

Developing for Ajax

Advanced Topics

Problems and Challenges with Building Ajax Applications



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Internet Application Spectrum

Page-based (PIA)

Page navigation
URL
Browser history
Back button = undo
Document model
Static content
Read-only
Synchronous
Page services
Browser chrome
Transient

Rich Interaction (RIA)

Micro content
Application state
Application history
Application undo
Object model
Dynamic content
Read/Write
Asynchronous
Web services
Application controls
Sovereign

Transitional Applications

Internet Application Spectrum

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y!mail (classic)
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y!mail beta
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Transitional Applications

yphotos3
yfinance
backpackit
flickr
gsuggests
gmail
gfinance
gmaps
writely

Internet Application Spectrum

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Page navigation

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Micro content

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Application history

Application undo

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Read/Write

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Web services

Application controls

Sovereign

flash

Transitional Applications

ajax

dhtml

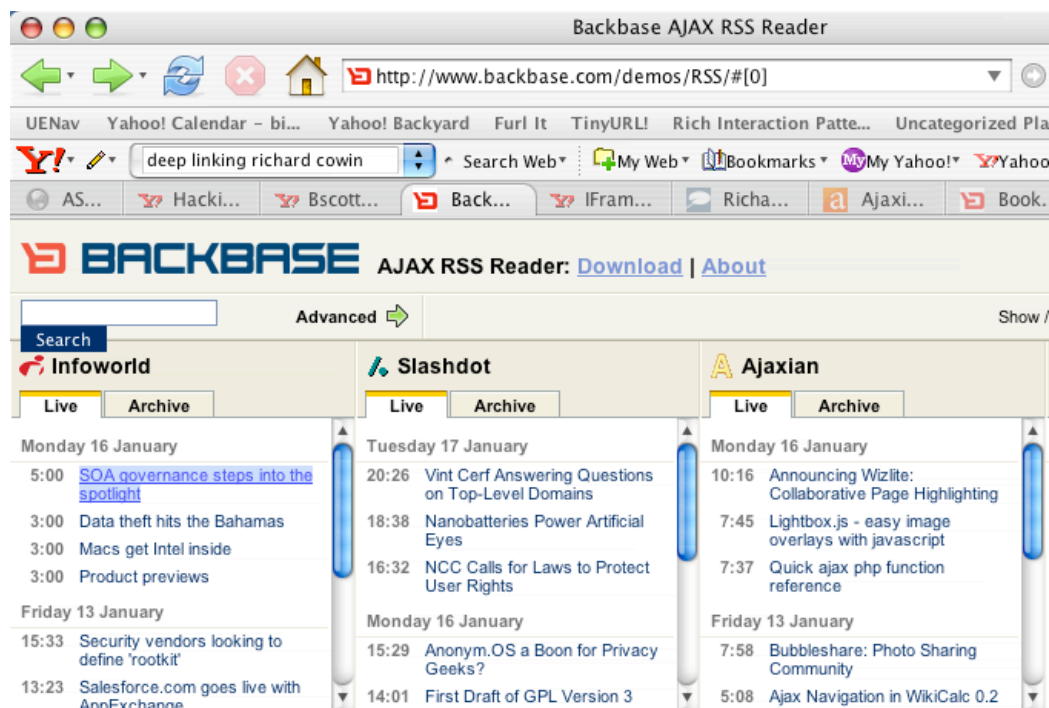
How Ajax Changes Things

Classic Web	Ajax/Web 2.0	Problems/Challenges
Page to page navigation	Micro content	Back button, SEO, bookmarking, accessibility, security
URL/Link = User's location	Application state	Back button, SEO, bookmarking, accessibility
Browser history	Application history	Back button, bookmarking, accessibility
Back button = Undo	Is unpredictable	Back button, bookmarking, accessibility
Little JavaScript	More JavaScript	Accessibility, degradability, security, memory, performance, debug, obfuscation, error handling
Document model	Application model	Back button, SEO, bookmarking, accessibility
Static content	Dynamic content	SEO, bookmarking, accessibility
Course-grained events	Micro states	Back button
Synchronous	Asynchronous	Error handling
Browser chrome	Application controls	Back button, bookmarking, accessibility
Page Services	Web Services	Security, XML vs. JSON

Back Button

- Problem: Ajax application state changes, URL does not. No browser history of state changes/navigation
- What does the user expect?
 - Often confused with Undo
 - True context view changes should be part of history
 - Navigation tabs; but not content tabs?
 - Steps in a process
 - Tree selection when views change
- Impact of tabbed browsers?

- URL hash, fragment identifier (**http://a.com#loc** does not trigger a page reload
- Fragment identifier (string after '#') can be used to record state changes in the URL



- Yahoo! Maps Beta also uses this technique
- Bottom line: tricky to implement
 - Dojo, Backbase provide direct support
 - One approach:
<http://www.contentwithstyle.co.uk/Articles/38/fixing-the-back-button-and-enabling-bookmarking-for-ajax-apps>
 - All links have fragment
 - Clicking link changes URL, not page
 - Timer monitors window.location.href & updates
- RSH - Really Simple History.
<http://www.onjava.com/pub/a/onjava/2005/10/26/ajax-handling-bookmarks-and-back-button.html>

Search Engine Optimization (Deep Linking)

- All the content may not be statically available for search engine crawlers
 - Won't find content to index your pages correctly
- Possible solutions
 - **Lightweight Indexing**: leverage existing tags such as meta, title and h1
 - **Extra Links**: extra links are placed on the site.
 - **Secondary Site**: a secondary site is fully accessible to the search engine. (See degraded experience)

source: backbase.com

Bookmarking

- Since we have broken the history and URL paradigm, bookmarking become problematic
- What does the user expect?
 - Do they expect to bookmark application state? content viewed?
 - Desktop apps often support bookmarking. It is always content based.

- Allow the user to save a bookmark at an interesting moment in an Ajax application
- Perhaps dynamically generate a link for bookmarking
- The URL generated for the bookmark is sufficient to restore the state

- Google Maps
 - Link is generated on each new map address
 - Link contains URL parameters to return to the page

 [Print](#)  [Email](#)  [Link to this page](#)

- OpenRico LiveGrid

http://richardcowin.typepad.com/blog/2005/07/there_has_been_.html

Listing movies

#	Title	Year
1	Mr and Mrs Smith	0
2	Shichinin no samurai	1954
3	The Lord of the Rings: T	2003
4	Buono, y il brutto, il cattivo, Il	1966
5	The Lord of the Rings: The Fellowship of the Ring	2001
6	Star Wars	1977
7	The Lord of the Rings: The Two Towers	2002
8	Star Wars: Episode V - The Empire Strikes Back	1980
9	Raiders of the Lost Ark	1981
10	Apocalypse Now	1979

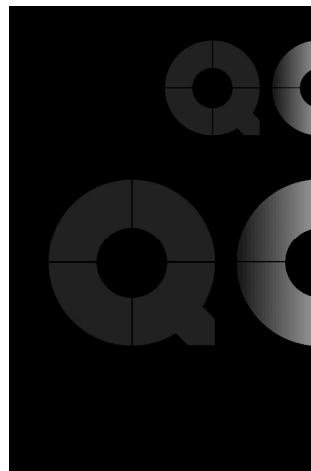
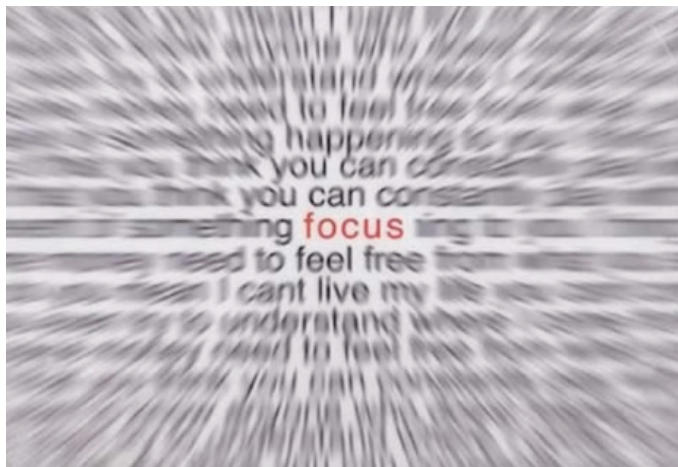
<http://openrico.org/rico/livegrid.page?>

[data_grid_index=60&data_grid_sort_col=rating&data_grid_sort_dir=ASC](http://openrico.org/rico/livegrid.page?data_grid_index=60&data_grid_sort_col=rating&data_grid_sort_dir=ASC)

Accessibility

DHTML Provides	Accessibility Expects	Problem
JavaScript enabled markup, new user interface controls	Simple markup	Markup has more meaning than expected. How does the assistive technology understand this is a tree control? How does it understand the state of a control?
Dynamic pages & content	Fairly static pages	How do I announce dynamic content?
Weak support for keyboard navigation	Keyboard navigation	Sight-impaired users will not be using rich interactions; they will use the keyboard (or another device that simulates the keyboard) But how to tab key, arrow key, select items with the keyboard?

Accessibility



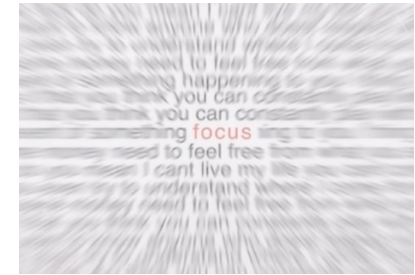
- Screen readers
- Speech browsers
- Braille readers
- Screen magnifiers
- Personalised CSS
- Device independence
- Windows accessibility options
- Internet Explorer accessibility options
- Site-specific access tools



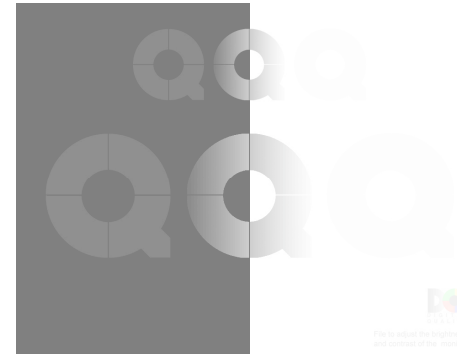
- Providing keyboard access
 - e.g., arrow keys, shortcuts
- Providing alternate keyboard control
 - e.g., slider with text field



tabindex value	Purpose	Tab key navigable?
Not set	Accept default behavior	Default behavior Form elements
tabindex = “-1”	For child elements (nodes in a tree)	No. You must set the focus with JavaScript
tabindex = “0”	To tab in HTML code order	Tabbing moves you field to field in the order they are added to the page
tabindex > “0”	To specify an exact order for each field	Value describes the tab order



- Basic concept... but focuses on readability
- Raises the issue of CSS



- Hints need to be provided for assistive technologies
 - alt?
 - Markup is simple, but need richer hints
 - e.g., tree control



- IBM/Mozilla Accessible DHTML API/Spec
- Direct support for keyboard traversal
 - Supports tab key to a container, arrow keys to navigate inside the container and enter key to select item
 - Setting tabindex=-1 allows focus to be set on a object without it being in the tab order
- A way to add metadata to HTML markup for assistive technologies to understand:
 - Widget roles, properties, values and events
- Working with assistive technology vendors to make them aware of this API (funded development)

<http://www.mozilla.org/access/>

http://developer.mozilla.org/en/docs/Accessible_DHTML



- Roles

```
<span tabindex="0" xhtml2:role="wairole:checkbox"
    property:checked="true"
    onkeydown="return checkBoxEvent(event);"
    onclick="return checkBoxEvent(event);">
    Any checkbox label
</span>
```

- Provides clues to assistive technologies

Progressive Enhancement

- Degradability - Managing the user experience as you move down in device/browser capability
- At Yahoo! we grade the browser by experience we will provide (A, B, X grade)
 - A-grade experience (majority of our users; greatest visual fidelity and richest interactions)
 - B-grade experience (almost A-grade, but either they are on bleeding edge, low adoption or low economic value). Not considered in development or testing
 - X-grade experience (baseline of support; content but little style or interaction). Crawlers and old browsers get this experience.



Graded Browser Support @ Yahoo!

	Win 98	Win 2000	Win XP	Mac 10.0	Mac 10.2	Mac 10.3	Mac 10.3.x	Mac 10.4
IE 7.0	n/a	n/a	A-grade	n/a	n/a	n/a	n/a	n/a
IE 6.0	A-grade	A-grade	A-grade	n/a	n/a	n/a	n/a	n/a
IE 5.5	A-grade	A-grade	n/a	n/a	n/a	n/a	n/a	n/a
IE 5.0	C-grade	C-grade	n/a	C-grade	C-grade	C-grade	C-grade	C-grade
Netscape 8.0	X-grade	X-grade	A-grade	n/a	n/a	n/a	n/a	n/a
Firefox 1.5	A-grade	A-grade	A-grade	A-grade	A-grade	A-grade	A-grade	A-grade
Firefox 1.0.7	A-grade	A-grade	A-grade	A-grade	A-grade	A-grade	A-grade	A-grade
Mozilla 1.7.12	X-grade	X-grade	A-grade	X-grade	X-grade	X-grade	X-grade	X-grade
Opera 8.5	X-grade	X-grade	A-grade	C-grade	C-grade	C-grade	X-grade	X-grade
Safari 1.0	n/a	n/a	n/a	X-grade	n/a	n/a	n/a	n/a
Safari 1.1	n/a	n/a	n/a	X-grade	X-grade	n/a	n/a	n/a
Safari 1.2	n/a	n/a	n/a	X-grade	X-grade	X-grade	n/a	n/a
Safari 1.3	n/a	n/a	n/a	n/a	n/a	X-grade	A-grade	n/a
Safari 2.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	A-grade



- Pre-emptive nag bar
- Semantic Markup
 - What's good for accessibility is good for degradability
- Design Issues
 - What is the experience for C-grade browsers?
 - What is the experience for non-browsers?

Web Services

- Web 2.0 - Web as a Platform. Lots of web services!
-  **YAHOO! DEVELOPER NETWORK**
 - del.icio.us, Finance, flickr, HotJobs, Maps, Merchant Solutions, Music, Design Patterns, RSS Feeds, Search, Search Marketing, Shopping, Travel, Traffic, upcoming.org, UI library, weather, webjay, widgets, JS Developer Center, PHP Developer Center
-  **Google Web APIs (beta)**
 - maps, search, desktop, sitemaps, adwords, finance, calendar

JSON

- JavaScript supports several string based notations
 - Allows the basic types to be represented as string literals
 - Strings are easy to pass over the wire
- JSON (JavaScript Object Notation - json.org)

```
{"name": "Jack B. Nimble", "at large": true, "grade":  
"A", "level": 3}
```

name	Jack B. Nimble
at large	true
grade	A
level	3


```
["Sunday", "Monday", "Tuesday", "Wednesday",  
"Thursday", "Friday", "Saturday"]
```

array of 7 named days

```
[  
[0, -1, 0],  
[1, 0, 0],  
[0, 0, 1]  
]
```

3x3 array

- JSON's simple values are the same as used in JavaScript
- No restructuring is requested: JSON's structures are JavaScript!
- JSON's object is the JavaScript object
- JSON's array is the JavaScript array
- Parsing is simple, native

- Obtain responseText
- Parse the responseText

```
responseData = eval('(' + responseText + ')');
```

OR

```
responseData = JSON.parseJSON(responseText);
```

- <http://api.search.yahoo.com/WebSearchService/V1/webSearch?appid=YahooDemo&query=finances&start=1&results=1&output=json>

```
{
  "ResultSet":
  {
    "totalResultsAvailable": "69200000",
    "totalResultsReturned": "1",
    "firstResultPosition": "1",
    "Result":
    {
      "Title": "Yahoo! Finance",
      "Summary": "manage the market and your money with Yahoo! Finance. Includes stock market quotes, business news, mutual funds, online bill pay, banking tools, loans, insurance, retirement planning, and tax tips and advice.",
      "Url": "http://finance.yahoo.com/",
      "ClickUrl": "http://finance.yahoo.com/",
      "ModificationDate": "1137225600",
      "MimeType": "text/html"
    }
  }
}
```



Getting info from a JSON response

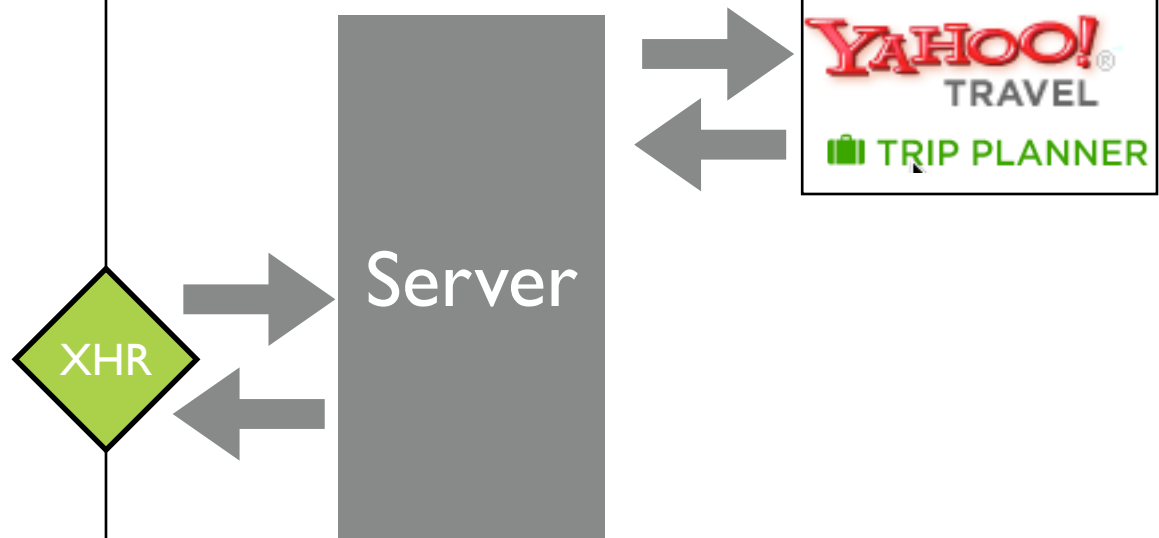
```
{
  "ResultSet":
  {
    "totalResultsAvailable": "69200000",
    "totalResultsReturned": "1",
    "firstResultPosition": "1",
    "Result":
    {
      "Title": "Yahoo! Finance",
      "Summary": "manage the market and your money with Yahoo! Finance. Includes stock  
market quotes, business news, mutual funds, online bill pay, banking tools, loans, insurance,  
retirement planning, and tax tips and advice.",
      "Url": "http://finance.yahoo.com/",
      "ClickUrl": "http://finance.yahoo.com/",
      "ModificationDate": "1137225600",
      "MimeType": "text/html"
    }
  }
}
```

```
responseData = JSON.parseJSON(responseText);
var resultsAvail = responseData.ResultSet.totalResultsAvailable;
var resultsReturned = responseData.ResultSet.totalResultsReturned;
var firstResultTitle = responseData.ResultSet.Result.Title;
var firstResultSummary = responseData.ResultSet.Result.Summary;
```

JSON Trip Finder

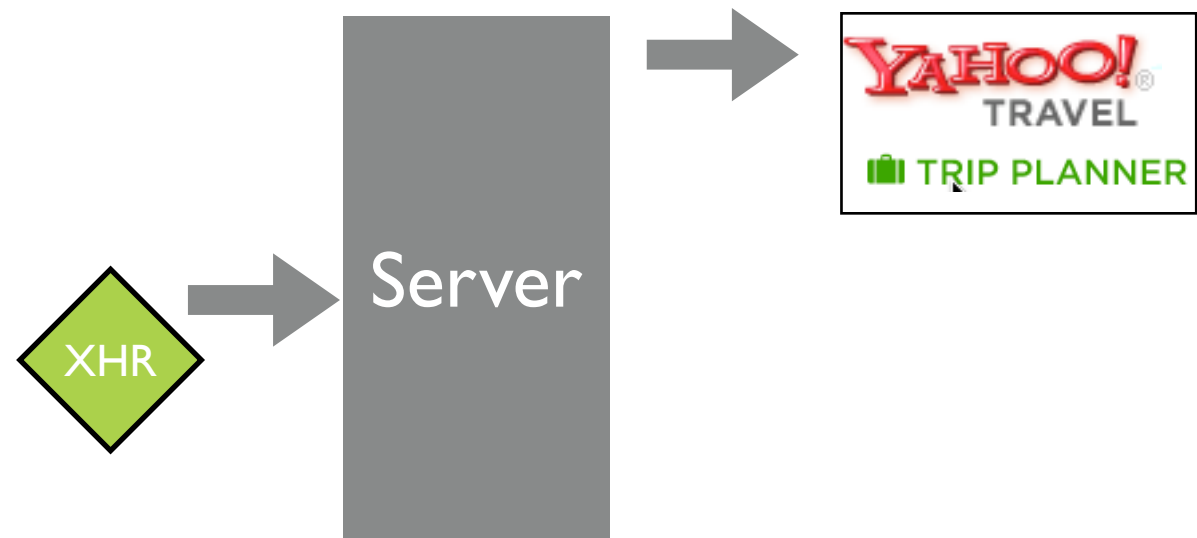
Find Trip Plans (using Ajax & JSON)

Search for Trip Plans



Yahoo! Trip Planner
exposes its service via an
URL that requires a free
partner key. Notice
output=json.

`http://api.travel.yahoo.com/TripService/V1/tripSearch?
appid=PARTNER_KEY&query=alaska&output=json`



```

{"ResultSet":{"firstResultPosition":
1,"totalResultsAvailable":"16","totalResultsReturned":
10,"Result":[

{"id":"351102","YahooID":"jk_95661","Title":"Cruise to Alaska
from Vancouver","Summary":"Things to do: Whistler Blackcomb -
Hiking,... Hotel: Hyatt Regency Vancouver, Howard
Jho...","Destinations":"Vancouver, Anchorage,
Vancouver, Ketchikan,
Se...", "CreateDate":"1130437928","Duration":"10",
{"Url":"http://us.i1.yimg.com/us.i1.yimg.com/
lp/cd/
100x100_cde24409e413d4d6da27953f6a
"Width":"66"},"Geocode":{"Latitude":
-123.120499,"precision":"not available"},
travel.yahoo.com/trip/?pid=351102

{"id":"400333","YahooID":"brdway_grl","Title":"Alaska","Summa
ry":"Things to do: Moose's Tooth Pub and Pizzer...
Restaurant: Orso, Simon's & Seafort's
Salo...", "Destinations":"Anchorage", "CreateDate":"1134676973",
"Duration":"10", "Image":{"Url":"http://us.i1.yimg.com/
us.i1.yimg.com/i/travel/tg/poi/ca/
100x100_cde605e44b47e30e731d3093b94afa37e.jpg", "Height":"75",
"Width":"66", "Caption":"Alaska", "Latitude":"61.190361", "Longitude":
:"not available"}, "Url":"http://
travel.yahoo.com/trip/?pid=400333&action=view"},
...
]]}

```

Y! service responds with a JSON text string, valid JavaScript object notation. This is passed directly back as the XHR result

Server

XHR

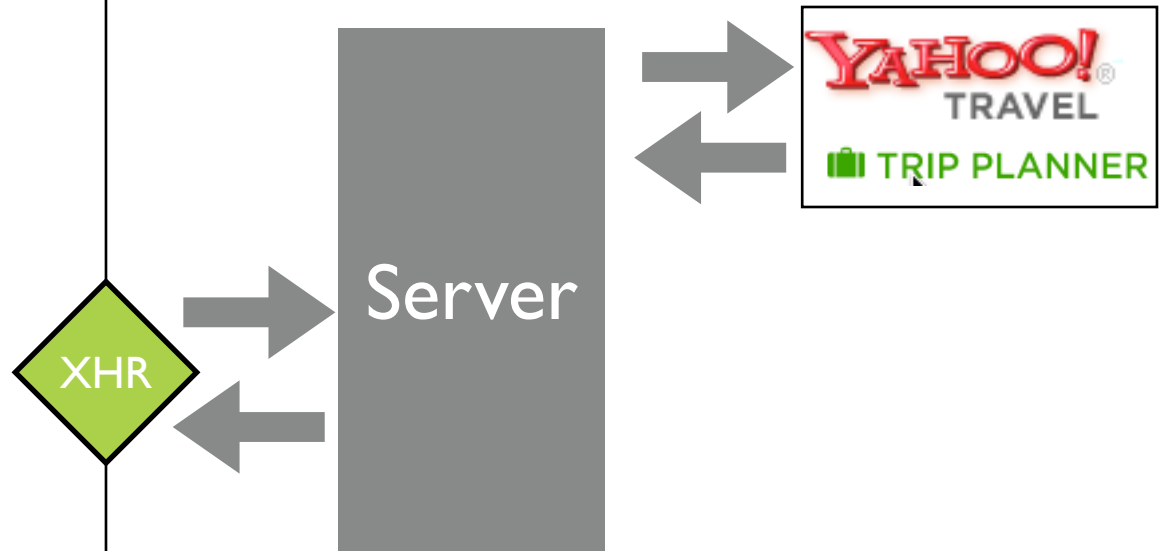



```
<script>
function showResponse() {
    if (xhr.readyState == 4) {
        if (xhr.status == 200) {
            var jsonText = xhr.responseText;
            var helloArea = document.getElementById("helloArea");
            var theTrip = eval( '(' + jsonText + ')' );
            var tripPlanHTML = "";
            for(var i=0; i<theTrip.ResultSet.totalResultsReturned; i++) {
                var result = theTrip.ResultSet.Result[i];
                tripPlanHTML = tripPlanHTML + '<div style="padding:4px;
border:1px solid gray;width: '+result.Image.Width+';"></img></div>'+
'<div ><a href="'+result.Url+' "><span style="font-weight:bold;font-size:
18px;">'+result.Title+'</span></a></div><div>'+result.Summary+'</div><br/>';
            }
            helloArea.innerHTML=tripPlanHTML;
        } else {
            alert('There was a problem with the request.');
```

JSON Trip Finder

Find Trip Plans (using Ajax & JSON)

Search for Trip Plans



Security: Same Site Rule

- The domain of the URL request destination must be same as one that serves up page containing script
- Why? XHR requests to a different site would carry cookies. Cookies would spoof authentication.
- Solutions
 - Proxies
 - `<script>` hack
 - Other remote scripting tricks
 - XMLHttpRequest (coming)

- I want to access multiple services (from different domains) without setting up a separate server (scalable, simpler to implement)
- Solution: Protocol that POSTs JSON text, gets response, parses the response into JavaScript value
 - No cookies sent
 - No other file formats accepted. Must be valid JS
 - JSON is safe JavaScript (data not functions)
 - Little or no error information provided to a miscreant
 - Accumulates random delays before trying again to frustrate denial of service attacks
 - Can support duplex!

Memory Management

- Hey, Internet Explorer is leaky!
 - Its memory garbage collector is the culprit
 - Uses reference counting; JS uses Mark & Sweep
 - Often closures are blamed
- Common problem that causes memory leaks
 - DOM <--> Application object reference each other
 - Event handlers left hanging around
- Tool for IE: Drip

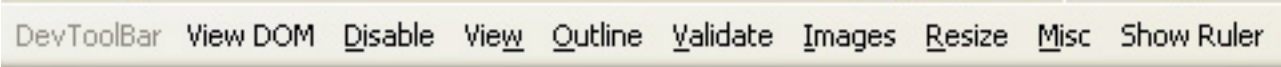
JavaScript Performance

- JavaScript requires common sense
 - Cache repeatedly accessed objects
 - Always use var for local variables
 - Use numbers for number and strings for strings
 - Avoid using eval() for accessing properties
eval("obj."+propName) --> obj[propName]
 - Look to your loops
- And a few surprises
 - Build DOM trees downward
 - Use array.join for lengthy string concatenations

source: Adam Platti



Debugging Tools

- Microsoft Script Editor
- Instant Source (IE Plugin)
- IE Dev Toolbar 
- Venkman (Mozilla)
- Firebug (Mozilla)
- DOM Inspector (Mozilla)
- Web Developer Tools (Mozilla)
- Safari JavaScript Console
- JSLint

DHTML Load - Carousel

An array of images are randomly chosen on load and 'next' events, simulating loading data from within the client space.



Also see the [documentation](#)

Done



- Lint are syntax checkers and validators
- JavaScript needs lint
- <http://www.crockford.com/jslint/lint.html>
- Scans source file & looks for common syntax problems
 - Nice way to catch silly mistakes
 - Try it at: <http://jslint.com>

Obsfucation or Minification

- JavaScript is easy to see with a Save or a <ctrl>-U
- JavaScript can increase page size & page load
 - Obsfucators mangle the code into unreadable form
 - Minifiers strip white space & comments
- Obsfucators go too far
 - Makes development way too hard
- Minification & compression do just enough
 - JSMIn (<http://www.crockford.com/javascript/jsmin.html>)

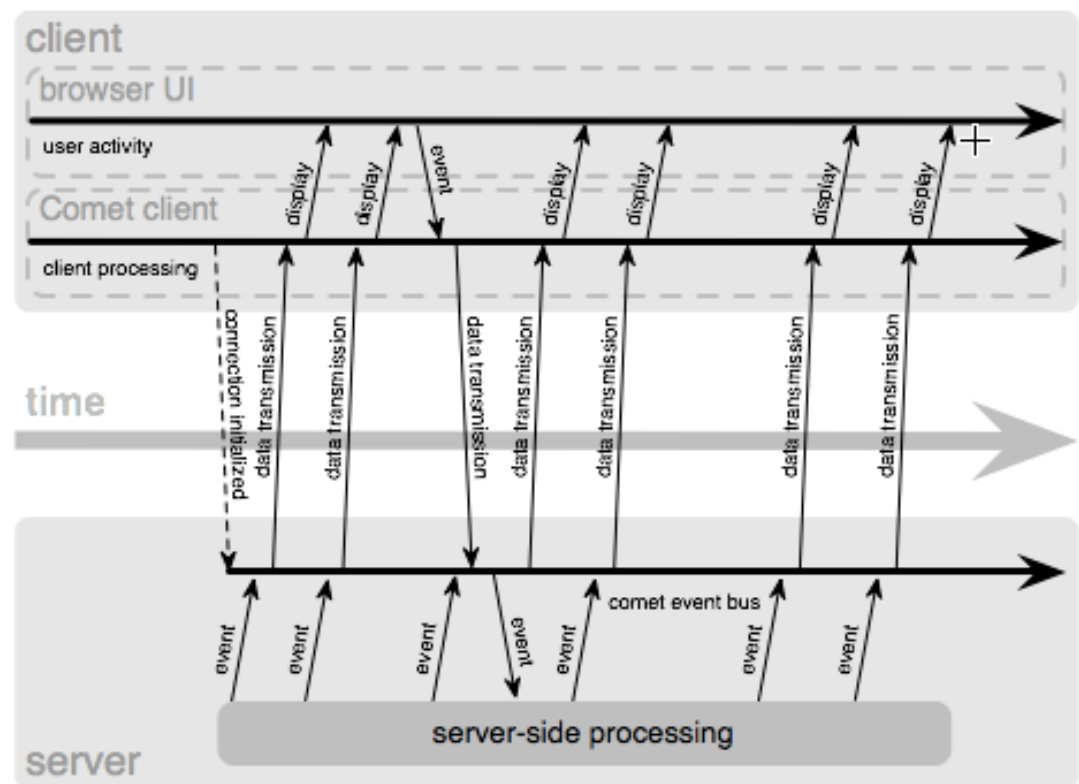
Error Handling

- Asynchronous error handling
 - Keep design simple (do you need multiple requests going at once?)
 - Will increase implementation issues
- Normal error handling
 - Check for error codes ($\neq 200$)
 - Roll your own HTTP status error codes
- Minimize server-side errors with intentional validation (error prevention)

Comet

- Can deliver data to client any time
 - Delivered over single, previously opened connection
- Example applications
 - gmail's GTalk integration
 - Jot Live
 - Renkoo
 - Meebo

Comet web application model



What about Flash?

- Adobe Flash/JS Bridge (finance.google.com)
- Adobe Flex/Ajax Bridge (8.5)
- Flash sites (maps.yahoo.com/beta)
- Flex: 2.0 is serious environment (Flash 8.5; free)
- Laszlo: Generates either Flash or DHTML/Ajax
- Communication Bridge
- Storage Mechanism
- Event Extender
- Rich Media Extender (sound, video, streaming)



Questions?