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QUICK COMMAND REFERENCE

Written by Ruhann

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*===========================*
   SHOW & DEBUG COMMANDS
*===========================*
# sh ip vrf                                      - Displays the list of all VRFs configured in the router

# sh ip vrf [detail] [interfaces] {VRF-NAME}     - Displays detailed VRF configuration
                                                 = Displays interfaces associated with VRFs

# sh ip protocols vrf {name}                     - Displays the routing protocols configured in a VRF

# sh ip route vrf {name} [summary]               - Displays the VRF routing table
                                                 = [Summary] : Displays a summary of routes

# sh ip bgp vpnv4 [all|RD|vrf{name}] labels      - Displays the labels associated with VPNv4 routes
# sh ip bgp vpnv4 vrf {name}                     - Displays per-VRF BGP parameters
# sh ip bgp vpnv4 rd {ASN:nn}                    - Displays the NLRI prefixes that have a matching RD.
# sh ip bgp vpnv4 all                            - Displays whole VPNv4 table
# sh ip bgp neighbors [IP]                       - Displays global BGP neighbors and the protocols negotiated with these neighbors.

# sh mpls interface {int} [detail]               - Displays the Interfaces that have mpls enabled on it.
                                                 = Displays MPLS status on individual interfaces
                                                 = Can be used to check MTU setting.

# sh mpls ldp parameters                         - Displays the LDP parameters on the local router
# sh mpls ldp discovery [vrf|all]                - Displays all discovered LDP neighbors
# sh mpls ldp neighbor [vrf] [int] [detail]      - Displays the individual LDP neighbors
                                                 = LDP Neighbors knows over a specific interface
```

```
# sh mpls forwarding vrf {name}                 - Displays labels allocated by an MPLS VPN for routes in the specified VRF

# sh mpls forwarding-table [detail|labels|vrf|next-hop|int]
                                                - Displays the LFIB ***

# sh mpls ldp bindings                          - Displays the LIB *** (LIB=TIB)

# sh ip cef [detail] [summary] [unresolved]     - Displays the FIB ***
                                                = Detail : Displays Ingress imposed labels on edge LSR's
                                                = unresolved : shows the unresolved FIB entries
                                                = summary : of the FIB table

# sh ip cef vrf {name}                          - Displays per-VRF CEF table
# sh ip cef vrf {name} {ip-prefix} {detail}     - Displays details of an individual CEF entry, including label stack

# debug mpls ldp                                - Debugs LDP adjacencies, session establishement, label bindings exchanges
# debug mpls lfib                               - Debugs LFIB events: label creations, removals, rewrites.
# debug mpls packets [int]                      - Debugs labeled packets switched by router



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*==========================*
   BASIC CONFIGURATIONS
*==========================*
*--------------------*
  Mandatory
*--------------------*
#ip cef [distributed]                     Step1 - Enable CEF Globally.
                                                = This command starts CEF switching and created the FIB table

#ip route-cache cef                       Step1 - Enable CEF per Interface

#mpls label protocol [ldp|tdp|both]       Step2 - Starts selected label distribution protocol on the specified interface.
                                                = From IOS 12.4(3) LDP is default.

#mpls ip / (tag-switching ip)             Step3 - Enables label switching on a frame-mode interface
                                                = Starts LDP on that interface.
                                                = 'tag-switching ip' is old config.

*--------------------*
  Optional
*--------------------*
#mpls ldp router-id {interface} [force]         - Configure the MPLS ID
                                                = Would be the 1st step if done
                                                = Global command
                                                = Disabled by default.
                                                = {interface}: Causes the IP of the specified INT to be used as the LDP router ID,
                                                      provided that the INT is operational.
                                                = [force]: Alters the behavior of the mpls ldp router-id command to force the use of
                                                      the named interface as the LDP router ID.
```

```
#mpls mtu {bytes}                                - Configure the MTU size for labeled packets
                                                 = Changes the Maximum size of Labelled packets.
                                                 = Interface MTU is automatically increased on WAN interfaces; IP MTU is
                                                       automatically decreased on LAN interfaces.
                                                 = Label-switching MTU can be increased on LAN interfaces (resulting in jumbo frames)
                                                       to prevent IP fragmentation.
                                                 = Min MTU is 64 bytes, Max MTU depends on the interfaces type.

#no mpls ip propagate-ttl [forwarded|local] - Configure IP TTL Propagation
                                                 = Be default TTL-Propagation is ENABLED
                                                 = Disables TTL-Propagation, useful to hide core routers.
                                                 = Forwarded : Trace doesn't work for transit traffic labeled by this router
                                                 = Local : Trace doesn't work from the router, but transit traffic does.

#mpls ldp adv-labels [FOR prefix-acl [TO peer-acl]]
                                                 - Configure Conditional label advertising
                                                 = By default, labels for all destinations are announced to all LDP or TDP neighbors.
                                                 = Conditional label advertisement works only over frame-mode interfaces.
                                                 = Enables you to selectively advertise some labels to some LDP neighbors.
                                                 = FOR : ACL that selects the destinations for which labels are generated.
                                                 = TO : ACL that selects the mpls neighbors that will receive the labels

      EXAMPLE: to only advertise labels for only loopback interfaces ie BGP next-hops
            #no mpls ldp advertise-labels
            #access-list 90 permit 192.168.254.0 0.0.0.255
            #access-list 91 permit any
            #mpls ldp advertise-labels for 90 to 91               => networks mathcing ACL90 are send to neighbors matching ACL91


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*==========================*
   VRF Tables
*==========================*
#ip vrf {vrf-name}                         Step1 - Creates a new VRF or enters configuration of an existing VRF
                                                 = VRF names are case-sensitive.
                                                 = VRF is not operational unless you configure RD.
                                                 = VRF names have only local significance.

#rd {route-distinguisher}                  Step2 - This command assigns a route distinguisher to a VRF.
                                                 = You can use ASN:nn or A.B.C.D:nn format for RD

#route-target export {RT}                  Step3 - Specifies an RT to be attached to every route exported from this VRF to MPBGP

#route-target import {RT}                  Step3 - Specifies an RT to be used as an import filter
                                                       (Only routes matching the RT are imported into the VRF.)

#int fa0/0
 #ip vrf forwarding {vrf-name}             Step4 - This command associates an interface with the specified VRF.
                                                 = CEF must be enable for the interface.

#vpn id {oui:vpn-index}                          - OPTIONAL command that assigns a VPN ID to the VRF.
```

```
#maximum routes limit {warn-threshold |warn-only}
                                                  - OPTIONAL command configures the maximum number of routes accepted into a VRF:
                                                  = Limit : is the route limit for the VRF.
                                                  = Warn-threshold : is the percentage value over which a warning message
                                                        is sent to syslog.
                                                  = Warn-only : creates a syslog error message when the maximum number of routes
                                                        exceeds the threshold.

#import map {route-map}                           - Configures selective VRF Import.
                                                  = This command attaches a route map to the VRF import process.
                                                  = A route is imported into the VRF only if at least one RT attached to the
                                                        route-map matches one RT configured in the VRF and
                                                        the route is accepted by the route map.(permit)


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*==============================*
   PE and PE: MP-iBGP
*==============================*
#router bgp {ASN}
 #neighbor {IP} remote-as {R-ASN}                 - All MP-BGP neighbors have to be configured under global BGP routing config.
 #neighbor {IP} update-source Loopback0           - MP-IBGP sessions have to run between loopback interfaces.

 #address-family vpnv4                            - Selects configuration of VPNv4 prefix exchanges under MP-BGP sessions.
  #neighbor {IP} activate                         - The BGP neighbor defined under BGP router configuration has to be activated
                                                        for VPNv4 route exchange.

  #neighbor {IP} [next-hop-self]                  - Change the 'next-hop' ip to local peer address.
  #neighbor {IP} send-community [std|ext|both]    - This command with the extended option is enabled by default.
                                                  - Extended is required for RT propagation.


 #no bgp default ipv4-unicast                     - This command disables the default exchange of IPv4 routes.
                                                  - Neighbors that need to receive IPv4 routes have to be activated for
                                                        IPv4 route exchange.
 #address-family ipv4
  #no neighbor {IP} activate                      - 2nd way to disable IPv4 route exchange



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*================================*
   PE to CE: Static route
*================================*
#ip route vrf {name} {prefix} {mask} [interface] [next-hop-address] [Global] [Permanent] [tag {tag}]
                                                  - This command configures per-VRF static routes
                                                  - The route is entered in the VRF table.
                                                  - You must specify a next-hop IP if you are not using a point-to-point interface.
                                                  = [global]: the given next-hop will be in the non-VRF routing table.
                                                  = [permanent]: the route not to be removed even if the interface is shut down.
```

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*==========================*
   PE to CE: RIP
*==========================*
#router rip
 #version 2                                      - Version MUST be specified as version 2!
 #address-family ipv4 vrf {name}
  #redistribute bgp {ASN} metric transparent     - The RIP hop count has to be manually set for routes redistributed into RIP.
                                                 - BGP routes must be redistributed back into RIP.
                                                 - When you are using RIP with other protocols, the metric must be manually set.
                                                 = For end-to-end RIP networks, the following applies:
                                                       > On the sending end, the RIP hop count is copied into the BGP MED.
                                                       > On the receiving end, the metric transparent option copies the BGP
                                                 MED into the RIP hop count, resulting in a consistent end-to-end RIP hop count.


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*==========================*
   PE to CE: EIGRP
*==========================*
#router eigrp {process-id}
 #address-family ipv4 vrf {name}                 - Enables the EIGRP AS number of the CE under the address family.
 #autonomous-system {ASN}                        - Configures per-instance AS number

 #redistribute bgp {ASN} metric {metric-value}   - External routes received without the configured metric are not to be
                                                       advertised to the CE router


*-------------------------------*
  EIGRP SOO Loop-Prevention
*-------------------------------*
> The Site Of Origin extended community can be used to prevent loops in dual-homed scenarios.
> A unique SOO value must be configured for each VPN site. This value must be used on the PE-CE interface

#route-map {name} permit {seq}
#set extcommunity soo {extended-community }      - Creates a route map that sets the SOO attribute
 (config-if)#ip vrf sitemap route-map-name       - Applies a route map that sets SOO extended community attribute
                                                       to inbound routing updates received from this interface



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*==========================*
   PE to CE: OSPF
*==========================*
#router ospf process-id vrf {name}         step1 - This command starts a Separate OSPF routing process for every VRF.
                                                 = The total number of routing processes per router is limited to 32.

#redistribute bgp as-number subnets        step2 - This command redistributes MP-BGP routes into OSPF.
                                                 = The subnets keyword is mandatory for proper operation.
```

```
#router bgp {ASN}                          step3 - Enters the Bgp process
#address-family ipv4 vrf {name}                  - OSPF-BGP route redistribution is configured with the redistribute command
                                                       under the proper address-family command.

#redistribute ospf {pid} [match [internal] [ex1] [ex2]] {tag {value}}
                                                 - Without the OSPF match keyword specified, only internal OSPF routes
                                                       are redistributed into OSPF.
                                                 = {tag} Internal OSPF routes have no tag field.
                                                 = The tag field can be set manually on the router, when redistributing
                                                       routes between OSPF domains.

*----------------------------*
  SHAM LINK
*----------------------------*
#router ospf pid vrf {name}
 #area {id} sham-link {src-ip} {dst-ip} cost {number}
                                                 - Configures a Sham Link.
                                                 - A separate /32 address space is required in each PE router for each sham link.



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*==========================*
  PE to CE: eBGP
*==========================*
#router bgp {ASN}
 #address-family ipv4 vrf {name}                 - Select per-VRF BGP context with the address-family command.
 #neighbor x.x.x.x remote-as {ASN}               - Configure CE EBGP neighbors in the VRF context, not in the global BGP config.
 #neighbor x.x.x.x activate                      - CE neighbors have to be activated with the neighbor activate command.

*----------------------------*
  OPTIONAL CONFIG
*----------------------------*
#neighbor {IP} maximum-prefix {no} [threshold] [warning-only]
                                                 - Controls how many prefixes can be received from a neighbor
                                                 = Threshold : specifies the percentage where a warning message is logged
                                                        (default is 75 percent)
                                                 = warning-only : specifies the action on exceeding the maximum number
                                                        (default is to drop peering)

#neighbor {ip} as-override                       - Configures the AS-override AS path update procedure for the specified neighbor.
                                                 > If the first AS number in the AS path is equal to the neighboring AS,
                                                       it is replaced with the provider AS number.

#neighbor allowas-in {no}                        - An incoming update is rejected only if the AS number of the PE router
                                                       appears in the AS path more often than the configured limit.
                                                 > Used when one CE is connected to two VPN in the same AS (two VRFs, 1 ASN)
                                                       via BGP and routes are relayed from one to the other.

#route-map {name} permit {seq}                   - Configuring Site Of Origin.
 #set extcommunity soo {extended-community}      - Creates a route map that sets the SOO attribute
#ip vrf sitemap route-map-name                   - Applies a route map that sets SOO extended community attribute to
                                                       inbound routing updates received from this interface
```

```
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*================================*
   TROUBLESHOOTING MPLS and LDP
*================================*
1 - The LDP session does not start.
2 - Labels are not allocated.
3 - Labels are not distributed.
4 - Packets are not labeled, although the labels have been distributed.
5 - MPLS intermittently breaks after an interface failure.
6 - Large packets are not propagated across the network.



  - 1 - LDP Session Startup Issues
=========================================================
 Symptom-1
-=-=-=-=-=-
      - LDP neighbors are not discovered.
      = The 'show mpls ldp discovery' command does not display expected LDP neighbors.
Diagnosis
      - MPLS is not enabled on the adjacent router.
Verification
      - Verify with the 'show mpls interface' command on the adjacent router


-=-=-=-=-=-
 Symptom-2
-=-=-=-=-=-
      - LDP neighbors are not discovered.
Diagnosis
      = There is a label distribution protocol mismatch—TDP on one end, LDP on the other end.
Verification
      - Verify with the show mpls interface detail command on both routers.


-=-=-=-=-=-
 Symptom-3
-=-=-=-=-=-
      - LDP neighbors are not discovered.
Diagnosis
      = Packet filter drops LDP neighbor discovery packets.
Verification
      - Verify access list presence with the show ip interface command.
      - Verify access list contents with the show access-list command.
```

-=-=-=-=-=-=-
 Symptom-4
-=-=-=-=-=-=-
      - LDP neighbors are discovered; the LDP session is not established.
      - The show mpls ldp neighbor command does not display a neighbor in operational state.
Diagnosis
      = The connectivity between loopback interfaces is broken;
      = The LDP session is usually established between loopback interfaces of adjacent LSRs.
Verification
      - Verify connectivity with the extended ping command.

  - 2 - Label Allocation Issues
==
Symptom
      - Labels are not allocated for local routes.
      - The show mpls forwarding-table command does not display any labels.
Diagnosis
= CEF is not enabled.
Verification
      - Verify with the show ip cef command

  - 3 - Label Distribution Issues
==
Symptom
      - Labels are allocated, but not distributed.
      - Using the show mpls ldp bindings command on the adjacent LSR does not display labels from this LSR.
Diagnosis
      = There are problems with conditional label distribution.
Verification
      - Debug label distribution with debug mpls ldp advertisements.
      - Examine the neighbor LDP router IP address with the show mpls ldp discovery command.
      - Verify that the neighbor LDP router IP address is matched by the access list specified in the mpls advertise command

  - 4 - Packet Labeling Issues
==
Symptom
      - Labels are distributed, but packets are not labeled.
      - Using the show interface statistic command does not show labeled packets being sent.
Diagnosis
      = CEF is not enabled on the input interface (potentially because of a conflicting feature being configured).
Verification
      - Verify with the show cef interface command.

```
  - 5 - Intermittent MPLS Failures After Interface Failure
=========================================================
Symptom
      - The overall MPLS connectivity in a router intermittently breaks after an interface failure.
Diagnosis
      = The IP address of a physical interface is used for the LDP (or TDP) identifier. Configure a loopback interface on the router.
Verification
      - Verify the local LDP identifier with the show mpls ldp neighbors command



  - 6 - Packet Propagation Issues
=========================================================
Symptom
      - Large packets are not propagated across the network.
      - Use of the extended ping command with varying packet sizes fails for packet sizes close to 1500
      - In some cases, MPLS might work, but MPLS VPN will fail.
Diagnosis
      = There are label MTU issues or switches that do not support jumbo frames in the forwarding path.
Verification
      - Issue the traceroute command through the forwarding path; identify all LAN segments in the path.
      - Verify the label MTU setting on routers attached to LAN segments.
      - Check for low-end switches in the transit path




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*================================*
   Troubleshooting MPLS VPN
*================================*
-1- Verifying the routing information flow CE-to-CE
1.1 = Are CE routes received by a PE Ingress router?
1.2 = Are routes redistributed into MP-BGP with proper extended communities?
1.3 = Are VPNv4 routes propagated to other PE routers?
1.4 = Is the BGP route selection process working correctly?
1.5 = Are VPNv4 routes inserted into VRFs on other Egress PE routers?
1.6 = Are VPNv4 routes redistributed from BGP into the PE-CE routing protocol?
1.7 = Are IPv4 routes propagated to other CE routers?


-2- Identifying the Issues When Verifying the Data Flow
2.1 = Is CEF enabled on the ingress PE router interface?
2.2 = Is the CEF entry correct on the ingress PE router?
2.3 = Is there an end-to-end label switched path tunnel (LSP tunnel) between PE routers?
2.4 = Is the LFIB entry on the egress PE router correct?
```

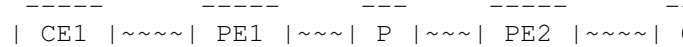

1.1 Are CE1 routes received by the PE1 Ingress router?

- Verify with the {show ip route vrf vrf-name} command on PE-1

1.2 Are routes redistributed into MP-BGP with proper extended communities?

- Verify with the {show ip bgp vpnv4 vrf vrf-name ip-prefix} command on PE-1.
- Troubleshoot with {debug ip bgp} commands

1.3 Are VPNv4 routes propagated to other PE routers?

- Verify with the {show ip bgp vpnv4 all ip-prefix/length} command on PE-1.
- Troubleshoot PE-to-PE connectivity with traditional BGP troubleshooting tools.

1.4 Is the BGP route selection process working correctly?

- Verify with the {show ip bgp vpnv4 vrf vrf-name ip-prefix} command on PE-2.
- Change local preference or weight settings if needed.
- Do not change MED if you are using IGP-BGP redistribution on PE-2.

1.5 Are VPNv4 routes inserted into VRFs on other PE Egress routers?

- Verify with the {show ip route vrf} command on PE-2.
- Troubleshoot with the {show ip bgp ip-prefix} and {show ip vrf detail} command.
- Perform additional BGP troubleshooting if needed.

1.6 Are VPNv4 routes redistributed from BGP into the PE-CE routing protocol?

- Verify redistribution configuration—is the IGP metric specified?
- Perform traditional routing protocol troubleshooting.

1.7 Are IPv4 routes propagated to other CE routers?

- Verify with the {show ip route} command on CE-Spoke.
- Alternatively, do CE-Spokes have a default route toward PE-2?
- Perform traditional routing protocol troubleshooting if needed.

2.1 = Is CEF enabled on the ingress PE router interface?
-=-

- Verify with the {show cef interface} command on PE-1
- MPLS VPN needs CEF enabled on the ingress PE router interface for proper operation.
- CEF might become disabled because of additional features deployed on the interface.

2.2 = Is the CEF entry correct on the ingress PE router?
-=-

- Display the CEF entry with the {show ip cef vrf vrf-name ip-prefix/length detail} command.
- This Command displays the Local Label
- Verify the label stack in the CEF entry.
- The top label in the stack should correspond to the BGP next-hop label as displayed by the following :
  {show mpls forwarding-table vrf name prefix}

2.3 = Is there an end-to-end LSP tunnel between PE routers?
-=-

- Check summarization issues—BGP next hop should be reachable as host route.
- Quick check—if TTL propagation is disabled, the trace from PE-2 to PE-1 should contain only one hop.
- If needed, check LFIB values hop by hop.
- Check for MTU issues on the path—MPLS VPN requires a larger label header than pure MPLS.

2.4 = Is the LFIB entry on the egress PE router correct?
-=-

- Find out the second label in the label stack on PE-2 with the {show ip cef vrf vrf-name ip-prefix detail} command.
- Verify correctness of LFIB entry on PE-1 with the {show mpls forwarding vrf vrf-name value detail} command