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**The Generalized TTL Security Mechanism (GTSM) for Label Distribution
Protocol (LDP)
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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 Label Distribution Protocol (LDP).

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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 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 Initialization message

GTSM specifies that it SHOULD NOT be enabled by default in order to remain backward-compatible with the unmodified protocol; this document specifies having a built-in dynamic GTSM capability negotiation for LDP to suggest the use of GTSM, provided GTSM is not enabled unless both peers can detect each others' support for GTSM procedures and agree on its usage as described in this document.

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

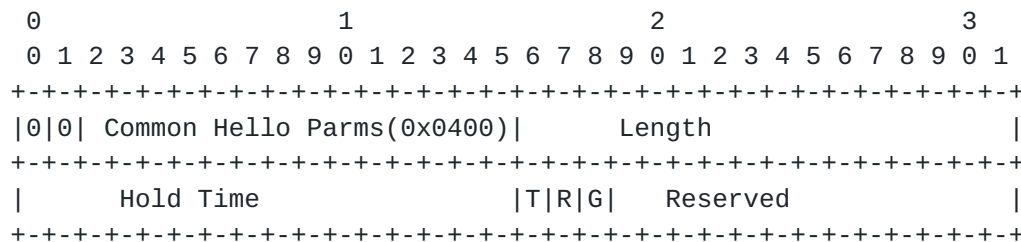
This document defines procedures for LDP using IPv4 routing, but not for LDP using IPv6 routing, since the latter has GTSM built into the protocol definition [[I-D.ietf-mpls-ldp-ipv6](#)].

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 that relies on multi-hop LDP peering sessions would not work with GTSM and will require (statically or dynamically) disabling GTSM. 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. 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 meaningful only if T and R flags are 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,

would continue to ignore the G flag, independent of T and R flags' value, as per [Section 3.5.2 of \[RFC5036\]](#).

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 assumed to have their IP TTL or Hop Count = 1.

An LSR that is capable of applying GTSM procedures to the subsequent TCP/LDP peering session MUST set the G flag (for GTSM) to 1 in Common Hello Parameter TLV in the LDP Link Hello message [[RFC5036](#)].

An LSR, upon receiving an LDP Link Hello message, would recognize the presence of G flag (in Common Hello Parameter TLV) only if it supports GTSM for LDP, as specified in this document. If an LSR recognizes the presence of G flag 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.

If an LSR that has sent the LDP Link Hello with G flag = 1, then the LSR MUST set IP TTL or Hop Count = 255 in the forthcoming TCP Transport Connection(s) with that neighbor (e.g., LSR2). Please see [Section 2.3](#) for more details about the TCP transport connection specifics.

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 (LSR2), then the LSR MUST enforce GTSM procedures, as defined in [Section 3 of \[RFC5082\]](#), in the forthcoming TCP Transport Connection with that neighbor (LSR2). 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 (LSR2), then the LSR MUST NOT enforce GTSM procedures, as defined in

[Section 3 of \[RFC5082\]](#), in the forthcoming TCP Transport Connection with that neighbor (LSR2).

3. Multi-Hop LDP peering Considerations for GTSM

The reason GTSM is enabled for Basic Discovery by default, 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. 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 disable GTSM on a per-peer basis. This would address all the exceptions listed above.

4. IANA Considerations

IANA is requested to assign the G, GTSM bit in the Common Hello

Parameters TLV (see Figure 1 in [Section 2.1](#)), as per allocation policy defined at [[I-D.ietf-mpls-ldp-iana](#)].

5. Security Considerations

This document increases the security for LDP, making it more resilient to off-link attacks.

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".

The authors would like to thank Loa Andersson and Bin Mo for a thorough review and most useful comments and suggestions.

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