NAT Detection in Secure Transport Protocols

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TLS
IETF 104, March 2019, Prague

Overview

Two drafts submitted in tandem:

TLS, *draft-kinnear-tls-client-net-address*

QUIC, *draft-pauly-quic-address-extension*

Cover use-case motivations

Examine and discuss tradeoffs

Defer wire-encoding discussions to the list

Use Cases

Middlebox keepalives

Long-lived connections need to send keepalives to avoid NAT or firewall mapping timeouts

Not detecting a NAT doesn't remove the need for handling keepalives, since firewalls may not translate addresses

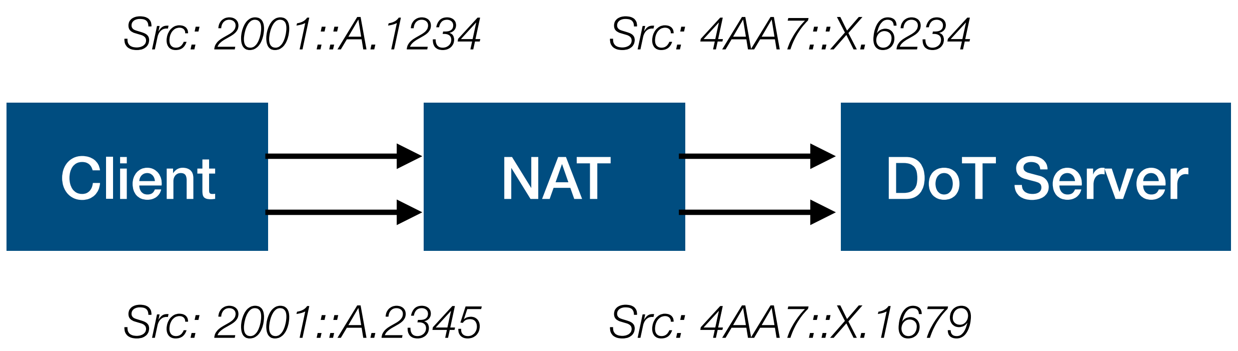
Detecting a NAT can optimize a client's algorithm by giving a better heuristic for keepalive timeouts (more aggressive when NATs are certain)

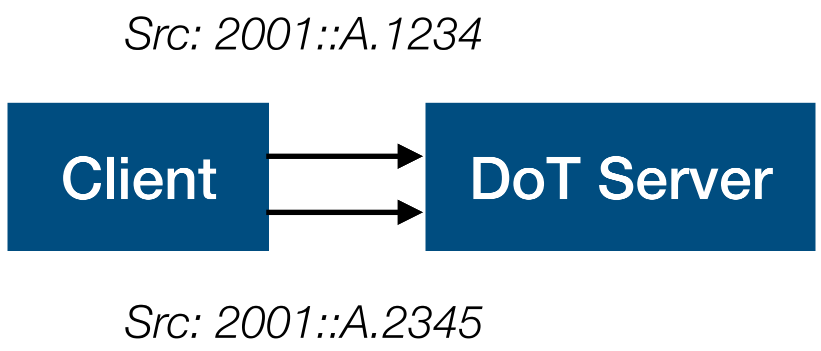
Use Cases

Unique Identifiers

Is my client IP address a unique end-to-end identifier?

> *For example*, if a client is behind a NAT, using separate connections for DoT queries can improve privacy; for a public IP address, this approach may actually harm privacy.





Use Cases

NAT rebinding detection

While NAT rebinding breaks TCP connections, MPTCP and QUIC can survive NAT rebindings

Getting a public IP address update notifies the client when a rebinding has occurred

- Useful for QUIC migration
- Identifies NAT timeout values

Use Cases

Detecting ASN for metrics

Clients behind NATs have difficulty detecting what ASN they are connected over without explicit probes

Detecting public IP addresses can help clients better identify their own network attachments using existing connections

> Can be viewed as a privacy issue, but only giving information that everyone else upstream in the network already knows

Goals and Constraints

Goals

- Allow endpoints to detect the presence of address-transforming middleboxes
- Allow endpoints to discover their own "public" IP addresses

Constraints

- Address information must be encrypted in transit
- Only public addresses should be transmitted
- Cannot rely on validating address information

Protocol Proposals

TLS & QUIC

TLS Client Address extension

- Asymmetric

- Clients request their **public** address from TLS server

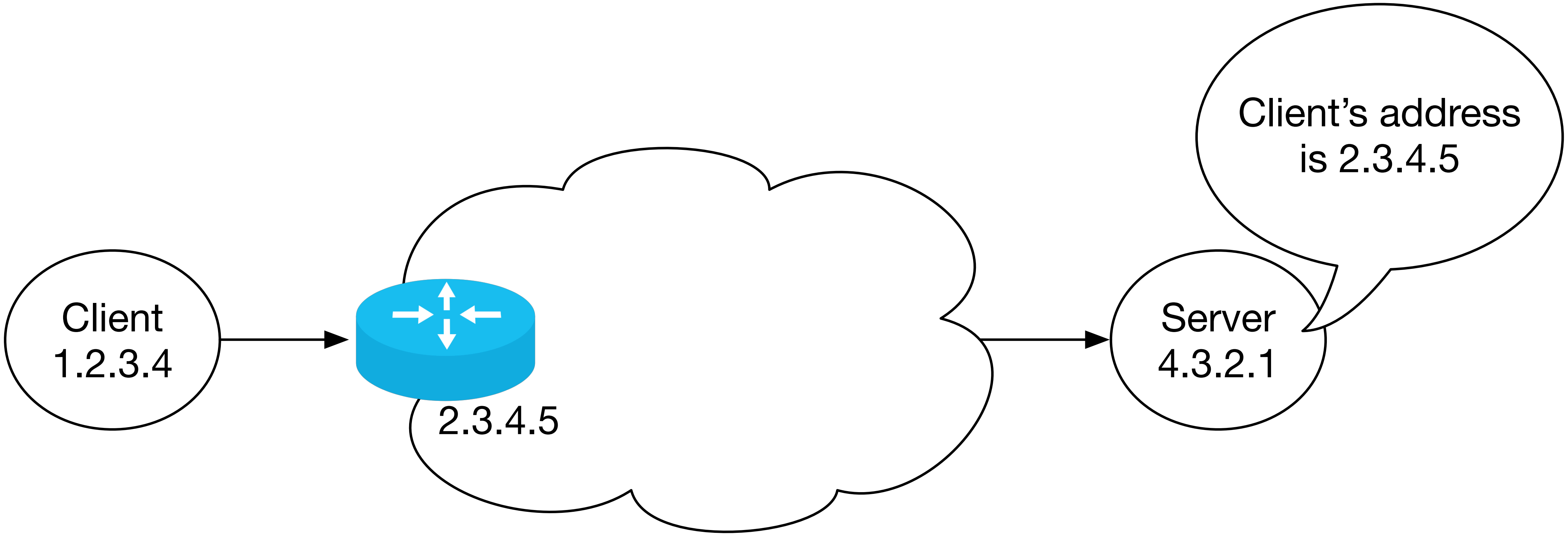
QUIC Address Request extension

- Symmetric

- Endpoints request their **public** address from peer

TLS Client Address

Example



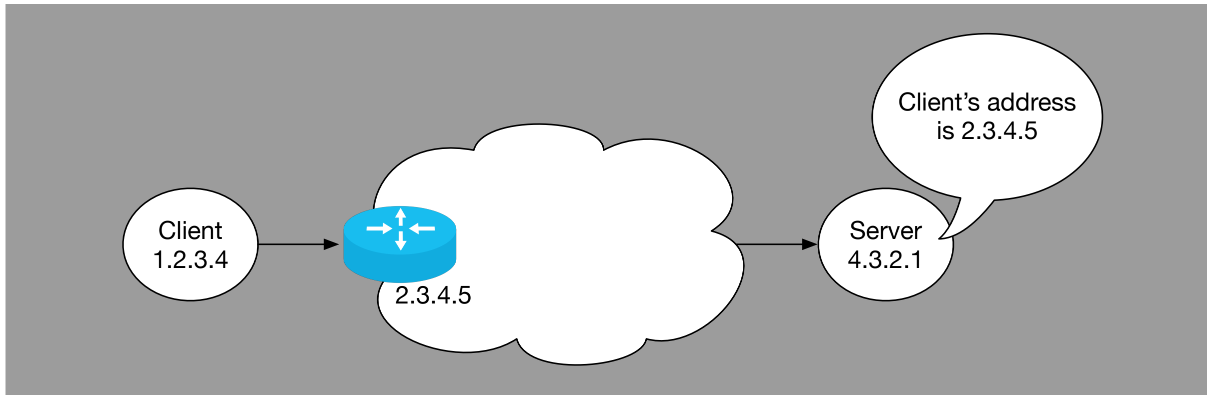
TLS Client Address

Example

```
  Client                     NAT                       Server
(1.2.3.4)                 (2.3.4.5)                  (4.3.2.1)

ClientHello
+ ...
+ network_address         -------->
                                                   ServerHello
                                                         + ...
                                         {EncryptedExtensions}
                                    + network_address(2.3.4.5)
                                         {CertificateRequest*}
                                                {Certificate*}
                                          {CertificateVerify*}
                                                    {Finished}
                          <--------        [Application Data*]

{Certificate*}
{CertificateVerify*}
{Finished}                -------->
[Application Data]        <------->
```



TLS Client Address

Limitations

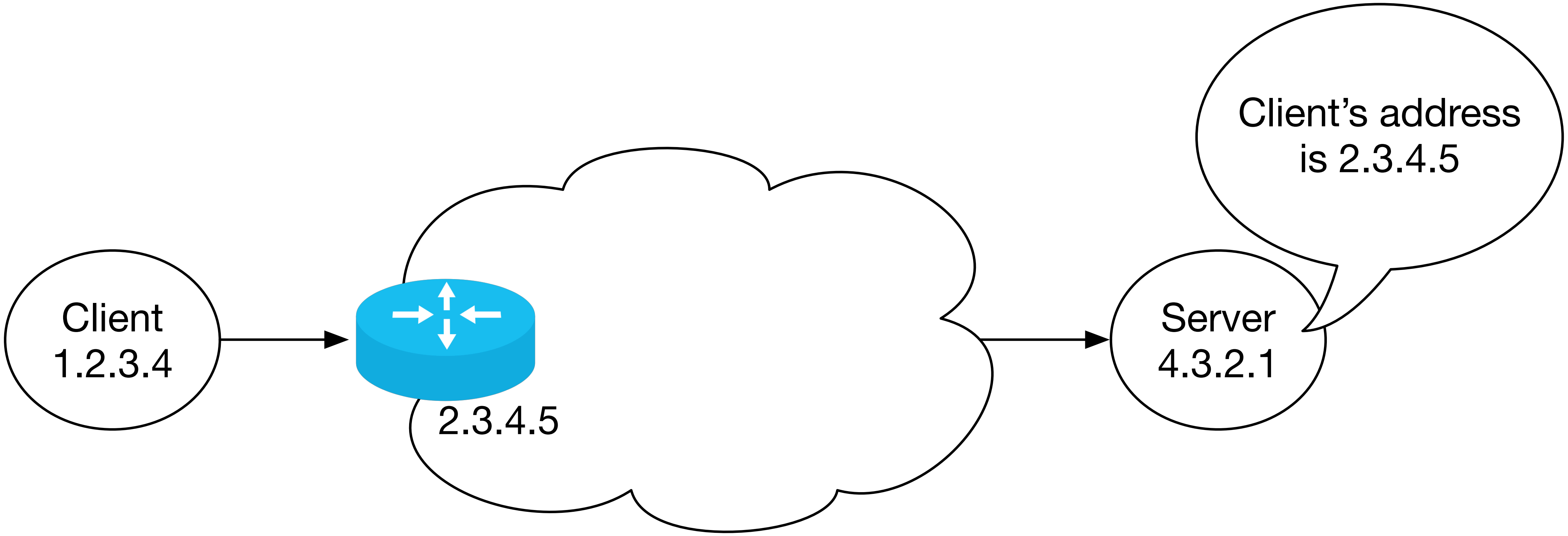
Cannot detect stateful firewalls that do not translate addresses

Only clients benefit (less server complexity?)

Occurs only during handshake, which may need to be changed for MPTCP

QUIC Address Request

Example



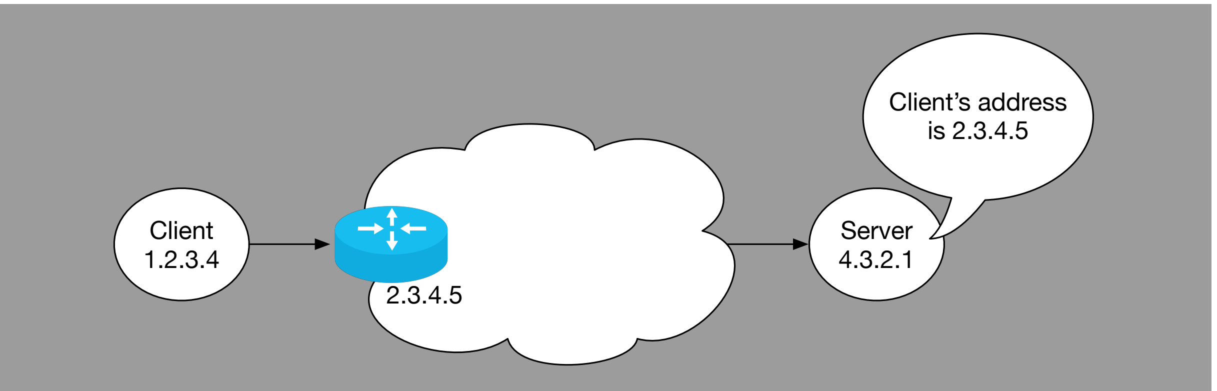
QUIC Address Request

Example

```
  Client                          NAT                              Server
(1.2.3.4)                      (2.3.4.5)                         (4.3.2.1)

                               <-------->
                           QUIC(TLS) Handshake
                               <-------->

[PUBLIC_ADDRESS_REQUEST(id=0)]
                               -------->
                                      [PUBLIC_ADDRESS_RESPONSE(id=0,
                                                           type=0x00,
                                                       value=2.3.4.5,
                                                          port=4567)]
                                -------
```



QUIC Address Request

Limitations

Like TLS, cannot detect stateful firewalls that do not translate addresses

Endpoints can request at any time, but NAT rebinding detection relies on a client asking for its address when it thinks a rebinding may have occurred (idle time, or due to PATH_CHALLENGE)

Questions?