Happy Eyeballs Tester

Patrick Sattler, Tim Betzer, Marcel Kempf, **Johannes Zirngibl**

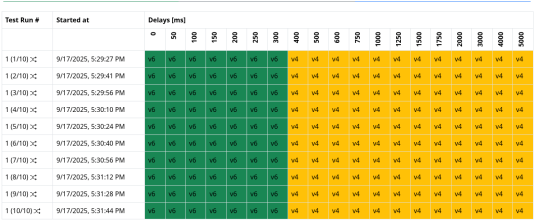
Monday 20th July, 2026

Technical University of Munich

Max Planck Institute for Informatics

Motivation

- The project started as a research project
  - What is the current behavior of clients based regarding Happy Eyeballs v1 and v2?
  - Covering: browsers, MASQUE proxies, resolvers
- but is still under development to support HEv3 standardization:
  - Add new DNS records
  - Add different HTTP versions and delays
  - Allow configurable tests
  - Allow for local/optimal setups

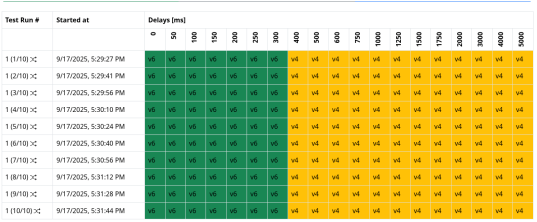


Test Run #	Started at	Delays [ms]																			
		0	50	100	150	200	250	300	400	500	600	750	1000	1250	1500	1750	2000	3000	4000	6000	8000
1 (1/10) ⤭	9/17/2025, 5:29:27 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (2/10) ⤭	9/17/2025, 5:29:41 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (3/10) ⤭	9/17/2025, 5:29:56 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (4/10) ⤭	9/17/2025, 5:30:10 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (5/10) ⤭	9/17/2025, 5:30:24 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (6/10) ⤭	9/17/2025, 5:30:40 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (7/10) ⤭	9/17/2025, 5:30:56 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (8/10) ⤭	9/17/2025, 5:31:12 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (9/10) ⤭	9/17/2025, 5:31:28 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (10/10) ⤭	9/17/2025, 5:31:44 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4

Test Run #	Started at	Delays [ms]																				
		0	50	100	150	200	250	300	400	500	600	750	1000	1250	1500	1750	2000	3000	4000	5000	10000	60000
1 (1/10) Delay A ⤭	9/17/2025, 5:37:37 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (1/10) Delay AAAA ⤭	9/17/2025, 5:37:37 PM	v6	v6	v6	v6	v4	v6	v6	v4	v6	v4	v4	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (2/10) Delay A ⤭	9/17/2025, 5:39:23 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (2/10) Delay AAAA ⤭	9/17/2025, 5:39:23 PM	v6	v6	v6	v4	v6	v4	v6	v6	v4	v6	v4	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4
1 (3/10) Delay A ⤭	9/17/2025, 5:40:37 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (3/10) Delay AAAA ⤭	9/17/2025, 5:40:37 PM	v6	v6	v6	v6	v4	v6	v6	v6	v6	v6	v4	v4	v4	v6	v4	v4	v4	v4	v4	v4	v4
1 (4/10) Delay A ⤭	9/17/2025, 5:41:46 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (4/10) Delay AAAA ⤭	9/17/2025, 5:41:46 PM	v6	v6	v6	v6	v4	v4	v4	v4	v6	v4	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4

Motivation

- The project started as a research project
  - What is the current behavior of clients based regarding Happy Eyeballs v1 and v2?
  - Covering: browsers, MASQUE proxies, resolvers
- but is still under development to support HEv3 standardization:
  - Add new DNS records
  - Add different HTTP versions and delays
  - Allow configurable tests
  - Allow for local/optimal setups

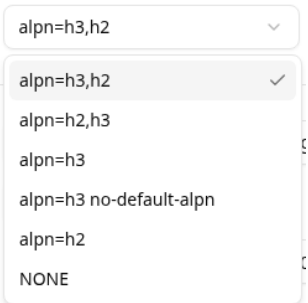


Test Run #	Started at	Delays [ms]																				
		0	50	100	150	200	250	300	400	500	600	750	1000	1250	1500	1750	2000	3000	4000	6000	8000
1 (1/10) ⤭	9/17/2025, 5:29:27 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (2/10) ⤭	9/17/2025, 5:29:41 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (3/10) ⤭	9/17/2025, 5:29:56 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (4/10) ⤭	9/17/2025, 5:30:10 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (5/10) ⤭	9/17/2025, 5:30:24 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (6/10) ⤭	9/17/2025, 5:30:40 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (7/10) ⤭	9/17/2025, 5:30:56 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (8/10) ⤭	9/17/2025, 5:31:12 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (9/10) ⤭	9/17/2025, 5:31:28 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (10/10) ⤭	9/17/2025, 5:31:44 PM	v6	v6	v6	v6	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4	v4

Test Run #	Started at	Delays [ms]																					
		0	50	100	150	200	250	300	400	500	600	750	1000	1250	1500	1750	2000	3000	4000	5000	10000	60000
1 (1/10) Delay A ⤭	9/17/2025, 5:37:37 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (1/10) Delay AAAA ⤭	9/17/2025, 5:37:37 PM	v6	v6	v6	v6	v4	v6	v6	v4	v6	v4	v4	v6	v4	v4	v4	v4	v4	v4	v4	v4	v4
1 (2/10) Delay A ⤭	9/17/2025, 5:39:23 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (2/10) Delay AAAA ⤭	9/17/2025, 5:39:23 PM	v6	v6	v6	v4	v6	v4	v6	v6	v4	v6	v4	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4
1 (3/10) Delay A ⤭	9/17/2025, 5:40:37 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (3/10) Delay AAAA ⤭	9/17/2025, 5:40:37 PM	v6	v6	v6	v6	v4	v6	v6	v6	v6	v6	v4	v4	v4	v6	v4	v4	v4	v4	v4	v4	v4
1 (4/10) Delay A ⤭	9/17/2025, 5:41:46 PM	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6	v6
1 (4/10) Delay AAAA ⤭	9/17/2025, 5:41:46 PM	v6	v6	v6	v6	v4	v4	v4	v4	v6	v4	v6	v6	v6	v4	v4	v4	v4	v4	v4	v4	v4

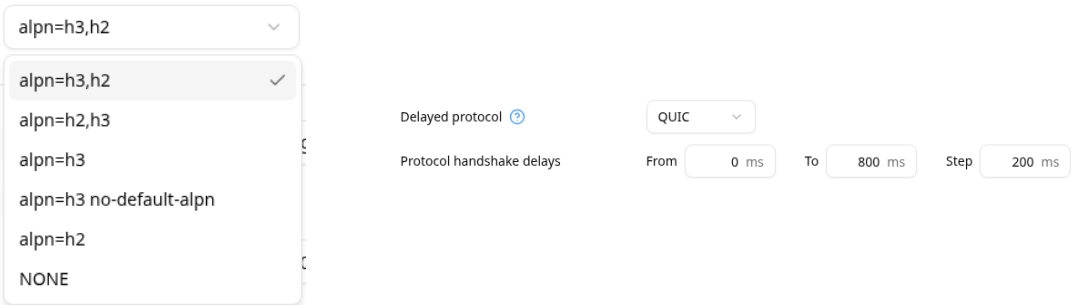
Happy Eyeballs Version 3

- Parameters are encoded in domains
- HTTP/3, HTTP/2 and HTTP/1 support
- Domains configured with A, AAAA and HTTPS records
  - The HTTPS record can be configured with different ALPN values
- Configurable delay for QUIC or TCP/TLS (delay of the Server Hello)
- Configurable delay for IPv6 or IPv4
  - Option 1: Delay impacts the network layer →already impacts TCP handshake
  - Option 2: Delay only impacts the TLS handshake →TCP handshake not impacted



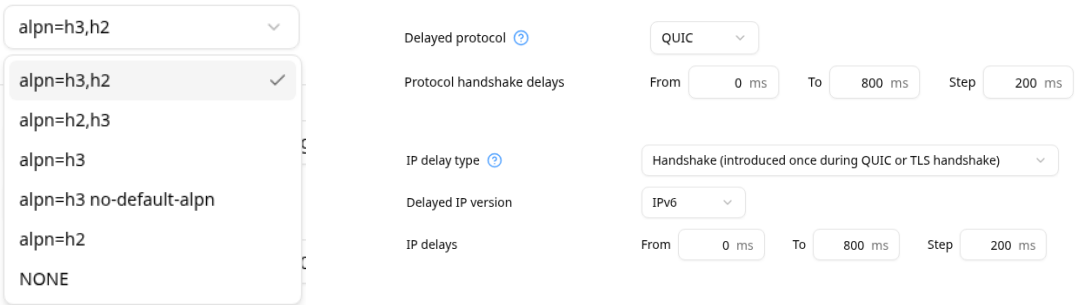
Happy Eyeballs Version 3

- Parameters are encoded in domains
- HTTP/3, HTTP/2 and HTTP/1 support
- Domains configured with A, AAAA and HTTPS records
  - The HTTPS record can be configured with different ALPN values
- Configurable delay for QUIC or TCP/TLS (delay of the Server Hello)
- Configurable delay for IPv6 or IPv4
  - Option 1: Delay impacts the network layer →already impacts TCP handshake
  - Option 2: Delay only impacts the TLS handshake →TCP handshake not impacted



Happy Eyeballs Version 3

- Parameters are encoded in domains
- HTTP/3, HTTP/2 and HTTP/1 support
- Domains configured with A, AAAA and HTTPS records
  - The HTTPS record can be configured with different ALPN values
- Configurable delay for QUIC or TCP/TLS (delay of the Server Hello)
- Configurable delay for IPv6 or IPv4
  - Option 1: Delay impacts the network layer →already impacts TCP handshake
  - Option 2: Delay only impacts the TLS handshake →TCP handshake not impacted



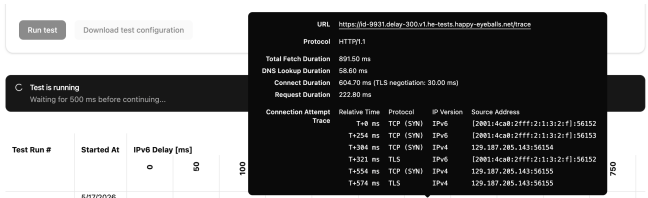
Happy Eyeballs Version 3

- Webtester tests a matrix of different delays
- List of tested configs, e.g., domains, can be downloaded to test specific configs
- Added additional debugging features, e.g., a connection trace

IP Delay [ms]	Protocol Handshake Delay [ms]				
	0	200	400	600	800
0 (Handshake)	QUIC / IPv6	QUIC / IPv6	QUIC / IPv6	TLS / IPv6	TLS / IPv6
200 (Handshake)	QUIC / IPv6	QUIC / IPv6	QUIC / IPv6	TLS / IPv6	TLS / IPv6
400 (Handshake)	QUIC / IPv4	QUIC / IPv4	QUIC / IPv4	TLS / IPv4	TLS / IPv4
600 (Handshake)	QUIC / IPv4	QUIC / IPv4	QUIC / IPv4	TLS / IPv4	TLS / IPv4
800 (Handshake)	QUIC / IPv4	QUIC / IPv4	QUIC / IPv4	TLS / IPv4	TLS / IPv4

Happy Eyeballs Version 3

- Webtester tests a matrix of different delays
- List of tested configs, e.g., domains, can be downloaded to test specific configs
- Added additional debugging features, e.g., a connection trace



Additional Feature Tests

We are adding tests for individual features

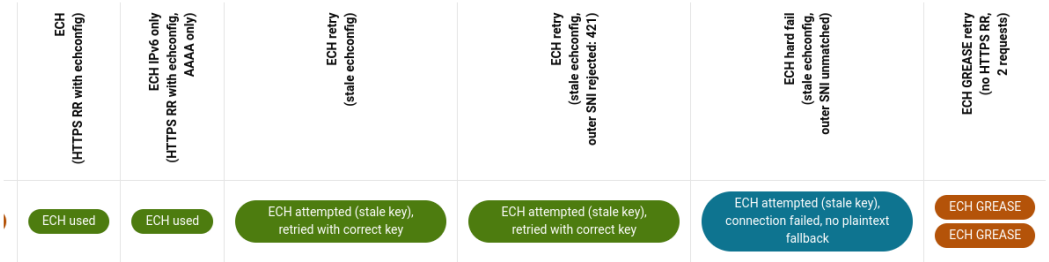
- Tests general availability with current configs
- Tests specific parts of the draft
- Tests functionality of related specs

We are happy to discuss further tests or ideas

QUIC Availability

Test Run #	Started At	Scenario				
		HTTP/3	HTTP/3 with HTTPS RR	HTTP/3 with cached HTTPS RR	HTTP/3 with Alt-Svc	HTTP/3 with Alt-Svc and HTTPS RR
#1 (1 / 1)	19.7.2026, 13:12:57	HTTP/2.0	HTTP/3.0	HTTP/3.0 HTTP/3.0	HTTP/2.0 HTTP/3.0	HTTP/3.0 HTTP/3.0

ECH Availability



HTTPS Alias Mode

Test Run #	Started At	Connection Type			
		Direct (control)	Via AliasMode HTTPS	Via ServiceMode HTTPS	HTTPS port Override
#1 (1 / 1)	19.7.2026, 13:18:09	IPv6	ERR	Target Followed	Port Followed

HTTPS Hints

Test Run #	Started At	Scenario			
		AAAA + HTTPS RR + SVCB RR	HTTPS RR with ipv6hint only	SVCB RR with ipv6hint only	AAAA only (control)
#1 (1 / 5)	19.7.2026, 13:20:22	AAAA	HTTPS ipv6hint	no connection	AAAA
#1 (2 / 5)	19.7.2026, 13:20:35	AAAA	HTTPS ipv6hint	no connection	AAAA

Delayed A record

Test Run #	Started At	A DNS Delay [ms]				
		0	200	400	600	800
#1 (1 / 1)	19.7.2026, 13:24:51	IPv4	IPv4	IPv6	IPv6	IPv6

Conclusion

Summary

- We are extending our test tool
- Feel free to reach out via mail or using the git repo

Open Questions

- What could we add?
- What does not work?

happy-eyeballs.net:

staging.he-test.net.in.tum.de: