Implementing LPTS

LPTS Overview

Local Packet Transport Services (LPTS) maintains tables describing all packet flows destined for the secure domain router (SDR), making sure that packets are delivered to their intended destinations.

LPTS uses two components to accomplish this task: the port arbitrator and flow managers. The port arbitrator and flow managers are processes that maintain the tables that describe packet flows for a logical router, known as the Internal Forwarding Information Base (IFIB). The IFIB is used to route received packets to the correct Route Processor for processing.

LPTS interfaces internally with all applications that receive packets from outside the router. LPTS functions without any need for customer configuration. However, the policer values can be customized if required. The LPTS show commands are provided that allow customers to monitor the activity and performance of LPTS flow managers and the port arbitrator.

LPTS Policers

In Cisco IOS XR, the control packets, which are destined to the Route Processor (RP), are policed using a set of ingress policers in the incoming ports. These policers are programmed statically during bootup by LPTS components. The policers are applied based on the flow type of the incoming control traffic. The flow type is determined by looking at the packet headers. The policer rates for these static ingress policers are defined in a configuration file, which are programmed on the route processor during bootup. You can change the policer values based on the flow types of these set of ingress policers. You are able to configure the rate per policer per node.

Note You can get the default policer values and the effective current rates of the flow types from the output of the following show command:

```
show lpts pifib hardware police
```

Configuration Example

Configure the LPTS policer for the OSPF and BGP flowtypes with the following values globally for all nodes:

- ospf unicast default rate 3000
- bgp default rate 4000

```
Router#configure
Router(config)#lpts pifib hardware police
Router(config-lpts-policer-global)#flow ospf unicast default rate 3000
Router(config-lpts-policer-global)#flow bgp default rate 4000
Router(config-lpts-policer-global)#commit
```

Running Configuration

```
Router#show running-config lpts
lpts pifib hardware police
 flow ospf unicast default rate 3000
 flow bgp default rate 4000
!
```

Verification

```
Router#show lpts pifib hardware police

-------------------------------------------------------------
                Node 0/RP0/CPU0:
-------------------------------------------------------------
FlowType               Policer Type    Cur. Rate Burst     Accepted     Dropped      npu
--------------------- ------- ------- --------- --------- ------------ ------------ ---------
Fragment               2       np      542       1000      0            0            0
OSPF-mc-known          3       np      1627      1000      0            0            0
OSPF-mc-default        4       np      1084      1000      0            0            0
OSPF-uc-known          5       np      542       1000      0            0            0
OSPF-uc-default        6       np      3000      1000      0            0            0
BFD-default            10      np      8136      1000      0            0            0
BFD-MP-known           11      np      8136      1000      0            0            0
BGP-known              16      np      17000     1000      0            0            0
BGP-cfg-peer           17      np      1627      1000      0            0            0
BGP-default            18      np      4000      1000      0            0            0
```

Configuration Example

Configure the LPTS policer for the OSPF and BGP flow types with the following values on an individual node - 0/0/CPU0:

- ospf unicast default rate 3000
- flow bgp default rate 4000

```
Router#configure
Router(config)#lpts pifib hardware police location 0/0/CPU0
Router(config-lpts-policer-local)#flow ospf unicast default rate 3000
Router(config-lpts-policer-local)#flow bgp default rate 4000
Router(config-lpts-policer-local)#commit
```

Running Configuration

```
Router#show running-config lpts
lpts pifib hardware police location 0/0/CPU0
 flow ospf unicast default rate 3000
 flow bgp default rate 4000
!
```

Verification

The **show lpts pifib hardware police location 0/0/CPU0** command displays pre-Internal Forwarding Information Base (IFIB) information for the designated node.

```
Router#show lpts pifib hardware police location 0/0/CPU0
-------------------------------------------------------------
                Node 0/0/CPU0:
-------------------------------------------------------------
FlowType               Policer Type    Cur. Rate Burst     Accepted     Dropped      npu
---------------------- ------- ------- --------- --------- ------------ ------------ ---------
Fragment               2       np      542       1000      0            0            0
Fragment               2       np      542       1000      0            0            1
OSPF-mc-known          3       np      1627      1000      0            0            0
OSPF-mc-known          3       np      1627      1000      0            0            1
OSPF-mc-default        4       np      1084      1000      0            0            0
OSPF-mc-default        4       np      1084      1000      0            0            1
OSPF-uc-known          5       np      542       1000      0            0            0
OSPF-uc-known          5       np      542       1000      0            0            1
OSPF-uc-default        6       np      3000      1000      0            0            0
OSPF-uc-default        6       np      3000      1000      0            0            1
BFD-default            10      np      8136      1000      0            0            0
BFD-default            10      np      8136      1000      0            0            1
BFD-MP-known           11      np      8136      1000      0            0            0
BFD-MP-known           11      np      8136      1000      0            0            1
BGP-known              16      np      17000     1000      0            0            0
BGP-known              16      np      17000     1000      0            0            1
BGP-cfg-peer           17      np      1627      1000      0            0            0
BGP-cfg-peer           17      np      1627      1000      0            0            1
BGP-default            18      np      4000      1000      0            0            0
BGP-default            18      np      4000      1000      0            0            1
```

Associated Commands

- **lpts pifib hardware police**
- **flow ospf**
- **flow bgp**
- **show lpts pifib hardware police**

LPTS and NPU Traps

Network Processing Unit (NPU) traps are raised by the routers for inspection. NPU traps are raised in response to the type of packets received by the router and can indicate either exception packets, error packets, or non-LPTS control packets.

- Examples of exception packets include glean adjacency traffic or packets with IPv4 options.
- Examples of error packets include IPv4 packet with bad checksum or IPv6 packets with a hop count of zero.

- Examples of non-LPTS control packets include those packets that do not get processed through LPTS (for example, LACP, LLDP and other L2 control packets).

Each of the NPU traps are policed at a rate that is pre-programmed by the router's system design. Packets are policed per NPU and excess traffic is dropped by the NPU with respect to the system design. Some NPU trap packets that are allowed by NPU policers are sent to the CPU if they need additional processing. Others that exceed the NPU policer rate are dropped by the NPU.

Verification

Use the command `show controllers npu stats traps-all instance` *`NPU-Number`*`|all location RP|LC` command to check the NPU trap statistics for all the NPUs or per NPU of a router.

For fixed systems, the NPU trap statistics is available for the location 0/RP0/CPU0 and is provided through the command `show controllers npu stats traps-all instance all location 0/RP0/CPU0`. For distributed systems, NPU trap statistics is available for the line card locations and is provided through the command `show controllers npu stats traps-all instance all location 0/1/CPU0`. You can use the command `clear controller npu stats traps-all instance` *`NPU-Number`*`|all location RP|LC`

In the following example:

- **(D)** indicates the trap packets that are dropped in the NPU.
- **(D*)** indicates the trap packets that are dropped in NPU but are available for analysis.
- The **Accepted** count in the output indicates the ones that are available for analysis.

```
Router# show controllers npu stats traps-all instance all location 0/RP/cpu0
Fri Oct 11 05:17:22.720 UTC


Trap Type                                     NPU  Trap     TrapStats     Policer              Packet             Packet

                                              ID    ID      ID                                Accepted       Dropped
========================================================================================================================
ETHERNET_ACL_DROP(D)                  0    0        0x0           1                          0                   0
ETHERNET_ACL_FORCE_PUNT(D*)           0    1        0x0           1                          0                   0
ETHERNET_VLAN_MEMBERSHIP(D*)          0    2        0x0           1                          0                   0
ETHERNET_ACCEPTABLE_FORMAT                    0    3        0x0           258                        0
 0
UNKNOWN_VLAN_OR_BUNDLE_MEMBER(D*)     0    4        0x0           259                        0                   0
NOT_MY_MAC(D*)                        0    5        0x0           260                        0                   0
ETHERNET_NO_SIP_MAPPING(D*)           0    6        0x0           1                          0                   0
ETHERNET_NO_VNI_MAPPING(D*)           0    7        0x0           1                          0                   0
ETHERNET_NO_VSID_MAPPING(D*)          0    8        0x0           1                          0                   0
ARP                                           0    9        0x0           264                        0
 0
ETHERNET_SA_ERROR(D*)                 0    11       0x0           266                        0                   0
ETHERNET_DA_ERROR(D*)                 0    12       0x0           1                          0                   0
ETHERNET_SA_MULTICAST(D*)             0    13       0x0           268                        0                   0
DHCPV4_SERVER                                 0    14       0x0           269                        0
 0
DHCPV4_CLIENT                                 0    15       0x0           270                        0
 0
ETHERNET_INGRESS_STP_BLOCK(D*)        0    18       0x0           1                          0                   0
PTP_OVER_ETHERNET                             0    16       0x0           274                        0
 0
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OAMP_BFD_INCORRECT_TTL(D*)            0    157      0x0           412                      0                   0
OAMP_BFD_INVALID_PROTOCOL(D*)         0    158      0x0           413                      0                   0
OAMP_BFD_INVALID_UDP_PORT(D*)         0    159      0x0           414                      0                   0
OAMP_BFD_INCORRECT_VERSION(D*)        0    160      0x0           415                      0                   0
```

```
OAMP_BFD_INCORRECT_ADDRESS(D*)        0    161      0x0           416                      0                   0
OAMP_BFD_MISMATCH_DISCR                       0    162      0x0           417                      0                   0
OAMP_BFD_STATE_FLAG_CHANGE                    0    163      0x0           418                      0                   0
OAMP_BFD_SESSION_RECEIVED(D*)         0    164      0x0           419                      0                   0
OAMP_PFC_LOOKUP_FAILED(D*)            0    165      0x0           420                      0                   0
OAMP_PFC_DROP_INVALID_RX(D*)          0    166      0x0           1                        0                   0
APP_SGACL_DROP (D*)                   0    168      0x0           1                        0                   0
```

Defining Dynamic LPTS Flow Type

The Dynamic LPTS flow type feature enables you to configure LPTS flow types and also enables you to define the maximum LPTS entries for each flow type in the TCAM. The dynamic LPTS flow type configuration is on per line card basis, hence you can have multiple profiles configured across line cards.

When the router boots, the default LPTS flow types are programmed in the TCAM. For each flow type the maximum flow entries are predefined. Later, at runtime, you have an option to choose the flow type based on network requirements and also configure the maximum flow entry value. The maximum flow entry value of zero denotes that a flow type is not configured.

Note You can get the default maximum flow values for both configurable flow and non-configurable flow from the output of the following show command:

```
show lpts pifib dynamic-flows statistics location <location specification>
```

The list of configurable and non-configurable flow types are listed in below tables. You can also use **show lpts pifib dynamic-flows statistics location** command to view the list of configurable and non-configurable flow types:

Note The sum of maximum LPTS entries configured for all flow types must not exceed 16000 entries per line card.

Configuration Example

In this example you will configure the BGP-known and ISIS-known LPTS flow type in the TCAM and define the maximum flow entries as 1800 and 500 for node location 0/1/CPU0. As the new maximum values are more than the default values, we have to create space in the TCAM by disabling other flow types so that the sum of maximum entries for all flow types per line card does not exceed 8000 entries. Hence RSVP-known flow type is set to zero in our example:

The maximum dynamic scale for any flow type should be configured such that all LPTS entries for that flow type are in hardware. One way to achieve that is to increase the dynamic scale. This may help avoid session flaps for NSR-enabled protocols like BGP and OSPF in case of triggers like RP fail overs.

```
Router#configure
Router(config)#lpts pifib hardware dynamic-flows location 0/1/CPU0
Router(config-pifib-flows-per-node)#flow bgp known max 1800
Router(config-pifib-flows-per-node)#flow rsvp known max 0
Router(config-pifib-flows-per-node)#commit
```

Running Configuration

```
Router#show running-config lpts pifib hardware dynamic-flows location 0/1/CPU0
lpts pifib hardware dynamic-flows location 0/1/CPU0
 flow bgp known max 1800
 flow rsvp known max 0
!
```

Verification

This show command displays dynamic flow statistics. You can see that the flow types BGP-known and ISIS-known are configured in the TCAM with newly configured maximum flow entry value. You can also see that the RSVP-known flow type is disabled:

```
Router#show lpts pifib dynamic-flows statistics location 0/1/CPU0

 Dynamic-flows Statistics:
 -------------------------
 (C - Configurable, T - TRUE, F - FALSE, * - Configured)
 Def_Max  - Default Max Limit
 Conf_Max - Configured Max Limit
 HWCnt    - Hardware Entries Count
 ActLimit - Actual Max Limit
 SWCnt    - Software Entries Count
 P, (+)   - Pending Software Entries


  FLOW-TYPE           C  Def_Max Conf_Max     HWCnt/ActLimit      SWCnt  P
 -------------------- -- ------- --------   -------/--------    -------- -
 Fragment             F        2       --         2/2                  2
 OSPF-mc-known        T      600       --         2/600                2
 OSPF-mc-default      F        4       --         4/4                  4
 OSPF-uc-known        T      300       --         1/300                1
 OSPF-uc-default      F        0       --         0/0                  1  +
 BFD-default          F        2       --         2/2                  2
 BFD-MP-known         T       40       --         1/40                 0
 BGP-known            T*    2400     1800         6/900                6
 BGP-cfg-peer         T      900       --         0/900                0
 BGP-default          F        4       --         4/4                  4
 PIM-mcast-default    F       40       --         0/40                 0
 PIM-mcast-known      T      300       --         0/300                0
 PIM-ucast            F       40       --         2/40                 2
 IGMP                 T     1200       --         0/1200               0
 ICMP-local           F        4       --         4/4                  4
 ICMP-control         F        5       --         5/5                  5
 LDP-TCP-known        T      300       --         0/300                0
 LDP-TCP-cfg-peer     T      300       --         0/300                0
 LDP-TCP-default      F       40       --         0/40                 0
 LDP-UDP              T      300       --         0/300                0
 All-routers          T      300       --         0/300                0
 RSVP-default         F        4       --         1/4                  1
 RSVP-known           T*     300        0         0/0                  1  +
 SNMP                 T      300       --         8/300                8
 SSH-known            T       40       --         0/40                 0
 SSH-default          T        1       --         1/1                  2  +
 HTTP-known           T       40       --         0/40                 0
 SHTTP-known          T       40       --         0/40                 0
 TELNET-known         T       40       --         0/40                 0
 TELNET-default       T        1       --         1/1                  1
 UDP-known            T        0       --         0/0                  0
 UDP-default          F        2       --         2/2                  2
 TCP-known            T       40       --         0/40                 0
 TCP-default          F        2       --         2/2                  2
 Raw-default          F        2       --         2/2                 2
 GRE                  F        4       --         0/4                 0
 VRRP                 T      150       --         0/150               0
 DNS                  T       40       --         0/40                0
 NTP-known            T       40       --         0/40                0
 DHCPv4               T       40       --         0/40                0
 DHCPv6               T       40       --         0/40                0
 TPA                  T     1000       --         0/1000              0
 PM-TWAMP             T       10       --         0/10                0
---------------------------------------------------
 Active TCAM Usage : 13421/16000 [Platform MAX: 16000]
 HWCnt/SWCnt       : 65/88
---------------------------------------------------
```

In the above show command output, the last column **P** specifies the pending software flow entries for the flow type.