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# Velocity

CONFERENCE

BUILD RESILIENT SYSTEMS AT SCALE



[velocity.oreilly.com.cn](http://velocity.oreilly.com.cn)

#velocityconf



## *The Quest to Delight Our Users*

## 取悅用户的探索

Alva Cheung



# Our quest as an application engineer

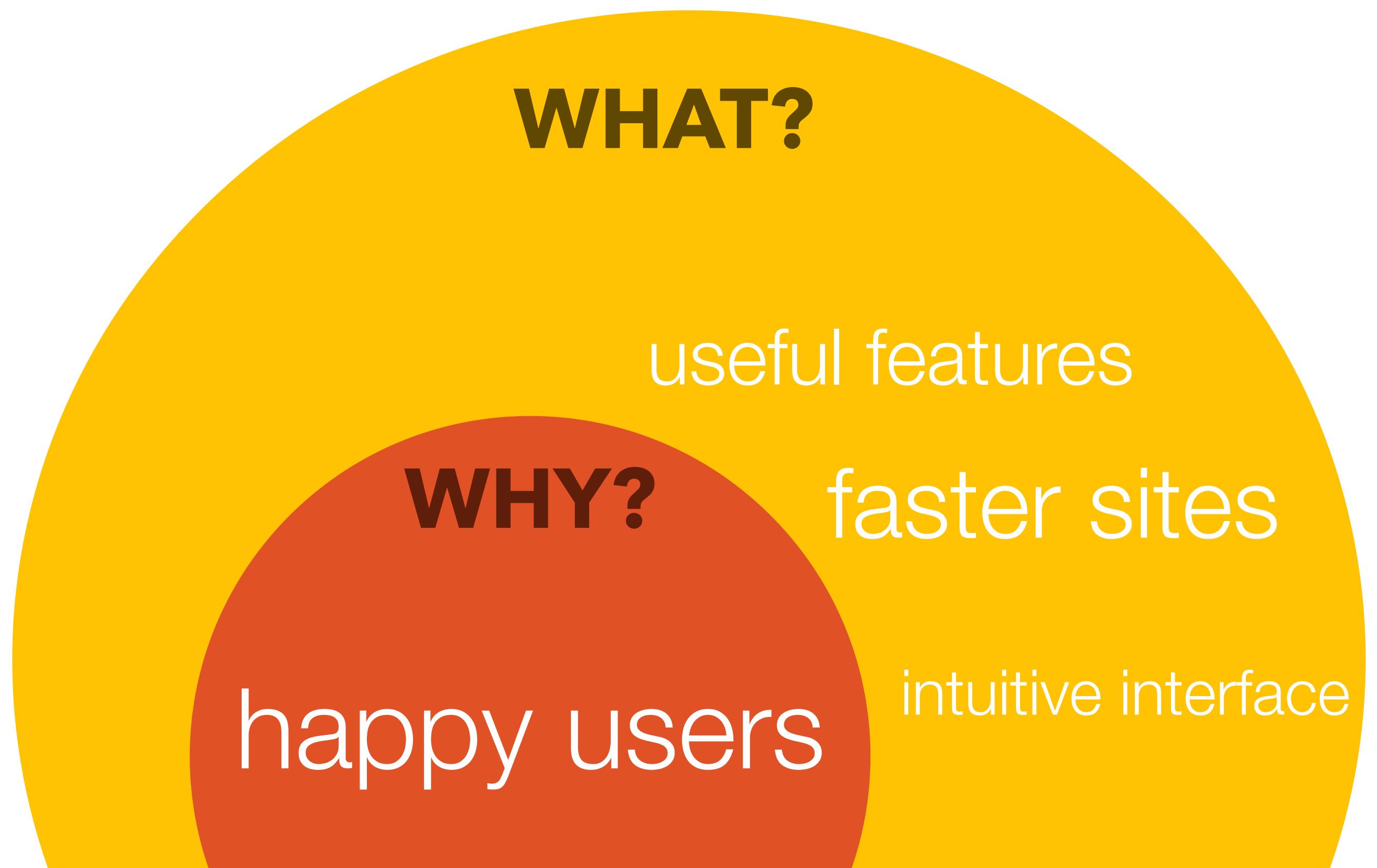
# Our quest as an application engineer



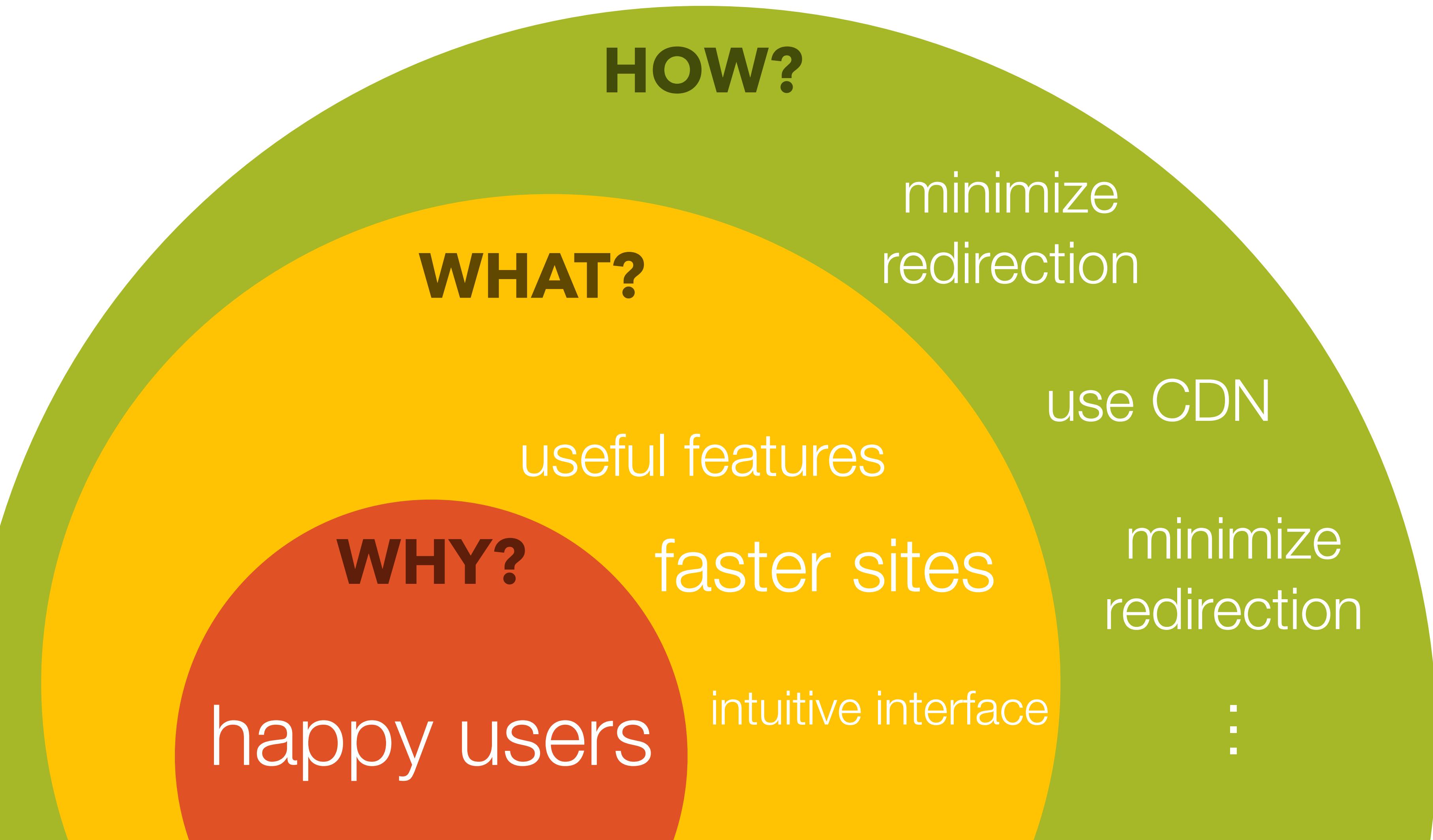
**WHY?**

happy users

# Our quest as an application engineer



# Our quest as an application engineer



# Delighting users, standardized approach

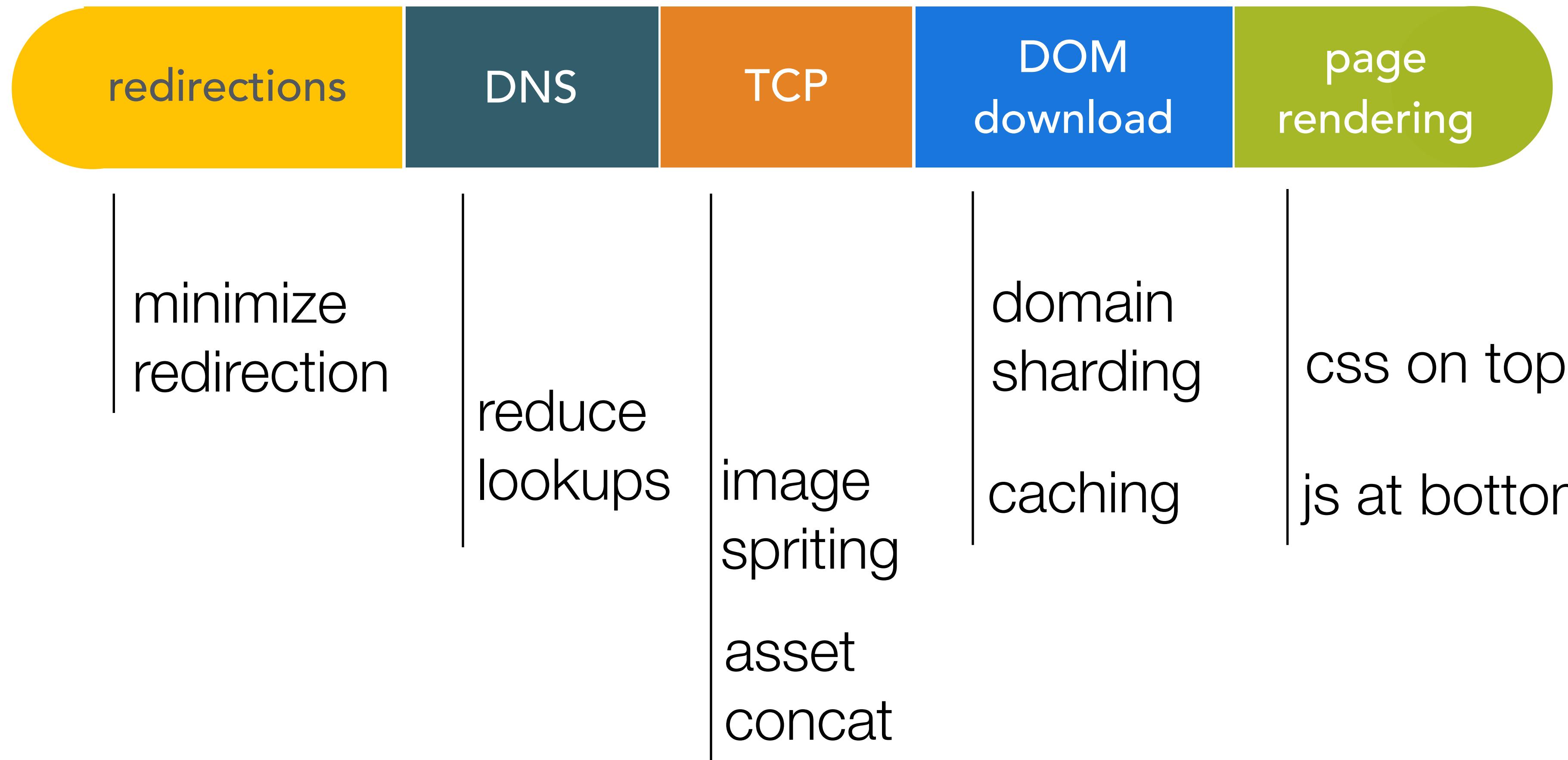
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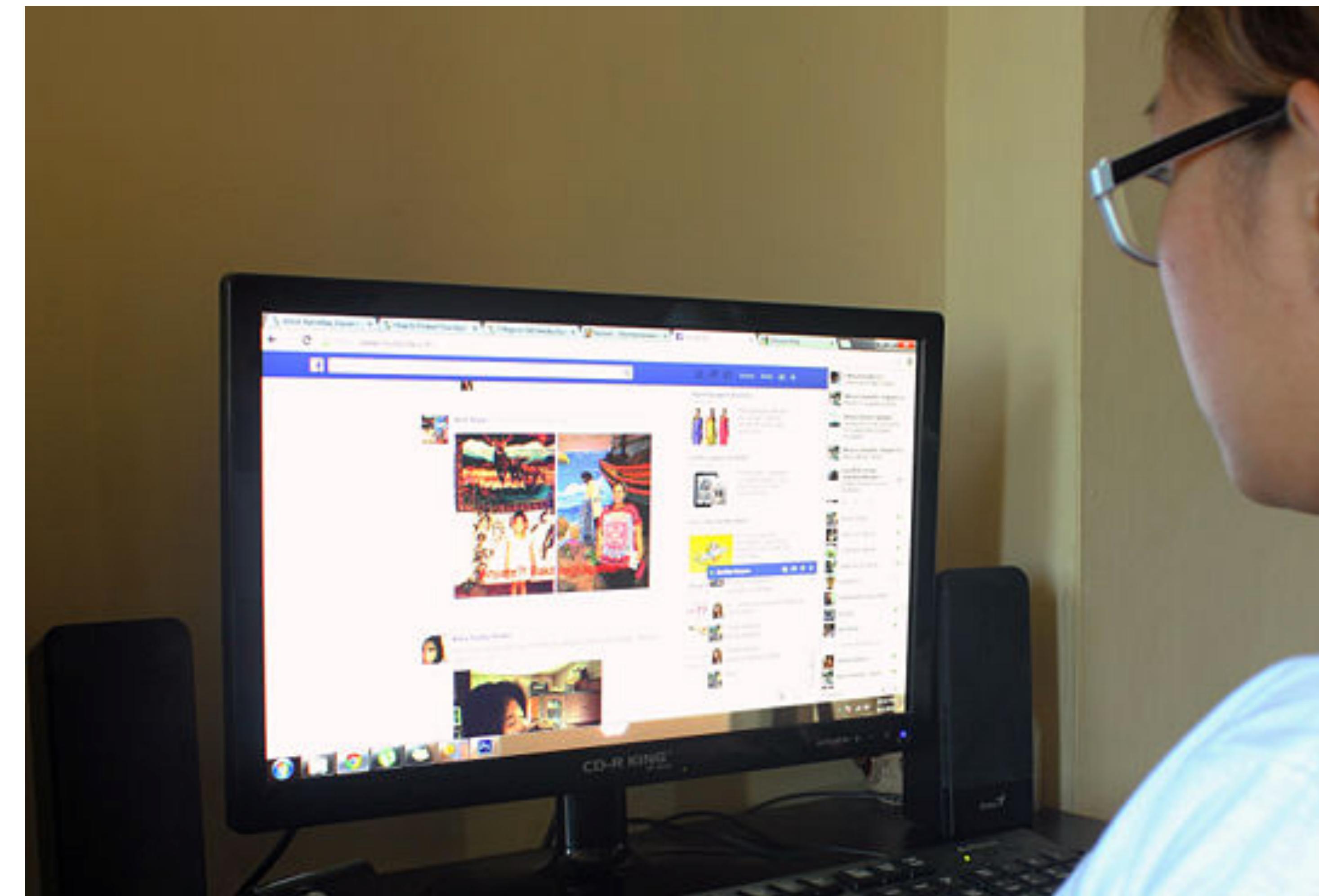
# Delighting users, standardized approach



# Delighting users, standardized approach



# Web landscape changes



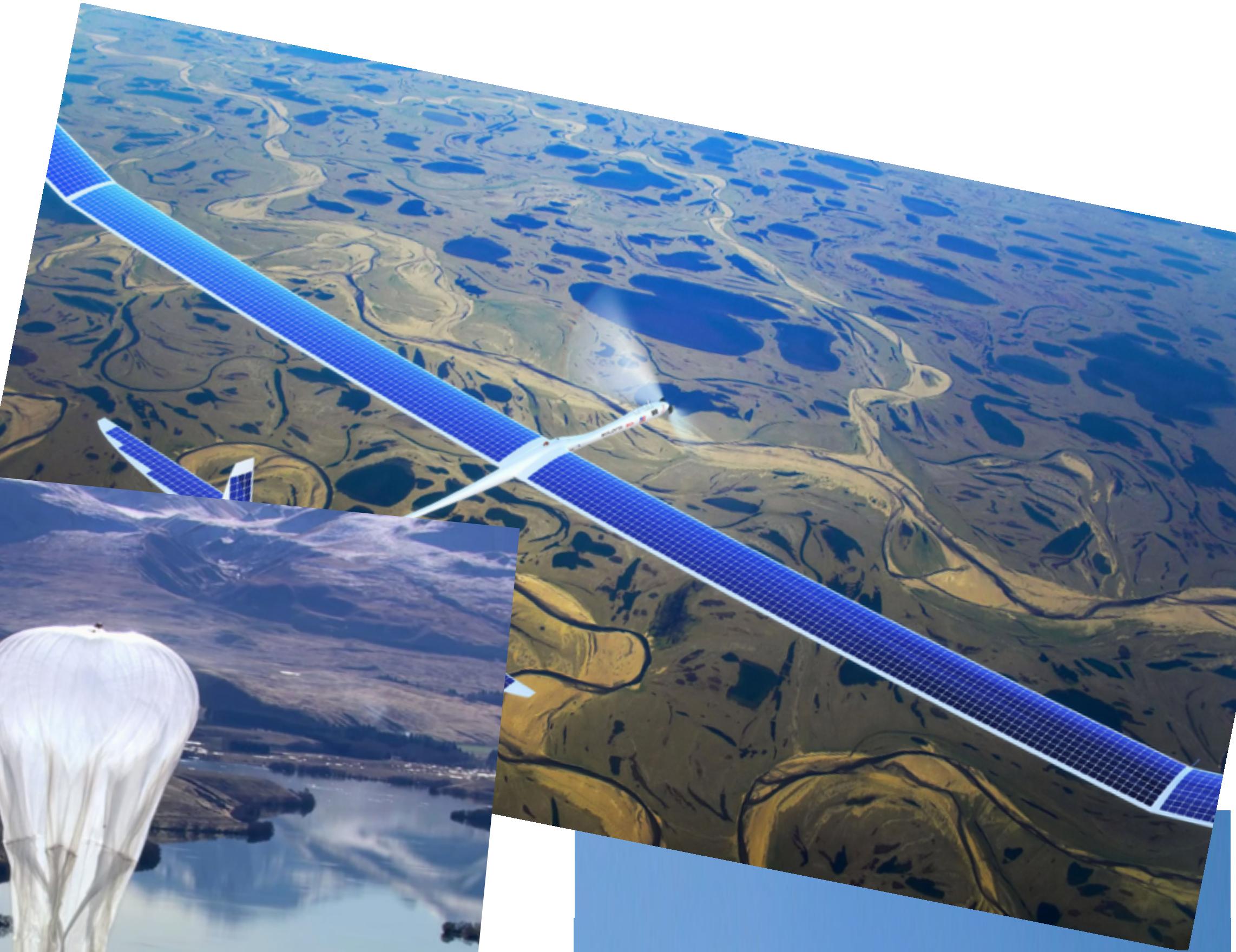
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# Web landscape changes



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# Web landscape changes



#velocityconf

# Web landscape changes

Global Rank	Country/Region	Q1 2015 Peak Mbps	QoQ Change	YoY Change
1	Singapore	98.5	17%	71%
2	Hong Kong	92.6	5.6%	40%
3	South Korea	79.0	4.7%	15%
6	Taiwan	71.5	11%	36%
7	Japan	70.1	1.6%	26%
29	Thailand	50.6	9.3%	47%
47	Australia	40.8	10%	29%
52	New Zealand	36.7	7.0%	51%
65	Malaysia	31.5	6.3%	13%
66	Sri Lanka	30.8	24%	97%
92	Vietnam	21.3	23%	74%
94	Philippines	20.3	-7.4%	8.1%
97	China	19.4	8.8%	43%
106	Indonesia	17.5	31%	-9.6%
108	India	17.4	20%	45%

[Akamai Q1 2015 State of the Internet Report](#)

# Web landscape changes

Global Rank	Country/Region	Q1 2015 Peak Mbps	QoQ Change	YoY Change
1	Singapore	98.5	17%	71%
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7	Japan	70.1	1.6%	26%
29	Thailand	50.6	9.3%	47%
47	Australia	40.8	10%	29%
52	New Zealand	36.7	7.0%	51%
65	Malaysia	31.5	6.3%	13%
66	Sri Lanka	30.8	24%	97%
92	Vietnam	21.3	23%	74%
94	Philippines	20.3	-7.4%	8.1%
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106	Indonesia	17.5	31%	-9.6%
108	India	17.4	20%	45%

15 State of the Internet Report

# Web landscape changes



Device	Data rate	Latency
Desktop	10Mbps 100 Mbps 1Gbps	65–145 ms

Data rates and latency for desktop connection

source: <http://chimera.labs.oreilly.com/books/1230000000545>  
<http://www.webperformancetoday.com>

# Web landscape changes



Device	Data rate	Latency
Desktop	10Mbps 100 Mbps 1Gbps	65–145 ms

Data rates and latency for desktop connection

Generation	Data rate	Latency
2G	100–400 Kbit/s	300–1000 ms
3G	0.5–5 Mbit/s	100–500 ms
4G	1–50 Mbit/s	< 100 ms

Data rates and latency for an active mobile connection

source: <http://chimera.labs.oreilly.com/books/1230000000545>  
<http://www.webperformancetoday.com>

# Web landscape changes

The image displays three versions of the Yahoo homepage side-by-side, illustrating the significant changes in web design and user interface over time.

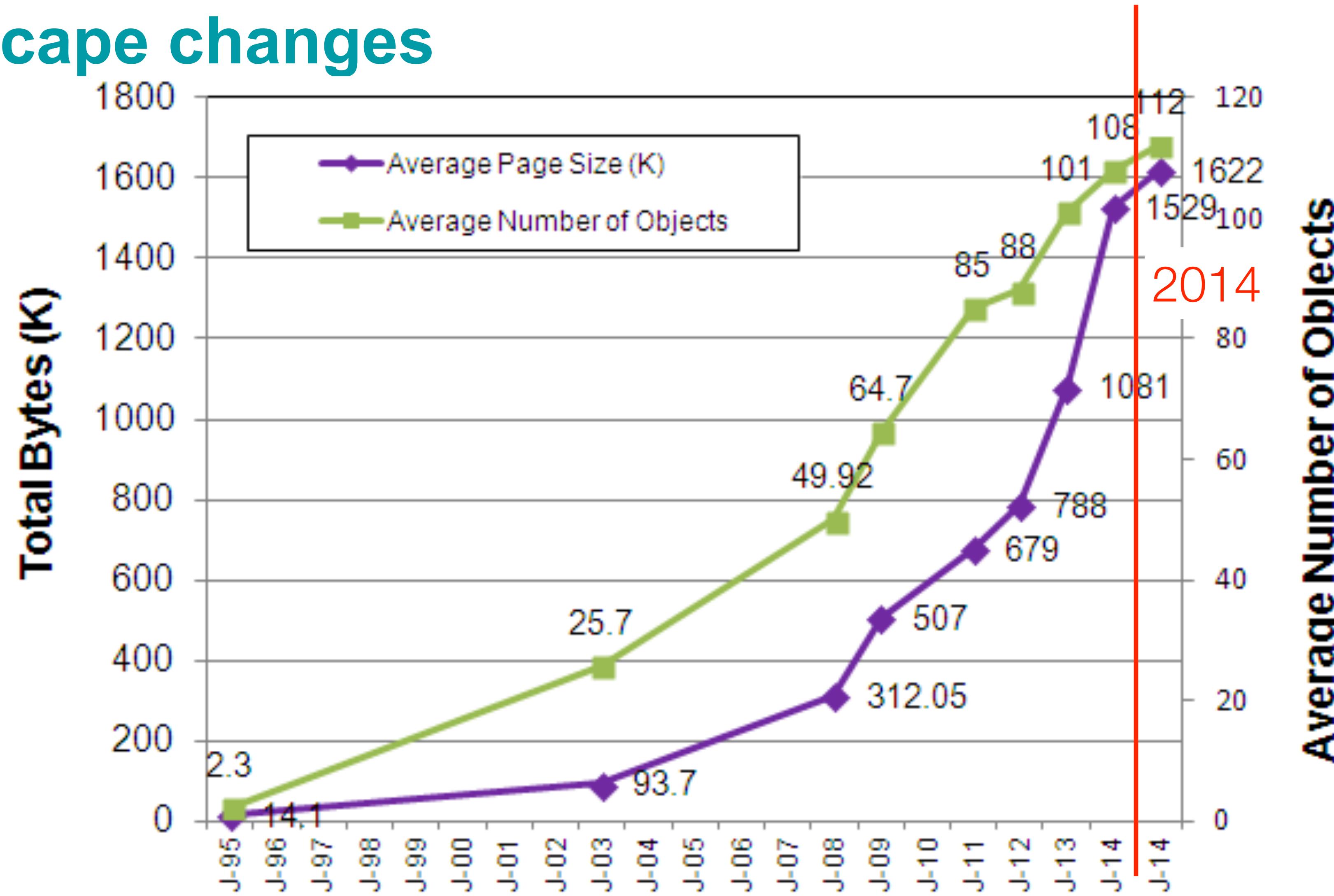
- Left Version (Early 2000s):** Features a dark blue header with the "YAHOO!" logo. Below it is a navigation bar with links like "Web", "Images", "Video", "Local", "Shopping", and "More". A large search bar is centered. On the left, there's a sidebar with "Yahoo Auctions" and various categories such as "Antiques", "Computers", "Books", "Comics", "Entertainment", "Finance", "Food", "Health", "Home & Garden", "Sports", "Technology", "Travel", and "TV". The main content area shows news headlines and a weather forecast for New York City.
- Middle Version (Mid-2000s):** Shows a transition to a lighter, more modern design. The "YAHOO!" logo is at the top left. A "Web Search" button is prominent. The sidebar on the left has been simplified. The main content area features a large "FEATURED" section with a travel photo and a headline about Machu Picchu, followed by other news items like "Former 'Idol' champ is getting married".
- Right Version (Late 2000s/Early 2010s):** The design is much cleaner and more minimalist. The "YAHOO!" logo is at the top left. A "Search Web" button is on the right. The sidebar is gone, replaced by a vertical column of "Yahoo! Services" icons. The main content area includes a large "FEES DON'T FLY WITH US" advertisement for Southwest Airlines, followed by a "In the News" section and a "Now Playing: Popular Videos" section.

source: <http://www.dailymail.co.uk>

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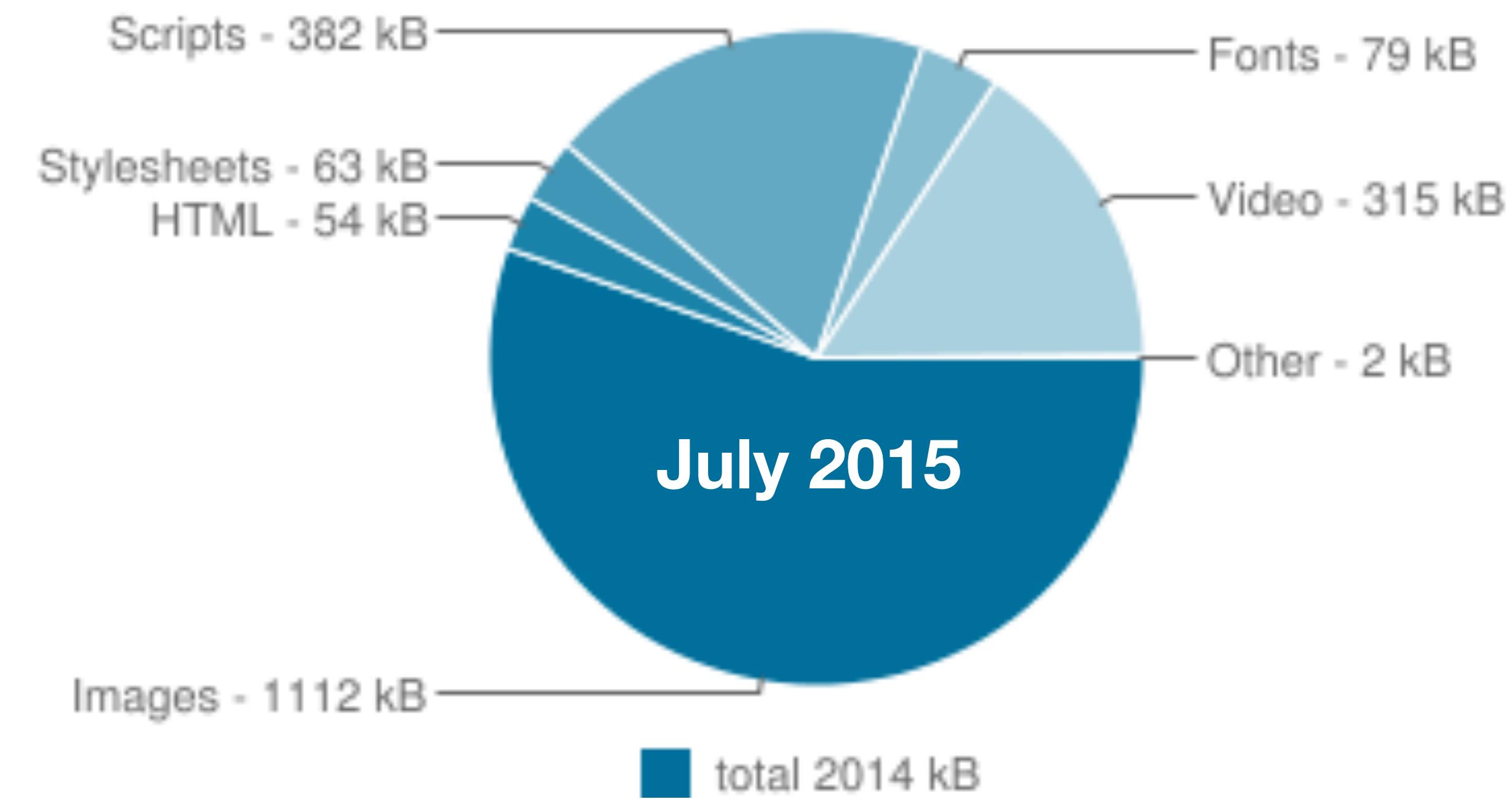
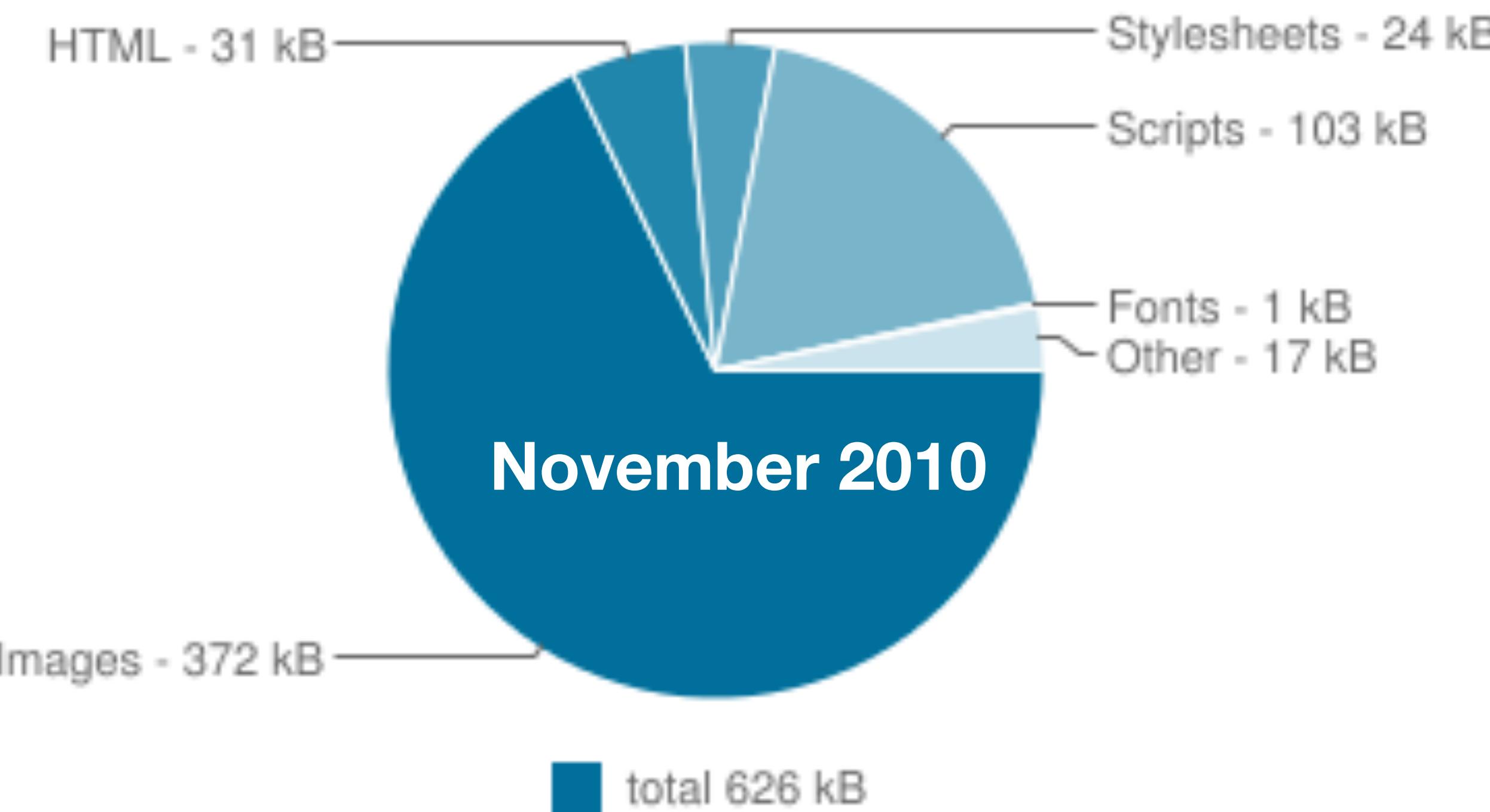
# Web landscape changes



Growth of average web page size and number of objects

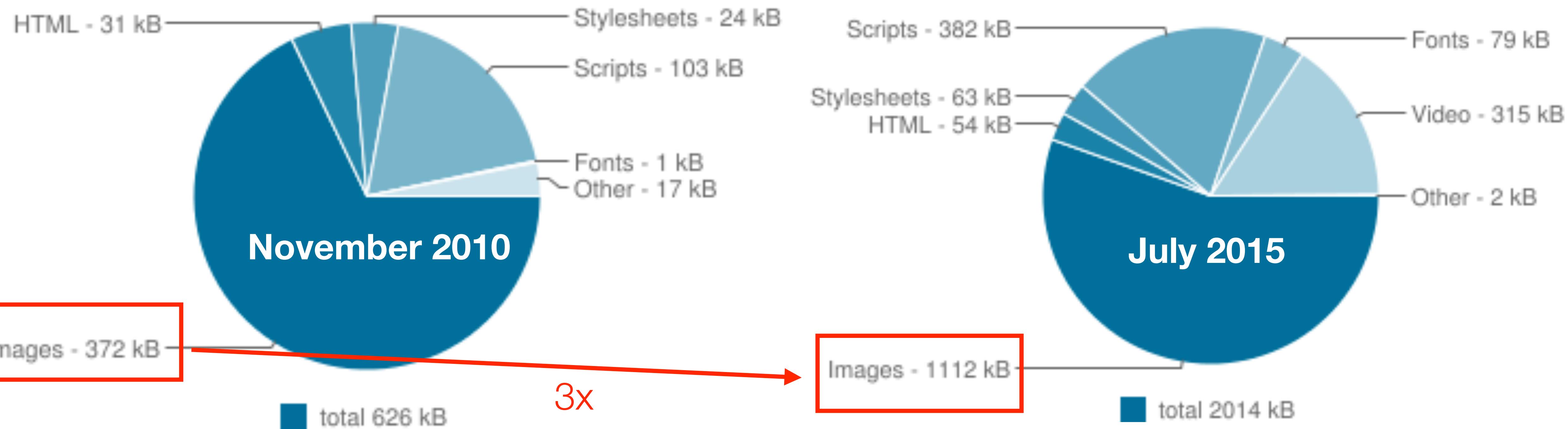
source: [websiteoptimization.com](http://websiteoptimization.com)

# Web landscape changes



source: <http://httparchive.org/>

# Web landscape changes



source: <http://httparchive.org/>

# Web landscape changes



source: <http://httparchive.org/>

# Web landscape changes

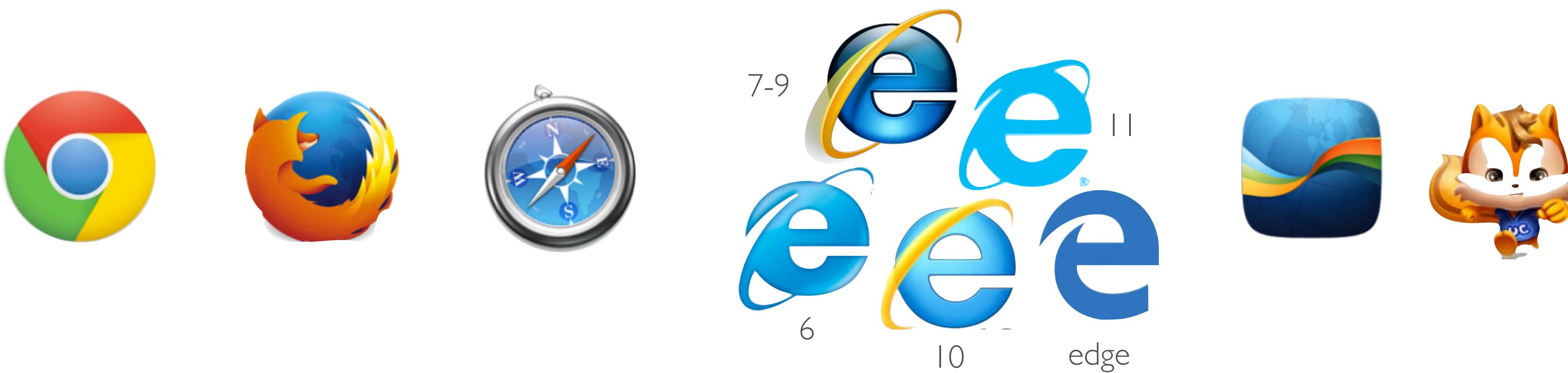
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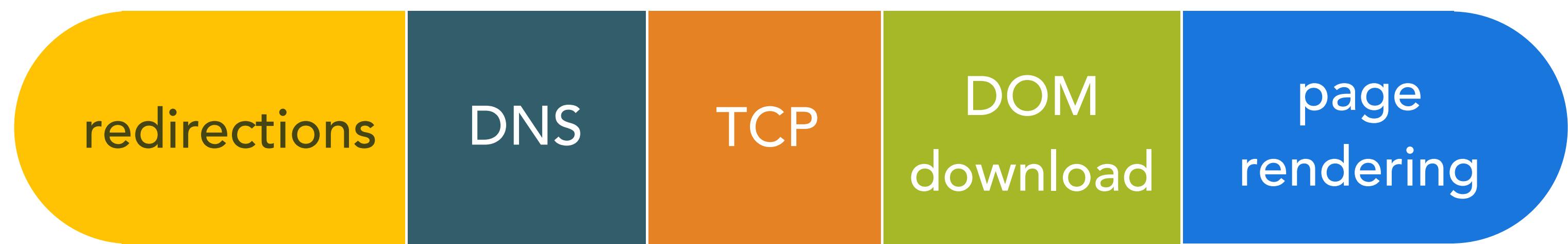
# Web landscape changes



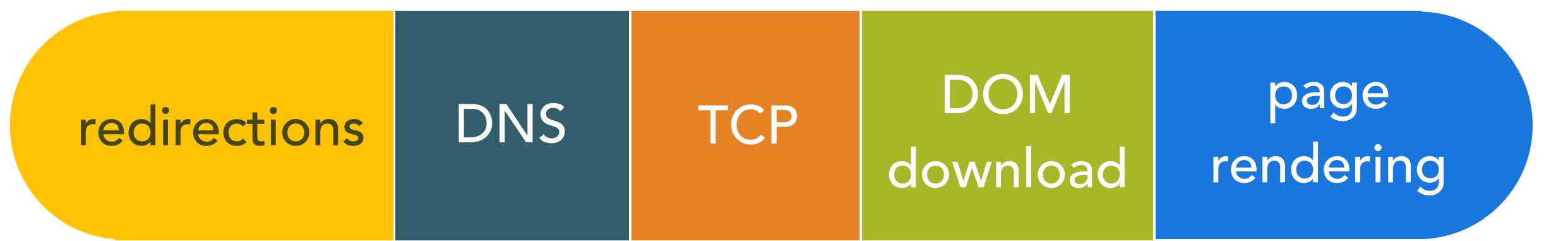
# Web landscape changes



# Delighting users in 2015



# Delighting users in 2015



# Delighting users in 2015



# Delighting users in 2015

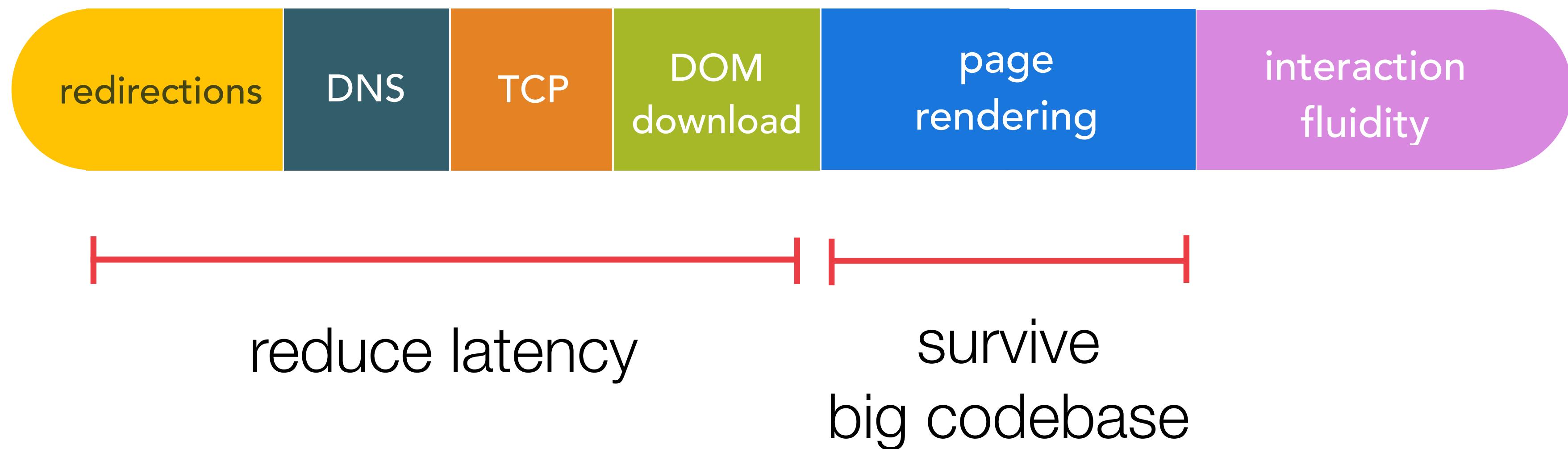


# Delighting users in 2015

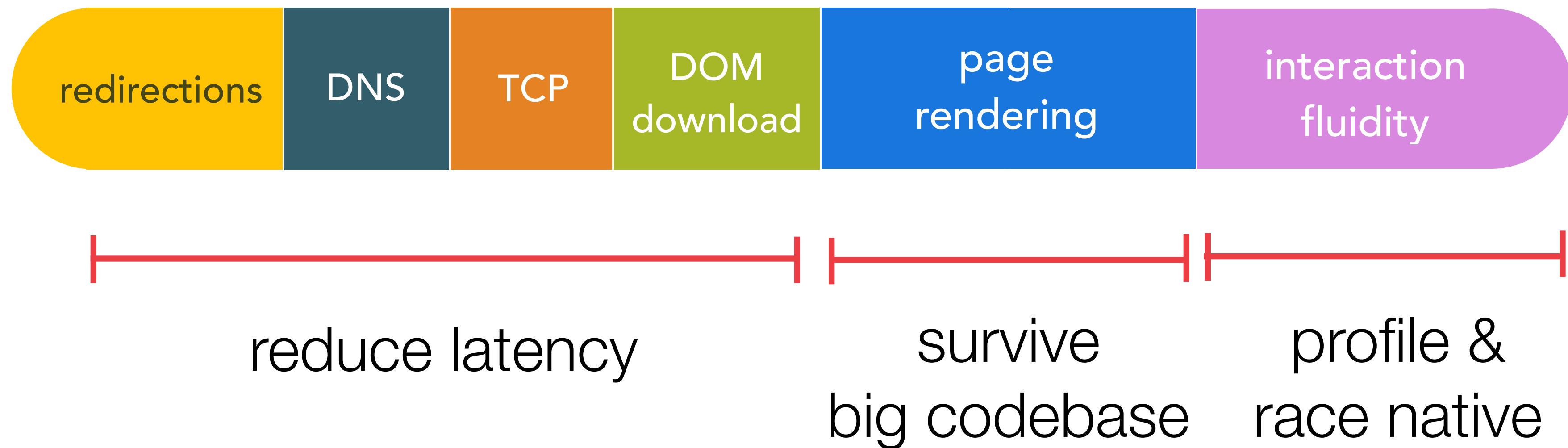


reduce latency

# Delighting users in 2015



# Delighting users in 2015



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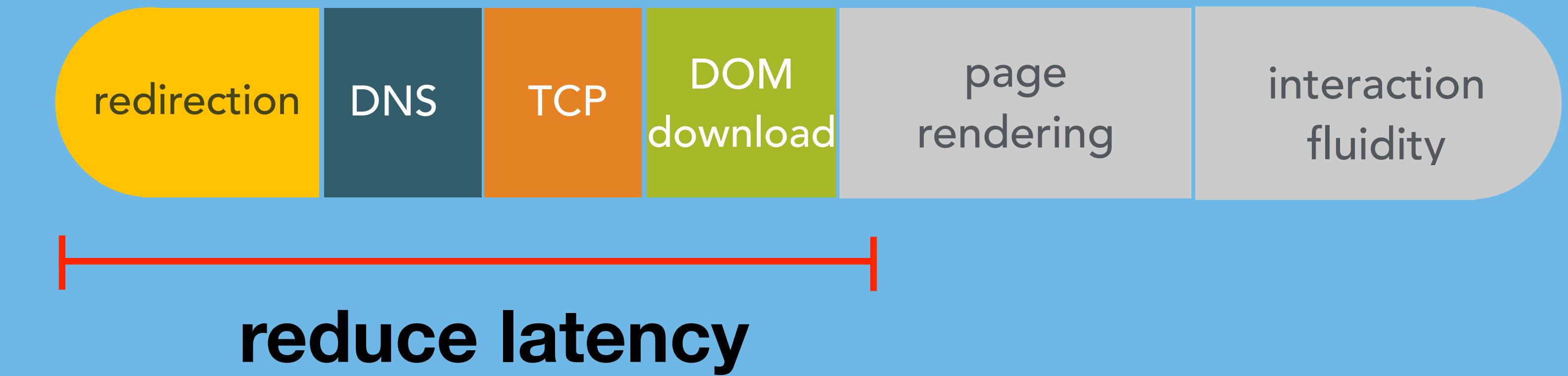
# Velocity

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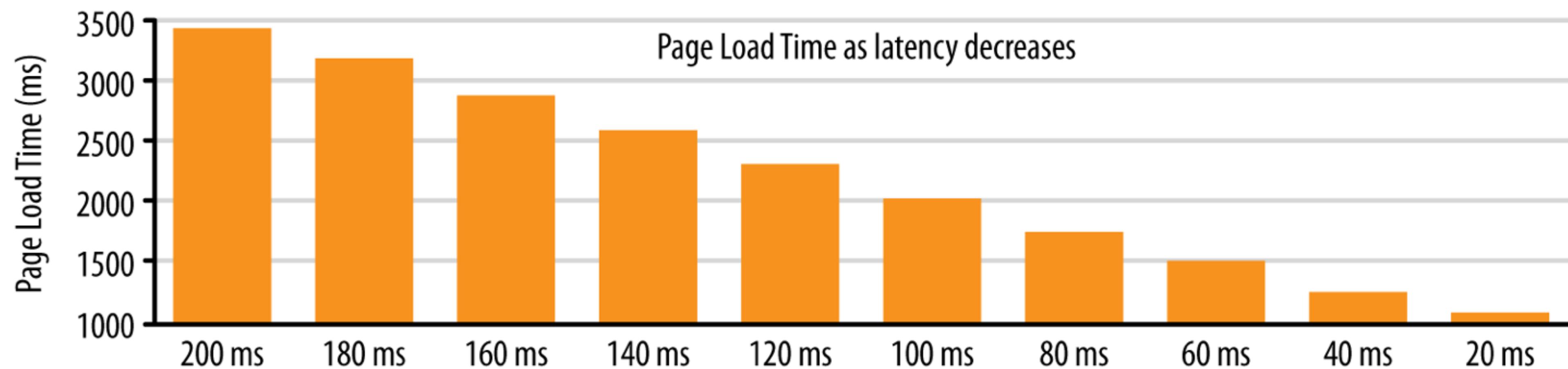
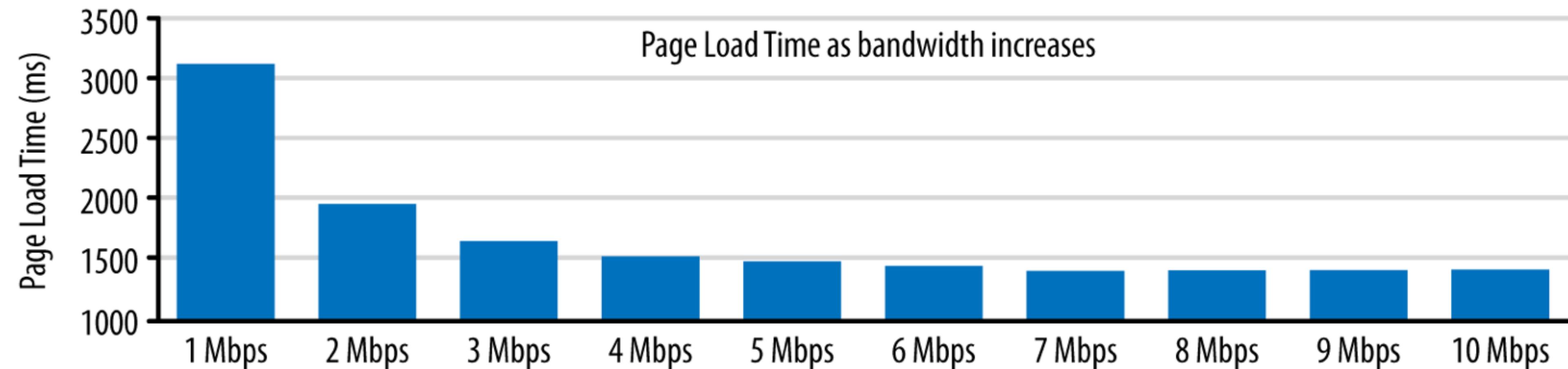
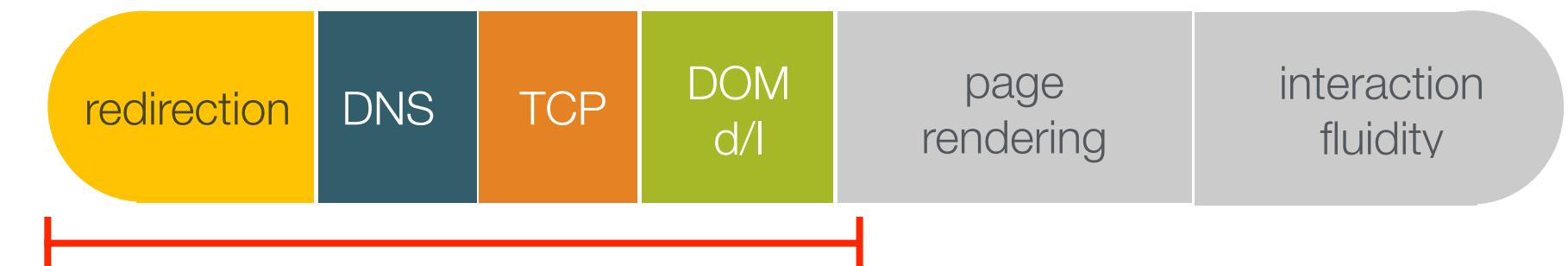
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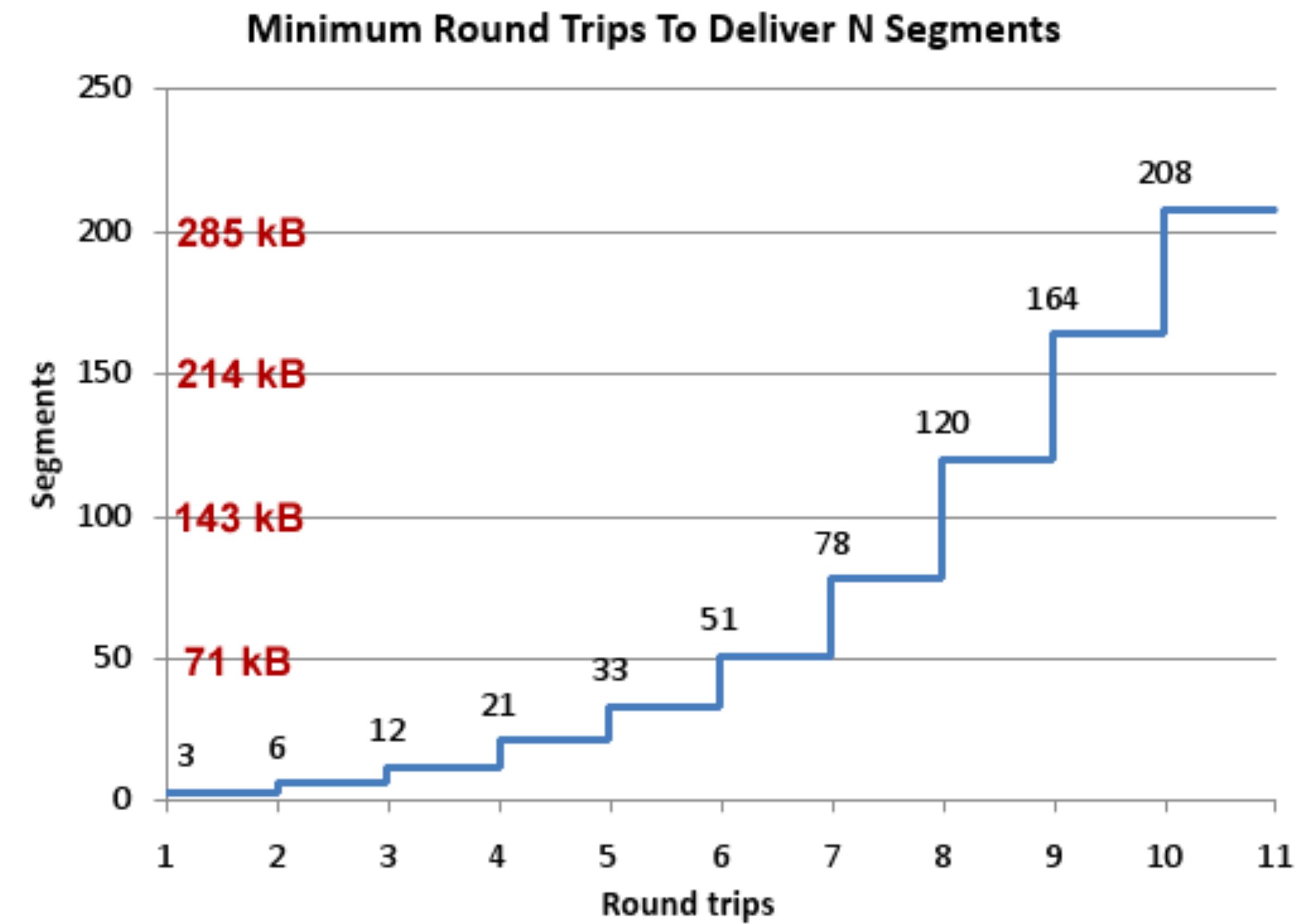
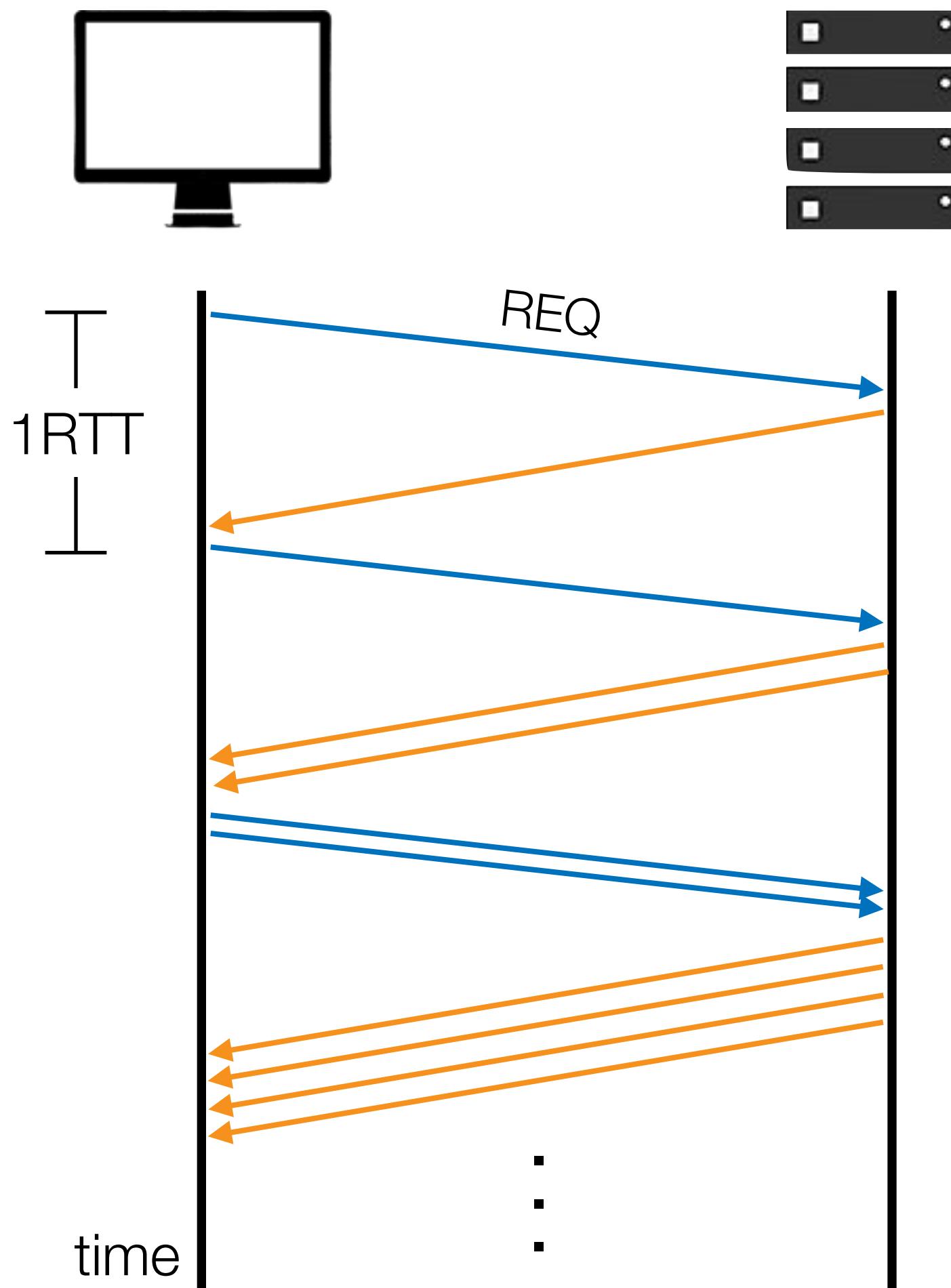


# Reducing latency matters



source: <http://chimera.labs.oreilly.com/books/1230000000545>

# TCP slow-start penalizes new connections



source: <http://www.stevesouders.com>

# HTTP/2 is here!



A screenshot of the Chrome DevTools Network tab. The title bar says 'chrome://net-internals/#http2'. Below it, a red header bar says 'HTTP/2 ▾ capturing events (9637)'. The main content shows the following list:

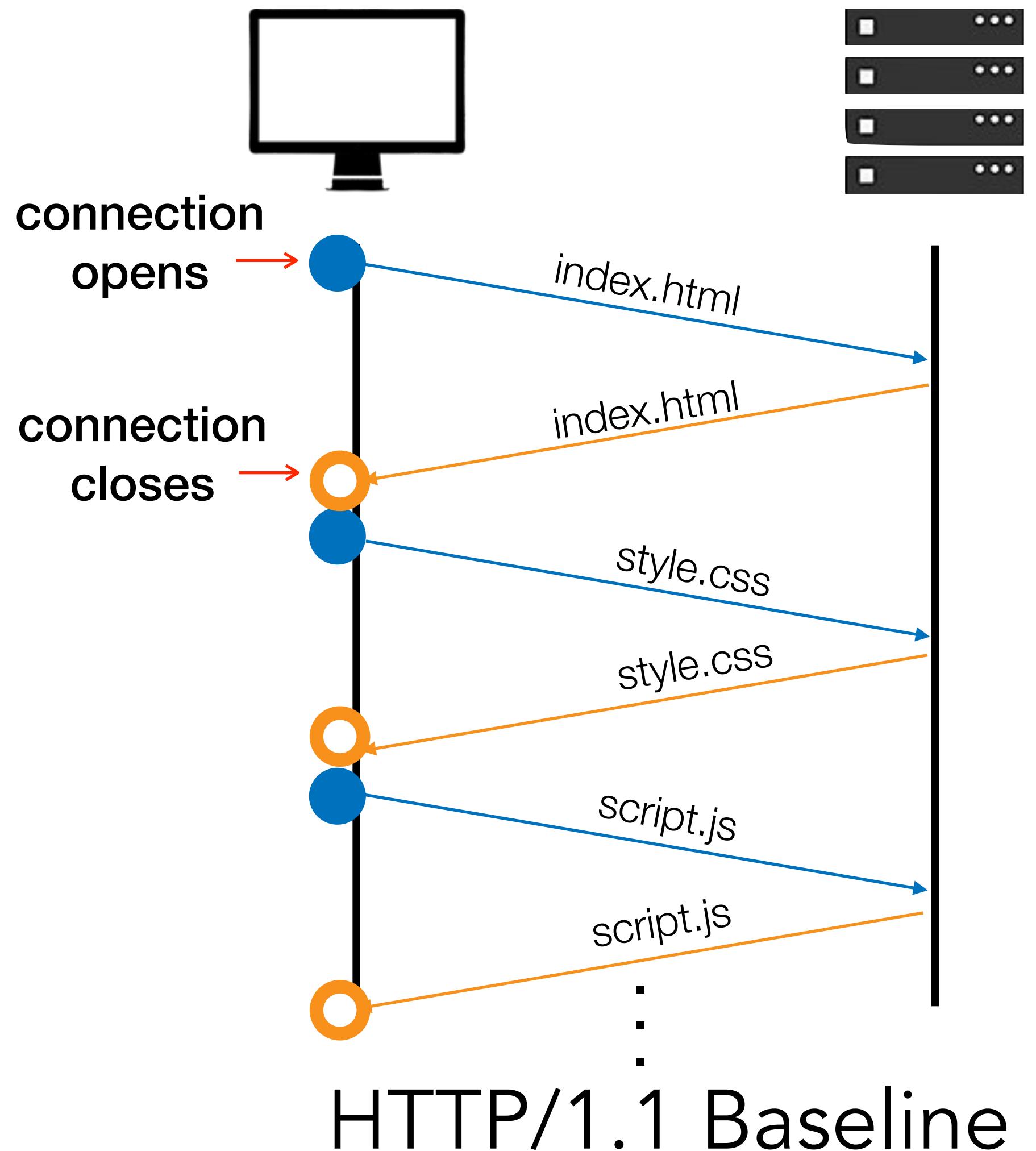
- HTTP/2 Enabled: true
- Use Alternative Service: true
- Next Protocols: http/1.1,spdy/3.1,h2-14,h2

## HTTP/2 sessions

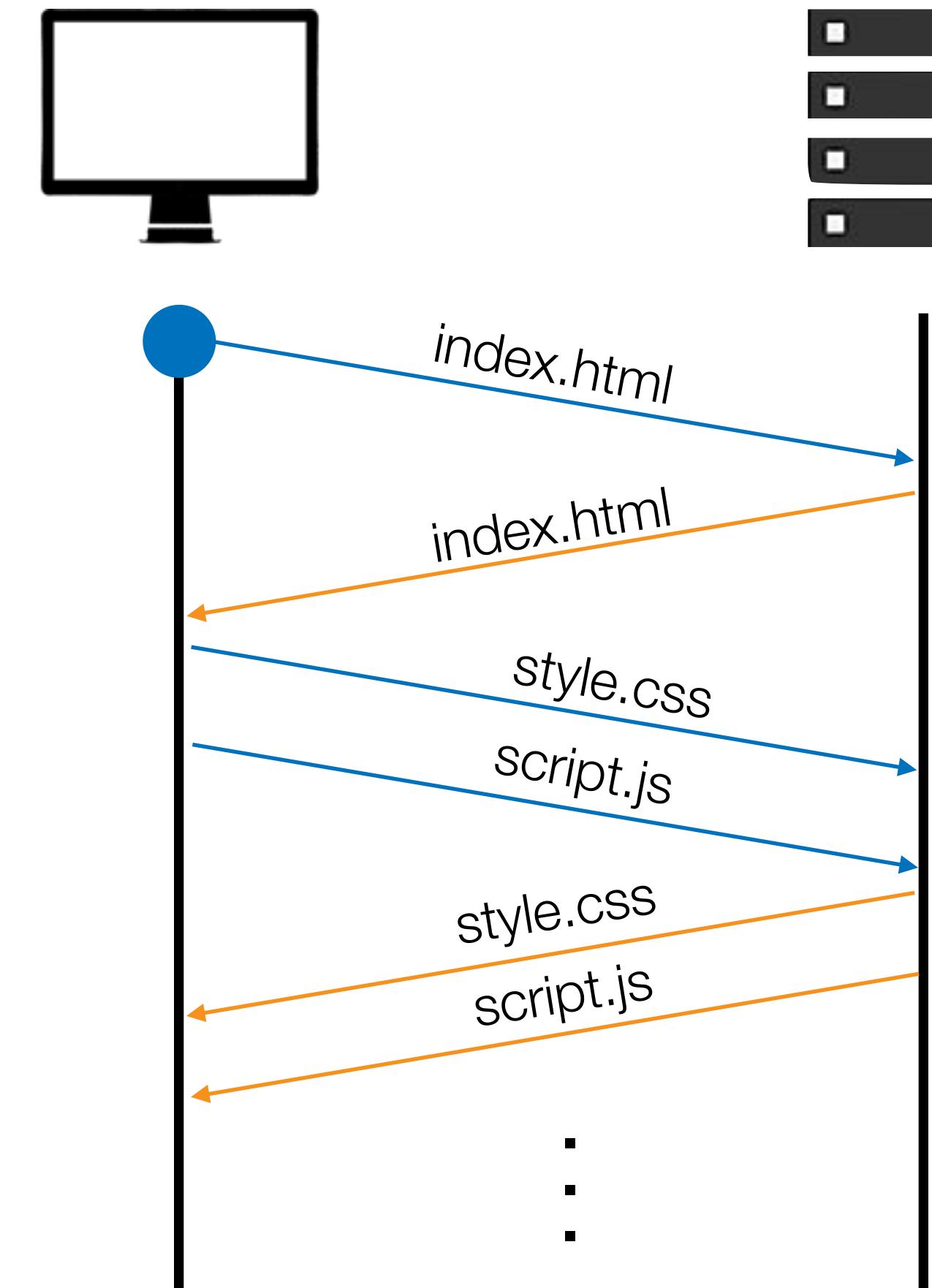
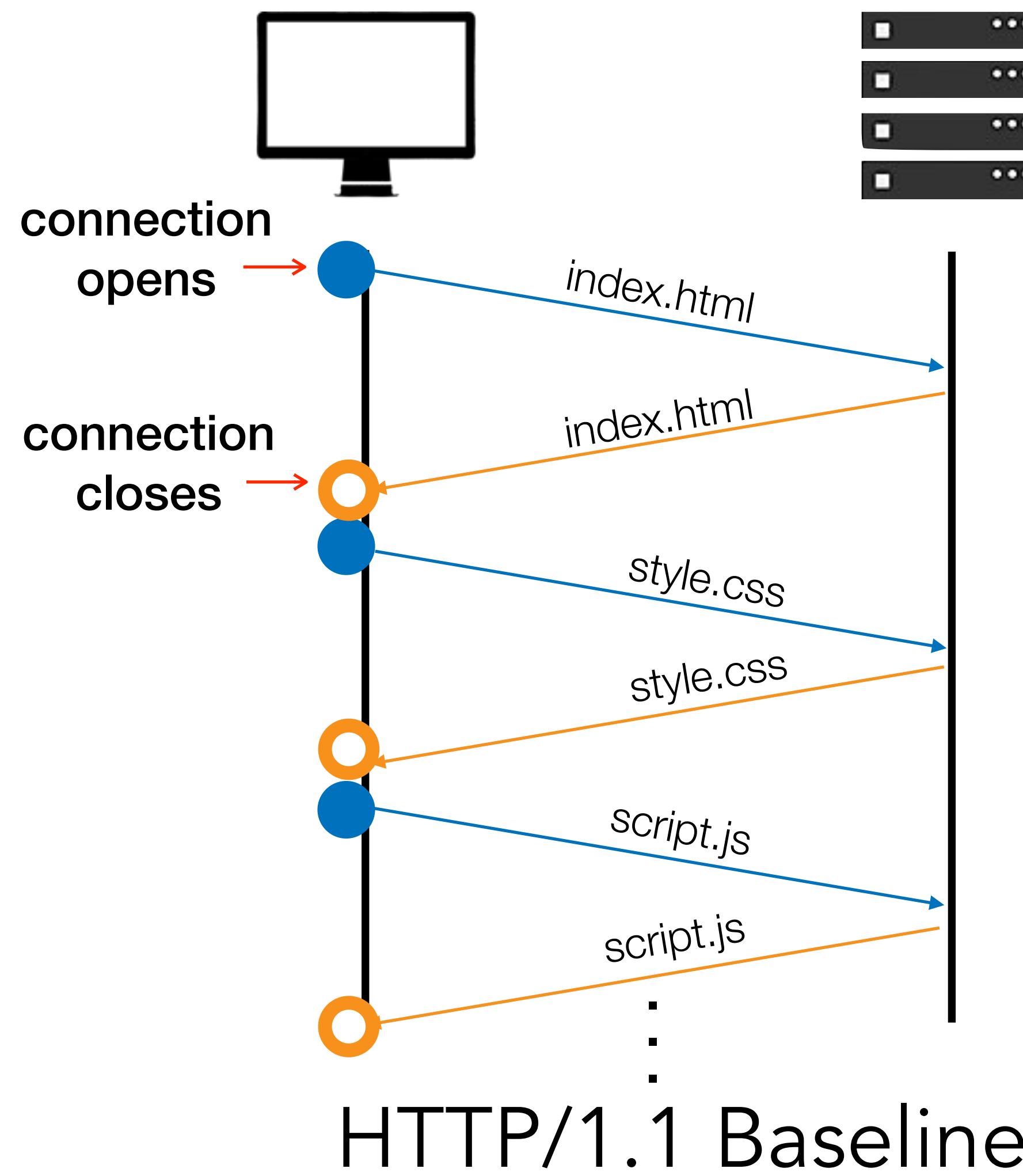
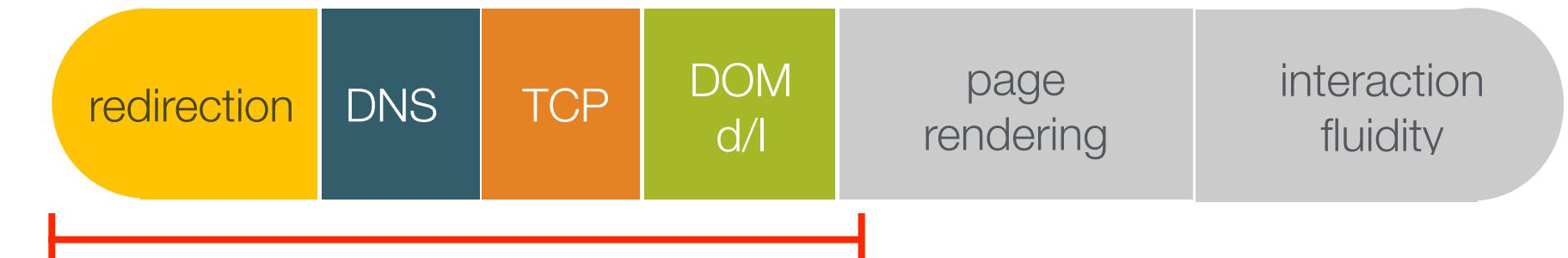
[View live HTTP/2 sessions](#)

Host	Proxy	ID	Protocol Negotiated	Active streams	Unclaimed pushed	Max	Initiated
2542116.fl.doubleclick.net:443	direct://	<a href="#">75067</a>	h2	0	0	100	0
55.docs.google.com:443	direct://	<a href="#">76032</a>	h2	0	0	100	1
ajax.googleapis.com:443	direct://	<a href="#">74947</a>	h2	0	0	100	0
clients2.googleusercontent.com:443	direct://	<a href="#">77896</a>	h2	0	0	100	0
clients4.google.com:443							
clients6.google.com:443	direct://	<a href="#">73882</a>	h2	0	0	100	6
docs.google.com:443							
cs.corp.google.com:443	direct://	<a href="#">71553</a>	h2	0	0	100	3
csi.gstatic.com:443	direct://	<a href="#">77137</a>	h2	0	0	100	0
extensionreporter.googleplex.com:443	direct://	<a href="#">77995</a>	h2	0	0	100	1
fonts.googleapis.com:443	direct://	<a href="#">74913</a>	h2	0	0	100	0
gg.google.com:443	direct://	<a href="#">76081</a>	h2	0	0	100	0

# Multiplexing in HTTP/2

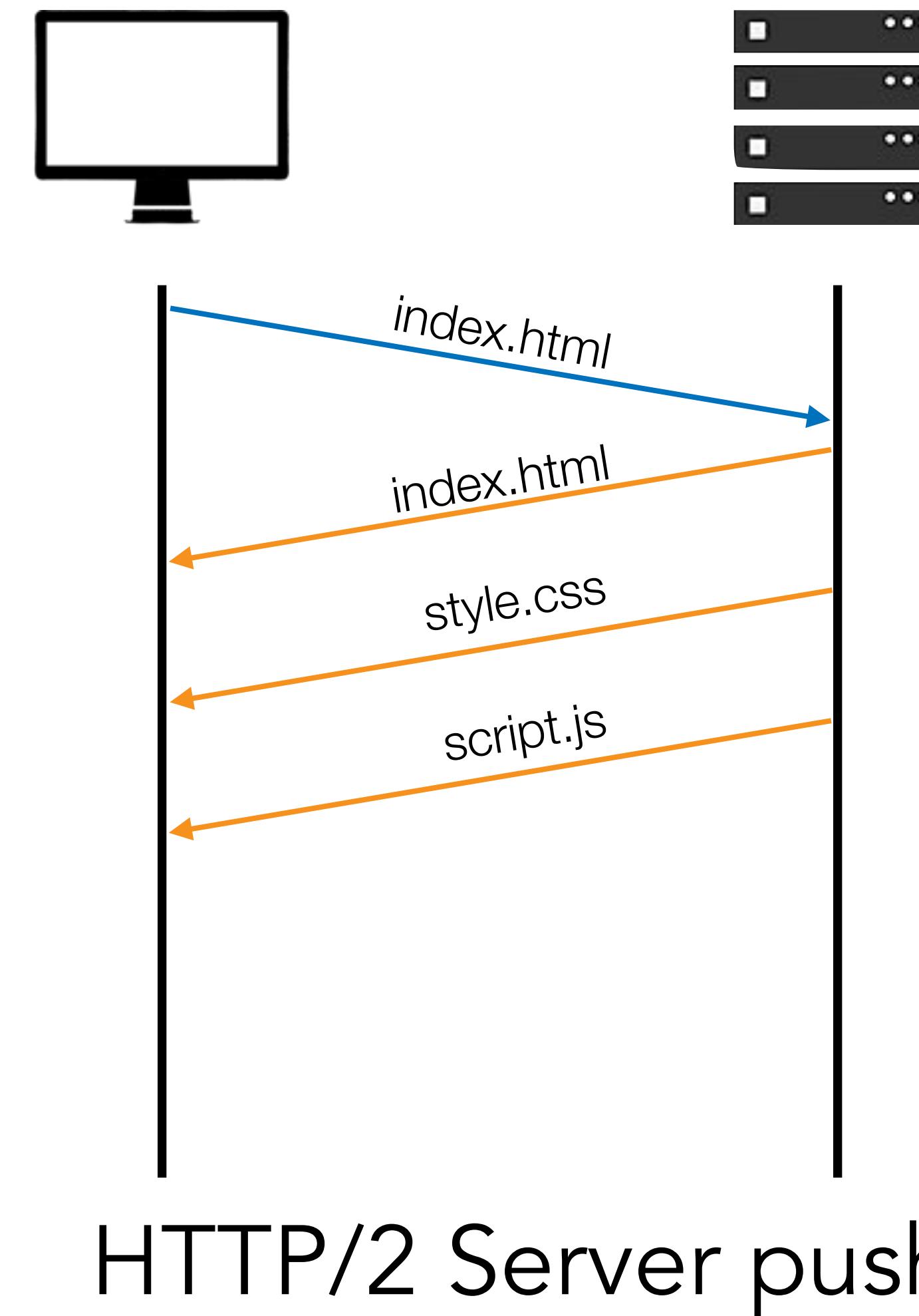
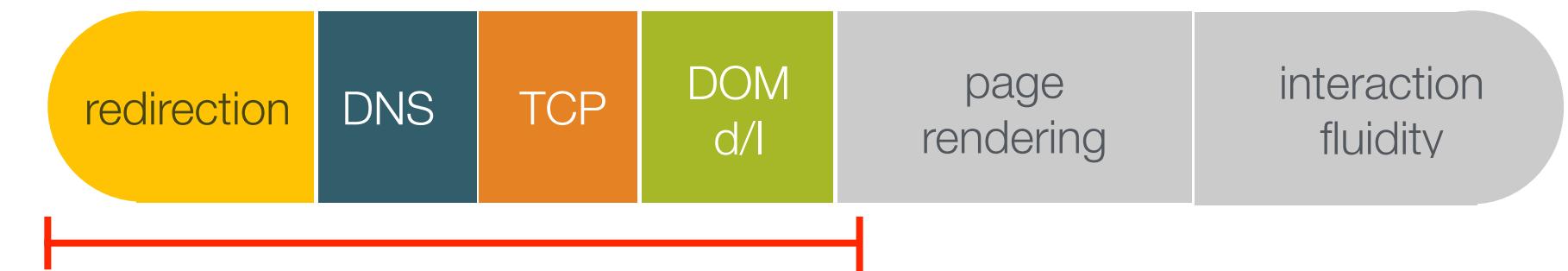


# Multiplexing in HTTP/2

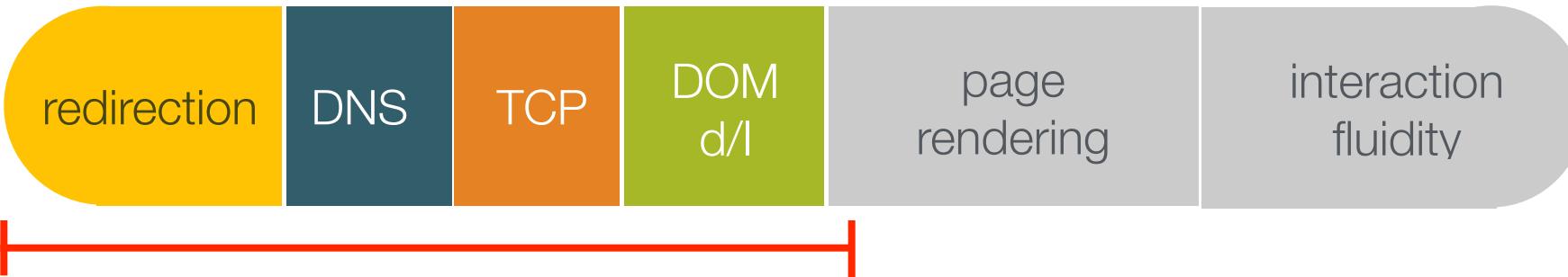


HTTP/2 Multiplexing

# Server push in HTTP/2



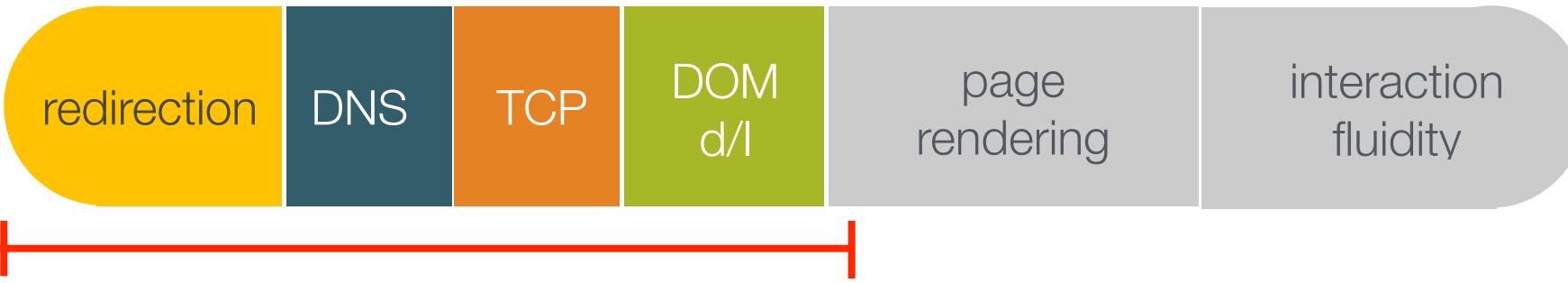
# Getting HTTP/2 alone is not enough



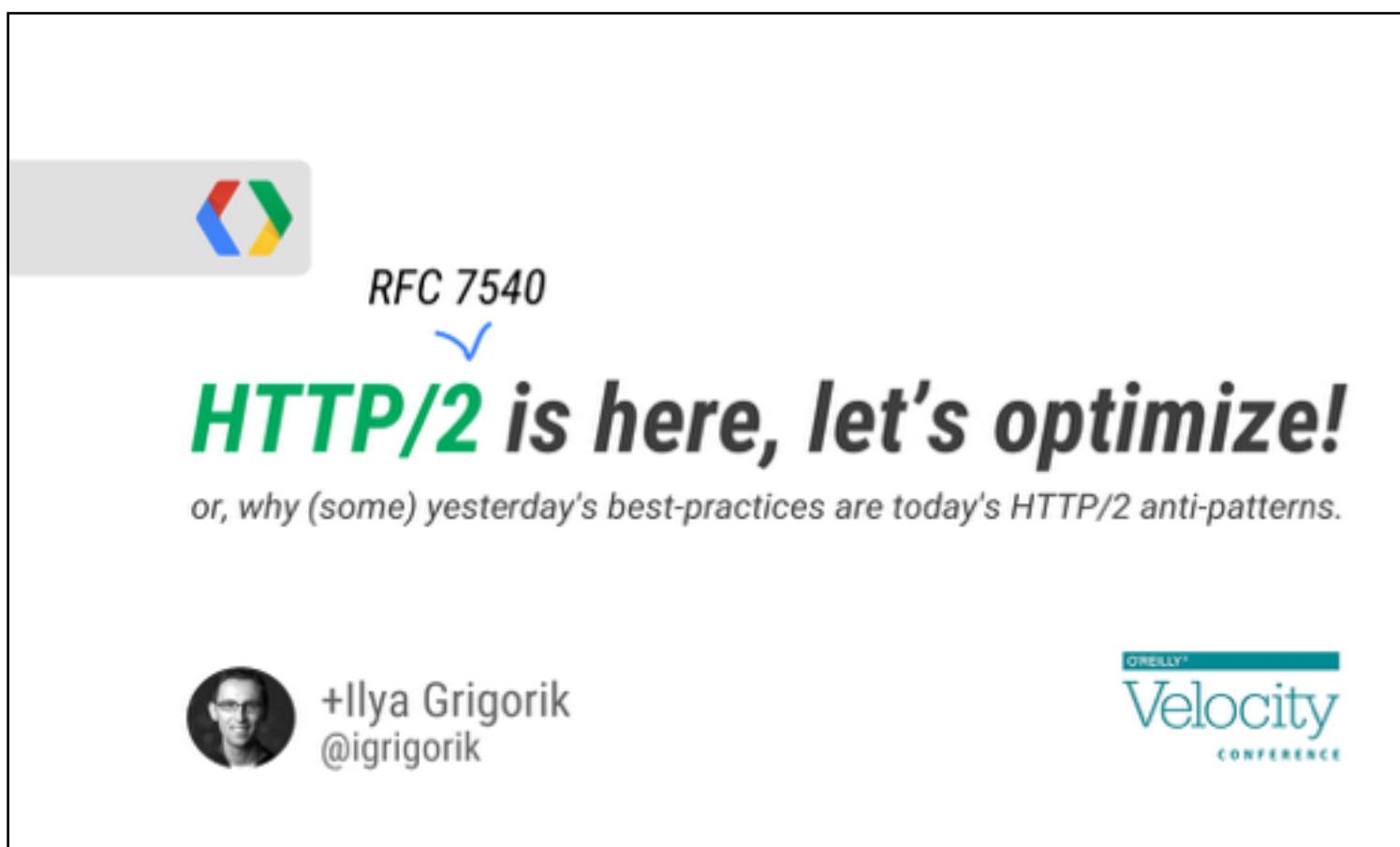
- *Switching to HTTP/2 does not guarantee a faster site*
- *Bad HTTP/2 implementation can hurt*



# Getting HTTP/2 alone is not enough



- *Switching to HTTP/2 does not guarantee a faster site*
- *Bad HTTP/2 implementation can hurt*



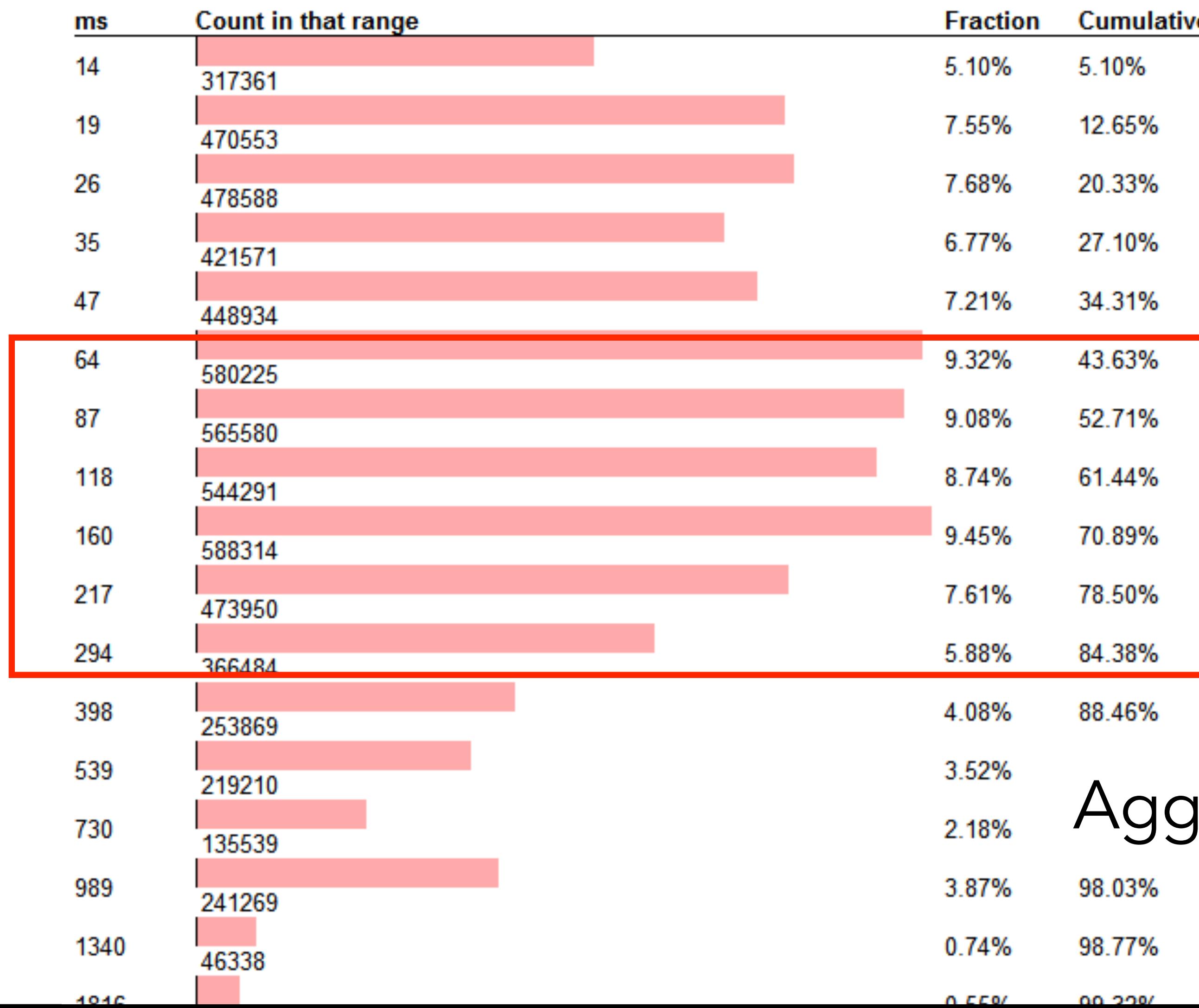
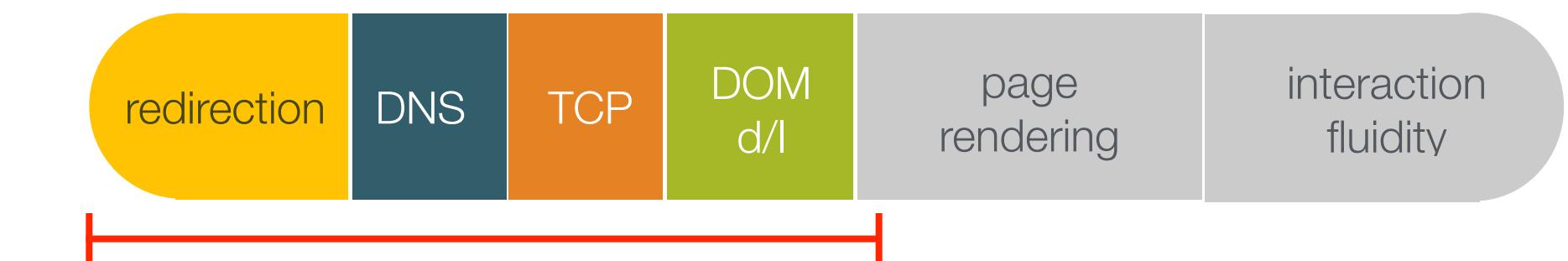
Great talk from Ilya Grigorik @ Velocity  
Santa Clara 2015

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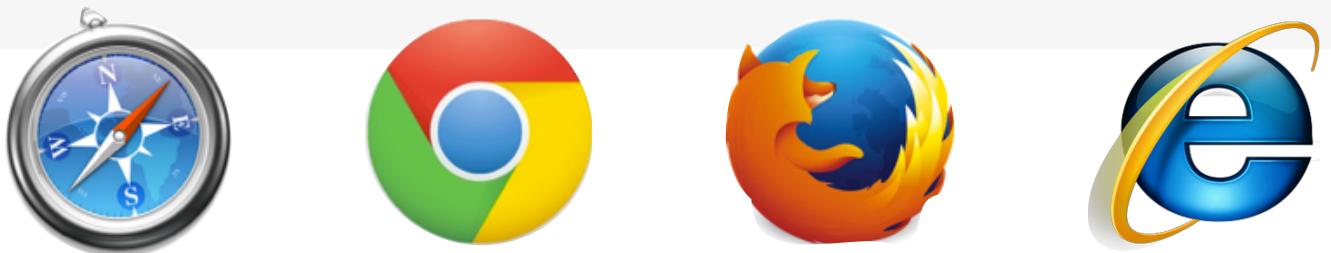
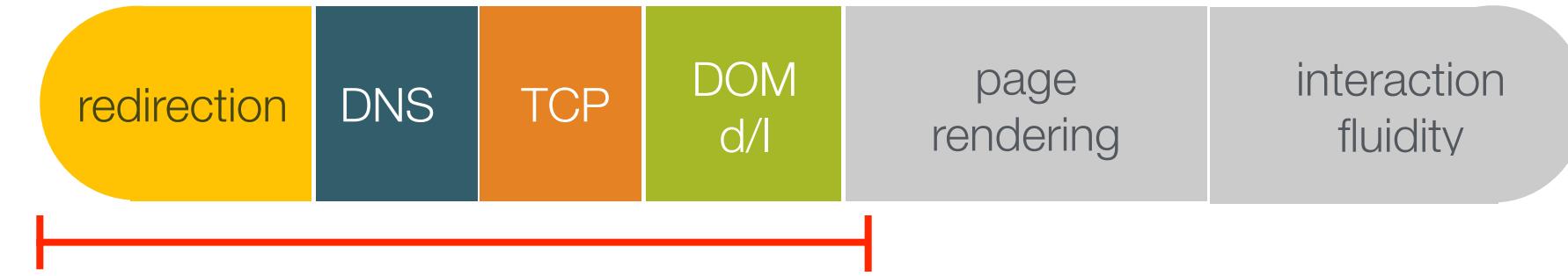
# DNS prefetch is getting more important



Aggregated DNS Resolution Times

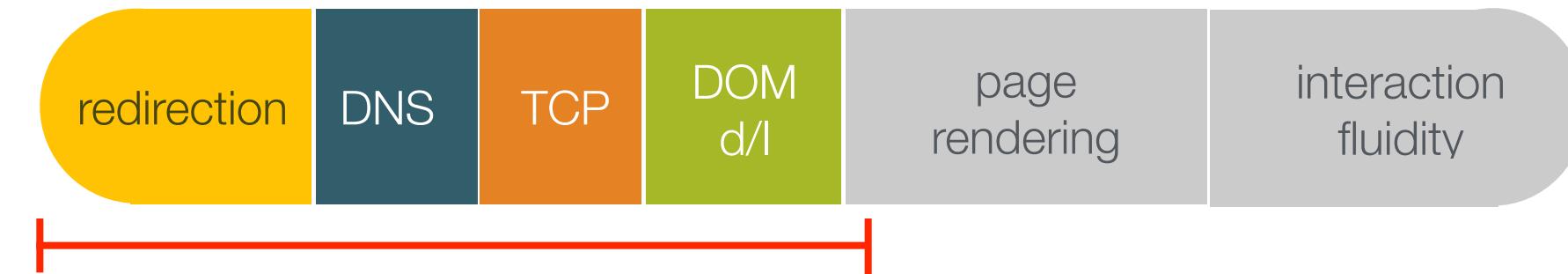
source: <http://blog.chromium.org/2008/09/dns-prefetching-or-pre-resolving.html>

# DNS prefetch



9+

# Checking prefetch status



Chrome

History

Extensions

Settings

About

Settings

The default browser is currently Google Chrome.

Privacy

[Content settings...](#)

[Clear browsing data...](#)

Google Chrome may use web services to improve your browsing experience.  
services. [Learn more](#)

Use a web service to help resolve navigation errors

Use a prediction service to help complete searches and URLs typed in the  
search box

Prefetch resources to load pages more quickly

Automatically report details of possible security incidents to Google

# Checking prefetch status



chrome://net-internals/#dns

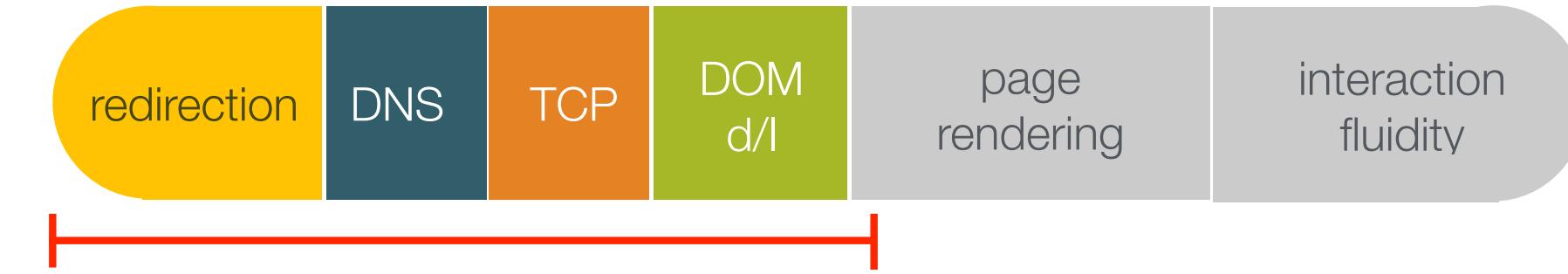
DNS ▾ capturing events (8949)

**Current State**

- Active entries: 14
- Expired entries: 5

Hostname	Family	Addresses	Expires
about.me	IPv4	54.174.231.238 52.5.90.2	2015-07-29 16:52:45.571 [Expired]
alvacheung.com	IPv4	175.41.131.233	2015-07-29 17:42:21.177
amazon.com	IPv4	176.32.98.166 205.251.242.103 72.21.206.6	2015-07-29 16:52:15.165 [Expired]
apis.google.com	IPv4	216.58.192.14	2015-07-29 16:52:46.162 [Expired]
blog.alvacheung.com	IPv4	175.41.131.233	2015-07-29 17:51:17.223
c.go-mpulse.net	IPv4	190.93.246.15 190.93.244.15 141.101.114.15 190.93.245.15 141.101.115.15	2015-07-29 16:56:21.367
clients4.google.com	IPv4	216.58.192.14	2015-07-29 16:53:17.501
coscup.org	IPv4	106.187.90.85	2015-07-29 17:51:44.628
en.wikipedia.org	IPv4	208.80.154.224	2015-07-29 17:01:44.600
inbox.google.com	IPv4	216.58.192.5	2015-07-29 16:56:31.122
oauth.googleusercontent.com	IPv4	74.125.239.42 74.125.239.43 74.125.239.44	2015-07-29 16:52:57.162 [Expired]

# DNS record is small enough to miss



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# DNS record is small enough to miss



```
$ dig google.com

; <>> DiG 9.8.3-P1 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 39582
;; flags: qr rd ra; QUERY: 1, ANSWER: 11, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.          197     IN      A      74.125.224.8
google.com.          197     IN      A      74.125.224.2
google.com.          197     IN      A      74.125.224.7
google.com.          197     IN      A      74.125.224.6
google.com.          197     IN      A      74.125.224.4
google.com.          197     IN      A      74.125.224.5
google.com.          197     IN      A      74.125.224.3
google.com.          197     IN      A      74.125.224.1
google.com.          197     IN      A      74.125.224.9
google.com.          197     IN      A      74.125.224.14
google.com.          197     IN      A      74.125.224.0

;; Query time: 51 msec
;; SERVER: 172.16.255.1#53(172.16.255.1)
;; WHEN: Wed Jul 29 17:17:19 2015
;; MSG SIZE  rcvd: 204
```

# DNS record is small enough to miss



```
$ dig google.com

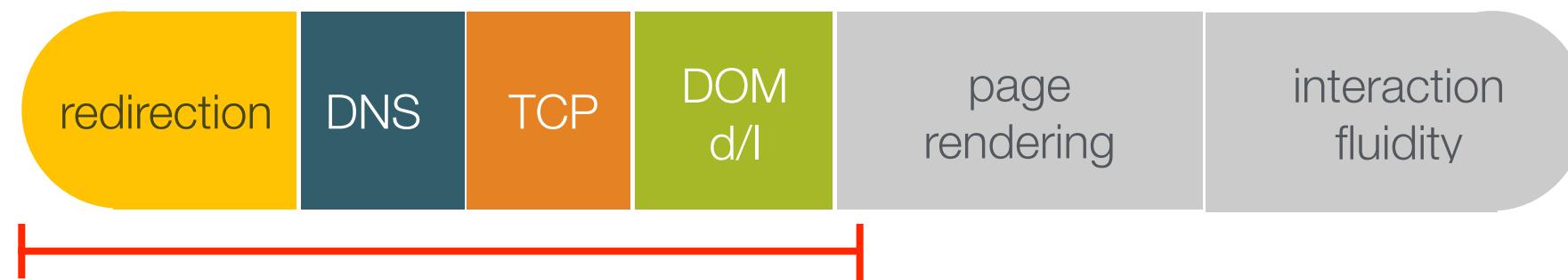
; <>> DiG 9.8.3-P1 <>> google.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 39582
;; flags: qr rd ra; QUERY: 1, ANSWER: 11, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;google.com.           IN      A

;; ANSWER SECTION:
google.com.          197     IN      A      74.125.224.8
google.com.          197     IN      A      74.125.224.2
google.com.          197     IN      A      74.125.224.7
google.com.          197     IN      A      74.125.224.6
google.com.          197     IN      A      74.125.224.4
google.com.          197     IN      A      74.125.224.5
google.com.          197     IN      A      74.125.224.3
google.com.          197     IN      A      74.125.224.1
google.com.          197     IN      A      74.125.224.9
google.com.          197     IN      A      74.125.224.14
google.com.          197     IN      A      74.125.224.0

;; Query time: 51 msec
;; SERVER: 172.16.255.1#53(172.16.255.1)
;; WHEN: Wed Jul 29 17:17:19 2015
;; MSG SIZE  rcvd: 204
```

# Other prefetches



Resource prefetch

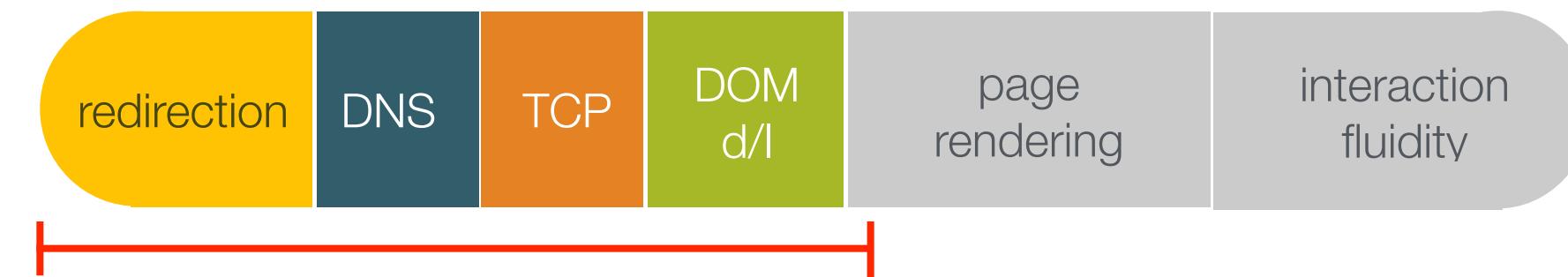


9+

html

```
<link rel="prefetch" href="http://alvacheung.com/">
```

# Other prefetches



Resource prefetch



9+

html

```
<link rel="prefetch" href="http://alvacheung.com/">
```

Page prerender



html

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

# Use prerender mindfully



Google search results for "browser page prerender":

- Make webpages load faster - Chrome Help - Google Help**  
[support.google.com › Chrome Help › Help › Advanced](https://support.google.com/chrome/answer/2364820) ▾ Google ▾  
You can make webpages load faster by telling Google Chrome to **prerender** ... When you're **browsing** a blog, you might click "next post" when you're done reading. ... a web address in the address bar, Chrome will begin to **prerender** that **page** ...
- Preconnect, prefetch, prerender... - Google Slides**  
[https://docs.google.com/.../d/.../present](https://docs.google.com/d/present) ▾ Google Docs, Sheets, and Slides ▾  
First page load is network bound; First page load is latency bound. . Our **pages** ...  
Prefetch. Prerender. Pre-resolve DNS names on **browser** startup... @igrigorik.
- Prerender - Google Groups**  
<https://groups.google.com/a/chromium.org/d/forum/prerender> ▾  
shock is always stopped and needs to resh **page** or wait to see if **page** loads. ... changing **Browser** this crazy waiting for almost a hour now to load a **page**; Completed .... Re: [chromium-discuss] prerender not enabled in chromium webview?
- Prerender and prefetch support (Windows) - MSDN - Microsoft**  
[https://msdn.microsoft.com/.../dn265030/](https://msdn.microsoft.com/dn265030/) ▾ Microsoft Developer Network ▾

source: <http://google.com>

# Use prerender mindfully



Google search results for "browser page prerender":

- Make webpages load faster - Chrome Help - Google Help**  
support.google.com › Chrome Help › Help › Advanced › Google  
You can make webpages load faster by telling Google Chrome to **prerender** ... When you're **browsing** a blog, you might click "next post" when you're done reading. ... a web address in the address bar, Chrome will begin to **prerender** that page ...
- Preconnect, prefetch, prerender... - Google Slides**  
<https://docs.google.com/.../d/.../present> ▾ Google Docs, Sheets, and Slides ▾  
First page load is network bound; First page load is latency bound.. Our **pages** ...  
Prefetch. Prerender. Pre-resolve DNS names on **browser** startup... @igrigorik.
- Prerender - Google Groups**  
<https://groups.google.com/a/chromium.org/d/forum/prerender> ▾  
shock is always stopped and needs to resh **page** or wait to see if **page** loads. ...  
changing **Browser** this crazy waiting for almost a hour now to load a **page**; Completed .... Re: [chromium-discuss] prerender not enabled in chromium webview?
- Prerender and prefetch support (Windows) - MSDN - Microsoft**  
<https://msdn.microsoft.com/.../dn265030/> ▾ Microsoft Developer Network ▾

click thru:  
35%-45%

# Use prerender mindfully



Google browser page prerender

Web Images Videos News Shopping More ▾ Search tools

About 342,000 results (0.31 seconds)

**Make webpages load faster - Chrome Help - Google Help**  
[support.google.com › Chrome Help › Help › Advanced](https://support.google.com/chrome/answer/2364820) Google  
You can make webpages load faster by telling Google Chrome to **prerender** ... When you're **browsing** a blog, you might click "next post" when you're done reading. ... a web address in the address bar, Chrome will begin to **prerender** that page ...

**Preconnect, prefetch, prerender... - Google Slides**  
<https://docs.google.com/d/present> Google Docs, Sheets, and Slides  
First page load is network bound; First page load is latency bound. Our pages ...  
Prefetch. Prerender. Pre-resolve DNS names on browser startup... @igrigorik.

**Prerender - Google Groups**  
<https://groups.google.com/a/chromium.org/d/forum/prerender>  
shock is always stopped and needs to resh page or wait to see if page loads. ... changing **Browser** this crazy waiting for almost a hour now to load a page; Completed .... Re: [chromium-discuss] prerender not enabled in chromium webview?

**Prerender and prefetch support (Windows) - MSDN - Microsoft**  
<https://msdn.microsoft.com/dn265030/> Microsoft Developer Network

click thru:  
35%-45%

click thru:  
15%-20%

source: <http://google.com>

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# Velocity

CONFERENCE

BUILD RESILIENT SYSTEMS AT SCALE

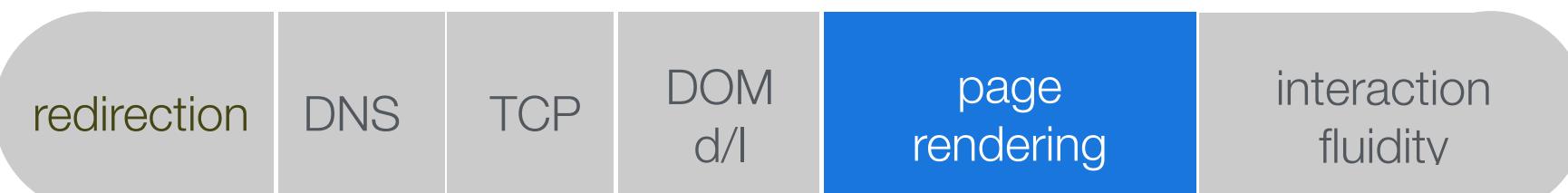
[velocity.oreilly.com.cn](http://velocity.oreilly.com.cn)

#velocityconf

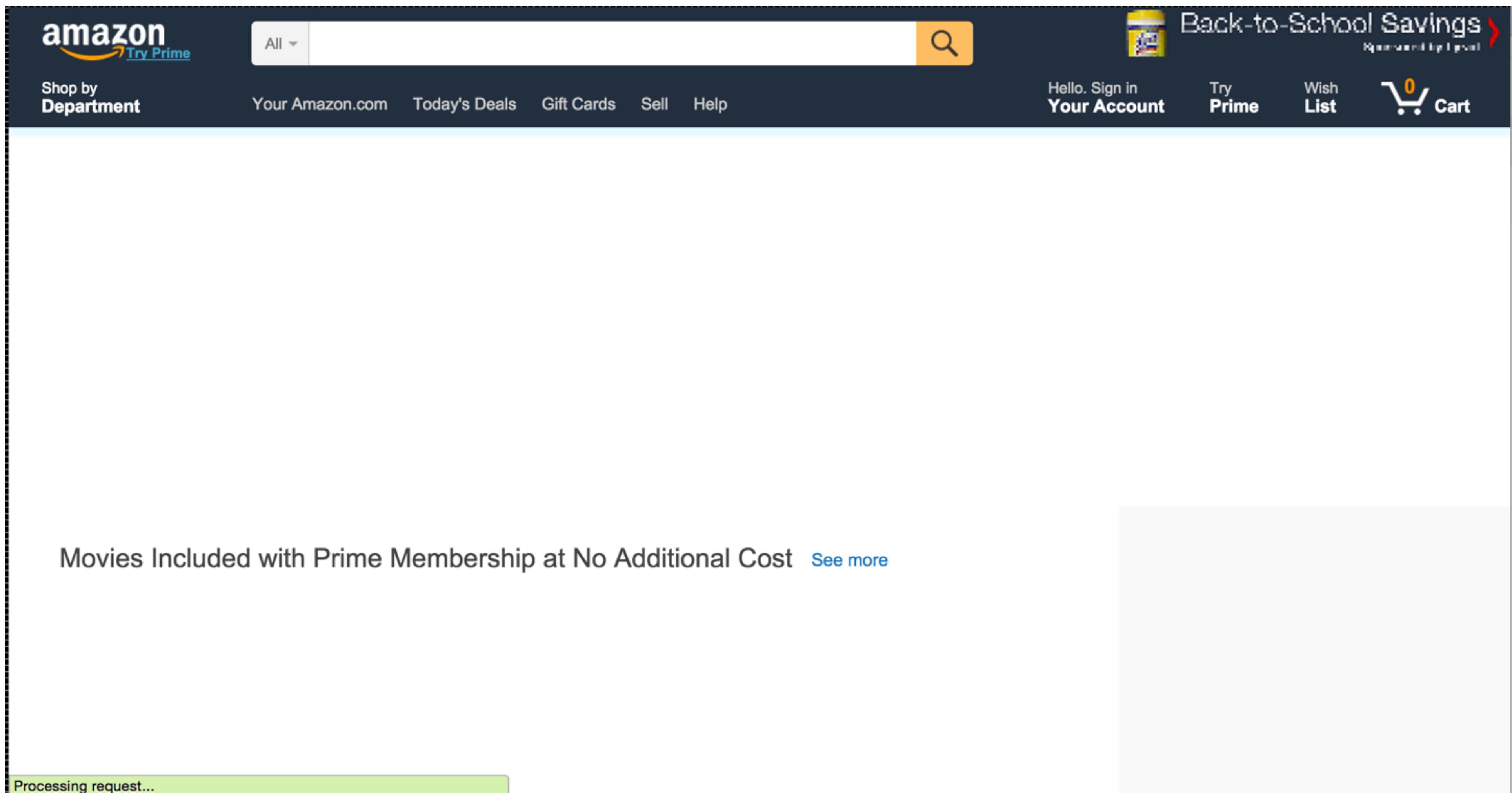
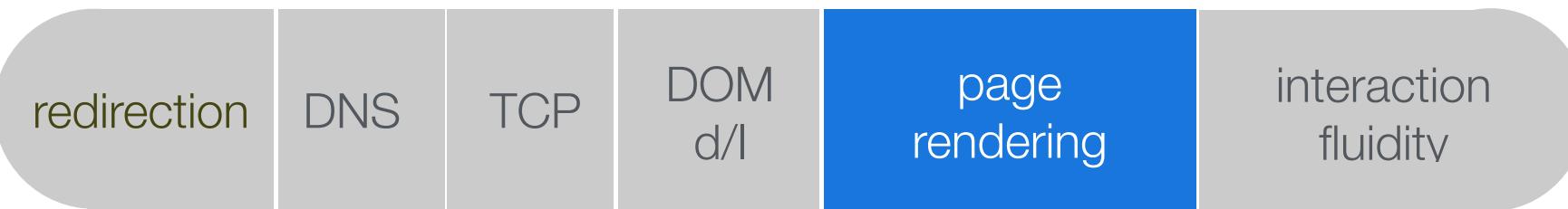


**survive  
big codebase**

# You are not your target audience

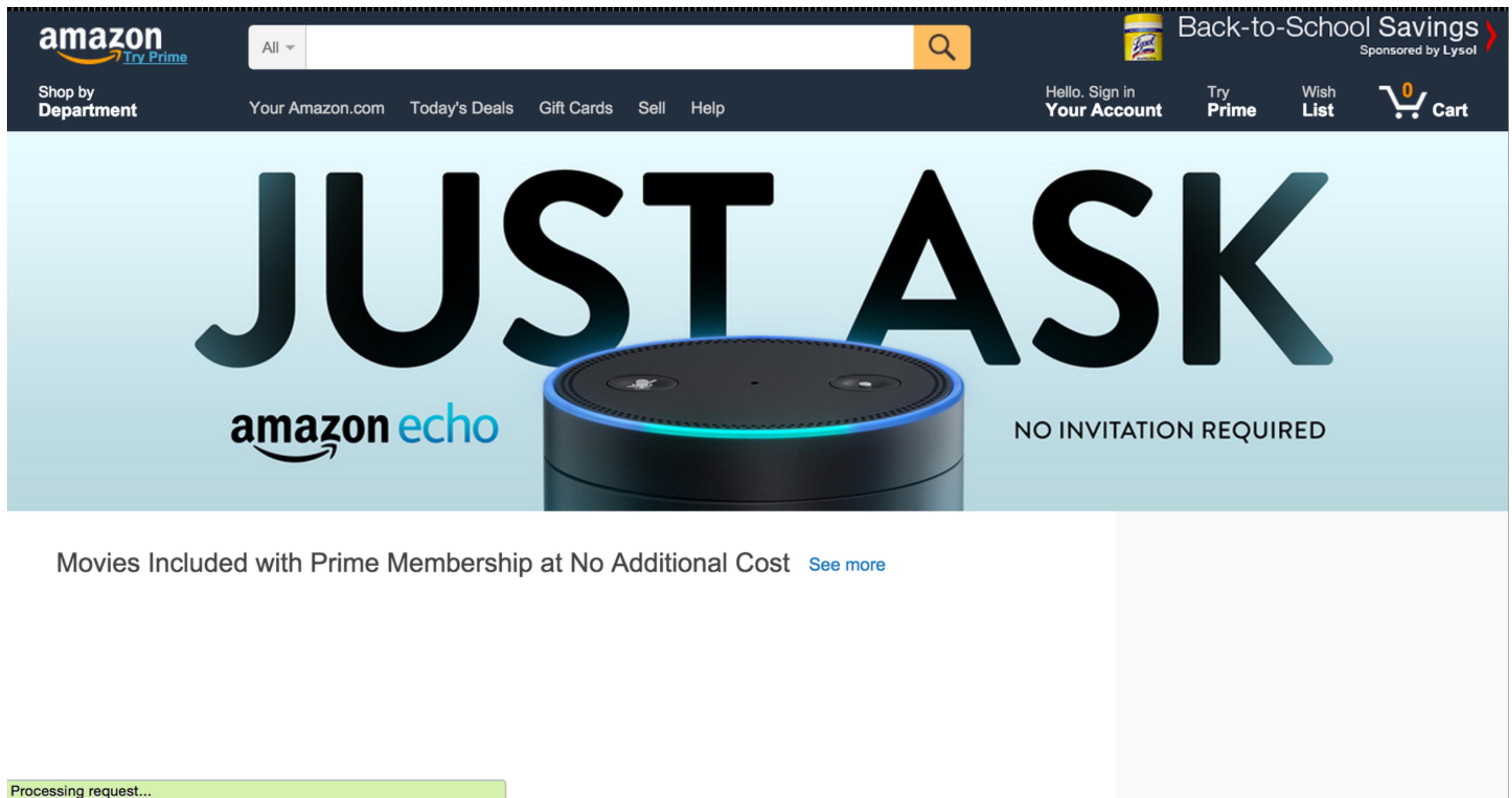
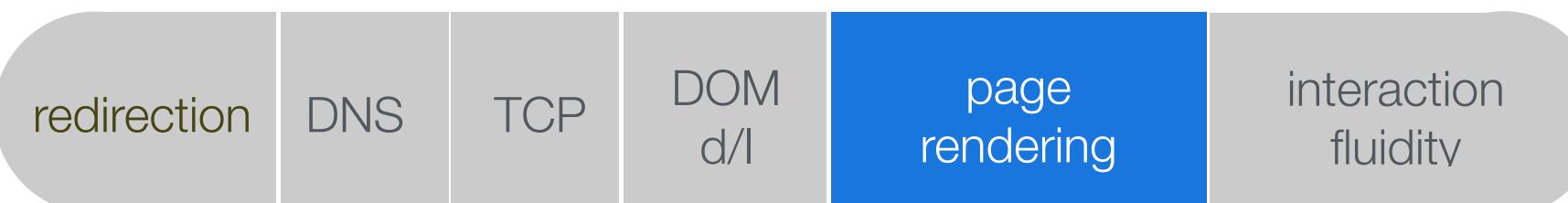


# Dealing with large pages



source: <http://amazon.com>

# Dealing with large pages



# Dealing with large pages

redirection

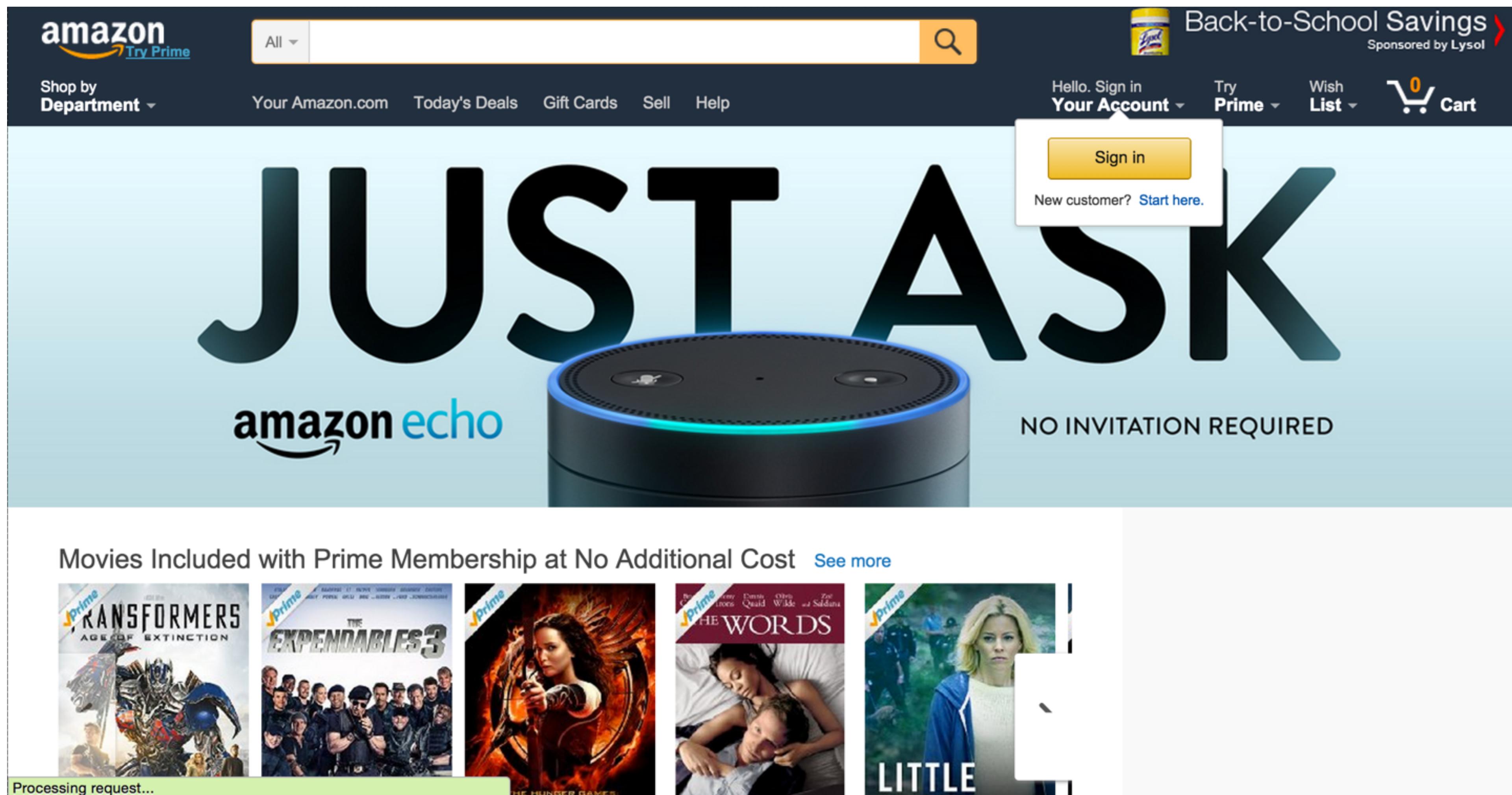
DNS

TCP

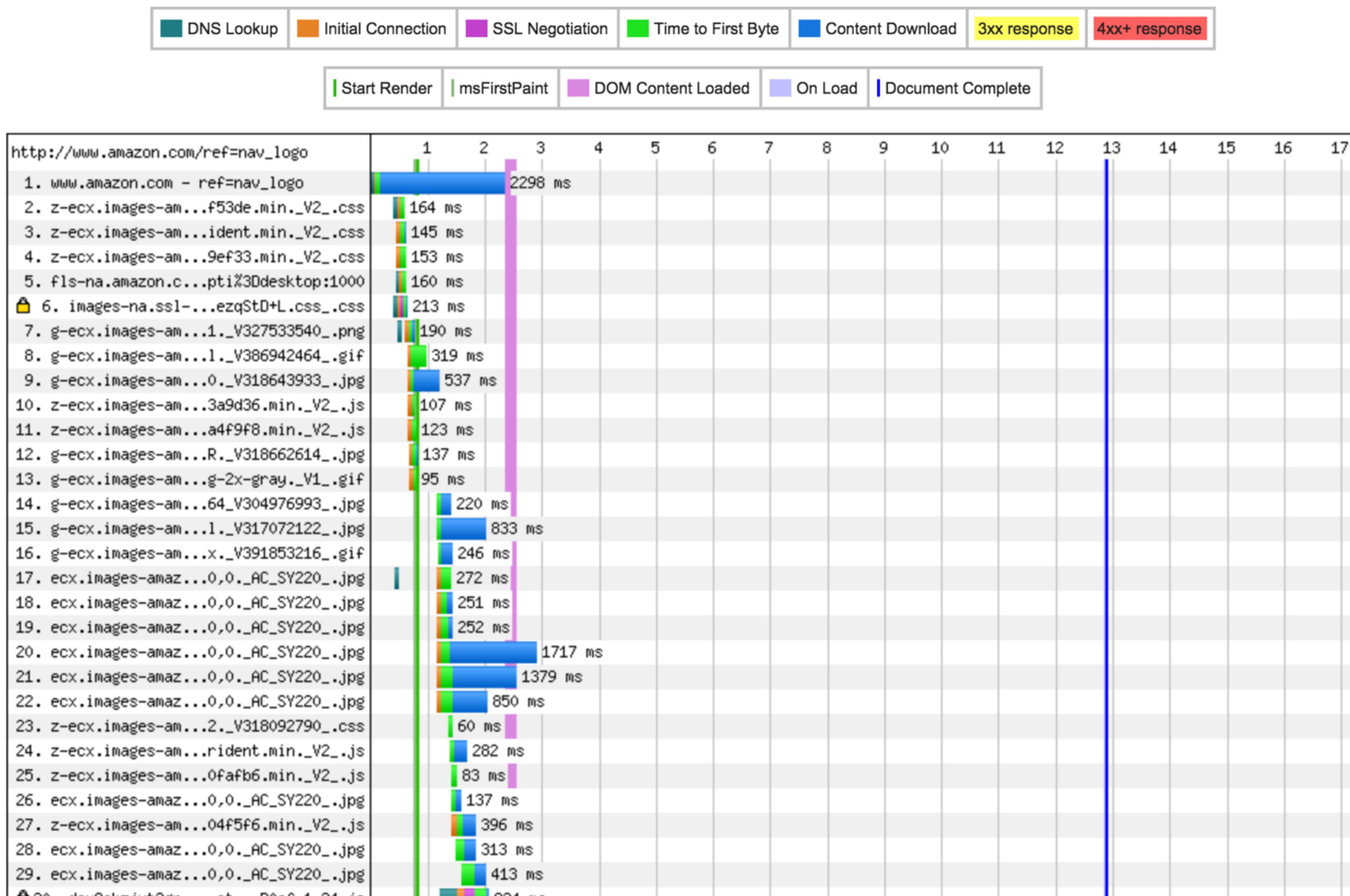
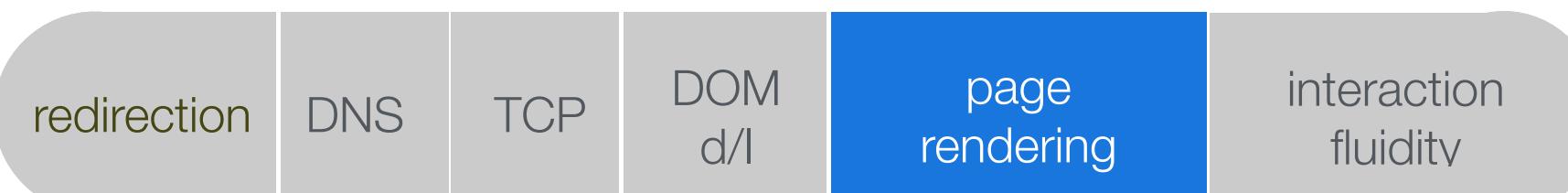
DOM  
d/l

page  
rendering

interaction  
fluidity



# Rendering large pages



[webpagetest.org/](http://webpagetest.org/)

# Render your critical feature first

redirection

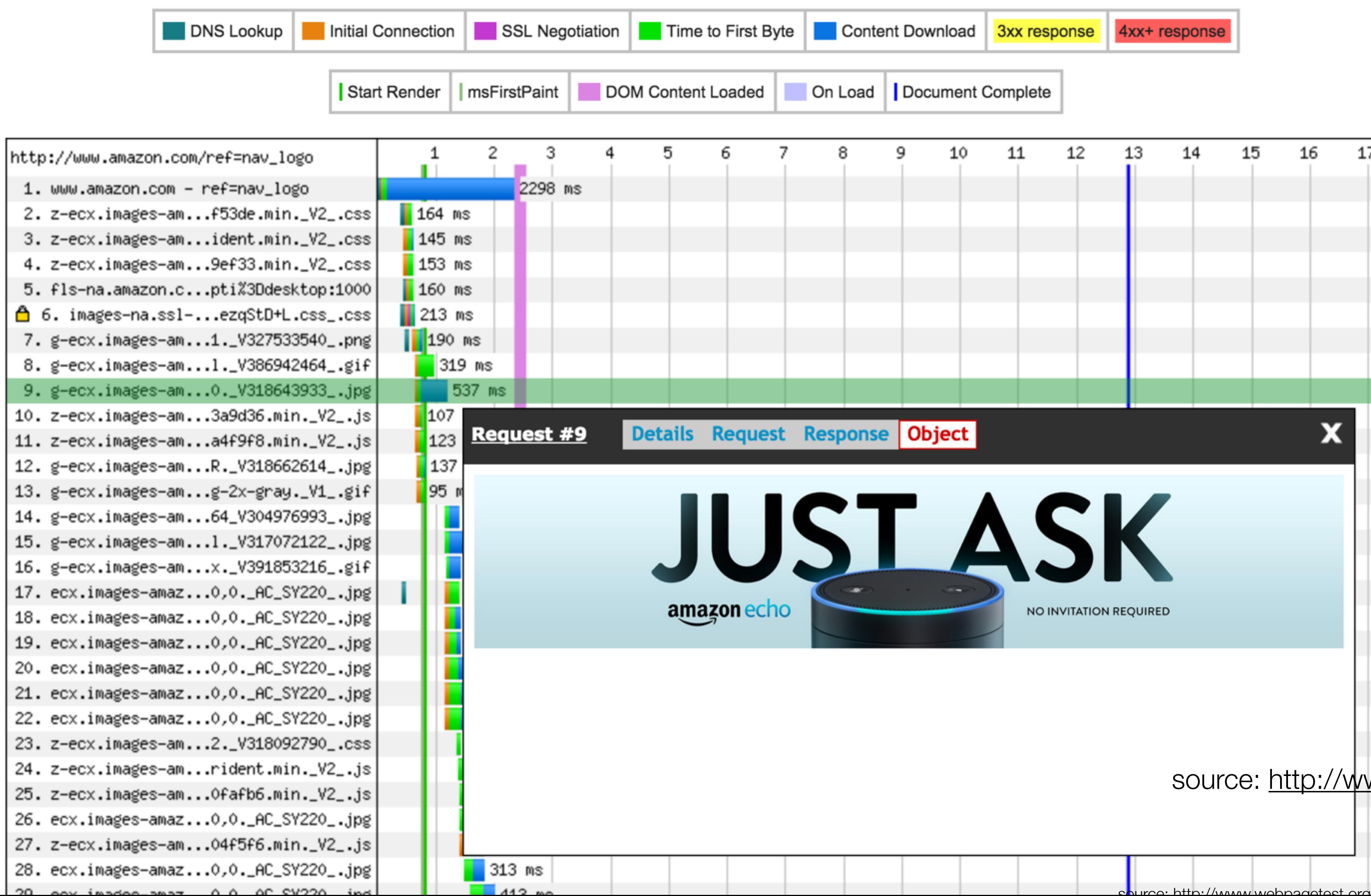
DNS

TCP

DOM  
d/l

page  
rendering

interaction  
fluidity



# Render your critical feature first

redirection

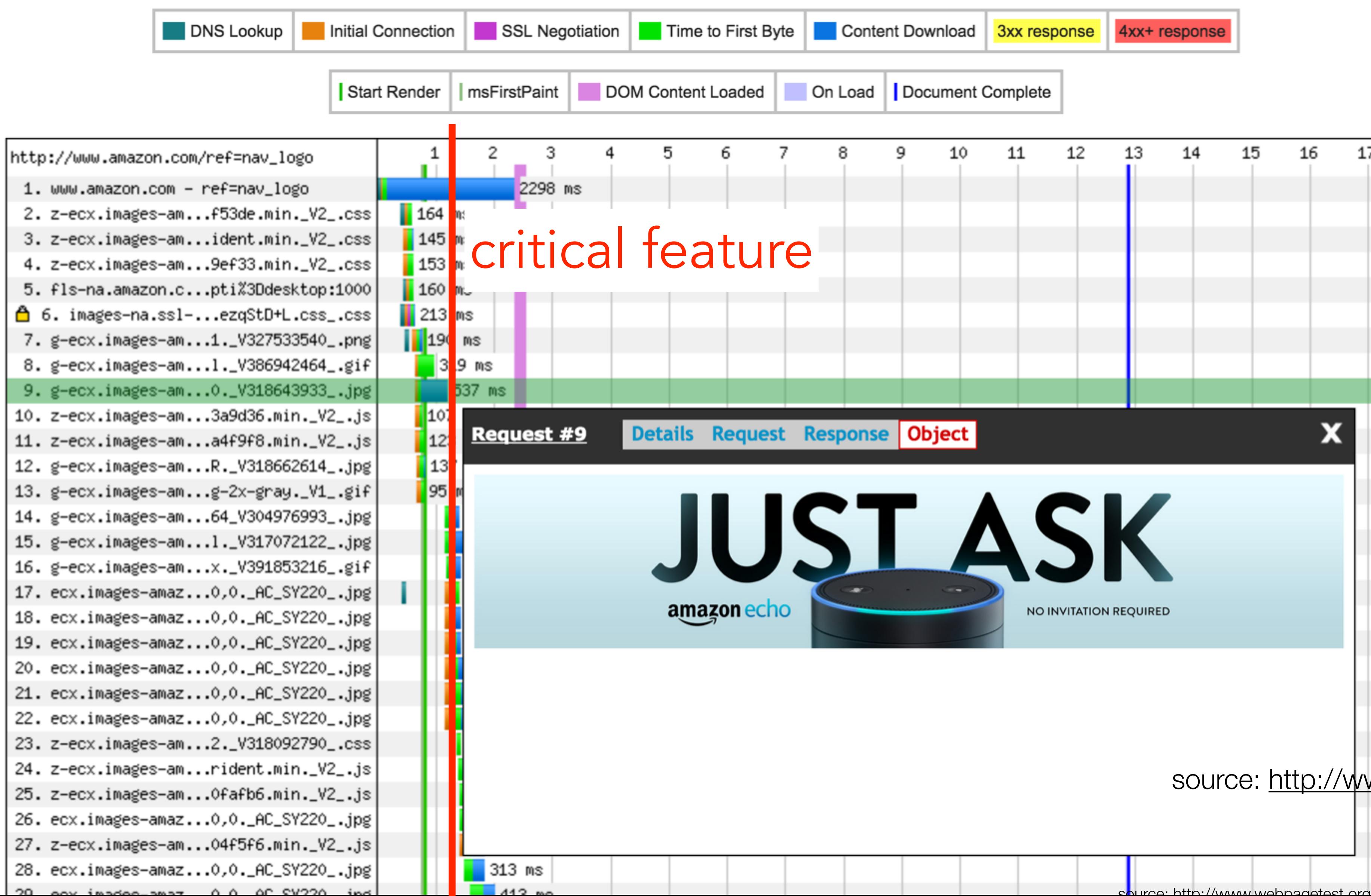
DNS

TCP

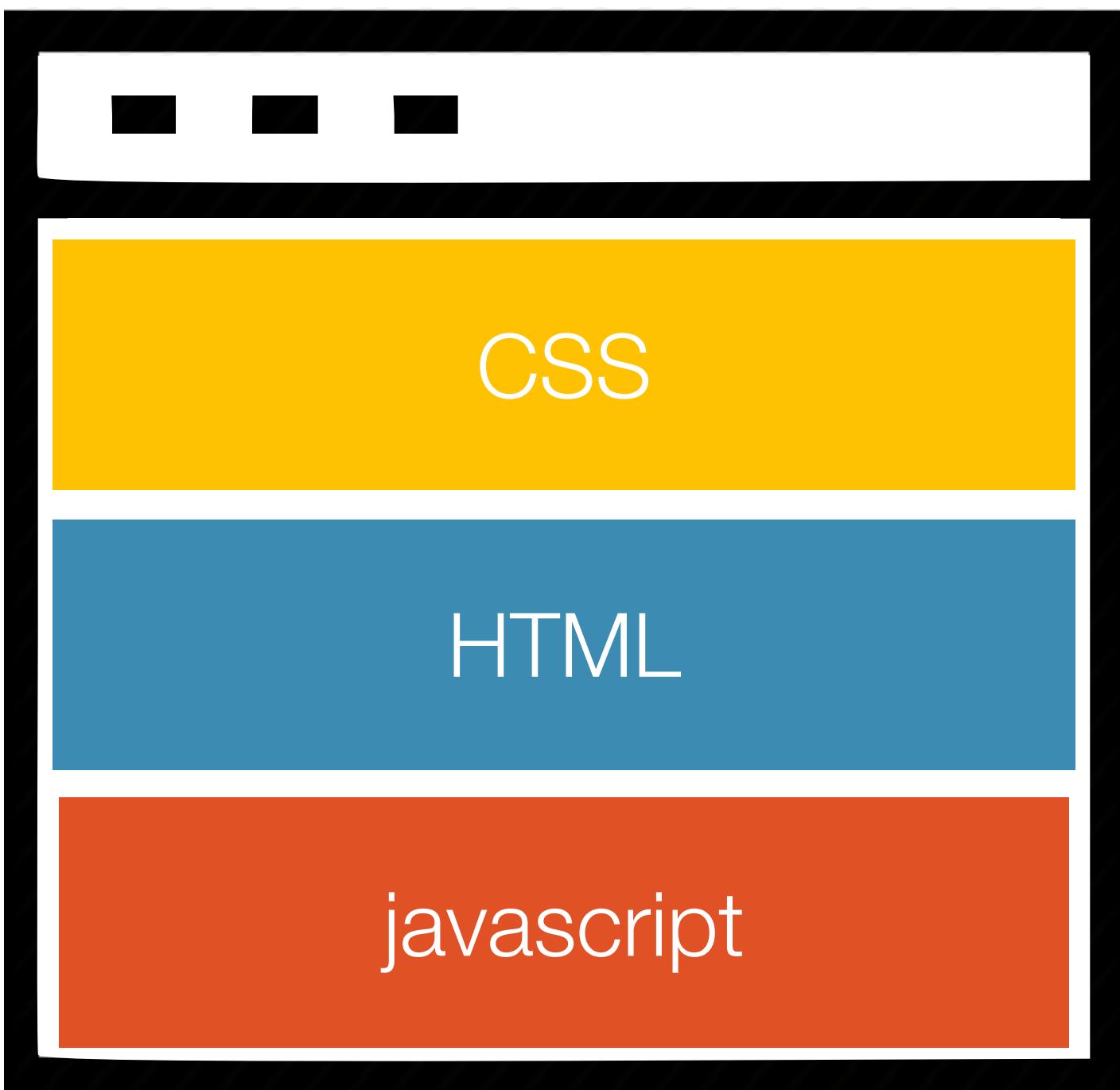
DOM  
d/l

page  
rendering

interaction  
fluidity

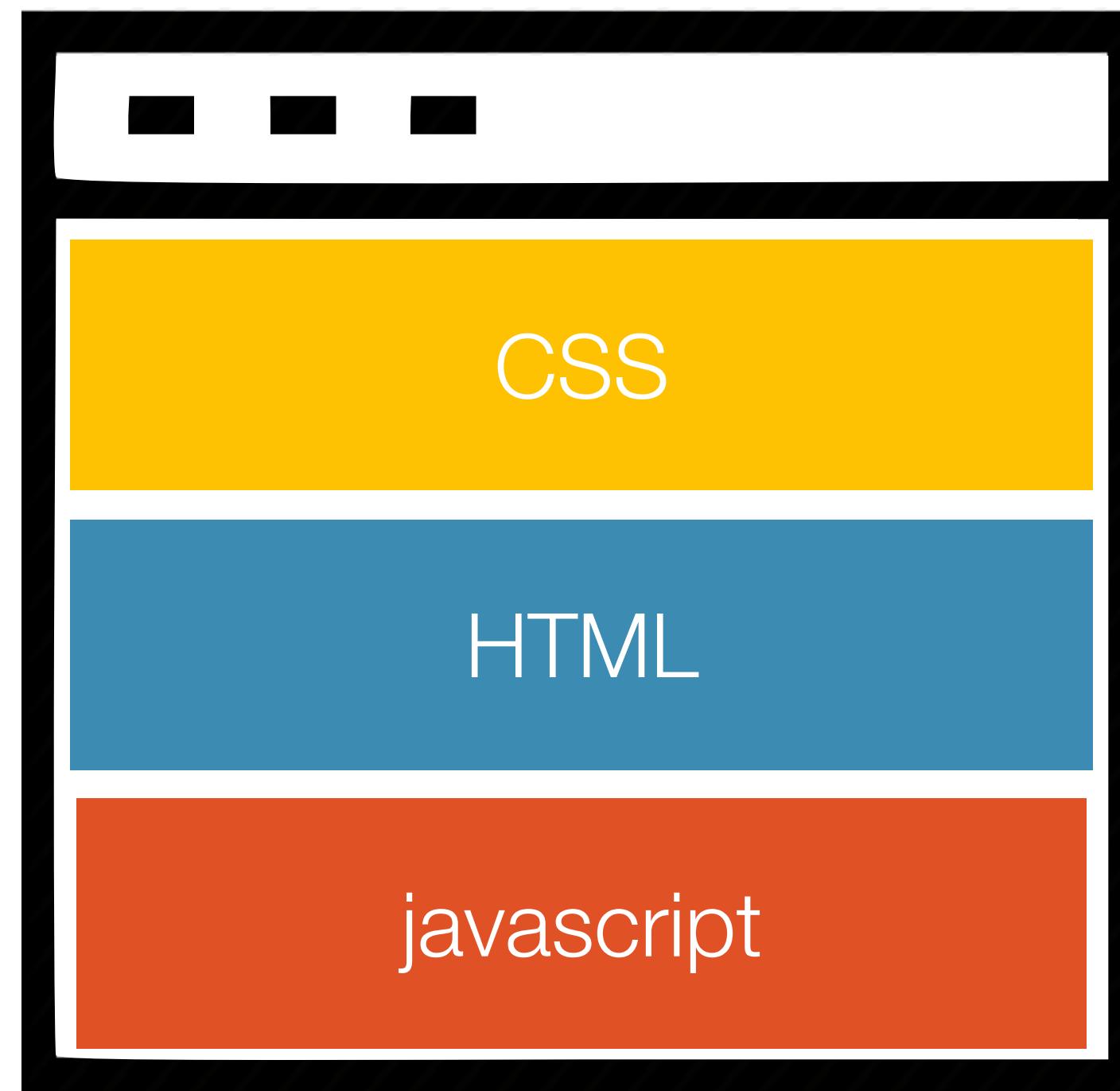


# Why we care about JS rendering?

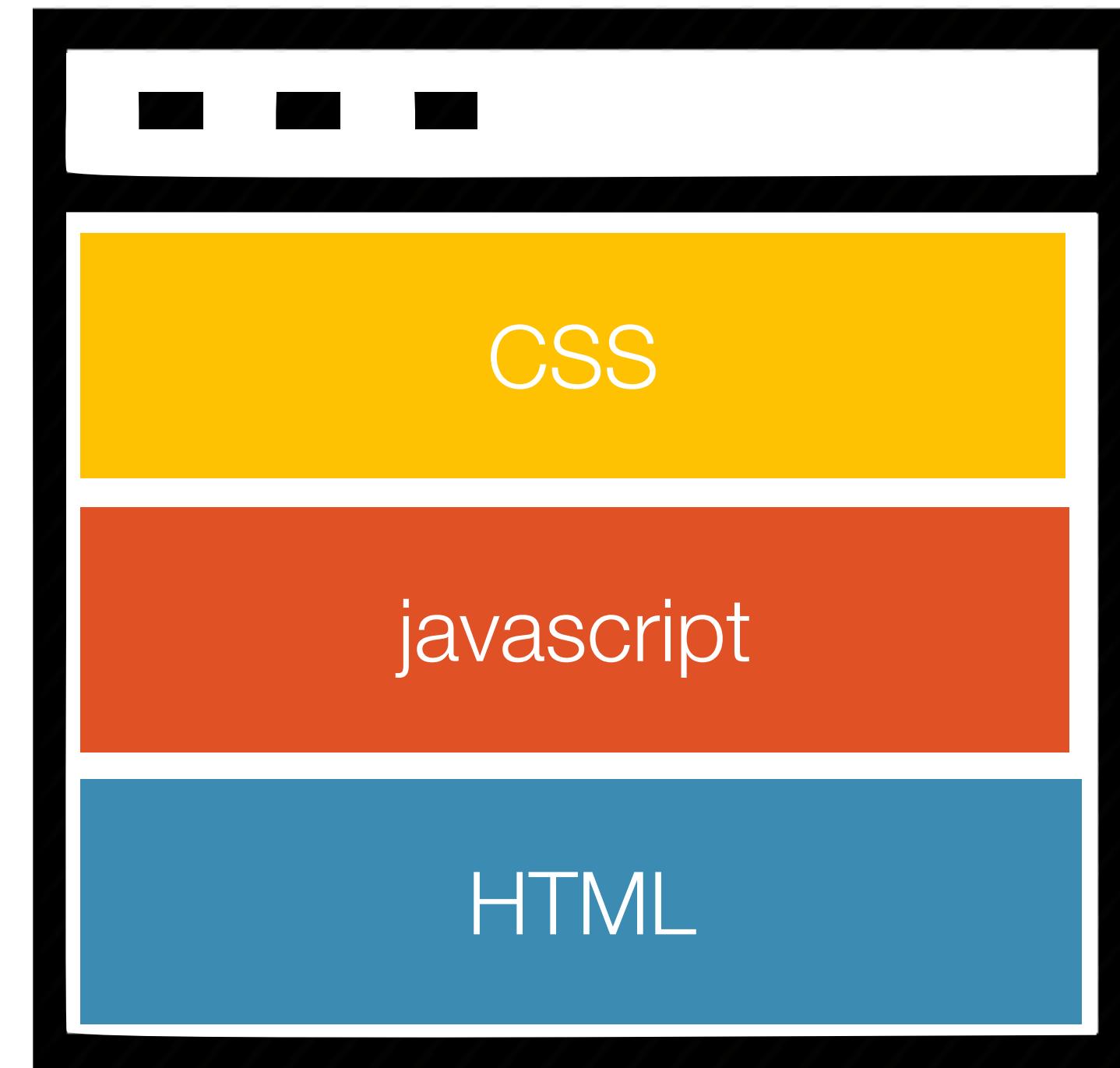


Static websites

# Why we care about JS rendering?



Static websites

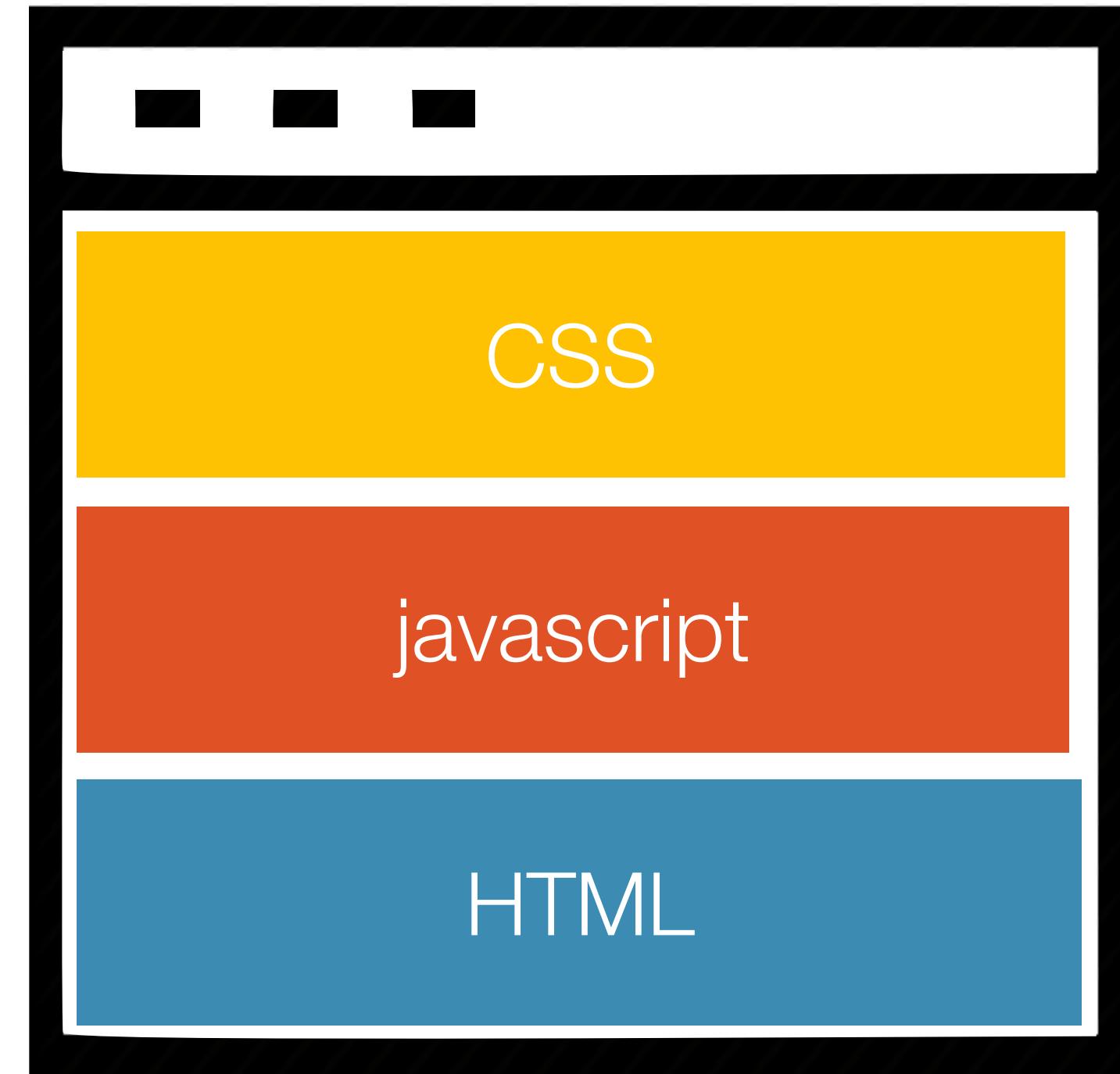


Interactive/js rendered  
websites

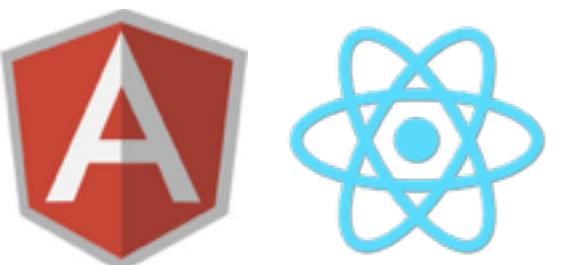
# Why we care about JS rendering?



Static websites



Interactive/js rendered  
websites



# Inline caching optimizes execution



```
dog.bark()
```

runtime

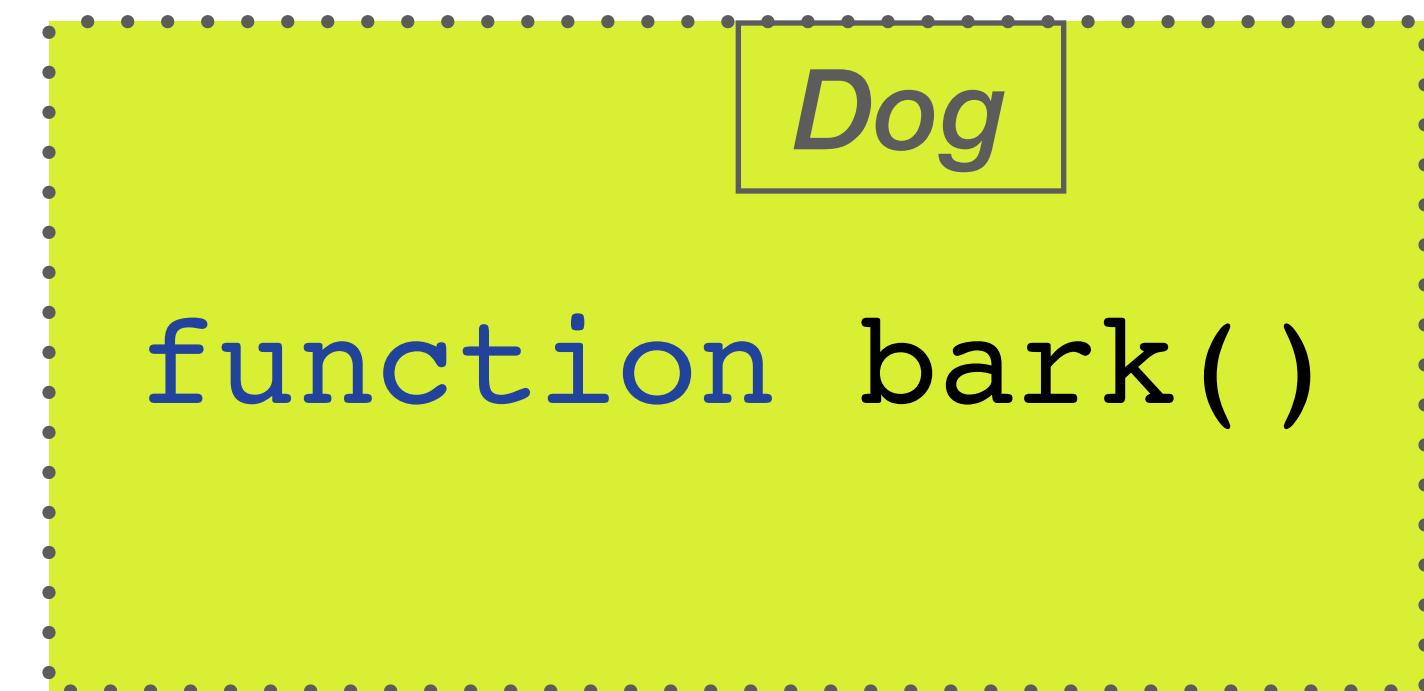
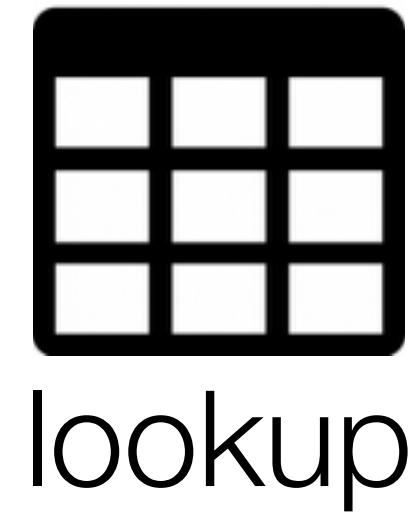
```
Dog  
function bark()
```

# Inline caching optimizes execution

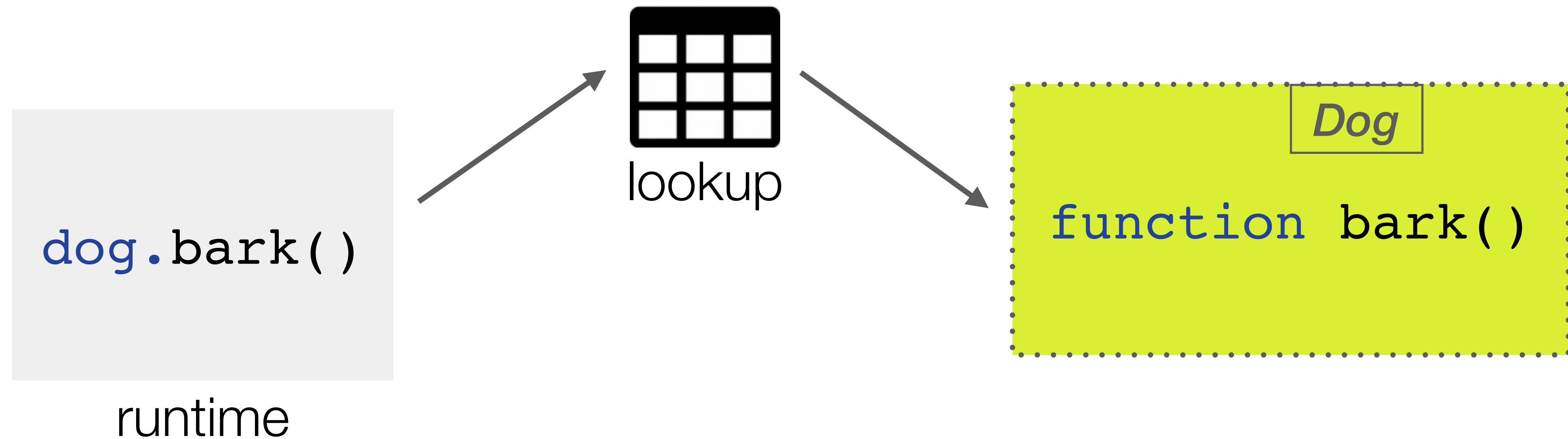


dog.bark()

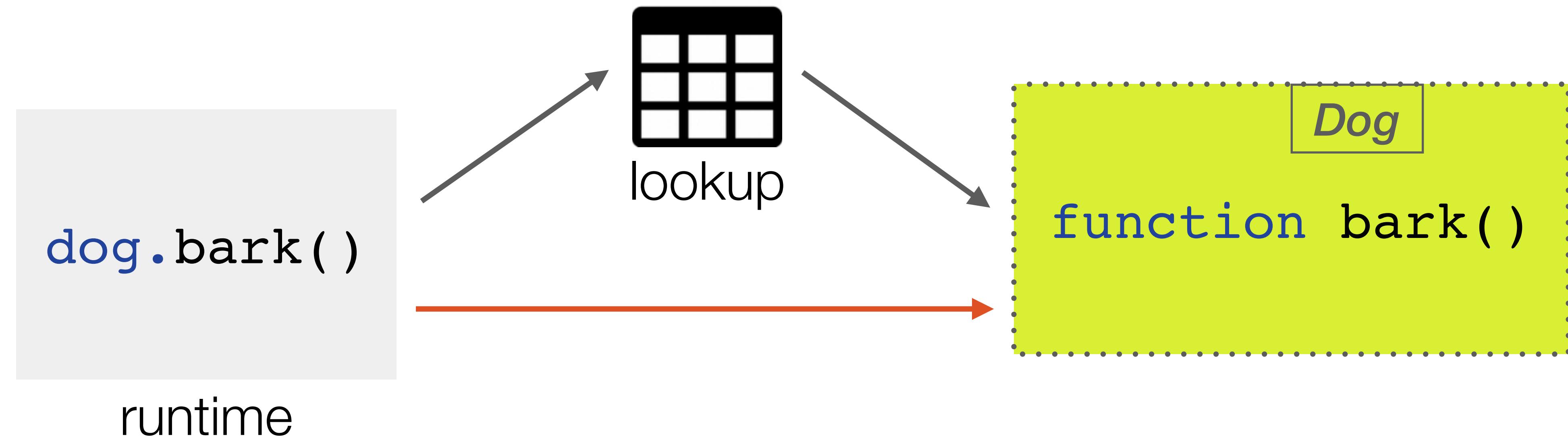
runtime



# Inline caching optimizes execution



# Inline caching optimizes execution

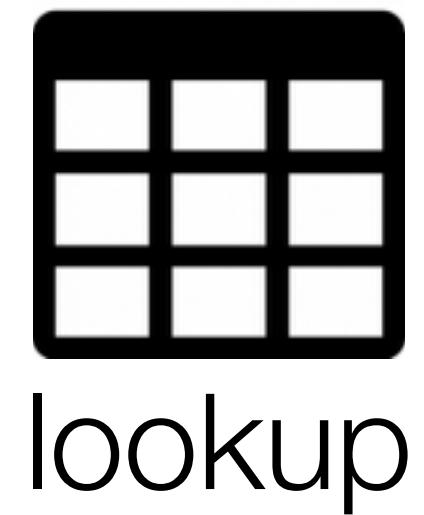


# Inline caching optimizes execution



dog.bark()

runtime



Dog

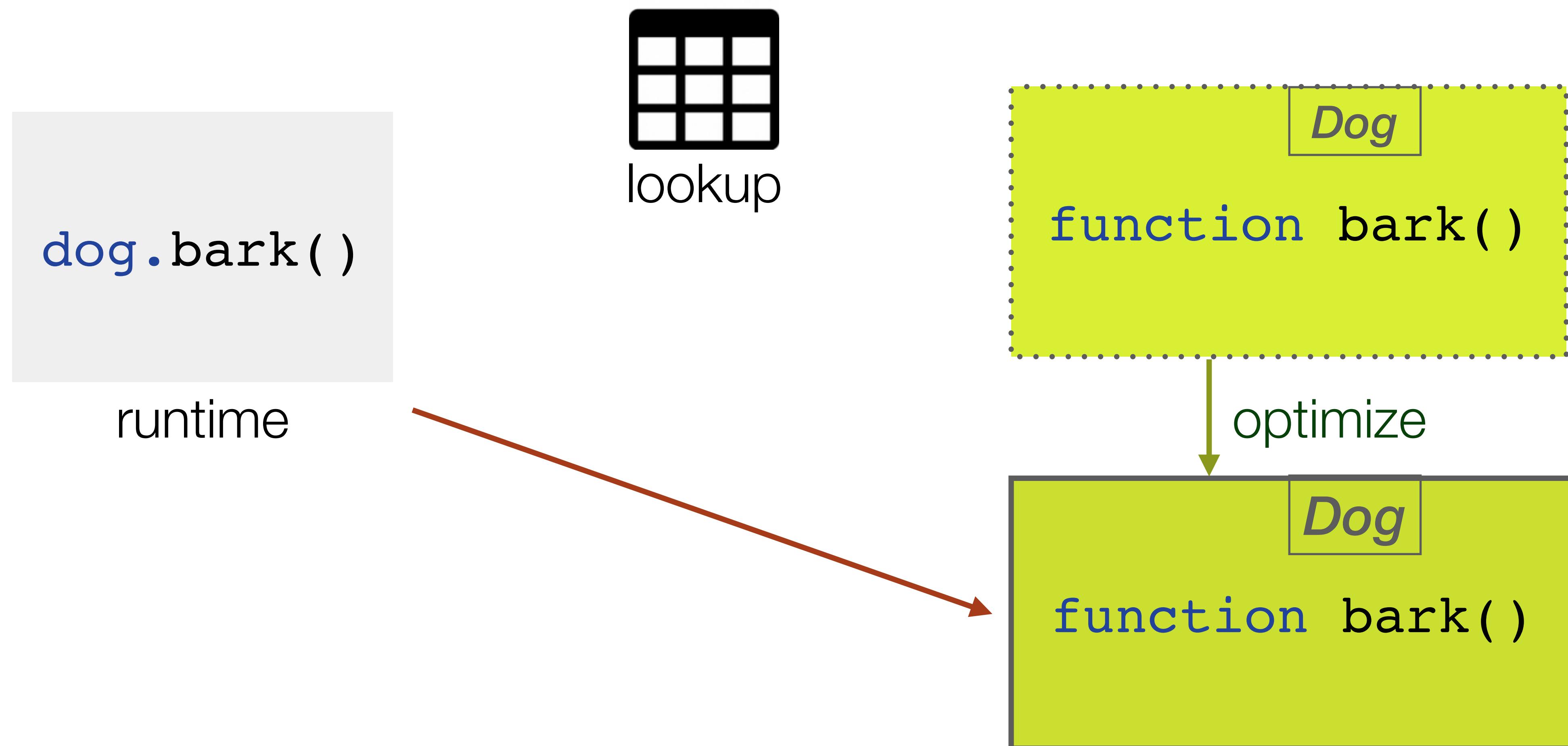
function bark()

Dog

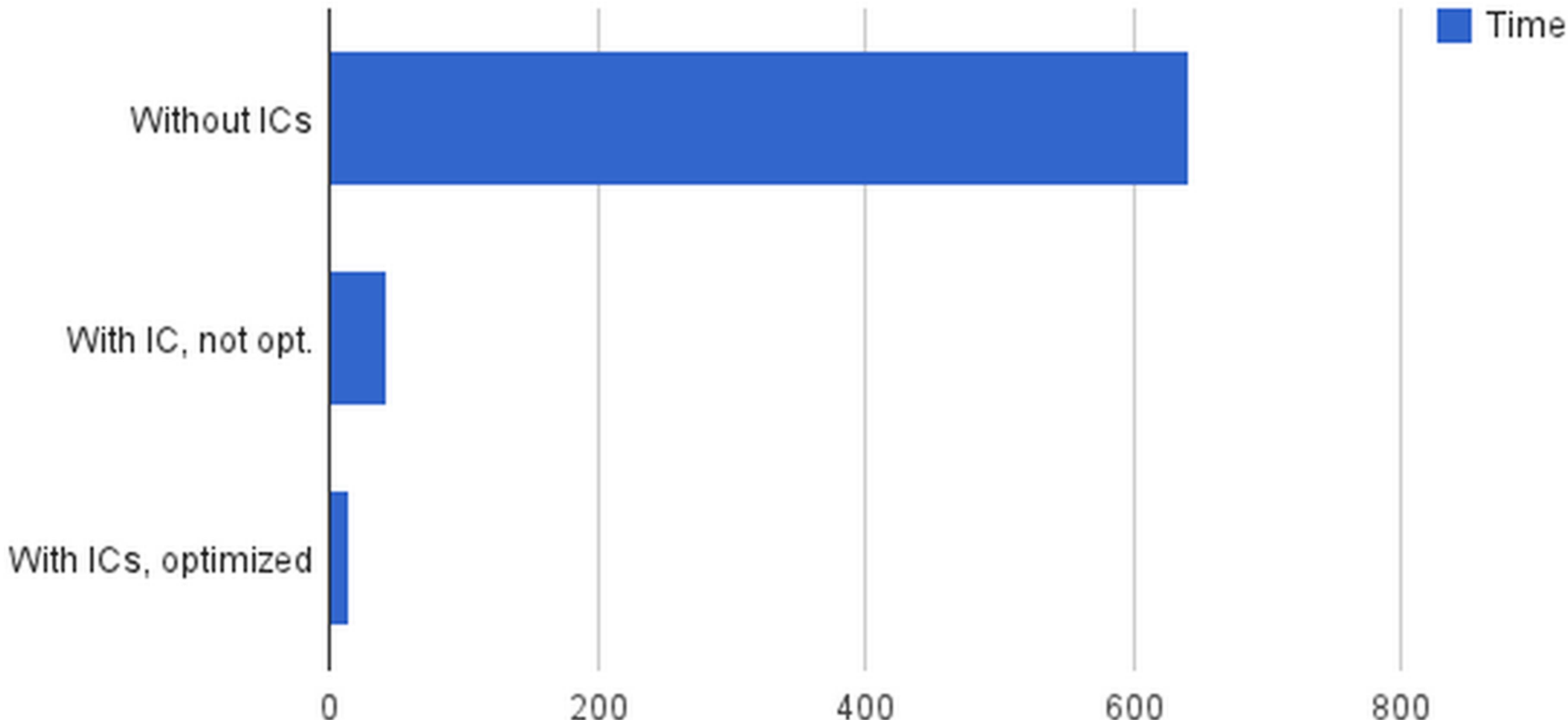
function bark()

optimize

# Inline caching optimizes execution



# Inline caching optimizes execution



source: <http://v8-io12.appspot.com/#68>

# Inline caching can be easily broken



```
function addTwoThings(thing1, thing2) {    javascript  
    return thing1 + thing2;  
}  
  
addTwoThings(1, 2);
```

# Inline caching can be easily broken



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

addTwoThings(1, 2);
addTwoThings(100, 200);
```

# Inline caching can be easily broken



```
function addTwoThings(thing1, thing2) {  
    return thing1 + thing2;  
}  
  
addTwoThings(1, 2);  
addTwoThings(100, 200);
```

javascript



# Inline caching can be easily broken



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

addTwoThings(1, 2);
addTwoThings(100, 200);
addTwoThings('a', 'b');
```

# Inline caching can be easily broken

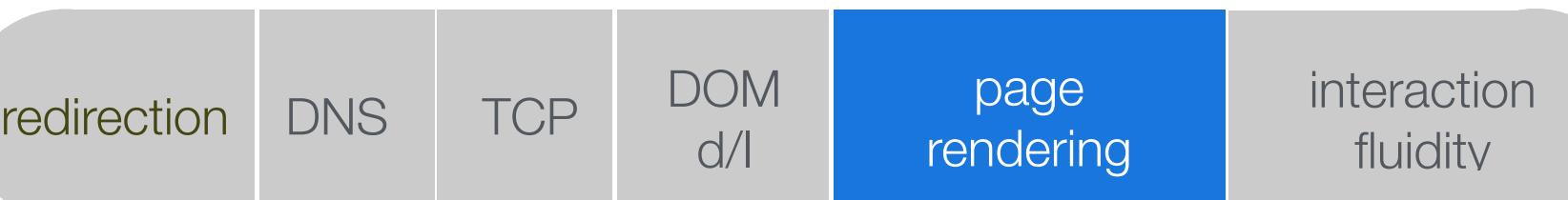


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}

addTwoThings(1, 2);
addTwoThings(100, 200);
addTwoThings('a', 'b');
```



# Inline caching can be easily broken



```
function Dog(name) {  
    this.name = name;  
}  
  
var dog1 = new Dog('Jim');
```

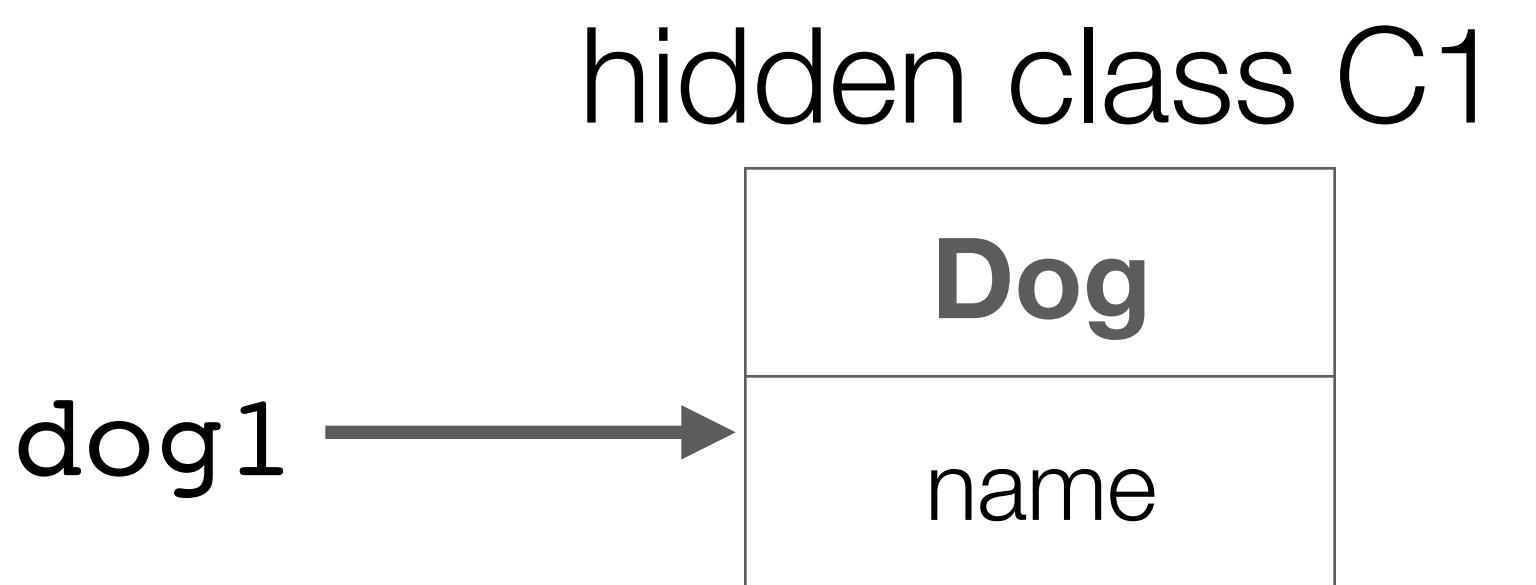
javascript

# Inline caching can be easily broken



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}  
  
var dog1 = new Dog('Jim');
```

javascript

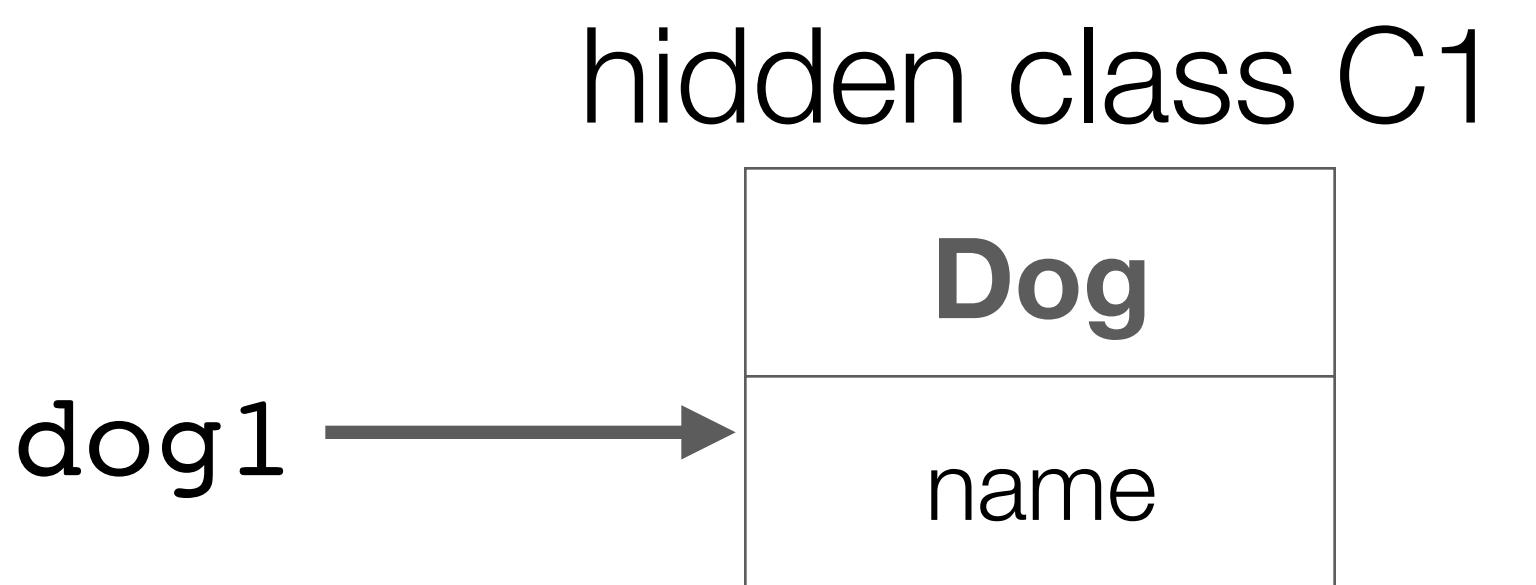


# Inline caching can be easily broken



```
function Dog(name) {  
    this.name = name;  
}  
  
var dog1 = new Dog('Jim');  
var dog2 = new Dog('Bin');
```

javascript

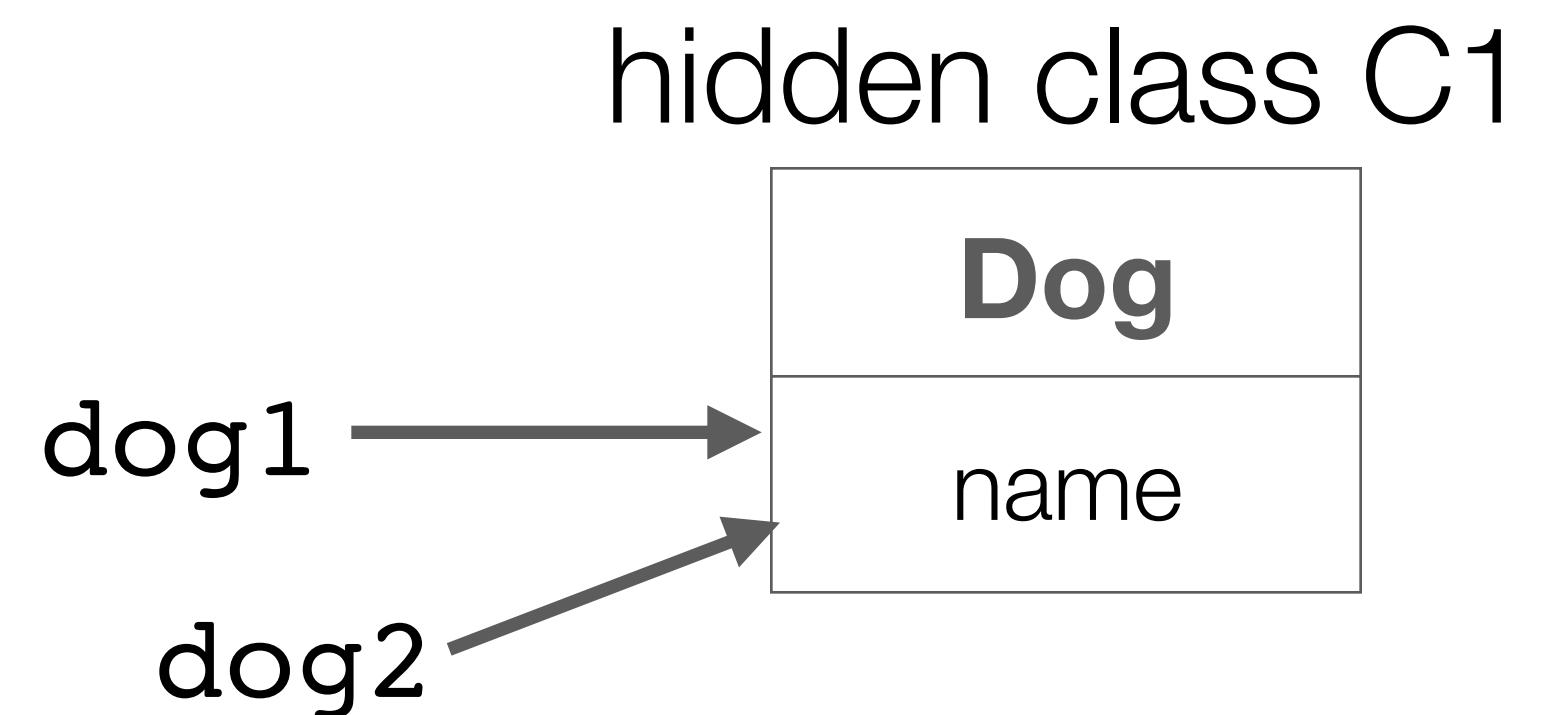


# Inline caching can be easily broken



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    this.name = name;  
}  
  
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var dog2 = new Dog('Bin');
```

javascript

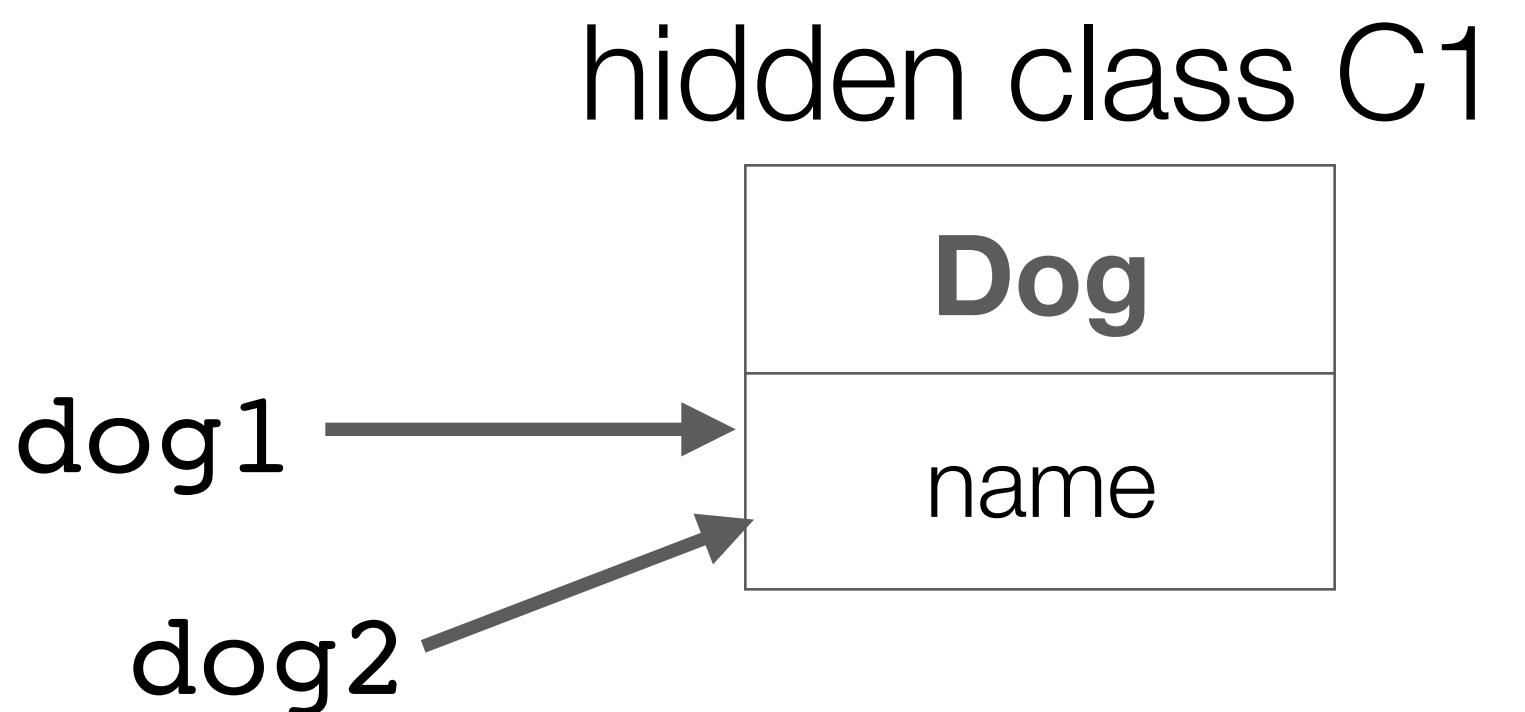


# Inline caching can be easily broken



```
function Dog(name) {  
    this.name = name;  
}  
  
var dog1 = new Dog('Jim');  
var dog2 = new Dog('Bin');  
dog2.breed = 'chihuahua';
```

javascript

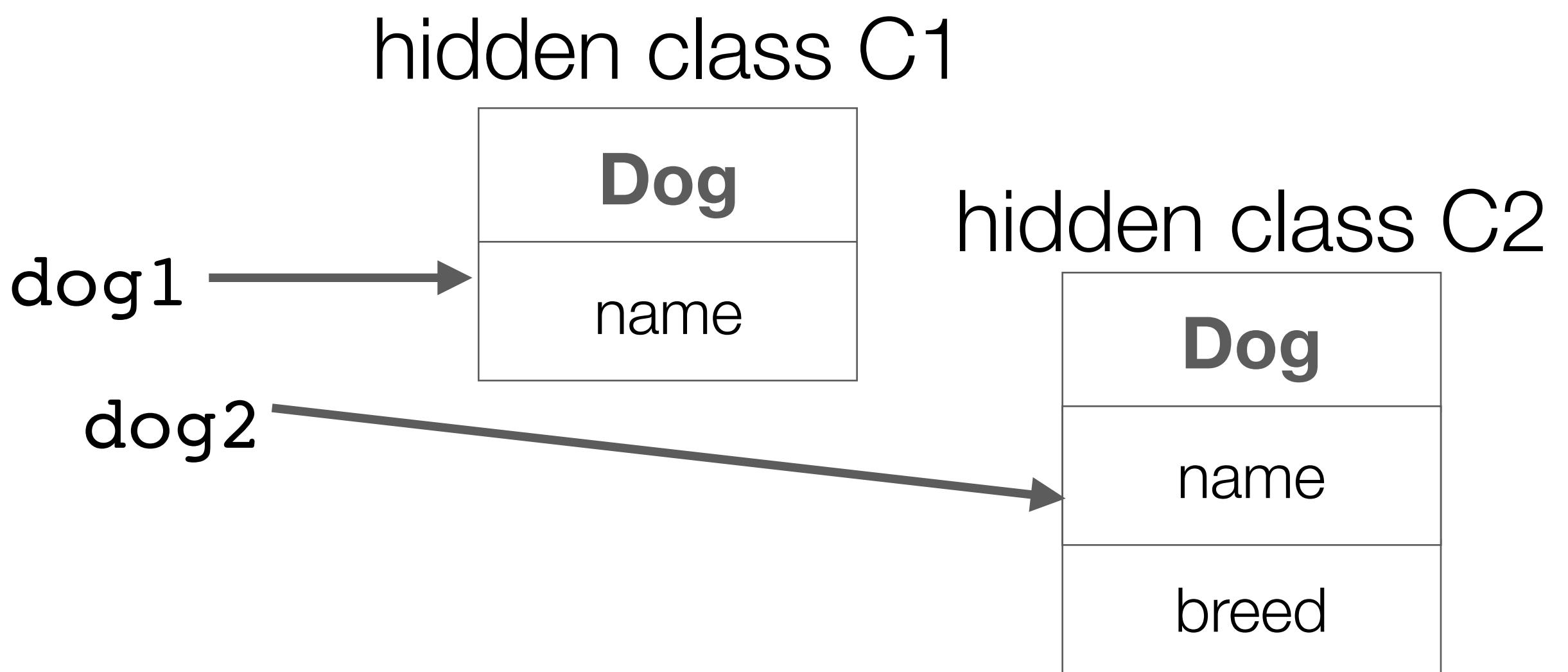


# Inline caching can be easily broken

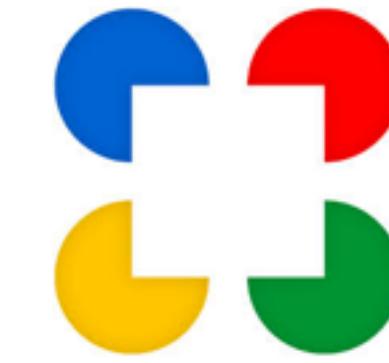


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    this.name = name;  
}  
  
var dog1 = new Dog('Jim');  
var dog2 = new Dog('Bin');  
dog2.breed = 'chihuahua';
```

javascript



# Compiler helps



*closure compiler*

- converts javascript to javascript

## TypeScript



- converts superset of javascript to javascript

- converts java to javascript

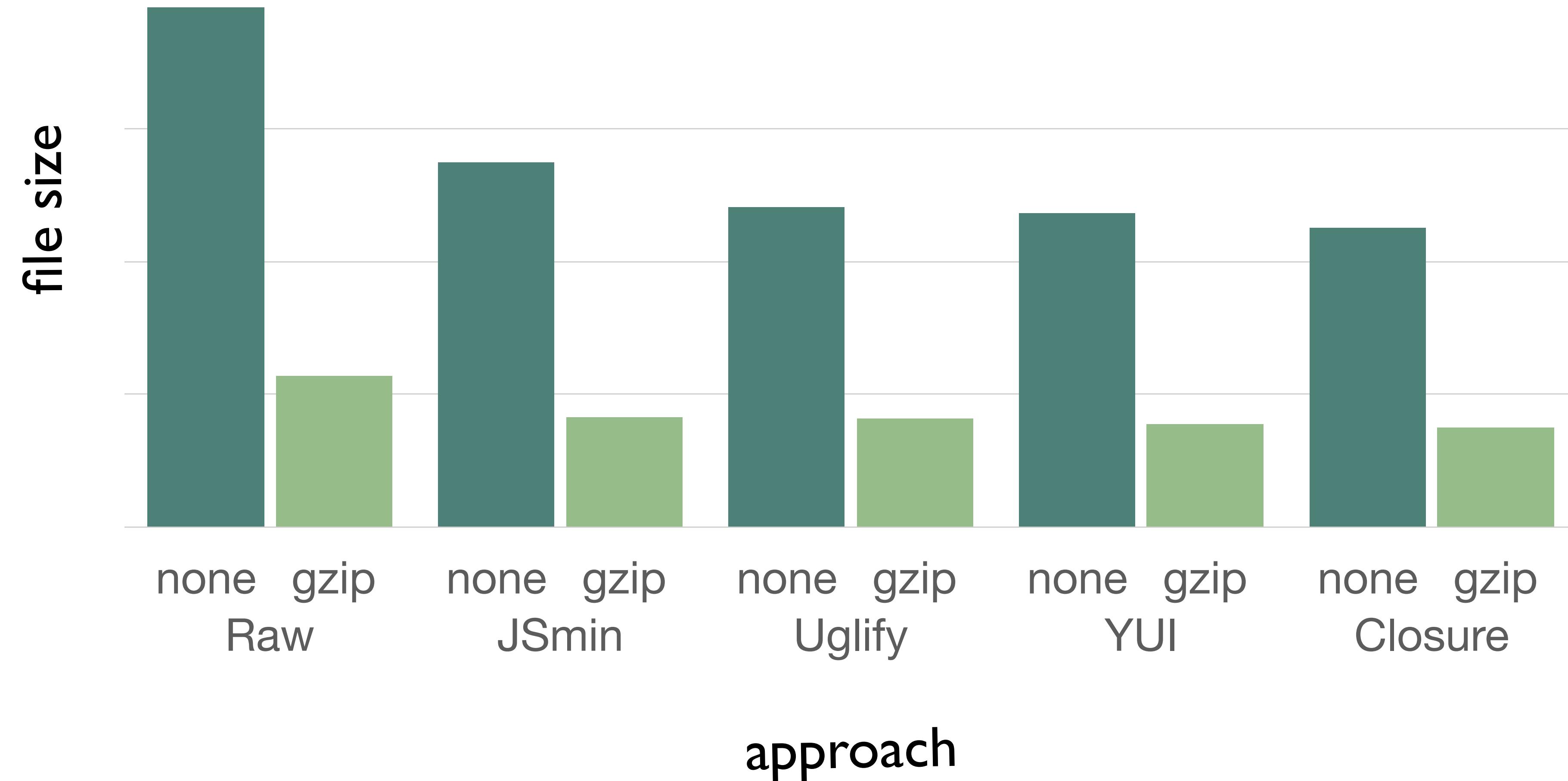
# Compiler helps



```
/**  
 * My class.  
 * @constructor  
 */  
function MyClass() {  
    /** @private {Array<string>} */  
    this.beers_ = [ ];  
}  
  
/** @const {string} */  
MyClass.MY_BEER = 'stout';  
  
/**  
 * @param {number} value Value to be added.  
 * @return {boolean} Whether operation succeed.  
 */  
MyClass.prototype.addValue = function(value) {  
    ...  
    return true;  
};
```

javascript

# Compiler helps



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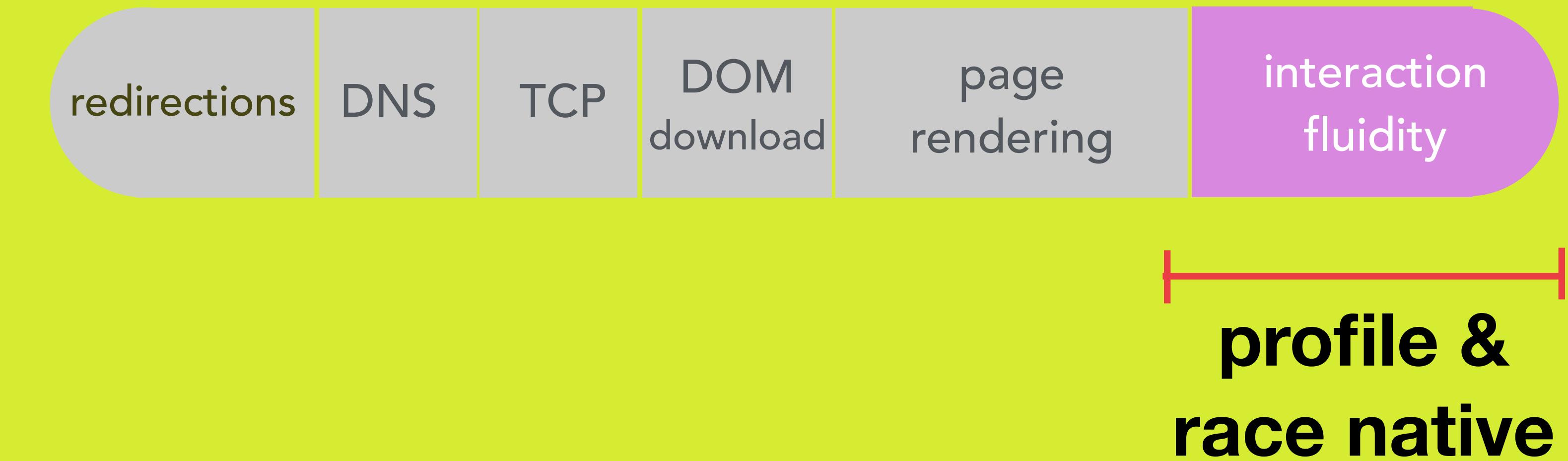
# Velocity

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[velocity.oreilly.com.cn](http://velocity.oreilly.com.cn)

#velocityconf



# Repaint/Reflow revisit

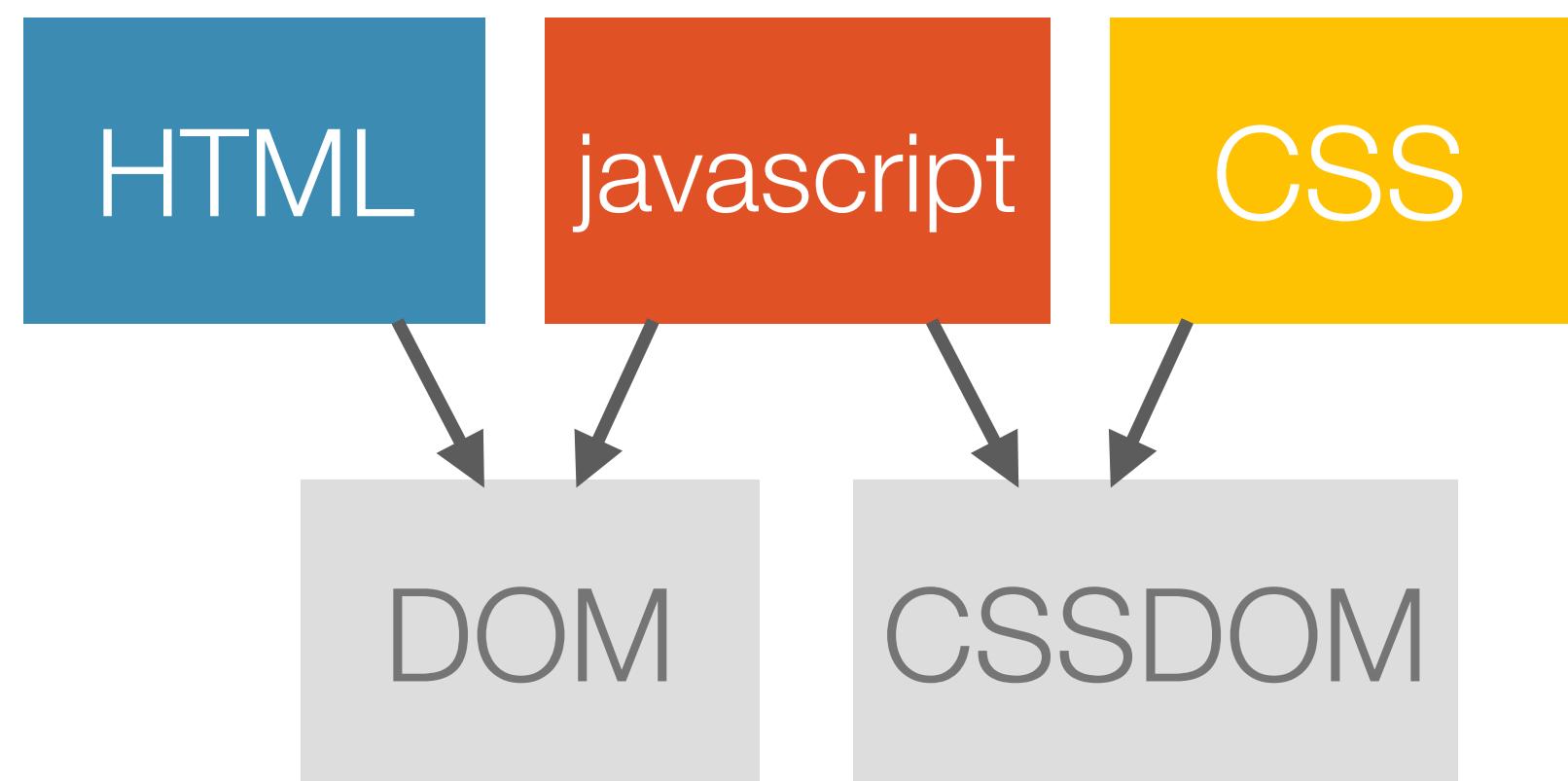
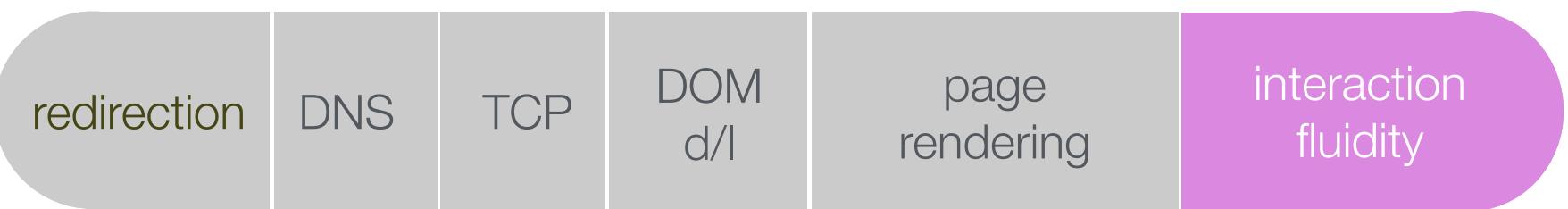


HTML

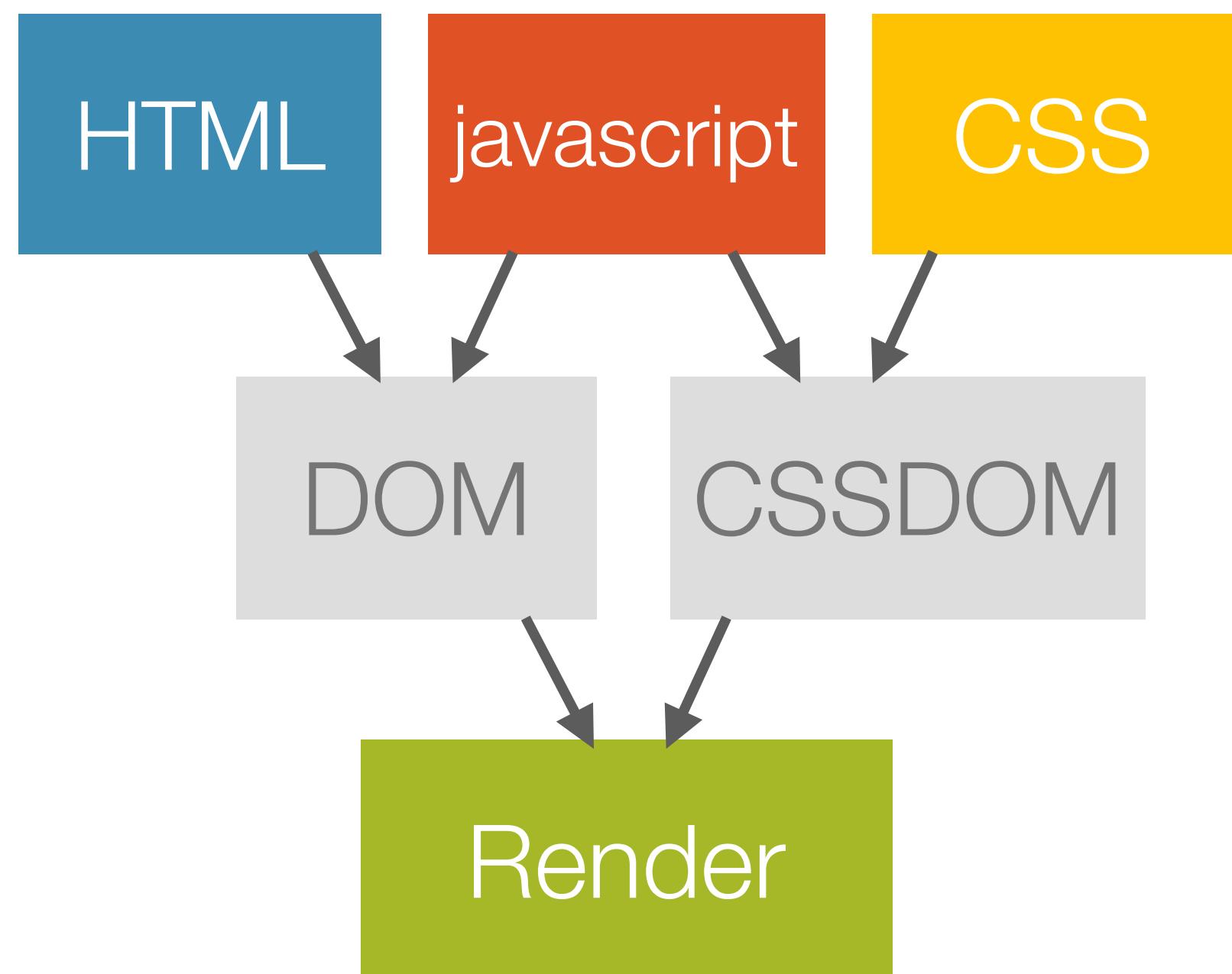
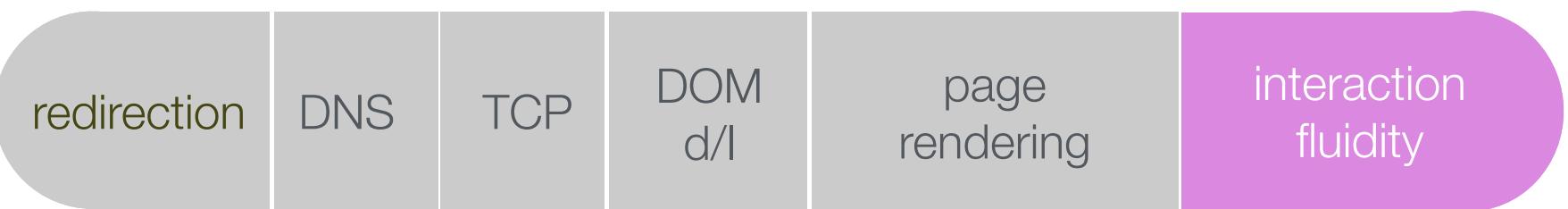
javascript

CSS

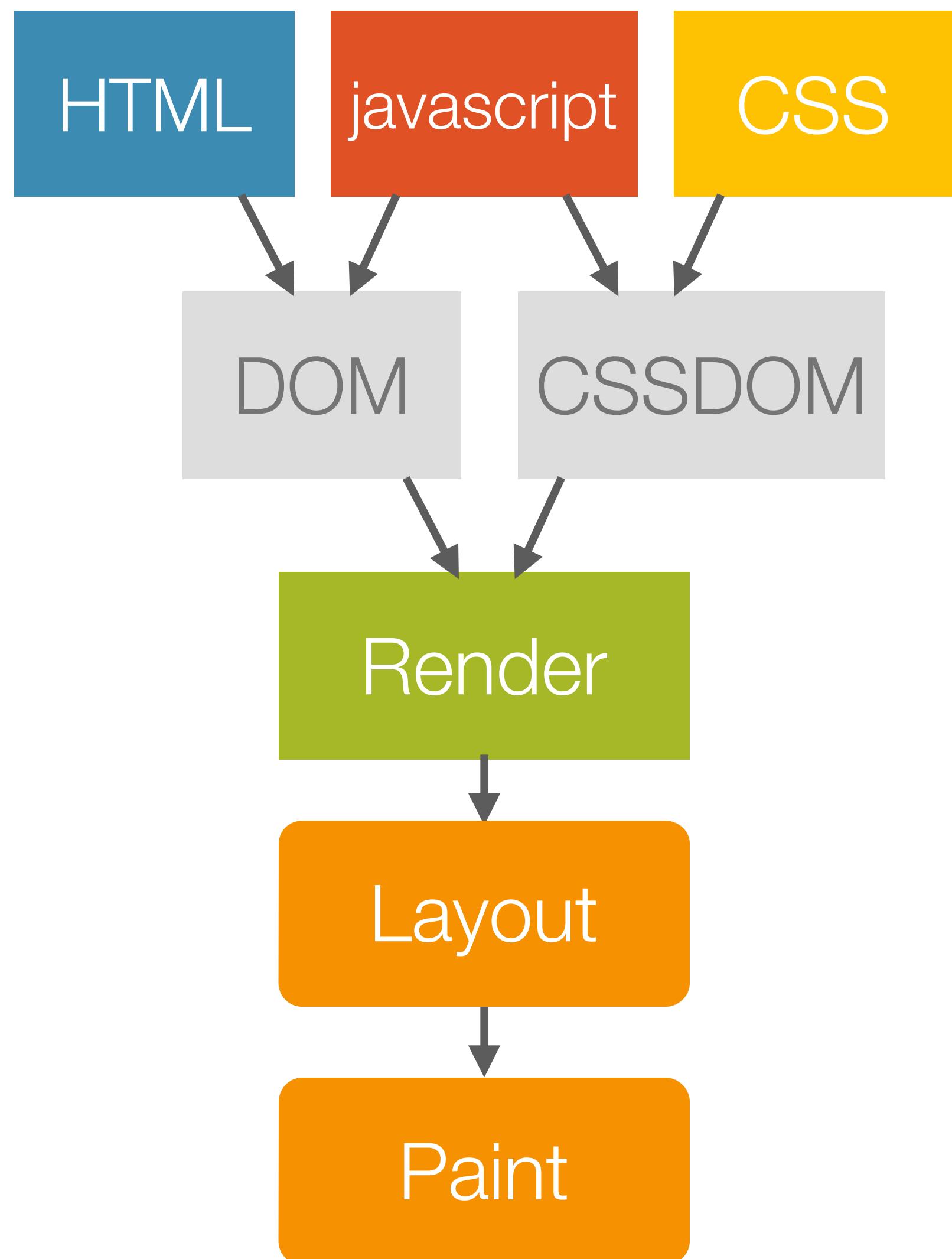
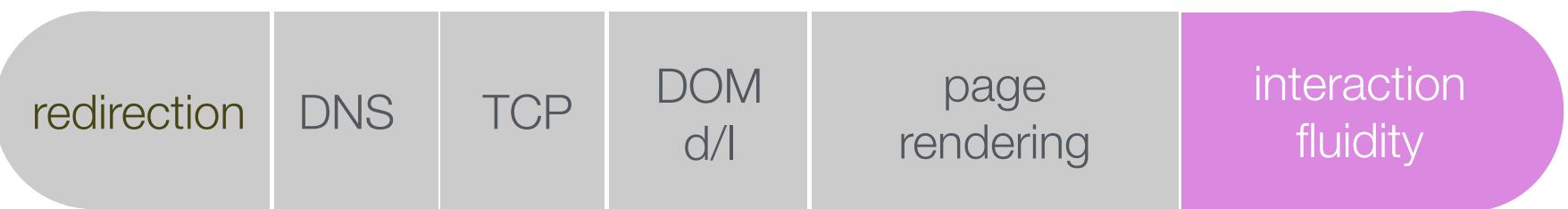
# Repaint/Reflow revisit



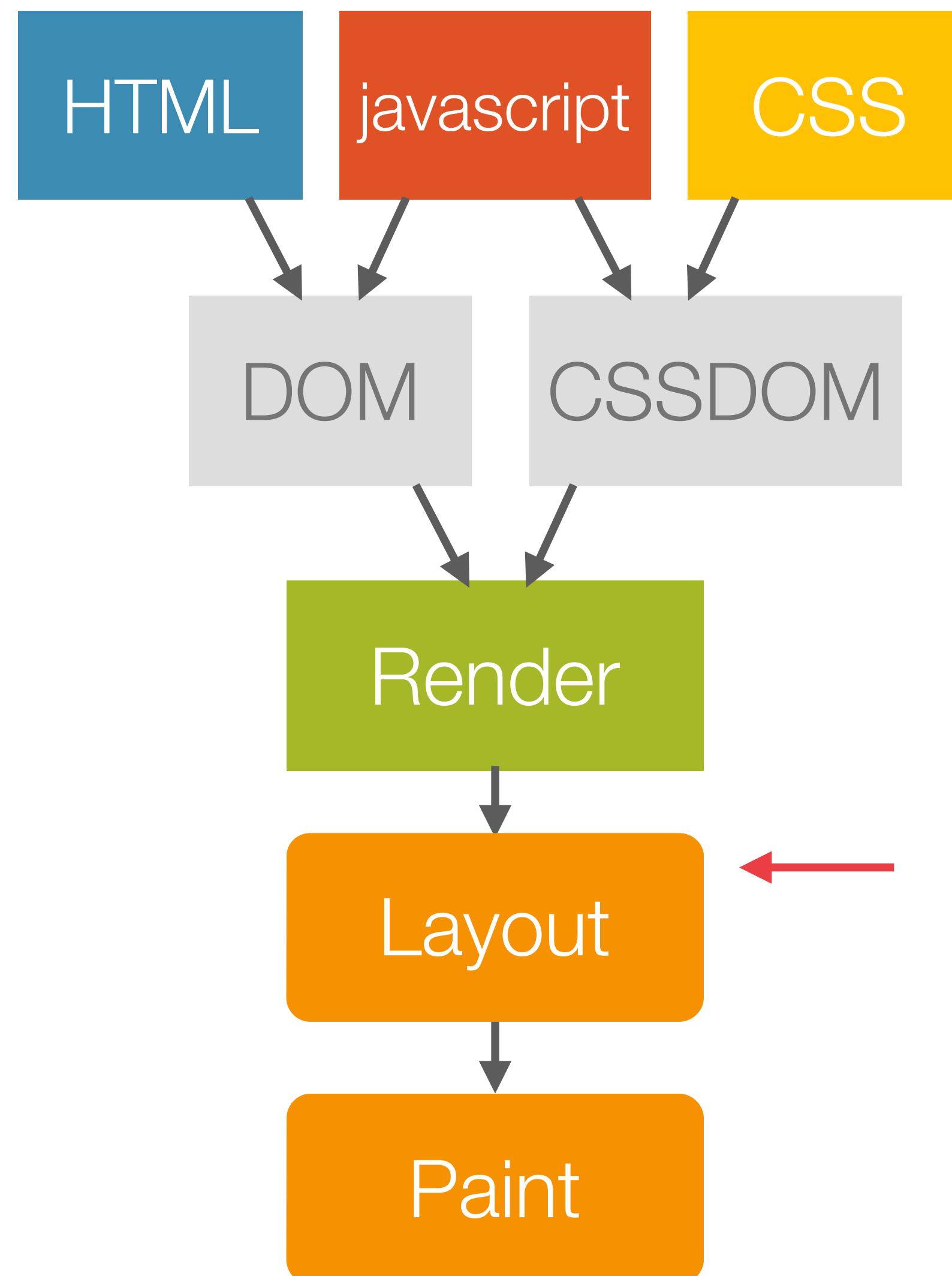
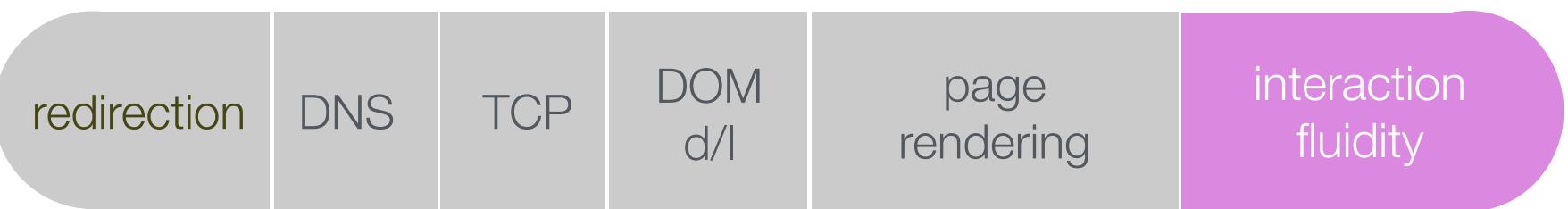
# Repaint/Reflow revisit



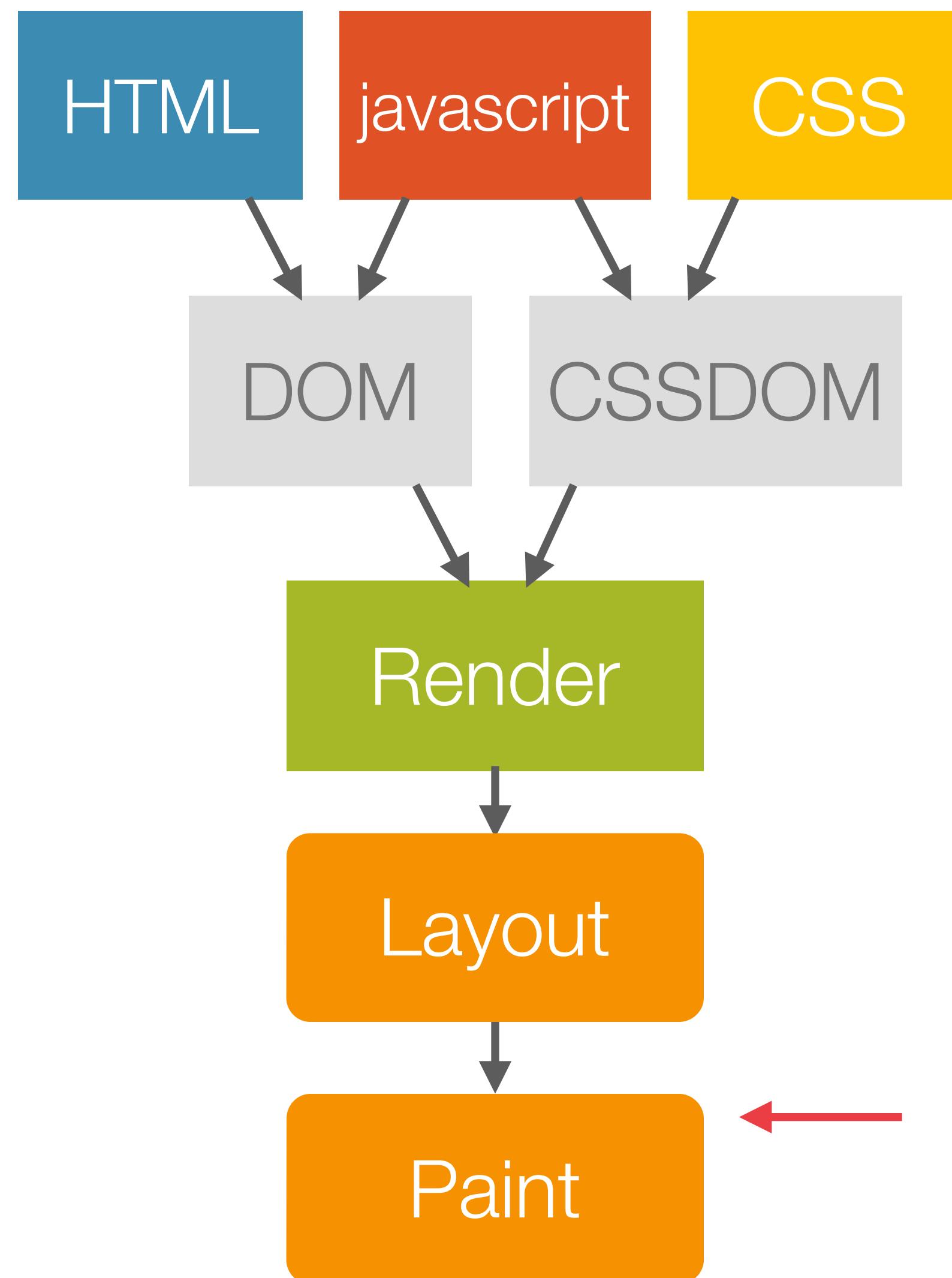
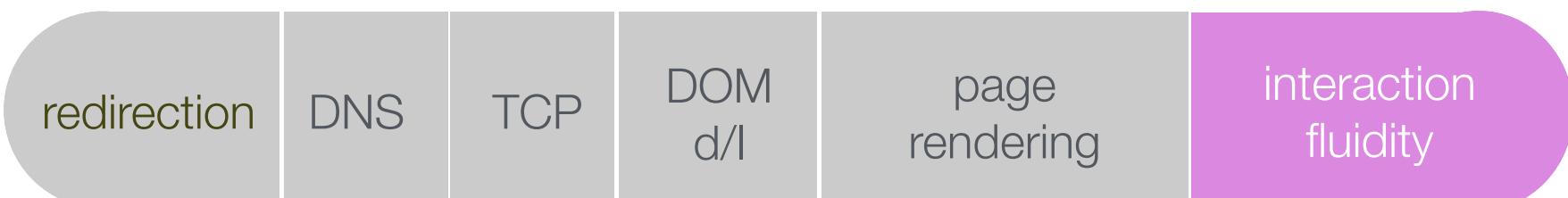
# Repaint/Reflow revisit



# Repaint/Reflow revisit



# Repaint/Reflow revisit



# Measure fps

redirection DNS TCP DOM d/l page rendering interaction fluidity

Device Google Nexus 6 Network

UA Mozilla/5.0 (Linux; Android 5.0; Nexus 6 Build/LYD13) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.132 Mobile Safari/537.36

View: Capture:  Stacks  Profile JS  Memory  Paint

30 fps 60 fps

RECORDS

1 2 3  
ABC DEF

4 5 6  
GHI JKL MNO

7 8 9  
PQRS TUV WXYZ

\*

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Summary Layers Paint Profiler

Range 0 -- -

Aggregated Time -

- Idle

# Measure fps

redirection DNS TCP DOM d/l page rendering interaction fluidity

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UA Mozilla/5.0 (Linux; Android 5.0; Nexus 6 Build/LYD13) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.132 Mobile Safari/537.36

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\*

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© 2015 Google

Summary Layers Paint Profiler

Range 0 -- -

Aggregated Time -

- Idle

# Measure fps

redirection DNS TCP DOM d/l page rendering interaction fluidity

The screenshot shows a mobile web application running on a Google Nexus 6 device. The application interface includes a navigation bar with 'Device' set to 'Google Nexus 6', a network status bar, and a main area with icons for Google+, Gmail, Voice, and Web. Below this is a numeric keypad and two large green buttons labeled 'Text' and 'Call'. At the bottom are links for 'Sign out', 'alvatest3@gmail.com', and 'Help', along with terms of service and copyright information.

The DevTools Timeline tab is active, displaying a timeline from 0 to 400 ms. Two horizontal bars represent frame rates: a red bar at the top labeled '30 fps' and a blue bar below it labeled '60 fps'. The timeline shows several vertical segments representing different tasks or frames. The bottom section of the DevTools interface is the Paint Profiler, which displays an 'Aggregated Time' chart with a single large light-gray circle representing the total time.

Timeline controls and settings are visible at the top of the DevTools window, including 'View' (grid, list), 'Capture' (checkboxes for Stacks, Profile JS, Memory, Paint), and a zoom scale from 0 to 400 ms.

# Measure fps on a real device

redirection

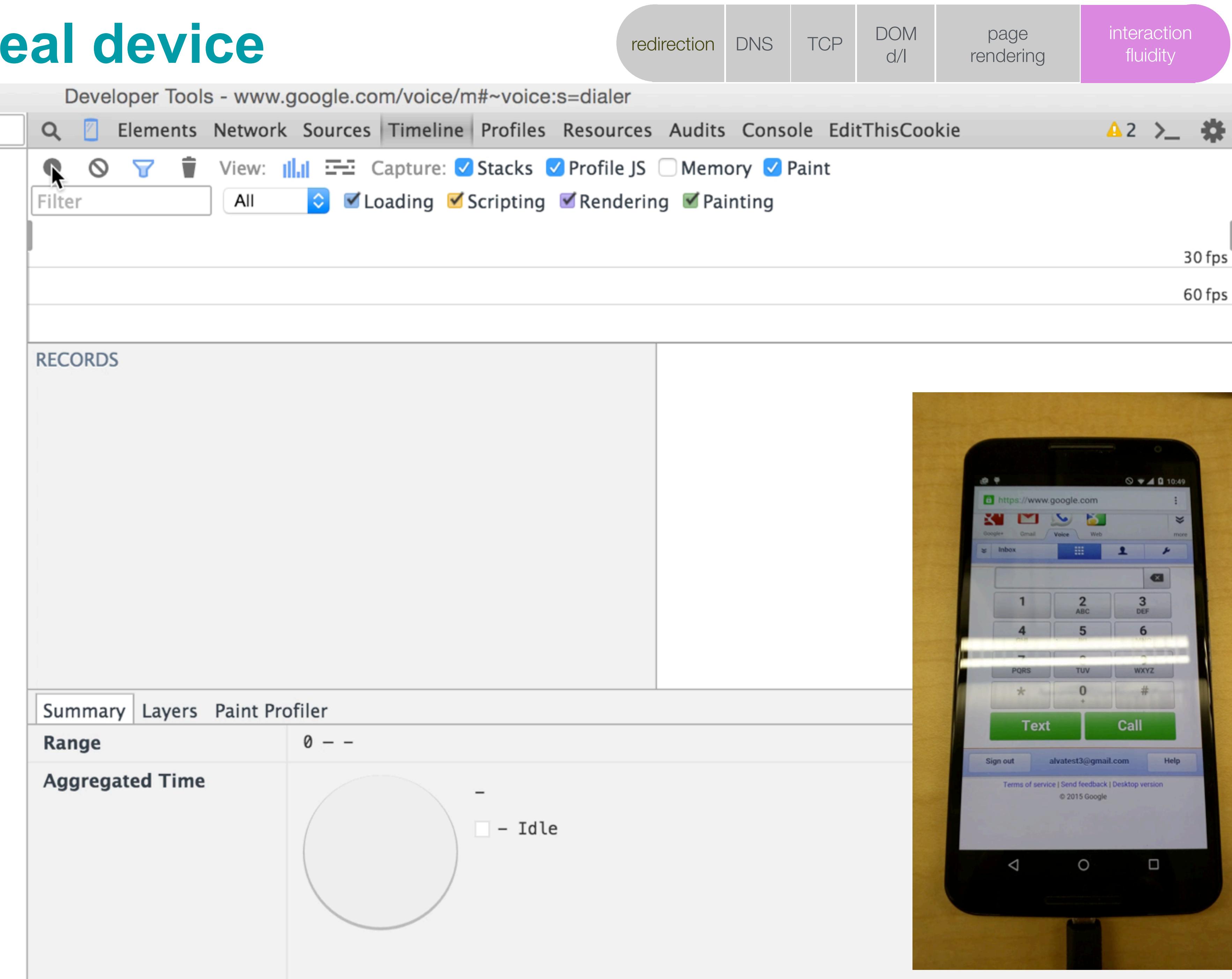
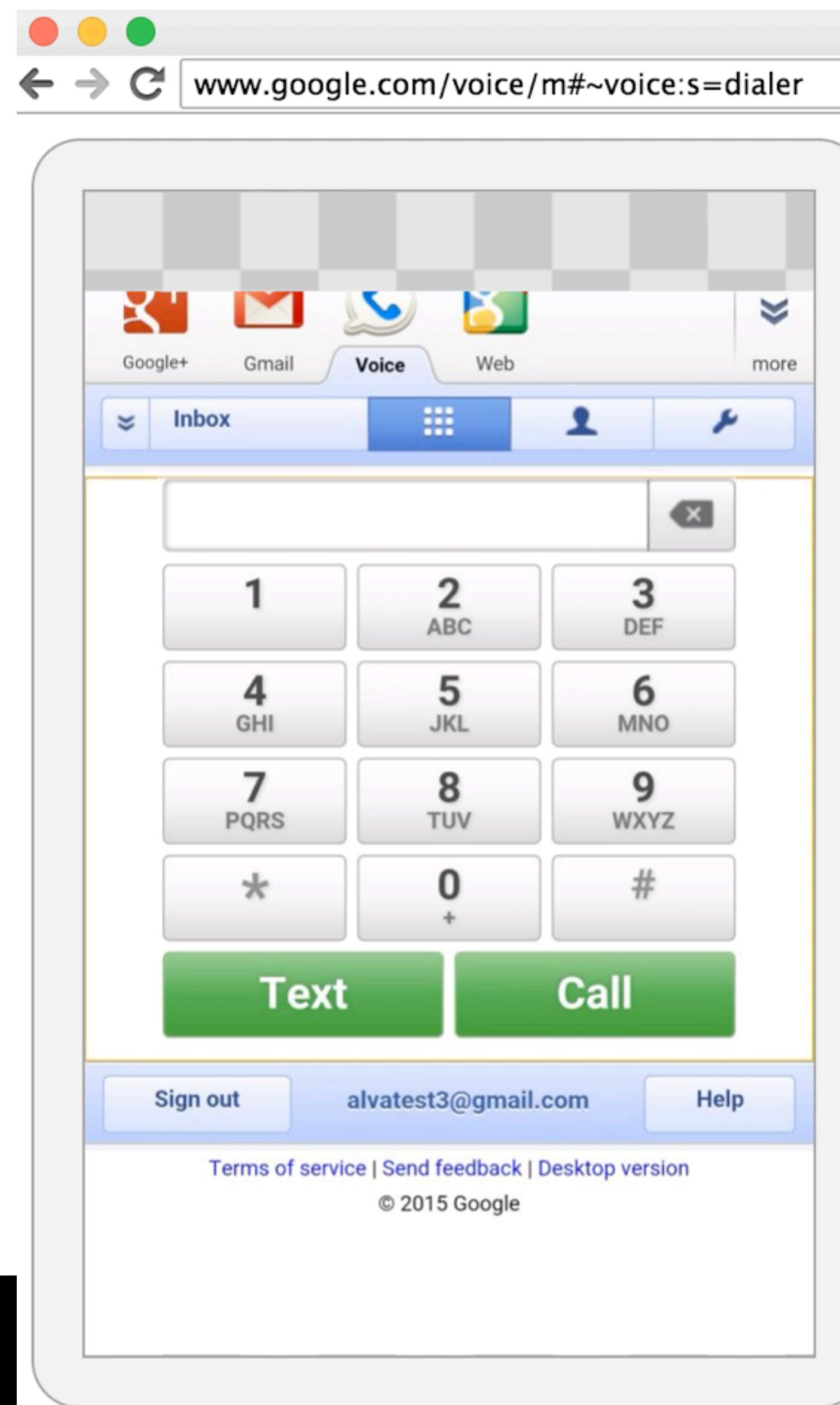
DNS

TCP

DOM  
d/l

page  
rendering

interaction  
fluidity



# Measure fps on a real device

redirection

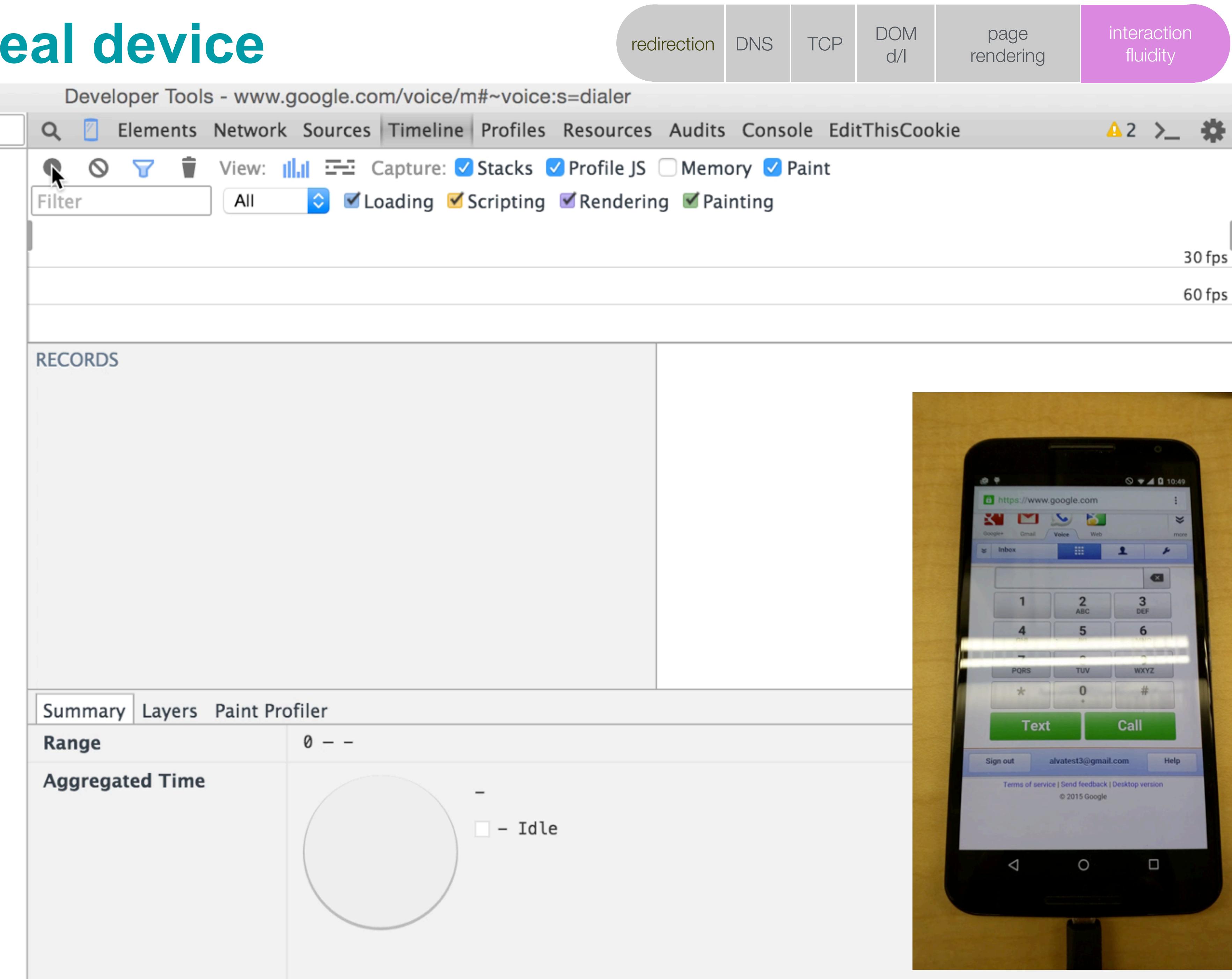
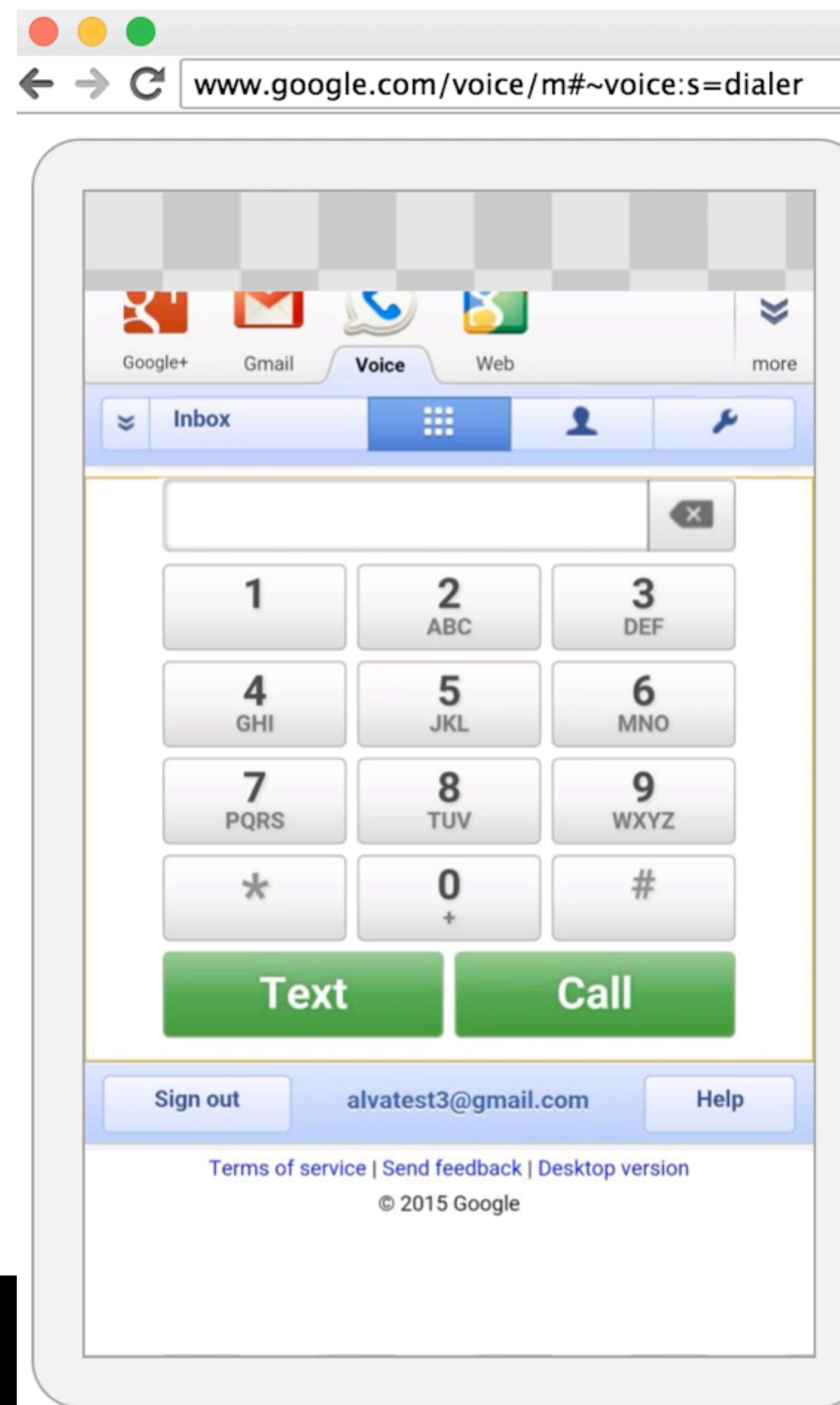
DNS

TCP

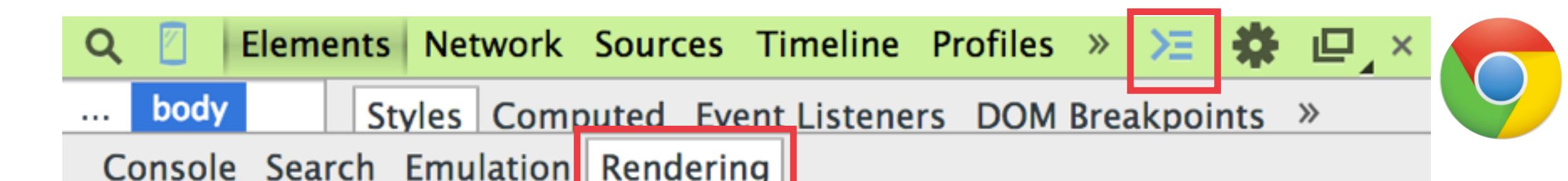
DOM  
d/l

page  
rendering

interaction  
fluidity



# Measure impact of repaint

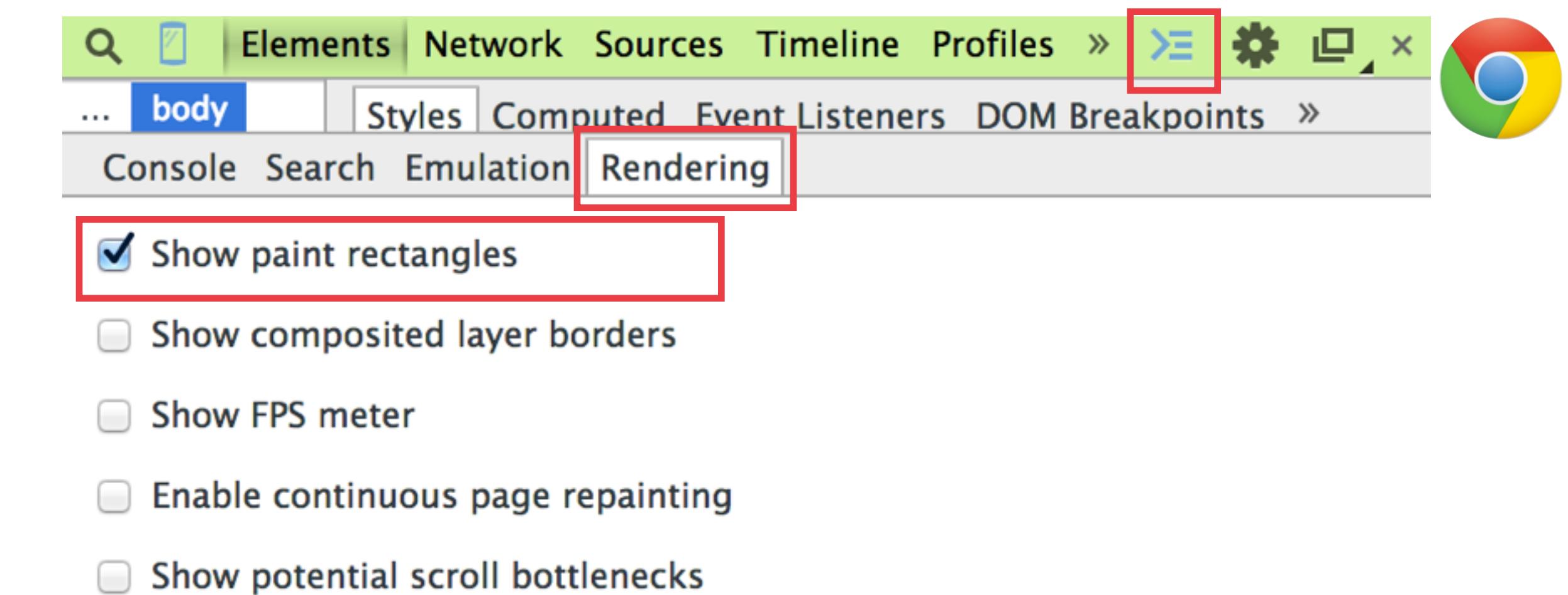
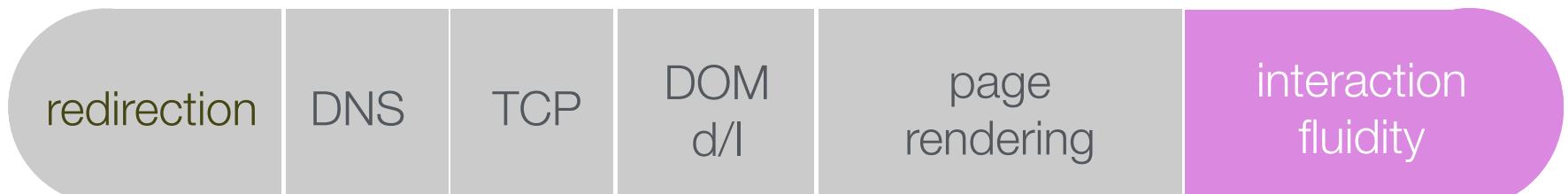


- Show paint rectangles
- Show composited layer borders
- Show FPS meter
- Enable continuous page repainting
- Show potential scroll bottlenecks

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Velocity

# Measure impact of repaint



# Event debouncing/throttling

redirection

DNS

TCP

DOM  
d/I

page  
rendering

interaction  
fluidity

```
function throttleEvent(callback, thres) {
  var lastTrigger = 0;
  var that = this;
  var deferTimer;
  return function() {
    var args = arguments;
    var currentTime = new Date().getTime();
    var remainingTime = thres - (currentTime - lastTrigger);
    if (remainingTime < 0) {
      lastTrigger = currentTime;
      clearTimeout(deferTimer);
      callback.apply(that, args);
    } else {
      // Only keep the latest event.
      clearTimeout(deferTimer);
      deferTimer = setTimeout(function() {
        callback.apply(that, args)
      }, remainingTime);
    }
  }
}
document.addEventListener('scroll', throttleEvent(callback, 100));
```

javascript

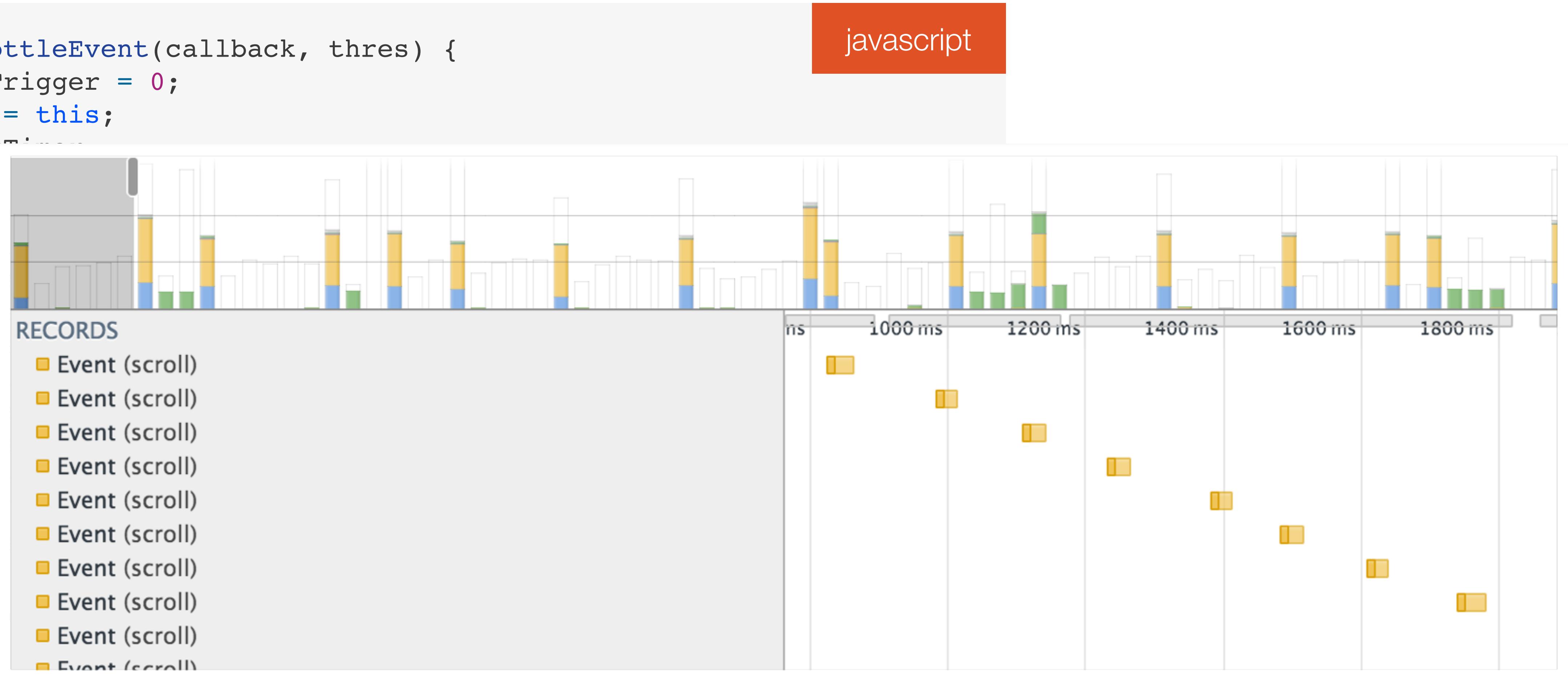
# Event debouncing/throttling



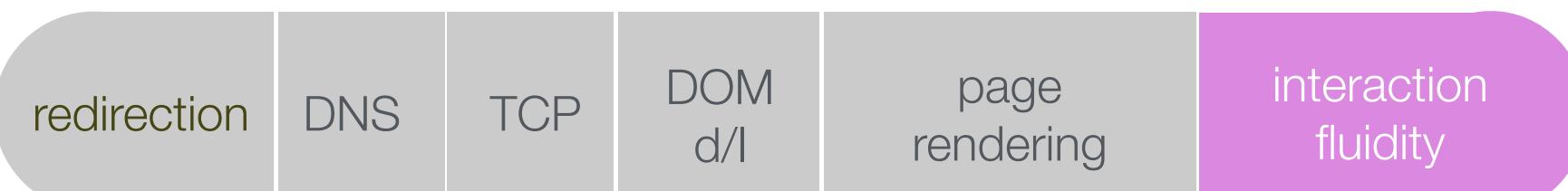
The figure displays a developer's workspace. On the left, a code editor window shows a JavaScript function named `throttleEvent`. The function uses a debouncing technique to limit scroll event callbacks. It maintains a `lastTrigger` timestamp, a `that` reference to the current object, and a `defer` variable. It returns a function that checks if the scroll event has occurred since the last trigger. If it has, it triggers the callback and updates the `lastTrigger` timestamp. Otherwise, it defers the execution of the callback. The timeline on the right shows the execution of this function over time, with many scroll events (represented by orange bars) being processed by the throttled function (represented by blue bars).

```
function throttleEvent(callback, thres) {
  var lastTrigger = 0;
  var that = this;
  var defer = false;
  return function() {
    var a = arguments;
    var c = new Date();
    var r = c - lastTrigger;
    if (r < thres) {
      if (defer) {
        defer();
      } else {
        /...
        /...
      }
    }
  }
}

document.addEventListener('scroll', throttleEvent(callback, 100));
```

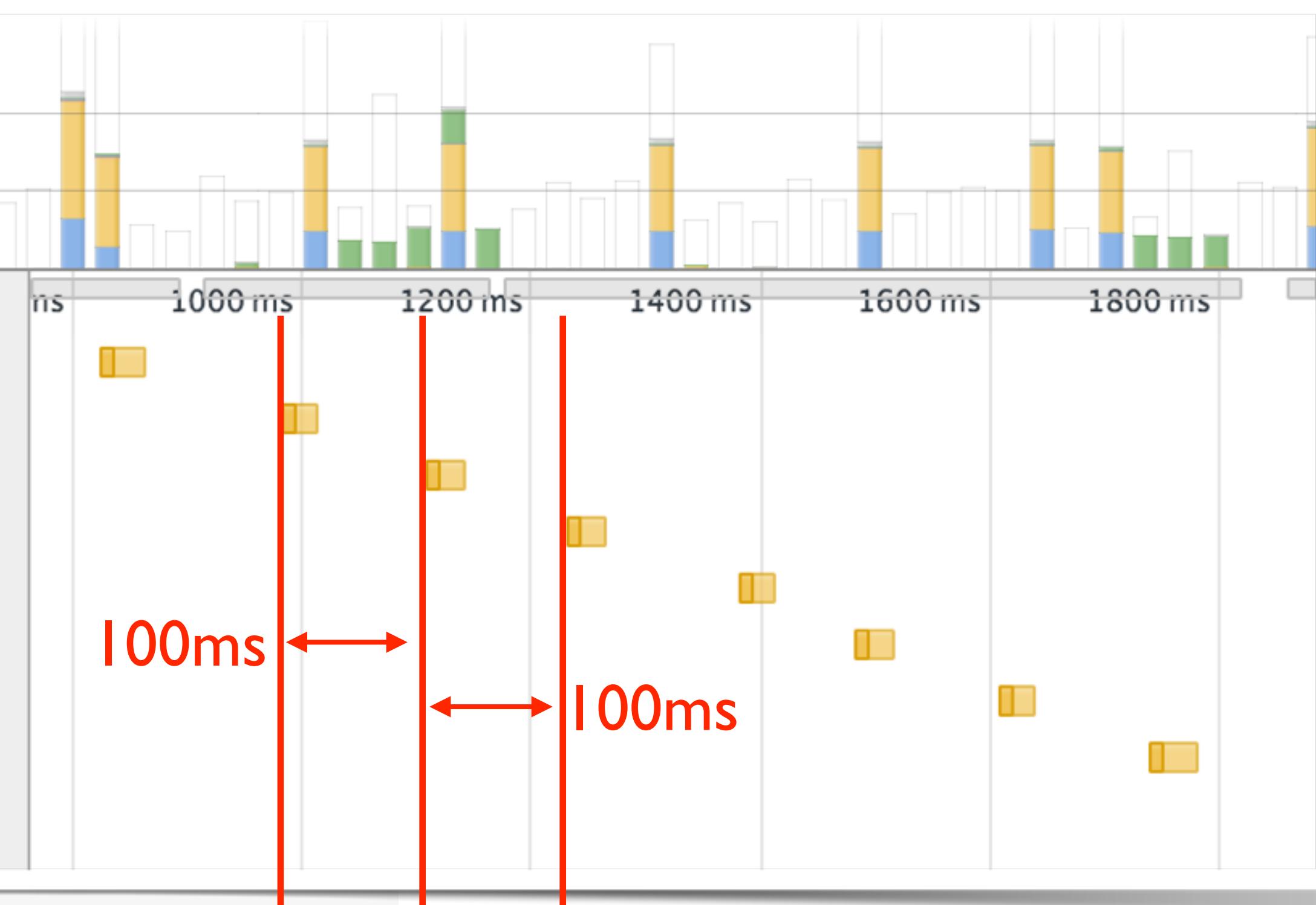


# Event debouncing/throttling

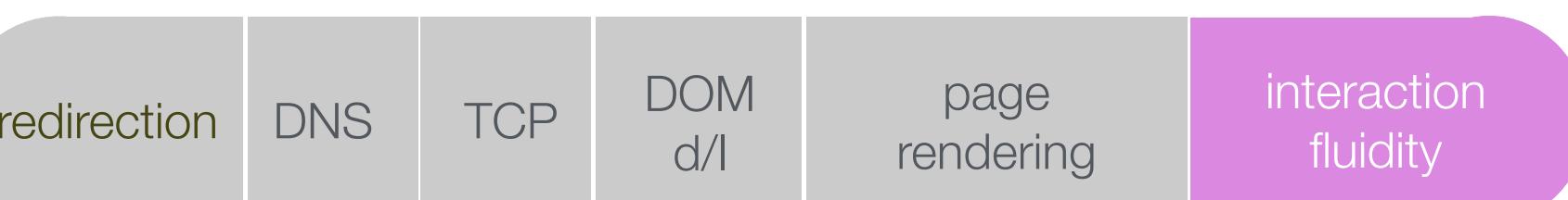


```
function throttleEvent(callback, thres) {  
  var lastTrigger = 0;  
  var that = this;  
  var defer = false;  
  return function(...args) {  
    var a = args[0];  
    var c = args[1];  
    var r = args[2];  
    if (r === undefined) {  
      a = c;  
      c = r;  
    } else if (c === undefined) {  
      a = r;  
    }  
    if (lastTrigger + thres < Date.now()) {  
      if (defer) {  
        defer();  
      }  
      defer = true;  
      callback(...args);  
    }  
  };  
}  
  
document.addEventListener('scroll', throttleEvent(callback, 100));
```

javascript



# Use the DOM change queue



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

javascript

# Use the DOM change queue



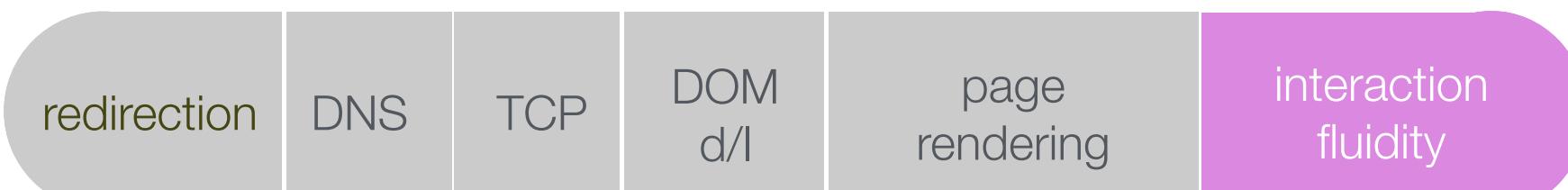
```
$div = $('#content');
elements = ['a','b','c','d'];
for (var i=0,j=elements.length; i<j; i++){
    $div.append(elements[i]);
}
```

javascript

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

javascript

# Use the DOM change queue



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

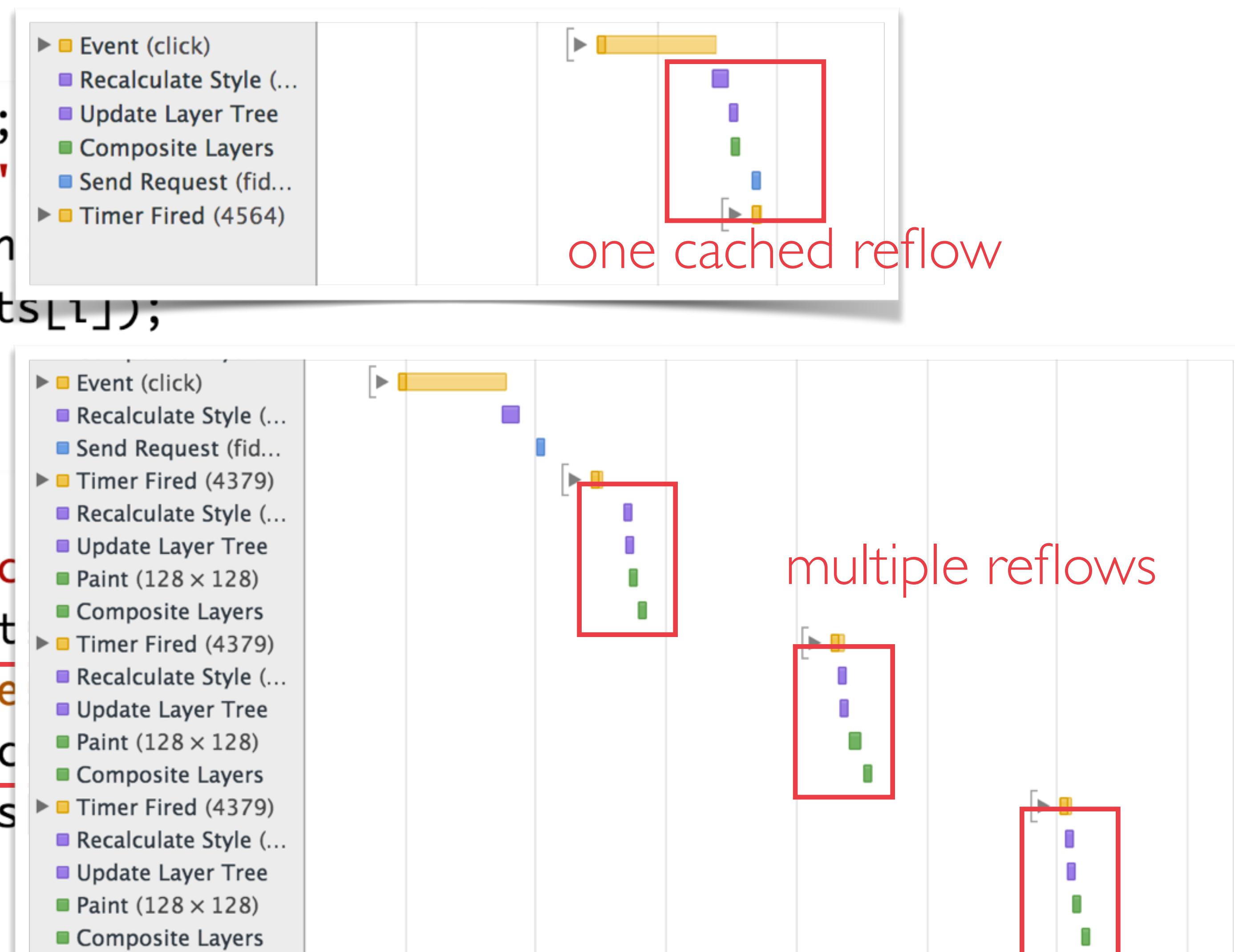
```
$div = $('#content');
elements = ['a','b','c'];
for (var i=0,j=elements.length; i < j; i++) {
    //one line of evilness
    var a = $(window).scrollTop();
    $div.append(elements[i]);
}
```



# Use the DOM change queue

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

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



# Distract users from noticing slowness



#velocityconf

O'REILLY®  
Velocity

# Distract users from noticing slowness

redirection

DNS

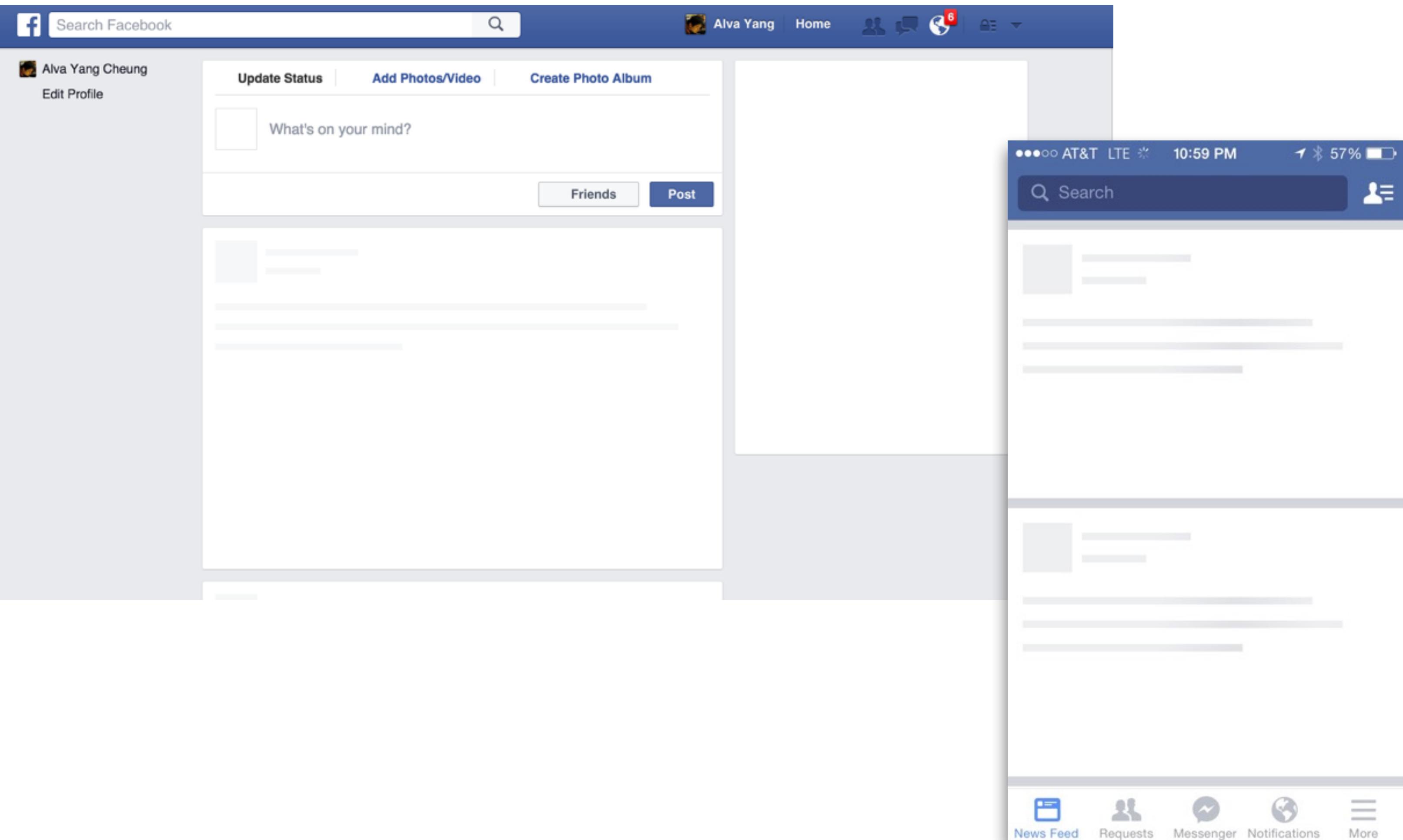
TCP

DOM  
d/I

page  
rendering

interaction  
fluidity

## ■ Placeholders



# Distract users from noticing slowness

redirection

DNS

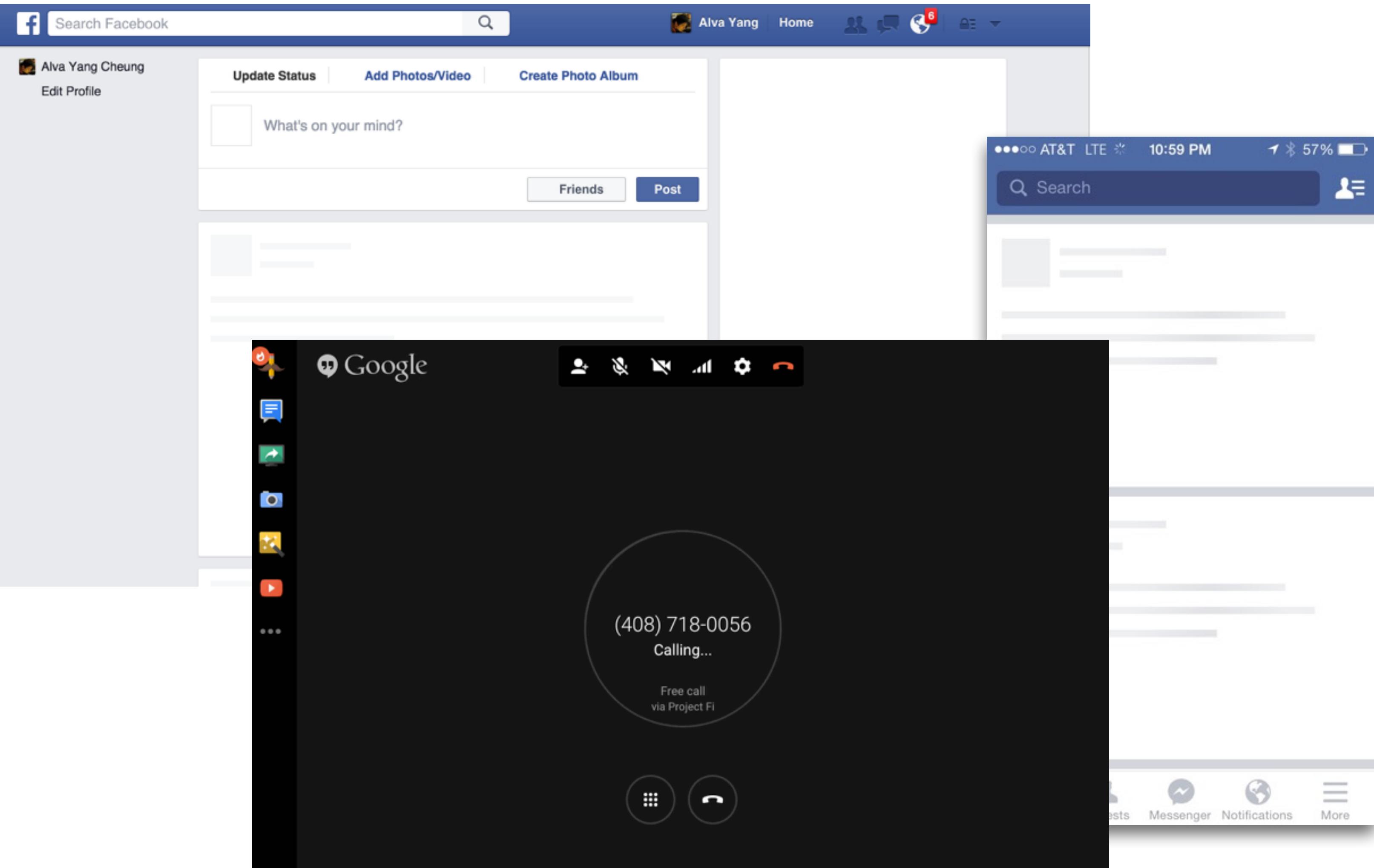
TCP

DOM  
d/I

page  
rendering

interaction  
fluidity

- Placeholders
- Animations



# Distract users from noticing slowness

redirection

DNS

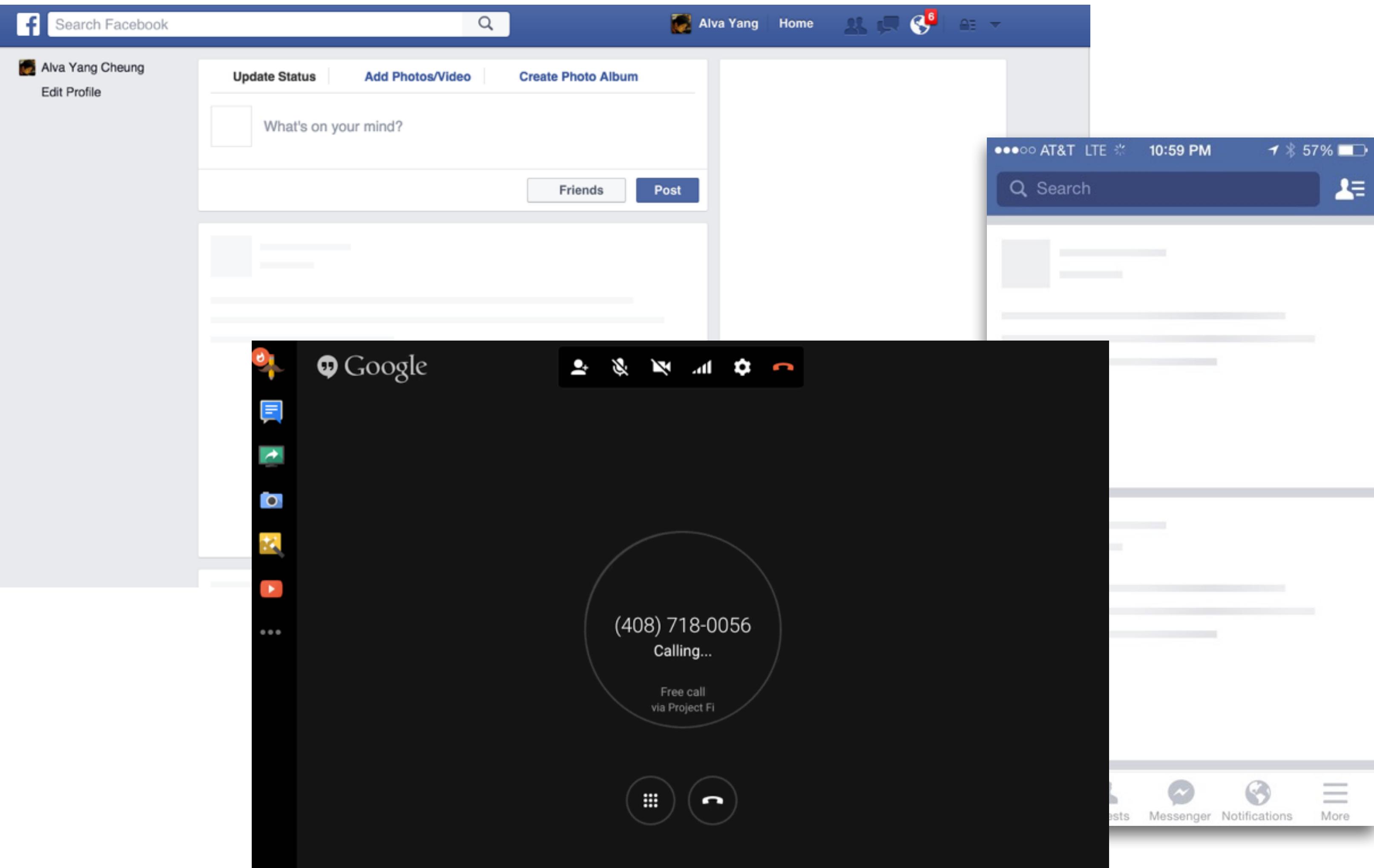
TCP

DOM  
d/I

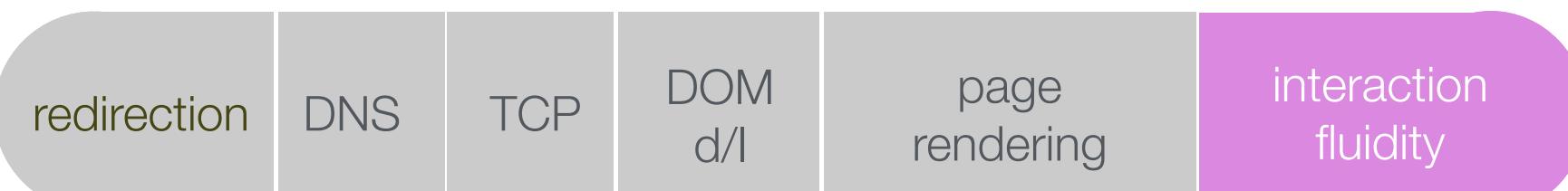
page  
rendering

interaction  
fluidity

- Placeholders
- Animations
- Partial loading



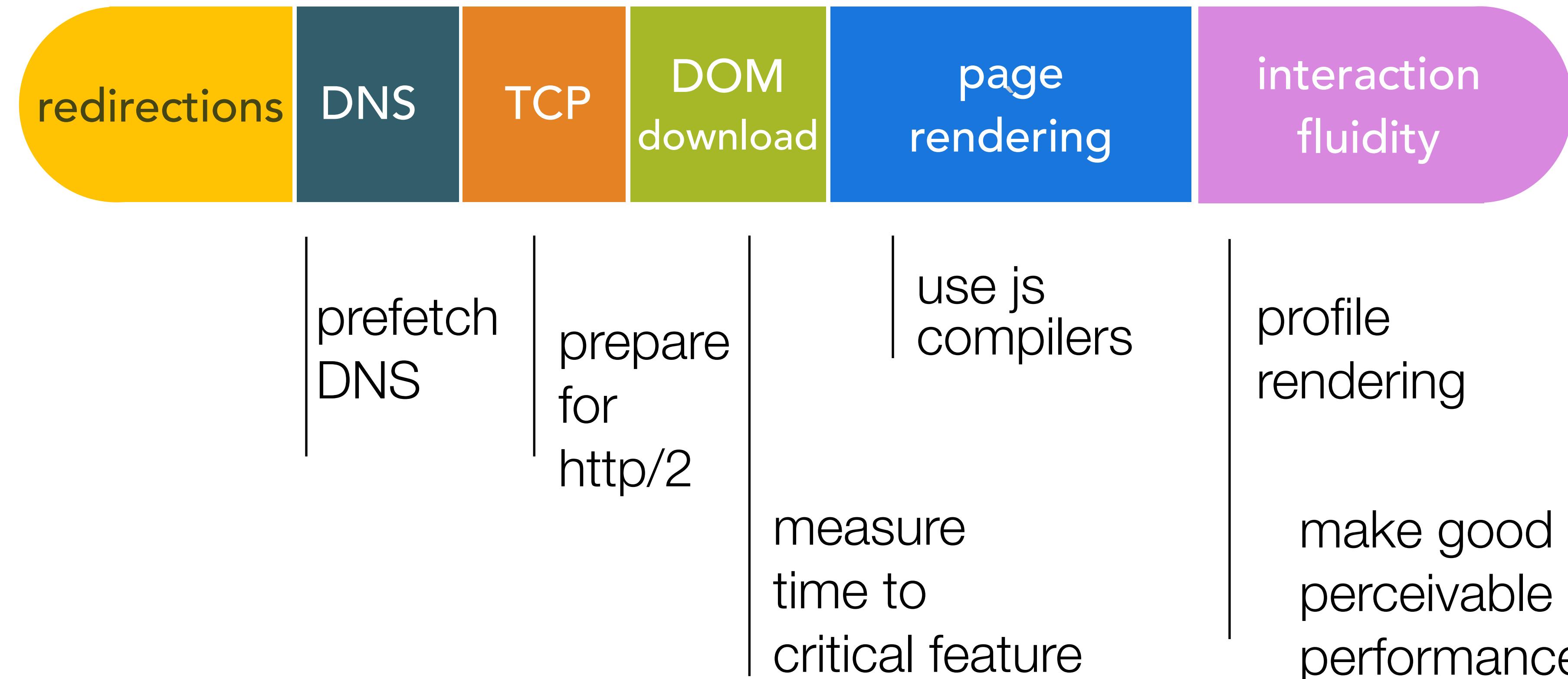
# Prepare to get offline



- navigator.onLine
- “Add to home screen” + Service worker
- Push API



# Try these!



Alva Cheung

slides: <http://tinyurl.com/alva-v2015-happy>

#velocityconf

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