APPENDIX A

Using MIBs

This chapter describes how to perform tasks on the Cisco 7200 Router.

Managing Router Physical Entities

The physical entity management feature of the Cisco 7200 SNMP implementation:

- Monitors and configures the status of field replaceable units (FRUs)
- Provides information about physical port to interface mappings
- Provides firmware and software information for chassis components

The entPhysicalTable enumerates the physical entities contained by the system. In addition, it classifies each physical entity into a vendor type and class.

Note The sample outputs and values that appear throughout this chapter are only examples of what you can view when using MIBs.

Mapping Information for ENTITY-MIB

Physical Entity Management MIBs

The following MIBs are used to manage physical entities on the Cisco 7200:

- CISCO-ENTITY-ASSET-MIB—Contains asset tracking information (ID PROM contents) for the physical entities listed in the entPhysicalTable of the ENTITY-MIB. The MIB provides device-specific information for physical entities, including orderable part number, serial number, manufacturing assembly number, and hardware, software, and firmware information.
- CISCO-ENTITY-FRU-CONTROL-MIB—Contains objects used to monitor and configure the administrative and operational status of field replaceable units (FRUs), such as power supplies that are listed in the entPhysicalTable of the ENTITY-MIB.
- CISCO-ENTITY-VENDORTYPE-OID-MIB—Contains the object identifiers (OIDs) for all physical entities in the router in the entPhysicalTable.
- CISCO-ENVMON-MIB—Contains information about the status of environmental sensors. For example, the MIB reports the chassis core inlet temperatures.
- ENTITY-MIB—Contains information for managing physical entities on the router. It also organizes the physical entities contained by a system into a tree, referred to as a containment tree. This tree describes the relationship of each physical entity to all others. The ENTITY-MIB contains the following tables:
  - The entPhysicalTable describes each physical component (entity) in the router. The table contains an entry for the top-level entity (the chassis) and for each entity in the chassis. Each entry provides information about that entity: its name, type, vendor, and a description, and describes how the entity fits into the hierarchy of chassis entities. Each entity is identified by a unique index (*entPhysicalIndex*) that is used to access information about the entity in this and other MIBs.

    The entPhysicalTable which contains two managed objects that describe a physical entity's relationship to its parent:

  - entPhysicalContainedIn – this object specifies the entPhysicalIndex of the physical entity representing this physical entity's parent; that is, the physical entity that contains this physical entity. For example, a physical entity representing a slot (within a chassis) typically contains a physical entity representing a card. The slot is the parent of the card.
  - entPhysicalParentRelPos – this object specifies an integer value that represents this physical entity's relationship relative to its parent. For example, a physical entity representing a slot will have an entPhysicalParentRelPos equal to the slot number of the physical slot it represents.
  - The entPhysicalContainsTable, which lists the children of each physical entity contained by the system. This table provides the management client with another view of the parent-child relationship between physical entities.

Mapping OLD-CISCO-CHASSIS-MIB to ENTITY-MIB

Use the ENTITY-MIB instead fo the OLD-CISCO-CHASSIS-MIB on the 7200 platform starting with the following releases:

- 12.3T
- 12.2SB

Serial numbers for the new port adapter hardware has been revised to be alphanumeric values instead of numeric values. As a result, all new hardware might display a zero (0) as cardSerial number in the OLD-CISCO-CHASSIS-MIB, including port adapters.

The key mappings for the OLD-CISCO-CHASSIS-MIB attributes are:

- CardType (integer value) -> entPhysicalVendorType (OID)
- cardSerial (integer value) -> entPhysicalSerialNum (String)
- cardSlotNumber -> entPhysicalContainedIn and entPhysicalParentRelPos

The difference between the ENTITY-MIB and the OLD-CISCO-CHASSIS-MIB is that the entity physical table in the ENTITY-MIB contains all physical entities supported in the router and the card table in the OLD-CISCO-CHASSIS-MIB only contains entries for the modules, such as the processor card and the port adapter which is in the router. The entity physical entry contains corresponding data for the cardType, cardSerial, and the cardSlotNumber objects which are in the card table entry of the OLD-CISCO-CHASSIS-MIB.

Entity Containment Tree

Each entity physical entry contains entPhysicalContainedIn and entPhysicalParentRelPos. The entire entity physical table represents a entity containment tree started from root, which is the chassis.

The following is a example of the entity containment tree for the C7200R which contains PA-A6-OC3MM in the PA slot 4. Each row has entPhysicalIndex, MIB variable, entPhysicalName, entPhysicalModelName, and entPhysicalVendorType (vendor OID) for the MIB variable.

Note Not all MIB objects in the entPhysicalentry are shown in this example.

Example A-1 Example of the Entity Containment Tree:

```
1 (cevChassis7204Vxr) : Chassis : CISCO7200 : 1.3.6.1.4.1.9.12.3.1.3.75
      2 (cevContainerSlot) : I/O and CPU Slot 0 : {} : 1.3.6.1.4.1.9.12.3.1.5.1
         7 (cevCpu7200Npeg1) : NPE-G1 0 : NPE-G1 : 1.3.6.1.4.1.9.12.3.1.9.5.56
            other entities conatined under the NPE-G1…
3 (cevContainerSlot) : PA Slot 1 : {} : 1.3.6.1.4.1.9.12.3.1.5.1
4 (cevContainerSlot) : PA Slot 2 : {} : 1.3.6.1.4.1.9.12.3.1.5.1
5 (cevContainerSlot) : PA Slot 3 : {} : 1.3.6.1.4.1.9.12.3.1.5.1
6 (cevContainerSlot) : PA Slot 4 : {} : 1.3.6.1.4.1.9.12.3.1.5.1
         30 (cevPaA6mmOc3) : module 4 : PA-A6-OC3MM= : 1.3.6.1.4.1.9.12.3.1.9.4.106
                  other entities info (i.e port) contained under PA-A6…
other entities contained under the CISCO7200…
```

Table A-1 lists the OLD-CISCO-CHASSIS-MIB variables and shows the equivalent MIB variable from the ENTITY-MIB and CISCO-ENTITY-EXT-MIB.

Table A-1 MIB Containment Information

Variables	OLD-CISCO-CHASSIS-MIB	Equivalent	MIB
Chassis cards			
	CardIndex	entPhysicalIndex	ENTITY-MIB
	CardType	entPhysicalVendorType	ENTITY-MIB
	CardDescr	entPhysicalDescr	ENTITY-MIB
	CardSerial	EntPhysicalSerialNum	ENTITY-MIB
	CardHwVersion	entPhysicalHardwareRev	ENTITY-MIB
	CardSwVersion	entPhysicalSoftwareRev	ENTITY-MIB
	CardSlotNumber		
	cardContainedByIndex	entPhysicalContainedIn	ENTITY-MIB
	CardSlots		
Chassis			
	ChassisId	entPhysicalSerialNum	ENTITY-MIB
	ChassisType	entPhysicalVendorType	ENTITY-MIB
	ChassisVersion	entPhysicalVendorType	ENTITY-MIB
	RomVersion	entPhysicalFirmwareRev	ENTITY-MIB
	RomSysVersion	entPhysicalSoftwareRev	ENTITY-MIB
	ProcessorRam	ceExtProcessorRam	CISCO-ENTITY-EXT-MIB
	NvRAMSize	ceExtNVRAMSize	CISCO-ENTITY-EXT-MIB
	NvRAMUsed	ceExtNVRAMUsed	CISCO-ENTITY-EXT-MIB
	ConfigRegister	ceExtConfigRegister	CISCO-ENTITY-EXT-MIB
	configRegNext	CeExtConfigRegNext	CISCO-ENTITY-EXT-MIB

Table A-2 lists the OLD-CISCO-CHASSIS-MIB card variables and shows the equivalent MIB variable from the ENTITY-MIB.

Table A-2 Interface Correlation for Chassis Cards

OLD-CISCO-CHASSIS-MIB	Description	Equivalent	MIB
CardIfIndex	ifIndex	entAliasMappingIdentifier	ENTITY-MIB
CardIfPortNumber	To identify the ports corresponding to a card		ENTITY-MIB
CardIfCardIndex	Used together with cardifindex for correlating cards with interface	entAliasMappingIdentifier	ENTITY-MIB

Performing Inventory Management

To obtain information about a particular physical entity in the Cisco 7200 Router walk through the entPhysicalTable in the ENTITY-MIB. The entPhysicalDescr gives a textual description of the entity. Using the entPhysicalIndex that corresponds to the description of the entity, you can obtain other parameters.

Notes about entPhysicalTable Entries

As you examine entries in the ENTITY-MIB entPhysicalTable, consider the following:

- entPhysicalIndex—Uniquely identifies each entity in the chassis. This index is also used to access information about the entity in other MIBs.
- entPhysicalContainedIn—Indicates the entPhysicalIndex of a component's parent entity.
- entPhysicalParentRelPos—Shows the relative position of same-type entities that have the same entPhysicalContainedIn value (for example, chassis slots).

Note The container is applicable if the physical entity class is capable of containing one or more removable physical entities. For example, each (empty or full) slot in a chassis will be modeled as a container. All removable physical entities should be modeled within a container entity, such as field-replaceable modules, fans, or power supplies.

The following output shows how the information from the MIB walk displays (this is only a section of the complete output):

```
entPhysicalDescr.1 = 7200 Chassis
entPhysicalDescr.2 = Chassis Slot
entPhysicalDescr.3 = Chassis Slot
entPhysicalDescr.4 = Chassis Slot
entPhysicalDescr.5 = Chassis Slot
entPhysicalDescr.6 = Chassis Slot
entPhysicalDescr.7 = Chassis Slot
entPhysicalDescr.8 = Power Supply Slot
entPhysicalDescr.9 = Power Supply Slot
entPhysicalDescr.10 = Network Service Engine 100 CPU Card
entPhysicalDescr.11 = Network Service Engine 100 Daughter Card
entPhysicalDescr.12 = Mistral EOBC
entPhysicalDescr.13 = GBIC Port Container
entPhysicalDescr.14 = 1000BaseSX
entPhysicalDescr.15 = Pinnacle GE
entPhysicalVendorType.1 = cevChassis7200
entPhysicalVendorType.2 = cevContainerSlot
entPhysicalVendorType.3 = cevContainerSlot
entPhysicalVendorType.4 = cevContainerSlot
entPhysicalVendorType.5 = cevContainerSlot
entPhysicalVendorType.6 = cevContainerSlot
entPhysicalVendorType.7 = cevContainerSlot
entPhysicalVendorType.8 = cevContainerC7200PowerSupplyBay
entPhysicalVendorType.9 = cevContainerC7200PowerSupplyBay
entPhysicalVendorType.10 = cevCpuC7200Nse100
entPhysicalVendorType.11 = cevC7200Nse100Db
entPhysicalVendorType.12 = cevPortFEIP
entPhysicalVendorType.13 = cevContainerGbic
entPhysicalVendorType.14 = cevMGBIC1000BaseSX
entPhysicalVendorType.15 = cevPortGe
entPhysicalContainedIn.1 = 0
entPhysicalContainedIn.2 = 1
```

```
entPhysicalContainedIn.3 = 1
entPhysicalContainedIn.4 = 1
entPhysicalContainedIn.5 = 1
entPhysicalContainedIn.6 = 1
entPhysicalContainedIn.7 = 1
entPhysicalContainedIn.8 = 1
entPhysicalContainedIn.9 = 1
entPhysicalContainedIn.10 = 2
entPhysicalContainedIn.11 = 10
entPhysicalContainedIn.12 = 10
entPhysicalContainedIn.13 = 10
entPhysicalContainedIn.14 = 13
entPhysicalContainedIn.15 = 14
.
.
.
```

Samples of ENTITY-MIB entPhysicalTable Entries

The output samples in this section show how information is stored in the entPhysicalTable. You can determine the Cisco 7200 Router configuration by examining entPhysicalTable entries. For example, the entPhysicalIndex = 1 corresponds to chassis type and the other information such as vendortype and physical class can be obtained by walking through the table.

Note The entPhysicalEntry.*entPhysicalIndex* uniquely identifies each entity in the chassis. Use this index to access information about the entity in other MIB tables.

entPhysicalTEntry.1

```
entPhysicalDescr.1 = 7200 Chassis
entPhysicalVendorType.1 = cevChassis7200
entPhysicalContainedIn.1 = 0
entPhysicalClass.1 = chassis(3)
entPhysicalParentRelPos.1 = -1
entPhysicalName.1 = 7200 Chassis
entPhysicalHardwareRev.1 = E
entPhysicalFirmwareRev.1 =
entPhysicalSoftwareRev.1 =
entPhysicalSerialNum.1 = SCA070400D8
entPhysicalMfgName.1 = Cisco Systems Inc
entPhysicalModelName.1 = 73-5916-02
entPhysicalAlias.1 =
entPhysicalAssetID.1 =
entPhysicalIsFRU.1 = true(1)
.
.
.
```

Table A-3 describes the configuration information that you can obtain from the sample entPhysicalEntry output for entPhysicalEntry.1 and entPhysicalEntry.11.

Table A-3 entPhysicalEntry Configuration Information

entPhysicalTEntries	entPhysicalTEntry Description
entPhysicalIndex = 1	Identifies the chassis type.
entPhysicalVendorType = cevChassis7200	An indication of the vendor-specific hardware type of the physical entity. An agent should set this object to a enterprise-specific registration identifier value indicating the specific equipment type in detail. The associated instance of entPhysicalClass is used to indicate the general type of hardware device (autonomous type). If no vendor-specific registration identifier exists for this physical entity or the value is unknown, then the value, 00, returns.
entPhysicalContainedIn = 0	An integer with a range value of 0 through 2147483647. The value of entPhysicalIndex for the physical entity which contains this physical entity. The container is applicable if the physical entity class is capable of containing one or more removable physical entities, possibly of different types. For example, each (empty or full) slot in a chassis will be modeled as a container. **Note** A value of zero indicates this physical entity is not contained in any other physical entity; therefore this is a chassis because the value is zero.
entPhysicalClass = chassis(3)	An indication of the general hardware type, such as a chassis and a module, of the physical entity. An agent should set this object to the standard enumeration value which most accurately indicates the general class of the physical entity or the primary class if there is more than one. If no appropriate standard registration identifier exists for this physical entity, then the value other(1) is returned. If the value is unknown by this agent, then the value unknown(2) is returned.

Table A-3 entPhysicalEntry Configuration Information (continued)

entPhysicalTEntries	entPhysicalTEntry Description
entPhysicalParentRelPos = -1	An integer with a range value of -1 through 2147483647. An indication of the relative position of this child component among all its sibling components. Sibling components are defined as entPhysicalEntries that share the same instance values of each of the entPhysicalContainedIn and entPhysicalClass objects. This object identifies the relative ordering for all sibling components of a particular parent (identified by the entPhysicalContainedIn instance in each sibling entry). This value should match any external labeling of the physical component if possible.
entPhysicalName = 7200 Chassis	The textual name of the physical entity. The value of this object should be the name of the component as assigned by the local device and should be suitable for use in commands entered at the device console. This might be a text name, such as `console' or a simple component number, for example, port or module number, such as 1, depending on the physical component naming syntax of the device. If there is no local name, or this object is otherwise not applicable, then this object contains a zero-length string.
entPhysicalHardwareRev = E	The vendor-specific hardware revision string for the physical entity. The preferred value is the hardware revision identifier actually printed on the component itself (if present).
entPhysicalFirmwareRev =	The vendor-specific firmware revision string for the physical entity. If no specific firmware programs are associated with the physical component, or this information is unknown to the agent, then this object will contain a zero-length string.
entPhysicalSoftwareRev =<*user input*>	The vendor-specific software revision string for the physical entity.
entPhysicalSerialNum = SCA070400D8	The vendor-specific serial number string for the physical entity.
entPhysicalMfgName = Cisco Systems Inc	The name of the manufacturer of this physical component.
entPhysicalModelName = 73-5916-02	The vendor-specific model name identifier string associated with this physical component. The preferred value is the customer-visible part number, which may be printed on the component itself.

Table A-3 entPhysicalEntry Configuration Information (continued)

entPhysicalTEntries	entPhysicalTEntry Description
entPhysicalAlias =	This object is an *alias* name for the physical entity as specified by a network manager, and provides a non-volatile *handle* for the physical entity. On the first instantiation of an physical entity, the value of entPhysicalAlias associated with that entity is set to the zero-length string. However, agent may set the value to a locally unique default value, instead of a zero-length string.
entPhysicalAssetID =	This object is a user-assigned asset tracking identifier for the physical entity as specified by a network manager, and provides non-volatile storage of this information. On the first instantiation of an physical entity, the value of entPhysicalAssetID associated with that entity is set to the zero-length string.
entPhysicalIsFRU = true(1)	This object indicates whether or not this physical entity is considered a field replaceable unit (FRU) by the vendor. This object contains the value true(1), therefore, this entPhysicalEntry identifies a field replaceable unit. **Note** For all entPhysicalEntries which represent components that are permanently contained within a field replaceable unit, the value false(2) should be returned for this object.

The following sample output illustrates a physical entity containment tree for a Cisco 7200 chassis containing a Cisco 7200 NSE-100 daughter card.

entPhysicalTEntry.11

```
entPhysicalDescr.11 = Network Service Engine 100 Daughter Card
entPhysicalVendorType.11 = cevC7200Nse100Db
entPhysicalContainedIn.11 = 10
entPhysicalClass.11 = module(9)
entPhysicalParentRelPos.11 = 1
entPhysicalName.11 = Network Service Engine 100 Daughter Card 0
entPhysicalHardwareRev.11 = 5.0
entPhysicalFirmwareRev.11 =
entPhysicalSoftwareRev.11 =
entPhysicalSerialNum.11 = CAT07050DSN
entPhysicalMfgName.11 = Cisco Systems Inc
entPhysicalModelName.11 = 73-5673-07
entPhysicalAlias.11 =
entPhysicalAssetID.11 =
entPhysicalIsFRU.11 = false(2)
.
.
.
```

Monitoring and Configuring FRU Status

View objects in the CISCO-ENTITY-FRU-CONTROL-MIB cefcModuleTable to determine the administrative and operational status of field replaceable units (FRU), such as power supplies:

- cefcModuleAdminStatus—The administrative state of the FRU. Use cefcModuleAdminStatus to enable or disable the FRU.
- cefcModuleOperStatus—The current operational state of the FRU.

Note Currently, the CISCO-ENTITY-FRU-CONTROL-MIB supports Cisco 7200. For additional MIB constraints, see the "CISCO-ENTITY-FRU-CONTROL-MIB" section on page 3-20.

The following example shows a cefcModuleTable entry for a Cisco 7200 card whose entPhysicalIndex is 9.

```
cefcModuleAdminStatus.9 = enabled(1)
cefcModuleOperStatus.9 = ok(2)
cefcModuleResetReason.9 = powerUp(2)
cefcModuleStatusLastChangeTime.9 = 3360
```

Generating SNMP Traps

This section provides information about the SNMP traps generated in response to events and conditions on the router, and describes how to identify which hosts are to receive traps.

- Identifying Hosts to Receive Traps
- Configuration Changes
- Environmental Conditions
- FRU Status Changes

Identifying Hosts to Receive Traps

You can use the CLI or SNMP to identify hosts to receive SNMP notifications and to specify the types of notifications they are to receive (traps or informs). For CLI instructions, see the "Enabling Notifications" section on page 4-2. To use SNMP to configure this information, use the following MIB objects:

Use SNMP-NOTIFICATION-MIB objects, including the following, to select target hosts and specify the types of notifications to generate for those hosts:

- snmpNotifyTable—Contains objects to select hosts and notification types:
  - snmpNotifyTag is an arbitrary octet string (a tag value) used to identify the hosts to receive SNMP notifications. Information about target hosts is defined in the snmpTargetAddrTable (SNMP-TARGET-MIB), and each host has one or more tag values associated with it. If a host in snmpTargetAddrTable has a tag value that matches this snmpNotifyTag value, the host is selected to receive the types of notifications specified by snmpNotifyType.
  - snmpNotifyType is the type of SNMP notification to send: trap(1) or inform(2).
- snmpNotifyFilterProfileTable and snmpNotifyFilterTable—Use objects in these tables to create notification filters to limit the types of notifications sent to target hosts.

Use SNMP-TARGET-MIB objects to configure information about the hosts to receive notifications:

- snmpTargetAddrTable—Transport addresses of hosts to receive SNMP notifications. Each entry provides information about a host address, including a list of tag values:
  - snmpTargetAddrTagList—A set of tag values associated with the host address. If a host's tag value matches snmpNotifyTag, the host is selected to receive the types of notifications defined by snmpNotifyType.
- snmpTargetParamsTable—SNMP parameters to use when generating SNMP notifications.

Use the notification enable objects in appropriate MIBs to enable and disable specific SNMP traps. For example, to generate mplsLdpSessionUp or mplsLdpSessionDown traps, the MPLS-LDP-MIB object mplsLdpSessionUpDownTrapEnable must be set to enabled(1).

Configuration Changes

If entity traps are enabled, the router generates an entConfigChange trap (ENTITY-MIB) when the information in any of the following tables changes (which indicates a change to the router configuration):

- entPhysicalTable
- entAliasMappingTable
- entPhysicalContainsTable

Note A management application that tracks configuration changes should occasionally check the value of entLastChangeTime (ENTITY-MIB) to detect any entConfigChange traps that were missed due to throttling or transmission loss.

Enabling Traps for Configuration Changes

To configure the router to generate an entConfigChange trap whenever its configuration changes, enter the following command from the CLI. Use the **no** form of the command to disable the traps.

```
Router(config)# snmp-server enable traps entity
Router(config)# no snmp-server enable traps entity
```

Environmental Conditions

The CISCO-ENVMON-MIB sends the following notifications to alert you to conditions detected by environmental sensors in the router:

- ciscoEnvMonShutdownNotification—Sent when the router is about to shut down.
- ciscoEnvMonTemperatureNotification—Sent when a temperature is outside its normal range.
- ciscoEnvMonRedundantSupplyNotification—Sent when a redundant Power Entry Module fails.

Enabling Environmental Traps

To configure the router to generate traps for environmental conditions, enter the following command from the CLI. Use the **no** form of the command to disable the traps.

```
Router(config)# snmp-server enable traps envmon
Router(config)# no snmp-server enable traps envmon
```

To enable environmental traps through SNMP, set the appropriate notification enable object to true(1). For example, ciscoEnvMonEnableShutdownNotification enables shutdown notifications. Disable the traps by setting the notification object to false(2).

FRU Status Changes

If FRU traps are enabled, the router generates the following traps in response to changes in the status of an FRU. See the CISCO-ENTITY-FRU-CONTROL-MIB for more information about these traps.

- cefcModuleStatusChange—The operational status (cefcModuleOperStatus) of an FRU changes.
- cefcFRUInserted—An FRU is inserted in the chassis. The trap indicates the entPhysicalIndex of the FRU and the container it was inserted in.
- cefcFRURemoved—An FRU is removed from the chassis. The trap indicates the entPhysicalIndex of the FRU and the container it was removed from.

Enabling FRU Traps

To configure the router to generate traps for FRU events, enter the following command from the CLI. Use the **no** form of the command to disable the traps.

```
Router(config)# snmp-server enable traps fru-ctrl
Router(config)# no snmp-server enable traps fru-ctrl
```

To enable FRU traps through SNMP, set cefcMIBEnableStatusNotification to true(1). Disable the traps by setting cefcMIBEnableStatusNotification to false(2).

Monitoring Router Interfaces

This section provides information about how to monitor the status of router interfaces to see if there is a problem or a condition that might affect service on the interface. To determine if an interface is down or experiencing problems, you can:

Check the Interface's Operational and Administrative Status

To check the status of an interface, view the following IF-MIB objects for the interface:

- ifAdminStatus—The administratively configured (desired) state of an interface. Use ifAdminStatus to enable or disable the interface.
- ifOperStatus—The current operational state of an interface.

Monitor linkDown and linkUp Traps

To determine if an interface has failed, you can monitor linkDown and linkUp traps for the interface. See the "Enabling Interface LinkUp/LinkDown Traps" section on page A-12 for instructions on how to enable these traps.

- linkDown—Indicates that an interface has failed or is about to fail.
- linkUp—Indicates that an interface is no longer in the Down state.

Enabling Interface LinkUp/LinkDown Traps

To configure SNMP to send a notification when a router interface changes state to Up (ready) or Down (not ready), perform the following steps to enable linkUp and linkDown traps:

Step 1 Issue the following CLI command to enable linkUp and linkDown traps for most, but not necessarily all, interfaces:

```
Router(config)# snmp-server enable traps snmp linkdown linkup
```

Step 2 View the setting of the ifLinkUpDownTrapEnable object (IF-MIB ifXTable) for each interface to determine if linkUp and linkDown traps are enabled or disabled for that interface.

Step 3 To enable linkUp and linkDown traps on an interface, set ifLinkUpDownTrapEnable to enabled(1). For information about how to configure the router to send linkDown traps only for the lowest layer of an interface, see the "SNMP Trap Filtering for linkDown Traps" section on page A-13.

Step 4 To enable the Internet Engineering Task Force (IETF) standard for linkUp and linkDown traps, issue the following command. (The IETF standard is based on RFC 2233.)

```
Router(config)# snmp-server trap link ietf
```

Step 5 To enable linkUp and linkDown traps on ATM subinterfaces, issue the following command:

```
Router(config)# snmp-server enable traps atm subif
```

Step 6 To enable linkUp and linkDown traps on an ATM permanent virtual circuit (PVC), issue the following commands. In the first command, **interval** specifies the minimum interval between successive traps, and **fail-interval** specifies the minimum interval for storing failed time stamps.

```
Router(config)# snmp-server enable traps atm pvc interval seconds fail-interval seconds
Router(config)# interface atm slot/subslot/port
Router(config-if)# pvc vpi/vci
Router(config-if-atm-vc)# oam-pvc manage
```

Step 7 To disable traps, use the **no** form of the appropriate command.

SNMP Trap Filtering for linkDown Traps

Use the SNMP trap filtering feature to filter linkDown traps so that SNMP sends a linkDown trap only if the main interface goes down. If an interfaces goes down, all of its subinterfaces go down, which results in numerous linkDown traps for each subinterface. This feature filters out those subinterface traps.

This feature is turned off by default. To enable the SNMP trap filtering feature, issue the following CLI command. Use the **no** form of the command to disable the feature.

```
[no] snmp ifmib trap throttle
```

Monitoring Quality of Service

This section provides an example of how to use SNMP to access QoS configuration information and statistics on the router. It contains the following sections:

Purpose and Benefits

Previously, the only way to access QoS configuration information and statistics was to enter **show** commands at the CLI.

With the enhanced management feature, you can use SNMP to access QoS configuration information and statistics on the router. This means that you can now collect and store QoS information for use in management applications. You can also use bulk-file transfer to copy the information to another system.

MIBs Used for QoS

- CISCO-CLASS-BASED-QOS-MIB

Configuring QoS

You configure QoS through the command line interface (CLI). For instructions, see the *Cisco 7200 Internet Series Router Software Configuration Guide*, "Configuring Quality of Service."

Accessing QoS Configuration Information and Statistics

The CISCO-CLASS-BASED-QOS-MIB provides access to QoS configuration information and statistics. Although you cannot use SNMP to configure QoS on the router, you can use SNMP to access QoS configuration information that has been configured through the CLI.

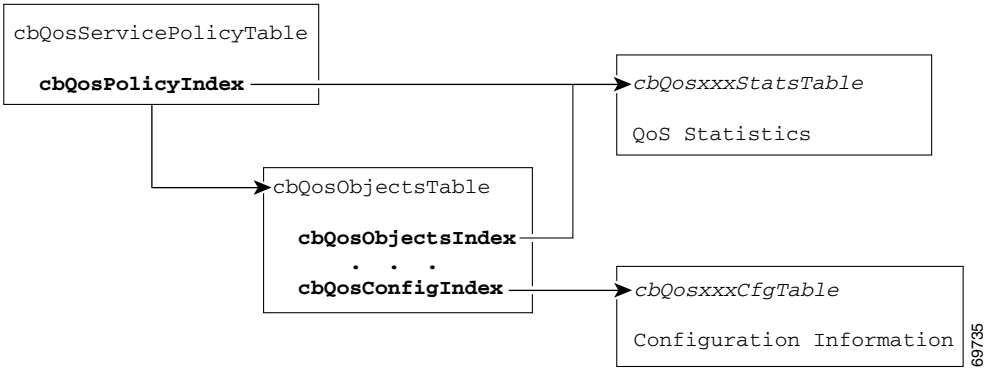
QoS Indexes

The indexes for accessing QoS configuration information and QoS statistics are:

- cbQosPolicyIndex—System-assigned index that identifies a policy map attached to an interface. (When attached to an interface, a policy map is known as a *service policy*.)
- cbQosObjectsIndex—System-assigned index that identifies each unique run-time instance of a QoS feature (for example, policy map, class map, match statement, and feature action).
- cbQosConfigIndex—System-assigned index that identifies each unique configuration of a QoS feature (for example, a class map or police action). Note that QoS objects with the same configuration share the same cbQosConfigIndex.
- cbQosREDValue—The IP precedence or IP differentiated services code point (DSCP) of a Weighted Random Early Detection (WRED) action. It is used as the index for configuration information and statistics for each RED class.

Figure A-1 shows how these indexes provide access to QoS configuration information and statistics.

Figure A-1 Cisco 7200 Router QoS Indexes



To access QoS configuration information and statistics for a particular QoS feature:

1. Look in cbQosServicePolicyTable and find the cbQosPolicyIndex assigned to the policy in which the feature is used.
2. Use cbQosPolicyIndex to access the cbQosObjectsTable, and find the cbQosObjectsIndex and cbQosConfigIndex assigned to the QoS feature.
   - Use cbQosConfigIndex to access configuration tables (cbQos*xxx*CfgTable) for information about the feature.
   - Use cbQosPolicyIndex and cbQosObjectsIndex to access QoS statistics tables (cbQos*xxx*StatsTable) for information about the QoS feature.

Sample QoS Configuration Settings

This section shows how QoS configuration settings are stored in CISCO-CLASS-BASED-QOS-MIB tables and shows information grouped by QoS object. However, the actual output of an SNMP query might show QoS information similar to the following. This is only a partial display of all QoS information.

7200# getmany -v3 10.86.0.94 test-user ciscoCBQosMIB

```
cbQosIfType.9583 = mainInterface(1)
cbQosIfType.9619 = mainInterface(1)
cbQosPolicyDirection.9583 = input(1)
cbQosPolicyDirection.9619 = output(2)
cbQosIfIndex.9583 = 3
cbQosIfIndex.9619 = 3
cbQosFrDLCI.9583 = 0
cbQosFrDLCI.9619 = 0
cbQosAtmVPI.9583 = 0
cbQosAtmVPI.9619 = 0
cbQosAtmVCI.9583 = 0
cbQosAtmVCI.9619 = 0
cbQosConfigIndex.9583.9583 = 9457
cbQosConfigIndex.9583.9585 = 9451
cbQosConfigIndex.9583.9587 = 9455
cbQosConfigIndex.9583.9589 = 9459
```

```
cbQosConfigIndex.9583.9591 = 9445
cbQosConfigIndex.9583.9593 = 9449
cbQosConfigIndex.9583.9595 = 9461
cbQosConfigIndex.9583.9597 = 1025
cbQosConfigIndex.9583.9599 = 1027
cbQosConfigIndex.9619.9619 = 9609
cbQosConfigIndex.9619.9621 = 9601
cbQosConfigIndex.9619.9623 = 9605
cbQosConfigIndex.9619.9625 = 9607
cbQosConfigIndex.9619.9627 = 9611
cbQosConfigIndex.9619.9629 = 1025
cbQosConfigIndex.9619.9631 = 1027
cbQosObjectsType.9583.9583 = policymap(1)
cbQosObjectsType.9583.9585 = classmap(2)
cbQosObjectsType.9583.9587 = matchStatement(3)
cbQosObjectsType.9583.9589 = police(7)
cbQosObjectsType.9583.9591 = classmap(2)
cbQosObjectsType.9583.9593 = matchStatement(3)
cbQosObjectsType.9583.9595 = police(7)
cbQosObjectsType.9583.9597 = classmap(2)
cbQosObjectsType.9583.9599 = matchStatement(3)
cbQosObjectsType.9619.9619 = policymap(1)
cbQosObjectsType.9619.9621 = classmap(2)
cbQosObjectsType.9619.9623 = matchStatement(3)
cbQosObjectsType.9619.9625 = matchStatement(3)
cbQosObjectsType.9619.9627 = queueing(4)
cbQosObjectsType.9619.9629 = classmap(2)
cbQosObjectsType.9619.9631 = matchStatement(3)
cbQosParentObjectsIndex.9583.9583 = 0
cbQosParentObjectsIndex.9583.9585 = 9583
cbQosParentObjectsIndex.9583.9587 = 9585
cbQosParentObjectsIndex.9583.9589 = 9585
cbQosParentObjectsIndex.9583.9591 = 9583
cbQosParentObjectsIndex.9583.9593 = 9591
cbQosParentObjectsIndex.9583.9595 = 9591
cbQosParentObjectsIndex.9583.9597 = 9583
cbQosParentObjectsIndex.9583.9599 = 9597
cbQosParentObjectsIndex.9619.9619 = 0
cbQosParentObjectsIndex.9619.9621 = 9619
cbQosParentObjectsIndex.9619.9623 = 9621
cbQosParentObjectsIndex.9619.9625 = 9621
cbQosParentObjectsIndex.9619.9627 = 9621
cbQosParentObjectsIndex.9619.9629 = 9619
cbQosParentObjectsIndex.9619.9631 = 9629
cbQosPolicyMapName.9457 = car
cbQosPolicyMapDesc.9457 =
cbQosCMName.1025 = class-default
cbQosCMDesc.1025 =
cbQosCMInfo.1025 = matchAny(3)
     . . .
```

The following samples are QoS CLI **show** command outputs.

7200# show class-map

```
class-map match-any prec1_dscp16
match ip prec 1
match ip dscp 16
```

7200# show policy-map

```
policy-map cbwfq-wred
```

```
class prec1_dscp16
       bandwidth percent 20
       random-detect
       random-detect exponential-weighting-constant 10
       random-detect precedence 0 10 126 10
       random-detect precedence 1 11 126 10
       random-detect precedence 2 12 126 10
       random-detect precedence 3 13 126 10
       random-detect precedence 4 14 126 10
       random-detect precedence 5 15 126 10
       random-detect precedence 6 16 126 10
       random-detect precedence 7 17 126 10
 interface gi0/1
service-policy output cbwfq-wred
policy-map car
       class prec1
          police 20000000 24000 24000 conform-action  set-dscp-transmit 5
exceed-action drop
       class dscp16
          police 20000000 24000 24000 conform-action transmit  exceed-action transmit
 interface pos4/0
service-policy input car
```

Note the following about the sample QoS configuration:

- Policy maps that are not attached to an interface are not included with SNMP data or displayed by the **show policy-map interface** command. This is why pm-1Meg is shown but pm1 is not.
- The default class map is always included with the SNMP data.
- Class maps that have no action defined are not included with the SNMP data.

The following output is a sample of RED configuration information stored in MIB tables applied to a Cisco 7200 interface.

```
cbQosREDCfgExponWeight.9776 = 10
cbQosREDCfgMeanQsize.9776 = 0
cbQosREDCfgDscpPrec.9776 = precedence(1)
cbQosREDCfgMinThreshold.9776.0 = 10
cbQosREDCfgMinThreshold.9776.1 = 11
cbQosREDCfgMinThreshold.9776.2 = 12
cbQosREDCfgMinThreshold.9776.3 = 13
cbQosREDCfgMinThreshold.9776.4 = 14
cbQosREDCfgMinThreshold.9776.5 = 15
cbQosREDCfgMinThreshold.9776.6 = 16
cbQosREDCfgMinThreshold.9776.7 = 17
cbQosREDCfgMaxThreshold.9776.0 = 126
cbQosREDCfgMaxThreshold.9776.1 = 126
cbQosREDCfgMaxThreshold.9776.2 = 126
cbQosREDCfgMaxThreshold.9776.3 = 126
cbQosREDCfgMaxThreshold.9776.4 = 126
cbQosREDCfgMaxThreshold.9776.5 = 126
cbQosREDCfgMaxThreshold.9776.6 = 126
cbQosREDCfgMaxThreshold.9776.7 = 126
cbQosREDCfgPktDropProb.9776.0 = 10
cbQosREDCfgPktDropProb.9776.1 = 10
cbQosREDCfgPktDropProb.9776.2 = 10
cbQosREDCfgPktDropProb.9776.3 = 10
cbQosREDCfgPktDropProb.9776.4 = 10
cbQosREDCfgPktDropProb.9776.5 = 10
cbQosREDCfgPktDropProb.9776.6 = 10
cbQosREDCfgPktDropProb.9776.7 = 10
. . .
```

Monitoring QoS

This section provides information about how to monitor QoS on the router by checking the QoS statistics in the MIB tables described in Table A-4. For information about how to determine the amount of traffic to bill customers for, see the "Billing Customers for Traffic" section on page A-22.

Note The CISCO-CLASS-BASED-QOS-MIB might contain more information than what is displayed in the output of CLI **show** commands.

Table A-4 QoS Statistics Tables

QoS Table	Statistics
cbQosCMStatsTable	Class Map—Counts of packets, bytes, and bit rate before and after QoS policies are executed. Counts of dropped packets and bytes.
cbQosMatchStmtStatsTable	Match Statement—Counts of packets, bytes, and bit rate before executing QoS policies.
cbQosPoliceStatsTable	Police Action—Counts of packets, bytes, and bit rate that conforms to, exceeds, and violates police actions.
cbQosQueueingStatsTable	Queueing—Counts of discarded packets and bytes, and queue depths.
cbQosTSStatsTable	Traffic Shaping—Counts of delayed and dropped packets and bytes, the state of a feature, and queue size.
cbQosREDClassStatsTable	Random Early Detection—Counts of packets and bytes dropped when queues were full and also when transmitted.

Considerations for Processing QoS Statistics

The router maintains 64-bit counters for most QoS statistics. However, some QoS counters are implemented as a 32-bit counter with a 1-bit overflow flag. In the following figures, these counters are shown as 33-bit counters.

When accessing QoS statistics in counters, consider the following:

- SNMPv2c or SNMPv3 applications—Access the entire 64 bits of the QoS counter through *cbQosxxx64* MIB objects.
- SNMPv1 applications—Access QoS statistics in the MIB as follows:
  - Access the lower 32 bits of the counter through *cbQosxxx* MIB objects.
  - Access the upper 32 bits of the counter through *cbQosxxxOverflow* MIB objects.

Sample QoS Statistics

This section shows how QoS statistics are displayed in show commands and stored in CISCO-CLASS-BASED-QOS-MIB tables.

For ease-of-use, the display shows some counters as a single object even though the counter is implemented as three objects. For example, `cbQosCMPrePolicyByte` is implemented as:

```
cbQosCMPrePolicyByteOverflow
cbQosCMPrePolicyByte
```

```
cbQosCMPrePolicyByte64
```

Note Due to implementation features, some of the QoS statistics counters might wrap before they reach the maximum value they can accommodate.

The following is a sample of QoS class map statistics.

```
class-map dscp16
       match ip dscp 16
       class-map prec1
       match ip prec 1
       policy-map car
       class prec1
          police 20000000 24000 24000 conform-action  set-dscp-transmit 5 exce
ed-action drop
       class dscp16
police 20000000 24000 24000 conform-action transmit  exceed-action transmit
 interface atm3/0
pvc 1/99
service-policy input car

class-map prec2
       match ip prec 2
       class-map prec1
       match ip prec 1
       policy-map cbwfq
       class prec1
         bandwidth perc 40
         queue-limit 33
       class prec2
         bandwidth perc 50
         queue-limit 55
 interface atm3/0
pvc 1/99
service-policy output cbwfq
```

cbQosPoliceStatsTable

```
cbQosPoliceStatsEntry
    cbQosPoliceConformedPktOverflow.9535.9541 = 0
    cbQosPoliceConformedPkt.9535.9541 = 226961
    cbQosPoliceConformedPkt64.9535.9541 = 0x000037691
    cbQosPoliceConformedByte.9535.9541 = 230592376
    cbQosPoliceConformedByteOverflow.9535.9541 = 0
    cbQosPoliceConformedByte64.9535.9541 = 0x00dbe8f78
    cbQosPoliceConformedBitRate.9535.9541 = 0
    cbQosPoliceExceededPktOverflow.9535.9541 = 0
    cbQosPoliceExceededPkt64.9535.9541 = 0x000000000
    cbQosPoliceExceededByte.9535.9541 = 0
    cbQosPoliceExceededBitRate.9535.9541 = 0
    cbQosPoliceViolatedPktOverflow.9535.9541 = 0
    cbQosPoliceViolatedPkt.9535.9541 = 0
    cbQosPoliceViolatedByteOverflow.9535.9541 = 0
    cbQosPoliceViolatedByte.9535.9541 = 0
    cbQosPoliceViolatedBitRate.9535.9541 = 0
```

cbQosQueueingStatsTable

```
cbQosQueueingStatsEntry
    cbQosQueueingCurrentQDepth.9619.9627 = 0
    cbQosQueueingMaxQDepth.9619.9627 = 0
```

```
cbQosQueueingDiscardByte.9619.9627 = 700700636
cbQosQueueingDiscardPkt.9619.9627 = 697909
```

Sample QoS Applications

This section presents examples of sample code showing how to retrieve information from the CISCO-CLASS-BASED-QOS-MIB to use for QoS billing operations. You can use these examples to help you develop billing applications. The sample code shows how to:

- Checking Customer Interfaces for Service Policies
- Retrieving QoS Billing Information

Checking Customer Interfaces for Service Policies

This section describes a sample algorithm that checks the CISCO-CLASS-BASED-QOS-MIB for customer interfaces with service policies, and marks those interfaces for further application processing (such as billing for QoS services).

The algorithm uses two SNMP **get-next** requests for each customer interface. For example, if the router has 2000 customer interfaces, 4000 SNMP **get-next** requests are required to determine whether those interfaces have transmit and receive service policies associated with them.

Note This algorithm is for informational purposes only. Your application needs may be different.

Check the MIB to see which interfaces are associated with a customer. Create a pair of flags to show whether a service policy has been associated with the transmit and receive directions of a customer interface. Mark non-customer interfaces TRUE (so no more processing is required for them).

```
FOR each ifEntry DO
  IF (ifEntry represents a customer interface) THEN
     servicePolicyAssociated[ifIndex].transmit = FALSE;
     servicePolicyAssociated[ifIndex].receive = FALSE;
  ELSE
     servicePolicyAssociated[ifIndex].transmit = TRUE;
     servicePolicyAssociated[ifIndex].receive = TRUE;
  END-IF
END-FOR
```

Examine the cbQosServicePolicyTable and mark each customer interface that has a service policy attached to it. Also note the direction of the interface.

```
x = 0;
done = FALSE;
WHILE (!done)
  status = snmp-getnext (
           ifIndex = cbQosIfIndex.x,
           direction = cbQosPolicyDirection.x
  );
  IF (status != 'noError') THEN
     done = TRUE
  ELSE
     x = extract cbQosPolicyIndex from response;
     IF (direction == 'output') THEN
       servicePolicyAssociated[ifIndex].transmit = TRUE;
     ELSE
       servicePolicyAssociated[ifIndex].receive = TRUE;
```

```
      END-IF
    END-IF
  END-WHILE
```

Manage cases in which a customer interface does not have a service policy attached to it.

```
FOR each ifEntry DO
  IF (!servicePolicyAssociated[ifIndex].transmit) THEN
     Perform processing for customer interface without a transmit service policy.
  END-IF
  IF (!servicePolicyAssociated[ifIndex].receive) THEN
     Perform processing for customer interface without a receive service policy.
  END-IF
END-FOR
```

Retrieving QoS Billing Information

This section describes a sample algorithm that uses the CISCO-CLASS-BASED-QOS-MIB for QoS billing operations. The algorithm periodically retrieves post-policy input and output statistics, combines them, and sends the result to a billing database.

The algorithm uses the following:

- One SNMP **get** request per customer interface—to retrieve the ifAlias.
- Two SNMP **get-next** requests per customer interface—to retrieve service policy indexes.
- Two SNMP **get-next** requests per customer interface for each object in the policy—to retrieve post-policy bytes. For example, if there are 100 interfaces and 10 objects in the policy, the algorithm requires 2000 **get-next** requests (2 x 100 x 10).

Note This algorithm is for informational purposes only. Your application needs may be different.

Set up customer billing information.

```
FOR each ifEntry DO
  IF (ifEntry represents a customer interface) THEN
     status = snmp-getnext (id = ifAlias.ifIndex);
     IF (status != 'noError') THEN
         Perform error processing.
     ELSE
        billing[ifIndex].isCustomerInterface = TRUE;
        billing[ifIndex].customerID = id;
        billing[ifIndex].transmit   = 0;
        billing[ifIndex].receive    = 0;
     END-IF
  ELSE
     billing[ifIndex].isCustomerInterface = FALSE;
  END-IF
END-FOR
```

Retrieve billing information.

```
x = 0;
done = FALSE;
WHILE (!done)
  response = snmp-getnext (
             ifIndex = cbQosIfIndex.x,
             direction = cbQosPolicyDirection.x
  );
  IF (response.status != 'noError') THEN
     done = TRUE
  ELSE
     x = extract cbQosPolicyIndex from response;
     IF (direction == 'output') THEN
        billing[ifIndex].transmit = GetPostPolicyBytes (x);
     ELSE
        billing[ifIndex].receive = GetPostPolicyBytes (x);
     END-IF
  END-IF
END-WHILE
```

Determine the number of post-policy bytes for billing purposes.

```
GetPostPolicyBytes (policy)
  x = policy;
  y = 0;
  total = 0;
  WHILE (x == policy)
     response = snmp-getnext (type = cbQosObjectsType.x.y);
     IF (response.status == 'noError')
        x = extract cbQosPolicyIndex from response;
        y = extract cbQosObjectsIndex from response;
        IF (x == policy AND type == 'classmap')
           status = snmp-get (bytes = cbQosCMPostPolicyByte64.x.y);
           IF (status == 'noError')
                   total += bytes;
           END-IF
        END-IF
     END-IF
  END-WHILE
RETURN total;
```

Billing Customers for Traffic

This section describes how to use SNMP QoS information to determine the amount of traffic to bill to your customers. It also includes a scenario for demonstrating that a QoS service policy attached to an interface is policing traffic on that interface.

This section describes the following topics:

- Determining the Amount of Traffic to Bill to a Customer, page A-23
- Scenario for Demonstrating QoS Traffic Policing, page A-23

Input and Output Interface Counts

The router maintains information about the number of packets and bytes that are received on an input interface and transmitted on an output interface. When a QoS service policy is attached to an interface, the router applies the rules of the policy to traffic on the interface and increments the packet and bytes counts on the interface.

The following CISCO-CLASS-BASED-QOS-MIB objects provide interface counts:

- cbQosCMDropPkt and cbQosCMDropByte (cbQosCMStatsTable)—Total number of packets and bytes that were dropped because they exceeded the limits set by the service policy. These counts include only those packets and bytes that were dropped because they exceeded service policy limits. The counts do not include packets and bytes dropped for other reasons.
- cbQosPoliceConformedPkt and cbQosPoliceConformedByte (cbQosPoliceStatsTable)—Total number of packets and bytes that conformed to the limits of the service policy and were transmitted.

Determining the Amount of Traffic to Bill to a Customer

Perform these steps to determine how much traffic on an interface is billable to a particular customer:

Step 1 Determine which service policy on the interface applies to the customer.

Step 2 Determine the index values of the service policy and class map used to define the customer's traffic. You will need this information in the following steps.

Step 3 Access the cbQosPoliceConformedPkt object (cbQosPoliceStatsTable) for the customer to determine how much traffic on the interface is billable to this customer.

Step 4 (Optional) Access the cbQosCMDropPkt object (cbQosCMStatsTable) for the customer to determine how much of the customer's traffic was dropped because it exceeded service policy limits.

Scenario for Demonstrating QoS Traffic Policing

This section describes a scenario that demonstrates the use of SNMP QoS statistics to determine how much traffic on an interface is billable to a particular customer. It also shows how packet counts are affected when a service policy is applied to traffic on the interface.

To create the scenario, follow these steps, each of which is described in the sections that follow:

1. Create and attach a service policy to an interface.
2. View packet counts before the service policy is applied to traffic on the interface.
3. Issue a **ping** command to generate traffic on the interface. Note that the service policy is applied to the traffic.
4. View packet counts after the service policy has been applied to determine how much traffic to bill the customer for:
   - Conformed packets—The number of packets within the range set by the service policy and for which you can charge the customer.
   - Exceeded or dropped packets—The number of packets that were not transmitted because they were outside the range of the service policy. These packets are not billable to the customer.

Note In the above scenario, the Cisco 7200 Router is used as an interim device (that is, traffic originates elsewhere and is destined for another device).

Service Policy Configuration

This scenario uses the following policy-map configuration. For information on how to create a policy map, see "Configuring Quality of Service" in the *Cisco 7200 Internet Series Router Software Configuration Guide*.

```
policy-map police-out
  class BGPclass
    police 8000 1000 2000 conform-action transmit exceed-action drop

interface GigabitEthernet1/0/0.10
 description VLAN voor klant
 encapsulation dot1Q 10
 ip address 10.0.0.17 255.255.255.248
 service-policy output police-out
```

Packet Counts Before the Service Policy Is Applied

The following CLI and SNMP output shows the interface's output traffic before the service policy is applied:

Sample CLI Command Output

```
7200# show policy-map interface g6/0/0.10

GigabitEthernet6/0/0.10

Service-policy output: police-out

   Class-map: BGPclass (match-all)
      0 packets, 0 bytes
      30 second offered rate 0 bps, drop rate 0 bps
      Match: access-group 101
      Police:
        8000 bps, 1000 limit, 2000 extended limit
        conformed 0 packets, 0 bytes; action: transmit
        exceeded 0 packets, 0 bytes; action: drop

   Class-map: class-default (match-any)
      4 packets, 292 bytes
      30 second offered rate 0 bps, drop rate 0 bps
      Match: any
      Output queue: 0/8192; 2/128 packets/bytes output, 0 drops
```

Sample SNMP Output

```
7200# getone -v2c 10.86.0.63 public ifDescr.65
ifDescr.65 = GigabitEthernet6/0/0.10-802.1Q vLAN subif
```

Generating Traffic

The following set of **ping** commands generates traffic:

```
7200# ping
Protocol [ip]:
Target IP address: 10.0.0.18
```

```
Repeat count [5]: 99
Datagram size [100]: 1400
Timeout in seconds [2]: 1
Extended commands [n]:
Sweep range of sizes [n]:
Type escape sequence to abort.

Sending 100, 1400-byte ICMP Echos to 10.0.0.18, timeout is 1 seconds:
.!!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..!.!..
!.!..!.!..!.!..!.!..!.!..!.!..!.!
Success rate is 42 percent (42/100), round-trip min/avg/max = 1/1/1 ms
```

Packet Counts After the Service Policy Is Applied

After you generate traffic using the **ping** command, look at the number of packets that exceeded and conformed to the committed access rate (CAR) set by the **police** command:

- 42 packets conformed to the police rate and were transmitted
- 57 packets exceeded the police rate and were dropped

The following CLI and SNMP output show the counts on the interface after the service policy is applied. (In the output, conformed and exceeded packet counts are shown in boldface.)

CLI Command Output

```
7200# show policy-map interface g6/0/0.10

FastEthernet6/0/0.10

Service-policy output: police-out

   Class-map: BGPclass (match-all)
      198 packets, 281556 bytes
      30 second offered rate 31000 bps, drop rate 11000 bps
      Match: access-group 101
      Police:
        8000 bps, 1000 limit, 2000 extended limit
        conformed 42 packets, 59892 bytes; action: transmit
        exceeded 57 packets, 81282 bytes; action: drop

   Class-map: class-default (match-any)
      15 packets, 1086 bytes
      30 second offered rate 0 bps, drop rate 0 bps
      Match: any
      Output queue: 0/8192; 48/59940 packets/bytes output, 0 drops
```

SNMP Output

```
7200# getmany -v2c 10.86.0.63 public ciscoCBQosMIB
        . . .
      cbQosCMDropPkt.1143.1145 = 57
        . . .
      cbQosPoliceConformedPkt.1143.1151 = 42
        . . .
```

How to Collect CPU Utilization on Cisco IOS Devices Using SNMP

If your IOS device has several CPUs, you must use CISCO-PROCESS MIB and its object cpmCPUTotal5minRev from the table called cpmCPUTotalTable , indexed with cpmCPUTotalIndex . This table allows CISCO-PROCESS MIB to keep CPU statistics for different physical entities in the router, such as different CPU chips, group of CPUs, or CPUs in different cards. In the case of a single CPU, cpmCPUTotalTable has only one entry.

Information about different physical entities in the router is stored in the entPhysicalTable of RFC 2737 standard-based ENTITY-MIB. You can link between two tables (cpmCPUTotalTable and entPhysicalTable) easily: each row of cpmCPUTotalTable has an object cpmCPUTotalPhysicalIndex that keeps the value of the entPhysicalIndex (index of entPhysicalTable), and points to the entry in entPhysicalTable , correspondent to the physical entity for which these CPU statistics are maintained.

This implies that the IOS device must support both CISCO-PROCESS MIB and ENTITY-MIB for you to be able to retrieve relevant information about CPU utilization.

The only case where you do not need to have or use ENTITY-MIB is when you only have a single CPU.

For detailed description about CPU unitlization, go to the following URL:

http://www.cisco.com/warp/public/477/SNMP/collect_cpu_util_snmp.pdf

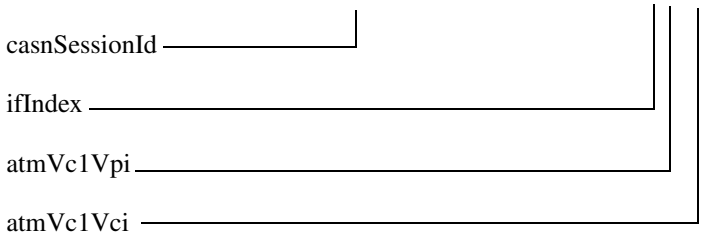
Using CISCO-AAA-SESSION-MIB

The following object support was added to the CISCO-AAA-SESSION-MIB to improve interface mapping sessions:

- casnNasPort—Identifies a particular conceptual row associated with the session identified by casnSessionId. The conceptual row that this object points to represents a port that is used to transport a session. If the port transporting the session cannot be determined, the value of this object will be zeroDotZero

  For example, a session is established using an ATM PVC. If the ifIndex of the ATM interface is 7 and the VPI/VCI values of the PVC are 1, 100 respectively, then the value of this object is (in this example):

casnNasPort.15 = atmVc1AdminStatus.7.1.100



Where atmVc1AdminStatus is the first accessible object of the atmVcTable of the ATM-MIB.

- casnVaiIfIndex—Identifies the ifIndex of the Virtual Access Interface (VAI) that is associated with the PPP session. This interface may not be represented in the IF-MIB in which case the value of this object will be zero.