Network Working Group
Request for Comments: 5038
Category: Informational

B. Thomas
Cisco Systems, Inc.
L. Andersson
Acreo AB

October 2007

The Label Distribution Protocol (LDP) Implementation Survey Results

Status of This Memo

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.

Table of Contents

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 implemented (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 implementation 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 Ptcl 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)

==========

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

==========

B. LDP Implementation Status, Availability, Origin

Status:
- [ ] Development
- [ ] Alpha
- [2] Beta
- [10] Product
- [ ] Other (describe):

Availability:
- [ ] Public and free
- [ ] Only to selected organizations/companies but free
- [11] On sale
- [ ] For internal company use only
- [1] Other:

Implementation based on: (check all that apply)
- [1] Purchased code
  (please list source if possible)
- [ ] Free code
  (please list source if possible)
- [7] Internal implementation
  (no outside code, just from specs)
- [4] 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 Component	3.5.3
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 Component	3.5.3
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 Ptcl 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	
IPv4 Transport Address	3.5.2	
Configuration Sequence Number	3.5.2	
IPv6 Transport Address	3.5.2	
Common Session Parameters	3.5.3	

KeepAlive Time	3.5.3	
PVLim	3.5.3	
Max PDU Length	3.5.3	
ATM Session Parameters	3.5.3	
M values		
0 No Merge	3.5.3	
1 VP Merge	3.5.3	
2 VC Merge	3.5.3	
3 VP & VC Merge	3.5.3	
D-bit	3.5.3	
ATM Label Range Component	3.5.3	
Frame Relay Session Parameters	3.5.3	
M values		
0 No Merge	3.5.3	
1 Merge	3.5.3	
D-bit	3.5.3	
Frame Relay Label Range Component	3.5.3	
Label Request Message Id	3.5.7	
Vendor-Private	3.6.1.1	
Experimental	3.6.2	

LDP Messages	3.5, throughout	
Notification	3.5.1	
Hello	3.5.2	
Initialization	3.5.3	
KeepAlive	3.5.4	
Address	3.5.5	
Address Withdraw	3.5.6	
Label Mapping	3.5.7	
Label Request Message Id TLV	3.5.7	
Hop Count TLV	3.5.7	
Path Vect TLV	3.5.7	
Label Request	3.5.8	
Hop Count TLV	3.5.8	
Path Vect TLV	3.5.8	
Label Withdraw	3.5.10	
Label TLV	3.5.10	
Label Release	3.5.11	
Label TLV	3.5.11	
Label Abort Req	3.5.9	
Vendor-Private	3.6.1.2	
Experimental	3.6.2	

LDP Status Codes	3.4.6	
Success	3.4.6, 3.9	
Bad LDP Id	3.5.1.2.1	
Bad Ptcl Version	3.5.1.2.1	
Bad PDU Length	3.5.1.2.1	
Unknown Message Type	3.5.1.2.1	
Bad Message Length	3.5.1.2.1	
Unknown TLV	3.5.1.2.2	
Bad TLV length	3.5.1.2.2	
Malformed TLV Value	3.5.1.2.2	
Hold Timer Expired	3.5.1.2.3	
Shutdown	3.5.1.2.4	
Loop Detected	3.4.5.1.2, 3.5.8.1	
Unknown FEC	3.4.1.1	
No Route	3.5.8.1	
No Label Resources	3.5.8.1	
Label Resources Available	3.5.8.1	
Session Rejected No Hello	2.5.3, 3.5.3	

Session Rejected Parameters Advert Mode	2.5.3, 3.5.3	
Session Rejected Parameters Max PDU Length	2.5.3, 3.5.3	
Session Rejected Parameters Label Range	2.5.3, 3.5.3	
KeepAlive Timer Expired	2.5.6, 3.5.1.2.3	
Label Request Aborted	3.5.9.1	
Missing Message Parameters	3.5.1.2.1	
Unsupported Address Family	3.4.1.1, 3.5.5.1	
Session Rejected Bad KeepAlive Time	3.5.1.2.5, 3.5.3	
Internal Error	3.5.1.2.7	

Author's Addresses

Bob Thomas
Cisco Systems, Inc.
1414 Massachusetts Ave.
Boxborough MA 01719

EMail: rhthomas@cisco.com

Loa Andersson
Acreo AB
Isafjordsgatan 22
Kista, Sweden

EMail: loa.andersson@acreo.se
loa@pi.se

Full Copyright Statement

Intellectual Property