Internet Engineering Task Force (IETF)
Request for Comments: 7999
Category: Informational
ISSN: 2070-1721

T. King
C. Dietzel
DE-CIX
J. Snijders
NTT
G. Doering
SpaceNet AG
G. Hankins
Nokia

October 2016

BLACKHOLE Community

Abstract

This document describes the use of a well-known Border Gateway Protocol (BGP) community for destination-based blackholing in IP networks. This well-known advisory transitive BGP community named "BLACKHOLE" allows an origin Autonomous System (AS) to specify that a neighboring network should discard any traffic destined towards the tagged IP prefix.

Status of This Memo

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

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Not all documents approved by the IESG are a candidate for any level of Internet Standard; see Section 2 of RFC 7841.

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/rfc7999.

Table of Contents

1. Introduction

Network infrastructures have been increasingly hampered by DDoS attacks. In order to dampen the effects of these DDoS attacks, IP networks have offered blackholing with BGP [RFC4271] using various mechanisms such as those described in [RFC3882] and [RFC5635].

DDoS attacks targeting a certain IP address may cause congestion of links used to connect to adjacent networks. In order to limit the impact of such a scenario on legitimate traffic, networks adopted a mechanism called "BGP blackholing". A network that wants to trigger blackholing needs to understand the triggering mechanism adopted by its neighboring networks. Different networks provide different mechanisms to trigger blackholing, including but not limited to pre-defined blackhole next-hop IP addresses, specific BGP communities, or out-of-band BGP sessions with a special BGP speaker.

Having several different mechanisms to trigger blackholing in different networks makes it an unnecessarily complex, error-prone, and cumbersome task for network operators. Therefore, a well-known BGP community [RFC1997] is defined for operational ease.

Having such a well-known BGP community for blackholing also further simplifies network operations because:

- Implementing and monitoring blackholing becomes easier when implementation and operational guides do not cover many variations to trigger blackholing.
- The number of support requests from customers about how to trigger blackholing in a particular neighboring network will be reduced as the codepoint for common blackholing mechanisms is unified and well-known.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" are to be interpreted as described in [RFC2119] only when they appear in all upper case. They may also appear in lower case or mixed case as English words, without normative meaning.

2. BLACKHOLE Community

This document defines the use of a new well-known BGP transitive community, BLACKHOLE.

The semantics of this community allow a network to interpret the presence of this community as an advisory qualification to drop any traffic being sent towards this prefix.

3. Operational Recommendations

3.1. IP Prefix Announcements with BLACKHOLE Community Attached

Accepting and honoring the BLACKHOLE community, or ignoring it, is a choice that is made by each operator. This community MAY be used in all bilateral and multilateral BGP deployment scenarios. In a bilateral peering relationship, use of the BLACKHOLE community MUST be agreed upon by the two networks before advertising it. In a multilateral peering relationship, the decision to honor or ignore the BLACKHOLE community is to be made according to the operator's routing policy. The community SHOULD be ignored, if it is received by a network that it not using it.

When a network is under DDoS duress, it MAY announce an IP prefix covering the victim's IP address(es) for the purpose of signaling to neighboring networks that any traffic destined for these IP address(es) should be discarded. In such a scenario, the network operator SHOULD attach the BLACKHOLE community.

The BLACKHOLE community MAY also be used as one of the trigger communities in a destination-based Remote Triggered Blackhole (RTBH) [RFC5635] configuration.

3.2. Local Scope of Blackholes

A BGP speaker receiving an announcement tagged with the BLACKHOLE community SHOULD add the NO_ADVERTISE or NO_EXPORT community as defined in [RFC1997], or a similar community, to prevent propagation of the prefix outside the local AS. The community to prevent propagation SHOULD be chosen according to the operator's routing policy.

Unintentional leaking of more specific IP prefixes to neighboring networks can have adverse effects. Extreme caution should be used when purposefully propagating IP prefixes tagged with the BLACKHOLE community outside the local routing domain, unless policy explicitly aims at doing just that.

3.3. Accepting Blackholed IP Prefixes

It has been observed in provider networks running BGP that announcements of IP prefixes longer than /24 for IPv4 and /48 for IPv6 are usually not accepted on the Internet (see Section 6.1.3 of [RFC7454]). However, blackhole prefix length should be as long as possible in order to limit the impact of discarding traffic for adjacent IP space that is not under DDoS duress. The blackhole prefix length is typically as specific as possible, /32 for IPv4 or /128 for IPv6.

BGP speakers in a bilateral peering relationship using the BLACKHOLE community MUST only accept and honor BGP announcements carrying the BLACKHOLE community under the two following conditions:

- The announced prefix is covered by an equal or shorter prefix that the neighboring network is authorized to advertise.
- The receiving party agreed to honor the BLACKHOLE community on the particular BGP session.

In topologies with a route server or other multilateral peering relationships, BGP speakers SHOULD accept and honor BGP announcements under the same conditions.

An operator MUST ensure that origin validation techniques (such as the one described in [RFC6811]) do not inadvertently block legitimate announcements carrying the BLACKHOLE community.

The BLACKHOLE community is not intended to be used with Network Layer Reachability Information (NLRI) [RFC5575] to distribute traffic flow specifications.

The error handling for this community follows the process in [RFC7606] that causes a malformed community to be treated as withdrawn.

Operators are encouraged to store all BGP updates in their network carrying the BLACKHOLE community for long-term analysis or internal audit purposes.

4. Vendor Implementation Recommendations

Without an explicit configuration directive set by the operator, network elements SHOULD NOT discard traffic destined towards IP prefixes that are tagged with the BLACKHOLE community. The operator is expected to explicitly configure the network element to honor the BLACKHOLE community in a way that is compliant with the operator's routing policy.

Vendors MAY provide a shorthand keyword in their configuration language to reference the well-known BLACKHOLE community attribute value. The suggested string to be used is "blackhole".

5. IANA Considerations

The IANA has registered BLACKHOLE in the "BGP Well-known Communities" registry.

BLACKHOLE (= 0xFFFF029A)

The low-order two octets in decimal are 666, a value commonly associated with BGP blackholing among network operators.

6. Security Considerations

BGP contains no specific mechanism to prevent the unauthorized modification of information by the forwarding agent. This allows routing information to be modified or removed; it also allows false information to be added by forwarding agents. Recipients of routing information are not able to detect this modification. BGPsec [BGPSEC] does not resolve this situation. Even when BGPsec is in place, a forwarding agent can alter, add, or remove BGP communities.

The unauthorized addition of the BLACKHOLE community to an IP prefix by an adversary may cause a denial-of-service attack based on denial of reachability.

In order to further limit the impact of unauthorized BGP announcements carrying the BLACKHOLE community, the receiving BGP speaker SHOULD verify by applying strict filtering (see Section 6.2.1.1.2 of [RFC7454]) that the peer announcing the prefix is authorized to do so. If not, the BGP announcement should be filtered.

BGP announcements carrying the BLACKHOLE community should only be accepted and honored if the neighboring network is authorized to advertise the prefix. The method of validating announcements is to be chosen according to the operator's routing policy.

It is RECOMMENDED that operators use best common practices to protect their BGP sessions, such as the ones in [RFC7454].

7. References

7.1. Normative References

[RFC1997] Chandra, R., Traina, P., and T. Li, "BGP Communities Attribute", RFC 1997, DOI 10.17487/RFC1997, August 1996, <http://www.rfc-editor.org/info/rfc1997>.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <http://www.rfc-editor.org/info/rfc2119>.

[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, <http://www.rfc-editor.org/info/rfc4271>.

[RFC7606] Chen, E., Ed., Scudder, J., Ed., Mohapatra, P., and K. Patel, "Revised Error Handling for BGP UPDATE Messages", RFC 7606, DOI 10.17487/RFC7606, August 2015, <http://www.rfc-editor.org/info/rfc7606>.

7.2. Informative References

[BGPSEC] Lepinski, M., Ed. and K. Sriram, Ed., "BGPsec Protocol Specification", Work in Progress, draft-ietf-sidr-bgpsec-protocol-18, August 2016.

[RFC3882] Turk, D., "Configuring BGP to Block Denial-of-Service Attacks", RFC 3882, DOI 10.17487/RFC3882, September 2004, <http://www.rfc-editor.org/info/rfc3882>.

[RFC5575] Marques, P., Sheth, N., Raszuk, R., Greene, B., Mauch, J., and D. McPherson, "Dissemination of Flow Specification Rules", RFC 5575, DOI 10.17487/RFC5575, August 2009, <http://www.rfc-editor.org/info/rfc5575>.

[RFC5635] Kumari, W. and D. McPherson, "Remote Triggered Black Hole Filtering with Unicast Reverse Path Forwarding (uRPF)", RFC 5635, DOI 10.17487/RFC5635, August 2009, <http://www.rfc-editor.org/info/rfc5635>.

[RFC6811] Mohapatra, P., Scudder, J., Ward, D., Bush, R., and R. Austein, "BGP Prefix Origin Validation", RFC 6811, DOI 10.17487/RFC6811, January 2013, <http://www.rfc-editor.org/info/rfc6811>.

[RFC7454] Durand, J., Pepelnjak, I., and G. Doering, "BGP Operations and Security", BCP 194, RFC 7454, DOI 10.17487/RFC7454, February 2015, <http://www.rfc-editor.org/info/rfc7454>.

Acknowledgements

The authors would like to gratefully acknowledge many people who have contributed discussions and ideas to the development of this document. They include Petr Jiran, Yordan Kritski, Christian Seitz, Nick Hilliard, Joel Jaeggli, Christopher Morrow, Thomas Mangin, Will Hargrave, Niels Bakker, David Farmer, Jared Mauch, John Heasley, and Terry Manderson.

Authors' Addresses

Thomas King
DE-CIX Management GmbH
Lichtstrasse 43i
Cologne 50825
Germany

Email: thomas.king@de-cix.net

Christoph Dietzel
DE-CIX Management GmbH
Lichtstrasse 43i
Cologne 50825
Germany

Email: christoph.dietzel@de-cix.net

Job Snijders
NTT Communications
Theodorus Majofskistraat 100
Amsterdam 1065 SZ
The Netherlands

Email: job@ntt.net

Gert Doering
SpaceNet AG
Joseph-Dollinger-Bogen 14
Munich 80807
Germany

Email: gert@space.net

Greg Hankins
Nokia
777 E. Middlefield Road
Mountain View, CA 94043
United States of America

Email: greg.hankins@nokia.com