Packet Duplication

Feature history for packet duplication

Table 1: Feature History

Feature Name	Release Information	Description
Packet Duplication for Noisy Channels	Cisco IOS XE Catalyst SD-WAN Release 16.12.1b	This feature helps mitigate packet loss over noisy channels, thereby maintaining high application QoE for voice and video.
Packet Duplication for Large Packets Using Underlay Fragmentation	Cisco IOS XE Catalyst SD-WAN Release 17.15.1a Cisco Catalyst SD-WAN Control Components Release 20.15.1	This feature enables packet duplication even when the packet size is greater than the path maximum transmission unit (PMTU) discovered on the duplicate tunnel. With the help of underlay fragmentation, this feature uses adjacency MTU instead of tunnel PMTU to provide this capability. Cisco SD-WAN Manager provides a chart for viewing packet duplication information for tunnels. IPv6 support for Packet Duplication is also added.

Packet duplication

The packet duplication feature can be used to mitigate packet loss. Packet duplication duplicates packets on alternate available SD-WAN tunnels.

Receiving Cisco IOS XE Catalyst SD-WAN devices forward one packet to the server and discard the duplicate packets.

Packet duplication is suitable for edges with multiple WAN links.

You can view the tunnel packet duplication statistics using device CLI or the Cisco SD-WAN Manager device dashboard.

Note From Cisco IOS XE Catalyst SD-WAN Release 17.18.1a, the tunnel selection algorithm has been optimized. While selecting a duplicate tunnel, the highest preference is given to the tunnel which has a different local color compared to that of the primary tunnel.

Packet Duplication for Large Packets Using Underlay Fragmentation

When packets are intercepted for duplication, the system queries the IP database using the incoming tunnel ID. It then fetches the duplicate tunnel object. The system compares the packet length with the path maximum transmission unit (PMTU) of the duplicate tunnel. If the packet length is smaller than the duplicate tunnel's PMTU, the packets are duplicated.

From Cisco IOS XE Catalyst SD-WAN Release 17.15.1a, packet duplication with underlay fragmentation ensures that packets get duplicated even when the packet size is more than the PMTU of duplicate tunnel.

For more information on how to enable underlay fragmentation, see VFR and Underlay Fragmentation.

To monitor packet duplication statistics, see View Loss Percentage, Latency, Jitter, Octet, and Packet Duplication Information for Tunnels.

Supported Traffic

Cisco IOS XE Catalyst SD-WAN Devices support packet duplication for the following traffic types:

From Cisco IOS XE Catalyst SD-WAN Release 16.12.1b:

IPv4 traffic over IPv4 tunnel

From Cisco IOS XE Catalyst SD-WAN Release 17.15.1a:

- IPv4 traffic over IPv6 tunnel
- IPv6 traffic over IPv4 tunnel
- IPv6 traffic over IPv6 tunnel

Configure packet duplication

Use one of these methods to configure packet duplication:

- Policy groups
- Classic policies

Configure packet duplication using policy groups

Minimum supported release: Cisco Catalyst SD-WAN Control Components Release 20.14.1

1. Select **Configuration** > **Policy Groups**.
2. Click **Application Priority & SLA**.
3. Click **Add Application Priority & SLA Policy**. Provide a policy name and description.
4. Enable **Advanced Layout** in the top right pane.
5. Click **Add Traffic Policy**.
6. Enter a name for the policy and specify VPNs.
7. In the **Direction** drop-down list, select **All**.
8. In the **Default Action**, click **Accept**.
9. Click **Add**.
10. Click **Add Rules**.
11. Click **Match**. Select appropriate match condition.
12. Click **Action** > **Loss Correction**.
13. In the **Type** drop-down list, choose **Packet Duplication**
14. Click **Save Match and Actions**.
15. Click **Save Policy**.

Configure packet duplication using classic policies

1. From the Cisco SD-WAN Manager menu, choose **Configuration > Policies**.
2. Select **Centralized Policy** at the top of the page and then click **Add Policy**.
3. Click **Next** twice to select **Configure Traffic Rules**.
4. Select **Traffic Data**, and from the **Add Policy** drop-down list, click **Create New**.
5. Click **Sequence Type** in the left pane.
6. From the **Add Data Policy** pop-up window, select **QoS**.
7. Click **Sequence Rule**.
8. In the **Applications/Application Family List/Data Prefix**, select one or more applications or lists.
9. Click **Actions** and choose **Loss Correction**.
10. In the Actions area, select the **Packet Duplication** option to enable the packet duplication feature.
    - **FEC Adaptive**: Only send Forward Error Correction (FEC) information when the system detects a packet loss.
    - **FEC Always**: Always send FEC information with every transmission.

- **None**: Use when no loss protection is needed.
- **Packet Duplication**: Enable when packets need to be duplicated and sent on the next available links to reduce packet loss.

11. Click **Save Match and Actions**.
12. Click **Save Data Policy**.
13. Click **Next** and take these actions to create a Centralized Policy:
    a. Enter a Name and a Description.
    b. Select **Traffic Data Policy**.
    c. Choose **VPNs/site list** for the policy.
    d. Save the policy.

Configure underlay fragmentation using configuration groups

Minimum supported releases: Cisco IOS XE Catalyst SD-WAN Release 17.15.1a

1. From the Cisco SD-WAN menu, choose **Configuration** > **Configuration Groups**.
2. Click **Transport & Management Profile**.
3. Select the desired transport profile and click **Edit**.
4. Click **Edit Ethernet Interface** > **Tunnel**.
5. Enable **Allow Fragmentation** and **MTU To Max**.
6. Click **Save**.

Restrictions for packet duplication

- Packet duplication interop along with forward error correction (FEC) and TCP optimization on Cisco IOS XE Catalyst SD-WAN devices is not supported between Cisco IOS XE Release 16.x and Cisco IOS XE Catalyst SD-WAN Release 17.x versions.
- Packet duplication cannot work in conjunction with local or remote TLOC in the policy. Data policy or AAR is not configured when specifying the packet duplicated tunnel.
- Packet duplication is supported only on Cisco IOS XE Catalyst SD-WAN devices but not on all the edge devices.

Monitor packet duplication statistics for a device using the CLI

The following is sample output from the **show sdwan tunnel statistics pkt-dup** command:

```
Device#show sdwan tunnel statistics pkt-dup
tunnel stats ipsec 192.0.2.1 203.0.113.1 12366 12406
pktdup-rx                           1313388
pktdup-rx-other                     526666
pktdup-rx-this                      1324958
pktdup-rx-fwd                       540190
pktdup-rx-fwd-dup-tun               789569
pktdup-tx                           0
pktup-tx-other                      0
pktdup-tx-dup-tun-selection-failed  0
pktdup-tx-dup-tun-sent-failed       0
pktdup-capable                      true
pktdup-tx-intercepted              0
pktdup-max-preselect               4
```

Monitor packet duplication statistics for a device using Cisco SD-WAN Manager

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.
2. Choose a device.
3. For a device, in the **Action** column, click **...** and choose **Real Time**.
4. In the **Device Options** drop-down menu, click **Tunnel Packet Duplication Statistics**.

The following table describes the packet duplication counters that appear in the **Tunnel Packet Duplication Statistics** pane:

Name of Counter	Description
pktdup-rx	Displays number of original packets received by primary tunnel.
pktdup-rx-other	Displays the number of duplicate packets received by this duplicate tunnel.
pktdup-rx-this	N/A
pktdup-rx-fwd	Displays the number of packets received and forwarded by this tunnel.
pktdup-rx-fwd-dup-tun	Displays the number of packets received and forwarded by the duplicate tunnel(s).
pktdup-tx	Displays the total number of duplicate packets generated with respect to this tunnel traffic which will be sent out on duplicate tunnel(s).
pktdup-tx-other	Displays the total number of duplicate packets sent out by this tunnel, but these packets belongs to some other original tunnel.
pktdup-tx-dup-tun-selection-failed	Displays the total number of failed duplication because duplicate tunnels are not available.

Name of Counter	Description
pktdup-tx-dup-tun-sent-failed	Displays the total number of duplicated packets failed to be sent out by duplicate tunnel(s).
pktdup-tx-intercepted	Displays the total number of packets which need to be duplicated with respect to this tunnel (equivalent to policy-match).
pktdup-capable	Indicates that this tunnel is capable of supporting the packet duplication functionality.

Monitor tunnel information for a device

1. From the Cisco SD-WAN Manager menu, choose **Monitor** > **Devices**.
2. Click a device name.
3. In the left pane, click **Tunnel** in the WAN area.

   The right pane displays information about tunnel connection information, including loss percentage, latency, jitter, octets, and packet duplication.
4. In the right pane, click **Chart Options** to choose the format in which you want to view the information.

Table 2:

Packet Duplication Counters	Description	Mapping to CLI Counters
RX	Displays the number of original packets received on this primary tunnel.	pktdup-rx
RX Fwd	Displays the number of original packets forwarded by this primary tunnel.	pktdup-rx-fwd
RX Dup Fwd	Displays the number of duplicated packets forwarded by duplicate tunnels. RX Fwd + RX Dup Fwd = RX	pktdup-rx-fwd-dup-tun
TX Intercepted	Displays the number of packets intercepted for duplication.	pktdup-tx-intercepted
TX Dup	Displays the number of successful duplicate packets on the duplicate tunnel(s).	(pktdup-tx) - (pktdup-tx-dup-tun-sent-failed)
TX Dup Failed	Displays the number of failed duplications.	(pktdup-tx-dup-tun-selection-failed) + (pktdup-tx-dup-tun-sent-failed)