Network Working Group
Internet Draft
Expiration Date: November 2007

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May 2007

LDP Capabilities

draft-ietf-mpls-ldp-capabilities-00.txt

Status of this Memo

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 LDP has no guidelines for advertising such enhancements at LDP session initialization time. There is also no mechanism to enable and disable enhancements after the session is established. This document provides guidelines for advertising LDP enhancements at session initialization time. It also defines a mechanism to enable and disable enhancements after LDP 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 [RFC4447], 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 guidelines for advertising such enhancements at LDP session initialization time. There is also no mechanism to enable and disable enhancements after the session is established.

This document provides guidelines for advertising LDP enhancements at session initialization time. It also defines a mechanism to enable and disable enhancements after LDP session establishment.

LDP capability advertisement provides means for an LDP speaker to announce what it can receive and process. It also provides means for a speaker to inform peers of deviations from behavior specified by [RFC3036]. An example of such a deviation is LDP graceful restart where a speaker retains MPLS forwarding state for LDP-signaled LSPs when its LDP control plane goes down. It is important to point out that not all LDP enhancements require capability advertisement. For example, upstream label allocation does but inbound label filtering, where a speaker installs forwarding state for only certain FECs, does not.

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 enhancements each of which has an associated capability. At any time a speaker may have none, one or more of those enhancements "enabled". When an enhancement 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 enhancement. For example, the actions may involve receiving and processing messages from a peer that the enhancement requires. Unless the capability has been advertised the speaker will not perform protocol actions specified for the corresponding enhancement.

- At session establishment time an LDP speaker MAY advertise a particular capability by including an optional parameter associated with the capability in its Initialization message.

- There is a well-known capability called Dynamic Capability Announcement which an LDP speaker MAY advertise in its Initialization message to indicate that it is capable of

processing capability announcements following session establishment.

If a peer had advertised the Dynamic Capability 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 specifies the capabilities being advertised or withdrawn.

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;

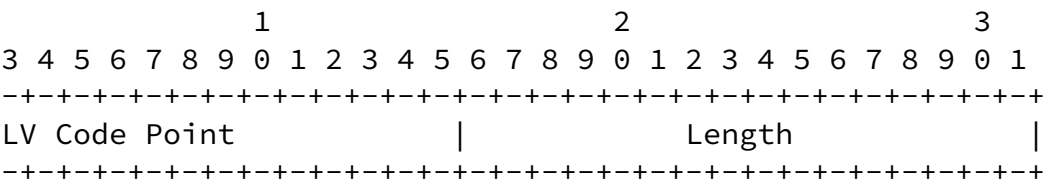
- Specifies the behavior of LDP when the enhancement is enabled. This includes the procedures, parameters, messages, and TLVs required by the enhancement;

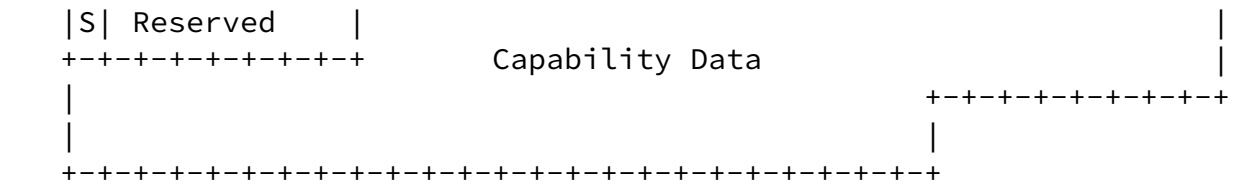
- Includes an IANA considerations section that notes that an IANA-assigned code point for the optional parameter corresponding to the enhancement is required.

4. Specifying Capabilities in LDP Messages

This document uses the term "Capability Parameter" to refer to an optional parameter that may be included in Initialization and Capability messages to advertise a capability.

The format of a TLV that is a Capability Parameter is:





where:

U and F bits:
As specified in [RFC3036].

TLV Code Point:
The TLV type which identifies a specific capability. The "IANA Considerations" section of [RFC3036] specifies the assignment of code points for LDP TLVs.

S-bit:
The State Bit indicates whether the sender is advertising or withdrawing the capability corresponding to the TLV Code Point. The State bit is used as follows:

1 - The TLV is advertising the capability specified by the TLV Code Point.
0 - The TLV is withdrawing the capability specified by the TLV Code Point.

Capability Data:

Information, if any, about the capability in addition to the TLV Code Point required to fully specify the capability.

An LDP speaker MAY include more than one instance of a Capability Parameter (as identified by the TLV Code Point) with different non-empty Capability Data in an Initialization or Capability message. The method for processing such Capability Parameters is specific to the TLV Code Point and MUST be described in the document specifying the capability.

To ensure backward compatibility with existing implementations the following TLVs play the role of a Capability Parameter when included in Initialization messages:

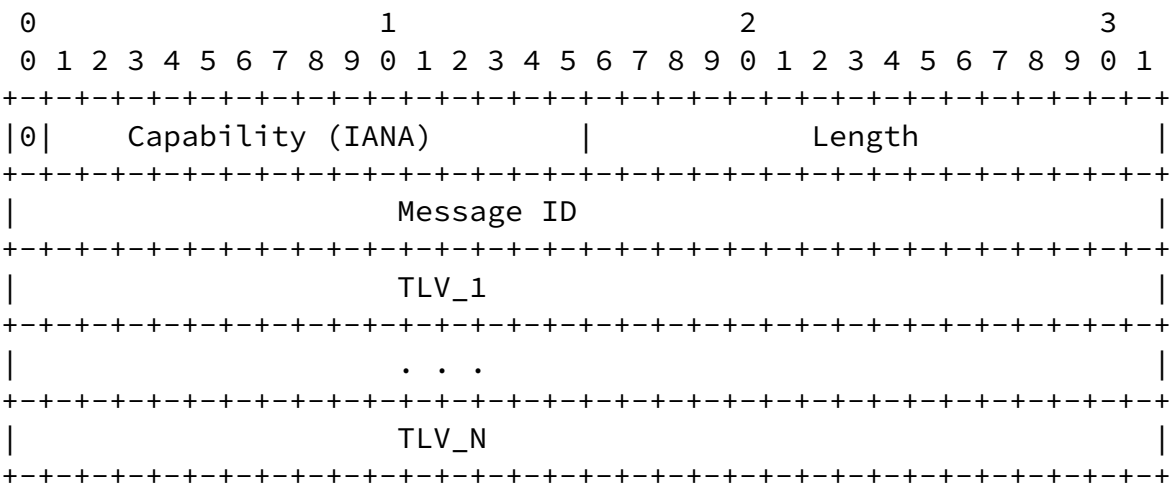
- FT Session TLV [RFC3479]

This document refers to such TLVs as Backward Compatibility TLVs.

5. 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.

The format of the Capability message is:



where TLV_1 through TLV_N are Capability Parameters. The S-bit of each of the TLVs specifies the new state for the corresponding capability.

Note that Backward Compatibility TLVs (see Section 4) MUST NOT be included in Capability messages.

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 associated with an enhancement". Bear in mind that it is an LDP enhancement that is enabled or disabled and that it is the corresponding capability that is advertisted or withdrawn.

7. Procedures for Capability Parameters in Initialization Messages

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

The S-bit of a Capability Parameter in an Initialization message MUST be 1 and SHOULD be ignored on receipt. This ensures that any Capability Parameter in an Initialization message enables the corresponding capability.

An LDP speaker determines the capabilities enabled by a peer by examining the set of of Capability Parameters present in the Initialization message received from the peer.

An LDP speaker MAY use a particular capability with its peer after the speaker determines that the peer has enabled that 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. In this situation whether or not capability C may be used for the session depends on the semantics of the enhancement 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 send messages to A used by the enhancement.

It is the responsibility of the capability designer to specify the behavior of an LDP speaker that has enabled a certain enhancement, advertised its capability 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 Parameter in its Initialization message SHOULD set the TLV U bit to 1. This ensures that an [RFC3036] compliant peer that does not support the capability mechanism will ignore the Capability Parameter and allow the session to be established.

8. Procedures for Capability Parameters in Capability Messages

An LDP speaker MUST NOT send a Capability message to a peer unless its peer had advertised the Dynamic Capability Announcement capability in its session Initialization message (see Section 10).

An LDP speaker MAY send a Capability message to a peer if its peer had advertised the Dynamic Capability Announcement capability in its session Initialization message (see Section 10).

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 a peer after the speaker determines that the peer has enabled the capability.

9. Extensions to Error Handling

This document defines a new LDP status code named Unsupported Capability. The E 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 TLVs TLV that MAY be carried in a Notification message. The U-bit setting for a Returned TLVs TLV in a Notification message SHOULD be 1 and the F-bit setting SHOULD be 0.

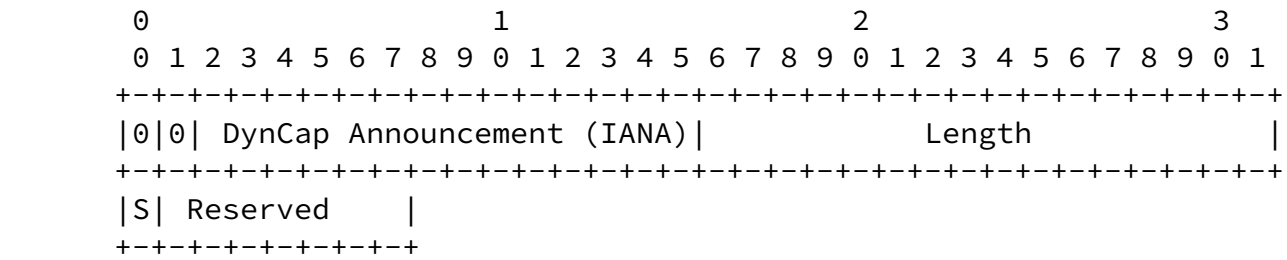
When the Status Code in a Notification message is Unsupported Capability the message SHOULD specify the capabilities that are

unsupported. When the Notification message specifies the unsupported capabilities it MUST include a Returned TLVs TLV which includes each unsupported Capability Parameter. The Returned TLVs TLV MUST include only the Capability Parameters for unsupported capabilities. In addition, the Capability Parameter for each such capability SHOULD be encoded as received from the peer.

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 TLVs TLV.

10. Dynamic Capability Announcement TLV

The Dynamic Capability Announcement TLV is a Capability Parameter. Its format is:



The Dynamic Capability Announcement Parameter MAY be included by an LDP speaker in an Initialization message to signal its peer that the speaker is capable of processing Capability messages.

An LDP speaker MUST NOT include the Dynamic Capability Announcement Parameter in Capability messages sent to its peers. Once enabled during session initialization the Dynamic Capability Announcement capability cannot be disabled.

An LDP speaker that receives a Capability message from a peer that includes the Dynamic Capability Announcement Parameter SHOULD silently ignore the parameter and process any other Capability Parameters in the message.

11. 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.

Section 3 identifies a set of Backward Compatibility TLVs that may appear in Initialization messages in the role of a Capability Parameter. This permits existing LDP enhancements that use an ad hoc mechanism for enabling capabilities at sesssion initialization time to continue to do so.

12. Security Considerations

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

13. IANA Considerations

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

- LDP message code point for the Capability message. The authors request message type 0x0202 for the Capability message.

- LDP TLV code point for the Dynamic Capability Announcemnt TLV. The authors request TLV type code 0x0506.

- LDP TLV code point for the Returned TLVs TLV. The authors request TLV type 0x304.

- LDP Status Code code point for the Unsupported Capability Status Code. The authors request Status Code 0x0000002C.

14. Acknowledgements

The authors wish to thank Enke Chen, Vanson Lim, Ina Minei, Bin Mo, Yakov Rekhter, and Eric Rosen for their comments.

15. References

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