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Happy Eyeballs Extension for Multiple Interfaces
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Abstract

The memo has been proposed to extend happy eyeballs algorithm to fit into multiple interfaces environment. Based on this extended heuristic algorithm, a client with multiple interface could determine the optimal flow path in which specific interface has been chosen. Furthermore, an appropriate IP address family for each interface can be also identified to guarantee user experiences during IPv6 transition period.

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1. Introduction

In multiple interface context, the problems raised by hosts with multiple interfaces have been discussed. The MIF problem statement[MIF-PS] has described the various issues when using a MIF node on which multiple interfaces are used and results in wrong domain selection. Happy Eyeballs [HAPPY-EYEBALLS] has described how a dual-stack client can determine the functioning path to a dual-stack server. It's using heuristic algorithm help applications to quickly determine if IPv6 or IPv4 is the most optimal to connect to a server. That is a good practice to achieve intelligent path selection. However, the assumption here is single-homed host. The interaction with multiple interfaces is still waiting for further study.

This memo has been proposed to extend happy eyeballs algorithm to fit into multiple interfaces environment. That could achieve win-win situation. Based on this extended heuristic algorithm, a client with multiple interface could determine the optimal flow path in which specific interface has been chosen. Furthermore, an appropriate IP address family for each interface can be also identified to guarantee user experiences during IPv6 transition period.

2. Heuristic Happy Eyeballs Extension Algorithm

The section details extended Happy Eyeballs algorithm, including new defined data structure, functionalities and example flow.

2.1. The Framework for Extended Algorithm

The Figure 1 shows the proposed framework for extended algorithm.

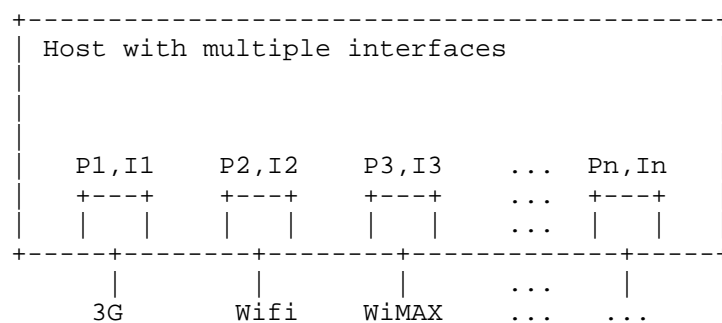


Figure 1: Multiple Interface Mode for Extended Algorithm

Each interface will be configured with weighting coefficient, which is composed of pair values. Apart from value P, which is following current definition in [HAPPY-EYEBALLS], value I is defined to indicate preference of interfaces selection. In general, value I is responsible for interface selection; value P is a indication to identify IPv4 or IPv6 family has been preferred.

2.2. Algorithm for Interface Selection

According to the definition, applications will take account of value I to identify which interface has been chosen before sending out data packages .

Each interface is configured with one value, I. I is served as an indication to identify which interface is preferred for a specific destination or hostname. A positive value indicates preference of specific interface compared to others. The value is justified according to TCP establishment duration. The detailed flow can be found in 2.4. The rule here is that shorter is winner. When one interface defeats others, the corresponding value I will be set to positive value. Other interfaces will be set negative value orderly according to caused time for TCP connection, like -1, -2, etc. A value of 0 indicates equal weight for multiple interfaces. In this case, the heuristic connection is not valid for interface selection.

After several interface values I have been configured, the traffic flow targeted to specific destination address or hostname will follow this guidance to choose proper interface. When connection problems are occurred to preferred connection, the value I need to be adjusted. The adjustment of value I will do polling-based scheme. the value I corresponding to suboptimal interface will be configured as positive. And previously optimal value I will be set to most-negative.

2.3. IPv4/IPv6 Selection Algorithm for Individual Interface

for a specific interface, the choice of IP address family relies on Happy Eyeballs algorithm, which defined in [HAPPY-EYEBALLS].

2.4. Example of Extended Algorithm

The Figure 2 shows example flow for algorithm implemetation, in which a host with three interfaces is demonstrated. It's easy to apply that to more interfaces situation.

	DNS Server	Client	Server
1.	<---www.example.com DNS query ---1		
2.	<---www.example.com DNS query ---2		
3.	<---www.example.com DNS query ---3		
4.	---DNS response, IP address---->1		
5.	---DNS response, IP address---->2		
6.	---DNS response, IP address---->3		
7.		1==TCP SYN, IP ==>	
8.		2==TCP SYN, IP ==>	
9.		3==TCP SYN, IP ==>	
10.		1 <=TCP SYN+ACK, IP==	
11.		2 <=TCP SYN+ACK, IP==	
12.		3 <=TCP SYN+ACK, IP==	
13.		1==TCP ACK, IP ==>	
14.		2==TCP ACK, IP ==>	
15.		3==TCP ACK, IP ==>	
16.		2--TCP RST, IP----->	
17.		3--TCP RST, IP----->	

Figure 2: Example of Algorithm Execution

Above example of algorithm execution emphasizes on the computation of coefficient value I. The value P will be calculated as defined in [HAPPY-EYEBALLS].

When client initiates application session, multiple interfaces will do DNS query simultaneously. As a results, DNS server will return IP address related to requested FQDN, as shown from step 1 to 6. Afterwards, three interfaces are trying to establish TCP connection with remote peer IP address synchronously as shown from step 7 to 15. In this example, interface 1 competes with another two and firstly finish TCP connection. So value I will be set to 1. And second one is set to -1; thelast one is set to -2. The interface 2 and 3 will then send RST to remote IP peer for release TCP sessions.

Through the whole process, interface 1 will be set to most-preferred interface for a specific this particular destination or hostname. if there is an accidental connection problem has occurred, the value I with interface 1 will be set to -2. And the values I related to interface 2 and 3 will increase sequentially to be set to 1 and -1. Subsequent traffic will take interface 2 as preferred interface for traffic delivery.

3. Additional Considerations

3.1. Usage Scope

Happy Eyeballs is trageting to HTTP context, but it is useful and applicable to other time-sensitive applications.

3.2. Flow Continuity

Usually, interface changing is happened at beginning of new session. So, there is no flow continuity issues for ongoing TCP session.

4. IANA Considerations

This memo includes no request to IANA.

5. Security Considerations

TBD

6. Normative References

[HAPPY-EYEBALLS]

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