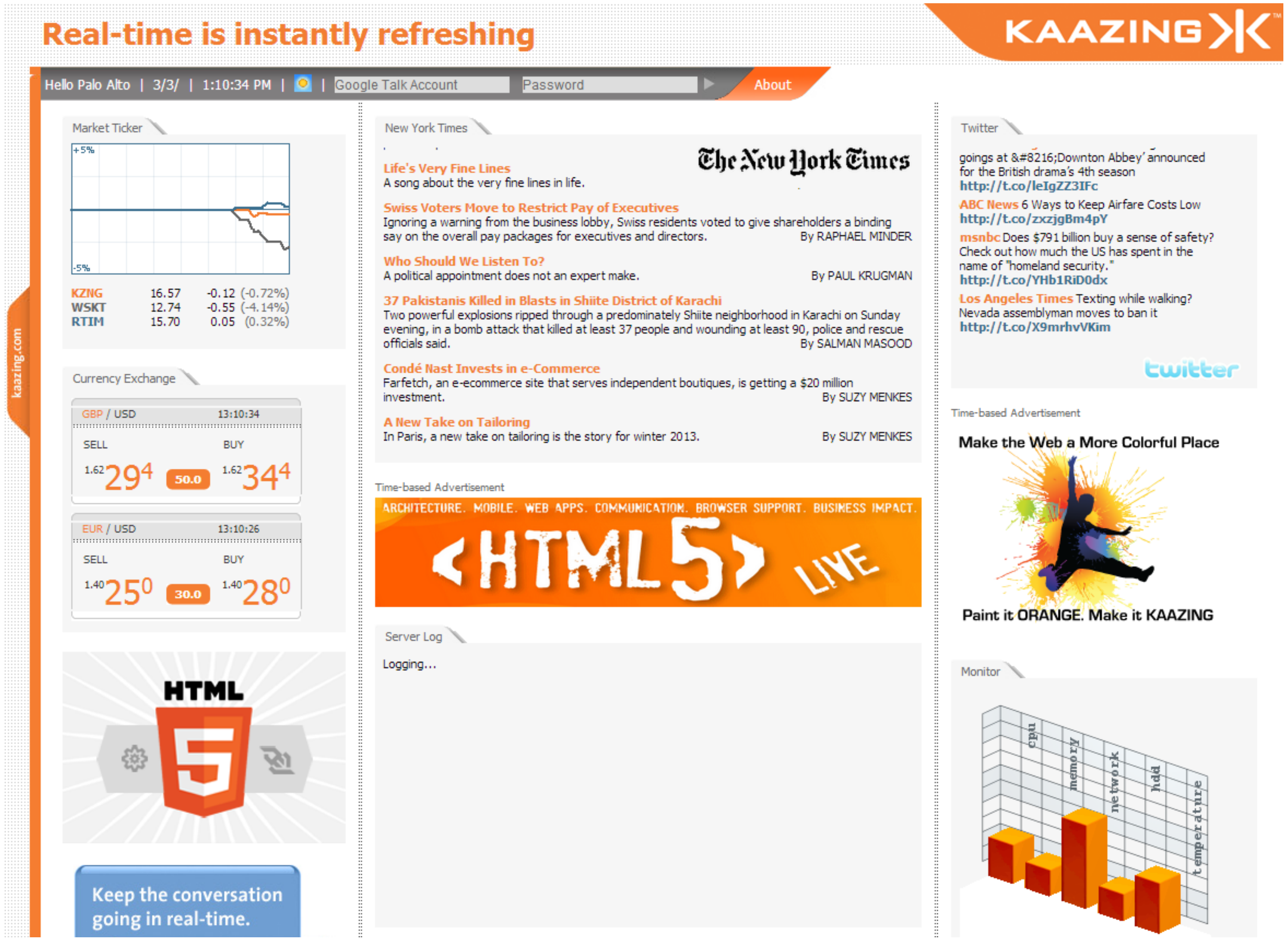
Server push and web sockets



Real-time is instantly refreshing

KAAZING

Hello Palo Alto | 3/3/ | 1:10:34 PM | | Google Talk Account Password About

Market Ticker

+5%

-5%

KZNG	16.57	-0.12	(-0.72%)
WSKT	12.74	-0.55	(-4.14%)
RTIM	15.70	0.05	(0.32%)

Currency Exchange

GBP / USD 13:10:34

SELL 1.62 29^4 50.0 BUY 1.62 34^4

EUR / USD 13:10:26

SELL 1.40 25^0 30.0 BUY 1.40 28^0

HTML 5

Keep the conversation going in real-time.

kaazing.com

New York Times

The New York Times

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Time-based Advertisement

ARCHITECTURE. MOBILE. WEB APPS. COMMUNICATION. BROWSER SUPPORT. BUSINESS IMPACT.

<HTML5> LIVE

Server Log

Logging...

Twitter

goings at &#8216;Downton Abbey' announced for the British drama's 4th season
http://t.co/leIgZZ3IFc

ABC News 6 Ways to Keep Airfare Costs Low
http://t.co/zxzjgBm4pY

msnbc Does $791 billion buy a sense of safety? Check out how much the US has spent in the name of "homeland security."
http://t.co/YHb1RiD0dx

Los Angeles Times Texting while walking? Nevada assemblyman moves to ban it
http://t.co/X9mrhvVKim

twitter

Time-based Advertisement

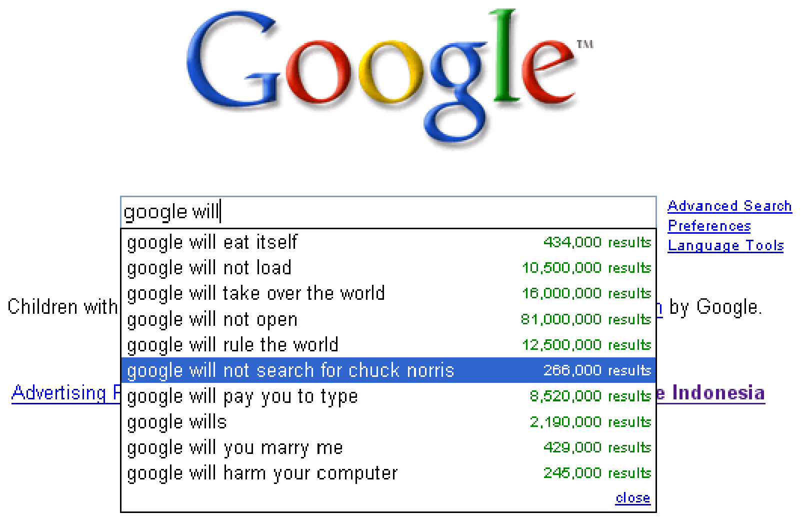
Make the Web a More Colorful Place

Paint it ORANGE. Make it KAAZING

Monitor

Responsive web apps, v1.0

- Problem: Client page needs info from server
- Solution: AJAX allows client to *pull* info
  - `XMLHttpRequest` makes asynchronous requests
    - Hacks to get around cross-domain restrictions
  - Uses standard HTTP request/response protocol
    - Small payload messages have high overhead
    - Latency introduced by HTTP processing



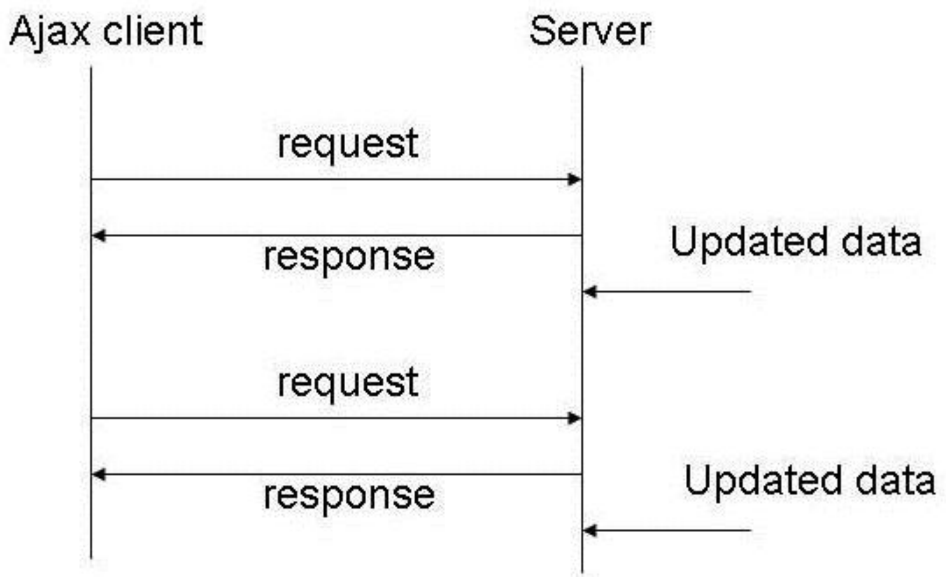
google will

google will eat itself	434,000 results
google will not load	10,500,000 results
google will take over the world	16,000,000 results
google will not open	81,000,000 results
google will rule the world	12,500,000 results
google will not search for chuck norris	266,000 results
google will pay you to type	8,520,000 results
google wills	2,190,000 results
google will you marry me	429,000 results
google will harm your computer	245,000 results

close

Responsive web apps, v2.0

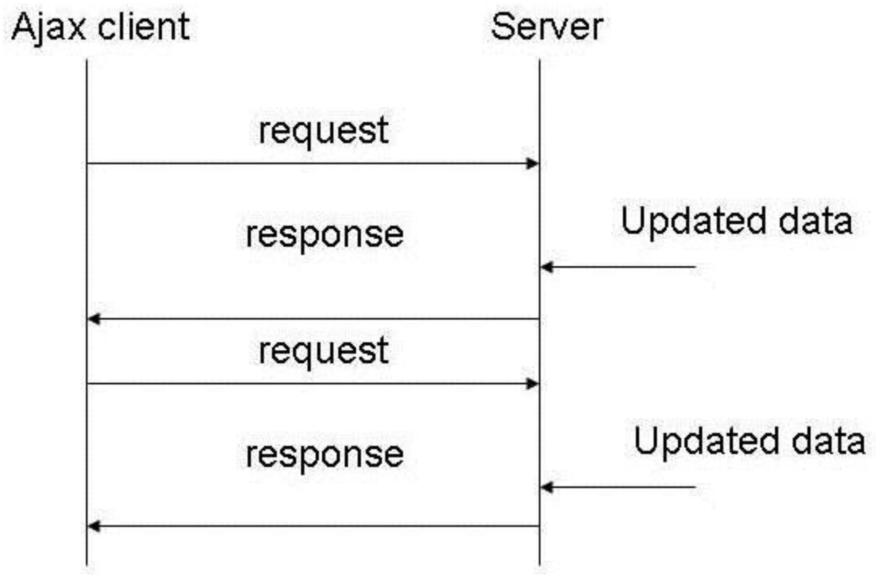
- Problem: Server needs to *push* info to client
  - e.g. update stock price, movement of players, etc.
- Possible solutions:
  - Polling: Client makes periodic AJAX requests
    - Works well if you know the correct polling interval
    - Otherwise wastes network/server resources



http://jfarcand.wordpress.com/2007/05/15/new-adventures-in-comet-polling-long-polling-or-http-streaming-with-ajax-which-one-to-choose/

Responsive web apps, v2.0

- Problem: Server needs to *push* info to client
  - e.g. update stock price, movement of players, etc.
- Possible solutions:
  - Long-polling: Client sends HTTP request, server waits until it has data to send in response
    - Hanging request may have high resource costs



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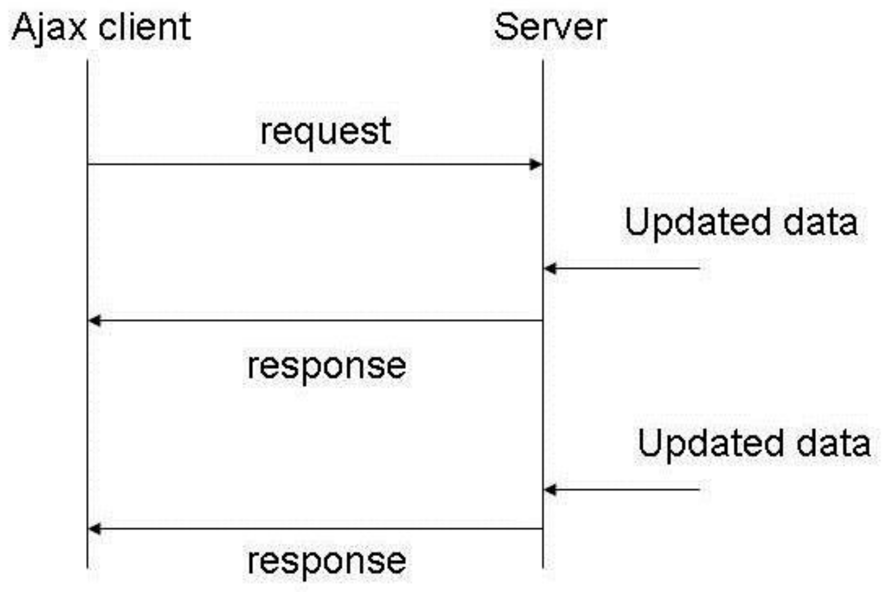
Responsive web apps, v2.0

- Problem: Server needs to *push* info to client
  - e.g. update stock price, movement of players, etc.
- Possible solutions:
  - Streaming: Server maintains open response continuously updated with push events
    - Subject to buffering by agents in network



http://jfarcand.wordpress.com/2007/05/15/new-adventures-in-comet-polling-long-polling-or-http-streaming-with-ajax-which-one-to-choose/

Streaming: HTTP response

- Response from server
  - Status line:
    - Protocol version, status code, status phrase
  - Response headers: extra info
  - Body: optional data

```
HTTP/1.1 200 OK
Date: Thu, 17 Nov 2011 15:54:10 GMT
Server: Apache/2.2.16 (Debian)
Last-Modified: Wed, 14 Sep 2011 17:04:27 GMT
Content-Length: 285

<html> …
```

Code	Meaning	Examples
1xx	Information	100 = server agrees to handle client's request
2xx	Success	200 = request succeeded; 204 = no content present
3xx	Redirection	301 = page moved; 304 = cached page still valid
4xx	Client error	403 = forbidden page; 404 = page not found
5xx	Server error	500 = internal server error; 503 = try again later

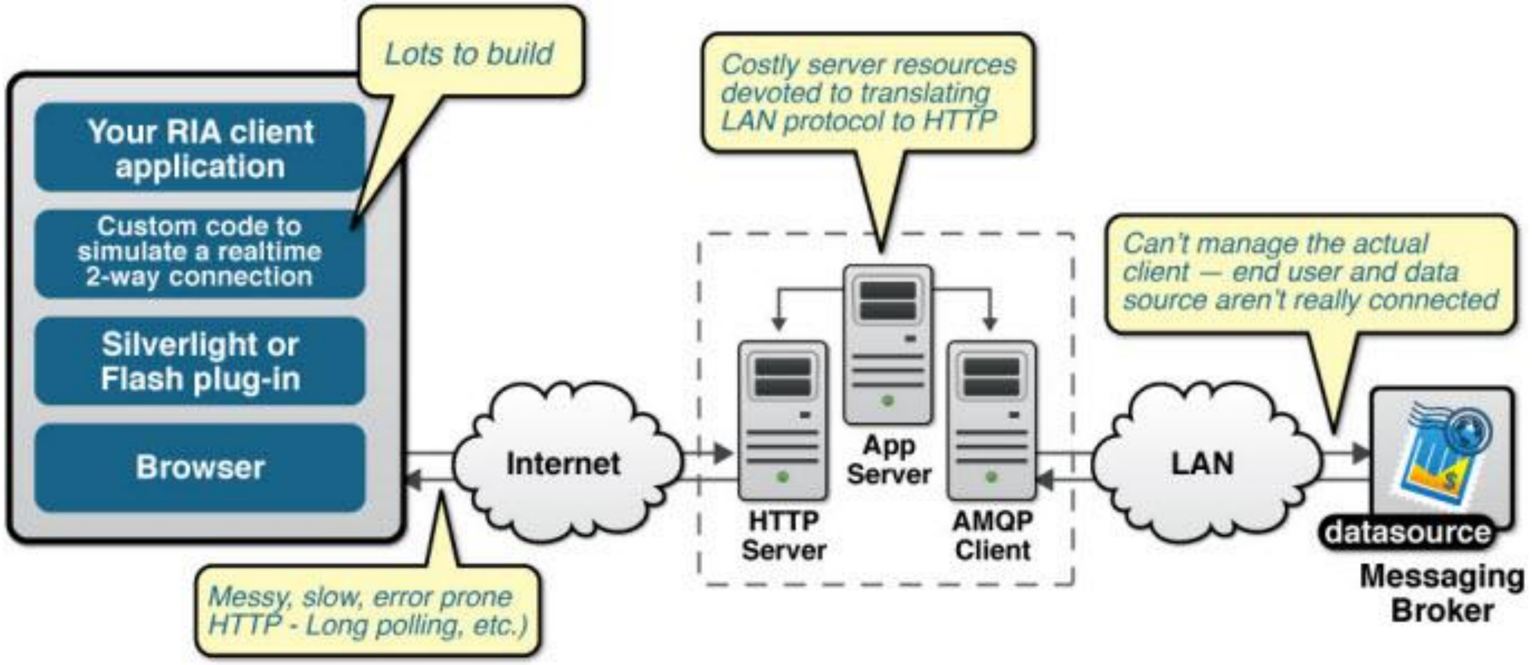
Streaming: HTTP response

- Chunked response
  - Each chunk specifies size in hex, last chunk = 0

```
HTTP/1.1 200 OK
Date: Thu, 17 Nov 2011 15:54:10 GMT
Server: Apache/2.2.16 (Debian)
Last-Modified: Wed, 14 Sep 2011 17:04:27 GMT
Transfer-Encoding: chunked
29
<html><body><p>The file you requested is
5
3,400
23
bytes long and was last modified:
1d
Sat, 20 Mar 2004 21:12:00 GMT
13
.</p></body></html>
0
```

Comet

- Comet (long-polling, streaming)
  - Simulate bi-directional communication
    - Using HTTP request/response protocol
    - Often requires two connections, one for downstream, one for upstream
    - Resource expensive and error prone to write

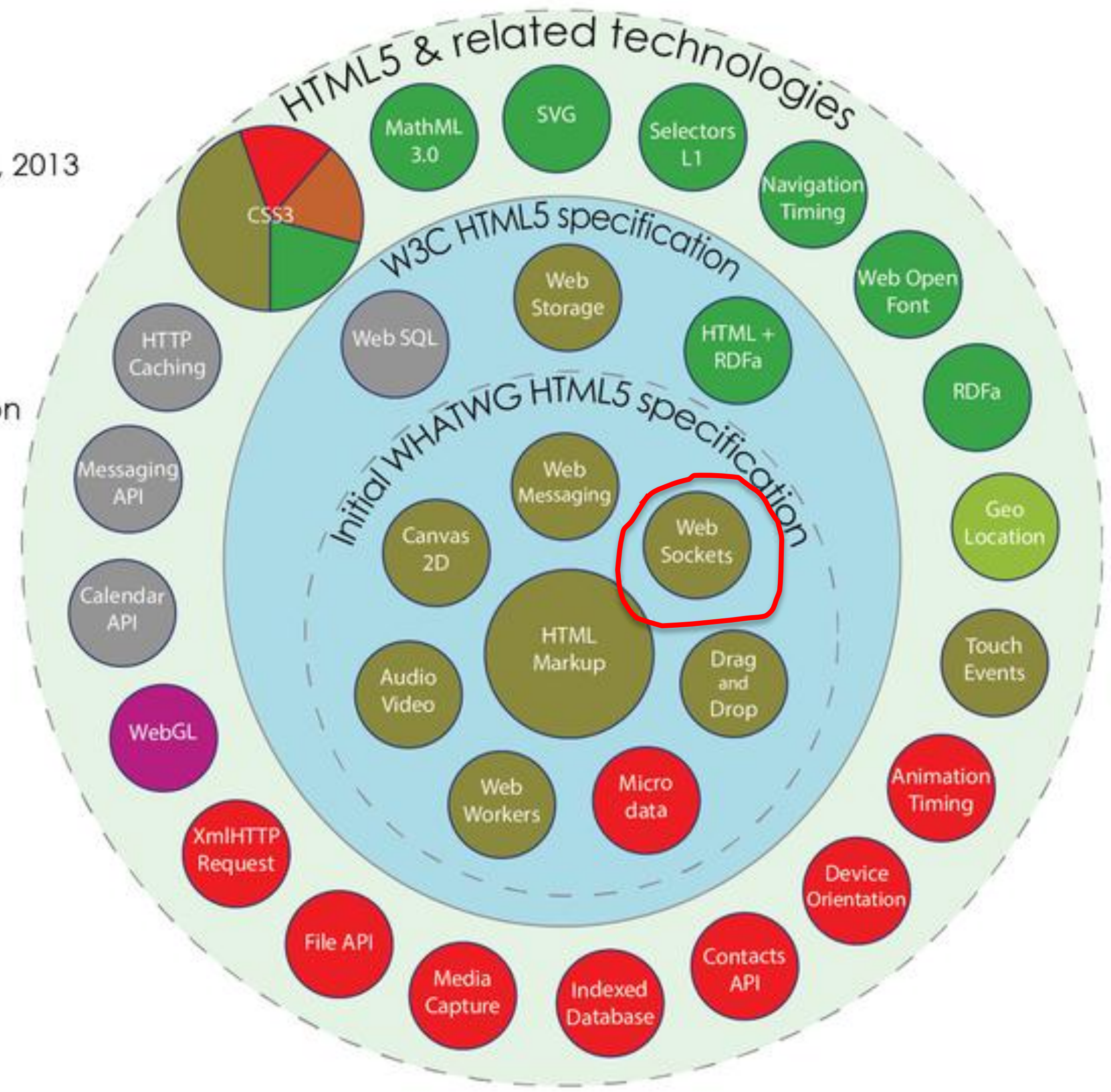

Lots to build
Your RIA client application
Custom code to simulate a realtime 2-way connection
Silverlight or Flash plug-in
Browser
Internet
Messy, slow, error prone HTTP - Long polling, etc.)
Costly server resources devoted to translating LAN protocol to HTTP
HTTP Server
App Server
AMQP Client
LAN
Can't manage the actual client — end user and data source aren't really connected
datasource
Messaging Broker

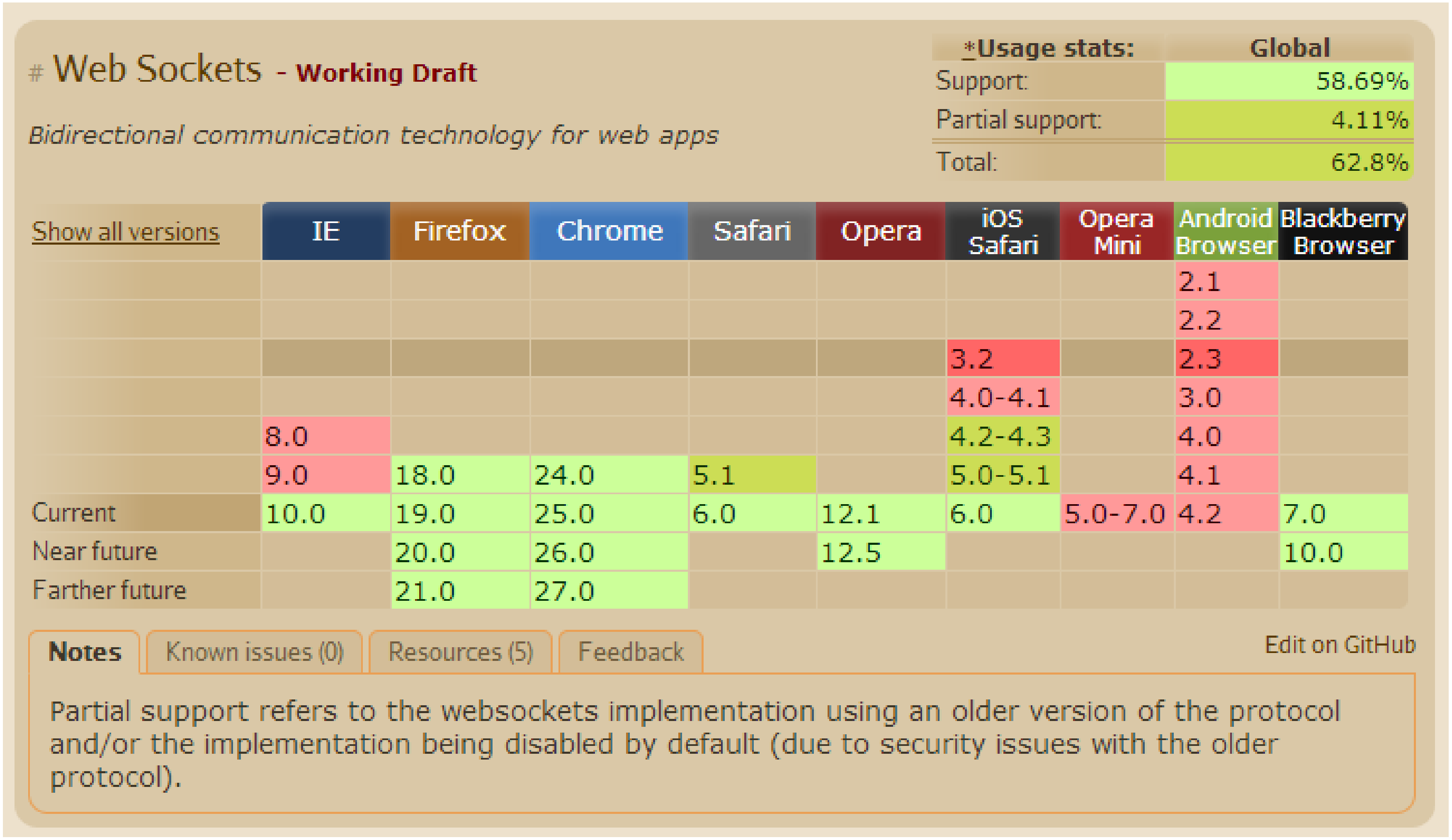
http://www.websocket.org/quantum.html

HTML5

Taxonomy & Status on January 20, 2013

🟢 W3C Recommendation
🟢 Proposed Recommendation
🟤 Candidate Recommendation
🟠 Last Call
🔴 Working Draft
🟣 Non-W3C Specifications
⚪ Deprecated





Web Sockets - **Working Draft**

Bidirectional communication technology for web apps

*Usage stats:	Global
Support:	58.69%
Partial support:	4.11%
Total:	62.8%

Show all versions	IE	Firefox	Chrome	Safari	Opera	iOS Safari	Opera Mini	Android Browser	Blackberry Browser
								2.1	
								2.2	
						3.2		2.3	
						4.0-4.1		3.0	
	8.0					4.2-4.3		4.0	
	9.0	18.0	24.0	5.1		5.0-5.1		4.1	
Current	10.0	19.0	25.0	6.0	12.1	6.0	5.0-7.0	4.2	7.0
Near future		20.0	26.0		12.5				10.0
Farther future		21.0	27.0						

Notes | Known issues (0) | Resources (5) | Feedback

Edit on GitHub

Partial support refers to the websockets implementation using an older version of the protocol and/or the implementation being disabled by default (due to security issues with the older protocol).

HTML5 Web Sockets

- Web sockets:
  - JavaScript interface for client-side
  - Full-duplex communication
    - Using a single object, send string or binary data
    - Low latency, low header overhead (strings = 2 bytes)
  - Initial handshake over HTTP
    - Upgraded to web socket protocol
      - Some proxies may not like and drop the connection
    - Runs on port 80 allowing it to traverse NATs

"Reducing kilobytes of data to 2 bytes…and reducing latency from 150ms to 50ms is far more than marginal. In fact, these two factors alone are enough to make Web Sockets seriously interesting to Google."

-Ian Hickson

Web socket protocol

- URL prefix:
  - ws:// for normal connections, wss:// for secure
- HTTP-compatible handshake:

```
GET ws://echo.websocket.org/?encoding=text HTTP/1.1
Origin: http://websocket.org
Cookie: __utma=99as Connection: Upgrade
Host: echo.websocket.org
Sec-WebSocket-Key: uRovscZjNol/umbTt5uKmw==
Upgrade: websocket
Sec-WebSocket-Version: 13
```

```
HTTP/1.1 101 WebSocket Protocol Handshake
Date: Fri, 10 Feb 2012 17:38:18 GMT
Connection: Upgrade
Server: Kaazing Gateway
Upgrade: WebSocket
Access-Control-Allow-Origin: http://websocket.org
Access-Control-Allow-Credentials: true
Sec-WebSocket-Accept: rLHCkw/SKsO9GAH/ZSFhBATDKrU=
Access-Control-Allow-Headers: content-type
```

Web socket protocol

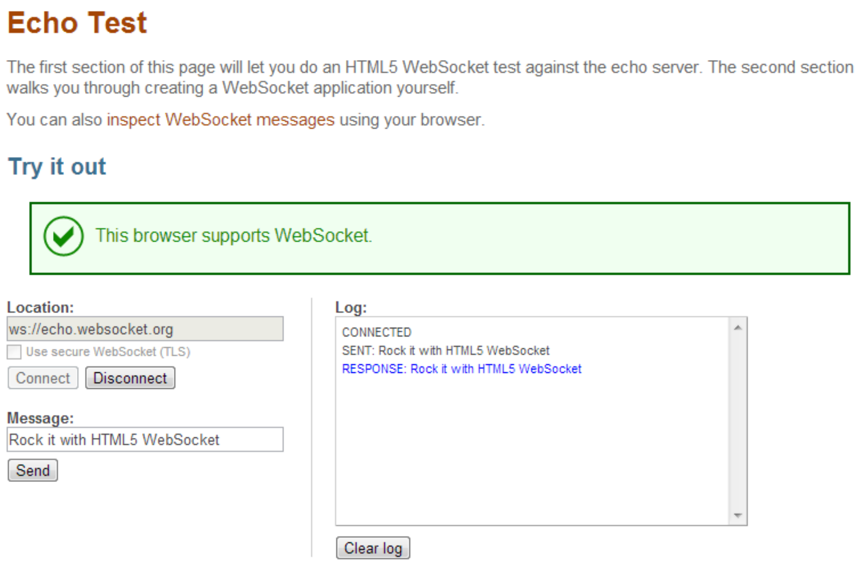
- After handshake:
  - HTTP connection broken down
  - Replaced by WebSocket connection
    - Over the same TCP/IP connection
    - Update is one way, can't go back to HTTP
- Framing:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-------+-+-------------+-------------------------------+
|F|R|R|R| opcode|M| Payload len |    Extended payload length    |
|I|S|S|S|  (4)  |A|     (7)     |             (16/64)           |
|N|V|V|V|       |S|             |   (if payload len==126/127)   |
| |1|2|3|       |K|             |                               |
+-+-+-+-+-------+-+-------------+ - - - - - - - - - - - - - - - +
|     Extended payload length continued, if payload len == 127  |
+ - - - - - - - - - - - - - - - +-------------------------------+
|                               |Masking-key, if MASK set to 1  |
+-------------------------------+-------------------------------+
| Masking-key (continued)       |          Payload Data         |
+-------------------------------- - - - - - - - - - - - - - - - +
:                     Payload Data continued ...                :
+ - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - +
|                     Payload Data continued ...                |
+---------------------------------------------------------------+
```

Example messages

- A single-frame unmasked text message
  - 0x81 0x05 0x48 0x65 0x6c 0x6c 0x6f (contains "Hello")
- A fragmented unmasked text message
  - 0x01 0x03 0x48 0x65 0x6c (contains "Hel")
  - 0x80 0x02 0x6c 0x6f (contains "lo")
- Unmasked Ping request and masked Ping response
  - 0x89 0x05 0x48 0x65 0x6c 0x6c 0x6f (contains a body of "Hello")
  - 0x8a 0x85 0x37 0xfa 0x21 0x3d 0x7f 0x9f 0x4d 0x51 0x58 (contains a body of "Hello", matching the body of the ping)
- 256 bytes binary message in a single unmasked frame
  - 0x82 0x7E 0x0100 [256 bytes of binary data]
- 64KiB binary message in a single unmasked frame
  - 0x82 0x7F 0x0000000000010000 [65536 bytes of binary data]

Web socket examples



Echo Test

The first section of this page will let you do an HTML5 WebSocket test against the echo server. The second section walks you through creating a WebSocket application yourself.

You can also inspect WebSocket messages using your browser.

Try it out

This browser supports WebSocket.

Location: ws://echo.websocket.org

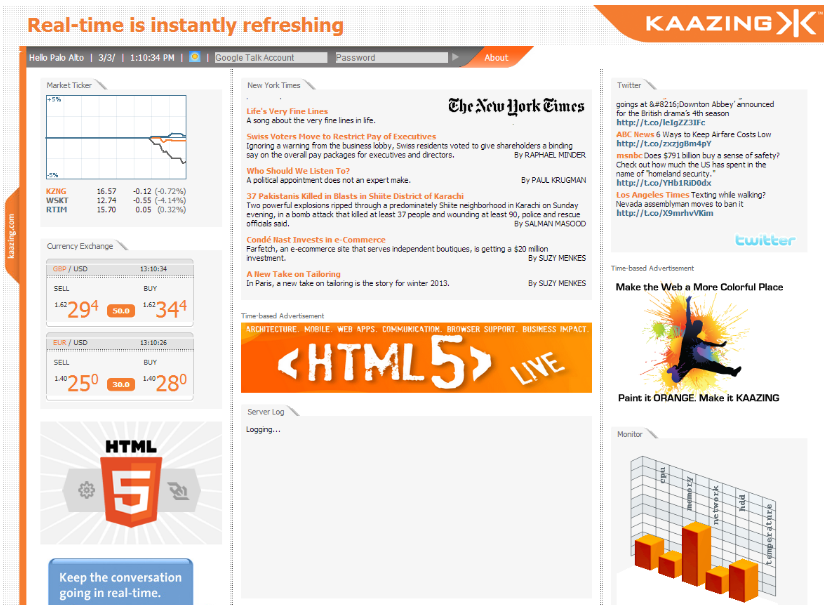
☐ Use secure WebSocket (TLS)

Message: Rock it with HTML5 WebSocket

Log:

```
CONNECTED
SENT: Rock it with HTML5 WebSocket
RESPONSE: Rock it with HTML5 WebSocket
```

http://www.websocket.org/echo.html



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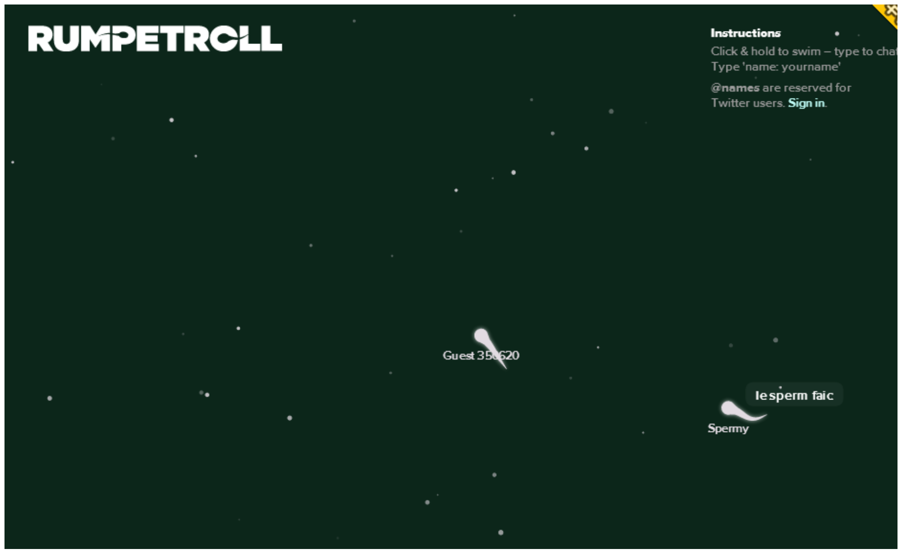

RUMPETROLL
Instructions
Click & hold to swim – type to chat
Type 'name: yourname'
@names are reserved for Twitter users. Sign in.
Guest 358620
le sperm faic
Spermy

http://rumpetroll.com/

http://labs.dinahmoe.com/plink/

http://www.youtube.com/watch?v=64TcBiqmVko

WebSocket interface

```
num BinaryType { "blob", "arraybuffer" };
[Constructor(DOMString url, optional (DOMString or DOMString[]) protocols)]
interface WebSocket : EventTarget
{
  readonly attribute DOMString url;

  // ready state
  const unsigned short CONNECTING = 0;
  const unsigned short OPEN = 1;
  const unsigned short CLOSING = 2;
  const unsigned short CLOSED = 3;
  readonly attribute unsigned short readyState;
  readonly attribute unsigned long bufferedAmount;

  // networking
           attribute EventHandler onopen;
           attribute EventHandler onerror;
           attribute EventHandler onclose;
  readonly attribute DOMString extensions;
  readonly attribute DOMString protocol;
  void close([Clamp] optional unsigned short code, optional DOMString reason);

  // messaging
           attribute EventHandler onmessage;
           attribute BinaryType binaryType;
  void send(DOMString data);
  void send(Blob data);
  void send(ArrayBuffer data);
  void send(ArrayBufferView data);
};
```

Simple text echo client

```
<!DOCTYPE html>
<html>
<head>
<meta charset="utf-8" />
<script>
function init()
{
   websocket           = new WebSocket("ws://echo.websocket.org/");
   websocket.onopen    = function(e) { onOpen(e)    };
   websocket.onclose   = function(e) { onClose(e)   };
   websocket.onmessage = function(e) { onMessage(e) };
   websocket.onerror   = function(e) { onError(e)   };
}
function onOpen(e)
{
   writeToScreen("CONNECTED");
   message = "Hello world!";
   writeToScreen("SENT: " + message);
   websocket.send(message);
}
function onClose(e)
{
   writeToScreen("DISCONNECTED");
}
function onMessage(e)
{
   writeToScreen('RESPONSE: ' + e.data);
   websocket.close();
}
function onError(e)
{
   writeToScreen('ERROR: ' + e.data);
}
```

```
function writeToScreen(message)
{
   document.getElementById("output").innerHTML +=
      message + "<br />";
}
window.addEventListener("load", init, false);
</script>
</head>

<body>
<h2>WebSocket Test</h2>
<div id="output"></div>
</body>
</html>
```

Supported data types

- In latest spec, send data as:
  - Text
  - ArrayBuffer
  - Blob

```
// Sending String
connection.send('your message');

// Sending canvas ImageData as ArrayBuffer
var img = canvas_context.getImageData(0, 0, 400, 320);
var binary = new Uint8Array(img.data.length);
for (var i = 0; i < img.data.length; i++)
{
   binary[i] = img.data[i];
}
connection.send(binary.buffer);

// Sending file as Blob
var file = document.querySelector('input[type="file"]').files[0];
connection.send(file);
```

```
// Setting binaryType to accept received binary as either 'blob' or 'arraybuffer'
connection.binaryType = 'arraybuffer';
connection.onmessage = function(e)
{
   console.log(e.data.byteLength); // ArrayBuffer object if binary
};
```

http://www.html5rocks.com/en/tutorials/websockets/basics/

Web socket server

- The server side
  - You need server-side support!
    - Must support a large number of open WebSocket Connections
    - Traditional stacks (e.g. LAMP) do not deal well with this
- Apache options:
  - apache-websocket
    - Apache module that handles the WebSocket protocol
    - Develop your own module (in C) for app-specific details
  - pywebsocket
    - As an Apache module or as a standalone server
    - Requires mod_python

Other server options…

- C/C++
  - libwebsockets
  - Mongoose
  - POCO C++ Libraries
  - Tufão
  - Wslay
  - QtWebsocket
- Erlang
  - Yaws
- Go
  - go.net/websocket
  - webrocket
- Haskell
  - websockets
- Java
  - Apache Tomcat 7
  - Play Framework
  - Atmosphere
  - Bristleback
  - GlassFish 3.1, Grizzly
  - HLL WebSockets
  - JBoss 7
  - Jetty 7
  - jWebsocket
  - Netty 3.3
  - MigratoryData WebSocket Server
- .NET Framework
  - Internet Information Services (IIS) 8, ASP.NET 4.5
  - Windows Communication Foundation 4.5 through NetHttpBinding
  - Fleck
  - SuperWebSocket
  - XSockets.NET
- Clojure
  - http-kit
  - aleph
- Nginx
  - Proxy (since version 1.3.13)
  - Push Stream (3-rd party module)
- Node.js
  - Socket.IO
  - WebSocket-Node
- Objective-C
  - SocketRocket
  - BLWebSocketsServer
- Perl
  - Mojolicious
  - PocketIO
- PHP
  - php-websocket
  - Ratchet
- Python
  - WebSocket-for-Python
  - txWS
  - AutobahnPython
- Ruby
  - EM-WebSocket
- Other
  - apache-websocket
  - mod_websocket for lighttpd
  - nginx supports websocket since version 1.3

Summary

- Responsive interactive web apps
  - Requires low latency bi-directional communication
  - Existing solutions:
    - Ajax polling, long polling, streaming
    - But these are really hacks working within an ill-suited HTTP request/response framework
  - HTML5 web sockets:
    - Simple client -side API
    - Requires server that supports web sockets
    - You have to develop app-specific logic in some way
      - e.g. Apache module, Java servelet, …