




Automating QUIC Interoperability Testing

Marten Seemann (Protocol Labs)
Jana Iyengar (Fastly)



Why Interoperability testing?

- test compatibility of protocol implementations
- expose irregularities in the specification

Interoperability testing - so far

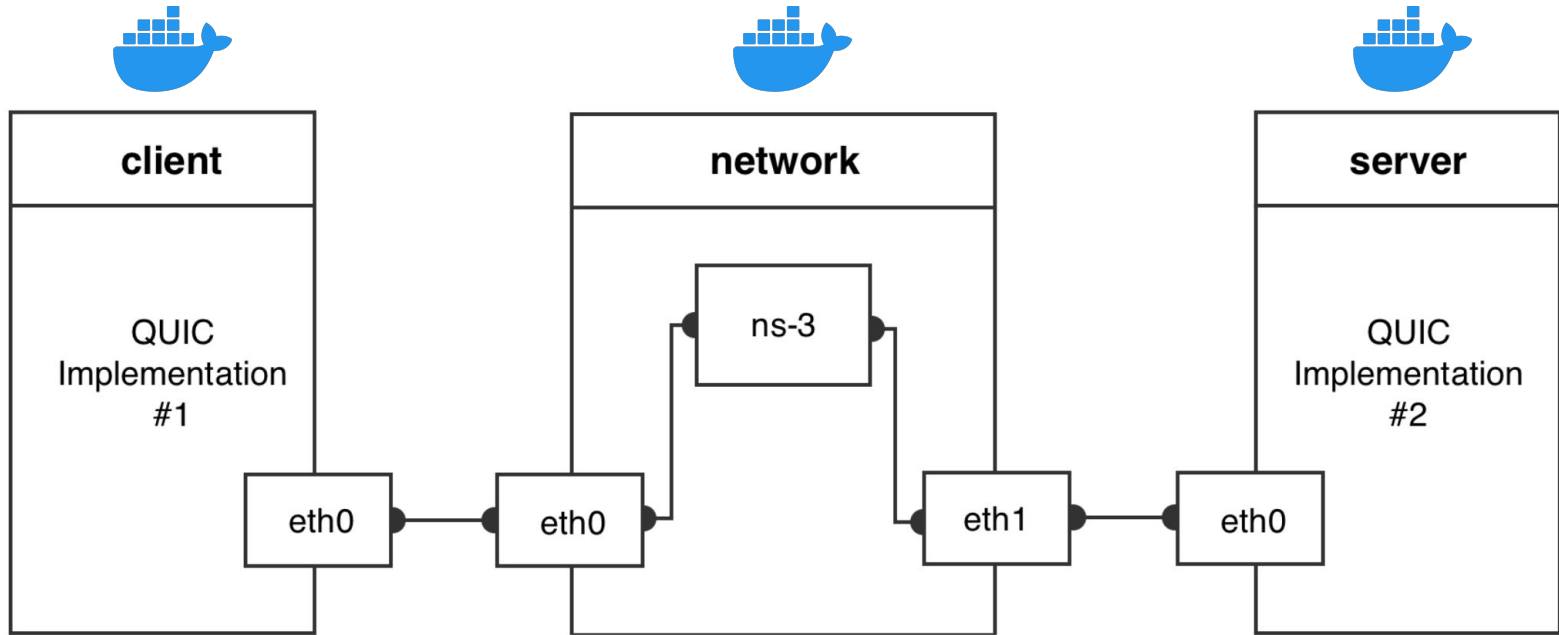
IETF QUIC Interop Matrix

File Edit View Insert Format Data Tools Add-ons Help Last edit was seconds ago

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
	server	client	quant	ngtcp2	mvfst	picoQUIC	msquic	f5	J.ber	ATS	quiche	lsquic	nginx-cloudflare	flupke	Quinn	akamai	aiologic	-gQUIC	wj	Neqo	Haskell QUIC		
3	h2o/quickly																						
4	quant	VHDCRSQ MBAUPELT	VHDCRSQ MBAU 3	VHDCRSQ MB 3	VHDCRSQ MBAUP 3	VHDCRSQ MBUP 3	VHDCRSQ U 3			VHDCRSQ M 3	VHDCRSQ 3	VHDCRSQ MBAUPE 3	VHDCRSQ 3			VHDCRSQ MBAUPE 3	VHDCRSQ MBAU 3	VHDCRSQ 3				VHDCRSQ MB 3	
5	ngtcp2		VHDCRSQ MBAU 3dp	VHDCRSQ MBA 3d	VHDCRSQ MBA 3	VHDCRSQ MBAU 3		VHDCRSQ U 3d				VHDCRSQ 3	VHDCRSQ MBAU 3dp	VHDCRSQ 3			VHDCRSQ MBAU 3d	VHDCRSQ MBAU 3dp	VHDCRSQ 3d				VHDCRSQ MBA 3d
6	mvfst			VHDCRSQ M 3	VHDCRSQ MBAUP 3																		
7	picoQUIC	VHDCRSQ MBAUPLT	VHDCRSQ MBAUT 3	VHDCRSQ MBAT 3	VHDCRSQ MBAUPLT 3	VHDCRSQ MBAUPT 3	VHDCRSQ UPLT 3			VHDCRSQ MBA 3	VHDCRSQ 3	VHDCRSQ MBAUPT 3	VHDCRSQ 3			VHDCRSQ MBAUP 3	VHDCRSQ MBAUPLT 3	VHDCRSQ 3				VHDCRSQ MBATL 3	
8	msquic	VHDCRSQ MBAUPL		VHDCRSQ M 3	VHDCRSQ MBAUP 3	VHDCRSQ MBAU 3	VHCRSQ U				VHDCRSQ						VHDCRSQ MBAUPL					VHCRSQ M	
9	f5	VHDCS PELT	VHDCS T 3	VHDCS T 3d	VHDCS PL 3	VHDCS P 3	VHDCS PLT 3d			VHDCS L 3	VHDCS 3	VHDCS PE 3d	VHDCS 3d			VHDCS P 3d	VHDCS P 3d	VHDCS 3d				VHDCS T 3	
10	f5_test																						
11	ATS																						
12	quiche																						
13	lsquic		VHDCRSQ MAT 3dp	VHDCRSQ T 3d	VHDCRSQ MPT 3	V	VHDCRSQ ET 3d					VHDCRSQ 3	VHDCRSQ MPET 3dp	VHDCRSQ 3			VHDCRSQ MP 3d	VHDCRSQ MPT 3dp	VHDCRSQ 3d			VHDCRSQ 3d	
14	nginx-cloudflare																						
15	quic-go																						
17	Quinn	VHDCRSQ BU 3d	VHDCRSQ BU 3d		VHDCRSQ BU 3	VHDCRSQ BU 3d	VHDCRSQ BU 3d				VHDCRSQ BU 3	VHDCRSQ BU 3d	VHDCRSQ BU 3				VHDCRSQ BU 3d	VHDCRSQ BU 3d	VHDCRSQ BU 3d			VHDCRSQ BU 3	
18	AkamaiQUIC																						
19	aiologic	VHDCRSQ MBAULT	VHDCRSQ MBAU 3dp	VHDCRSQ MBLT 3dp	VHDCRSQ MBAUPLT 3	VHDCRSQ MBAUPL 3						VHDCRSQ 3	VHDCRSQ MBAUPT 3dp	VHDCRSQ 3			VHDCRSQ MBAUPLT 3dp	VHDCRSQ M 3d	VHDCRSQ B 3d			VHDCRSQ MBAL 3	
20	-gQUIC	V					VHDCRSQ 3d					VHDCRSQ 3					VHDCRSQ B 3d	VHDCRSQ B 3d					
21	Kwik&Flupke	VHDCRSQ		VHDCRSQ 3	VHDCRSQ 3	VHDCRSQ						VHDCRSQ 3					VHDCRSQ 3	VHDCRSQ 3					
22	Neqo					VHDCS 3																	
23	Haskell QUIC	VHDCRSQ MBA	VHDCRSQ MBA 3	VHDCRSQ MBA 3	VHDCRSQ MBA 3	VHDCRSQ MBA 3	VHDCRSQ MBA 3					VHDCRSQ 3	VHDCRSQ MBA 3	VHDCRSQ 3			VHDCRSQ MBA 3	VHDCRSQ MBA 3	VHDCRSQ B 3			VHDCRSQ MBA 3	

- doesn't scale!
- unpredictable network conditions
- Tests are *interpreted* by different implementers

QUIC Interop Runner - Setup



QUIC Interop Runner - Tests

Feature Tests:

- Handshake
- Retry
- 0-RTT
- Heavy Stream Multiplexing
- Handshake Completion under Packet Loss / Corruption
- ...

Benchmark Tests:

- Goodput
- TCP Cross-Traffic

Running a Test

Setup

1. generate random files
2. mount files into the server image
3. start the client with a list of URLs

Validation

1. check return value
2. compare downloaded files
3. check pcaps for test-specific features