Internet Anycasting Service

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Abstract- This work studies how to provide a scalable and efficient global Internet Anycasting Service (ISA). We propose a new routing group concept and adopt the overlay network mechanism to achieve scalability and efficiency. In our design, an anycast address is allowed to be within the unicast address space, as proposed in the specification of IPv6. We show that the routing table size of an anycast router can be bounded by $O(\sqrt{N})$, where N denoted the number of anycast group. Our preliminary simulation results verified this bound.

1. INTRODUCTION

Recently, a new routing service, called anycast, has been proposed. Anycast [1] is defined in the next generation network (IPv6) addressing architecture [2,3] as a novel routing model which allows a sender to access anyone in a group which shares the same anycast address, ideally the nearest one, where nearest is defined according to the distance measured by the routing protocol. Anycast can be used to develop numerous potential killer applications, e.g., DNS, replicated ftp or www servers. It is expected that IP anycast can significantly improve the network performance by routing packets to the nearest server or sharing the loads among group members [4].

Currently, how to provide a scalable and efficient Internet anycast routing is still an open issue [6-8]. The current standard does not define any protocol for performing anycast routing due to the lack of a scalable and feasible solution. One important feature of anycast address in IPv6 specification is that anycast address should be assigned form same address space as the unicast address, makes it indistinguishable form a unicast address. As a consequence, a backbone router needs to have a routing entry for each anycast address. Furthermore, the routing entries of anycast can not be aggregated regardless of their actual address prefix, which implies the anycast routing entires need to store individually on a router. As the anycast service gets to be more commonly used, the routing tables of backbone routers for anycast will become too large to be tractable.

Our study is to design a novel scalable and feasible anycast routing protocol for global Internet. We propose a new routing group concept and adopt the overlay network mechanism to achieve scalability and efficiency. The anycast routers can be self-organized into various overlay networks according to their routing groups. Anycast router in the same routing group maintains the anycast routing entries of each other by distributed Bellman-Ford algorithm. In our design, an anycast address is allowed within unicast address space and the routing table size of a anycast router can be bounded by $O(\sqrt{N})$, where ***N*** denoted the number of anycast group.

The rest of this paper is organized as follows. Section 2 describes the design details of our anycast routing protocol, and Section 3 shows the preliminary simulation results. Finally, Section 4 presents our conclusions.

2. INTERNET ANYCASTING SERVICE

As aforementioned, scalability is the most challenging issue of providing anycast service. In order to forward anycast packets as unicast packets, a router needs to maintain next hop information of all anycast addresses which certainly is not scalable. To solve this problem, we introduce a novel routing group (RG) concept.

The basic idea of RG is to *divide and conquer* the large number of anycast groups (addresses). Specifically, a global hash function is used to map anycast group addresses into routing groups. A backbone router also uses the same hash function to decide which routing group it belongs to, using one of its anycast addresses as the input (or any unicast addresses if it does not have any anycast addresses). The number of routing groups is a system parameter. Ideally, it is suggested to set to $\sqrt{N}$, where ***N*** is the number of anycast groups. Then, the most important idea of our RG is that all routers in the same routing group, say group A, know how to route anycast packets with addresses that are mapped to group A. There are three mechanisms to achieve this work:

(1)Neighbor discovery: each router needs to know several nearby routers of the same group and one router of each of the rest of routing groups. This can be done by flooding a special BGP message with a limited TTL, say 3.

(2)Address registration: for each anycast address of a router, if the address is mapped to a routing group that is different of the one the router belongs to, the router needs to register the information to a router which belongs to the same group of the anycast address. Recall that each router knows at least one router of each of other groups.

(3)Routing table exchange: routers of the same routing group will run BGP to exchange their anycast routing information such that anycast packets whose addresses belong to this group should be able to be routed successfully. Neighboring routers found in the neighbor discovery stage are viewed as the router's BGP peers. Therefore, routers in the same group can be viewed as a overlay network.

Anycast packets are routed as follows. When a router receives an anycast packet, it first determines which group is belongs to. If it belongs to the same group of the router, the router knows how to forward this anycast packet. If not, the router forwards it to a nearby router which belongs to the same group as the anycast packet. The packet can then be successfully routed by routers of that routing group.

Figure 1 shows the example of how to route anycast packets. In this example, there are three routing groups, namely, x-RG, y-RG, and z-RG. The anycast addresses of domain 1,3,7 belong to z-RG, domain 2,4,6 belong to x-RG, and domain 5, CCU belong to y-RG. When a packet received by a router of domain 7 destined to domain 5, it is forwarded to a router in y-RG first, based on the hashing result. Routers of y-RG then take over the routing duty based on BGP routing.

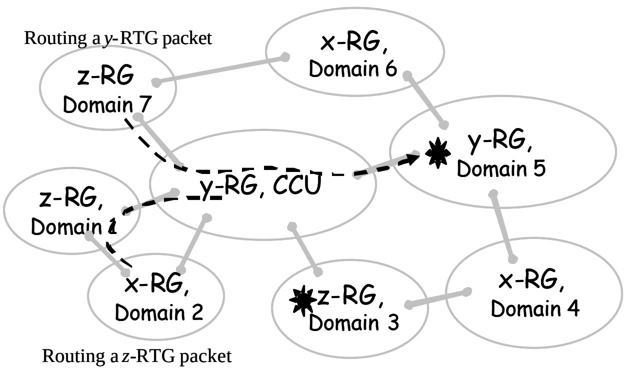

Fig. 1: The example of Internet anycasting service

If the number of routing groups is $\sqrt{N}$, it is trivial to show that the anycast routing table of each router is bounded by $O(\sqrt{N})$, where N denoted the number of anycast group.

3. SIMULATION RESULTS

In this section, we show the preliminary simulation results of the routing table size under various anycast group sizes. We ran simulation on the 10,000 nodes AS network topology. The number of routing group is set to a prime number that closes to $\sqrt{N}$. Figure 2 shows that with 5,000 anycast groups in the 10,000-node network (2 members per group, 71 routing groups), the routing table size of each router is only around 70 entries.

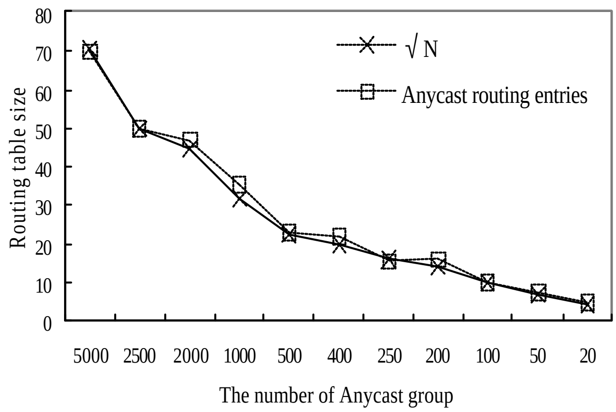

Fig. 2: Routing table size under various number of anycast group

4. CONCLUSIONS

In this paper, we proposed a scalable and feasible anycast routing mechanism We introduced a novel routing group (RG) concept to achieve scalability. Our design can significantly reduce the anycast routing table size. Furthermore, the proposed protocol can be implemented using BGP. In the further, we will evaluate more performance metrics of this protocol, such as routing efficiency.

5. REFERENCES

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