



Massive, Global, Mobile, WIFI, and RUM

How eBay and PayPal Measure and Improve Site Speed

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The eBay Inc. Portfolio





Performance Management at eBay MarketPlace

Raja

Works With
Internal Teams:

- Prepare For CDN
- Tune Internal Ops For CDN

Manages **Internal**
Development Of
Real User Metrics
Performance
Measurement
Tools

Steve

Works With
External CDN
Vendors And
Deploys CDN
Configurations

Manages **External**
Synthetic
Performance
Measurement
Tools



Massive, Global, Mobile, WIFI, and RUM

Massive

- Many Billions Of Hits Per Day

Global

- From Just About Every Country- With Non-USA Business Same Size As USA Business- But Growing Quickly

Mobile

- “Mobile First” Company- App Volumes Already Substantial Part Of Our Business And Also Trending Upward

WIFI

- Wireless Broadband Devices Such As Tablets, Smart TVs, And Digital Signage Stores All Part Of Our Strategy

RUM

- We Develop Our Own Real User Metrics That Can Handle Our Measurement Needs At Our Scale



Performance Measurement – Three Main Types

Synthetic testing (ThousandEyes, Catchpoint, Keynote, etc)

- Waterfall chart
- Small numbers of agents
- Powerful for network measurements and triage
- Small sample size = not ideal
- CDN cache proximity to agents can distort results

Real User Metrics Are 100% Accurate But

- No waterfall chart
- Generate massive data
- Not in use by every client app

Log Analysis

- Best solution if you have storage/CPU

Best Practice: Use Everything

- TRIANGULATE AND INTERPRET from all methods

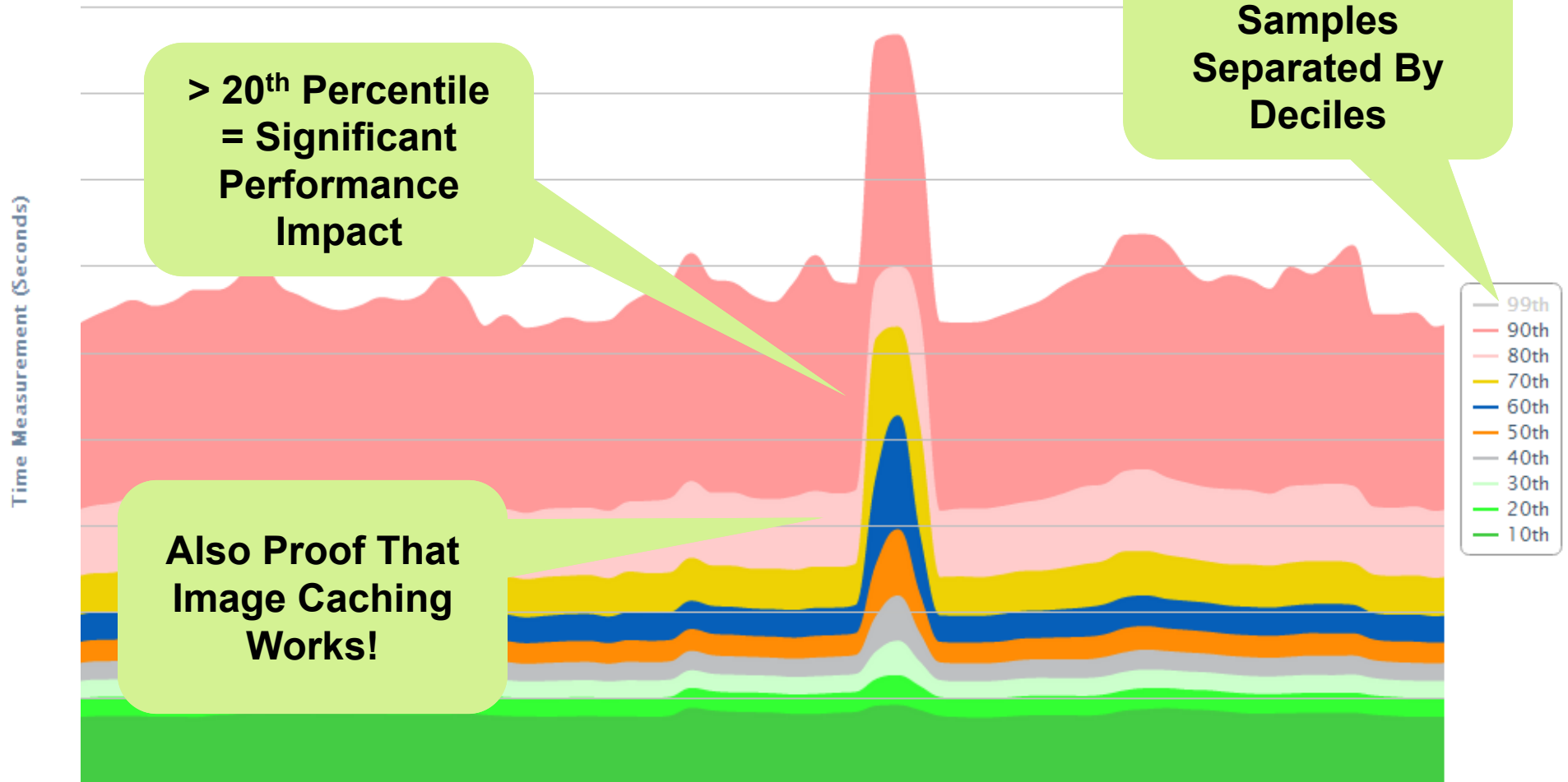


Measuring Performance: View Of A Catastrophic Failure



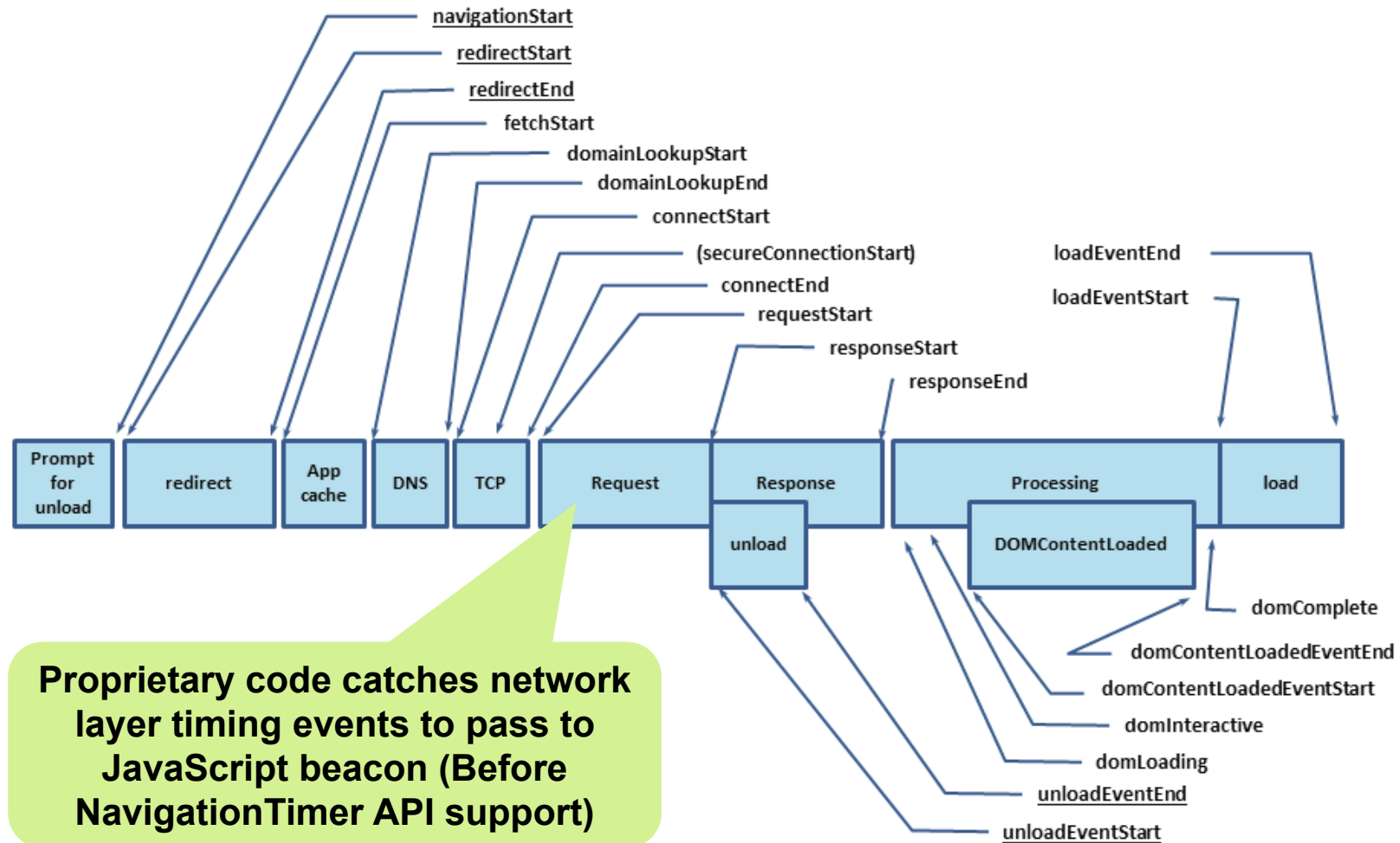


Measuring Performance: Catastrophic Failure Impact From Site Speed Gauge





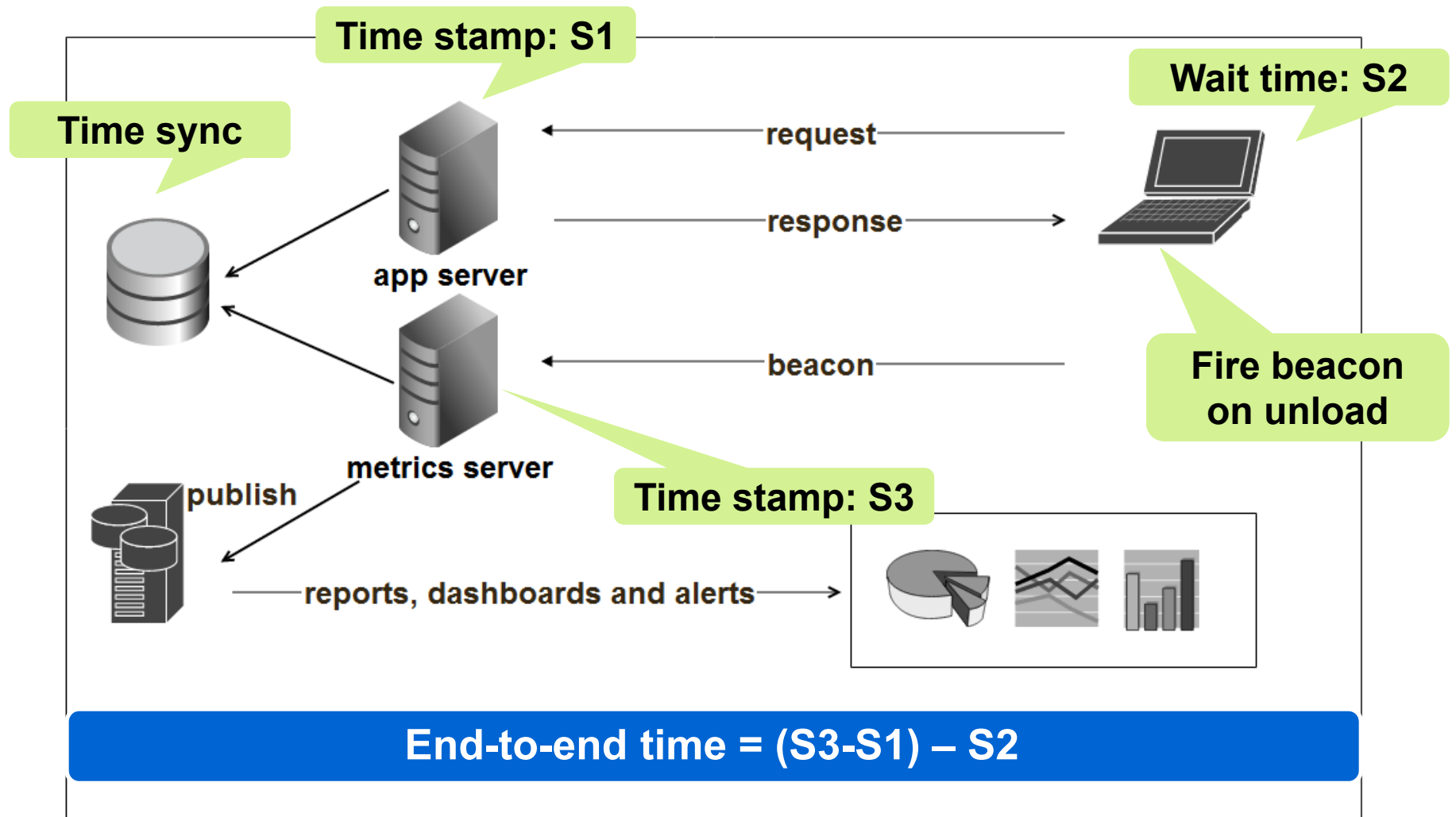
Visualization of Web Page Timing Elements



Event Graph Source: <https://dvcs.w3.org/hg/webperf/raw-file/tip/specs/NavigationTiming/Overview.html>



High Level RUM Design





Adding RUM To Pages: Easy!

```
<%@ taglib prefix="r" uri=...%>
<html>
  <head>
    <r:RUMTop/>
    ....
  </head>
  <body>
    ...
    <r:RUMBottom/>
  </body>
</html>
```

Limit Data Volume

Default Sampling (X%)

Sampling Can Be Customized @

- **Page**
- **Experiment**
- **Pool Or Box**



eBay Timing API

Supports All Browsers

Total Server Side Time

Fine Granular Server Side Visibility

- **Services End-to-end Time**
- **HTML Markup Generation Time**
- **Fragments Generation Time**

Fine Granular Client Side Visibility

- **Document Ready**
- **On Load**
- **Dwell Time (On Load To Un Load)**
- **AJAX Calls End-to-end Time**
- **Total Ads (Iframes) End-to-end Time**
- **Individual Ads End-to-end Time**
- **Fragments Load Time**

Custom Timers



Ads: The Little Things That Cause Total Obliteration And Lots Of Revenue

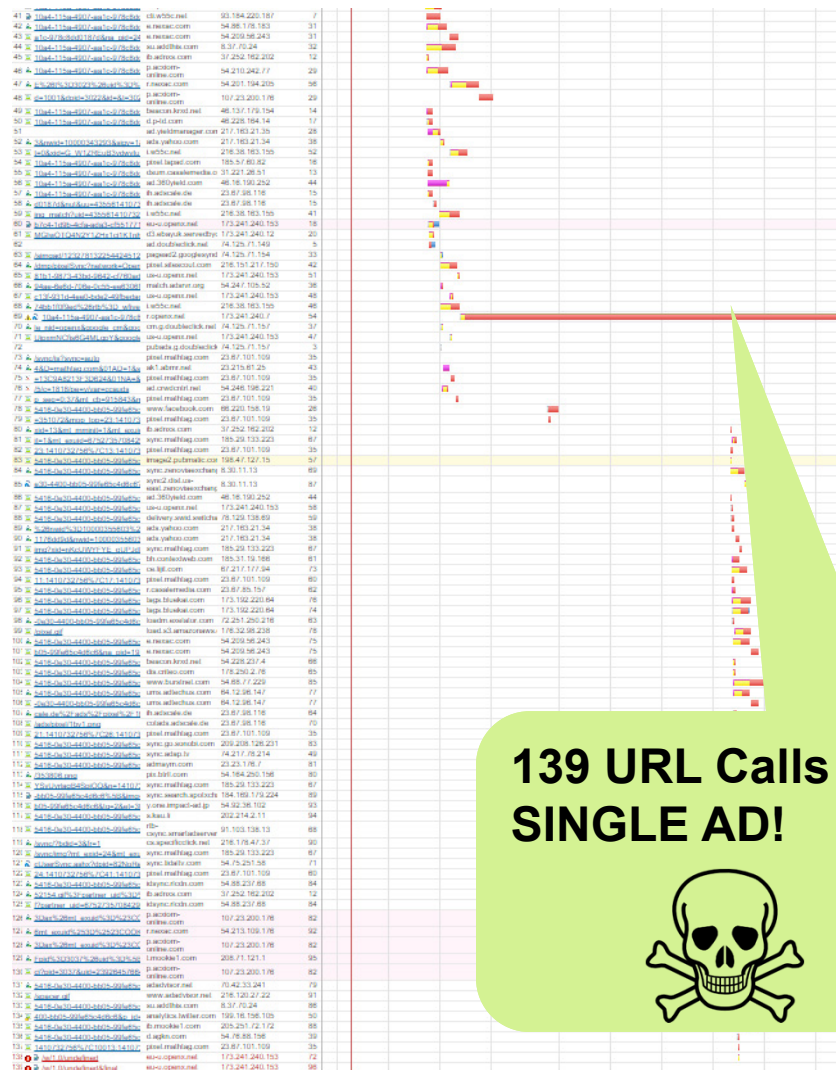
Major Contributor Of SLOWNESS

Majority Of 3rd Party Ads Are Not Optimized

- Too Many Resources/Domains
- No Basic Optimizations Like Minification
- Too Many Re-directions
- Too Much Everything!

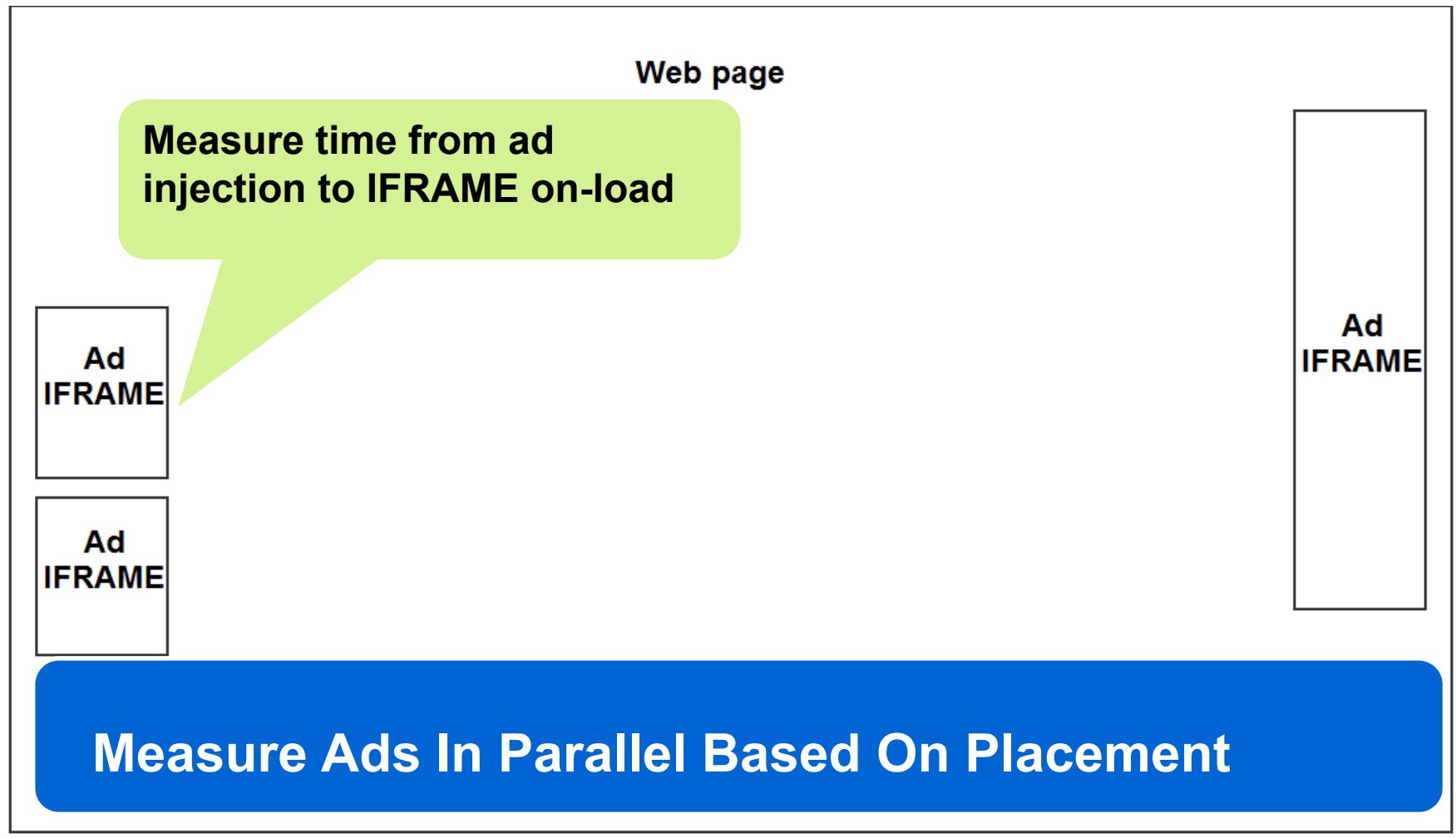
A/B Tests With / Without Ads:

- Business Metrics Improve Without Ads
- Ad Revenue Decreases (Obviously)





How eBay Measures Ad Load Time

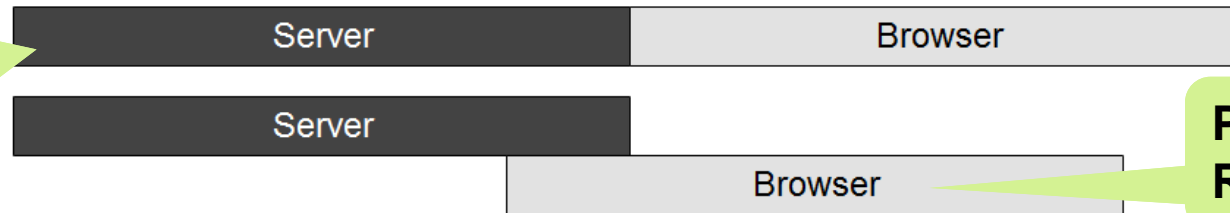




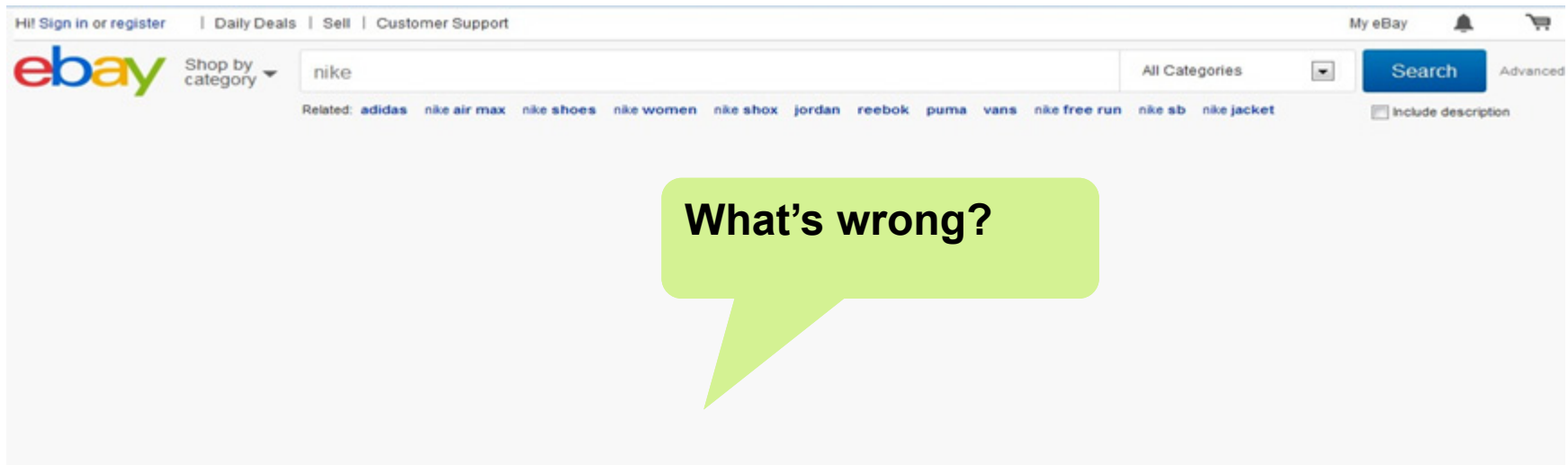
End-to-end Time Vs. Perception Experiments

Progressive rendering improved end-to-end time in our tests

Classic
Page
Serving



Progressive
Rendering



Degraded perception due to delayed content loading above fold



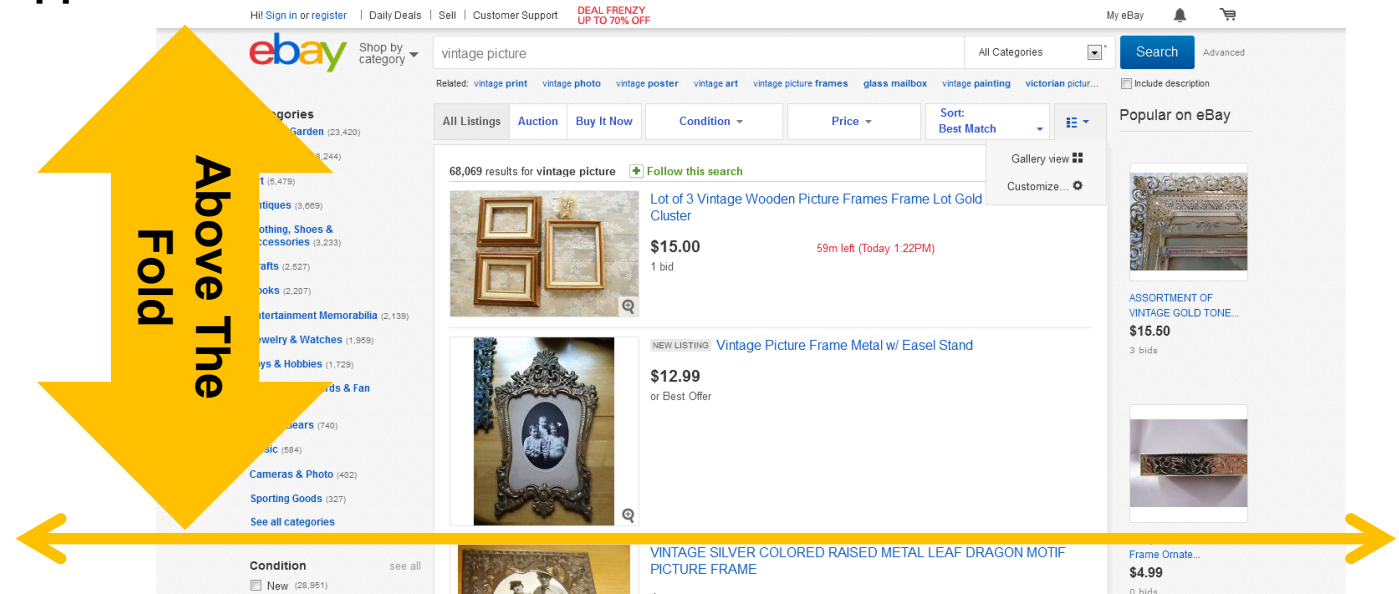
How eBay Measures Performance Above Fold

eBay Measures

- Above Fold: time from first pixel change to last pixel change in viewport
- No browser API support yet for this

eBay Custom API

- Use many images
- Measure time from first byte until all above fold images load
- Result is a good approximation of above-the-fold load time





Page Load Time Vs. User Experience

Some Features Increase Page Load Time

- Bigger images, videos...etc.

Better User Experience Justifies Page Load Time

- Example:

Everyone prefers largest image



96x96 (2.5K)



140x140 (5K)

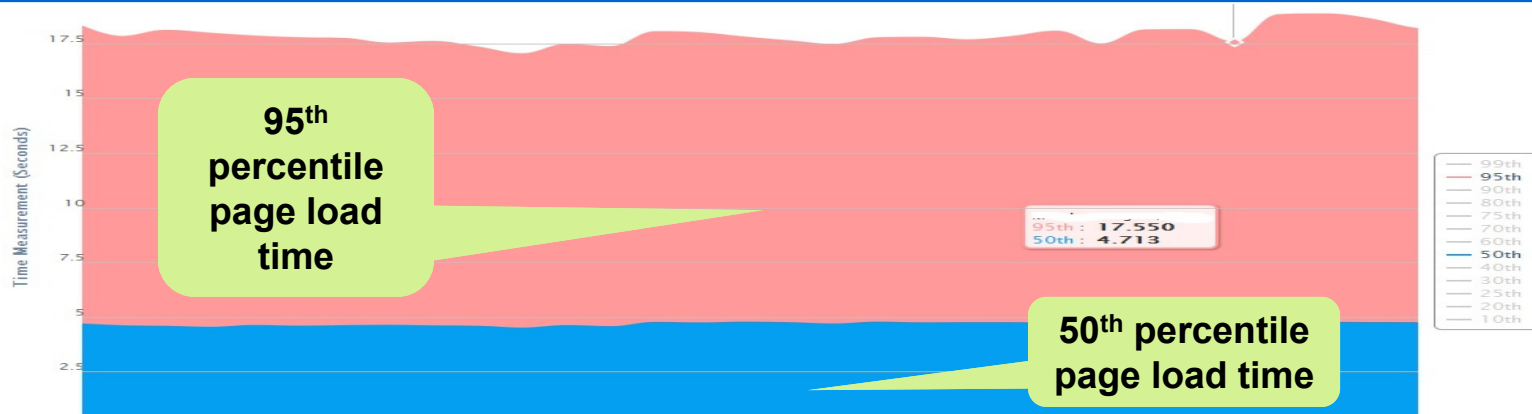


225x225 (6.8K)



How eBay improves performance for 95th percentile users

eBay RUM Data



Bandwidth Detection

- Covers only transfer rate of bytes
- Not effective

Bandwidth Plus Performance Detection

- Measures almost everything
- Leverages RUM data
- Drop heavy features for 95th percentile users and experiment



eBay Synthetic Testing: ThousandEyes

ThousandEyes  Dashboard Views Alerts Reports Sharing Settings

Agent Los Angeles, CA

Date

Drag to zoom, click to go to a specific date

Generate Report

Details for Los Angeles, CA

Run Test

DOM Load 844 ms

Page Load 2,269 ms
(Target = 3,000 ms)

Breakdown by Domain

Breakdown by Provider

Total Wire Size 1,188.1 kB

Bytes Received

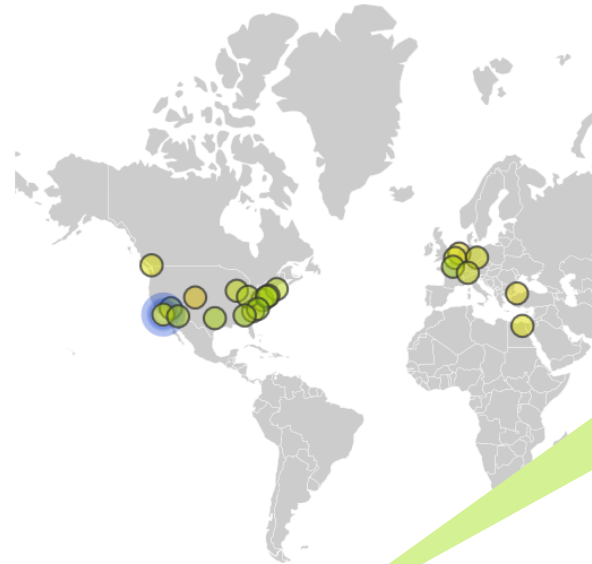
Throughput 234 kB/s

Objects 104



Total Response Time (ms)

Throughput (kB/s)



Click on an agent to select it, click on the background to deselect

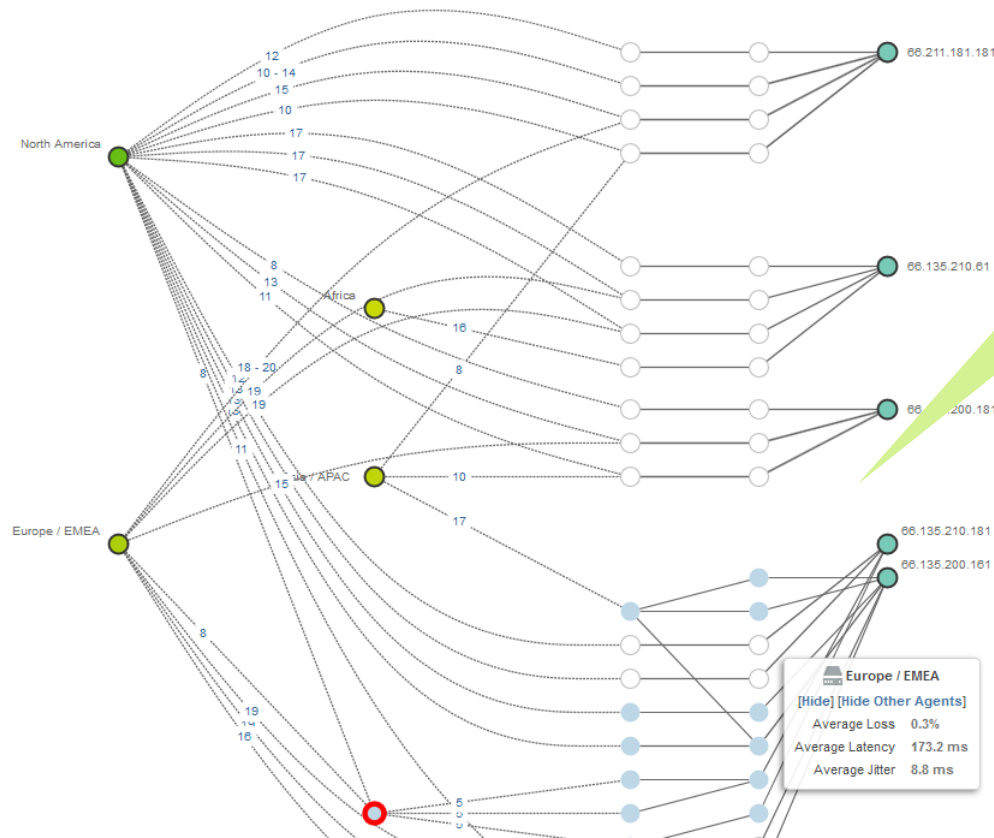
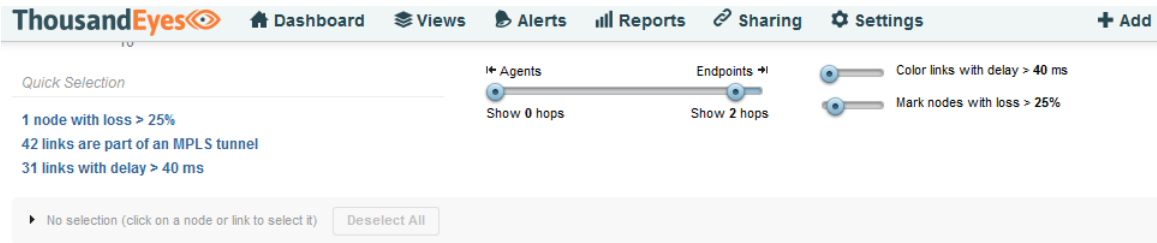
Standard Waterfall Used To Troubleshoot Object Issues

Pubmatic Ad Server = Ouch

Object	Domain	Provider	Size (kB)	Waterfall	
/	www.ebay.com	eBay, Inc	88.9	586 ms	
all.min	gh.ebaystatic.com	Akamai T...	49.6	SPug	image4.pubmatic... 23 ms
pd3rpssucq2ftk2un2hkhz3...	ir.ebaystatic.com	Akamai T...	57.2	62247-Q3-Generic-Refres...	p.ebaystatic.com 5 ms
spr9.png	p.ebaystatic.com	Akamai T...	3.9	AdDisplayTrackerServlet	aktrack.pubmatic... 8 ms
wrry1v30fe2n3h3eb1c1kktl...	ir.ebaystatic.com	Akamai T...	271.4	up.html	ads.pubmatic.com 13 ms
rpt.min	gh.ebaystatic.com	Akamai T...	32.1	universalpixel.js	ads.pubmatic.com 11 ms
imaba.jpg	p.ebaystatic.com	Akamai T...	1.4	UPug	image3.pubmatic... 936 ms
				pixel.js	ads.pubmatic.com 11 ms
				dpsync.html	ads.pubmatic.com 19 ms



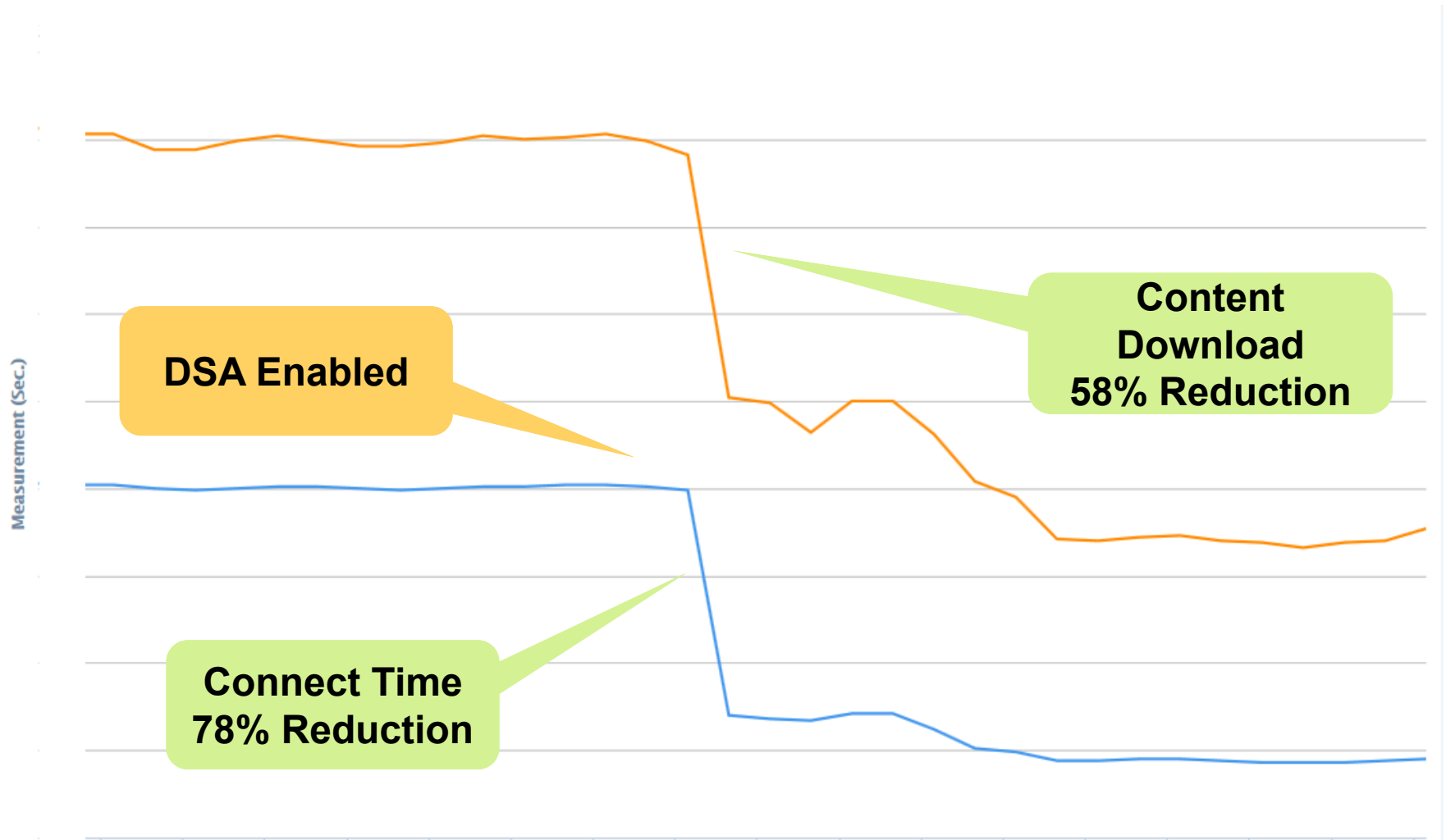
eBay Synthetic Testing: ThousandEyes



**Network Path
View Used For
Troubleshooting
Internet Issues**



Performance: Akamai DSA for Italy www.ebay.it





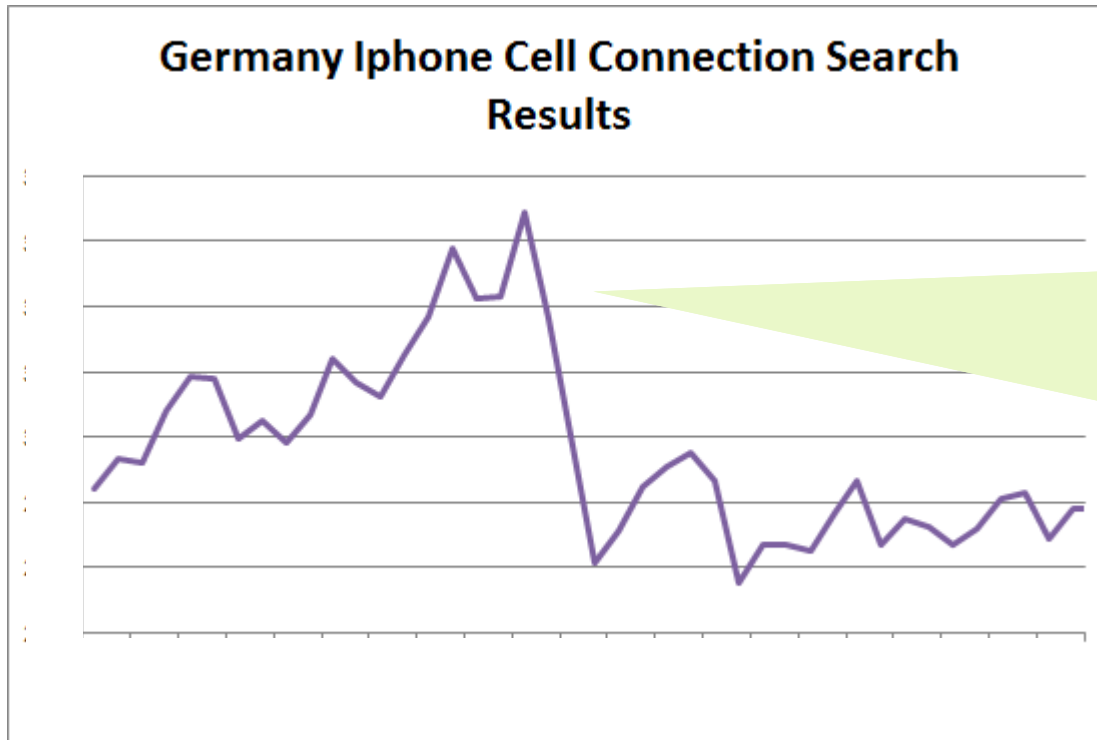
Performance: TRIANGULATE! DSA In Italy



**90% Reduction In Latency
From ThousandEyes
Agents To www.ebay.it
When DSA Enabled**



Performance: DSA w/ SSL For Mobile JSON API Mobile App

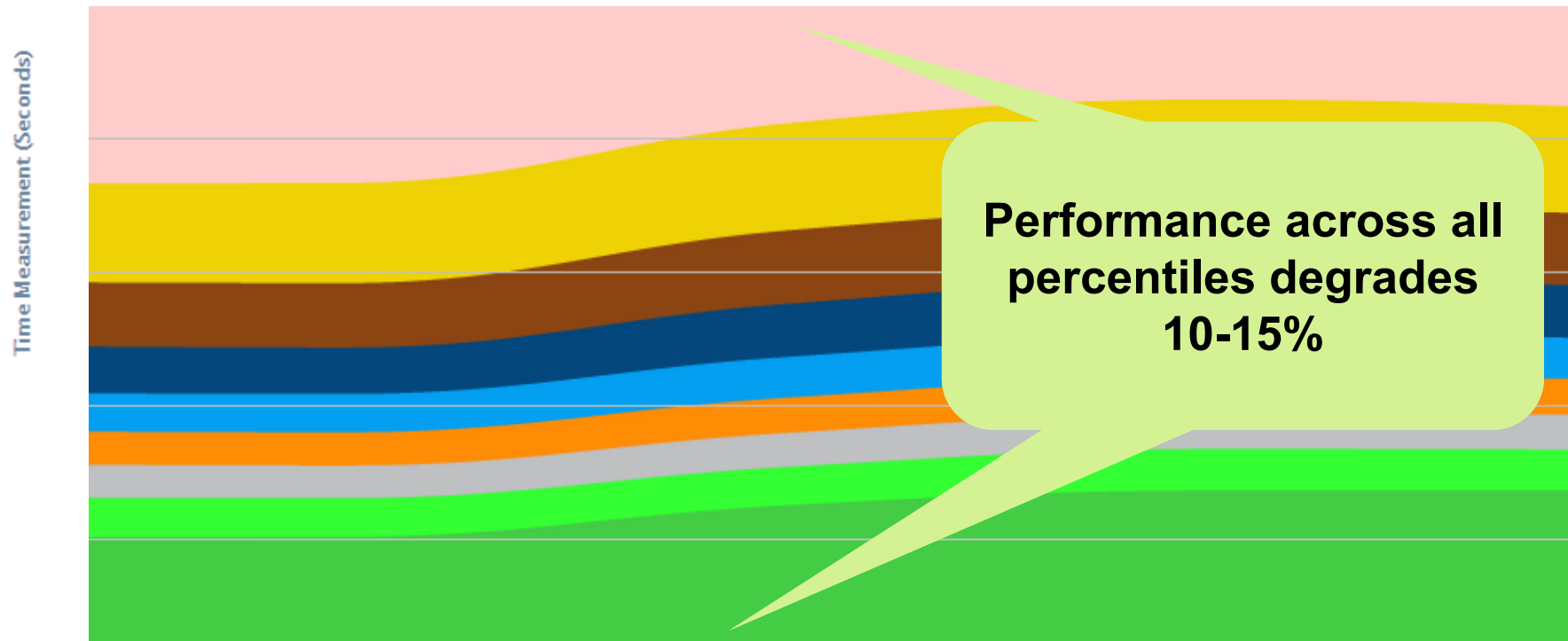


**DSA Improve
Mobile Search
Results In Germany
By One Second
(27%) At Peak**

**Data From eBay
Mobile Team**

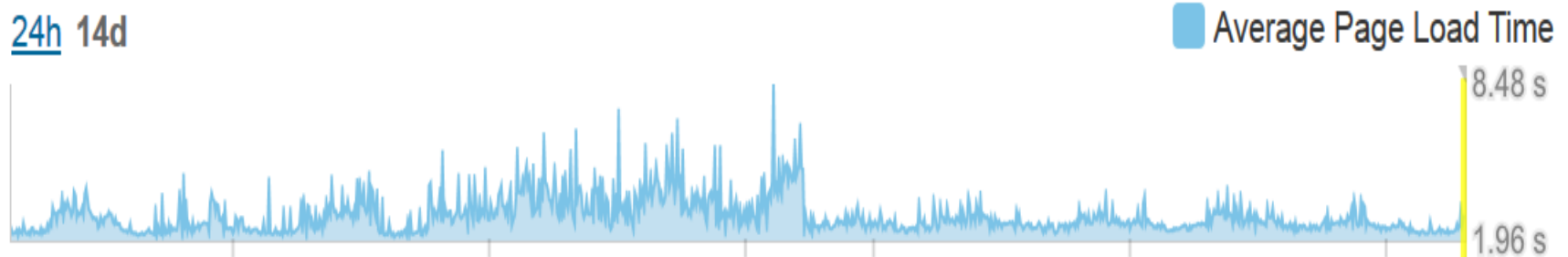


Performance: What Happens When We Turn DSA OFF?

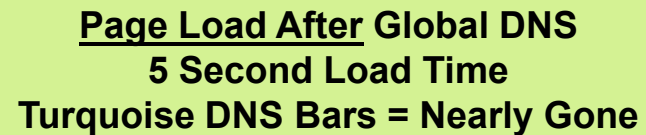
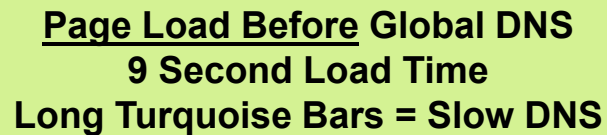




Performance: Global DNS



**50% Reduction In Page Load Time
Measured From ThousandEyes
Global Synthetic Agents**

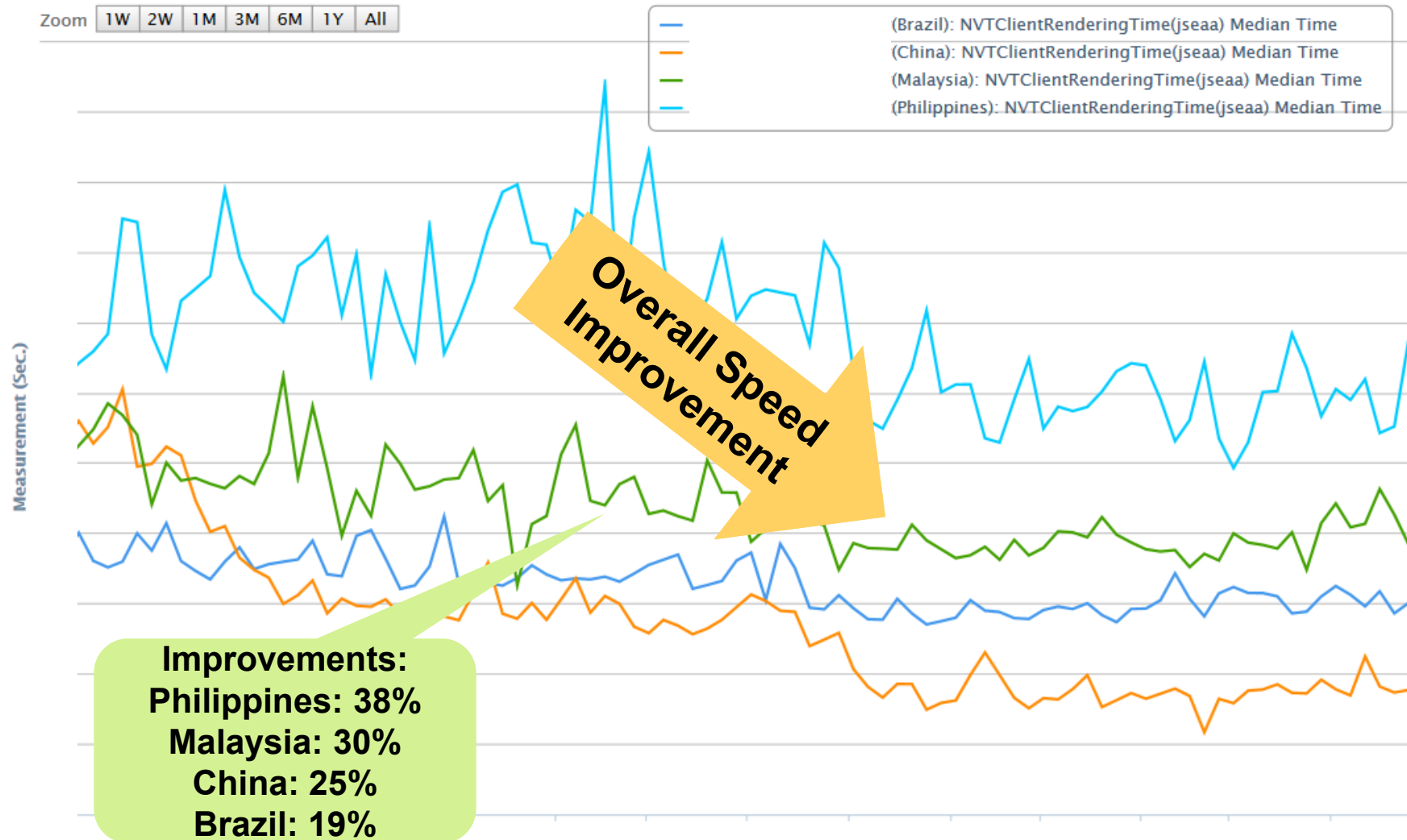


**>1 Sec
DNS
Time**

**70ms
DNS
Time**



Performance: Switching CDNs For ViewItem Photos





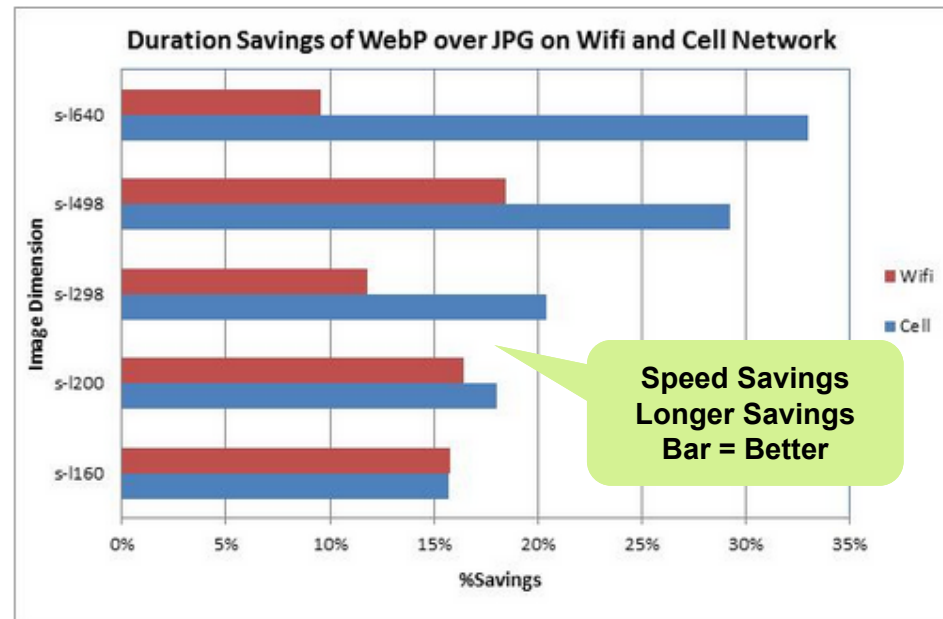
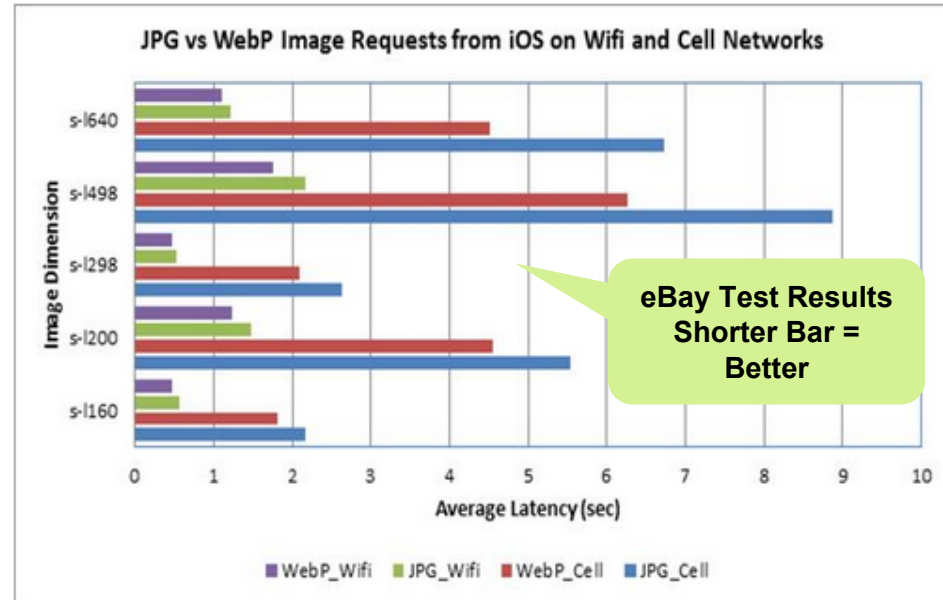
Next Up: WebP



**JPG: 19K
(500x500)**



**WebP: 13K
(500x500)**





Inside View Of Key CDN Settings

Using Dynamic Site Acceleration (DSA)

- Can Be Used As Giant Big Dumb Proxy To Move TCP And SSL Termination Close To End-users

Tiered Distribution

- Turn On For Images, N/A For DSA

Downstream Cacheability Settings

- Ensure That You Separate Cache Behavior Of CDN From Cache Behavior Sent To Clients
- Should You Pass Headers From Origin? Do Origin Apps Set Correct Cache Control?

Triggering Measurements Based On

- User Agent (Mobile Vs Tablet Vs PC)
- Geo
- Image Type (Webp Vs JPEG)



Summary, Wisdom, And The Future

The Internet Is A Multidimensional Universe!

- **Don't Fall For (Or Supply) A Single Summary Metric- It Doesn't Exist**

Performance Measurement Requires A Multifaceted Approach

- **Synthetic Tests**
- **Real User Metrics**
- **Ideally Log File Analysis**
- **Triangulate Results To Understand Cause And Effect**

The Future

- **Link RUM And Synthetic Testing**
- **Link Cost To Performance**
- **Eliminate barriers to scaling analysis: Elasticsearch, MapReduce, CloudVMs**



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