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CT 420 Real-Time Systems

Web Performance Benchmarking

Dr. Jawad Manzoor Assistant Professor School of Computer Science



Contents

- User QoE
- Case Studies
- Core Web Vitals
- Performance Measurements Tools



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Speed and Performance

- Speed and performance plays a vital role in the success of any online venture.
- Websites that load quickly and respond to user input in a timely fashion engage and retain users better than websites that are slow to load, and feel sluggish.
- Modern websites ship lots of code and mobile devices in particular have limited CPU power and memory. Coupled with adverse network conditions, this can create poor performance.
- Monitoring performance is of utmost importance today.



User Experience Factors

The speed it takes to load a page

How easy it is to find what I'm looking for

How well the site fits my screen

How simple the site is to use

How attractive the site looks

	24%	

Source: SPEED MATTERS: Designing for Mobile Performance, Awwwards





Speed Matters

U When page load time increases from..

1s to 3s the probability of bounce increases 32%

1s to 5s the probability of bounce increases 90%

Source: Google/SOASTA Research, 2017.



How to measure performance?

Speed and performance are relative terms.

Each application dictates its own set of requirements based on:

- **Business** criteria
- Context
- User expectations
- Complexity of the task

In the context of web, we need to plan and design for specific, user-centric perceptual processing time constants.



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User's Perspective

Scenario 1: Pages Load Content Progressively Seems Faster





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User's Perspective

Scenario 2: Pages Appear Quickly But Respond to User Interaction Slowly





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Older Metrics of Measurement

Document: DOMContentLoaded event

- The DOMContentLoaded event fires when the HTML document has been completely parsed, and all deferred scripts (<script defer src="..."> and <script type="module">) have downloaded and executed.
- It doesn't wait for other things like images, subframes, and async scripts to finish loading.
- □ Window: load event
 - The load event is fired when the whole page has loaded, including all dependent resources such as stylesheets, scripts, iframes, and images.
- Older metrics like load or DOMContentLoaded are not good because they don't necessarily correspond to what the user sees on their screen.





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Core Web Vitals

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Core Web Vitals

- U Web Vitals is an initiative by Google to provide unified guidance for quality signals that are essential to delivering a great user experience on the web.
- Core Web Vitals are the subset of Web Vitals that apply to all web pages and should be measured by all site owners.
- Each of the Core Web Vitals represents a distinct facet of the user experience, is measurable in the field, and reflects the real-world experience of a critical usercentric outcome.
- The current set for Core Web Vitals focuses on three aspects of the user experience—loading, interactivity, and visual stability.



Core Web Vitals



Perceived Load Speed

First Contentful Paint (FCP)

Largest Contentful Paint (LCP)

Speed Index

X

Load Responsiveness

First Input Delay (FID)

Time To Interactive(TTI)

Total Blocking Time (TBT)



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Visual Stability

Cumulative Layout Shift (CLS)

□ First Contentful Paint (FCP)

- First Contentful Paint marks the time at which the first text or image is painted
- FCP measures how long it takes the browser to render the first piece of DOM content after a user navigates to your page.
- FCP score is a comparison of your page's FCP time and FCP times for real websites, based on data from the HTTP Archive.
- For example:
 - Sites performing in the ninety-ninth percentile render FCP in about 1.2 seconds.
 - If your website's FCP is 1.2 seconds, your FCP score is 99. •



Largest Contentful Paint (LCP)

- LCP measures when the largest content element in the viewport is rendered to the screen.
- This approximates when the main content of the page is visible to users.
- Lighthouse extracts LCP data from Chrome's tracing tool.
- The table below shows how to interpret your LCP score:

LCP time (in seconds)	Color-coding
0-2.5	Green (fast)
2.5-4	Orange (moderate)
Over 4	Red (slow)



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port is rendered to the screen. Die to users.









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Speed Index

- Speed Index measures how quickly content is visually displayed during page load.
- Lighthouse first captures a video of the page loading in the browser and computes the visual progression between frames.
- Lighthouse then generates the Speed Index score, which is a comparison of your page's speed index and the speed indices of real websites, based on data from the HTTP Archive.
- This table shows how to interpret your mobile Speed Index score:

Speed Index (in seconds)	Color-coding
0-3.4	Green (fast)
3.4–5.8	Orange (moderat
Over 5.8	Red (slow)





Given States First Input Delay

- It is important it is to make a good first impression
- The First Input Delay (FID) metric helps measure your user's first impression of your site's interactivity and responsiveness.
- FID measures the time from when a user first interacts with a page (that is, when they click a link, tap on a button, or use a custom, JavaScript-powered control) to the time when the browser is actually able to begin processing event handlers in response to that interaction.





□ Time to Interactive (TTI)

- TTI measures how long it takes a page to become fully interactive. A page is considered fully interactive when:
 - The page displays useful content, which is measured by the First Contentful Paint, ullet
 - Event handlers are registered for most visible page elements, and ۲
 - The page responds to user interactions within 50 milliseconds. ullet
- Measuring TTI is important because some sites optimize content visibility at the expense of interactivity. This can create a frustrating user experience:

TTI metric (in seconds)	Color-coding
0-3.8	Green (fast)
3.9–7.3	Orange (moderate)
Over 7.3	Red (slow)



Total Blocking Time (TBT)

- TBT measures the total amount of time that a page is blocked from responding to user input, such as mouse clicks, screen taps, or keyboard presses.
- The sum is calculated by adding the blocking portion of all long tasks between First Contentful Paint and Time to Interactive.
- Any task that executes for more than 50 ms is a long task. The amount of time after 50 ms is the blocking portion.
- For example: if Lighthouse detects a 70 ms long task, the blocking portion would be 20 ms.

TBT time (in milliseconds)	Color-codin
0–200	Green (fast)
200-600	Orange (mode
Over 600	Red (slow)



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lerate)

Timeline of a typical web page load

- A page makes some network requests for resources (CSS and JS files)
- After those resources are finished downloading, they're processed on the main thread.





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Long first input delays typically occur between FCP and TTI because the page has rendered some of its content but isn't yet reliably interactive.





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Main thread is Idle for 5+ seconds

- Suppose a user tried to interact with the page near the beginning of the longest task
- The input occurs while the browser is in the middle of running a task, therefore, it has to wait until the task completes before it can respond to the input.





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Main thread is Idle for 5+ seconds

- □ We have often been in a situation when we are:
- Reading an article online and something suddenly changes on the page without warning, the text moves, and you've lost your place.
- Or you're about to tap a link or a button, but in the instant before your finger lands—BOOM—the link moves, and you end up clicking something else!
- This is annoying and can sometimes cause real damage.



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- Unexpected movement of page content usually happens because resources are loaded asynchronously or DOM elements get dynamically added to the page above existing content.
- □ The culprit might be:
 - An image or video with unknown dimensions
 - A font that renders larger or smaller than its fallback
 - A third-party ad or widget that dynamically resizes itself.



Cumulative Layout Shift (CLS):

- A layout shift occurs any time a visible element changes its position from one rendered frame to the next.
- A burst of layout shifts, known as a session window, is when one or more individual layout shifts occur in rapid succession with less than 1-second in between each shift and a maximum of 5 seconds for the total window duration.
- The largest burst is the session window with the maximum cumulative score of all layout shifts within that window.
- CLS is a measure of the largest burst of layout shift scores for every unexpected layout shift that occurs during the entire lifespan of a page.



Cumulative Layout Shift (CLS)





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Layout Shift Score:

The browser looks at the viewport size and the movement of unstable elements in the viewport between two rendered frames and calculates *impact fraction* and the *distance* fraction.

layout shift score = impact fraction * distance fraction



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- The impact fraction is the union of the visible areas of all unstable elements for the previous frame and the current frame—as a fraction of the total area of the viewport.
- The element in the image takes up half of the viewport in one frame.
- Then, in the next frame, the element shifts down by 25% of the viewport height.
- The red, dotted rectangle indicates the union of the element's visible area in both frames, which is 75% of the total viewport, so its impact fraction is 0.75.



Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed nec lacus commodo, molestie est non, dapibus leo. Pellentesque volutpat nec libero nec cursus. Maecenas vulputate ultrices libero, vitae tincidunt mi sodales ac. Suspendisse potenti. Vivamus enim nisl, mollis at pretium at, laoreet id est. In sit amet ex a ligula pulvinar ultrices sed a nulla. Donec et vulputate orci. Suspendisse non lacus fringilla, dignissim eros a, euismod tellus. Curabitur sit amet ultricies lectus





- The distance fraction is the distance that unstable elements have moved, relative to the viewport. The distance fraction is the greatest distance any unstable element has moved in the frame divided by the viewport's largest dimension.
- In the image, the largest viewport dimension is the height, and the unstable element has moved by 25% of the viewport height, which makes the distance fraction 0.25.
- In this example the impact fraction is 0.75 and the distance fraction is 0.25, so the layout shift score is 0.75 * 0.25 = 0.1875.



Lorem ipsum dolor sit amet, consectetur adipiscing elit. Sed nec lacus commodo, molestie est non, dapibus leo. Pellentesque volutpat nec libero nec cursus. Maecenas vulputate ultrices libero, vitae tincidunt mi sodales ac. Suspendisse potenti. Vivamus enim nisl, mollis at pretium at, laoreet id est. In sit amet ex a ligula pulvinar ultrices sed a nulla. Donec et vulputate orci. Suspendisse non lacus fringilla, dignissim eros a, euismod tellus. Curabitur sit amet ultricies lectus.



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Curabitur sit amet ultricies lectus.

Cumulative Layout Shift (CLS):

To provide a good user experience, sites should strive to have a CLS score of 0.1 or less.







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Case Study: Vodafone

Vodafone is a leading telecommunications company operating fixed and mobile networks in 21 countries.

An A/B test was run on a landing page (where version A was optimized for Web) Vitals and had a 31% better LCP score)





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Optimized Ad Landing page

better LCP than the default landing page. Traffic expected: 100k clicks/day & 34K visits/day

Default ADV Landing page

"baseline" default page of the A/B test Traffic expected: 100k clicks/day & 34K visits/day





Case Study: Vodafone

Vodafone determined that the optimization resulted in a very positive Return on Investment (ROI)





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Improvement in the cart to visit rate

Improvement in LCP

Case Study: Rakuten 24

- Rakuten 24 is an online store that collaborates with both major multinational and domestic consumer goods manufacturers to offer a great variety of daily necessities.
- This store is provided by Rakuten Group, Inc.—a global leader in internet services, and is among the top performers on their digital marketplace platform in Japan.
- Rakuten 24 decided to use the web-vitals JavaScript library to measure Core Web Vitals and other metrics in the field and send the data to inhouse analytics tool.
- Rakuten 24 also ran an A/B test focused on optimizing Core Web Vitals and related metrics.





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n major multinational and at variety of daily necessities. leader in internet services, place platform in Japan.

Case Study: Rakuten 24







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Case Study: Rakuten 24

Web performance optimization is challenging but rewarding.





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Performance Measurement Tools

Performance Pillars

- Networking fetching resources
- Rendering page layout and rendering
- Computing JavaScript execution

The rendering and computing steps follow a single-threaded approach

- it is not possible to perform concurrent modifications of the resulting Document Object Model (DOM).
- optimizing how the rendering and script execution runtimes work together is of critical importance.
- □ Fast and efficient delivery of network resources is also a performance keystone of web applications.
 - Optimizations of rendering won't do much good if the browser is blocked on the network, waiting for the resources to arrive





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Resource Waterfall

- The resource waterfall is likely the single most insightful network performance and diagnostics tool at our disposal.
- Every HTTP request is composed of several separate stages



- In this example, the Yahoo! homepage took 683 ms to download.
- Over 200 ms of that time was spent waiting on the network, which amounts to 30%. of total
- The rest of the time is spent downloading resources.



5 0.6	0.7	0.8	0.9	
	683 r	ns		
e to First Byte	Cont	ent Downk	bad	

- A modern web application needs a wide variety of resources to produce the final output.
- In the given example, to load the Yahoo! homepage, the browser requires 52 resources, fetched from 30 different hosts, all adding up to 486 KB in total.
- The resource waterfall reveals several important insights about the structure of the page and the browser processing pipeline.
- It is a powerful tool that can help reveal the chosen optimizations, or lack thereof, for any page or application.



http://www.yahoo.com	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
1. www.yahoo.com – /	68	3 ms							
2. l.yimg.com – combo	161 ms								
3. l1.yimg.com – p1.gif	📕 126 ms								
4. l2.yimg.com – p1.gif	📕 119 ms								
5. 13.yimg.com – p1.gif	17 9 m:	s							
6. l4.yimg.com – p1.gif	161 m:	s							
7. l.yimg.com – p2.gif	94 ms	*							
8. l1.yimg.com – p2.gif	8 9 ms								
9. 12.yimg.com – p2.gif	92 ms								
10. l.yimg.com - p1.gif	🧧 62 ms								
11. l.yimg.com – combo	92 ms								31. l.yimg.com – bc_2.0.5.js
12. l.yimg.com – combo	85 ms								32. 1.ying.com - combo
13. l.yimg.com – combo		538 m	s				·		
14. l3.yimg.com - p2.gif	115 m:	5							33. b.scorecardresearch.com - p
15. l4.yimg.com - p2.gif	106 ms	s							34. www.yahoo.com - ie9_favicon.ico
16. l.yimg.com – 120x451ho74qbs3.png		40	ms						35. us.bc.yahoo.com – b
17. 13.yimg.com - b250_1363616797.jpg		. . :	172 ms						36. csc.beap.bc.yahoo.com – yi
18. 14.yimg.com - bx48_1363616797.jpg		:	173 ms						37. l.yimg.com – combo
19. l1.yimg.com - j×48_1363561086.jpg		:	170 ms						38. b.scorecardresearch.com - p2
20. 12.yimg.com - M×48_1363615363.jpg			173 ms						39. l.yimg.com - combo
21. l1.yimg.com - ax48_1363608320.jpg		:	172 ms						40. ad.doubleclickd=1363622082.56279
22. 12.yimg.com - 1×48_1363564400.jpg		:	172 ms						
23. l.yimg.com – transparent-95031.png		1	135 ms						41. ad.yieldmanager.com – imp
24. l.yimg.com - p.gif		:	134 ms						42. www.yahoo.com3COEdRDDAA016bvZx4
25. l.yimg.com – combo			136 ms						43. 13.yimg.com - 470_2598663.jpg
26. 14.yimg.com – prite_0307_10am.png			114 ms						44. 13.yimg.com – 1anne-hough-467.jpg
27. 13.yimg.com – video_15x11.png		·	100 ms						45. 14.yimg.com - 11h2.gif
28. ads.yimg.com – adchoice_1.png			257 m						46. l2.yimg.com – kka.gif
29. l.yimg.com – combo			118 🛛	ns					47. 12.yimg.com - gaj.gif
30. l.yimg.com – cs_0.2.js				111 ms					48. 14.yimg.com - iie_2.gif
									10. 11.91M8.00M 11C_2.811

43. 13.91mg.com - 470_2398883.jpg
44. 13.yimg.com - 1...anne-hough-467.jpg
45. 14.yimg.com - 11h2.gif
46. 12.yimg.com - kka.gif
47. 12.yimg.com - gaj.gif
48. 14.yimg.com - gaj.gif
49. d.p-td.com - 52822746
50. cookex.amp.yahoo.com - imp
51. ad.yieldmanager.com - imp
52. 1.yimg.com - 300x2501t6t60bm8.swf
——BandwidthIn (0 - 3,778 Kbps)
Initial Connection



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Resource waterfall analysis

- Notice that HTML parsing is performed incrementally, allowing the browser to discover required resources early and dispatch the HTTP requests in parallel.
- The incremental discovery of each resource in the document is what creates the distinct resource "waterfall effect."
- The "Start Render" (green vertical line) occurs well before all the resources are fully loaded, allowing the user to begin interacting with the page while the page is being built.
- the "Document Complete" event (blue vertical line), also fires early and well before the remaining assets are loaded.
- Different browsers implement different logic for when, and in which order, the individual resource requests are dispatched.



Connection View





Connection View

The connection view shows the life of each TCP connection

□ In this example:

- 14 DNS lookups
- 22 TCP handshakes
- A lot of network latency (indicated in green) while waiting to receive the first byte of each response
- The download time (indicated in blue) is a small fraction of the total time.

Why some requests are showing the green bar (time to first byte) only? In the bandwidth chart, why is the utilization of the available connection very low?





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Browser Developer Tools

DevTools

- Chrome DevTools is a set of web developer tools built directly into the Google Chrome browser.
- It provides in-depth analysis on everything that happens while your page loads or runs.
- **Given Seatures:**
 - Evaluate site performance
 - Log network requests
 - Simulate mobile devices with Device Mode
 - Many more ...
- Other browsers (Firefox, Safari etc.) also have developer tools that offer similar functionality.



DevTools

Features

- View the network activity
- Inspect a resource's details
- Filter resources
- View/Search headers, responses, cookies, timing etc.
- Customize columns
- Simulate a slower network connection
- Recorder
- Emulate a first-time visitor
- Emulate slow network connections
- Export data





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Network Activity	Demo X	+						
os://devtools.g	glitch.me/	network/getsta	rted.html					:
t Netw	ork	Activit	v De	emo				
	••••		,					
n demo for tl	he <u>Inspe</u>	ct Network A	<u>ctivity Ir</u>	Chrom	e DevTools	tutoria	ul.	
onsole Sourc	es Netw	ork Performan	ice Men	nory Ap	plication »		:	×
		by frame Pre		, ,		fline On	line	•
-		XHR JS CSS						
	00 ms	250 ms 300 r	-		400 ms 450		500 ms	5
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Ctatus	Tree	Initiator	Cine	Time	Waterfall			
Status 200	Type docum	Initiator	Size 1.3 KB	Time 302 ms	vvaleriali			
200	stylesh	getstarted.html	691 B	109 ms			-	
	01,100,111	gototartoannin					_	
200	script	getstarted.html	330 B	124 ms				
	script png	getstarted.html getstarted.html	330 B 7.3 KB	124 ms 11 ms			۵ د	
200		-					1	
200 200	png	getstarted.html	7.3 KB	11 ms			4	
200 200 200	png png	getstarted.html	7.3 KB 3.1 KB	11 ms 17 ms			4	



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Lighthouse

Lighthouse

- Lighthouse is an open-source, automated tool for improving the performance, quality, and correctness of your web apps.
- Give Lighthouse an URL and it runs a series of audits against the web page.
- □ It generates a report that offers opportunities for optimization.
- □ It has audits for:
 - Performance
 - Accessibility
 - Progressive web apps
 - SEO



Lighthouse

How to run Lighthouse?

- Chrome DevTools Easily audit pages that require authentication, and read your reports in a user-friendly format.
- Command line Automate your Lighthouse runs via shell scripts.
- **Node module** Integrate Lighthouse into your continuous integration systems.
- Web UI Run Lighthouse and link to reports without installing a thing



Demo

- 1. Navigate to PageSpeed Insights.
- 2. Enter a web page URL.
- 3. Click Analyze.



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Audit Report





Performance

Values are estimated and may vary. The performance score is calculated directly from these metrics. See calculator.









Audit Report

METRICS

First Contentful Paint
 0.9 S

Total Blocking Time 30 ms

Speed Index
0.9 S

OPPORTUNITIES

Opportunity

- Serve images in next-gen formats
- Efficiently encode images

Properly size images

- Largest Contentful Paint **1.3 S**
- Cumulative Layout Shift
 0.003



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Estimated Savings

2.56s 🗸
1.16s 🗸
0.36s 🗸



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WebPage Test

WebPage Test

- It is an open-source project and a free web service that provides a system for testing the performance of web pages from multiple locations around the world.
- It also allows you to add packet-level network emulation on top, including aspects such as packet loss





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(Experimental: Measures carbon footprint. Chromium browsers only)

(Loads the page, closes the browser and then loads the page again)

(Runs on Chrome, emulated Moto G4 device, over simulated 3G Fast

WebPage Test





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i Note: Metric availability will vary

wait dns connect ssl	html js	css image	flash	font	video	other	JS Executior
tep_1	0.2 0.4 0.6 0.8	3 1.0 1.2	1.4 1.6	1.8 2.0	2.2	2.4 2.6	5 2.8
1. www.facebook.com - /	369 ms	84					
🔉 2. static.xx.fbc Oui98GyjX45.css	126 ms						
3. static.xx.fbc UiF6KvaaDMc.css	85 ms						
4. static.xx.fbc C-u07Uhe2Ld.css	82 ms						
5. static.xx.fbc sE-LYoTFzMc.css	76 ms						
6. static.xx.fbc 3ursT_F1fbk.css	88 ms						
7. static.xx.fbc LTP94XvPA2s.js		77 ms 👝 🖂 🗤					
8. static.xx.fbc fhrZ5Qrt,jNj.css	94 ms						
9. static.xx.fbcdn.net - rSZ1-Pdwb3G.js		37 ms					
10. static.xx.fbcdn 41Cu2zih0ca.svg	161						
11. static.xx.fbcdn.net - rf7yAhNGY86.js		100 ms					
12. static.xx.fbcdn 5_76epdonNu.css		36 ms					
13. static.xx.fbcdn.net - YoTddyRzZmh.js		50 ms			_		
		48 ms					
14. static.xx.fbcdn.net – v75M7CPu9–P.js							
15. www.facebook.comcard_image_1.png		96 ms					
16. www.facebook.comcard_image_2.png		124 ms					
17. www.facebook.comcard_image_3.png		190 ms					
18. www.facebook.comcard_image_4.png		222 ms					
19. www.facebook.compopup_image_1.png		38	6 ms				
20. www.facebook.compopup_image_2.png			553 ms				
21. www.facebook.compopup_image_3.png			724				
22. www.facebook.compopup_image_4.png				808 ms			
23. static.xx.fbcdn 07nelmd9XSI.png		55 ms					
24. static.xx.fbcdn Y0L6f5sxdIV.png		76 ms					
25. static.xx.fbcdn.net - a10LcVhluEP.js		133 ms					
26. static.xx.fbcdn.net - fi9_yN9n_WX.js		137 ms					
27. static.xx.fbcdn.net - wm4d5zAAo-a.js		139 ms					
28. static.xx.fbcdn.net - 3FPJ9YC_wUr.js		142 ms					
29. static.xx.fbcdn.net - 35Ah1Ujo6FX.js		153 m					
30. static.xx.fbcdn.net - s_Izg7nAY9js		164 🛛					
31. static.xx.fbcdn.net - 1FK_RCKM9IT.js		164 г					
32. static.xx.fbcdn.net - uxo64bLLIeV.js		177					
33. static.xx.fbcdn.net - TN5IuRI1AGx.js		186					
34. static.xx.fbcdn.net - nDIMG4z3c_3.js			275 ms				
-							
35. static.xx.fbcdn.net - 91Diey119HS.js			266 ms				
36. static.xx.fbcdn.net – 9XJWkOh–7V5.js			237 ms				
37. static.xx.fbcdn.net – QcYlxMWQTQ–.js			229 ms				
38. static.xx.fbcdn.net – qvzskUrY1YC.js			250 ms				
39. static.xx.fbcdn.net - o95MhjcKs5m.js			259 ms				
40. static.xx.fbcdn.net - sKtrEJAtiUM.js		-	274 ms				
41. static.xx.fbcdn.net - RkKp7NL-4Sq.js			277 ms				
42. static.xx.fbcdn.net - vxcH5tf_3VZ.js		-	387 ms				
43. static.xx.fbcdn.net - PtmfxLVwAb7.js			389 ms				
44. static.xx.fbcdn.net - PBxn1dUtKfr.js			390 ms				
45. static.xx.fbcdn.net - zn37L1-eFvQ.js			402 ms				
46. static.xx.fbcdn.net - dqd6vCA9PNV.js			412 ms				
47. static.xx.fbcdn.net – cA_3fTtJxgp.js			414 ms				
48. static.xx.fbcdn.net - t6t6mVeu0oB.js			433 ms	:			
49. static.xx.fbcdn.net – hs3cFqIcg1k.js			455 m	s			
50. static.xx.fbcdn.net – L1dUp3PL_gy.js			459 m	IS			
51. static.xx.fbcdn.net - EcHbCLLcfHK.js			469	ns			
52. static.xx.fbcdn.net - PceR4zK3RHZ.js			470	ns			
53. static.xx.fbcdn.net - SrKAqQA2141.js			51	9 ms			
54. static.xx.fbcdn.net - w6HRanQvzJ5.js				639 ms			
55. static.xx.fbcdn.net - euLeui0FtEX.js				658 ms			
56. static.xx.fbcdn.net - zyRovCtoGSI.js				662 ms			
57. static.xx.fbcdn.net - ISUe9_7D94n.js				664 ms			
58. facebook.com – hsts-pixel.gif	1		494 ms	004 143			
·			434 03	4.20	2		
59. www.facebook.com - bz					9 ms 2 ms		
50. www.facebook.com - manifest/					2 ms		
51. static.xx.fbcdn hLRJ1GG_y0J.ico				40 ms			
52. static.xx.fbcdn eFZD1KABzRA.png					37 ms		
53. www.facebook.com - bz							159 ms
	0.2 0.4 0.6 0.8	3 1.0 1.2	1.4 1.6	1.8 2.0	2.2	2.4 2.6	5 2.8
CPU Utilization							
Bandwidth In (0 - 5,000 Kbps)							



Repeat view

Long Tasks



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Resource Waterfall of the Test

Lar	gest Co	ontentf	ul Pain	t	DO	M Inte	eractive		D	OM Co	ontent l	oadeo		C	n Loac) (t	Do	cumen	t Comp	olete
	htm	1		js		CSS		ima	ge	fl	lash		font		vide	0	ot	her	JS E:	xecution
0.1	0.2	0.3			0.6	0.7	0.8	0.9		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
			1	r INS		20	9 ms													
									1		121	ms						169	ms I	
0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8			2.1
						ſ			-			_								
								h												
	0.1	0.1 0.2	htm1	html 0.1 0.2 0.3 0.4 347	0.1 0.2 0.3 0.4 0.5 347 ms	html js 0.1 0.2 0.3 0.4 0.5 0.6 347 ms	html js css 0.1 0.2 0.3 0.4 0.5 0.6 0.7 347 ms	html js css 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 347 ms 209 ms	html js css imag 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 347 ms 1 209 ms	html js css image 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0	html js css image fi 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1	html js css image flash 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 347 ms 1 209 ms 1 33 r 121 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2	html js css image flash 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3	html js css image flash font 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4	html js css image flash font 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5	html js css image flash font vide 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6	html js css image flash font video 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7	html js css image flash font video oth 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 347 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8	html js css image flash font video other 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 347 ms 1 209 ms 133 ms 121 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9	html js css image flash font video other JSE 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0 347 ms 1 209 ms 1 133 ms 121 ms 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0

Connection View of the Test



First view





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	fon	t		video		other			
	_								
1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1		
						1			
1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1		
					_				
							_		

Acknowledgements

https://developer.chrome.com/docs/lighthouse

https://web.dev/

https://www.webpagetest.org/





Thank you for your attention!