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Sevice Implemenation using MPLS VPN in IPv6

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ABSTRACT

Service implementation is done for providing different services to the customer. Detailed layer3 virtual private network implementation in internet protocol version 6 is done in this paper. Layer 3 virtual private network in internet protocol version 6 is known as 6VPE technology, where virtual private network implementation is done for service provider for providing different services and also study of how traffic flows from different network in layer 3 virtual private network.

Key words :. CE, IPv6, MPLS, MP-BGP ,PE,VPN , VPE , VRF

1. INTRODUCTION

Internet protocol version 6 (IPv6) is an enhanced version of internet protocol version 4(IPv4) with IPv6 having 64 bit address whereas IPv4 having 32 bit address. Currently, IPv6 is deployed only in certain places like CNGI in china and e-japan in japan.There are many issues arises while interconnecting IPv4 & IPv6 networks, tunnelling technologies are used to connect separated IPv6 networks.

Implementation of virtual private network (VPN)[1] in IPv6 is known as 6VPE technology which is extended version of Layer 3 virtual private network technology. 6VPE can carry an IPv6 or IPv4 virtual private network service . Like IPv4, 6VPE also logically separates routing table entries for virtual private network customer. For transferring to IPv6 network next hop has to be IPv6 address even if the provider network is an IPv4,the next hop of the advertising 6VPE router will be an IPv4-mapped IPv6 address and this is done by prepending ::FFFF to IPv4 next-hop.

6 VPE is a RFC 4364-like virtual private network model for IPv6 networks. It is a method in which a service provider may use its packet-switched backbone to provide virtual private network services for its IPv6 customer. 6VPE supports multiple IPv6 virtual routing forwardings on provider edge(PE) routers.
multiprotocol-border gateway protocol(M-BGP) is used to distribute IPv6 routes over service provider backbone and thus deal with issue of overlapping addresses, redistribution policies and scalablity issues. IPv6 virtual private network addresses prepended with route distinguisher. Route target extended community is used to distribution of routing information by tagging exported routes and filtering imported routes.
Forwarding decision is taken by ingress provider edge router in the data plane based on content of virtual routing forwarding(VRF) table. IPv6 data packets are encapsulated with a service & transport label for transmission across core.

layer 2	lSP label	L3 VPN label	IPv6 data

Figure 1: 6VPE label stack

In IPv6 label , the outer label is known as top, transport or LSP label that identifies the transport tunnel between provider edge's signalled via Label Distribution Protocol (LDP) Resource Reservation Protocol (RSVP)[2]. The inner label is known as the service, virtual circuits (VC) , or virtual private network (VPN) label that identifies the customer virtual private network that is signalled via Multi protocol-border gateway protocol.

VPN operation of routing is divided into 2 component :

1.) Core routing
2.) Edge routing

Core routing involves Provider Edge(PE) router and Provider (P) routers and is performed by IPv4 Interior Gateway Protocols(IGPs) like OSPF etc. It enables connectivity among the provider and provider edge routers[3].

Edge routing takes place in 2 directions. Routing between provider edge pairs achieved through multiprotocol-border gateway protocol using a specific address family(VPN-IPv6) & routing between a provider edge and a customer edge. Routing between the customer edge and its provider edge is achieved using routing protocols that is VRF-aware like border gateway protocol or static routes.

The following routing tables are used at incoming provider edge router:

1.) IPv6 VRF – It is a set of customer-specific IPv6 routing table that contain customer routes. Each of these routing tables contain routes received from the Customer Edge (CE) routers, as well as routes from remote sites in the same virtual private network.

2.) A default routing table that is exclusively used to reach routers inside the provider network. It is an IPv4 table if core is IPv4 base else IPv6 otherwise.

3.) A BGP table that contains entries from all customer-specific IPv6 routing tables.

Route distribution between sites occur in following ways:

1.) The incoming customer edge router announces customer prefix to the incoming provider edge router. Although this entry belongs to the default routing table at the incoming customer edge router, it is installed in a virtual routing forwarding IPv6 table at the incoming provider edge router. The interface on which these are received determines the table into which they should be installed.

2.) Incoming provider edge router redistribute this entry into its multiprotocol bprder gateway routing protocol after prefixing it with the Route Distinguisher (RD) after taking reference from virtual routing forwarding table[4].

3.) The entry will be announced to outgoing provider edge router at other end from border gateway protocol(BGP) table.

4.) Once installed in the outgoing provider edge BGP table, the entry is redistributed into one or more virtual routing forwarding tables after stripping of the route distinguisher.

5.) From the virtual routing forwarding table, the entry is finally redistributed into customer site.

Here route distinguisher is used to distinguish entries in BGP, while BGP community (route targets) are used to determine which entry from which virtual routing forwarding table is to be distributed in which virtual routing forwarding table on remote provider edge.

1.1 Functions of routers in 6VPE

Ingress 6VPE router-data plane – As the ingress 6VPE router receives an IPv6 packet, it looks for the destination address in VRF table For the prefix learned through the remote 6VPE router, the ingress router does a lookup in the VPN-IPv6 forwarding table. The VPN-IPv6 route has an associated multi protocol label switching (MPLS) label to a MBGP next-hop and an associated L3 VPN service label. The ingress 6VPE router needs to push two MPLS labels in order to send the packets to the egress 6VPE router, where the top label is an MPLS IPv4 label used to reach the egress 6VPE router and the bottom label is an MPLS label that is advertised in MBGP by remote 6VPE for IPv6 prefixes in the VRF.

Egress 6VPE router-data plane – As the core router label switch the packets to the correct egress 6VPE through the transport label, the egress 6VPE router receive label-stacked packets from the core. The egress 6VPE router pops the transport label, and pops the bottom IPv6 L3VPN service label and identifies the target VRF and the address family. A further L3 lookup is performed in the target VRF and the IPV6 packet is sent towards the proper customer edge router in the IPv6 domain. The egress 6VPE forwards unlabelled packets to the customer.

Configuration of MPLS VPN in IPv6 in ALCATEL routers

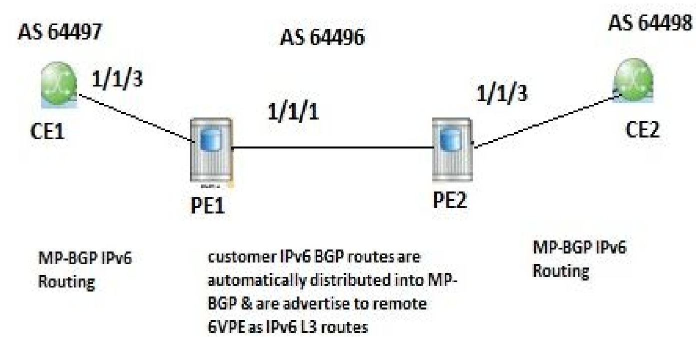

Figure 2: Architecture of IPv6 implementation

```
#--------------------------------------------------
echo " configure bgp on CE "
#--------------------------------------------------
    Configure bgp
  Local-as 64497
  group “to PE1”
  family IPV6
  neighbor 2001:db8:12::2
  export “direct-bgp”
  peer-as 64496
exit all

#--------------------------------------------------
echo " policy configuration to redistribute customer route into BGP "
#--------------------------------------------------
    Configure router bgp
  Policy-options
  begin
  Policy statement “direct bgp”
  Entry 10
     From
     Protocol direct
     Exit
     To protocol bgp
```

```
      exit
      Ation accept
      Exit
   Exit
exit

#--------------------------------------------------
echo " configure bgp on PE1 "
#--------------------------------------------------
vprn 10 customer 10 create
   description "vprn service for customer"
   router-id 10.10.10.1
autonomous-system 64496
   Route-distinguisher 64496:1
   Auto-bind ldp
   vrf-target target:64496:10
   interface "to R3" create
   ipv6
   address 2001:db8:12::2/64
   exit
   sap 1/1/3 create
exit
exit
   bgp
group "to CE1"
family IPV6
export "mpbgp-bgp"
neighbor 2001:db8:12::1
peer-as 64497
exit
exit
exit
no shutdown
exit

#--------------------------------------------------
echo " MP-BGP configuration on PE1
#--------------------------------------------------

   configure router bgp
   group "multi-bgp "
   family vpn-ipv4 vpn-ipv6
   peer-as 64496
   neighbor 10.10.10.2
   local address 10.10.10.1
   exit all

#--------------------------------------------------
echo " policy configuration on PE1"
#--------------------------------------------------
   Policy-options
   begin
   Policy statement "mpbgp-bgp"
   Entry 10
      From
      Protocol bgp-vpn
      Exit
      To
protocolbgp
      exit
      Ation accept
      Exit
   Exit
Exit
Commit
```

5. CONCLUSION

The service implementation can be done in IPv6 using MPLS VPN using interior gateway and multi protocol BGP which are used to distribute route to and fro the network and also to pass this information to IPv4 network appending to IPv4 packet is need to be done as size of IPv4 and IPv6 packets differ. Thus a small model showing implementation of MPLS VPN in IPv6 is shown and also a complete study of 6VPE is done.

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