IPv4 vs IPv6: A Comparative Performance Analysis

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Introduction

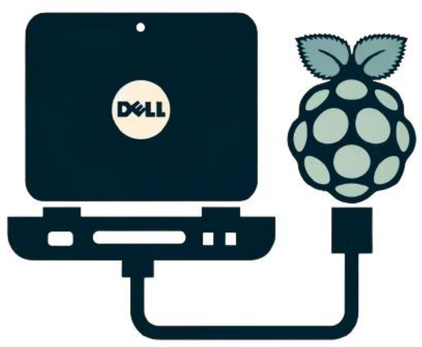
This project compares the performance of IPv4 and IPv6. With the advent of IPv6, it is anticipated to offer performance enhancements over its predecessor, IPv4, due to features like a larger address space, simplified header format, improved packet handling, elimination of Network Address Translation (NAT), and better support for multicast and anycast. This study aims to measure and validate these theoretical benefits in real-world scenarios, including direct RJ45 UTP connections and internet environments, using a variety of metrics such as latency, throughput, and website loading times.

IPv4 vs IPv6 Brief Comparison

	Address Space	Header Format	Packet Handling	NAT
IPv4	32bits	20~60 bytes		Needed
IPv6	128bits	Fixed 40 bytes	Flow Label	Not Needed

Measuring IPv4 vs IPv6 Performance in Two Scenarios

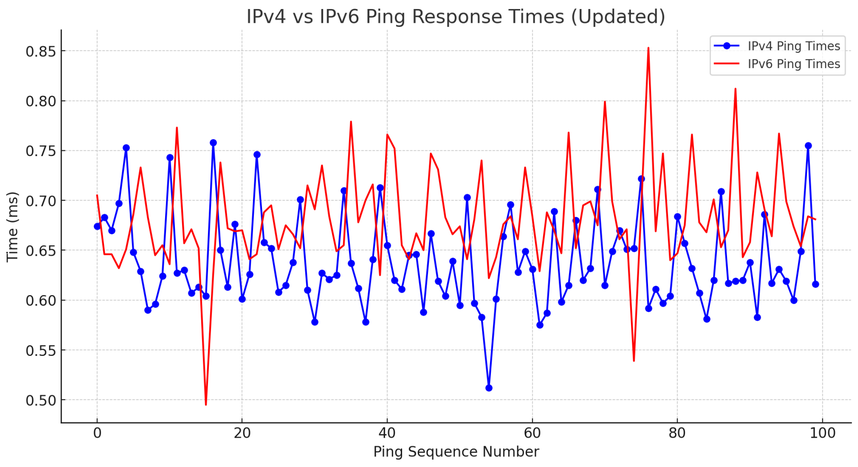
1. Direct RJ45 UTP Connection



Host
Hardware : Raspberry Pi 3B (100Mbps Fast Ethernet)
Software : Raspberry Pi OS (debian bookworm)

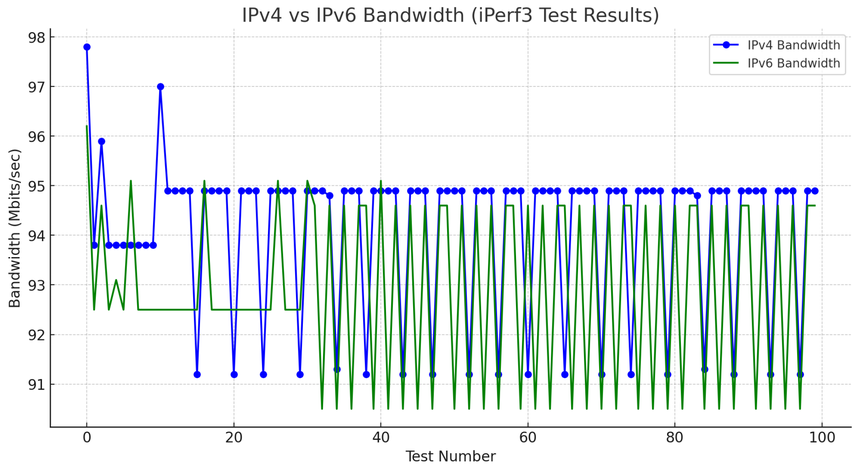
Client
Hardware : Dell laptop with 3rd generation Intel core i5 (1Gbps Gigabit Ethernet)
Software : Ubuntu 22.04

Analysis of 100 Ping Test Results



The differences are not significant, indicating that both protocols performed similarly in terms of latency.

Analysis of 100 iPerf3 Test Results



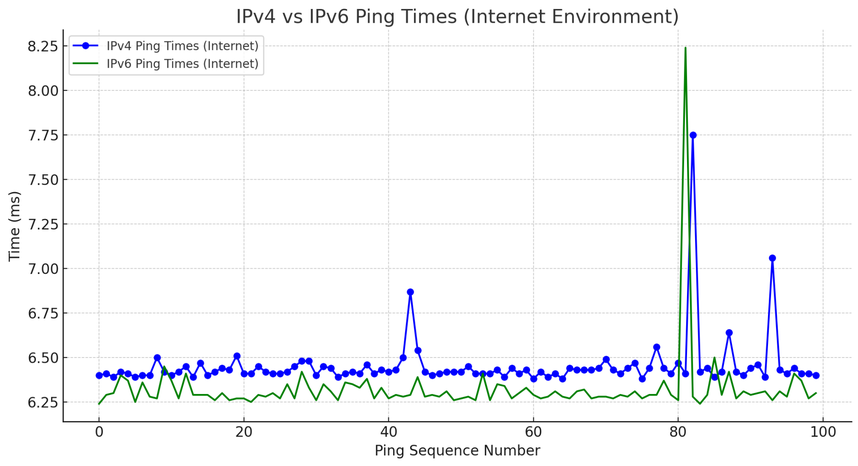
Again, the differences are not significant, indicating that both protocols perfo rmed similarly in terms of throughput too.

2. Internet Environment

Host
Google Server
IPv4 address : 8.8.8.8
IPv6 address : 2001:4860:4860::8888

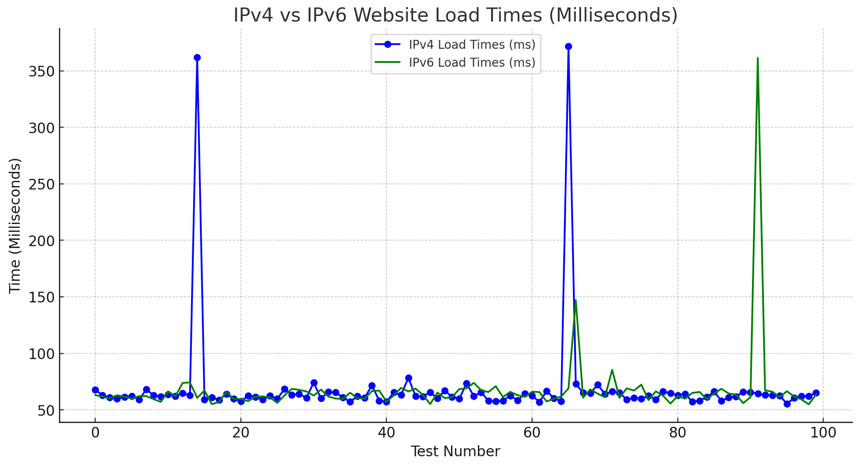
Client
Amazon AWS (US west Oregon)
Software : Ubuntu 22.04

Analysis of 100 Ping Test Results



The differences are not significant but we can see that IPv6 shows slightly faster latency than IPv4 in Internet Environment. This might be because of better routing capability that IPv6 has.

Analysis of 100 Curl Test Results



Unlike latency comparison, the website loading is hard to see the difference between IPv4 and IPv6.

Conclusion

Contrary to belief and theoretical advantages, our measurements reveal that IPv6 does not demonstrate a significant performance improvement over IPv4 in practical scenarios. While IPv6 offers a myriad of benefits like larger address space and simplified network configurations, these advantages do not translate into noticeable performance gains in terms of latency and throughput. These findings suggest that while IPv6 is the future of internet protocol due to its scalability and advanced features, its performance is currently on par with the well-established IPv4, challenging the notion that newer technology invariably equates to better performance.