Pseudo MIPv6 for Anycast and Fault Tolerant Services

Ting-Yun Chi
Department of Electrical Engineering,
National Dong Hwa University, Hualien,
louk@louk.dyndns.org,

Han-Chieh Chao
Department of Electronic Engineering,
National Ilan University, I-Lan, Taiwan
hcc@niu.edu.tw

ABSTRACT

In the paper, we would like to propose a pseudo anycast mechanism based on MIPv6 (RFC3775, RFC3667)[3][4]. By our solution, we can provide the function for anycast and layer 3 faul-tolerant by MIPv6-like mechanism. We will also compare some load balance solutions with our solution [1][2]. With our solution, the potential customers (clients) can utilize the powerful service functions without any patching work.

Keywords: MobileIPv6, anycast, load balance

1. Introduction

As we see in today's life, there is more and more service work on the network. The new services and ideas are proposed everyday. If the service is not popular and the idea doesn't work, the service will withdraw from the competition – network business. On the contrary, if the people love the service and they would like to pay for it. The company will get the other problem – how to make sure every customer can access the service without difficulty. Purchasing more bandwidth seems not like a good answer to the company. Load-balance and fail-tolerance sound much like a good option.

Anycast is a revolutionary IPv6 development that replaces the IPv4 load balance method. It takes the IPv4 load balance into the IP layer and provides a universal load balance standard. In other words, anycast is a visionary development on Ipv6. Anycast try to provide a simple mechanism for choose the best server. It's quite simple and easy to implement. Because IPv6 is a whole new protocol, so writing a new API for anycast purpose should not be a problem.

Currently, many Ipv6-related technologies have adopted the anycast mechanism for optimal search routing including the Dynamic Home Agent Address Discovery (DHAAD) and micro handover.[5]

Unfortunately, anycast still is a dream in the real world. Although it's quite simple, but no one has written the API for it yet. Most of the manufacturers only implement the unicast and

multicast for IPv6 and most of the Operation Systems don't provide the anycast API as well.

Only a few people use anycast in the experimental network. Some of the implementation need to patch the layer 3 or layer 4 and some of them even require to patch the application layer (layer 7). Keep in mind that the goal of anycast is to provide an "IP technology" solution to save the problem at the beginning.

IPv6 has quickly developed and correlated many operating systems to support IPv6. This development has extended to Mobile IP with its own RFC3775 and RFC3776 standard. Conversely, the pace for IPv6 anycast development was relatively slower.

The anycast protocol dictates that the Host creates a link to connect an anycast address in return for unicast site through the router. This is quite similar to the Mobile mechanism in which the CN starts a link to the home address and the HA returns a real connection to the CoA. Taking advantage of the available Mobile IP standard in the following three aspects realizes anycast development.

1. Mobile IP has already been standardized.
2. The amount of software in Mobile IP can be used directly on the nodes.
3. Mobile IP has taken CN support into consideration.

We want to provide a load balance and fault- tolerant service with the pseudo MIPv6 API.

2. Related Work

This session will introcude the main load-balance solutions over the world and the latest implementation for anycast and an anycast working group. A similar idea for use MIPv6 to provide the anycast service will also presented.

There are many load balancing solutions. One is client oriented requiring each client to have special demand software for one special application [7]. Another method is DNS oriented [8]. It is simple and easy to deploy but less sensitive. The most famous method is NAT [9]. NAT is a popular IP layer solution, but it has a bottleneck problem.

[Table 1] Comparison between the famous load balance mechanisms

Name	DNS	LS-NAT MacNAT	App-client
Good	Easy to use	Easy to use	powerful
weakness	Refresh time.	bottle	specially designated
reconnection	no	yes	yes

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2.1 DNS

Early work on distribution and assignment of incoming connections across a cluster of servers has relied on Round-Robin DNS (RR-DNS) to distribute incoming connections across a cluster of servers. This is done by providing a mapping from a single host name to multiple IP addresses. Due to DNS protocol intricacies (e.g. DNS caching and invalidation), RR-DNS was found to be of limited value for the purposes of load balancing and fault tolerance of scalable Web server clusters. The research described in quantifies these limitations.

2.2 NAT-tunnel based

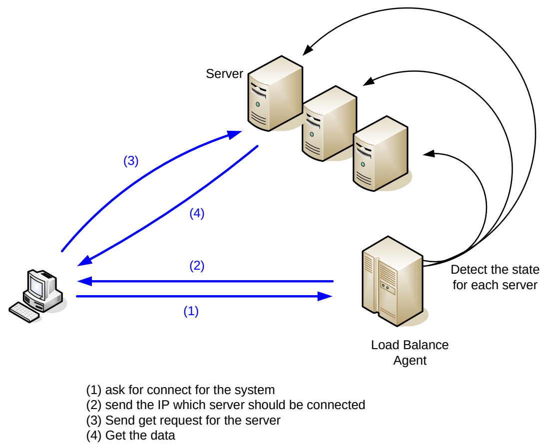
In the usual case (i.e., a non-clustered server), there is only one Web server serving the requests addressed to one hostname or Internet Protocol (IP) address. With a cluster-based server, several back-end Web servers cooperatively serve the requests addressed to the hostname or IP address corresponding to the: company's Web site. All of these servers provide the same content. The content is either replicated on each machine's local disk or shared on a network file system. Each request destined for that hostname or IP address will be distributed, based on load-sharing algorithms, to one back-end server within the cluster and served by that server. The distribution is realized by either a software module running on a common operating system or by a special-purpose hardware device plugged into the network. In either case, we refer to this entity as the 'dispatcher'. Busy sites such as Excite, Inc. depend heavily on clustering technologies to handle a large number of requests. There are two different kinds of cluster-based Web servers clustering technologies. The first is LSMAC, in which the dispatcher forwards packets by controlling Medium Access Control (MAC) addresses. The second is LSNAT, in which the dispatcher distributes packets by modifying IP addresses.

[Table 2] Compare with the LSMAC and LSNAT

Comparison of key feature of the LSMAC and LSNAT implementations		
Feature	LSMAC	LSNAT
OSI layer	L2	L3
Traffic Flow through dispatcher	Unidirectional	Bidirectional
Incoming Packet Modification	No	Des. IP address and checksum
Outgoing Packet Modification	Not applicable	Source. IP address and checksum
Routing table change in immediate router	Yes	No
Servers in different LANs	Requires interface on each LANs	Allowed

2.3 Application-client base

In the Figure1, you have three main components. The first one is Load Balance Agent, the second one is service server and the last one is client.

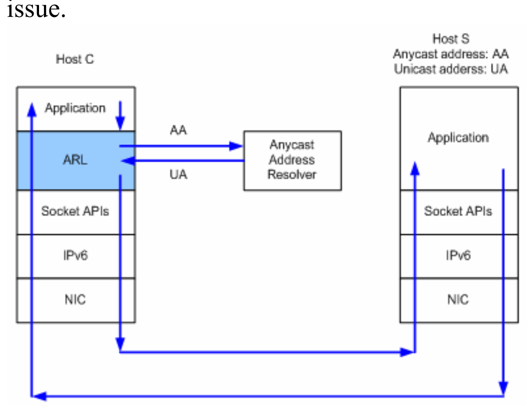


[Figure 1] The process for application based mechanism

The load balance Agent will get the CPU loading and other parameters. The agent will process the data to decide which server should be connected. When the client wants to use the service, the user must install the special application software first. The special client software will send signal to ask Load Balance Agent which server should be connected.
The process looks like "load balance DNS based". However you can understand from the figure 1, it's in the application layer.

2.4 Anycast

Several solutions have been used for anycast implementation. The first solution is the "Source Identification Option" which was proposed in an Internet Draft published in 1996 [10]. The second solution is "Anycast Address Mapper". Both solutions were implemented in the paper cited in [10]. Anycast Resolving Layer (ARL) [12] (Figure2) is a new IETF draft that uses a sub layer to resolve the anycast address issue.

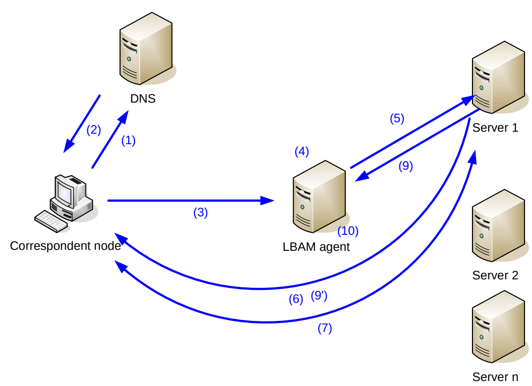


[Figure 2] Protocol Stack of AARP

We can go to Practical Anycasting.com [13] to get more information on recent anycast work. People discuss how to implement and deploy anycast service in the real world on this website. Users can post mail in the maillist to encourage interested parties to join an anycast work group involved in deploying anycast service. It was said the "Currently, IPv6 Anycast is used only in limited areas for limited purposes. It is a pity that IPv6 Anycast is not widely used. This situation should be changed". [14]

2.5 LBAM

The development of a whole new API for anycast is needed. Figure3 has a similar idea for using pseudo mobile IP for anycast, but this is not enough. We can do something more, late. The drawback of LBAM (Pseudo Anycast) is "it can't work with RFC3775."



[Figure 3] The process for LBAM

3. Pseudo MIPv6 for Anycast and Fault Tolerant Services

3.1 Trigger signal

Because we use the MIPv6 function in our solution, so we can ask the client reconnect to another server – IP layer Hot Swap. For the trigger signal, we try to use the natural signal in MIPv6 to re-initial the connection.[19]

MobileIPv6 don't provide reconnection signal for load balance naturally. However, we find two messages can be the trigger signal for our idea. The first one is icmpv6 destination unreachable message. The second one is sent to the binding message to pretend the MN return home. If you can't find it, try to search the error condition in RFC, I have said "MobileIPv6 don't provide reconnection signal for load balance