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Requirements for Address Selection Mechanisms

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Abstract

There are some problematic cases when using the default address selection mechanism that RFC 3484 defines. This document describes additional requirements that operate with RFC 3484 to solve the problems.

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1. Introduction

Today, the RFC 3484 [RFC3484] mechanism is widely implemented in major OSs. However, in many sites, the default address-selection rules are not appropriate, and cause a communication failure. The problem statement (PS) document [RFC5220] lists problematic cases that resulted from incorrect address selection.

Though RFC 3484 made the address-selection behavior of a host configurable, typical users cannot make use of that because of the complexity of the mechanism and lack of knowledge about their network topologies. Therefore, an address-selection autoconfiguration mechanism is necessary, especially for unmanaged hosts of typical users.

This document contains requirements for address-selection mechanisms that enable hosts to perform appropriate address selection automatically.

2. Requirements of Address Selection

Address-selection mechanisms have to fulfill the following eleven requirements.

2.1. Effectiveness

The mechanism can modify RFC 3484 default address-selection behavior at nodes. As documented in the PS [RFC5220], the default rules defined in RFC 3484 do not work properly in some environments. Therefore, the mechanism has to be able to modify the address-selection behavior of a host and to solve the problematic cases described in the PS document.

2.2. Timing

Nodes can perform appropriate address selection when they select addresses.

If nodes need to have address-selection information to perform appropriate address selection, then the mechanism has to provide a function for nodes to obtain the necessary information beforehand.

The mechanism should not degrade usability. The mechanism should not enforce long address-selection processing time upon users. Therefore, forcing every consumer user to manipulate the address-selection policy table is usually not an acceptable solution. So, in this case, some kind of autoconfiguration mechanism is desirable.

2.3. Dynamic Behavior Update

The address-selection behavior of nodes can be dynamically updated. When the network structure changes and the address-selection behavior has to be changed accordingly, a network administrator can modify the address-selection behavior of nodes.

2.4. Node-Specific Behavior

The mechanism can support node-specific address-selection behavior. Even when multiple nodes are on the same subnet, the mechanism should be able to provide a method for the network administrator to make nodes behave differently. For example, each node may have a different set of assigned prefixes. In such a case, the appropriate address-selection behavior may be different.

2.5. Application-Specific Behavior

The mechanism can support application-specific address-selection behavior or combined use with an application-specific address-selection mechanism such as address-selection APIs.

2.6. Multiple Interface

The mechanism can support those nodes equipped with multiple interfaces. The mechanism has to assume that nodes have multiple interfaces and makes address selection of those nodes work appropriately.

2.7. Central Control

The address-selection behavior of nodes can be centrally controlled. A site administrator or a service provider could determine or could have an effect on the address-selection behavior at their users' hosts.

2.8. Next-Hop Selection

The mechanism can control next-hop-selection behavior at hosts or cooperate with other routing mechanisms, such as routing protocols and RFC 4191 [RFC4191]. If the address-selection mechanism is used with a routing mechanism, the two mechanisms have to be able to work synchronously.

2.9. Compatibility with RFC 3493

The mechanism can allow an application that uses the basic socket interface defined in RFC 3493 [RFC3493] to work correctly. That is, with the basic socket interface the application can select appropriate source and destination addresses and can communicate with the destination host. This requirement does not necessarily mean that OS protocol stack and socket libraries should not be changed.

2.10. Compatibility and Interoperability with RFC 3484

The mechanism is compatible with RFC 3484. Now that RFC 3484 is widely implemented, it is preferable that a new address selection mechanism does not conflict with the address selection mechanisms defined in RFC 3484.

If the solution mechanism changes or replaces the address-selection mechanism defined in RFC 3484, interoperability has to be retained. That is, a host with the new solution mechanism and a host with the mechanism of RFC 3484 have to be interoperable.

2.11. Security

The mechanism works without any security problems. Possible security threats are described in the Security Considerations section of this document.

3. Security Considerations

3.1. List of Threats Introduced by New Address-Selection Mechanism

There will be some security incidents when combining the requirements described in Section 2 into a protocol. In particular, there are 3 types of threats: leakage, hijacking, and denial of service.

1. Leakage: Malicious nodes may tap to collect the network policy information and leak it to unauthorized parties.

2. Hijacking: Nodes may be hijacked by malicious injection of illegitimate policy information. RFC 3484 defines both a source and destination selection algorithm. An attacker able to inject malicious policy information could redirect packets sent by a victim node to an intentionally chosen server that would scan the victim node activities to find vulnerable code. Once vulnerable code is found, the attacker can take control of the victim node.

3. Denial of Service: This is an attack on the ability of nodes to communicate in the absence of the address-selection policy. An attacker could launch a flooding attack on the controller to prevent it from delivering the address selection policy information to nodes, thus preventing those nodes from appropriately communicating.

3.2. List of Recommendations in Which Security Mechanism Should Be Applied

The address selection mechanism should be afforded security services listed below. It is preferable that these security services are afforded via use of existing protocols (e.g., IPsec).

1. Integrity of the network policy information itself and the messages exchanged in the protocol. This is a countermeasure against leakage, hijacking, and denial of service.

2. Authentication and authorization of parties involved in the protocol. This is a countermeasure against Leakage and Hijacking.

4. Normative References

[RFC3484] Draves, R., "Default Address Selection for Internet Protocol version 6 (IPv6)", RFC 3484, February 2003.

[RFC3493] Gilligan, R., Thomson, S., Bound, J., McCann, J., and W. Stevens, "Basic Socket Interface Extensions for IPv6", RFC 3493, February 2003.

[RFC4191] Draves, R. and D. Thaler, "Default Router Preferences and More-Specific Routes", RFC 4191, November 2005.

[RFC5220] Matsumoto, A., Fujisaki, T., Hiromi, R., and K. Kanayama, "Problem Statement for Default Address Selection in Multi-Prefix Environments: Operational Issues of RFC 3484 Default Rules", RFC 5220, July 2008.

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