Web Programming Systems

CS160: User Interfaces

John Canny

Topics

- Basics: HTTP Get/Post
- Scripting
- Ajax
- HTML5, SVG
- Toolkits
- Server push (Comet)
- Going Browserless

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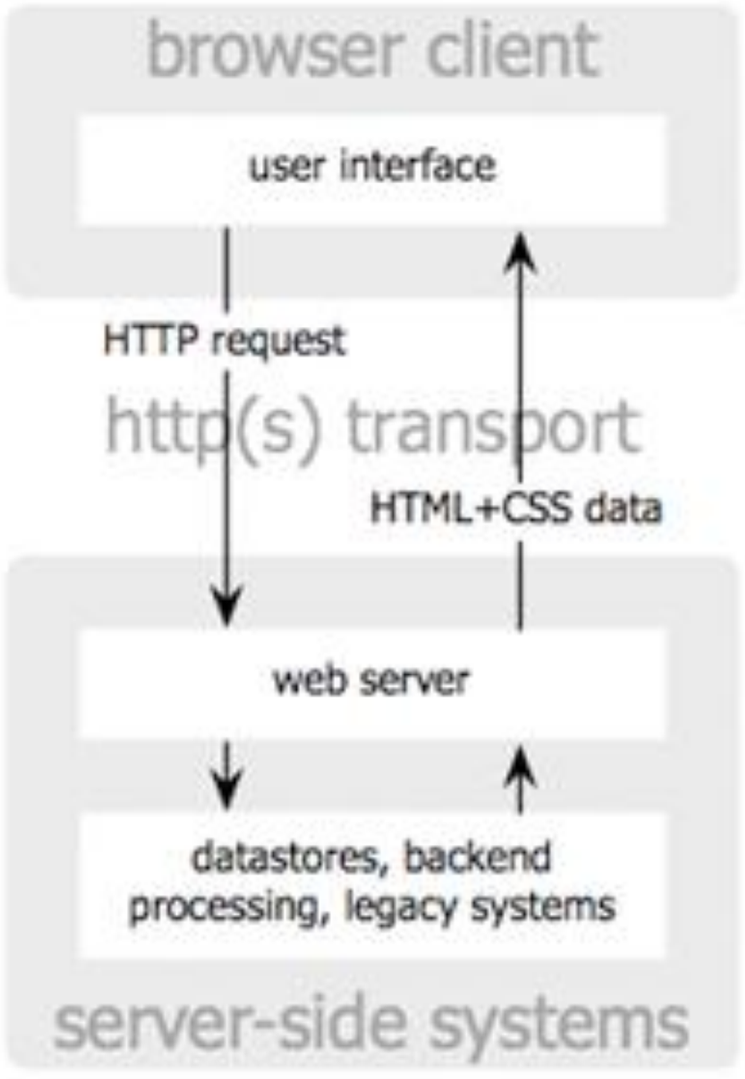
HTML + HTTP



classic
web application model

Jesse James Garrett / adaptivepath.com

HTTP Get and Post

Both retrieve a web page

Get:

- Sends a URL (only) to the server
- Client data encoded as arguments in the URL
- **Idempotent (no change to server state)**

Post:

- Sends a "form" to the server at a specified URL
- Client and server have to agree on the format of this data
- **Causes change to server state (DB update)**
- Or to send large data blocks

HTTP Get

http://en.wikipedia.org/wiki/Hypertext_Transfer_Protocol

https://www.google.com/search?hl=en&q=http+get

https://maps.google.com/maps?q=berkeley,+ca&hl=en&sll=37.269174,-119.306607&sspn=11.758442,18.479004&hnear=Berkeley,+Alameda,+California&t=m&z=13

HTTP Post

You can post data in any format, but the server and client need to know what it is.

Common examples:

- A HTML document (a "form" with fields filled in).
- An XML document.
- A URL-encoded string (like Get).
- JSON data.

```
POST /path/script.cgi HTTP/1.0
From: joe@joeblow.com
User-Agent: HTTPTool/1.0
Content-Type: application/x-www-form-urlencoded
Content-Length: 32
```

JSON

JavaScript Object Notation: A format for exchanging data with JavaScript engines.

A more compact, simpler alternative to XML (no Schema).

```
{
"employees": [
{ "firstName":"John" , "lastName":"Doe" },
{ "firstName":"Anna" , "lastName":"Smith" },
{ "firstName":"Peter" , "lastName":"Jones" }
]}
```

JSON in Javascript

```
<!DOCTYPE html>
<html>
<body>
<h2>JSON Object Creation in JavaScript</h2><p>
Name: <span id="jname"></span><br />
Age: <span id="jage"></span><br />
Address: <span id="jstreet"></span><br />
Phone: <span id="jphone"></span><br />
</p>

<script type="text/javascript">
var JSONObject= {
"name":"John Johnson",
"street":"Oslo West 555",
"age":33,
"phone":"555 1234567"};
document.getElementById("jname").innerHTML=JSONObject.name
document.getElementById("jage").innerHTML=JSONObject.age
document.getElementById("jstreet").innerHTML=JSONObject.street
document.getElementById("jphone").innerHTML=JSONObject.phone
</script>
```

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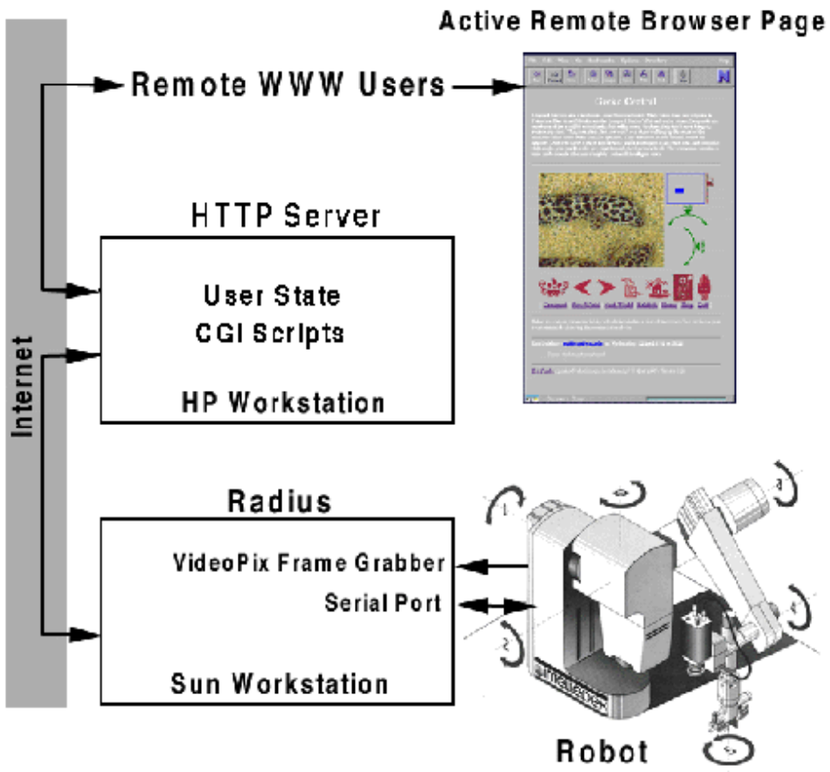
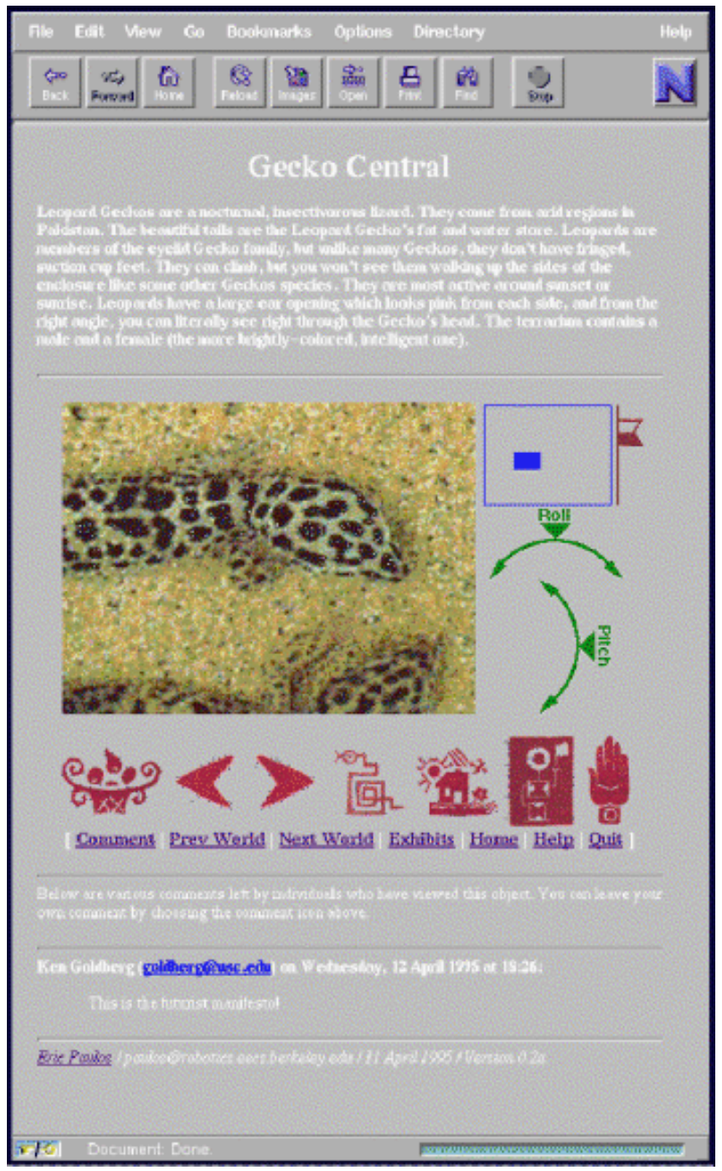
1995: Javascript

- 1995: Netscape introduces client-side scripting using Javascript.
- This supported a variety of richer client interaction (than clicking links) but server data still required page refresh and GET/POST.

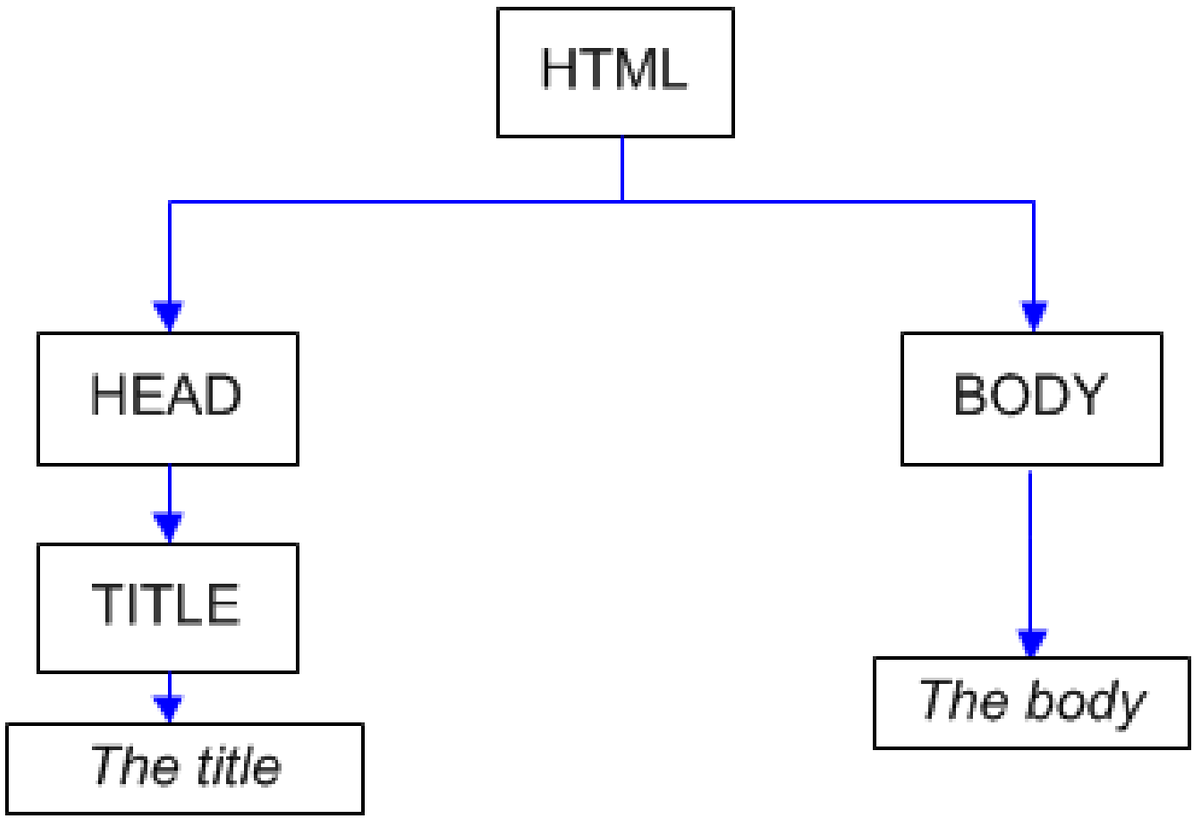


Telerobotic camera control using client-side scripting



Javascript and Dom

```
<html>
  <head>
    <title>The title</title>
  </head>
  <body>
   The body
  </body>
</html>
```



document.getElementById(“body").innerHTML=“Some new text”

Javascript Example

See http://www.w3schools.com/js/default.asp

```
<!DOCTYPE html>
<html><head>
<script>
function myFunction()
{
document.getElementById("demo").innerHTML=“A JavaScript Function";
}
</script>
</head>
<body>
<h1>My Web Page</h1>
<p id="demo">A Paragraph</p>
<button type="button" onclick="myFunction()">Try it</button>
</body>
</html>
```

Javascript Limitations

- No widgets
- Browser-specific code!!

```
function getXHR () {
var request = null;
if (window.XMLHttpRequest) {
 try {
  request = new XMLHttpRequest();
 } catch(e) {
  request = null;
 } // Now try the ActiveX (IE) version
} else if (window.ActiveXObject) {
 try {
  request = new ActiveXObject("Msxml2.XMLHTTP");
  // Try the older ActiveX object for older versions of IE
 } catch(e) {
  try {
   request = new ActiveXObject("Microsoft.XMLHTTP");
  } catch(e) {
   request = null;
  } } }
 return request;
};
```

jQuery (2005)

http://jquery.com Major overlay API on Javascript. Perhaps 70% of Javascript sites use jQuery?

- Follows the HTML/CSS paradigm for web page structure.
- Provides browser-independent operations.
- Full Ajax support*.
- Animations.
- JQuery UI widgets: http://jquery.com/demos

Browser Runtimes

Almost all other Web Toolkits (later) use Javascript as the output script.

Other common runtimes include:

- Adobe Flash
- Java
- Microsoft Silverlight
- Curl

But these require a plugin.

Once upon a time there was a large performance gap between Java and JS, but with intensive effort on JS JIT compilers, it has substantially closed. See:

http://shootout.alioth.debian.org/u32/benchmark.php?test=all&lang=v8&lang2=java

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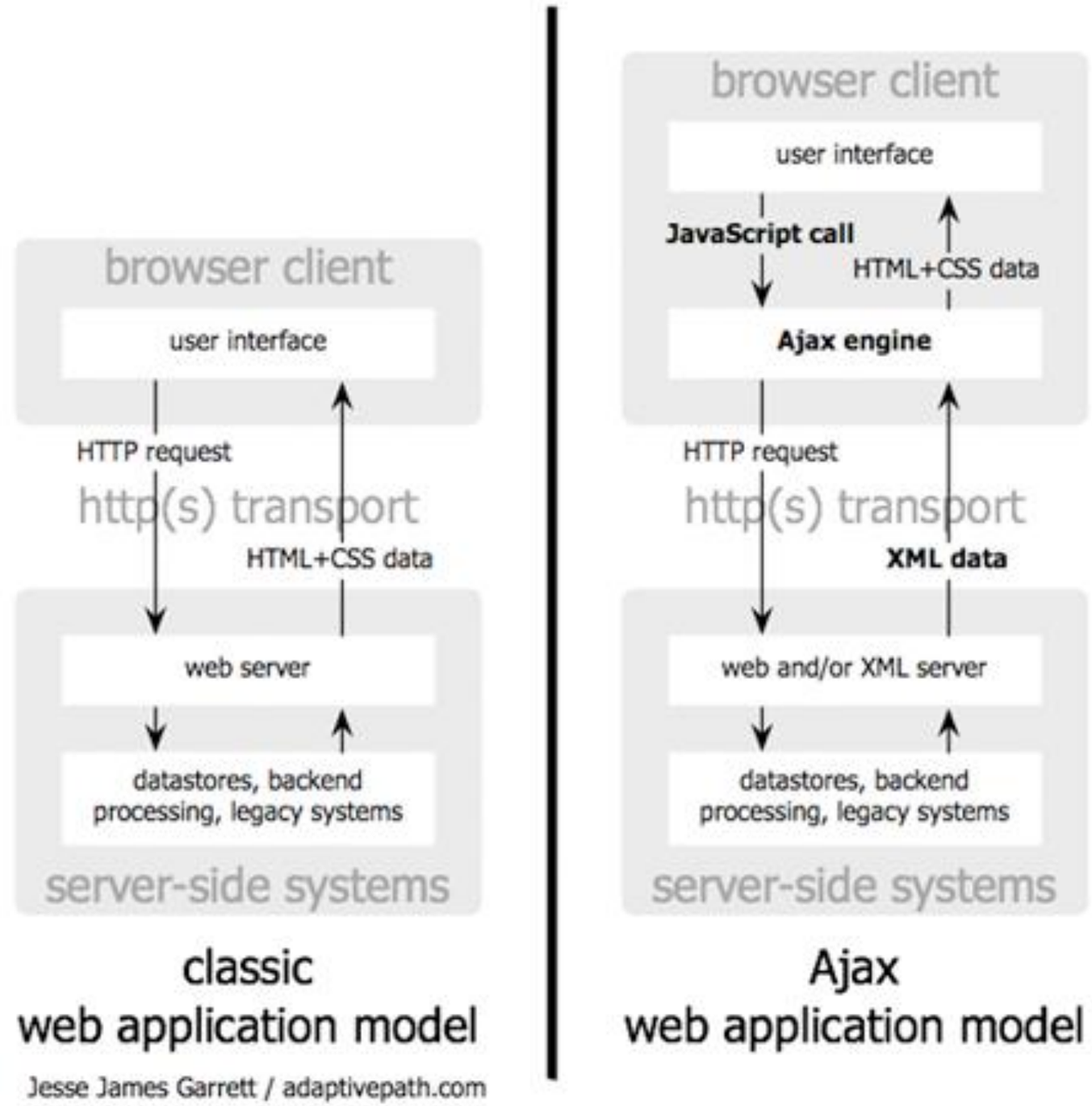
Ajax



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XMLHttpRequest (2000)

- Originally designed for Outlook Remote Access by Microsoft.
- XMLHttpRequest is an API that supports GET and POST requests to a web server, and makes the result available to a script.
- i.e. XMLHttpRequest allows general message-passing between client and server.

- XMLHttpRequest was the key technology of what became know as “Ajax” later.

XMLHttpRequest examples

http://www.w3schools.com/dom/tryit.asp?filename=try_dom_xmlhttprequest_first

http://www.w3schools.com/dom/tryit.asp?filename=try_dom_xmlhttprequest_suggest

Ajax in jQuery

Much cleaner thanks to encapsulation of browser-specific code in jQuery.

http://www.w3schools.com/jquery/tryit.asp?filename=tryjquery_ajax1

http://www.w3schools.com/jquery/tryit.asp?filename=tryjquery_ajax2

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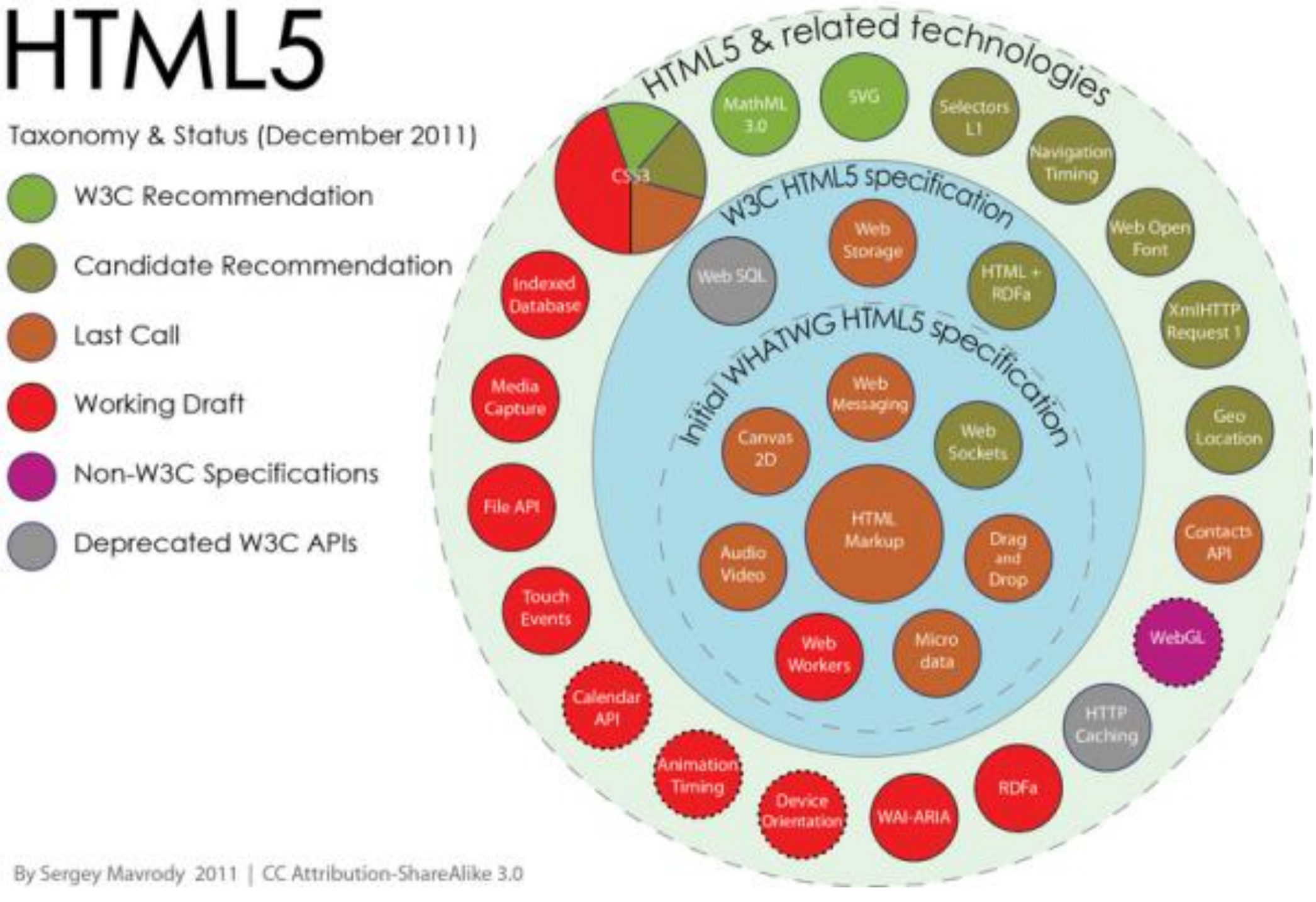
HTML5



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HTML5

Some important components:

- CSS3
- Canvas for drawing, SVG for animation
- Media, audio/video
- Web Storage
- WebGL, for 3D

CSS3 capabilities

http://www.w3schools.com/css3/tryit.asp?filename=trycss3_border-radius

http://www.w3schools.com/css3/tryit.asp?filename=trycss3_text-shadow_tut

http://www.w3schools.com/css3/tryit.asp?filename=trycss3_transition2

http://www.w3schools.com/css3/tryit.asp?filename=trycss3_animation3

HTML5 drawing

HTML5 Canvas:

- Draw directly on the screen.
- No "objects," only pixels.
- Animation OK, but requires complete redraw.

or SVG:

- Is an XML format that you can edit via its DOM.
- Vector graphic form – display independent.
- Very rich animation possibilities.

SVG should be the better option for non-trivial animation.

Performance?: generally canvas drawing is faster, but depends on many factors.

```
<script>
var c=document.getElementById("myCanvas");
{
    var ctx=c.getContext("2d");
    ctx.fillStyle="#FF0000";
    ctx.fillRect(20,20,100,50);

    var grd=ctx.createLinearGradient(140,20,240,70);
    grd.addColorStop(0,"black");
    grd.addColorStop(1,"white");
    ctx.fillStyle=grd;
    ctx.fillRect(140,20,100,50);

var grd2=ctx.createLinearGradient(20,90,120,90);
grd2.addColorStop(0,"black");
grd2.addColorStop("0.3","magenta");
grd2.addColorStop("0.5","blue");
grd2.addColorStop("0.6","green");
grd2.addColorStop("0.8","yellow");
grd2.addColorStop(1,"red");
ctx.fillStyle=grd2;
ctx.fillRect(20,90,100,50);

    ctx.font="30px Verdana";
    var grd3=ctx.createLinearGradient(140,20,240,90)
    grd3.addColorStop(0,"black");
    grd3.addColorStop("0.3","magenta");
    grd3.addColorStop("0.6","blue");
    grd3.addColorStop("0.8","green");
    grd3.addColorStop(1,"red");
    ctx.strokeStyle=grd3;
    ctx.strokeText("Smile!",140,120);
}
</script>
```

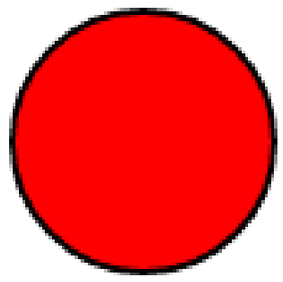
SVG

Inline XML that describes graphic elements

```
<html>
<body>

<svg xmlns="http://www.w3.org/2000/svg" version="1.1">
  <circle cx="100" cy="50" r="40" stroke="black"
  stroke-width="2" fill="red" />
</svg>

</body>
</html>
```



HTML5 graphics

Some advanced examples:

http://www.jswidget.com/ipaint.html

https://tinkercad.com/

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Toolkits: Gware

Closure Toolkit: an alternative Javascript toolkit to jQuery

- Includes an optimizing "compiler" to javascript.
- Somewhat richer widget library than jQuery UI.
- Templates for common designs.

GWT: Google Web Toolkit:

- Develop web applications in Java, APIs + UI widgets.
- Compiles into Javascript for the client.
- Eclipse support, GWT designer.
- Jetty server, concurrent client/server debugging.

GWT examples

Toolkits: Python

Pyjamas: A framework for web app. Development entirely in Python. Includes:

- Python-based API, with compilation into Javascript.
- Ajax library.
- GUI widget set.
- Pyjamas Desktop: a library that allows Pyjamas apps to run browserless.

Pyjamas is a port of GWT to Python.

Toolkits - Dojo

- A component-oriented Javascript framework.
- Rich, high-level widget library.
- Eclipse support, and an open-source WYSIWYG editor: Wavemaker Visual Ajax Studio.
- Lucid desktop supports desktop apps.
- CometD web server.
- Development tools: Marquetta, General Interface: http://dojofoundation.org/projects/
- http://demos.dojotoolkit.org/demos/

Toolkits

Other tools you know about? Pros and Cons?

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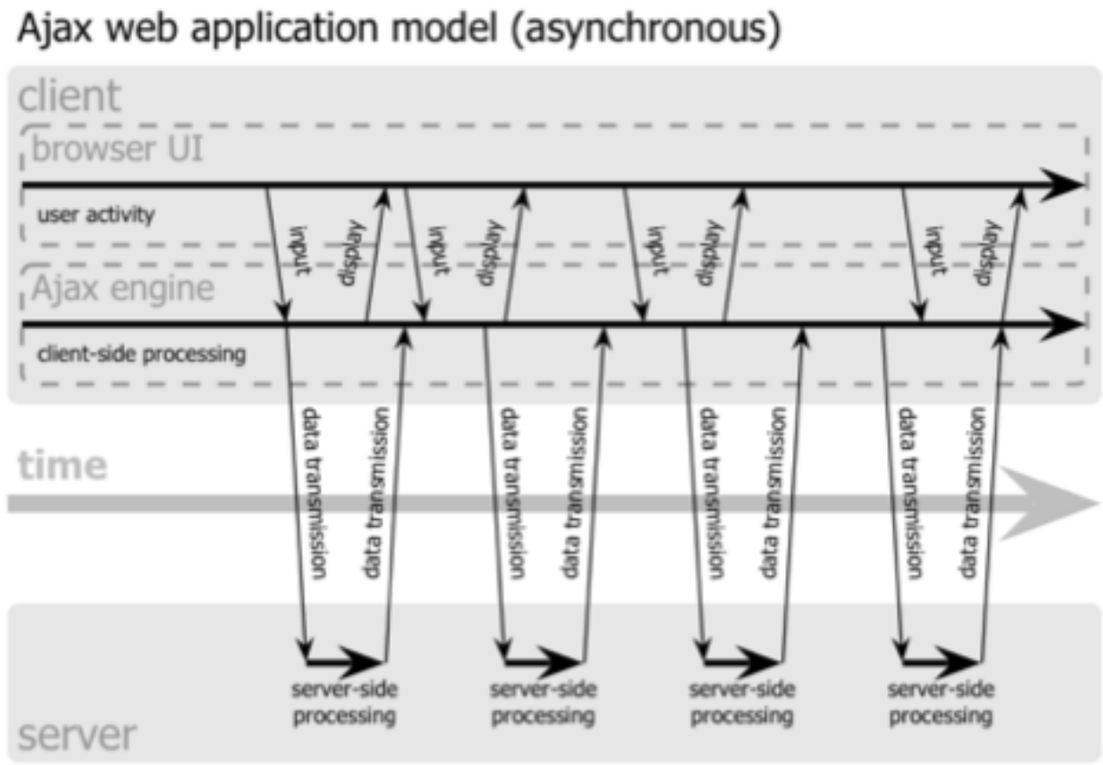
Comet: Server Push

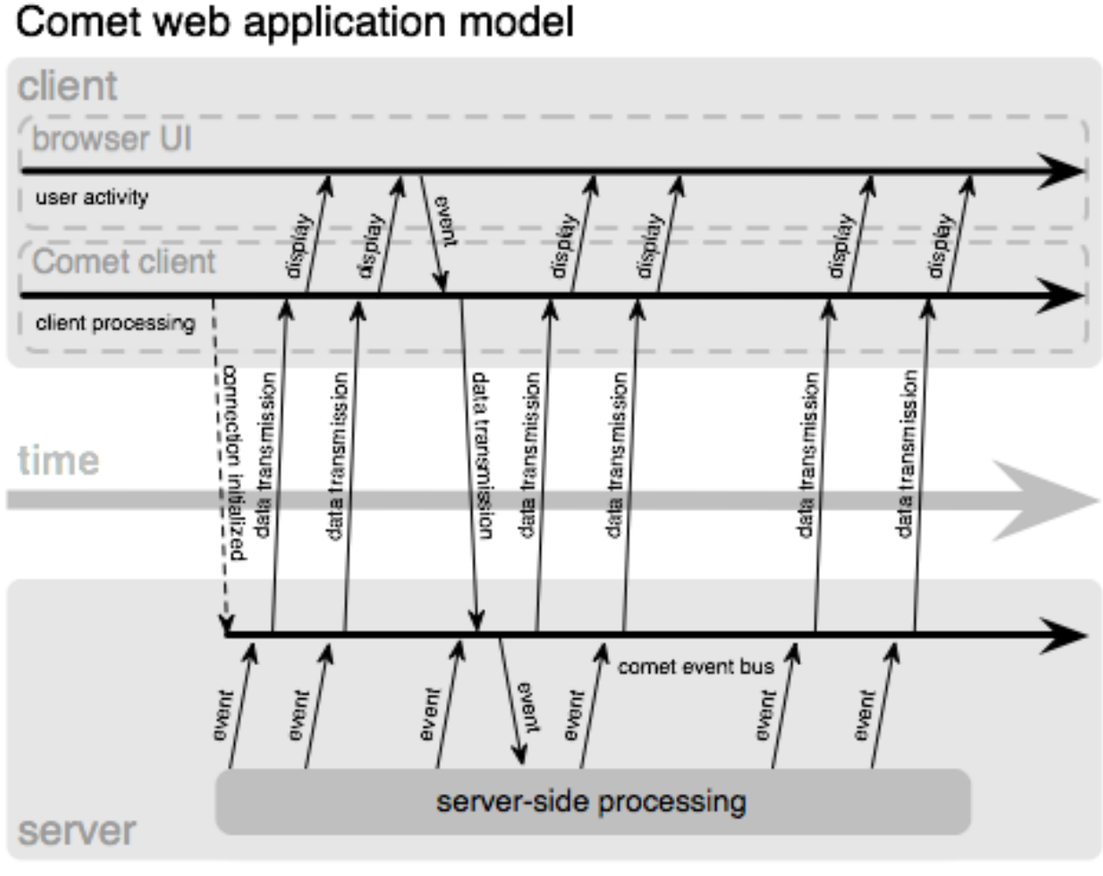
- In standard HTTP and Ajax, all interactions are initiated by the server via GET, POST, etc.
- They don't support live updates from the server:
  - Instant messaging
  - Shared calendars
  - Email updates
- Comet is the (relatively new) "push" part of Ajax.
- It was adopted widely in 2006.

Comet

CometD (web server) is an implementation of Comet in Java, and should be good for testing push applications.

Its part of the Dojo project.





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Browserless Runtimes

- Adobe AIR (Webkit)
- Microsoft Silverlight 3+
- Google Chrome OS (runs on non-Chromebooks as well)
- Apple OS X Lion Automator
- JavaFX
- Lucid Desktop, Pyjamas Desktop,…

What they do:

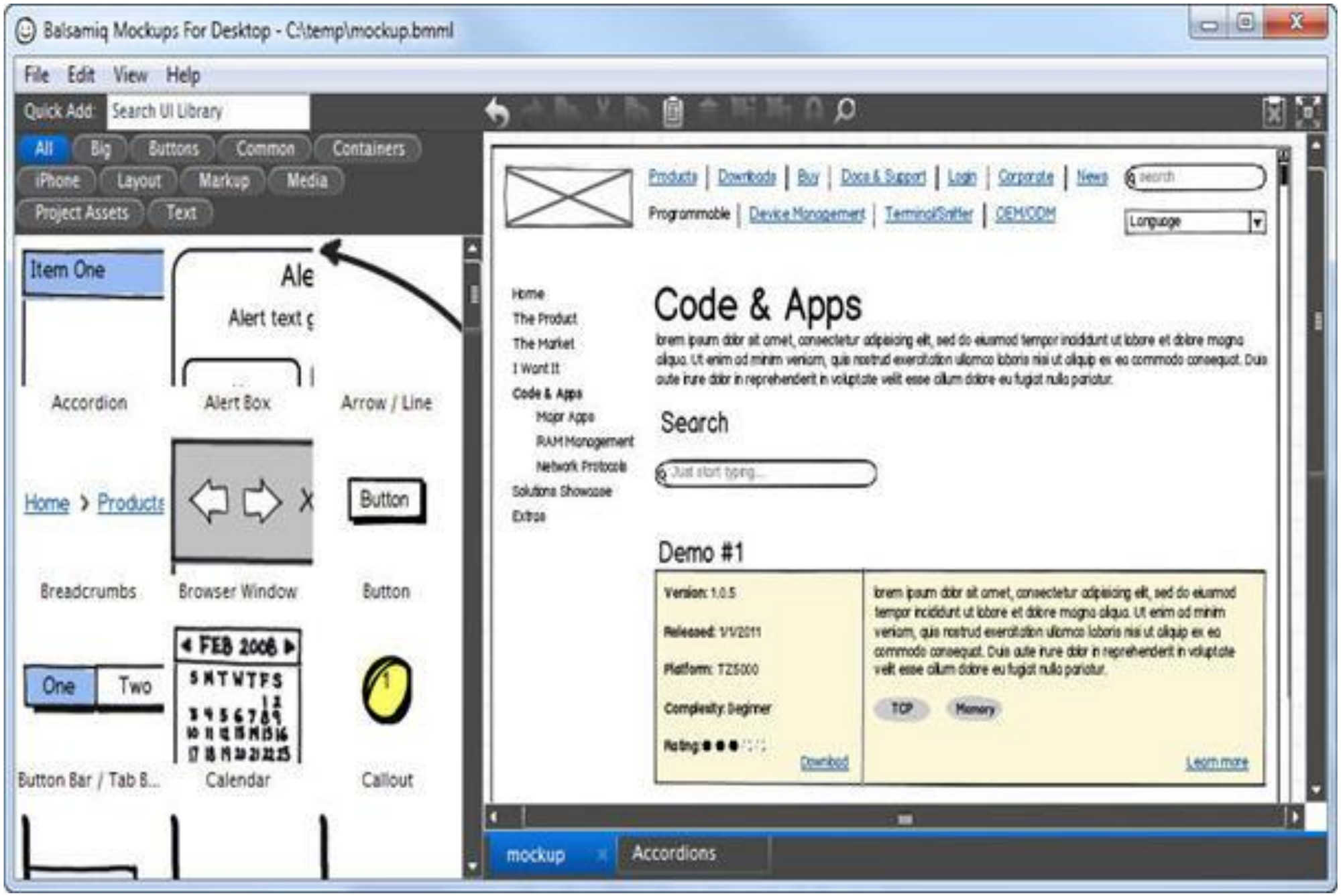
- Allow apps to run outside a browser
- Provide shortcuts and access through normal application menus
- Open up access to the local filesystem, local devices,…

Adobe AIR

Adobe Integrated Runtime (AIR), released in 2008:

- Supports Adobe Flash, Apache Flex, and HTML/Ajax (via Webkit) applications on the desktop or in a browser.
- App still needs to be "installed" locally, and signed.
- Most standard web apps will run, but custom code is needed to:
  - Access the local file system
  - Use taskbar/dock features
  - Access sensors like GPS, accelerometer, touchscreen
- Some extra security restrictions, but works with jQuery, Dojo, and MooTools.
- Adobe claims > 100 million installations (compulsory install with Adobe Reader 9).

Balsamiq Mockups for Desktop (AIR)



Perspective

- Web applications have expanded enormously from hypertext link-following in 1994.

- Scripting allowed progressively richer experiences in the browser, rivaling native interaction.

- Server innovations have allowed the application “back end” to migrate comfortably into the network.

- HTML5 and its component standards has great potential to become a true standard for content design (WebKit helps).

Perspective

- No standard of complexity comparable to HTML 5 has ever succeeded (Flash/Flex lives!).

- There remains and “Uncanny valley” between desktop (or browser) web applications and native applications.

- Cloud-based services are great for providers, but for consumers?