Server Push

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Motivation

- Save a round trip
  - Especially useful with high latency connections
- Save more round trips (every consecutive page load can be completed in a single round trip)
  - The most powerful amongst round trip saving optimizations
  - The hardest to master

● Regular connection:

Name	Status	Domain	Type	Initiator	Size	Time	Timeline – Start Time
blog.cloudflare.com	200	blog.cloudflare.com	document	Other	4.8 KB	139 ms	
screen.css?v=430de421d3	200	blog.cloudflare.com	stylesheet	(index):17	21.6 KB	232 ms	
FB-banner-webinar-1200x628px_wBorder_v1.jpg	200	blog.cloudflare.com	jpeg	(index):103	131 KB	488 ms	
jquery.fitvids.js?v=430de421d3	200	blog.cloudflare.com	script	(index):246	2.9 KB	485 ms	
view.gif?page=/ask-some-http-2-pros-the-hard-ques...	200	blog.cloudflare.com	gif	(index):251	166 B	487 ms	
opensans-400.woff	200	blog.cloudflare.com	font	(index):246	15.7 KB	231 ms	
opensans-700.woff	200	blog.cloudflare.com	font	(index):246	15.6 KB	340 ms	
opensans-400i.woff	200	blog.cloudflare.com	font	(index):246	16.4 KB	342 ms	
cloudflare-sprite-small.png	200	blog.cloudflare.com	png	(index):246	10.8 KB	342 ms	
data:image/png;base...	200		png	(index):246	(from cac...	0 ms	

● With Server Push:

Name	Status	Domain	Type	Initiator	Size	Time	Timeline – Start Time
blog.cloudflare.com	200	blog.cloudflare.com	document	Other	6.5 KB	116 ms	
screen.css?v=430de421d3	200	blog.cloudflare.com	stylesheet	Push / (index):17	21.6 KB	213 ms	
FB-banner-webinar-1200x628px_wBorder_v1.jpg	200	blog.cloudflare.com	jpeg	Push / (index):1...	131 KB	438 ms	
jquery.fitvids.js?v=430de421d3	200	blog.cloudflare.com	script	Push / (index):2...	2.9 KB	3 ms	
view.gif?page=/ask-some-http-2-pros-the-hard-ques...	200	blog.cloudflare.com	gif	Push / (index):2...	166 B	3 ms	
cloudflare-sprite-small.png	200	blog.cloudflare.com	png	Push / (index):-I...	10.8 KB	4 ms	
opensans-400.woff	200	blog.cloudflare.com	font	Push / (index):-I...	15.7 KB	5 ms	
opensans-700.woff	200	blog.cloudflare.com	font	Push / (index):-I...	15.6 KB	5 ms	
data:image/png;base...	200		png	(index):-Infinity	(from cac...	0 ms	
opensans-400i.woff	200	blog.cloudflare.com	font	Push / (index):-I...	16.4 KB	7 ms	

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Server Push @ CloudFlare

- Origin provides hint with the <Link> response header
- Max 50 per page
- Up to the origin to decide what to push and estimate performance benefits
  - Plugins exists for some platforms
- Debug header: <cf-h2-pushed>
- A lot of positive feedback:
  - "HTTP2 Push headers, which by the way are awesome! We've seen about a 20-30% speedup on page render time across the board once implementing it."

Server Push @ CloudFlare

- A bit hard to get right for the average user
- Can rarely save a full round trip from page load
  - External dependencies

Name	Status	Domain	Type	Initiator	Size	Time	Timeline – Start Time
blog.cloudflare.com	200	blog.cloudflare.com	document	Other	8.2 KB	120 ms	
screen.css?v=430de421d3	200	blog.cloudflare.com	stylesheet	Push / (index):21	21.6 KB	208 ms	
FB-banner-webinar-1200x628px_wBorder_v1.jpg	200	blog.cloudflare.com	jpeg	Push / (index):179	131 KB	439 ms	
in.js	200	platform.linkedin.com	script	(index):179	2.1 KB	34 ms	
jquery-1.11.3.min.js	200	code.jquery.com	script	(index):316	38.3 KB	38 ms	
bizible.js	200	cdn.bizible.com	script	(index):93	22.9 KB	17 ms	
jquery.fitvids.js?v=430de421d3	200	blog.cloudflare.com	script	Push / (index):3...	2.9 KB	6 ms	
view.gif?page=/ask-some-http-2-pros-the-hard-ques...	200	blog.cloudflare.com	gif	Push / (index):3...	166 B	7 ms	
cloudflare.min.js	200	ajax.cloudflare.com	script	(index):13	21.9 KB	26 ms	
analytics.js	200	www.google-analyt...	script	(index):24	11.3 KB	10 ms	
munchkin.js	200	munchkin.marketo...	script	(index):90	1.1 KB	6 ms	
opensans-400.woff	200	blog.cloudflare.com	font	Push / (index):1...	15.7 KB	3 ms	
opensans-700.woff	200	blog.cloudflare.com	font	Push / (index):1...	15.6 KB	3 ms	
opensans-400i.woff	200	blog.cloudflare.com	font	Push / (index):1...	16.4 KB	3 ms	
cloudflare-sprite-small.png	200	blog.cloudflare.com	png	Push / (index):1...	10.8 KB	2 ms	
embed.js	200	cloudflare.disqus.c...	script	(index):163	50.5 KB	31 ms	
widgets.js	200	platform.twitter.com	script	(index):169	31.5 KB	19 ms	
all.js	200	connect.facebook...	script	(index):176	56.2 KB	35 ms	
secureAnonymousFramework?v=0.0.1195-RC8.57159...	200	platform.linkedin.com	script	in.js:84	45.7 KB	47 ms	
platform.js	200	apis.google.com	script	(index):184	15.2 KB	102 ms	
st.js	200	s.swiftypecdn.com	script	(index):194	105 KB	56 ms	
data:image/png;base...	200		png	(from cac...		0 ms	
munchkin.js	200	munchkin.marketo...	script	munchkin.js:6	3.9 KB	22 ms	
collect?v=1&_v=j44&a=801014799&t=pageview&_s=...	200	www.google-analyt...	gif	Other	63 B	11 ms	
count.js	200	cloudflare.disqus.c...	script	(index):328	1.3 KB	23 ms	
ipv?_biz_r=&_biz_h=802059049&_biz_u=cf6727ca18f...	200	cdn.bizible.com	gif	Other	470 B	7 ms	
https://cdn.bizible.com/m/ipv?_biz_r=&_biz_h=802059049&_biz_u=cf6727ca18fc4ab5df8caf416730a1b4&_biz_s=2e5ef3&_biz_l=https%3A%2F%2Fblog.cloudflare.com%2F&_biz_t=1469225821682&_biz_i=HTTP%2F2%20and%20Server%20Push&_biz_n=110&rnd=120353&cdn_o=a&_biz_z=1469225							
?base=default&version=1cde8c7fb2db946b524cf77d...	200	disqus.com	document	embed.js:19	3.2 KB	9 ms	
share?url=https%3A%2F%2Fblog.cloudflare.com%2Fa...	200	www.linkedin.com	script	secureAnonym...	699 B	59 ms	
visitWebPage?_mchNc=1469225822166&_mchCn=&...	200	473-xsc-918.mktor...	xhr	munchkin.js:10	472 B	417 ms	
sprite_connect_v14.png	200	static.licdn.com	png	(index):-Infinity	41.2 KB	22 ms	
button.1813ea3f78757294e1ba1cea21b068a0.js	200	platform.twitter.com	script	widgets.js:1	2.0 KB	11 ms	
cb=gapi.loaded_0	200	apis.google.com	script	platform.js:7	41.2 KB	17 ms	
cb=gapi.loaded_1	200	apis.google.com	script	platform.js:7	23.0 KB	14 ms	
fastbutton?usegapi=1&size=medium&origin=https%3...	200	apis.google.com	document	platform.js:23	11.5 KB	69 ms	
?api_key=596756540369391&lid=115&payload=%7B...	200	www.facebook.com	gif	Other	175 B	49 ms	
bz-D0tzmBsw.js?version=42	200	staticxx.facebook.c...	document	all.js:80	11.0 KB	21 ms	
lounge.load.1cde8c7fb2db946b524cf77dca48c7d5.js	200	a.disquscdn.com	script	?base=default...	8.3 KB	18 ms	
_KobMC_zsd_tDx_7NWiX.json	200	s.swiftypecdn.com	xhr	bizible.js:121	4.9 KB	24 ms	
tweet_button.a9003d9964444592507bbb36b98c70...	200	platform.twitter.com	document	widgets.js:10	12.0 KB	9 ms	
postmessageRelay?parent=https%3A%2F%2Fblog.clo...	200	accounts.google.co...	document	cb=gapi.loaded...	397 B	35 ms	
new_embed-28251278dfbb54588d68fbd8d7cc72ba...	200	s.swiftypecdn.com	stylesheet	st.js:10	34.2 KB	28 ms	
sTdaA6j0Psb920Vjv-mrzH-_kf6ByYO6CLYdB4HQE-Y...	(pendin...	fonts.gstatic.com		fastbutton?use...	0 B	Pending	
uYECMKoHcO9x1wdmbyHlm3-_kf6ByYO6CLYdB4HQ...	(pendin...	fonts.gstatic.com		fastbutton?use...	0 B	Pending	
tnj4SB6DNbdaQnsM8CFqBX-_kf6ByYO6CLYdB4HQE...	(pendin...	fonts.gstatic.com		fastbutton?use...	0 B	Pending	
_VYFx-s824kXq_Ul2BHqYH-_kf6ByYO6CLYdB4HQE-Y...	(pendin...	fonts.gstatic.com		fastbutton?use...	0 B	Pending	
NJ4vxlgWwWbEsv18dAhqnn-_kf6ByYO6CLYdB4HQE...	(pendin...	fonts.gstatic.com		fastbutton?use...	0 B	Pending	
Ks_cVxiCiwUWVsFWFA3Bjn-_kf6ByYO6CLYdB4HQE-...	(pendin...	fonts.gstatic.com		fastbutton?use...	0 B	Pending	
oMMgfZMQthOryQo9n22dcuvvDin1pK8aKteLpeZ5c0...	200	fonts.gstatic.com	font	fastbutton?use...	10.1 KB	8 ms	

1.00 s 1.50 s 2.00 s 2.50 s 3.00 s

Server Push at CloudFlare

- A bit hard to get right for the average user
- Can rarely save a full round trip from page load
  - External dependencies
- Very wasteful
  - 47% of pushed assets are canceled by browser (RST_STREAM)
  - Probably part of the other assets end up unused too

Some HTTP/2 metrics @ CloudFlare

- Over 25 % of connections are SSL:
  - 24 % of those are HTTP/2
  - 9 % are SPDY
  - The rest are HTTP/1.X
- Only 0.15% of all HTTP/2 connections utilize Server Push :(
- However:
  - HTTP/1.X connection: 2.5 requests
  - HTTP/2 connection: 5.5 requests
  - HTTP/2 + Server Push connection: 24 requests!

To Push or not to Push, that is the question

- Two major challenges with Server Push
  - What to Push
    - Identify ALL critical assets on the page, and push them
    - Missing assets will trigger an extra round trip
  - What not to Push
    - Identify items already in browser cache
    - False positives will trigger an extra round trip

What to Push?

- Link headers
  - Pros: Works; Simple; No extra resources (besides network); No server side state;
  - Inflexible
    - Enhance with flags that can increase flexibility
- Push everything
  - Parse/render the page when it is first cached (independently for each supported User-Agent)
  - Pros: Probably works; Simple; Requires processing on server; Speed;
- Learning system
  - Pros: potentially the most efficient; Speed
  - Cons:A lot of state keeping; Processing

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What not to Push

- Cookies
- Server side state
- Cache digest

How to generate a Push Promise?

- Push Promise = Request
  - Client needs to match a Promise to outgoing request
- Legitimate request has many headers:
  - Must include: :method: GET; :authority:; :path:
  - Probably should: accept-encoding; user-agent;
  - Not clear: accept-language; cache-control; cookie; etc
- Queries
- Fragment?
- Priority