

Understanding the Usage of New Internet Protocols in the Wild

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• Well known properties of the Internet



HOW ARE PROTOCOLS USED IN THE WILD?

It depends / we don't know



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Net-Ray Protocol Observatory



Goal: measure protocol adoption & usage regularly at large



IFIP Networking'17 SIGCOMM Internet-QoE'17

push.comsys.rwth-aachen.de

SSICLOPS

TCP IW 12410?

ACM IMC'17

iw.comsys.rwth-aachen.de

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Current Internet Change: HTTP1 -> HTTP2 (Tall to a the subscript)





How much faster is H2/H2-Push over H1?

- PLT measurements in Chrome
- H1 vs H2-push
 - Most sites benefit from just switching on H2
 - A few sites are slowed down by H2
 - This is also supported by related works

H2-no-push vs H2-push

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- Most sites: push makes no difference
- Some websites are accelerated up to 63%
- Others are slowed down by up to 67%





Takeaway: H2 (Push) can **speed-up** but also **slow-d**own the Web!

Why can't push keep its promise?

- We tried to correlate PLT improvements to how push is being used
 - The amount of objects does not seem to make a difference
 - Nor does the amount of bytes pushed
 - Or if it is a certain fraction of resource on the page
 - Only high RTTs show a trend in PLT reduction
 - Push saves round trips

PS

■ Yet, for CDN-typical RTTs below 50ms there is no trer 🖺



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300

250

200

150

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No Guidelines on *What* to Push *How*

Number of objects that are pushed

- ▶ 50% of all pages push no more than 6 objects
- 20% push at least 17 objects
- One site even pushed 72 objects
- Ratio of pushes to available resources
 - Some sites push all their resources
 - Other only parts

SSICLOPS

- There is no pattern visible
- Still push on 2nd visit? Not standardized!
 - IP based: Servers identify clients by IP and don't push again (NATs?)
 - Cookie-based, Client-side JS Code, …

Takeaway: No optimal strategy exists – site dependent optimization!





HTTP2 Push: End-User Perception

Push can speed-up or slow-down the Web

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▶ Is the protocol engineered correctly? \rightarrow Do users perceive it?

- User Study [ACM SIGCOMM Internet-QoE'17]
 - Lab Study
 - Crowdsourcing

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28 subjects

323 subjects













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Study Design

• Pair-wise comparison study

- Side-by-side loading process
- Show video (reproducible)

PS

- Which version loaded faster?
 - Left, No Difference, Right
- Allow users to replay video
- Monitor time and activity on website

	User Study: Internet Q	uality	
	Please select an answer below ((*).	
	Video 8 / 8		
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C Replay Video	Which version loaded faster	?* Right	Next

Condition	Definition
C ₀	Control (same video, e.g., H1 vs. H1)
C ₁	H1 vs. H2 without push (or vice versa)
C ₂	H1 vs. H2 with push (or vice versa)
C ₃	H2 w/o push vs. H1 (or vice versa)

Try yourself: https://userstudy.comsys.rwth-aachen.de



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Try yourself: https://userstudy.comsys.rwth-aachen.de





Participants Overview and Comparison

Study	Users	Gender ♀, ♂, ○	Age <25, 25-31, >31	Expertise -, ∅, +	Online [h] <4, 4-8, >8	Duration [s]
Lab	28	6, 21, 1	6, 20, 2	0, 9, 19	7, 11, 10	273.72
Crowd	323*	72, 246, 5	143, 119, 61	7, 95, 221	86, 130, 107	114.37

*after filtering 82 out of 405

• Compare votes contained in *both* groups

Verdict: Average over votes, encoding -1, 0, +1



Takeaway: Lab (controlled) & Crowd (uncontrolled) yield similar ratings



HTTP2 Push QoE: Some Pages Benefit Some Don'



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Summary: HTTP2

• H2 adoption is increasing but still low

- CDNs have a huge potential to increase the adoption
- Data available at: <u>https://push.comsys.rwth-aachen.de</u>

Almost no deployment for Server Push

No out of the box support

SSICLOPS

We find questionable use of server push

• Server Push not production ready

- Requires complex, site-dependent optimization
- Easy to make it wrong and slow down sites!
- Only high RTTs makes it likely that push helps