

WEB

PERFORMANCE AND FUTURE

Yan (Peter) Li / Sep 2015



<http://10.197.38.188/velocity>

<https://github.microstrategy.com/pages/yali/web-performance-and-future>

View online



<http://10.197.38.188/velocity/pdf>

Download PDF

HELLO, I'M YAN



- Joined MSTR in July 2008
- Work on Usher Network Manager
- Love Web

TOPIC

- Web Performance Tuning
- Brief Introduction to HTTP/2
- A little on HTTPS

Hope it helps!

DO YOU KNOW WEB?

Frontend

+

Backend

PAGE SIZE (TOP 1000)

Year	Requests	Avg. Transfer Size	Growth
12/17/2010	82	655 KB	N/A
12/15/2011	90	810 KB	24%
12/15/2012	99	1163 KB	44%
12/15/2013	112	1607 KB	38%
12/15/2014	117	1834 KB	14%
08/15/2015	128	2008 KB	9%

<http://httparchive.org/trends.php>

PAGE SIZE

Site	Requests	Size	Time
www.163.com	434	3.6 MB	1.7 min
www.taobao.com	116	1.3 MB	40.35 s
www.jd.com	79	1.6 MB	1.2 min
www.microsoft.com	76	2.2 MB	16.79 s
www.microstrategy.com	81	1.1 MB	37.29 s

NETWORK SPEED

Desktop		Mobile		
Data rate	Latency	G	Data rate	Latency
10 Mbps	65-145 ms	2G	100-400 Kbps	300-1000 ms
100 Mbps		3G	0.5-1 Mbps	100-500 ms
1 Gbps		4G	1-50 Mbps	<100 ms

<http://www.webperformancetoday.com/2012/04/02/mobile-versus-desktop-latency/>

http://chimera.labs.oreilly.com/books/1230000000545/ch07.html#_brief_history_of_the_g_8217_s

FASTER WEB SITES

What rules/best practices do you know?

YAHOO! BEST PRACTICES

1. Make Fewer HTTP Requests
2. Use a CDN
3. Add Expires or Cache-Control Header
4. Gzip Components
5. Put Stylesheets at Top
6. Put Scripts at Bottom
7. ...

<https://developer.yahoo.com/performance/rules.html>

GOOGLE PAGESPEED INSIGHTS

<https://developers.google.com/speed/pagespeed/insights/>

PAGE LOAD TIMELINE

redirections	DNS	TCP	request response	rendering
minimize redirection	reduce lookups	image spriting minify	caching domain sharding	css on top js at bottom

Similar graph: <http://www.w3.org/TR/navigation-timing/#processing-model>

REDIRECTIONS

redirections

DNS

TCP

request
response

rendering

minimize
redirection

MINIMIZE REDIRECTIONS

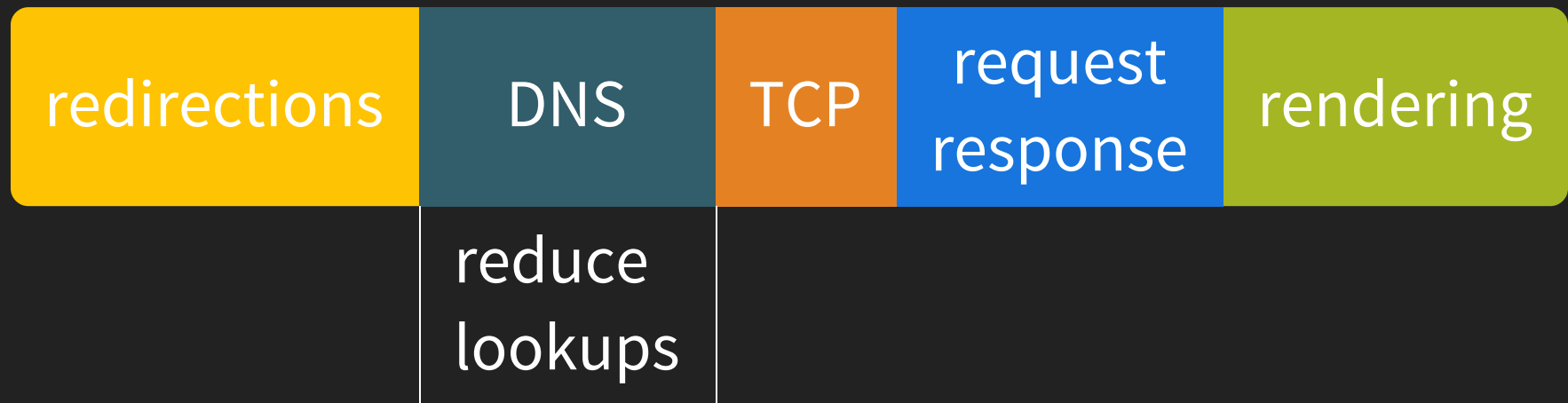
- Links/forms
- HTTP 3XX status codes
- HTML meta refresh

```
<meta http-equiv="refresh" content="5; url=http://example.com/">
```

- JavaScript

```
window.location.reload(true); // document.location?  
window.location.replace("http://www.z.cn");  
window.location.assign("http://www.z.cn");  
window.location.href = "http://www.z.cn";  
window.location = "http://www.z.cn";  
window.history.forward();  
window.history.back();  
window.history.go(-1);
```

DNS



DNS LOOKUP

www.google.com

1. *Browser/OS* cache
2. *Intranet* cache
3. *ISP/local* cache
4. *Root* name server
5. *.com* name server
6. *google.com* name server

HOW FAST IS YOUR LOCAL DNS?

<chrome://histograms/DNS.ResolveSuccess>

- Good: <30ms
- Average: 30-100ms
- Ouch: 100ms+

HTTPDNS

- 1st request: Http gets nearest server IP
- Subsequent: nearest server IP

全局精确流量调度新思路-HttpDNS服务详解
App域名劫持之DNS高可用 - 开源版HttpDNS方案详解

DNS PREFETCH

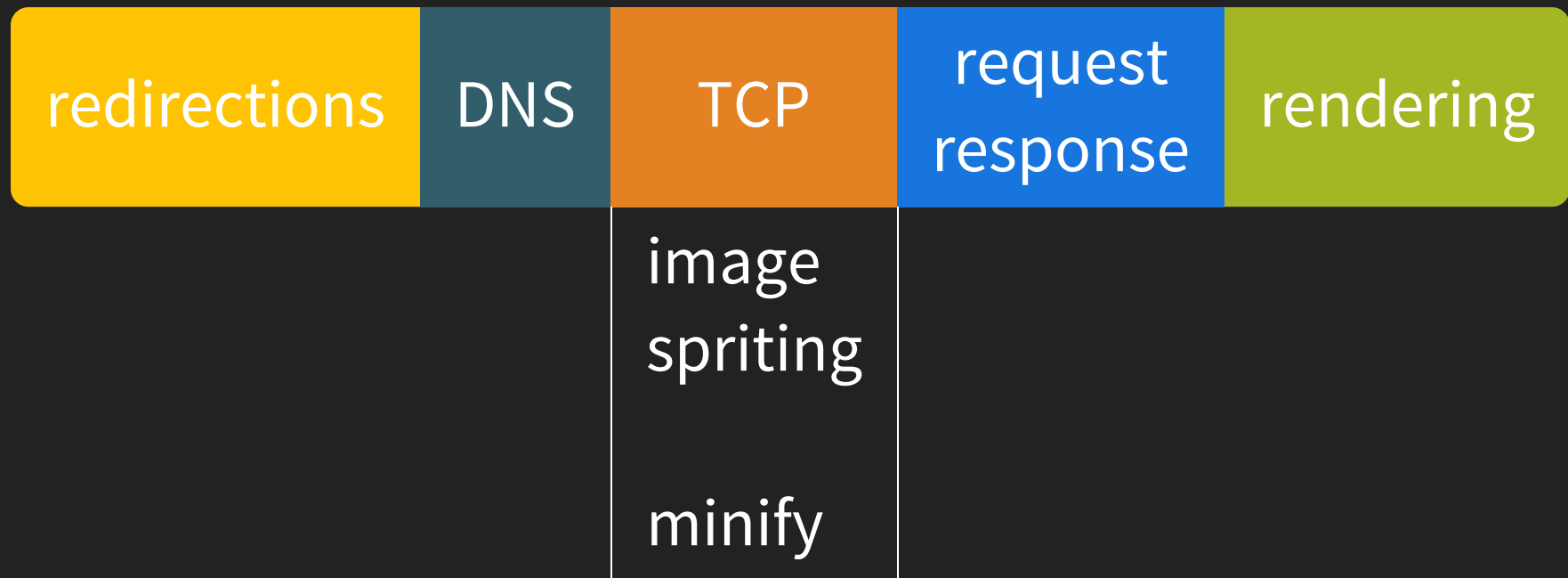
```
<link rel="dns-prefetch" href="www.microstrategy.com">
```

Hint browser to pre-resolve these names

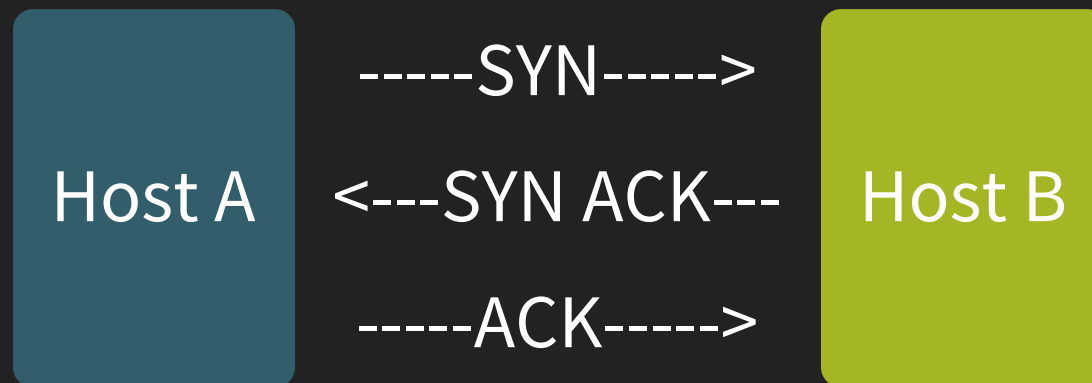
Supported: Chrome, Firefox, Safari, IE9+

<chrome://dns/>

TCP

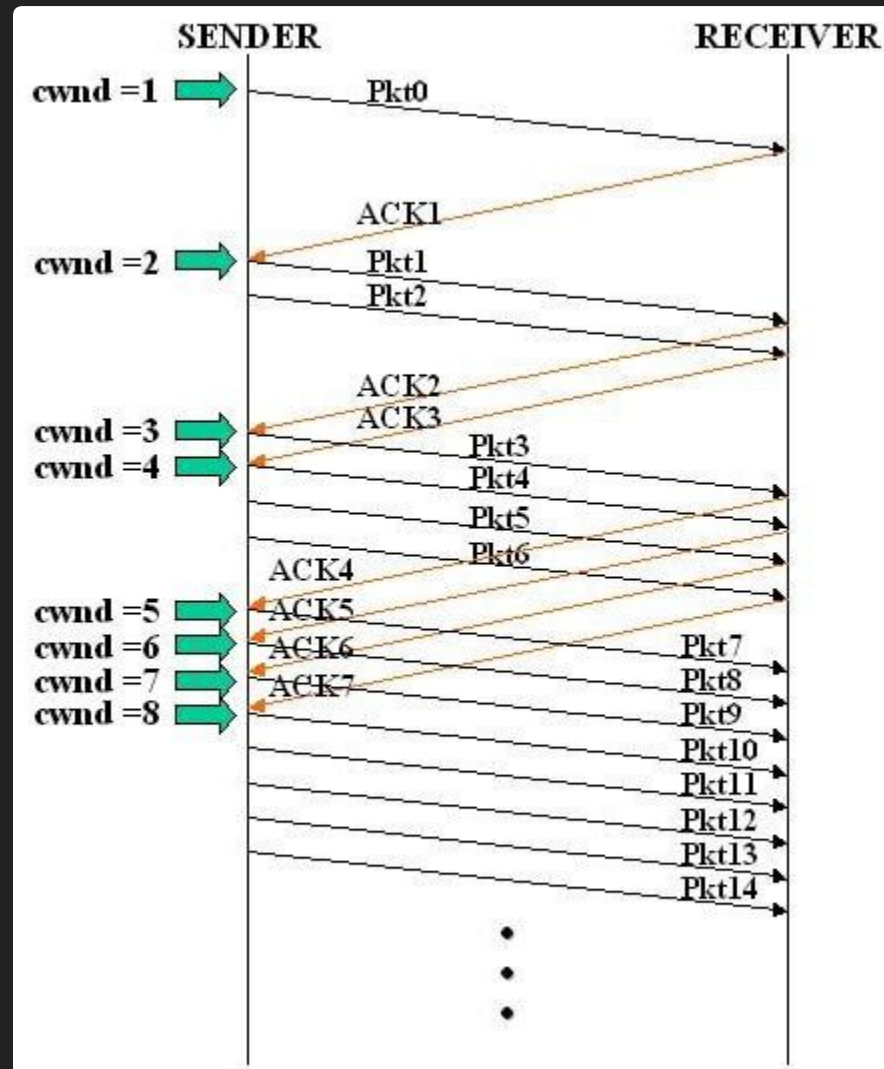


TCP 3-WAY HANDSHAKE



See [TCP 3-Way Handshake \(SYN,SYN-ACK,ACK\)](#)

TCP SLOW START



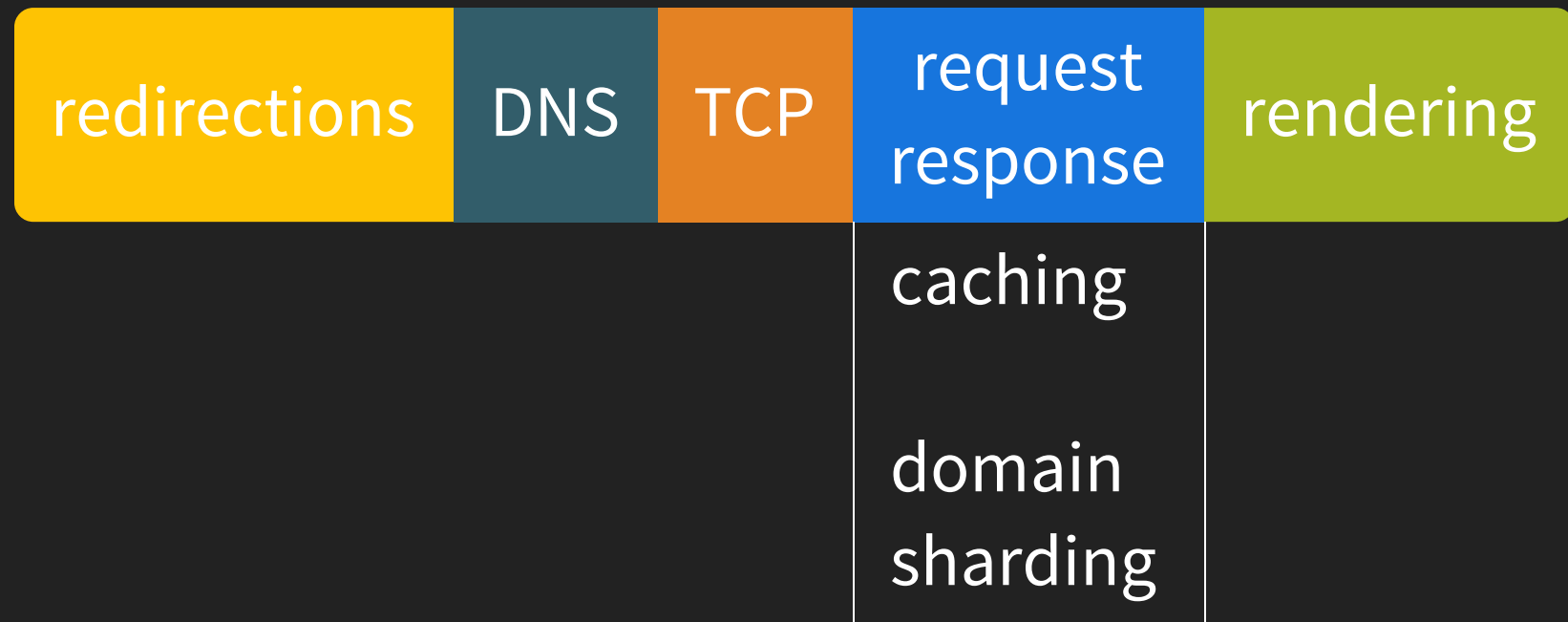
TCP SLOW START

[Wikipedia: Slow Start](#)

[Tuning initcwnd for optimum performance](#)

[Linux TCP/IP tuning for scalability \(tcp_slow_start_after_idle\)](#)

REQUEST & RESPONSE



CACHING

Caching Tutorial by Mark Nottingham

Check your pages with REDbot

DOMAIN SHARDING

Browser

2(1999) simultaneous connections
6-8(2010) simultaneous connections

Domain

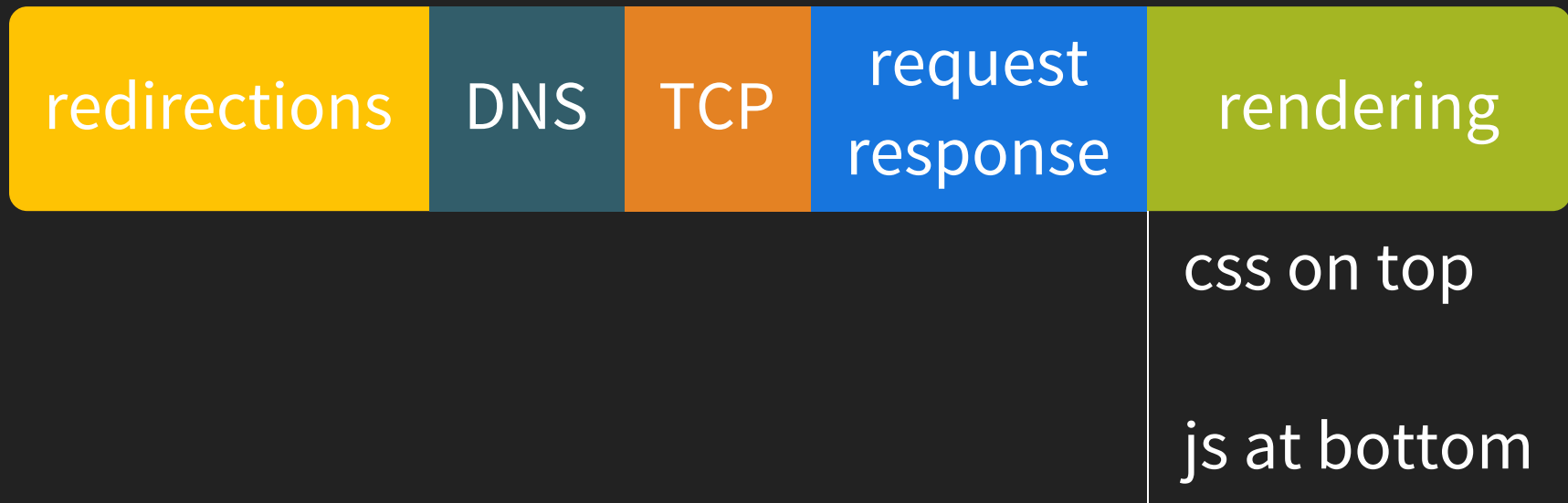
<http://www.mobify.com/blog/domain-sharding-bad-news-mobile-performance/>

RESOURCE PREFETCH

```
<link rel="prefetch" href="next-page.css">  
<link rel="subresource" href="critical.js">
```

- prefetch
 - Low-priority download of resources to be used on subsequent pages
 - Chrome, Firefox, Safari, IE9+
- subresource
 - Early loading of resources within the current page
 - Chrome only

RENDERING



INLINE CRITICAL RESOURCES

Eliminate render-blocking JavaScript and CSS in above-the-fold content

Your page has 2 blocking script resources and 2 blocking CSS resources. This causes a delay in rendering your page.

None of the above-the-fold content on your page could be rendered without waiting for the following resources to load. Try to defer or asynchronously load blocking resources, or inline the critical portions of those resources directly in the HTML.

Remove render-blocking JavaScript:

<https://use.typekit.net/uza8xtu.js>

<https://...js>

Optimize CSS Delivery of the following:

<https://...min.css>

<https://use.typekit.net/...d4c9c19d9c76d37e9ffaa92b500b8c940d090388>

<http://www.smashingmagazine.com/2015/08/understanding-critical-css/>

Alva Cheung

“Load non-critical features asynchronously”

Facebook - The technology behind preview photos

PRERENDER

```
<link rel="prerender" href="http://www.microstrategy.com">
```

Initiate background pre-render of entire page

Supported: Chrome, Firefox

<chrome://net-internals/#prerender>

<chrome://predictors/>

JAVASCRIPT RENDERING

Why care?

Static Web Pages	Interactive
<div>CSS</div> <div>HTML</div> <div>JavaScript</div>	<div>CSS</div> <div>JavaScript</div> <div>HTML</div>

AngularJS, React

INLINE CACHING

Speed up runtime method binding by remembering the results of a previous method lookup directly at the call site

https://en.wikipedia.org/wiki/Inline_caching

INLINE CACHING CAN BE EASILY BROKEN

```
function addTwoThings(thing1, thing2) {  
    return thing1 + thing2;  
}
```

```
addTwoThings(1, 2);  
addTwoThings(100, 200); /* fast */  
addTwoThings('a', 'b'); /* slow */
```

```
function Dog(name) {  
    this.name = name;  
}
```

```
var dog1 = new Dog('Jim'); /* hidden class C1 */  
var dog2 = new Dog('Bin'); /* hidden class C2 */  
dog2.gender = 'male';
```

CSS RENDERING

- Reflow
 - relocate elements
 - change content
 - window resize
- Repaint
 - change color
 - change background color
 - change visibility

EVENT DEBOUNCING/THROTTLING

onresize, onscroll...etc

USE THE DOM CHANGE QUEUE

```
var $div = $('#content')
var elements = ['a', 'b', 'c', 'd'];
for(var i=0,l=elements.length; i<l; i++) {
    $div.append(elements[i]);
}
```

```
var $div = $('#content')
var elements = ['a', 'b', 'c', 'd'];
for(var i=0,l=elements.length; i<l; i++) {
    // one line of evilness
    var a = $(window).scrollTop;
    $div.append(elements[i]);
}
```

PAINTING PERFORMANCE

- Minimize DOM depth
- Minimize z-index depth
- Minimize CSS rules
- Use faster selectors
 - Avoid descendant selector
 - Structure selector right to left

```
.class ul li a { color: blue; }
```

- Use expensive properties sparingly

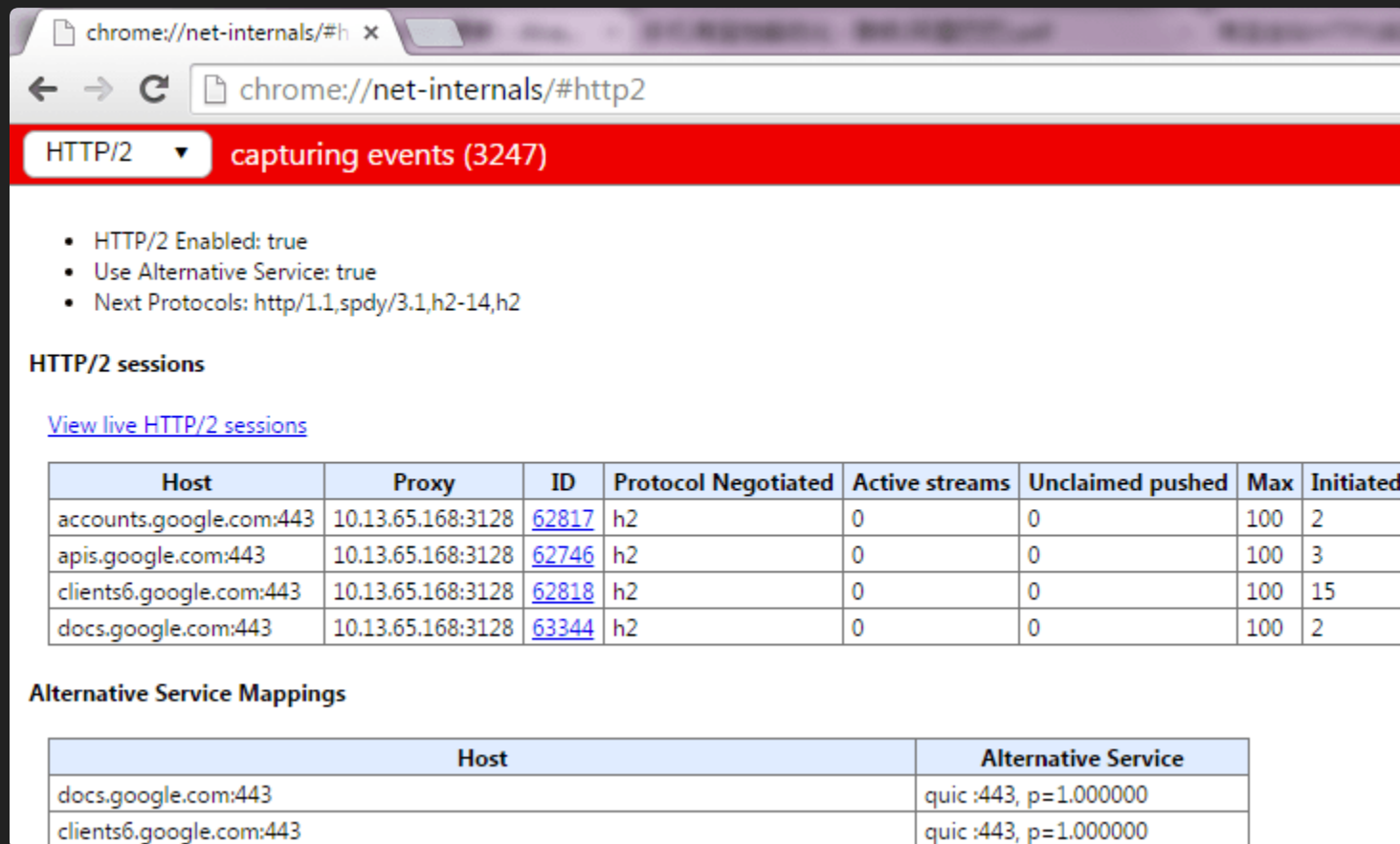
```
border-radius; box-shadow; transform, filter; :nth-child; position: fixed;
```

- Don't use universal selectors

```
*; [disabled]; [type="text"]
```

PREPARE FOR HTTP/2

IETF RFC 7540



The screenshot shows the Chrome DevTools interface with the 'chrome://net-internals/#http2' page open. The top bar indicates 'HTTP/2' is selected and 'capturing events (3247)'. Below this, a list of settings shows 'HTTP/2 Enabled: true', 'Use Alternative Service: true', and 'Next Protocols: http/1.1,spdy/3.1,h2-14,h2'. The 'HTTP/2 sessions' section includes a link to 'View live HTTP/2 sessions' and a table of active sessions. The 'Alternative Service Mappings' section shows a table of mappings for 'docs.google.com:443' and 'clients6.google.com:443' to 'quic :443, p=1.000000'.

chrome://net-internals/#h x

chrome://net-internals/#http2

HTTP/2 capturing events (3247)

- HTTP/2 Enabled: true
- Use Alternative Service: true
- Next Protocols: http/1.1,spdy/3.1,h2-14,h2

HTTP/2 sessions

[View live HTTP/2 sessions](#)

Host	Proxy	ID	Protocol Negotiated	Active streams	Unclaimed pushed	Max	Initiated
accounts.google.com:443	10.13.65.168:3128	62817	h2	0	0	100	2
apis.google.com:443	10.13.65.168:3128	62746	h2	0	0	100	3
clients6.google.com:443	10.13.65.168:3128	62818	h2	0	0	100	15
docs.google.com:443	10.13.65.168:3128	63344	h2	0	0	100	2

Alternative Service Mappings

Host	Alternative Service
docs.google.com:443	quic :443, p=1.000000
clients6.google.com:443	quic :443, p=1.000000

HTTP/2 AIMS

1. Reduce latency
2. Reduce total number of TCP connections
i.e., reduce number of open sockets
3. Maintain compatibility with HTTP/1.1
clients and server
4. Maintain same usability as HTTP/1.1
i.e., can be used wherever we use HTTP/1.1
5. Better web security

HTTP/2 FEATURES

1. Multiplexing

Multiple asynchronous HTTP requests over a single TCP connection.

2. Server Push

Multiple responses for single request

3. Header Compression

Compress HTTP headers along with content.

4. Request prioritization

While making multiple HTTP requests to a same domain they can be prioritized.

5. Binary Protocol

HTTP/2 is binary protocol whereas HTTP/1.1 is text protocol.

[HTTP/2 Complete Tutorial](#)

HTTP/2 COMPATIBILITY

Request	Response	
HTTP/2 Client	HTTP/1.1 Server	HTTP/2 Server
GET / HTTP/1.1 Host: server.example.com Connection: Upgrade, HTTP2-Settings Upgrade: h2c HTTP2-Settings: <payload>	HTTP/1.1 200 OK Content-Length: 243 Content-Type: text/html ...	HTTP/1.1 101 Switching Protocols Connection: Upgrade Upgrade: h2c [HTTP/2 connection ...

See IETF RFC 7540

MULPLEXING IN HTTP/2

- HTTP/1.1 Pipelining
 - Multiple HTTP requests are sent on a single TCP connection asynchronously
 - Server responses synchronously
 - First-in-first-out
 - Head-of-line (HOL) blocking, [see Wiki](#)
- HTTP/2 Muxlexing
 - Streams and frames

Every HTTP/2 request and response is given a unique id called as stream id
 - Server also responses asynchronously
 - The request and response both happen parallelly

SERVER PUSH IN HTTP/2

- Server sends multiple responses for a single request
- A client can request that server push be disabled
- A client cannot push

IETF RFC 7540, Section 8.2 Server Push

HEADER COMPRESSION IN HTTP/2

- A technique of not sending the same headers again
- Client and server maintain a headers table containing the last response and request headers
- For the first request or response they send all the required header
- For subsequent requests client and server omit headers which are same as the previous request or response

IETF RFC 7541, HPACK: Header Compression for HTTP/2

HTTPS

HTTP + **SSL/TLS** = HTTPS

- **Authentication**

Am I talking to who they claim to be?

- **Data integrity**

Has anyone tampered with the data?

- **Encryption**

Can anyone see my conversation?

Equally Important!

ENCRYPTION

- Handshake: asymmetric crypto
- Application data transfer: symmetric crypto

Transport Layer Security

IS HTTPS SLOW?

- Extra CPU costs
- Extra roundtrips

IsTlsFastYet.com:

“TLS has exactly one performance problem: it is not used widely enough. Everything else can be optimized.”

Dive deeper: [YouTube - Is TLS Fast Yet?](#)

HTTPS

- Get a 2048-bit TLS certificate
- Eliminate both *Yello Triangle* and *Shield*
- Use latest version of Kernal, OpenSSL and Apache/Nginx
- Use SPDY3.1 & HTTP/2
- Use protocol relative URIs

```
<script src="//code.jquery.com/jquery-1.11.3.min.js"></script>
```

- HTTP URL --> 301 --> HTTPS URL
- Apply HSTS (see next slide)

Mozilla Wiki
Qualys SSL Labs

HTTP STRICT TRANSPORT SECURITY (HSTS)

```
Strict-Transport-Security: max-age=10886400; includeSubDomains
```

Browser remembers (for specified max-age period) that it should automatically request HTTPS resources for this site and its subdomains.

HSTS eliminates HTTP --> HTTPS redirects.

RECOMMEND

Web Development Reading List: <https://wdrl.info/>

REFERENCES

1. The Quest to Delight Our Users by Alva Cheung(Google)
2. eBay对页面性能的监控和调优 by 施尉霁(eBay)
3. 淘宝全站HTTPS实践 by 李振宇(阿里巴巴)
4. 手机淘宝性能优化 by 黎明(阿里巴巴)
5. Google I/O 2014 - HTTPS Everywhere
6. Preconnect, prefetch, prerender by Ilya Grigorik
7. Resource Hints
8. <https://http2.github.io/>

THANKS!



WeChat ID: peterleepersonal