RIPE NCC
RIPE NETWORK COORDINATION CENTRE

IPv4-mapped IPv6 addresses

Ondřej Caletka | 23 May 2024 | RIPE 88

What is an IPv4-mapped IPv6 address?

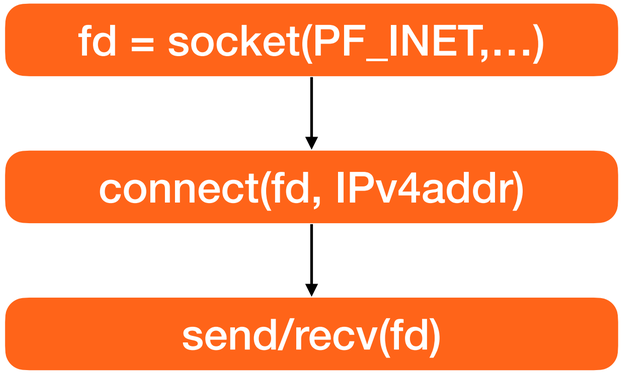
`::ffff:192.0.2.1`

- IPv6 address **like any other**
- Constant prefix `::ffff:0:0/96` + IPv4 address
- Used for **IPv4 compatibility** in IPv6 socket API

Socket API

How to program for both
IPv4 and IPv6

Client



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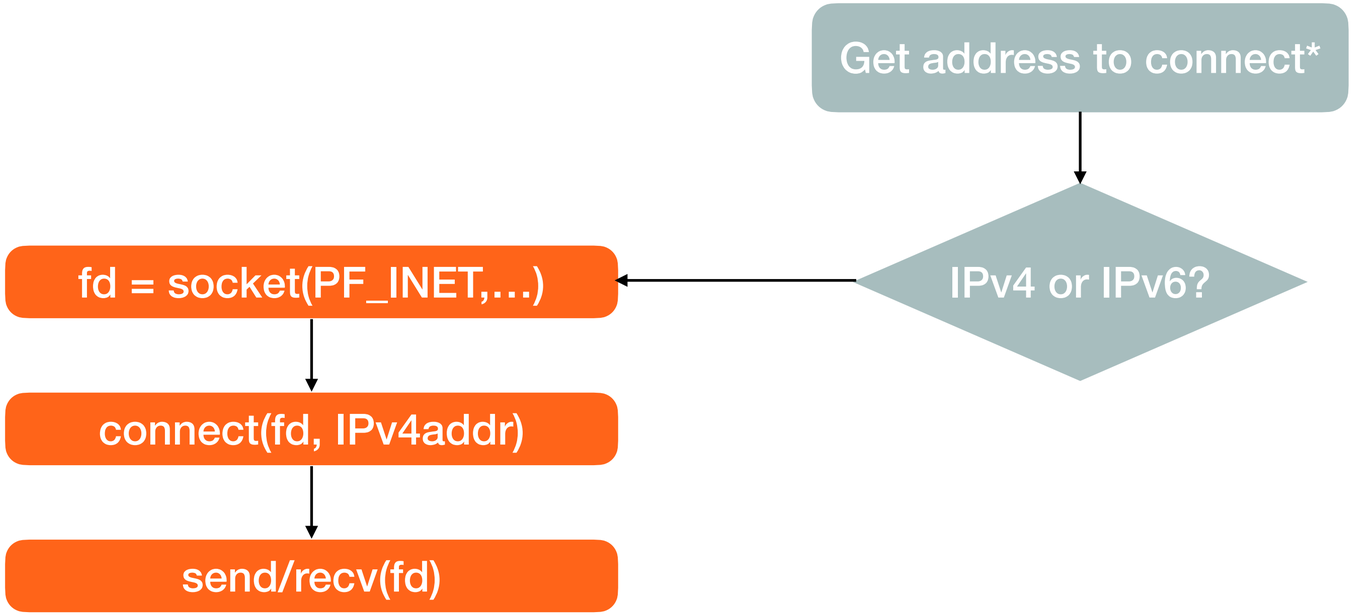

*for instance, by means of `getaddrinfo(3)`

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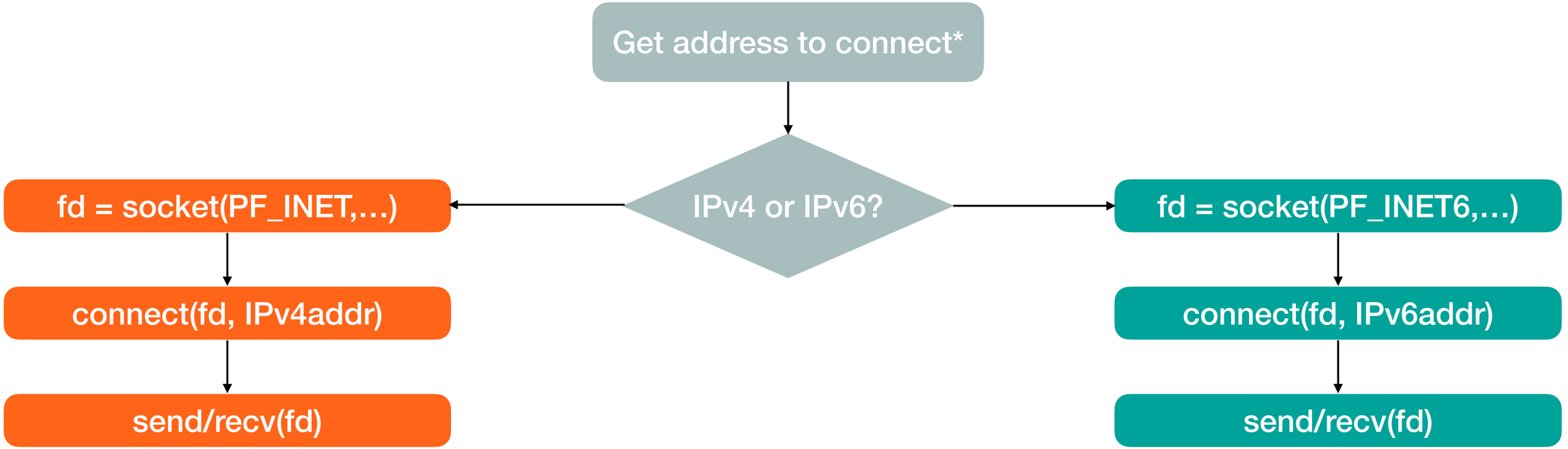

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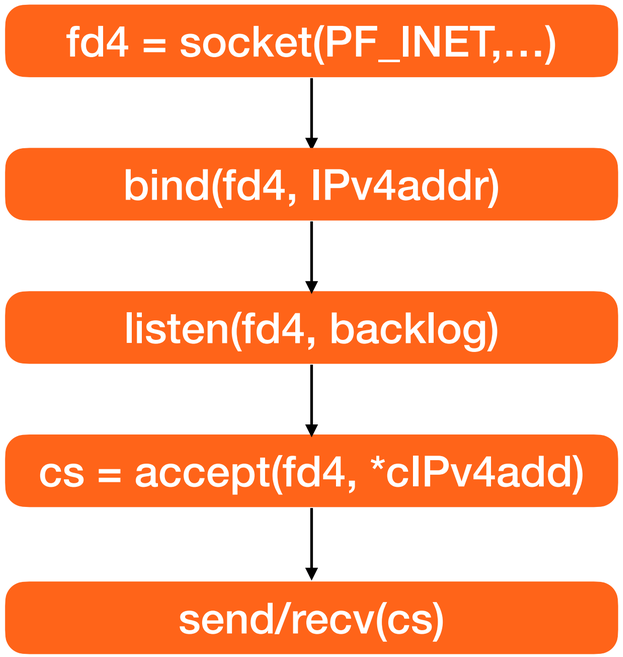
Server


fd4 = socket(PF_INET,…)
bind(fd4, IPv4addr)
listen(fd4, backlog)
cs = accept(fd4, *cIPv4add)
send/recv(cs)

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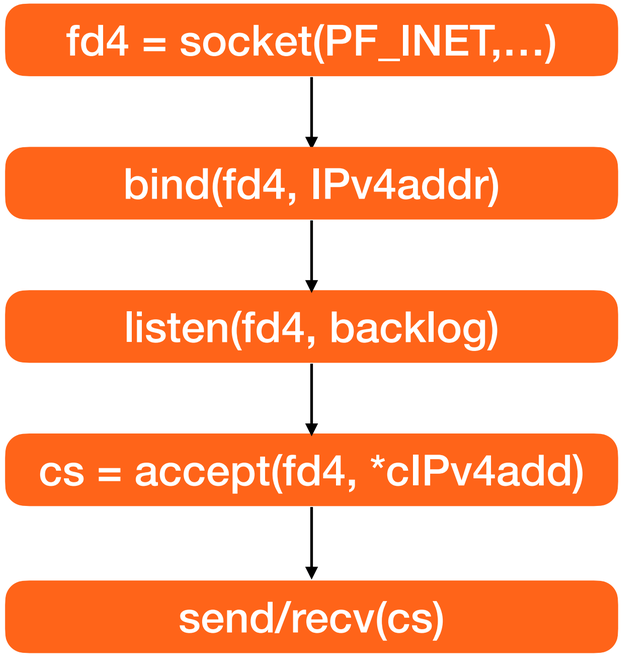
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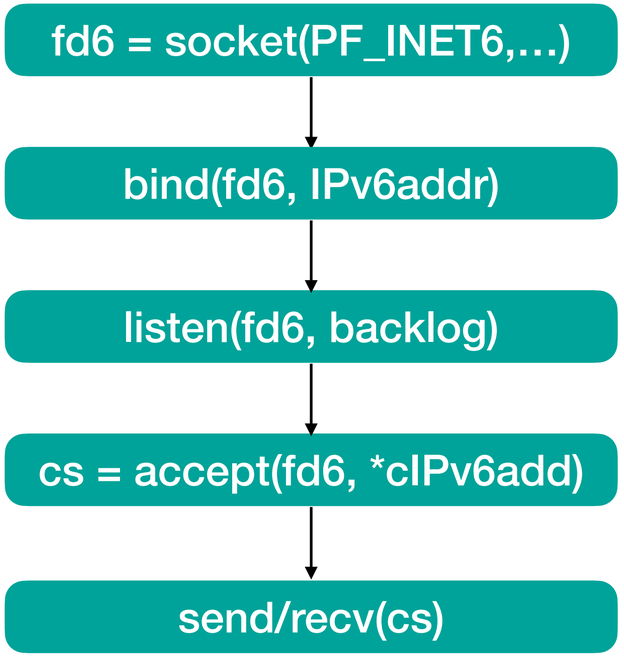
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listen(fd6, backlog)
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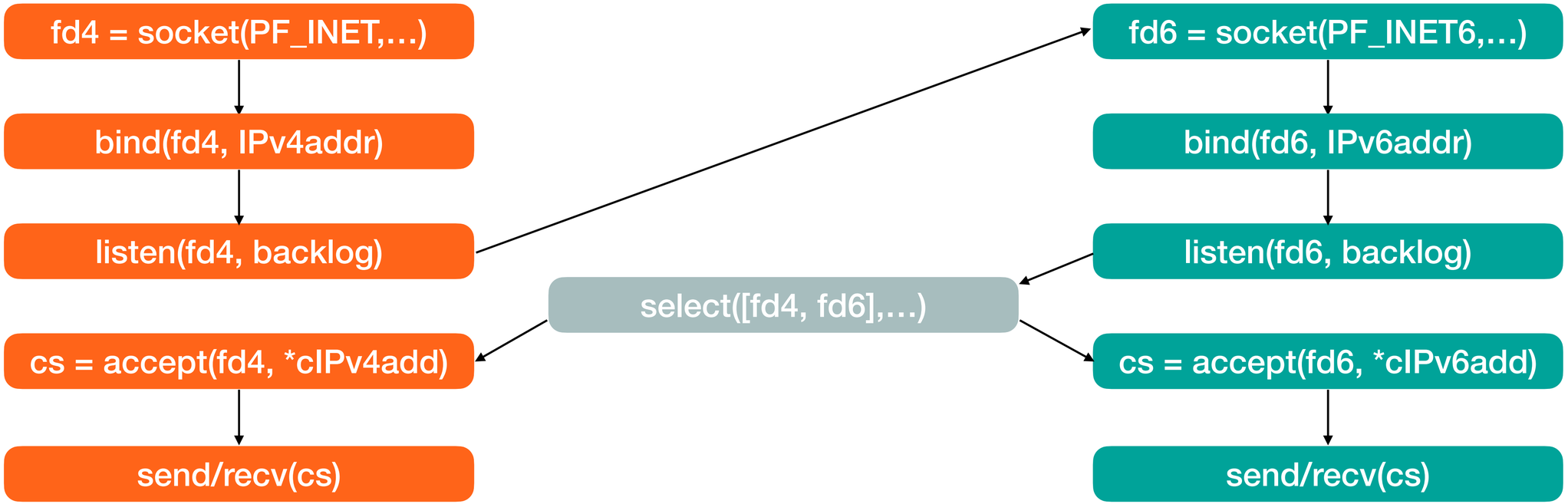
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  - OpenBSD deliberately **does not support it**

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- Enabled compatibility will block opening similar IPv4 socket

IPv4-mapped IPv6 addresses in the wild

IPv4-mapped IPv6 addresses

- Represent IPv4 addresses in **IPv6-only socket API**
- Should **never leave the host**
- Should never appear in **any IPv6 packet anywhere**
- It **would be silly** to try to put them **into the DNS**

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- It **would be silly** to try to put them **into the DNS**
- **Yet people are doing it**

```
$ host bam.nr-data.net
bam.nr-data.net is an alias for bam.cell.nr-data.net.
bam.cell.nr-data.net is an alias for fastly-tls12-bam.nr-data.net.
fastly-tls12-bam.nr-data.net has address 162.247.243.29
fastly-tls12-bam.nr-data.net has IPv6 address ::ffff:162.247.243.29
```

Why would somebody do that?

We did this to **drive down the cost** with our DNS provider. Queries for AAAA records that didn't exist, followed by queries for A records, was **costing us significantly** and we needed to alleviate that.

Our AAAA answers **follow the standards**, and our local dual-stack testing has shown no issues. The IPv4 addresses embedded in the IPv6 answers should be accurate, and should match the A record requests, and should all be routable in the IPv4 space.

Source: New Relic support forum, shared by Thomas Schäfer

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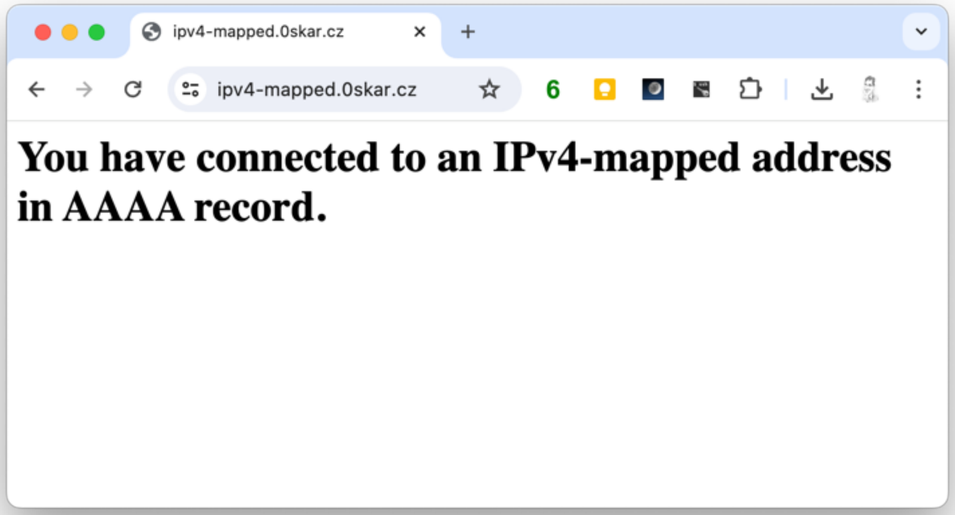

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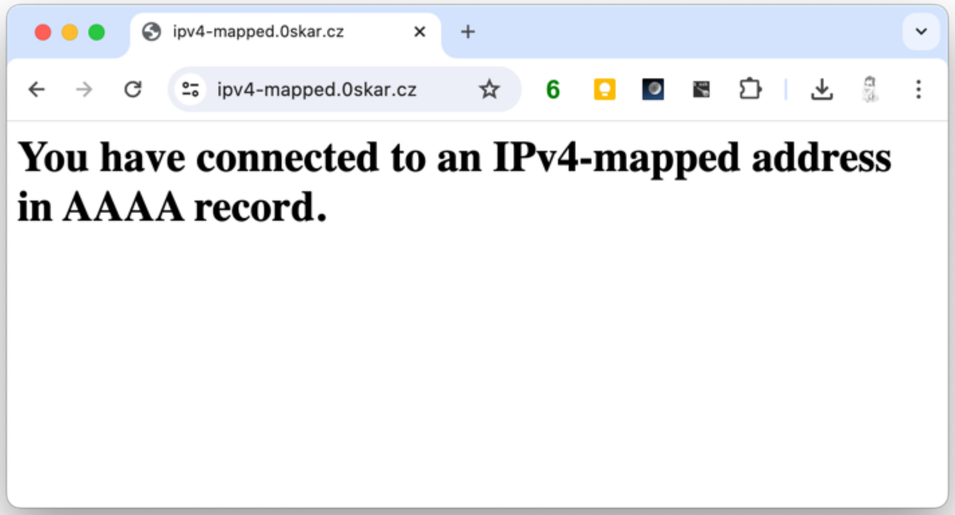

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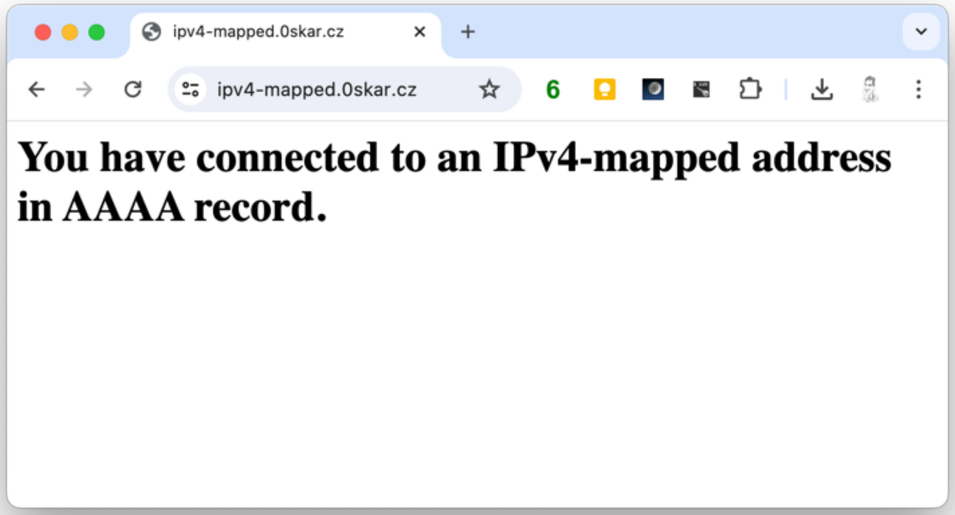

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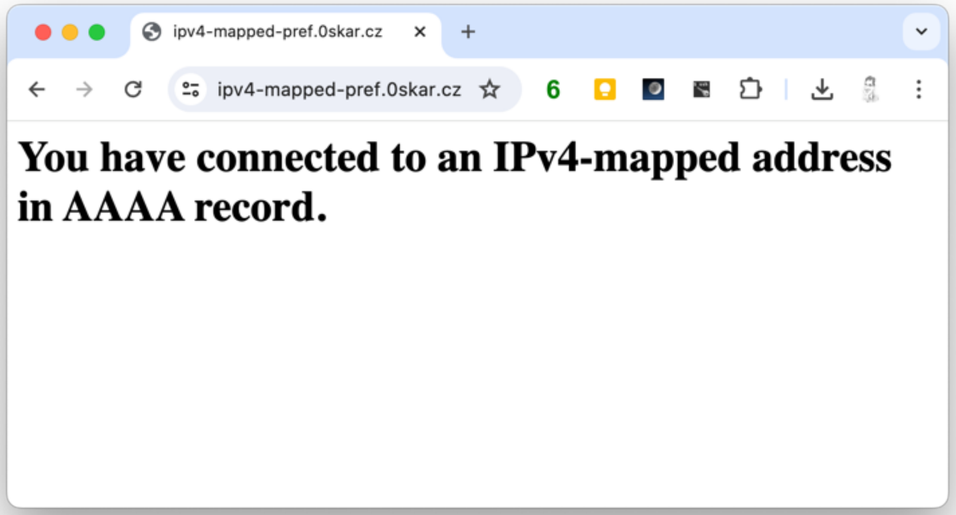

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- The results depend on:
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  - network (dual-stack vs. IPv6-only)
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macOS on a dual-stack network

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macOS on an IPv6-only network

Is this really a problem?

- Happy Eyeballs successfully **hide similar problems**
- Having a broken AAAA record **will break DNS64**
  - this can be avoided by setting up DNS64 to **ignore AAAA records** with addresses **outside the global unicast range**

What can we do about this?

- **DNS64 operators**:
  - **ignore addresses** outside 2000::/3 as valid AAAA-records
- **Operating system and/or browser vendors**:
  - *maybe* filter IPv4-mapped IPv6 addresses in the resolver?
- **DNS hosters**:
  - **don’t charge** your customers more **for empty responses**
- **Anyone**:
  - bring this to the IETF and clarify *unacceptable usage* of IPv4-mapped addresses

Questions

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@oskar456@mastodon.social

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ACADEMY

IPv6 Fundamentals E-learning Course

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- Interactive learning

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