

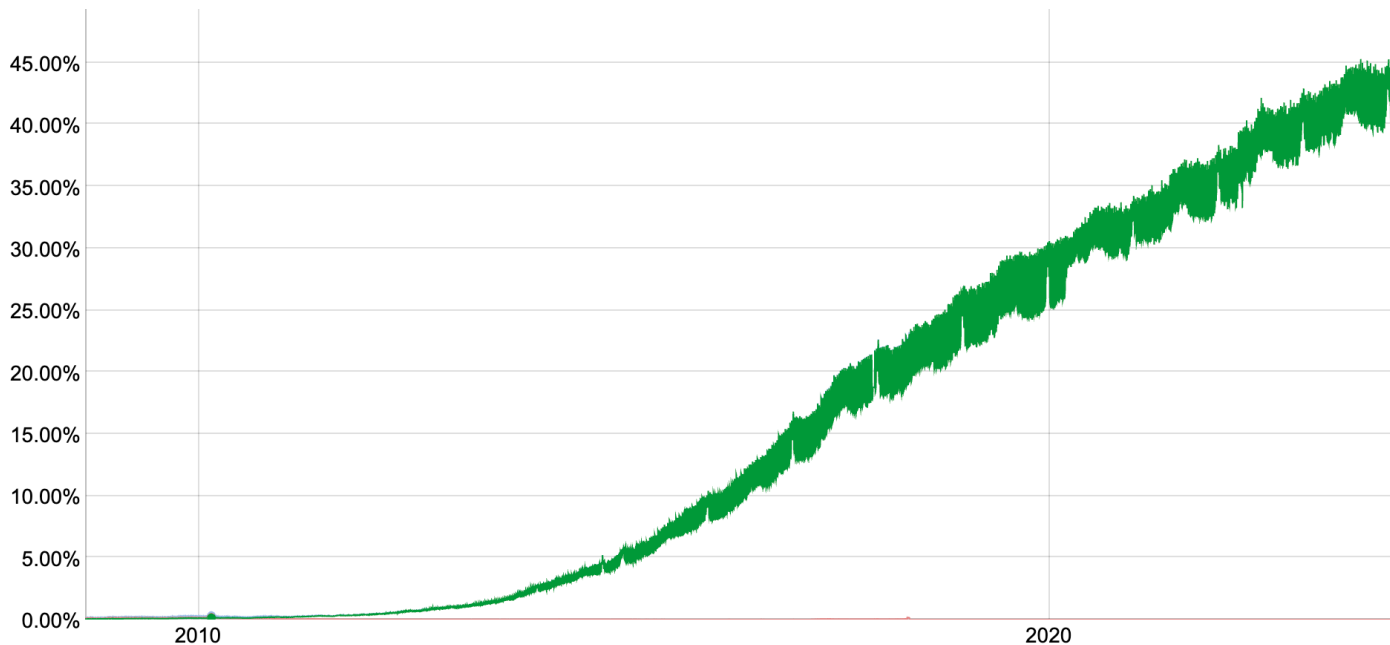
# A First Look at NAT64 Deployment In-The-Wild

Amanda Hsu, Frank Li, Paul Pearce, Oliver Gasser



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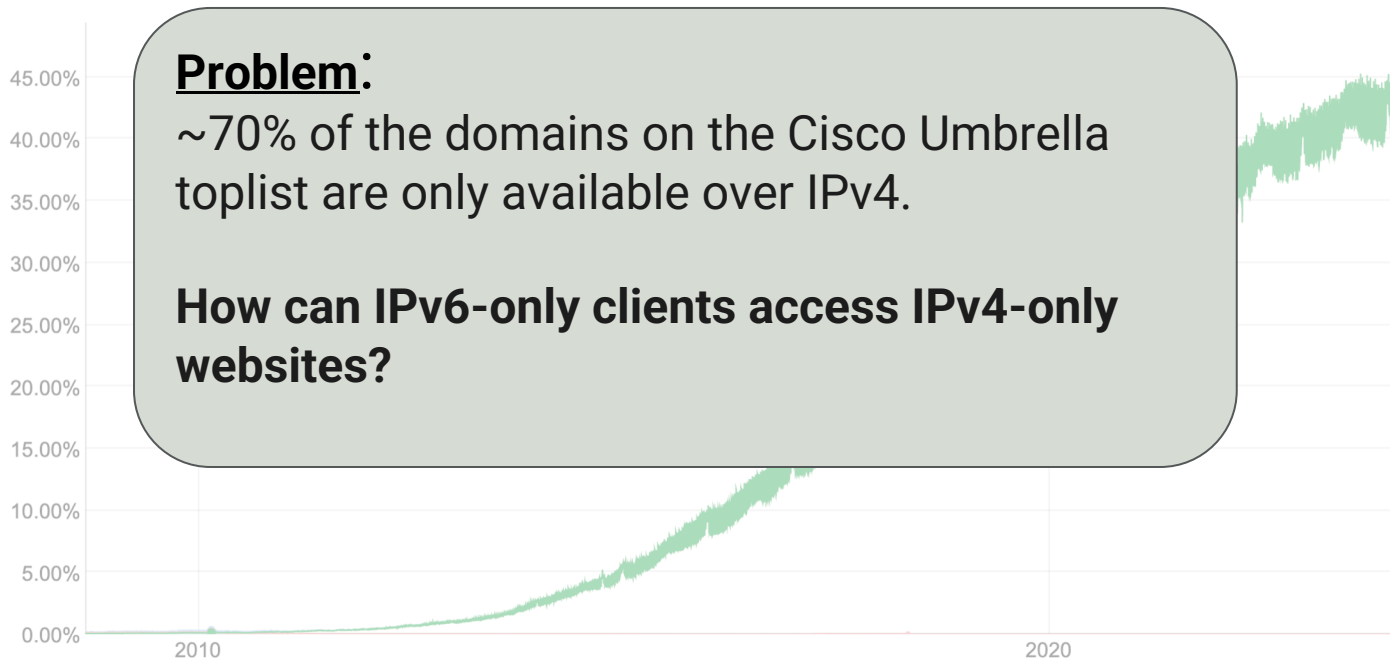
# Background: IPv6 Adoption



Source: <https://www.google.com/intl/en/ipv6/statistics.html>

Today, IPv6 is almost 45% of traffic to Google.

# Background: IPv6 Adoption



## **Problem:**

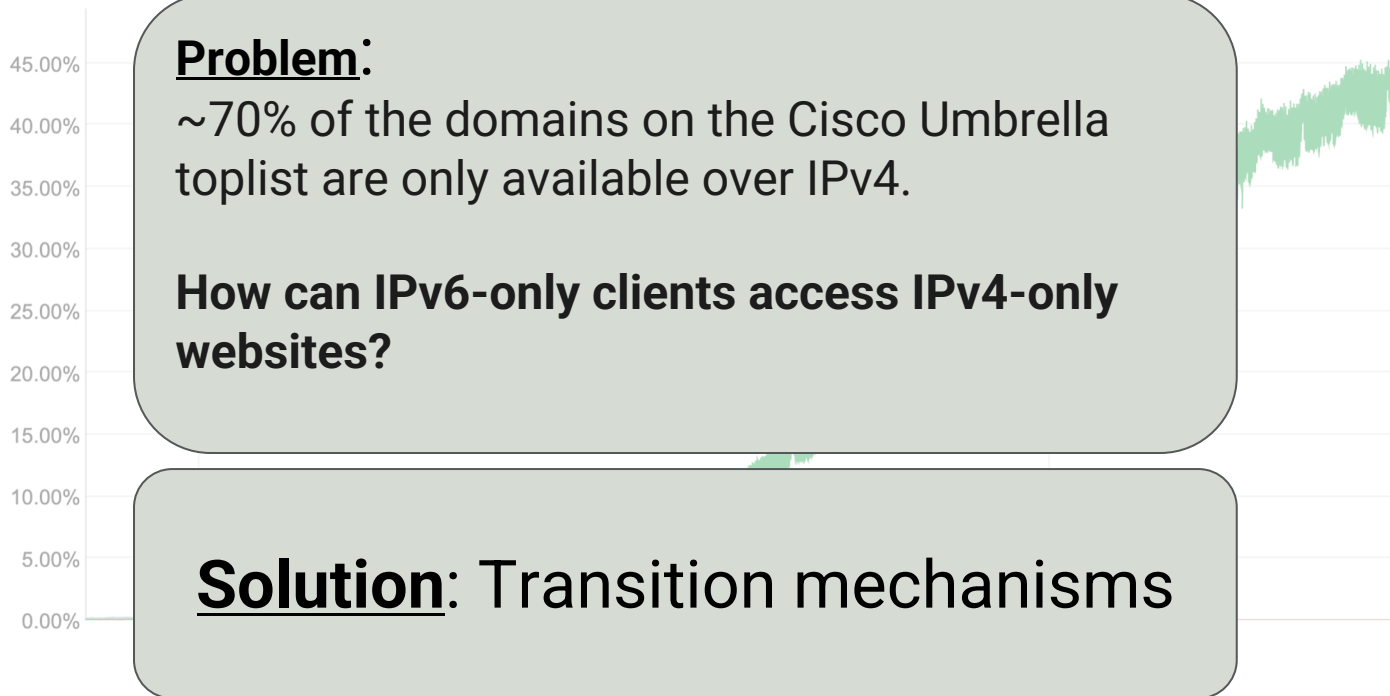
~70% of the domains on the Cisco Umbrella toplist are only available over IPv4.

**How can IPv6-only clients access IPv4-only websites?**

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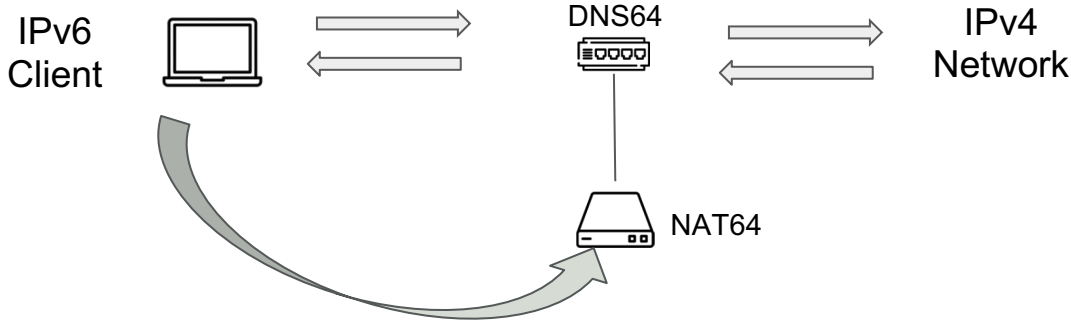
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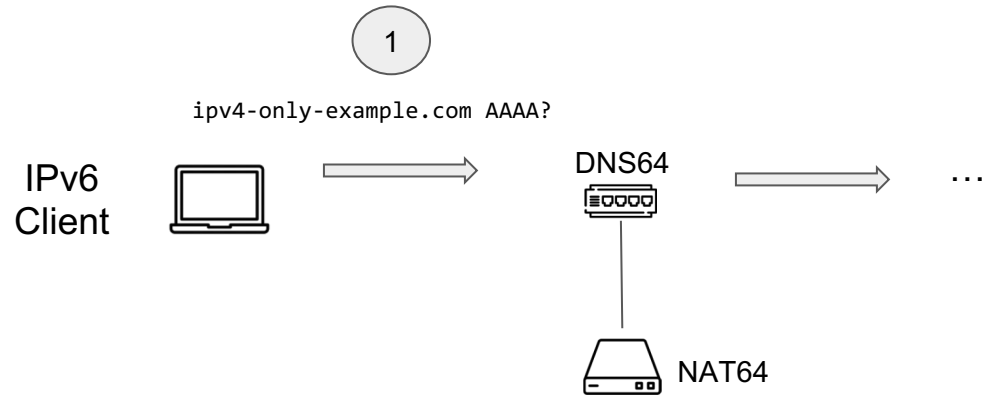


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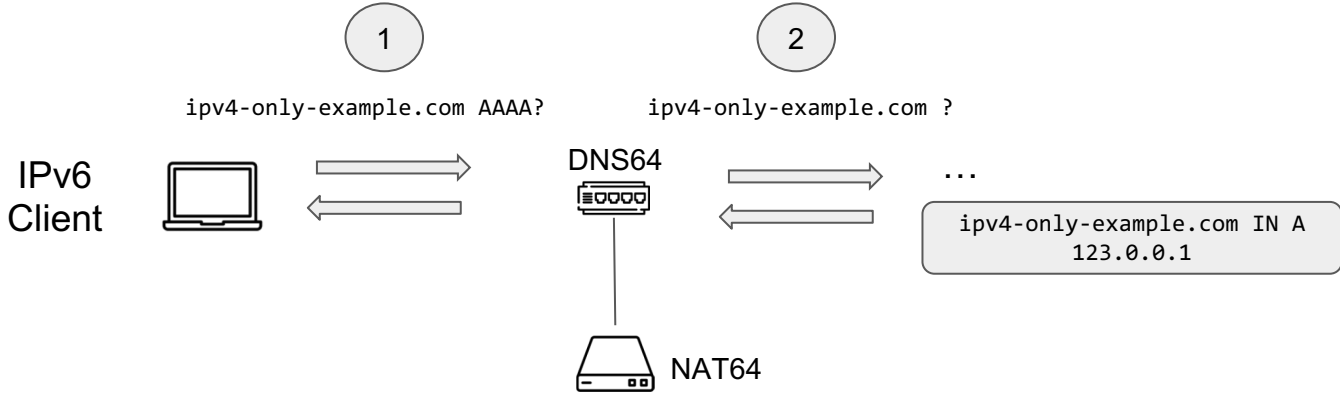
# Transition Mechanisms: NAT64



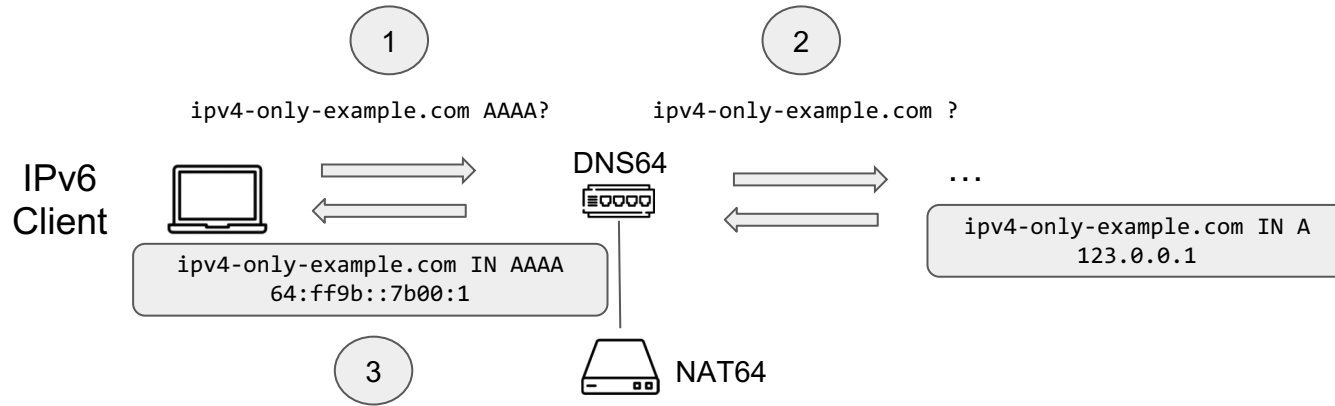
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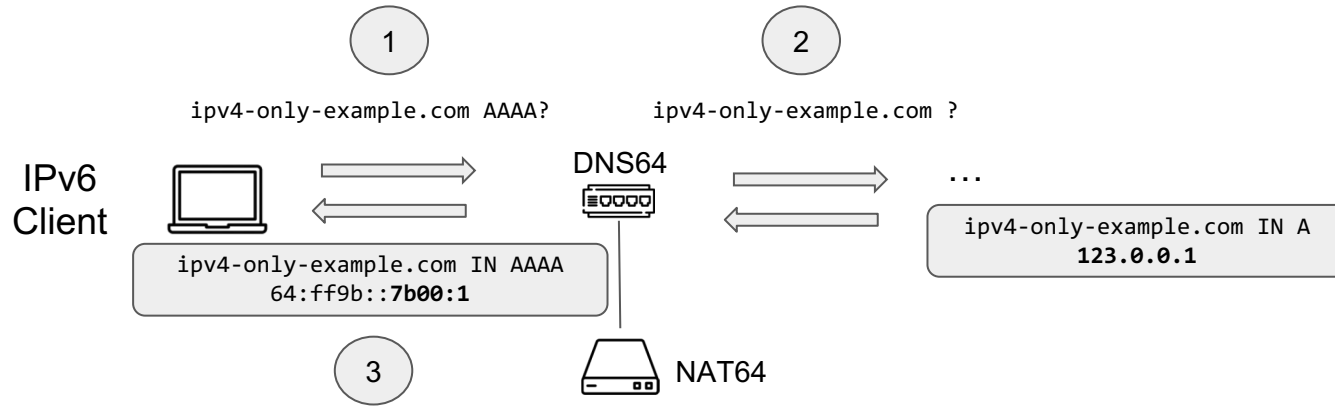


DNS64 maps IPv4 address to an IPv6 address

- IPv6 address can be globally unique, or from the special use prefix **64:ff9b::/96**
- The **IPv4 address is embedded** in the last 32 bits of the IPv6 address



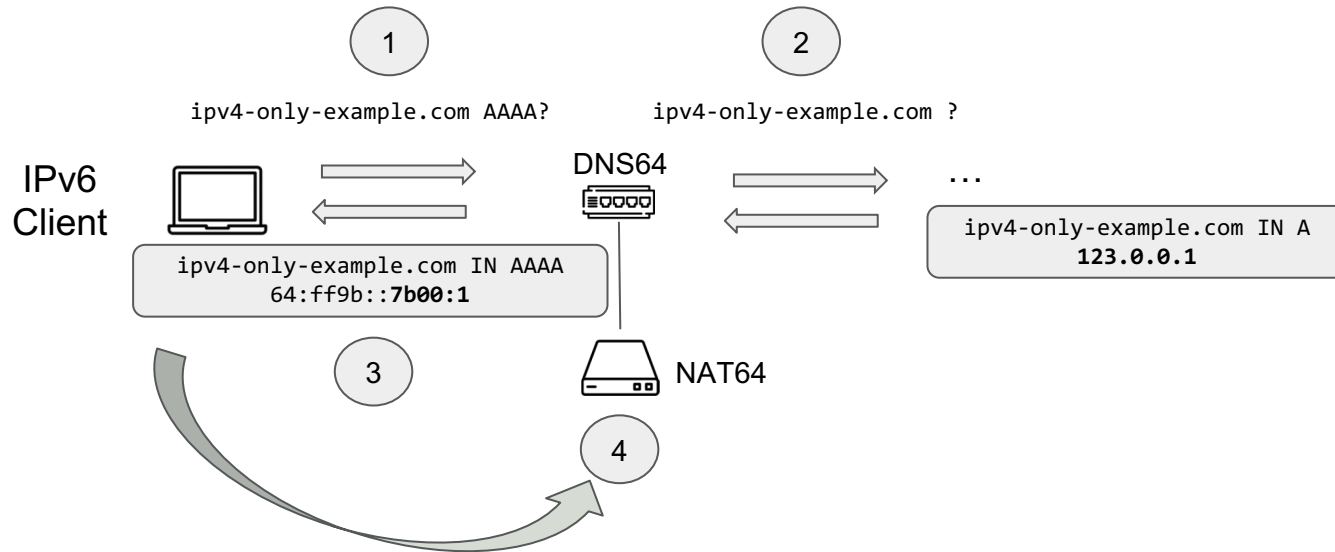
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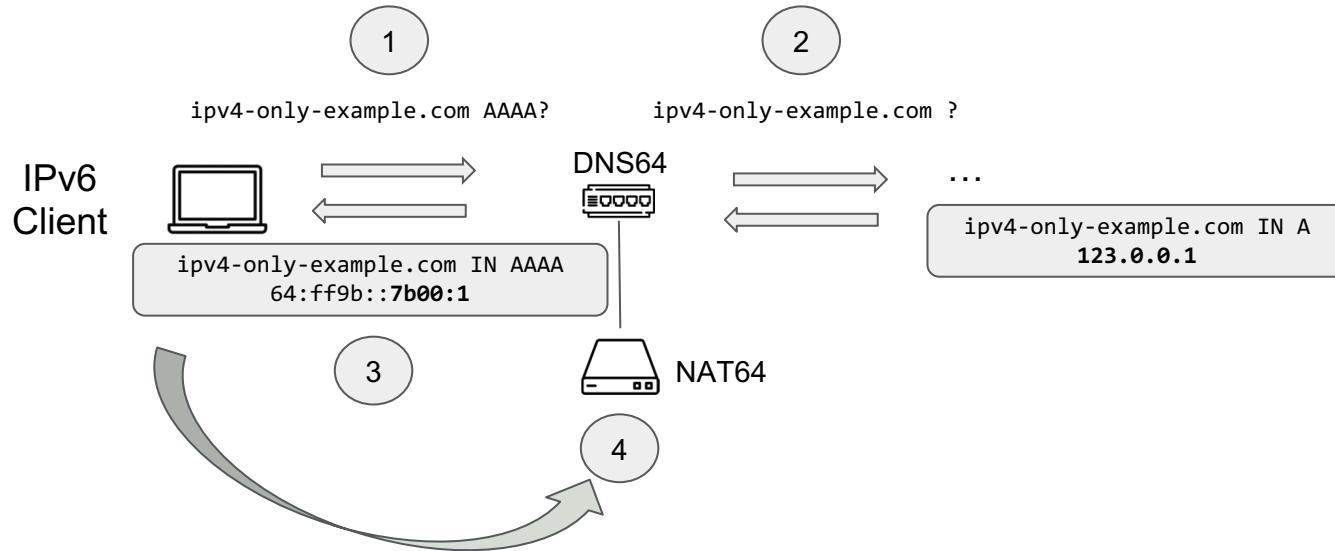
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# Transition Mechanisms: NAT64



We request an AAAA record for IPv4-only domain from resolvers. If they respond with a AAAA record, the resolver is potentially using DNS64.

# Research Questions

## Deployment and demographics

What is the prevalence of NAT64? Where is NAT64 deployed?

## Configuration

How are NAT64 gateways configured?

## Security

Are NAT64 gateways publicly accessible?

# Methodology: Measurement

## 1. DNS resolvers

IPv6 resolvers from the IPv6 Hitlist and IPv4 resolvers from the Censys dataset.

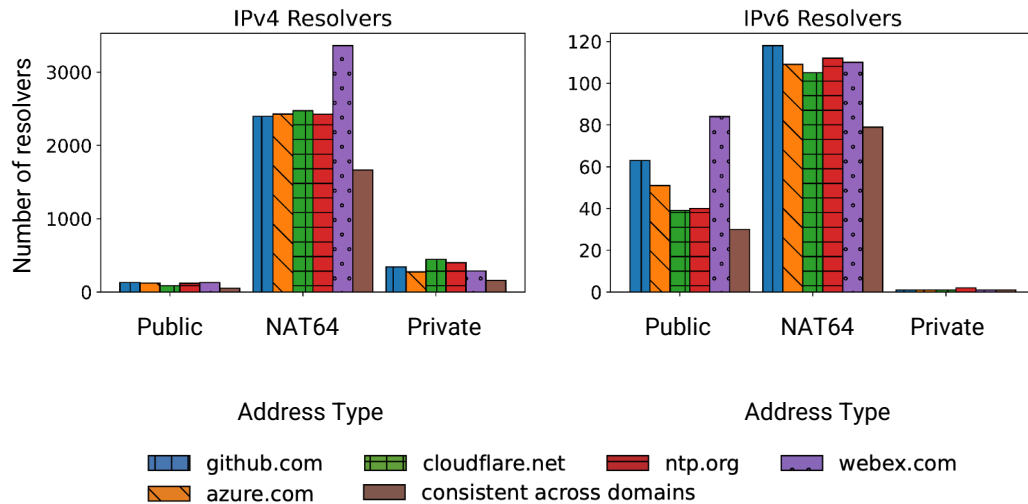
## 2. Clients

We identify whether the RIPE Atlas probe is using NAT64 for IPv4 connectivity.

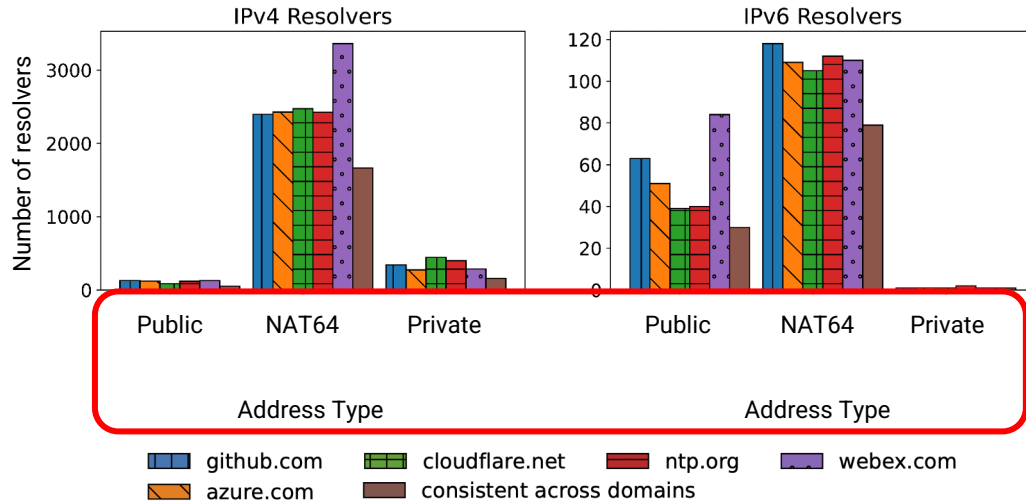
## 3. Clients -> Our Webserver

We set up a domain that only has an A record and use RIPE Atlas probes to send AAAA record requests.

# Results: Resolver Demographics

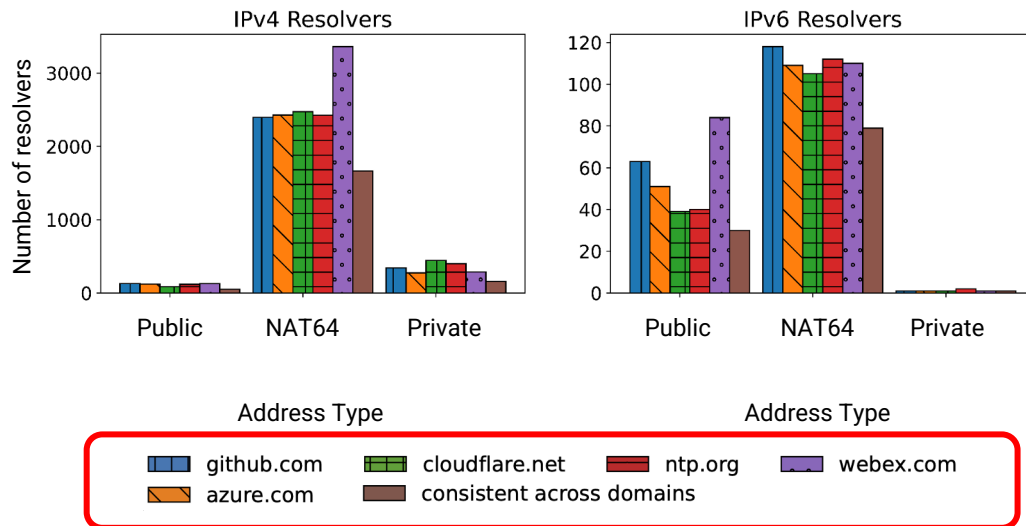


# Results: Resolver Demographics



Type of addressing on synthetic AAAA records returned by resolver

# Results: Resolver Demographics

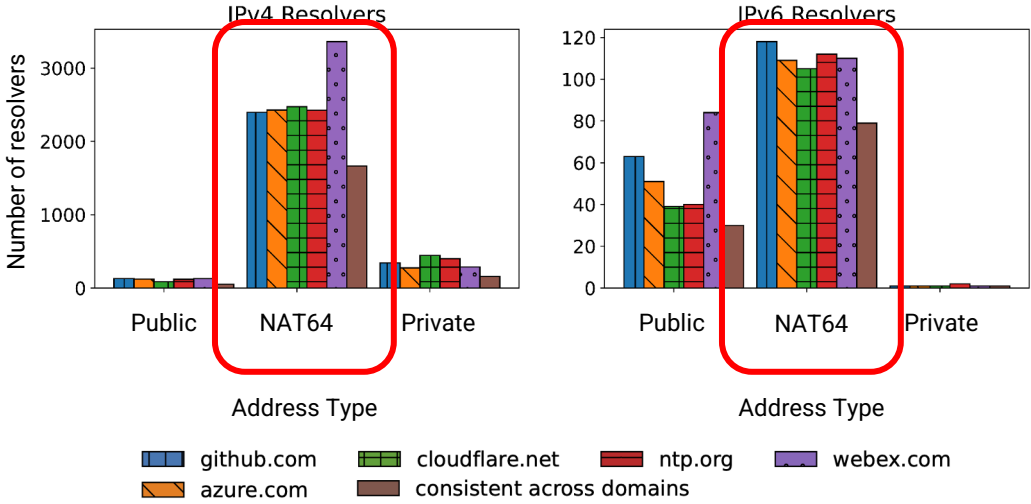


IPv4-only domains

\* At the time of measurements

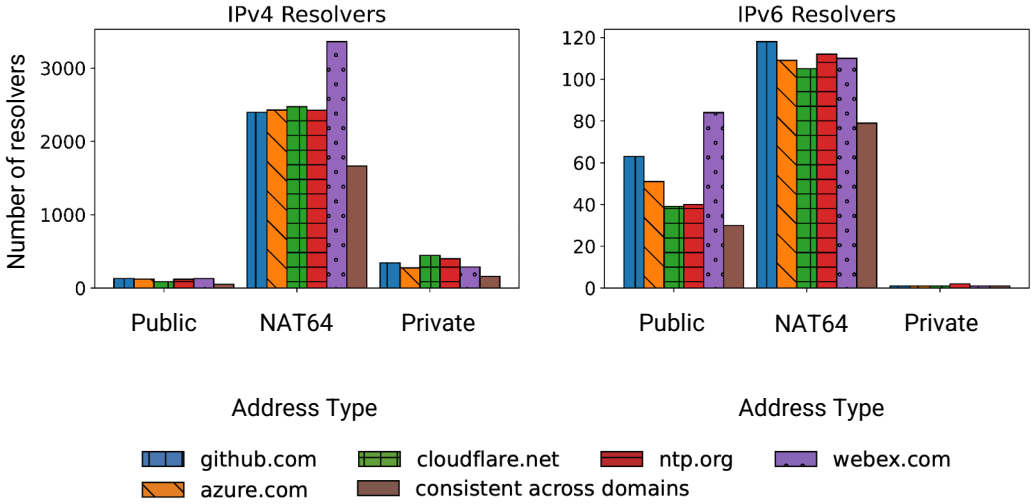


# Results: Resolver Demographics



Across all public resolvers, most NAT64 deployments leverage the special-use prefix.

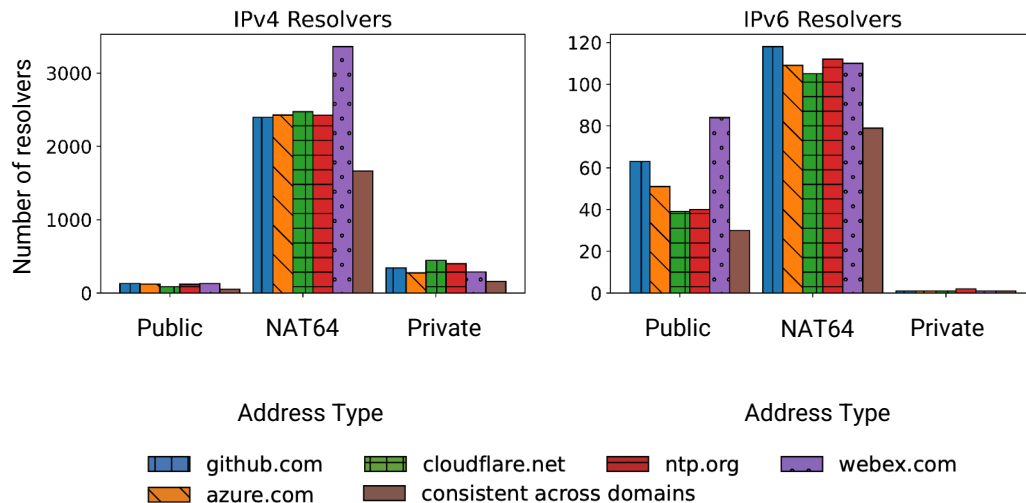
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0.1% IPv4 resolvers

0.04% IPv6 resolvers

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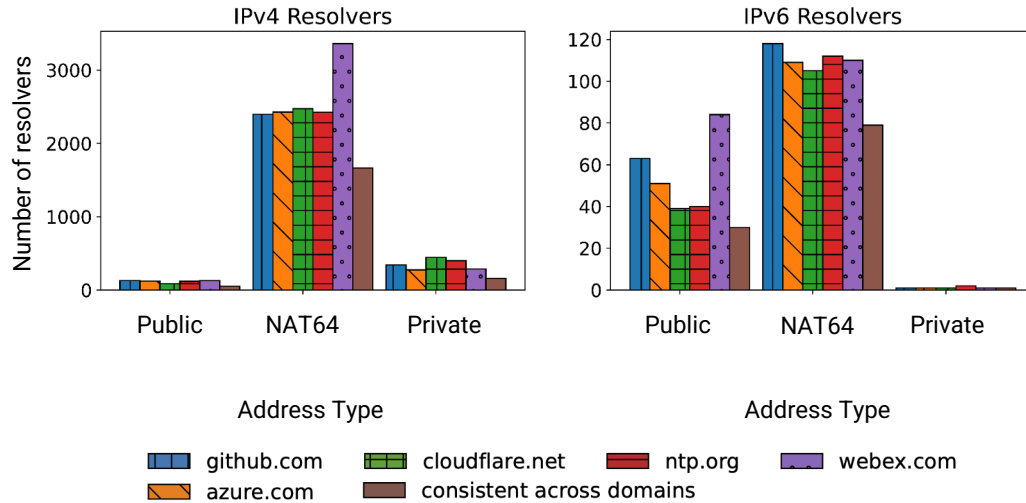


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DNS64 is not deployed widely across public resolvers.

# Results: Resolver Demographics

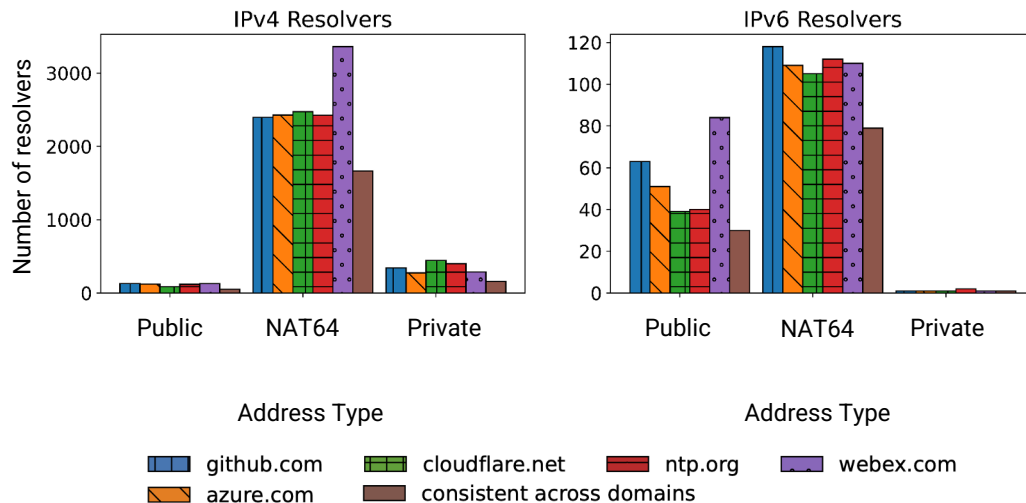


## Top Resolver ASes:

**IPv4:** Mediatecom, Tata Teleservices, China Telecom, Yettel Hungary

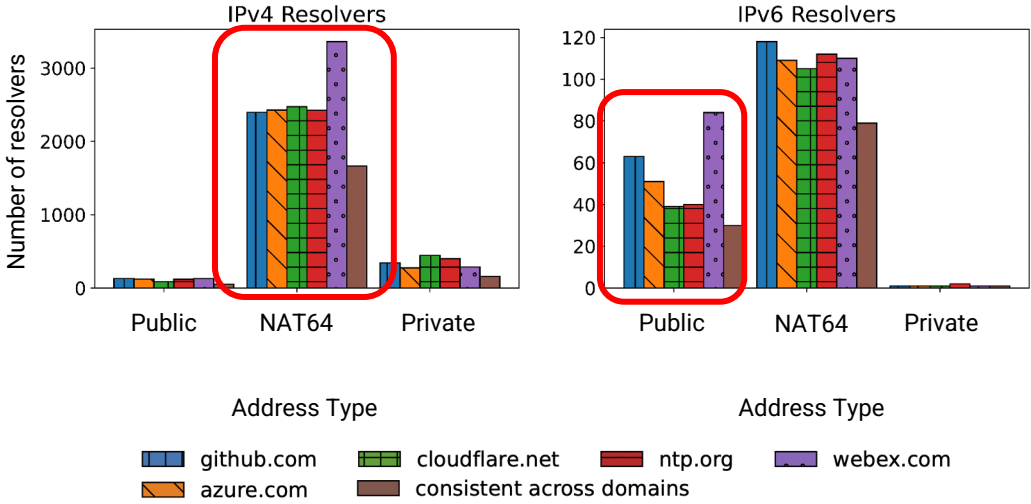
**IPv6:** China Telecom, Hurricane Electric, Akamai, Cergnet, Giginet

# Results: Resolver Demographics

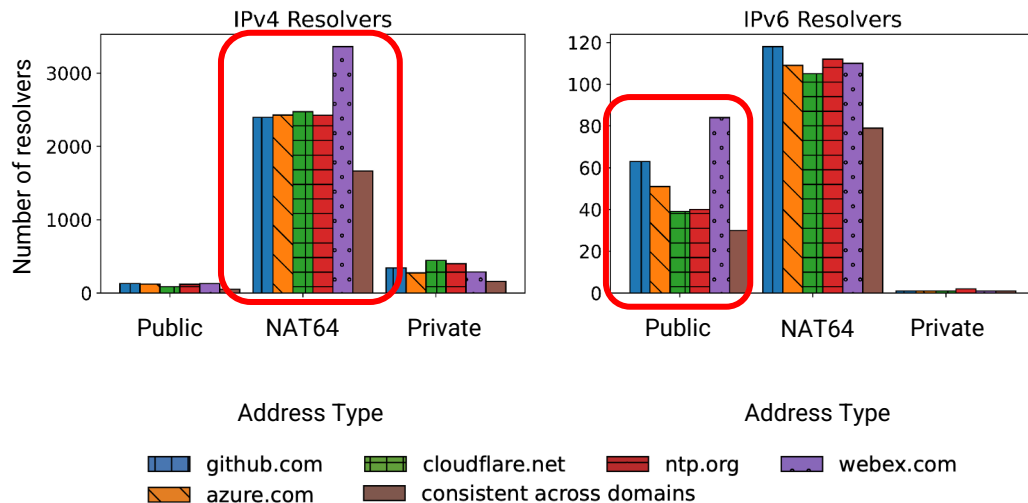


DNS64 resolvers are concentrated in mobile networks, network service providers, and Chinese networks.

# Results: Resolver Demographics



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Resolvers respond inconsistently across requests for different domains.

Resolvers in **China Education Network (AS 4538)** are more likely to respond to requests for **webex.com** than other domains.

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- **Private Address Space:** 3%
- **Special-Use Prefix:** 73%
- **Public Addresses:** 24%

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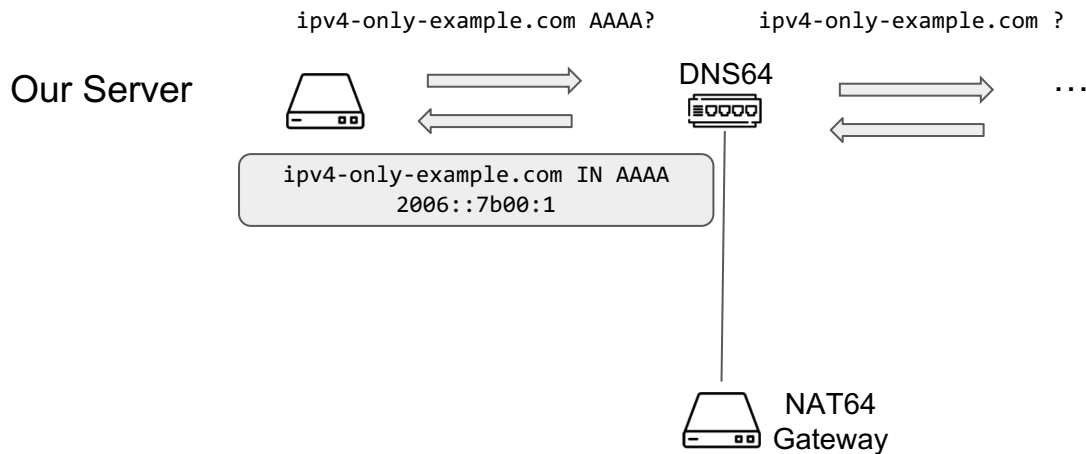
Largely, clients do not use NAT64.

# Results: NAT64 Security

## Are NAT64 gateways publicly accessible?

### Method:

1

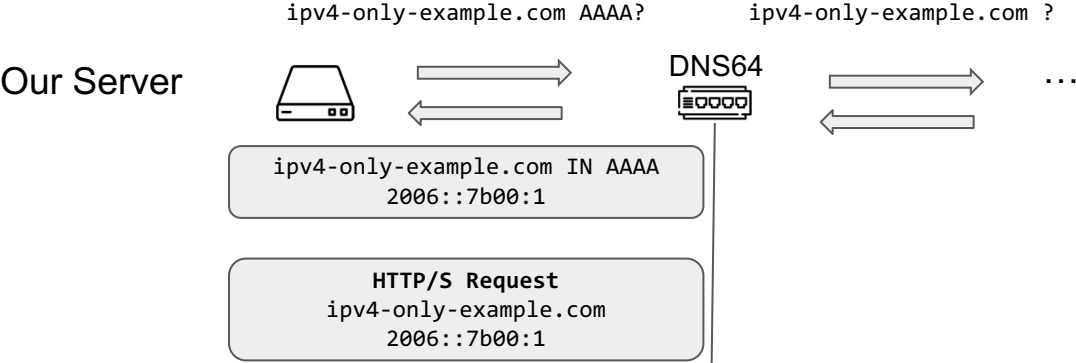


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## Are NAT64 gateways publicly accessible?

### Method:

1



2

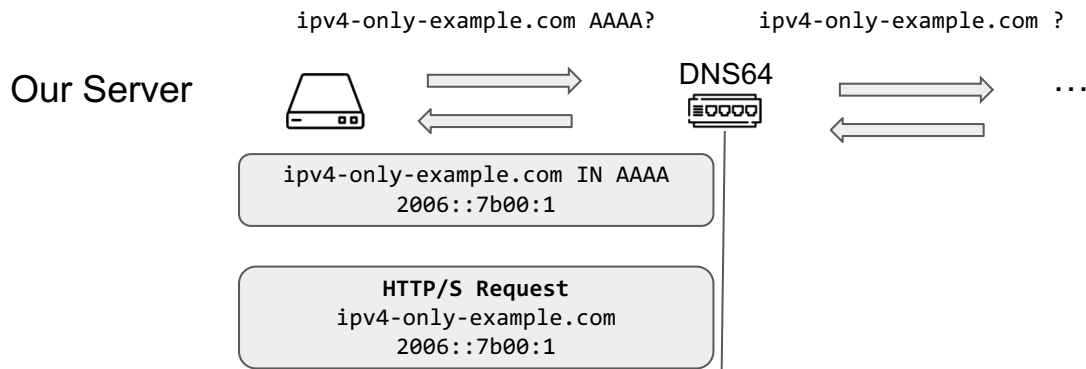


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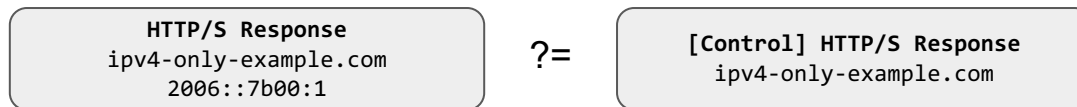
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3





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**Are NAT64 gateways publicly accessible?**

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## Are NAT64 gateways publicly accessible?

### Measurements from Our Server

**IPv6 Resolvers:** 6.6-26.6% HTTP, 11.1-15.6% HTTPS

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- "Incorrect" certificates include hosting provider domains, parked domains, or other domains (e.g. `netflix.com`)

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NAT64 gateways on public IPs are not largely accessible by servers outside the network.

# Summary

- DNS64 resolvers are not deployed publicly at large.
  - All resolver measurements significantly vary by the domain requested.
- Measurable clients do not largely use NAT64 for IPv4-connectivity.
  - Although, RIPE Atlas probes may not be representative of the Internet.
- Most NAT64 gateways are not publicly accessible.
- **Largely, DNS64 resolvers embed A records correctly.**

# Feedback and Input

Does your network use NAT64? Do you have experience using it?

We would love to discuss others experiences with NAT64 and transition mechanisms!

We welcome any input on our methodology and findings.

# Questions? Feedback?

[ahsu67@gatech.edu](mailto:ahsu67@gatech.edu)



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