Computer Networks

Hybrid Tunneling Mechanisms using Multithreading

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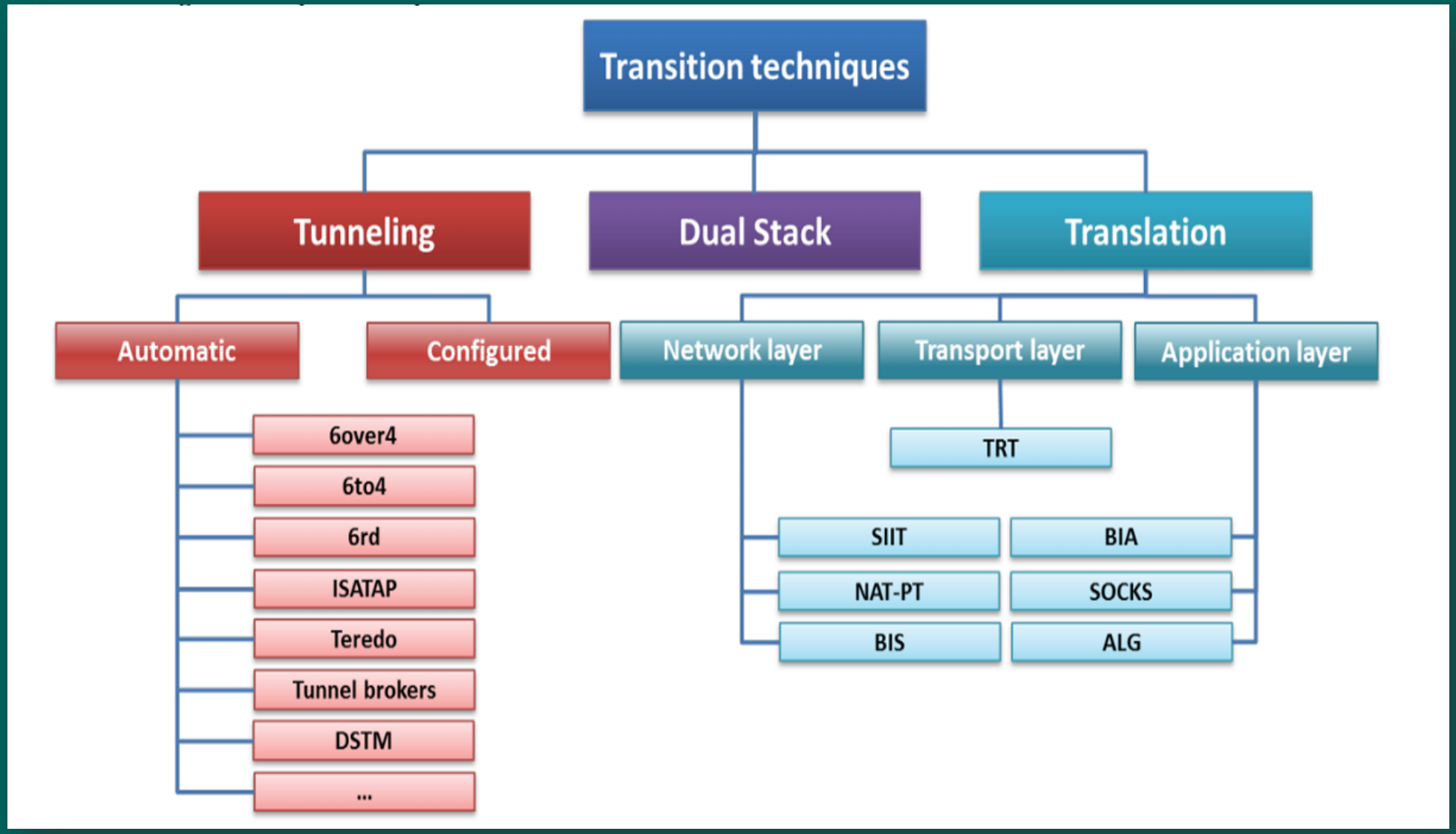
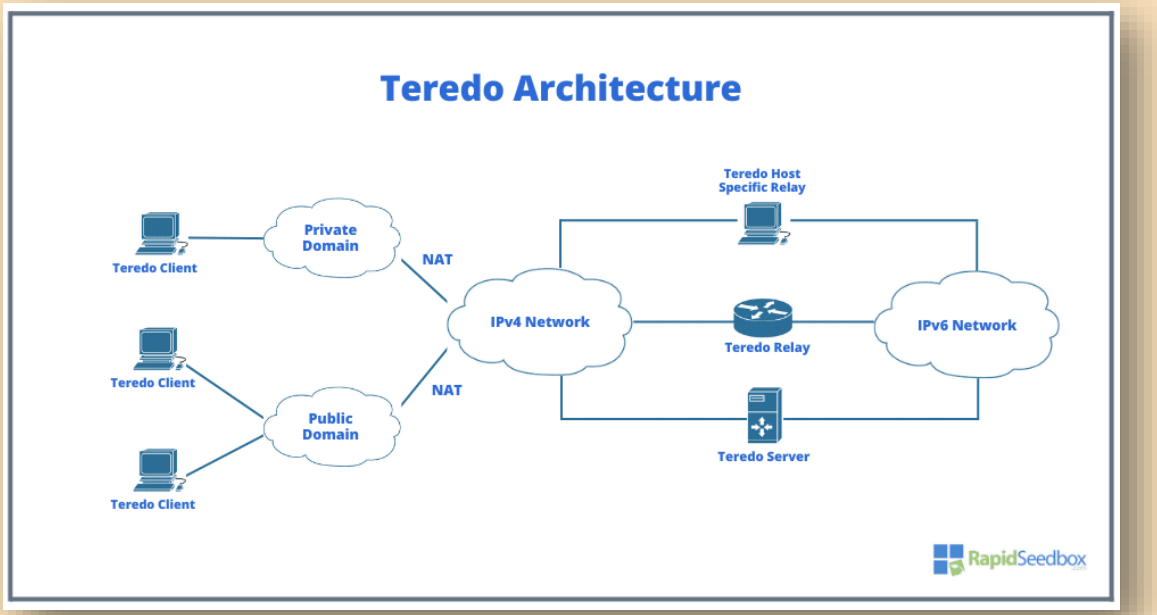
Literature Review

Introduction

Currently, Internet Protocol version 4 (IPv4) addresses have been depleted. Many Internet Service Providers (ISPs), researchers and end users are migrating from IPv4 to IPv6 due to strong features of IPv6 and limitation in IPv4. Different tunneling techniques have been deployed to migrate on IPv6 for ordinary users. However, these techniques create many issues such as compatibility, complexity, connectivity and traffic. Due to the dissimilar header structure and incompatibility of IPv4 and IPv6, the devices are unable to communicate with each other because devices do not support IPv6 addresses directly. The performance of network is also compromised due to huge increment in data transmission traffic. This project proposes a technique to provide full IPv6 connectivity and enhancing the network performances by combining two tunneling techniques such as IPv6 Rapid Deployment (6RD) and Teredo.


Transition techniques
Tunneling
Dual Stack
Translation
Automatic
Configured
Network layer
Transport layer
Application layer
6over4
6to4
6rd
ISATAP
Teredo
Tunnel brokers
DSTM
...
TRT
SIIT
BIA
NAT-PT
SOCKS
BIS
ALG

TEREDO

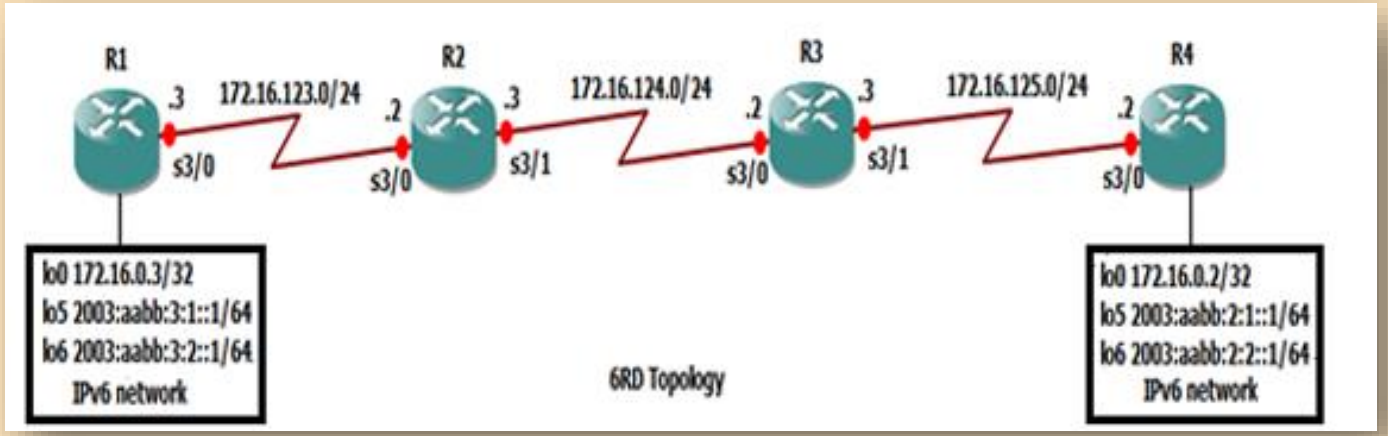


Teredo tunneling is a transition technology that allows IPv6 packets to be transmitted over an IPv4 network. It is primarily used to enable communication between IPv6-enabled devices across the IPv4 internet, even if the devices are behind NAT (Network Address Translation).

6RD

6RD SIMULATION CONFIGURATION GNS3

Router	Interface	IP Address
R1	S3/0	172.168.123.3
	Loopback 0(tunnel1)	172.16.0.3
	Loopback 5	2003:AABB:3:1::1
	Loopback 6	2003:AABB:3:2::1
R2	S3/0	172.16.123.2
	S3/1	172.16.124.3
R3	S3/0	172.16.124.2
	S3/1	172.16.125.3
R4	S3/0	172.16.125.2
	Loopback 0(tunnel1)	172.16.0.2
	Loopback 5	2003:AABB:2:1::1
	Loopback 6	2003:AABB:2:2::1



6RD (IPv6 Rapid Deployment) is a tunneling mechanism that enables Internet Service Providers (ISPs) to provide IPv6 connectivity to their customers over an existing IPv4 network. It is a stateless and cost-effective solution designed to accelerate IPv6 deployment without requiring a native IPv6 infrastructure

HYBRID TUNNELING SETUP
USING SOCKET PROGRAMMING
WITH THREADS

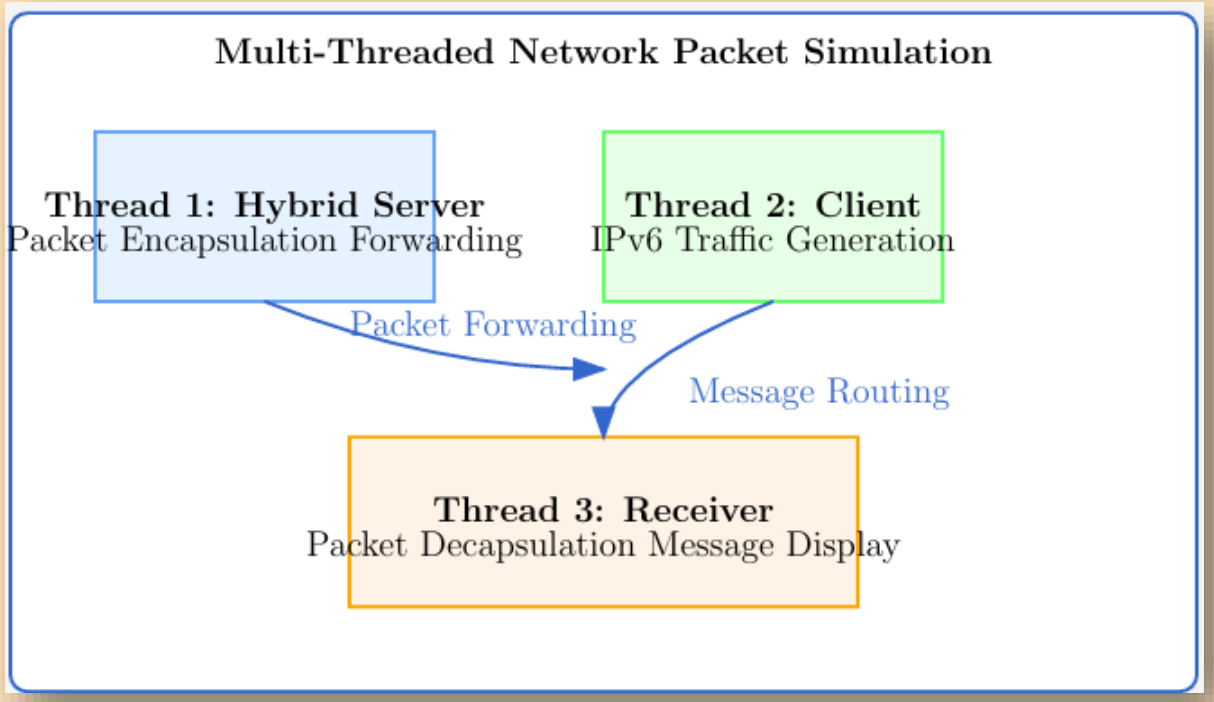
```
if (pthread_create(&sixrd_thread, NULL, sixrd_server, NULL) != 0)
    handle_error("Failed to create 6RD thread");

if (pthread_create(&teredo_thread, NULL, teredo_server, NULL) != 0)
    handle_error("Failed to create Teredo thread");
```

WHY HYBRID APPROACH ?

The proposed work merge Teredo and 6RD together to create a hybrid network. The features of both networks are combined to facilitate the current IPv4 addresses, the issues of 6RD can be covered in Teredo and vice versa. By combining both we make use of the positives of both setup and create a well Connected and an enhanced with high performance and low latency.

ARCHITECTURE



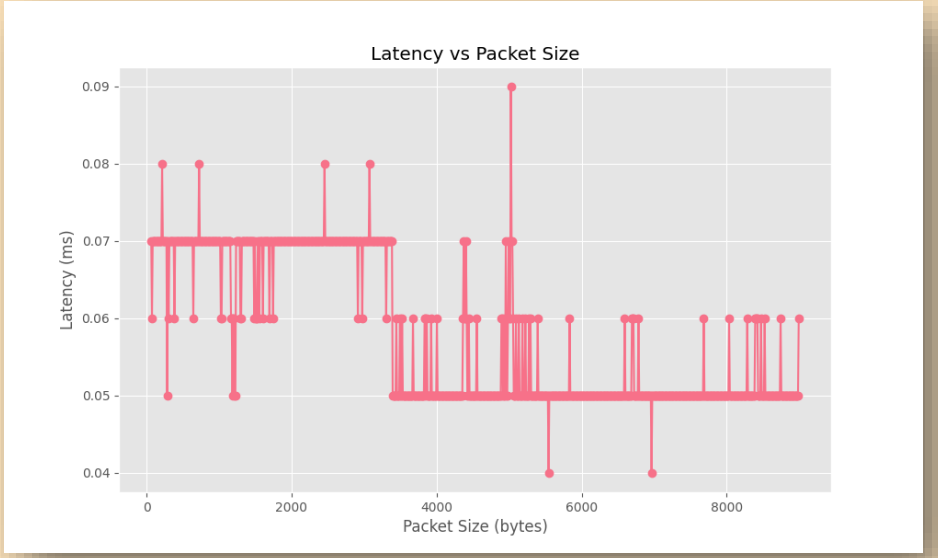
Two servers tunneling between a sender and a receiver

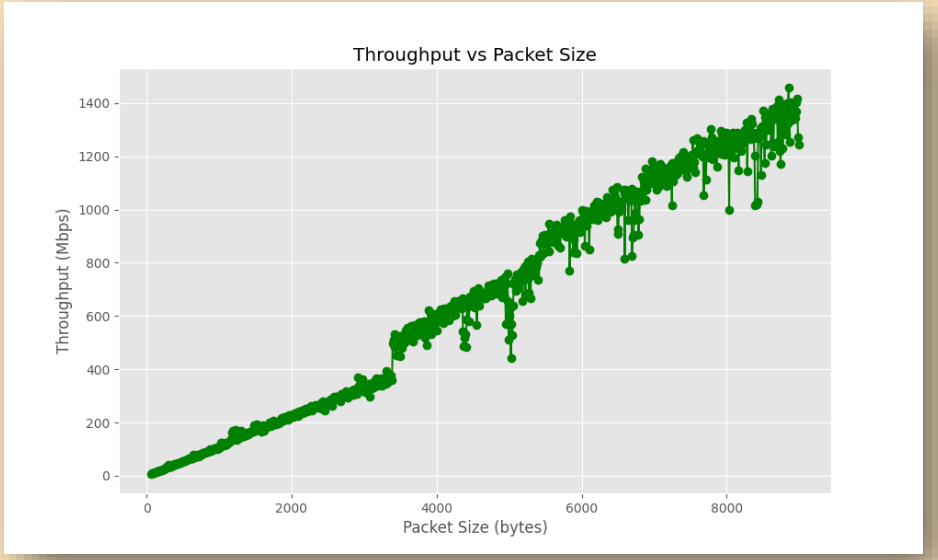
```c
if (argc != 2) {
    printf("Usage: %s <mode>\n", argv[0]);
    printf("Modes:\n");
    printf("1 - Run servers\n");
    printf("2 - Run sender\n");
    printf("3 - Run receiver\n");
    return 1;
}
```

Analysis

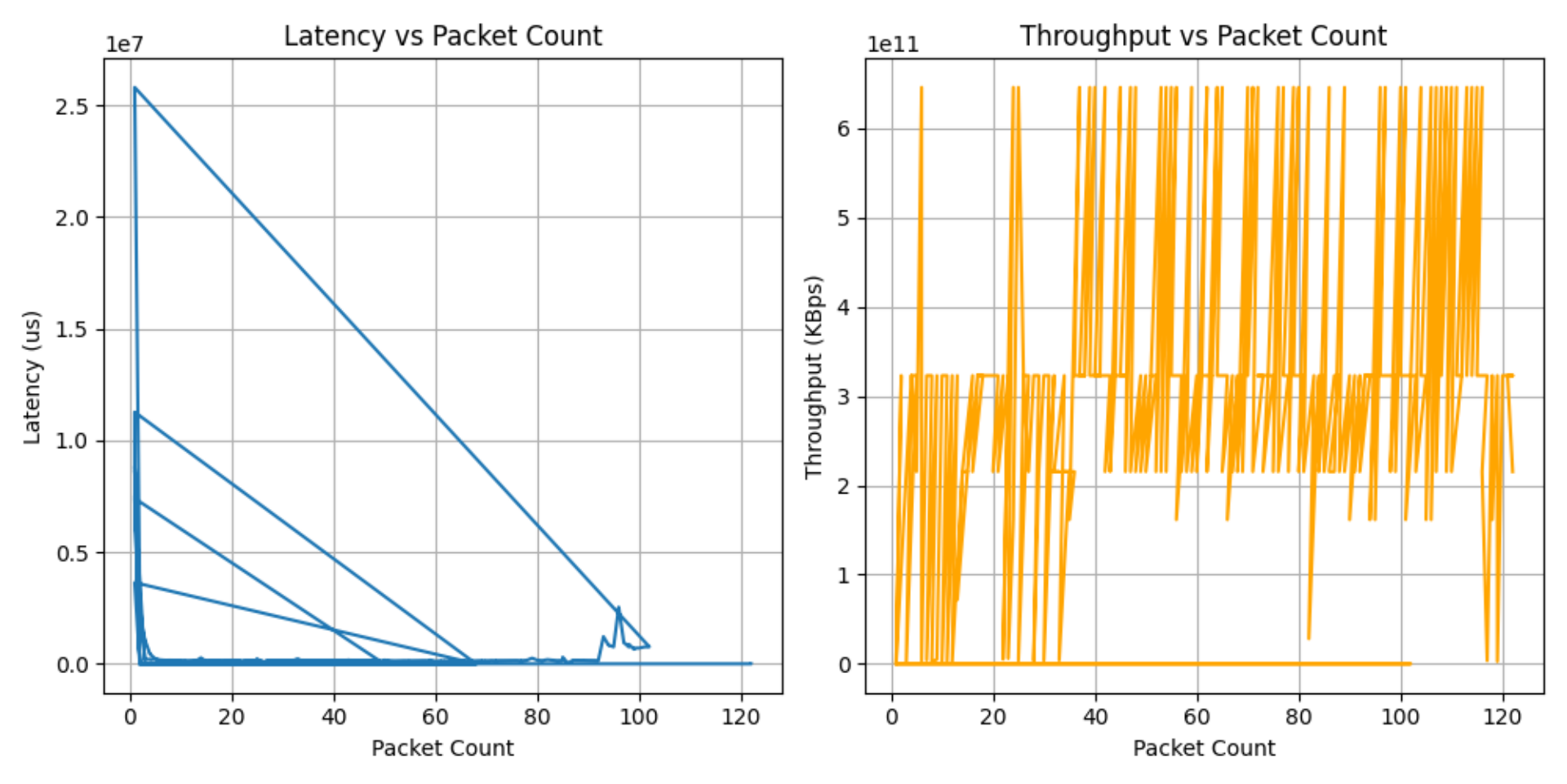
TEREDO TUNNELING:

Packet Size	Latency (ms)	Throughput(Mbps)
64	0.07	6.80
394	0.07	40.91
1214	0.05	169.57
2404	0.07	272.24
3054	0.07	331.34
4504	0.05	638.48
6984	0.05	1100.4
7894	0.0.5	1221.38
8994	0.06	1244.6





Hybrid Approach



Future Scope

- Enhance security with advanced encryption for tunneled packets.Reduced carbon footprint
- Explore dynamic load balancing across tunneling mechanisms.

Outcomes

Thus the hybrid performance network, a merge of 6RD and Teredo Tunneling mechanism has been analyzed using multithreaded socket simulating a basic tunnel over two hosts. The latency and throughput metrics have been measured against the packet size up to a jumbo size of 9000 bytes and has been compared in the graphs. It is noted that the hybrid approach has lower latency when it comes to a larger packet size with throughput almost remaining the same for most of the packets.

Thank You

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