# DNS-over-QUIC (DoQ)

## draft-ietf-dprive-dnsoquic

Christian Huitema
**Sara Dickinson**
**Allison Mankin**

# DNS-over-QUIC

- Why are we standardizing ANOTHER protocol for encrypted DNS?
- Where are we with the IETF standards process?
- Where are we with implementation and deployment?
  - Next steps?

# QUIC - Background

- QUIC and HTTP/3 developed by Google as experiment in 2012
- Development moved to IETF in 2015, standardized in 2021
- Deployed by browsers and CDNs (7.6% websites)

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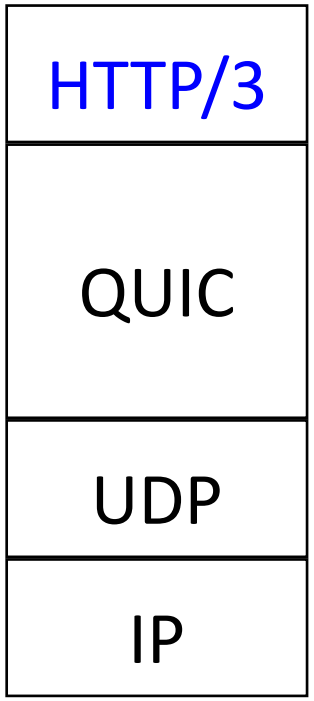
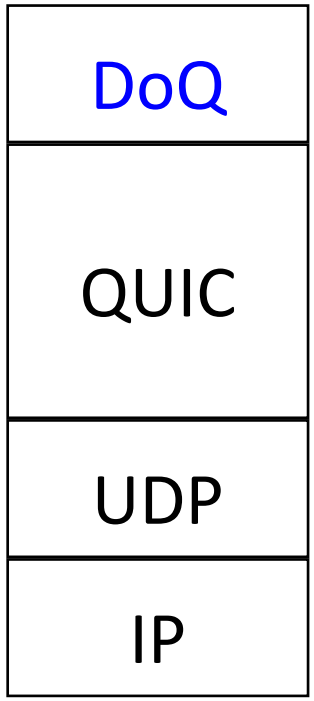
- Deployed by browsers and CDNs (7.6% websites)
- **Key QUIC characteristics**
  - TLS 1.3 secured transport that runs over UDP
  - Reduced latency in handshake (0-RTT)
  - Stream based - no head of line blocking
  - Improved error detection and loss recovery compared to TCP
  - Connection migration (IP address can change)
- HTTP/3 runs over QUIC



# DoQ - Background

- Early realisation that DoQ would be a good fit for encrypted DNS
  - Low latency
  - UDP but with QUIC benefits and
    - Source address validation
    - Path MTU does not limit size of messages
- But… QUIC WG decided QUIC v1 would only support HTTP/3



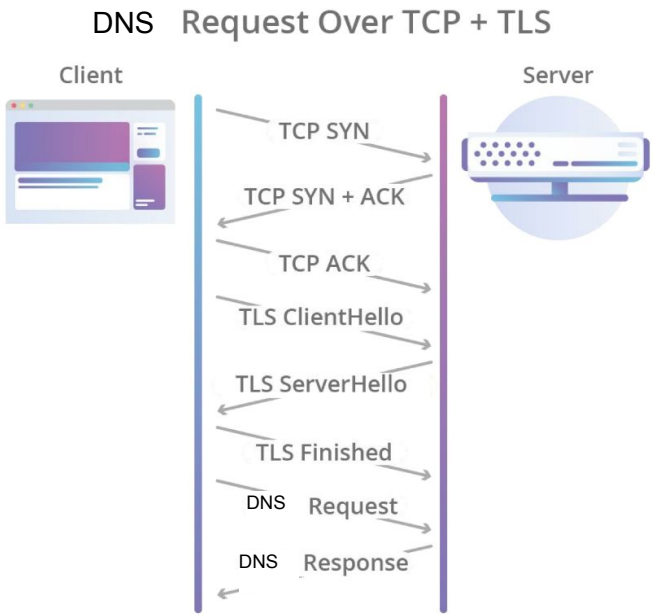
# DoQ - Background

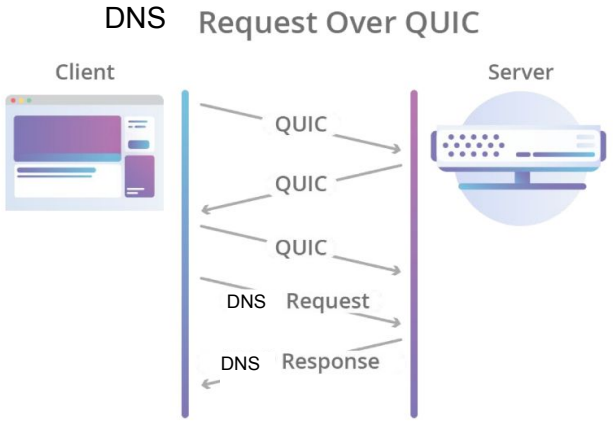
- **April 2017** - First Draft in QUIC WG
- **December 2018** - Adguard DoQ service launched

- **Apr 2020** - Draft adopted in DPRIVE WG (stub to rec ONLY)
- **2021** - Re-scoped to include XFR and rec to auth, mapping updated and port 853 requested (more later)
- **Oct-Dec 2021 -** Working group last call
- **January 2022** - IETF Last Call  (RFC later this year?)

# What does DoQ look like?

- Set up a connection with a QUIC handshake (TLS 1.3)
- Use ALPN ‘doq’




*Images from https://blog.cloudflare.com/the-road-to-quic/*

# What does DoQ look like?

- Exchange of messages on streams (ids are 4, 8,12)
- One stream is used for one DNS query/response (then closed)
- There are $2^{64}$ stream IDs - that's a lot of messages on one connection
  - MessageID is ALWAYS 0

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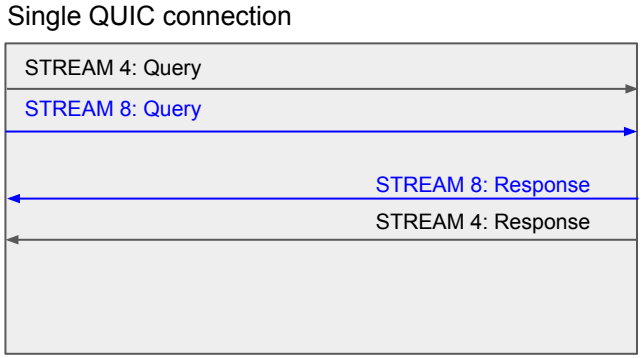
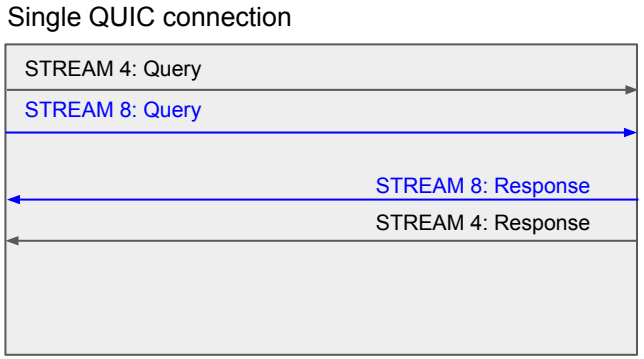
- There are $2^{64}$ stream ID - that's a lot of messages on one connection
  - MessageID is ALWAYS 0
- Original mapping
  - JUST DNS message
  - Immediate close at both ends

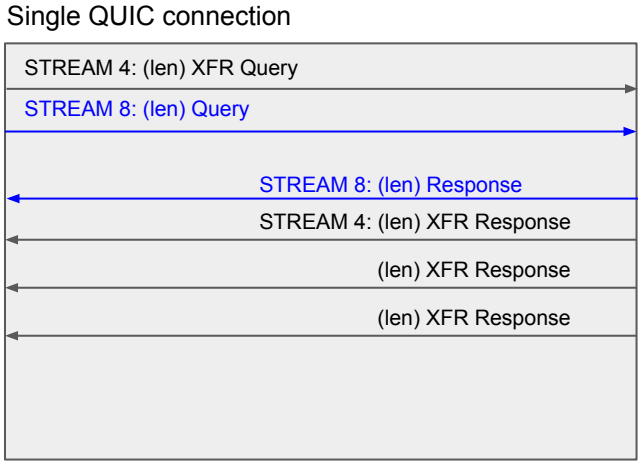


# But.. if we want to do XFR…

- **Original mapping**




- **Current mapping**
  - Prepend with length field (like TCP)
  - Server can send multiple responses



# DoQ is a general purpose protocol

- AdGuard claim **good performance** (particularly in mobile networks)
- With the more flexible mapping **XFR is now possible** (RFC for XFR-over-TLS last year)
- **Lots of interest in using DoQ for recursive to authoritative**
  - Lighter weight than DoT and DoH, better latency
  - Protocol is maturing

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- Originally port 784 was used for experiments but WG proposed to use port 853 (assigned to DNS-over-DTLS in 2016). IANA process but…. now agreed.
  - TCP port 853: DNS-over-TLS
  - **UDP port 853: DNS over DTLS or QUIC**

# DoQ Implementations (open source)

| Implementation | Language | Notes |
|---|---|---|
| **CoreDNS** | Go | AdGuard use as DoQ server |
| **AdGuard DNS Proxy** | Go | Simple proxy or server supporting DoQ (used in ADGuard Home) |
| **dnslookup** | Go | Command line utility wrapper for Adguard DNS proxy |
| **AdGuard C++ DNS libs** | C++ | AdGuard use in mobile app |
| **Quicdoc** | C | Simple DoQ impl based on Picoquic |
| **aioquic** | Python | QUIC implementation includes example DoQ client/server |
| **Flamethrower** | C++ | DNS performance utility with experimental DoQ |

- Starting to hear interest in recursive to auth experiments

# DoQ open issues

- Padding
  - Multiple studies show padding is needed or ML can derive the encrypted queries
  - Discussion: Require implementation of the Experimental RFC 8467
  - This will be a new IETF Last Call to approve a Down Reference  for RFC 8467 to be Normative
- Security Considerations
  - Does community see missing considerations for recursive to auth?
    - Note that authentication model for rec to auth are still a WIP
    - Privacy vs Security is a tricky trade-off for DoQ

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Please review the specification!

# Backup slides

# DoQ vs DoT vs DoH3?