queue-limit

Tospecify or modify the maximum number of packets the queue can hold for a class policy configured in a policy map, use the **queue-limit** policy-map class configuration command. To remove the queue packet limit from a class, use the **no** form of this command.

queue-limit *number-of-packets*

no queue-limit *number-of-packets*

Syntax Description

number-of-packets	A number in the range from 1 to 64 specifying the maximum number of packets that the queue for this class can accumulate.

Defaults

On the Versatile Interface Processor (VIP)-based platforms, the default value is chosen as a function of the bandwidth assigned to the traffic class. The default value is also based on available buffer memory. If sufficient buffer memory is available, the default **queue-limit** value is equal to the number of 250-byte packets that would lead to a latency of 500 milliseconds (ms) when the packets are delivered at the configured rate. For example, if two 250-byte packets are required to lead to a latency of 500 ms, the default *number-of-packets* value would be 2.

On all other platforms, the default is 64.

Command Modes

Policy-map class configuration

Command History

Release	Modification
12.0(5)T	This command was introduced.
12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE. Support for VIP-enabled Cisco 7500 series routers was added.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T. Support for VIP-enabled Cisco 7500 series routers was added.

Usage Guidelines

Queues Created by Weighted Fair Queueing (WFQ)

WFQ creates a queue for every class for which a class map is defined. Packets satisfying the match criteria for a class accumulate in the queue reserved for the class until they are sent, which occurs when the queue is serviced by the fair queueing process. When the maximum packet threshold you defined for the class is reached, enqueueing of any further packets to the class queue causes tail drop or, if Weighted Random Early Detection (WRED) is configured for the class policy, packet drop to take effect.

Overriding Queue Limits Set by the Bandwidth Command

The **bandwidth** command can be used with the Modular Command-Line Interface (MQC) to specify the bandwidth for a particular class. When used with the MQC, the **bandwidth** command uses a default queue limit for the class. This queue limit can be modified using the **queue-limit** command, thereby overriding the default set by the **bandwidth** command.

Note Using the **queue-limit** command to modify the default queue-limit is especially important for higher-speed interfaces, in order to meet the minimum bandwidth guarantees required by the interface.

Examples

The following example configures a policy map called policy11 to contain policy for a class called acl203. Policy for this class is set so that the queue reserved for it has a maximum packet limit of 40.

```
policy-map policy11
 class acl203
  bandwidth 2000
  queue-limit 40
```

Related Commands

Command	Description
bandwidth	Specifies or modifies the bandwidth allocated for a class belonging to a policy map
class (policy-map)	Specifies the name of the class whose policy you want to create or change, and the default class (commonly known as the class-default class) before you configure its policy.
class class-default	Specifies the default traffic class whose bandwidth is to be configured or modified.
policy-map	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy.

queue-list default

To assign a priority queue for those packets that do not match any other rule in the queue list, use the **queue-list default** global configuration command. To restore the default value, use the **no** form of this command.

queue-list *list-number* **default** *queue-number*

no queue-list *list-number* **default** *queue-number*

Syntax Description

list-number	Number of the queue list. Any number from 1 to 16 that identifies the queue list.
queue-number	Number of the queue. Any number from 1 to 16.

Defaults

This command is disabled by default.

The default number of the queue list is queue number 1.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.

Usage Guidelines

When you use multiple rules, remember that the system reads the **queue-list** commands in order of appearance. When classifying a packet, the system searches the list of rules specified by **queue-list** commands for a matching protocol or interface type. When a match is found, the system assigns the packet to the appropriate queue. The system searches the list in the order specified, and the first matching rule terminates the search.

Queue number 0 is a system queue. It is emptied before any of the other queues are processed. The system enqueues high-priority packets, such as keepalives, to this queue.

Use the **show interfaces** command to display the current status of the output queues.

Examples

In the following example, the default queue for list 10 is set to queue number 2:

```
queue-list 10 default 2
```

Related Commands

Command	Description
custom-queue-list	Assigns a custom queue list to an interface.
queue-list interface	Establishes queueing priorities on packets entering on an interface.
queue-list protocol	Establishes queueing priority based on the protocol type.
queue-list queue byte-count	Specifies how many bytes the system allows to be delivered from a given queue during a particular cycle.
queue-list queue limit	Designates the queue length limit for a queue.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

queue-list interface

To establish queueing priorities on packets entering on an interface, use the **queue-list interface** global configuration command. To remove an entry from the list, use the **no** form of this command.

queue-list *list-number* **interface** *interface-type interface-number queue-number*

no queue-list *list-number* **interface** *interface-type interface-number queue-number*

Syntax Description

list-number	Number of the queue list. Any number from 1 to 16 that identifies the queue list.
interface-type	Type of the interface.
interface-number	Number of the interface.
queue-number	Number of the queue. Any number from 1 to 16.

Defaults

No queueing priorities are established.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.

Usage Guidelines

When you use multiple rules, remember that the system reads the **queue-list** commands in order of appearance. When classifying a packet, the system searches the list of rules specified by **queue-list** commands for a matching protocol or interface type. When a match is found, the system assigns the packet to the appropriate queue. The list is searched in the order specified, and the first matching rule terminates the search.

Examples

In the following example, queue list 4 establishes queueing priorities for packets entering on interface tunnel 3. The queue number assigned is 10.

```
queue-list 4 interface tunnel 3 10
```

Related Commands

Command	Description
custom-queue-list	Assigns a custom queue list to an interface.
queue-list default	Assigns a priority queue for those packets that do not match any other rule in the queue list.
queue-list protocol	Establishes queueing priority based on the protocol type.
queue-list queue byte-count	Specifies how many bytes the system allows to be delivered from a given queue during a particular cycle.
queue-list queue limit	Designates the queue length limit for a queue.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

queue-list lowest-custom

To set the lowest number for a queue to be treated as a custom queue, use the **queue-list lowest-custom** command in global configuration mode. To restore the default value, use the **no** form of this command.

queue-list *list-number* **lowest-custom** *queue-number*

no queue-list *list-number* **lowest-custom** *queue-number*

Syntax Description

list-number	Number of the queue list. Any number from 1 to 16 that identifies the queue list.
queue-number	Number of the queue. Any number from 1 to 16.

Defaults

The default number of the lowest custom queue is 1.

Command Modes

Global configuration

Command History

Release	Modification
11.0	This command was introduced.

Usage Guidelines

All queues from queue 0 to the queue prior to the one specified in the **queue-list lowest-custom** command use the priority queue. (Queue 0 has the highest priority.)

All queues from the one specified in the **queue-list lowest-custom** command to queue 16 use a round-robin scheduler.

Use the **show queueing custom** command to display the current custom queue configuration.

Examples

In the following example, the lowest custom value is set to 2 for queue list 4:

```
queue-list 4 lowest-custom 2
```

Related Commands

Command	Description
custom-queue-list	Assigns a custom queue list to an interface.
queue-list interface	Establishes queueing priorities on packets entering on an interface.
queue-list protocol	Establishes queueing priority based on the protocol type.
queue-list queue byte-count	Specifies how many bytes the system allows to be delivered from a given queue during a particular cycle.
queue-list queue limit	Designates the queue length limit for a queue.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

queue-list protocol

To establish queueing priority based upon the protocol type, use the **queue-list protocol** global configuration command. To remove an entry from the list, use the **no** form of this command.

queue-list *list-number* **protocol** *protocol-name queue-number queue-keyword keyword-value*

no queue-list *list-number* **protocol** *protocol-name queue-number queue-keyword keyword-value*

Syntax Description

list-number	Number of the queue list. Any number from 1 to 16.
protocol-name	Protocol type: **aarp**, **apollo**, **appletalk**, **arp**, **bridge** (transparent), **clns**, **clns_es**, **clns_is**, **cmns**, **compressedtcp**, **decnet**, **decnet_node**, **decnet_routerl1**, **decnet_routerl2**, **dlsw**, **ip**, **ipx**, **pad**, **rsrb**, **stun**, **vines**, **xns**, and **x25**.
queue-number	Number of the queue. Any number from 1 to 16.
queue-keyword keyword-value	Possible keywords are **fragments, gt, list, lt, tcp**, and **udp**. See Table 10 from the **priority-list protocol** command.

Defaults

No queueing priorities are established.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.

Usage Guidelines

When you use multiple rules for a single protocol, remember that the system reads the **queue-list** commands in order of appearance. When classifying a packet, the system searches the list of rules specified by **queue-list** commands for a matching protocol. When a match is found, the system assigns the packet to the appropriate queue. The system searches the list in the order specified, and the first matching rule terminates the search.

The **decnet_router-l1** keyword refers to the multicast address for all level 1 routers, which are intra-area routers, and the **decnet_router-l2** keyword refers to all level 2 routers, which are interarea routers.

The **dlsw**, **rsrb**, and **stun** keywords refer only to direct encapsulation.

Use Table 10, Table 11, and Table 12 in the **priority-list protocol** command section to configure the queueing priorities for your system.

Examples

The following example assigns 1 as the custom queue list, specifies DECnet as the protocol type, and assigns 3 as a queue number to the packets sent on this interface:

```
queue-list 1 protocol decnet 3
```

The following example assigns DECnet packets with a size greater than 200 bytes to queue number 2:

```
queue-list 2 protocol decnet 2 gt 200
```

The following example assigns DECnet packets with a size less than 200 bytes to queue number 2:

```
queue-list 4 protocol decnet 2 lt 200
```

The following example assigns traffic that matches IP access list 10 to queue number 1:

```
queue-list 1 protocol ip 1 list 10
```

The following example assigns Telnet packets to queue number 2:

```
queue-list 4 protocol ip 2 tcp 23
```

The following example assigns User Datagram Protocol (UDP) Domain Name Service packets to queue number 2:

```
queue-list 4 protocol ip 2 udp 53
```

The following example assigns traffic that matches Ethernet type code access list 201 to queue number 1:

```
queue-list 1 protocol bridge 1 list 201
```

Related Commands

Command	Description
custom-queue-list	Assigns a custom queue list to an interface.
queue-list default	Assigns a priority queue for those packets that do not match any other rule in the queue list.
queue-list queue byte-count	Specifies how many bytes the system allows to be delivered from a given queue during a particular cycle.
queue-list queue limit	Designates the queue length limit for a queue.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

queue-list queue byte-count

To specify how many bytes the system allows to be delivered from a given queue during a particular cycle, use the **queue-list queue byte-count** global configuration command. To return the byte count to the default value, use the **no** form of this command.

queue-list *list-number* **queue** *queue-number* **byte-count** *byte-count-number*

no queue-list *list-number* **queue** *queue-number* **byte-count** *byte-count-number*

Syntax Description

list-number	Number of the queue list. Any number from 1 to 16.
queue-number	Number of the queue. Any number from 1 to 16.
byte-count-number	The average number of bytes the system allows to be delivered from a given queue during a particular cycle.

Defaults

This command is not enabled by default.

The default byte count is 1500 bytes.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.

Examples

In the following example, queue list 9 establishes the byte count as 1400 for queue number 10:

```
queue-list 9 queue 10 byte-count 1400
```

Related Commands

Command	Description
custom-queue-list	Assigns a custom queue list to an interface.
queue-list default	Assigns a priority queue for those packets that do not match any other rule in the queue list.
queue-list interface	Establishes queueing priorities on packets entering on an interface.
queue-list protocol	Establishes queueing priority based on the protocol type.
queue-list queue byte-count	Specifies how many bytes the system allows to be delivered from a given queue during a particular cycle.
queue-list queue limit	Designates the queue length limit for a queue.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

queue-list queue limit

To designate the queue length limit for a queue, use the **queue-list queue limit** global configuration command. To return the queue length to the default value, use the **no** form of this command.

queue-list *list-number* **queue** *queue-number* **limit** *limit-number*

no queue-list *list-number* **queue** *queue-number* **limit** *limit-number*

Syntax Description

list-number	Number of the queue list. Any number from 1 to 16.
queue-number	Number of the queue. Any number from 1 to 16.
limit-number	Maximum number of packets that can be enqueued at any time. The range is from 0 to 32767 queue entries. A value of 0 means that the queue can be of unlimited size.

Defaults

The default queue length limit is 20 entries.

Command Modes

Global configuration

Command History

Release	Modification
10.0	This command was introduced.

Examples

In the following example, the queue length of queue 10 is increased to 40:

```
queue-list 5 queue 10 limit 40
```

Related Commands

Command	Description
custom-queue-list	Assigns a custom queue list to an interface.
queue-list default	Assigns a priority queue for those packets that do not match any other rule in the queue list.
queue-list interface	Establishes queueing priorities on packets entering on an interface.
queue-list protocol	Establishes queueing priority based on the protocol type.
queue-list queue byte-count	Specifies how many bytes the system allows to be delivered from a given queue during a particular cycle.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

random-detect dscp

To change the minimum and maximum packet thresholds for the differentiated services code point (DSCP) value, use the **random-detect dscp** interface configuration command. To return the minimum and maximum packet thresholds to the default for the DSCP value, use the **no** form of this command.

random-detect dscp *dscpvalue min-threshold max-threshold* [*mark-probability-denominator*]

no random-detect dscp *dscpvalue min-threshold max-threshold* [*mark-probability-denominator*]

Syntax Description

dscpvalue	Specifies the DSCP value. The DSCP value can be a number from 0 to 63, or it can be one of the following keywords: **ef**, **af11**, **af12**, **af13**, **af21**, **af22**, **af23**, **af31**, **af32**, **af33**, **af41**, **af42**, **af43**, **cs1**, **cs2**, **cs3**, **cs4**, **cs5**, or **cs7**.
min-threshold	Minimum threshold in number of packets. The value range of this argument is from 1 to 4096. When the average queue length reaches the minimum threshold, Weighted Random Early Detection (WRED) randomly drops some packets with the specified DSCP value.
max-threshold	Maximum threshold in number of packets. The value range of this argument is from the value of the *min-threshold* argument to 4096. When the average queue length exceeds the maximum threshold, WRED drops all packets with the specified DSCP value.
mark-probability-denominator	(Optional) Denominator for the fraction of packets dropped when the average queue depth is at the maximum threshold. For example, if the denominator is 512, 1 out of every 512 packets is dropped when the average queue is at the maximum threshold. The value range is from 1 to 65536. The default is 10; 1 out of every 10 packets is dropped at the maximum threshold.

Defaults

If WRED is using the DSCP value to calculate the drop probability of a packet, all entries of the DSCP table are initialized with the default settings shown in Table 14 in the "Usage Guidelines" section of this command.

Command Modes

Interface configuration

Command History

Release	Modification
12.1(5)T	This command was introduced.

Usage Guidelines

The **random-detect dscp** command allows you to specify the DSCP value. The DSCP value can be a number from 0 to 63, or it can be one of the following keywords: **ef**, **af11**, **af12**, **af13**, **af21**, **af22**, **af23**, **af31**, **af32**, **af33**, **af41**, **af42**, **af43**, **cs1**, **cs2**, **cs3**, **cs4**, **cs5**, or **cs7**.

This command must be used in conjunction with the **random-detect** (interface) command.

Additionally, the **random-detect dscp** command is available only if you specified the *dscp-based* argument when using the **random-detect** (interface) command.

Table 14 lists the default settings used by the **random-detect dscp** command for the DSCP value specified. Table 14 lists the DSCP value, and its corresponding minimum threshold, maximum threshold, and mark probability. The last row of the table (the row labeled "default") shows the default settings used for any DSCP value not specifically shown in the table.

Table 14 random-detect dscp Default Settings

DSCP (Precedence)	Minimum Threshold	Maximum Threshold	Mark Probability
af11	32	40	1/10
af12	28	40	1/10
af13	24	40	1/10
af21	32	40	1/10
af22	20	40	1/10
af23	24	40	1/10
af31	32	40	1/10
af32	28	40	1/10
af33	24	40	1/10
af41	32	40	1/10
af42	28	40	1/10
af43	24	40	1/10
cs1	22	40	1/10
cs2	24	40	1/10
cs3	26	40	1/10
cs4	28	40	1/10
cs5	30	40	1/10
cs6	32	40	1/10
cs7	34	40	1/10
ef	36	40	1/10
rsvp	36	40	1/10
default	20	40	1/10

Examples

The following example enables WRED to use the DSCP value af22. The minimum threshold for DSCP value af22 is 20, the maximum threshold is 40, and the mark probability is 10.

```
random-detect dscp af22 20 40 10
```

Related Commands

Command	Description
random-detect (interface)	Enables WRED or DWRED.
show queueing	Lists all or selected configured queueing strategies.
show queueing interface	Displays the queueing statistics of an interface or VC.

random-detect (interface)

To enable Weighted Random Early Detection (WRED) or distributed WRED (DWRED), use the **random-detect** interface configuration command. To configure WRED as class policy in a policy map, use the **random-detect** interface and policy-map class configuration command. To disable WRED or DWRED, use the **no** form of this command.

random-detect [*dscp-based* | *prec-based*]

no random-detect [*dscp-based* | *prec-based*]

Syntax Description

dscp-based	(Optional) Specifies that WRED is to use the differentiated services code point (DSCP) value when it calculates the drop probability for a packet.
prec-based	(Optional) Specifies that WRED is to use the IP Precedence value when it calculates the drop probability for a packet.

Defaults

WRED and DWRED are disabled by default.

If you choose not to use either the *dscp-based* or the *prec-based* argument, WRED uses the IP Precedence value (the default method) to calculate drop probability for the packet.

Command Modes

Interface configuration when used on an interface

Policy-map class configuration when used to specify class policy in a policy map

Command History

Release	Modification
11.1 CC	This command was introduced.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T. Arguments were added to support Differentiated Services (DiffServ) and Assured Forwarding (AF) Per Hop Behavior (PHB).

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. DWRED is similar to WRED but uses the Versatile Interface Processor (VIP) instead of the Route Switch Processor (RSP). WRED and DWRED are most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

The router automatically determines parameters to use in the WRED calculations. To change these parameters, use the **random-detect precedence** command.

The DWRED feature is supported only on Cisco 7000 series routers with an RSP7000 card and Cisco 7500 series routers with a VIP2-40 or greater interface processor. A VIP2-50 interface processor is strongly recommended when the aggregate line rate of the port adapters on the VIP is greater than DS3. A VIP2-50 interface processor is required for OC-3 rates.

To use DWRED, distributed Cisco Express Forwarding (dCEF) switching must first be enabled on the interface. For more information on dCEF, refer to the *Cisco IOS Switching Services Configuration Guide* and the *Cisco IOS Switching Services Command Reference*.

WRED in a Policy Map

You can configure WRED as part of the policy for a standard class or the default class. The WRED **random-detect** command and the weighted fair queueing (WFQ) **queue-limit** command are mutually exclusive for class policy. If you configure WRED, its packet drop capability is used to manage the queue when packets exceeding the configured maximum count are enqueued. If you configure the WFQ **queue-limit** command for class policy, tail drop is used.

To configure a policy map and create class policies, use the **policy-map** and **class** (policy-map) commands. When specifying class policy within a policy map, you can use the **random-detect** command with either of the following commands:

- **bandwidth** (policy-map class)
- **fair-queue** (class-default)—for the default class only

Note that if you use WRED packet drop instead of tail drop for one or more classes composing a policy map, you must ensure that WRED is not configured for the interface to which you attach that service policy.

The DWRED feature is not supported for class policy.

Two Methods for Calculating the Drop Probability of a Packet

This command includes two optional arguments, *dscp-based* and *prec-based*, that determine the method WRED uses to calculate the drop probability of a packet.

Note the following points when deciding which method to instruct WRED to use:

- With the *dscp-based* argument, WRED uses the DSCP value (that is, the first six bits of the IP type of service (ToS) byte) to calculate the drop probability.
- With the *prec-based* argument, WRED will use the IP Precedence value to calculate the drop probability.
- The *dscp-based* and *prec-based* arguments are mutually exclusive.
- If neither argument is specified, WRED uses the IP Precedence value to calculate the drop probability (the default method).

Examples

The following example configures WRED on the High-Speed Serial Interface (HSSI) 0/0/0 interface:

```
interface Hssi0/0/0
 random-detect
```

The following example configures the policy map called policy1 to contain policy specification for the class called class1. During times of congestion, WRED packet drop is used instead of tail drop.

```
! The following commands create the class map called class1:
class-map class1
 match input-interface FE0/1

! The following commands define policy1 to contain policy specification for class1:
policy-map policy1
 class class1
  bandwidth 1000
  random-detect
```

The following example enables WRED to use the DSCP value 8. The minimum threshold for the DSCP value 8 is 24 and the maximum threshold is 40. This configuration was performed at the interface level.

```
Router(config-if)# interface seo/0
Router(config-if)# random-detect dscp-based
Router(config-if)# random-detect dscp 8 24 40
```

The following example enables WRED to use the DSCP value 8 for class c1. The minimum threshold for DSCP value 8 is 24 and the maximum threshold is 40. The last line attaches the service policy to the output interface or virtual circuit (VC) p1.

```
Router(config-if)# class-map c1
Router(config-cmap)# match access-group 101
Router(config-if)# policy-map p1
Router(config-pmap)# class c1
Router(config-pmap-c)# bandwidth 48
Router(config-pmap-c)# random-detect dscp-based
Router(config-pmap-c)# random-detect dscp 8 24 40
Router(config-if)# service-policy output p1
```

Related Commands

Command	Description
random-detect dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
random-detect exponential-weighting-constant	Configures the WRED and DWRED exponential weight factor for the average queue size calculation.
random-detect flow	Enables flow-based WRED.
random-detect precedence	Configures WRED and DWRED parameters for a particular IP Precedence.
show interfaces	Displays statistics for all interfaces configured on the router or access server.
show queueing	Lists all or selected configured queueing strategies.
show tech-support rsvp	Generates a report of all RSVP-related information.

random-detect (per VC)

To enable per-virtual circuit (VC) Weighted Random Early Detection (WRED) or per-VC VIP-distributed WRED (DWRED), use the **random-detect** VC submode command. To disable per-VC WRED and per-VC DWRED, use the **no** form of this command.

random-detect [**attach** *group-name*]

no random-detect [**attach** *group-name*]

Syntax Description

attach *group-name*	(Optional) The name of the WRED or DWRED group.

Defaults

WRED and DWRED are disabled by default.

Command Modes

VC submode

Command History

Release	Modification
12.0(3)T	This command was introduced.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. DWRED is similar to WRED but uses the Versatile Interface Processor (VIP) instead of the Route Switch Processor (RSP). WRED and DWRED are most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

WRED and DWRED are configurable at the interface and per-VC levels. The VC-level WRED or DWRED configuration will override the interface-level configuration if WRED or DWRED is also configured at the interface level.

Use this command to configure a single ATM VC or a VC that is a member of a bundle.

Note the following points when using the **random-detect** (per VC) command:

- If you use this command without the optional **attach** keyword, default WRED or DWRED parameters (such as minimum and maximum thresholds) are used.
- If you use this command with the optional **attach** keyword, the parameters defined by the specified WRED or DWRED parameter group are used. (WRED or DWRED parameter groups are defined through the **random-detect-group** command.) If the specified WRED or DWRED group does not exist, the VC is configured with default WRED or DWRED parameters.

When this command is used to configure an interface-level WRED or DWRED group to include per-VC WRED or DWRED as a drop policy, the configured WRED or DWRED group parameters are inherited under the following conditions:

- All existing VCs—including Resource Reservation Protocol (RSVP) switched virtual circuits (SVCs) that are not specifically configured with a VC-level WRED or DWRED group—will inherit the interface-level WRED or DWRED group parameters.
- Except for the VC used for signalling and the Interim Local Management Interface (ILMI) VC, any VCs created after the configuration of an interface-level DWRED group will inherit the parameters.

When an interface-level WRED or DWRED group configuration is removed, per-VC WRED or DWRED parameters are removed from any VC that inherited them from the configured interface-level WRED or DWRED group.

When an interface-level WRED or DWRED group configuration is modified, per-VC WRED or DWRED parameters are modified accordingly if the WRED or DWRED parameters were inherited from the configured interface-level WRED or DWRED group configuration.

This command is only supported on interfaces that are capable of VC-level queueing. The only currently supported interface is the Enhanced ATM port adapter (PA-A3).

The DWRED feature is only supported on Cisco 7000 series routers with an RSP7000 card and Cisco 7500 series routers with a VIP2-40 or greater interface processor. A VIP2-50 interface processor is strongly recommended when the aggregate line rate of the port adapters on the VIP is greater than DS3. A VIP2-50 interface processor is required for OC-3 rates.

To use DWRED, distributed Cisco Express Forwarding (dCEF) switching must first be enabled on the interface. For more information on dCEF, refer to the *Cisco IOS Switching Services Configuration Guide* and the *Cisco IOS Switching Services Command Reference*.

Examples

The following example configures per-VC WRED for the permanent virtual circuit (PVC) called cisco. Because the **attach** keyword was not used, WRED uses default parameters.

```
pvc cisco 46
 random-detect
```

The following example creates a DWRED group called Rome and then applies the parameter group to an ATM PVC:

```
! The following commands create the DWRED parameter group Rome:
random-detect-group Rome
 precedence rsvp 46 50 10
 precedence 1 32 50 10
 precedence 2 34 50 10
 precedence 3 36 50 10
 precedence 4 38 50 10
 precedence 5 40 50 10
 precedence 6 42 50 10
 precedence 7 44 50 10
 exit
exit
```

```
! The following commands create a PVC on an ATM interface and then apply the
! DWRED group Rome to that PVC:
interface ATM2/0.23 point-to-point
 ip address 10.9.23.10 255.255.255.0
 no ip mroute-cache
 pvc vc1 201/201
  random-detect attach Rome
  vbr-nrt 2000 1000 200
  encapsulation aal5snap
```

The following **show queueing** command displays the current settings for each of the IP Precedences following configuration of per-VC DWRED:

```
Router# show queueing random-detect interface atm2/0.23 vc 201/201

random-detect group Rome:

exponential weight 9
class    min-threshold    max-threshold    mark-probability
------------------------------------------------------------

0        30               50               1/10
1        32               50               1/10
2        34               50               1/10
3        36               50               1/10
4        38               50               1/10
5        40               50               1/10
6        42               50               1/10
7        44               50               1/10
rsvp     46               50               1/10
```

Related Commands

Command	Description
class (policy-map)	Specifies the name of the class whose policy you want to create or change, and the default class (commonly known as the class-default class) before you configure its policy.
random-detect exponential-weighting-constant	Configures the WRED and DWRED exponential weight factor for the average queue size calculation.
random-detect-group	Defines the WRED or DWRED parameter group.
random-detect precedence	Configures WRED and DWRED parameters for a particular IP Precedence.
show interfaces	Displays the statistical information specific to a serial interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

random-detect exponential-weighting-constant

To configure the Weighted Random Early Detection (WRED) and distributed WRED (DWRED) exponential weight factor for the average queue size calculation for the queue, use the **random-detect exponential-weighting-constant** interface configuration command. To configure the exponential weight factor for the average queue size calculation for the queue reserved for a class, use the **random-detect exponential-weighting-constant** policy-map class configuration command. To return the value to the default, use the **no** form of this command.

random-detect exponential-weighting-constant *exponent*

no random-detect exponential-weighting-constant

Syntax Description

exponent	Exponent from 1 to 16 used in the average queue size calculation.

Defaults

The default exponential weight factor is 9.

Command Modes

Interface configuration when used on an interface

Policy-map class configuration when used to specify class policy in a policy map, or when used in the Modular Quality of Service Command-Line Interface (MQC)

Command History

Release	Modification
11.1 CC	This command was introduced.
12.0(5)T	This command was made available as a policy-map class configuration command.
12.0(5)XE	This command was integrated into Cisco IOS Release 12.0(5)XE. Support for VIP-enabled Cisco 7500 series routers was added.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T. Support for VIP-enabled Cisco 7500 series routers was added.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. DWRED is similar to WRED but uses the Versatile Interface Processor (VIP) instead of the Route Switch Processor (RSP). WRED and DWRED are most useful with protocols like TCP that respond to dropped packets by decreasing the transmission rate.

Use this command to change the exponent used in the average queue size calculation for the WRED and DWRED services. You can also use this command to configure the exponential weight factor for the average queue size calculation for the queue reserved for a class

Note The default WRED or DWRED parameter values are based on the best available data. We recommend that you do not change the parameters from their default values unless you have determined that your applications would benefit from the changed values.

The DWRED feature is not supported for class policy.

The DWRED feature is only supported on Cisco 7000 series routers with an RSP7000 card and Cisco 7500 series routers with a VIP2-40 or greater interface processor. A VIP2-50 interface processor is strongly recommended when the aggregate line rate of the port adapters on the VIP is greater than DS3. A VIP2-50 interface processor is required for OC-3 rates.

To use DWRED, distributed Cisco Express Forwarding (dCEF) switching must first be enabled on the interface. For more information on dCEF, refer to the *Cisco IOS Switching Services Configuration Guide* and the *Cisco IOS Switching Services Command Reference*.

Examples

The following example configures WRED on an interface with a weight factor of 10:

```
interface Hssi0/0/0
 description 45Mbps to R1
 ip address 10.200.14.250 255.255.255.252
 random-detect
 random-detect exponential-weighting-constant 10
```

The following example configures the policy map called policy1 to contain policy specification for the class called class1. During times of congestion, WRED packet drop is used instead of tail drop. The weight factor used for the average queue size calculation for the queue for class1 is 12.

```
! The following commands create the class map called class1:
class-map class1
 match input-interface FE0/1

! The following commands define policy1 to contain policy specification for class1:
policy-map policy1
 class class1
 bandwidth 1000
 random-detect
 random-detect exponential-weighting-constant 12
```

The following example configures policy for a traffic class named int10 to configure the exponential weight factor as 12. This is the weight factor used for the average queue size calculation for the queue for traffic class int10. WRED packet drop is used for congestion avoidance for traffic class int10, not tail drop.

```
policy-map policy12
 class int10
 bandwidth 2000
 random-detect exponential-weighting-constant 12
```

Related Commands

Command	Description
bandwidth (policy-map class)	Specifies or modifies the bandwidth allocated for a class belonging to a policy map.
exponential-weighting-constant	Configures the exponential weight factor for the average queue size calculation for a WRED parameter group.
fair-queue (class-default)	Specifies the number of dynamic queues to be reserved for use by the class-default class as part of the default class policy.
precedence (VC bundle)	Configures precedence levels for a VC class that can be assigned to a VC bundle and thus applied to all VC members of that bundle.
precedence (WRED group)	Configures a WRED group for a particular IP Precedence.
random-detect dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
random-detect (per VC)	Enables per-VC WRED or per-VC DWRED.
random-detect precedence	Configures WRED and DWRED parameters for a particular IP Precedence.
show policy-map	Displays the configuration of all classes for a specified service policy map or all classes for all existing policy maps.
show policy-map interface	Displays the configuration of all classes configured for all service policies on the specified interface or displays the classes for the service policy for a specific PVC on the interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

random-detect flow

To enable flow-based Weighted Random Early Detection (WRED), use the **random-detect flow** interface configuration command. To disable flow-based WRED, use the **no** form of this command.

random-detect flow

no random-detect flow

Syntax Description

This command has no arguments or keywords.

Defaults

Flow-based WRED is disabled by default.

Command Modes

Interface configuration

Command History

Release	Modification
12.0(3)T	This command was introduced.

Usage Guidelines

You must use this command to enable flow-based WRED before you can use the **random-detect flow average-depth-factor** and **random-detect flow count** commands to further configure the parameters of flow-based WRED.

Before you can enable flow-based WRED, you must enable and configure WRED. For complete information, refer to the *Cisco IOS Quality of Service Solutions Configuration Guide*.

Examples

The following example enables flow-based WRED on serial interface 1:

```
interface Serial1
 random-detect
 random-detect flow
```

Related Commands

Command	Description
random-detect dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
random-detect exponential-weighting-constant	Configures the WRED and DWRED exponential weight factor for the average queue size calculation.
random-detect flow average-depth-factor	Sets the multiplier to be used in determining the average depth factor for a flow when flow-based WRED is enabled.
random-detect flow count	Sets the flow count for flow-based WRED.
random-detect precedence	Configures WRED and DWRED parameters for a particular IP Precedence.
show interfaces	Displays the statistical information specific to a serial interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

random-detect flow average-depth-factor

To set the multiplier to be used in determining the average depth factor for a flow when flow-based Weighted Random Early Detection (WRED) is enabled, use the **random-detect flow average-depth-factor** interface configuration command. To remove the current flow average depth factor value, use the **no** form of this command.

random-detect flow average-depth-factor *scaling-factor*

no random-detect flow average-depth-factor *scaling-factor*

Syntax Description

scaling-factor	The numbers 2, 4, 8, or 16.

Defaults

The default average depth factor is 4.

Command Modes

Interface configuration

Command History

Release	Modification
12.0(3)T	This command was introduced.

Usage Guidelines

Use this command to specify the scaling factor that flow-based WRED should use in scaling the number of buffers available per flow and in determining the number of packets allowed in the output queue for each active flow. This scaling factor is common to all flows. The outcome of the scaled number of buffers becomes the per-flow limit.

If this command is not used and flow-based WRED is enabled, the average depth scaling factor defaults to 4.

A flow is considered nonadaptive—that is, it takes up too much of the resources—when the average flow depth times the specified multiplier (scaling factor) is less than the depth for the flow, for example:

average-flow-depth * (scaling factor) < flow-depth

Before you use this command, you must use the **random-detect flow** command to enable flow-based WRED for the interface. To configure flow-based WRED, you may also use the **random-detect flow count** command.

Examples

The following example enables flow-based WRED on serial interface 1 and sets the scaling factor for the average flow depth to 8:

```
interface Serial1
 random-detect
 random-detect flow
 random-detect flow average-depth-factor 8
```

Related Commands

Command	Description
random-detect dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
random-detect exponential-weighting-constant	Configures the WRED and DWRED exponential weight factor for the average queue size calculation.
random-detect flow	Enables flow-based WRED.
random-detect flow count	Sets the flow count for flow-based WRED.
random-detect precedence	Configures WRED and DWRED parameters for a particular IP Precedence.
show interfaces	Displays the statistical information specific to a serial interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

random-detect flow count

To set the flow count for flow-based Weighted Random Early Detection (WRED), use the **random-detect flow count** interface configuration command. To remove the current flow count value, use the **no** form of this command.

random-detect flow count *number*

no random-detect flow count *number*

Syntax Description

number	Specifies a value from 16 to 2^{15} (32768).

Defaults

256

Command Modes

Interface configuration

Command History

Release	Modification
12.0(3)T	This command was introduced.

Usage Guidelines

Before you use this command, you must use the **random-detect flow** command to enable flow-based WRED for the interface.

Examples

The following example enables flow-based WRED on serial interface 1 and sets the flow threshold constant to 16:

```
interface Serial1
 random-detect
 random-detect flow
 random-detect flow count 16
```

Related Commands

Command	Description
random-detect dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
random-detect exponential-weighting-constant	Configures the WRED and DWRED exponential weight factor for the average queue size calculation.
random-detect flow	Enables flow-based WRED.
random-detect precedence	Configures WRED and DWRED parameters for a particular IP Precedence.
show interfaces	Displays the statistical information specific to a serial interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.

random-detect-group

To define the Weighted Random Early Detection (WRED) or distributed WRED (DWRED) parameter group, use the **random-detect group** global configuration command. To delete the WRED or DWRED parameter group, use the **no** form of this command.

random-detect-group *group-name* [*dscp-based* | *prec-based*]

no random-detect-group *group-name* [*dscp-based* | *prec-based*]

Syntax Description

group-name	Name for the WRED or DWRED parameter group.
dscp-based	(Optional) Specifies that WRED is to use the differentiated services code point (DSCP) value when it calculates the drop probability for a packet.
prec-based	(Optional) Specifies that WRED is to use the IP Precedence value when it calculates the drop probability for a packet.

Defaults

No WRED or DWRED parameter group exists.

If you choose not to use either the *dscp-based* or the *prec-based* argument, WRED uses the IP Precedence value (the default method) to calculate drop probability for the packet.

Command Modes

Global configuration

Command History

Release	Modification
11.1(22)CC	This command was introduced.
12.1(5)T	This command was integrated into Cisco IOS Release 12.1(5)T. Arguments were added to support Differentiated Services (DiffServ) and Assured Forwarding (AF) Per Hop Behavior (PHB).

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when there is congestion. DWRED is similar to WRED but uses the Versatile Interface Processor (VIP) instead of the Route Switch Processor (RSP). WRED and DWRED are most useful when the traffic uses protocols such as TCP that respond to dropped packets by decreasing the transmission rate.

The router automatically determines parameters to use in the WRED calculations. If you want to change these parameters for a group, use the **exponential-weighting-constant** or **precedence** command.

Two Methods for Calculating the Drop Probability of a Packet

This command includes two optional arguments, *dscp-based* and *prec-based*, that determine the method WRED uses to calculate the drop probability of a packet.

Note the following points when deciding which method to instruct WRED to use:

- With the *dscp-based* argument, WRED uses the DSCP value (that is, the first six bits of the IP type of service (ToS) byte) to calculate the drop probability.
- With the *prec-based* argument, WRED will use the IP Precedence value to calculate the drop probability.
- The *dscp-based* and *prec-based* arguments are mutually exclusive.
- If neither argument is specified, WRED uses the IP Precedence value to calculate the drop probability (the default method).

Examples

The following example defines the WRED parameter group called sanjose:

```
random-detect-group sanjose
  precedence 0 32 256 100
  precedence 1 64 256 100
  precedence 2 96 256 100
  precedence 3 128 256 100
  precedence 4 160 256 100
  precedence 5 192 256 100
  precedence 6 224 256 100
  precedence 7 256 256 100
```

The following example enables WRED to use the DSCP value 9. The minimum threshold for the DSCP value 9 is 20 and the maximum threshold is 50. This configuration can be attached to other virtual circuits (VCs) as required.

```
Router(config)# random-detect-group sanjose dscp-based
Router(cfg-red-grp)# dscp 9 20 50
Router(config-subif-vc)# random-detect attach sanjose
```

Related Commands

Command	Description
dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
exponential-weighting-constant	Configures the exponential weight factor for the average queue size calculation for a WRED parameter group.
precedence (WRED group)	Configures a WRED group for a particular IP Precedence.
random-detect-group	Defines the WRED or DWRED parameter group.
show queueing	Lists all or selected configured queueing strategies.
show queueing interface	Displays the queueing statistics of an interface or VC.

random-detect precedence

To configure Weighted Random Early Detection (WRED) and distributed WRED (DWRED) parameters for a particular IP Precedence, use the **random-detect precedence** command in interface configuration mode. To configure WRED parameters for a particular IP Precedence for a class policy in a policy map, use the **random-detect precedence** command in policy-map class configuration mode. To return the values to the default for the precedence, use the **no** form of this command.

random-detect precedence {*precedence* | **rsvp**} *min-threshold max-threshold max-probability-denominator*

no random-detect precedence

Syntax Description

precedence	IP Precedence number. The value range is from 0 to 7. For Cisco 7000 series routers with an RSP7000 interface processor and Cisco 7500 series routers with a VIP2-40 interface processor (VIP2-50 interface processor strongly recommended), the precedence value range is from 0 to 7 only; see Table 15 in the "Usage Guidelines" section.
rsvp	Indicates Resource Reservation Protocol (RSVP) traffic.
min-threshold	Minimum threshold in number of packets. The value range of this argument is from 1 to 4096. When the average queue length reaches the minimum threshold, WRED randomly drops some packets with the specified IP Precedence.
max-threshold	Maximum threshold in number of packets. The value range of this argument is from the value of the *min-threshold* argument to 4096. When the average queue length exceeds the maximum threshold, WRED drops all packets with the specified IP Precedence.
max-probability-denominator	Denominator for the fraction of packets dropped when the average queue depth is at the maximum threshold. For example, if the denominator is 512, 1 out of every 512 packets is dropped when the average queue is at the maximum threshold. The value range is from 1 to 65536. The default is 10; 1 out of every 10 packets is dropped at the maximum threshold.

Command Default

For all precedences, the *max-probability-denominator* default is 10, and the *max-threshold* is based on the output buffering capacity and the transmission speed for the interface.

The default *min-threshold* depends on the precedence. The *min-threshold* for IP Precedence 0 corresponds to half of the *max-threshold*. The values for the remaining precedences fall between half the *max-threshold* and the *max-threshold* at evenly spaced intervals. See Table 15 in the "Usage Guidelines" section of this command for a list of the default minimum threshold values for each IP Precedence.

Command Modes

Interface configuration when used on an interface (config-if)
Policy-map class configuration when used to specify class policy in a policy map (config-pmap-c)

Command History

Release	Modification
11.1CC	This command was introduced.
12.2(28)SB	This command was integrated into Cisco IOS Release 12.2(28)SB.
12.2(33)SRA	This command was integrated into Cisco IOS Release 12.2(33)SRA.
12.2SX	This command is supported in the Cisco IOS Release 12.2SX train. Support in a specific 12.2SX release of this train depends on your feature set, platform, and platform hardware.
12.4(20)T	Support was added for hierarchical queueing framework (HQF) using the Modular Quality of Service (QoS) Command-Line Interface (CLI) (MQC). **Note** This command replaces the **random-detect prec-based** command in policy-map configuration.

Usage Guidelines

WRED is a congestion avoidance mechanism that slows traffic by randomly dropping packets when congestion exists. DWRED is similar to WRED but uses the Versatile Interface Processor (VIP) instead of the Route Switch Processor (RSP).

When you configure the **random-detect** command on an interface, packets are given preferential treatment based on the IP Precedence of the packet. Use the **random-detect precedence** command to adjust the treatment for different precedences.

If you want WRED or DWRED to ignore the precedence when determining which packets to drop, enter this command with the same parameters for each precedence. Remember to use reasonable values for the minimum and maximum thresholds.

Note that if you use the **random-detect precedence** command to adjust the treatment for different precedences within class policy, you must ensure that WRED is not configured for the interface to which you attach that service policy.

Table 15 lists the default minimum threshold value for each IP Precedence.

Table 15 Default WRED and DWRED Minimum Threshold Values

	Minimum Threshold Value (Fraction of Maximum Threshold Value)	
IP Precedence	WRED	DWRED
0	9/18	8/16
1	10/18	9/16
2	11/18	10/16
3	12/18	11/16
4	13/18	12/16
5	14/18	13/16
6	15/18	14/16
7	16/18	15/16
RSVP	17/18	—

Note The default WRED or DWRED parameter values are based on the best available data. We recommend that you do not change the parameters from their default values unless you have determined that your applications would benefit from the changed values.

The DWRED feature is supported only on Cisco 7000 series routers with an RSP7000 card and Cisco 7500 series routers with a VIP2-40 or greater interface processor. A VIP2-50 interface processor is strongly recommended when the aggregate line rate of the port adapters on the VIP is greater than DS3. A VIP2-50 interface processor is required for OC-3 rates.

To use DWRED, distributed Cisco Express Forwarding (dCEF) switching must first be enabled on the interface. For more information on dCEF, refer to the *Cisco IOS IP Switching Configuration Guide* and the *Cisco IOS IP Switching Command Reference*.

Note The DWRED feature is not supported in a class policy.

Examples

The following example enables WRED on the interface and specifies parameters for the different IP Precedences:

```
interface Hssi0/0/0
 description 45Mbps to R1
 ip address 10.200.14.250 255.255.255.252
 random-detect
 random-detect precedence 0 32 256 100
 random-detect precedence 1 64 256 100
 random-detect precedence 2 96 256 100
 random-detect precedence 3 120 256 100
 random-detect precedence 4 140 256 100
 random-detect precedence 5 170 256 100
 random-detect precedence 6 290 256 100
 random-detect precedence 7 210 256 100
 random-detect precedence rsvp 230 256 100
```

The following example configures policy for a class called acl10 included in a policy map called policy10. Class acl101 has these characteristics: a minimum of 2000 kbps of bandwidth are expected to be delivered to this class in the event of congestion and a weight factor of 10 is used to calculate the average queue size. For congestion avoidance, WRED packet drop is used, not tail drop. IP Precedence is reset for levels 0 through 4.

```
policy-map policy10
class acl10
 bandwidth 2000
 random-detect
 random-detect exponential-weighting-constant 10
 random-detect precedence 0 32 256 100
 random-detect precedence 1 64 256 100
 random-detect precedence 2 96 256 100
 random-detect precedence 3 120 256 100
 random-detect precedence 4 140 256 100
```

Related Commands

Command	Description
bandwidth (policy-map class)	Specifies or modifies the bandwidth allocated for a class belonging to a policy map.
fair-queue (class-default)	Specifies the number of dynamic queues to be reserved for use by the class-default class as part of the default class policy.
random-detect dscp	Changes the minimum and maximum packet thresholds for the DSCP value.
random-detect (per VC)	Enables per-VC WRED or per-VC DWRED.
random-detect exponential-weighting-constant	Configures the WRED and DWRED exponential weight factor for the average queue size calculation.
random-detect flow count	Sets the flow count for flow-based WRED.
show policy-map interface	Displays the configuration of all classes configured for all service policies on the specified interface or displays the classes for the service policy for a specific PVC on the interface.
show queue	Displays the contents of packets inside a queue for a particular interface or VC.
show queueing	Lists all or selected configured queueing strategies.