Implementing LPTS

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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

Table 1: Feature History Table

Feature Name	Release Information	Description
Monitor LPTS Host Path Drops via YANG Data Model	Release 7.3.2	This feature allows you to use the `Cisco-IOS-XR-lpts-pre-ifib-oper.yang` data model to monitor the policer action for Local Packet Transport Services (LPTS) flow type for all IOS XR platforms. To access this data model, see the Github repository.

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.

Configuration Example

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

- ospf unicast default rate 200
- bgp configured rate 200
- bgp default rate 100

```
Router#configure
Router(config)#lpts pifib hardware police
Router(config-pifib-policer-global)#flow ospf unicast default rate 200
Router(config-pifib-policer-global)#flow bgp configured rate 200
Router(config-pifib-policer-global)#flow bgp default rate 100
Router (config-pifib-policer-global)#commit
```

Running Configuration

```
lpts pifib hardware police
flow ospf unicast default rate 200
flow bgp configured rate 200
flow bgp default rate 100
!
```

Verification

```
Router#show run lpts pifib hardware police
lpts pifib hardware police
flow ospf unicast default rate 200
flow bgp configured rate 200
flow bgp default rate 100
```

Note The **show lpts pifib hardware police location 0/RP0/CPU0** command displays pre-Internal Forwarding Information Base (IFIB) information for the designated node.

Configuration Example

Configure the LPTS policer for the OSPF and BGP flow types with the following values:

- ospf unicast default rate 100
- bgp configured rate 300

```
Router#configure
Router(config)#lpts pifib hardware police
Router(config-pifib-policer-per-node)#flow ospf unicast default rate 200
Router(config-pifib-policer-per-node)#flow bgp configured rate 200
```

```
Router(config-pifib-policer-per-node)#flow bgp default rate 100
Router(config-pifib-policer-per-node)#commit
```

Running Configuration

```
lpts pifib hardware police location 0/RP0/CPU0
flow ospf unicast default rate 100
flow bgp configured rate 300
```

Verification

```
Router#show run lpts pifib hardware police
lpts pifib hardware police
flow ospf unicast default rate 100
flow bgp configured rate 300
!
```

Verification

The **show controllers npu stats traps-all instance all location 0/0/CPU0** command displays packets that are locally processed and packets that are dropped by the CPU.

```
Router# show controllers npu stats traps-all instance all location 0/0/CPU0
```

Trap Type	NPU ID	Trap ID	TrapStats ID	Policer	Packet Accepted	Packet Dropped
RxTrapMimSaMove(CFM_DOWM_MEP_DMM)	0	6	0x6	32037	0	0
RxTrapMimSaUnknown(RCY_CFM_DOWN_MEP_DMM)	0	7	0x7	32037	0	0
RxTrapAuthSaLookupFail (IPMC default)	0	8	0x8	32033	0	0
RxTrapSaMulticast	0	11	0xb	32018	0	0
RxTrapArpMyIp	0	13	0xd	32001	0	0
RxTrapArp	0	14	0xe	32001	11	0
RxTrapDhcpv4Server	0	18	0x12	32022	0	0
RxTrapDhcpv4Client	0	19	0x13	32022	0	0
RxTrapDhcpv6Server	0	20	0x14	32022	0	0
RxTrapDhcpv6Client	0	21	0x15	32022	0	0
RxTrapL2Cache_LACP	0	23	0x17	32003	0	0
RxTrapL2Cache_LLDP1	0	24	0x18	32004	0	0
RxTrapL2Cache_LLDP2	0	25	0x19	32004	1205548	0
RxTrapL2Cache_LLDP3	0	26	0x1a	32004	0	0
RxTrapL2Cache_ELMI	0	27	0x1b	32005	0	0
RxTrapL2Cache_BPDU	0	28	0x1c	32027	0	0
RxTrapL2Cache_BUNDLE_BPDU	0	29	0x1d	32027	0	0
RxTrapL2Cache_CDP	0	30	0x1e	32002	0	0

RxTrapHeaderSizeErr	0	32	0x20	32018	0	0
RxTrapIpCompMcInvalidIp	0	35	0x23	32018	0	0
RxTrapMyMacAndIpDisabled	0	36	0x24	32018	0	0
RxTrapMyMacAndMplsDisable	0	37	0x25	32018	0	0
RxTrapArpReply	0	38	0x26	32001	2693	0
RxTrapFibDrop	0	41	0x29	32018	0	0
RxTrapMTU	0	42	0x2a	32020	0	0
RxTrapMiscDrop	0	43	0x2b	32018	0	0
RxTrapL2AclDeny	0	44	0x2c	32034	0	0
Rx_UNKNOWN_PACKET	0	46	0x2e	32018	0	0
RxTrapL3AclDeny	0	47	0x2f	32034	0	0
RxTrapOamY1731MplsTp(OAM_SWOFF_DN_CCM)	0	57	0x39	32029	0	0
RxTrapOamY1731Pwe(OAM_SWOFF_DN_CCM)	0	58	0x3a	32030	0	0
RxTrapOamLevel	0	64	0x40	32023	0	0
RxTrapRedirectToCpuOamPacket	0	65	0x41	32025	0	0
RxTrapOamPassive	0	66	0x42	32024	0	0
RxTrap1588	0	67	0x43	32038	0	0
RxTrapExternalLookupError	0	72	0x48	32018	0	0
RxTrapArplookupFail	0	73	0x49	32001	0	0
RxTrapUcLooseRpfFail	0	84	0x54	32035	0	0
RxTrapMplsControlWordTrap	0	88	0x58	32015	0	0
RxTrapMplsControlWordDrop	0	89	0x59	32015	0	0
RxTrapMplsUnknownLabel	0	90	0x5a	32018	0	0
RxTrapIpv4VersionError	0	98	0x62	32018	0	0
RxTrapIpv4ChecksumError	0	99	0x63	32018	0	0
RxTrapIpv4HeaderLengthError	0	100	0x64	32018	0	0
RxTrapIpv4TotalLengthError	0	101	0x65	32018	0	0
RxTrapIpv4Ttl0	0	102	0x66	32008	0	0
RxTrapIpv4Ttl1	0	104	0x68	32008	0	0
RxTrapIpv4DipZero	0	106	0x6a	32018	0	0
RxTrapIpv4SipIsMc	0	107	0x6b	32018	0	0
RxTrapIpv6VersionError	0	109	0x6d	32018	0	0

```
RxTrapIpv6HopCount0                              0    110  0x6e        32011   0          0
RxTrapIpv6LoopbackAddress                        0    113  0x71        32018   0          0
RxTrapIpv6MulticastSource                        0    114  0x72        32018   0          0
RxTrapIpv6NextHeaderNull                         0    115  0x73        32010   0          0
RxTrapIpv6Ipv4CompatibleDestination              0    121  0x79        32018   0          0
RxTrapMplsTtl1                                   0    125  0x7d        32012   316278     2249
RxTrapUcStrictRpfFail                            0    137  0x89        32035   0          0
RxTrapMcExplicitRpfFail                          0    138  0x8a        32033   0          0
RxTrapOamp(OAM_BDL_DN_NON_CCM)                   0    141  0x8d        32031   0          0
RxTrapOamEthUpAccelerated(OAM_BDL_UP_NON_CCM)    0    145  0x91        32032   0          0
RxTrapReceive                                    0    150  0x96        32017   125266112  0
RxTrapUserDefine_FIB_IPV4_NULL0                  0    151  0x97        32018   0          0
RxTrapUserDefine_FIB_IPV6_NULL0                  0    152  0x98        32018   0          0
RxTrapUserDefine_FIB_IPV4_GLEAN                  0    153  0x99        32016   0          0
RxTrapUserDefine_FIB_IPV6_GLEAN                  0    154  0x9a        32016   0          0
RxTrapUserDefine_IPV4_OPTIONS                    0    155  0x9b        32006   0          0
RxTrapUserDefine_IPV4_RSVP_OPTIONS               0    156  0x9c        32007   0          0
RxTrapUserDefine                                 0    157  0x9d        32026   0          0
RxTrapUserDefine_BFD                             0    163  0xa3        32028   0          0
RxTrapMC                                         0    181  0xb5        32033   0          0
RxNetflowSnoopTrap0                              0    182  0xb6        32018   0          0
RxNetflowSnoopTrap1                              0    183  0xb7        32018   0          0
RxTrapMimSaMove(CFM_DOWM_MEP_DMM)                1    6    0x6         32037   0          0
RxTrapMimSaUnknown(RCY_CFM_DOWN_MEP_DMM)         1    7    0x7         32037   0          0
RxTrapAuthSaLookupFail (IPMC default)            1    8    0x8         32033   0          0
RxTrapSaMulticast                                1    11   0xb         32018   0          0
RxTrapArpMyIp                                    1    13   0xd         32001   0          0
```

Starting Cisco IOS XR Software Release 7.3.2, you can use `Cisco-IOS-XR-lpts-pre-ifib-oper` YANG data model across all IOS XR platforms to retrieve the policer statistics of the flow type. The following example shows the sample RPC request:

```
===== RPC request ======
<rpc message-id="101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <get>
    <filter>
      <lpts-pifib xmlns="http://cisco.com/ns/yang/Cisco-IOS-XR-lpts-pre-ifib-oper">
```

```
        <nodes>
          <node>
            <node-name>0/0/CPU0</node-name>
            <pifib-hw-flow-policer-stats/>
          </node>
        </nodes>
      </lpts-pifib>
    </filter>
  </get>
</rpc>
##
```

The following example show the relevant snippet of the `ICMP-local` flow response to the RPC request:

```
<police-info>
       <flow-type>23</flow-type>
       <flow-name>ICMP-local</flow-name>
       <type>2</type>
       <type-name>Global</type-name>
       <domain-id>0</domain-id>
       <domain-name>default</domain-name>
       <npu-id>255</npu-id>
       <policer-rate>0</policer-rate>
       <burst-size>750</burst-size>
       <accepted>2000</accepted>
       <dropped>1000</dropped>
      </police-info>
      <police-info>
```

The policer stats of each flow type is the aggregate of all the NPU counters. In the example, the NPU ID of 255 indicates that the value is an aggregate of all NPU stats and provides a simplified view of policer stats per flow type.

Understanding ACL-based Policers

ACL-based LPTS policers are session-based policers that provide secure network access for each session.

Benefits

These are the benefits of ACL-based policer:

- Provides rate limit on incoming packets based on session.
- Modifies policer rates depending on traffic load.
- Blocks entire traffic based on a specific session without impacting other sessions with the same flow.

Restrictions

- It is recommended to have up to 10 prefixes in a single ACL. The ACEs in an ACL should be managed such that there is no overlap of prefixes.
- Up to 50 ACL-based LPTS policers can be configured on a router.
- ACL-based LPTS policers can be configured to an IPv4 LPTS session that has a particular flow type and that matches the default VRF.
- ACL-based LPTS policers can be configured to an IPv4 or IPv6 LPTS session that has a particular flow type and that matches the VRF ID.

Configure IPv4 ACL-based LPTS Policers

This section describes how you can configure IPv4 ACL-based LPTS policers.

Configuration Example

To configure ACL-based LPTS policers for IPv4 sessions, complete the following configurations:

1. Configure an ACL.
2. Configure LPTS policer for a particular IPv4 session matching an ACL and VRF.

Configuration

```
/* Enter the global configuration mode and configure an ACL */
Router# configure
Router(config)# ipv4 access-list ACL1_OSPF
Router(config-ipv4-acl)# 10 permit ipv4 host 192.168.1.5 any
Router(config-ipv4-acl)# commit
Router(config-ipv4-acl)# exit

/* Configure LPTS policer for a particular IPv4 session matching an ACL and VRF. */
Router(config)# lpts pifib hardware police
Router(config-pifib-policer-global)# acl ACL1_OSPF rate 2000 vrf red8
Router(config-if)# commit
```

Verification

Use the following command to display the ACL-based LPTS policer entries attached to matching entries:

```
Router#show lpts pifib hardward entry statistics location 0/RP0/CPU0
Offset  NPU   L3   VRF id  L4  Intf Dest Pkts/Drops laddr,Port     raddr,Port  acl name
------  ----- ---  ------  --- ---  ----- -------  --------        --------   -----
  37    0 [0] IPV4   *    any  any   Local  0/0     any,any           any,any
  38    0 [1] IPV4   *    any  any   Local  0/0     any,any           any,any
  .       .     .    .     .    .     .       .         .                .
  .       .     .    .     .    .     .       .         .                .
  .       .     .    .     .    .     .       .         .                .
 187    0 [0] IPV4   *    ICMP any   Local  0/0     any,8             any,ECHO   ACL3_ICMP
 188    0 [1] IPV4   *    ICMP any   Local  0/0     any,8             any,ECHO   ACL3_ICMP
 189    0 [2] IPV4   *    ICMP any   Local  0/0     any,8             any,ECHO   ACL3_ICMP
 190    0 [3] IPV4   *    ICMP any   Local  0/0     any,8             any,ECHO   ACL3_ICMP
8963    0 [0] IPV4 default UDP OptV2 Local  22588/0 192.168.10.2,646  any,any    ACL4_UDP
8964    0 [1] IPV4 default UDP OptV2 Local  22590/0 192.168.10.2,646  any,any    ACL4_UDP
8965    0 [2] IPV4 default UDP OptV2 Local  0/0     192.168.10.2,646  any,any    ACL4_UDP
8966    0 [3] IPV4 default UDP OptV2 Local  0/0     192.168.10.2,646  any,any    ACL4_UDP
  .       .     .    .     .    .     .       .         .                .
  .       .     .    .     .    .     .       .         .                .
  .       .     .    .     .    .     .       .         .                .
8279    0 [0] IPV4 default OSPF OptV2 Local 846248/0 192.168.10.5,any any,any    ACL1_OSPF
8280    0 [1] IPV4 default OSPF OptV2 Local 962717/0 192.168.10.5,any any,any    ACL1_OSPF
8281    0 [3] IPV4 default OSPF OptV2 Local 421169/0 192.168.10.5,any any,any    ACL1_OSPF
8281    0 [4] IPV4 default OSPF OptV2 Local 0/0      192.168.10.5,any any,any    ACL1_OSPF
  .       .     .    .     .    .     .       .         .                .
  .       .     .    .     .    .     .       .         .                .
  .       .     .    .     .    .     .       .         .                .
8339    0 [0] IPV4 red8    OSPF OptV2 Local  0/0     192.168.10.5,any any,any    ACL1_OSPF
8340    0 [1] IPV4 red8    OSPF OptV2 Local  0/0     192.168.10.5,any any,any    ACL1_OSPF
8341    0 [2] IPV4 red8    OSPF OptV2 Local  11099/0 192.168.10.5,any any,any    ACL1_OSPF
8342    0 [1] IPV4 red8    OSPF OptV2 Local  0/0     192.168.10.5,any any,any    ACL1_OSPF
```

```
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8363   0 [0] IPV4  red7   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8364   0 [1] IPV4  red7   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8365   0 [2] IPV4  red7   OSPF OptV2 Local  11099/0 192.168.10.5,any any,any    ACL1_OSPF
8366   0 [3] IPV4  red7   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8375   0 [0] IPV4  red6   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8376   0 [1] IPV4  red6   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8377   0 [2] IPV4  red6   OSPF OptV2 Local  11103/0 192.168.10.5,any any,any    ACL1_OSPF
8378   0 [3] IPV4  red6   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8391   0 [0] IPV4  red5   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8392   0 [1] IPV4  red5   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8393   0 [2] IPV4  red5   OSPF OptV2 Local  11104/0 192.168.10.5,any any,any    ACL1_OSPF
8394   0 [3] IPV4  red5   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8411   0 [0] IPV4  red4   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8412   0 [1] IPV4  red4   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8413   0 [2] IPV4  red4   OSPF OptV2 Local  11101/0 192.168.10.5,any any,any    ACL1_OSPF
8414   0 [3] IPV4  red4   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8427   0 [0] IPV4  red3   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8428   0 [1] IPV4  red3   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8429   0 [2] IPV4  red3   OSPF OptV2 Local  11107/0 192.168.10.5,any any,any    ACL1_OSPF
8430   0 [3] IPV4  red3   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8439   0 [0] IPV4  red1   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8440   0 [1] IPV4  red1   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
8441   0 [2] IPV4  red1   OSPF OptV2 Local  11099/0 192.168.10.5,any any,any    ACL1_OSPF
8442   0 [3] IPV4  red1   OSPF OptV2 Local   0/0    192.168.10.5,any any,any    ACL1_OSPF
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
  .      .     .    .     .    .     .       .         .                .
8276   0 [1] IPV4 default OSPF OptV2 Local  1752/0  any,any         any,any
```

Configure IPv6 ACL-based LPTS Policers

This section describes how you can configure IPv6 ACL-based LPTS policers.

Configuration Example

To configure ACL-based LPTS policers for IPv6 sessions, complete the following configurations:

1. Configure a VRF.
2. Configure an ACL.
3. Configure LPTS policer for a particular IPv6 session matching an ACL and VRF ID.

Configuration

```
/* Enter the global configuration mode and configure an VRF */
Router# configure
Router(config)# vrf red83
Router(config)# commit

/* Configure an ACL */
Router(config)# ipv6 access-list ACL33
Router(config-ipv6-acl)# 10 permit ipv6 host 4000:21::1 host 4000:21::2
Router(config-ipv6-acl)# 60 permit ipv6 host 4000:53::1 host 4000:53::2
Router(config-ipv6-acl)# commit
Router(config-ipv6-acl)# exit

/* Configure LPTS policer for a particular IPv6 session matching an ACL and VRF ID. */
Router(config)# lpts pifib hardware police
Router(config-pifib-policer-global)# acl ACL33 rate 5000 vrf red83 ipv6
Router(config-pifib-policer-global)# commit
```

Verification

Use the following command to display the ACL-based LPTS policer entries attached to matching entries:

```
Router#show lpts pifib hardward entry statistics location 0/RP0/CPU0

Offset  NPU   L3    VRF id  L4   Intf Dest Pkts/Drops  laddr,Port    raddr,Port    acl name
------  -----  ---  ------  ---  ---  -----  -------    --------      --------      -----
1498    0 [0] IPV6  red83  TCP  any  Local  383/0  4000:53::1,179  4000:53::1,179   ACL33
1499    0 [1] IPV6  red83  TCP  any  Local  0/0    4000:53::1,179  4000:53::2,43329 ACL33
1450    0 [2] IPV6  red83  TCP  any  Local  0/0    4000:53::1,179  4000:53::2,43329 ACL33
1451    0 [3] IPV6  red83  TCP  any  Local  0/0    4000:53::1,179  4000:53::2,43329 ACL33
```