Cisco Ultra Traffic Optimization

This chapter describes the following topics:

Feature Summary and Revision History

Summary Data

Applicable Product(s) or Functional Area	• IPSG • 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* • *IPSG Administration Guide*

Revision History

Revision Details	Release
With this release, Cisco Ultra Traffic Optimization is qualified on IPSG.	21.8

Overview

As traffic grows, Quality of Experience (QoE) drops because more consumers are sharing the radio channel with increasingly richer, more data consuming application. Connection speed (bits per second) is crucial. Traditional approaches to maintaining connection speed in the face of traffic growth (that is, Network Densification) focus on hardware-based approaches, such as adding new base stations and building the MIMO. While necessary, this approach is very time consuming and expensive.

The Cisco Ultra Traffic Optimization is a RAN optimization technology that increases subscriber connection speeds in congested cells and, as a result, increases the cell capacity significantly. The result is an optimized RAN, where Mobile Network Operators (MNOs) can deploy fewer cells, on an ongoing basis, and absorb more traffic growth while meeting network quality targets.

Large traffic flows, such as Adaptive Bit Rate (ABR) video, saturate radio resources and swamp the eNodeB scheduler. The Cisco Ultra Traffic Optimization employs machine learning algorithms to detect large traffic flows (such as video) in the network and optimize the delivery of those flows to mitigate the network congestion without changing user quality (that is, video works the same for the end user). In other words, by employing software intelligence at the network core, Cisco Ultra Traffic Optimization mitigates the overwhelming impact video has on the RAN.

The resulting benefits are seen in congested network sites. The Cisco Ultra Traffic Optimization:

- Increases average user throughput.

- Increases congested cell site capacity.

- Reduces scheduler latency.

- Maintains user quality of experience even when more users and more traffic share a cell.

- Is measured directly by eNodeB performance counters (for example, average UE throughput, scheduler latency), which are the key performance indicators that are used for network capacity planning.

- Provides permanent savings in RAN investment requirements.

- Is integrated in the Cisco StarOS P-GW.

- Requires no new hardware or cabling complexity - it can be turned on for a market in an hour.

- Supports all types of traffic, including HTTP(s) and QUIC.
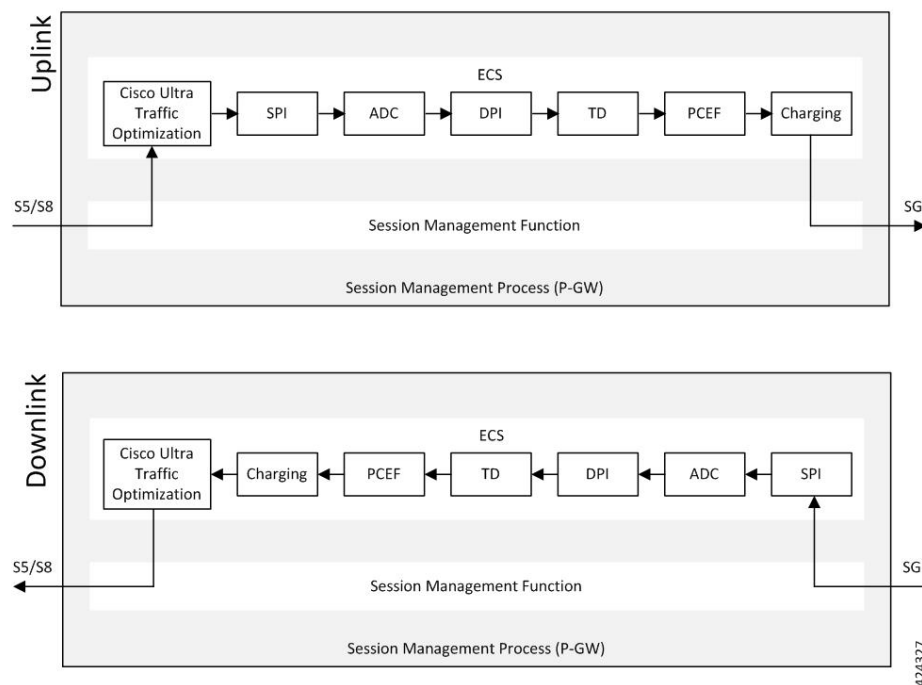
How Cisco Ultra Traffic Optimization Works

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.

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.

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.

```
2,1,2606:ae00:c663:b66f:0000:0058:be03:ae01,0172:0020:0224:0059:2200:0000:0000:0033,0,0,
1489572442058,1489572444759,5051223,1489572444755,3900,3900,0,0,0,11,0,0,11,1,1,
1489572444755,1950,4,0,0,1,1489572446761,0,2010,0,0,1,1489572448771,0,2007,0,0,1,1489572450778,0,2008,
0,0,1,1489572452786,0,2005,0,0,1,1489572454791,0,2003,0,0,1,1489572456794,0,2005,0,0,1,1489572458799,0,
2003,0,0,1,1489572460802,0,1848,0,0,0,1489572462650,0,2002,0,0,1,1489572464652,0,107,0,0,1,1515659685107,0,2007,0,0,0,3,1,1515659687114,0,2004,0,0,0,3
```

Where:

- *instance_id*: Instance ID.

- *flow_type*: Large flow (1)

- *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.

- *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

  - *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).

  - *max_num_queued_packets*: Identifies the maximum number of packets queued.

  - *policy_id*: Identifies the traffic optimization policy ID.

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.

The IPSG supports only certain triggers for which the information is available with the IPSG service.

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.

Configuring Threshold Value

Use the following CLI commands to configure the threshold value for the TCP flow to be considered for the traffic optimization:

```
configure
   active-charging service service_name
      traffic-optimization-profile
         heavy-session detection-threshold bytes
         end
```

Notes:

- **detection-threshold** *bytes*: Specifies the Detection Threshold (in bytes), beyond which it is considered as heavy session.

  bytes must be an integer from 1 to 4294967295.

  For optimum traffic optimization benefits, it is recommended to set the threshold above 3 MB.

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.

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.

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 flow-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

Traffic Optimization Levels	Subscriber Class configuration and Triggers
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.

Configuring Rulebase to Allow UDP Traffic Optimization

☞

Important From Release 21.8 onwards, it is recommended to enable TCP and UDP protocol for Traffic Optimization by using the CLI commands mentioned in the *Enabling TCP and UDP* section of this chapter.

Use the following configuration in ACS Rulebase Configuration Mode to turn ON/OFF the traffic optimization for UDP traffic.

☞

Important Enabling/Disabling the Cisco Ultra Traffic Optimization solution is controlled by Service-scheme Framework.

```
configure
  active-charging service service_name
    rulebase rulebase_name
      [ no ] traffic-optimization udp
      end
```

NOTES:

- **udp**: Specifies traffic optimization for UDP traffic.

- By default, UDP traffic optimization is disabled.

- If previously configured, use the **no traffic-optimization udp** CLI command to disable traffic optimization for UDP traffic.

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. By default, two policies are pre-configured. 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** UDP/QUIC based Traffic Optimization is supported only on PORT 443.

- Selection of a policy depends on the priority configured. Priorities can be configured for traffic optimization policies using a Trigger Condition. The priority can be set regardless of a specific location where the traffic optimization policy is being applied. A traffic optimization policy can be overridden by another policy based on the priorities configured.

- 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
    [ 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 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.

- **efd-flow-cleanup-interval**: Configures EFD flow cleanup interval. The interval value is an integer that ranges from 10 to 5000 milliseconds.

- **stats-interval**: Configures the flow statistics collection and reporting interval in seconds. The interval value is an integer that ranges from 1 to 60 seconds.

- **stats-options**: Configures options to collect the flow statistics.

> **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
    [ no ] traffic-optimization-policy policy_name
      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
        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
        heavy-session { standard-flow-timeout [ threshold threshold_value |
threshold threshold_value [ standard-flow-timeout timeout_value ] }
        [ no ] 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 ] ] }
        [ no ] 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 ] }
        [ no ] session-params
        end
```

NOTES:

- **no**: Overwrites the traffic-optimization configured parameter(s) with default values. Before deleting a policy profile, all policies associated to the policy profile should be removed. If policy associations are not removed before deletion, the following error message will be displayed:

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

- **bandwidth-mgmt**: Configures 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. The shaping rate value is an integer ranging from 100 to 10000.

- **min-flow-control-rate**: Configures the minimum rate allowed in Kbps to control the flow of heavy-session-flows during congestion. The control rate value is an integer ranging from 100 to 10000.

- **curbing-control**: Configures curbing flow control related parameters.

- **max-phases**: Configures consecutive phases where target shaping rate is below threshold-rate to trigger curbing flow control. The maximum phase value is an integer ranging from 2 to 10.

- **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 from 0 to 10000. To disable fixed flow control rate, set the flow control rate value to 0.

- **threshold-rate**: Configures the minimum target shaping rate in kbps to trigger curbing. The threshold rate is an integer ranging from 100 to 10000.

- **time**: Configures the duration of a flow control phase in milliseconds. The flow control duration value is an integer ranging from 0 to 600000. To disable flow control, set the flow control duration value to 0.

- **heavy-session**: Configures parameters for heavy-session detection.

- **standard-flow-timeout**: Configures the idle timeout in milliseconds, for expiration of standard flows. The timeout value is an integer ranging from 100 to 3000.

- **threshold**: Configures heavy-session detection threshold in bytes. On reaching the threshold, the flow will be monitored and potentially managed. The threshold value is an integer ranging from 0 to 100000000.

- **link-profile**: Configures link profile parameters.

- **initial-rate**: Configures the initial seed value of the acquired peak rate in Kbps for a traffic session. The initial seed value is an integer ranging from 100 to 30000.

- **max-rate**: Configures the maximum learned peak rate allowed in Kbps for a traffic session. The max rate value is an integer ranging from 100 to 30000.

- **peak-lock**: Confirms with the link peak rate available at the initial link peak rate setting.

- **session-params**: Configures session parameters.

- **tcp-ramp-up**: Configures the ramp-up-phase duration in milliseconds, for TCP traffic. The TCP ramp-up duration is an integer ranging from 0 to 5000.

- **udp-ramp-up**: Configures the ramp-up-phase duration in milliseconds, for UDP traffic. The UDP ramp-up duration is an integer ranging from 0 to 5000.

> **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.

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                  : 600 (kbps)
   Max-Phases            : 2
   Threshold-Rate        : 600 (kbps)

Heavy-Session:

   Threshold             : 4000000 (bytes)
   Standard-Flow-Timeout : 500 (ms)

Link-Profile:

   Initial-Rate          : 7000 (kbps)
   Max-Rate              : 10000 (kbps)
   Peak-Lock             : Disabled

Session-Params:

   Tcp-Ramp-Up           : 5000 (ms)
   Udp-Ramp-Up           : 0 (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.

> Ú
>
> **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.

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.

> Ú
>
> **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. With the Multi-Policy Support feature, traffic optimization in a service-scheme framework allows the operator to configure multiple policies and to configure traffic optimization based on a desirable location.

The service-scheme 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.

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/counters that is introduced in support of Cisco Ultra Traffic Optimization solution.

show active-charging rulebase name <rulebase_name>

The output of this show command has been enhanced to display if the UDP traffic optimization is Enabled or Disabled. Following are the fields that has been introduced:

- Traffic Optimization:
    - UDP: Enabled/Disabled

show active-charging traffic-optimization counters { tcp | udp } sessmgr all

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:
    - Total Normal Flow Count:
    - 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:
  - Total Normal Flow Count:
  - 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:
  - Total Normal Flow Count:
  - 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

- Curbing-Control

    - Time

    - Rate

    - Max-phases

    - Threshold-Rate

- Link-Profile

    - Initial-Rate

    - Max-Rate

- Peak-Lock

- Session-Params
    - Tcp-Ramp-Up
    - Udp-Ramp-Up

show active-charging traffic-optimization policy