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RESEARCH ARTICLE

TUNNEL-BASED IPV6 TRANSITION WITH AUTOMATIC BANDWIDTH MANAGEMENT

Srinidhi K S[1], Smt. R. Anitha[2], A.V.Srikantan[3]

[1]M.Tech Student, CSE Department, The National Institute of Engineering, Mysore, Karnataka, India

[2]Associate Professor, CSE Department, The National Institute of Engineering, Mysore, Karnataka, India

[3]Divisional Engineer(TM), RTTC, Mysore, Karnataka, India

[1] srinidhiks50@gmail.com; [2] Anithamahendra_99@yahoo.com; [3] srikanta.venugopal@gmail.com

Abstract— The Internet will soon be sailing in very rough as it is about to run out of the current Internet Protocol Version four (IPV4). Moving from Internet Protocol version Four (IPv4) to Internet Protocol version six (IPv6) is not straightforward because IPv4 and IPv6 are incompatible protocols. To enable the smooth transition between IPv4 and IPv6, several transition mechanisms have been proposed by IETF IPng Transition Working Group (NGTrans) such as Tunneling, dual stack, Translation. Tunneling supports "like-to-like" IP connectivity across an "unlike" network, whereas translation supports "like-to-unlike" IP interconnectivity. No comprehensive strategy exists to address all possible scenarios. Because tunneling can keep the end-to-end model that the Internet is built on. Tunneling enables IPv6 connectivity across an IPv4 network and vice versa. Although tunneling can't achieve direct interworking between IPv4 and IPv6, but broadly adopting it as the foundation for IPv6 transition will accelerate IPv6 adoption, and retain the legacy IPv4 connectivity, and let operators leverage their existing IPv4 assets during the transition period. The key concern is that tunneling retains the end-to-end notion and IP like-to-like affinity on which the Internet is built.

Bandwidth allocation is an important factor to be considered in networking. Efficient bandwidth management technique is important in satisfying the requested services. In this project, the emphasis is laid on developing a tunnel-based framework that solves the transition problems in backbone and allocation of bandwidth efficiently by allocating the requested bandwidth as per the demand.

Keywords— Bandwidth Management, IPV4, IPV6, Tunneling

I. INTRODUCTION

Tunneling: It enables IPv6 connectivity across an IPv4 network and vice versa. Tunneling operations include encapsulation, decapsulation, and tunnel endpoint signaling, with no upper layer operation required. Hardware can implement data forwarding at the network layer with line speed capacity. Although tunneling can't achieve direct interworking between IPv4 and IPv6, we believe that broadly adopting it as the foundation for IPv6 transition will accelerate IPv6 adoption, retain legacy IPv4 connectivity, and let operators leverage their existing IPv4 assets during the transition period. The key concern is that tunneling retains the end-to-end notion and IP like-to-like affinity on which the Internet is built. Here, the project deals with a tunnel-based IPv6 transition framework. Considering the diversity in network structure and functionality, the framework applies different tunneling mechanisms to backbone and access networks. Backbone networks must support both IPv4 and IPv6 connectivity for client networks even when the backbone is homogenous IPv4 or IPv6 [1].

Overlay tunneling encapsulates IPv6 packets in IPv4 packets for delivery across an IPv4 infrastructure (a core network or the Internet (see the figure below). By using overlay tunnels, you can communicate with isolated IPv6 networks without upgrading the IPv4 infrastructure between them. Overlay tunnels can be configured between border routers or between a border router and a host; however, both tunnel endpoints must support both the IPv4 and IPv6 protocol stacks. IPv6 supports the following types of overlay tunneling mechanisms:

- Manual
- Generic routing encapsulation (GRE)
- IPv4-compatible
- 6to4
- Intrasite Automatic Tunnel Addressing Protocol (ISATAP)

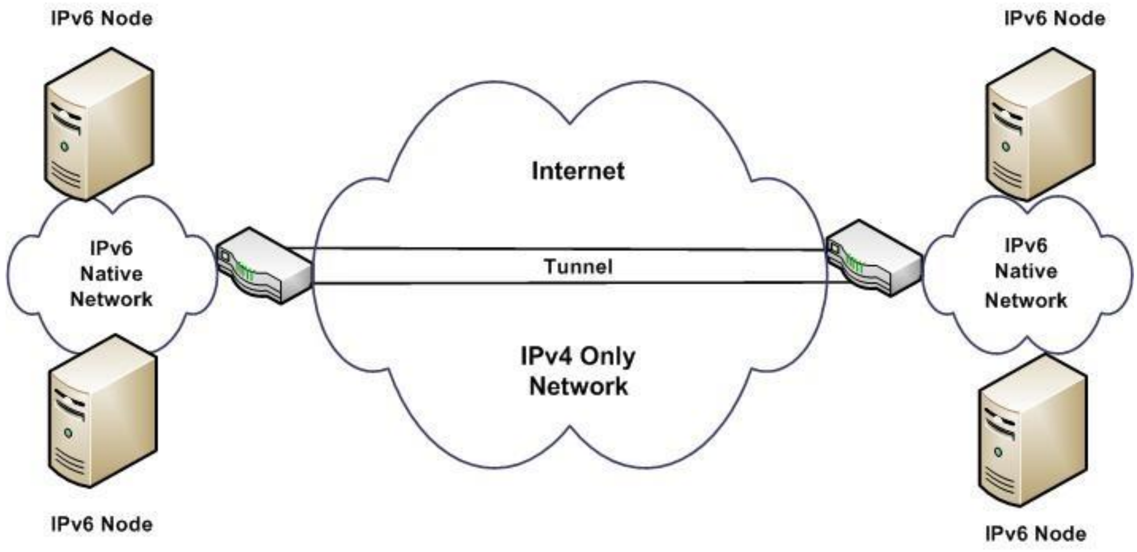


Figure 1 IPv6 Tunneling over IPV4 only network

A manually configured tunnel is equivalent to a permanent link between two IPv6 domains over an IPv4 backbone. The primary use is for stable connections that require regular secure communication between two edge routers or between an end system and an edge router, or for connection to remote IPv6 networks.

An IPv6 address is manually configured on a tunnel interface, and manually configured IPv4 addresses are assigned to the tunnel source and the tunnel destination. The host or router at each end of a configured tunnel must support both the IPv4 and IPv6 protocol stacks. Manually configured tunnels can be configured between border routers or between a border router and a host [2].

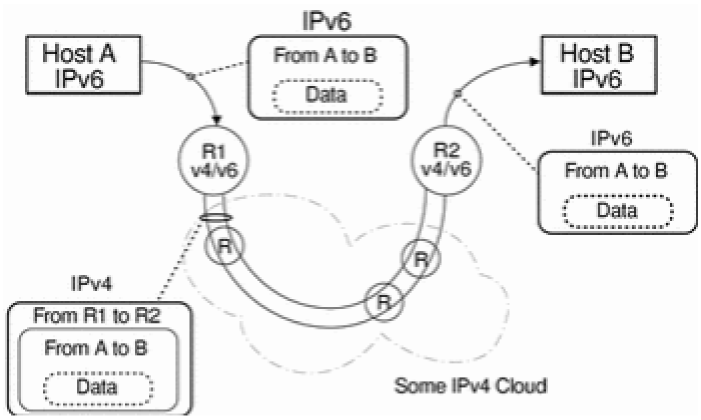


Figure 2 tunneling procedure

Access networks developed in the next few years will mainly be IPv6-only. To provide dual-stack access to such networks, we need an IPv4-over-IPv6 tunneling mechanism that can sustain IPv4 availability when access networks switch to IPv6, and hence significantly advance the transition. Early tunneling research focused on developing IPv6-over-IPv4 techniques. Recently, with the growth of IPv6 access net- works, the Internet community has proposed a series of IPv4-over-IPv6 tunneling techniques, including Public 4over6, Dual-Stack Lite, and 4rd, to satisfy various transition demands [3].

Efficient dynamic resource provisioning mechanisms are necessary to the development and automation of Quality of Service networks. In telecommunication networks, resource allocation is performed mainly in a static way, on time scales on the order of hours to months. However, statically provisioned network resource can become insufficient or considerably under-utilized if traffic statistics change significantly. Therefore, a key challenge for the deployment of Quality of Service networks is the development of solutions that can dynamically track traffic statistics and allocate network resources efficiently, satisfying the QoS requirements of users while aiming at maximizing, at the same time, resource utilization and network revenue. Recently, dynamic bandwidth allocation has attracted research interest [4].

II. BACKGROUND

Internet Protocol Version 4 (IPv4) which was developed almost three decades ago is the prevalent protocol version in use today. However, with the unanticipated growth of internet and an increase of interconnected devices, we could soon be facing a scenario where IPv4 addresses are exhausted. While IPv4 addressing allows for billions of addresses, IPv6, the next version of the protocol, has provisions for trillions of addresses which are potentially inexhaustible. Sooner rather than later, migration to IPv6 will be inevitable for all enterprises.

By 2015, there will be more than 7 billion mobile connected devices globally. Smart phones, home and industrial appliances, transportation, integrated telephony, sensor networks, distributed computing, gaming, online business and all other spheres are being driven by the internet increasingly. The unprecedented growth in the number of devices connecting to the network and the interactions between them brings an increased focus on the rate of depletion of IPv4 addresses, network security and QoS making the transition to IPv6 inevitable. By Not adopting IPv6 will not only limit the growth of the internet but also the business potential of enterprises. As more and more users start adopting IPv6- only devices, enterprises with IPv4 websites will surely be reeling under if they do not provide for this transition.

Realizing the urgency, governments across the world are mandating a transition to IPv6. The US government has mandated its federal agencies to ensure that all internal applications that communicate with public internet servers migrate to IPv6 by 2014.

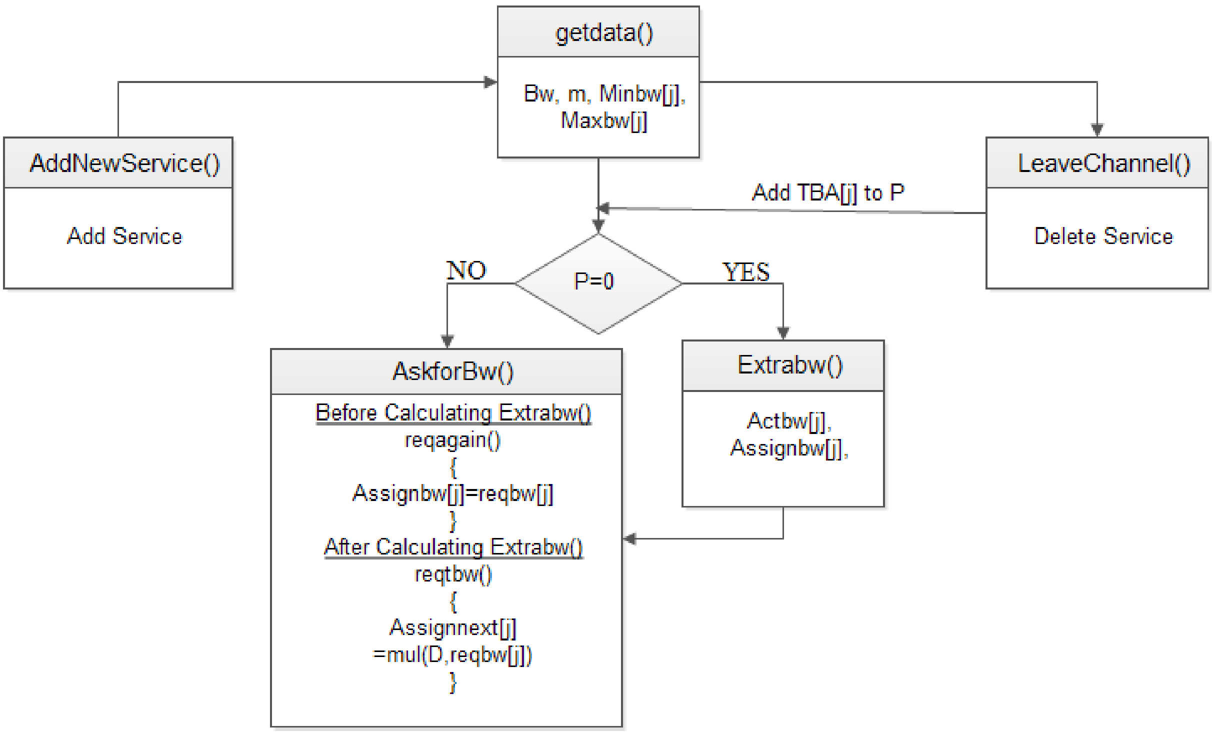
III. WORKING

This project concentrates on how the automatic bandwidth management is done more efficiently. To implement this work firstly, we require general manual configured tunnel setup to be done. Secondly, proposed algorithm is coded and need to embedded into IOS of the router in assembly language. Then, configuration is done at console and output is observed. Implementing this in router or SNMP server will perform better than existing priority, predefined or manual bandwidth configuration.

Configuring Manual IPv6 Tunnels

Prerequisites**:** With manually configured IPv6 tunnels, an IPv6 address is configured on a tunnel interface, and manually configured IPv4 addresses are assigned to the tunnel source and the tunnel destination. The host or router at each end of a configured tunnel must support both the IPv4 and IPv6 protocol stacks.

Automatic Bandwidth Management Algorithm



Working of Automatic Bandwidth Management

Bandwidth Allocation works in four Phases. First is specifying free bandwidth available and setting usage bandwidth, second is requesting for minimum bandwidth and maximum bandwidth, third is allocation of bandwidth, and lastly re-calculating and assigning requested bandwidth to each service.

- Specification of free available bandwidth & Setting Usage bandwidth
- Requesting for minimum bandwidth and maximum bandwidth
- Allocation of bandwidth
- Re-calculation and assigning of bandwidth

AMB works in four Phases. First is specifying free bandwidth available and setting usage bandwidth, second is requesting for minimum bandwidth and maximum bandwidth, third is allocation of bandwidth, and lastly re-calculating and assigning requested bandwidth to each service.

- **Specification of free available bandwidth & Setting Usage bandwidth**

Bandwidth provider or admin is responsible for providing bandwidth to users. Bandwidth allocation to the services is done from freely available bandwidth. Usage bandwidth is the percentage of bandwidth made available for the services in order to satisfy services requesting for bandwidth. This usage bandwidth is a part of freely available bandwidth provided by admin and remaining bandwidth apart from usage bandwidth is used as buffer i.e. it is used in times of packet lost in order to inform source node using ICMP and used for retransmission. For this purpose small amount bandwidth is taken out from available bandwidth.

- **Requesting for minimum bandwidth and maximum bandwidth**

This is the task of user in case of manual configuration; in case of automatic configuration this input is taken from the program itself. User is going to request for bandwidth and come up with maximum and minimum bandwidth information. This serves as an input to the proposed algorithm.

- **Allocation of bandwidth**

Allocation of bandwidth is done in two ways depending upon conditions. First, until and unless the available bandwidth becomes equal to zero, allocation of bandwidth is done as much as requested. Second, once the available bandwidth becomes equal to zero proposed algorithm comes into picture. It starts calculating bandwidth that was supposed to be given for the particular user (Actbw[j]).

Bw- Freely available bandwidth

m- Percentage of usage bandwidth

y=(m/100)×Bw; //usage bandwidth

P=y; //bandwidth remaining for allocation

Assignbw[j]=reqbw[j]; //reqbw[j]-bandwidth requested by service

Assignbw[j]=Assignbw[j]+reqbw[j]; //Bandwidth assigned for service at different time T1,T2….etc. Second case will be explained in Re-calculation and assigning of bandwidth phase.

- **Re-calculation and assigning of bandwidth**

This phase begins when the value of P becomes equal to zero. At this condition comparision of Actbw[j] and Assignbw[j] is undertaken.

When P=0;

Rembw=y-∑Minbw[j];

MAX=∑Maxbw[j];

Actbw[j] = (Maxbw[j]/MAX)×Rembw; //D=(Maxbw[j]/MAX)

Assignbw[j]=TBA[j]-Minbw[j]; **//** TBA[j]- Total Bandwidth Allocated for service

Or

Assignbw[j]=Assignbw[j]+reqbw[j];

Then it compares **Actbw[j]** with the assigned bandwidth **Assignbw[j]** which is summation of bandwidth allocated for each service.

Now if the

Assignbw[j]>Actbw[j] then,

Ebw[j]=Actbw[j]-Assignbw[j];

And Ebw[j] will be added to **P.** So now the remaining bw P value is updated to **P=P+Ebw[j];**

So now after when the bandwidth is requested by service, then allocation is done in terms of percentage.

Assignnext=(Maxbw[j]/MAX)×reqbw;

By following this proposed algorithm all the service are given equal priority and overcomes the drawback found in existing priority algorithm. Thus all the services are provided with bandwidth without any discrimination. Percentage of bandwidth to be assigned to the service is calculated each and every time when service leaves the channel or adds to bandwidth channel. In order to assign bandwidth to each service with excellence.

IV. CONCLUSION

Since the exhaustion of IPV4 address, it has become imminent for all the internet service providers to migrate towards new technology of addressing i.e., IPV6 which can allot IP addresses to 2^128 devices. Also, it is not practical to replace all the existing IPV4 back-haul networks with IPV6 devices per say. Because, the cost of implementation by installing IPV4 devices in every network will be a financial constraint. So, by using various techniques involving in IPV6, it helps in co-existence of both IPV4 and IPV6.

By adopting Dual-Stack devices, which can support both IPV4 and IPV6 devices, it can be implemented in newer networks. But, the problem with this technology is it works fine in smaller networks.

To overcome this problem, Tunneling is the best option for migration from IPV4 to IPV6 and also in the co-existence of IPV4 and IPV6. Dual-Stack routers are needed to be installed only in near customers end, and the already existing network of IPV4 devices remains untouched. Thereby, it helps successfully transferring IPV6 traffic in IPV4 network by encapsulation and decapsulation.

The drawback of the current manual bandwidth allocation algorithm in the cisco routers is that the allocated bandwidth is either under-utilized or over-utilized by the customers. To overcome this drawback, a new automatic bandwidth management algorithm is proposed wherein, the priority of the relative customers are not taken into account, every service are provided with a minimum and maximum bandwidth as per the user requirements, thereby providing every customer a minimum bandwidth.

V. **FUTURE ENHANCEMENTS**

The proposed Automatic Bandwidth Management can be implemented through SNMP server monitoring which is used to monitor the routers. Also, the proposed Automatic Bandwidth Management can be embedded into router's IOS, and can be used as standard dynamic bandwidth allocation protocol along with RIP or OSPF protocols.

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