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The Generalized TTL Security Mechanism (GTSM) for Label Distribution Protocol (LDP) draft-ietf-mpls-ldp-gtsm-06

Abstract

The Generalized TTL Security Mechanism (GTSM) describes a generalized use of a packets Time to Live (TTL) (IPv4) or Hop Limit (IPv6) to verify that the packet was sourced by a node on a connected link, thereby protecting the router's IP control-plane from CPU utilization based attacks. This technique improves security and is used by many protocols. This document defines the GTSM use for the Label Distribution Protocol (LDP).

This specification uses a bit reserved in RFC 5036 and therefore updates RFC 5036.

Status of this Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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Table of Contents

1. Introduction

LDP [RFC5036] specifies two peer discovery mechanisms, a Basic one and an Extended one, both using UDP transport. The Basic Discovery mechanism is used to discover LDP peers that are directly connected at the link level, whereas the Extended Discovery mechanism is used to locate Label Switching Router (LSR) neighbors that are not directly connected at the link level. Once discovered, the LSR neighbors can establish the LDP peering session, using the TCP transport connection.

The Generalized TTL Security Mechanism (GTSM) [RFC5082] is a mechanism based on IPv4 Time To Live (TTL) or (IPv6) Hop Limit value verification so as to provide a simple and reasonably robust defense from infrastructure attacks using forged protocol packets from outside the network. GTSM can be applied to any protocol peering session that is established between routers that are adjacent. Therefore, GTSM can fully benefit LDP protocol peering session established using Basic Discovery.

This document specifies LDP enhancements to accommodate GTSM. In particular, this document specifies the enhancements in the following areas:

1. Common Hello Parameter TLV of LDP Link Hello message

2. Sending and Receiving procedures for LDP Link Hello message

3. Sending and Receiving procedures for LDP Initilization message

GTSM specifies that "it SHOULD NOT be enabled by default in order to remain backward-compatible with the unmodified protocol" (see Section 3 of [RFC5082]). This document specifies a "built-in dynamic GTSM capability negotiation" for LDP to suggest the use of GTSM. GTSM will be used as specified in this document provided both peers on an LDP session can detect each others' support for GTSM procedures and agree to use it. That is, the desire to use GTSM (i.e., its negotiation mechanics) is enabled by default.

This specification uses a bit reserved in Section 3.5.2 of [RFC5036] and therefore updates [RFC5036].

1.1. Specification of Requirements

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 [RFC2119].

1.2. Scope

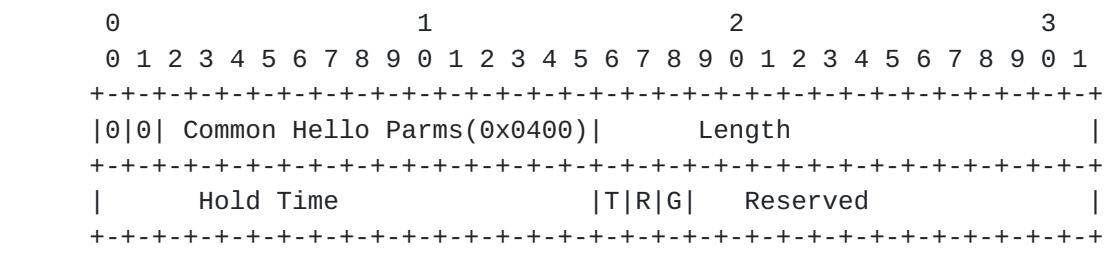
This document defines procedures for LDP using IPv4 routing, but not for LDP using IPv6 routing, since the latter has GTSM built into the protocol definition [I-D.ietf-mpls-ldp-ipv6].

Additionally, the GTSM for LDP specified in this document applies only to single-hop LDP peering sessions, and not to multi-hop LDP peering sessions, in line with Section 5.5 of [RFC5082]. Consequently, any LDP method or feature (such as LDP IGP Synchronization [RFC5443], or LDP Session Protection [LDP-SPROT]) that relies on multi-hop LDP peering sessions would not work with GTSM and will require (statically or dynamically) disabling the GTSM capability. See Section 3.

2. GTSM Procedures for LDP

2.1. GTSM Flag in Common Hello Parameter TLV

A new flag in Common Hello Parameter TLV, named G flag (for GTSM), is defined by this document in a previously reserved bit. An LSR indicates that it is capable of applying GTSM procedures, as defined in this document, to the subsequent LDP peering session, by setting the GTSM flag to 1. The Common Hello Parameters TLV, defined in Section 3.5.2 of [RFC5036], is updated as shown in Figure 1.



T, Targeted Hello
As specified in [RFC5036].

R, Request Send Targeted Hellos
As specified in [RFC5036].

G, GTSM
A value of 1 specifies that this LSR supports GTSM procedures, where a value of 0 specifies that this LSR does not support GTSM.

Reserved
This field is reserved. It MUST be set to zero on transmission and ignored on receipt.

Figure 1: GTSM Flag in Common Hello Parameter TLV

The G flag is meaingful only if the T flag is set to 0 (which must be the case for Basic Discovery), otherwise, the value of G flag SHOULD be ignored on receipt.

Any LSR not supporting GTSM for LDP as defined in this document (i.e., an LSR that does not recognize the G flag), would continue to ignore the G flag, independent of T and R flags' value, as per Section 3.5.2 of [RFC5036]. Similarly, an LSR that does recognize the G flag but that it does not support GTSM (either because it is not implemented, or because it is so configured), would clear the G flag (i.e.,g G=0) on send and would effectively ignore the G flag on receipt.

2.2. GTSM Sending and Receiving Procedures for LDP Link Hello

Firstly, LSRs using LDP Basic Discovery [RFC5036] send LDP Hello messages to link-level multicast address (224.0.0.2 or "all routers"). Such messages are never forwarded beyond one hop and RECOMMENDED to have their IP TTL or Hop Count = 1.

Unless configured otherwise, an LSR that supports GTSM procedures MUST set the G flag (for GTSM) to 1 in Common Hello Parameter TLV in the LDP Link Hello message [RFC5036].

If an LSR that supports GTSM and is configured to use it recognizes the presence of G flag (in Common Hello Parameter TLV) with the value =1 in the received LDP Link Hello message, then it MUST enforce GTSM for LDP in the subsequent TCP/LDP peering session with the neighbor that sent the Hello message, as specified in Section 2.3 of this document.

If an LSR does not recognize the presence of G flag (in Common Hello Parameter TLV of Link Hello message), or recognizes the presence of G flag with the value = 0, then the LSR MUST NOT enforce GTSM for LDP in the subsequent TCP/LDP peering session with the neighbor that sent the Hello message. This ensures backward compatibility as well as automatic GTSM de-activation.

2.3. GTSM Sending and Receiving Procedures for LDP Initialization

If an LSR that has sent and received LDP Link Hello with G flag = 1 from the directly-connected neighbor, then the LSR MUST enforce GTSM procedures, as defined in Section 3 of [RFC5082], in the forthcoming TCP Transport Connection with that neighbor. This means that the LSR MUST check for the incoming unicast packets' TTL or Hop Count to be 255 for the particular LDP/TCP peering session and decide the further processing as per the [RFC5082].

If an LSR that has sent LDP Link Hello with G flag = 1, but received LDP Link Hello with G flag = 0 from the directly-connected neighbor, then the LSR MUST NOT enforce GTSM procedures, as defined in Section 3 of [RFC5082], in the forthcoming TCP Transport Connection with that neighbor.

3. LDP Peering Scenarios and GTSM Considerations

This section discusses GTSM considerations arising from the LDP peering scenarios used, including single-hop versus multi-hop LDP neighbors, as well as the use of LDP basic discovery versus extended discovery.

The reason that the GTSM capability negotiation is enabled for Basic Discovery by default (i.e.,g G=1), but not for Extended Discovery is that the usage of Basic Discovery typically results in a single-hop LDP peering session, whereas the usage of Extended Discovery typically results in a multi-hop LDP peering session. GTSM protection for multi-hop LDP sessions is outside the scope of this specification (see Section 1.2). However, it is worth clarifying the following exceptions that may occur with Basic or Extended Discovery usage:

a. Two adjacent LSRs (i.e., back-to-back PE routers) forming a single-hop LDP peering session after doing an Extended Discovery (e.g., for Pseudowire signaling)

b. Two adjacent LSRs forming a multi-hop LDP peering session after doing a Basic Discovery, due to the way IP routing is setup between them (either temporarily or permanently)

c. Two adjacent LSRs (i.e. back-to-back PE routers) forming a single-hop LDP peering session after doing both Basic and Extended Discovery.

In the first case (a), GTSM is not enabled for the LDP peering session by default. In the second case (b), GTSM is actually enabled by default and enforced for the LDP peering session, and hence, it would prohibit the LDP peering session from getting established (note that this may impact features such as LDP IGP Synchronization [RFC5443], or LDP Session Protection [LDP-SPROT]). In the third case (c), GTSM is enabled by default for Basic Discovery and enforced on the subsequent LDP peering, and not for Extended Discovery. However, if each LSR uses the same IPv4 transport address object value in both Basic and Extended discoveries, then it would result in a single LDP peering session and that would be enabled with GTSM. Otherwise, GTSM would not be enforced on the second LDP peering session corresponding to the Extended Discovery.

This document allows for the implementation to provide an option to statically (e.g., via configuration) and/or dynamically override the default behavior and enable/disable GTSM on a per-peer basis. This would address all the exceptions listed above.

4. IANA Considerations

This document has no IANA actions.

5. Security Considerations

This document increases the security for LDP, making it more resilient to off-link attacks. Security considerations for GTSM are detailed in Section 5 of [RFC5082].

6. Acknowledgments

The authors of this document do not make any claims on the originality of the ideas described. The concept of GTSM for LDP has

been proposed a number of times, and is documented in both the Experimental and Standards Track specifications of GTSM. Among other people, we would like to acknowledge Enke Chen and Albert Tian for their document "TTL-Based Security Option for the LDP Hello Message".

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7. References

7.1. Normative References

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