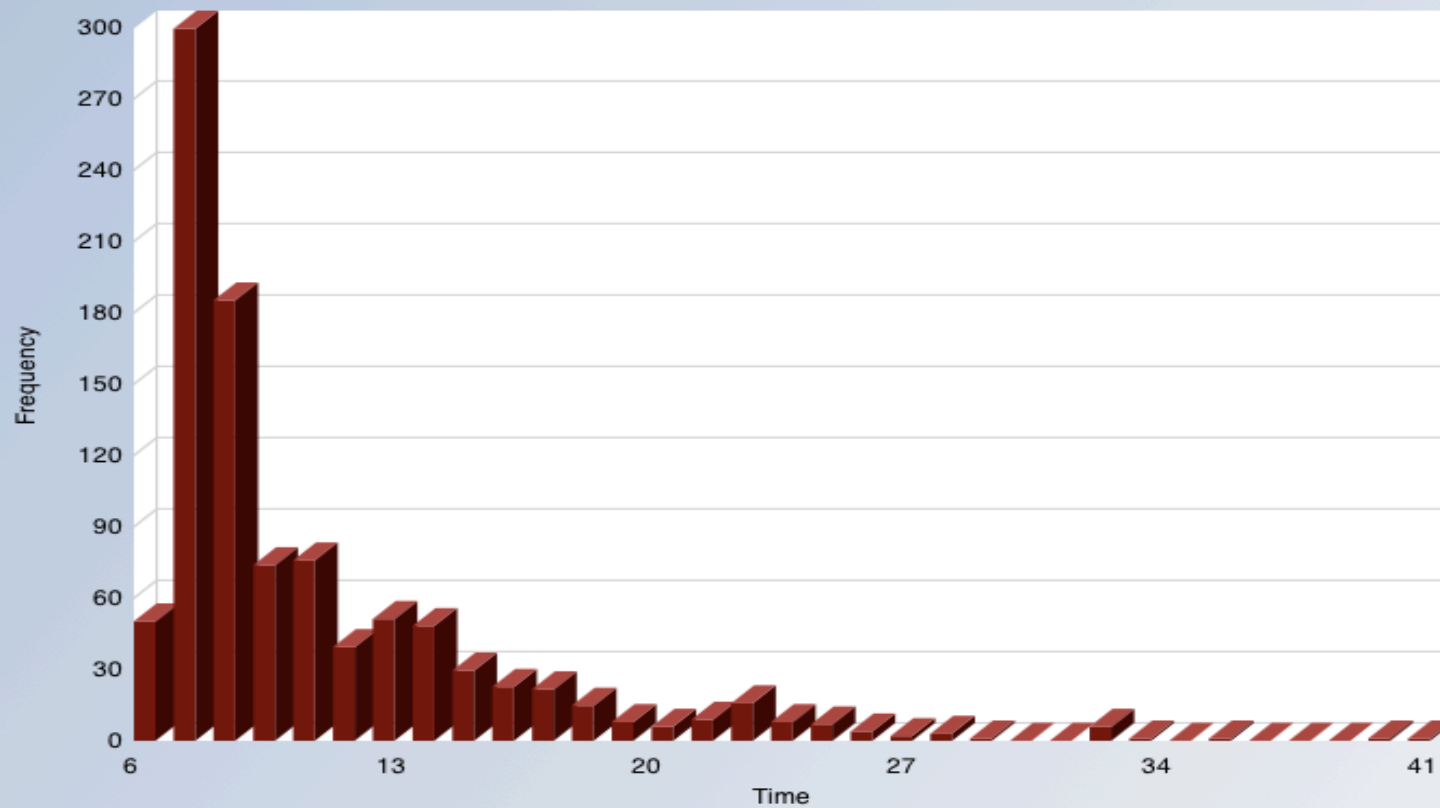
Time To Send Large Message



Statistics	
Min:	6.00
Max:	41.00
N:	1000
Mean:	10.23
Stdev:	4.86

Legend	
Chrome	Firefox
Safari	

Time To Send Large Message



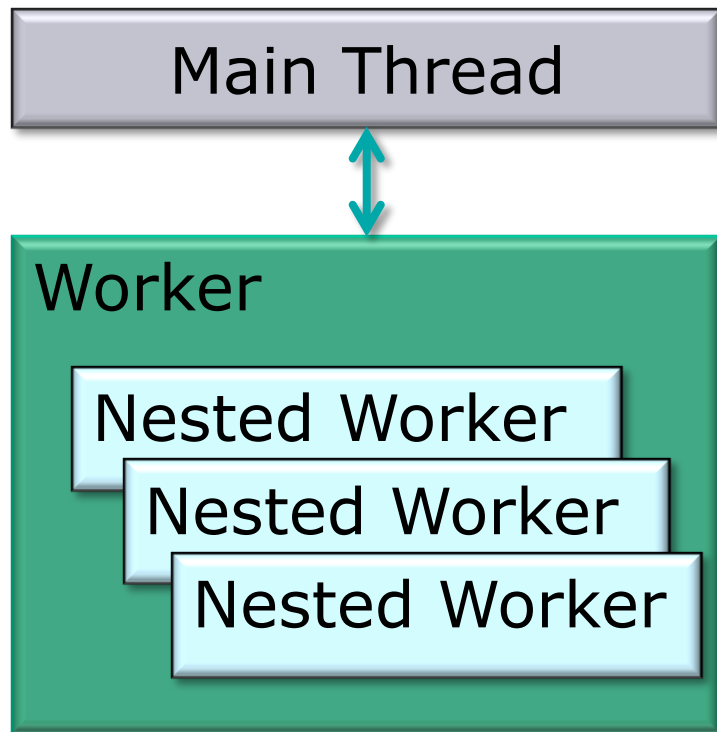
Statistics	
Min:	6.00
Max:	41.00
N:	1000
Mean:	10.23
Stdev:	4.86

Legend	
	Chrome

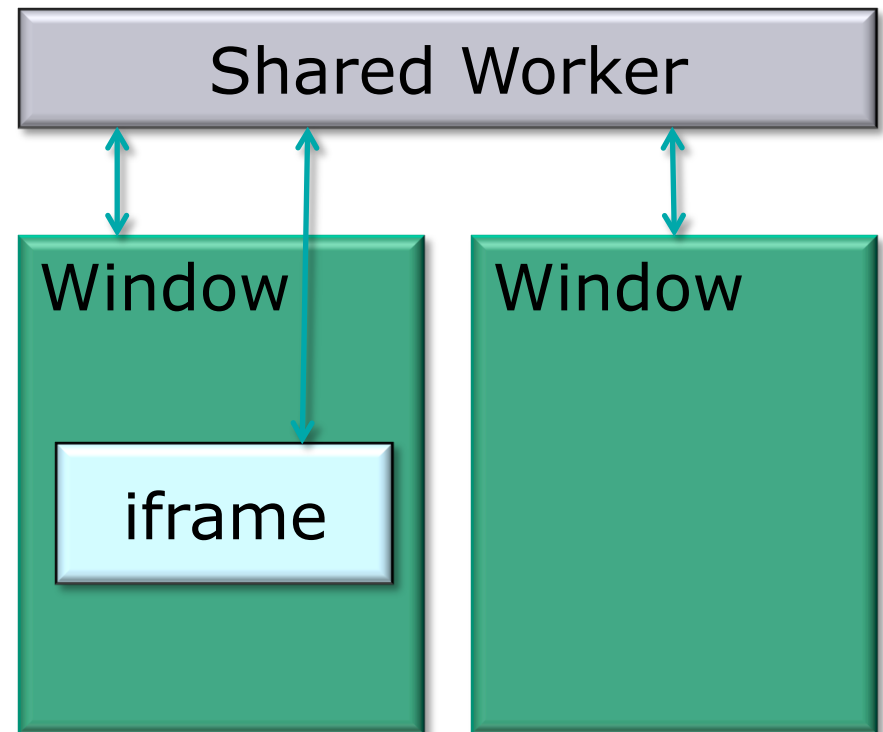
Web Worker Variations

- Inline vs. External
 - BlobBuilder
 - Inline only supported by FF and Chrome
 - No difference in performance
- Dynamic
 - Method determined at run time from JSON string
 - Altered and changed by user at run time

Nested

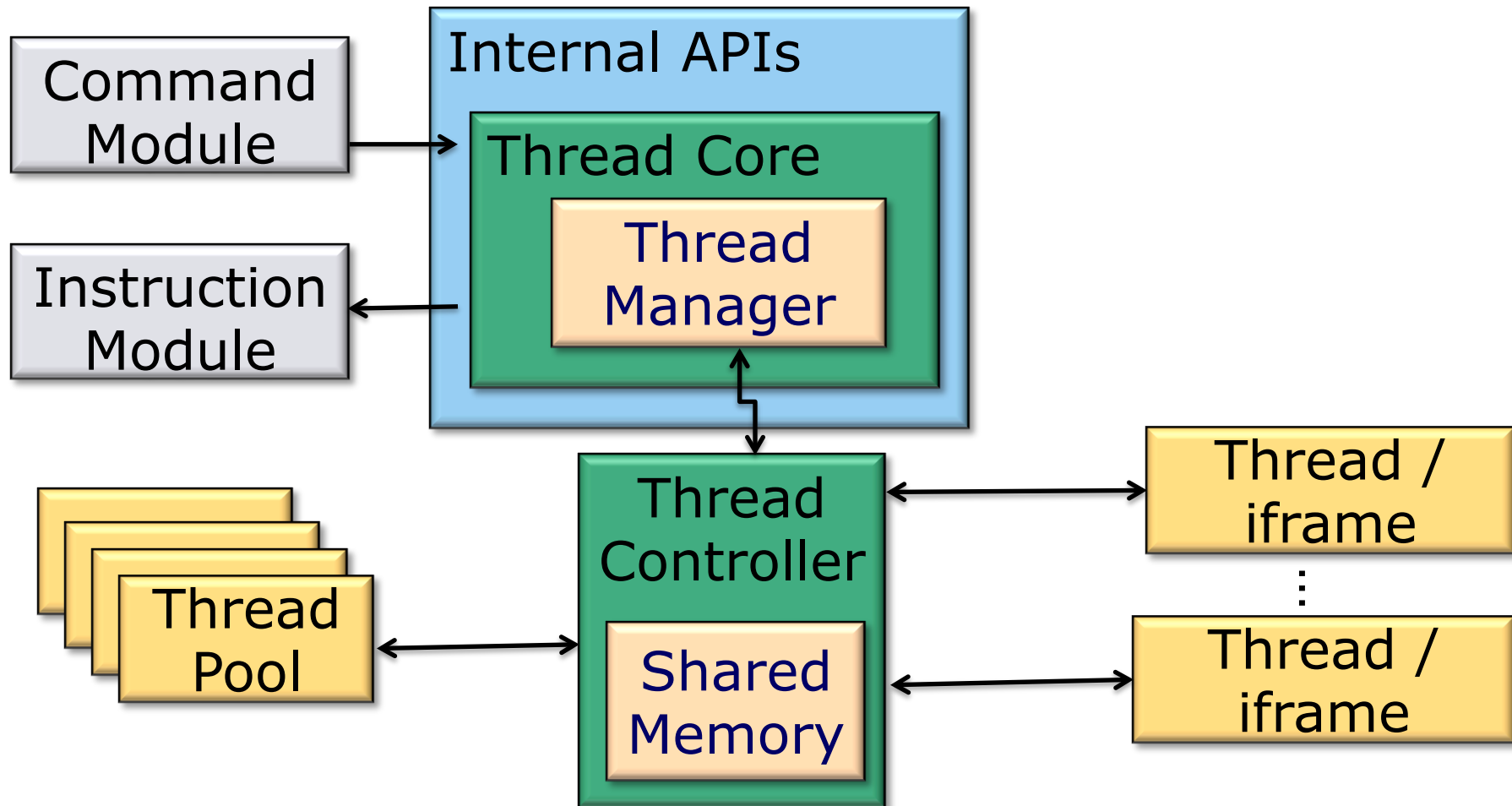


Shared

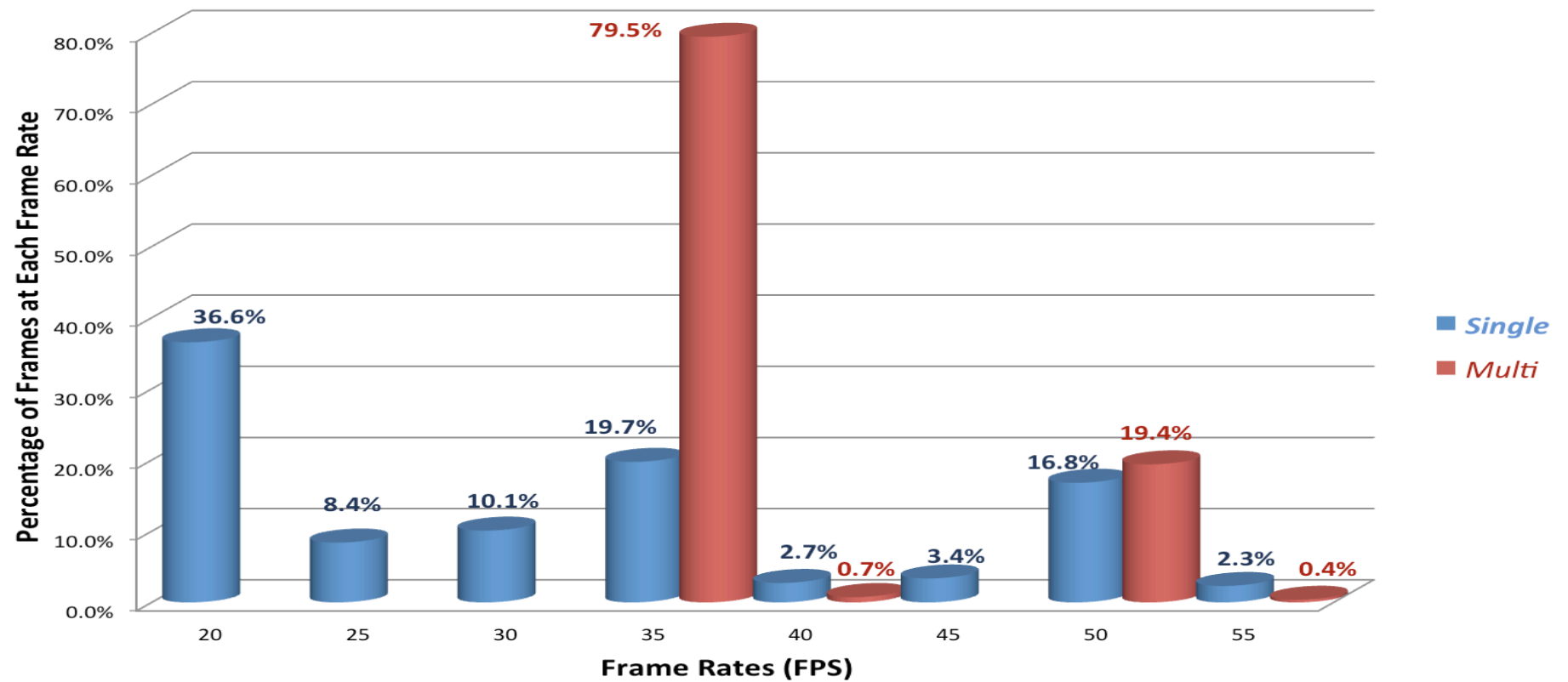


Platform Support

- Chrome/Firefox/Safari
 - Chrome/Safari supports Shared Only
 - Firefox supports Nested Only
- Android – (via Firefox and Opera Browser)
- iOS
- IE 10



Frame Rates for JaHOVA OS Multithreading Demo of Omega Resistance





OpenGL ES 2.0

WebGL

The Basics

- JavaScript Wrapper for OpenGL ES 2.0
- Programmable Graphics Pipeline (GLSL)
- Hardware Acceleration

Sample API/Libraries

- SpiderGL
- Copperlicht
- CubicVR
- Gladius

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Total Number of Units: 0



WebGL Hardware Test

Chrome

Verts	Polys	Draw	FPS	CPU	RAM	Video	OS
858,750	485,292	654	30	2.2GHz Intel i7 Quad Core	4GB	AMD Radeon 6750M 1GB	OSX
634,179	353,386	483	30	2.53GH z Intel Core 2 Duo	4GB	NVIDIA 9800+ 1GB	Windows 7
590,898	333,924	450	33.33	2.53GH z Intel Core 2 Duo	8GB	NVIDIA GeForce 9600M GT	OSX

Browser vs Browser

Browser	Verts	Polys	Draw Calls
Chrome	590,898	333,924	450
Aurora	426,773	241,174	325
WebKit Nightly	393,948	222,624	300
Safari	295,473	166,974	225
Firefox	262,648	148,424	200

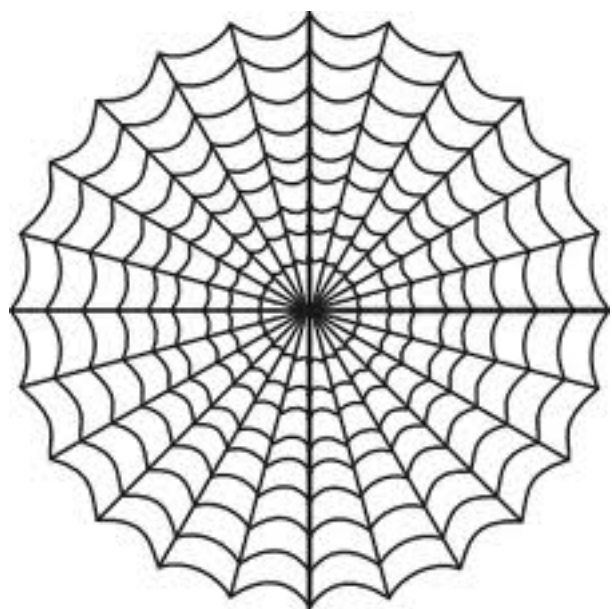
WebGL Tid Bits

Tips

- DebugContext
- WebGL Inspector
- requestAnimationFrame
- BMP Support
- No IE Support with out plugins and Hackery

Up and coming

- WebGL Running in Web Worker
- Swapping Memory Buffer rather than copy



+



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Web Sockets

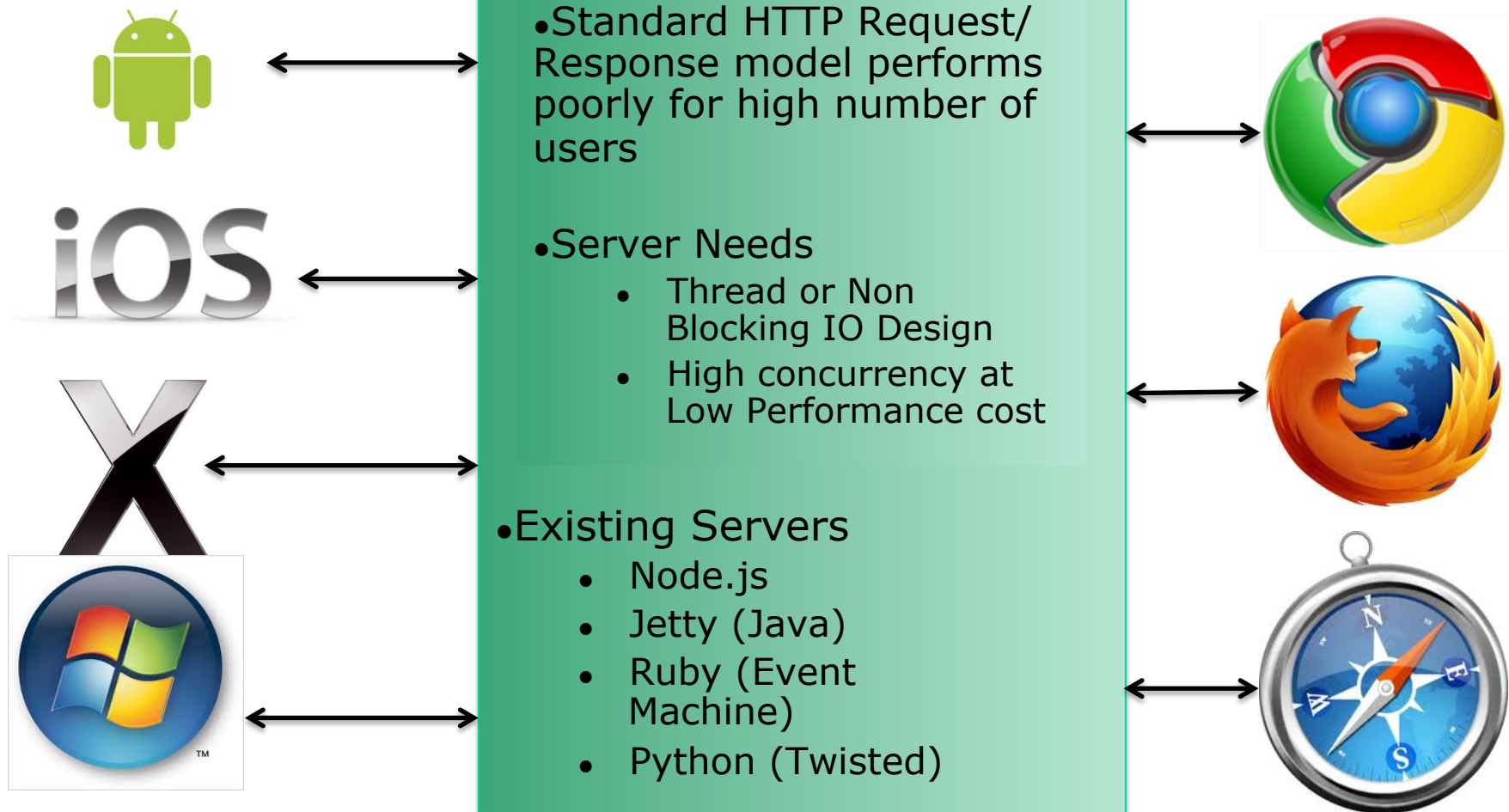
- Full Duplex Communication
- No HTTP overhead
- Has Secure Transport Protocol
- Cross Origin Communication
- Very Simple Client Side API
 - `Socket.onmessage = function(){}`
 - `Socket.onopen = function(){}`
 - `Socket.open(), Socket.send(), Socket.close()`

Nitty Gritty

- 2 Bytes Overhead Per Message
 - XHR ~871 Bytes
- Constant Connection
 - No need to re-establish connection (COMET)
- Connecting to Non Browser Applications (via Proxy/Server)
 - Byte Arrays
 - Bit Shifting

Server Side Implementation

Daniel Montgomery



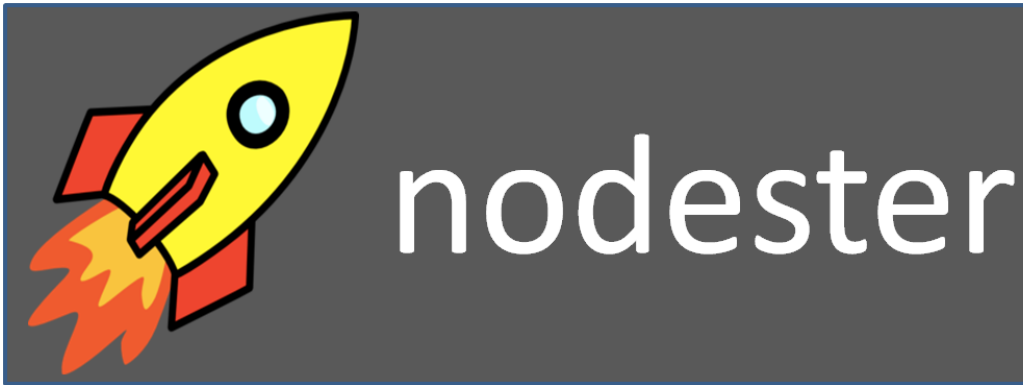


FEATURES

- Google V8 Engine
- JavaScript
- Event Driven
 - Event Loop with Callbacks
 - Non-Blocking
- Native C++ Bindings
- Fast!!

Modules (NPM)

- WebSocket Server
 - Socket.IO
 - Kaazing Gateway
- TCP Server
- File Server
- MySQL, MongoDB, NoSQL



FEATURES

- Well Kept After
 - Documented
 - Quick Response
 - Use existing Git
 - npm dependencies
 - Fast!
 - ("Hello World!" in 1 minute)
- Free!!!

Other hosting options...

 JoyentCloud <http://no.de>

<http://nodejitsu.com>



nodejitsu



<http://heroku.com>

<http://cloudno.de>



JaHOVA OS Server Module

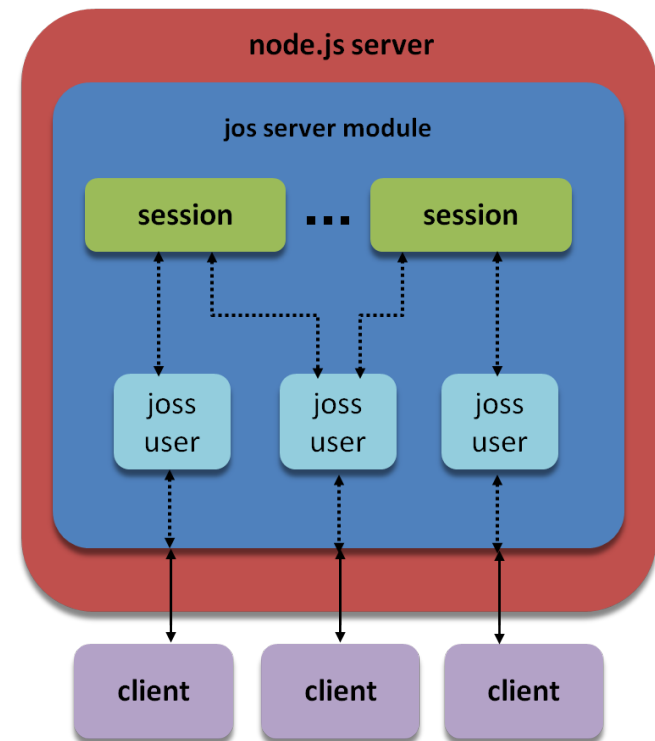
- Connect to Multiple Applications on same server
 - Remote Stream Functions
- User Creation on the fly
- Support for Multiple Connection Types
 - TCP
 - WebSockets
- Socket.IO and Express node.js modules



JOSSM: Breakdown

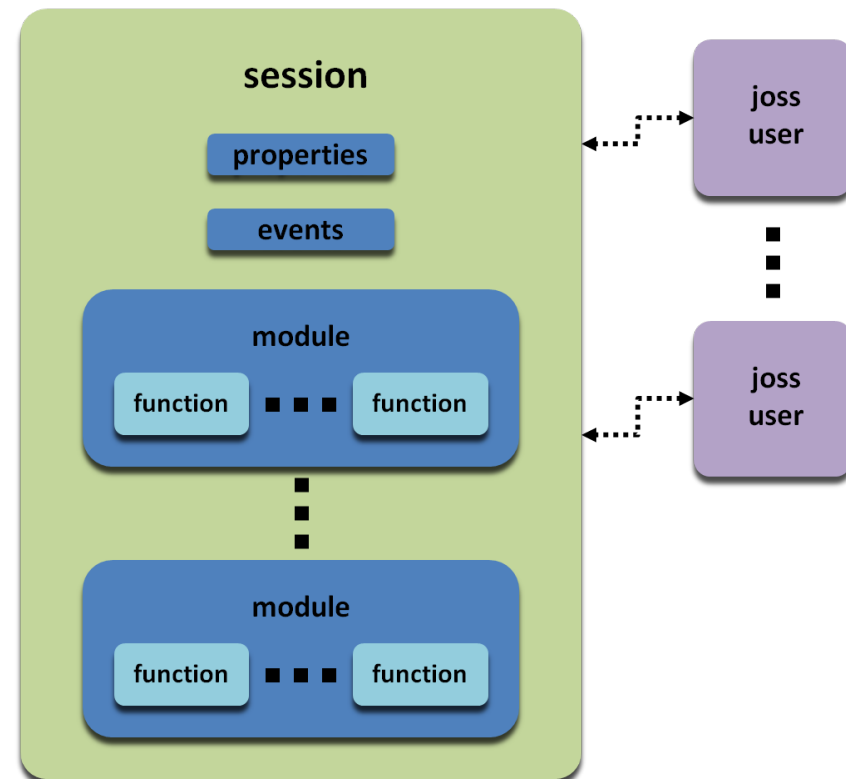
- Multiple Sessions
- Multiple Session Types
 - Defined in a single line!
- Streamed Sessions, Modules, and Functions
- Easily add and connect users to multiple sessions

```
handler.createSession("Omega", "", ["gunner", "pilot"]);
```



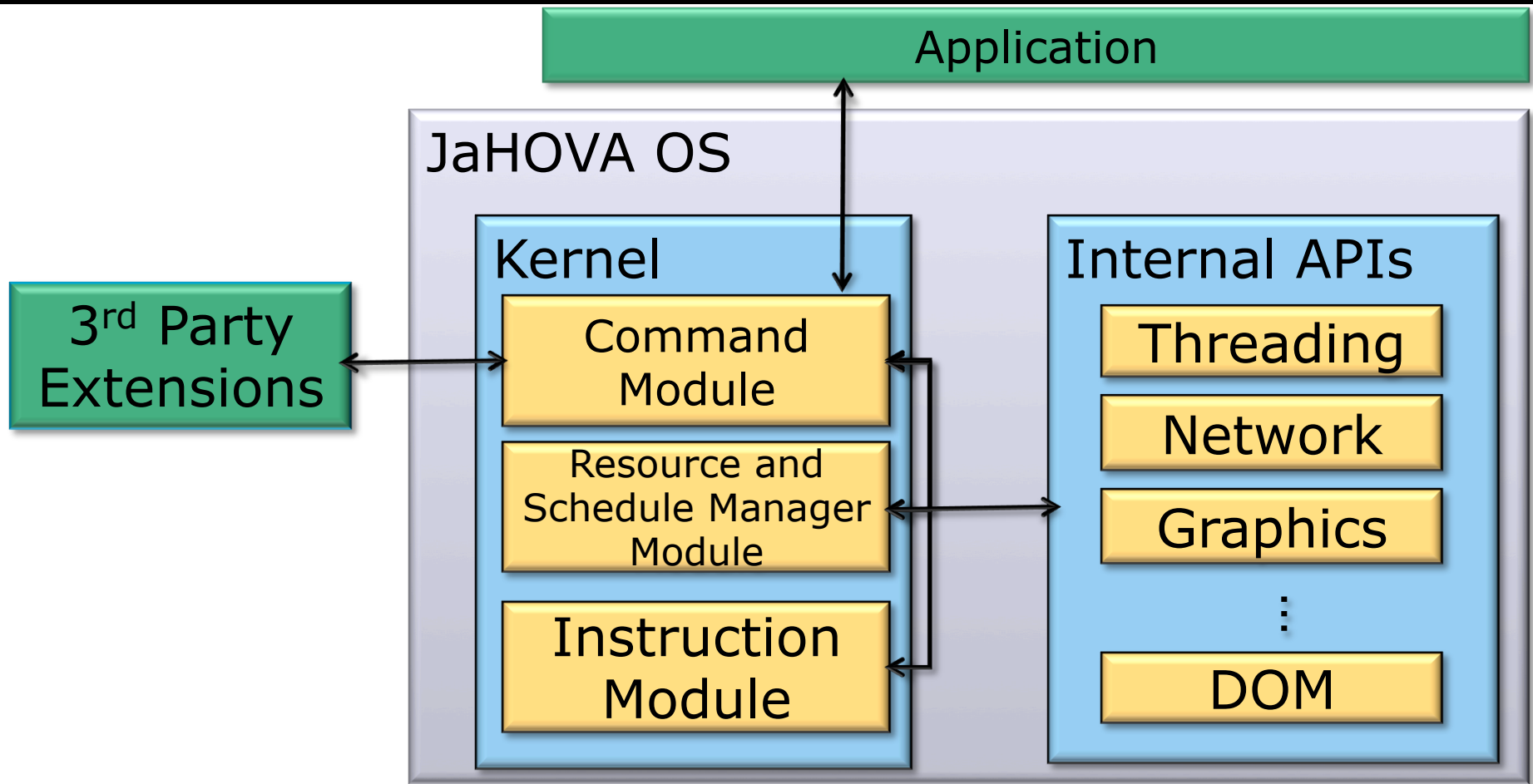
JOSSM: Session Breakdown

- Session Specific Properties
- On Events
 - Open
 - Close
 - Message
 - Error
- Multiple Modules
- Remote Module Requests

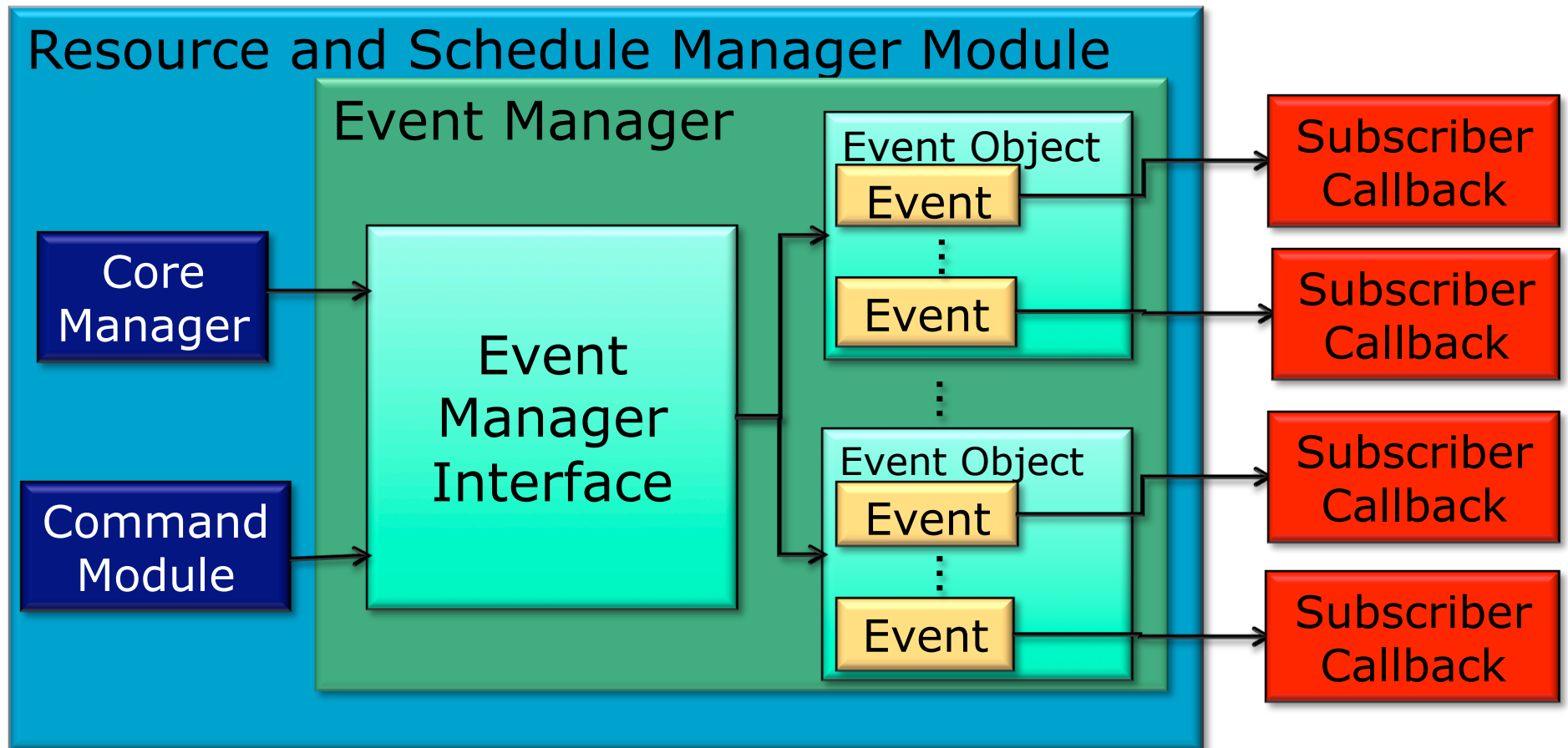


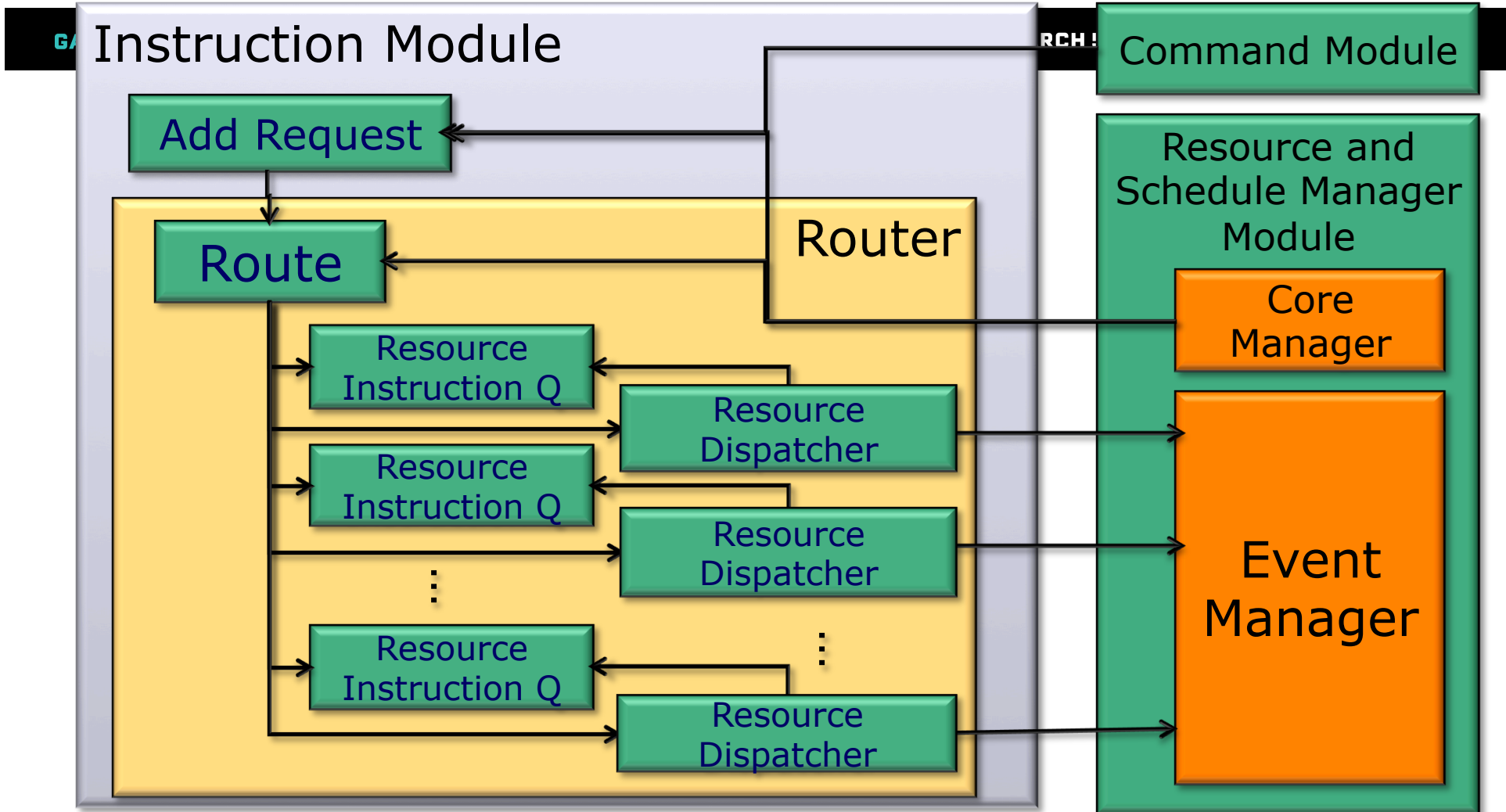
Engine Architecture

- Dynamic Nested/Shared Web Worker
 - Thread Controller
 - Shared Memory Pool
- Custom Event Management System
- Available Engines
 - Akihabara (2D)
 - Effect Game (2D)
 - Isogenic Engine
 - Johmoho



Resource and Schedule Manager Module





Engine Demonstration

- WebGL, WebSockets, Web Workers
- HTML5 Audio
- Thread Controller
 - Networking and Physics
- Node.js
 - JaHOVA OS Server Module
 - WebSocket - SocketIO
- Developed in under a week

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Final Thoughts

- Initialize Threads at Startup
- Initialization Timing
 - Serialize for dependencies and registration
- Careful with Debuggers and Web Workers
- See more at
 - <http://jahovaos.com> : Descriptions and Blog
 - <http://demo.jahovaos.com> : Code
- Expo Floor 2-4 on Wed @ DeVry Booth