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Problem Statement and Requirement of Simple IP Multi-homing of the Host
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Abstract

This document discusses current issues with simple IP multi-homing. In order to have deep understanding of the issue, the document also analyzes related works in IETF. In the end gives the requirements of the simple IP multi-homing in concern of technical implements. Simple IP multi-homing focuses on simultaneous multiple IP connections of the host.

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1. Introduction

Simple IP Multi-homing means the host connects to more than one physical network through different network interfaces, and assigns different network flows to each interface, and ensure all the interfaces can deliver the flow simultaneously.

Simple IP Multi-homing is a necessary part of daily life, i.e., you have to connect to your company office network through VPN connection by your Ethernet interface, at the same time you want to watch the stock market, which is not allowed through office network. And you have a GPRS card, so you would like to use ethernet and GPRS at the same time.

Current the operating systems only allow one default network connection. If there are multiple connections of the host, all the flows will go to the default gateway based on RFC1122 description. One default gateway guarantees the host always has one entry to the network, but lead to the multiple connections be difficult. The most convenient way to make the host work under several networks at the same time is to add specific static route in the host route table, so that certain flow can use the assigned interface while others use the default one, but it is not easy for the ordinary users to handle it.

2. Problem statements of Simple IP Multi-homing

As description above, simple IP multi-homing can not work based on the current specification. There are several reasons cause it invalid, and this section analyzes them in detail.

2.1. Default Gateway

The Windows operating system in the host follows the default gateway mechanism, which will choose the unify gateway among more than one default routes ('0.0.0.0'), the detail is described in RFC1122. The default gateway guarantees there always has a route to network when the host can not find a specific route for a datagram in the route table.

But when it comes to multi-homing, the default gateway also causes all the flows go out through one interface, although there has more than one network connections. Nowadays there are diverse networks can be chosen by the user, and the terminal have the capability and interfaces to connect to more than one networks at the same time. It is possible and necessary for the user to require connecting to different networks to ensure the best user experiences of different services, but the default gateway mechanism only allows one connection at once. Although you can connect your host to several networks physically, and each network has already assigned a IP address for your host interface, even you can see different default routes in the route table, all the flow goes to the default gateway chosen by the operation system other than different gateways actually.

2.2. Merging of parameters

In multiple interfaces host, each interface will get its own IP parameters in the procedure of IP address allocation all other policy deployment, such as DNS, metrics of routings, TOS. How to merge the same type of parameters derived form multiple interfaces to act harmoniously in the host is the problem presented in multiple interfaces host.

2.2.1. DNS consideration

DNS will be configured to the interface manually or by DHCP procedure, and multiple interfaces will obtain multiple DNS. The host will reserve several DNS in this situation. Referring to different domain names the host should query proper DNS so that the domain names can be resolved. The problem is current DNS selection mechanism is lack

to choose a right one for specific visited domain name, so that we need to merge multiple DNS to provide the host with the best connectivity.

2.2.2. Metrics consideration

Metrics are used to measure the performance of routings, the lower metric it owns, the higher priority it has. For example, the default gateway is chosen based on the metric rule as RFC1122 description, The one have the lowest metric value becomes to the default gateway among several connected gateways, and the interface correspond to this gateway turns to be the default interface.

Metric rules are different depending on the access technology and routing protocol, if the multiple interfaces connect to multiple access networks which have different measurements of metrics, the metric will not reflect the routing performances correctly. For example, current metric rules define the 100M bps Ethernet network card to be 20 and 10M bps to be 30, but the CDMA data card set its metric value as 1, although its speed is lower than 100M bps Ethernet network card. The merging of metrics is necessary in multiple interfaces condition.

2.2.3. TOS consideration

TOS can be a parameter of routing item to indicate which kind of IP data is suitable to deliver by this routing. The multiple interfaces will connect to multiple access networks, so that the preference of TOS need to be merged to have a better performance of data delivery. For example, the WiFi access could indicate itself has broader bandwidth comparing with 2G access, and set the TOS as broad bandwidth. When another interface connects the Ethernet, the TOS is also set as broad bandwidth preferred. In this situation, it needs some mechanism to merge and reorder the TOS getting form multiple interfaces.

2.3. Source address selection for IPv4

For the host has more than one IP addresses which are obtained by multiple interfaces, the source address selection is the key issue in order to use multiple interfaces reasonably. The application needs to select right source address so that the data will be delivered by the corresponding interface. This mechanism is lack currently which needs to be solved in multiple interfaces situation.

3. Analysis of Related Work in IETF

Multi-homing is a wide topic contains different aspects, and there are some work groups in IETF worked on a certain aspect of multi-homing.

This section explains their work, and compares the covered field with the simple IP multi-homing. In the end we will find the simple IP multi-homing is still a problem which is not solved yet.

3.1. Multi6

Multi6 WG in IETF focuses on the multi-homed site, which has more than one connection to the public internet with those connections through either the same or different ISPs. The reasons to choose site multi-homing are to improve fault tolerance, perform load balancing, etc.

The Multi6 WG mainly focuses on site multi-homing solutions that tend to minimize adverse impacts on the end-to-end routing system and limit the number of prefixes that need to be advertised in the Default-Free Zone (DFZ). The background is site multi-homing today is done largely by having a site obtain a dedicated block of address space and then advertising a route for its prefix through each of its ISP connections. A site's ISPs in turn advertise the prefix to some or all of their upstream connections and the route for the prefix may propagate to all of the routers connected to the default-free zone. As the number of sites multi-homing in this manner increase, the number of routes propagated throughout the DFZ increases and overall routing stability decreases because of the burden on convergence time.

Multi6 WG tries to solve this by defining a set of goals for IPv6 site multi-homing architecture, and analyzing the current limitations and the approaches to the site multi-homing. What's need to notice is that the working group is not chartered to make significant changes to the nature of IP addresses or to inter-domain routing. Obviously, the site multi-homing does not consider the host multiple connection which is the key problem of this document.

3.2. Shim6

Shim6 is another WG in IETF aims at site multi-homing. Shim6 work is based on the architecture developed by the Multi6 WG, and completes the required protocol developments and the architecture and security analysis of the required protocols. Different form Multi6, Shim6

focuses on surviving hosts on the multi-homing site from the changes or for creating new associations, when one or more of the site's address prefixes becomes unreachable.

Shim6 WG produces specifications for an IPv6-based site multi-homing solution that inserts a new sub-layer (shim) into the IP stack of end-system hosts. It enables hosts on multi-homed sites to use a set of provider-assigned IP address prefixes and switch between them without upsetting transport protocols or applications. But it can not support connecting to all the ISPs simultaneously.

3.3. Monami6

The objective of the Monami6 WG is to produce a clear problem statement and to produce standard track specifications to the straight-forward problems associated with the simultaneous use of multiple addresses for either mobile hosts using Mobile IPv6 or mobile routers using NEMO Basic Support and their variants (FMIPv6, HMIPv6,etc).

The WG does not define a tunnel selection mechanism, but document how to use existing mechanisms based upon preferences or policies. They explain the limitations for mobile hosts using multiple simultaneous Care-of Addresses and Home Agent addresses using Mobile IPv6, whether issues are specific to Mobile IPv6 or not. They also deliver a protocol extension to Mobile IPv6 (RFC 3775) and NEMO Basic Support (RFC 3963) to support the registration of multiple Care-of Addresses at a given Home Agent address [Standard Track]. What's more, Monami6 WG makes a "Flow/binding policies exchange" solution for an exchange of policies from the mobile host/router to the Home Agent and from the Home Agent to the mobile host/router influencing the choice of the Care-of Address and Home Agent address.

Monami6 focus the same field with simple IP multi-homing, which is ensuring simultaneous use of multiple addresses for the host. The difference is Monami6 puts this aim to under a certain condition, the mobile host using MIP6, while the simple IP multi-homing focuses on ordinary host using IPv4/6.

3.4. Netlmm

Netlmm WG studies Proxy Mobile IPv6 (PMIPv6) which supports multiple interfaces binding, by maintaining multiple binding cache entries for a given MN. The scenario concerned by PMIPv6 is each interfaces gets different prefix form others, however, there are many other scenarios associated with multiple interface attachment are not covered. The specific scenario needs specific solutions which require some

enhancement/modification to the current PMIPv6 protocol, and the simple IP multi-homing hasn't supported in the PMIPv6 environment as well.

What's more, the multi-homing in PMIPv6 lacks flow filtering support. The LMA must has filter rules to allocate certain flow to traverse via a certain care-of address, but the mechanism in PMIPv6 is currently not supported.

4. Requirements for Simple IP Multi-homing

Based on problem statements and related work analysis, the requirements for simple IP multi-homing is concluded and listed as follows:

1) The host with multiple network interfaces should be capable to connect with different networks simultaneously.

2) The default gateway mechanism needs to be improved to support several gateways working at the same time.

3) New metric mechanism must be defined to adapt to various network cards nowadays.

4) The policies to assign different flows to the appropriate interface are required, and how to apply the policies to the host need to be considered as well.

5 Network side should be capable of distributing the IP flow according to some parameters, such as IP address prefix, network type and so on.

5. Security Considerations

This document doesn't propose any new protocol.

6. IANA Considerations

This document doesn't require any new number from IANA.

7. References

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