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Effective Interoperability between IPV6 Networks through Tunneling and Dual Stack Mechanism

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***Abstract*: Based on the migration mechanism from IPv4 to IPv6, the performance of three kinds of mechanism options, double-stack protocol, ISATAP tunneling and 6to4 tunneling technique are analyzed and tested. The result shows there are some performance advantages on double stack protocol mechanism IPv6 network than IPv4, IPv6 ISATAP tunnel and IPv6 6to4 tunnel network. IT is mainly about analyzing the performance traffic between IPv6 and IPv4 using transition mechanisms in terms of network metrics such as Hop count , CPU utilization and latency. The main purpose of analyzing the performance traffic is to compare which method is better for users to migrate their IPs into IPv6 environment.**

I. INTRODUCTION

Due to IPv4 network suffering more and more problems, especially the lack of address space as well as the network security flaws, the next generation IPv6 network research is caught to be focused . The IPv6 has solved IP address crisis, which expands IP addresses from 32-bit to 128-bit. There is limitation of compatibility between IPv6 and IPv4, therefore, transition mechanism from IPv4 to IPv6 is studied widely, mainly focuses on dual stack mechanism and the tunnel mechanism two options. This paper describes the principle of transitional mechanism, makes a comparison and analysis by testing the performance of IPv6 based on commonly used transition mechanism. The exhaustion of the remaining pool of unallocated IPv4 address is approaching within the next few years. It has been a concern by many network experts to overcome this problem. According to the survey from IANA (Internet Assign Number Authority), IPv4 addresses only provided for around 4 billion addresses only and estimated to reach exhaustion at the year of 2012. As the consumption of IPv4 addresses seems to be increase every day, it is ideal for users to migrate into IPv6 environment.

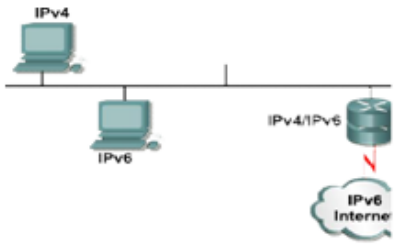
II. TRANSITION MECHANISM

A. Dual-stack protocol

In dual-stack, all hosts/routers maintain both protocol IPv4 and IPv6 stacks. Dual stack hosts/routers are able to communicate with not only IPv6 system, but also IPv4 system. The dual stack hosts use IPv6 address while communicating with IPv6 hosts, and use the IPv4 address while communicating with IPv4 hosts. Applications choose between using IPv6 or IPv4 with the application selecting the correct address based on the type of IP traffic and particular requirements of the communication. This allows all the end hosts and intermediate network devices (like routers, switches, modems etc.) to have both IPv4 and IPv6 addresses and protocol stack.

If both the end stations support IPv6, they can communicate using IPv6; otherwise they will communicate using IPv4.

This will allow both IPv4 and IPv6 to coexist and slow transition from IPv4 to IPv6 can happen.



Dual stack protocol

B. Tunnel Mechanism

Another transition to IPv6 is using tunne element of this approach is to encapsulate IPv IPv4 by dual-stack protocol routers whil entering IPv4 network, and to make the IPv part of IPv4 packet. Then IPv6 packets star IPv4 tunnel network. At the point of the IPv4 the tunnel of IPv4 network, the dual-stack router data, the original IPv6 packet,

to the IPv6 proto essence of tunnel technique is IPv6 encapsulated in IPv4 packets, using communication problems between. IPv4, path as IPv6 data link layer, can be regarded virtual link. When any organization wants to implement IPv6 network in their service area, it is not possible to implement all of sudden in entire area. It needs slow migration from IPv4 to IPv6 without affecting the service much. IPv6 tunneling mechanism is the solution to overcome IPv4 exhaustion. There are different types of tunneling mechanism which can be used for migration into IPv6 environment. However, users might hardly make decision when comes to implement the migration mechanism. In order to decide which mechanism is better, IPv6 tunnel mechanisms will be implemented and analyzed the traffic performance in terms of latency, throughput, round trip time, reliability.

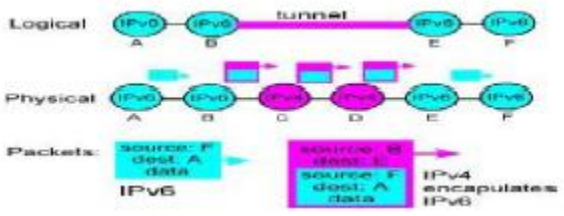
1) 6to4 Tunnel Mechanism

The core idea of 6to4 tunnel mechanis address prefix contains IPv4 tunnel por mapping created between IPv4 address of sit and IPv6 address of intra-site hosts, and directl address of site border router as part of IPv6 a intra-site (b) 6to4 tunnel mechanism tunnel technique. The IPv6 datagram into hile IPv6 datagram IPv6 packet become start transition within 4 datagram leaves routers will forward protocol stack. The packets will be the existing IPv4 transmission as a point to point unneling echanism is that site port address, a site border routers directly uses IPv4 address prefix of hostel.

2) Manual IPv6 Tunnel

The manual tunneling mechanism builds a permanent virtual link between two IPv6 networks that are connected over an IPv4 backbone. It is a point static tunnel. The start and end points of the tunnel have IPv4 – routable addresses and an IPv6 address is configured on the tunnel interface. These tunnels are generally not scalable, because they have to be manually configured. The primary use is for stable connections that require regular se communication between two edge devices or between an end system and an edge device, or for connection to remote IPv6 networks.

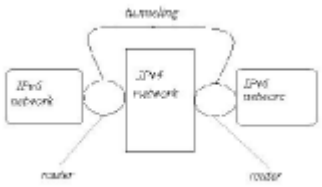
The host or device at each end of a configured tunnel must support both the IPv4 and IPv6 protocol stacks. Manually configured tunnels can be configured between border devices or between a border device and a host.



(c) manual IPv6 tunnel mechanism.

3*) ISATAP tunneling Mechanism*

Intra-site Automatic Tunnel Addressing designed for the With ISATAP, the interlink layer for IPv6 and network are viewed a An ISATAP address is identifier. After that, the each other via the IPv6 address.



(d) ISATAP tunnel mechanism

III. PERFORMANCE ANALYSIS

In this paper, the throughput and round tested by comparing IPv6 to IPv4 network well as IPV6 network performances under mechanisms above. Based on test network performance advantage is proved.

B) Testing structure

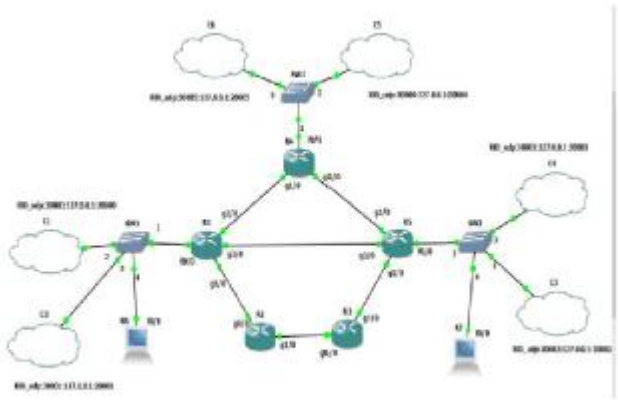


Fig 1

The most straight forward way for IPv6 nodes to remain compatible with IPv4 – only nodes is by providing a complete IPv4 implementation. IPv6 nodes that provide complete IPv4 and IPv6 implementations are called "IPv6 / IPv4 nodes". A network node includes both IPv4 and IPv6 protocol nodes in parallel is called dual stack mechanism (Figure 1). IPv6 / IPv4 nodes have the ability to send and receive both IPv4 and IPv6 packets. They can directly interoperate with IPv4 nodes using IPv4 packets, and also directly interoperate with IPv6 nodes using IPv6 packets.

The IPv6 over IPv4 tunnel processes packets in the following way, a host in the IPv6 network sends an IPv6 packet to Device A at the tunnel source. After determining from the routing table that the packet must be forwarded through the tunnel, Device A encapsulates the IPv6 packet with an IPv4 header and forwards it through the physical interface of the tunnel. The encapsulated packet goes through the tunnel to reach Device B at the tunnel destination. Device B checks that it is the destination address of the encapsulated packet and de – encapsulates packet. Device B forwards the packet according to the destination address in the de - encapsulated IPv6 packet. If the destination address is the device itself, Device B forwards the IPv6 packet to the upper for processing. Found-trip delay is performance adder those threat results, IPV6 packet to the upper – Layer for processing.

A. Test analysis

Tests were performed using the ping6 program run on a reliable ICMPv6 Internet layer. The ping6utility works like its IPv4 counterpart does. It sends ICMPv6 packets to the command argument specified network node and checks the replied message. To determine whether a particular node is alive. Upon the receipt of the packet, the server sent the same size packet back to the original client. When the client receives the packet, the whole process is completed.

1) Throughput

Throughput is defined as the transmitted over the entire path calculated from the formula throughput, P represents the represents the time cost in transfer throughput test, test data packe 1408 bytes, and each group's resul 10 times test. shows comparison network throughput under the dual stack IPv6 network th ISATAP tunnel mechanism and 6to4 tunnel mechanism Throughput is defined as the amount of packet data that is transmitted over the entire path per time unit. The throughput is calculated from the formula T=P/L where T represents the throughput, P represents the transferred data size, and L repress nts the time cost in transfer. Fig 5.4 shows the throughput of the IPv6.

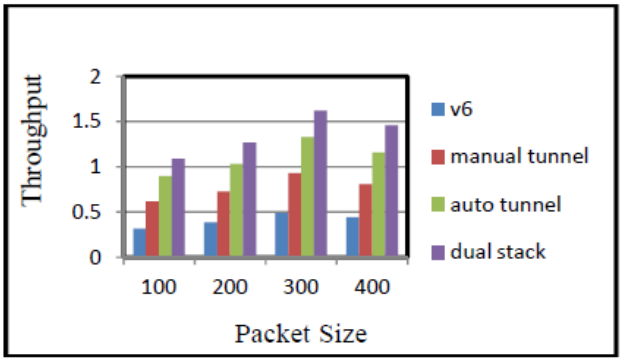


Fig.2 Throughput analysis

B. Round-trip delay test

IPv6 and IPv4 network round-trip delay test uses ICMPv6 and ICMP protocol respectively, test data packet size is 1024 bytes and each group test results obtain from the average of 100 tests. Figure 4 shows 50 groups result of IPv6 ! IPv4 network for dual stack mechanism. Figure 5 is for IPv6 network round-trip delay comparison of dual-stack mechanism, ISATAP and 6to4 tunnel mechanism. It can be seen from Figure 4, the round-trip delay of IPv6 is shorter than IPv4 with the same network load and packet size for dual stack mechanism, and Figure 5 shows round-trip delay of 6to4 tunnel mechanism is similar to ISATAP tunnel mechanism under the same test conditions, but round-trip delay of IPv6 network for dual stack mechanism is the shortest comparing with 6to4 and ISATAP tunnel mechanism.

It should be noted that above test results are obtained in a small Ethernet LAN environment which have some limitations and specificities. The further research should be carried out in the WAN.

III. LATENCY ANALYSIS

In evaluating the performance of the tunneling mechanisms, the average transmission latency was measured first. Typically, the average transmission latency is the time taken for a packet to be transmitted across a network connection from sender to receiver. Tests were performed using the ping6 program run on a reliable ICMPv6 Internet layer. The ping6 utility works like its IPv4 counterpart does. It sends ICMPv6 packets to the command argument specified network node and checks the replied message. To determine whether a particular node is alive. Upon the receipt of the packet, the server sent the same size packet back to the original client. When the client receives the packet, the whole process is completed.

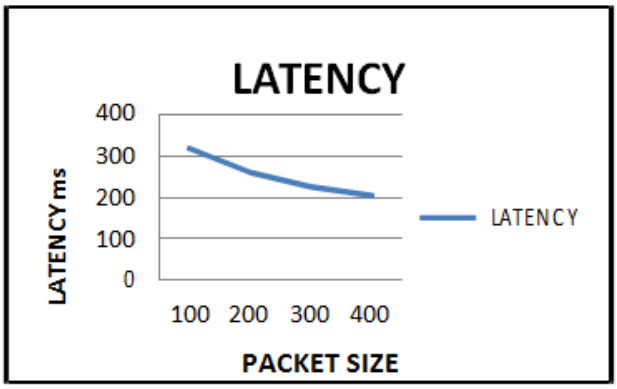


Fig.3Latency Analysis

IV. CONCLUSION

Based on analysis transition mechanism of IPv6, the dual stack protocol, 6 to 4 tunneling mechanism, and ISATAP tunnel network performance are studied and tested based on program implemented by our group. In general, results indicate that dual stack protocol IPv6 network has better performance than dual stack protocol IPv4, and 6 to 4 mechanism and ISATAP mechanism. Thus, the configured-tunnel mechanism is used to connect IPv6 nodes in the IPv4 Ocean. The tunnel endpoints must be manually configured in the routing table entry. The configured-tunnel mechanism has more feasible because the usage of this mechanism is more strictly controlled to provide greater network QoS, multicast and anycast. By Dual stack mechanism the convergences of IPv4 and IPv6 have completed successfully and there is no reduction in the quality of service. The comparison between IPv6 and tunneling and dual stack shows that the latency is lesser and the throughput is higher.

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