High Performance Web Sites

14 rules for faster pages

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Exceptional Performance

quantify and improve the performance of all Yahoo! products worldwide

center of expertise

build tools, analyze data

gather, research, and evangelize best practices
The Importance of Front-End Performance
## Time Spent on the Frontend

<table>
<thead>
<tr>
<th>Domain</th>
<th>Empty Cache</th>
<th>Full Cache</th>
</tr>
</thead>
<tbody>
<tr>
<td>amazon.com</td>
<td>82%</td>
<td>86%</td>
</tr>
<tr>
<td>aol.com</td>
<td>94%</td>
<td>86%</td>
</tr>
<tr>
<td>cnn.com</td>
<td>81%</td>
<td>92%</td>
</tr>
<tr>
<td>ebay.com</td>
<td>98%</td>
<td>92%</td>
</tr>
<tr>
<td>google.com</td>
<td>86%</td>
<td>64%</td>
</tr>
<tr>
<td>msn.com</td>
<td>97%</td>
<td>95%</td>
</tr>
<tr>
<td>myspace.com</td>
<td>96%</td>
<td>86%</td>
</tr>
<tr>
<td>wikipedia.org</td>
<td>80%</td>
<td>88%</td>
</tr>
<tr>
<td>yahoo.com</td>
<td>95%</td>
<td>88%</td>
</tr>
<tr>
<td>youtube.com</td>
<td>97%</td>
<td>95%</td>
</tr>
</tbody>
</table>
The Performance Golden Rule

80-90% of the end-user response time is spent on the front-end. Start there.

- Greater potential for improvement
- Simpler
- Proven to work
14 Rules
14 Rules

1. Make fewer HTTP requests
2. Use a CDN
3. Add an Expires header
4. Gzip components
5. Put stylesheets at the top
6. Move scripts to the bottom
7. Avoid CSS expressions
8. Make JS and CSS external
9. Reduce DNS lookups
10. Minify JS
11. Avoid redirects
12. Remove duplicate scripts
13. Configure ETags
14. Make AJAX cacheable
Rule 1: Make fewer HTTP requests

CSS sprites
combined scripts, combined stylesheets
Image maps
CSS Sprites

size of combined image is less

<span style="background-image: url('sprites.gif'); background-position: -260px -90px;">"</span>
# Rule 2: Use a CDN

<table>
<thead>
<tr>
<th>Domain</th>
<th>CDN Provider(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>amazon.com</td>
<td>Akamai</td>
</tr>
<tr>
<td>aol.com</td>
<td>Akamai</td>
</tr>
<tr>
<td>cnn.com</td>
<td></td>
</tr>
<tr>
<td>ebay.com</td>
<td>Akamai, Mirror Image</td>
</tr>
<tr>
<td>google.com</td>
<td></td>
</tr>
<tr>
<td>msn.com</td>
<td>SAVVIS</td>
</tr>
<tr>
<td>myspace.com</td>
<td>Akamai, Limelight</td>
</tr>
<tr>
<td>wikipedia.org</td>
<td></td>
</tr>
<tr>
<td>yahoo.com</td>
<td>Akamai</td>
</tr>
<tr>
<td>youtube.com</td>
<td></td>
</tr>
</tbody>
</table>

distribute your static content before distributing your dynamic content
## Rule 3: Add an Expires header

not just for images

<table>
<thead>
<tr>
<th>Domain</th>
<th>Images</th>
<th>Stylesheets</th>
<th>Scripts</th>
<th>%</th>
<th>Median Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>amazon.com</td>
<td>0/62</td>
<td>0/1</td>
<td>0/3</td>
<td>0%</td>
<td>114 days</td>
</tr>
<tr>
<td>aol.com</td>
<td>23/43</td>
<td>1/1</td>
<td>6/18</td>
<td>48%</td>
<td>217 days</td>
</tr>
<tr>
<td>cnn.com</td>
<td>0/138</td>
<td>0/2</td>
<td>2/11</td>
<td>1%</td>
<td>227 days</td>
</tr>
<tr>
<td>ebay.com</td>
<td>16/20</td>
<td>0/2</td>
<td>0/7</td>
<td>55%</td>
<td>140 days</td>
</tr>
<tr>
<td>froogle.google.com</td>
<td>1/23</td>
<td>0/1</td>
<td>0/1</td>
<td>4%</td>
<td>454 days</td>
</tr>
<tr>
<td>msn.com</td>
<td>32/35</td>
<td>1/1</td>
<td>3/9</td>
<td>80%</td>
<td>34 days</td>
</tr>
<tr>
<td>myspace.com</td>
<td>0/18</td>
<td>0/2</td>
<td>0/2</td>
<td>0%</td>
<td>1 day</td>
</tr>
<tr>
<td>wikipedia.org</td>
<td>6/8</td>
<td>1/1</td>
<td>2/3</td>
<td>75%</td>
<td>1 day</td>
</tr>
<tr>
<td>yahoo.com</td>
<td>23/23</td>
<td>1/1</td>
<td>4/4</td>
<td>100%</td>
<td>n/a</td>
</tr>
<tr>
<td>youtube.com</td>
<td>0/32</td>
<td>0/3</td>
<td>0/7</td>
<td>0%</td>
<td>26 days</td>
</tr>
</tbody>
</table>
Rule 4: Gzip components

you can affect users'
download times
90%+ of browsers support
compression
# Gzip: not just for HTML

<table>
<thead>
<tr>
<th>Domain</th>
<th>HTML</th>
<th>Scripts</th>
<th>Stylesheets</th>
</tr>
</thead>
<tbody>
<tr>
<td>amazon.com</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aol.com</td>
<td>x</td>
<td>some</td>
<td>some</td>
</tr>
<tr>
<td>cnn.com</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ebay.com</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>froogle.google.com</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>msn.com</td>
<td>x</td>
<td>deflate</td>
<td>deflate</td>
</tr>
<tr>
<td>myspace.com</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>wikipedia.org</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>yahoo.com</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>youtube.com</td>
<td>x</td>
<td>some</td>
<td>some</td>
</tr>
</tbody>
</table>

Gzip scripts, stylesheets, XML, JSON (not images, PDF)
Rule 5: Put stylesheets at the top

stylesheets block rendering in IE
solution: put stylesheets in HEAD (per spec)
avoids Flash of Unstyled Content
use LINK (not @import)
Rule 6: Move scripts to the bottom

Scripts block parallel downloads across all hostnames.

Scripts block rendering of everything below them in the page.

Script defer attribute is not a solution:
- blocks rendering and downloads in FF
- slight blocking in IE
Rule 7: Avoid CSS expressions

used to set CSS properties dynamically in IE

```javascript
width: expression(
    document.body.clientWidth < 600 ?
    "600px" : "auto" );
```

problem: expressions execute many times
- mouse move, key press, resize, scroll, etc.

alternatives:
- one-time expressions
- event handlers
Rule 8: Make JS and CSS external

inline: HTML document is bigger
external: more HTTP requests, but cached
variables
- page views per user (per session)
- empty vs. primed cache stats
- component re-use

external is typically better
extra credit: post-onload download, dynamic inlining
Rule 9: Reduce DNS lookups

typically 20-120 ms
block parallel downloads
OS and browser both have DNS caches
## Rule 10: Minify JavaScript

<table>
<thead>
<tr>
<th>Website</th>
<th>Minify External?</th>
<th>Minify Inline?</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.amazon.com">www.amazon.com</a></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><a href="http://www.aol.com">www.aol.com</a></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><a href="http://www.cnn.com">www.cnn.com</a></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><a href="http://www.ebay.com">www.ebay.com</a></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>froogle.google.com</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><a href="http://www.msn.com">www.msn.com</a></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><a href="http://www.myspace.com">www.myspace.com</a></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><a href="http://www.wikipedia.org">www.wikipedia.org</a></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><a href="http://www.yahoo.com">www.yahoo.com</a></td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><a href="http://www.youtube.com">www.youtube.com</a></td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

*minify inline scripts, too*
# Minify vs. Obfuscate

<table>
<thead>
<tr>
<th>Website</th>
<th>Original</th>
<th>JSMin Savings</th>
<th>Dojo Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.amazon.com">www.amazon.com</a></td>
<td>204K</td>
<td>31K (15%)</td>
<td>48K (24%)</td>
</tr>
<tr>
<td><a href="http://www.aol.com">www.aol.com</a></td>
<td>44K</td>
<td>4K (10%)</td>
<td>4K (10%)</td>
</tr>
<tr>
<td><a href="http://www.cnn.com">www.cnn.com</a></td>
<td>98K</td>
<td>19K (20%)</td>
<td>24K (25%)</td>
</tr>
<tr>
<td><a href="http://www.myspace.com">www.myspace.com</a></td>
<td>88K</td>
<td>23K (27%)</td>
<td>24K (28%)</td>
</tr>
<tr>
<td><a href="http://www.wikipedia.org">www.wikipedia.org</a></td>
<td>42K</td>
<td>14K (34%)</td>
<td>16K (38%)</td>
</tr>
<tr>
<td><a href="http://www.youtube.com">www.youtube.com</a></td>
<td>34K</td>
<td>8K (22%)</td>
<td>10K (29%)</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>85K</td>
<td>17K (21%)</td>
<td>21K (25%)</td>
</tr>
</tbody>
</table>

minify - it's safer

not much difference
Rule 11: Avoid redirects

3xx status codes - mostly 301 and 302
HTTP/1.1 301 Moved Permanently
Location: http://stevesouders.com/newuri

add Expires headers to cache redirects
worst form of blocking
Rule 12: Remove duplicate scripts

- hurts performance
  - extra HTTP requests (IE only)
  - extra executions
- atypical?
  - 2 of 10 top sites contain duplicate scripts
- team size, # of scripts
**Rule 13: Configure ETags**

unique identifier returned in response

ETag: "c8897e-aee-4165acf0"
Last-Modified: Thu, 07 Oct 2004 20:54:08 GMT

used in conditional GET requests

If-None-Match: "c8897e-aee-4165acf0"
If-Modified-Since: Thu, 07 Oct 2004 20:54:08 GMT

if ETag doesn't match, can't send 304

ETag format
- Apache: inode-size-timestamp
- IIS: Filetimestamp:ChangeNumber

Use `em or lose `em
- Apache: FileETag none
- IIS: http://support.microsoft.com/kb/922703/
Rule 14: Make AJAX cacheable and small

XHR, JSON, iframe, dynamic scripts can still be cached (and minified, and gzipped)

a personalized response should still be cacheable by that person
YSlow

http://developer.yahoo.com/yslow
performance lint tool
grades web pages for each rule
Firefox add-on integrated with Firebug
open source license
Disturbing thoughts

Find out what Yahoo! users think of "Disturbia" – a modern twist on the classic "Rear Window." » Reviews

- Showtimes  ▶ Trailer  ▶ Photos
- LeBeouf to star in 'Indiana Jones 4'

Users review the new thriller 'Disturbia'

Scientists: Scrap the Internet and start over

This page has 4 external JavaScript files.

1. Minimize HTTP requests
2. Use edge computing
3. Add an Expires header
4. Gzip components
5. Move CSS to the top
Takeaways

focus on the front-end
harvest the low-hanging fruit
you do control user response times
Small investment up front keeps on giving
LOFNO - be an advocate for your users
Links

examples: http://stevesouders.com/examples/
image maps: http://www.w3.org/TR/html401/struct/objects.html#h-13.6
CSS sprites: http://alistapart.com/articles/sprites
jsmin: http://crockford.com/javascript/jsmin
dojo compressor: http://dojotoolkit.org/docs/shrinksafe
HTTP status codes: http://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html
IBM Page Detailer: http://alphaworks.ibm.com/tech/pagedetailer
Fasterfox: http://fasterfox.mozdev.org/
LiveHTTPHeaders: http://livehttpheaders.mozdev.org/
Firebug: http://getfirebug.com/
http://yuiblog.com/blog/2007/03/01/performance-research-part-3/
YDN: http://developer.yahoo.net/blog/archives/2007/03/high_performanc.html
http://developer.yahoo.net/blog/archives/2007/04/rule_1_make_few.html