Above the Fold Time: A Graphical Approach to a Browser Independent Latency Metric

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http://www.webperformancecentral.com/wiki/Main_Page
Motivation

Compare latency of different:
- webpages
- browsers
New latency measure needed

What should latency measure?
What is the latency of this page?

Watch video of www.verawang.com loading in IE8
What is the latency of this page?

(0) Google Proprietary

(6) bottom right video appears

(7) name brand flashed

(11) bottom right video starts

(15)

(20)
Latency: people disagree

Latency should measure how fast:

- functionality becomes available
- content is rendered
- the site “feels”

Latency is subjective

- depends on the particular user
- users perceive and use sites differently
Summary so far

People disagree.

What about browser events?
Latency: browsers disagree

Screens differ at same browser event
- load www.bing.com in FF and IE

Event triggers differ between browsers
- IE *does not* wait for extern JS in websearch results page
- Firefox and Chrome *do* wait for extern JS
Summary so far

People disagree.

Browsers disagree.

Agreement is essential for comparison.

Latency metric:
- agrees with itself (selects comparable images)
- directly corresponds to our users' experiences
Above the fold time (AFT) latency metric

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

AFT selects comparable images
- content in final state is equivalent
- regardless of progressive rendering
- regardless of os, network, or browser variability
AFT in Vera Wang example

White text on bottom right video is latest content that doesn't change after it appears.

(name brand flashed)

bottom right video appears

bottom right video starts

AFT
Paradigm shift: coder → user perspective

Coder perspective: measure point in sequence of code execution

User perspective: measure point in sequence of graphical changes on the screen

AFT directly correspond to our users' experiences
Summary

People disagree.

Browsers disagree.

AFT agrees (selects comparable images).  
AFT corresponds directly to users' experiences.
AFT challenges

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

Distinguish
- continuous animation ✓
- finite animation ✔
- progressive rendering ✔
- frame flow ✔
Continuous animation changes late in load

Early Cutoff

- upper bound after which the page is surely loaded
- content that changes after early cutoff is 'continuous'
Latest of Early example

Early Cutoff
20secs

start  end

Pixel

A  B  C  D
Latest of Early example

Early Cutoff
20secs

start

end

Time

Pixel

A

B

C

D

✓

✓

✓

✗
Latest of Early example

Latest of Early

Early Cutoff
20 secs

start

end

Time

Pixel

A

B

C

D

Pixel

Yes

Yes

No

No

Google Proprietary
Latest of Early: low confidence results

Animation ending before early cutoff
- www.verawang.com
- www.bing.com (flashing squares)
- www.newyorktimes.com (watch page load video)
- ad that animates 10s then stops

New content or animation after early cutoff
- www.figaro.fr (watch page load video)
- youtube watch page (watch page load video)

Automated tag of 'low confidence' results
Change frequency determines confidence

Low confidence if
- pixels change frequently, then stop early in load
- pixels change seldom, then change late in load

Pixels that change frequently $\leftrightarrow$ change $>5$ times
Latest of Seldom Changed example

Change late in load that is not animation (like www.figaro.fr example)
Latest of Seldom Changed example

Change late in load that is not animation (like www.figaro.fr example)
Latest of Seldom Changed example

Change late in load that is not animation (like www.figaro.fr example)

Low confidence result
Latest of Seldom Changed example

Continuous animation that ends early
(like www.newyorktimes.com example)
Latest of Seldom Changed example

Continuous animation that ends early (like www.newyorktimes.com example)

Latest of Early Changed

Early Cutoff 20secs

Low confidence result
Limited animation that ends early
(like www.verawang.com example)

Latest of Early
Latest of Seldom Changed
Early Cutoff
20secs

High confidence result
Determining animation cutoff

How many changes before a pixel ignored?

5 changes recommended:
- 100% sites with no animation have $\leq 5$ changes
  (for 20 manually selected from Alexa top 100)
- 85% high confidence
  (for 40 randomly selected from Alexa top 100)
AFT Algorithm summary

High confidence results on 85% of popular urls
High confidence results are comparable

Satisfies two motivating use cases:
- comparing most webpages
- comparing browsers