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                        LDP End-of-LIB
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Abstract

   There are situations following LDP session establishment where it
   would be useful for an LDP speaker to know when its peer has
   advertised all of its labels. These include session establishment
   when LDP-IGP sync is in use, as well as session re-establishment
   following loss of an LDP session when LDP graceful restart is in use.
   The LDP specification [RFC5036] provides no mechanism for an LDP
   speaker to notify a peer when it has completed its initial label
   advertisements to that peer. This document specifies means for an
   LDP speaker to signal completion of its initial label advertisements
   following session establishment.

Conventions used in this document

   In examples, "C:" and "S:" indicate lines sent by the client and
   server respectively.

   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].

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1. Introduction

There are situations following LDP session establishment where it
would be useful for an LDP speaker to know when its peer has
advertised all of its labels. For example, when an LDP speaker is
using LDP-IGP synchronization procedures [LDPSync], it would be
useful for the speaker to know when its peer has completed
advertisement of its IP label bindings. Similarly, after an LDP
session is re-established when LDP Graceful Restart [RFC3478] is in
effect, it would be helpful for each peer to signal the other after
it has advertised all its label bindings.

The LDP specification [RFC5036] provides no mechanism for an LDP
speaker to notify a peer when it has completed its initial label
advertisements to that peer.

This document specifies use of a Notification message with the "End-
of-LIB" Status Code for an LDP speaker to signal completion of its
label advertisements following session establishment.

RFC5036 implicitly assumes that new Status Codes will be defined over
the course of time. However, it does not explicitly define the
behavior of an LDP speaker which does not understand the Status Code
in a Notification message. To avoid backward compatibility issues
this document specifies use of the LDP capability mechanism [LDPCap]
at session establishment time for informing a peer that an LDP
speaker is capable of handling a Notification message that carries an
unrecognized Status Code.

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2. Specification Language

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].

3. Unrecognized Notification Capability

An LDP speaker MAY include a Capability Parameter [LDPCap] in the
Initialization message to inform a peer that it ignores Notification
Messages that carry a Status TLV with a non-fatal Status Code unknown
to it.

The Capability Parameter for the Unrecognized Notification capability
is a TLV with the following format:

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|U|F| Unrecog Notif (IANA)      |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|S| Reserved      |
+-+-+-+-+-+-+-+-+-+
```

Figure 1 Unrecognized Notification Capability format

Where:

   U and F bits: Should be set 1 and 0 respectively as per section 4
of LDP Capabilities [LDPCap].

   Unrecog Notif: TLV code point to be assigned by IANA.

   S-bit: Must be 1 (indicates that capability is being advertised).

Upon receiving a Notification with an unrecognized Status Code an LDP
speaker MAY generate a console or system log message for trouble
shooting purposes.

4. Signaling Completion of Label Advertisement

An LDP speaker MAY signal completion of its label advertisements to a
peer by means of a Notification message, if its peer had advertised
the Unrecognized Notification capability during session
establishment. The LDP speaker MAY send the Notification message (per
FEC Type) to a peer even if the LDP speaker had no Label bindings to
advertise.

Such a Notification message MUST carry:

   - A status TLV with TLV E- and F-bits set to zero that carries an
     "End-of-LIB" Status Code.

   - A FEC TLV with the Typed Wildcard FEC Element [TypedWC] that
     identifies the FEC type for which initial label advertisements
     have been completed. In terms of Section 3.5.1 of RFC5036,
     this TLV is an "Optional Parameter" of the Notification
     message.

An LDP speaker MUST NOT send a Notification which carries a Status
TLV with the End-of-LIB Status Code to a peer unless the peer had
advertised the Unrecognized Notification capability during session
establishment.

This applies to both non-directed and directed LDP peers.

5. Usage Guidelines

The FECs known to an LDP speaker and the labels the speaker has bound
to those FECs may change over the course of time. This makes
determining when an LDP speaker has advertised "all" of its label
bindings for a given FEC type an issue. Ultimately, this
determination is a judgement call the LDP speaker makes. The
following guidelines may be useful.

An LDP speaker is assumed to "know" a set of FECs. Depending on a
variety of criteria, such as:

   - The label distribution control mode in use (Independent or
     Ordered);

   - The set of FEC's to which the speaker has bound local labels;

   - Configuration settings which may constrain which label bindings
     the speaker may advertise to peers;

the speaker can determine the set of bindings for a given FEC type
that it is permitted to advertise to a given peer.

IGP-Sync, LDP Graceful Restart, and the response to a Wildcard Label
Request [TypedWC] are situations that would benefit from End-of-LIB
Notification. In these situations, after an LDP speaker completes
its label binding advertisements to a peer, it should send the peer

an End-of-LIB Notification. The following subsections cover each of
these situations in turn.

5.1. IGP-Sync

LDP-IGP Sync is a mechanism directly connected LDP speakers may use
to delay using the link connecting them for IP traffic until the
labels required to support IP over MPLS traffic on the link have been
learned.

Without an End-of-LIB Notification the speaker must rely on some
heuristic to determine when it has received all of its peer's label
bindings. The heuristic chosen could cause LDP to signal the IGP too
soon in which case the likelihood that traffic will be dropped
increases, or too late in which case traffic is kept on sub-optimal
paths longer than necessary.

Following session establishment with a directly connected peer that
has advertised the Unrecognized Notification capability, an LDP
speaker using LDP-IGP Sync may send the peer an End-of-LIB
Notification after it completes advertisement of its IP label
bindings to the peer. Similarly, the LDP speaker may use the End-of-
LIB Notification received from a directly connected peer to determine
when the peer has completed advertisement of its label bindings for
IP prefixes. After receiving the notification, the speaker should
consider LDP to be fully operational for the link and signal the IGP
to start advertising the link with normal cost.

5.2. LDP Graceful Restart

LDP Graceful Restart helps reduce the loss of MPLS traffic caused by
the restart of a router's LDP component. It defines procedures that
allow routers capable of preserving MPLS forwarding state across the
restart to continue forwarding MPLS traffic for a pre-agreed upon
period using forwarding state installed prior to the restart.

During that period the restarting router and its peers consider the
preserved forwarding state to be usable but stale until it is
refreshed by receipt of new label advertisements following re-
establishment of new LDP sessions. When the period elapses any
remaining stale forwarding state is removed by the router.

Receipt of the End-of-LIB Notification from a peer in an LDP Graceful
Restart scenario enables an LDP speaker to stop using stale
forwarding information learned from that peer and to recover the
resources it requires without having to wait until the timeout
occurs.

5.3. Wildcard Label Request

When an LDP speaker receives a Label Request message for a Typed
Wildcard FEC (e.g. a particular FEC element type) from a peer it
determines the set of bindings, it is permitted to advertise the peer
for the FEC type specified by the request. Assuming the peer had
advertised the Unrecognized Notification capability at session
initialization time, the speaker should send the peer an End-of-LIB
Notification for the FEC type when it completes advertisement of the
permitted bindings.

As in the previous applications, receipt of the Notification
eliminates uncertainty as to when the peer has completed its
advertisements of label bindings for the requested Wildcard FEC
Element Type.

5.4. Missing Expected End-of-LIB Notifications

There is no guarantee that an LDP speaker will receive End-of-LIB
Notifications from a peer even if the LDP speaker has signaled its
capability. Therefore, an implementation SHOULD NOT depend on the
receipt of such a Notification.

To deal with the possibility of missing notifications, an LDP speaker
may time out receipt of an expected End-of-LIB Notification, and if
the timeout occurs, it may behave as if it had received the
notification. If the End-of-LIB Notification message is received
after the time-out occurs, then the message should be ignored.

6. Security Considerations

No security considerations beyond those that apply to the base LDP
specification and described in [RFC5036] apply to signaling the End-
of-LIB condition as described in this document.

7. IANA Considerations

This draft introduces a new LDP Status Code and a new LDP Capability both of which require IANA assignment.

8. Acknowledgments

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This document was prepared using 2-Word-v2.0.template.dot.

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