# Application Performance Monitor

**Note** To achieve simplification and consistency, the Cisco SD-WAN solution has been rebranded as Cisco Catalyst SD-WAN. In addition, from Cisco IOS XE SD-WAN Release 17.12.1a and Cisco Catalyst SD-WAN Release 20.12.1, the following component changes are applicable: **Cisco vManage** to **Cisco Catalyst SD-WAN Manager**, **Cisco vAnalytics** to **Cisco Catalyst SD-WAN Analytics**, **Cisco vBond** to **Cisco Catalyst SD-WAN Validator**, **Cisco vSmart** to **Cisco Catalyst SD-WAN Controller**, and **Cisco Controllers** to **Cisco Catalyst SD-WAN Control Components**. See the latest Release Notes for a comprehensive list of all the component brand name changes. While we transition to the new names, some inconsistencies might be present in the documentation set because of a phased approach to the user interface updates of the software product.

***Table 1: Feature History***

| Feature Name | Release Information | Description |
|---|---|---|
| Application Performance Monitor | Cisco IOS XE Catalyst SD-WAN Release 17.5.1a<br><br>Cisco vManage Release 20.5.1 | This feature provides an express method for configuring an intent-based performance monitor with the help of predefined monitoring profiles.<br><br>Configure this feature using the CLI Add-on feature template in Cisco SD-WAN Manager. |



# Overview of Application Performance Monitor

The Application Performance Monitor feature is a simplified framework that enables you to configure intent-based performance monitors. With this feature, you can view real-time, end-to-end application performance filtered by client segments, network segments, and server segments. This information helps you optimize application performance.

An application performance monitor is a predefined configuration that is used to collect performance metrics for specific traffic.

### Key Concepts in Application Performance Monitoring

**Monitoring Profile:** A profile is a predefined set of traffic monitors that can be enabled or disabled for a context. As part of this feature, the sdwan-performance profile has been enhanced to include Application Response Time (ART) and media monitors to monitor traffic passing through Cisco Catalyst SD-WAN tunnel interfaces. The sdwan-performance profile has a dedicated policy to filter traffic based on your intent.

When you choose the sdwan-performance profile, the related configuration is generated and applied automatically.

**Context:** A context represents a performance monitor policy map that is attached to an interface for ingress and egress traffic. A context contains information about a traffic monitor that has to be enabled. When a context is attached to an interface, two policy-maps are created, one each for ingress and egress traffic. Depending on the direction specified in the traffic monitor, the policy maps are attached in that direction and the traffic is monitored.

**Note** A context can be attached to multiple interfaces. Only one context can be attached to an interface. You can modify the context only when it is not attached to an interface.

**Traffic Monitoring Specifications:** You can choose to filter performance metrics using classification and sampler.

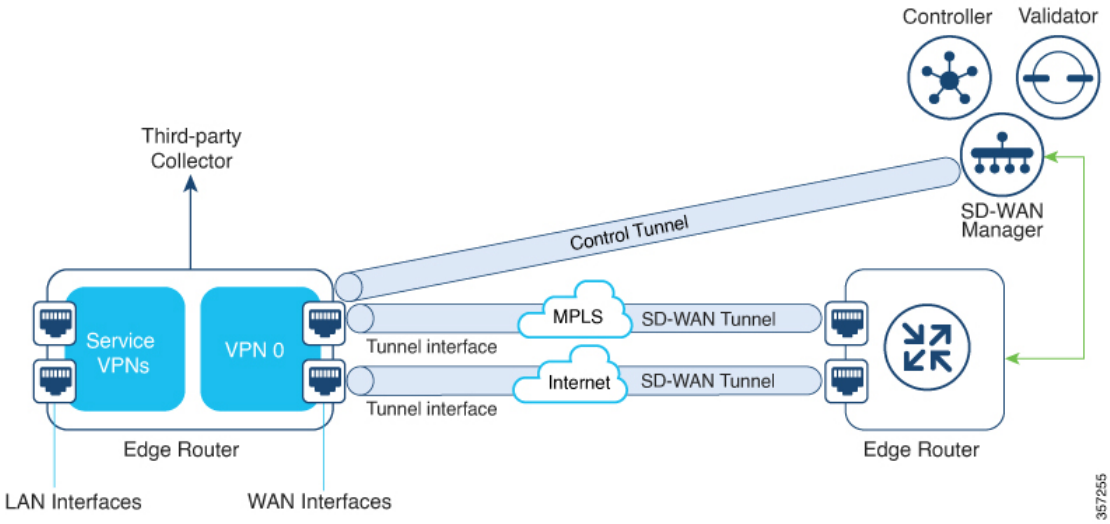
- **Classification:** Classification is a filter that defines the traffic that should be monitored for specified applications. This filter reduces the load on the device and performance collectors because they only need to monitor performance for specific applications.
- **Sampler:** A sampler monitors random traffic flows, based on the sampling rate specified, rather than all the flows. Enabling the sampler reduces scaling and performance impact when the scale of traffic is large.

### Features and Benefits

- ART can be monitored for TCP flows. Some of the parameters that can be monitored are—server network delay, client network delay, and application delay.
- Jitter can be monitored for Real-time Transport Protocol (RTP) audio and video traffic.
- Information about input and output interfaces and local and remote TLOCs can be collected for every flow that matches the performance monitor.
- Performance monitor can be configured on all WAN tunnel interfaces or specific WAN tunnel interfaces using CLI commands.
- Global performance sampler is supported. The sampler allows you to monitor random flows based on the sampling rate configured, rather than the entire traffic, therefore, reducing performance and scaling overhead.

### How Application Performance Monitor Works

*Figure 1: Performance Monitoring Workflow*




In this image, performance monitor has been applied globally (on all tunnel interfaces). You also have the option to enable it on specific interfaces. Performance is monitored for traffic going out of, and coming into the WAN tunnel interfaces. Based on the exporter parameters defined in the context that is initiated from the monitoring profile, the metrics that are collected are sent to the third-party collector that is defined. You can then view details of the application or media that you are monitoring using various show commands.

# Limitations and Restrictions

- Performance monitoring is only supported on IPv4 traffic. IPv6 traffic is not supported.
- Once a performance monitor is applied to a device, the configuration cannot be modified and reapplied to the device. Follow these steps to make any modifications to performance monitor configuration:

  1. Edit the CLI Add-on feature template or device CLI template to remove the **performance monitor apply** command from the template. Update the device CLI template or the device template to which the CLI Add-on feature template is attached.
  2. Edit the **performance monitor context** in the CLI Add-on feature template, and apply the performance monitor again using the **performance monitor apply** command. Update the device template to which the CLI Add-on feature template is attached.

  Alternatively, configure a new context based on the same monitoring profile, and remove the previous context configuration.
- App visibility must be enabled in a policy to be able to set the connector initiator value appropriately.

# Configure Application Performance Monitor

You can enable application performance monitor globally (on all WAN tunnel interfaces) or on specific WAN tunnel interfaces. You can also enable performance monitoring for ART, or media monitors, or both.

To configure application performance monitoring using Cisco SD-WAN Manager, create a CLI add-on feature template and attach it to the device template.

### Enable Performance Monitor Globally

The following example shows how to configure a performance monitor context using the sdwan-performance profile. This configuration enables monitoring of traffic metrics for ART and media, and applies the configuration to all SD-WAN tunnel interfaces. Here, 10.0.1.128 is the IP address of the third-party collector, GigabitEthernet9 is the source interface, and 2055 is the listening port of the third-party collector.

```
performance monitor context CISCO-APP-MONITOR profile sdwan-performance
 exporter destination 10.0.1.128 source GigabitEthernet9 port 2055
 traffic-monitor application-response-time
 traffic-monitor media
!
performance monitor apply CISCO-APP-MONITOR sdwan-tunnel
```

### Enable Performance Monitor on a Specific Interface

The following example shows how to configure a performance monitor context using the sdwan-performance profile. This configuration enables monitoring of traffic metrics for ART and media, and applies it to a specific tunel interface, in this case, Tunnel1. Here, 10.0.1.128 is the IP address of the third-party collector, GigabitEthernet9 is the source interface, and 2055 is the listening port of the third-party collector.

```
performance monitor context CISCO-APP-MONITOR profile sdwan-performance
 exporter destination 10.0.1.128 source GigabitEthernet9 port 2055
 traffic-monitor application-response-time
 traffic-monitor media
!
interface Tunnel1
 performance monitor context CISCO-APP-MONITOR
```

### Specify Additional Monitoring Filters and Sampling Rate

The following example shows how to enable specific type of traffic to be monitored. In this case, the match protocol of rtp-audio is defined in the class map named match-audio. This class in then referenced in **traffic-monitor media class-and** *match-audio* so that rtp-audio traffic is specifically monitored. Alternatively, you can use the keyword **class-and** . In such a case, the customized class map replaces the default class map, which is automatically created when you enable the sdwan-performance profile.

In this example, performance monitor is applied globally, which means that it is applied on all Cisco Catalyst SD-WAN tunnel interfaces. The sampling rate of 10 indicates that one in 10 flows is monitored. Sampling rate 100 indicates that one in 100 flows is monitored.

```
class-map match-any match-audio
 match protocol rtp-audio
!
performance monitor context CISCO-APP-MONITOR profile sdwan-performancekeyword
 exporter destination 10.75.212.84 source GigabitEthernet0/0/0 port 2055
```

```
 traffic-monitor application-response-time
 traffic-monitor media class-and (or class-replace) match-audio
!
performance monitor apply CISCO-APP-MONITOR sdwan-tunnel
performance monitor sampling-rate 10
```

# Verify Performance Monitoring Configuration

### View Performance Monitor Configuration Summary

The following sample out displays the information about traffic monitors that are enabled and the interfaces to which they are applied.

```
Device# show performance monitor context CISCO-MONITOR summary

================================================================================

|                              CISCO-MONITOR                                   |

================================================================================

Description: User defined


Based on profile: sdwan-performance


Coarse-grain NBAR based profile


Configured traffic monitors

===========================

 application-response-time:

 media: class-and match_audio


Attached to Interfaces

======================

 Tunnel1
```

The following sample out displays operational information about the third-party exporters that are attached to the specified context.

```
Device# show performance monitor context CISCO-MONITOR exporter

================================================================================

|                 Exporters information of context CISCO-MONITOR               |

================================================================================
```

```
Flow Exporter 175_SDWAN-1:
  Description:              performance monitor context CISCO-MONITOR exporter
  Export protocol:          IPFIX (Version 10)
  Transport Configuration:
    Destination type:       IP
    Destination IP address: 10.75.212.84
    Source IP address:      10.74.28.19
    Source Interface:       GigabitEthernet0/0/0
    Transport Protocol:     UDP
    Destination Port:       2055
    Source Port:            63494
    DSCP:                   0x0
    TTL:                    255
    Output Features:        Used
  Options Configuration:
    interface-table (timeout 600 seconds) (active)
    sampler-table (timeout 600 seconds) (active)
    application-table (timeout 600 seconds) (active)
    sub-application-table (timeout 600 seconds) (active)
    application-attributes (timeout 600 seconds) (active)
    tunnel-tloc-table (timeout 600 seconds) (active)
Flow Exporter 175_SDWAN-1:
  Packet send statistics (last cleared 04:13:19 ago):
    Successfully sent:         10270                (13709142 bytes)


  Client send statistics:
    Client: Option options interface-table
      Records added:           312
        - sent:                312
      Bytes added:             31824
        - sent:                31824
```

```
Client: Option options sampler-table
  Records added:           28
    - sent:                28
  Bytes added:             1344
    - sent:                1344

Client: Option options application-name
  Records added:           38766
    - sent:                38766
  Bytes added:             3217578
    - sent:                3217578

Client: Option sub-application-table
  Records added:           858
    - sent:                858
  Bytes added:             144144
    - sent:                144144

Client: Option options application-attributes
  Records added:           38038
    - sent:                38038
  Bytes added:             9813804
    - sent:                9813804

Client: Option options tunnel-tloc-table
  Records added:           26
    - sent:                26
  Bytes added:             1352
    - sent:                1352

Client: MMA EXPORTER GROUP MMA-EXP-1
  Records added:           0
```

```
    Bytes added:             0


  Client: Flow Monitor 175_SDWAN-art_ipv4
    Records added:           0
    Bytes added:             0
```

For more information, see the `show performance monitor context` command page.

### View Flow Record Cache

The following sample output displays flow record cache for the specified monitor, in this case, CISCO-MONITOR-art_ipv4 .

```
Device# show performance monitor cache

 Monitor: CISCO-MONITOR

 Data Collection Monitor:

  Cache type:                          Synchronized (Platform cache)
  Cache size:                                 4000
  Current entries:                               0

  Flows added:                                   0
  Flows aged:                                    0
  Synchronized timeout (secs):                  60


 Monitor: CISCO-MONITOR-art_ipv4

 Data Collection Monitor:

  Cache type:                          Synchronized (Platform cache)
  Cache size:                                11250
```

```
  Current entries:                              0


  Flows added:                                  0
  Flows aged:                                   0
  Synchronized timeout (secs):                 60
```

For more information, see the `show performance monitor cache` command page.

### View Performance Monitor Templates

The following sample output displays flow exporter template information for the specified monitor.

```
Device# show flow exporter CISCO-MONITOR templates

Flow Exporter CISCO-MONITOR:


  Client: Option options sampler-table
  Exporter Format: IPFIX (Version 10)
  Template ID    : 257
  Source ID      : 6
  Record Size    : 48
  Template layout

  ________________________________________________________________________________
  |                 Field                    |    ID | Ent.ID | Offset |  Size |
  --------------------------------------------------------------------------------
  | FLOW SAMPLER                             |    48 |        |      0 |     4 |
  | flow sampler name                        |    84 |        |      4 |    41 |
  | flow sampler algorithm export            |    49 |        |     45 |     1 |
  | flow sampler interval                    |    50 |        |     46 |     2 |
  --------------------------------------------------------------------------------


  Client: Option options application-name
  Exporter Format: IPFIX (Version 10)
  Template ID    : 258
  Source ID      : 6
  Record Size    : 83
  Template layout
```

```
_______________________________________________________________________________
|                 Field                   |    ID | Ent.ID | Offset |  Size |
-------------------------------------------------------------------------------
| APPLICATION ID                          |    95 |        |      0 |     4 |
| application name                        |    96 |        |      4 |    24 |
| application description                 |    94 |        |     28 |    55 |
-------------------------------------------------------------------------------

Client: Option sub-application-table
Exporter Format: IPFIX (Version 10)
Template ID    : 259
Source ID      : 6
Record Size    : 168
Template layout
_______________________________________________________________________________
|                 Field                   |    ID | Ent.ID | Offset |  Size |
-------------------------------------------------------------------------------
| APPLICATION ID                          |    95 |        |      0 |     4 |
| SUB APPLICATION TAG                     |    97 |        |      4 |     4 |
| sub application name                    |   109 |        |      8 |    80 |
| sub application description             |   110 |        |     88 |    80 |
-------------------------------------------------------------------------------

Client: Option options application-attributes
Exporter Format: IPFIX (Version 10)
Template ID    : 260
Source ID      : 6
Record Size    : 258
Template layout
_______________________________________________________________________________
|                 Field                   |    ID | Ent.ID | Offset |  Size |
-------------------------------------------------------------------------------
```

```
| APPLICATION ID                          |    95 |        |      0 |     4 |
| application category name               | 12232 |      9 |      4 |    32 |
| application sub category name           | 12233 |      9 |     36 |    32 |
| application group name                  | 12234 |      9 |     68 |    32 |
| application traffic-class               | 12243 |      9 |    100 |    32 |
| application business-relevance          | 12244 |      9 |    132 |    32 |
| p2p technology                          |   288 |        |    164 |    10 |
| tunnel technology                       |   289 |        |    174 |    10 |
| encrypted technology                    |   290 |        |    184 |    10 |
| application set name                    | 12231 |      9 |    194 |    32 |
| application family name                 | 12230 |      9 |    226 |    32 |
-------------------------------------------------------------------------------

  Client: Option options tunnel-tloc-table

  Exporter Format: IPFIX (Version 10)

  Template ID    : 261

  Source ID      : 6

  Record Size    : 52

  Template layout

_______________________________________________________________________________
|                Field                    |    ID | Ent.ID | Offset |  Size |
-------------------------------------------------------------------------------
| TLOC TABLE OVERLAY SESSION ID           | 12435 |      9 |      0 |     4 |
| tloc local color                        | 12437 |      9 |      4 |    16 |
| tloc remote color                       | 12439 |      9 |     20 |    16 |
| tloc tunnel protocol                    | 12440 |      9 |     36 |     8 |
| tloc local system ip address            | 12436 |      9 |     44 |     4 |
| tloc remote system ip address           | 12438 |      9 |     48 |     4 |
-------------------------------------------------------------------------------

Client: Flow Monitor CISCO-MONITOR-art_ipv4

  Exporter Format: IPFIX (Version 10)

  Template ID    : 0
```

```
Source ID      : 0

Record Size    : 208

Template layout

_______________________________________________________________________________

|                 Field                    |    ID | Ent.ID | Offset |  Size |

-------------------------------------------------------------------------------

| interface input snmp                     |    10 |        |      0 |     4 |

| connection client ipv4 address           | 12236 |      9 |      4 |     4 |

| connection server ipv4 address           | 12237 |      9 |      8 |     4 |

| ip dscp                                  |   195 |        |     12 |     1 |

| ip protocol                              |     4 |        |     13 |     1 |

| ip ttl                                   |   192 |        |     14 |     1 |

| connection server transport port         | 12241 |      9 |     15 |     2 |

| connection initiator                     |   239 |        |     17 |     1 |
| timestamp absolute monitoring-interval   |   359 |        |     18 |     8 |

| flow observation point                   |   138 |        |     26 |     8 |

| overlay session id input                 | 12432 |      9 |     34 |     4 |

| routing vrf service                      | 12434 |      9 |     38 |     4 |

| application id                           |    95 |        |     42 |     4 |

| interface output snmp                    |    14 |        |     46 |     4 |

| flow direction                           |    61 |        |     50 |     1 |

| flow sampler                             |    48 |        |     51 |     1 |

| overlay session id output                | 12433 |      9 |     52 |     4 |

| timestamp absolute first                 |   152 |        |     56 |     8 |

| timestamp absolute last                  |   153 |        |     64 |     8 |

| connection new-connections               |   278 |        |     72 |     4 |

| connection sum-duration                  |   279 |        |     76 |     8 |

| connection server counter bytes long     |   232 |        |     84 |     8 |

| connection server counter packets long   |   299 |        |     92 |     8 |

| connection client counter bytes long     |   231 |        |    100 |     8 |

| connection client counter packets long   |   298 |        |    108 |     8 |

| connection server counter bytes network  |  8337 |      9 |    116 |     8 |
```

```
  | connection client counter bytes network |  8338 |      9 |    124 |      8 |
  | connection delay response to-server sum |  9303 |      9 |    132 |      4 |
  | connection server counter responses     |  9292 |      9 |    136 |      4 |
  | connection delay response to-server his |  9300 |      9 |    140 |      4 |
  | connection client counter packets retra |  9268 |      9 |    144 |      4 |
  | connection delay application sum        |  9306 |      9 |    148 |      4 |
  | connection delay response client-to-ser |  9309 |      9 |    152 |      4 |
  | connection transaction duration sum     |  9273 |      9 |    156 |      4 |
  | connection transaction duration min     |  9275 |      9 |    160 |      4 |
  | connection transaction duration max     |  9274 |      9 |    164 |      4 |
  | connection transaction counter complete |  9272 |      9 |    168 |      4 |
  | connection client counter bytes retrans |  9267 |      9 |    172 |      4 |
  | connection server counter bytes retrans |  9269 |      9 |    176 |      4 |
  | connection server counter packets retra |  9270 |      9 |    180 |      4 |
  | connection delay network long-lived to- |  9255 |      9 |    184 |      4 |
  | connection delay network to-client num- |  9259 |      9 |    188 |      4 |
  | connection delay network long-lived to- |  9254 |      9 |    192 |      4 |
  | connection delay network to-server num- |  9258 |      9 |    196 |      4 |
  | connection delay network long-lived cli |  9256 |      9 |    200 |      4 |
  | connection delay network client-to-serv |  9257 |      9 |    204 |      4 |
  ---------------------------------------------------------------------------


Client: Flow Monitor CISCO-MONITOR-media_ipv4
  Exporter Format: IPFIX (Version 10)
  Template ID    : 0
  Source ID      : 0
  Record Size    : 180
  Template layout
  _____________________________________________________________________________
  |                 Field                   |    ID | Ent.ID | Offset |  Size |
  -----------------------------------------------------------------------------
  | ipv4 source address                     |     8 |        |      0 |     4 |
  | ipv4 destination address                |    12 |        |      4 |     4 |
```

| | | | | |
|---|---|---|---|---|
| interface input snmp | 10 | | 8 | 4 |
| ip dscp | 195 | | 12 | 1 |
| ip protocol | 4 | | 13 | 1 |
| ip ttl | 192 | | 14 | 1 |
| ipv6 source address | 27 | | 15 | 16 |
| ipv6 destination address | 28 | | 31 | 16 |
| transport source-port | 7 | | 47 | 2 |
| transport destination-port | 11 | | 49 | 2 |
| connection initiator | 239 | | 51 | 1 |
| timestamp absolute monitoring-interval | 359 | | 52 | 8 |
| flow observation point | 138 | | 60 | 8 |
| overlay session id input | 12432 | 9 | 68 | 4 |
| routing vrf service | 12434 | 9 | 72 | 4 |
| application id | 95 | | 76 | 4 |
| routing forwarding-status | 89 | | 80 | 1 |
| interface output snmp | 14 | | 81 | 4 |
| flow direction | 61 | | 85 | 1 |
| flow sampler | 48 | | 86 | 1 |
| overlay session id output | 12433 | 9 | 87 | 4 |
| transport rtp ssrc | 4254 | 9 | 91 | 4 |
| transport rtp payload-type | 4273 | 9 | 95 | 1 |
| counter bytes long | 1 | | 96 | 8 |
| counter packets | 2 | | 104 | 4 |
| timestamp absolute first | 152 | | 108 | 8 |
| timestamp absolute last | 153 | | 116 | 8 |
| connection new-connections | 278 | | 124 | 4 |
| transport packets expected counter | 4246 | 9 | 128 | 4 |
| transport packets lost counter | 4251 | 9 | 132 | 4 |
| transport packets lost rate | 4253 | 9 | 136 | 4 |
| transport rtp jitter mean | 4255 | 9 | 140 | 4 |
| transport rtp jitter minimum | 4256 | 9 | 144 | 4 |
| transport rtp jitter maximum | 4257 | 9 | 148 | 4 |

```
| counter bytes rate                      |  4235 |      9 |    152 |      4 |
| application media bytes counter         |  4236 |      9 |    156 |      4 |
| application media bytes rate            |  4238 |      9 |    160 |      4 |
| application media packets counter       |  4239 |      9 |    164 |      4 |
| application media packets rate          |  4241 |      9 |    168 |      4 |
| transport rtp jitter mean sum           |  4325 |      9 |    172 |      8 |
--------------------------------------------------------------------------------
```

For more information, see the `show flow exporter` command page.