Above the Fold Time:
Measuring Web Page Performance Visually
3/15/2011

Jake Brutlag jakeb@google.com

Zoe Abrams zoe@fb.com

Pat Meenan pmeenan@google.com

When is the page rendered?

Q: How fast is your web page?

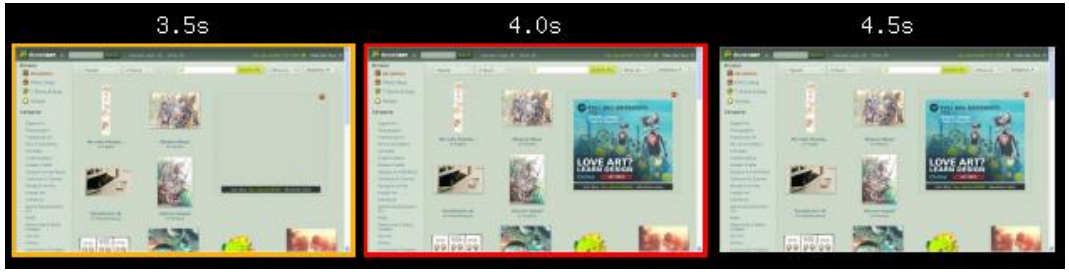
One answer: How long does it take the user to see all visible content?

Above the Fold Time (AFT): Time when content that stops changing and is above-the-fold reaches its final state.

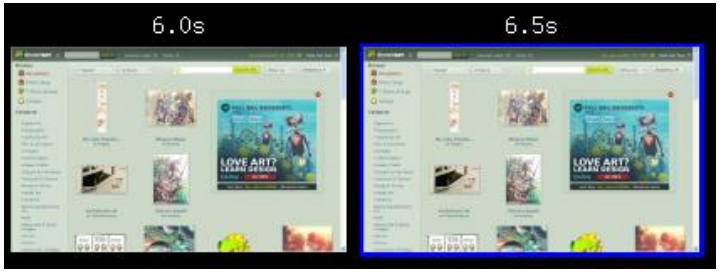
Browser events

Page load time (PLT): start of navigation until browser Onload event (IE DocumentComplete) for document

Can overestimate above-the-fold time

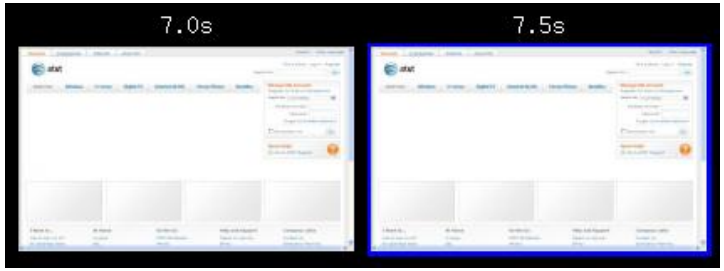


AFT



PLT

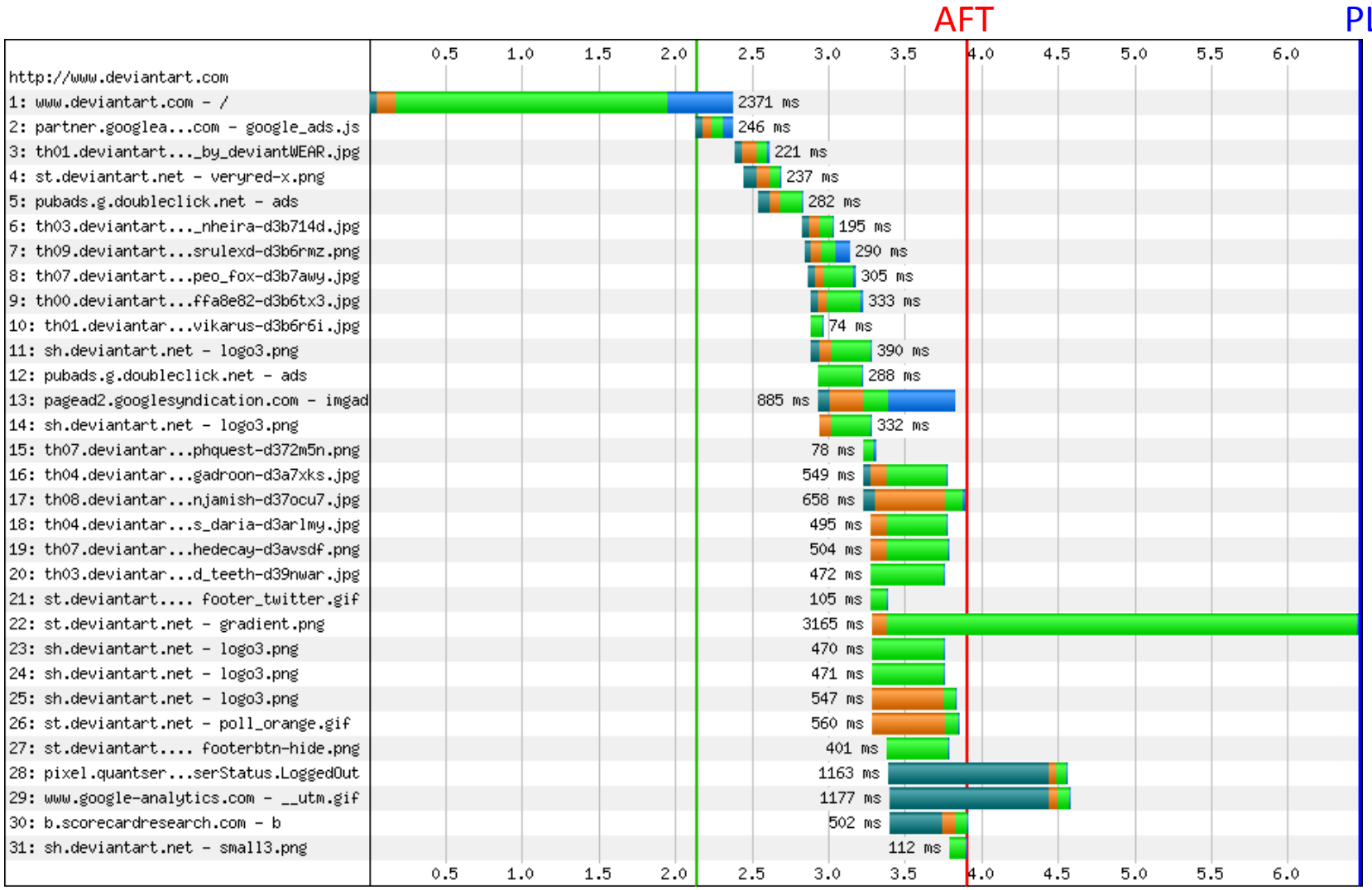
Can underestimate above-the-fold time



PLT

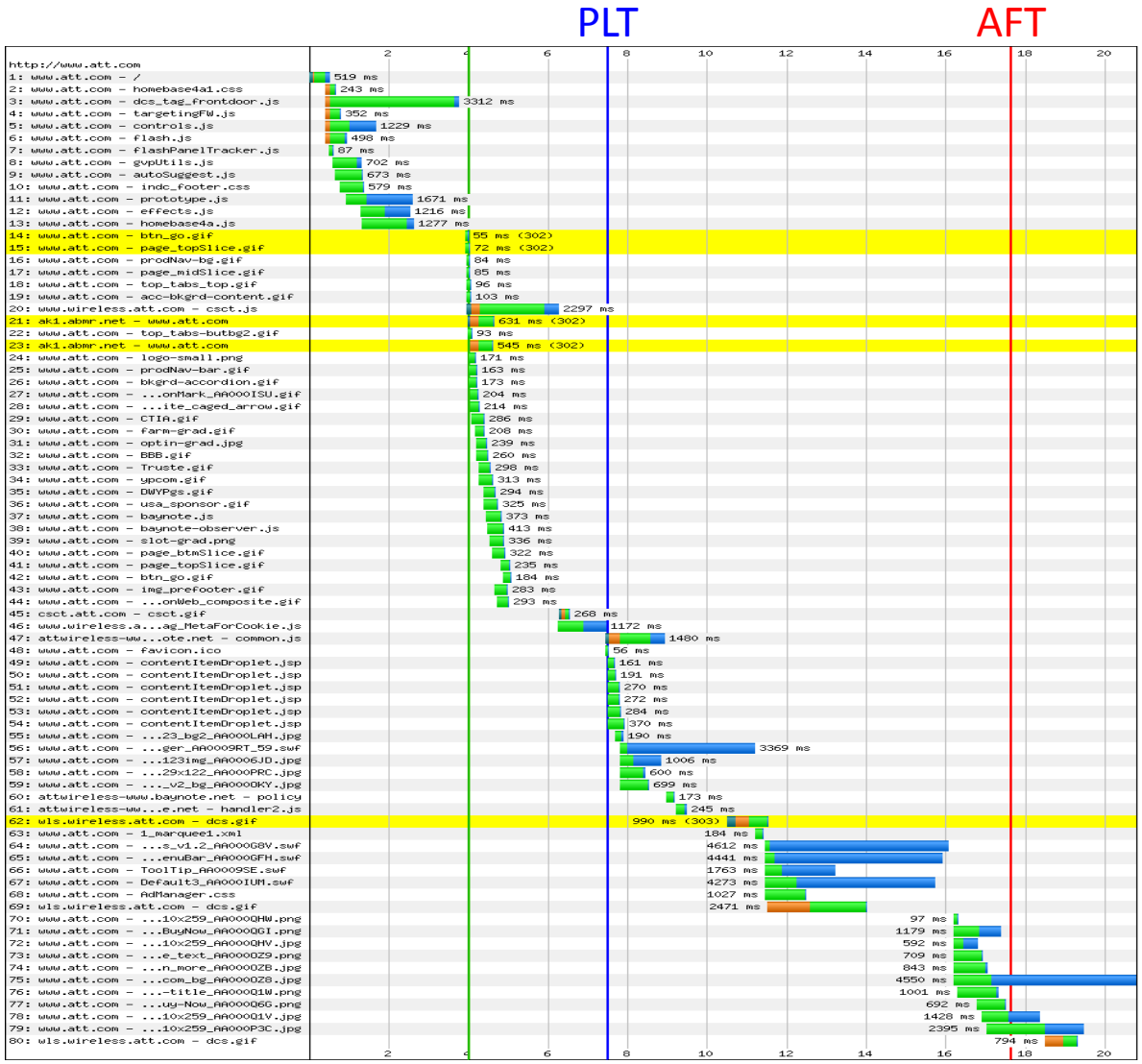
AFT

deviantart.com overestimate



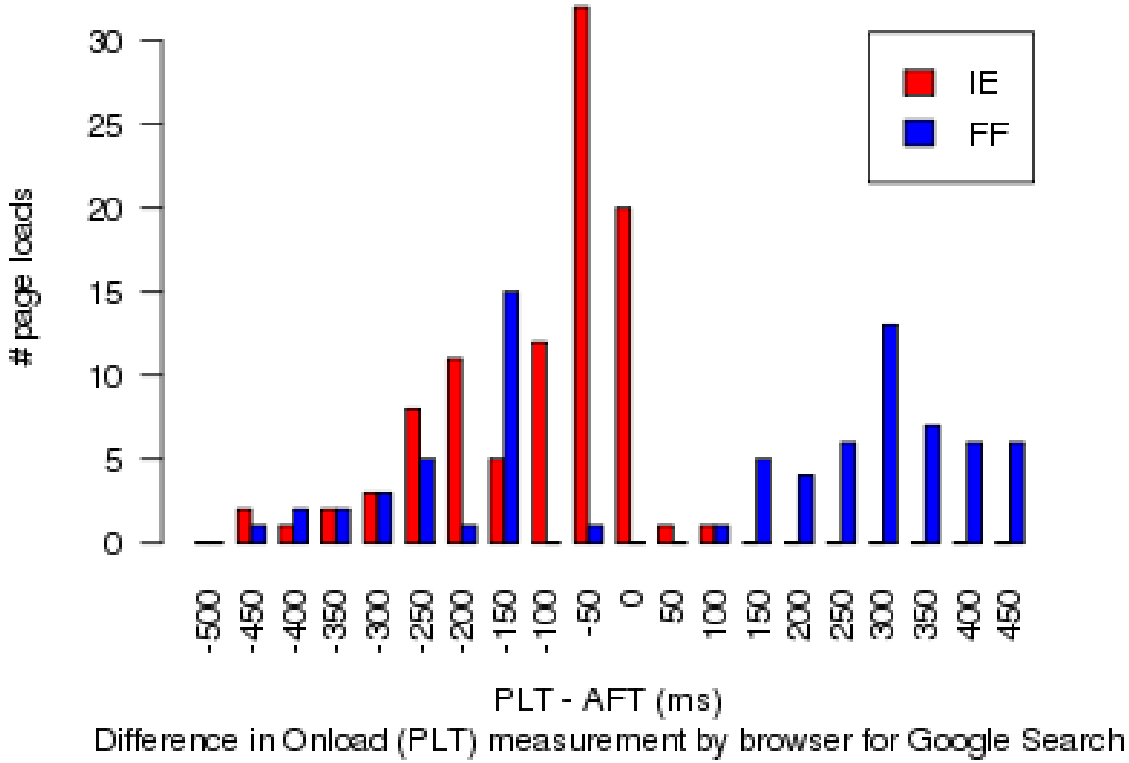
Below the fold (not visible) content pushes out Onload

att.com underestimate



Above-the-fold content loaded by JS and Flash occurs after Onload

Browser events are not cross-browser

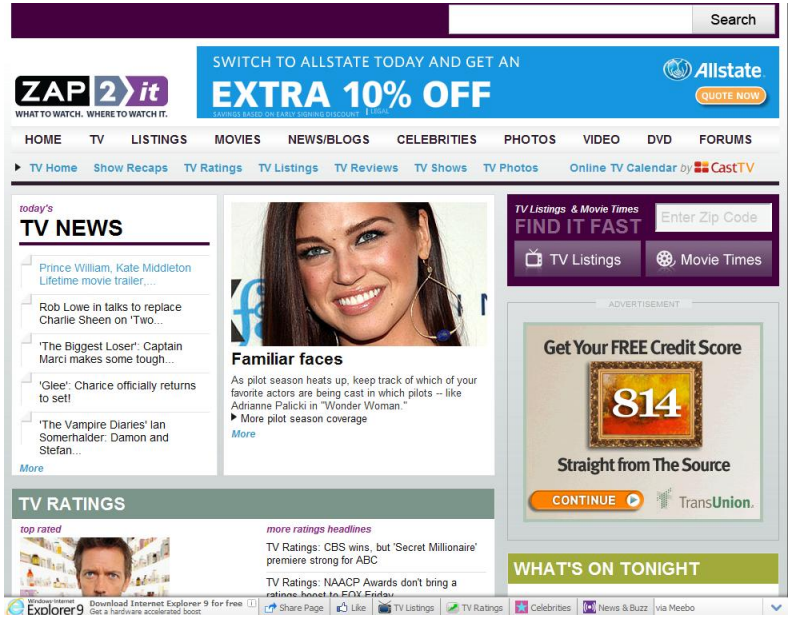


Difference is not primarily a rendering difference.

But JS blocking for Onload in FF, non-blocking for IE.

Estimating AFT (1)

Naïve: AFT = time of the last pixel change above-the-fold



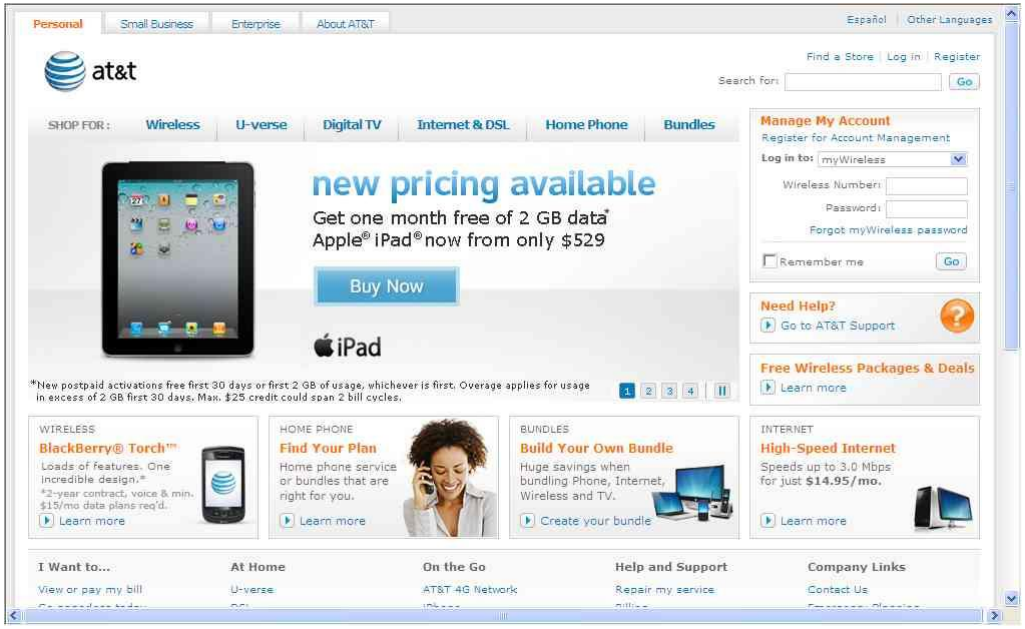
Challenge: Animation/video = pixels keep changing

Estimating AFT (2)

- Specify an upper bound, the AFT cutoff time, on the page load
  - Function of connection speed/quality, i.e. 45 s for DSL
- Classify pixels as static or dynamic
  - Static = pixels that change < 5 times and don't change after AFT cutoff
  - Dynamic = pixels that change ≥ 5 times and keep changing after AFT cutoff
  - Capture video for period > AFT cutoff to identify dynamic pixels with confidence
- AFT = latest change of a static pixel before the AFT cutoff

AFT for att.com

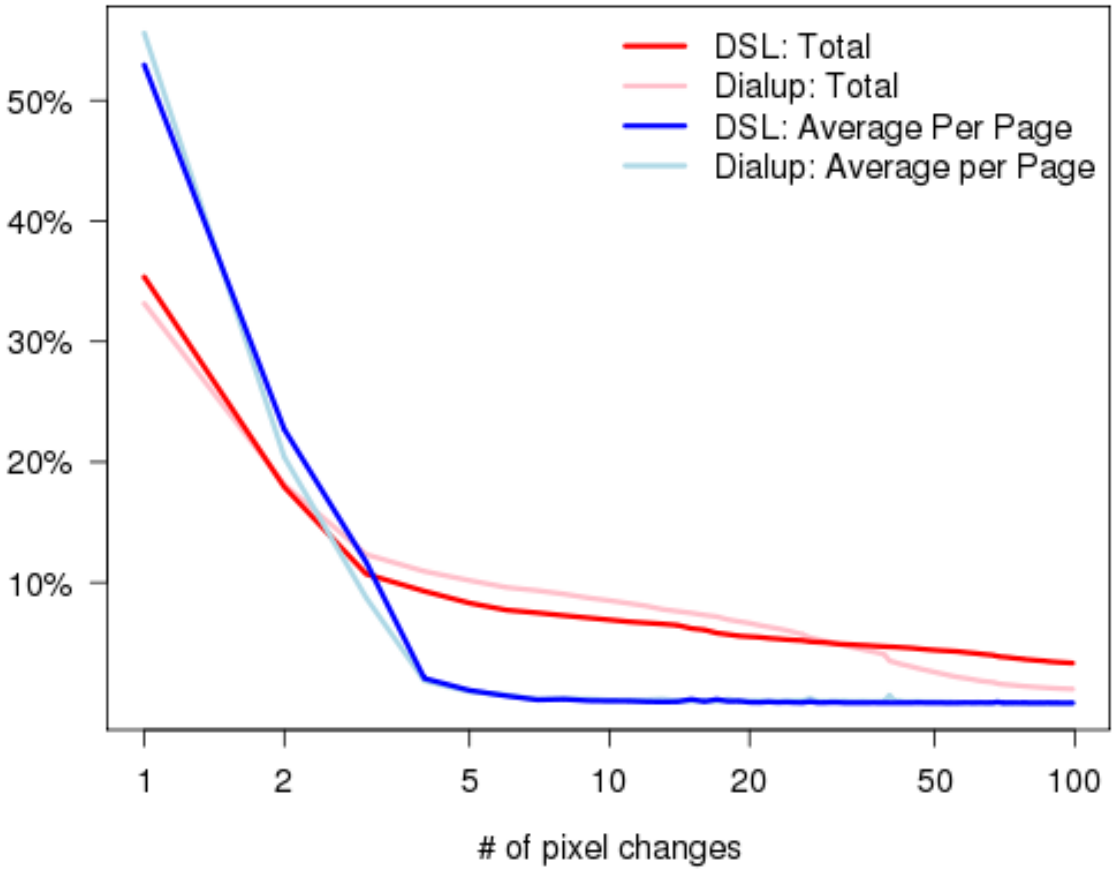
Black = unpainted pixels
White = static pixels
Blue = dynamic pixels
Green = last static pixels to change → AFT



Rotating content panel = dynamic pixels
AFT is defined by the Pause button.
Button rendered once panel is initialized.

5 pixel change heuristic

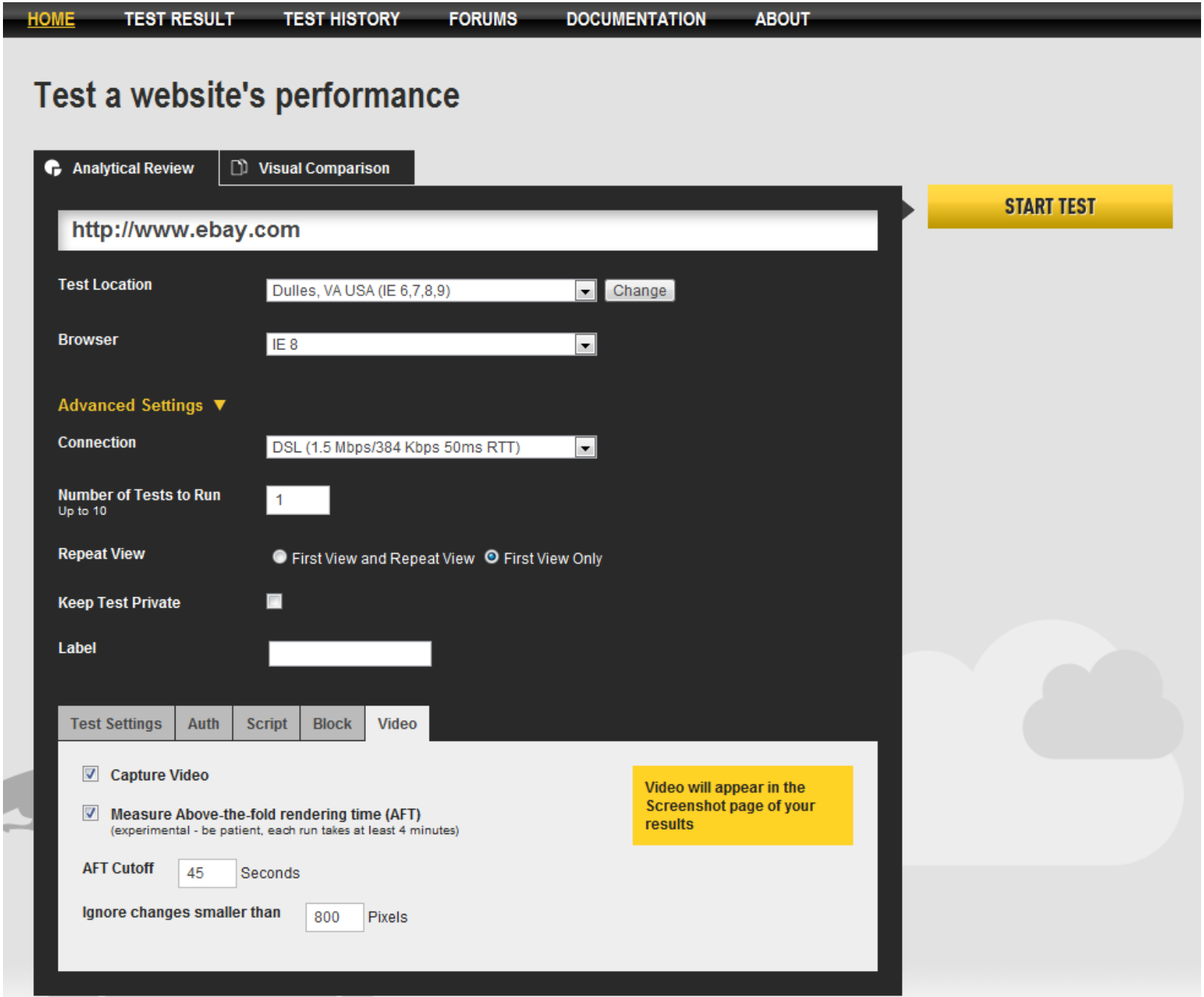
Alexa Top 200 Home Pages,
% of Pixels Rendered by # of Pixel Changes

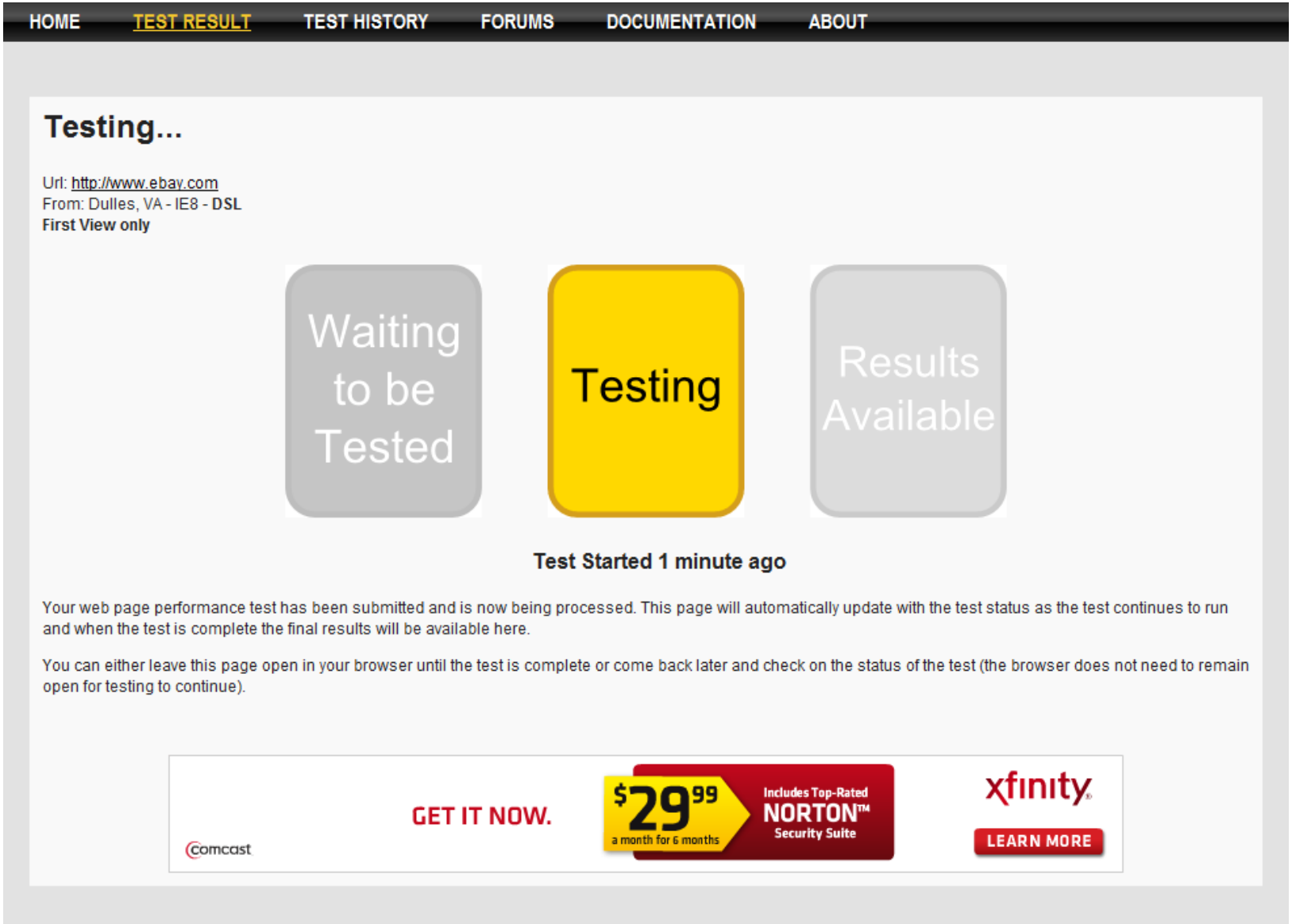


90% pixels rendered in the Alexa Top 200 home pages change fewer than 5 times.

Similar pattern for DSL and Dialup, despite more progressive rendering on Dialup.

http://www.webpagetest.org





wait 4 minutes…

Web Page Performance Test for
www.ebay.com

From: Dulles, VA - IE8 - DSL

Page Speed Score: 90/100 — Need help improving?

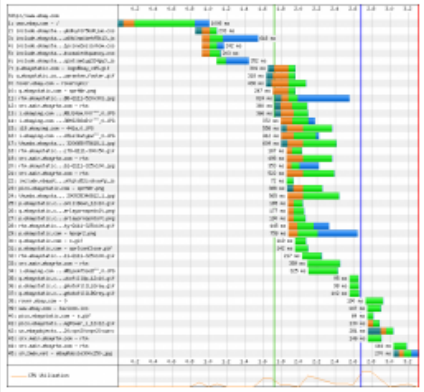
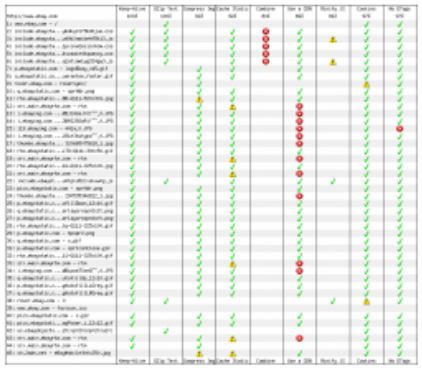
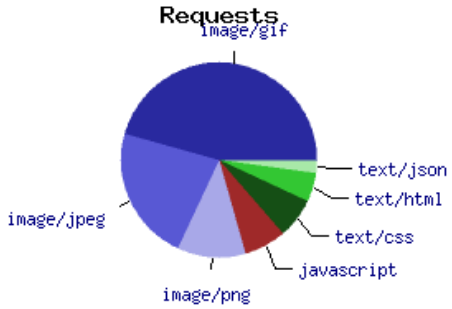
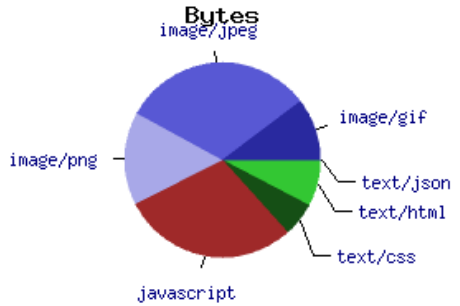
A	A	A	A	B	D
Keep-alive Enabled	Compress Text	Compress Images	Cache Static Content	Combine JS/CSS Files	Use of CDN

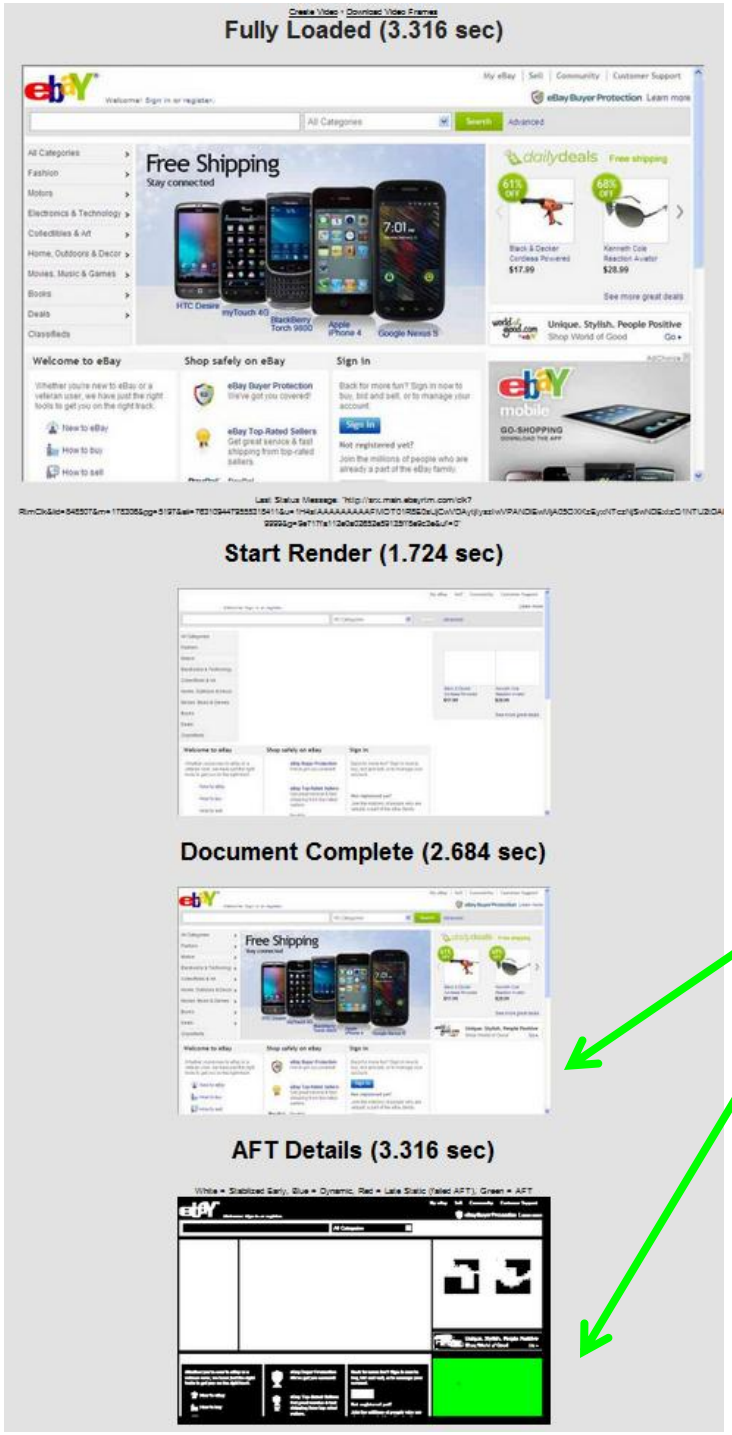
First View only

Re-run the test

Raw page data - Raw object data
Export HTTP Archive (.har)

	Load Time	First Byte	Start Render	Above the Fold	Document Complete Time	Document Complete Requests	Document Complete Bytes In	Fully Loaded Time	Fully Loaded Requests	Fully Loaded Bytes In
First View	2.684s	0.849s	1.724s	3.3s	2.684s	37	237 KB	3.316s	44	261 KB

	Waterfall	Optimization Checklist	Screen Shot	Video
First View (2.684s)				Filmstrip View - Watch Video - Compare to
Content Breakdown				

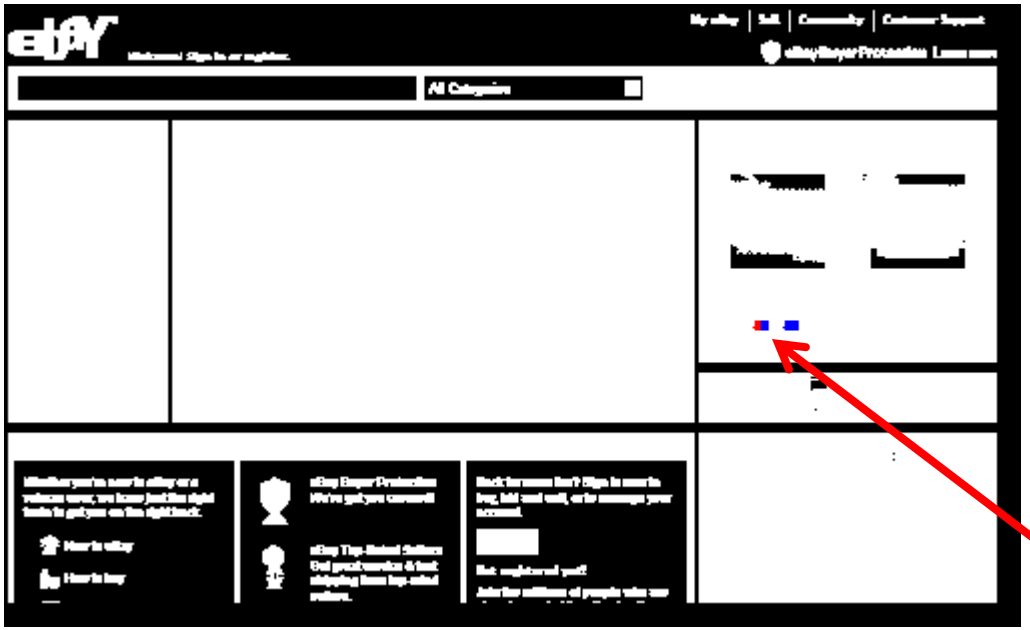


Key Screen Shots.

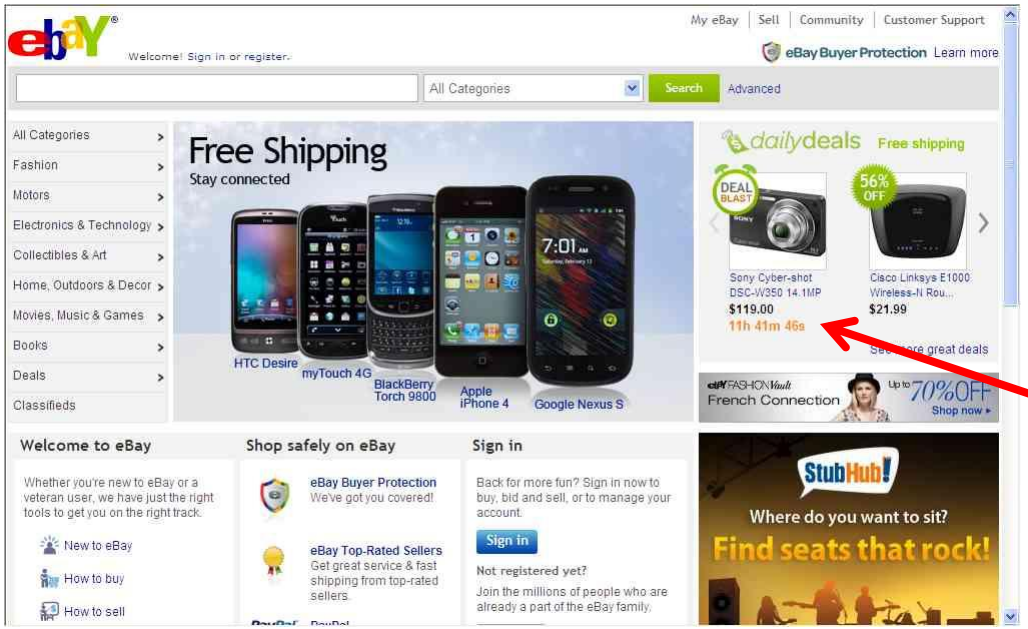
In this example, OnLoad (DocumentComplete) does not include lower right panel.

AFT often agrees with Onload/DocumentComplete or Fully Loaded (= all resources fetched).

ebay.com example not ignoring small changes



Black = unpainted pixels
White = static pixels
Blue = dynamic pixels
Red = Pixels that change < 5 times with last change after the AFT cutoff → AFT is N/A.



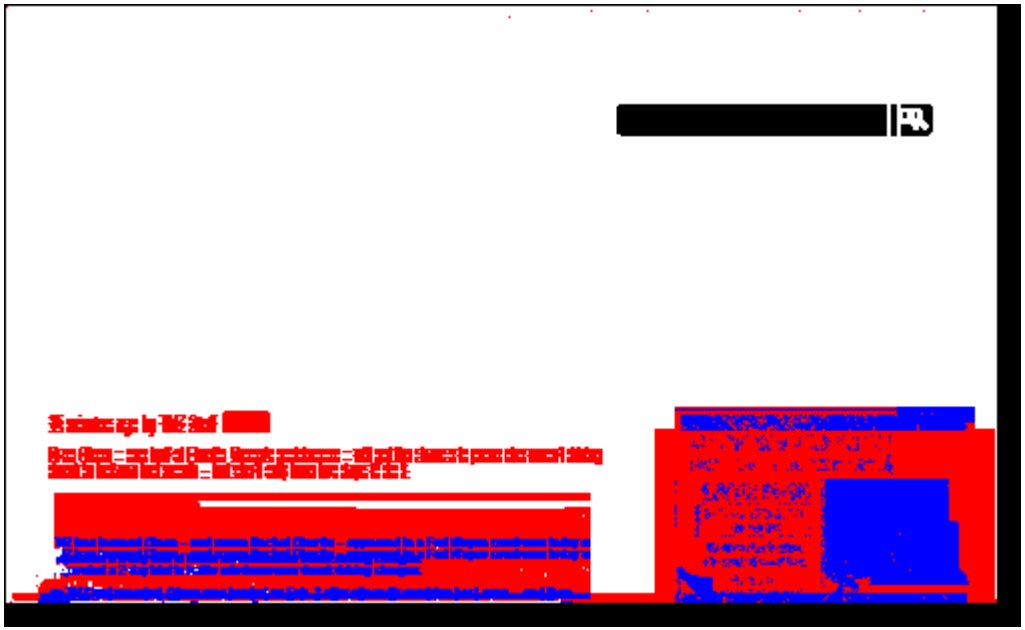
Page has “daily deal” timer: 11h 41m 46s
Minutes are updated after AFT cutoff.

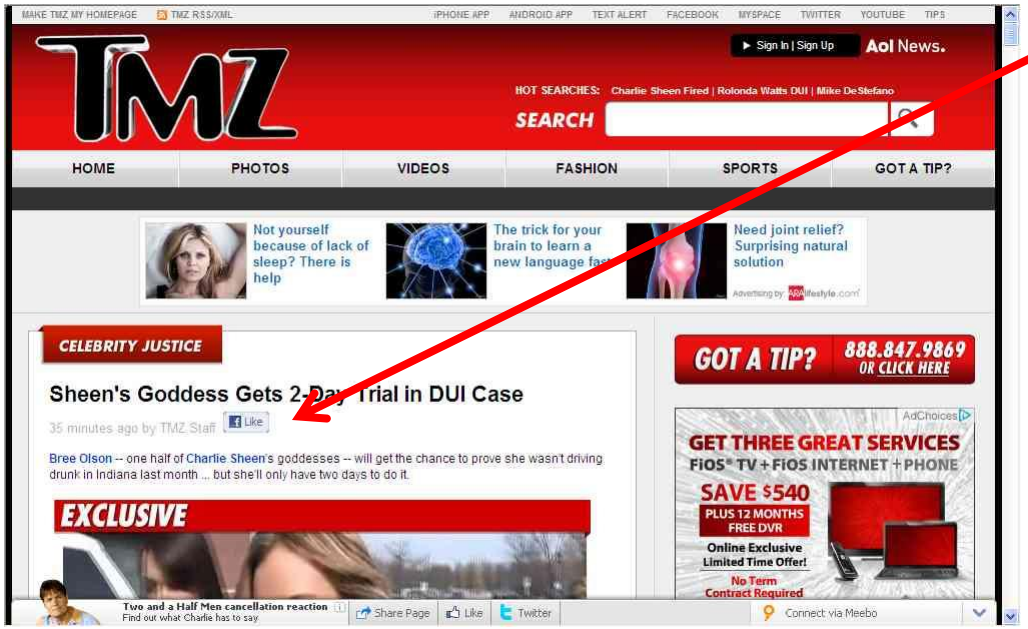
Wrap up

- Applications of AFT
  - Visual measure of page performance
  - Cross-browser metric
  - Validation of other metrics (i.e. JS metrics)
- Limitations of AFT
  - Only applicable to lab setting
  - Does not reflect user perceived latency based on functionality
- AFT heuristics always need further iteration
  - http://www.webpagetest.org/forums/

Ambiguous Cases for Estimating AFT

- One time animation: pixels that change ≥ 5 times but don't change after the AFT cutoff.
  - Should one time animation be included in AFT?
  - Current algorithm: No.
- Pixels that change < 5 times with last change after the AFT cutoff.
  - Perhaps AFT cutoff needs to be extended
  - tmz.com example
- AFT may be decided by small (perhaps not user visible) changes.
  - Previous ebay.com example





tmz.com example DSL, AFT Cutoff=25 s

Red = Pixels that change < 5 times with last change after the AFT cutoff → AFT is N/A.

Cause:

Like button forces frame flow re-render (pushes content down) at 40 s.

Solution:

Increase AFT cutoff from 25 s to 45 s to include this re-render in AFT.