Why is My Website Running Slow?



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Performance Vs. Conversion



An Example of Performant Website



Measuring Site Performance







First Paint & First Contentful Paint

First Meaningful Paint

Visually Complete

Construction Metrics

Web Page Performance Test for https://hknog.net/

Requests







MIME Type	Requests V
js	25
CSS	11
image	6
font	3
html	1
flash	0
other	0
video	0

MIME Type	Bytes V	Uncompressed
image	191,902	189,615
js	141,553	384,147
font	80,369	79,180
CSS	43,648	235,240
html	6,594	33,787
flash	0	0
other	0	0
video	0	0

Category	Time (ms) 🔻
Idle	4,573
Scripting	290
Layout	150
Painting	25
Loading	19
Other	2

W3C Navigation & Resource Timings



Example: Navigating https://hknog.net/





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	custom.c	200	http/1.1	https	stylesheet	1.7 KB	69 ms	Stalled		2.36 ms		
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PLT != Bytes / BW

Deep-diving into the Problem...



Latency 101

- Queueing Buffer & Processing
- Transmission Bandwidth
- **Propagation** Distance





Example: Browser Timing

Queueing vs. Stalled

Official definition:-

- Queueing. The browser queues requests when:
 - There are higher priority requests.
 - There are already six TCP connections open for this origin, which is the limit. Applies to HTTP/1.0 and HTTP/1.1 only.
 - The browser is briefly allocating space in the disk cache
- Stalled. The request could be stalled for any of the reasons described in Queueing.







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	agroup ppg		~ ~		\sim				
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Head-of-Line Blocking



Multiple Connections

HTTP/1.x

Request #1	Response #1	Request #2	Response #2	Request #3	Response #3	Request #4	Response #4
Request #1	Response #1	Request #2	Response #2	Request #3	Response #3	Request #4	Response #4
Request #1	Response #1	Request #2	Response #2	Request #3	Response #3	Request #4	Response #4
				•			
				•			
Request #1	Response #1	Request #2	Response #2	Request #3	Response #3	Request #4	Response #4

How Many Connections Are Enough?





Bandwidth Delay Product (BPD):

• 7.2Mbps¹ x 50ms² \approx 44KB

For a Chrome user (6 persistent conns for one HTTP/1.x domain):

• 6 x 352B ≈ 2KB

For my customer's app (8 persistent conns):

• 8 x 352B ≈ 3KB

¹Global Average and Average Peak Connection Speeds. Akamai's State of the Internet, Q1 2017.

²Latency between Hong Kong and Tokyo with Akamai's Route Optimization. https://www.akamai.com/us/en/solutions/intelligent-platform/visualizing-akamai/network-performance-comparison.jsp

Better Approaches



Server-side Blocking

Name	S	H ⁻	TTP/2		< ´	lize		Waterfall 5	0.00 ms	100.00 ms	150.00 ms	200.00 ms	250.00 ms
wchan-akamaiflowershop	20				\rightarrow	3.7 KB	- 110	cai in the					
stylesheet.css	200	To	1	\sum	Push	1.9 KB				0			
icon_category.png	200	h2	69.192		(index)	586 B	1						
jquery-1.3.2.min.js	200	h2	69.192		(index)	19.5 KB				Output at ER 42 mg			
icon_information.png	200	h2	69.192	***	(index)	763 B	1			Queueu at 56.42 ms			
icon_currency.png	200	h2	69.192		(index)	880 B	1			Started at 00.10 ms			
icon_bestsellers.png	200	h2	69.192		(index)	812 B	1			Resource Scheduling		TIME	
Bloodroot-38x38.jpg	200	h2	69.192	j	(index)	3.1 KB	1			Queueing		9.74 ms	
Epilobium-38x38.jpg	200	h2	69.192	Jur	(index)	2.6 KB	1			Connection Start		TIME	
thickbox-compressed.js	200	h2	69.192	m	(index)	2.9 KB				Stalled	100	19.69 ms	
get_flash_player.gif	404	h2	69.192	t	(index)	392 B	1			Demiest/Deensnee		TIME	
WoodAnemone-120x120.jpg	200	h2	69.192	j	(index)	17.8 KB	1			Request sent	12	4.71 ms	
TwinFlower-120x120.jpg	200	h2	69.192	j	(index)	16.2 KB	1			Waiting (TTFB)		152.85 ms	
Trillium-120x120.jpg	200	h2	69.192	j	(index)	15.9 KB	1		L	Content Download	-	5.06 ms	
thickbox.css	200	h2	69.192		(index)	1.1 KB				Destauration		102.04	
Toadshade-120x120.jpg	200	h2	69.192	j	(index)	16.6 KB	1			Explanation		192.04 ms	
Searocket-120x120.jpg	200	h2	69.192	j	(index)	7.6 KB	1						
PurpleClematis-120x120.jpg	200	h2	69.192	j	(index)	18.3 KB	1			-			
PinkPurslane-120x120.jpg	200	h2	69.192	j	(index)	17.0 KB	1			C. Manager			
tab.js	200	h2	69.192	-	(index)	423 B							
FirePink-120x120.jpg	200	h2	69.192	j	(index)	11.5 KB	1						
- University_Header.png	200	h2	69.192		(index)	23.7 KB	1						
avment.ong	200	h2	69.192		(index)	5.2 KB	1			-			

Transport-layer Blocking



3			
ſ	Queued at 0		
	Quedeo at 0		
	Started at 0.36 ms		
1	Resource Scheduling		TIME
	Queueing		0.36 ms
	Connection Start		TIME
	Stalled		2.36 ms
	DNS Lookup		241.93 ms
	Initial connection	1	32.55 ms
9	SSL	1	26.87 ms
2	Request/Response		TIME
	nequest nesponse	- N	111916
	Request sent		39 µs
	Waiting (TTFB)		1.24 s
	Content Download		6.09 ms

E.g., TTFB and Content Download:-

Other Browser Timings



https://hknog.net/

Fixing the Bottlenecks by BW and RTT?



Many Ways to Improving Site Performance

Propagation

- Akamai Cache Hierarchy
- Sureroute
- NetStorage
- Cloudlets
- Direct Connect
- Cloud Wrapper
- Downstream Cacheability
- Script Management
- API Gateway

Transmission

- Last Mile Acceleration (GZIP)
- Resource Optimizer (Brotli & Zopfli)
- Image Manager
- FEO (Inlining, minifying, JIT)
- Large File Optimization (LFO)

Queueing

- Adaptive Acceleration (e.g., automated link preconnect, server push)
- HTTP/2
- QUIC
- Object and Page Prefetching







Thank you!

