Development of Web Applications

Principles and Practice

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5 Client Technologies

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Today’s agenda

- AJAX,
- JSONP,
- HTML5,
- WebSockets.

AJAX

AJAX Asynchronous JavaScript and XML

With AJAX, a JavaScript script can send data to, and retrieve data from, a server asynchronously (in the background) without interfering with the display and behavior of the existing page.

Despite the name, the use of XML is not required. In fact, JSON is much more popular.

AJAX call example

```
var xhr = new XMLHttpRequest();
xhr.open('get', 'http://example/method');

xhr.onreadystatechange = function() {
  // Ready state 4 means the request is done
  if (xhr.readyState === 4) {
    if (xhr.status === 200) {
      alert('Success: ' + xhr.responseText);
    } else {
      alert('Error: ' + xhr.status);
    }
  }
}

xhr.send(null);
```

AJAX: XML or JSON response

XML response:

```
xhr.responseType = "document";
xhr.responseXML.documentElement
```

JSON response:

```
xhr.responseType = "json";
eval(xhr.responseText)
```

(if you trust the response source!).

Same origin policy

AJAX requests can be made only to URLs of the same domain (host and port) as the page.

AJAX is hence useful for communication with the server of a web application, but not for doing calls to a third-party API.

For remote API calls, several workarounds are used:

- JSONP (by far the most popular),
- Using the application server as a proxy (costly),
- iframes / using the URL to communicate (tricky),
- Messages (the clean way, in HTML5).

W3C Specification

- Level 1 (1999)
- Level 2 (2008)
  - progress events,
  - support for cross-site requests,
  - handling of byte streams

http://www.w3.org/TR/XMLHttpRequest/

http://www.w3.org/TR/XMLHttpRequest2/

JSONP

JSONP JSON with Padding

An alternative to AJAX, for requesting data from a server in a different domain.

How it works?

- The client script generates the request by adding a `<script>` tag to the page:

```
<script type="application/javascript"
        src="http://directory/?id=42">
```

- The server returns a JavaScript containing a JSON value, wrapped into a function call (the padding):

```
callback({"id": 42,
          "name": "Vincent Simonet"});
```

JSONP in practice

- The name of the padding is usually passed as an argument in the request:

```
<script type="application/javascript"
        src="...?id=42&jsonp=mycallback">
mycallback({"id": 42,
            "name": "Vincent Simonet"});
```

- JavaScript frameworks provide helper functions for making this transparent. E.g. in jQuery:

```
$.ajax({url : 'http://.../?id=42',
        dataType : 'jsonp',
        jsonp : 'jsonp',
        success : function(data){}
});
```

JSONP limitations

- Only GET (POST is doable, but tricky),
- No access to HTTP headers (in request and response), including cookies.

WebSockets

The problem

In HTTP and AJAX, all exchanges are initiated by **client** requests.

In some applications, it is useful to have the server pushing information to the client. E.g.:

- Notifications in a news website,
- Messages in a chat system,
- etc.

Workaround solutions

- The client can make periodic requests to the server,
- The client can make a request to the server, which will answer with an "infinite" response. Known as Comet.
  Several implementations:
  - Streaming (using iframe or special XmlHttpRequest),
  - Long polling (using XmlHttpRequest or script tags).

The HTML5 solution: WebSockets

WebSocket is is a protocol providing full-duplex communications channels over a single TCP connection.

Enables a stream of *messages*.

Its only relationship to HTTP are:

- its handshake is interpreted by HTTP servers as an Upgrade request,
- it is using port 80 as default port.

WebSocket protocol handshake

Request:

```
GET /mychat HTTP/1.1
Host: server.example.com
Upgrade: websocket
Connection: Upgrade
Sec-WebSocket-Key: x3JJHMbDL1EzLkh9GBhXDw==
Sec-WebSocket-Protocol: chat
Sec-WebSocket-Version: 13
Origin: http://example.com
```

Response:

```
HTTP/1.1 101 Switching Protocols
Upgrade: websocket
Connection: Upgrade
Sec-WebSocket-Accept: HSmrc0sMlYUkAGmm5OPpG2HaGWk=
Sec-WebSocket-Protocol: chat
```

Client-side JavaScript API

```
var connection = new WebSocket('ws://.../echo',
['soap', 'xmpp']);

connection.onopen = function () {
  connection.send('Ping');
};

connection.onerror = function (error) {
  console.log('WebSocket Error ' + error);
};

connection.onmessage = function (e) {
  console.log('Server: ' + e.data);
};
```

Server-side implementations

- Java: Jetty
- Node.js: ws, WebSocket-Node
- Python: pywebsocket

HTML5

What is HTML5?

The 5th version of the HTML language, subsuming HTML 4.01 and XHTML 1.1

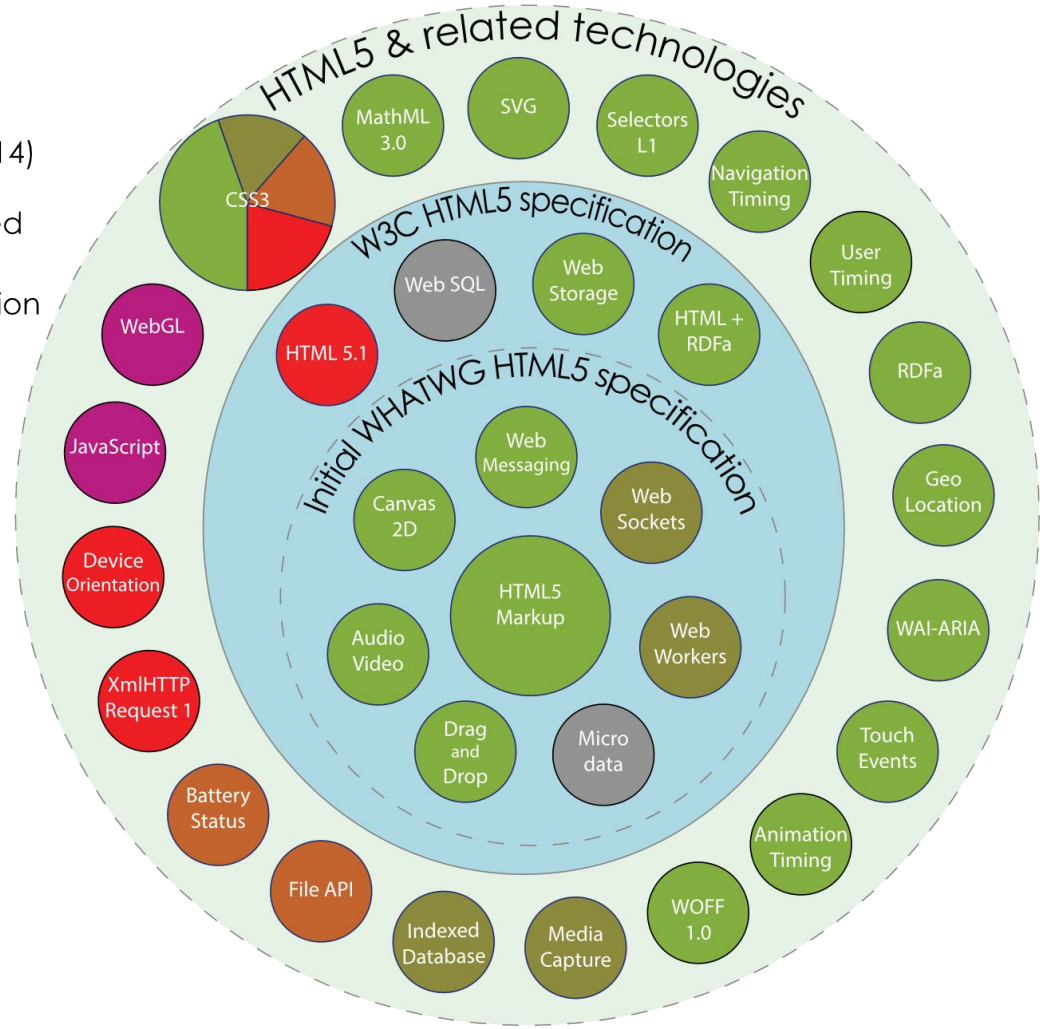
New/extended markup, and a galaxy of APIs.

Specification status

HTML5

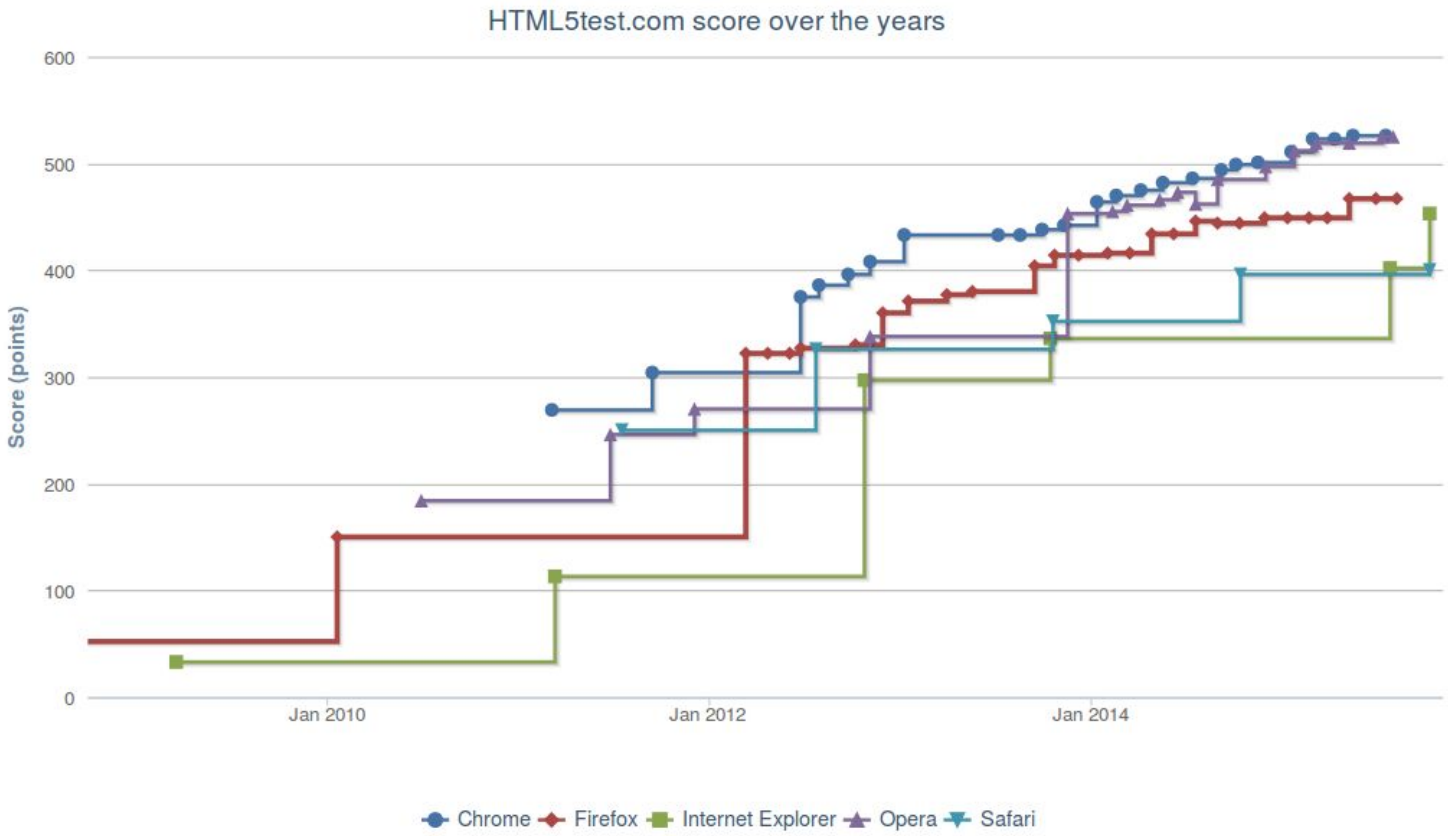
Taxonomy & Status (October 2014)

- Recommendation/Proposed
- Candidate Recommendation
- Last Call
- Working Draft
- Non-W3C Specifications
- Deprecated or inactive



Implementation status

Source: html5test.com



Main HTML5 features

- **Semantic tags,**
- **Canvas,**
- Video,
- **Geo-localisation,**
- Local storage,
- Offline,
- **Improved forms,**
- **Microdata,**
- **History manipulation.**

Tags in HTML5

- Semantic replacements of `<div>` or `<span>`:
  `<nav>` `<header>` `<footer>` `<section>` `<hgroup>` `<article>` `<aside>` `<time>` `<mark>`
- Replacements of `<object>`:
  `<audio>` `<video>`
- Removal of some style tags:
  `<font>` `<center>` `<strike>` `<tt>`

(non-exhaustive list)

Canvas

HTML:

```
<canvas id="c" width="500"
                height="375"></canvas>
```

JavaScript:

```
var c_canvas = document.getElementById
("c");
var context = c_canvas.getContext("2d");
for (var x = 0.5; x < 500; x += 10) {
  context.moveTo(x, 0);
  context.lineTo(x, 375);
}
```

Geo-localisation

```
navigator.geolocation.getCurrentPosition(
  handle_success, handle_error, options);

function handle_success(position) {
  var latitude = position.coords.latitude;
  var longitude = position.coords.longitude;
  // let's do something interesting!
}

function handle_error(error) {
  alert(error.code + ': ' + error.message);
}
```

Geo-localisation

POSITIONOPTIONS OBJECT

Property	Type	Default	Notes
`enableHighAccuracy`	Boolean	false	true might be slower
`timeout`	long	(no default)	in milliseconds
`maximumAge`	long	0	in milliseconds

POSITION OBJECT

Property	Type	Notes
`coords.latitude`	double	decimal degrees
`coords.longitude`	double	decimal degrees
`coords.altitude`	double or `null`	meters above the reference ellipsoid
`coords.accuracy`	double	meters
`coords.altitudeAccuracy`	double or `null`	meters
`coords.heading`	double or `null`	degrees clockwise from true north
`coords.speed`	double or `null`	meters/second
`timestamp`	DOMTimeStamp	like a `Date()` object

Improved forms

- **New input types:** color, date, datetime, datetime-local, email, month, number, range, search, tel, time, url, week

```
<input type="color" name="favcolor">
<input type="number" name="quantity" min="1" max="5">
```

- **New input attributes:** autocomplete, autofocus, multiple, min, max, pattern, required, etc.
- **New elements:** `<datalist>` `<keygen>` `<output>`

Use them!

Microdata

```
<article itemscope itemtype=
         "http://data-vocabulary.org/Organization">
  <h1 itemprop="name">Google, Inc.</h1>
  <p itemprop="address" itemscope
     itemtype="http://data-vocabulary.org/Address">
    <span itemprop="street-address">
      1600 Amphitheatre Parkway</span><br>
    <span itemprop="locality">Mountain View</span>,
    <span itemprop="region">CA</span>
    <span itemprop="postal-code">94043</span><br>
    <span itemprop="country-name">USA</span>
  </p>
  <p itemprop="tel">650-253-0000</p>
</article>
```

History manipulation

```
window.history.pushState(
  "object or string", "Title", "/new-url");
window.history.replaceState(
  "object or string", "Title", "/new-url");


window.addEventListener("popstate", function(e) {
    swapPhoto(location.pathname);
});
```

http://diveintohtml5.info/