

Simple IP Multi-homing of the Host

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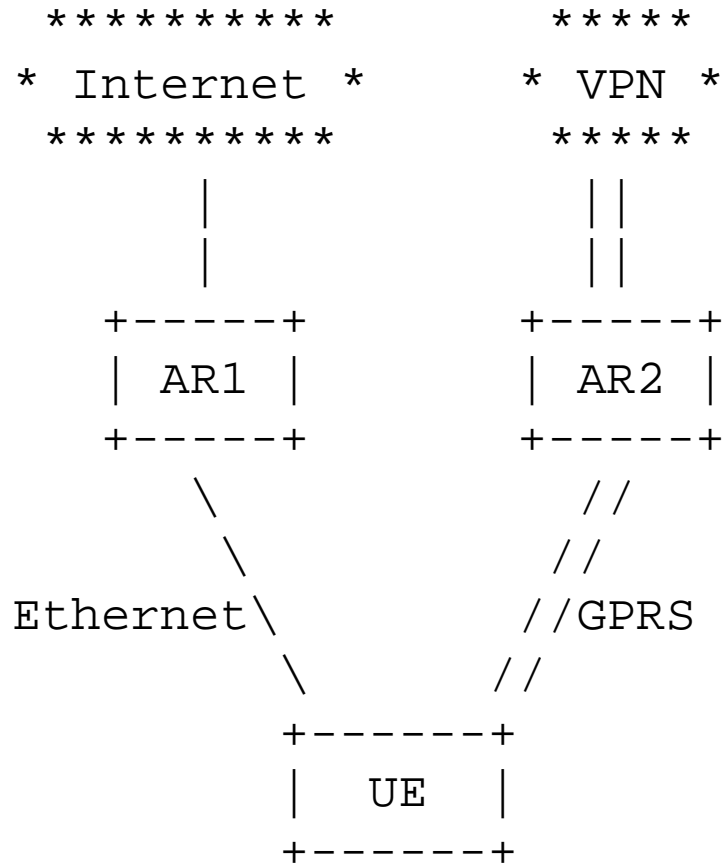
Agenda

- Introduction and Scenarios
- Problem Statements
- Solution
 - Routing policy
 - DHCP extension
 - Configuration procedure

Introduction

- Simple IP Multi-homing means the host connects to more than one physical network through different network interfaces simultaneously.
- Simple IP multi-homing is necessary in nowadays, for there are various access networks and UE is equipped with several interfaces.
- The problem is current TCP/IP model only allows one default network connection at once.
- This document illustrates the specific scenario and gives a probable solution by extending DHCP.

Scenario



Problem Statements – 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 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.
- 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.

Problem Statements – Metric Rules

- The default gateway is chosen based on the metric rule. The one have the lowest metric value becomes to the default gateway among several connected gateways.
- Current metric rules define the 100M bps Ethernet network card to be 20 and 10M bps to be 30. But it is not a strict definition, and the user can change the metric value manually.
- The problem is not every network card follow the metric rules, so the operating system cannot always choose the best performance route as the default one for the IP flow. This will cause the default gateway guarantee mechanism meaningless.

Problem Statements – Weak and Strong Host Model

- There exists two different host model today, which are weak host model and strong host model, described in RFC 1122.
- The weak host model treats the destination and the source as a host rather than an interface, so the default gateway mechanism chooses only one connection as the default one.
- The strong host model divides the host to several separated hosts logically, what means the flow can only use the specific interface.
- Current host operating systems such as Windows 2000/XP all apply weak host model on its network interface, so the host can not differ the flow to different interfaces for multi-homing usage.

Source address selection (IPv4) - RFC1122

- the transport layer on a multi-homed host needs to know which source address to use
- If the application does not specify it, the transport layer must ask the IP layer to perform the conceptual mapping:
 - GET_SRCADDR(remote IP addr, TOS) -> local IP address
- rules for implementing this mapping
 - If the remote Internet address lies on one of the (sub-) nets to which the host is directly connected, a corresponding source address may be chosen
 - The route cache may be consulted, to see if there is an active route to the specified destination network through any network interface
 - The table of static routes, if any may be similarly consulted
 - The default gateways may be consulted. If these gateways are assigned to different interfaces, the interface corresponding to the gateway with the highest preference may be chosen.

Source Address Selection (IPv6) - RFC3484

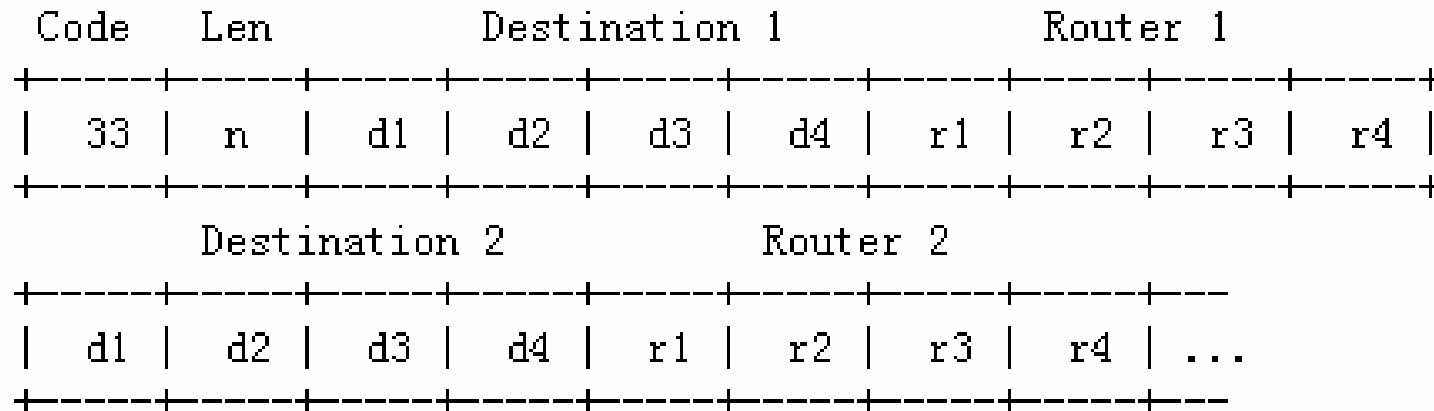
- two addresses SA and SB from the candidate set , a given destination address D
 - Rule 1: Prefer same address.
 - If $SA = D$, then prefer SA. Similarly, if $SB = D$, then prefer SB.
 - Rule 2: Prefer appropriate scope.
 - If $Scope(SA) < Scope(SB)$: If $Scope(SA) < Scope(D)$, then prefer SB, and otherwise prefer SA.
 - Rule 3: Avoid deprecated addresses.
 - The addresses SA and SB have the same scope. If one of the two source addresses is "preferred" and one of them is "deprecated" (in the RFC 2462 sense), then prefer the one that is "preferred."
 - Rule 4: Prefer home addresses.
 - If SA is simultaneously a home address and care-of address and SB is not, then prefer SA.
 - If SA is just a home address and SB is just a care-of address, then prefer SA.
 - Rule 5: Prefer outgoing interface.
 - If SA is assigned to the interface that will be used to send to D and SB is assigned to a different interface, then prefer SA.
 - Rule 6: Prefer matching label.
 - If $Label(SA) = Label(D)$ and $Label(SB) \neq Label(D)$, then prefer SA.
 - Rule 7: Prefer public addresses.
 - If SA is a public address and SB is a temporary address, then prefer SA.
 - Rule 8: Use longest matching prefix.
 - If $CommonPrefixLen(SA, D) > CommonPrefixLen(SB, D)$, then prefer SA.

Solution – Routing policy

- The routing policy can be applied in the host so that different IP flows can go to different interfaces depending on the policies.
- To maintain a simple host routing table, the policy can be allocated by the network side, i.e. the gateway.
- The policy is distributed to the host as soon as it attaches to the gateway, and the policy will be applied in the initial procedure of the host.
- The routing policy information should contain the proper interface allocation according to IP destination and service type.

RFC 2132 – DHCP static router option

- This option specifies a list of static routes that the client should install in its routing cache. If multiple routes to the same destination are specified, they are listed in descending order of priority.
- The routes consist of a list of IP address pairs. The first address is the destination address, and the second address is the router for the destination.
- The default route (0.0.0.0) is an illegal destination for a static route. See section 3.5 for information about the router option.
- The code for this option is 33. The minimum length of this option is 8, and the length MUST be a multiple of 8.



Solution – DHCP extension

- DHCP is a proper message to carry the host routing policy information. For doing this, DHCP should make an extension in the option field.

Code	Len	Destination 1	Mask 1
x	n	d1 d2 d3 d4	m1
TOS1 Router1			
m2	m3	m4	t1 r1 r2 r3
Destination 2		Mask2	
r4	d1	d2 d3	m1 m2 m3
TOS2 Router2			
m4	t2	t1 t2 t3 t4	...

Solution – DHCP extension

- Code is a number represents the specific DHCP option, which needs to be assigned by IANA.
- Len represents the length of the option form the byte after the Len field.
- Destination is the Destination IP address of the datagram, occupying 4 byte. Mask field represents the subnet mask of the destination.
- TOS follows the definition in RFC1349, and it represents the requirement of specific IP flow, such as bandwidth and delay.
- Router is the IP address of the network gateway. Either the router interface address or the corresponding host interface address is suitable.

Solution – Configuration procedure

1. When host requires IP configuration as soon as it first attaches the network, DHCP server will send the routing policy together with the IP configuration to the host.
2. Then the routing policy carried on the DHCP message is obtained by the host, and applied as the static routing entries in the host routing table.
3. The host operating system will select the source address (RFC1122, RFC3484) for a datagram by looking up the host routing table.
 - If it finds an available routing for specific destination, the host interface of this routing entry will be used to send out this datagram.
 - The IP address of this interface is selected to be the source address of the datagram.
 - So that the static routing entry formed according to DHCP routing policy can constrain specific IP flow to certain interface, and different IP flows can use multiple connections properly and simultaneously.

1. Accepted as a Work item?