



## Problem Statement

- IPv6 is being gradually deployed by websites as the transition from IPv4 to IPv6 continues
- The goal of this transition is to create more address space for the Internet, as IPv4 addresses have already begun to run low
- This project identifies which sites of the Alexa Top 500 Global Sites have IPv6 addresses. It then investigates the differences between each site's IPv6 paths and IPv4 paths in the context on both the Autonomous System (AS) level and on the router level
- The goal is to develop programs that collect relevant data, present the data, and analyze the data in order to characterize the IPv6 and IPv4 paths each site.
- One potential application of this data is Border Gateway Protocol (BGP) anomaly detection, which is where improper router announcements propagate through the network, directing requests to the wrong locations.

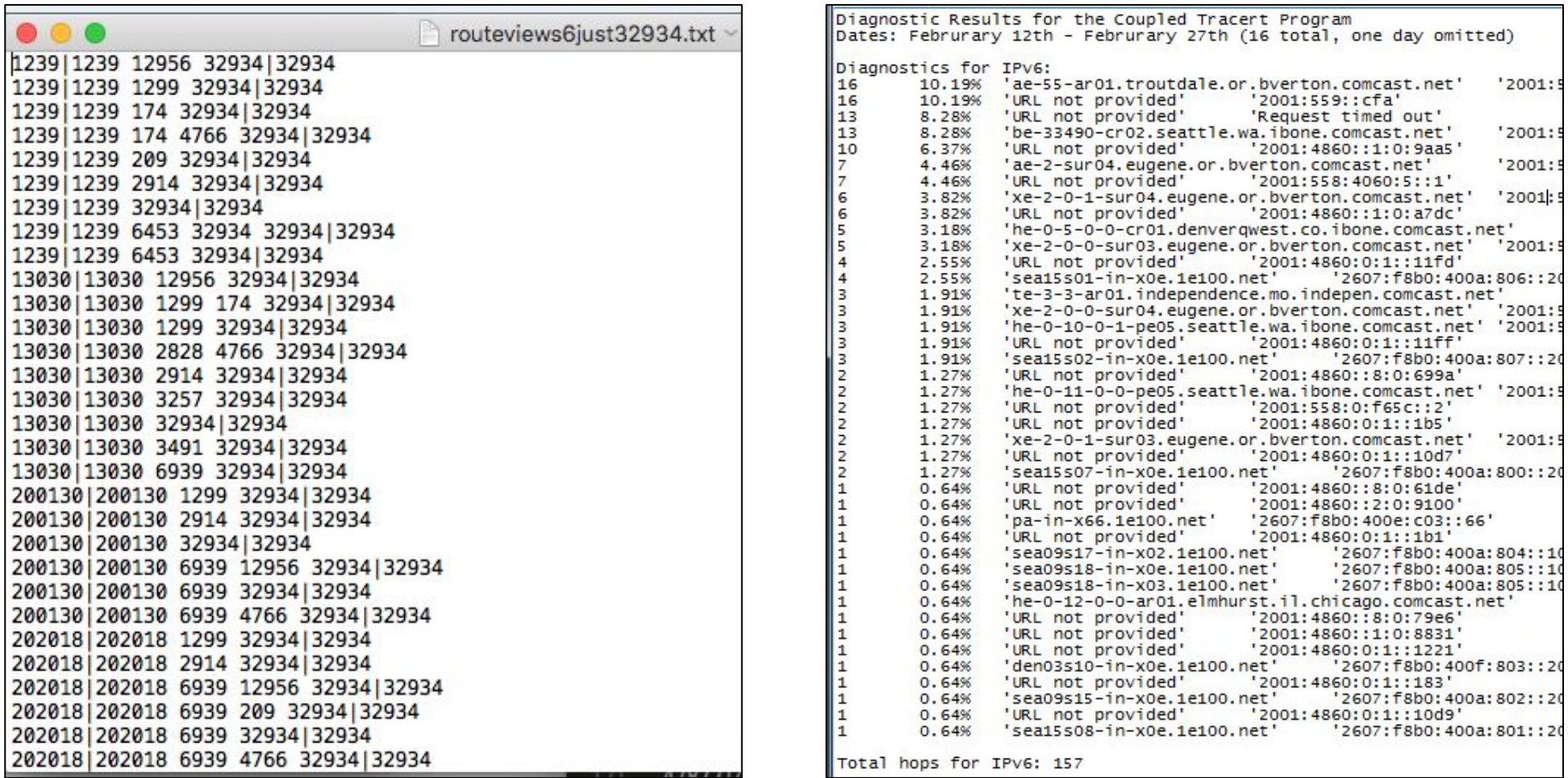
## Hypothesis

IPv4 paths should have a higher level of diversity compared to IPv6 paths on both the router level and the AS level. IPv6 routes should update with less frequency than IPv4 routes. Finally, we expect IPv6 to exhibit a more high volume traffic routers.

## Methods

### Traceroutes (router level)

We developed a program that examined traceroutes over time to investigate how often paths on both IPv4 and IPv6 changed going from a certain origin to IPv6 enabled sites. We then examined how often a router was used along this path. We compared IPv6 to IPv4 paths and the usage rate of different routers along these paths to see if there were any routers that facilitated a disproportionate amount of traffic, and to see if there was a difference in diversity of the router utilization.



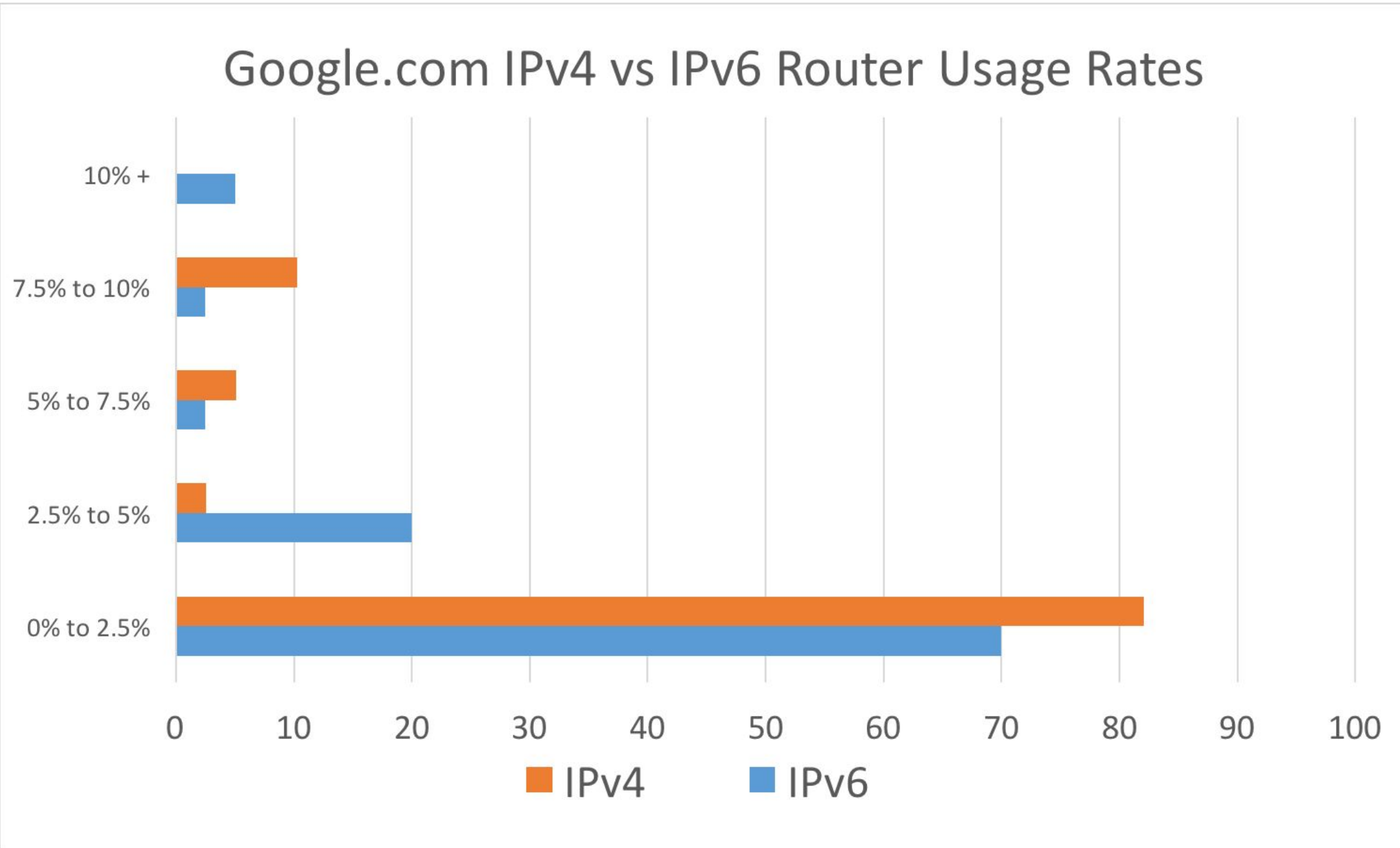
Screenshots of output from the traceroute (left) and RIB table (right) diagnostics tools

### Routing Info Base (RIB) Tables (AS level)

The other part of this project consisted of creating a program for examining RIB tables to see if there was any sort of a pattern to be found in the paths in terms of ASes passed through. We compared the average length of these AS paths.. We also examined the rate of withdrawals and announcements for both IPv6 and IPv4 tables.

## Results

Of the Alexa Top 500 Global Sites, 27 support IPv6. The figure below highlights Google.com's traceroute results



Google's IPv4 Variance: 0.0678% All Sites IPv4 Variance: 0.0078%  
Google's IPv6 Variance: 0.0611% All Sites IPv6 Variance: 0.0048%

	Avg IPv4 ASN Path Length	Avg IPv6 ASN Path Length
Google	2.17	1.92
facebook	2.42	2.38
YAHOO!	3.67	2.07

## Conclusions

- IPv6 router usage tends to exhibit more variance than IPv4. This seems to suggest more static IPv6 paths.
- IPv6 routers pass through fewer ASes than IPv4 routers
- In general, IPv6 requests travel less dynamic, less diverse, and shorter paths than IPv4 requests