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Scenic Routing for IPv6

Abstract

This document specifies a new routing scheme for the current version of the Internet Protocol version 6 (IPv6) in the spirit of "Green IT", whereby packets will be routed to get as much fresh-air time as possible.

Status of This Memo

This document is not an Internet Standards Track specification; it is published for informational purposes.

This is a contribution to the RFC Series, independently of any other RFC stream. The RFC Editor has chosen to publish this document at its discretion and makes no statement about its value for implementation or deployment. Documents approved for publication by the RFC Editor are not a candidate for any level of Internet Standard; see Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc7511.

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1. Introduction

In times of Green IT, a lot of effort is put into reducing the energy consumption of routers, switches, servers, hosts, etc., to preserve our environment. This document looks at Green IT from a different angle and focuses on network packets being routed and switched around the world.

Most likely, no one ever thought about the millions of packets being disassembled into bits every second and forced through copper wires or being shot through dark fiber lines by powerful lasers at continuously increasing speeds. Although RFC 5841 [RFC5841] provided some thoughts about Packet Moods and began to represent them as a TCP option, this doesn't help the packets escape their torturous routine.

This document defines another way to deal with Green IT for traffic and network engineers and will hopefully aid the wellbeing of a myriad of network packets around the world. It proposes Scenic Routing, which incorporates the green-ness of a network path into the routing decision. A routing engine implementing Scenic Routing should therefore choose paths based on Avian IP Carriers [RFC1149] and/or wireless technologies so the packets will get out of the miles/kilometers of dark fibers that are in the ground and get as much fresh-air time and sunlight as possible.

As of the widely known acceptance of the current version of the Internet Protocol (IPv6), this document only focuses on version 6 and ignores communication still based on Vintage IP [RFC791].

1.1. Conventions and Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Additionally, the key words "MIGHT", "COULD", "MAY WISH TO", "WOULD PROBABLY", "SHOULD CONSIDER", and "MUST (BUT WE KNOW YOU WON'T)" in this document are to interpreted as described in RFC 6919 [RFC6919].

2. Scenic Routing

Scenic Routing can be enabled with a new option for IPv6 datagrams.

2.1. Scenic Routing Option (SRO)

The Scenic Routing Option (SRO) is placed in the IPv6 Hop-by-Hop Options Header that must be examined by every node along a packet's delivery path [RFC2460].

The SRO can be included in any IPv6 datagram, but multiple SROs MUST NOT be present in the same IPv6 datagram. The SRO has no alignment requirement.

If the SRO is set for a packet, every node en route from the packet source to the packet's final destination MUST preserve the option.

The following Hop-by-Hop Option is proposed according to the specification in Section 4.2 of RFC 2460 [RFC2460].

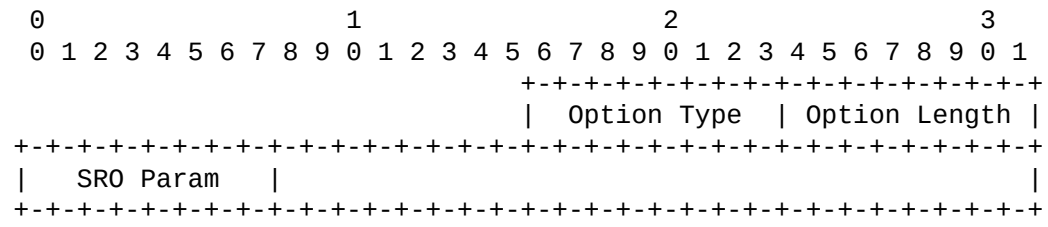

Figure 1: Scenic Routing Option Layout

Option Type

8-bit identifier of the type of option. The option identifier 0x0A (On Air) is proposed for Scenic Routing.

HEX	act	chg	rest	
0A	00	0	01010	Scenic Routing

Figure 2: Scenic Routing Option Type

The highest-order two bits are set to 00 so any node not implementing Scenic Routing will skip over this option and continue processing the header. The third-highest-order bit indicates that the SRO does not change en route to the packet's final destination.

Option Length

8-bit unsigned integer. The length of the option in octets (excluding the Option Type and Option Length fields). The value MUST be greater than 0.

SRO Param

8-bit identifier indicating Scenic Routing parameters encoded as a bit string.

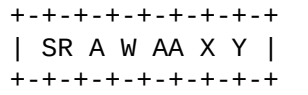

Figure 3: SRO Param Bit String Layout

The highest-order two bits (SR) define the urgency of Scenic Routing:

00 - Scenic Routing MUST NOT be used for this packet.

01 - Scenic Routing MIGHT be used for this packet.

10 - Scenic Routing SHOULD be used for this packet.

11 - Scenic Routing MUST be used for this packet.

The following BIT (A) defines if Avian IP Carriers should be used:

0 - Don't use Avian IP Carrier links (maybe the packet is afraid of pigeons).

1 - Avian IP Carrier links may be used.

The following BIT (W) defines if wireless links should be used:

0 - Don't use wireless links (maybe the packet is afraid of radiation).

1 - Wireless links may be used.

The following two bits (AA) define the affinity for link types:

00 - No affinity.

01 - Avian IP Carriers SHOULD be preferred.

10 - Wireless links SHOULD be preferred.

11 - RESERVED

The lowest-order two bits (XY) are currently unused and reserved for future use.

3. Implications

3.1. Routing Implications

If Scenic Routing is requested for a packet, the path with the known longest Avian IP Carrier and/or wireless portion MUST be used.

Backbone operators who desire to be fully compliant with Scenic Routing MAY WISH TO -- well, they SHOULD -- have separate MPLS paths ready that provide the most fresh-air time for a given path and are to be used when Scenic Routing is requested by a packet. If such a path exists, the path MUST be used in favor of any other path, even if another path is considered cheaper according to the path costs used regularly, without taking Scenic Routing into account.

3.2. Implications for Hosts

Host systems implementing this option of receiving packets with Scenic Routing requested MUST honor this request and MUST activate Scenic Routing for any packets sent back to the originating host for the current connection.

If Scenic Routing is requested for connections of local origin, the host MUST obey the request and route the packet(s) over a wireless link or use Avian IP Carriers (if available and as requested within the SRO Params).

System administrators MIGHT want to configure sensible default parameters for Scenic Routing, when Scenic Routing has been widely adopted by operating systems. System administrators SHOULD deploy Scenic Routing information where applicable.

3.3. Proxy Servers

If a host is running a proxy server or any other packet-relaying application, an application implementing Scenic Routing MUST set the same SRO Params on the outgoing packet as seen on the incoming packet.

Developers SHOULD CONSIDER Scenic Routing when designing and implementing any network service.

4. Security Considerations

The security considerations of RFC 6214 [RFC6214] apply for links provided by Avian IP Carriers.

General security considerations of wireless communication apply for links using wireless technologies.

As the user is able to influence where flows and packets are being routed within the network, this MIGHT influence traffic-engineering considerations and network operators MAY WISH TO take this into account before enabling Scenic Routing on their devices.

5. IANA Considerations

This document defines a new IPv6 Hop-by-Hop Option, the Scenic Routing Option, described in Section 2.1. If this work is standardized, IANA is requested to assign a value from the "Destination Options and Hop-by-Hop Options" registry for the purpose of Scenic Routing.

There are no IANA actions requested at this time.

6. Related Work

As Scenic Routing is heavily dependent on network paths and routing information, it might be worth looking at designing extensions for popular routing protocols like BGP or OSPF to leverage the full potential of Scenic Routing in large networks built upon lots of wireless links and/or Avian IP Carriers. When incorporating information about links compatible with Scenic Routing, the routing algorithms could easily calculate the optimal paths providing the most fresh-air time for a packet for any given destination.

This would even allow preference for wireless paths going alongside popular or culturally important places. This way, the packets don't only avoid the dark fibers, but they get to see the world outside of the Internet and are exposed to different cultures around the globe, which may help build an understanding of cultural differences and promote acceptance of these differences.

7. References

7.1. Normative References

[RFC1149] Waitzman, D., "Standard for the transmission of IP datagrams on avian carriers", RFC 1149, April 1990, <http://www.rfc-editor.org/info/rfc1149>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[RFC2460] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", RFC 2460, December 1998, <http://www.rfc-editor.org/info/rfc2460>.

[RFC6214] Carpenter, B. and R. Hinden, "Adaptation of RFC 1149 for IPv6", RFC 6214, April 2011, <http://www.rfc-editor.org/info/rfc6214>.

[RFC6919] Barnes, R., Kent, S., and E. Rescorla, "Further Key Words for Use in RFCs to Indicate Requirement Levels", RFC 6919, April 2013, <http://www.rfc-editor.org/info/rfc6919>.

7.2. Informative References

[RFC5841] Hay, R. and W. Turkal, "TCP Option to Denote Packet Mood", RFC 5841, April 2010, <http://www.rfc-editor.org/info/rfc5841>.

[RFC791] Postel, J., "Internet Protocol", STD 5, RFC 791, September 1981, <http://www.rfc-editor.org/info/rfc791>.

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