

Cisco Ultra Traffic Optimization

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Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	P-GW
Applicable Platform(s)	• ASR 5500 • Ultra Gateway Platform
Feature Default	Disabled - License Required
Related Changes in This Release	Not Applicable
Related Documentation	• *Command Line Interface Reference* • *P-GW Administration Guide*

Revision History

Important Revision history details are not provided for features introduced before release 21.2 and N5.1.

Revision Details	Release
In this release, P-GW supports Cisco Ultra Traffic Optimization show commands and outputs are enhanced to show Rx/Tx packets statistics for Uplink and Downlink for UDP and TCP split.	21.23
In this release, Cisco Ultra Traffic Optimization P-GW supports high throughput (4G or 5G) optimization of the traffic.	21.22
In this release, P-GW supports MBR/GBR handling in optimization library.	21.21
In this release, ranges of configurable policy parameters for Cisco Ultra Traffic Optimization are modified.	21.20.4
In this release the following three new parameters are added in Large TODR: **1.** International Mobile Subscriber Identity (IMSI) **2.** Flow-ID and Flow-ID list **3.** User Location Information (ULI) For more information, refer the *Large TODR Enhancement* section.	21.19.1
The Cisco Ultra Traffic Optimization library version has been upgraded from 3.0.9 to 3.0.11.	21.14.2
With this release, new keywords **large-flows-only** and **managed-large-flows-only** are implemented as part of the **data-record** command to enable the CUTO library to stream respective statistics to the external server. New bulk statistics are added in support of this enhancement	21.14
With this release, Cisco Ultra Traffic Optimization solution is enhanced to support basic Quick UDP Internet Connections (QUIC) UDP traffic along with the existing support for TCP traffic.	21.3.17
Reboot of chassis is no longer required to enable Cisco Ultra Traffic Optimization related configuration.	21.3.x
Multi-Policy support for Cisco Ultra Traffic Optimization solution.	21.6
Cisco Ultra Traffic Optimization solution is supported in Ultra Gateway Platform (UGP).	21.6
Cisco Ultra Traffic Optimization solution is enhanced to support basic Quick UDP Internet Connections (QUIC) UDP traffic along with the existing support for TCP traffic.	21.5
Reboot of chassis is no longer required to enable Cisco Ultra Traffic Optimization related configuration.	21.5
First introduced.	21.2

Overview

In a high-bandwidth bulk data flow scenario, user experience is impacted due to various wireless network conditions and policies like shaping, throttling, and other bottlenecks that induce congestion, especially in the RAN. This results in TCP applying its saw-tooth algorithm for congestion control and impacts user experience, and overall system capacity is not fully utilized.

The Cisco Ultra Traffic Optimization solution provides clientless optimization of TCP and HTTP traffic. This solution is integrated with Cisco P-GW and has the following benefits:

- Increases the capacity of existing cell sites and therefore, enables more traffic transmission.
- Improves Quality of Experience (QoE) of users by providing more bits per second.
- Provides instantaneous stabilizing and maximizing per subscriber throughput, particularly during network congestion.

How Cisco Ultra Traffic Optimization Works

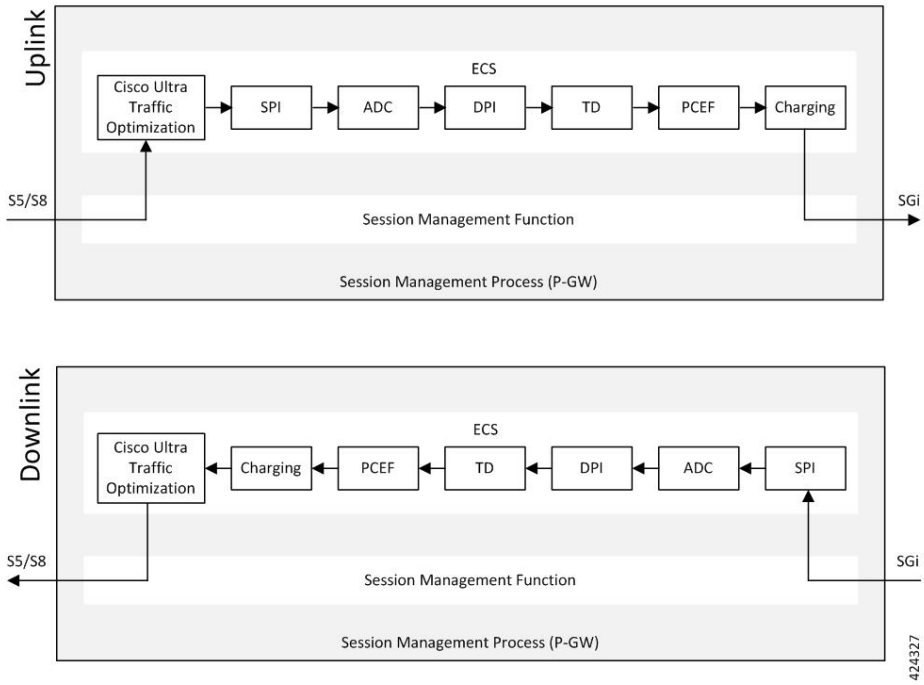
The Cisco Ultra Traffic Optimization achieves its gains by shaping video traffic during times of high network load/congestion. It monitors and profiles each individual video flow that passes through the gateway and uses its machine learning algorithms to determine whether that flow is traversing a congested channel. Cisco Ultra Traffic Optimization then flow-controls video to varying levels and time, depending on the degree of detected congestion, and efficiently aligns delivery of the video traffic to less-congested moments while still providing adequate bandwidth to videos to maintain their quality. The result is less network latency and higher user throughputs while maintaining HD video. Cisco Ultra Traffic Optimization does not drop packets or modify data payloads in any way.

The Cisco Ultra Traffic Optimization integrates with standard Cisco P-GW functions such as Application Detection and Control (ADC), allowing mobile operators to define optimization policies that are based on the traffic application type as well as APN, QCI, and other common traffic delineations. Cisco Ultra Traffic Optimization is fully radio network aware, allowing management on a per eNodeB cell basis.

Architecture

StarOS has a highly optimized packet processing framework, the Cisco Ultra Traffic Optimization engine, where the user packets (downlink) are processed in the operating systems user space. The high-speed packet processing, including the various functions of the P-GW, is performed in the user space. The Cisco Ultra Traffic Optimization engine is integrated into the packet processing path of Cisco's P-GW with a well-defined Application Programming Interface (API) of StarOS.

The following graphic shows a high-level overview of P-GW packet flow with traffic optimization.



Licensing

The Cisco Ultra Traffic Optimization is a licensed Cisco solution. Contact your Cisco account representative for detailed information on specific licensing requirements. For information on installing and verifying licenses, refer to the *Managing License Keys* section of the *Software Management Operations* chapter in the *System Administration Guide*.

Limitations and Restrictions

- The values which the P-GW chooses to send to the Cisco Ultra Traffic Optimization engine are the values associated from the bearer GBR and bearer MBR.
- In the current implementation, only downlink GBR and MBR are sent to the engine for traffic optimization.
- UDP/QUIC based Traffic Optimization is supported only on PORT 443.
- The traffic-optimization data-records are generated in the same folder as that of EDRs. Also, the file rotation criteria will be similar to that of EDRs.
- A povision to dynamically load the library without statically linking it is restricted.
- OP works on ‘per flow’ level GBR/MBR to optimize the flows However, P-GW supports only sending bearer level GBR/MBR.
- The sending GBR and MBR values to Optimation library functionality is applicable only for P-GW product.

Handling of Traffic Optimization Data Record

The Traffic Optimization Data Record (TODR) is generated only on the expiry of idle-timeout of the Cisco Ultra Traffic Optimization engine. No statistics related to session or flow from P-GW is included in this TODR. The data records are a separate file for the Traffic Optimization statistics, and available to external analytics platform.

Large TODR Enhancement

In 21.19.1 and later releases, the following three new parameters are added in large TODR:

1. International Mobile Subscriber Identity (IMSI)
2. Flow-ID and Flow-ID list
3. User Location Information (ULI)

   The Flow-ID is used to correlate the ACS Flow ID that is visible in End Point Detection and Response ("sn-flow-id" attribute) and then the ULI is correlated with RAN counters.



Note These new fields are only available in Large TODRs generated on non-VPP based P-GW and SAEGW.

Enhancing Large TODR

Use the following configuration to enable enhanced large TODR.

```
configure
  active-charging service service_name
    traffic-optimization-profile
      data-record
        enhanced-large-todr [ imsi | acs-flow-id | uli ]
        end
```

Example 1: When all fields are to be displayed:

```
enhanced-large-todr
```

Example 2: When IMSI and ULI are to be displayed:

```
enhanced-large-todr imsi
enhanced-large-todr uli
```

Show Commands and Outputs

```
show active-charging traffic-optimization info
```

Output Example 1:

```
[local]laas-setup# show active-charging traffic-optimization info
        Version   : 3.1.1
        Mode      : Active
        Configuration:
                Data Records(TODR): ENABLED     TODR Type: ALL_FLOWS
                Statistics Options: DISABLED
                EFD Flow Cleanup Interval: 1000(milliseconds)
                Statistics Interval: 60(seconds)
```

```
                Enhanced Large TODR: DISABLED
[local]laas-setup#
```

Output Example 2 for IMSI and ULI:

```
[local]laas-setup# show active-charging traffic-optimization info
        Version   : 3.1.1
        Mode      : Active
        Configuration:
                Data Records(TODR): ENABLED     TODR Type: ALL_FLOWS
                Statistics Options: DISABLED
                EFD Flow Cleanup Interval: 1000(milliseconds)
                Statistics Interval: 60(seconds)
                Enhanced Large TODR: ENABLED, Fields: imsi uli
[local]laas-setup#
```

The output of this command includes the following fields:

- Enhanced Large TODR

Enhancement to the Existing Large TODRs

1. **Large TODRs with IMSI**

   IMSI: Indicates the International Mobile Subscriber Identity.

   IMSI value is 0 if it is a trusted build.

2. **ACS Flow ID**

   ACS Flow ID is a newly introduced field. As there could be a lot of flow, it is limited to a maximum of 20 flows as a part of TODR.

   acs_flow_id_count: Number of ACS Flow Ids present in this TODR. A Maximum of 20 ACS Flow IDs is present.

   acs_flow_id_list: List of individual ACS Flow Ids. For examples, acs_flow_id1, acs_flow_id2 and so on.

   a. **EDR ACS Flow ID**

      In EDR, each ACS flow ID is printed by enabling the attribute ‘sn-flow-id’ in EDR config as given below :

      ```
      config
      active-charging service ACS
          edr-format EDR_SN
          delimiter comma
            attribute sn-flow-id priority 10
            rule-variable bearer 3gpp imsi priority 15
            rule-variable bearer qci priority 20
      ```

      It is printed out in EDR in the following format **92:30278:14786055** where:

      - 92 is the Session Manager instance
      - 30278 is the Session Handle orsession number
      - 14786055 is the ACS flow identifier

   b. **TODR ACS Flow ID**

      TODR ACS flow idshould follow the same format as in EDR so customers can correlate TODRs with EDRs. Therefore, each flow ID in the list acs_flow_id_list that is acs_flow_id1, acs_flow_id2, and so on should get printed out in TODR as `smgr instance:session handle: flow id`.

An example is **92:30278:14786055** where:

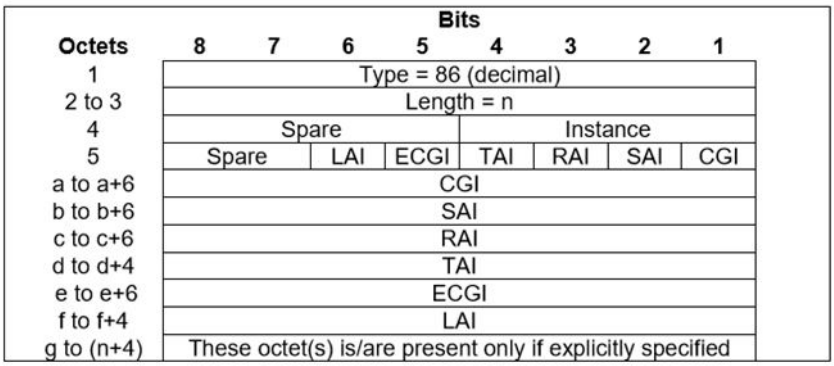
- 92 is the Session Manager instance
- 30278 is the Session Handle orsession number
- 14786055 is the ACS flow identifier

3. **ULI**

Even though the original requirment was to print ECGI, it does not cover all the scenarios. For example, when PGW is the anchor for a call that moves from 4G to 3G, ECGI does not make sense as the ULI (User Location Information) indicates CGI rather than ECGI as the user is now in 3G. Normally, MME informs PGW through SGW of the changes happened in ULI. This feature supports ULI that is s superset of ECGI.

The new field is called ULI. However, ULI is a complex IE composed of multiple identifiers and of variable length. For more details, refer the 3GPP TS 29.274.

Figure 1: User Location Information (ULI)



An ULI can be composed of one or more identifiers For example, there could be TAI and ECGI both in the ULI. Supporting such identifiers is problematic since the total length of ULI goes beyond 8 bytes and on per packet level, and have to pass an byte array and that has performance implications. In order, to overcome this issuse, ULI is formed as a combined type (for example, TAI AND ECGI together), then alone the ECGI part is shown in TODRs. This is done to ensure that identifier portion of ULI is accommodated in `uint64_t` (8 bytes). Specifically,

a. If TAI and ECGI both are present as a combined type, then only ECGI is shown.

b. If CGI and RAI both are present as a combined type, then only CGI is shown.

c. If both SAI and RAI both are present as a combined type, then only RAI is shown .

Every TODR can have multiple phases with a granularity of 2 seconds. ULI is added to the list of Phase attributes:

a. *ULI*: Newly introduced field.

ULI Details

ECGI is stored in ULI as given in the figure below. It needs to be printed in this format:

ULI Type: ULI Value

ULI Type can be any one of these:

- 1–CGI
- 2–SAI
- 4–RAI
- 8–TAI
- 16–ECGI

ECGI is stored in ULI as given in the figure below. It needs to be printed in this format:

ULIType:ULIValue

An example is given below when ULI Type is ECGI:

16:0x21635401234567

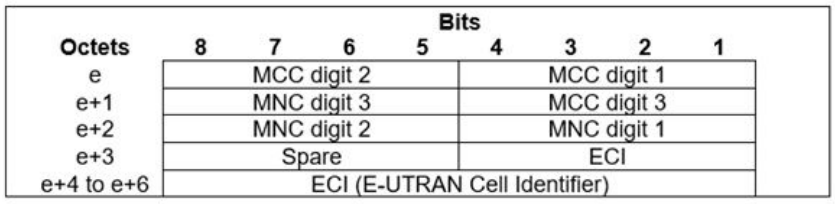
Here 16 represents that ULI Type is ECGI

0x21635401234567 is the hexadecimal representation of ECGI

MCC is '123' i.e. the three digits of MCC are '1', '2' and '3' MNC is '456', that is. the three digits of MNC are '4', '5' and '6'

ECI is '19088743' in decimal ('1234567' in hexadecimal)

Figure 2: ECGI Field



List of Attributes and File Format

All TODR attributes of traffic optimization is enabled by a single CLI command. The output is always comma separated, and in a rigid format.

Standard TODR

The following is the format of a Standard TODR:

```
instance_id,flow_type,srcIP,dstIP,policy_id, proto_type, dscp,
flow_first_pkt_rx_time_ms,flow_last_pkt_rx_time_ms,flow_cumulative_rx_bytes
```

Example:

```
1,0,173.39.13.38,192.168.3.106,0,1,0,
 1489131332693,1489131335924,342292
```

Where:

- *instance_id*: Instance ID.

- *flow_type*: Standard flow (0)
- *srcIP*: Indicates the source IP address.
- *dstIP*: Indicates the destination IP address.
- *policy_id*: Indicates the traffic optimization policy ID.
- *proto_type*: Indicates the IP protocol being used. The IP protocols are: TCP and UDP.
- *dscp*: Indicates the DSCP code for upstream packets.
- *flow_first_pkt_rx_time_ms*: Indicates the timestamp when the first packet was detected during traffic optimization.
- *flow_last_pkt_rx_time_ms*: Indicates the timestamp when the last packet was detected during traffic optimization.
- *flow_cumulative_rx_bytes*: Indicates the number of bytes transferred by this flow.

Large TODR

The following is a sample output of a Large TODR.

```
19,1,404005123456789,22.22.0.1,209.165.200.225.8,custom1,2,0,1588858362158,1588858952986,16420806,1588858364162,419,351,7000,0,0,1,
19:2:15,2,0,0,2,1,1,16:0x12546300012345,
1588858364162,80396,1472,0,0,0,2,1,16:0x12546300012345,1588858366171,146942,1937,7000,0,0,2
```

Where:

- *instance_id*: Instance ID.
- *flow_type*: Large flow (1)
- *imsi_id*: Indicates the International Mobile Subscriber Identity.
- *srcIP*: Indicates the source IP address.
- *dstIP*: Indicates the destination IP address.
- *policy_name*: Identifies the name of the configured traffic optimization policy.
- *policy_id*: Indicates the traffic optimization policy ID.
- *proto_type*: Indicates the IP protocol being used. The IP protocols are: TCP and UDP.
- *dscp*: Indicates the DSCP code for upstream packets.
- *flow_first_pkt_rx_time_ms*: Indicates the timestamp when the first packet was detected during traffic optimization.
- *flow_last_pkt_rx_time_ms*: Indicates the timestamp when the last packet was detected during traffic optimization.
- *flow_cumulative_rx_bytes*: Indicates the number of bytes transferred by this flow.
- *large_detection_time_ms*: Indicates the timestamp when the flow was detected as Large.
- *avg_burst_rate_kbps*: Indicates the average rate in Kbps of all the measured bursts.
- *avg_eff_rate_kbps*: Indicates the average effective rate in Kbps.

- *final_link_peak_kbps*: Indicates the highest detected link peak over the life of the Large flow.
- *recovered_capacity_bytes*: Indicates the recovered capacity in Kbps for this Large flow.
- *recovered_capacity_ms*: Indicates the timestamp of recovered capacity for this Large flow.
- *acs_flow_id_count*: Indicates the number of ACS Flow IDs present in this TODR. A maximum of 20 ACS Flow IDs is present.
- *acs_flow_id_list*: Indicates the list of individual ACS Flow IDs. For example, acs_flow_id1, acs_flow_id2, and so on.
- *phase_count*: Indicates the Large flow phase count.
- *min_gbr_kbps*: Indicates the Minimum Guaranteed Bit Rate (GBR) in Kbps.
- *max_gbr_kbps*: Indicates the Maximum Guaranteed Bit Rate (MBR) in Kbps.
- *phase_count_record*: Indicates the number of phases present in this record.
- *end_of_phases*: 0 (not end of phases) or 1 (end of phases).
- Large flow phase attributes:
  - *phase_type*: Indicates the type of the phase. This field represents that the flow was in one of the following three possible states where each state is represented by a numeric value:
    - 0 - Ramp-up Phase (if the Flow was previously idle)
    - 1 - Measurement Phase (required)
    - 2 - Flow Control Phase (if congestion detected during Measurement Phase)
  - *uli_type*: Indicates the type of ULI.
  - *phase_start_time_ms*: Indicates the timestamp for the start time of the phase.
  - *burst_bytes*: Indicates the burst size in bytes.
  - *burst_duration_ms*: Indicates the burst duration in milliseconds.
  - *link_peak_kbps*: Indicates the peak rate for the flow during its life.
  - *flow_control_rate_kbps*: Indicates the rate at which flow control was attempted (or 0 if non-flow control phase). This field is valid only when flow is in ‘Flow Control Phase’.
  - *max_num_queued_packets*: Identifies the maximum number of packets queued.
  - *policy_id*: Identifies the traffic optimization policy ID.

Sending GBR and MBR Values to Optimization Library

P-GW sends:

- GBR and MBR values based on the classification of traffic optimization selection
- Flow level GBR and MBR values to the optimization library
- Only downlink GBR and MBR to the optimization library

P-GW passes Zero GBR value for flows on a non-GBR bearer towards optimization library.

Optimatization library maintains logical flow based on Source IP, Destination IP, and Protocol IP (3-tuple). Whereas, P-GW provides GBR and MBR values based on Source IP, Destination IP, Source Port, Destination Port, and Protocol IP (5-tuple) to the optimization library. Because of these, multiple StarOS 5-tuple entries can belong to same 3-tuple entry in optimization library. Optimization library uses:

- Minimum of all MBR values that belong to the same 3-tuple entry as upper-limit.
- Maximum of all GBR values that belong to same 3-tuple entry as lower-limit.

High Throughput Traffic Optimization Support

Cisco Ultra Traffic Optimization feature is enhanced to support the subscribers through the optimization of traffic. With High Throughput Traffic Optimization Support feature, support is added for optimization of traffic for 5G subscribers (high throughput). The feature also allows automatic switching of traffic optimization parameters depending on throughput characteristics (which is in turn based on 4G or 5G).



Note This is a licensed feature. Contact your Cisco Account representative for detailed information on specific licensing requirements.

The existing Cisco Ultra Traffic Optimization single flow logic is enhanced to dynamically toggle between algorithms depending on the profile packet pattern real time (for example, 4G LTE vs 5G mm and wave traffic pattern).

Cisco Ultra Traffic Optimization library is updated to introduce two separate sets of policy parameters under a traffic optimization policy:

- Base policy parameters - these parameters are applied by the Cisco Ultra Traffic Optimization algorithm when it detects normal throughput (for example, 4G throughput). They are called 'Base' policy parameters. These parameters are the same as the parameters that existed before the High Throughput Traffic Optimization Support feature was introduced.
- Extended policy parameters - these parameters are applied by the Cisco Ultra Traffic Optimization algorithm when it detects high throughput for a flow (for example, 5G throughput). They are called ‘Extended’ policy parameters.

The two separate policy parameters under the same policy quickly switch from one set to the other without requiring any intervention from session managers when there is a change in throughput.

Hence, having two separate sets of policy parameters in the same policy helps meet the requirement that the Cisco Ultra Traffic Optimization algorithm automatically, dynamically, and immediately adjusts to the change in throughput. This change in throughput could be due to a change in RAN characteristics, for example, when UE enters a 5G or high speed 4G coverage area.

How High Throughput Optimization Support Works

Cisco Ultra Traffic Optimization algorithm monitors the traffic and automatically transitions between Base and Extended policy parameters based on the following logic:

1. Start with base policy.
2. If measurement phase burst rate > extended link profile initial-rate then move to the extended policy.

3. If measurement phase burst rate < base link profile max-rate then move to the base policy.
4. Repeat steps 2,3 for every measurement phase.

.

Multi-Policy Support for Traffic Optimization

Cisco Ultra Traffic Optimization engine supports Traffic Optimization for multiple policies and provides Traffic Optimization for a desired location. It supports a maximum of 32 policies that include two pre-configured policies, by default. Operators can configure several parameters under each Traffic Optimization policy.

This feature includes the following functionalities:

- By default, Traffic Optimization is enabled for TCP and UDP data for a particular Subscriber, Bearer, or Flow that use the Service-Schema.

Important PORT 443 supports UDP or QUIC-based Traffic Optimization.

- Selection of a policy depends on the priority configured. A trigger-condition is used to prioritize a traffic optimization policy. The priority is configurable regardless of a specific location where the traffic optimization policy is applied. Based on the configured priorities, a traffic optimization policy can be overridden by another policy.
- A configuration to associate a traffic optimization policy with a Trigger Action, under the Service-Schema.
- A configuration to select a Traffic Optimization policy for a Location Trigger. Currently, only ECGI Change Detection is supported under the Local Policy Service Configuration mode.

Important Location Change Trigger is not supported with IPSG.

Important Policy ID for a flow is not recovered after a Session Recovery (SR) or Inter-Chassis Session Recovery (ICSR).

Important The Multi-Policy Support feature requires the same Cisco Ultra Traffic Optimization license key be installed. Contact your Cisco account representative for detailed information on specific licensing requirements.

How Multi-Policy Support Works

Policy Selection

Cisco's Ultra Traffic Optimization engine provides two default policies – Managed and Unmanaged. When Unmanaged policy is selected, traffic optimization is not performed.

When Managed policy is selected, traffic optimization is performed using default parameters. Managed policy is applied when a policy is not specified in a Trigger Action where traffic optimization is enabled without specifying a policy.

When Managed policy is selected, traffic optimization is performed using default parameters. Managed policy is applied when a policy is not specified in a Trigger Action where traffic optimization is enabled without specifying a policy.

- Session Setup Trigger – If a Trigger Action is applied only for a Session Setup in a Service-Schema, then the trigger action is only applied to new sessions only.
- Bearer Setup Trigger – If a trigger action is applied only for a Bearer Setup, changes in the trigger action will be applicable to newly created bearers and its flows.
- Flow Creation Trigger – Under a trigger condition corresponding to a flow create, conditions can be added based on a rule-name, local-policy-rule or an IP protocol in addition to the trigger condition: any-match.

When traffic optimization on existing flows is disabled because of a trigger condition, then the traffic optimization engine will apply the default Unmanaged policy on them.

Deleting a Policy

Before deleting a Policy profile, all association to a traffic optimization policy should be removed.

For more information on deletion of a policy, refer to the *Traffic Optimization Policy Configuration* section.

Configuring Multi-Policy Support

The following sections describes the required configurations to support the Multi-Policy Support.

Configuring a Traffic Optimization Profile

Use the following CLI commands to configure a Traffic Optimization Profile.

```
configure
  require active-charging
  active-charging service service_name
    traffic-optimization-profile profile_name
      data-record[ large-flows-only | managed-large-flows-only ]
      no data record
      [ no ] efd-flow-cleanup-interval cleanup_interval
      [ no ] stats-interval stats_interval
      [ no ] stats-options { flow-analyst [ flow-trace ] | flow-trace [
 flow-analyst ] }
      end
```

NOTES:

- **require active-charging**: Enables the configuration requirement for an Active Charging service.

Important After you configure this command, you must save the configuration and then reload the chassis for the command to take effect. For information on saving the configuration file and reloading the chassis, refer to the *System Administration Guide* for your deployment.

- **data-record**: Enables the generation of traffic optimization data record.

  large-flows-only: Enables the traffic optimization data record generation for large flows.

  managed-large-flows-only: Enables the traffic optimization data record generation for managed large flows.

  The keywords - **large-flows-only** and **managed-large-flows-only** when configured along with **data-record** enables the CUTO library to stream the respective statistics as part of the **stats-options** command, to the external server. The operator can configure a combination of the **stats-options** keywords **flow-trace** and **flow-analyst** and the **data-record** command to notify the CUTO library accordingly.

Note One of the above the two keywords can be configured as part of the data-record, which enables the CUTO library to stream the respective statistics.

The default behavior of the **data-record** command is not affected with the above implementation . If configured without any of the options, then TODRs are generated for all standard and large flows, which is the existing behavior.

- **efd-flow-cleanup-interval**: Configures the EFD flow cleanup interval. The interval value is an integer that ranges 10–5000 milliseconds.
- **stats-interval**: Configures the flow statistics collection and reporting interval in seconds. The interval value is an integer that ranges 1–60 seconds.
- **stats-options**: Configures options to collect the flow statistics. It only specifies whether the stream must be a Flow Trace or a Flow Analyst or both, to an external server.

Note From Release 21.6 onwards, the **heavy-session** command is deprecated.

Configuring a Traffic Optimization Policy

Use the following CLI commands to configure a Traffic Optimization Policy.

```
configure
   require active-charging
   active-charging service service_name[extended]
      [ no ] traffic-optimization-policy policy_name[extended]
        bandwidth-mgmt { backoff-profile [ managed | unmanaged ] [
min-effective-rate effective_rate [ min-flow-control-rate flow_rate ] |
min-flow-control-rate flow_rate [ min-effective-rate effective_rate ] ] |
min-effective-rate effective_rate [ backoff-profile [ managed | unmanaged ]
 [ min-flow-control-rate flow_rate ] | min-flow-control-rate control_rate [
```

backoff-profile [managed | unmanaged]] | min-flow-control-rate [[backoff-profile [managed | unmanaged] [min-effective-rate *effective_rate* **] | [min-effective-rate** *effective_rate* **] [backoff-profile [managed | unmanaged]] }**

extended-bandwidth-mgmt { backoff-profile [managed | unmanaged] [min-effective-rate *effective_rate* **[min-flow-control-rate** *flow_rate* **] | min-flow-control-rate** *flow_rate* **[min-effective-rate** *effective_rate* **]] | min-effective-rate** *effective_rate* **[backoff-profile [managed | unmanaged] [min-flow-control-rate** *flow_rate* **] | min-flow-control-rate** *control_rate* **[backoff-profile [managed | unmanaged]] | min-flow-control-rate [[backoff-profile [managed | unmanaged] [min-effective-rate** *effective_rate* **] | [min-effective-rate** *effective_rate* **] [backoff-profile [managed | unmanaged]] }**

[no] bandwidth-mgmt

[no] extended-bandwidth-mgmt

curbing-control { max-phases *max_phase_value* **[rate** *curbing_control_rate* **[threshold-rate** *threshold_rate* **[time** *curbing_control_duration* **]]] | rate** *curbing_control_rate* **[max-phases [threshold-rate** *threshold_rate* **[time** *curbing_control_duration* **]]] | threshold-rate [max-phases** *max_phase_value* **[rate** *curbing_control_rate* **[time** *curbing_control_duration* **]]] | time [max-phases** *max_phase_value* **[rate** *curbing_control_rate* **[threshold-rate** *threshold_rate***]]] }**

extended-curbing-control { max-phases *max_phase_value* **[rate** *curbing_control_rate* **[threshold-rate** *threshold_rate* **[time** *curbing_control_duration* **]]] | rate** *curbing_control_rate* **[max-phases [threshold-rate** *threshold_rate* **[time** *curbing_control_duration* **]]] | threshold-rate [max-phases** *max_phase_value* **[rate** *curbing_control_rate* **[time** *curbing_control_duration* **]]] | time [max-phases** *max_phase_value* **[rate** *curbing_control_rate* **[threshold-rate** *threshold_rate***]]] }**

[no] curbing-control

[no] extended-curbing-control

heavy-session { standard-flow-timeout [threshold *threshold_value* **| threshold** *threshold_value* **[standard-flow-timeout** *timeout_value* **] }**

extended-heavy-session { standard-flow-timeout [threshold *threshold_value* **| threshold** *threshold_value* **[standard-flow-timeout** *timeout_value* **] }**

[no] heavy-session

[no] extended-heavy-session

link-profile { initial-rate *initial_seed_value* **[max-rate** *max_peak_rate_value* **[peak-lock]] | max-rate [initial-rate** *initial_seed_value* **[peak-lock]] | peak-lock [initial-rate** *initial_seed_value* **[max-rate** *max_peak_rate_value* **]] }**

extended-link-profile { initial-rate *initial_seed_value* **[max-rate** *max_peak_rate_value* **[peak-lock]] | max-rate [initial-rate** *initial_seed_value* **[peak-lock]] | peak-lock [initial-rate** *initial_seed_value* **[max-rate** *max_peak_rate_value* **]] }**

[no] link-profile

[no] extended-link-profile

session-params { tcp-ramp-up *tcp_rampup_duration* **[udp-ramp-up** *udp_rampup_duration* **] | udp-ramp-up** *udp_rampup_duration* **[tcp-ramp-up** *tcp_rampup_duration* **] }**

```
      extended-session-params { tcp-ramp-up tcp_rampup_duration [ udp-ramp-up
 udp_rampup_duration ] | udp-ramp-up udp_rampup_duration [ tcp-ramp-up
tcp_rampup_duration ] }
       [ no ] session-params
       [ no ] extended-session-params
       end
```

NOTES:

- Only when **extended** keyword is used after the policy name, you will be able to see the '**extended-***' parameters, for example **extended-bandwidth-mgmt**.
- **no**: Overwrites the configured parameters with default values. The operator must remove all associated policies in a policy profile before deleting a policy profile. Otherwise, the following error message is displayed:

  ```
  Failure: traffic-optimization policy in use, cannot be deleted.
  ```

- **bandwidth-mgmt**: Configures Base bandwidth management parameters.
  - **backoff-profile**: Determines the overall aggressiveness of the back off rates.
  - **managed**: Enables both traffic monitoring and traffic optimization.
  - **unmanaged**: Only enables traffic monitoring.
  - **min-effective-rate**: Configures minimum effective shaping rate in Kbps.
  - **min-flow-control-rate**: Configures the minimum rate that is allowed in Kbps to control the flow of heavy-session-flows during congestion.
- **extended-bandwidth-mgmt**: Configures Extended bandwidth management parameters.
  - **backoff-profile**: Determines the overall aggressiveness of the back off rates.
  - **managed**: Enables both traffic monitoring and traffic optimization.
  - **unmanaged**: Only enables traffic monitoring.
  - **min-effective-rate**: Configures minimum effective shaping rate in Kbps.
  - **min-flow-control-rate**: Configures the minimum rate that is allowed in Kbps to control the flow of heavy-session-flows during congestion.
- **curbing-control**: Configures Base curbing flow control related parameters.
  - **max-phases**: Configures consecutive phases where the target shaping rate is below **threshold-rate** to trigger curbing flow control. .
  - **rate**: Configures the curbing flow-control at a fixed rate in Kbps instead of a dynamic rate.
  - **threshold-rate**: Configures the minimum target shaping rate in kbps to trigger curbing..
  - **time**: Configures the duration of a flow control phase in milliseconds.
- **extended-curbing-control**: Configures Extended curbing flow control related parameters.

    - **max-phases**: Configures consecutive phases where the target shaping rate is below **threshold-rate** to trigger curbing flow control. The maximum phase value is an integer ranging 2–10 for extended parameter. The default value inherits base.
    - **rate**: Configures the curbing flow-control at a fixed rate in Kbps instead of a dynamic rate. The control rate value is an integer ranging 0-100000 kbps for extended parameter. The default value inherits base.
    - **threshold-rate**: Configures the minimum target shaping rate in kbps to trigger curbing.The threshold rate is an integer ranging 100-100000 kbps for extended parameter. The default value inherits base.
    - **time**: Configures the duration of a flow control phase in milliseconds.

      The flow control duration value is an integer ranging 0–600000 for extended parameter. The default value inherits base.

- **heavy-session**: Configures parameters for Base heavy-session detection.
    - **standard-flow-timeout**: Configures the idle timeout in milliseconds, for expiration of standard flows.
    - **threshold**: Configures heavy-session detection threshold in bytes. On reaching the threshold, the flow is monitored and potentially managed..
- **extended-heavy-session**: Configures parameters for Extended heavy-session detection.
    - **standard-flow-timeout**: Configures the idle timeout in milliseconds, for expiration of standard flows. .
    - **threshold**: Configures heavy-session detection threshold in bytes. On reaching the threshold, the flow is monitored and potentially managed.
- **link-profile**: Configures Base link profile parameters.
    - **initial-rate**: Configures the initial seed value of the acquired peak rate in Kbps for a traffic session.
    - **max-rate**: Configures the maximum learned peak rate that is allowed in Kbps for a traffic session.
    - **peak-lock**: Confirms with the link peak rate available at the initial link peak rate setting.
- **extended-link-profile**: Configures Extended link profile parameters.
    - **initial-rate**: Configures the initial seed value of the acquired peak rate in Kbps for a traffic session.
    - **max-rate**: Configures the maximum learned peak rate that is allowed in Kbps for a traffic session.
    - **peak-lock**: Confirms with the link peak rate available at the initial link peak rate setting.
- **session-params**: Configures Base session parameters.
    - **tcp-ramp-up**: Configures the ramp-up-phase duration in milliseconds, for TCP traffic.
    - **udp-ramp-up**: Configures the ramp-up-phase duration in milliseconds, for the UDP traffic..
- **extended-session-params**: Configures Extended session parameters.
    - **tcp-ramp-up**: Configures the ramp-up-phase duration in milliseconds, for TCP traffic.

- **udp-ramp-up**: Configures the ramp-up-phase duration in milliseconds, for the UDP traffic..



Important After you configure **require active-charging** command, you must save the configuration and then reload the chassis for the command to take effect. For information on saving the configuration file and reloading the chassis, refer to the *System Administration Guide* for your deployment.

The following table shows the parameter ranges for both Base and Extended set parameters, the default values of those parameters and, the validated Range/value for configuring the parameters for Cisco Ultra Traffic Optimization library.

Parameter category (Base/Extended)	Parameter	Base Parameter Range	Base default value	Extended Parameter Range	Extended default value	Range/value check	Comment
bandwidth-mgmt /extended-bandwidth-mgmt	**backoff-profile**	**managed /unmanaged**	**managed**	**managed /unmanaged**	Inherits base	require match base	If you enter a value different from Base, the value from Base parameter and an appropriate message will be displayed.
	min-effective-rate	100-100000 kbps	600	100-500000 kbps	45000	allow full range	
	min-flow-control-rate	100-100000 kbps	250	100- 500000 kbps	1000	allow full range	

Parameter category (Base/Extended)	Parameter	Base Parameter Range	Base default value	Extended Parameter Range	Extended default value	Range/value check	Comment
curbing-control / **extended-curbing-control**	**max-phases**	2-10	2	2-10	Inherits base	allow full range	
	rate	0-100000 kbps	0	0-100000 kbps	Inherits base	allow full range	
	threshold-rate	100-100000 kbps	600	100-100000 kbps	Inherits base	allow full range	
	time	0-600000 ms	0	0-600000 ms	Inherits base	allow full range	
heavy-session / **extended-heavy-session**	**standard-flow-timeout**	100-10000 ms	500	100-10000 ms	Inherits base	allow full range	
	threshold	100000–100000000 bytes	3000000	100000–100000000 bytes	Inherits base	allow full range	

Parameter category (Base/Extended)	Parameter	Base Parameter Range	Base default value	Extended Parameter Range	Extended default value	Range/value check	Comment
link-profile / **extended-link-profile**	**initial-rate**	100-100000 kbps	7000	100-500000 kbps	50000	require greater than or equal to base max-rate	If you enter a value different from Base, the value from Base parameter and an appropriate message will be displayed.
	max- rate	100-100000 kbps	15000	100-500000 kbps	100000	require greater than or equal to base max-rate	If you enter a value different from Base, the value from Base parameter and an appropriate message will be displayed.
	peak-lock	enabled/disabled	disabled	enabled/disabled	disabled	allow either	

Parameter category (Base/Extended)	Parameter	Base Parameter Range	Base default value	Extended Parameter Range	Extended default value	Range/value check	Comment
session-params / **extended- session-params**	**tcp-ramp-up**	0-10000 ms	2000	0-10000 ms	2000	allow full range	
	udp-ramp-up	0-10000 ms	2000	0-10000 ms	2000	allow full range	

Traffic Optimization Policy - Default Values

```
Bandwidth-Mgmt:

   Backoff-Profile         : Managed
   Min-Effective-Rate      : 600 (kbps)
   Min-Flow-Control-Rate   : 250 (kbps)

Curbing-Control:

   Time                    : 0 (ms)
   Rate                    : 0 (kbps)
   Max-Phases              : 2
   Threshold-Rate          : 600 (kbps)

Heavy-Session:

   Threshold               : 3000000(bytes)
   Standard-Flow-Timeout   : 500 (ms)

Link-Profile:

   Initial-Rate            : 7000 (kbps)
   Max-Rate                : 15000 (kbps)
   Peak-Lock               : Disabled

Session-Params:

   Tcp-Ramp-Up             : 2000 (ms)
   Udp-Ramp-Up             : 2000 (ms)
```

Associating a Trigger Action to a Traffic Optimization Policy

Use the following CLI commands to associate a Trigger Action to a Traffic Optimization Policy.

```
configure
   require active-charging
   active-charging service service_name
      trigger-action trigger_action_name
         traffic-optimization policy policy_name
         [ no ] traffic-optimization
         end
```

NOTES:

- **traffic-optimization policy**: Configures a traffic optimization policy.
- **no**: Removes the configured traffic optimization policy.

Enabling TCP and UDP

Use the following CLI commands to enable TCP and UDP protocol for Traffic Optimization:

```
configure
   require active-charging
   active-charging service service_name
      trigger-condition trigger_condition_name
         [ no ] ip protocol = [ tcp | udp ]
         end
```

NOTES:

- **no**: Deletes the Active Charging Service related configuration.
- **ip**: Establishes an IP configuration.
- **protocol**: Indicates the protocol being transported by the IP packet.
- **tcp**: Indicates the TCP protocol to be transported by the IP packet.
- **udp**: Indicates the UDP protocol to be transported by the IP packet.



Important After you configure this command, you must save the configuration and then reload the chassis for the command to take effect. For information on saving the configuration file and reloading the chassis, refer to the *System Administration Guide* for your deployment.

Service-Scheme Configuration for Multi-Policy Support

The service-schema framework enables traffic optimization at APN, rule base, QCI, and Rule level. In 21.6, with the Multi-Policy Support feature, traffic optimization in a service-schema framework allows the operator to configure multiple policies and to configure traffic optimization based on a desirable location.

The service-schema framework helps in associating actions based on trigger conditions, which can be triggered either at call-setup time, Bearer-creation time, or flow-creation time.

Session Setup Trigger

The **any-match = TRUE**, a wildcard configuration, is the only supported condition for this trigger and so this is applicable to all the flows of the subscriber.

Use the following configuration to setup a Session Trigger:

```
configure
    active-charging service service_name
       trigger-action trigger_action_name
          traffic-optimization
          exit
       trigger-condition trigger_condition_name1
          any-match = TRUE
          exit
       service-scheme service_scheme_name
          trigger sess-setup
             priority priority_value trigger-condition trigger_condition_name1
trigger-action trigger_action_name
```

```
            exit
        subs-class sub_class_name
            apn = apn_name
            exit
        subscriber-base subscriber_base_name
           priority priority_value subs-class sub_class_name bind service-scheme
service_scheme_name
            end
```

Sample Configuration

Following is a sample configuration for Session Setup Trigger:

```
service-scheme SS1
     trigger sess-setup
       priority 1 trigger-condition sess-setup trigger-action sess-setup
     #exit
   trigger-condition sess-setup
     any-match = TRUE
   #exit
   trigger-action sess-setup
     traffic-optimization policy sess-setup
   #exit
```

Bearer Creation Trigger

The trigger conditions related to QCI can be used for this trigger, and so this is applicable to all the flows of specific bearers.

Use the following configuration to configure a Bearer Creation Trigger:

```
configure
  active-charging service service_name
    service-scheme service_scheme_name
       trigger bearer-creation
         priority priority_value trigger-condition trigger_condition_name2
trigger-action trigger_action_name
         exit
       trigger-condition trigger_condition_name2
         qci = qci_value
         exit
       trigger-action bearer-creation
         traffic-optimization policy bearer-creation
         exit
```

Sample Configuration

The following is a sample configuration for Bearer Creation Trigger:

```
service-scheme SS1
     trigger bearer-creation
       priority 1 trigger-condition bearer-creation trigger-action bearer-creation
     #exit
   trigger-condition bearer-creation
     qci = 1 to 2
   #exit
   trigger-action bearer-creation
```

```
    traffic-optimization policy bearer-creation
  #exit
```

Flow Creation Trigger

The trigger conditions related to rule-name and QCI can be used here, and so this is related to specific flow.

Use the following configuration to configure a flow creation trigger:

```
configure
   active-charging service service_name
      service-scheme service_scheme_name
         trigger bearer-creation
            priority priority_value trigger-condition trigger_condition_name
trigger-action trigger_action_name
            exit
         trigger-condition trigger_condition_name
            ip-protocol = protocol_type
            rule-name = rule_name
               **Multi-line or All-lines**
            exit
```

Sample Configuration

The following is a sample configuration for Flow Creation Trigger using the default Cisco Ultra Traffic Optimization policy:

```
service-scheme SS1
    trigger flow-create
      priority 1 trigger-condition TC5 trigger-action TA4
    #exit
    trigger-condition TC5
      ip protocol = tcp
      ip protocol = udp
      multi-line-or all-lines
    #exit
    trigger-action TA4
      traffic-optimization
    #exit
```

Configuring: ecgi-change

The following demonstrates ecgi-change sample configuration:

Trigger Condition and Trigger Action in ACS Configuration

```
configure
active-charging-service ACS
   trigger-action TA1
      traffic-optimization policy flow-create-ecgi-change
    #exit
    trigger-condition TC4
      local-policy-rule = ruledef-ecgi
    #exit
 end
```

Service Schema Configuration

```
configure
active-charging-service ACS
```

```
    service-scheme SS1
      trigger flow-create
        priority 2 trigger-condition TC4 trigger-action TA1
      #exit
    subs-class SC1
      any-match = TRUE
    #exit
    subscriber-base SB1
      priority 1 subs-class SC1 bind service-scheme SS1
    #exit
end
```

Local Policy Configuration

```
local-policy-service LP
    ruledef anymatch
      condition priority 1 imsi match *
    #exit
    ruledef ecgi-1
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1AE7F0A 1AE7F0B 1AE7F28 1AE7F29
1AE7F46 1AE7F47 1AEAC00 1AEAC01 1AEAC02 1AEAC0A 1AEAC0B 1AEAC0C 1AEAC14 1AEAC15 1AEAC16
1AEAC28 1AEAC29 1AEAC2A 1AEAC46 1AEAC47 1AEAC48 1AEAC50 1AEAC51 1AEAC52 1AEAC6E 1AEAC6F
1AEAC70 1AEAC78 1AEAC79 1AEAC7A
    #exit
    ruledef ecgi-10
      condition priority 1 ecgi mcc 300 mnc 235 eci match 1F36C52 1F36C6E 1F36C6F 1F36C70
1F36C78 1F36C79 1F36C7A
    #exit
    ruledef ecgi-2
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1AEBE01 1AEBE02 1AEBE0B 1AEBE0C
1AEBE15 1AEBE16 1AEBE29 1AEBE2A 1AEBE47 1AEBE48 1AEBF00 1AEBF01 1AEBF02 1AEBF0A 1AEBF0B
1AEBF0C 1AEBF14 1AEBF15 1AEBF16 1AEBF1E 1AEBF1F 1AEBF20 1AEBF28 1AEBF29 1AEBF2A 1AEBF46
    #exit
    ruledef ecgi-3
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1AEBF47 1AEBF48 1AEBF50 1AEBF51
1AEBF52 1AEBF6E 1AEBF6F 1AEBF70 1AEBF78 1AEBF79 1AEBF7A 1AF0E00 1AF0E01 1AF0E02 1AF0E0A
1AF0E0B 1AF0E0C 1AF0E14 1AF0E15 1AF0E16 1AF0E28 1AF0E29 1AF0E2A 1AF0E46
    #exit
    ruledef ecgi-4
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1AF0E47 1AF0E48 1AF4A0A 1AF4A0B
1AF4A14 1AF4A15 1AF4A28 1AF4A29 1AF4A46 1AF4A47 1AF4D00 1AF4D01 1AF4D0A 1AF4D0B 1AF4D14
1AF4D15 1AF4D28 1AF4D29 1AF4D46 1AF4D47 1AF4D50 1AF4D51 1AF4D6E 1AF4D6F
    #exit
    ruledef ecgi-5
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1AF4D78 1AF4D79 1AF7200 1AF7201
1AF7202 1AF720A 1AF720B 1AF720C 1AF7214 1AF7215 1AF7216 1AF721E 1AF721F 1AF7444 1AF7228
1AF7229 1AF722A 1AF7246 1AF7247 1AF7248 1AF7250 1AF7251 1AF7252 1AF726E
    #exit
    ruledef ecgi-6
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1AF726F 1AF7270 1B04C00 1B04C01
1B04C02 1B04C03 1B04C0A 1B04C0B 1B04C0C 1B04C0D 1B04C14 1B04C15 1B04C16 1B04C17 1B04C1E
1B04C1F 1B04C20 1B04C21 1B04C28 1B04C29 1B04C2A 1B04C2B 1B04C46 1B04C47
    #exit
    ruledef ecgi-7
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1B04C48 1B04C49 1B04C50 1B04C51
1B04C52 1B04C53 1B04C6E 1B04C6F 1B04C70 1B04C71 1B04C78 1B04C79 1B04C7A 1B04C7B 1B05300
1B05301 1B05302 1B0530A 1B0530B 1B0530C 1B05314 1B05315 1B05316 1B05328 1B05329
    #exit
    ruledef ecgi-8
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1B0532A 1B05346 1B05347 1B05348
1B32F00 1B32F01 1B32F02 1B32F0A 1B32F0B 1B32F0C 1B32F14 1B32F15 1B32F16 1B32F28 1B32F29
1B32F2A 1B32F46 1B32F47 1B32F48 1B76400 1B76401 1B76402 1B7640A 1B7640B 1B7640C 1B76428
    #exit
    ruledef ecgi-9
```

```
      condition priority 1 ecgi mcc 111 mnc 444 eci match 1B76429 1B7642A 1B76446 1B76447
1B76448 1F36C00 1F36C01 1F36C02 1F36C0A 1F36C0B 1F36C0C 1F36C14 1F36C15 1F36C16 1F36C1E
1F36C1F 1F36C20 1F36C28 1F36C29 1F36C2A 1F36C46 1F36C47 1F36C48 1F36C50 1F36C51
    #exit
    actiondef activate_lp_action
      action priority 1 activate-lp-rule name ruledef-tai
    #exit
    actiondef activate_lp_action1
      action priority 3 event-triggers ecgi-change
    #exit
    actiondef ecgi_change
      action priority 1 activate-lp-rule name ruledef-ecgi
    #exit
    eventbase default
     rule priority 1 event new-call ruledef anymatch actiondef activate_lp_action1 continue

      rule priority 11 event new-call ruledef ecgi-1 actiondef ecgi_change continue
      rule priority 12 event new-call ruledef ecgi-2 actiondef ecgi_change continue
      rule priority 13 event new-call ruledef ecgi-3 actiondef ecgi_change continue
      rule priority 14 event new-call ruledef ecgi-4 actiondef ecgi_change continue
      rule priority 15 event new-call ruledef ecgi-5 actiondef ecgi_change continue
      rule priority 16 event new-call ruledef ecgi-6 actiondef ecgi_change continue
      rule priority 17 event new-call ruledef ecgi-7 actiondef ecgi_change continue
      rule priority 18 event new-call ruledef ecgi-8 actiondef ecgi_change continue
      rule priority 19 event new-call ruledef ecgi-9 actiondef ecgi_change continue
      rule priority 20 event new-call ruledef ecgi-10 actiondef ecgi_change continue
      rule priority 21 event ecgi-change ruledef ecgi-1 actiondef ecgi_change continue
      rule priority 22 event ecgi-change ruledef ecgi-2 actiondef ecgi_change continue
      rule priority 23 event ecgi-change ruledef ecgi-3 actiondef ecgi_change continue
      rule priority 24 event ecgi-change ruledef ecgi-4 actiondef ecgi_change continue
      rule priority 25 event ecgi-change ruledef ecgi-5 actiondef ecgi_change continue
      rule priority 26 event ecgi-change ruledef ecgi-6 actiondef ecgi_change continue
      rule priority 27 event ecgi-change ruledef ecgi-7 actiondef ecgi_change continue
      rule priority 28 event ecgi-change ruledef ecgi-8 actiondef ecgi_change continue
      rule priority 29 event ecgi-change ruledef ecgi-9 actiondef ecgi_change continue
      rule priority 30 event ecgi-change ruledef ecgi-10 actiondef ecgi_change continue
    #exit
  #exit
end
```

Traffic Optimization Policy Configuration

```
configure
active-charging-service ACS
traffic-optimization-policy Config:
    traffic-optimization-policy flow-create-ecgi-change
      heavy-session threshold 400000
    #exit
end
```

Local Policy Configuration



Important Configuring Local Policy needs a Local Policy Decision Engine License. Contact your Cisco account representative for information on specific licensing requirements.

This section describes the traffic optimization policy configuration that is based on location.

Use the following sample configuration to enable a eCGI change rule:

```
configure
   active-charging service service_name
      local-policy-service service_name
         ruledef ruledef_name
            condition priority priority_value ecgi mccmcc_value mnc mnc_value eq
eq_value
            exit
         actiondef actiondef_name1
            action priority priority_value event-triggers actiondef_name2
            exit
         actiondef actiondef_name2
            action priority priority_value activate-lp-ruleruledef_name
            exit
         eventbase eventbase_name
            rule priority priority_value event event_name ruledef ruledef_name
actiondef actiondef_name1continue
            rule priority priority_value event event_name ruledef ruledef_name
actiondef actiondef_name1continue
            exit
```

Service-Scheme Configuration

```
configure
   active-charging service service_name
      service-scheme service_scheme_name
         trigger flow-create
            priority priority_value trigger-condition trigger_condition_name
trigger-action trigger_action_name
            exit
         trigger condition trigger_condition_name
            local-policy-rule = rule_name
            exit
         trigger action trigger_action_name
            traffic-optimization policy policy_name
            exit
```

Configuring L7 Rule



Important Configuring L7 Rule needs an Application Detection Control License. Contact your Cisco account representative for detailed information on specific licensing requirements.

Use the following CLI to configure an L7 rule:

```
configure
   active-charging service service_name
      service-scheme service_scheme_name
         trigger bearer-creation
            priority priority_value trigger-condition trigger_condition_name
trigger-action trigger_action_name
            exit
         trigger-condition trigger_condition_name
```

```
        rule-name = rule_name
        rule-name = rule_name
          **Multi-line or All-lines**
    trigger-action trigger_action_name
        traffic-optimization policy policy_name
        exit
```

Sample Configuration

The following is a sample configuration for L7 Rules:

```
service-scheme SS1
    trigger flow-create
      priority 1 trigger-condition TC6 trigger-action TA6
    #exit
    trigger-condition TC6
      rule-name = whatsapp
      rule-name = http
      multi-line-or all-lines
    #exit
    trigger-action TA6
      traffic-optimization policy flow-create-L7-Rules
    #exit
```

Ookla Speedtest

Use the configuration information discussed in the section Configuring L7 Rule, on page 27.

Sample Configuration

The following is a sample configuration for Ookla Speedtest:

```
service-scheme SS1
     trigger flow-create
       priority 1 trigger-condition ookla trigger-action ookla
     #exit
   trigger-condition ookla
     rule-name = speedtest
   #exit
   trigger-action ookla
     no traffic-optimization
   #exit
```

Location and App-based Configuration

Sample Configuration

```
service-scheme SS1
   trigger flow-create
     priority 1 trigger-condition TC3 trigger-action TA2
   #exit
   trigger-condition TC3
     local-policy-rule = ruledef-ecgi
     rule-name = youtube
     rule-name = whatsapp
     multi-line-or all-lines
   #exit
   trigger-action TA2
     traffic-optimization policy flow-create-ecgi-change
   #exi
```

Selective Configuration by Disabling TCP and UDP

Sample Configuration

```
service-scheme SS1
    trigger flow-create
      priority 1 trigger-condition tcponly trigger-action tcponly
      priority 2 trigger-condition udponly trigger-action udponly
    #exit
    trigger-condition tcponly
      ip protocol = tcp
    #exit
    trigger-condition udponly
      ip protocol = udp
    #exit
    trigger-action tcponly
      no traffic-optimization
    #exit
    trigger-action udponly
      no traffic-optimization
    #exit
```

L7/ADC and Location Trigger based Configuration

Sample Configuration

This sample configuration describes a scenario where an operator wants to always disable Traffic Optimization for Speedtest. The configuration disables traffic optimization regardless of the location. It applies a specific policy for a specific location (ECGI) (except for Speedtest) and overrides any other policy set by any trigger condition.

Also, for a specific policy optimization, for example: YouTube, the policy selection is prioritized as follows:

```
Service Scheme Configuration:
service-scheme SS1
trigger flow-create
  priority 1 trigger-condition speedtest-tc trigger-action speedtest-ta
  priority 2 trigger-condition location-tc trigger-action location-ta
  priority 3 trigger-condition youtube-tc trigger-action youtube-ta
  #exit
  trigger-condition location-tc
    local-policy-rule = ruledef-ecgi
  #exit
  trigger-action location-ta
    traffic-optimization policy flow-create-ecgi-change
  #exit
  trigger-condition speedtest-tc
    *rule-name = speedtest
  #exit
  trigger-action speedtest-ta
    no traffic-optimization
  #exit
  trigger-condition youtube-tc
    rule-name = youtube
  #exit
  trigger-action youtube-ta
    traffic-optimization policy youtube-policy
  #exit
* Provided rule-name = speedtest, is configured such that it always detects this traffic.
```

Cisco Ultra Traffic Optimization Bulk Statistics Enhancements

Feature Description

In this StarOS 21.23 release, the following show commands and bulk statistics schema counters are enhanced to show Rx/Tx packet statistics for Uplink and Downlink for UDP and TCP split in Cisco Ultra Traffic Optimization solution.

- show active-charging traffic-optimization counters sessmgr all
- show active-charging traffic-optimization counters tcp sessmgr all
- show active-charging traffic-optimization counters udp sessmgr all

Monitoring and Troubleshooting

Show Commands and Outputs

show active-charging traffic-optimization counters sessmgr all

You can view CUTO Control Plane statistics for the following show command.

Table 1: show active-charging traffic-optimization counters sessmgr all

Field	Description
CUTO Control Plane Stats:	
Total Active Streams	Displays total number of active streams.
Active TCP Streams	Displays total number of active TCP uplink and downlink streams received.
Active UDP(QUIC) Streams	Displays total number of active UDP uplink nd downlink streams transmitted.

You can also view similar outputs for the folowing show commands:

- **show active-charging traffic-optimization counters tcp sessmgr all**
- **show active-charging traffic-optimization counters udp sessmgr all**

show bulkstats variables ecs

The following ECS level statistic variables are added for the Cisco Ultra Traffic Optimization feature.

Table 2: Bulk Statistic Variables in the ECS Schema

Variables	Description	Data Type
cuto-tcp-uplink-rx	**Description:** Displays the total number of TCP packets received from the UE for Cisco Ultra Traffic Optimization **Type:** Counter **Triggers**: Increments whenever a TCP packet is received from the UE for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64
cuto-tcp-uplink-tx	**Description:** Displays the total number of TCP packets sent towards the UE for Cisco Ultra Traffic Optimization. **Type:** Counter **Triggers**: Increments whenever a TCP packet is sent towards the UE for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64
cuto-tcp-dnlink-rx	**Description:** Displays the total number of TCP packets received from the internet for Cisco Ultra Traffic Optimization. **Type:** Counter **Triggers**: Increments whenever a TCP packet is received from the internet for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64
cuto-tcp-dnlink-tx	**Description:** Displays the total number of TCP packets sent towards the internet for Cisco Ultra Traffic Optimization **Type:** Counter **Triggers**: Increments whenever a TCP packet is sent towards the internet for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64

Variables	Description	Data Type
cuto-udp-uplink-rx	**Description:** Displays the total number of UDP packets received from the UE for Cisco Ultra Traffic Optimization. **Type:** Counter **Triggers**: Increments whenever a UDP packets is received from the UE for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64
cuto-udp-uplink-tx	**Description:** Displays the total number of UDP packets sent towards the UE for Cisco Ultra Traffic Optimization **Type:** Counter **Triggers**: Increments whenever a UDP packet is sent towards the UE for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64
cuto-udp-dnlink-rx	**Description:** Displays the total number of UDP packets received from the internet for Cisco Ultra Traffic Optimization. **Type:** Counter **Triggers**: Increments whenever a UDP packets is received from the internet for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64
cuto-udp-dnlink-tx	**Description:** Displays the total number of UDP packets sent towards the internet for Cisco Ultra Traffic Optimization. **Type:** Counter **Triggers**: Increments whenever a UDP packet is sent towards the internet for Cisco Ultra Traffic Optimization. **Availability**: Per Active Charging Service.	Int64

Bulk Statistics

The following bulk statistics are added in the ECS schema.

ECS Schema

Table 3: Bulk Statistics Variables in the ECS Schema

Variables	Description
cuto-tcp-uplink-rx	Indicates that the total number of TCP packets received from the UE for Cisco Ultra Traffic Optimization.
cuto-tcp-uplink-tx	Indicates that the total number of TCP packets sent towards the UE for Cisco Ultra Traffic Optimization.
cuto-tcp-dnlink-rx	Indicates that the total number of TCP packets received from the internet for Cisco Ultra Traffic Optimization.
cuto-tcp-dnlink-tx	Indicates that the total number of TCP packets sent towards the internet for Cisco Ultra Traffic Optimization.
cuto-udp-uplink-rx	Indicates that the total number of UDP packets received from the UE for Cisco Ultra Traffic Optimization.
cuto-udp-uplink-tx	Indicates that the total number of UDP packets sent towards the UE for Cisco Ultra Traffic Optimization.
cuto-udp-dnlink-rx	Indicates that the total number of UDP downlink packets received from the internet for Cisco Ultra Traffic Optimization.
cuto-dnlink-forward	Indicates that thee total number of data packets that are forwarded by Cisco Ultra Traffic Optimization library in the downlink direction.
cuto-dnlink-tx	Indicates that the total number of downlink packets sent by Cisco Ultra Traffic Optimization library.
cuto-dnlink-rx	Indicates that the total number of downlink packets received by Cisco Ultra Traffic Optimization library.
cuto-dnlink-hold	Indicates that the total number of data packets that are held by Cisco Ultra Traffic Optimization library in the downlink direction.

Configuring Cisco Ultra Traffic Optimization

This section provides information on enabling support for the Cisco Ultra Traffic Optimization solution.

Loading Traffic Optimization

Use the following configuration under the Global Configuration Mode to load the Cisco Ultra Traffic Optimization as a solution:

```
configure
   require active-charging traffic-optimization
   end
```

Important After you configure this command, you must save the configuration and then reload the chassis for the command to take effect. For information on saving the configuration file and reloading the chassis, refer to the *System Administration Guide* for your deployment.

Important Enabling or disabling the traffic optimization can be done through the Service-scheme framework.

Important After you configure the **require active-charging traffic-optimization** CLI command, you must save the configuration and then reload the chassis for the command to take effect. For information on saving the configuration file and reloading the chassis, refer to the *System Administration Guide* for your deployment.

Important In 21.3, and 21.5 and later releases, the dependency on the chassis reboot is not valid anymore. The Cisco Ultra Traffic Optimization engine is loaded by default. The Cisco Ultra Traffic Optimization configuration CLIs are available when the license is enabled. As such, the **traffic-optimization** keyword has been deprecated.

Enabling Cisco Ultra Traffic Optimization Configuration Profile

Use the following configuration under ACS Configuration Mode to enable the Cisco Ultra Traffic Optimization profile:

```
configure
   active-charging service service_name
      traffic-optimization-profile
      end
```

NOTES:

- The above CLI command enables the Traffic Optimization Profile Configuration, a new configuration mode.

Configuring the Operating Mode

Use the following CLI commands to configure the operating mode under Traffic Optimization Profile Configuration Mode for the Cisco Ultra Traffic Optimization engine:

```
configure
   active-charging service service_name
      traffic-optimization-profile
         mode [ active | passive ]
         end
```

Notes:

- **mode**: Sets the mode of operation for traffic optimization.
- **active**: Active mode where both traffic optimization and flow monitoring is done on the packet.
- **passive**: Passive mode where no flow-control is performed but monitoring is done on the packet.

Enabling Cisco Ultra Traffic Optimization Configuration Profile Using Service-scheme Framework

The service-scheme framework is used to enable traffic optimization at APN, rule base, QCI, and Rule level. There are two main constructs for the service-scheme framework:

- **Subscriber-base** – This helps in associating subscribers with service-scheme based on the subs-class configuration.
  - **subs-class** – The conditions defined under subs-class enables in classifying the subscribers based on rule base, APN, v-APN name. The conditions can also be defined in combination, and both OR as well as AND operators are supported while evaluating them.
- **Service-scheme** – This helps in associating actions based on trigger conditions which can be triggered either at call-setup time, Bearer-creation time, or flow-creation time.
  - **trigger-condition** – For any trigger, the trigger-action application is based on conditions defined under the trigger-condition.
  - **trigger-actions** – Defines the actions to be taken on the classified flow. These actions can be traffic optimization, throttle-suppress, and so on.

Session Setup Trigger

The **any-match = TRUE**, a wildcard configuration, is the only supported condition for this trigger and so this is applicable to all the flows of the subscriber.

Following is a sample configuration:

```
configure
   active-charging service service_name
      service-scheme service_scheme_name
          trigger sess-setup
             priority priority_value trigger-condition trigger_condition_name1
trigger-action trigger_action_name
             exit
          trigger-condition trigger_condition_name1
             any-match = TRUE
             exit
          trigger-action sess-setup
          traffic-optimization policy sess-setup
             exit
```

Bearer Creation Trigger

The trigger conditions related to QCI can be used for this trigger, and so this is applicable to all the flows of specific bearers.

The following is a sample configuration:

```
configure
   active-charging service service_name
      trigger-action trigger_action_name
         traffic-optimization
         exit
      trigger-condition trigger_condition_name1
         any-match = TRUE
         exit
      trigger-condition trigger_condition_name2
         qci = qci_value
         exit
      service-scheme service_scheme_name
         trigger bearer-creation
            priority priority_value trigger-condition trigger_condition_name2
trigger-action trigger_action_name
            exit
         exit
      subs-class sub_class_name
         apn = apn_name
         exit
      subscriber-base subscriber_base_name
        priority priority_value subs-class sub_class_name bind service-scheme
 service_scheme_name
         end
```

Flow Creation Trigger

The trigger conditions related to rule-name and QCI can be used here, and so this is related to specific flow.

The following is a sample configuration:

```
configure
   active-charging service service_name
      trigger-action trigger_action_name
         traffic-optimization
         exit
      trigger-condition trigger_condition_name1
         any-match = TRUE
         exit
      trigger-condition trigger_condition_name2
         qci = qci_value
         exit
      trigger-condition trigger_condition_name3
         rule-name = rule_name
         exit
      service-scheme service_scheme_name
         trigger bearer-creation
```

```
            priority priority_value trigger-condition trigger_condition_name3
trigger-action trigger_action_name
            exit
         exit
      subs-class sub_class_name
         apn = apn_name
         exit
      subscriber-base subscriber_base_name
         priority priority_value subs-class sub_class_name bind service-scheme
 service_scheme_name
         end
```

Notes:

- *trigger_condition_name3* can have only rules, only QCI, both rule and QCI, or either of rule and QCI.

The following table illustrates the different levels of Traffic Optimization and their corresponding Subscriber Class configuration and Triggers.

Traffic Optimization Levels	Subscriber Class configuration and Triggers
Applicable to all the calls or flows	**subs-class** *sc1* **any-match = TRUE** **exit** Sessetup trigger condition is **any-match** = **TRUE**
Applicable to all calls or flows of a rulebase	**subs-class** *sc1* **rulebase = prepaid** **exit** Sessetup trigger condition is **any-match** = **TRUE**
Applicable to all calls or flows of an APN	**subs-class** *sc1* **apn = cisco.com** **exit** Sessetup trigger condition is **any-match** = **TRUE**
Applicable to all flows of a Bearer	**trigger-condition** *TC1* **qci = 1** **exit** Bearer creation trigger condition is TC1
Applicable to a particular flow	**trigger-condition** *TC1* **qci = 1** **rule-name = tcp** **multi-line-or all-lines** **exit** Flow creation trigger condition is TC1



Important In case of LTE to eHRPD handover, since QCI is not valid for eHRPD, it is recommended to configure rule-name as the trigger-condition under service-scheme.

Generating TODR

Use the following CLI commands under ACS Configuration Mode to enable Traffic Optimization Data Record (TODR) generation:

```
configure
   active-charging service service_name
      traffic-optimization-profile
         data-record
         end
```

NOTES:

- If previously configured, use the **no data-record** command to disable generating TODR.

Monitoring and Troubleshooting

This section provides information regarding commands available to monitor and troubleshoot the Cisco Ultra Traffic Optimization solution on the P-GW.

Cisco Ultra Traffic Optimization Show Commands and/or Outputs

This section provides information about show commands and the fields that are introduced in support of Cisco Ultra Traffic Optimization solution.

show active-charging traffic-optimization counters

The **show active-charging traffic-optimization counters sessmgr { all | instance** *number* **}** CLI command is introduced where:

- **counters** – Displays aggregate flow counters/statistics from Cisco Ultra Traffic Optimization engine.



Important This CLI command is license dependent and visible only if the license is loaded.

Following are the new field/counters:

- Traffic Optimization Flows:
  - Active Normal Flow Count
  - Active Large Flow Count
  - Active Managed Large Flow Count

- Active Unmanaged Large Flow Count
- Base Policy:
  - Active Large Flow Count
  - Active Managed Large Flow Count
  - Active Unmanaged Large Flow Count
- Extended Policy:
  - Active Large Flow Count
  - Active Managed Large Flow Count
  - Active Unmanaged Large Flow Count
- Total Normal Flow Count
- Total Large Flow Count
- Total Managed Large Flow Count
- Total Unmanaged Large Flow Count
- Base Policy:
  - Total Large Flow Count
  - Total Managed Large Flow Count
  - Total Unmanaged Large Flow Count
- Extended Policy:
  - Total Large Flow Count
  - Total Managed Large Flow Count
  - Total Unmanaged Large Flow Count
- Total IO Bytes
- Total Large Flow Bytes
- Total Recovered Capacity Bytes
- Total Recovered Capacity ms

On executing the above command, the following new fields are displayed for the Multi-Policy Support feature:



Important This CLI command is license dependent and visible only if the license is loaded.

- TCP Traffic Optimization Flows:
  - Active Normal Flow Count

- Active Large Flow Count
- Active Managed Large Flow Count
- Active Unmanaged Large Flow Count
- Base Policy:
  - Active Large Flow Count
  - Active Managed Large Flow Count
  - Active Unmanaged Large Flow Count
- Extended Policy:
  - Active Large Flow Count
  - Active Managed Large Flow Count
  - Active Unmanaged Large Flow Count
- Total Normal Flow Count
- Total Large Flow Count
- Total Managed Large Flow Count
- Total Unmanaged Large Flow Count
- Base Policy:
  - Total Large Flow Count
  - Total Managed Large Flow Count
  - Total Unmanaged Large Flow Count
- Extended Policy:
  - Total Large Flow Count
  - Total Managed Large Flow Count
  - Total Unmanaged Large Flow Count
- Total IO Bytes
- Total Large Flow Bytes
- Total Recovered Capacity Bytes
- Total Recovered Capacity ms

- UDP Traffic Optimization Flows:
  - Active Normal Flow Count
  - Active Large Flow Count

- Active Managed Large Flow Count
- Active Unmanaged Large Flow Count
- Base Policy:
  - Active Large Flow Count
  - Active Managed Large Flow Count
  - Active Unmanaged Large Flow Count
- Extended Policy:
  - Active Large Flow Count
  - Active Managed Large Flow Count
  - Active Unmanaged Large Flow Count

-
  - Total Normal Flow Count
  - Total Large Flow Count
  - Total Managed Large Flow Count
  - Total Unmanaged Large Flow Count
  - Base Policy:
    - Total Large Flow Count
    - Total Managed Large Flow Count
    - Total Unmanaged Large Flow Count
  - Extended Policy:
    - Total Large Flow Count
    - Total Managed Large Flow Count
    - Total Unmanaged Large Flow Count
  - Total IO Bytes:
  - Total Large Flow Bytes
  - Total Recovered Capacity Bytes
  - Total Recovered Capacity ms

show active-charging traffic-optimization info

This show command has been introduced in Exec Mode, where:

- **traffic-optimization** – Displays all traffic optimization options.
- **info** – Displays Cisco Ultra Traffic Optimization engine information.

The output of this CLI command displays the version, mode, and configuration values.

Following are the new fields/counters:

- Version:
- Mode:
- Configuration:
  - Data Records (TODR)
  - Statistics Options
  - EFD Flow Cleanup Interval
  - Statistics Interval

show active-charging traffic-optimization policy

On executing the above command, the following new fields are displayed for the Multi-Policy Support feature:

- Policy Name
- Policy-Id
- Bandwidth-Mgmt
  - Backoff-Profile
  - Min-Effective-Rate
  - Min-Flow-Control-Rate
- Extended-Bandwidth-Mgmt
  - Backoff-Profile
  - Min-Effective-Rate
  - Min-Flow-Control-Rate
- Curbing-Control
  - Time
  - Rate
  - Max-phases
  - Threshold-Rate
- Extended-Curbing-Control
  - Time
  - Rate
  - Max-phases

    - Threshold-Rate
- Heavy-Session
    - Threshold
    - Standard-Flow-Timeout
- Extended-Heavy-Session
    - Threshold
    - Standard-Flow-Timeout
- Link-Profile
    - Initial-Rate
    - Max-Rate
    - Peak-Lock
- Extended-Link-Profile
    - Initial-Rate
    - Max-Rate
    - Peak-Lock
- Session-Params
    - Tcp-Ramp-Up
    - Udp-Ramp-Up
- Extended-Session-Params
    - Tcp-Ramp-Up
    - Udp-Ramp-Up

Bulk Statistics

The following bulk statistics are added in the ECS schema to support Large and Managed flows:

Bulk Statistics	Description
tcp-active-base-large-flow-count	Indicates the number of TCP active-base-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-base-managed-large-flow-count	Indicates the number of TCP active-base-managed-large-flow count for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
tcp-active-base-unmanaged-large-flow-count	Indicates the number of TCP active-base-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-ext-large-flow-count	Indicates the number of TCP active-ext-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-ext-managed-large-flow-count	Indicates the number of TCP active-ext-managed-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-ext-unmanaged-large-flow-count	Indicates the number of TCP active-ext-managed-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-base-large-flow-count	Indicates the number of TCP total-base-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-base-managed-large-flow-count	Indicates the number of TCP total-base-managed-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-base-unmanaged-large-flow-count	Indicates the number of TCP total-base-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-ext-large-flow-count	Indicates the number of TCP active-ext-managed-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-ext-managed-large-flow-count	Indicates the number of TCP total-ext-managed-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-ext-unmanaged-large-flow-count	Indicates the number of TCP total-ext-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
udp-active-base-large-flow-count	Indicates the number of UDP active-base-large-flow-count count for Cisco Ultra Traffic Optimization.
udp-active-base-managed-large-flow-count	Indicates the number of UDP active-base-managed-large-flow count for Cisco Ultra Traffic Optimization.
udp-active-base-unmanaged-large-flow-count	Indicates the number of UDP active-base-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
udp-active-ext-large-flow-count	Indicates the number of UDP active-ext-large-flow count for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
udp-active-ext-managed-large-flow-count	Indicates the number of UDP active-ext-managed-large-flow count for Cisco Ultra Traffic Optimization.
udp-active-ext-unmanaged-large-flow-count	Indicates the number of UDP active-ext-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-base-large-flow-count	Indicates the number of UDP total-base-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-base-managed-large-flow-count	Indicates the number of UDP total-base-managed-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-base-unmanaged-large-flow-count	Indicates the number of UDP total-base-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-ext-large-flow-count	Indicates the number of UDP total-ext-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-ext-managed-large-flow-count	Indicates the number of UDP total-ext-managed-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-ext-unmanaged-large-flow-count	Indicates the number of UDP total-ext-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-normal-flow-count	Indicates the number of TCP active-normal-flow count for Cisco Ultra Traffic Optimization.
tcp-active-large-flow-count	Indicates the number of TCP active-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-managed-large-flow-count	Indicates the number of TCP active-managed-large-flow count for Cisco Ultra Traffic Optimization.
tcp-active-unmanaged-large-flow-count	Indicates the number of TCP active-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-normal-flow-count	Indicates the number of TCP total-normal-flow count for Cisco Ultra Traffic Optimization.
tcp-total-large-flow-count	Indicates the number of TCP total-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-managed-large-flow-count	Indicates the number of TCP total-managed-large-flow count for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
tcp-total-unmanaged-large-flow-count	Indicates the number of TCP total-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
tcp-total-io-bytes	Indicates the number of TCP total-IO bytes for Cisco Ultra Traffic Optimization.
tcp-total-large-flow-bytes	Indicates the number of TCP total-large-flow bytes for Cisco Ultra Traffic Optimization.
tcp-total-recovered-capacity-bytes	Indicates the number of TCP total-recovered capacity bytes for Cisco Ultra Traffic Optimization.
tcp-total-recovered-capacity-ms	Indicates the number of TCP total-recovered capacity ms for Cisco Ultra Traffic Optimization.
udp-active-normal-flow-count	Indicates the number of UDP active-normal-flow count for Cisco Ultra Traffic Optimization.
udp-active-large-flow-count	Indicates the number of UDP active-large-flow count for Cisco Ultra Traffic Optimization.
udp-active-managed-large-flow-count	Indicates the number of UDP active-managed-large-flow count for Cisco Ultra Traffic Optimization.
udp-active-unmanaged-large-flow-count	Indicates the number of UDP active-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-normal-flow-count	Indicates the number of UDP total-normal-flow count for Cisco Ultra Traffic Optimization.
udp-total-large-flow-count	Indicates the number of UDP total-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-managed-large-flow-count	Indicates the number of UDP total-managed-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-unmanaged-large-flow-count	Indicates the number of UDP total-unmanaged-large-flow count for Cisco Ultra Traffic Optimization.
udp-total-io-bytes	Indicates the number of UDP total-IO bytes for Cisco Ultra Traffic Optimization.
udp-total-large-flow-bytes	Indicates the number of UDP total-large-flow bytes for Cisco Ultra Traffic Optimization.
udp-total-recovered-capacity-bytes	Indicates the number of UDP total-recovered capacity bytes for Cisco Ultra Traffic Optimization.
udp-total-recovered-capacity-ms	Indicates the number of UDP total-recovered capacity ms for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
tcp-uplink-drop	Indicates the number of TCP uplink-drop for Cisco Ultra Traffic Optimization.
tcp-uplink-hold	Indicates the number of TCP uplink-hold for Cisco Ultra Traffic Optimization.
tcp-uplink-forward	Indicates the number of TCP uplink-forward for Cisco Ultra Traffic Optimization.
tcp-uplink-forward-and-hold	Indicates the number of TCP uplink-forward and hold for Cisco Ultra Traffic Optimization.
tcp-uplink-hold-failed	Indicates the number of TCP uplink-hold-failed for Cisco Ultra Traffic Optimization.
tcp-uplink-bw-limit-flow-sent	Indicates the number of TCP uplink-bw limit-flow sent for Cisco Ultra Traffic Optimization.
tcp-dnlink-drop	Indicates the number of TCP downlink-drop for Cisco Ultra Traffic Optimization.
tcp-dnlink-hold	Indicates the number of TCP downlink-hold for Cisco Ultra Traffic Optimization.
tcp-dnlink-forward	Indicates the number of TCP downlink-forward for Cisco Ultra Traffic Optimization.
tcp-dnlink-forward-and-hold	Indicates the number of TCP downlink-forward and hold for Cisco Ultra Traffic Optimization.
tcp-dnlink-hold-failed	Indicates the number of TCP downlink-hold-failed for Cisco Ultra Traffic Optimization.
tcp-dnlink-bw-limit-flow-sent	Indicates the number of TCP downlink-bw limit-flow sent for Cisco Ultra Traffic Optimization.
tcp-dnlink-async-drop	Indicates the number of TCP downlink-async-drop for Cisco Ultra Traffic Optimization.
tcp-dnlink-async-hold	Indicates the number of TCP downlink-async-hold for Cisco Ultra Traffic Optimization.
tcp-dnlink-async-forward	Indicates the number of TCP downlink-async-forward for Cisco Ultra Traffic Optimization.
tcp-dnlink-async-forward-and-hold	Indicates the number of TCP downlink-async-forward and hold for Cisco Ultra Traffic Optimization.
tcp-dnlink-async-hold-failed	Indicates the number of TCP downlink-async-hold-failed for Cisco Ultra Traffic Optimization.
tcp-process-packet-drop	Indicates the number of TCP process-packet-drop for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
tcp-process-packet-hold	Indicates the number of TCP process-packet-hold for Cisco Ultra Traffic Optimization.
tcp-process-packet-forward	Indicates the number of TCP process-packet-forward for Cisco Ultra Traffic Optimization.
tcp-process-packet-forward-failed	Indicates the number of TCP process-packet-forward-failed for Cisco Ultra Traffic Optimization.
tcp-process-packet-forward-and-hold	Indicates the number of TCP process-packet-forward and hold for Cisco Ultra Traffic Optimization.
tcp-process-packet-forward-and-hold-failed	Indicates the number of TCP process-packet-forward and hold-failed for Cisco Ultra Traffic Optimization.
tcp-pkt-copy	Indicates the number of TCP packet-copy for Cisco Ultra Traffic Optimization.
tcp-pkt-Copy-failed	Indicates the number of TCP packet-copy-failed for Cisco Ultra Traffic Optimization.
tcp-process-pkt-copy	Indicates the number of TCP process-packet-copy for Cisco Ultra Traffic Optimization.
tcp-process-pkt-copy-failed	Indicates the number of TCP process-packet-copy-failed for Cisco Ultra Traffic Optimization.
tcp-process-pkt-no-packet-found-action-forward	Indicates the number of TCP process packet, no packet found, and action forward for Cisco Ultra Traffic Optimization.
tcp-process-pkt-no-packet-found-forward-and-hold	Indicates the number of TCP process packet, no packet found, action forward and hold for Cisco Ultra Traffic Optimization.
tcp-process-pkt-no-packet-found-action-drop	Indicates the number of TCP process packet, no packet found, action drop for Cisco Ultra Traffic Optimization.
tcp-todrs-generated	Indicates the number of TCP TODRs generated for Cisco Ultra Traffic Optimization.
udp-uplink-drop	Indicates the number of UDP uplink-drop for Cisco Ultra Traffic Optimization.
udp-uplink-hold	Indicates the number of UDP uplink-hold for Cisco Ultra Traffic Optimization.
udp-uplink-forward	Indicates the number of UDP uplink-forward for Cisco Ultra Traffic Optimization.
udp-uplink-forward-and-hold	Indicates the number of UDP uplink-forward and hold for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
udp-uplink-hold-failed	Indicates the number of UDP uplink-hold failed for Cisco Ultra Traffic Optimization.
udp-uplink-bw-limit-flow-sent	Indicates the number of UDP uplink-bw limit-flow sent for Cisco Ultra Traffic Optimization.
udp-dnlink-drop	Indicates the number of UDP downlink-drop for Cisco Ultra Traffic Optimization.
udp-dnlink-hold	Indicates the number of UDP downlink-hold for Cisco Ultra Traffic Optimization.
udp-dnlink-forward	Indicates the number of UDP downlink-forward for Cisco Ultra Traffic Optimization.
udp-dnlink-forward-and-hold	Indicates the number of UDP downlink-forward and hold for Cisco Ultra Traffic Optimization.
udp-dnlink-hold-failed	Indicates the number of UDP downlink-hold failed for Cisco Ultra Traffic Optimization.
udp-dnlink-bw-limit-flow-sent	Indicates the number of UDP downlink-bw limit-flow sent for Cisco Ultra Traffic Optimization.
udp-dnlink-async-drop	Indicates the number of UDP downlink-async-drop for Cisco Ultra Traffic Optimization.
udp-dnlink-async-hold	Indicates the number of UDP downlink-async-hold for Cisco Ultra Traffic Optimization.
udp-dnlink-async-forward	Indicates the number of UDP downlink-async-forward for Cisco Ultra Traffic Optimization.
udp-dnlink-async-forward-and-hold	Indicates the number of UDP downlink-async-forward and hold for Cisco Ultra Traffic Optimization.
udp-dnlink-async-hold-failed	Indicates the number of UDP downlink-async-hold failed for Cisco Ultra Traffic Optimization.
udp-process-packet-drop	Indicates the number of UDP process-packet-drop for Cisco Ultra Traffic Optimization.
udp-process-packet-hold	Indicates the number of UDP process-packet-hold for Cisco Ultra Traffic Optimization.
udp-process-packet-forward	Indicates the number of UDP process-packet-forward for Cisco Ultra Traffic Optimization.
udp-process-packet-forward-failed	Indicates the number of UDP process-packet-forward failed for Cisco Ultra Traffic Optimization.
udp-process-packet-forward-and-hold	Indicates the number of UDP process-packet-forward and hold for Cisco Ultra Traffic Optimization.

Bulk Statistics	Description
udp-process-packet-forward-and-hold-failed	Indicates the number of UDP process-packet-forward and hold failed for Cisco Ultra Traffic Optimization.
udp-pkt-copy	Indicates the number of UDP packet-copy for Cisco Ultra Traffic Optimization.
udp-pkt-Copy-failed	Indicates the number of UDP packet-copy-failed for Cisco Ultra Traffic Optimization.
udp-process-pkt-copy	Indicates the number of UDP process-packet-copy for Cisco Ultra Traffic Optimization.
udp-process-pkt-copy-failed	Indicates the number of UDP process-packet-copy failed for Cisco Ultra Traffic Optimization.
udp-process-pkt-no-packet-found-action-forward	Indicates the number of UDP process packet, no packet found, action forward for Cisco Ultra Traffic Optimization.
udp-process-pkt-no-packet-found-forward-and-hold	Indicates the number of UDP process packet, no packet found, action forward and hold for Cisco Ultra Traffic Optimization.
udp-process-pkt-no-packet-found-action-drop	Indicates the number of UDP process packet, no packet found, action drop for Cisco Ultra Traffic Optimization.
udp-todrs-generated	Indicates the number of UDP TODRs generated for Cisco Ultra Traffic Optimization.