Dual Stack Deployment in a Carrier Grade Network to Fulfill the Demands of Next Generation of Internet

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ABSTRACT

The Internet is migrating from IPv4 (Internet Protocol version 4) to IPv6 (Internet Protocol version 6). The high cost of migration services from IPv4-IPv6 and system complexity are main factors for slow adaption of IPv6 This paper presents the implementation of migration techniques from IPv4-IPv6. Furthermore, existing IPv4 addresses have already been depleted in IANA (Internet Assigned Numbers Authority) and will be soon exhausted in RIR (Regional Internet Registry) while more clients are joining the Internet. Slower rate of the progress of IPv6 confirms complete shifting from IPv4-IPv6 at once is still long away, although fewer parts of IPv6 have been employed in current market goods. Integration of IPv4 and IPv6 is carried in order to take care of online users. In this paper, it is suggested that hierarchical direction finding structural design in IPv4 and IPv6 will improve the efficiency of IPv4 network. This research work provides the way to design the network scenario for the carrier grade set of connections. The carrier grade network scenario routers are named to be Karachi, Sukkur, Islamabad, Multan and Peshawar for the managerial simulation purposes. The carrier grade network deployment is implemented along with dual stack to migrate to IPv6. This study holds the way to deploy IPv4-IPv6 carrier grade network by providing real time scenario which is yet not considered in the literature to the best of our knowledge.

Key Words: Dual Stack, Carrier grade, IPv4, IPV6, ISPs.

1. INTRODUCTION

IANA's pool of IPv4 address has exhausted in February 3rd, 2011 [1] and it is estimated that RIRs pool are possibly depleted recently. IPv6, has standardized for a long time, is now only possible solution for the next generation internet address scheme. IPv6 or IP (Internet Protocol), is the protocol intended to change the existing IPv4 [2]. During the initial phase of internet evolution, users were unaware of the disadvantages caused by internet, because internet was not only mean for communication. For more than twenty years, IPv4 has

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been widely used in internet activities around the world. IPv6 is accepted to replace gradually IPv4 over the next few years [3]. This paper is based on the deployment of IPv4 and IPv6 in the carrier grade network. Carrier grade network is a nation level ISP (Internet Service Provider) which promotes the idea of deploying IPv4 and IPv6. As internet is growing and becoming complex, the MSP (Mobile Service Providers) and the other contributors are facing difficulties because of unavailability of blocks for fresh IPs in IPv4 addresses, which employs the solution to migrate from IPv4-IPv6 [4]. With IPv6 large address space, the problem of address depletion in IPv4 can be resolved effortlessly [5]. Most of the corporate organizations are setup with IPv4 traditionally which restrict sudden migration to IPv6, instead a parallel simultaneous steady migration to IPv6 will be favorable. While these gradual changes are taking place, the two protocols are accepted to co-exist for a long time [5-6]. This paper presents the deployment of IPv4 and IPv6 in the carrier grade network along with use of dual stack implementation. This paper presents simulation of different IPv4 and IPv6.

The rest of the paper is organized as follows. The Section 2 constitutes the comparison of IPv4-IPv6, features and advantages of IPv6. Section 3 presents the supplant of IPv6. Section 4 presents deployment model for ISP carrier grade implementation. Section 5 highlights the applied scheme details in the deployed system Section 6 discusses the packet delay and traffic monitoring analysis of both IPv4 and IPv6 carrier grade implementation. Section 7 concludes the work.

2. TECHNICAL COMPARISON OF IPv4-IPv6

The global hierarchical formation of the IP addresses space management by the designated organization IANA [1,7]. IANA allocates /8 blocks to the RIRs. A /8 block contains 2^{24} IPv4 addresses, which implies 16,777,216 addresses. It is expected that the RIRs will have no more public IPv4 addresses to allocate in the short term beyond 2013 [3,8]. This scares the platform management IPv4 address shortage. The next decade is insufficient to meet the projected growth in global IP address space, which causes to be a long-term solution. This opts allowing service providers to develop solutions for internet communication.

ISPs are considering a shift from IPv4-IPv6. IPv4 protocol has the capability to migrate to IPv6 within a short period [2,9]. It costs too heavy and does not allow the interruption of the service, and damage to critical distributed applications. At IPv4 and IPv6 network between the gateways will be a long process, during which both protocols can coexist in [10,11]. IPv4 has various limitations that are being focused as the internet continues its phenomenal growth and expansion of services. Along with its limited address space, the most familiar problem is its inefficient address allocation mechanism [12,13]. The problems of exhaustion of IP address space has also been experienced by the time [11].

One way to implement translation, amongst several of them, is the SIIT (Stateless IP/ICMP Translation Algorithm), which provides a mechanism for transition, between IPv4 and IPv6 packet headers (including ICMP headers) without requiring any per-connection state [14]. We have only considered the dual stack deployment of IPv4 and IPv6 in the current text. A comparative summary of IPv4 and IPv6 features is concluded in Table 1 which highlights 12 key distinctions between IPv4 and IPv6 [15].

3. SUPPLANT OF IPv6

Compared with the 32 bit IPv4 addresses, IPv6 has increased to up to 128 bit addresses (Table 1). A 128 bit address space allows for 2^{128} or $3.4x10^{38}$ possible addresses [16]. The reason for sending that huge amount is flexibility in address format.

This means that you need to address the problem without having to try a number of different bits and space allocation. This allows address age and a gain for 64 bit while the identity of the core creating a hierarchy of networks can be accomplished by implementing individual IPv6 address format [10,12]. IPv6 is 128 bits long; which can be used in implementing routing networks and as well as on the huge address based network. IPv6 always denoted by hexadecimal digits. 128 bits are divided into 8 blocks where each block consists of 16 bits in hexadecimal format [14,17]. The key features of IPv6 are discussed in the sequel.

The next section presents the deployed model for our implementation.

3.1 System Design

We have designed a subnet scheme model for ISP network (IPv4). Our deployed network grade model for the ISP dual stack implementation is shown in Fig. 1. The figure shows six Routers connected parallel under an autonomous system 100. These are named to be Karachi, Sukkur, Islamabad, Multan and Peshawar respectively for the managerial simulation scenario purposes. Every router is connected with corresponding Ethernet switch. The connections use fast Ethernet links i.e. f_0/0=fast Ethernet in slot and interface 0.

There are three upstream

LHR_US=Lahore upstream

(autonomous system 10)

KHI_US= Karachi upstream

(autonomous system 20)

ISB_US= Islamabad upstream

(autonomous system 30)

These upstream are managed in a way to provide upstream data to the other router. This is a scenario of class B for private IP address 172.16.0.0. It is obvious that an ISP can have multiple networks so that sub-netting techniques must be used.

TABLE 1. DISTINCTIONS BETWEEN IPV4 AND IPV6 [5]

Features	IPv4	IPv6
Addresses	32 bits	128 bits
Checksum in header	Included	No Checksum
Header includes option	Required	Move to IPv6 extension header
Quality of Service	Differentiated Services	Use Traffic classes & flow labels
Fragmentation	Done by router & source node	Only by the source node
IP Configuration	Manually or DHCP	Auto- Configuration or DHCP
IPSec Support	Optional	Required
Unicast, multicast and broadcast	Use all	Use unicast, multicast and Anycast
Address Resolution Protocol	Use to resolve an IPv4 address	Replaced by Neighbor Discovery
Internet Group Management Protocol	Use to manage local subnet group	Replaced with Multicast listener Discovery
Domain Name Server	Use host address (A) resources records	Use host address (AAAA) resources records
Mobility	Use Mobile IPv4	MIPv6 with faster handover, routing and hierarchical mobility

We consider the fact that in point to point links it is better to make use of /30 mask [11]. This is due to the reason that in point to point links; only two host's IP addresses are used. Usually IP addresses are assigned to the router interfaces connected to each other. In this way the scenario, 172.16.0.0/30 is configured for the point to point links.

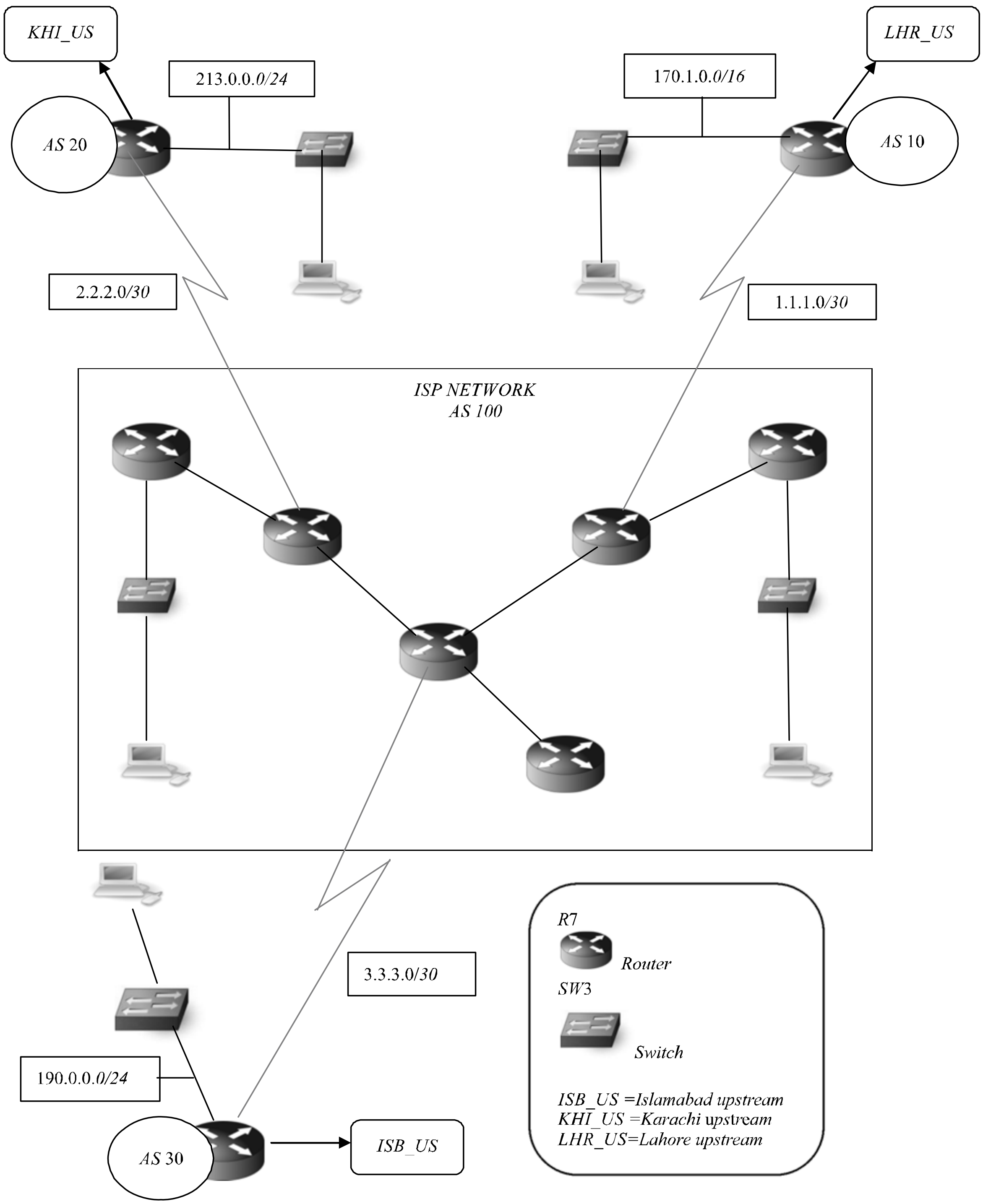

FIG. 1. IPv4 ADDRESSES ASSIGNED ISP NETWORK

It provides 2^{14} subnets with 2 hosts in each subnet. /30 are used to reduce broadcast domain and in order to save wastage of address space. The rest of interfaces configurations for the model presented in Fig. 1 is shown in Table 2.

In the following subsection we discuss the implemented subnet scheme for our deployed model within the ISP network (IPv6)

3.2 Designing Subnet Scheme for ISP Network (IPv6)

Fig. 2 shows the IPv6 addresses configurations assigned to the deployed ISP network. We have deployed IPv6 on the ISP network which is designed for this research work. It is successfully deployed in a real ISP network. Our deployed ISP ranges to the country level network, hence it is assumed that the given block are of /32 of IPv6. This configuration is followed to deploy /35 blocks in Karachi, Lahore and Islamabad networks respectively which is further divided into /48 and /64 blocks to the customer level. To simulate IPv6 in our ISP scenario, two more hosts are connected which speak only IPv6. Fig. 2 depicts the complete diagram of IPv6 designed ISP scenario.

The beauty of this research/simulation is that it works on both IPv4 and IPv6. If a connection fails then there is no effect on remaining network. This paper implements

TABLE 2. PROPOSED ROUTERS INTERFACE CONFIGURATIONS FOR FIG.1 MODEL

Router Name	Interface	IP Address
Karachi	F1/0	172.16.0.9/30
	F0/0	172.16.0.2/30
	F0/1	172.16.0.14/30
Lahore	F1/0	172.16.0.18/30
	F0/0	172.16.0.1/30
	F0/1	172.16.0.5/24
	S3/0	2.0.0.1/8
Islamabad	F1/0	172.16.0.10/30
	F0/1	172.16.0.6/30
	F0/0	172.16.0.22/30
Sukkur	F0/1	172.16.0.13/30
Sukkur	F0/0	192.168.10.1/24
Multan	F1/0	172.16.0.17/30
	F0/0	10.0.0.1/8
Peshawar	F0/0	172.16.0.21/30
KH_US	F0/0	213.0.0.1/24
	S2/2	2.2.2.1/30
LHR_US	S2/2	1.1.1.1/30
	F0/0	170.1.0.1/16
ISB_US	S2/2	3.3.3.1/16
	F0/0	190.0.0.1/24
C1	NIO_udp:30000:127.0.0.1:20000	192.168.10.2/24
C2	NIO_udp:30001:127.0.0.1:20001	10.0.0.2/8
C3	NIO_udp:30002:127.0.0.1:20002	190.0.0.2/24
C4	NIO_udp:30003:127.0.0.1:20003	170.1.0.2/16
C5	NIO_udp:30004:127.0.0.1:20004	213.0.0.2/24

IPv4 and IPv6 in good working conditions, and the simulation utilizes both IPv4 and IPv6 networks in dual stack.

The next section discusses the analysis of both IPv4 and IPv6 in dual stack and their comparison performance achieved by the above discussed models.

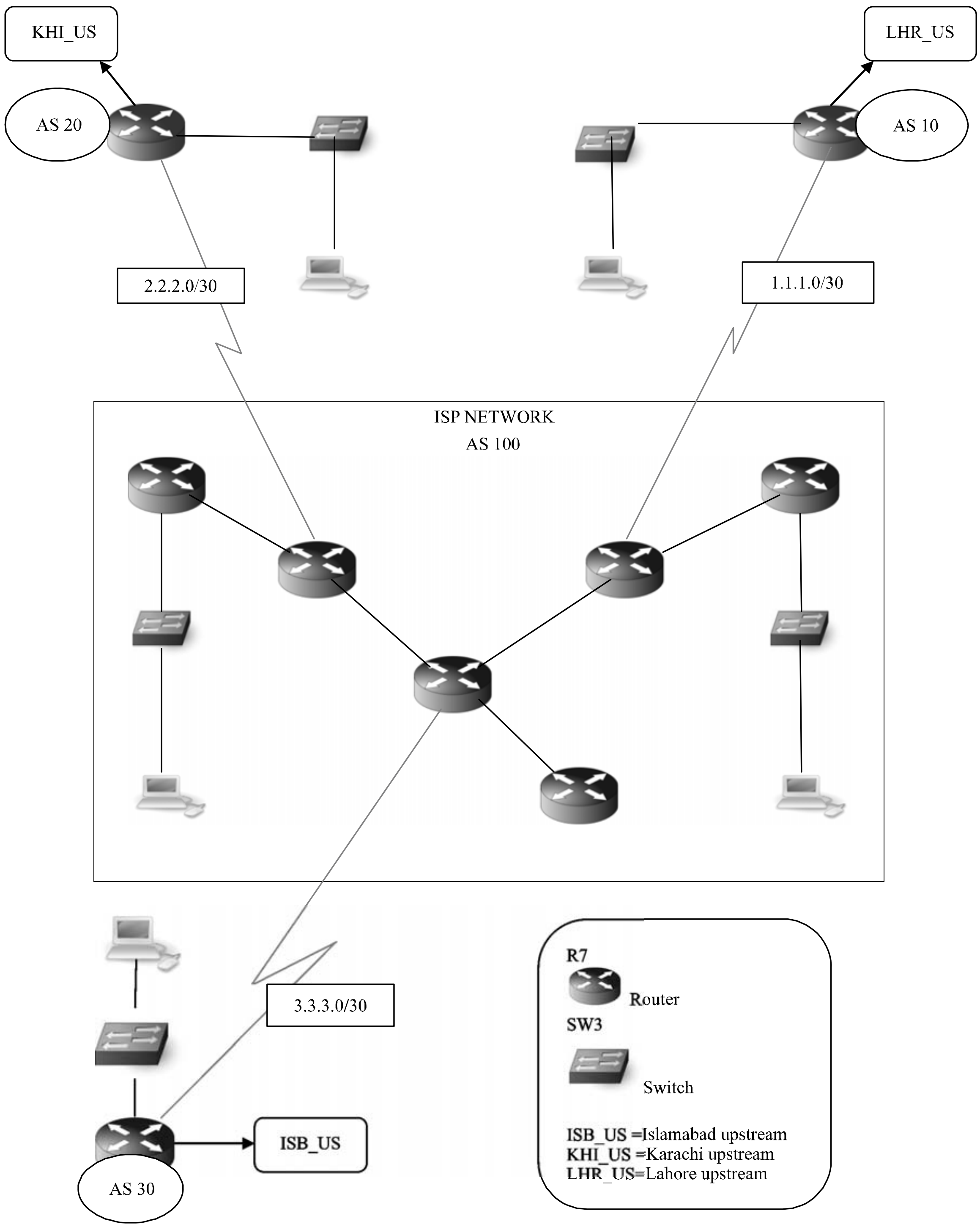

FIG. 2. IPv6 ADDRESSES ASSIGNED ISP NETWORK

3.3 Traffic Monitoring And Packet Delay Analysis

Theoretically, IPv6 has lots of advantages compared to IPv4. From this study we know that there is another way to conform whether a network equipment support IPv6 or not, which is done by referring to the IPv6 in dual stack deployment.

An achievement of this work is that we have formulated IPv6 migration strategy. Through product information gathering that we carried out in this study, it is found that there is inconsistency between theoretical IPv6 performances against actual IPv6 performance.

Fig. 3 shows the snapshot of verification of IPv6 connectivity check between VPCS (Virtual PCs) hosts connected to the routers presented in our model using ping utility. Fig. 4 shows the average delay in IPv4 and IPv6 as the packet size increases. It is vivid from the figure that the IPv6 is matured than IPv4 due to its delay contro l as the packet size increases. Results for all five routers are compared both for IPv4 and IPv6 which depicts the fact that in all routers, IPv6 get the similar delay trend while in IPv4 it varies (dependent upon the router distance).

Fig. 5 shows the packets delay in IPv4 and IPv6 with respect to the time. In IPv4 the packet delay oscillates with the time while IPv6 shows rising delay at early stages and later on smooth behavior is carried out. This effect comply mature performance of IPv6 w.r.t. time in comparison with IPv4. Similar effect is presented in all cases of routers which conclude the negligence of distance in maturity of IPv6.

Fig. 6 presents the time consumption analysis with the increase of number of packets both in IPv4 and IPv6. The increase in number of packets does not vary the time relation in both cases. A normal relative time enhanced trend is observed in both schemes, however, IPv6 network decreases the relative time while high number of traffic is observed which mimic rapid convergence of the network for the case of IPv6.

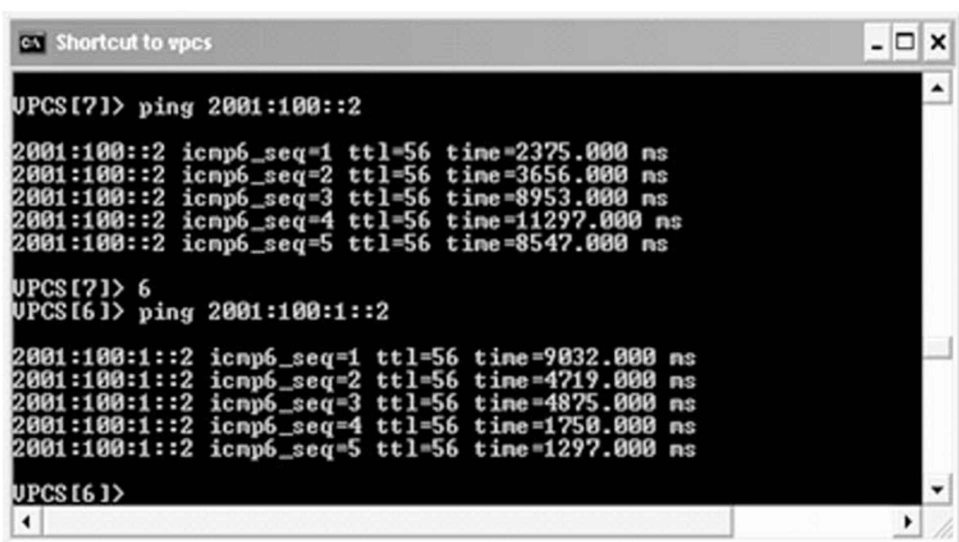

FIG. 3. VERIFICATION THROUGH PINGING BETWEEN IPv6 HOSTS USING VPCS

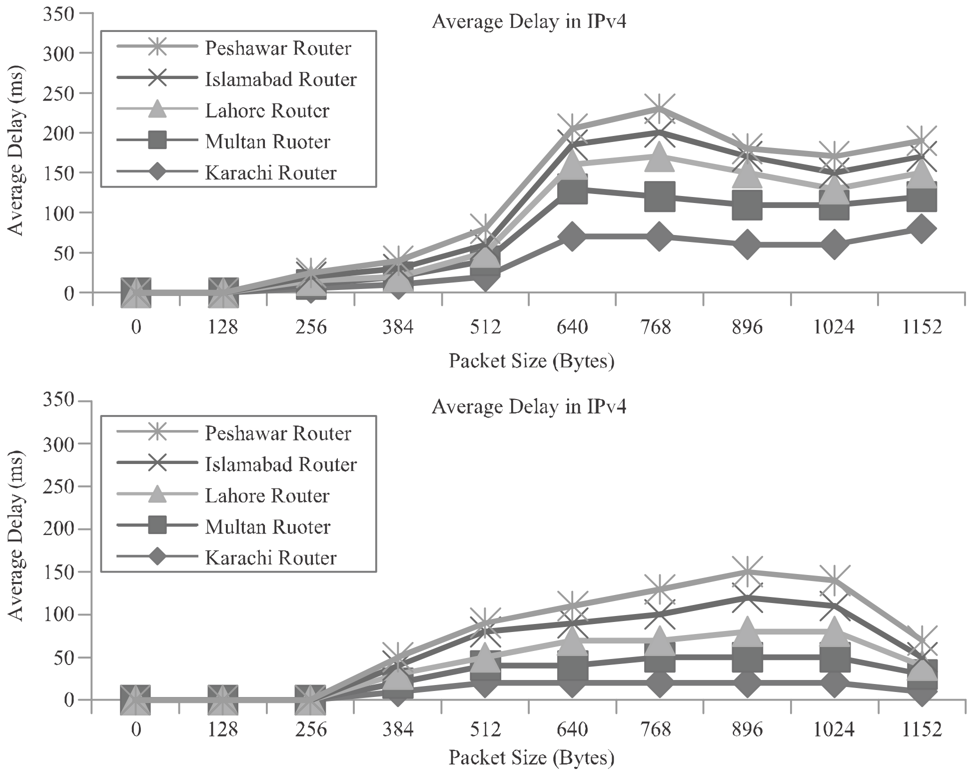

FIG. 4. AVERAGE DELAY IN IPv4 AND IPv6

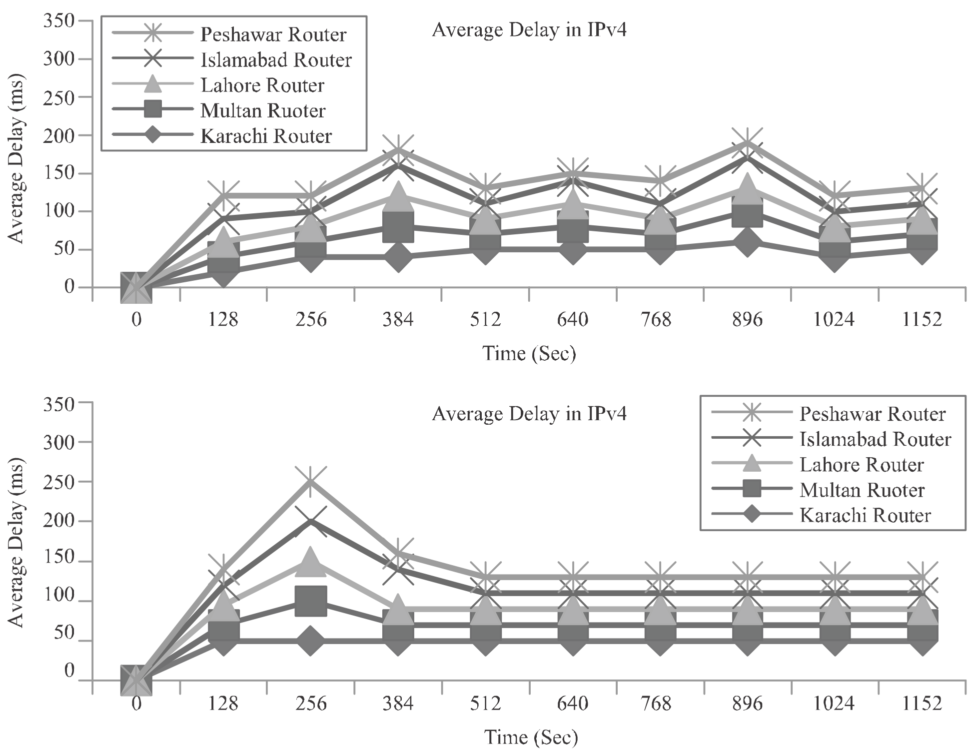

FIG. 5. PACKETS DELAY IN IPv4 AND IPv6

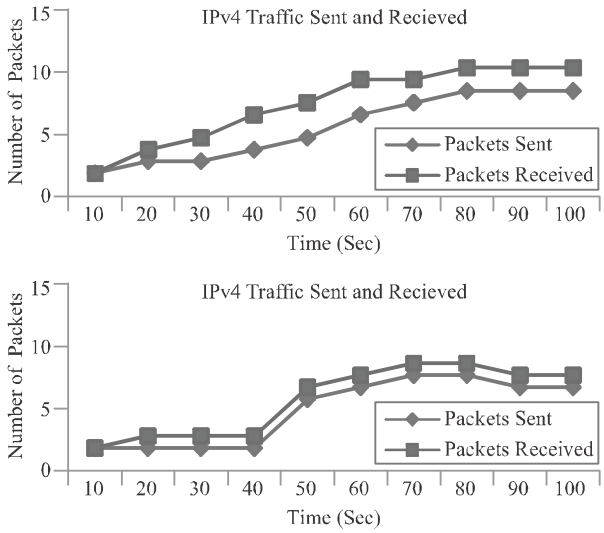

FIG. 6. TRAFFIC SENT AND RECEIVED FOR IPv4 AND IPv6

4. CONCLUSIONS

By reading this named "Dual stack deployment in a carrier grade network is fulfill demands of next generation of internet", it is obvious that this paper explain ways to deploy the IPv4 and IPv6 in the carrier grade network. We have simulated an ISP model which is able to provide services to IPv4 customers as well as to IPv6 customers successfully. In this work each is implemented for the deployment of IPv4 and next generation IP (IPv6). By using snapshots and other useful diagrams the implementation model is deployed as a practical network. The assignment of IP addresses are efficient maintained amongst point to point router links. Demonstration of Dual stack is configured and verified using Cisco commands successfully.

We resolved many problems aroused during the implementation by deploying the complex BGP (Border Gateway Protocol). GNS3 (Graphical Network Simulator) simulation is used to analyze the traffic monitoring and packet delay analysis. Our analysis shown that the IPv6 matured than IPv4 due to its delay control as the packet size increases. Results depict that IPv6 get the similar delay trend while in IPv4 delay varies dependant upon the router distance. The packet delay oscillates with the time in IPv4 while IPv6 shows rising delay during the convergence time and the delay became smooth afterwards. This effect comply mature behavior of IPv6 and the negligence of distance. The time consumption analysis show normal relative time enhanced trend is observed in both schemes mimic rapid convergence of the network for the case of IPv6. The model presented in this work is a prototype for large business organizations to implement IPv4 and IPv6 based networks.

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