

# Implementing Network Management on ATM Interfaces

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## Introduction

### Prerequisites

Requirements

Components Used

Conventions

### Interface Statistics

Octet and Packet Counts Per Layer

### Octet and Packet Counts Per ATM Subinterface

### Octet and Packet Counts Per ATM VC

### SNMP Traps

### MIBs for ATM Interfaces

### Related Information

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## Introduction

This document provides a single reference on how to gather network management data on an ATM interface through the use of Simple Network Management Protocol (SNMP). It focuses specifically on Cisco router ATM interfaces.

## Prerequisites

### Requirements

There are no specific requirements for this document.

### Components Used

This document is not restricted to specific software and hardware versions.

### Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

## Interface Statistics

ATM comprises a three-layer stack: an ATM adaptation layer (AAL), an ATM layer, and a physical layer, such as Sonet or T1. Each layer counts packets and octets in a slightly different way. Correspondingly, an ATM interface appears multiple times in the ifTable, with these entries:

- Physical layer, such as Sonet
- ATM cell layer
- AAL5 layer
- Any sub-interfaces (depending on the Cisco IOS Software level)

Here is an example of ifTable data that illustrates these multiple layers:

```
# snmpwalk -c public 192.168.1.1 ifDescr
IF-MIB::ifDescr.1 = STRING: ATM0
IF-MIB::ifDescr.2 = STRING: Ethernet0
IF-MIB::ifDescr.3 = STRING: ATM0-atm layer
IF-MIB::ifDescr.4 = STRING: ATM0.0-atm subif
IF-MIB::ifDescr.5 = STRING: ATM0-aal5 layer
IF-MIB::ifDescr.6 = STRING: ATM0.0-aal5 layer
IF-MIB::ifDescr.7 = STRING: Null0
IF-MIB::ifDescr.8 = STRING: ATM0.1-atm subif
IF-MIB::ifDescr.9 = STRING: ATM0.1-aal5 layer
IF-MIB::ifDescr.10 = STRING: ATM0.11-atm subif
IF-MIB::ifDescr.11 = STRING: ATM0.11-aal5 layer
```

```
# snmpwalk -c public 192.168.1.1 ifType
IF-MIB::ifType.1 = INTEGER: sonet(39)
IF-MIB::ifType.2 = INTEGER: ethernetCsmacd(6)
IF-MIB::ifType.3 = INTEGER: atm(37)
IF-MIB::ifType.4 = INTEGER: atmSubInterface(134)
IF-MIB::ifType.5 = INTEGER: aal5(49)
IF-MIB::ifType.6 = INTEGER: aal5(49)
IF-MIB::ifType.7 = INTEGER: other(1)
IF-MIB::ifType.8 = INTEGER: atmSubInterface(134)
IF-MIB::ifType.9 = INTEGER: aal5(49)
IF-MIB::ifType.10 = INTEGER: atmSubInterface(134)
IF-MIB::ifType.11 = INTEGER: aal5(49)
```

Refer to [SNMP Counters: Frequently Asked Questions](#) for more details on SNMP counters.

## Octet and Packet Counts Per Layer

An AAL5 protocol data unit (PDU) contains:

- Eight-byte RFC 1483 encapsulation header
- Original Layer 3 packet
- Variable-length padding
- Eight bytes of AAL5 trailer

Variable-length padding is used to make the total AAL5 PDU size a multiple of 48 bytes. Octets at the AAL5 layer count only bytes of the original Layer 3 packet and the eight bytes of the RFC1483 header. Packets at this level count the number of AAL5 PDUs. Use the **show ATM vc** and **show interface ATM** command-line interface (CLI) counters or use SNMP to look at the AAL5 layer information to see this output:

```
# snmpwalk -c public 192.168.1.1 ifDescr | grep aal5
IF-MIB::ifDescr.5 = STRING: ATM0-aal5 layer
IF-MIB::ifDescr.6 = STRING: ATM0.0-aal5 layer
IF-MIB::ifDescr.9 = STRING: ATM0.1-aal5 layer
IF-MIB::ifDescr.11 = STRING: ATM0.11-aal5 layer
```

AAL5 PDUs are further segmented into multiple 48-byte blocks, and then each block is provided with a five-byte cell header to form a 53-byte ATM cell at the ATM layer.

On Cisco Campus ATM switches, octets at the ATM layer count the total bytes of the ATM cell, while packets count the number of cells.

On Cisco routers, ATM cell-layer SNMP counters are not maintained because of limitations in the drivers of most ATM interfaces. ATM cell layer for ATM subinterfaces on the router inherits this limitation. For more

details on cell counters, refer to *Measuring the Utilization of ATM PVCs*.

At the physical layer (with, for example, SONET or T1), SNMP counters for the main interface still represent AAL5 PDUs, the same as in the **show interface ATM** command output. In this case, these are ifTable/ifXTable counters for:

```
#snmpwalk -c public 192.168.1.1 ifDescr.1
IF-MIB::ifDescr.1 = STRING: ATM0

#snmpwalk -c public 192.168.1.1 ifType.1
IF-MIB::ifType.1 = INTEGER: sonet(39)
```

Non-unicast, broadcast, and multicast packets counters have no meaning at Sonet and AAL5 layers; they are not present or set to 0.

At the physical layer (with, for example, SONET or T1), you can get octet and packet counts using the ifTable and ifXTable.

## Octet and Packet Counts Per ATM Subinterface

Technologies such as ATM, Frame Relay, and virtual LANs (VLANs) introduced a different type of interface: the virtual interface, or subinterface. On an ATM interface, for example, you may have several permanent virtual circuits (PVCs). Although the overall utilization of the main interface is important, the amount of traffic on individual subinterfaces is of interest as well. RFC 1573 (later superseded by RFC 2233 ) introduced the concept of sparse tables for subinterfaces. Sparse tables means that a row in the ifTable for a subinterface may not have values in columns where the objects do not apply to the subinterface.

Cisco IOS Software implemented support for subinterfaces in the ifTable in release 11.1. Frame Relay and ATM LAN emulation (LANE) subinterface support was added in Cisco IOS Software release 11.1. Support of other ATM subinterfaces was added in 12.0(1)T for Cisco 12000, 4x00/M, 72xx, and 75xx platforms. Each subinterface is represented with two ifTable entries: one for the atmSubInterface layer (ATM layer) and one for the AAL5 layer. As for the main interface, packet and octet counters are available only for the AAL5 layer entities, because most ATM router interfaces do not support cell-layer counts.

The ifType atmSubInterface (Internet Assigned Numbers Authority [IANA] ifType number = 134) is defined for an ATM subinterface. The atmSubInterface layer is a virtual ATM layer. The Interface MIB variables that correspond to the atmSubInterface layer have the same semantics as those of the ATM layer on a main (physical) interface.

These conformance groups apply to the atmSubInterface layer:

- ifGeneralInformationGroup
- ifFixedLengthGroup
- ifHCFixedLengthGroup

The values of these variables are set for both atmSubInterface and AAL5 layers when the ATM subinterface is created:

- ifIndex
- ifDescr
- ifName
- ifType

The values of these variables are updated identically for the atmSubInterface and AAL5 layers:

- **ifSpeed, ifHighSpeed** These variables are updated during an **SNMP GET** request using the bandwidth configured on the ATM subinterface. If there is no separate bandwidth configured on the subinterface, the bandwidth of the main interface is used.
- **ifPhysAddress** This variable is updated with the network service access point (NSAP) address for the subinterface, during every **SNMP GET** request to account for the possibility of NSAP address removal.
- **ifAdminStatus, ifOperStatus** These variables reflect administrative and operational status of the subinterface, and the values are determined from states available in Cisco IOS Software and hardware interface descriptor blocks (IDBs).
- **ifLastChange** This variable is updated with the **sysUpTime** at the time the subinterface enters its current operational state.

These variables are not maintained for the atmSubInterface layer due to the lack of cell-layer counters in the drivers of current interfaces:

- ifInOctets, ifOutOctets
- ifHCInOctets, ifHCOctets

The counters may be implemented if the drivers of new ATM Port Adapters (PAs) provide cell-layer counters.

These variables are not maintained for the atmSubInterface layer because they are not maintained at the ATM layer:

- ifInUcastPkts, ifInNUcastPkts
- ifOutUcastPkts, ifOutNUcastPkts
- ifInBroadcastPkts, ifOutBroadcastPkts
- ifInMulticastPkts, ifOutMulticastPkts
- ifInDiscards
- ifHCInUcastPkts, ifHCInMulticastPkts, ifHCInBroadcastPkts,
- ifHCOctetsUcastPkts, ifHCOctetsMulticastPkts, ifHCOctetsBroadcastPkts

These variables are not updated at the atmSubInterface layer because it is not possible to gather these statistics on a per-VC basis:

- ifInErrors
- ifOutErrors
- ifInUnknownProtos
- ifOutDiscards
- ifOutQLen

These variables are hardwired to FALSE for ATM subinterfaces:

- ifPromiscuousMode
- ifConnectorPresent

## Octet and Packet Counts Per ATM VC

For counters for each AAL5 VC, use CISCO-AAL5-MIB and refer to Measuring the Utilization of ATM PVCs for more details. If your AAL5 VC is the only VC configured on an ATM subinterface, then you can get correspondent AAL5 counters for it through SNMP by using **AAL5-layer** entries for that subinterface in the ifTable/ifXTable. Absolute values of the **AAL5-layer** subinterface counters may reflect past states for VCs that were previously configured on this subinterface and were later deleted or replaced. Generally, this is

not a concern, as you normally use delta (the difference between two counter polls) in a calculation.

## SNMP Traps

ATM interfaces support the generic link up and down traps defined in MIB II. This sample output was captured on an ATM inverse multiplexing over an ATM (IMA) network module. It used the **debug snmp packet** command to view the contents of the traps.

```
3640-1.1(config)# interface ATM 2/0
3640-1.1(config-if)# no shutdown
3640-1.1(config-if)#
*Mar  1 20:17:24.222: SNMP: Queuing packet to 171.69.102.73
*Mar  1 20:17:24.222: SNMP: V1 Trap, ent products.110,
addr 10.10.10.1, gentrap 3, spectrap 0

!--- The gentrap value "3" identifies the LinkUp generic trap.

ifEntry.1.1 = 1
ifEntry.2.1 = ATM2/0
ifEntry.3.1 = 18
lifEntry.20.1 = up
*Mar  1 20:17:24.290: SNMP: Queuing packet to 171.69.102.73
*Mar  1 20:17:24.290: SNMP: V1 Trap, ent ciscoSyslogMIB.2,
addr 10.10.10.1, gentrap 6, spectrap 1
clogHistoryEntry.2.49 = LINK
clogHistoryEntry.3.49 = 4
clogHistoryEntry.4.49 = UPDOWN
clogHistoryEntry.5.49 = Interface ATM2/0, changed state to up
clogHistoryEntry.6.49 = 7304420
```

Issue the **show snmp** command to confirm that the router sent a trap PDU.

```
3640-1.1# show snmp
Chassis: 10526647
55 SNMP packets input
  0 Bad SNMP version errors
 16 Unknown community name
  0 Illegal operation for community name supplied
  0 Encoding errors
 37 Number of requested variables
  0 Number of altered variables
  2 Get-request PDUs
 37 Get-next PDUs
  0 Set-request PDUs
55 SNMP packets output
  0 Too big errors (Maximum packet size 1500)
  2 No such name errors
  0 Bad values errors
  0 General errors
 39 Response PDUs
 16 Trap PDUs
```

Prior to Cisco IOS Software Release 12.2, the output of the **debug snmp packet** command displays a value of **NO\_SUCH\_INSTANCE\_EXCEPTION** for the locIfReason object on an ATM subinterface. In other words, for an ATM subinterface, the router generates a trap that contains this information by default:

```
sysUpTime.0 = 53181
snmpTrapOID.0 = snmpTraps.3
ifEntry.1.64 = 64
ifEntry.2.64 = ATM1/0.1-aal5 layer
ifEntry.3.64 = 49
ifEntry.20.64 = NO_SUCH_INSTANCE_EXCEPTION
```

This exception occurs because the OLD-CISCO-INTERFACES-MIB does not support subinterfaces. Cisco bug ID CSCdp41317 ( registered customers only) resolves this problem through the **snmp-server trap link ietf** command. This output is now expected and complies with RFC 2233:

```
sysUpTime.0 = 46573
snmpTrapOID.0 = snmpTraps.4
ifEntry.1.64 = 64
ifEntry.7.64 = 1
ifEntry.8.64 = 1
ifEntry.2.64 = ATM1/0.1-aal5 layer
ifEntry.3.64 = 49
```

## MIBs for ATM Interfaces

RFC 1695 defines the ATM-MIB, which provides ATM and AAL5-related objects for managing ATM interfaces, ATM virtual links, ATM cross-connects, AAL5 entities, and AAL5 connections. This MIB organizes the managed objects into eight groups:

- ATM Interface configuration
- ATM Interface DS3 PLCP
- ATM Interface TC Sublayer
- ATM Interface VPL configuration
- ATM Interface VCL configuration
- ATM VP Cross Connect
- ATM VC Cross Connect
- ATM Interface AAL5 VCC performance statistics

Cisco IOS Software Releases 11.2 and later provide a standard ATM-MIB instrumentation for many of the counters already provided in the ATM interfaces of the router. ATM-MIB provides some capabilities to change ATM configuration on the device by supporting a number of **SNMP SET** operations (refer to Configuration of ATM Virtual Connections with SNMP for more details). This ATM-MIB **snmp set** functionality is not supported on Cisco routers with ATM interfaces, but you can use it for Cisco ATM switches. There are still some limitations. For example, ATM-MIB is not supported for cross-connection of VC/VPs to pseudo ATM interfaces (ATM-P) for circuit emulation service (CES) port adapters.

To locate other ATM-related MIBs supported by each product, use Cisco IOS MIB Tools, as well as data sheets and configuration guides for the specific ATM port adapter or module.

This is a list of ATM-related MIBs typically supported on routers:

- ATM-MIB
- CISCO-AAL5-MIB
- CISCO-ATM-EXT-MIB
- CISCO-ATM-PVCTRAP-EXTN-MIB
- CISCO-BUS-MIB
- CISCO-IETF-ATM2-PVCTRAP-MIB
- CISCO-LEC-DATA-VCC-MIB
- CISCO-LEC-EXT-MIB
- CISCO-LECS-MIB
- CISCO-LES-MIB
- LAN-EMULATION-CLIENT-MIB

This is a list of ATM-related MIBs typically supported on Cisco Campus ATM switches:

- ATM-MIB

- ATM-RMON-MIB
- ATM-SOFT-PVC-MIB
- CISCO-ATM-ACCESS-LIST-MIB
- CISCO-ATM-ADDR-MIB
- CISCO-ATM-CONN-MIB
- CISCO-ATM-IF-MIB
- CISCO-ATM-IF-PHYS-MIB
- CISCO-ATM-RM-MIB
- CISCO-ATM-SERVICE-REGISTRY-MIB
- CISCO-ATM-SIG-DIAG-MIB
- CISCO-ATM-SWITCH-ADDR-MIB
- CISCO-ATM-SWITCH-CUG-MIB
- CISCO-ATM-SWITCH-FR-IWF-MIB
- CISCO-ATM-SWITCH-FR-RM-MIB
- CISCO-ATM-TRAFFIC-MIB
- CISCO-ATM2-MIB
- CISCO-BUS-MIB
- CISCO-LEC-DATA-VCC-MIB
- CISCO-LEC-EXT-MIB
- CISCO-LECS-MIB
- CISCO-LES-MIB
- CISCO-OAM-MIB
- CISCO-PNNI-MIB
- CISCO-RHINO-MIB
- IMA-MIB
- LAN-EMULATION-CLIENT-MIB
- PNNI-MIB

In addition, consider MIBs related to the physical medium, such as DS1-MIB, DS3-MIB, and SONET-MIB.

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## Related Information

- **How To Calculate Bandwidth Utilization Using SNMP**
- **Cisco IOS MIB Tools**
- **SNMP Support Page**
- **Measuring the Utilization of ATM PVCs**
- **ATM PVC Trap Support**
- **ATM SNMP Trap and OAM Enhancements**
- **Configuration of ATM Virtual Connections with SNMP (From "The Simple Times. Quarterly Newsletter of SNMP Technology, Comment, and Events" Volume 3, Number 2. August, 1994)**
- **ATM Technology Support**
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