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| **MPLS** |

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| MPLS is a packet forwarding paradigm which differs from regular IP forwarding. Instead |

of IP addresses being used to make the decision on finding the exit interface, a router will instead use an exact match on a 32 bit/4 byte header called the MPLS label. This label is inserted between the ethernet (layer 2) header and the IP (layer 3) header. One can statically or dynamically assign label allocations, but we will focus on dynamic allocation of labels using some sort of label distribution protocol (such as the aptly named Label Distribution Protocol / LDP, Resource Reservation Protocol / RSVP, or Segment Routing through OSPF/ISIS). These protocols allow for the creation of a unidirectional/unicast path called a labeled switched path (initialized as LSP) throughout the network that operates very much like a tunnel through the network. An easy way of thinking about how an MPLS LSP actually forwards traffic throughout a network is to think of a GRE tunnel. They are not the same in how they operate, but they are the same in how they handle the tunneled packet. It would be good to think of MPLS as a tunneling technology that can be used to transport many different types of packets, to aid in traffic engineering by allowing one to specify paths throughout the network (using RSVP or SR), and to generally allow for easier intra/inter network transport of data

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| packets. |

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| For more information on how MPLS label switching works, please go visit Wikipedia |

(MPLS).

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| **Note** |

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| MPLS support in VyOS is not finished yet, and therefore its functionality is limited. |

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| Currently there is no support for MPLS enabled VPN services such as L2VPNs and |

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| mVPNs. RSVP support is also not present as the underlying routing stack (FRR) does not |

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| implement it. Currently VyOS implements LDP as described in RFC 5036; other LDP |

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| standard are the following ones: RFC 6720, RFC 6667, RFC 5919, RFC 5561, RFC 7552, |

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| RFC 4447. Because MPLS is already available (FRR also supports RFC 3031). |
| **Label Distribution Protocol** |

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| The MPLS architecture does not assume a single protocol to create MPLS paths. VyOS |

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| supports the Label Distribution Protocol (LDP) as implemented by FRR, based on **RFC** |

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| **5036**. |

LDP is a TCP based MPLS signaling protocol that distributes labels creating MPLS label switched paths in a dynamic manner. LDP is not a routing protocol, as it relies on other routing protocols for forwarding decisions. LDP cannot bootstrap itself, and therefore

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| relies on said routing protocols for communication with other routers that use LDP. |

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| In order to allow for LDP on the local router to exchange label advertisements with other |

routers, a TCP session will be established between automatically discovered and statically assigned routers. LDP will try to establish a TCP session to the **transport address** of other routers. Therefore for LDP to function properly please make sure the

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| transport address is shown in the routing table and reachable to traffic at all times. |

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| It is highly recommended to use the same address for both the LDP router-id and the |

discovery transport address, but for VyOS MPLS LDP to work both parameters must be

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| explicitly set in the configuration. |

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| Another thing to keep in mind with LDP is that much like BGP, it is a protocol that runs |

on top of TCP. It however does not have an ability to do something like a refresh capability like BGPs route refresh capability. Therefore one might have to reset the neighbor for a capability change or a configuration change to work.

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| **Configuration Options** |

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| **set protocols mpls interface <interface>** |

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| Use this command to enable MPLS processing on the interface you define. |

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| **set protocols mpls ldp interface <interface>** |

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| Use this command to enable LDP on the interface you define. |

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| **set protocols mpls ldp router-id <address>** |

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| Use this command to configure the IP address used as the LDP router-id of the local |

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| device. |

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| **set protocols mpls ldp discovery transport-ipv4-address <address> set protocols mpls ldp discovery transport-ipv6-address <address>** |

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| Use this command to set the IPv4 or IPv6 transport-address used by LDP. |

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| **set protocols mpls ldp neighbor <address> password <password>** |

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| Use this command to configure authentication for LDP peers. Set the IP address of the |

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| LDP peer and a password that should be shared in order to become neighbors. |

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| **set protocols mpls ldp neighbor <address> session-holdtime <seconds>** |

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| Use this command to configure a specific session hold time for LDP peers. Set the IP |

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| address of the LDP peer and a session hold time that should be configured for it. You |

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| may have to reset the neighbor for this to work. |

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| **set protocols mpls ldp neighbor <address> ttl-security <disable | hop count>** |

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| Use this command to enable, disable, or specify hop count for TTL security for LDP |

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| peers. By default the value is set to 255 (or max TTL). |

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| **set protocols mpls ldp discovery hello-ipv4-interval <seconds> set protocols mpls ldp discovery hello-ipv4-holdtime <seconds> set protocols mpls ldp discovery hello-ipv6-interval <seconds> set protocols mpls ldp discovery hello-ipv6-holdtime <seconds>** |

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| Use these commands if you would like to set the discovery hello and hold time |

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| parameters. |

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| **set protocols mpls ldp discovery session-ipv4-holdtime <seconds> set protocols mpls ldp discovery session-ipv6-holdtime <seconds>** |

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| Use this command if you would like to set the TCP session hold time intervals. |

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| **set protocols mpls ldp import ipv4 import-filter filter-access-list <access list number>**  **set protocols mpls ldp import ipv6 import-filter filter-access-list6 <access list number>** |

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| Use these commands to control the importing of forwarding equivalence classes (FECs) |

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| for LDP from neighbors. This would be useful for example on only accepting the labeled |

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| routes that are needed and not ones that are not needed, such as accepting loopback |

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| interfaces and rejecting all others. |

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| **set protocols mpls ldp export ipv4 export-filter filter-access-list <access list number>**  **set protocols mpls ldp export ipv6 export-filter filter-access-list6 <access list number>** |

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| Use these commands to control the exporting of forwarding equivalence classes (FECs) |

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| for LDP to neighbors. This would be useful for example on only announcing the labeled |

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| routes that are needed and not ones that are not needed, such as announcing loopback |

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| interfaces and no others. |

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| **set protocols mpls ldp export ipv4 explicit-null set protocols mpls ldp export ipv6 explicit-null** |

Use this command if you would like for the router to advertise FECs with a label of 0 for

explicit null operations.

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| **set protocols mpls ldp allocation ipv4 access-list <access list number> set protocols mpls ldp allocation ipv6 access-list6 <access list number>** |

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| Use this command if you would like to control the local FEC allocations for LDP. A good |

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| example would be for your local router to not allocate a label for everything. Just a label |

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| for what it’s useful. A good example would be just a loopback label. |

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| **set protocols mpls ldp parameters cisco-interop-tlv** |

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| Use this command to use a Cisco non-compliant format to send and interpret the Dual- |

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| Stack capability TLV for IPv6 LDP communications. This is related to **RFC 7552**. |

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| **set protocols mpls ldp parameters ordered-control** |

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| Use this command to use ordered label distribution control mode. FRR by default uses |

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| independent label distribution control mode for label distribution. This is related to **RFC** |

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| **5036**. |

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| **set protocols mpls ldp parameters transport-prefer-ipv4** |

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| Use this command to prefer IPv4 for TCP peer transport connection for LDP when both |

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| an IPv4 and IPv6 LDP address are configured on the same interface. |

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| **set protocols mpls ldp targeted-neighbor ipv4 enable set protocols mpls ldp targeted-neighbor ipv6 enable** |

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| Use this command to enable targeted LDP sessions to the local router. The router will |

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| then respond to any sessions that are trying to connect to it that are not a link local type |

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| of TCP connection. |

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| **set protocols mpls ldp targeted-neighbor ipv4 address <address> set protocols mpls ldp targeted-neighbor ipv6 address <address>** |

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| Use this command to enable the local router to try and connect with a targeted LDP |

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| session to another router. |

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| **set protocols mpls ldp targeted-neighbor ipv4 hello-holdtime <seconds>** |

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| **set protocols mpls ldp targeted-neighbor ipv4 hello-interval <seconds> set protocols mpls ldp targeted-neighbor ipv6 hello-holdtime <seconds> set protocols mpls ldp targeted-neighbor ipv6 hello-interval <seconds>** |

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| Use these commands if you would like to set the discovery hello and hold time |

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| parameters for the targeted LDP neighbors. |

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| **Sample configuration to setup LDP on VyOS** |

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| set protocols ospf area 0 network '192.168.255.252/32' <--- Routing for loopback set protocols ospf area 0 network '192.168.0.5/32' <--- Routing for an interface connecting to the network  set protocols ospf parameters router-id '192.168.255.252' <--- Router ID setting for OSPF set protocols mpls interface 'eth1' <--- Enable MPLS for an interface connecting to network  set protocols mpls ldp discovery transport-ipv4-address '192.168.255.252' <--- Transport address for LDP for TCP sessions to connect to  set protocols mpls ldp interface 'eth1' <--- Enable LDP for an interface connecting to network  set protocols mpls ldp interface 'lo' <--- Enable LDP on loopback for future services connectivity  set protocols mpls ldp router-id '192.168.255.252' <--- Router ID setting for LDP set interfaces ethernet eth1 address '192.168.0.5/31' <--- Interface IP for connecting to network  set interfaces loopback lo address '192.168.255.252/32' <--- Interface loopback IP for router ID and other uses |

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| **Operational Mode Commands** |

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| When LDP is working, you will be able to see label information in the outcome of show ip route . Besides that information, there are also specific *show* commands for   |  | | --- | |  | |

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| LDP: |

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| **Show** |

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| **show mpls ldp binding** |

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| Use this command to see the Label Information Base. |

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| **show mpls ldp discovery** |

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| Use this command to see discovery hello information |

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| **show mpls ldp interface** |

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| Use this command to see LDP interface information |

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| **show mpls ldp neighbor** |

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| Use this command to see LDP neighbor information |

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| **show mpls ldp neighbor detail** |

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| Use this command to see detailed LDP neighbor information |

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| **Reset** |

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| **reset mpls ldp neighbor <IPv4 or IPv6 address>** |

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| Use this command to reset an LDP neighbor/TCP session that is established |

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