Deep Dive into IPv6 Extension Header Testing: CDN

IETF 116

draft-elkins-v6ops-eh-deepdive-cdn

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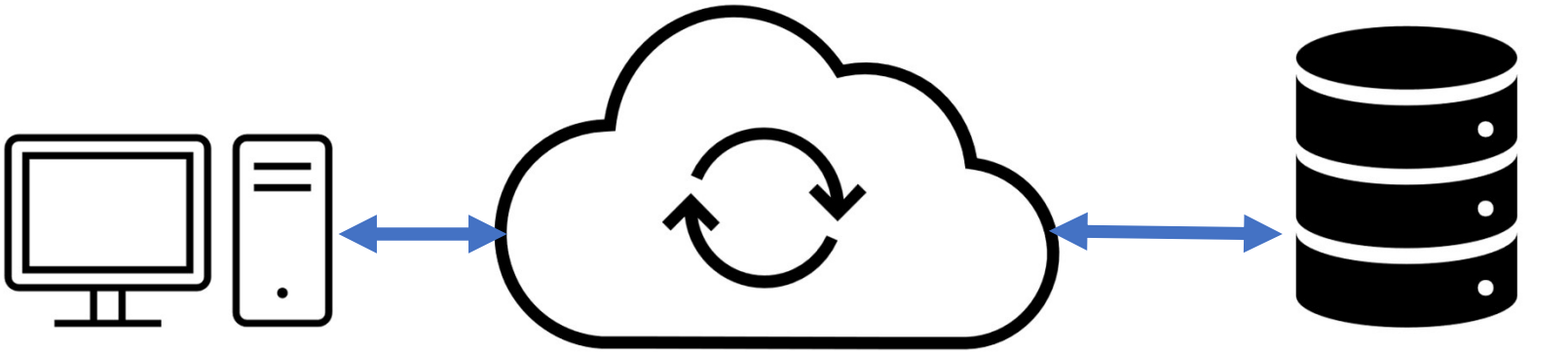
What Topologies Being Tested?

- Client – Internet – Server
- Client – Internet – CDN Cache Server – CDN network – Origin Server
  - (Internal to CDN may have multiple more complex topologies)
- Client – Internet – Edge of Cloud Provider – Origin server hosted by cloud provider

Simplest: Client – Internet -- Server



Client

Internet

Server

Goal of testing

- EHs serve a useful and needed function
- Why look at CDNs?
  - Many high usage websites on the internet use CDNs
  - They have a disproportionate impact on IPv6 and EH use
- Need to figure out
  - Where EH can be sent with 90%+ probability (**and why**)
  - Where EH CANNOT be sent with 90%+ probability (**and why**)
  - What is unknown

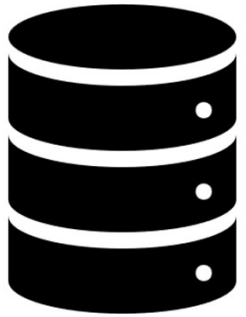
. Diagnostic Methodology

The following methodology assumes that the operator has:

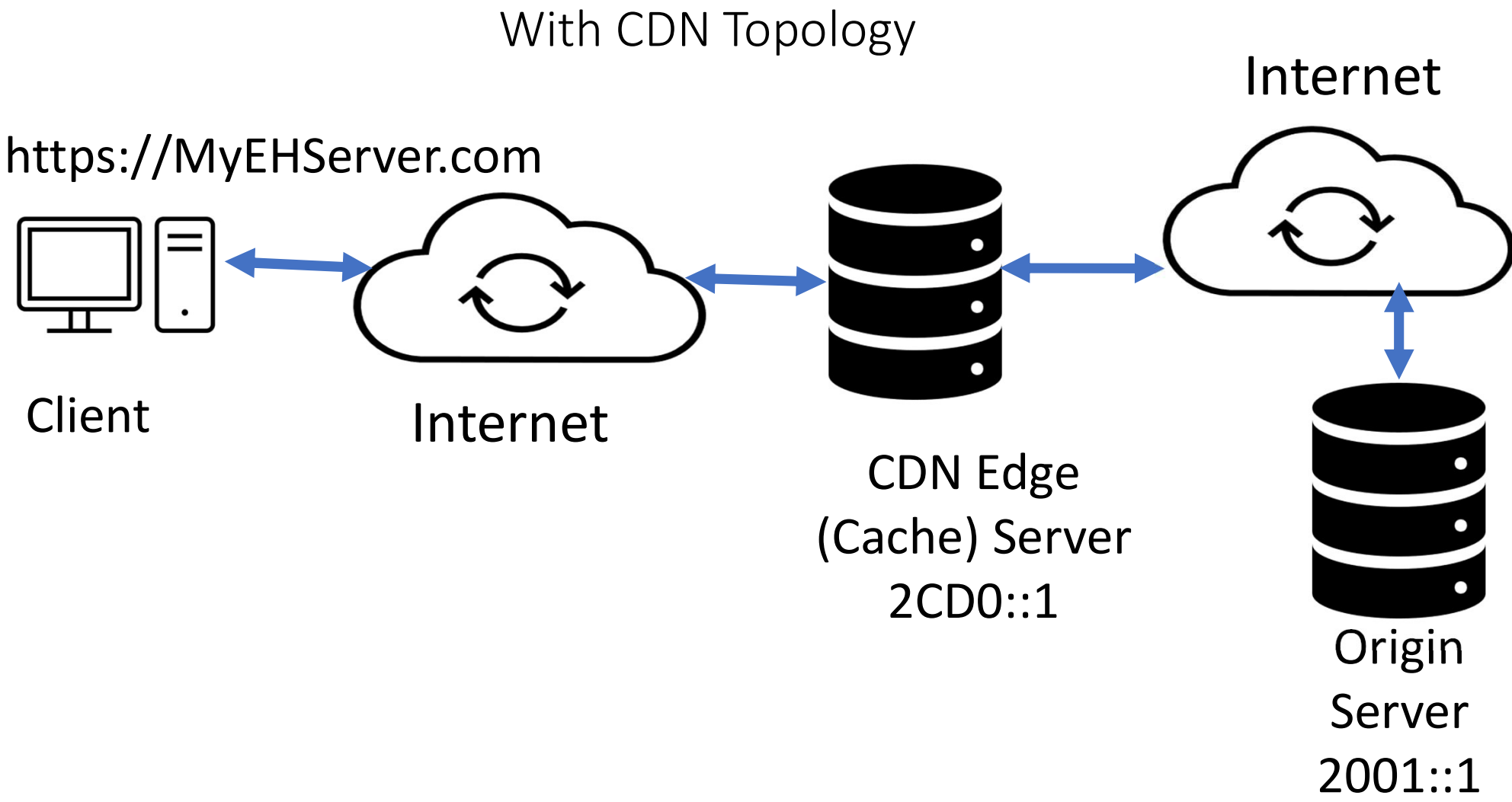
- a test server enabled to send EH with every packet
- an IPv6 enabled web server (Apache / NGINX / Tomcat, et al)
- a packet trace capture tool such as TCPDump, WireShark, etc.

Move Server Behind CDN

- Our server has a domain name: MyEHServer
- Our server also has an IPv6 address (also IPv4 probably)
- Let's say: 2001::1 and 201.1.1.1 (MyEHServer resolves to these)
- To move behind a CDN, you have to give the CDN authority to resolve MyEHServer
- Let's give the CDN IPv6 addresses starting with 2CD0::/64 (2CD0::1, 2CD0::2, etc)
- After CDN move, MyEHServer will resolve to some CDN cache server address (2CD0::1 for example)



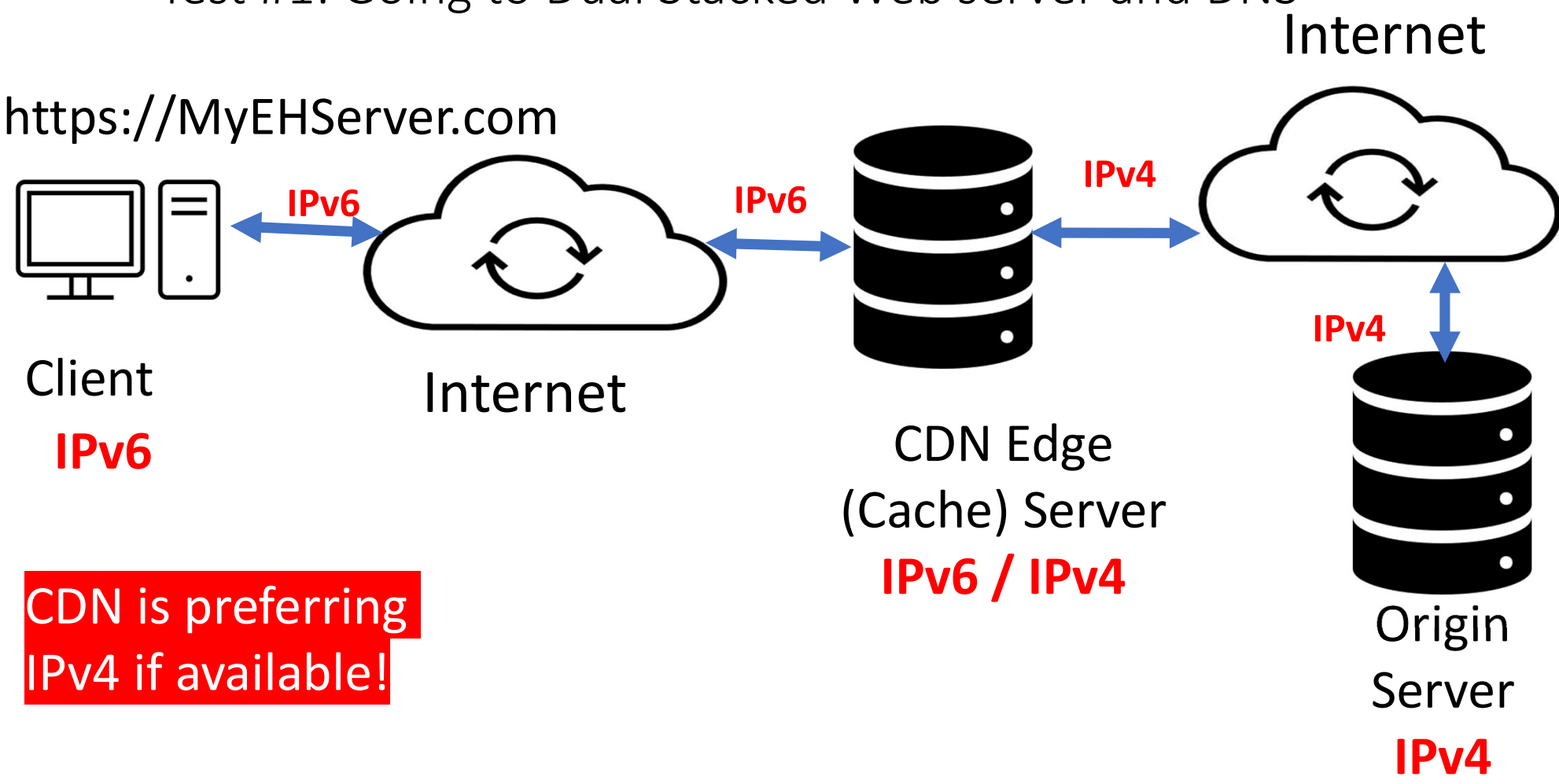
We will now refer to our server as the "Origin Server"

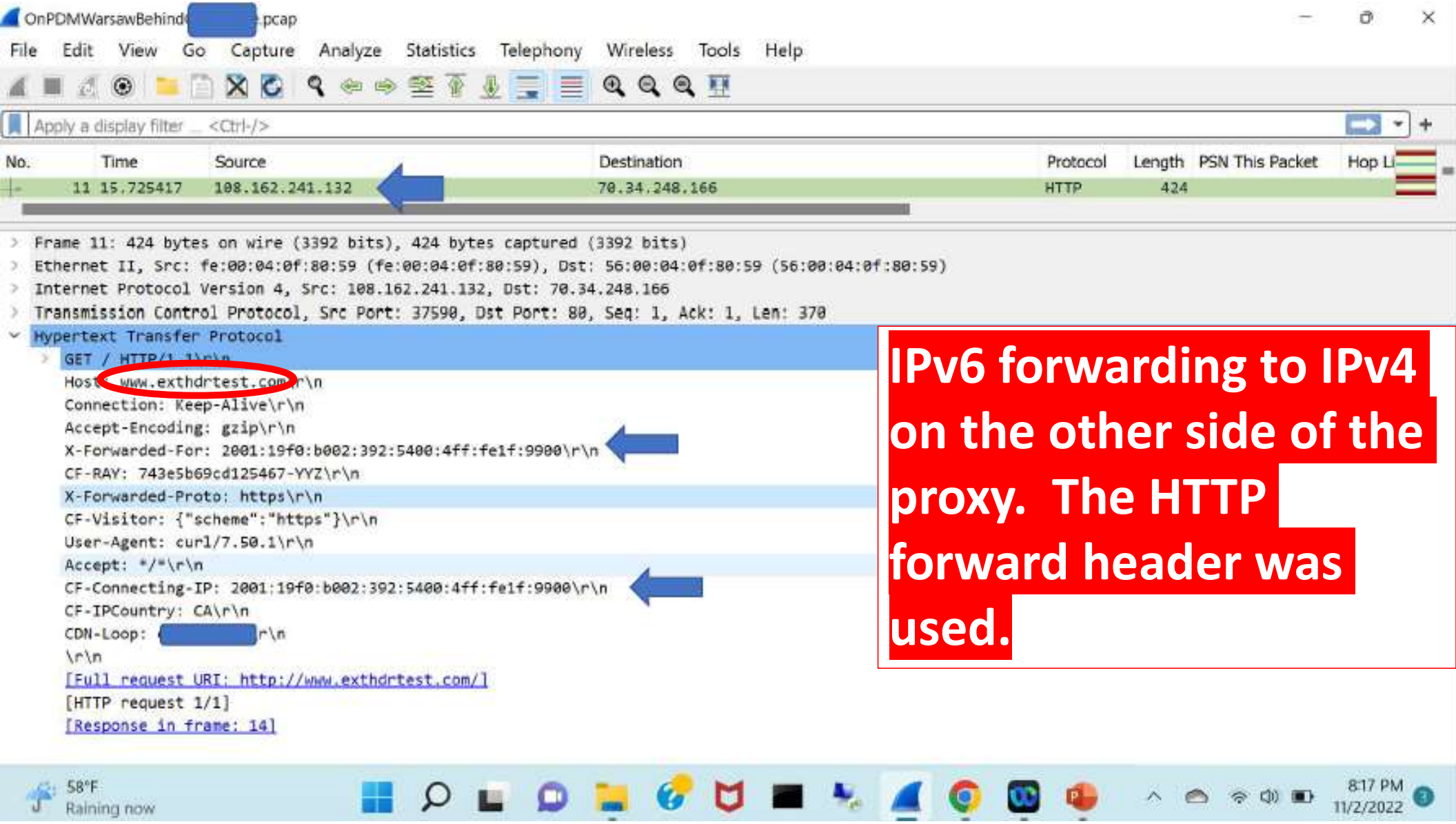

With CDN Topology
Internet
https://MyEHServer.com
Client
Internet
CDN Edge
(Cache) Server
2CD0::1
Origin
Server
2001::1

Type ▲	Name	Content	Proxy status	TTL	Actions
A	exthdrtest.com	45.76.3.11	Proxied	Auto	Edit
⚠ A	ww4	45.76.3.11	DNS only	Auto	Edit
A	www	45.76.3.11	Proxied	Auto	Edit
⚠ AAAA	ww6	2001:19f0:5:3ce7:5400:4ff:fe31:1527	DNS only	Auto	Edit
AAAA	ww6p	2001:19f0:5:3ce7:5400:4ff:fe31:1527	Proxied	Auto	Edit
AAAA	www	2001:19f0:5:3ce7:5400:4ff:fe31:1527	Proxied	Auto	Edit

So, the way many CDNs work is that they can either serve as “DNS only” or “DNS and Proxy”

Test #1: Going to Dual Stacked Web server and DNS




OnPDMWarsawBehind pcap
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
Apply a display filter ... <Ctrl-/>
No. Time Source Destination Protocol Length PSN This Packet Hop Li
11 15.725417 108.162.241.132 70.34.248.166 HTTP 424
Frame 11: 424 bytes on wire (3392 bits), 424 bytes captured (3392 bits)
Ethernet II, Src: fe:00:04:0f:80:59 (fe:00:04:0f:80:59), Dst: 56:00:04:0f:80:59 (56:00:04:0f:80:59)
Internet Protocol Version 4, Src: 108.162.241.132, Dst: 70.34.248.166
Transmission Control Protocol, Src Port: 37590, Dst Port: 80, Seq: 1, Ack: 1, Len: 370
Hypertext Transfer Protocol
GET / HTTP/1.1\r\n
Host: www.exthdrtest.com\r\n
Connection: Keep-Alive\r\n
Accept-Encoding: gzip\r\n
X-Forwarded-For: 2001:19f0:b002:392:5400:4ff:fe1f:9900\r\n
CF-RAY: 743e5b69cd125467-YYZ\r\n
X-Forwarded-Proto: https\r\n
CF-Visitor: {"scheme":"https"}\r\n
User-Agent: curl/7.50.1\r\n
Accept: */*\r\n
CF-Connecting-IP: 2001:19f0:b002:392:5400:4ff:fe1f:9900\r\n
CF-IPCountry: CA\r\n
CDN-Loop: r\n
\r\n
[Full request URI: http://www.exthdrtest.com/]
[HTTP request 1/1]
[Response in frame: 14]
IPv6 forwarding to IPv4 on the other side of the proxy. The HTTP forward header was used.
58°F Raining now
8:17 PM 11/2/2022

Let’s take out the IPv4 definitions in DNS

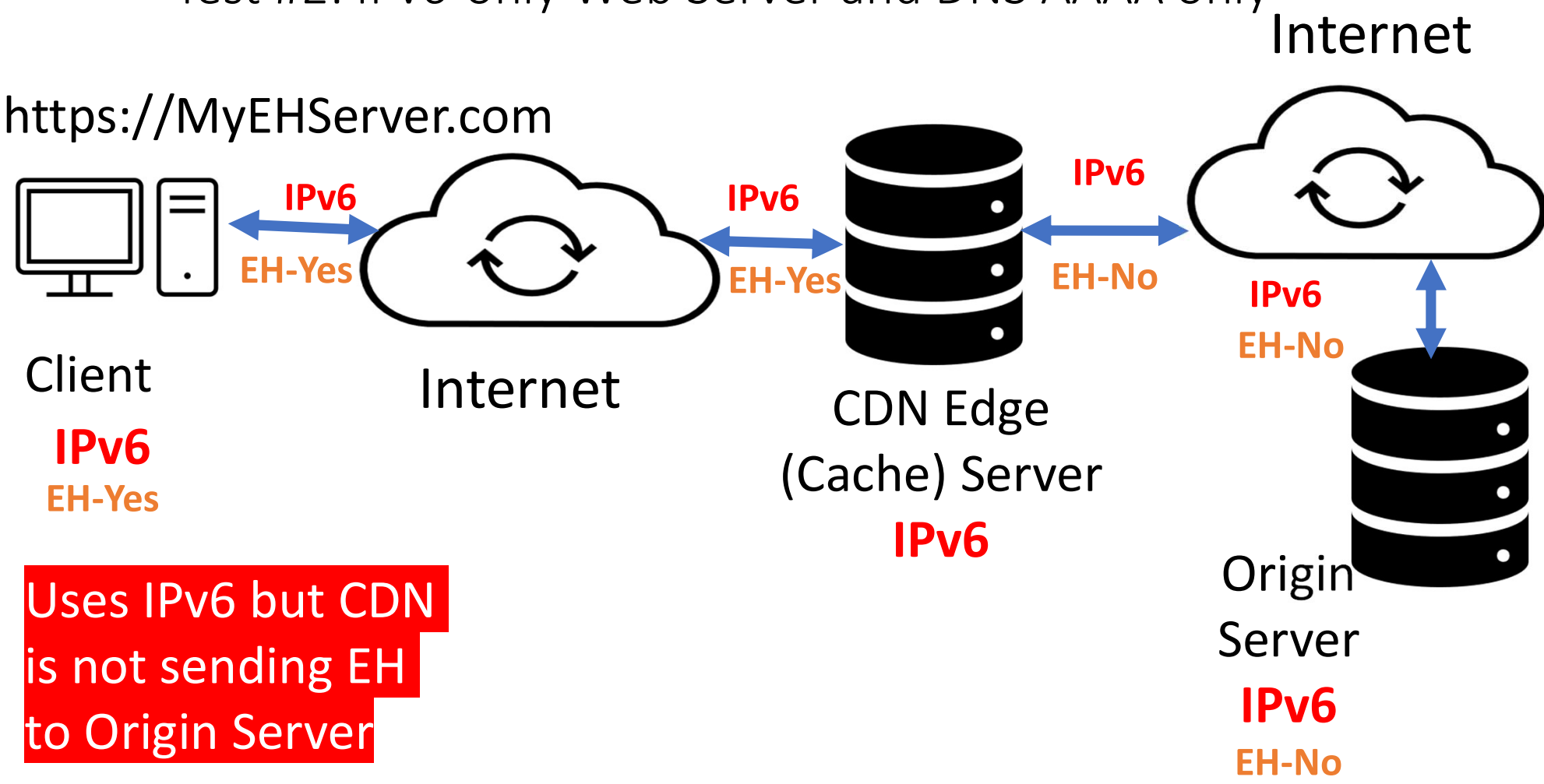
Original

```
;; A Records
exthdrtest.com.          1    IN    A       45.76.3.11
ww4.exthdrtest.com.      1    IN    A       45.76.3.11
www.exthdrtest.com.      1    IN    A       45.76.3.11
;; AAAA Records
• www.exthdrtest.com.    1    IN    AAAA    2001:19f0:5:3ce7:5400:4ff:fe31:1527
```

New

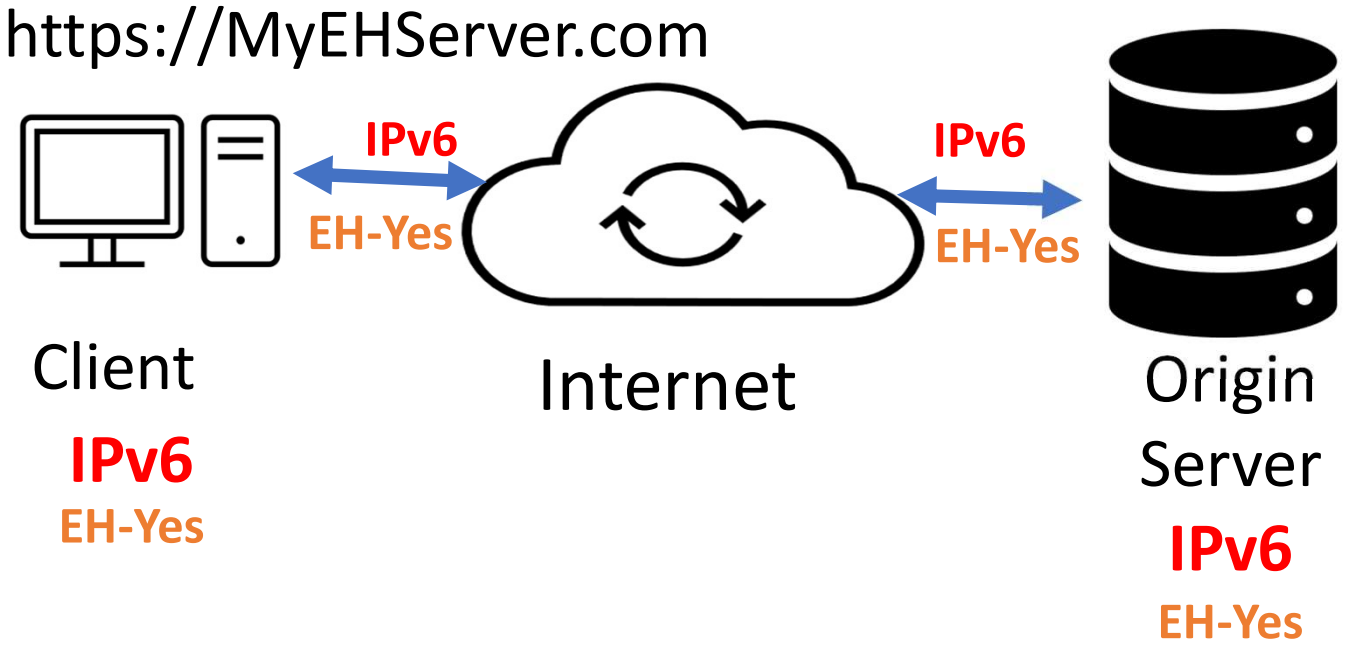
```
;; A Records
ww4.exthdrtest.com.      1    IN    A       45.76.3.11

;; AAAA Records
www.exthdrtest.com.      1    IN    AAAA    2001:19f0:5:3ce7:5400:4ff:fe31:1527
```

Test #2: IPv6-only Web Server and DNS AAAA only



Uses IPv6 but CDN is not sending EH to Origin Server

Test #3: Doing DNS only at CDN



This works. We have managed to send EH to Origin Server by bypassing CDN Proxy. Now we are back to simple client / server scenario

Interesting observation regarding CDN #1

	Total number of sites responding to PDM	Total number of sites with CDN #1	Percentage of sites responding
November capture	5	16	31.25%
February capture	9	9	100.00%

Interesting observation regarding CDN #2

	Total number of sites responding to PDM	Total number of sites with CDN #2	Percentage of sites responding
November capture	16	100	16.00%
February capture	103	104	99.04%

Preliminary Conclusions

- Where EH can be sent with 90%+ probability (and why)
  - Standalone webservers (certain size / type EH)

- Where EH CANNOT be sent (to Origin Server) with 90%+ probability (and why)
  - CDN mediated web sites (unless in DNS-only mode)
  - “Proxy” may be the reason
  - More complications being researched

- What is unknown
  - Is it possible to collocate with CDN proxy to return EH?

Questions for WG

- Should CDNs be encouraged to prioritize IPv6 over IPv4 in DNS?
- Should CDNs be encouraged to do IPv6 to Origin Server?
- Should CDNs be encouraged to send EH to Origin Server?
- Should there be a BCP?