Studying the Performance of IPv4 and IPv6

WN Project Group-10

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Akshat Tilak   (2020020)
Jahanvi Bakshi   (2021069)
Yogesh Kaushik   (2020163)
Shubham Sharma   (2021099)

Problem Statement

The Problem Statement / Project Aim is to assess and compare the performance of IPv4 and IPv6 connections by pinging a selected group of websites over 4G networks provided by different ISPs (Jio and Airtel) on different days. Then, analyze how geolocation data, estimated from the websites' IP addresses, correlates with connectivity performance, potentially offering insights about network efficiency and the impact of different Internet protocols.

Related Work

1. Use ping and traceroute to get data for hops and pings for both ipv4 and ipv6.

2. Use Wget to get data on how long websites take to fetch for both ipv4 and ipv6

Methodology

Websites Selection

1. A list of websites has been compiled for this project, ensuring a diverse representation across various domains and geographic locations.
2. Then, both IPv4 and IPv6 addresses of these websites have been fetched for comparative analysis.
3. It was crucial to know that these websites had support for both ipv4 and ipv4, as without it, we could not correlate the data between them.

Network and Tools

1. Access to 4G networks from Jio and Airtel ISPs has been established using mobile hotspot.
2. Network tools like ping, traceroute, and Wget were used.
3. Systems need to be compatible with IPV4 and IPV6 connections

Data Collection

Ping tests are conducted for the selected websites using both IPv4 and IPv6 addresses. These tests are executed on multiple days, and 40 pings per website are sent to

understand the potential variations due to network fluctuations. For extensive analysis, we stored Geolocation data based on the website's IP address, hop data for each ping based on traceroute and also used bash scripts utilizing tools like Wget to download the content of the whole website.

All data collection was automated with Python and shell scripts as well as graph generation.

Data collection was done from 11th - 17th November 2023 for ping/traceroute and 26th November - 2nd December 2023 for Wget in the morning at 9:30 for 2 ISP's namely :
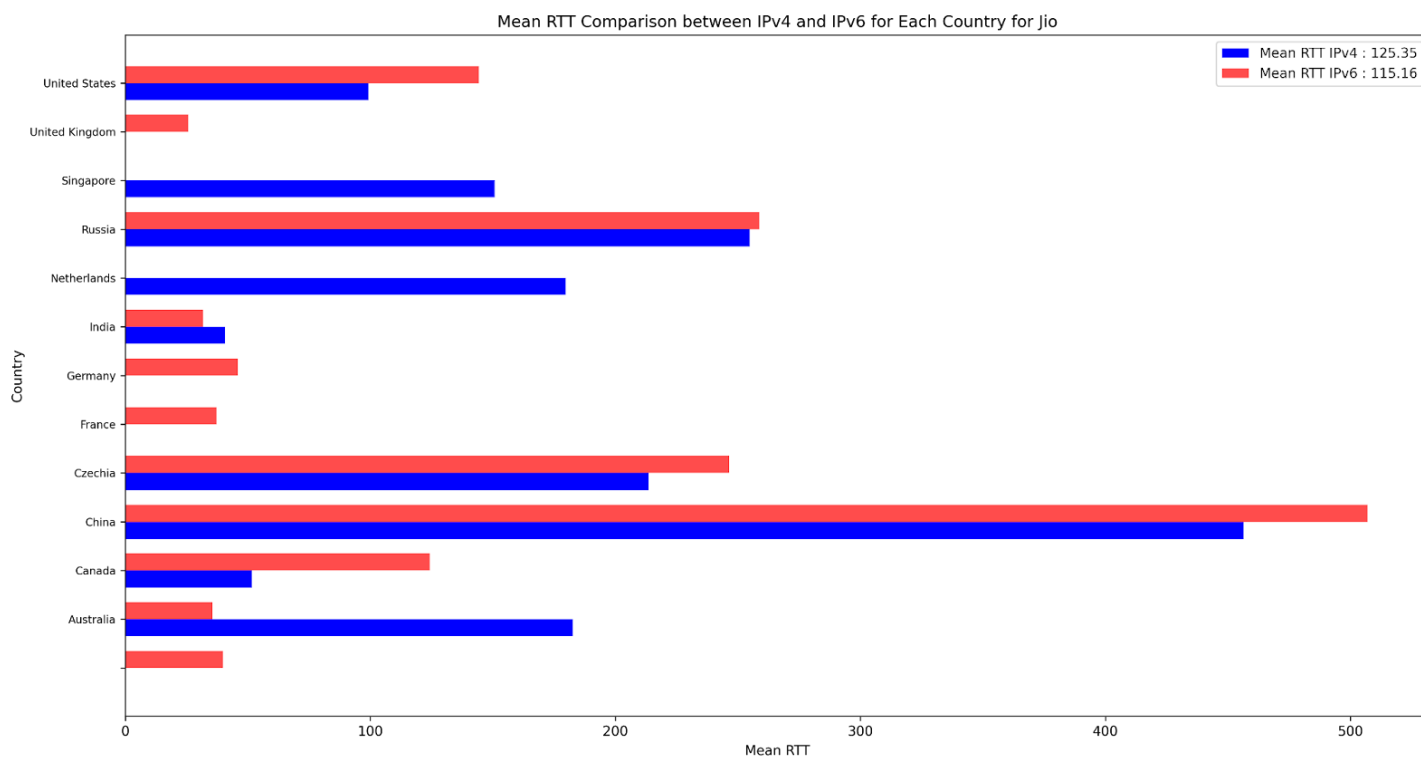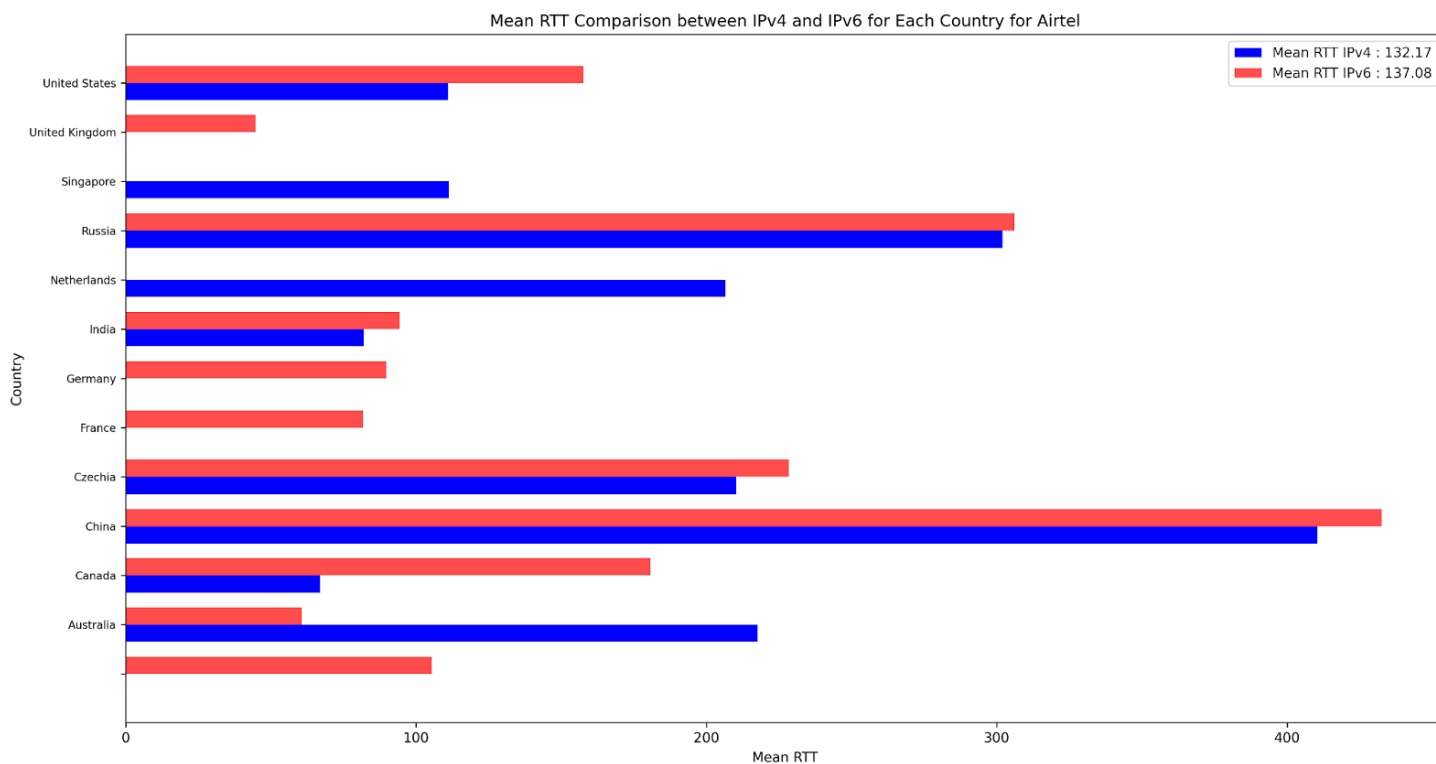
1. Jio
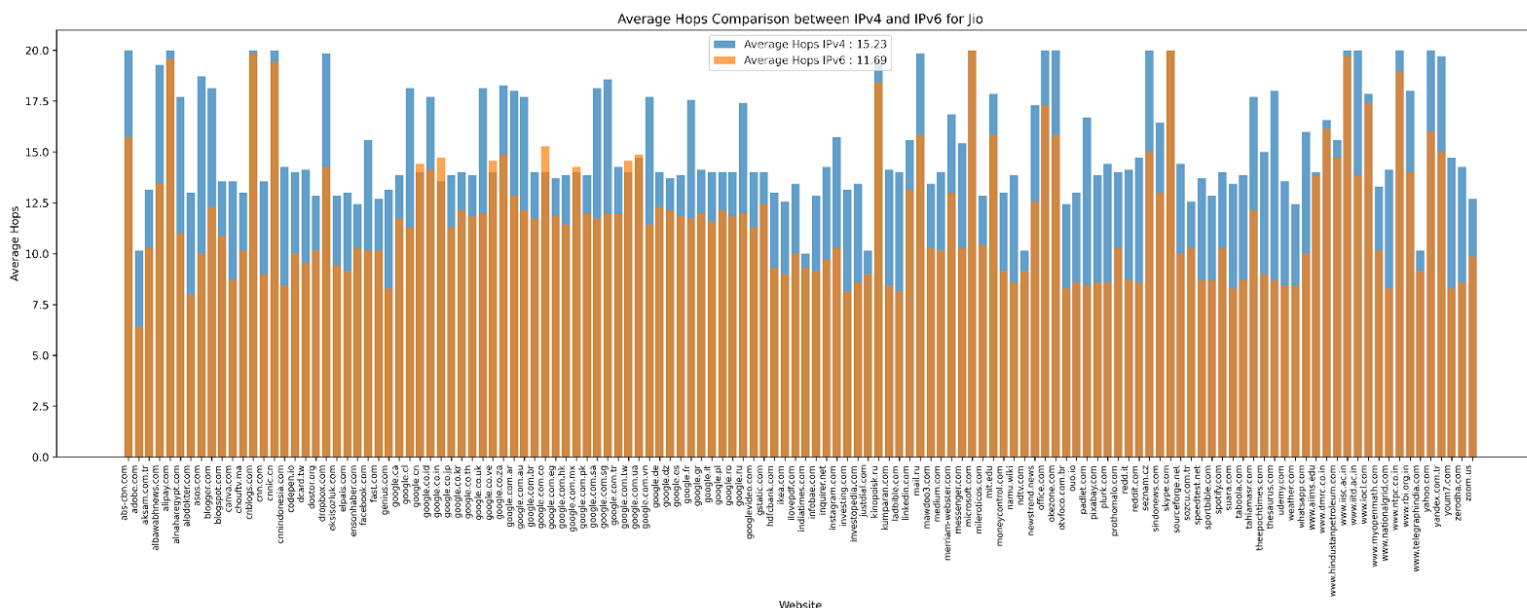2. Airtel

Results

I. Plots

We have created multiple plots, all of which are automated through Python scripts. We created plots comparing IPV4 and IPV6 based on groupings of :

1. Websites
2. Geolocation
3. Hops
4. Page retrieval times
5. Dates

Since we have a lot of them we will present only the main ones here in the report and their findings.

Mean RTT Comparison between IPv4 and IPv6 for Each Country for Airtel

Mean RTT IPv4 : 132.17
Mean RTT IPv6 : 137.08

Mean RTT Comparison between IPv4 and IPv6 for Each Country for Jio

Mean RTT IPv4 : 125.35
Mean RTT IPv6 : 115.16

In these graphs, we compare the RTT between Jio and Airtel for IPV4 and IPV6. As expected, India performs the best due to proximity.

IPV6 performs better for Jio than Airtel, and in the end, the difference is very minuscule as the readings are in ms.

Average Hops Comparison between IPv4 and IPv6 for Airtel

Average Hops Comparison between IPv4 and IPv6 for Jio

Again, we compare Jio and Airtel but this time for the number of hops for both IPV6 and IPV4. We can see again that there were fewer Hops for Jio in IPv6 as compared to that of Airtel. This trend of Jio outperforming Airtel continues as we go on.

Coming to the results of Wget, we mainly noticed there was not much difference in the time for retrieving a full webpage between IPV4 and IPV6 In the following graph for Airtel, we can see that the times are similar
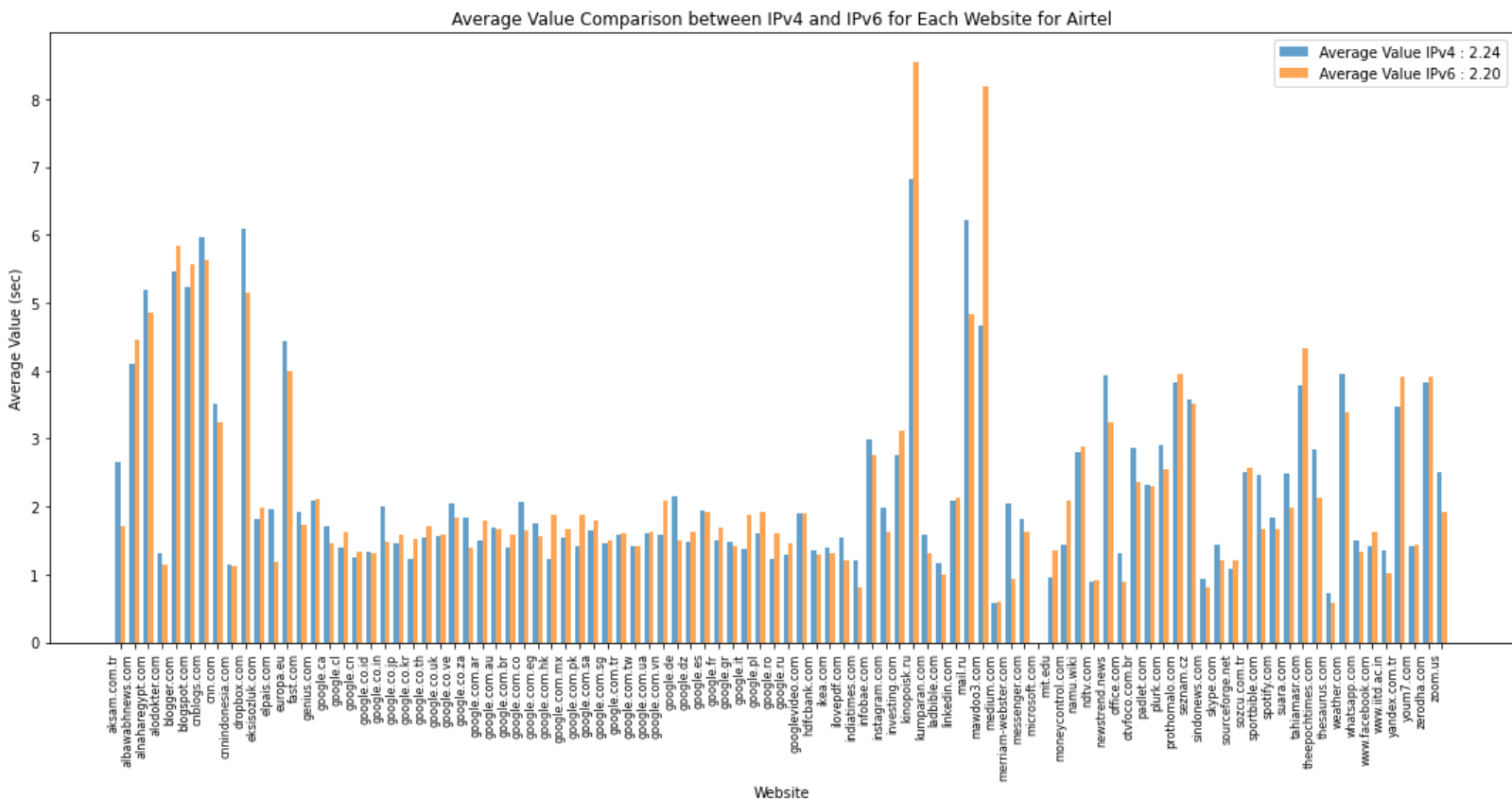

These time values are all in seconds, and we also realize from this that the smaller gains in hops, RTT, or any other metric that IPV6 gained just cancel out in a real-world scenario of fetching larger data.

We also made graphs to show country-wise Wget speeds for both IPV4 and IPV6

Mean Avg Comparison between IPv4 and IPv6 for Each Country for Airtel
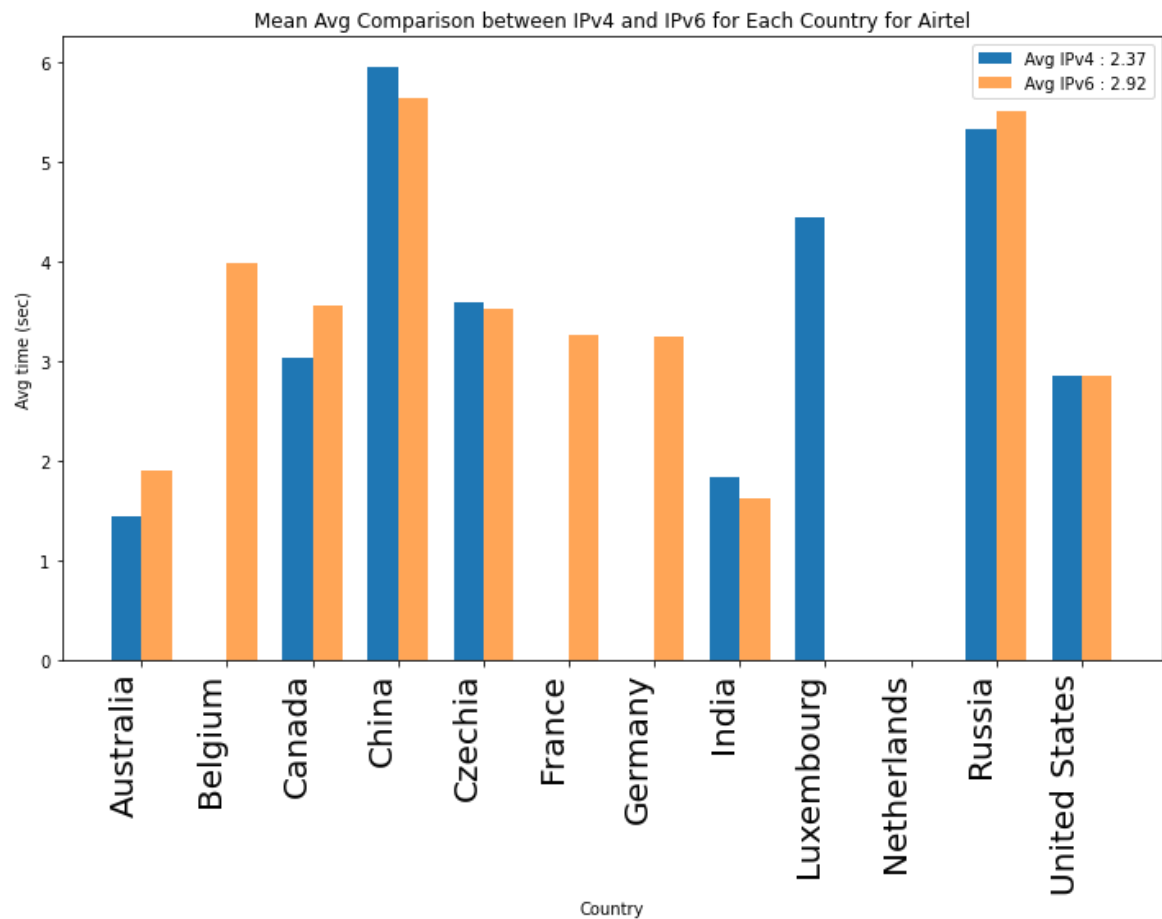
We can see in this as well that India had a lead in terms of fetching data just because of proximity. The only interesting case was Australia, which performed much better than the rest, almost similar to India.
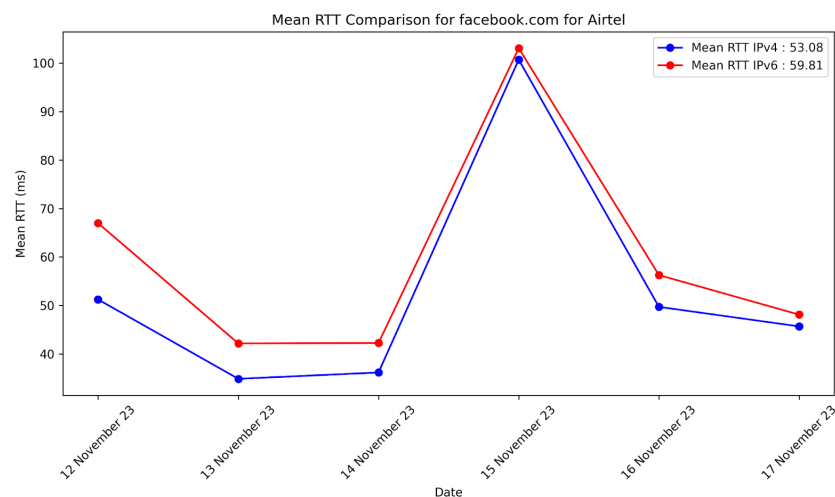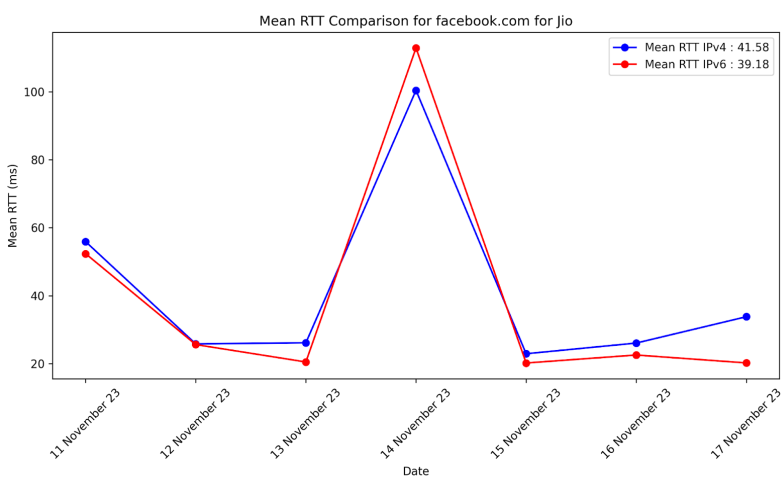
We have a lot of graphs for date-based and hop-based groups of websites and can't show all of them. In these specific ones above, we see that Jio again outperforms Airtel, and IPV6 also performs better for Jio on average as compared to Airtel.

II.   Interesting Findings

Besides the findings above, we noticed that:

1. Geolocation data for IPV6 was very hard to find and usually not maintained by most in a database.
2. Airtel had many websites which refused connection using IPV6 as compared to Jio for which all IPV6 websites worked.
3. For all metrics, IPV6 performed objectively better for Jio, and in many cases, it performed worse than IPV4 for Airtel.
4. Overall, there were very little transfer rate gains between both IPV4 and IPV6, and it is hard to say which is better even with all this information as it varies very much on service providers, infrastructure and geolocation for the IP's. But between ISPs, Jio performed better and clearly supports IPV6 protocols better.

Contributions

I.   Akshat Tilak

Data collection and data analysis

II.   Jahanvi Bakshi

Data collection and report generation.

III.   Yogesh Kaushik

Scripting and data analysis

IV.   Shubham Sharma

Data collection and analysis