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R. Bonica  
Juniper Networks  
C. Lenart  
Verizon  
G. Presbury  
Hughes Network Systems  
G. Chen  
Baidu  
Y. Zhu  
China Telecom  
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**The IPv6 Virtual Private Network (VPN) Context Information Option  
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Abstract

This document defines a new IPv6 Destination Option that can be used to encode Virtual Private Network (VPN) context information. It is applicable when VPN payload is transported over IPv6.

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## [1.](#) Introduction

Virtual Private Network (VPN) technologies allow network providers to emulate private networks with shared infrastructure. For example, assume that a red sites and blue sites connect to a provider network. The provider network facilitates communication among red sites and facilitates communication among blue sites. However, it prevents communication between red sites and blue sites.

The IETF has standardized many VPN technologies, including:

- o Layer 2 VPN (L2VPN) [[RFC6624](#)].
- o Layer 3 VPN (L3VPN) [[RFC4364](#)].
- o Virtual Private LAN Service (VPLS) [[RFC4761](#)][[RFC4762](#)].
- o Ethernet VPN (EVPN) [[RFC7432](#)].
- o Pseudowires [[RFC8077](#)].

The above-mentioned technologies include the following components:

- o Customer Edge (CE) devices.
- o Provider Edge (PE) devices.
- o Routing Instances.



- o VPN context information.
- o Transport tunnels.

CE devices participate in closed communities called VPNs. CEs that participate in one VPN can communicate with one another but cannot communicate with CEs that participate in another VPN.

CE devices connect to provider networks through PE devices. Each PE maintains one Routing Instance for each VPN that it supports. A Routing Instance is a VPN specific Forwarding Information Base (FIB). In EVPN, Routing Instances are called Ethernet Virtual Instances (EVI).

Assume that one CE sends a packet through a provider network to another CE. The packet enters the provider network through an ingress PE and leaves the provider network through an egress PE. The packet may traverse one or more intermediate nodes on route from PE to PE.

When the ingress PE receives the packet, it:

- o Identifies the Routing Instance that supports the originating CE's VPN.
- o Searches that Routing Instance for the packet's destination.

If the search fails, the ingress PE discards the packet. If the search succeeds, it yields the following:

- o VPN context information.
- o The egress PE's IP address.

The ingress PE prepends VPN context information and a transport header to the packet, in that order. It then forwards the packet through a transport tunnel to the egress PE.

The egress PE removes the transport header, if it has not already been removed by an upstream device. It then examines and removes the VPN context information. Finally, it uses the VPN context information to forward the packet to its destination (i.e., a directly connected CE).

In the above-mentioned VPN technologies, the ingress PE encodes VPN context information in a Multiprotocol Label Switching (MPLS) [[RFC3031](#)] label. Depending upon the transport tunnel type, the transport header can be:



- o A MPLS label or label stack.
- o An IPv4 [[RFC0791](#)] header.
- o An IPv6 [[RFC8200](#)] header.
- o A Generic Routing Encapsulation (GRE) [[RFC2784](#)] header encapsulated in IPv4 or IPv6.

Some PE devices cannot process MPLS headers. While these devices have several alternatives to MPLS-based transport tunnels, they require an alternative to MPLS-based encoding of VPN context information. This document defines a new IPv6 Destination Option that can be used to encode VPN context information. It is applicable when VPN payload is transported over IPv6.

## **2. Requirements Language**

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

## **3. VPN Context Information**

VPN context information specifies a forwarding procedure to be executed by the egress PE. However, VPN context information values are not globally mapped to forwarding procedures. Each egress PE maps each forwarding procedure that it supports to a VPN context information value. Therefore, VPN context information values are locally scoped to the egress PE.

PE devices can acquire VPN Context Information:

- o From one another, using a distributed, control plane protocol (e.g., BGP [[RFC4271](#)] [[RFC4760](#)])
- o From a controller.

The mechanisms by which PE devices acquire VPN Context Information are beyond the scope of this document.

## **4. The VPN Context Information Option**



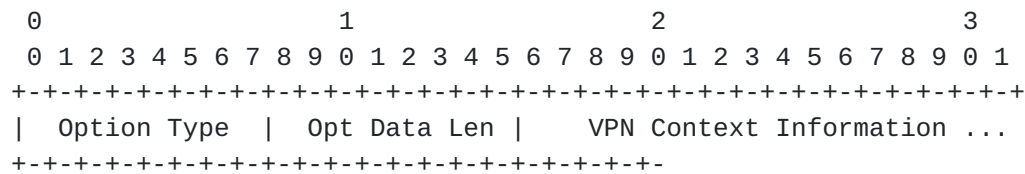


Figure 1

Figure 1 depicts the VPN Context Information Option.

Option fields are as follows:

- o Option Type - VPN Context Information option. Value TBD by IANA. See Notes below.
- o Opt Data Len - Length of Option Data, measured in bytes.
- o VPN Context Information - Specifies a forwarding procedure to be executed by the egress PE.

The VPN Context Information Option MAY appear in a Destination Options header that precedes an upper-layer header. It MUST NOT appear in a Hop-by-hop Options header and SHOULD NOT appear in a Destination Options header that precedes a Routing header. If it appears in a Hop-by-hop Options header, the processing node will discard the packet and send an ICMPv6 [[RFC4443](#)] Parameter Problem, Code 2, message to the packet's Source Address, pointing to the Option Type. If it appears in a Destination Options header that precedes a Routing header, the processing node will attempt to process the option, because it has not yet encountered the Routing header.

If the VPN Context Information appears in a Destination Options header, it SHOULD be the final option listed in the header. Because the VPN Context Information Option causes the packet to be decapsulated and forwarded, all options listed after the VPN Context Information Option will be ignored.

NOTE 1: The highest-order two bits of the Option Type (i.e., the "act" bits) are 10. These bits specify the action taken by a destination node that does not recognize VPN Context Information option. The required action is to discard the packet and, regardless of whether or not the packet's Destination Address was a multicast address, send an ICMPv6 Parameter Problem, Code 2, message to the packet's Source Address, pointing to the unrecognized Option Type.





NOTE 2: The third highest-order bit of the Option Type (i.e., the "chg" bit) is 0. This indicates that Option Data cannot be modified along the path between the packet's source and its destination.

## 5. Security Considerations

A VPN can be deployed:

- o In a walled-garden environment.
- o In an over-the-top environment.

In a walled-garden environment, all PE devices and all devices that connect PEs to one another reside in the same security domain. Therefore, there is no risk that a packet might be modified as it travels from PE to PE.

In an over-the-top environment, all PE devices reside in one security domain while devices that connect PEs to one another can reside in a different security domain. In that case, there is significant risk that a packet might be modified as it travels from PE to PE.

Therefore, the VPN Context Information option MUST be authenticated when used in over-the-top environments. In this scenario, an IPv6 Encapsulating Security Payload (ESP) [RFC4303] MUST precede the Destination Options header that carries the VPN Context Information option. The ESP integrity service MUST be enabled.

## 6. IANA Considerations

IANA is requested to allocate a codepoint from the Destination Options and Hop-by-hop Options registry (<https://www.iana.org/assignments/ipv6-parameters/ipv6-parameters.xhtml#ipv6-parameters-2>). This option is called "VPN Context Information". The "act" bits are 10 and the "chg" bit is 0.

## 7. Acknowledgements

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## 8. References

### 8.1. Normative References

[RFC0791] Postel, J., "Internet Protocol", STD 5, [RFC 791](https://www.rfc-editor.org/info/rfc791), DOI 10.17487/RFC0791, September 1981, <<https://www.rfc-editor.org/info/rfc791>>.



- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.
- [RFC4303] Kent, S., "IP Encapsulating Security Payload (ESP)", [RFC 4303](#), DOI 10.17487/RFC4303, December 2005, <<https://www.rfc-editor.org/info/rfc4303>>.
- [RFC4443] Conta, A., Deering, S., and M. Gupta, Ed., "Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification", STD 89, [RFC 4443](#), DOI 10.17487/RFC4443, March 2006, <<https://www.rfc-editor.org/info/rfc4443>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, [RFC 8200](#), DOI 10.17487/RFC8200, July 2017, <<https://www.rfc-editor.org/info/rfc8200>>.

## 8.2. Informative References

- [I-D.ietf-6man-segment-routing-header] Filsfils, C., Previdi, S., Leddy, J., Matsushima, S., and d. daniel.voyer@bell.ca, "IPv6 Segment Routing Header (SRH)", [draft-ietf-6man-segment-routing-header-16](#) (work in progress), February 2019.
- [RFC2784] Farinacci, D., Li, T., Hanks, S., Meyer, D., and P. Traina, "Generic Routing Encapsulation (GRE)", [RFC 2784](#), DOI 10.17487/RFC2784, March 2000, <<https://www.rfc-editor.org/info/rfc2784>>.
- [RFC3031] Rosen, E., Viswanathan, A., and R. Callon, "Multiprotocol Label Switching Architecture", [RFC 3031](#), DOI 10.17487/RFC3031, January 2001, <<https://www.rfc-editor.org/info/rfc3031>>.
- [RFC4271] Rekhter, Y., Ed., Li, T., Ed., and S. Hares, Ed., "A Border Gateway Protocol 4 (BGP-4)", [RFC 4271](#), DOI 10.17487/RFC4271, January 2006, <<https://www.rfc-editor.org/info/rfc4271>>.



- [RFC4364] Rosen, E. and Y. Rekhter, "BGP/MPLS IP Virtual Private Networks (VPNs)", [RFC 4364](#), DOI 10.17487/RFC4364, February 2006, <<https://www.rfc-editor.org/info/rfc4364>>.
- [RFC4760] Bates, T., Chandra, R., Katz, D., and Y. Rekhter, "Multiprotocol Extensions for BGP-4", [RFC 4760](#), DOI 10.17487/RFC4760, January 2007, <<https://www.rfc-editor.org/info/rfc4760>>.
- [RFC4761] Kompella, K., Ed. and Y. Rekhter, Ed., "Virtual Private LAN Service (VPLS) Using BGP for Auto-Discovery and Signaling", [RFC 4761](#), DOI 10.17487/RFC4761, January 2007, <<https://www.rfc-editor.org/info/rfc4761>>.
- [RFC4762] Lasserre, M., Ed. and V. Kompella, Ed., "Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling", [RFC 4762](#), DOI 10.17487/RFC4762, January 2007, <<https://www.rfc-editor.org/info/rfc4762>>.
- [RFC6624] Kompella, K., Kothari, B., and R. Cherukuri, "Layer 2 Virtual Private Networks Using BGP for Auto-Discovery and Signaling", [RFC 6624](#), DOI 10.17487/RFC6624, May 2012, <<https://www.rfc-editor.org/info/rfc6624>>.
- [RFC7432] Sajassi, A., Ed., Aggarwal, R., Bitar, N., Isaac, A., Uttaro, J., Drake, J., and W. Henderickx, "BGP MPLS-Based Ethernet VPN", [RFC 7432](#), DOI 10.17487/RFC7432, February 2015, <<https://www.rfc-editor.org/info/rfc7432>>.
- [RFC8077] Martini, L., Ed. and G. Heron, Ed., "Pseudowire Setup and Maintenance Using the Label Distribution Protocol (LDP)", STD 84, [RFC 8077](#), DOI 10.17487/RFC8077, February 2017, <<https://www.rfc-editor.org/info/rfc8077>>.

#### Authors' Addresses

Ron Bonica  
Juniper Networks  
2251 Corporate Park Drive  
Herndon, Virginia 20171  
USA

Email: [rbonica@juniper.net](mailto:rbonica@juniper.net)



Chris Lenart  
Verizon  
22001 Loudoun County Parkway  
Ashburn, Virginia 20147  
USA

Email: [chris.lenart@verizon.com](mailto:chris.lenart@verizon.com)

Greg Presbury  
Hughes Network Systems  
11717 Exploration Lane  
Germantown, Maryland 20876  
USA

Email: [greg.presbury@hughes.com](mailto:greg.presbury@hughes.com)

Gang Chen  
Baidu  
Baidu Technology Park Building No.2, No.10 Xibeiwang East Road Haidian District  
Beijing 100193  
P.R. China

Email: [phdgang@gmail.com](mailto:phdgang@gmail.com)

Yongqing Zhu  
China Telecom  
109 West Zhongshan Ave, Tianhe District  
Guangzhou  
P.R. China

Email: [zhuyq.gd@chinatelecom.cn](mailto:zhuyq.gd@chinatelecom.cn)



