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LDP Capabilities

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Abstract

A number of enhancements to the Label Distribution Protocol (LDP) have been proposed. Some have been implemented, and some are advancing toward standardization. It is likely that additional enhancements will be proposed in the future. At present there is no common mechanism for LDP speakers to activate such enhancements. Consequently, an enhancement specification typically includes an ad hoc procedure for activating it at session initialization time. This draft specifies a mechanism for activating enhancements that allows LDP speakers to enable enhancements at session establishment time as well as to to enable and disable them following session establishment.

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1. Introduction

A number of enhancements to LDP as specified in [[RFC3036](#)] have been proposed. These include LDP Graceful Restart [[RFC3478](#)], Fault Tolerant LDP [[RFC3479](#)], multicast extensions [[MLDP](#)], signaling for layer 2 circuits [[PWE](#)], a method for learning labels advertised by next next hop routers in support of fast reroute node protection [[NNHOP](#)], upstream label allocation [[UPSTREAM_LDP](#)], and extensions for signaling inter-area LSPs [[IALDP](#)]. Some have been implemented, and some are advancing toward standardization. It is likely that additional enhancements will be proposed in the future.

At present LDP has no common mechanism for LDP speakers to activate such enhancements. Consequently, the enhancement specifications typically include ad hoc procedures for activating the enhancement at session initialization time or assume that the enhancement is always active. Furthermore, LDP has no mechanism for de-activating an enhancement once activated.

This draft specifies an LDP capability advertisement mechanism for managing the use of enhancements that associates capabilities with LDP enhancements and defines an infrastructure for enabling and disabling enhancements that enables peers to:

- Advertise the capability associated with an enhancement at session establishment time or following session establishment, thereby enabling the enhancement.
- Withdraw the capability associated with an enhancement following session establishment thereby disabling the corresponding capability.

The LDP capability advertisement mechanism is similar to the BGP capability advertisement mechanism [[RFC3392](#)] [[BGP-DYNCAP](#)].

When the capability advertisement mechanism is in place an LDP enhancement requiring LDP capability advertisement will be specified by a document that:

- Describes the motivation for the enhancement;
- Specifies the behavior of LDP when the enhancement is enabled. This includes the procedures, parameters, messages, and TLV's required by the enhancement;

- Includes an IANA considerations section that notes that an IANA-assigned code point for the capability corresponding to the enhancement is required.

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. The LDP Capability Mechanism

Enhancements are likely to be announced during LDP session establishment as each LDP speaker advertises capabilities corresponding to the enhancements it desires.

Beyond that, capability advertisements may be used to dynamically modify the characteristics of the session to suit changing conditions. For example, an LSR capable of a particular enhancement in support of some "feature" may not have advertised the corresponding capability to its peers at session establishment time because the feature was disabled at that time. Later an operator may enable the feature, at which time the LSR would react by advertising the corresponding capability to its peers. Similarly, when an operator disables a feature associated with a capability the LSR reacts by withdrawing the capability advertisement from its peers.

The LDP capability advertisement mechanism operates as follows:

- Each LDP speaker is assumed to implement a set of features each of which has an associated capability. At any time a speaker may have none, one or more of those features "enabled". When a feature is enabled the speaker advertises the associated capability to its peers. By advertising the capability to a peer the speaker asserts that it shall perform the protocol actions specified for the associated feature. For example, the actions may involve receiving and processing messages from a peer that the feature requires. Unless the capability has been advertised the speaker will not perform protocol actions specified for the corresponding feature.
- At session establishment time an LDP speaker MAY advertise capabilities for features that are currently enabled by including a Capability List TLV in its Initialization message.

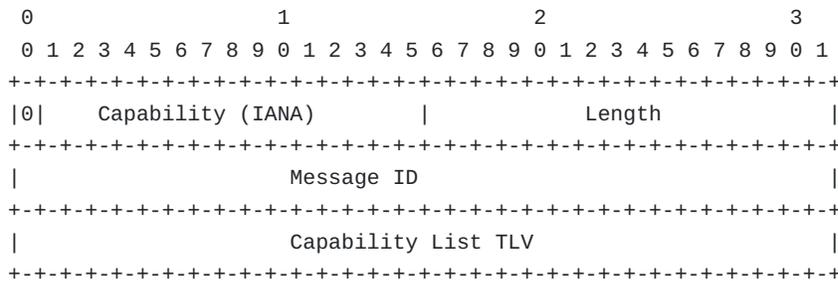
- There is a well-known capability called Dynamic Announcement which an LDP speaker MAY advertise in its Initialization message to indicate that it is capable of advertising and withdrawing capabilities following session establishment.

If a peer had advertised the Dynamic Announcement capability in its Initialization message then at any time following session establishment an LDP speaker MAY announce changes in its advertised capabilities to that peer. To do this the LDP speaker sends the peer a Capability message that includes a Capability List TLV which specifies capabilities being advertised or withdrawn.

4. Capability Message

The LDP Capability message is used by an LDP speaker subsequent to session establishment to announce changes in the state for one or more of its capabilities. In addition, it is used to carry acknowledgements for capability state changes announcements that require them (see [Section 8](#)).

The format of the Capability message is:



where the Capability List TLV specifies capability state changes being advertised or acknowledged.

5. The Capability List TLV

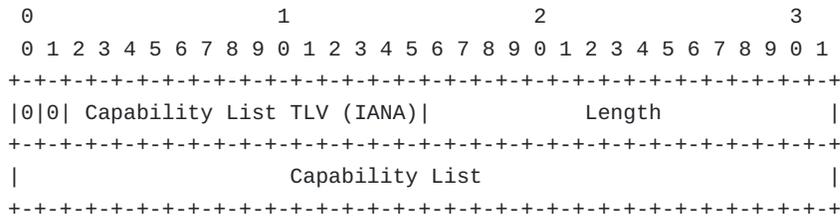
An LDP speaker MAY include a Capability List TLV as an optional parameter in an Initialization message to announce capabilities it has enabled to its LDP peer.

In addition, if its peer had advertised the Dynamic Announcement capability at session establishment time an LDP speaker MAY send the peer a Capability message when the speaker wishes to change the capabilities it has advertised. The Capability List TLV included in

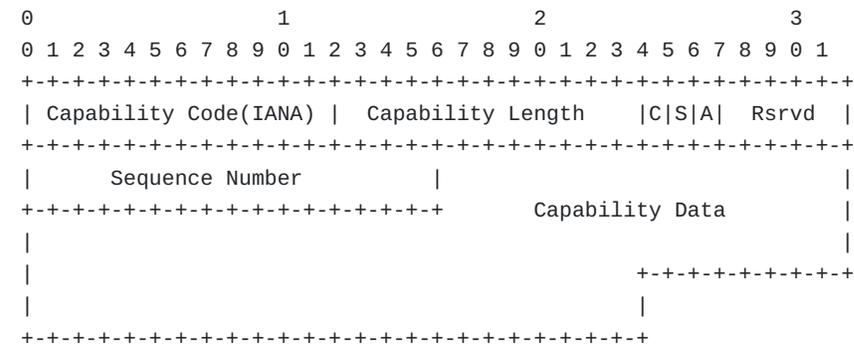
the Capability message specifies the capabilities the LDP speaker wishes to advertise or withdraw.

The Capability List TLV MAY also be carried in a Notification message when the Status Code in the Status TLV is Unsupported Capability as described below.

The format of the Capability List TLV is:



where Capability List is a list of 1 or more Capability Objects, each of which has the format:



where:

Capability Code: Identifies the capability. Capability codes are assigned by IANA.

Capability Length: The length in octets of the Capability Object exclusive of the Capability Code and Length fields.

C, S, A bits:
Each MUST be 0 in a Capability Object included in an Initialization message.

The C, S, and A bits of a Capability Object in a Capability message are used as follows:

C bit: The Command Bit indicates whether the sender is

announcing a change in state for the specified capability or acknowledging receipt of a state change announcement.

- 1 - Announcement of a capability state change
- 0 - Acknowledgement of an capability announcement

S bit: The State Bit indicates whether the sender is advertising or withdrawing the specified capability. The S bit is ignored for acknowledgements (C-bit = 0).

- 1 - Capability is advertised
- 0 - Capability is withdrawn

A bit: The Acknowledgement Request Bit indicates that the sender requests the receiver acknowledge the change in state of the specified capability. The A bit is ignored for acknowledgements (C bit = 0).

- 1 - Acknowledgement requested for capability advertisement (withdrawal)
- 0 - Acknowledgement not required

Rsvrd: Reserved for future use.

Sequence Number:

The Sequence Number MUST be 0 in a Capability Object included in an Initialization message.

The Sequence Number is used to uniquely identify the revision of the capability state for a capability state change initiated by a Capability message that requires acknowledgement. The Sequence Number is specified by the LDP speaker initiating the change and included by its peer in the peer's acknowledgement of the change.

Capability Data: Additional data required to fully specify the capability.

6. Note on Terminology

The sections that follow talk of enabling and disabling capabilities. The terminology "enabling (or disabling) a capability" is short hand for "advertising (or withdrawing) a capability". Bear in mind that it is an LDP enhancement that is enabled or disabled and that it is the corresponding capability that is advertised or withdrawn.

7. Procedures for Capability TLVs in Initialization Messages

An LDP speaker SHOULD NOT include more than one instance of a capability with the same Capability Code, Capability Length, and Capability Value in an Initialization message. Note however, that processing multiple instances of such a capability does not require special handling, as additional instances do not change the meaning of an announced capability.

An LDP speaker determines the capabilities enabled by a peer by examining the list of capabilities in the Capability List TLV, if present in the Initialization message the speaker receives from the peer.

An LDP speaker that has enabled a particular capability MAY use the capability with its peer after the speaker determines that the peer has enabled the capability.

These procedures enable an LDP speaker A that advertises a specific LDP capability C to establish an LDP session with speaker B that does not advertise C though B may support the LDP Capability List TLV and the feature associated with C. In this situation whether or not capability C may be used for the session depends on the semantics of the functionality associated with C. If the semantics do not require both A and B advertise C to one another then B could use it; that is, A's advertisement of C permits B to use the corresponding functionality for the session.

It is the responsibility of the capability designer to specify the behavior of an LDP speaker that has enabled a certain enhancement and determines that its peer has not advertised the corresponding capability. The document specifying procedures for the capability MUST describe the behavior in this situation. If the specified procedure is to terminate the session the LDP speaker SHOULD send a Notification message to the peer before terminating the session. The Status Code in the Status TLV of the Notification message SHOULD be Unsupported Capability, and the message SHOULD contain the unsupported capabilities (see [Section 9](#) for more details). In this case the session SHOULD NOT be re-established automatically. How the session is re-established is beyond the scope of this document. It depends on the LDP capability and MUST be specified along with the procedures specifying the capability.

An LDP speaker that supports capability advertisement and includes a Capability List TLV in its Initialization message MAY set the TLV U bit to 1. This ensures that an [RFC3036](#) compliant peer that does not support the capability mechanism will ignore the TLV and allow the session to be established.

8. Procedures for Capability List TLVs in Capability Messages.

An LDP speaker MUST NOT send a Capability message to a peer unless both the speaker and its peer had advertised the Dynamic Announcement capability in their session Initialization messages and neither has disabled the capability by means of a Capability message.

An LDP speaker MAY send a Capability message to a peer if both the speaker and its peer had advertised the Dynamic Announcement capability in their session Initialization messages.

An LDP speaker determines the capabilities enabled by a peer by determining the set of capabilities enabled at session initialization (as specified in [Section 7](#)) and tracking changes to that set made by Capability messages from the peer.

An LDP speaker that has enabled a particular capability MAY use the enhancement corresponding to the capability with its peer after the speaker determines that the peer has enabled the capability.

Some capabilities may be such that when dynamically enabled or disabled proper operation requires synchronization of the protocol message stream between LDP speakers. The purpose of the synchronization is to ensure that when a protocol message is received and processed during the state transition of such a capability the capability state in effect at the receiver is the same as the capability state in effect when the sender generated the message.

The following acknowledgement mechanism provides the coordination required for such capabilities:

- The LDP speaker that initiates the state change for such a capability MUST include an acknowledgement request with the Capability Object in the Capability message to its peer, and the peer receiving a Capability message for a change that includes an acknowledgement request MUST acknowledge receipt of the capability state change by means of a Capability message.
- For the LDP speaker initiating the capability change the change for generating messages related to the capability takes effect immediately after the Capability message is sent, and the change for processing received messages takes effect immediately after an acknowledgement is received from its peer.
- For the peer receiving the capability change announcement the change for processing received messages takes effect immediately after the capability change is received and the change for generating messages takes effect immediately after the

acknowledgement is sent.

Not every capability requires the type of synchronization the acknowledgement mechanism provides. Furthermore, the announcement of a capability in an Initialization message does not require it since no messages other than those required to establish the session are permitted until the session is fully established.

It is the responsibility of the capability designer to specify whether the capability requires the acknowledgement mechanism when it is announced by means of a Capability message.

9. Extensions to Error Handling

This document defines a new LDP status code named Unsupported Capability. The S bit of the Status TLV carried in a Notification message that includes this status code SHOULD be set to 0.

In addition, this document defines a new LDP TLV named Returned TLV that MAY be carried in a Notification message. The U- bit and F bit settings for the Returned TLV in a Notification message is TBD and will be specified when the Returned TLV is fully specified.

When the Status Code in a Notification message is Unsupported Capability the message SHOULD specify the capabilities that are unsupported. When the Notification message specifies the unsupported capabilities it MUST specify them as a Capability List TLV included in a Returned TLV, the Capability List TLV MUST include only the capabilities not supported, and each capability MUST be encoded in the way it would be in an Initialization TLV.

When the Status Code in a Notification Message is Unknown TLV the message SHOULD specify the TLV that was unknown. When the Notification message specifies the TLV that was unknown it MUST include the unknown TLV in a Returned TLV.

10. Backward Compatibility

From the point of view of the LDP capability advertisement mechanism an [RFC3036](#) compliant peer has label distribution for IPv4 enabled by default. To ensure compatibility with an [RFC3036](#) compliant peer LDP implementations that support capability advertisement have label distribution for IPv4 enabled until it is explicitly disabled and MUST assume that their peers do as well.

Existing LDP enhancements that use an ad hoc mechanism for activation

(e.g., [[RFC3478](#)] [[RFC3479](#)]) MAY continue to do so.

11. Security Considerations

The security considerations described in [[RFC3036](#)] that apply to the base LDP specification apply to the capability mechanism described in this document.

12. IANA Considerations

This document creates a new LDP capability name space for the Capability codes contained in the Capability List TLV. The LDP capability name space is to be managed by IANA.

- Capability Code value 0 is reserved.
- Capability Code value 1 is assigned to the Dynamic Announcement capability defined in this document.
- Capability Code values 2 through 1023 are to be assigned by IANA using the "IETF Consensus" policy defined in [RFC 2434](#).
- Capability Code values 1024 through 2047 are to be assigned by IANA, using the "First Come First Served" policy defined in [RFC 2434](#).
- Capability Code values 2048 through 4095 are for "Private Use" as defined in [RFC 2434](#).

This document specifies the following which require code points assigned by IANA:

- New LDP Capability message. The authors request message type 0x202 for the Capability message.
- New LDP Capability List TLV type. The authors request TLV type 0x505 for the Capability List TLV.
- New LDP Returned TLV TLV type. The authors request TLV type 0x506.
- New LDP Unsupported Capability Status Code.

[13.](#) Acknowledgements

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