Beyond Cookies:

Persistent Storage (and Offline Access) for AJAX Applications Using Dojo.Storage

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New Kind of Web

- Persistent client-side storage
  - Saving large amounts of data securely
- Offline access
- Works right now, with installed base
  - Cross browser and cross platform

New Kind of Web

- What could you build?
  - Web-based collaborative word processors
  - Offline AJAX RSS readers
  - Offline web book reader using Open Library

New Kind of Web

- Working on vision for years
- Many false starts and dead ends
- Thought it might not be possible

Vision is Real

- Exists right now
- Demo

Moxie

- Example web-based word processor
- Open source in Dojo repository
- Persistent client-side storage
  - Needs no server
- Offline access
- Works across big three
  - IE, Firefox, Safari

Demo

- Moxie

Moxie

- Put together in one day using Dojo:
  - Dojo Widgets
  - Dojo Events
  - Dojo Storage

Agenda

- Dojo Storage
- Storage Providers
- Flash Storage Provider
- Building Sample Application - Moxie
- Dojo.flash
- How to do Offline
- Status
- Future

Acknowledgements

- Julien Couvreur
- The Dojo Team

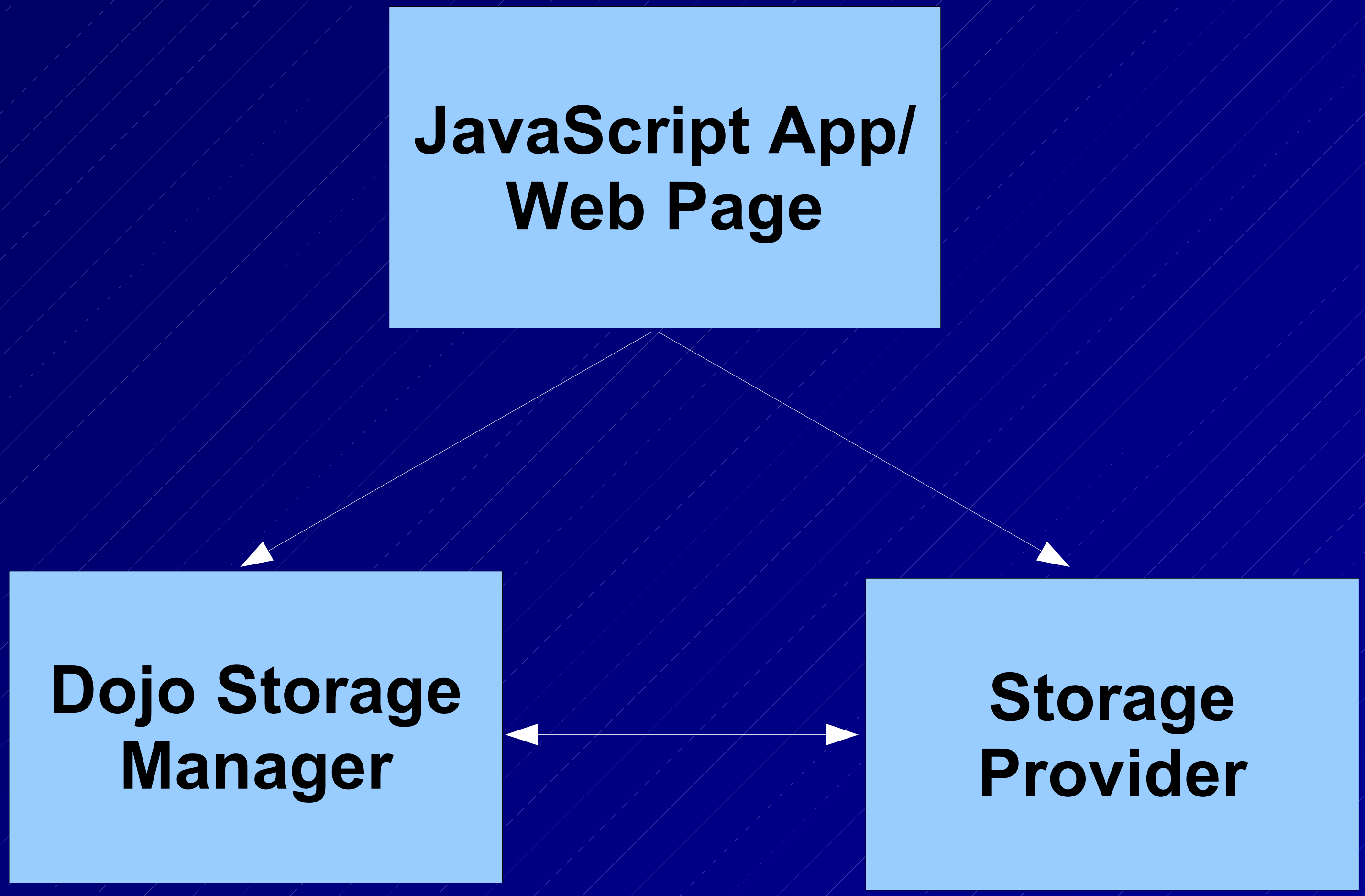
What is Dojo Storage?

- Unified API to provide JavaScript applications with storage
- Open source
- Dojo Toolkit
- Automagic detection of available storage and environment

Relationship to AMASS

- Ajax MAssive Storage System
- Released in October, 2005
- Proof-of-concept prototype of Flash based storage
- Only worked on Firefox and IE
- Not well-tested
- Not integrated into Dojo or generic

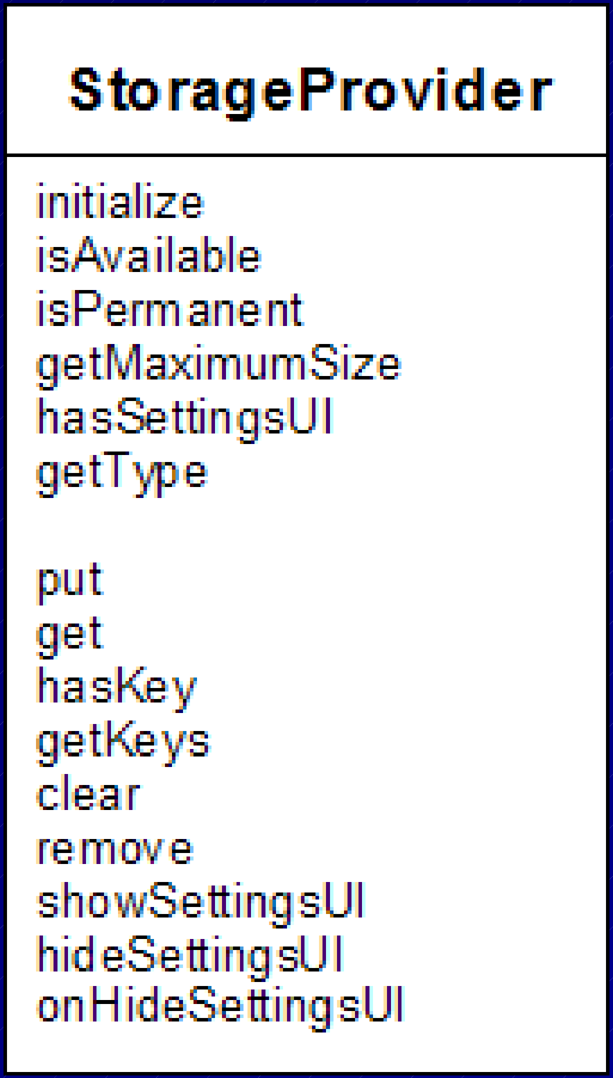
Dojo Storage Architecture



Storage Provider API

- Generic API
- Gives hash table abstraction to underlying storage type

Storage Provider API


StorageProvider

initialize
isAvailable
isPermanent
getMaximumSize
hasSettingsUI
getType

put
get
hasKey
getKeys
clear
remove
showSettingsUI
hideSettingsUI
onHideSettingsUI

Possible Providers

- Cookie Storage Provider
- Flash Storage Provider
- ActiveX Storage Provider
- Form Save Storage Provider
- XPCOM Storage Provider
- More

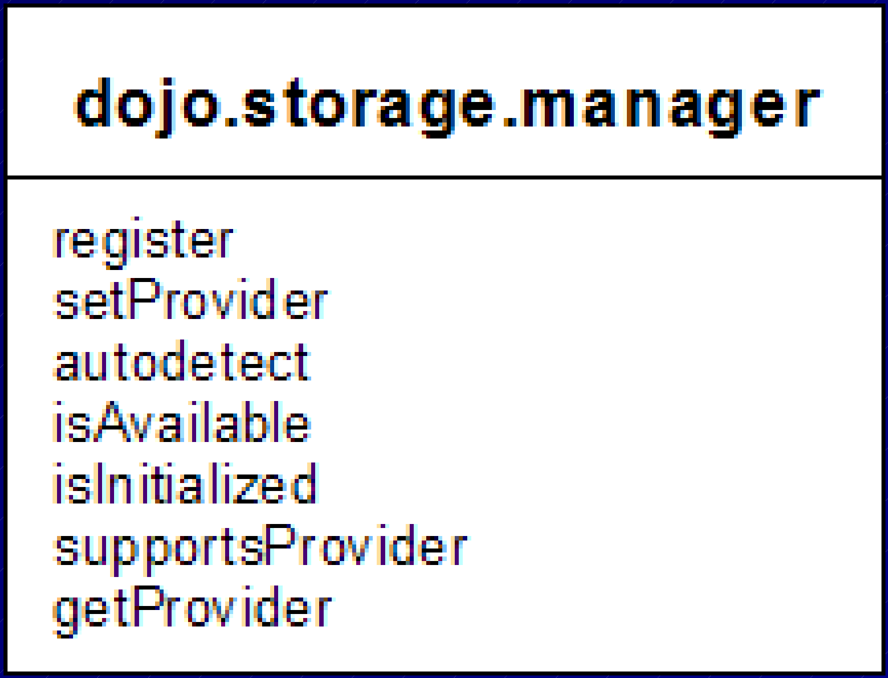
Flash Storage Provider

- Currently only storage provider available
- Uses Flash 6+ features
- SharedObjects
- dojo.flash

Why Flash?

- Has greater installed base than Internet Explorer
  - Flash 6+ = 97.1%
  - Internet 5, 6, 7 = 64.7%
- Cross-browser and cross-platform
- Use as hidden runtime to extend browser
- This is what Flash Storage Provider does

Storage Manager API



dojo.storage.manager

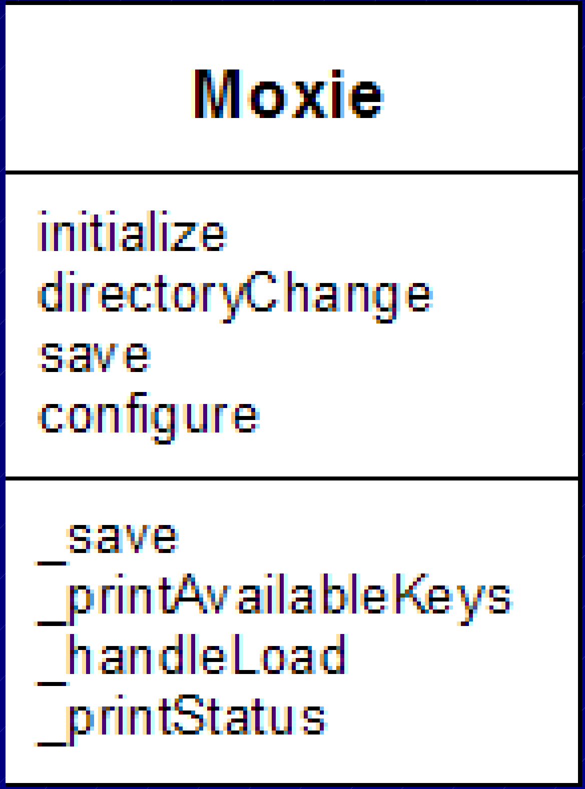
register
setProvider
autodetect
isAvailable
isInitialized
supportsProvider
getProvider

Building Sample Application - Moxie

- Don't have to know about FlashStorageProvider

Moxie's Architecture

- Two files - editor.html, editor.js
- Singleton JS object



Moxie's HTML (editor.html)

- Dojo Editor Widget
- Dojo Widgets
  - Easy, reusable DHTML components

```
<div id="storageValue" dojoType="Editor"
     items="textGroup;|;blockGroup;|;
            justifyGroup;|;colorGroup;|;
            listGroup;|;indentGroup;|;
            linkGroup;">
   Click Here to Begin Editing
</div>
```

Moxie's JS (editor.js)

- Import Dojo packages

```
dojo.require("dojo.dom");
dojo.require("dojo.event.*");
dojo.require("dojo.html");
dojo.require("dojo.fx.*");
dojo.require("dojo.widget.Editor");
dojo.require("dojo.storage.*");
```

Moxie's JS (editor.js)

- Wait until dojo.storage is finished loading

```
if(dojo.storage.manager.isInitialized() ==
                                    false){
     dojo.event.connect(dojo.storage.manager,
                        "loaded", Moxie,
                        Moxie.initialize);
}else{
     dojo.event.connect(dojo, "loaded",
                        Moxie,
                        Moxie.initialize);
}
```

Loading Data

```
var results = dojo.storage.get(key);
```

Saving Data

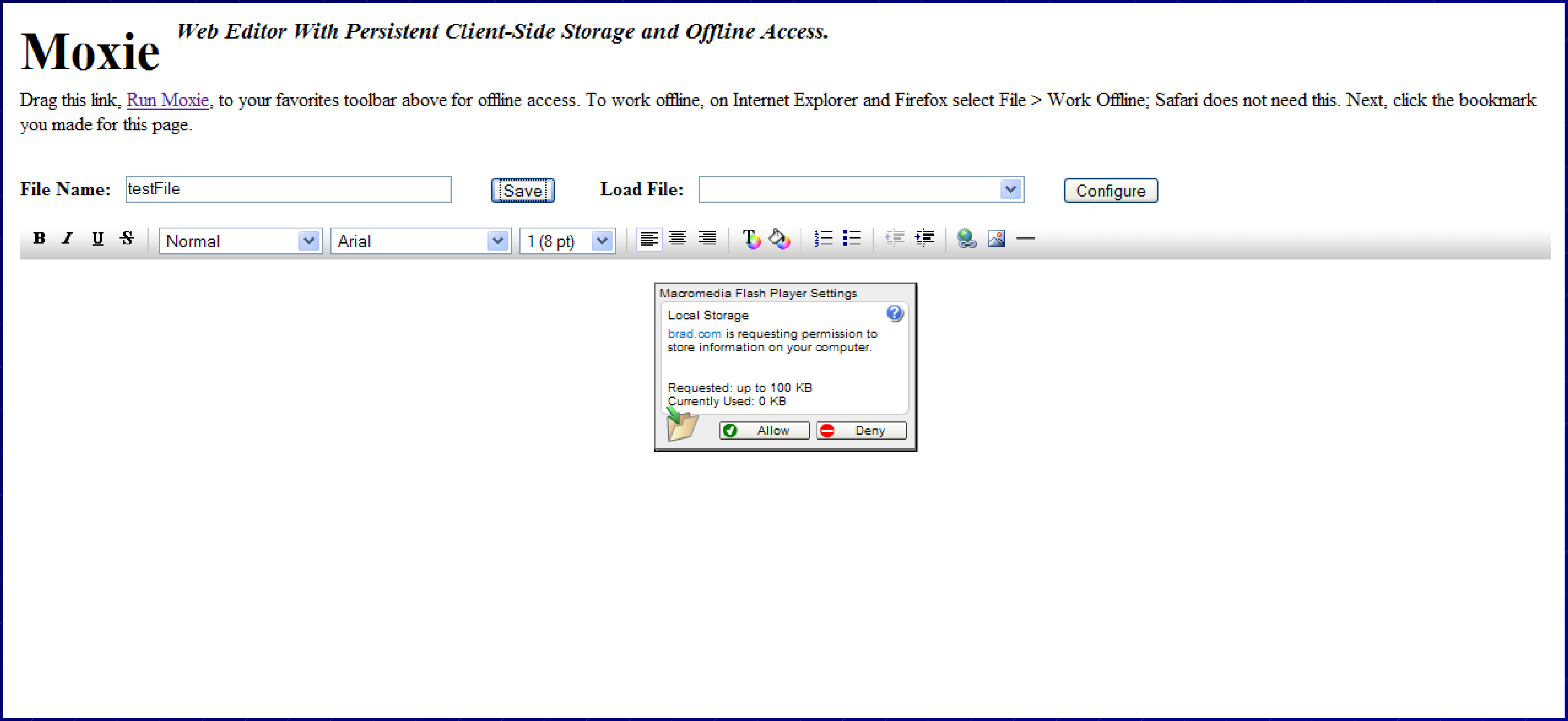
```
try{
     dojo.storage.put(key, value,
                      saveHandler);
}catch(exp){
     alert(exp);
}
```

- Value can be string or JS object
  - Internal JSONing of all objects
- User might decline save request

Results Handler

- Callback function with two arguments:
  - status
    - dojo.storage.SUCCESS
    - dojo.storage.FAILED
    - dojo.storage.PENDING
  - keyName

Results Handler



Moxie *Web Editor With Persistent Client-Side Storage and Offline Access.*

Drag this link, Run Moxie, to your favorites toolbar above for offline access. To work offline, on Internet Explorer and Firefox select File > Work Offline; Safari does not need this. Next, click the bookmark you made for this page.

File Name: testFile | Save | **Load File:** | Configure

Normal | Arial | 1 (8 pt)

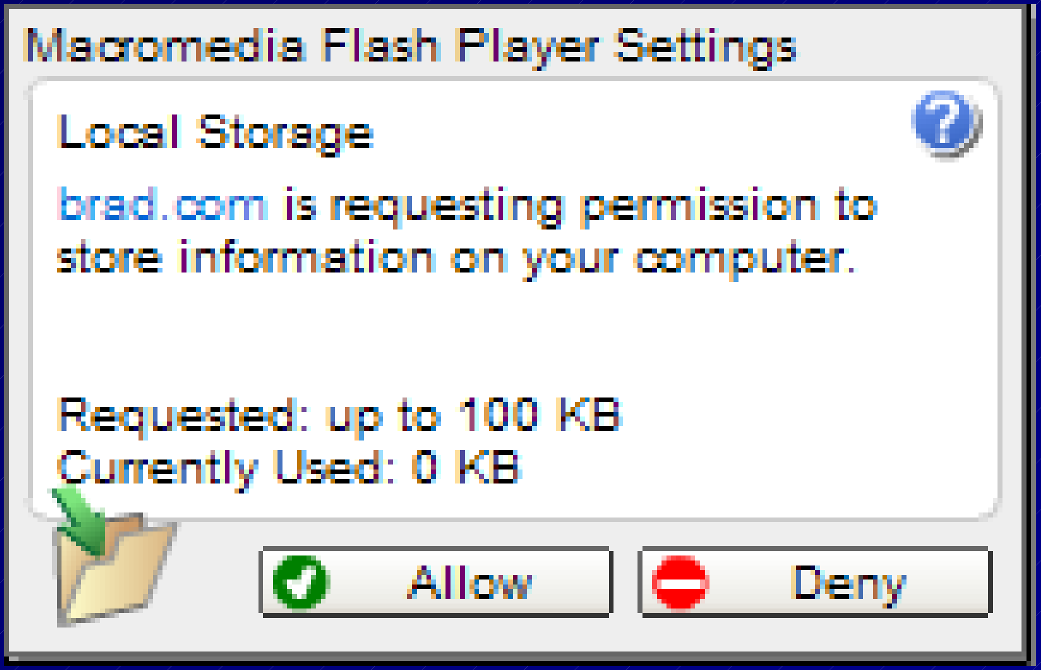
Macromedia Flash Player Settings

Local Storage

brad.com is requesting permission to store information on your computer.

Requested: up to 100 KB
Currently Used: 0 KB

Results Handler


Macromedia Flash Player Settings

Local Storage

brad.com is requesting permission to store information on your computer.

Requested: up to 100 KB
Currently Used: 0 KB

Results Handler

```
var saveHandler = function(status, keyName){
        if(status == dojo.storage.PENDING)
                // ...
        else if(status == dojo.storage.FAILED)
                // ...
        else if(status == dojo.storage.SUCCESS){
                // ...
}
```

Print Available Keys

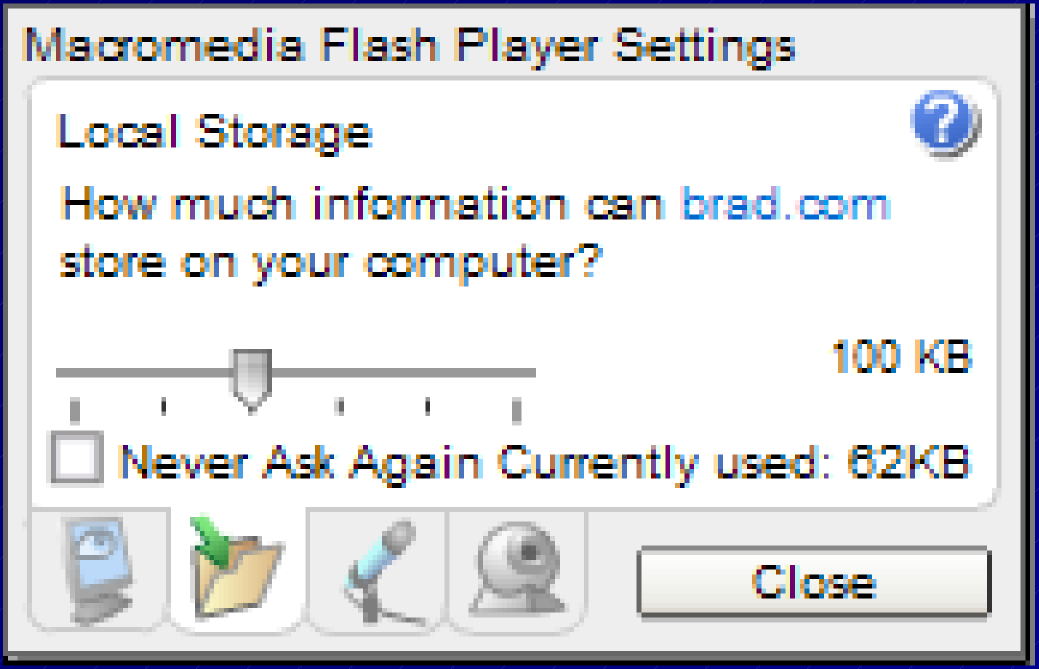
```
var directory = dojo.byId("directory");

// clear out any old keys
directory.innerHTML = "";

// add new ones
var availableKeys = dojo.storage.getKeys();
for (var i = 0; i < availableKeys.length; i++) {
        var optionNode = document.createElement("option");
        optionNode.appendChild(document.createTextNode(
                                      availableKeys[i]));
        optionNode.value = availableKeys[i];
        directory.appendChild(optionNode);
}
```

Configure

- Configuration button to control storage



Macromedia Flash Player Settings

Local Storage

How much information can brad.com store on your computer?

100 KB

☐ Never Ask Again Currently used: 62KB

Configure

```
if(dojo.storage.hasSettingsUI()){
        var self = this;
        dojo.storage.onHideSettingsUI = function(){
                self._printAvailableKeys();
        }

        // show the dialog
        dojo.storage.showSettingsUI();
}
```

Flash Dialog + Rich Edit Control

- Firefox
- Flash dialog on top of rich text area
  - z-index issues
- When dialog is showing, hide rich edit area

Flash Dialog + Rich Edit Control

```
if(status == dojo.storage.PENDING){
        if(dojo.render.html.moz){
                var storageValue = dojo.byId("storageValue");
                storageValue.style.display = "none";
        }

        return;
}else{
        if(dojo.render.html.moz){
                var storageValue = dojo.byId("storageValue");
                storageValue.style.display = "block";
        }
}
```

Moxie - That's It

- A bit more code for some fancy status displaying
- Responding to mouse and keyboard events

Dojo Flash

- Cross-browser, fast, reliable JS+Flash communication is hard and ugly
- Encapsulates these details

Dojo.flash

- Provides several major services:
  - dojo.flash.Info
    - Is Flash available + what version of Flash?
  - dojo.flash.Embed
    - Embeds Flash into page for Flash+JS communication

Dojo.flash

- Provides several major services:
  - dojo.flash.Communicator
    - Provides uniform, fast, reliable, JS + Flash communication
  - dojo.flash.Install
    - Uniform installation and upgrading of Flash

Dojo.flash.Communicator

- Very hard to create
- Where magic happens

Dojo.flash.Communicator

- Provides method abstraction between Flash + JS
- JavaScript:
  - sayHello() is Flash function
  - dojo.flash.comm.sayHello();
- Flash:
  - DojoExternalInterface.call("dojo.storage.save", resultsHandler)

DojoExternalInterface

- Backport of Flash 8 External Interface to Flash 6
- Callbacks are registered

DojoExternalInterface

```
DojoExternalInterface.initialize();
DojoExternalInterface.addCallback("put",
                                  this, put);
DojoExternalInterface.addCallback("get",
                                  this, get);
DojoExternalInterface.addCallback("remove",
                                  this,
                                  remove);
DojoExternalInterface.loaded();
```

Flash + JS Communication

- Three ways:
  1) LiveConnect/ActiveX + fscommands - Flash 6
     - Pro: Extremely fast, can send very large data, mature
     - Con: Only works on IE and Firefox

Flash + JS Communication

2)ExternalInterface - Flash 8

- Pro: Easy to use, Works on Safari
- Con: Unbelievably slow, performance degrades O(n^2), serious serialization bugs

Flash + JS Communication

3)getURL/LocalConnection/New Flash Applets - Flash 7

- Pro: Very cross platform
- Cons: Destroys history, serious data size limitations and performance issues

Flash + JS Communication

- Only mechanisms 1 and 2 are acceptable
- Use LiveConnect/ActiveX + fscommands for IE/Firefox - Flash 6 communication
- Use ExternalInterface for Safari - Flash 8 communication
  - Find workarounds to fix performance and serialization bugs
  - Performance workarounds only work in Safari

Flash 8 Communication

- Needed for Safari
- 3 months to finish
- Safari Support = 30% more time to any project

Flash 8 Communication

- Performance/Serializing issues
- Workarounds:
  - Chunk data into many different small calls through ExternalInterface
    - Makes performance linear

Flash 8 Communication

- Used debugger to find hidden JS serialization methods used by Flash plugin
  - Internal XML serialization - doesn't escape characters
  - Uses eval()
  - Found way to bypass and do it all manually

Flash 8 Communication

- Example bypass code:

```
plugin.CallFunction(
     '<invoke name="chunkArgumentData" '
     + 'returntype="javascript">'
          + '<arguments>'
               + '<string>'
                    + piece
               + '</string>'
               + '<number>'
                    + argIndex
               + '</number>'
          + '</arguments>'
     + '</invoke>');
```

Flash 8 Communication

- Workarounds:
  - Double encode and decode all XML characters on both sides:
    - &amp; --> &amp&amp;
  - Very important for persisting XML
    - Lots of testing

Flash 8 Communication

- With workarounds, performance and reliability are great
- Without them, simply not realistic to use ExternalInterface
- Only works on Safari

Flash 8 Communication Demo

- Saving book used to take minutes - now takes seconds
- XML impossible before
- Demo of saving XML and large book with Safari

Flash 6 Communication

- Little more straightforward
- JS -> Flash:
  - JS uses plugin.SetVariable to build up method values
  - Calls plugin.Play() to execute
  - Flash reads values off _root
- Flash -> JS:
  - fscommand

Flash 6 Communication

- Things that were hard to figure out:
  - Sensitive to way you embed Flash into page
  - Robustly handle different timing issues
    - For example, on some IE versions, Flash can start running before fscommands will work

Other Areas

- Showing Flash settings dialog and knowing when closed
- Centering across different HTML DOCTYPEs and browsers

Other Areas

- Serializing and deserializing JavaScript objects as JSON strings
- Short-circuiting JSON eval() if dealing with large strings
    - Drastically better performance

Other Areas

- Build system to easily create Flash 6 and Flash 8 versions of ActionScript files
  - Ant task - buildDojoFlash
- Reliably determining Flash version installed
- Automated Flash installation and upgrading

Dojo Flash

- Lots of QA testing
- Poor mans QA/distributed QA:
  - Go to copy shops like Kinkos
  - Spend lots of money to use rental machines
  - Beg people at coffee shops

Dojo Flash

- I experienced pain so you don't have to
- Dojo.flash externally is easy to use
- Internally was hell to create

How to do Offline

- Julien Couvreur discovered offline mechanism
  - Figured out HTTP response headers
  - TiwyWiki - Take It With You Wiki
  - Blog
    - http://blog.monstuff.com

How to do Offline

- HTTP Caching
- Magic happens on server-side
- Send over HTTP response headers:
  - Etag
  - Last-Modified
  - Expires
  - Cache-Control

How to do Offline

- Etag and Last-Modified on by default in Apache 2

How to do Offline

- Expires and Cache-Control must be turned on in httpd.conf:
  - mod_expires

```
LoadModule expires_module modules/mod_expires.so

<Directory "c:/dev/dojo/">
    ExpiresActive On
    ExpiresDefault "access plus 1 month"
</Directory>
```

How to do Offline

- The page is now in browser cache after first access
- In IE and Firefox, go to File > Work Offline
  - Just navigate to URL
- In Safari, just go to URL
- Provide link to drag to toolbar

How to do Offline

- Depends on persistent storage
- Even if offline, still have access to data
- When network appears, just sync using persistent cache

How to do Offline

- Simple
- Issue:
  - If user clears cache, UI is gone
  - If user has not visited site recently, not in cache
- Can live with issues
- In practice works well for commonly used web apps

Status

- Dojo.storage is in beta and in Dojo repository
- Will be bundled with next release of Dojo
  - http://dojotoolkit.org
- Has had lots of QA testing and is stable

Status

- Download Dojo 0.3 (hot off the presses!)
  - http://blog.dojotoolkit.org
- Moxie:
  - http://codinginparadise.org/e
- Test Storage UI:
  - http://codinginparadise.org/x

Status

- Offline mechanisms have had less QA
  - Need more QA testing

Future

- Bring dojo.storage to full release after wide stress testing by community
- Create zoo of storage providers

Future

- Dojo.offline and dojo.sync
  - Truly advanced offline abilities
    - client-server syncing
  - More offline QA

Future

- Advanced collaborative tools that simply work, right in the browser
- Use dojo.flash to get access to "Flash runtime"
  - audio and video conferencing with webcams
    - GTalk right in the browser
    - Wikis + webcams, no downloads
  - Streaming sockets and multiplexing
    - Browser-Based SubEthaEdit

Future

- Paper Airplane - 2003
  - Research mockup and prototypes of deeply collaborative web browser
  - Pieces can be done in AJAX/DHTML
    - Don't need new browser
  - http://codinginparadise.org/paperairplane

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