

The Label Distribution Protocol (LDP) Implementation Survey Results

Status of This Memo

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Abstract

Multiprotocol Label Switching (MPLS), described in RFC 3031, is a method for forwarding packets that uses short, fixed-length values carried by packets, called labels, to determine packet next hops. A fundamental concept in MPLS is that two Label Switching Routers (LSRs) must agree on the meaning of the labels used to forward traffic between and through them. This common understanding is achieved by using a set of procedures, called a Label Distribution Protocol (as described in RFC 3036), by which one LSR informs another of label bindings it has made. One such protocol, called LDP, is used by LSRs to distribute labels to support MPLS forwarding along normally routed paths. This document reports on a survey of LDP implementations conducted in August 2002 as part of the process of advancing LDP from Proposed to Draft Standard.

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1. Introduction

Multiprotocol Label Switching (MPLS) is a method for forwarding packets that uses short fixed-length values carried by packets, called labels, to determine packet next hops [RFC3031]. A fundamental MPLS concept is that two Label Switching Routers (LSRs) must agree on the meaning of the labels used to forward traffic between and through them. This common understanding is achieved by using a set of procedures by which one LSR informs another of label bindings it has made.

Label Distribution Protocol (LDP) specifies a set of procedures LSRs use to distribute labels to support MPLS forwarding along normally routed paths. LDP was specified originally by [RFC3036]. The current LDP specification is [RFC5036], which obsoletes [RFC3036]. [RFC3037] describes the applicability of LDP.

This document reports on a survey of LDP implementations conducted in August 2002 as part of the process of advancing LDP from Proposed to Draft standard.

This section highlights some of the survey results. Section 2 presents the survey results for LDP features, and Appendix A presents the survey results in full. Appendix B contains a copy of the survey form.

1.1. The LDP Survey Form

The LDP implementation survey requested the following information about LDP implementation:

- Responding organization. Provisions were made to accommodate organizations that wished to respond anonymously.
- The status, availability, and origin of the LDP implementation.
- The LDP features implemented and for each whether it was tested against an independent implementation. The survey form listed each LDP feature defined by [RFC3036] and requested one of the following as the status of the feature:

- t: Tested against another independent implementation
- y: Implemented but not tested against independent implementation
- n: Not implemented
- x: Not applicable to this type of implementation

In addition, for the 'n' status, the responder could optionally provide the following additional information:

- s: RFC specification inadequate, unclear, or confusing
- u: Utility of feature unclear
- r: Feature not required for feature set implemented

This document uses the following conventions for reporting survey results for a feature:

At By Cn indicates:

- A responders implemented the feature and tested it against another independent implementation (t)
- B responders implemented the feature but have not tested it against an independent implementation (y)
- C responders did not implement the feature (n)

(Ds Eu Fr) indicates optional responses:

- D responders thought the RFC 3036 specification of the feature inadequate, unclear, or confusing (s).
- E responders thought the utility of the feature unclear (u).
- F responders considered the feature not required for the feature set implemented (combines x and r).

1.2. LDP Survey Highlights

This section presents some highlights from the implementation survey.

- There were 12 responses to the survey, 2 of which were anonymous. At the time of the survey, 10 of the implementations were available as products and 2 were in beta test. Eleven of the implementations were available for sale; the remaining implementation had been done by a company no longer in business.
- Seven implementations were independently written from the RFC 3036 specification. Four implementations combined purchased or free code with code written by the responder.

One of the implementations was fully purchased code ported to the vendor's platform.

- Every LDP feature in the survey questionnaire was implemented by at least 2 respondents.

- Each of the 8 LDP Label Distribution Modes implemented and tested:

| | |
|----------|---------------------------|
| 8t 2y 2n | DU, Ord Cntl, Lib reten |
| 7t 1y 4n | DU, Ind Cntl, Lib reten |
| 7t 1y 4n | DoD Ord Cntl, Cons reten |
| 6t 1y 5n | DoD, Ind Cntl, Cons reten |
| 6t 1y 5n | DU, Ord Cntl, Cons reten |
| 6t 0y 6n | DU, Ind Cntl, Cons reten |
| 4t 3y 5n | DoD, Ord Cntl, Lib reten |
| 4t 2y 6n | DoD, Ind Cntl, Lib reten |

- Platform and Interface Label Spaces were both widely supported.

| | |
|-----------|---------------|
| 12t 0y 0n | Per platform |
| 7t 1y 4n | Per interface |

- LDP Basic and Targeted Sessions were both widely supported.

| | |
|-----------|--------------------------|
| 12t 0y 0n | Basic/Directly Connected |
| 11t 1y 0n | Targeted |

- The TCP MD5 Option for LDP session TCP connections was not widely implemented.

| | |
|----------|--|
| 3t 1y 8n | |
|----------|--|

2. Survey Results for LDP Features

This section presents the survey results for LDP features using the notational convention described in Section 1.2. It omits the optional status responses (s, u, r); complete results may be found in Appendix A.

| Feature | Survey Result |
|---------|---------------|
|---------|---------------|

Interface types

| | |
|-----------|-------------|
| 12t 0y 0n | Packet |
| 2t 3y 7n | Frame Relay |
| 6t 2y 4n | ATM |

Label Spaces

| | |
|-----------|---------------|
| 12t 0y 0n | Per platform |
| 7t 1y 4n | Per interface |

LDP Discovery

| | |
|-----------|----------|
| 12t 0y 0n | Basic |
| 11t 1y 0n | Targeted |

| | |
|----------------|---------------------------|
| LDP Sessions | |
| 12t 0y 0n | Directly Connected |
| 11t 1y 0n | Targeted |
| LDP Modes | |
| 7t 1y 4n | DU, Ind Cntl, Lib reten |
| 8t 2y 2n | DU, Ord Cntl, Lib reten |
| 6t 0y 6n | DU, Ind Cntl, Cons reten |
| 6t 1y 5n | DU, Ord Cntl Cons reten |
| 4t 2y 6n | DoD, Ind Cntl, Lib reten |
| 4t 3y 5n | DoD, Ord Cntl, Lib reten |
| 6t 1y 5n | DoD, Ind Cntl, Cons reten |
| 7t 1y 4n | DoD, Ord Cntl, Cons reten |
| Loop Detection | |
| 9t 2y 1n | |
| TCP MD5 Option | |
| 3t 1y 8n | |
| LDP TLVs | |
| 7t 4y 0n | U-bit |
| 7t 4y 0n | F-bit |
| 12t 0y 0n | FEC TLV |
| 6t 5y 1n | Wildcard |
| 12t 0y 0n | Prefix |
| 10t 0y 2n | Host |
| 12t 0y 0n | Address List TLV |
| 10t 1y 1n | Hop Count TLV |
| 9t 2y 1n | Path Vector TLV |
| 12t 0y 0n | Generic Label TLV |
| 6t 2y 4n | ATM Label TLV |
| 2t 3y 7n | Frame Relay Label TLV |
| 12t 0y 0n | Status TLV |
| 9t 3y 0n | Extended Status TLV |
| 6t 4y 2n | Returned PDU TLV |
| 6t 4y 2n | Returned Message TLV |
| 12t 0y 0n | Common Hello Param TLV |
| 12t 0y 0n | T-bit |
| 11t 0y 1n | R-bit |
| 11t 1y 0n | Hold Time |
| 12t 0y 0n | IPv4 Transport Addr TLV |
| 7t 2y 3n | Config Sequence Num TLV |
| 1t 1y 1n | IPv6 Transport Addr TLV |
| 12t 0y 0n | Common Session Param TLV |
| 12t 0y 0n | KeepAlive Time |
| 11t 0y 1n | PVLim |
| 11t 1y 0n | PDU Max Length |
| 6t 2y 2n | ATM Session Param TLV |
| | M values |
| 5t 3y 4n | 0 No Merge |
| 3t 3y 6n | 1 VP Merge |

| | |
|------------------|---------------------------|
| 5t 3y 4n | 2 VC Merge |
| 3t 3y 6n | 3 VP & VC Merge |
| 6t 2y 4n | D-bit |
| 6t 2y 4n | ATM Label Range Component |
| 2t 3y 7n | FR Session Param TLV |
| | M values |
| 2t 3y 7n | 0 No Merge |
| 2t 3y 7n | 1 Merge |
| 2t 3y 7n | D-bit |
| 2t 3y 7n | FR Label Range Component |
| 10t 0y 2n | Label Request Msg ID TLV |
| 2t 5y 5n | Vendor-Private TLV |
| 1t 5y 6n | Experimental TLV |
| LDP Messages | |
| 12t 0y 0n | Notification Msg |
| 12t 0y 0n | Hello Msg |
| 12t 0y 0n | Initialization Msg |
| 12t 0y 0n | KeepAlive Msg |
| 12t 0y 0n | Address Msg |
| 12t 0y 0n | Address Withdraw Msg |
| 12t 0y 0n | Label Mapping Msg |
| 10t 0y 2n | Label Request Msg Id TLV |
| 10t 1y 1n | Hop Count TLV |
| 10t 1y 1n | Path Vect TLV |
| 9t 0y 3n | Label Request Msg |
| 9t 0y 3n | Hop Count TLV |
| 9t 0y 3n | Path Vect TLV |
| 12t 0y 0n | Label Withdraw Msg |
| 12t 0y 0n | Label TLV |
| 11t 0y 1n | Label Release Msg |
| 10t 1y 1n | Label TLV |
| 9t 2y 1n | Label Abort Req Msg |
| 2t 5y 5n | Vendor-Private Msg |
| 1t 5y 6n | Experimental Msg |
| LDP Status Codes | |
| 9t 3y 0n | Success |
| 8t 4y 0n | Bad LDP Id |
| 7t 5y 0n | Bad Pttl Version |
| 7t 5y 0n | Bad PDU Length |
| 7t 5y 0n | Unknown Message Type |
| 7t 5y 0n | Bad Message Length |
| 7t 4y 0n | Unknown TLV |
| 7t 5y 0n | Bad TLV length |
| 7t 5y 0n | Malformed TLV Value |
| 11t 1y 0n | Hold Timer Expired |
| 11t 1y 0n | Shutdown |
| 10t 1y 1n | Loop Detected |
| 7t 5y 0n | Unknown FEC |

| | |
|-----------|---------------------------|
| 11t 1y 0n | No Route |
| 9t 3y 0n | No Label Resources |
| 8t 3y 1n | Label Resources Available |
| | Session Rejected |
| 7t 5y 0n | No Hello |
| 9t 2y 1n | Param Advert Mode |
| 9t 2y 1n | Param PDUMax Len |
| 8t 3y 1n | Param Label Range |
| 7t 5y 0n | Bad KA Time |
| 11t 1y 0n | KeepAlive Timer Expired |
| 9t 1y 2n | Label Request Aborted |
| 6t 5y 1n | Missing Message Params |
| 7t 5y 0n | Unsupported Addr Family |
| 7t 5y 0n | Internal Error |

3. Security Considerations

This document is a survey of existing LDP implementations; it does not specify any protocol behavior. Thus, security issues introduced by the document are not discussed.

4. Informative References

- [RFC3031] Rosen, E., Viswanathan, A., and R. Callon, "Multiprotocol Label Switching Architecture", RFC 3031, January 2001.
- [RFC3036] Andersson, L., Doolan, P., Feldman, N., Fredette, A., and B. Thomas, "LDP Specification", RFC 3036, January 2001.
- [RFC3037] Thomas, B. and E. Gray, "LDP Applicability", RFC 3037, January 2001.
- [RFC5036] Andersson, L., Ed., Minei, I., Ed., and B. Thomas, Ed., "LDP Specification", RFC 5036, October 2007.

Appendix A. Full LDP Survey Results

LDP Implementation Survey Form (V 1.0)

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A. General Information

Responders:

Anonymous: 2
Public: 10

Agilent Technologies
Celox Networks, Inc.
Cisco Systems, Inc.
Data Connection Ltd.
NetPlane Systems, Inc
Redback Networks
Riverstone Networks
Trillium, An Intel Company
Vivace Networks, Inc.
Wipro Technologies

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B. LDP Implementation Status, Availability, Origin

Status:

- ☐ Development
- ☐ Alpha
- ☒ Beta
- ☒ Product
- ☐ Other (describe):

Availability:

- ☐ Public and free
- ☐ Only to selected organizations/companies but free
- ☒ On sale
- ☐ For internal company use only
- ☒ Other:

Implementation based on: (check all that apply)

- ☒ Purchased code
(please list source if possible)
- ☐ Free code
(please list source if possible)
- ☒ Internal implementation
(no outside code, just from specs)
- ☒ Internal implementation on top of purchased
or free code

=====

C. LDP Feature Survey

For each feature listed, please indicate the status of the implementation using one of the following:

- 't' tested against another independent implementation
- 'y' implemented but not tested against independent implementation
- 'n' not implemented
- 'x' not applicable to this type of implementation

Optional: For 'n' status, indicate reason for not implementing using one of the following:

- 's' RFC specification inadequate, unclear, or confusing
- 'u' utility of feature unclear
- 'r' feature not required for feature set implemented

| Feature Survey Result | | RFC 3036 Section(s) |
|--------------------------|---------------------------|-------------------------------|
| Interface types | | 2.2.1, 2.5.3, 2.8.2, 3.4.2 |
| 12t 0y 0n | Packet | |
| 2t 3y 7n(3r 1x) | Frame Relay | |
| 6t 2y 4n(3r) | ATM | |
| Label Spaces | | 2.2.1, 2.2.2 |
| 12t 0y 0n | Per platform | |
| 7t 1y 4n(4r) | Per interface | |
| LDP Discovery | | 2.4 |
| 12t 0y 0n | Basic | 2.4.1 |
| 11t 1y 0n | Targeted | 2.4.2 |
| LDP Sessions | | 2.2.3 |
| 12t 0y 0n | Directly Connected | -- |
| 11t 1y 0n | Targeted | 2.3 |
| LDP Modes | | 2.6 |
| 7t 1y 4n(2u 1r) | DU, Ind cntl, Lib reten | 2.6 |
| 8t 2y 2n(1r) | DU, Ord cntl, Lib reten | 2.6 |
| 6t 0y 6n(2u 2r) | DU, Ind cntl, Cons reten | 2.6 |
| 6t 1y 5n(1u 2r) | DU, Ord cntl, Cons reten | 2.6 |
| 4t 2y 6n(2u 2r) | DoD, Ind cntl, Lib reten | 2.6 |
| 4t 3y 5n(2r) | DoD, Ord cntl, Lib reten | 2.6 |
| 6t 1y 5n(2u 2r) | DoD, Ind cntl, Cons reten | 2.6 |
| 7t 1y 4n(1u 2r) | DoD, Ord cntl, Cons reten | 2.6 |
| Loop Detection | | 2.8 |
| 9t 2y 1n | | |

| | | |
|---------------------|--------------------------|----------------------|
| TCP MD5 Option | | 2.9 |
| 3t 1y 8n(1u 1r 1x) | | |
| LDP TLVs | | 3.3, 3.4, throughout |
| 7t 4y 0n(1 noreply) | U-bit | 3.3 |
| 7t 4y 0n(1 noreply) | F-bit | 3.3 |
| | FEC TLV | 1, 2.1, 3.4.1 |
| 6t 5y 1n(1r) | Wildcard | 3.4.1 |
| 12t 0y 0n | Prefix | 3.4.1 |
| 10t 0y 2n(s1 1u 1r) | Host | 2.1, 3.4.1 |
| 12t 0y 0n | Address List TLV | 3.4.3 |
| 10t 1y 1n | Hop Count TLV | 3.4.4 |
| 9t 2y 1n | Path Vector TLV | 3.4.5 |
| 12t 0y 0n | Generic Label TLV | 3.4.2.1 |
| 6t 2y 4n(2r) | ATM Label TLV | 3.4.2.2 |
| 2t 3y 7n(1u 2r 1x) | Frame Relay Label TLV | 3.4.2.3 |
| 12t 0y 0n | Status TLV | 3.4.6 |
| 9t 3y 0n | Extended Status TLV | 3.5.1 |
| 6t 4y 2n | Returned PDU TLV | 3.5.1 |
| 6t 4y 2n | Returned Message TLV | 3.5.1 |
| 12t 0y 0n | Common Hello Param TLV | 3.5.2 |
| 12t 0y 0n | T-bit | 3.5.2 |
| 11t 0y 1n | R-bit | 3.5.2 |
| 11t 1y 0n | Hold Time | 3.5.2 |
| 12t 0y 0n | IPv4 Transport Addr TLV | 3.5.2 |
| 7t 2y 3n | Config Sequence Num TLV | 3.5.2 |
| 1t 1y 1n(1u 4r 1x) | IPv6 Transport Addr TLV | 3.5.2 |
| 12t 0y 0n | Common Session Param TLV | 3.5.3 |
| 12t 0y 0n | KeepAlive Time | 3.5.3 |
| 11t 0y 1n | PVLim | 3.5.3 |
| 11t 1y 0n | PDU Max Length | 3.5.3 |
| 6t 2y 2n(1r 1x) | ATM Session Param TLV | 3.5.3 |
| | M values | |
| 5t 3y 4n(1r 1x) | 0 No Merge | 3.5.3 |
| 3t 3y 6n(s 1 1r 1x) | 1 VP Merge | 3.5.3 |
| 5t 3y 4n(1r 1x) | 2 VC Merge | 3.5.3 |
| 3t 3y 6n(s1 1r 1x) | 3 VP & VC Merge | 3.5.3 |
| 6t 2y 4n(1r 1x) | D-bit | 3.5.3 |
| 6t 2y 4n(1r 1x) | ATM Label Range | 3.5.3 |
| | Component | |
| 2t 3y 7n(1u 1r 2x) | FR Session Param TLV | 3.5.3 |
| | M values | |
| 2t 3y 7n(1u 1r 2x) | 0 No Merge | 3.5.3 |
| 2t 3y 7n | 1 Merge | 3.5.3 |
| 2t 3y 7n(1u 1r 2x) | D-bit | 3.5.3 |
| 2t 3y 7n(1u 1r 2x) | FR Label Range | 3.5.3 |
| | Component | |
| 10t 0y 2n | Label Request Msg Id TLV | 3.5.7 |
| 2t 5y 5n(1u 1r) | Vendor-Private TLV | 3.6.1.1 |

| | | |
|---------------------|---------------------------|--------------------|
| 1t 5y 6n(2r) | Experimental TLV | 3.6.2 |
| LDP Messages | | 3.5, throughout |
| 12t 0y 0n | Notification Msg | 3.5.1 |
| 12t 0y 0n | Hello Msg | 3.5.2 |
| 12t 0y 0n | Initialization Msg | 3.5.3 |
| 12t 0y 0n | KeepAlive Msg | 3.5.4 |
| 12t 0y 0n | Address Msg | 3.5.5 |
| 12t 0y 0n | Address Withdraw Msg | 3.5.6 |
| 12t 0y 0n | Label Mapping Msg | 3.5.7 |
| 10t 0y 2n(1r) | Label Request Msg Id TLV | 3.5.7 |
| 10t 1y 1n | Hop Count TLV | 3.5.7 |
| 10t 1y 1n | Path Vect TLV | 3.5.7 |
| 9t 0y 3n(1x) | Label Request Msg | 3.5.8 |
| 9t 0y 3n(1x) | Hop Count TLV | 3.5.8 |
| 9t 0y 3n(1x) | Path Vect TLV | 3.5.8 |
| 12t 0y 0n | Label Withdraw Msg | 3.5.10 |
| 12t 0y 0n | Label TLV | 3.5.10 |
| 11t 0y 1n | Label Release Msg | 3.5.11 |
| 10t 1y 1n | Label TLV | 3.5.11 |
| 9t 2y 1n | Label Abort Req Msg | 3.5.9 |
| 2t 5y 5n(1u 1r) | Vendor-Private Msg | 3.6.1.2 |
| 1t 5y 6n(2r) | Experimental Msg | 3.6.2 |
| LDP Status Codes | | 3.4.6 |
| 9t 3y 0n | Success | 3.4.6, 3.9 |
| 8t 4y 0n | Bad LDP Id | 3.5.1.2.1 |
| 7t 5y 0n | Bad Pctl Version | 3.5.1.2.1 |
| 7t 5y 0n | Bad PDU Length | 3.5.1.2.1 |
| 7t 5y 0n | Unknown Message Type | 3.5.1.2.1 |
| 7t 5y 0n | Bad Message Length | 3.5.1.2.1 |
| 7t 4y 0n(1 noreply) | Unknown TLV | 3.5.1.2.2 |
| 7t 5y 0n | Bad TLV Length | 3.5.1.2.2 |
| 7t 5y 0n | Malformed TLV Value | 3.5.1.2.2 |
| 11t 1y 0n | Hold Timer Expired | 3.5.1.2.3 |
| 11t 1y 0n | Shutdown | 3.5.1.2.4 |
| 10t 1y 1n | Loop Detected | 3.4.5.1.2, 3.5.8.1 |
| 7t 5y 0n | Unknown FEC | 3.4.1.1 |
| 11t 1y 0n | No Route | 3.5.8.1 |
| 9t 3y 0n | No Label Resources | 3.5.8.1 |
| 8t 3y 1n | Label Resources Available | 3.5.8.1 |
| | Session Rejected | 2.5.3, 3.5.3 |
| 7t 5y 0n | No Hello | 2.5.3, 3.5.3 |
| 9t 2y 1n | Param Advert Mode | 2.5.3, 3.5.3 |
| 9t 2y 1n | Param PDU Max Len | 2.5.3, 3.5.3 |
| 8t 3y 1n | Param Label Range | 2.5.3, 3.5.3 |
| 7t 5y 0n | Bad KA Time | 3.5.1.2.5, 3.5.3 |
| 11t 1y 0n | KeepAlive Timer Expired | 2.5.6, 3.5.1.2.3 |
| 9t 1y 2n | Label Request Aborted | 3.5.9.1 |
| 6t 5y 1n | Missing Message Params | 3.5.1.2.1 |

| | | |
|----------|-------------------------|------------------|
| 7t 5y 0n | Unsupported Addr Family | 3.4.1.1, 3.5.5.1 |
| 7t 5y 0n | Internal Error | 3.5.1.2.7 |

Appendix B. LDP Implementation Survey Form

LDP Implementation Survey Form (V 1.0)

The purpose of this form is to gather information about implementations of LDP as defined by RFC 3036. The information is being requested as part of the process of advancing LDP from Proposed to Draft Standard.

The form is patterned after the implementation report form used for HTTP/1.1; see:

<http://www.ietf.org/IESG/Implementations/http1.1-implementations.txt>

=====

A. General Information

Please provide the following information.

Organization:

Organization url(s):

Product title(s):

Brief description(s):

Contact for LDP information

Name:

Title:

E-mail:

Organization/department:

Postal address:

Phone:

Fax:

=====

B. LDP Implementation Status, Availability, Origin

Please check [x] the boxes that apply.

Status:

- ☐ Development
- ☐ Alpha
- ☐ Beta
- ☐ Product
- ☐ Other (describe):

Availability

- ☐ Public and free
- ☐ Only to selected organizations/companies but free
- ☐ On sale.
- ☐ For internal company use only
- ☐ Other:

Implementation based on: (check all that apply)

- ☐ Purchased code
(please list source if possible)
- ☐ Free code
(please list source if possible)
- ☐ Internal implementation
(no outside code, just from specs)
- ☐ Internal implementation on top of purchased
or free code
List portions from external source:
List portions developed internally:

=====

C. LDP Feature Survey

For each feature listed, please indicate the status of the implementation using one of the following:

't' tested against another independent implementation
 'y' implemented but not tested against independent implementation
 'n' not implemented
 '-' not applicable to this type of implementation

Optional: For 'n' status, indicate reason for not implementing using one of the following:

's' RFC specification inadequate, unclear, or confusing
 'u' utility of feature unclear
 'r' feature not required for feature set implemented

| Feature | RFC 3036 Section(s) | Status (one of t, y, n, -; if n, optionally one of s, u, r) |
|-----------------|----------------------------|--|
| Interface types | 2.2.1, 2.5.3, 2.8.2, 3.4.2 | |
| Packet | | |
| Frame Relay | | |
| ATM | | |
| Label Spaces | 2.2.1, 2.2.2 | |
| Per platform | | |
| Per interface | | |
| LDP Discovery | 2.4 | |
| Basic | 2.4.1 | |
| Targeted | 2.4.2 | |

| | | |
|-------------------------------|----------------------|--|
| LDP Sessions | 2.2.3 | |
| Directly Connected | -- | |
| Targeted | 2.3 | |
| LDP Modes | 2.6 | |
| DU, Ind cntl, Lib retention | 2.6 | |
| DU, Ord cntl, Lib retention | 2.6 | |
| DU, Ind cntl, Cons retention | 2.6 | |
| DU, Ord cntl, Cons retention | 2.6 | |
| DoD, Ind cntl, Lib retention | 2.6 | |
| DoD, Ord cntl, Lib retention | 2.6 | |
| DoD, Ind cntl, Cons retention | 2.6 | |
| DoD, Ord cntl, Cons retention | 2.6 | |
| Loop Detection | 2.8 | |
| TCP MD5 Option | 2.9 | |
| LDP TLVs | 3.3, 3.4, throughout | |
| U-bit | 3.3 | |
| F-bit | 3.3 | |
| FEC | 1., 2.1, 3.4.1 | |

| | | |
|----------------------------------|------------|--|
| Wildcard | 3.4.1 | |
| Prefix | 2.1, 3.4.1 | |
| Host | 2.1, 3.4.1 | |
| Address List | 3.4.3 | |
| Hop Count | 3.4.4 | |
| Path Vector | 3.4.5 | |
| Generic Label | 3.4.2.1 | |
| ATM Label | 3.4.2.2 | |
| Frame Relay Label | 3.4.2.3 | |
| Status | 3.4.6 | |
| Extended Status | 3.5.1 | |
| Returned PDU | 3.5.1 | |
| Returned Message | 3.5.1 | |
| Common Hello Parameters | 3.5.2 | |
| T-bit | 3.5.2 | |
| R-bit | 3.5.2 | |
| Hold Time | 3.5.2 | |
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