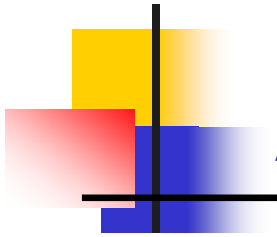
© Copyright 2006, Glassbox Corporation

AJAX Performance and Monitoring

Ron Bodkin, Glassbox Leader
ron.bodkin@glassbox.com

© Copyright 2006, Glassbox Corporation

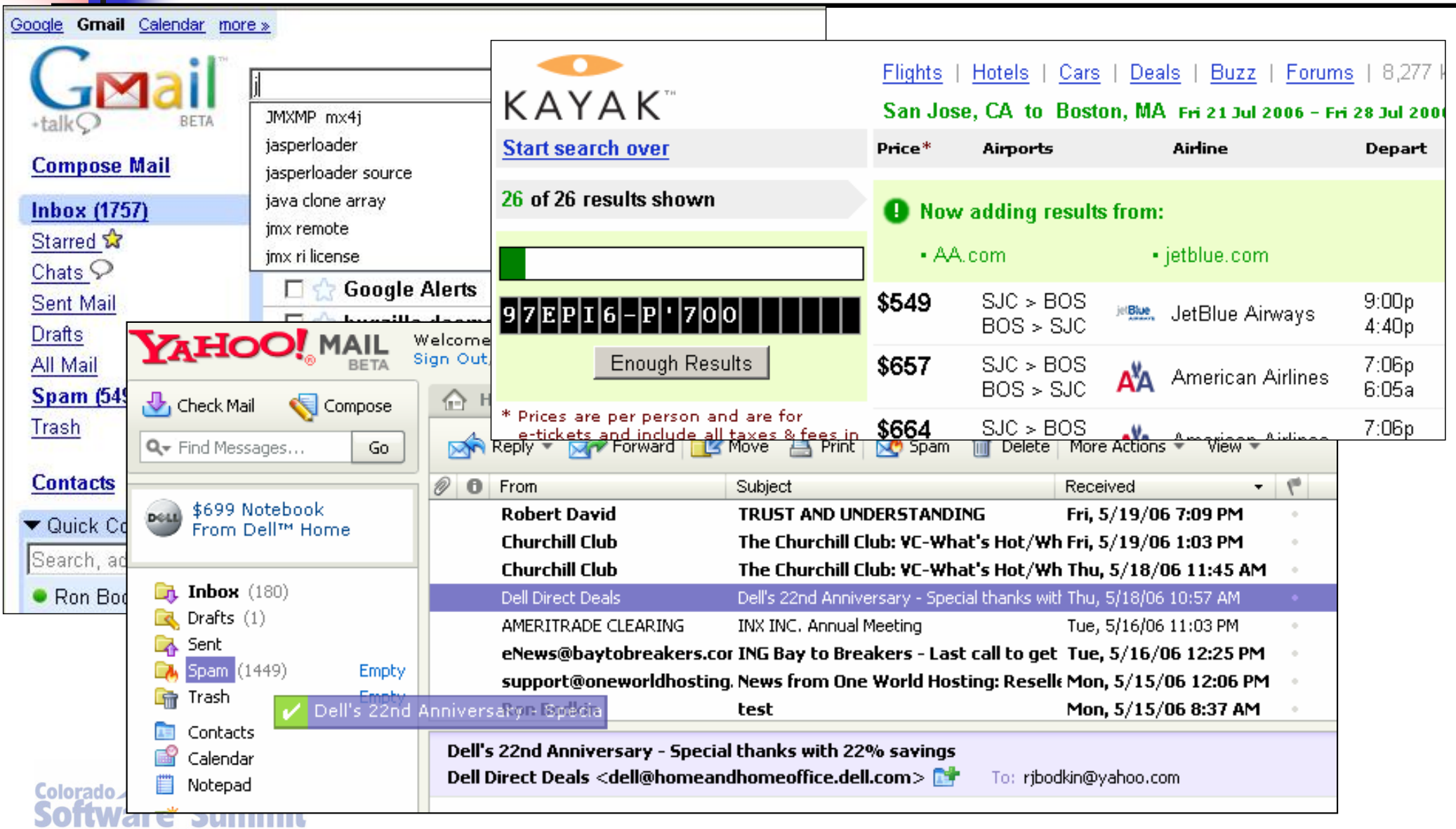


Agenda

- AJAX Overview
- AJAX Technology
- Challenges
- Solutions

© Copyright 2006, Glassbox Corporation

AJAX...

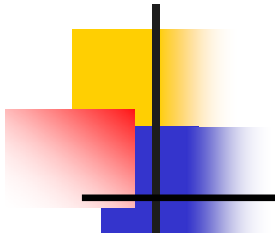


© Copyright 2006, Glassbox Corporation

AJAX Defined

- **A**synchronous JavaScript And XML
- A *group* of technologies: HTML, JavaScript and XML
- Still HTML-based, but with JavaScript packages that make web pages feel more responsive
- Parts of a page fetch data and update without the major re-load everyone is used to
- Used correctly, Ajax brings the interactivity of good desktop apps to the Web, such as a spell checker that checks on the fly like Outlook.
- Ajax can be chatty, so it needs a good network and thoughtful design

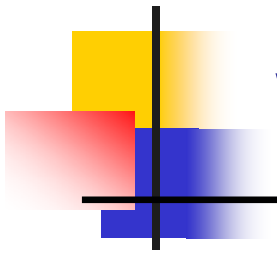
© Copyright 2006, Glassbox Corporation



Other Options

- Fat Client
  - Most interactive
  - Hard to distribute, maintain
- HTML
  - Easy to write, most portable
  - Less interactive especially on WAN
- Flash
  - Wide deployment (>95%)... still mostly used for animation
  - Harder to develop, integrate
- Java
  - applets had early promise, limited to a niche
- Microsoft XAML/Avalon
  - Windows Vista only... ask me in 2009

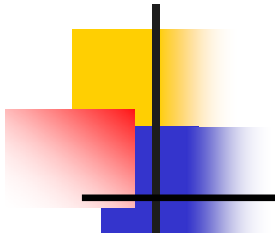
© Copyright 2006, Glassbox Corporation



Why AJAX?

- Rich interactivity
  - Responsiveness like a desktop app
  - Lively site
  - Ease of use
- Browser-based
  - Standards
  - Ubiquitous
  - Easy update
- Productive, usable, networked applications

© Copyright 2006, Glassbox Corporation

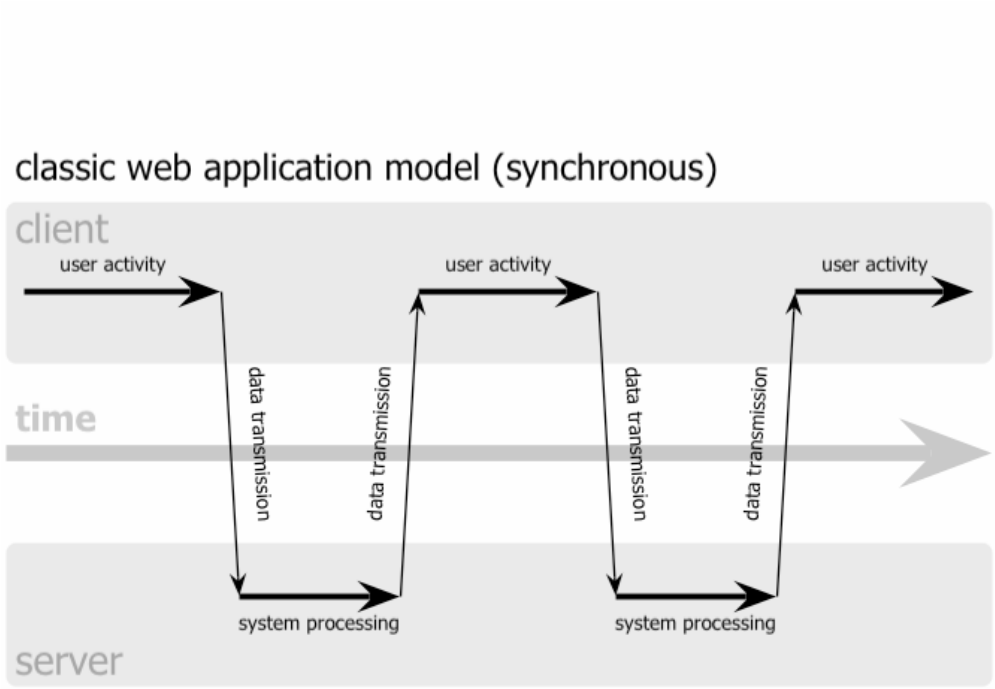


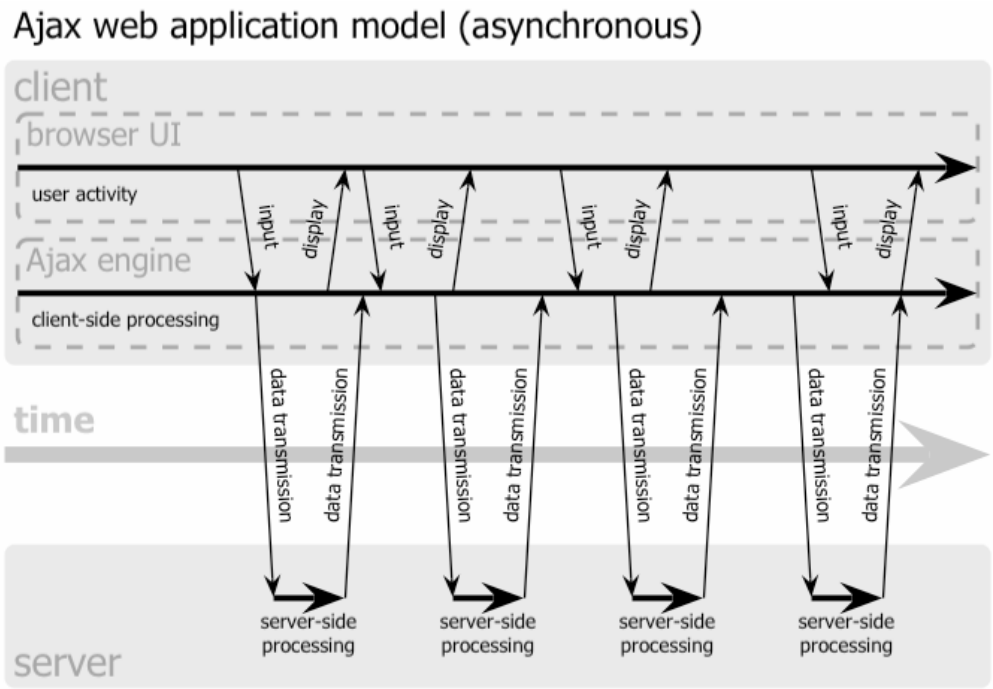
Why Now?

- Technology matured
- Successful large-scale applications
- Emergence of tools and frameworks
- Even as IE went from 95% to 85% share

© Copyright 2006, Glassbox Corporation

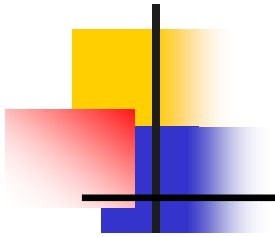
New Interaction Patterns





Source: Adaptive Path

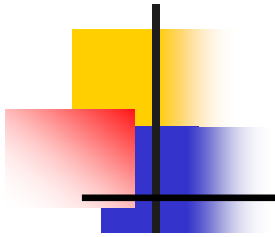
© Copyright 2006, Glassbox Corporation



Agenda

- AJAX Overview
- AJAX Technology
- Challenges
- Solutions

© Copyright 2006, Glassbox Corporation



Enabling Technologies

- XMLHttpRequest
  - Allows *asynchronous* communication with server
  - Generates events as data is received
- JavaScript
  - Better portability across major browsers
  - Still a lot of conditional logic required
- Dynamic updates to page
  - DOM gives full object access
  - innerHTML attribute for modifying HTML inside a tag

© Copyright 2006, Glassbox Corporation

Javascript (Browser) Libraries

- dojo (widgets, packaging, utilities, persistence)
- Prototype (framework)
- script.aculo.us (effects, widgets)
- AjaxTK/Apache Kabuki - Zimbra (widgets)
- Yahoo! User Interface Library (widgets)
- TIBCO General Interface (framework & tools)

© Copyright 2006, Glassbox Corporation

Browser + Server Frameworks

- Java
  - DWR (Direct Web Remoting)
  - Google Web Toolkit
  - ZK
  - AjaxTags
  - Ajax4JSF
- PHP
  - Symfony
  - AjaxAC
- .NET
  - Atlas
  - Ajax.NET
  - MagicAjax.NET
- Ruby on Rails
- Python: Django
- Perl
  - Catalyst
  - CGI::Ajax

© Copyright 2006, Glassbox Corporation

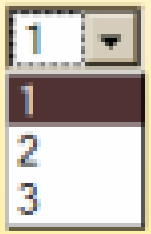
Example: DWR 1.0 AJAX

Web Browser

Web Server

HTML / Javascript

```
function eventHandler()
{
   AjaxService.getOptions(populateList);
}

function populateList(data)
{
   DWRUtil.addOptions("listid", data);
}
```



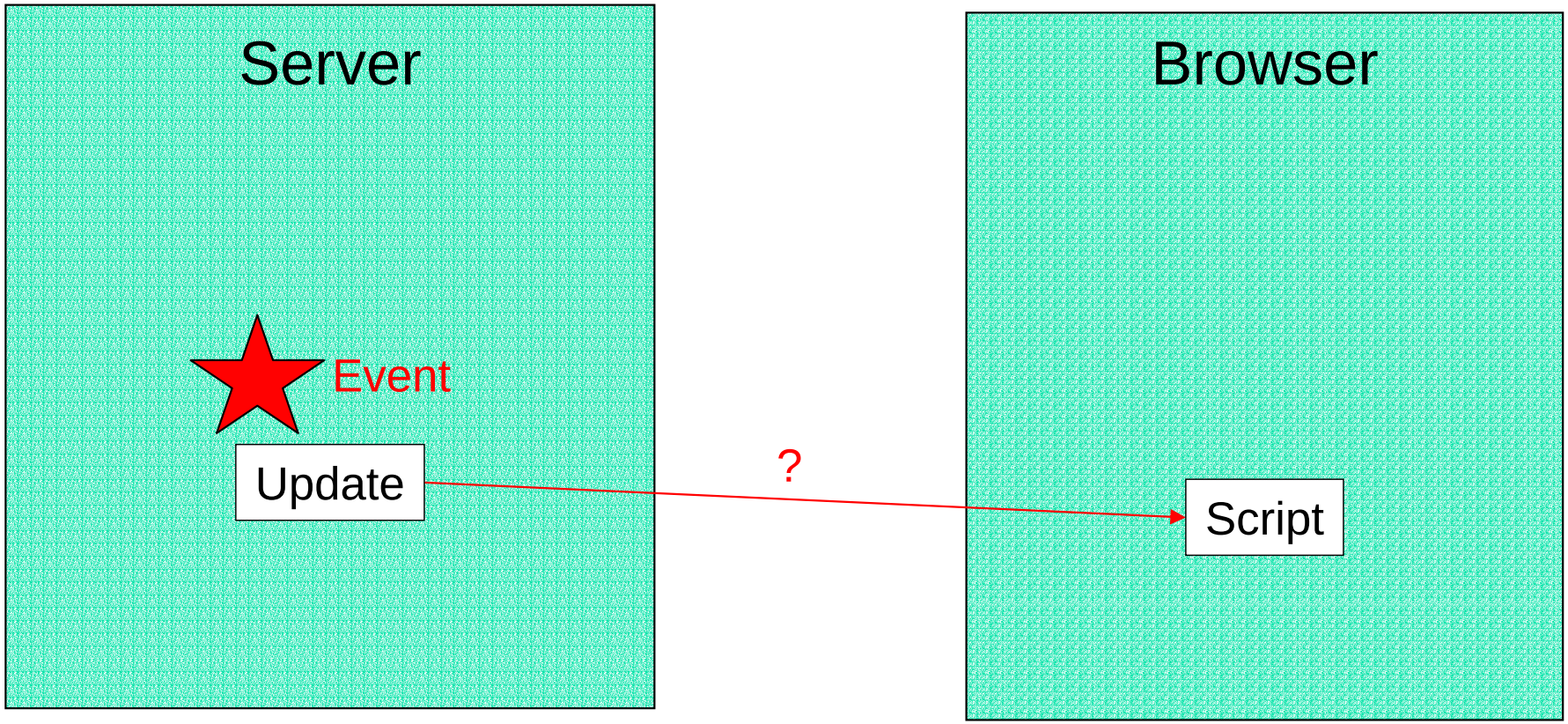
Java

```
public class AjaxService
{

  public String[] getOptions()
  {
    return new String[] { "1", "2", "3" };
  }

}
```

Source: Getahead

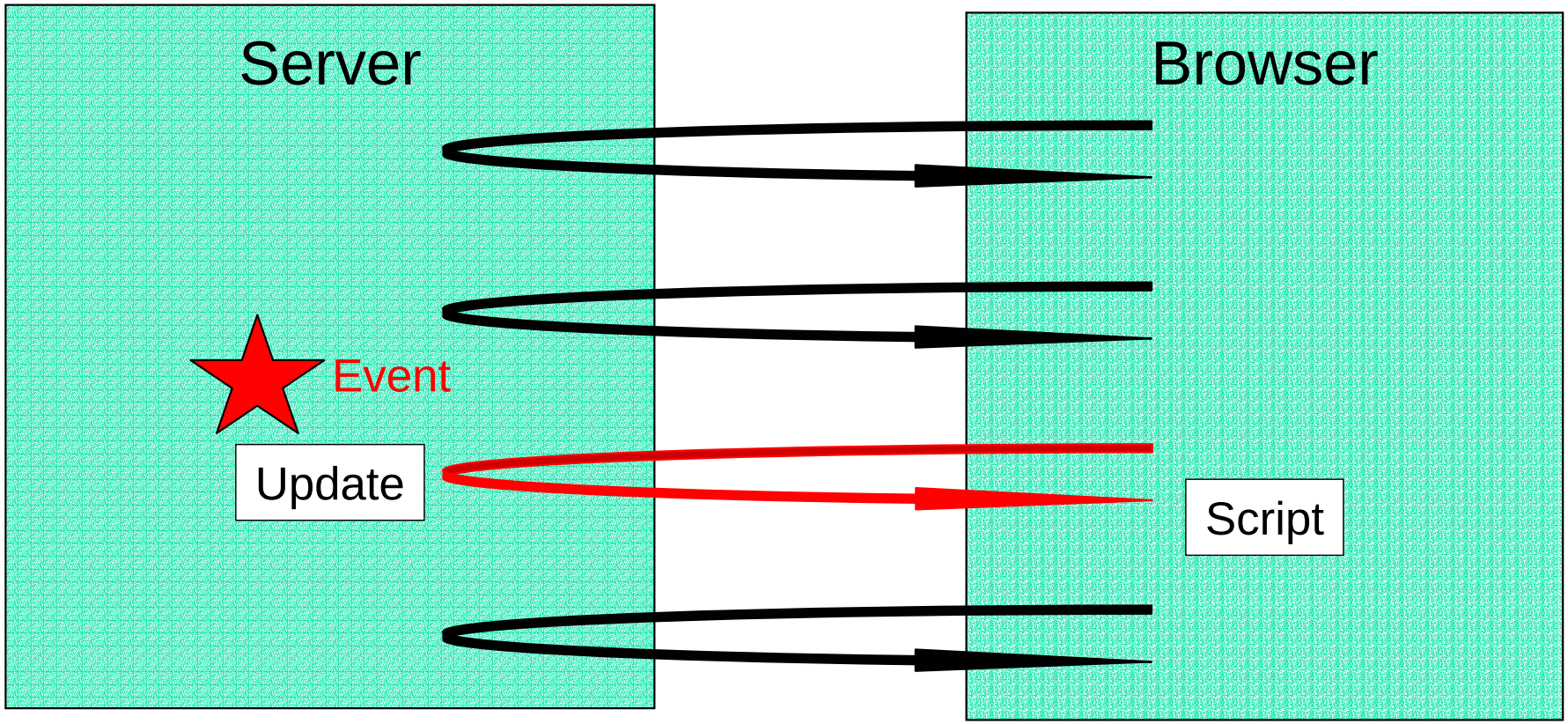
© Copyright 2006, Glassbox Corporation

Reverse AJAX: Automatic Updates



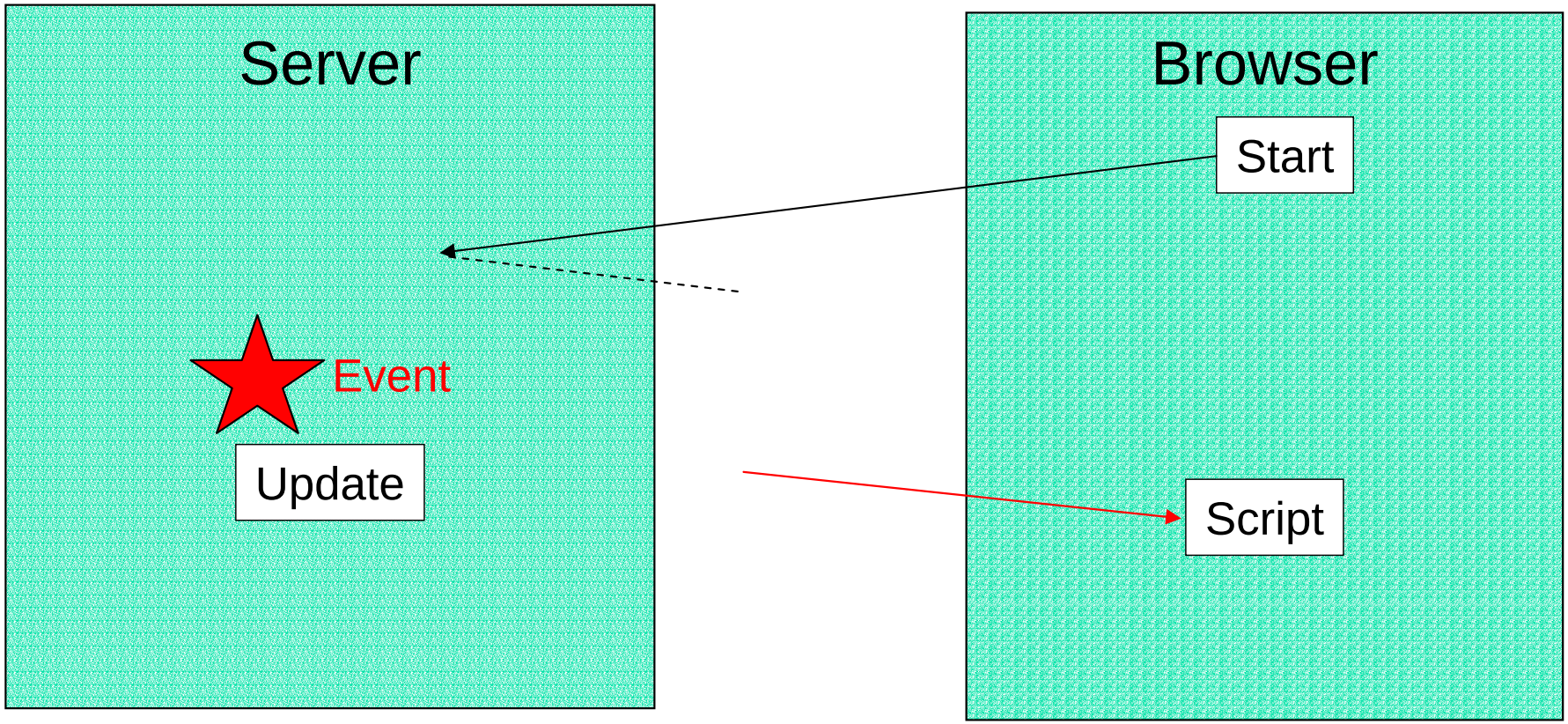
© Copyright 2006, Glassbox Corporation

Reverse AJAX: Polling



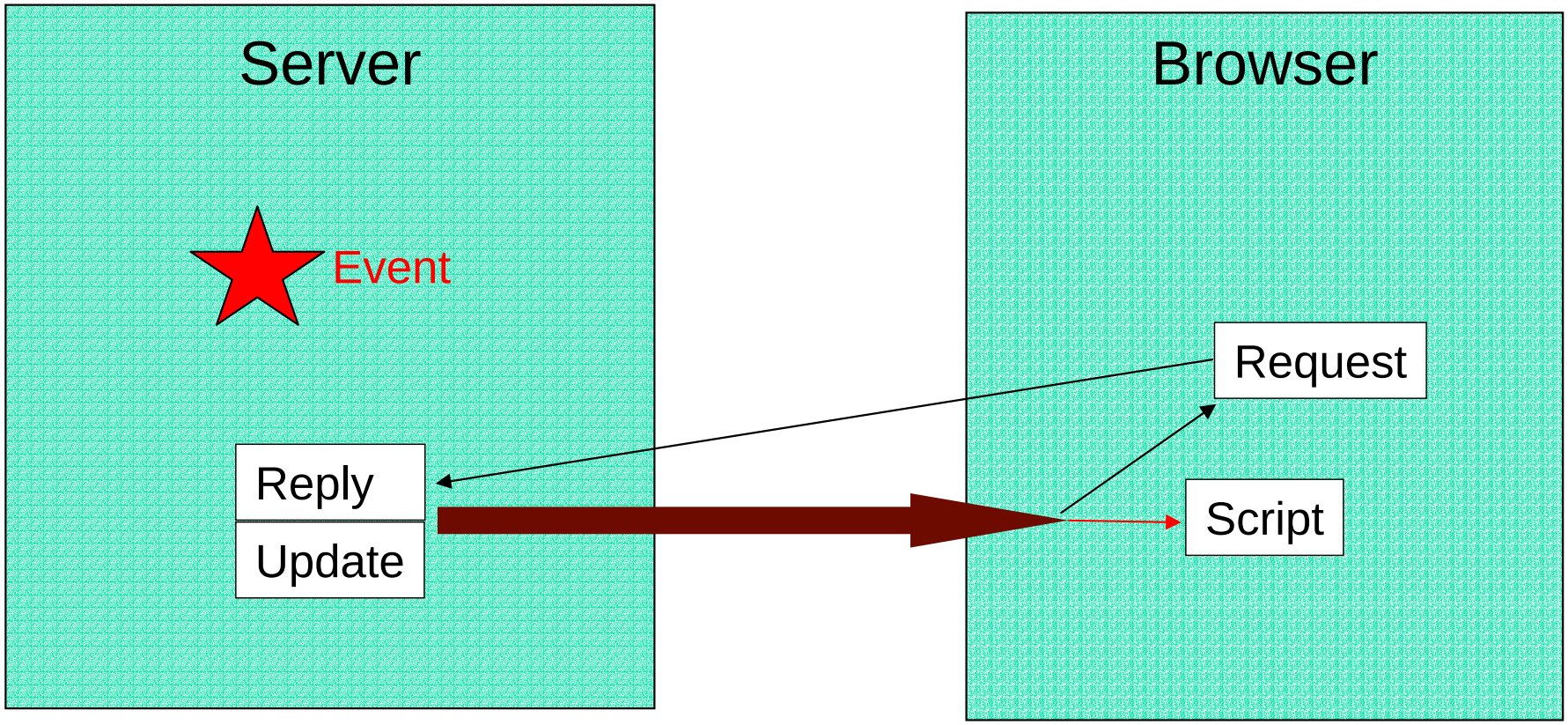
© Copyright 2006, Glassbox Corporation

Reverse AJAX: Comet



© Copyright 2006, Glassbox Corporation

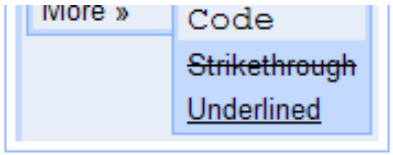
Reverse AJAX: Piggy Back

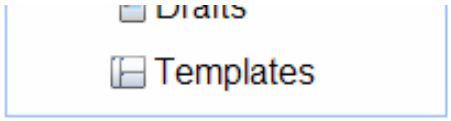


Often discussed, but who is implementing it?

© Copyright 2006, Glassbox Corporation

Widgets, *e.g.*, Google Web Toolkit

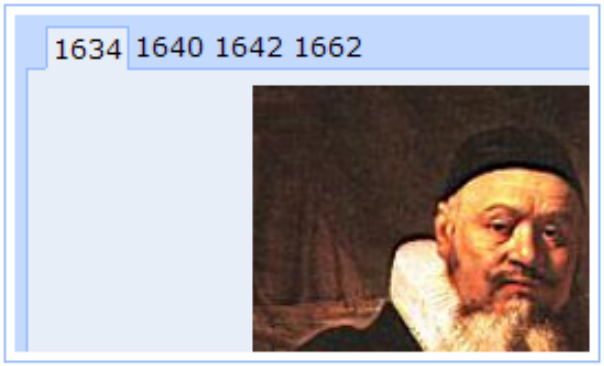




Table

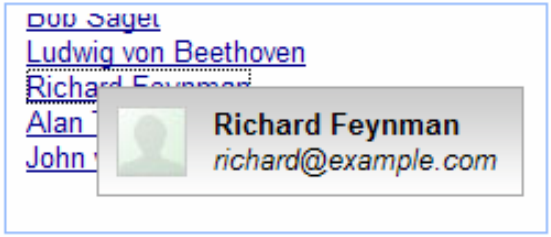
sender	email
markboland05	mark@example.com
Hollie Voss	hollie@example.com
boticario	boticario@example.com
Emerson Milton	emerson@example.com
Healy Colette	healy@example.com
Brigitte Cobb	brigitte@example.com
Elba Lockhart	elba@example.com

TabBar



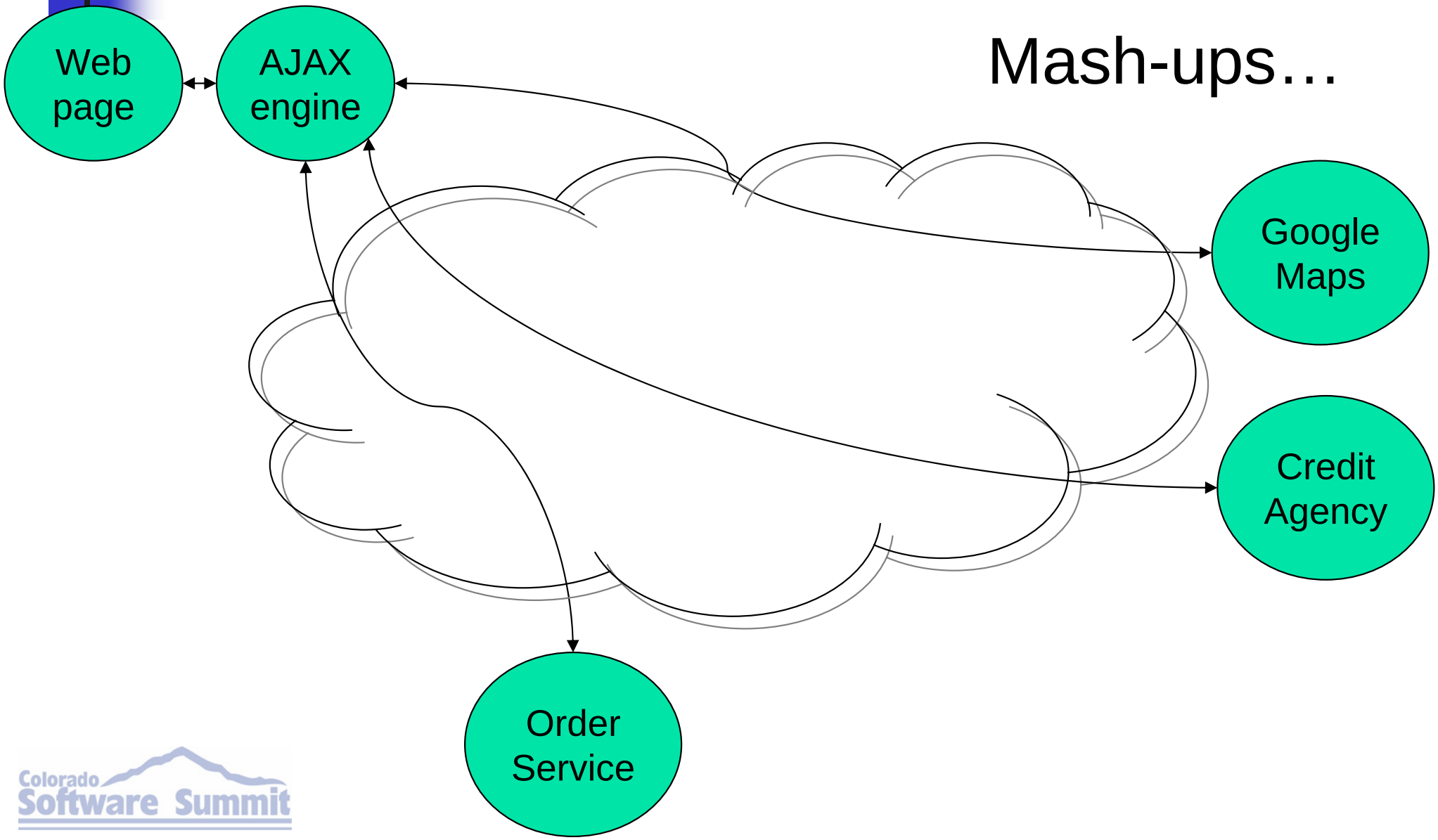
DialogBox

PopupPanel



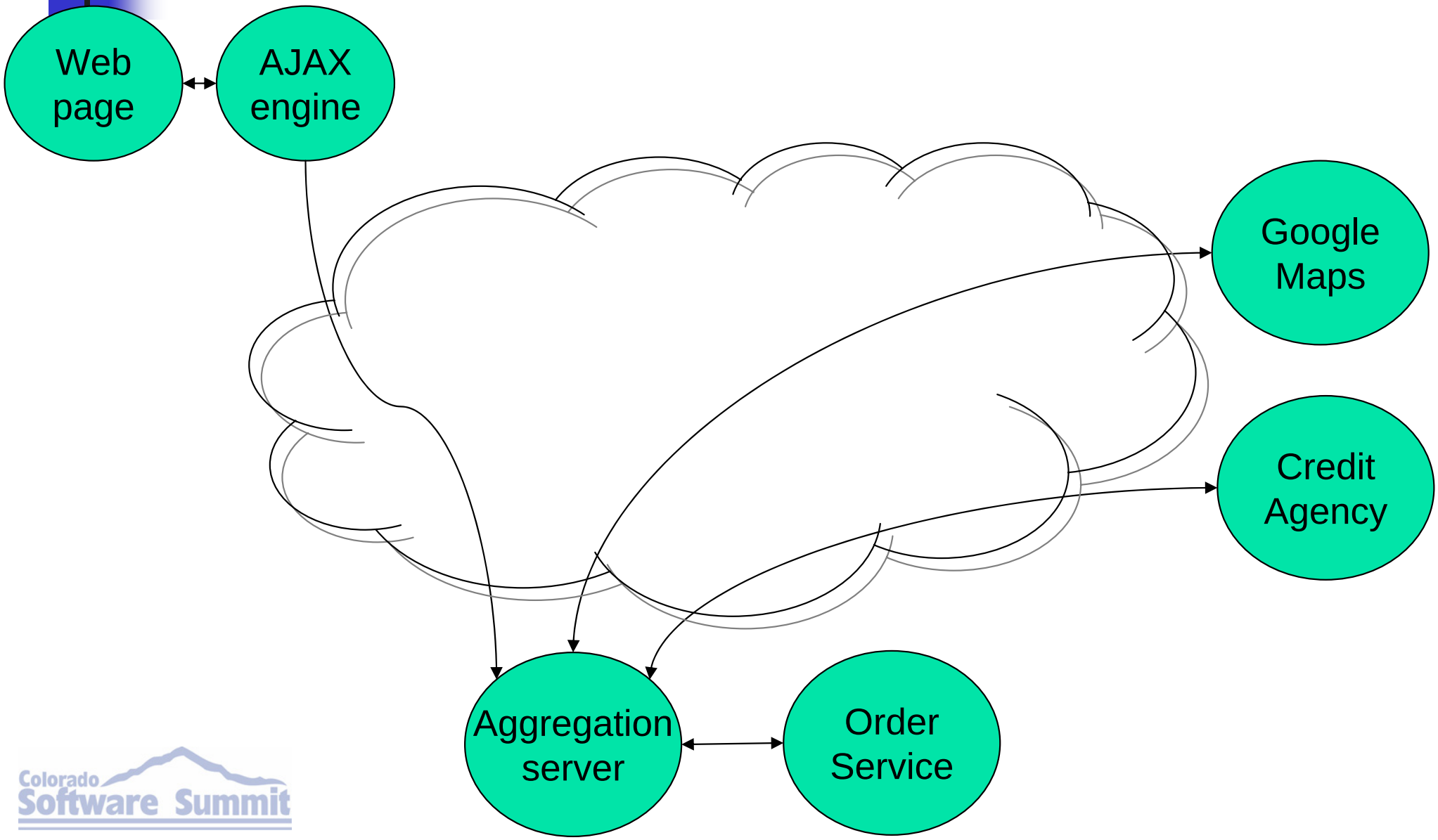
© Copyright 2006, Glassbox Corporation

Direct Service Integration



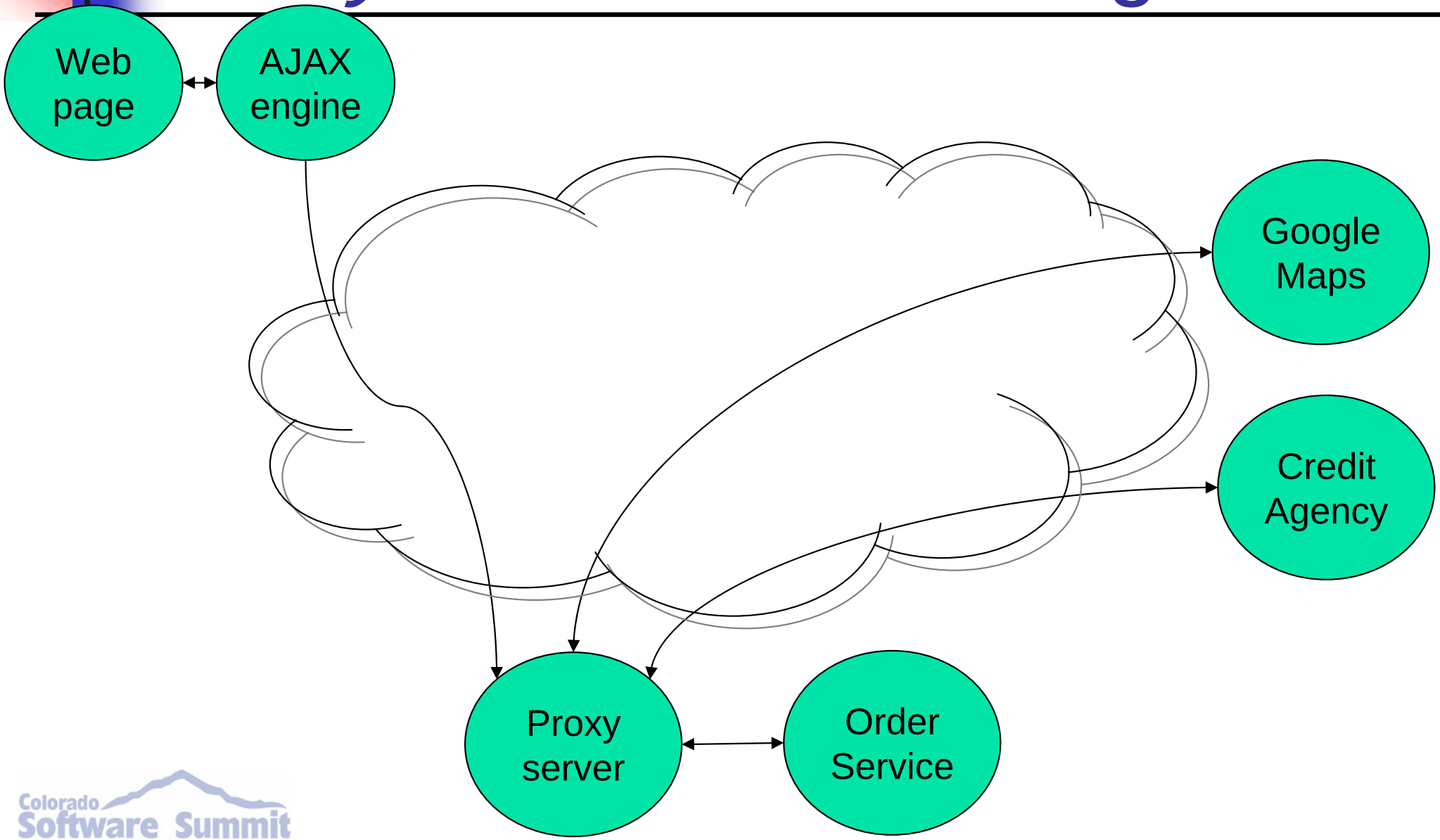
© Copyright 2006, Glassbox Corporation

Indirect Service Integration

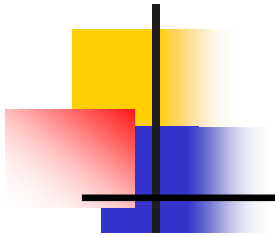


© Copyright 2006, Glassbox Corporation

Proxy Web Service Integration



© Copyright 2006, Glassbox Corporation



Agenda

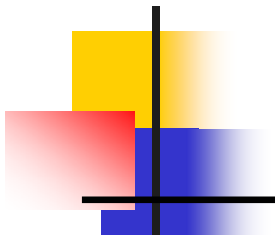
- AJAX Overview
- AJAX Technology
- Challenges
- Solutions

© Copyright 2006, Glassbox Corporation

AJAX Problem Areas

- Excess server requests
- JavaScript problems
- Server load
- Service fragility
- Integration server problems

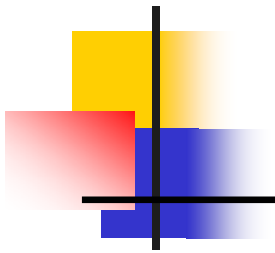
© Copyright 2006, Glassbox Corporation



Excess Server Requests

- Adds complexity
  - One single action can generate a flood of requests
  - Or a handful of slower ones
  - What happens if some are unreliable?
  - One missing timeout can produce a huge backlog
- Hard to Monitor End User Performance
  - Initial page load time isn't the issue...
  - Can't determine cause of requests without page analysis
- Hard to correlate Requests with Pages let alone User Actions

© Copyright 2006, Glassbox Corporation



JavaScript Problems

- Not as fast as compiled languages!
- Processing large data sets is hard
- Engines can do a lot of work
- Browser portability is still an issue
  - May require digging into framework code
- Stateful UI's: what interactions led to errors?
  - Debugging nested DOM/CSS/JS...
- Accessibility
- HTTP limit of 2 simultaneous connections per server by default (configurable)

© Copyright 2006, Glassbox Corporation

Server Load: Pre-AJAX

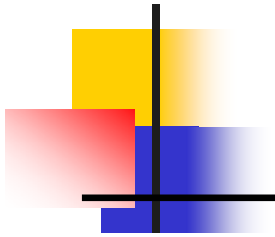
- Short spikes of activity
- Long pauses of inactivity “think time”
- Efficient for use of server sockets and threads
- Can tax CPU
- Dynamic pages integrate big static chunks

© Copyright 2006, Glassbox Corporation

Server Load: AJAX

- Initial download of engine (static content)
- Bursts of activity (change of context)
- With more frequent updates
- Typically shorter less intensive interactions
- Frequent requests and polling use network, CPU, sockets, and threads
- Comet instead uses much more **sockets** and typically **threads** and **buffers**
- More demanding of client too
- More *static* content

© Copyright 2006, Glassbox Corporation



Service Fragility

- Each service is a possible point of failure
  - Outages
  - Configuration problems
  - Changes to service
- Cascading slowness possible
  - Not meeting SLA
  - Tests robustness/race conditions in browser

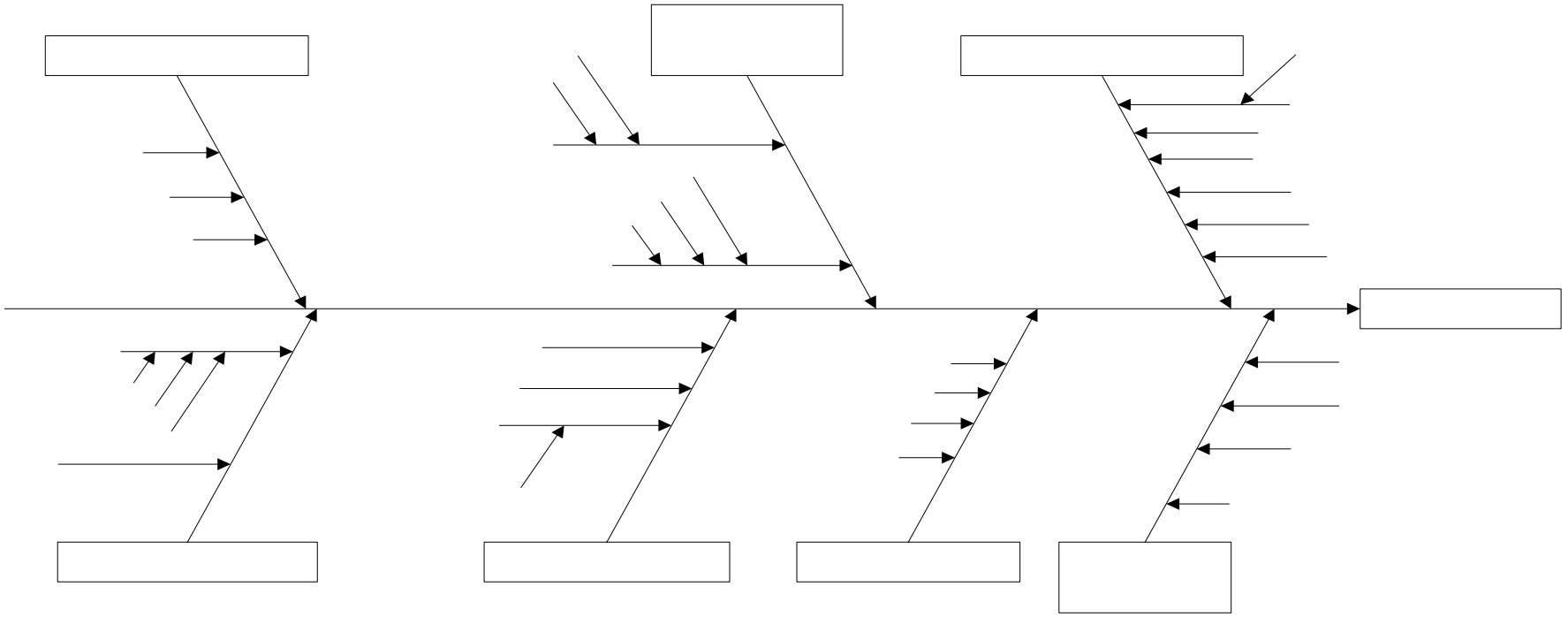
© Copyright 2006, Glassbox Corporation

Integration Server Problems

- Slow database query
- Too many queries
- Bottlenecks from aggregating many services
  - memory, sockets, ...
- Contention for locks in server...
  - lots of threads for one session
- Outages/misconfiguration
- ... Traditional problems in a new context

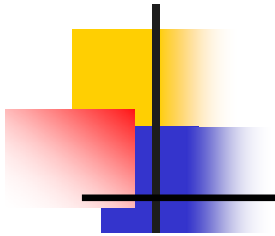
© Copyright 2006, Glassbox Corporation

Typical Application Problems



Hardware Problem

© Copyright 2006, Glassbox Corporation

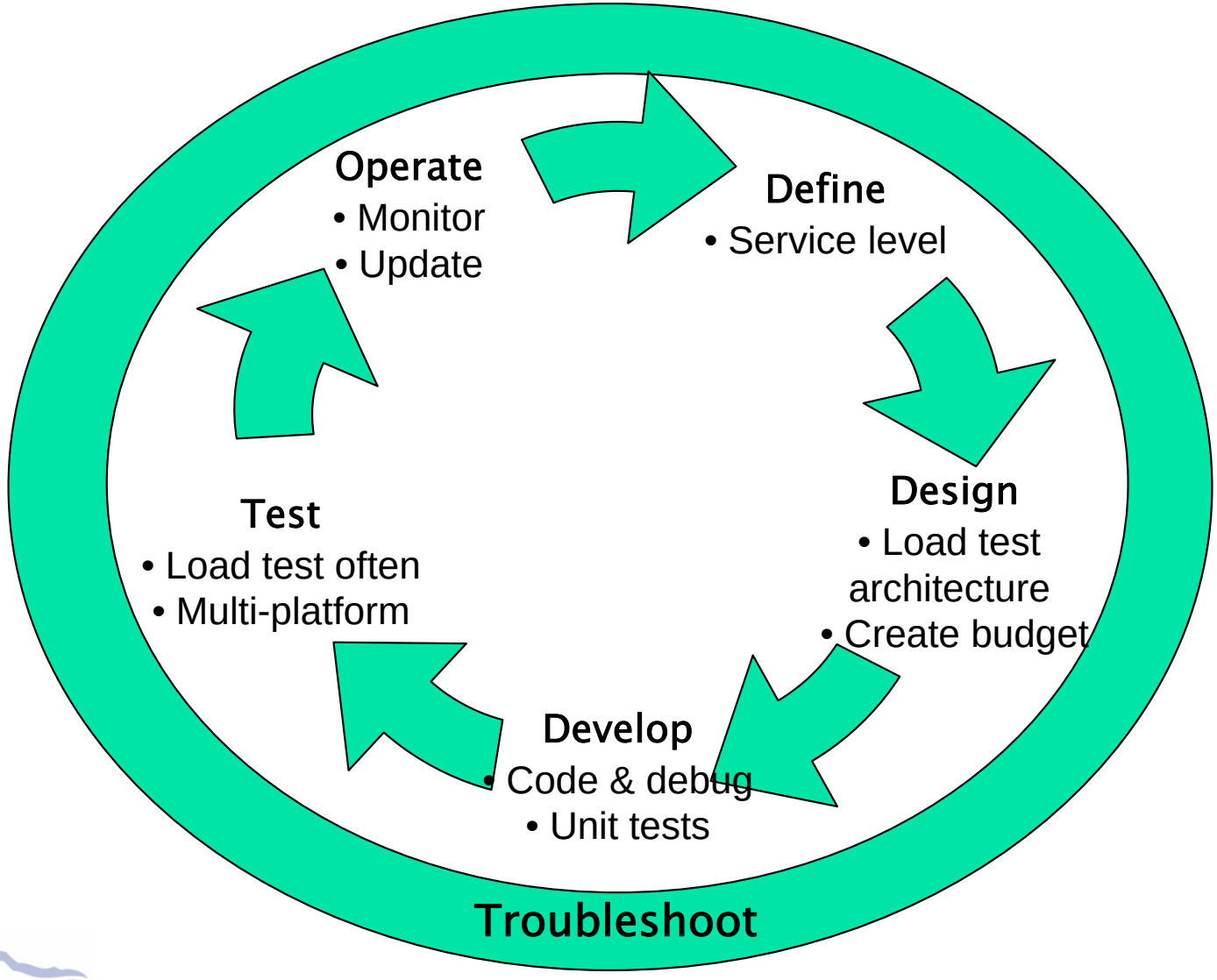


Agenda

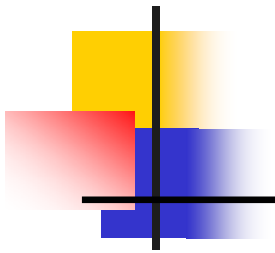
- AJAX Overview
- AJAX Technology
- Challenges
- Solutions

© Copyright 2006, Glassbox Corporation

The Performance Lifecycle



© Copyright 2006, Glassbox Corporation



Architecture Is Key

- AJAX shuffles the deck
  - Changed workloads
  - Emerging, immature technologies
- Allocate work sensibly
  - Informs basic goals and SLA's
- Budgets for both latency and scalability
  - Interactive events (heavy & light)
  - Update callbacks
- Prototype basic elements
  - Many new technologies at play
- Extrapolate to model performance

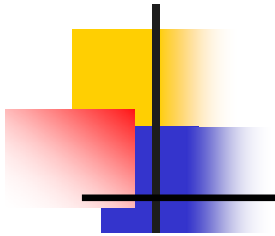
© Copyright 2006, Glassbox Corporation

Server Options

- The usual suspects...
  - Java EE (Tomcat, JBoss, Jetty, GlassFish, WebSphere*, WebLogic*...)
  - .NET for Windows*
  - LAMP
- Emerging networking options
  - Grizzly event-based HTTP Connector (in GlassFish)
  - COMETd (Perl)
  - Twisted (Python)
  - Scala, Erlang/OTP (Concurrency Oriented Languages)
  - Apache 2 Event MPM
  - Continuation support...

* Indicates cost to use.

© Copyright 2006, Glassbox Corporation

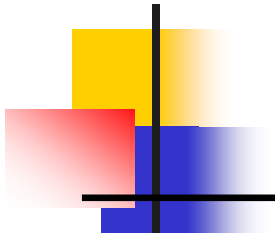


Emerging Standards?

The Jetty open source Java Web container:

- Uses NIO to only use threads when processing I/O
- Server requests set up a *continuation*
  - If waiting for data, they suspend by throwing
  - When data is available, they are resumed
  - The server replays the processing, but the next time they will continue
- Continuations allow using one thread per active request
- Also uses NIO split buffers to limit buffers for many requests
- DWR 2's Reverse AJAX
  - works with Jetty continuations
  - Supports polling & COMET

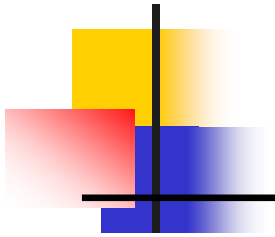
© Copyright 2006, Glassbox Corporation



Continuations

- Object to represent the state of program execution
  - Native support in dynamic languages like Ruby, Smalltalk
  - Java options rely on specialized state
- Jetty implementation supports AJAX scalability
  - Requires no side effects in code
  - Replays state based on request state & session state
  - Doesn't checkpoint session state...
- Other frameworks use to simplify conversations
  - RIFE framework for Java
  - Seaside framework for Smalltalk

© Copyright 2006, Glassbox Corporation

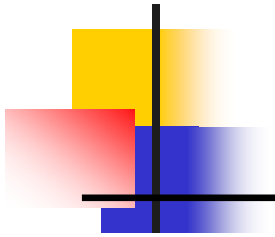


IDE Support

- Eclipse
  - ATF (editor, debugger)
  - MyEclipse * (editor, code assist, debugger)
  - Aptana * (code completion)
- IntelliJ IDEA* (refactoring editor)

* Indicates cost to use.

© Copyright 2006, Glassbox Corporation

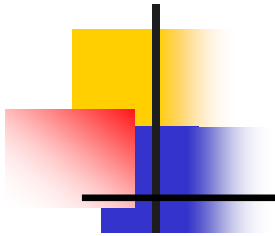


Browser Development Tools

- Debugging
  - Mozilla Venkman debugger & profiler
  - Microsoft Script Debugger for IE
- Inspectors
  - WebDeveloper toolbar for Firefox: CSS, inspector
  - FireBug console viewer, inspector, debugger
  - Mouseover DOM Inspector
- Request monitoring
  - FireBug
  - GreaseMonkey: XMLHttpRequest Tracing/Debugging
  - Eclipse ATF
- Logging: MochiKit, dojo... *server-side*?

* Indicates cost to use.

© Copyright 2006, Glassbox Corporation

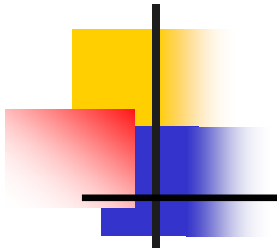


Venkman Profiling Output

33 <http://localhost:8080/glassbox/dwr/util.js>
  util.js: 750 - 2500 milliseconds
    Function Name: anonymous (Lines 294 - 375)
    Total Calls: 6930 (max recurse 0)
    Total Time: 2093.01 (min/max/avg 0/10.02/0.3)
    Time (ex. calls): 1011.45 (min/max/avg 0/10.02/0.15)

35 <http://localhost:8080/glassbox/js/troubleshooter.js>
  troubleshooter.js: 750 - 2500 milliseconds
    Function Name: loadRowInfo (Lines 78 - 83)
    Total Calls: 99 (max recurse 0)
    Total Time: 2293.3 (min/max/avg 20.03/40.06/23.16)
    Time (ex. calls): 0 (min/max/avg 0/0/0)

© Copyright 2006, Glassbox Corporation



Unit Test

- Baseline test for functionality AND performance
- In browser
  - Script.aculo.us, JsUnit, ASTUce
- JavaScript unit tests
  - Rhino, MS Windows Script Host
  - JavaScript Coverage Validator (beta)*
- On server
  - JUnit, NUnit
  - Java Coverage: Emma, Cobertura, Clover*

* Indicates cost to try or use.

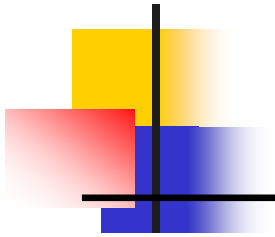
© Copyright 2006, Glassbox Corporation

System Test

- Functional system tests (in browser)
  - Script recording and playback validation
    - Selenium, Squish/Web*
  - Script code objects (*e.g.*, for JUnit)
    - Waitij/Waitir (Win/IE scripting for Java/Ruby)
- Load and Stress tests: simulate traffic
  - OpenSTA (http/s only... confused by gmail)
  - JMeter (http/s only)
  - LoadRunner (http/s, script objects too)*

* Indicates cost to try or use.

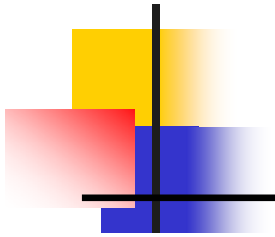
© Copyright 2006, Glassbox Corporation



Configuration

- Tune based on Load Test
- Network
  - Load balancers, firewalls, routers
- OS level
  - Maximum sockets
  - Maximum threads
- Web server
  - Timeouts
- Application server
  - Threads
  - Timeouts
- VM
  - Memory settings (*e.g.*, -Xss thread stack size)

© Copyright 2006, Glassbox Corporation



Systems Monitoring

- Network-level
  - Router, sniffer metrics: throughput, latency
  - End-user response time (not just http pings!)
  - Customer Experience Management complicated: Keynote*, TeaLeaf*
- OS-level : sockets, IO, processes, CPU...
  - netstat, top, Nagios, Hyperic, HP Openview*, Tivoli*

Colorado Software Summit

* Indicates cost to try or use.

© Copyright 2006, Glassbox Corporation

Using Fiddler: Mail Login & View

Yahoo Mail Beta

- Request Count: 52
- Bytes Sent: 61,069
- Bytes Received: 165,677

...

- US West Coast (DSL - 30KB/sec)
- Round trip cost: 5.20s
- Elapsed Time: 12.20s

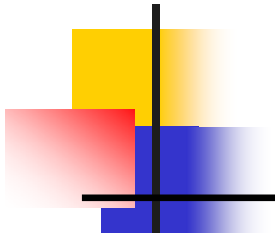
Gmail

- Request Count: 48
- Bytes Sent: 55,443
- Bytes Received: 51,044

...

- US West Coast (DSL - 30KB/sec)
- Round trip cost: 4.80s
- Elapsed Time: 7.80s

© Copyright 2006, Glassbox Corporation



App Server Monitoring

- Container
  - Server JMX: request queue, pools, throughput
- Java VM with Java 5 JMX Data
  - All threads, memory
- Key elements
  - threads, memory, request queues, throughput, *etc*.

Colorado Software Summit

* Indicates cost to try or use.

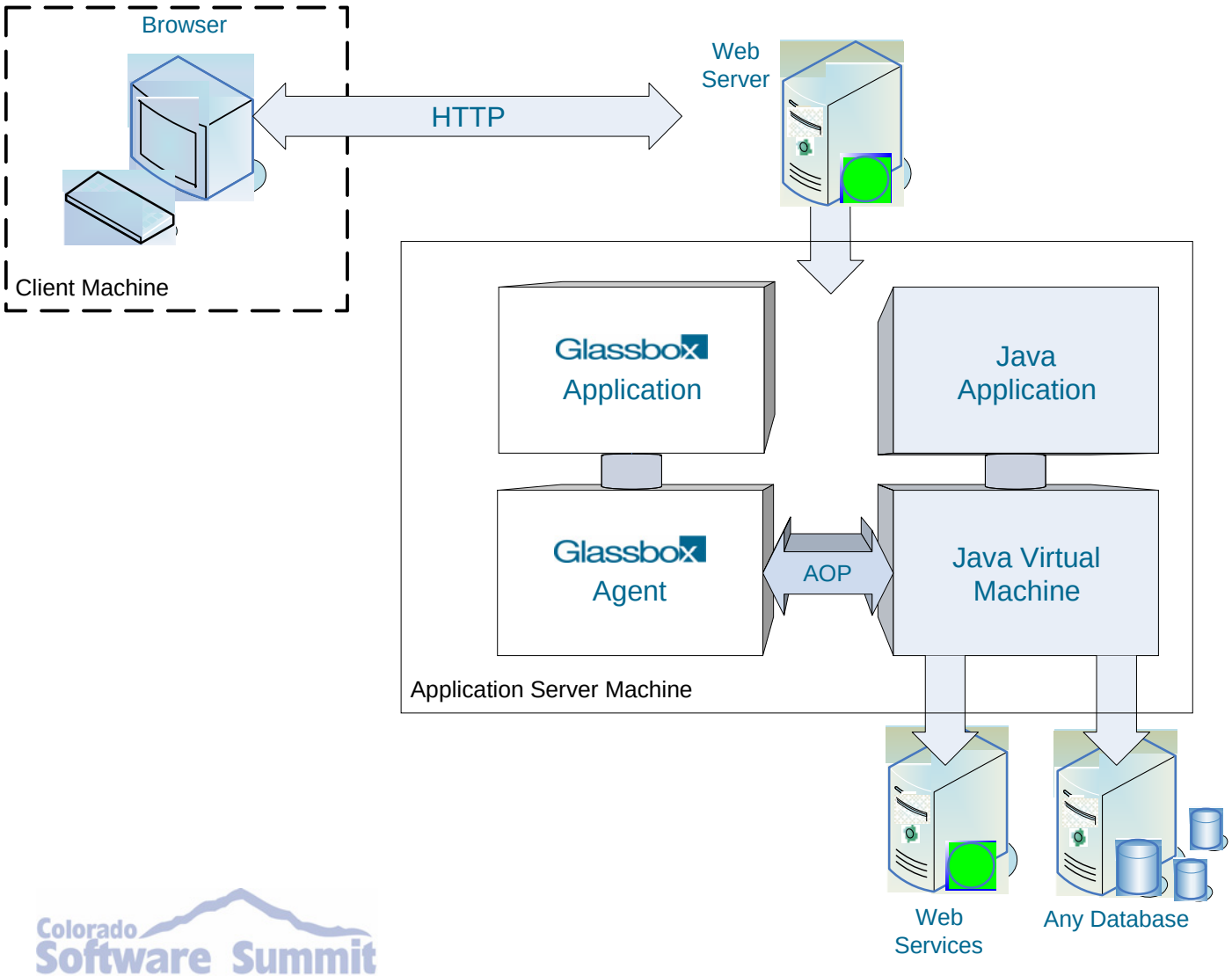
© Copyright 2006, Glassbox Corporation

App Monitoring with Aspects

- Aspects run automatically at well-defined points at runtime
- **No need to instrument code**
- Allows low overhead tracking
- Easy to update monitoring policies
  - Enable and disable, even sampling
- Standardized support
  - AspectJ load-time weaving avoids changes to build process
  - Popular extensible language for Java 5 javaagents
  - Spring AOP allows proxy-based option for coarse-grained components
- Flexibility
  - Reuse open source monitors for common APIs
  - Easy to extend for custom monitoring

© Copyright 2006, Glassbox Corporation

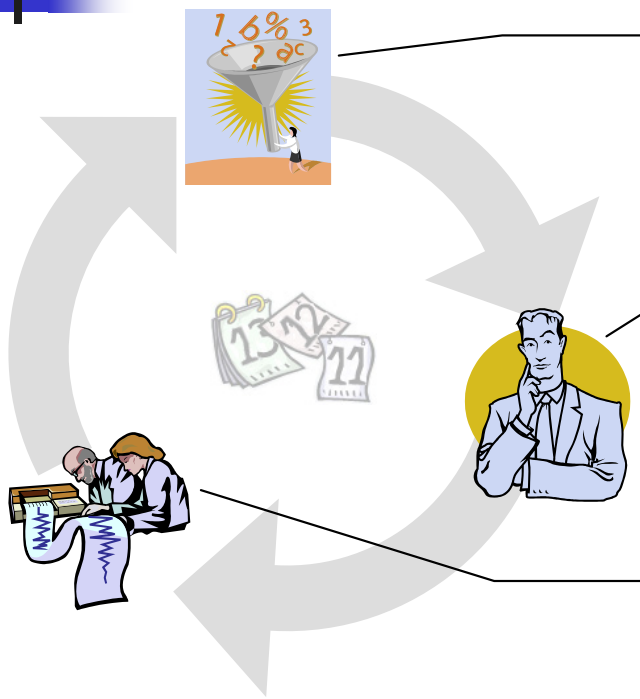
Glassbox Open Source



- Java 1.4+
- Discovers and tracks *operations* as they execute
- Load-time weaving
- Low overhead
- Detects *common problems*, *e.g.*
  - AJAX latency, load
  - Excess queries
  - Slow/broken Web services

© Copyright 2006, Glassbox Corporation

Troubleshooting Tools Provide



1. Aggressive data filtering can reduce the data haystack early

2. Troubleshooting intelligence means users need not be experts in the tool or have written the system

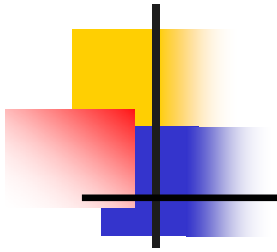
3. Cleaner data and more accurate diagnoses streamline communication

Benefits

- Fix problems faster and cheaper by streamlining communication.
- Fix more problems by enabling non-experts to track them down.

Colorado Software Summit

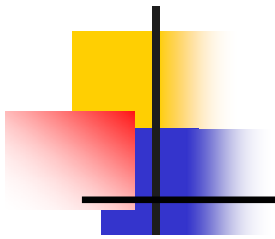
© Copyright 2006, Glassbox Corporation



Bringing It Together

DEMO

© Copyright 2006, Glassbox Corporation



Conclusions

- AJAX is now ready for prime time
  - Emphasize high-value interactivity
- Supporting technologies becoming mainstream
  - But test carefully and watch for shifts
- Focus on *architecture* up front
  - Benchmark latency and throughput
- Integrate monitoring and troubleshooting up front
- We're looking for collaborators to build better AJAX monitoring & troubleshooting
- Please leave your business card to get updates
- These slides will be updated on the post-conference CD

© Copyright 2006, Glassbox Corporation

Resources

- *Ajaxian* for News: www.ajaxian.com
- *Ajax Patterns* for Technologies: ajaxpatterns.org
- *Ajax: A New Approach to Web Applications*: http://adaptivepath.com/publications/essays/archives/000385.php
- *Ajax Impact on Server Scaling*: www.zimbra.com/blog/archives/2006/04/ajax_impact_on.html
- *Scaling Connections for AJAX with Jetty 6:* www.mortbay.com/MB/log/gregw/?permalink=ScalingConnections.html
- *Not There Yet: COMET with Apache and Jetty*: http://blogs.pathf.com/agileajax/2006/05/not_there_yet_c.html
- *What I Didn't Know About XHR:* http://www.oreillynet.com/xml/blog/2006/10/what_i_didnt_know_about_xhr.html
- *Glassbox*: www.glassbox.com