LDP User Guide

Version 23.8.1.2, 06 November 2023

Registered Address	Support	Sales
26, Kingston Terrace, Princeton, New Jersey 08540, United States		
		+91 80 4850 5445
http://www.rtbrick.com	support@rtbrick.com	sales@rtbrick.com

Table of Contents

1. Overview

Label distribution protocol (LDP) is the most commonly used protocol in the MPLS network. It generates and distributes labels and thus helps in MPLS packet switching and forwarding. By using LDP, label-switching routers in an MPLS network can exchange label mapping information to create label-switched paths (LSPs) for switching data packets. RtBrick FullStack (RBFS) supports Dual-stack, which means LDP can exchange FEC-label bindings over either IPv4 or IPv6 networks.

1.1. Peer Discovery

LDP sends UDP multicast hello packets to discover its neighbors and establishes neighbor adjacency with other directly connected label switch routers (LSRs). The hello message is periodically sent on LDP-enabled interfaces.

1.2. Session Establishment

After peer discovery, “initialization messages” are sent to each other. In these messages, the session Parameters are sent to each other. The LDP sessions are maintained by periodic keep-alive message.

After the LDP neighbors are discovered, the TCP session is established and the LDP FSM is triggered, and LDP session becomes operational. LSRs start exchanging label mapping information with each other.

1.3. Dual-stack LDP

By default, RBFS is dual-stack capable, which means it can exchange IPv4/IPv6 FEC bindings over IPv4/IPv6 media (LDP over IPv4/IPv6).

To enable or disable a particular address family in RBFS, use "status <enable|disable>" CLI. For details, see LDP Address Family Configuration.

When LDP is enabled on an interface that supports both IPv4 and IPv6, LDP will start exchanging IPv4 hellos. To send an IPv6 hello, the source IPv6 address must be configured. For details about configuring the source address, see LDP Instance Configuration.

By default, both IPv4 and IPv6 hello will use the same transport preference as IPv6, but this can be changed by using the "connection-preference <ipv4|ipv6>" CLI. For details, see LDP Instance Configuration.

The following points should be noted regarding this functionality:

Source address:

- Unless modified, IPv4 and IPv6 hellos will be sent with transport preference as IPv6 when the IPv6 source address is configured.
- When the IPv6 source address is not configured, only IPv4 hello will be sent with transport-preference IPv4 and still act as a dual-stack router and exchange both IPv4 and IPv6 FEC bindings.

When IPv4 status is disabled:

- Only IPv6 hello will be sent without Dual-stack TLV.
- Only IPv6 FEC binding will be exchanged.

When IPv6 status is disabled:

- Only IPv4 hello will be sent without Dual-stack TLV.
- Only IPv4 FEC binding will be exchanged.

When both IPv4 and IPv6 statuses are enabled:

- Both IPv4 and IPv6 hellos will be exchanged (IPv6 source address configuration is mandatory for sending IPv6 hello).
- By default, the hello message uses IPv6 as the transport preference, unless otherwise specified.
- Both IPv4 and IPv6 FEC bindings will be exchanged.

1.4. Label Generation

LDP generates label bindings for the IP addresses of the LDP-enabled loopback interfaces and then advertises them to all neighbors.

1.5. Label Management Modes

1.5.1. Label Advertisement Mode

LDP supports the Downstream Unsolicited feature in RBFS, where label bindings are advertised to all upstream neighbors. By default, label advertisement operates in the Downstream Unsolicited mode.

1.5.2. Label Distribution Control Mode

LDP supports the Ordered Label Distribution Control, where an LSR will initiate the transmission of the label mapping only for the prefix for which it has a label mapping from the next hop of the prefix or for which it is an egress.

1.5.3. Label Retention Mode

LDP supports the Liberal Label Retention Mode where all the label mapping advertisements for all routes received from all the LDP neighbors are retained.

1.6. Supported LDP Standards

RFC Number	Description
RFC 5036	LDP Specification The following modes are supported by RBFS for the features listed in RFC 5036: • Label advertisement: Downstream Unsolicited mode is supported but not Downstream on Demand mode. • Label distribution control: Ordered mode is supported, but not Independent mode. • Label retention: Liberal mode is supported, but not Conservative mode.
RFC 5283	LDP Extension for Inter-Area Label Switched Paths (LSPs)
RFC 5443	LDP IGP Synchronization
RFC 7552	IPv6 Dual-Stack

RFC and draft compliance are partial except as specified.

1.7. Supported LDP Features

The following LDP features are supported in this release of RBFS:

- Support for the following label management modes.
  - Downstream unsolicited mode in label advertisement
  - Ordered mode in the label distribution control
  - Liberal mode in label retention
- Loop detection
- Inter-area support
- Tracking IGP metric
- IGP LDP synchronization
- LDP Dual-stack support

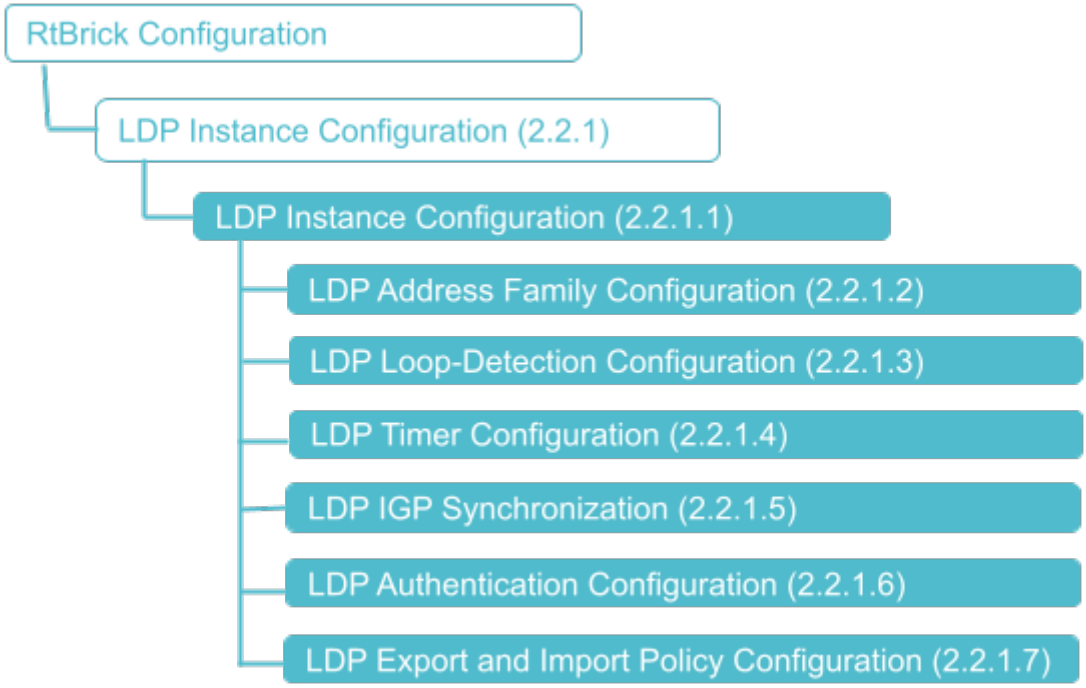
- LDP TCP authentication
- LDP redistribution
- LDP policy configuration

1.8. Supported Platforms

Not all features are necessarily supported on each hardware platform. Refer to the *Platform Guide* for the features and the sub-features that are or are not supported by each platform.

2. Configuration Hierarchy

The diagram below illustrates the LDP configuration hierarchy.



2.1. Configuration Syntax and Commands

The following sections describe the LDP configuration syntax and commands.

2.1.1. LDP Instance Configuration

At this configuration hierarchy, you configure LDP protocol parameters which are generic to the LDP instance.

Syntax:

set instance <instance-name> **protocol ldp** <attribute> <value>

Attribute	Description
<instance-name>	Name of the LDP instance.
interface <name>	Name of the logical interface.
router-id <router-id>	Router identifier in IPv4 format.

Attribute	Description
address-family <afi>	Address family identifier (AFI). Supported values: ipv4, or ipv6. Refer to section 2.1.2, "LDP Address Family Configuration" for LDP address family configuration details.
connection-preference <afi>	Specifies the connection preference for the TCP session. Supported values: ipv4, or ipv6. By default, IPv6 is used as the preferred TCP connection if an IPv6 source address is configured. Refer to section 1.3, "Dual-stack LDP" for more information on the LDP Dual-stack behaviour.
igp-synchronization <...>	LDP IGP synchronization configuration. This option is supported only on interfaces running Intermediate System-to-System (IS-IS) or OSPFv2 processes. Refer to section 2.1.5, "LDP IGP Synchronization" for LDP-IGP synchronization configuration details.
source-address <ipv4|ipv6> <source-address>	Use the specified IP addresses (IPv4 or IPv6) as the transport address for the LDP session. For LDP over IPv6, the IPv6 source address is mandatory. Refer to section 1.3, "Dual-stack LDP" for more information on the LDP Dual-stack behavior.
loop-detection <...>	The LDP loop detection feature enables LDP to detect loops during an LSP establishment. Refer to section 2.1.3, "LDP Loop Detection Configuration" for the loop detection configuration details.
timer <...>	Specifies the Hello hold time, Hello interval, Keepalive hold time, and Keepalive interval. Refer to section 2.1.4, "LDP Timer Configuration" for the LDP timer configuration details.
peer <ipv4|ipv6> <address> authentication-id <...>	Specifies an IPv4 or IPv6 LDP peer attributes to apply TCP authentication. Refer to section 2.1.6, "LDP Authentication Configuration".
peer <ipv4|ipv6> <address> export-policy|import-policy <...>	Specifies an IPv4 or IPv6 LDP peer attributes to apply import/export policy configurations. Refer to section 2.1.7, "LDP Import and Export Policy Configuration".

Example: LDP Instance Configuration

The following example shows some LDP instance configuration attributes. The further LDP configurations like timers and loop detection are shown in the examples in the subsequent sections.

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp
{
    "rtbrick-config:ldp": {
      "router-id": "198.51.100.1",
      "interface": [
        {
          "name": "ifl-0/0/0/1"
        },
        {
          "name": "ifl-0/0/0/100"
        },
        {
          "name": "ifl-0/0/0/101"
        },
        {
          "name": "ifl-0/0/1/102"
        },
        {
          "name": "ifl-0/0/2/1"
        },
        {
          "name": "ifl-0/0/3/1"
        },
        {
          "name": "lo-0/0/0/1"
        },
        {
          "name": "lo-0/0/0/2"
        },
        {
          "name": "lo-0/0/0/3"
        },
        {
          "name": "lo-0/0/0/4"
        },
        {
          "name": "lo-0/0/0/5"
        }
      ]
    }
  }
supervisor@rtbrick>SPINE01: cfg>
```

2.1.2. LDP Address Family Configuration

The address-family command allows you to enable the address families that LDP will route and configure settings that are specific to that address family.

Syntax:

set instance <instance-name> **protocol ldp address-family** <attribute> <value>

Attribute	Description
<afi>	Address family identifier (AFI). Supported values: ipv4, ipv6

Attribute	Description
<afi> status <enable|disable>	Enable or disable address family. By default, both IPv4 and IPv6 address families are enabled, as LDP supports dual stack. Refer to section 1.3, "Dual-stack LDP" for more information on the LDP Dual-stack behavior.
<afi> redistribute <source>	Specifies the source from which the routes are to be redistributed. The available options include direct, ipoe, isis, ospf, ppp, and static.
<afi> redistribute <source> policy <policy>	Specifies the name of the policy map. The redistribute attach point allows routes from other sources to be advertised by LDP. The policy can be applied only to the routes that are redistributed from other sources to LDP.

Example 1: LDP Address Family Configuration

```
supervisor@rtbrick>SPINE01: cfg>  show config instance default protocol ldp
address-family
{
  "rtbrick-config:address-family": [
    {
      "afi": "ipv6",
      "status": "disable"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

Example 2: LDP Redistribution Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp
address-family ipv4 redistribution direct
{
  "rtbrick-config:redistribution": [
    {
      "source": "direct"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

Example 3: LDP Policy Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp
address-family ipv4 redistribution
{
  "rtbrick-config:redistribution": [
    {
      "source": "direct",
      "policy": "filter-link-addres"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

2.1.3. LDP Loop Detection Configuration

The LDP loop detection feature enables LDP to detect loops during an LSP establishment.

Syntax:

set instance <instance-name> **protocol ldp loop-detection** <attribute> <value>

Attribute	Description
hop-count <hop-count>	Specifies the hop count limit for loop detection. Range: 0-255. Default: 32.
status <enable|disable>	Enables or disables loop detection. By default, this option is disabled. When this option is enabled, both hop count and path vector are enabled.
vector-length <vector-length>	Specifies the path vector length limit for loop detection. Range: 0-255. Default: 32.

Example 1: LDP Loop Detection Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp loop-
detection
{
    "rtbrick-config:loop-detection": {
      "enable": "true",
      "hop-count": 64,
      "vector-length": 64
    }
  }
supervisor@rtbrick>SPINE01: cfg>
```

2.1.4. LDP Timer Configuration

Specify the hello timer and hold-down timer for LDP adjacency. Similarly, specify the keepalive and keepalive timeout settings for the LDP session.

Syntax:

set instance <instance-name> **protocol ldp timer** <attribute> <value>

Attribute	Description
hello hold-time <hold-time>	Specifies the hello hold-time interval in seconds before declaring a neighbor to be down. Range: 0-65535. Default: 15.
hello interval <interval>	Specifies the hello messages interval in seconds. Range: 0-65535. Default: 5.
session keepalive-interval <keepalive-interval>	Specifies the session keepalive messages interval in seconds. Range: 1-65535. Default: 10.
session keepalive-timeout <keepalive-timeout>	Specifies the session keepalive timeout in seconds before declaring a session to be down. Range: 1-65535. Default: 30.

Example 1: LDP Timer Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp timer
{
    "rtbrick-config:timer": {
      "hello": {
        "interval": 10,
        "hold-time": 20
      },
      "session": {
        "keepalive-interval": 3000,
        "keepalive-timeout": 5000
      }
    }
  }
supervisor@rtbrick>SPINE01: cfg>
```

2.1.5. LDP IGP Synchronization

Synchronization between LDP and the underlying interior gateway protocol (IGP) ensures that the LDP path is fully established before the IGP path is used for forwarding traffic. LDP IGP synchronization is supported only on interfaces running Intermediate System-to-System (IS-IS) or OSPFv2 processes.

Syntax:

set instance <instance-name> **protocol ldp igp-synchronization** <attribute> <value>

Attribute	Description
hold-timer <hold-timer>	Specifies the hold-timer in seconds to limit how long the IGP session must wait before declaring the LDP synchronization. Range: 0-60. Default: 10.

Example 1: LDP IGP Synchronization Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp igp-
synchronization
{
    "rtbrick-config:igp-synchronization": {
     hold-timer": 60,
    }
  }
supervisor@rtbrick>SPINE01: cfg>
```

2.1.6. LDP Authentication Configuration

To meet the security requirements of LDP sessions, configure LDP authentication.

Syntax:

set instance <instance-name> **protocol ldp peer ipv4|ipv6** <address> **authentication-id** <authentication-id>

Attribute	Description
<address>	Specifies the transport IP address of the peer.
<authentication-id>	Authentication Tuple Identifier

Example 1: LDP Authentication Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp peer
ipv4
{
  "rtbrick-config:ipv4": [
    {
      "address": "192.168.1.2",
      "authentication-id": "auth_id_1"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

2.1.6.1. TCP Authentication Configuration

In the instance TCP authentication hierarchy, you can optionally enable MD5 or HMAC SHA authentication. Authentication is not configured for LDP directly, but for the TCP sessions used by LDP.

Syntax:

set instance <instance> **tcp authentication** <authentication-id> <attribute> <value>

Attribute	Description
<authentication-id>	Authentication identifier
type <type>	Authentication identifier such as MD5
key1-id <key1-id>	Key ID1 of the receiver
key1-encrypted-text <key1-encrypted-text>	Encrypted text of key1
key1-plain-text <key1-plain-text>	Plain text of key1
key2-id <key2-id>	Key ID2 of the receiver
key2-encrypted-text <key2-encrypted-text>	Encrypted text of key2
key2-plain-text <key2-plain-text>	Plain text of key2

Example: LDP TCP Authentication Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default tcp authentication
auth_id_1
{
  "rtbrick-config:authentication": [
    {
      "authentication-id": "auth_id_1",
      "type": "MD5",
      "key1-id": 1,
      "key1-encrypted-text": "$2a6fd7db50a18a9f1f16b5c5b4214fab0"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

2.1.7. LDP Import and Export Policy Configuration

Syntax:

set instance <instance-name> **protocol ldp peer ipv4|ipv6** <address> <attribute> <value>

Attribute	Description
<address>	Specifies the IPv4 or IPv6 address.

Attribute	Description
export-policy <export-policy>	Export policy identifier
import-policy <import-policy>	Import policy identifier

Example 1: LDP Export Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp peer
ipv4
{
  "rtbrick-config:ipv4": [
    {
      "address": "192.168.1.2",
      "export-policy": "exp-policy1"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

Example 3: LDP Import Configuration

```
supervisor@rtbrick>SPINE01: cfg> show config instance default protocol ldp peer
ipv4
{
  "rtbrick-config:ipv4": [
    {
      "address": "192.168.1.2",
      "import-policy": "imp-policy1"
    }
  ]
}
supervisor@rtbrick>SPINE01: cfg>
```

3. LDP Operational Commands

3.1. LDP Show Commands

The LDP show commands provide detailed information about the LDP protocol operations.

3.1.1. LDP Summary

Syntax:

show ldp summary <options>

Option	Description
-	Without any option, the command displays the LDP summary information for all instances.
instance <instance-name>	Displays LDP summary information about the specified instance.

Example: LDP summary for the default instance

```
supervisor@rtbrick>SPINE01: op> show ldp summary
Instance: default
  General information:
    LDP identifier: 198.51.100.1:0, Version: 1
    FEC resolution: Best match
    Protocol preference: 9
    LSR ID: 198.51.100.1
    IPv4 Status: True
    IPv6 Status: True
  Modes:
    Advertisement mode: Downstream Unsolicited
    Advertisement control mode: Ordered
    Label retention mode: Liberal
  Capabilities:
    IPv6 address family: -  , Graceful restart: False
    Loop detection: False
      Hop count: -, Vector length: -
  Timers:
    Adjacency:
      Hello: 5s, Holdtime: 15s
    Targeted adjacency:
      Hello: 15s, Holdtime: 45s
    Session:
      Keepalive: 10s, Holdtime: 30s
  Statistics:
    Adjacency:
      Link adjacency: 5, Targeted adjacency: 0
    Session:
      Session in non-existent: 0, Session in initialized: 0
      Session in opensent: 0, Session in openconfirm: 0
      Session in operational: 2
supervisor@rtbrick>SPINE01: op>
```

3.1.2. LDP Neighbor

Syntax:

show ldp neighbor <options>

Option	Description
-	Without any option, this command displays information about LDP neighbors.
detail	Detailed information about the LDP neighbors.
instance <instance-name>	Displays LDP neighbor information about the specified instance.
instance <instance-name> detail	Displays detailed LDP neighbor information about the specified instance.
instance <instance-name> ldp-id <ldp-id>	Displays LDP neighbor information about the specified LDP identifier and instance.

Option	Description
interface <name>	Displays LDP neighbor information about the specified interface.
interface <name> detail	Displays detailed LDP neighbor information about the specified interface.
ldp-id <ldp-id>	Displays LDP neighbor information about the specified LDP identifier.

Example 1: Summary view of LDP Neighbor

```
supervisor@rtbrick>SPINE01: op> show ldp neighbor
Instance: default
  Interface           LDP ID              Transport IP  Up Since
Expires
  ifl-0/0/0/1      198.51.100.2:0      198.51.100.2   Thu Feb 09 12:17:15       in
11s
  ifl-0/0/2/1      198.51.100.3:0      198.51.100.3   Thu Feb 09 12:17:31       in
12s
  ifl-0/0/0/100    198.51.100.2:0      198.51.100.2   Thu Feb 09 12:17:15       in
11s
  ifl-0/0/0/101    198.51.100.2:0      198.51.100.2   Thu Feb 09 12:17:15       in
11s
  ifl-0/0/1/102    198.51.100.2:0      198.51.100.2   Thu Feb 09 12:17:15       in
11s
supervisor@rtbrick>SPINE01: op>
```

Example 2: Detailed View of LDP Neighbor

```
supervisor@rtbrick>SPINE01: op> show ldp neighbor detail
Instance: default
  LDP-Identifier: 198.51.100.2:0, Interface: ifl-0/0/0/1, Type: Link
  Negotiated holdtime: 15000, Expiry time: 13s 183407us
  Local link address: 192.0.2.1, Peer link address: 192.0.2.2
  Local transport address: 198.51.100.1:0, Peer transport address: 198.51.100.2
  Local holdtime: 15, Peer holdtime: 15, Up since: Tue May 02 13:28:17
  Local transport preference : ipv4, Peer transport preference : ipv4
  Last transition time: Tue May 02 13:38:52 GMT +0000 2023
<...>
```

3.1.3. LDP Session

Syntax:

show ldp session <options>

Option	Description
-	Without any option, this command displays a summary of LDP session information.

Option	Description
detail	Displays detailed information about the LDP sessions.
instance <instance-name>	Displays LDP session information about the specified instance.
instance <instance-name> detail	Displays detailed LDP session information about the specified instance.
instance <instance-name> ldp-id <ldp-id>	Displays LDP session information about the specified LDP identifier and instance.
ldp-id <ldp-id>	Displays LDP session information about the specified LDP identifier.

Example 1: Summary view of LDP Session

```
supervisor@rtbrick>SPINE01: op> show ldp session
Instance: default
  LDP ID            Peer IP           State             Up/Down           FECRcvd   FECSent
  198.51.100.2:0    198.51.100.2       Operational       0d:00h:29m:44s         15        15
  198.51.100.3:0    198.51.100.3       Operational       0d:00h:29m:29s         15        15
supervisor@rtbrick>SPINE01: op>
```

Example 2: Detailed View of LDP Session

```
supervisor@rtbrick>SPINE01: op> show ldp session detail
Instance: default
  LDP Identifier: 198.51.100.2:0, Peer IP: 198.51.100.2, Local IP: 198.51.100.1
    Type: link, State: Operational, Uptime: 0d:00h:34m:35s
    Reason:
    Last transition: Thu Feb 09 12:17:28 GMT +0000 2023, Flap count: 0
  Advertisement Mode:
    Peer: Downstream unsolicited, Local: Downstream unsolicited
    Negotiated: Downstream unsolicited
  Timers:
    Connect retry: 10s
    Peer keepalive interval: 10s, Local keepalive interval: 10s
    Peer keepalive timeout: 30s, Local keepalive timeout: 30s
    Negotiated keepalive interval: 10s
    Negotiated keepalive timeout: 30s
  Received messages:
    Initialization: 1, KeepAlive: 208, Notification: 0
    Address: 1, Address Withdraw: 0, Label Mapping: 15
    Label Withdraw: 0, Label Release: 0
  Sent messages:
    Initialization: 1, KeepAlive: 208, Notification: 0
    Address: 1, Address Withdraw: 0, Label Mapping: 15
    Label Withdraw: 0, Label Release: 0
  Capability:
    Typed WildCard FEC:
    Local Support: True, Peer Support: True, Negotiated: True
  Total received messages:
    Initialization: 1, KeepAlive: 92, Notification: 0
    Address: 2, Address Withdraw: 0, Label Mapping: 20
  Total sent messages:
    Initialization: 1, KeepAlive: 92, Notification: 0
    Address: 2, Address Withdraw: 0, Label Mapping: 20
    Label Withdraw: 0, Label Release: 0
<...>
```

3.1.4. LDP Address

Syntax:

show ldp address <options>

Option	Description
-	Without any option, this command displays a summary of all the interface addresses received from the LDP sessions.
instance <instance-name>	Displays LDP address information about the specified instance.
instance <instance-name> <afi>	Displays LDP address of the specified address family (AFI). Supported values: ipv4, ipv6.
instance <instance-name> ldp-id <ldp-id>	Displays LDP address information about the specified LDP identifier and instance.

Option	Description
ldp-id <ldp-id>	Displays LDP address information about the specified LDP identifier.

Example: Summary View of LDP Address

```
supervisor@rtbrick>SPINE01: op> show ldp address
Instance: default, LDP Identifier: 198.51.100.2:0, AFI: ipv4
  198.51.100.61
  198.51.100.102
  198.51.100.63
  198.51.100.94
  198.51.100.2
  198.51.100.65
  198.51.100.222
  198.51.100.21
  198.51.100.2145
  198.51.100.48
<...>
```

3.1.5. LDP Binding

Syntax:

show ldp binding <options>

Option	Description
-	Without any option, this command displays a summary of all the LDP label bindings.
instance <instance-name>	Displays LDP label binding information about the specified instance.
instance <instance-name> prefix <ip>	Displays LDP label binding information about the specified prefix and instance. Supported prefix values: ipv4, ipv6.
prefix <ip>	Displays the LDP label binding information for the specified prefix. Supported prefix values: ipv4, ipv6.
received	Displays the LDP received label binding information of the LDP sessions.
received instance <instance-name>	Displays LDP received label binding information of the specified instance.
received instance <instance-name> ldp-id <ldp-id>	Displays LDP received label binding information about the specified LDP identifier and instance.
received ldp-id <ldp-id>	Displays LDP received label binding information of the specified LDP identifier.

Option	Description
sent	Displays the LDP sent label binding information of the LDP sessions.
sent instance <instance-name>	Displays LDP sent label binding information of the specified instance.
sent instance <instance-name> ldp-id <ldp-id>	Displays LDP sent label binding information about the specified LDP identifier and instance.
sent ldp-id <ldp-id>	Displays LDP sent label binding information of the specified LDP identifier.

Example 1: Summary view of LDP Binding

```
supervisor@rtbrick>SPINE01: op> show ldp binding

Instance: default, AFI: ipv4
  Prefix                In Label           Out Label          LDP ID
Status
  198.51.100.1/32        -                  label:3            -
Best
                         label:20066        -                  198.51.100.3:0
Non-best
                         label:20065        -                  198.51.100.2:0
Non-best
  198.51.100.11/32       -                  label:3            -
Best
                         label:20066        -                  198.51.100.3:0
Non-best
                         label:20065        -                  198.51.100.2:0
Non-best
  198.51.100.41/32       -                  label:3            -
Best
                         label:20066        -                  198.51.100.3:0
Non-best
                         label:20065        -                  198.51.100.2:0
Non-best
  198.51.100.44/32       -                  label:3            -
Best
                         label:20066        -                  198.51.100.3:0
Non-best
                         label:20065        -                  198.51.100.2:0
Non-best
  198.51.100.47/32       -                  label:3            -
Best
                         label:20066        -                  198.51.100.3:0
Non-best
                         label:20065        -                  198.51.100.2:0
Non-best
  198.51.100.2/32        label:3            label:20065        198.51.100.2:0
Best
                         label:20065        -                  198.51.100.3:0
Non-best
  198.51.100.21/32       label:3            label:20065        198.51.100.2:0
Best
                         label:20065        -                  198.51.100.3:0
Non-best
  198.51.100.42/32       label:3            label:20065        198.51.100.2:0
Best
                         label:20065        -                  198.51.100.3:0
Non-best
<...>
```

Example 2: Summary view of LDP Binding for the specified prefix

```
supervisor@rtbrick>SPINE01: op> show ldp binding prefix 198.51.100.2/32
Instance: default, AFI: ipv4
  Prefix                In Label           Out Label          LDP ID
Status
  198.51.100.2/32        label:3            label:20065       198.51.100.2:0
Best
                         label:20065        -                 198.51.100.3:0
Non-best
supervisor@rtbrick>SPINE01: op>
```

3.1.6. LDP Route

Syntax:

show ldp route <options>

Option	Description
-	Without any option, this command displays a summary of LDP route information.
instance <instance-name>	Displays LDP route information for the specified instance.
instance <instance-name> <afi>	Displays LDP route information for the specified address family and instance. Supported AFI values: ipv4, ipv6, and mpls.
instance <instance-name> ipv4 prefix <ip>	Displays LDP route information for the specified address family of IPv4 prefix and instance.
instance <instance-name> ipv6 prefix <ip>	Displays LDP route information for the specified address family of IPv6 prefix and instance.
instance <instance-name> prefix <ip>	Displays LDP route information for the specified prefix and instance.
instance <instance-name> label <label>	Displays LDP route information for the specified MPLS label and instance.
instance <instance-name> mpls	Displays LDP route information about MPLS labels.
instance <instance-name> mpls label <label>	Displays LDP route information for the specified MPLS label and instance.
label <label>	Displays LDP route information for the specified MPLS label.
ipv4	Displays LDP route information about the IPv4 address family.
ipv4 prefix <ip>	Displays LDP route IPv4 address family information for the specified prefix.

Option	Description
ipv6	Displays LDP route information about the IPv6 address family.
ipv6 prefix <ip>	Displays LDP route IPv6 address family information for the specified prefix.
mpls	Displays LDP route information about MPLS labels.
mpls label <label>	Displays LDP route information for the specified MPLS label.
prefix <ip>	Displays LDP route information for the specified prefix address.

Example: Summary view of LDP Route

```
supervisor@rtbrick>SPINE01: op> show ldp route
Instance: default, AFI: ipv4, SAFI: labeled-unicast
  Prefix/Label         Advertised label  Received label    Next Hop
Interface           Metric
  198.51.100.1/32       3                 -                 -              -
-
  198.51.100.2/32       20065             -                 198.51.100.61
ifl-0/0/0/1      1000000
  198.51.100.3/32       20067             20067             198.51.100.61
ifl-0/0/0/1      2000001
  198.51.100.11/32       3                 -                 -              -
-
  198.51.100.21/32       20065             -                 198.51.100.61
ifl-0/0/0/1      1000000
  198.51.100.31/32       20067             20067             198.51.100.61
ifl-0/0/0/1      2000001
  198.51.100.41/32       3                 -                 -              -
-
  198.51.100.42/32       20065             -                 198.51.100.61
ifl-0/0/0/1      1000000
  198.51.100.43/32       20067             20067             198.51.100.61
ifl-0/0/0/1      2000001
  198.51.100.44/32       3                 -                 -              -
-
  198.51.100.45/32       20065             -                 198.51.100.61
ifl-0/0/0/1      1000000
  198.51.100.46/32       20067             20067             198.51.100.61
ifl-0/0/0/1      2000001
  198.51.100.47/32       3                 -                 -              -
-
  198.51.100.48/32       20065             -                 198.51.100.61
ifl-0/0/0/1      1000000
  198.51.100.49/32       20067             20067             198.51.100.61
ifl-0/0/0/1      2000001
<...>
```

3.1.7. LDP Statistics

Syntax:

show ldp statistics <options>

Option	Description
-	Without any option, the command displays the LDP statistics for all instances.
instance <instance-name>	Displays LDP statistics information about the specified instance.
instance <instance-name> ldp-id <ldp-id>	Displays LDP statistics information about the specified LDP identifier and instance.

Example: LDP statistics information

```
supervisor@rtbrick>SPINE01: op> show ldp statistics
Instance: default, LDP ID: 198.51.100.2:0
  Received messages:
    Initialization: 1, KeepAlive: 558, Notification: 0
    Address: 1, Address Withdraw: 0, Label Mapping: 15
    Label Withdraw: 0, Label Release: 0
  Sent messages:
    Initialization: 1, KeepAlive: 558, Notification: 0
    Address: 1, Address Withdraw: 0, Label Mapping: 15
    Label Withdraw: 0, Label Release: 0
Instance: default, LDP ID: 198.51.100.3:0
  Received messages:
    Initialization: 1, KeepAlive: 557, Notification: 0
    Address: 1, Address Withdraw: 0, Label Mapping: 15
    Label Withdraw: 0, Label Release: 0
  Sent messages:
    Initialization: 1, KeepAlive: 557, Notification: 0
    Address: 1, Address Withdraw: 0, Label Mapping: 15
    Label Withdraw: 0, Label Release: 0
supervisor@rtbrick>SPINE01: op>
```

3.1.8. LDP TCP connection

Syntax:

show ldp tcp connection <options>

Option	Description
-	Without any option, the command displays the TCP connections used by LDP for all instances.
detail	Detailed list view of the TCP connections.

Option	Description
detail instance <instance-name>	Detailed list view of the TCP connections of the specified instance.
instance <instance-name>	TCP connections summary of the specified instance.

Example: Summary view of the LDP TCP connections

```
supervisor@rtbrick>SPINE01: op> show ldp tcp connection
Instance       Local IP             Remote IP            Local port     Remote
port   State
default        198.51.100.1          198.51.100.2                646
64718   Established
default        198.51.100.1          198.51.100.3                646
64718   Established
supervisor@rtbrick>SPINE01: op>
```

3.2. LDP Clear Commands

Clear commands allow resetting operational states.

3.2.1. Clear LDP Session

Syntax:

clear ldp session <options>

Option	Description
all	Clears all the LDP sessions.
all soft-in	Sends route refresh to all neighbors to receive FEC bindings.
all soft-out	Re-advertises all the routes previously sent to the peers.
instance <instance-name> all	Clears all the LDP sessions for the specified instance.
instance <instance> all soft-in	Sends route refresh to all neighbors to receive FEC bindings for the specified instance.
instance <instance> all soft-out	Re-advertises all the routes previously sent to the peers for the specified instance.
instance <instance-name> peer ldp-id <ldp-id>	Clears the LDP session for the specified instance and peer LDP identifier.
instance <instance> peer ldp-id <ldp-id> soft-in	Sends route refresh to the specific peer to receive FEC bindings for the specified instance and peer ldp-id.

Option	Description
instance <instance> peer ldp-id <ldp-id> soft-out	Re-advertises all the routes previously sent to the specific peer for the specified instance and peer ldp-id.

Example: The example below shows how to clear all the LDP sessions.

```
supervisor@rtbrick>SPINE01: op> clear ldp session all
LDP session cleared with instance default
supervisor@rtbrick>SPINE01: op>
```

3.2.2. Clear LDP Statistics

Syntax:

clear ldp statistics <options>

Option	Description
all	Clears all the LDP statistics.
instance <instance-name> all	Clears all the LDP statistics for the specified instance.
instance <instance-name> peer ldp-id <ldp-id>	Clears the LDP statistics for the specified instance and peer LDP identifier.

Example: The example below shows how to clear all the LDP statistics.

```
supervisor@rtbrick>SPINE01: op> clear ldp statistics all
LDP statistics cleared for instance default
supervisor@rtbrick>SPINE01: op>
```

3.2.3. Clear LDP Neighbor

Syntax:

clear ldp neighbor <options>

Option	Description
all	Clears all the LDP neighbors.
instance <instance-name>	Clears the LDP neighbor for the specified instance.

Example: The example below shows how to clear all the LDP neighbor.

```
supervisor@rtbrick>SPINE01: op> clear ldp neighbor all
LDP neighbor cleared with instance default
supervisor@rtbrick>SPINE01: op>
```