U S WEST Communications, Inc. Technical Publication

Customer Network Management for U S WEST Frame Relay Service and U S WEST Switched Multimegabit Data Service

77376
Issue B
December 1996

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NOTICE

This document describes the Customer Network Management (CNM) Option offered by U S WEST to its customers. The Customer Network Management is a service option offered in conjunction with U S WEST Frame Relay Service (FRS) and U S WEST Switched Multimegabit Data Service (SMDS). The Customer Network Management Options allows a U S WEST FRS and/or SMDS subscriber to access selected network management information pertinent to the customer's subscribed portions of the U S WEST Frame Relay and SMDS Network.

SMDS service is no longer offered by U S WEST. Existing SMDS customers have “grandfathered” service.

The information provided in this document includes a description of the U S WEST CNM Option features, functions, technical specifications, performance objectives, and network interfaces. The CNM Option is offered by U S WEST in selected areas of the intrastate jurisdictions.

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1. Introduction

1.1 General

This document describes the Customer Network Management (CNM) Option offered by U S WEST to its customers. The Customer Network Management Option is a service option offered in conjunction with U S WEST Frame Relay Service (FRS) and U S WEST Switched Multimegabit Data Service (SMDS). The Customer Network Management Option allows a U S WEST FRS and/or SMDS subscriber to access selected network management information pertinent to the customer's subscribed portions of the U S WEST Frame Relay and SMDS Network.

SMDS service is no longer offered by U S WEST. Existing SMDS customers have "grandfathered" service

The information provided in this document includes a description of the U S WEST CNM Option features, technical specifications, performance objectives, and network interfaces. The CNM Option is offered by U S WEST in selected areas of the intrastate jurisdictions.

1.2 Purpose

The purpose of this document is to describe the Customer Network Management Option supported by U S WEST Frame Relay Service and U S WEST Switched Multimegabit Data Service. Sufficient technical detail is furnished to allow a customer (e.g., Interexchange Carrier [IC] or an End-User [EU]) to select a Customer Network Management Service Option which may be incorporated into an end-to-end data communications service. It is not the intent of this document to provide specific ordering information, but to describe the technical features and functions of this particular service option.

A full description of the U S WEST Frame Relay Service and U S WEST SMDS is beyond the scope of this document. The U S WEST Frame Relay Service and U S WEST SMDS are described in U S WEST Technical Publications 77372 and 77373, respectively.

1.3 Reason For Reissue

The reason this technical publication is being reissued is to include the Cascade MIBs which are available to the Frame Relay customers via the Cascade STDX 9000.

2. Description of Service

2.1 Applicability of Technical Specifications

The technical specifications presented in this document are applicable to the CNM Option available for U S WEST Frame Relay Service and U S WEST SMDS only. It is not the intent of this document to describe the various types of transmission, switching, network management systems used to provide CNM for Frame Relay and SMDS. The CNM Service Option, as described in this document, pertains to specific fast packet switching equipment deployed in selected serving areas of U S WEST. Initially, the Customer Network Management Option will only be supported for customers whose serving Frame Relay Node or SMDS Node contains CNM capability.

2.2 Customer Network Management Description

The purpose for providing the CNM option is to enable End-User customers to perform network management functions on the subscribed portion of the U S WEST SMDS and Frame Relay Network. CNM Option is implemented within a centralized U S WEST CNM Platform, and is based on the Simple Network Management Protocol. Read-only capability is supported for exchanging information between a customer network management system and the U S WEST CNM Platform. Customer network management options enable the following functions which can be performed by the Frame Relay customer subscribing to the U S WEST CNM Option :

- Fault Detection
- Network Monitoring
- Configuration Management
- Performance
- Security
- Data Collection

The information necessary to support the above network management functions is contained within the specific Management Information Bases (MIBs) supported by U S WEST. Information contained within the MIB is an abstract representation of the subscribed Frame Relay and/or SMDS Network. In-band access to the MIBs is provided using the existing U S WEST Frame Relay and/or SMDS Network via a defacto standard management application protocol known as Simple Network Management Protocol Version 1 (SNMPv1). Other network management application protocols such as SNMP Version 2 (SNMPv2) and Common Management Information Protocol (CMIP) are not supported for the U S WEST CNM Option.

2.3 Description of U S WEST CNM Option Features and Functions

The following U S WEST CNM features and functions are supported for U S WEST SMDS and Frame Relay Service:

- In-Band Access via Simple Network Management Protocol (SNMPv1)
- Customer access to the network management information contained within the MIBs is accomplished via the existing U S WEST Frame Relay or SMDS Access Connections. SNMPv1 requests and responses are accomplished over frame relay permanent virtual connections or assigned SMDS addresses. No additional U S WEST access facilities are required to provide customers with the CNM Option. A majority of the customer network management software applications implement the SNMPv1 as a management application protocol.
- Configuration Management for Frame Relay and SMDS Port Interfaces
- The CNM Option provides read-only access to selected configuration management information for the customer frame relay and/or SMDS port interfaces. Customer subscribed frame relay and SMDS access connections terminate on frame relay and SMDS port interfaces. The port interfaces reside on the U S WEST Frame Relay and SMDS switching equipment. Logical information (e.g., permanent virtual connections, address) associated with the port interfaces is also available.
- Fault Management via Operational Status Information and SNMPv1 Traps
- The CNM Option supports the capability to retrieve the operational status information for physical and logical connections (e.g., data link connection identifiers) provisioned within the customer's access connection. In addition, event notification is supported via the use of specific SNMPv1 messages known as "Traps".
- Performance Management
- The CNM Option supports the capability to retrieve performance information for the following U S WEST Frame Relay and SMDS entities:
    1. Physical layer facilities, namely, DS1 and DS3 transport systems (applicable for SMDS only)
    2. Frame Level Performance for Frame Relay
    3. SMDS Interface Protocol (SIP) Level Performance
- Traffic and Usage Management
- The U S WEST CNM Option Customers can retrieve traffic statistic information for the purpose of determining Wide Area Network (WAN) utilization and bandwidth requirements. Traffic information such as the quantity of octets, frames, and PDUs which are received or transmitted during a specific measurement interval.

2.4 Industry Standards and Technical References Applicable to U S WEST Customer Network Management Option

Listed below are the primary reference documents which are applicable to the U S WEST CNM Option. The focus of these documents is to address customer network management functionality, as well as interoperability for functions performed by the upper layers (i.e., OSI Reference Model layers 3 thru 7). Since customer network management stations using SNMPv1 typically reside on the customer router-based networks, the U S WEST CNM Option encompasses upper layer functionalities of the OSI Reference Model.

RFC 1155	Structure and Identification of Management Information for CP/IP-based Internets
RFC 1157	The Simple Network Management Protocol
RFC 1212	Concise MIB Definitions
RFC 1213	Management Information Base for Network Management of TCP/IP-based Internets: MIB II
RFC 1122	Requirements for Internet Hosts - Communication Layers
RFC 1209	The Transmission of IP Datagrams over the SMDS Service
RFC 1490	Multiprotocol Interconnect over Frame Relay
RFC 1604	Definitions of Managed Objects for Frame Relay Service
FRF.3.1	Multiprotocol Encapsulation Implementation Agreement
FRF.6	Frame Relay Service Customer Network Management Implementation Agreement, Final Draft - January 1994

TR-TSV-001062 Bellcore Technical Reference, Issue 1, Generic Requirement for Phase 1 SMDS Customer Network Management Service

The Request for Comment (RFC) reference documents listed above are an on-line publication series maintained by the Internet Engineering Task Force (IETF), and are located in the *Internet* Repository via the World Wide Web site at:

http://ds.internic.net/ds/dspg1intdoc.html

The IETF is the protocol engineering, development, and standardization body of the Internet Activities Board (IAB).

The aforementioned standard references are only applicable to the U S WEST CNM Option. For the technical specification information pertinent to the U S WEST Frame Relay Service and U S WEST SMDS, refer to the U S WEST Technical Publications 77372 and 77373, respectively.

2.5 General Architecture

In order to perform network management functions on the subscribed service, CNM functionality must be implemented in the service provider network equipment as well as the customer's network management equipment. The U S WEST CNM Option will support both private and standard MIBs which are applicable to the currently deployed Frame Relay and SMDS platforms. The vendor specific MIBs supported by the U S WEST CNM Option are registered with Internet Activities Board (IAB), and are located in the Internet's Private MIB Subtree. Chapter 5 provides further details on the specific MIBs supported by the U S WEST CNM Option.

The implementation of CNM in the U S WEST SMDS Network equipment is primarily based on the Bellcore Document TR-TSV-001062 describing Customer Network Management Service for SMDS. The implementation of CNM in the U S WEST Frame Relay Network equipment complies with the Frame Relay Service Customer Network Management Implementation Agreement described in the Frame Relay Forum Document FRF.6 including the Frame Relay Service MIBs.

2.5.1 CNM Architecture Description

The architecture required to support CNM is shown in Figure 2-1. The CNM architecture components are described below:

U S WEST Network Management System (NMS) Element Manager

The U S WEST NMS Element Manager manages, controls, and diagnoses the U S WEST Frame Relay and SMDS Nodes. Two-way communication between the element manager and the Frame Relay/SMDS Nodes enables the collection of alarm, configuration, and performance monitoring information. The U S WEST NMS Element Manager is centrally administered by U S WEST, and contains remote network management capabilities. An SNMPv1 Proxy Agent is implemented in the U S WEST NMS Element Manager based on the following references: RFC 1155, RFC 1157, RFC 1212, RFC 1213 (see reference section). The proxy agent functionality implemented in the U S WEST NMS Element Manager enables authorized U S WEST CNM Option Customers to query Frame Relay or SMDS Nodes via a mediation device known as the U S WEST CNM User Gateway.

U S WEST Customer Network Management User Gateway

The U S WEST CNM User Gateway provides a mediated interface between the customer NMS and the U S WEST NMS Element Manager. The primary purpose of the U S WEST CNM User Gateway is to provide mediation services between the customer network management station and the U S WEST NMS Element Manager. Mediation services include access security and management application protocol flow control. See Chapter 4, Section 4.5 for further description of access security.

U S WEST Frame Relay Network and/or SMDS Network

Customer is provided access to the U S WEST CNM User Gateway via the U S WEST Frame Relay Network or the U S WEST SMDS Network. A customer may access the U S WEST CNM User Gateway by designating the destination of the Frame Relay and/or SMDS protocol data unit (containing SNMPv1 Request) to be the CNM User Gateway. For a description of the U S WEST Frame Relay and SMDS Network architecture, see U S WEST Frame Relay Service Technical Publication 77372 Issue D and U S WEST SMDS Technical Publication 77373 Issue B, respectively.

Customer Network Management Station (NMS)

The CNM architecture was developed based on the goal of extending the customer's network management view to include the subscribed portion of the U S WEST Frame Relay and SMDS Network. The following requirements must be supported in the customer network management station:

- Customer network management station must support SNMP Version 1.
- The customer access to U S WEST CNM User Gateway is provided via a customer provided router which supports connectivity to the U S WEST Frame Relay Access Link or a U S WEST SMDS access link.
- Customer network management station must be able to incorporate the MIB into the customer NMS database. Typically, MIB compilers are used to incorporate a MIB into the customer network management application software and graphical user interface.
- Management Information Bases (MIBs)
- Several MIBs are supported via the U S WEST CNM User Gateway. A MIB is essentially a database of managed objects which are logically organized in an abstract MIB Tree. Each managed object is uniquely identified by an object identifier. The MIB object identifiers are similar to telephone numbers such that object identifiers are organized hierarchically, and portions of each number are assigned by different organizations. A Customer Network Management System accesses each object identifier via SNMP Version 1. Chapter 5 further describes the specific MIBs and the SNMP Management Framework which is supported by U S WEST CNM Option.

- U S WEST CNM Platform Router
- The U S WEST CNM Platform Router interconnects the U S WEST CNM User Gateway with the lower layer data transport service (i.e., U S WEST SMDS or Frame Relay Service). The U S WEST CNM Platform Router processes the IP packets which contain SNMPv1 Messages issued to and from the CNM User Gateway. A redundant router is implemented in the U S WEST CNM Platform for robustness.
- Customer Provided Router.
- The customer provided router forwards IP packets to and from the Customer NMS. Encapsulated SNMPv1 requests issued over the customer LAN are forwarded to the U S WEST CNM Platform via the subscribed portion of the U S WEST Frame Relay or SMDS Network.

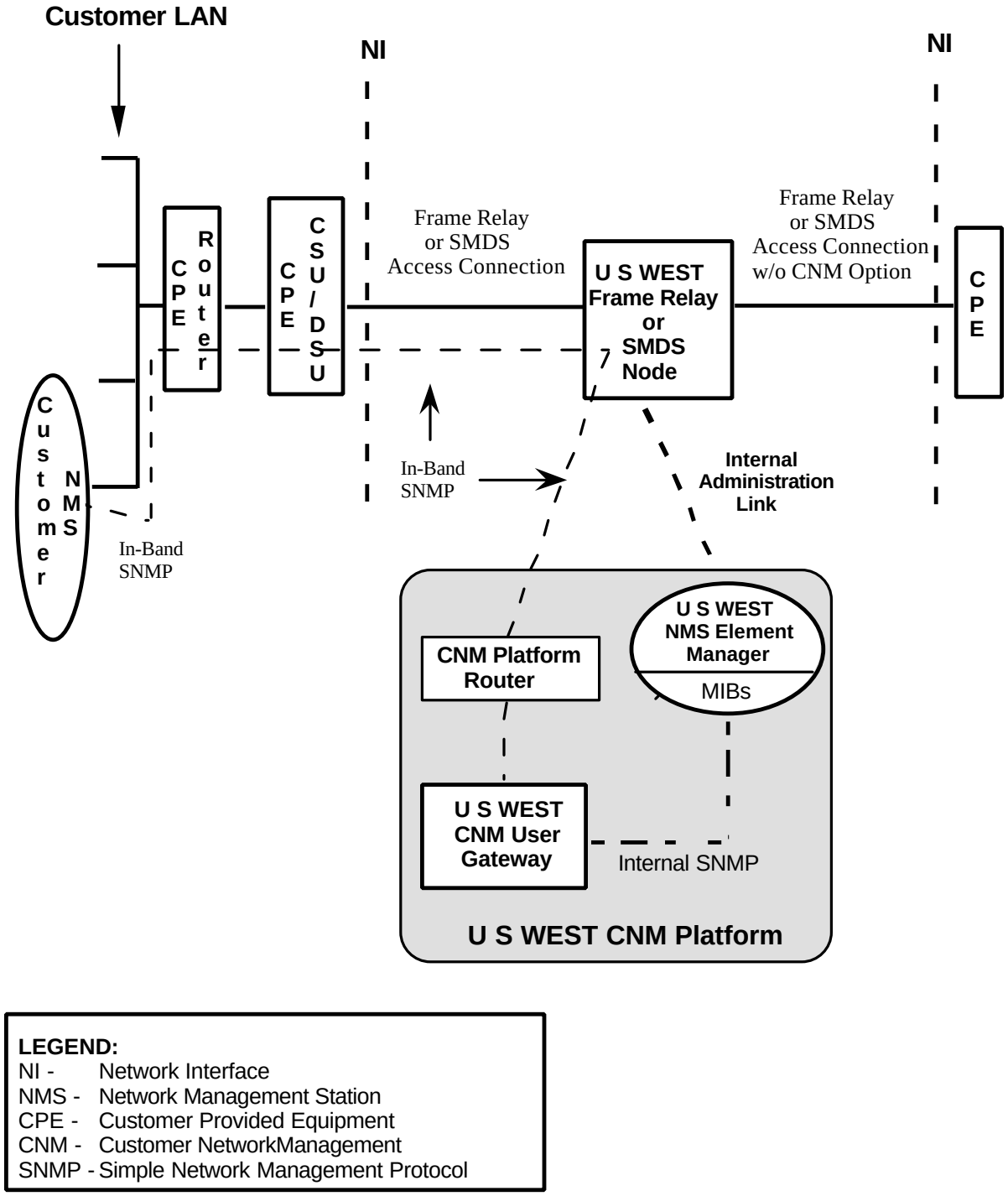

Figure 2-1 General CNM Architecture and Associated Components

3. Customer Network Management Access

The purpose of this section is to describe the manner in which the U S WEST Frame Relay Service and/or SMDS Customers with the CNM Option access network management information.

3.1 U S WEST CNM Upper and Lower Layer Protocol Requirements

The U S WEST CNM Option is supported in conjunction with the U S WEST Frame Relay Service and U S WEST SMDS. Customer access is provided via the U S WEST Frame Relay and SMDS Access Connections. The U S WEST Frame Relay Service and the U S WEST SMDS support lower layer functions for the purpose of transporting customer data. The U S WEST CNM Option encompasses upper layer functionalities supported by both the customer network management equipment and the U S WEST CNM Platform. Figure 3-1 depicts the protocols and OSI reference model functions pertinent to the U S WEST CNM Option.

The CNM Option is comprised of the following upper layer functions operating over SMDS and/or Frame Relay:

- Network Management Application Layer

  The network management application supported by U S WEST CNM Option is the Simple Network Management Protocol (SNMP) Version 1. Originally, SNMPv1 was developed to manage TCP/IP-based networks. However, SNMPv1 is now being implemented in non-TCP/IP networks for the purpose of network management.

- Transport Layer

  The transport requirements for U S WEST CNM Option include the use of the User Datagram Protocol (UDP). UDP is part of the TCP/IP Protocol Suite, and provides a connectionless-mode transport service. See Chapter 4 for further details on transport layer requirements.

- Network Layer

  The network layer requirements for U S WEST CNM Option include the use of the Internet Protocol (IP). The addressing and routing requirements are discussed in Chapter 4 of this document.

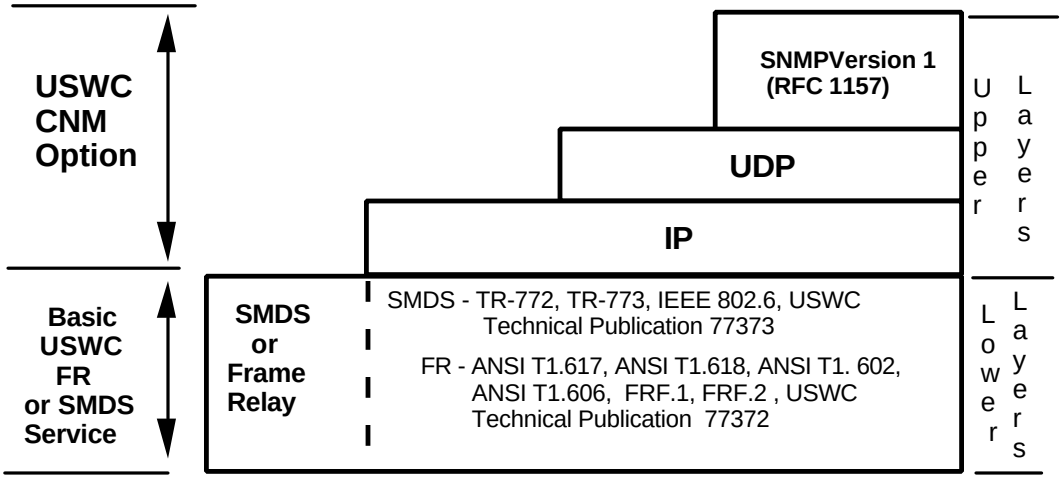

Figure 3-1 CNM Option Upper and Lower Layer Protocols

3.2 CNM Access via U S WEST Frame Relay Service

The U S WEST Frame Relay Service (FRS) Customers with the CNM Option access the U S WEST CNM Platform via FR Access Connections. The U S WEST FR Access Connections provide FRS Customers access to the U S WEST Frame Relay Network. The technical requirements of the FR access connections are described in the U S WEST Technical Publication 77372, Issue D. The CNM Option does not impose any additional standards compliance requirements on the FR access connections. U S WEST FRS Customers will only be permitted to access the MIBs which are pertinent to the U S WEST FRS and the U S WEST CNM Option. The MIB access is administered by U S WEST via the establishment of MIB View Privileges (See Chapter 4, Section 4.8.2).

As indicated in Figure 3-2, a U S WEST FRS Customer is provided access to the U S WEST CNM Platform via a U S WEST CNM Platform Router which is interconnected to the U S WEST Frame Relay Network. For U S WEST CNM Option, a Permanent Virtual Connection (PVC) must be established between the customer router and the U S WEST CNM Platform Router. This PVC is established by provisioning an additional Data Link Connection Identifier (DLCI) on the customer's U S WEST FRS Access Connection. All customer SNMPv1 Requests must be routed to U S WEST CNM Router for processing by the CNM User Gateway. U S WEST has a designated Internet Address Space (Class C) in order to accomplish the necessary IP routing for CNM requests between the customer NMS and the U S WEST CNM Platform.

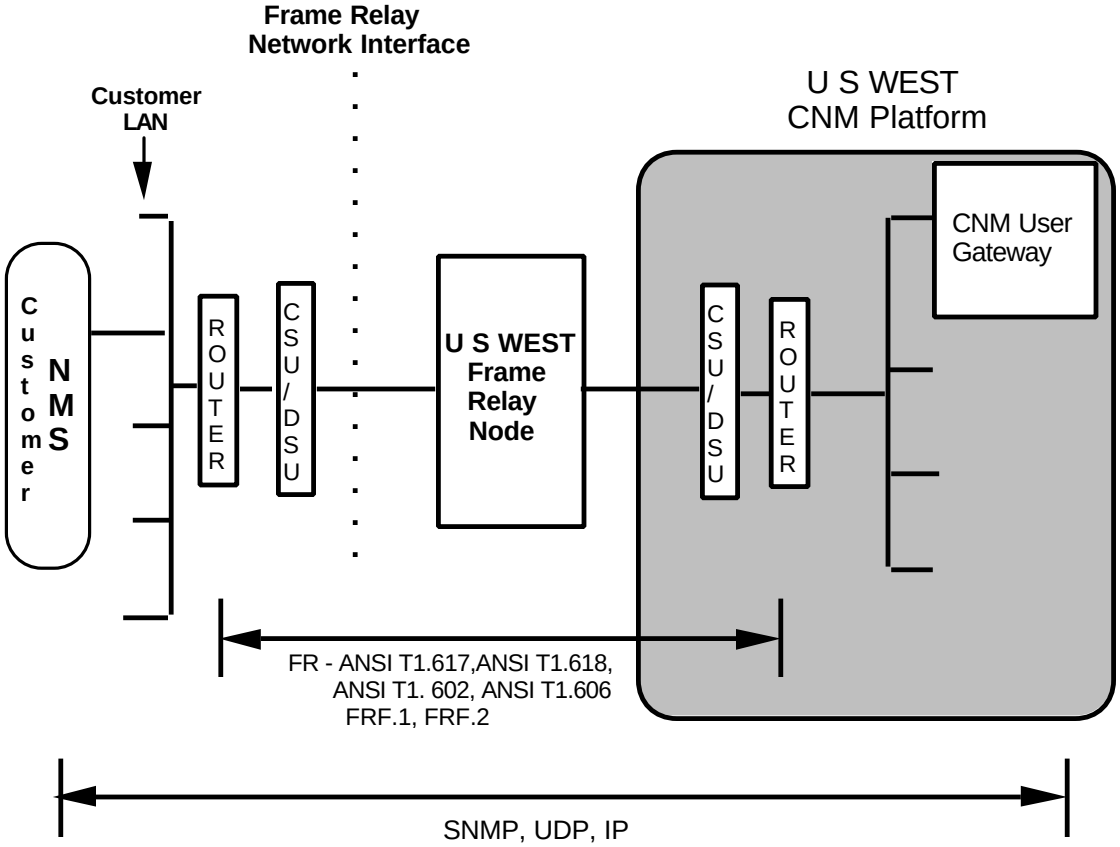

Figure 3-2 Frame Relay Access to the U S WEST CNM Option

3.3 CNM Access via U S WEST SMDS

The U S WEST SMDS Customers with the CNM Option access the U S WEST CNM Platform via SMDS Access Connections. Customer accesses the platform by designating the destination of the SMDS protocol data unit to be the CNM User Gateway. U S WEST SMDS Access Connections provide SMDS Customers access to the U S WEST SMDS Network. The technical requirements of the SMDS access connections are described in the U S WEST Technical Publication 77373, Issue B. The CNM Option does not impose any additional standards compliance requirements on the SMDS access connections.

The U S WEST SMDS Customers will only be permitted to access the MIBs which are pertinent to the U S WEST SMDS and the U S WEST CNM Option. The MIB access privileges are administered by the U S WEST CNM system administrators via the establishment of MIB View Privileges (See Chapter 4, Section 4.8.2).

As indicated in Figure 3-3, the U S WEST SMDS Customer is provided access to the U S WEST CNM Platform via a U S WEST CNM Platform Router which is interconnected to the U S WEST SMDS Network. The Class C IP address of the U S WEST CNM User Gateway is provided to the SMDS customers subscribing to the U S WEST CNM Option. All customer SNMPv1 requests encapsulated in SMDS protocol data units must be routed to U S WEST CNM Router for processing by the U S WEST CNM User Gateway. U S WEST has a designated Internet Address Space (Class C) in order to accomplish the necessary IP routing for CNM requests between the customer NMS and the U S WEST CNM Platform.

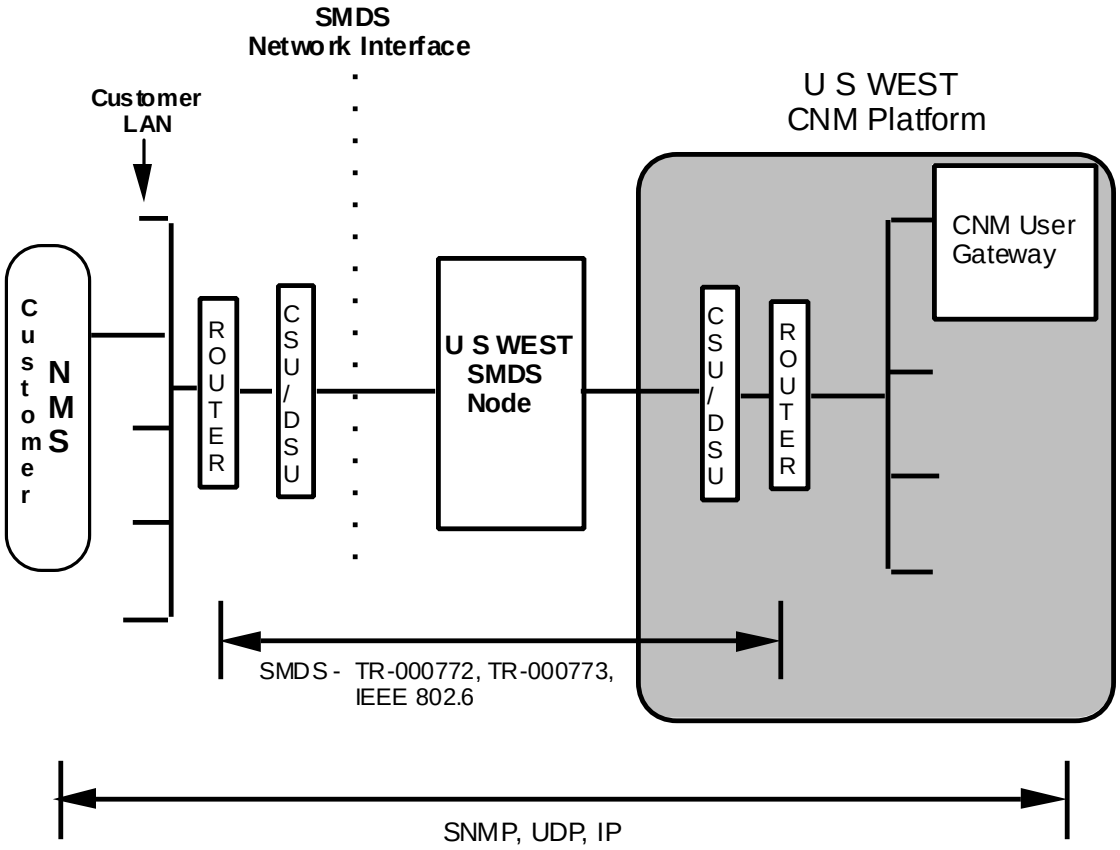

Figure 3-3 SMDS Access to the U S WEST CNM Option

3.4 U S WEST CNM Service Configuration and Associated NMS Access Options

The U S WEST CNM Option provides the U S WEST Frame Relay and SMDS Customers access to customer network management information. The U S WEST CNM Option Customers are provided access to the U S WEST CNM Platform via existing subscribed Frame Relay or SMDS Access Connections which terminate on a serving U S WEST Frame Relay or SMDS Node. The internal U S WEST Official Communications Network is responsible for transporting SNMPv1 messages between the serving U S WEST Frame Relay or SMDS Node (managed element) and the U S WEST CNM User Gateway. The geographical location of the serving node with respect to the centrally located U S WEST CNM Platform determines if a customer SNMPv1 request will transit the internal U S WEST Official Communications Network.

The U S WEST CNM functionality currently supported enables the end user's customer NMS to access the U S WEST CNM Platform via SNMPv1. Hence, due to the access functionality supported in the existing U S WEST CNM Platform, the IC and/or Independent Carrier must access the U S WEST CNM Platform via the end user customer router. Additional functionality is planned for supporting Interexchange Carrier and/or Independent Carrier NMS access to the U S WEST CNM Platform via SNMPv1. In the future, the IC or Independent Carrier NMS access functionality will enable the IC and/or Independent Carrier to remotely access network information which encompasses an end-to-end service.

3.4.1 End User Customer NMS Access to the U S WEST CNM Option

The CNM Option for U S WEST Frame Relay Service and SMDS is offered in the respective state tariffs within the U S WEST Serving Territory. The U S WEST CNM Option is offered in conjunction with the U S WEST Frame Relay Service and SMDS in the FCC jurisdiction.

As shown in Figure 3-4, the end user customer's NMS accesses the U S WEST Frame Relay or SMDS Network supporting CNM via an existing subscribed U S WEST Frame Relay or SMDS Access Connection. The access connection terminates on the end user customer's serving U S WEST Frame Relay or SMDS Node Port(s). In order to process the U S WEST Frame Relay or SMDS Customer's SNMPv1 requests, the SNMPv1 request messages are forwarded from the serving U S WEST Frame Relay/SMDS Node to the centrally located U S WEST CNM User Gateway. The CNM User Gateway responds with an SNMPv1 Response Message containing network management information pertinent to the customer's subscribed Frame Relay or SMDS Port.

3.4.2 Interconnection of Multiple Networks Supporting Customer Network Management

The U S WEST CNM Option supports access to the MIBs which are pertinent to the U S WEST Frame Relay Service and the U S WEST SMDS. The MIBs supported by the U S WEST CNM Option are solely for the purpose of managing the U S WEST SMDS or Frame Relay Nodes, Ports, and associated port logical assignments (e.g., PVCs, IP addresses, SMDS addresses). If a particular customer's SMDS and/or Frame Relay Service encompasses multiple service provider networks, the customer NMS must poll each individual service provider's MIBs in order to establish an end-to-end view of the underlying data transport services.

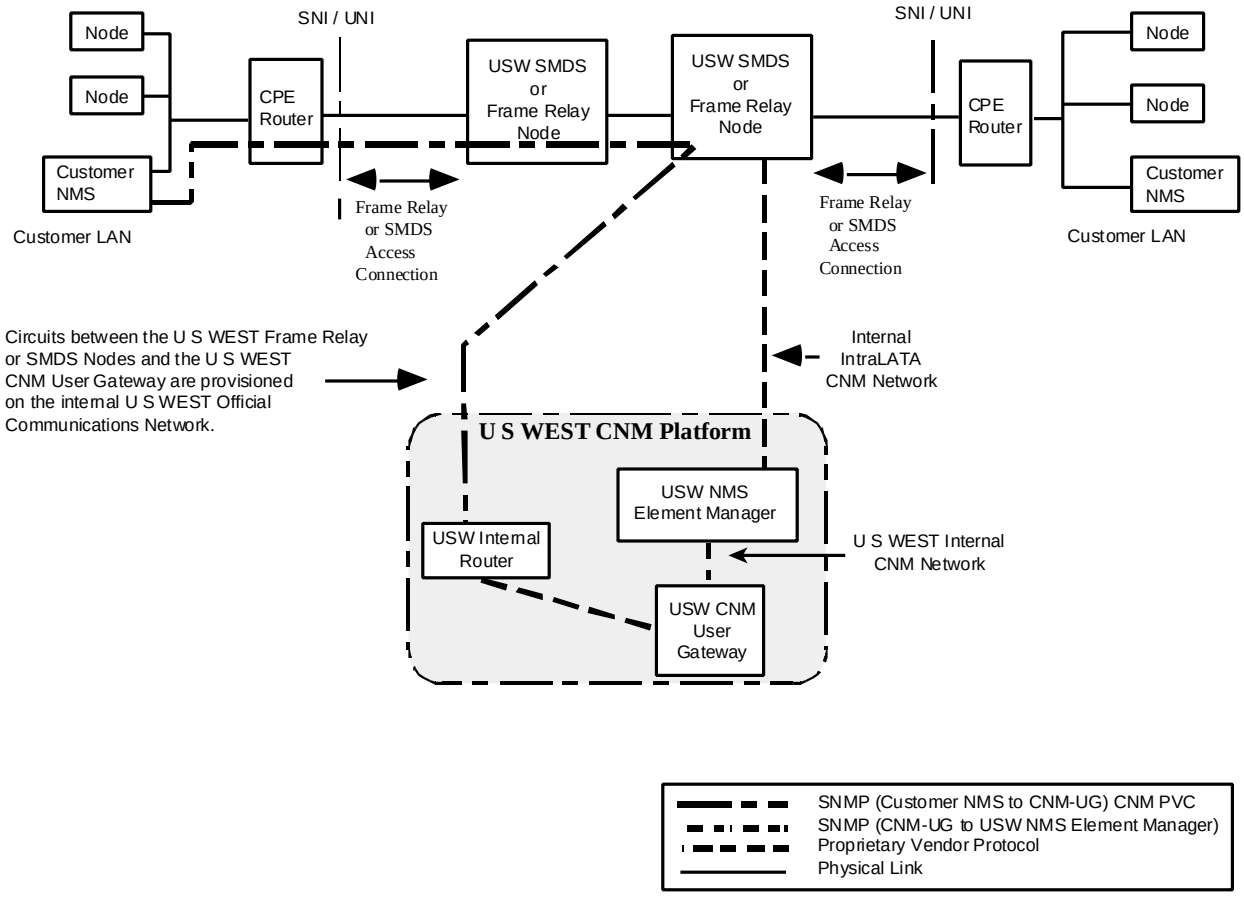

Figure 3-4 End-User Customer NMS Access to the U S WEST CNM Option

4. U S WEST Customer Network Management Protocols and Framework

4.1 SNMP Management Framework

Network management information is communicated between network management systems using a management application protocol. The SNMP management framework is a model used to describe the key U S WEST CNM components and their relationships necessary to provide network management functionality. The framework includes the following components:

- Network Elements

  The network elements contain network management agents which typically include protocol engines and management profiles. A protocol engine implements a network management application protocol, and communicates with other similar protocol engines. A management profile is a subset of all the network management variables. The U S WEST Frame Relay and SMDS Nodes are managed by the U S WEST NMS Element Manager. The U S WEST NMS Element Manager implements an SNMPv1 proxy agent, and is perceived by the customer's protocol engine as a proxy agent for the U S WEST Frame Relay or SMDS Nodes.

- Network Management Stations (NMS)

  Network management stations typically execute network management applications on an operating system resident within the station. The customer NMS is responsible for the administration, control, and monitoring of the network elements.

- Network Management Application Protocol

  A network management application protocol is used to communicate the network management information between the customer network management station and the U S WEST NMS Element Manager Proxy Agent. In technical terms, the U S WEST NMS Element Manager implements an SNMPv1 Proxy Agent functionality which serves as the agent to the customer network management station. The U S WEST Element Manager which resides within the U S WEST CNM Platform is mediated by the U S WEST CNM User Gateway.

- Network Management Information Model

  The information model defines how the network management information is structured. The SNMP information model is an object information model specified in RFC 1155 - Structure of Management Information (SMI). SMI specifies the rules for developing MIBs which organize data in a logical tree. The vendor specific MIBs supported in the U S WEST CNM Platform are compliant with RFC 1155.

4.2 Simple Network Management Protocol Version 1 (SNMPv1) Description

The U S WEST CNM Option is based on the Simple Network Management Application Protocol specified in RFC 1157. SNMPv1 is a network management application protocol used to access the management information bases (MIBs).

SNMPv1 is a request/response protocol which supports following primitive operators:

- GET.
- An SNMPv1 operator used to retrieve specific instances of an object.
- GET-NEXT.
- An SNMPv1 operator used to traverse the abstract MIB tree of managed objects.
- SET.
- An SNMPv1 operator used to modify instances of an managed object. The U S WEST CNM Option does not allow customers to modify instances of an object. Hence, the SET SNMPv1 Operator is not acknowledged by the U S WEST CNM User Gateway.
- Trap.
- An SNMPv1 primitive that provides a mechanism for a managed device (i.e., U S WEST Frame Relay Node and/or SMDS Node) to provide an unsolicited notification to the network management station that a significant event has occurred. U S WEST CNM Option defines vendor specific traps that indicate link status, cold start, and authentication failures. Chapter 5, Section 5.5 discusses the types of traps supported by the U S WEST CNM Option.

4.3 SNMPv1 Message Encapsulation Scheme

The previous sections described the format of the SNMPv1 messages which are exchanged between the U S WEST CNM Customer NMS and the U S WEST CNM Platform. The SNMPv1 management application protocol determines how the SNMPv1 messages are to be exchanged. However, SNMPv1 must rely on the functionalities supported by the lower layer protocols in order to exchange SNMPv1 messages between the manager and the agent.

Typically, a customer NMS is located on a customer Local Area Network (LAN) which supports a particular Medium Access Control (MAC) procedure (e.g., IEEE 802.3, IEEE 802.5). The customer NMS issues SNMPv1 Messages over the LAN by using a particular encapsulation scheme. An example of typical SNMPv1 message encapsulation is shown in Figure 4-1. Due to the wide variety of local area networks and network operating systems which may reside on the customer LAN, the SNMPv1 message encapsulation scheme on the customer LAN is beyond the scope of this document.

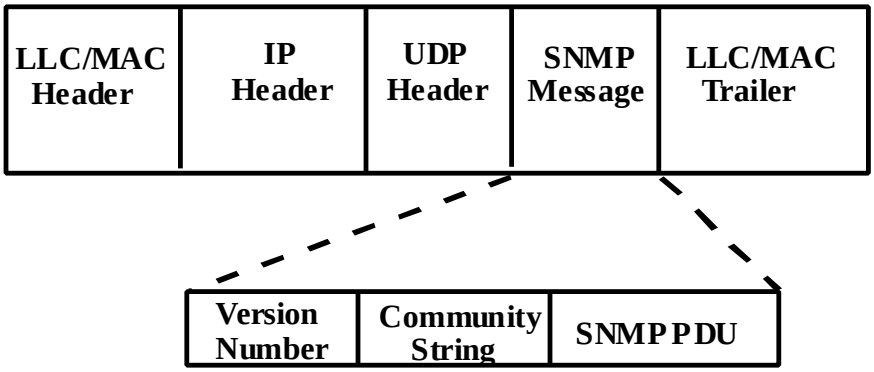

Figure 4-1 SNMPv1 Message Encapsulation on the Customer LAN

A U S WEST CNM Customer's NMS may issue an SNMPv1 requests to the U S WEST CNM User Gateway. The customer's NMS must build the necessary packet which encapsulates the SNMPv1 message into the appropriate format (see Figure 4.1), and sends the SNMPv1 Request to the customer router providing connectivity to the U S WEST SMDS or Frame Relay Network. The IP address of the CNM User Gateway is used as the destination address for the SNMPv1 requests pertinent to the U S WEST Frame Relay or SMDS Network.

The customer router providing connectivity to the U S WEST Frame Relay or SMDS network receives the SNMPv1 Request messages from the customer NMS. The customer router encapsulates the SNMPv1 message into the format shown in Figure 4-2 below.

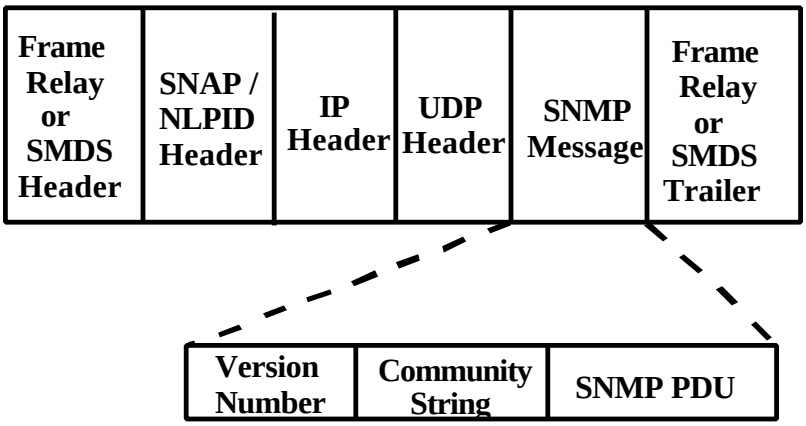

Figure 4-2 SNMPv1 Message Encapsulation for the U S WEST CNM Option

4.4 SNMPv1 Message Format

The U S WEST CNM Option enables a customer's NMS to exchange SNMPv1 messages with the U S WEST CNM Platform via the U S WEST CNM User Gateway. The SNMPv1 message consists of two parts, namely, the community string and the SNMPv1 Protocol Data Unit (PDU) The SNMPv1 Message Format is shown is Figure 4-3.

A community name determines an access environment for a set of customer NMSs using a specific community string. The customer NMSs within a community are classified to exist in the same administrative domain. NMSs that do not know the proper community string are precluded from access to the community.

The SNMPv1 Protocol Data Unit contains specified SNMPv1 operations (e.g., Get, Get Next) and associated operands. The SNMPv1 operands indicate the object instances involved in a particular SNMPv1 message exchange process. The maximum SNMPv1 message size supported by the U S WEST CNM Option is 1024 bytes. In addition, no more than 20 objects can be specified in a single SNMPv1 PDU.

Figure 4-3 SNMPv1 Message Format

4.4.1 SNMPv1 Request/Response PDU Format

The format of the SNMPv1 Request/Response PDU is shown in Figure 4-4. The SNMPv1 Request/Response PDU is composed of the following fields:

PDU Type	Distinguishes between PDU type
Request ID	An integer used to associate requests with responses. The SNMPv1 application entity uses the Request ID to correlate incoming responses with outstanding requests.
Error-Status	Indicates an error and an error type. no Error (0), too Big(1), no Such Name(2), badValue(3), read-only(4), genError(5)
Error-Index	Associates the error with a particular object instance
Variable-Bindings	The term variable refers to an instance of a managed object. A variable binding refers to the pairing of the variable name and the corresponding object value.

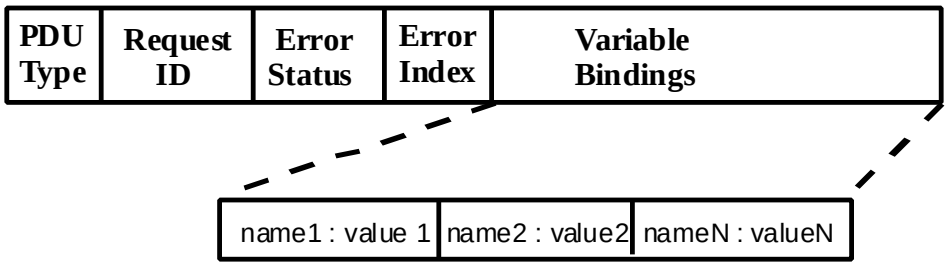

Figure 4-4 SNMPv1 Request/Response PDU Format

4.4.2 SNMPv1 Trap Message Format

The format of the SNMPv1 Trap PDU is shown in Figure 4-5. The Trap PDU is composed of the following fields.

Enterprise Field	Identifies the type of object generating the trap message via an object identifier
Agent Address	Network address of the object generating the trap
Trap Type	Indicates the nature of the event
Time Stamp	Identifies when a trap is generated
Variable Bindings	The term variable refers to an instance of a managed object. A variable binding refers to the pairing of the variable name and the corresponding object value.

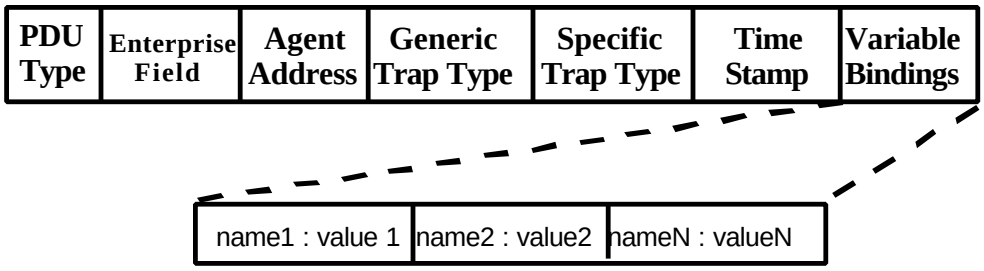

Figure 4-5 SNMPv1 Trap PDU Format

4.5 U S WEST CNM Option Upper Layer Protocol Specifications

The upper layer protocols which are used to exchange SNMPv1 messages between the U S WEST CNM Platform Router and the customer router are shown in Figure 4-6 below. Thus, the protocol stack shown in Figure 4-6 must be implemented in both the U S WEST Platform CNM Router and customer router providing connectivity to the U S WEST SMDS and Frame Relay Network. The IP packet is encapsulated into the information field of the SMDS L3 PDU or the Frame Relay Information Field.

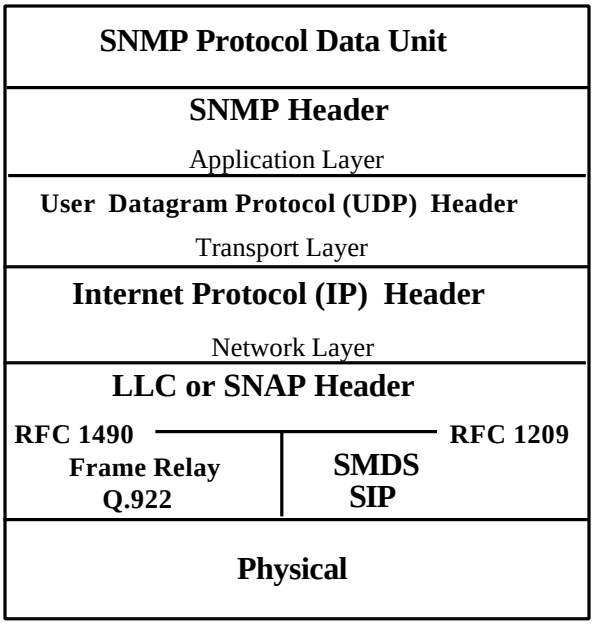

Figure 4-6 CNM Protocol Stack Information

4.5.1 Application Layer Specifications

The U S WEST CNM Option initially supports version 1 of the Simple Network Management Protocol which is specified in RFC 1157. The U S WEST CNM Platform's implementation of SNMPv1 is compliant RFC 1157 specifications. In order to invoke the CNM Option with the U S WEST SMDS and Frame Relay Service, the following general requirements apply to each U S WEST CNM Option Customer:

- Customer Network Management Station must support SNMP Version 1 based on RFC 1157.
- Customer NMS Station must be able to accept SNMPv1 Trap messages.
- Customer NMS must be able to import MIBs provided by U S WEST. Typically, a customer's network management system software contains a MIB compiler which will compile the U S WEST CNM MIBs into the customer network management application software and graphical user interface.
- The customer NMS must have a registered Internet Protocol (IP) Address.
- U S WEST strongly recommends that the customer NMS support the capability to time stamp particular SNMPv1 Request Messages issued to the U S WEST CNM Platform.

4.5.2 Transport Layer Specifications

The following transport layer specification requirements are applicable for the customer NMS:

- Customer NMS must support User Datagram Protocol (UDP) for transporting SNMPv1 messages between the customer NMS and the U S WEST CNM Platform. UDP is described in RFC 768.
- The customer NMS must encapsulate SNMPv1 messages into a User Datagram Protocol (UDP) packet, and must receive SNMPv1 messages encapsulated in a UDP packet. The ports used by the server processes for UDP are specified in RFC 1060. The customer's NMS will send and receive SNMPv1 messages on the UDP Port 161. The customer NMS will receive SNMPv1 Traps on UDP Port 162.
- The customer's NMS implementation of UDP must be consistent with RFC 1122.

4.5.3 Network Layer Specifications

The following specifications must be supported in the customer router providing connectivity to the U S WEST CNM User Gateway via the U S WEST Frame Relay and/or SMDS Network:

- The customer router must implement the IP protocol entity as specified in RFC 1122 and RFC 791.
- The protocol identifier in the IP packet should specify the use of UDP. The protocol identifier for UDP is the value 17 as specified in RFC 1060.
- For SMDS applications, the customer router must support the encapsulation scheme specified in RFC 1209 for enclosing an IP Datagram inside a SMDS L3 PDU.
- For Frame Relay applications, the customer router must support RFC 1490, ANSI T1.617 Annex F, and the Frame Relay Forum Implementation Agreement FRF.3.1 for encapsulating an IP datagram inside a ANSI T1.618 Frame. ANSI T1.617 Annex and RFC 1490 specify IP encapsulation within the frame relay protocol.

4.5.4 Physical Layer Specifications

The physical layer specifications at the network interface are specified in the U S WEST SMDS and Frame Relay Technical Publications. Thus, the Network Channel Interface (NCI) Codes and Network Channel (NC) Codes which are described in the respective U S WEST Technical Publications are applicable for the U S WEST CNM Option. For further information on the physical specifications for Frame Relay and SMDS, see U S WEST Technical Publications 77372 and 77373, respectively.

4.6 U S WEST CNM Platform Router and Customer Router Configuration Requirements

The U S WEST CNM Platform Router provides connectivity between the U S WEST CNM User Gateway and the lower layer data transport services such as the U S WEST Frame Relay Service or SMDS. The customer router provides connectivity between the customer NMS and the subscribed data transport services such as the U S WEST Frame Relay Service or SMDS.

4.6.1 CNM Platform Router General Configuration Information

The following general information is required in order to configure the U S WEST CNM Platform Router for interoperation with the customer provided router:

- SMDS Individual and Group Addresses of the customer's router providing SMDS connectivity for customer's NMS.
- All U S WEST SMDS Customers with the CNM Option will be assigned an SMDS Group Address for the purpose of receiving Routing Information Protocol (RIP) updates. RIP updates will be issued over a logical CNM subnet which is comprised of the CNM Option customer routers and the U S WEST CNM Platform Router(s). U S WEST will provide a secondary Class C IP address for each customer's SNI in order to establish the logical CNM subnet. The secondary IP address should not be used for transmitting data traffic.
- Frame Relay Data Link Connection Identifier (DLCI) and the IP address of the customer's router providing Frame Relay connectivity for the customer NMS
- DLCI provisioning information for transmitting/receiving SNMPv1 packets between the customer provided router and the U S WEST CNM Router providing connectivity to the CNM User Gateway.
- Upon subscription to the U S WEST CNM Option for Frame Relay, the customer must provision an additional DLCI on the existing subscribed Frame Relay Access Connection in order to establish a permanent virtual connection between the customer provided router and the U S WEST CNM Platform.
- IP Address of the Customer NMS.
- Only IP packets destined to or from the CNM User Gateway are forwarded by the U S WEST CNM Router(s). Non-CNM type IP packets will not be forwarded by the U S WEST CNM Router.

In addition, the transport and network layer technical specifications described in Section 4.5 must be supported to provide interoperability between the U S WEST CNM Platform Router and the customer provided router.

4.6.2 Customer Router General Configuration Information

The following general configuration requirement apply for the customer router providing connectivity to the U S WEST Frame Relay or SMDS Network:

- Customer provided router supporting SMDS or Frame Relay connectivity for the customer NMS must be configured with IP address of the U S WEST CNM User Gateway and U S WEST CNM router.
- For SMDS applications, the customer router must be configured with the SMDS address of the U S WEST CNM User Gateway.
- For Frame Relay applications, the customer router must be configured with a PVC destined for the U S WEST CNM User Gateway. Customer provided router must maintain the necessary address tables for the IP and DLCI mapping.

In addition, the transport and network layer technical specifications described in Section 4.5 must be supported to provide interoperability between the U S WEST CNM Platform Router and the customer provided router.

4.7 High-level SNMP Message Exchange Description

The SNMPv1 PDUs are exchanged between the U S WEST CNM User Gateway and the Customer NMS. This exchange of information occurs utilizing the lower layer data transport services such as the U S WEST Frame Relay Service or SMDS. Provided below is a high level description of a typical interaction which occurs between the U S WEST CNM User Gateway and the Customer NMS:

- The End-User customer initiates a SNMPv1 GET Request Message from the customer network management station, or equivalent, which is located on the customer premise LAN. The customer NMS sends the SNMPv1 GET Request Message to the customer router providing connectivity to the lower layer data transport services such as Frame Relay or SMDS.
- The Customer SNMPv1 GET Request Message is encapsulated within a UDP and IP packet by the customer router providing connectivity to the lower layer data transport service (e.g., SMDS, Frame Relay).
- Based on the destination IP address, the customer router forwards the encapsulated SNMPv1 packet to the CNM User Gateway via the lower layer data transport service (i.e., Frame Relay or SMDS).
- The U S WEST CNM User Gateway validates the SNMPv1 Request Message, and forwards (utilizing SNMPv1) the SNMPv1 GET Request Message to the U S WEST NMS Element Manager (or Proxy Agent).
- The U S WEST NMS Element Manager processes the SNMPv1 GET Request Message by retrieving the necessary network management information from the customer subscribed U S WEST Frame Relay or SMDS Node(s).
- The U S WEST NMS Element Manager places the requested MIB objects into an SNMPv1 PDU format and sends a SNMPv1 GET-RESPONSE message to the CNM User Gateway.
- The CNM User Gateway sends the SNMPv1 GET-RESPONSE message to the CNM Platform Router providing connectivity to the lower layer data transport service (i.e., SMDS or Frame Relay).

- Based on the destination IP address, the CNM Platform router forwards the SNMPv1 GET-RESPONSE message via the lower layer data transport service (i.e., SMDS or Frame Relay) (Frame Relay or SMDS).
- Customer router receives SNMPv1 GET-RESPONSE message and forwards the SNMPv1 GET-RESPONSE message to the customer NMS located on the customer LAN.
- Requested MIB information is presented to the customer NMS (typically via a graphical user interface).

4.8 U S WEST CNM Security Mechanism via Mediated Access

The U S WEST CNM User Gateway provides secure access to the authorized U S WEST CNM Option Customers. Access control, authentication / intrusion detection, and Read-Only capability are the security mechanisms which are implemented in the U S WEST CNM platform. In particular, the customer SNMPv1 request and response message exchanges are performed via the mediation services provided in the U S WEST CNM User Gateway. U S WEST CNM Option Customers are only allowed to access network management information that is pertinent to the customer's subscribed service.

4.8.1 Authentication

The CNM User Gateway generates authentication failure SNMPv1 Trap messages to all interested customer network management stations if a request from any single customer NMS fails security identification. An interested customer NMS is configured in the U S WEST CNM User Gateway via trap community strings at service subscription time.

4.8.2 Access Permission and MIB Views

The CNM User Gateway maintains access permission information for each customer. The access permission information is entered into the CNM User Gateway during CNM Option service subscription time. The following information is maintained by the U S WEST CNM User Gateway:

- Customer Network Management System Internet Protocol (IP) Address. Each customer may have a maximum of 32 NMS IP addresses provisioned in the CNM User Gateway Customer NMS Database. If the CNM User Gateway receives an SNMPv1 message whose IP address is not configured in the U S WEST CNM User Gateway Customer Database, the SNMPv1 message is discarded and no further action is taken.

- A Community Name, represented by an alphanumeric character string of up to 31 characters, is a password mechanism that is included in each SNMPv1 message. All customer NMS IP addresses must be associated with a particular community name at service subscription time. Each community string contains 1 to 16 access control blocks. Each access control block specifies the community string's MIB access and MIB view privileges.
- An MIB view is a set of network interfaces which an SNMPv1 manager (located in a customer NMS) is configured for access. The U S WEST NMS Element Manager Proxy Agent examines the MIB View associated with each customer NMS SNMPv1 Request. The proxy agent will only provide data for interfaces contained within a customer's configured MIB View.

Each PDU community string is compared with the list of community strings associated with the customer's NMS IP address. After each successful community string verification process, the MIB access is administered on each SNMPv1 Message. If a SNMPv1 SetRequest is identified, the intrusion detection process is invoked.

Intrusion detection is a process which is invoked in the U S WEST CNM User Gateway if the following conditions occur:

- Unsuccessful association of a community string association with a customer NMS IP address.
- Unsuccessful verification of MIB access permission.

Upon the occurrence of each intrusion detection, a Number Authorization Intrusion Attempts (NAIA) Counter is incremented, and an authentication trap (i.e., "Authoriation Failure" Trap) is issued to all appropriate customer network management stations. If the NAIA counter exceeds a configurable maximum value (also known as the Maximum Allowed Intrusion Access Attempts [MAIAA]), a Service Deny Timer (SDT) is initiated. While the SDT is in effect, any further intrusion attempts from the same NMS IP address are discarded, and no further action is initiated. The MAIAA and SDT values supported for the U S WEST CNM Option are indicated in Table 4-1.

Table 4-1 Intrusion Detection Parameters Supported by U S WEST CNM Option

Intrusion Detection Parameter	Range	Default
Number Authorization Intrusion Attempts	1 thru MAIAA	increments of 1
Service Deny Timer	10 s - 900 s	60 seconds
Maximum Allowed Intrusion Access Attempts (MAIAA)	1 - 10000	100

4.8.3 Read-Only Capability

The U S WEST CNM Option supports read-only capability for all network management information. Specifically, the U S WEST CNM User Gateway does not support the SNMPv1 Primitive Set Command. With read-only capability, the unauthorized customers cannot modify network management configuration information. All SNMPv1 Set Commands and associated variable instances issued by a customer's NMS are ignored by the CNM User Gateway, and the current variable instances are returned in the SNMPv1 Set Response Command.

5. U S WEST CNM Management Information Bases (MIBs) and Traps

5.1 General Description of Management Information Bases

A management information base (MIB) is a collection of managed objects that can be accessed via a network management application protocol. The basis for establishing MIBs as a repository for managed objects is to achieve management application protocol independence. The Structure of Management Information (SMI) specified in RFC 1155 defines the rules for how managed objects are described, and how the managed objects are accessed via the management application protocols. Essentially, SMI provides a well-defined interface between the management application protocol and the MIB.

5.2 Defining Managed Objects using Abstract Syntax Notation One (ASN.1) and Object Identifiers

A managed object is a single element contained within a management information base. The data description language specified in RFC 1155 for defining managed objects is a subset of OSI Abstract Syntax Notation One (ASN.1). ISO 8824 describes ASN.1 which provides the capability to describe information object structures in a machine independent or canonical format. The manner in which information objects are encoded using ASN.1 is specified in ISO 8825. A MIB is completely independent of any network management application protocol (e.g., SNMPv1, SNMPv2, CMIP). The MIB's independence attribute enables private vendors to develop "enterprise" MIBs for managing vendor specific network hardware.

The data description language specified in RFC 1155 to define managed objects is a subset of OSI Abstract Syntax Notation One (ASN.1). ASN.1 provides the capability to describe information object structures in a machine-independent or canonical format. In other words, a MIB is completely independent of any network management application protocol. The MIB's protocol independence attribute enables private vendors to develop "enterprise" MIBs for managing vendor specific network hardware.

Each managed object contains a data type (named set of values) and a data value (instance of a named set). Semantics of the managed objects are conveyed via the use of ASN.1 definitions. Data types and values are further described in Section 5.3.

5.2.1 Identification of Managed Objects

Each managed object is identified by an object identifier and/or an object descriptor:

- Object Identifier

  These unique sequence of numbers are assigned and administered by various organizations including International Organization for Standardization (ISO), International Electromechanical Commission (IEC), Internet Engineering Task Force (IETF), U. S. National Institute of Science and Technology (NIST), Internet Activities Board (IAB), and private vendors. An example of an object identifier for the Time Stamp object contained within an AT&T Frame Relay Interface Measurement Table is: "1.3.6.1.4.1.74.2.15.8.2.1.3". The derivation of the MIB object's unique sequence of numbers is based on a hierarchical approach for organizing data in an abstract MIB Tree (described in the Section 5.2.2).

- Object Descriptor or Object Name

  A text string which is a symbolic representation of a specific object. The object descriptor of the Time Stamp Object contained within an AT&T Frame Relay Interface Measurement Table is : "attCNMefrMeasTimeStamp".

5.2.2 Organization of Managed Objects and the MIB Tree

All managed objects are hierarchically organized into a MIB tree. A MIB tree imposes a hierarchical structure on a collection of objects. A MIB tree is a collection of managed objects called nodes, along with a relation (parent-child) that places hierarchical structure on the nodes. One of the nodes is distinguished as the root. Each node may have children of its own such that the node may be classified as a subtree.

Each node of the MIB tree has an assigned numerical value which is administered by various organizations such as ISO, CCITT, Internet, NIST, and private vendors. Figure 5-1 depicts the entire MIB tree which identifies the location of the AT&T MIBs supported by the U S WEST CNM Option. Figure 5-2 depicts the entire MIB tree which identifies the location of the MIB II and FRF.6 MIBs supported by the U S WEST CNM Option. The MIBs supported by the U S WEST CNM Option are the AT&T MIBs, the Internet MIB II System Group, the MIB II Interfaces group and the MIB II frnetservMIB. In the future, additional vendor product MIBs may be supported to enable the management of other vendors products deployed in the U S WEST Frame Relay and SMDS Network.

Per Figure 5-1, many subtrees exist in the overall MIB tree including the Internet Subtree, Private Subtree, and the Enterprise Subtree. The Enterprise Subtree is utilized to allow private parties or vendors providing networking subsystems to register product models. Objects within the MIBs are also hierarchically organized such that each can be uniquely identified by a sequence of numbers. The MIB, MIB elements (e.g., table, list), and MIB objects are uniquely identified by the sequence of integers (defined as Object Identifiers) which denote the path of traversal from the root. For example, the AT&T CNM Enhanced Frame Relay MIB and the AT&T CNM SMDS MIB are identified by the following object identifiers, respectively: "1.3.6.1.4.1.74.2.15.8" and "1.3.6.1.4.1.74.2.15.6".

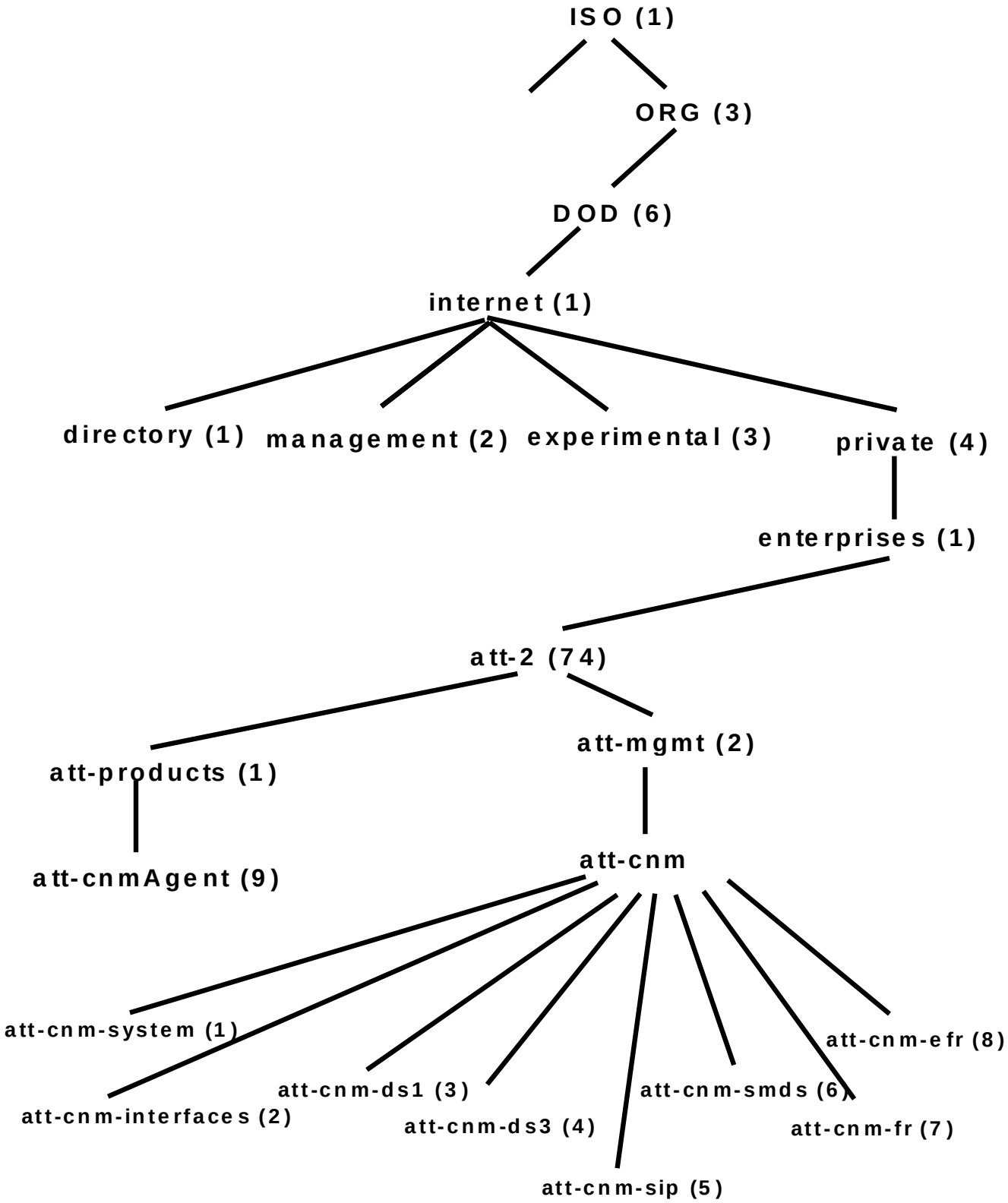

Figure 5-1 AT&T MIBs Supported by U S WEST CNM Option

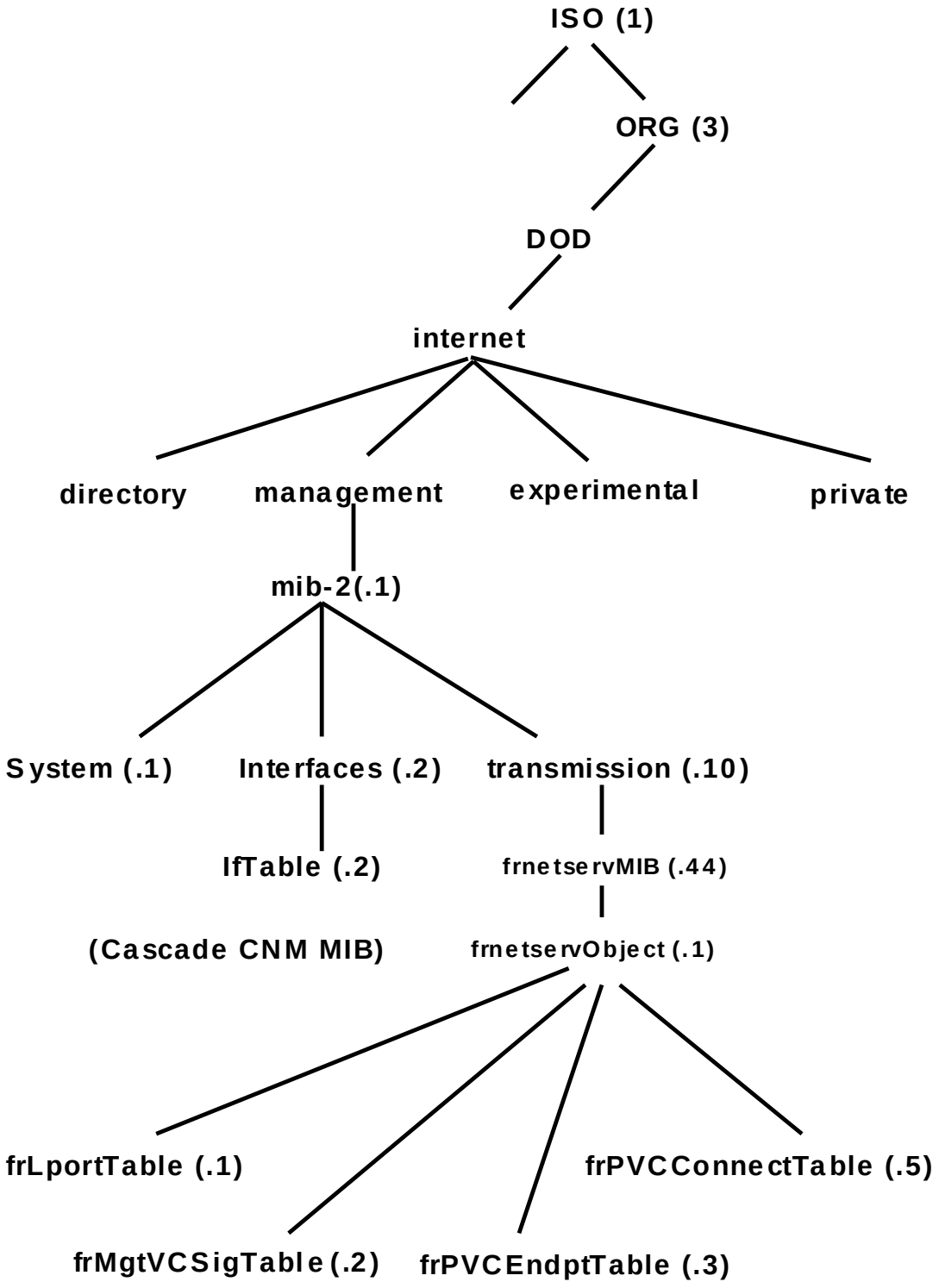

Figure 5-2 Cascade MIBs Supported by U S WEST CNM Option

5.3 Management Information Base Object Structure

The structure of the managed objects which are contained within a MIB is based on ASN.1 type Object Syntax as specified in RFC 1155. RFC 1155 defines the different syntax's which may be used to define the structure of a MIB. The object types of the MIB elements are defined using object-type macros specified in RFC 1212.

5.3.1 Macro Object Type Definitions and Syntax for MIBs Supported U S WEST CNM Option

The macro object-type permits the key aspects of an object type to be described in a formal and consistent manner. The macro object-type entities specified in RFC 1212 - *Concise MIB Definitions* are described below:

SYNTAX:	Defines the data type or an abstract data structure for an object type
ACCESS:	Defines the minimum level of support required for an object type
STATUS:	Defines the implementation support required for an object type
DESCRIPTION:	Provides textual description of object type
INDEX:	Defines instance identification information for an object type which corresponds to a conceptual row

The following semantic notations are used to describe MIB elements contained in the actual MIBs supported by the U S WEST CNM Option:

"SYNTAX" - < (Object Syntax as defined in RFC 1155 - SMI) >

"ACCESS" - < ("Read-Only", "read-write", "write-only", "not-accessible") >

"STATUS" - < ("mandatory", "optional", or "obsolete") >

"DESCRIPTION" - A textual description of the semantics of the object type.

5.3.2 Data Types for MIBs Supported by U S WEST CNM Option

The structure of a managed object is dependent upon the data types. SMI specifies the use of the following data types for defining the structure of managed objects:

Primitive Types

The following primitive types are applicable for defining types of managed objects for the U S WEST CNM Option:

INTEGER:	Positive of negative whole numbers, including zero.
OCTET STRING:	Ordered sequence of zero of more octets.
OBJECT IDENTIFIER:	Points (references) to another object located within an abstract MIB Tree
NULL:	Single value of null

Constructor Types

The ASN.1 constructor type SEQUENCE is supported for the purpose of generating ordered lists. The SEQUENCE type is used to develop tables of lists and rows of a table. The semantics for using the SEQUENCE type within a MIB is shown below.

The standard form for the List data type in a MIB is as follows :

<List> : : = SEQUENCE

{<type1>,

<typeN>}

The standard form for the Table data type in a MIB is as follows :

Table : a data type of the form

<Table> :=

SEQUENCE OF

<list>

Defined Types

A defined type is constructed via the use of primitive types and other defined types. New application-wide types may be defined such that each can resolve into a implicitly defined ASN.1 primitive type, list, table, or another application-wide type.

Examples of application-wide defined types are as follows :

IpAddress :	32-bit internet address
Counter :	Non-negative integer which monotonically increases until it reaches a maximum value, then wraps around and starts from zero
Gauge :	Non-negative integer which may increase or decrease, but latches at a maximum value
TimeTicks :	Non-negative integer which counts the time in hundredths of a seconds.

5.4 Management Information Bases (MIBs) Supported by U S WEST CNM Option

Initially, the MIBs supported by the U S WEST CNM Option are the AT&T MIBs located in the Private and Enterprise Subtrees. In addition, the MIB II System Group will be supported. As previously stated, the Enterprise Subtree is utilized to allow private parties or vendors providing networking subsystems to register models of their product. Thus, the following subsections provide a description of the AT&T MIBs supported by the U S WEST CNM Option.

5.4.1 AT&T CNM System MIB

The System group of managed objects (att-cnm-system) provide information relevant to the entire system. The 7 AT&T System Group Objects are described below :

attCNMsysDescr :	Textual description of device
attCNMsysObjectID :	Numeric identification of agent software
attCNMsysUpTime :	Elapsed time since last agent reboot
attCNMsysContact :	Name of contact person responsible for managed node
attCNMsysName :	Name of managed node
attCNMsysLocation :	Physical location of managed Node
attCNMsysServices :	Services (physical, data link, internet, end-to-end) provided by this managed Node.

The Interface Group of managed objects (att-cnm-interfaces) provides general information for all the Frame Relay and SMDS interfaces supported by the system. It includes the following tables :

- Interfaces Configuration Table

  This table provides configuration information on the interfaces managed by this system.

- Interfaces Status Table

  This table contains status information on the interfaces supported by this system.

See Table A-2 in the appendix section for specific information regarding the individual MIB objects within the Interface Group Tables shown above.

5.4.2 MIB II System Group

The implementation of the MIB-II System Group is mandatory for all systems. This group of objects contains 7 MIB elements which provide demographic information about the system. The 7 MIB elements are described below :

sysDescr :	Textual description of device
sysObjectID :	Numeric identification of agent software
sysUpTime :	Elapsed time since last agent reboot
sysContact :	Name of contact person responsible for managed node
sysName :	Name of managed node
sysLocation :	Physical location of managed Node
sysServices :	Services (physical, data link, internet, end-to-end) provided by this managed Node

5.4.3 AT&T DS1 MIB for Customer Network Management

The DS1 group of managed objects (att-cnm-ds1) supported by the U S WEST CNM Option are organized into the following abstract tables :

- DS1 Configuration Table.

  This table provides configuration information for the DS1 interfaces supported by this system

- DS1 Status Table.

  This table provides status information on the DS1 interfaces supported by this system.

- DS1 Error Counts Table.

  This table provides counts on the various protocol errors encountered by a DS1 interface during the specified measurement interval.

The MIB objects in the tables listed above provide network management information for the U S WEST SMDS and Frame Relay 1.544 Mbit/s Access Connections. See Table A-3 in the appendix section for specific information regarding the individual MIB objects within the DS1 MIB Tables mentioned above

5.4.4 AT&T DS3 MIB for Customer Network Management

The DS3 group of managed objects (att-cnm-ds3) supported by the U S WEST CNM Option are organized into the following abstract tables :

- DS3 Configuration Table.

  This table provides configuration information on DS3 interfaces supported by this system.

- DS3 Status Table.

  This table provides status information on DS3 interfaces supported by this system.

- DS3 Error Counts Table.

  This table provides counts on the various protocol errors encountered by a DS3 interface during the specified measurement interval.

The MIB objects in the tables listed above provide network management information for the U S WEST SMDS 44.736 Mbit/s Access Connections. See Table A-4 in the appendix section for specific information regarding the individual MIB objects within the MIB Tables mentioned above.

5.4.5 AT&T SMDS Interface Protocol (SIP) MIB for Customer Network Management

The SIP group of managed objects (att-cnm-sip) supported by the U S WEST CNM Option are organized into the following abstract tables :

- SIP Configuration Table.

  This table provides configuration information on the SIP interfaces supported by this system.

- SIP Measurements Table.

  This table provides counts on the various traffic measurements maintained by a SIP interface during the specified measurement interval.

- SIP Level 3 Error Log Table.

  This table provides a log of the latest occurrences of the various protocol errors encountered at the Level 3 layer of all SIP interfaces supported by this system.

The MIB objects in the SIP Tables listed above provide network management information for the Level 2 and Level 3 portion of the U S WEST SNIs. See Table A-5 in the appendix section for specific information regarding the individual MIB objects within the SIP MIB Tables mentioned above.

5.4.6 AT&T SMDS MIB for Customer Network Management

The SMDS group of managed objects (att-cnm-smds) supported by the U S WEST CNM Option are organized into the following abstract tables :

- SMDS Configuration Table.

  This table provides SMDS subscription parameters and configuration values maintained by all SMDS Subscriber-Network Interfaces (SNIs) that are supported by this system.

- SMDS SNI Addresses Table.

  This table lists the SMDS addresses assigned to the Subscriber-Network Interfaces (SNIs) supported by this system.

- SMDS Individual Address Screening Table.

  This table provides the list of SMDS addresses that form the Individual Address Screening Table for a subscriber-network interface.

- SMDS Group Address Screening Table.

  This table provides the list of SMDS addresses that form the Group Address Screening Table for a subscriber-network interface.

- SMDS Member-Group Address Table.

  This table identifies the group addresses that are associated with a particular individual address.

- SMDS Group-Member Address Table.

  This table identifies the member individual addresses that belong to a particular group, identified by a group address.

- SMDS Disagreements Table.

  This table provides the counts on the various SMDS disagreement errors encountered by all SNIs supported by this system.

- SMDS Disagreements Log Table

  This table provides a log of the latest occurrences of the various SMDS disagreements encountered by all SNIs supported by this system.

The objects in the SMDS MIB Tables listed above provide SMDS subscriber information maintained for the SNIs. See Table A-6 in the appendix section for specific information regarding the individual MIB objects within the SMDS MIB Tables mentioned above.

5.4.7 AT&T Frame Relay MIB

The Frame Relay group of managed objects (att-cnm-fr) supported by the U S WEST CNM Option are organized into the following abstract tables :

- Frame Relay Configuration Table

  This table provides configuration information the Frame Relay interfaces supported by this system.

- Frame Relay Measurements Table

  This table provides counts on the various measurement counts maintained by a Frame Relay interface during the specified measurement interval.

- Frame Relay PVC-level Measurements Table

  This table provides counts on the various PVC-level measurement counts maintained by a Frame Relay interface during the specified measurement interval.

- Frame Relay PVC-level Status Table

  This table provides status information on Data Link Connections on all Frame Relay interfaces supported by this system.

The objects in the Frame Relay MIB Tables listed above provide network management information for Frame Relay Access Connections which terminate on U S WEST Frame Relay Node Port(s). The Frame Relay MIB is only supported in designated U S WEST Frame Relay Nodes. See Table A-7 in the appendix section for specific information regarding the individual MIB objects within the Frame Relay MIB Tables mentioned above.

5.4.8 AT&T Enhanced Frame Relay MIB for Customer Network Management

The Frame Relay group of managed objects (att-cnm-efr) supported by the U S WEST CNM Option are organized into the following abstract tables :

- Frame Relay Interface-level Configuration Table

  This table provides configuration information on the Frame Relay interfaces supported by this system.

- Frame Relay Interface-level Measurements Table

  This table provides counts on the various measurement counts maintained by a Frame Relay interface during the specified measurement interval.

- Frame Relay PVC-level Configuration Table

  This table provides PVC-level configuration information for the Frame Relay interfaces supported by this system.

- Frame Relay PVC-level Measurements Table

  This table provides counts on the various PVC-level measurement counts maintained by a Frame Relay interface during the specified measurement interval.

- Frame Relay PVC-level Status Table

  This table provides status information on Data Link Connections on all Frame Relay interfaces supported by this system.

The objects in the Enhanced Frame Relay MIB Tables listed above provide network management information for Frame Relay Access Connections which terminate on a U S WEST Frame Relay Node Port(s). The Frame Relay MIB is only supported in designated U S WEST Frame Relay Nodes. See Table A-8 in the appendix section for specific information regarding the individual MIB objects within the Enhanced Frame Relay MIB Tables mentioned above.

The AT&T Enhanced Frame Relay MIB refers to "local" and "remote" devices. These terms are used to identify devices relative to the interface that is being managed. The "local" device is the Frame Relay equipment connected to the interface (port) being managed. The "remote" device refers to the Frame Relay equipment connected to the interface that will be at the other end of the virtual connection associated with the PVCs being managed.

5.4.9 Cascade Frame Relay MIB for Customer Network Management

The Frame Relay group of managed objects supported by the U S WEST CNM Option are organized into the following abstract tables :

- Frame Relay MIBII System Table.

  This table provides information about the CNM gateway.

- Frame Relay MIBII Interfaces Table.

  This table provides subscriber interface information.

- Frame Relay MIBII FrNetServMIB Table.

  This table provides the Cascade Frame Relay MIB.

5.5 SNMPv1 Traps Supported by U S WEST CNM Option

The U S WEST CNM Option supports four types of SNMPv1 Traps :

- Cold Start Trap

  This type of trap is issued to the customer NMS when the U S WEST NMS Element Manager Proxy Agent re-initializes.

- Link Up

  This type of trap is issued to the customer NMS when a customer's interface (within the subscribed portion of the U S WEST Frame Relay or SMDS Network) is placed into normal operation.

- Link Down

  This type of trap is issued to the customer NMS when a customer's interface (within the subscribed portion of the U S WEST Frame Relay or SMDS Network) is non-operational.

- Authentication Failure

  An authentication Failure is issued to all interested customer NMSs if an authentication failure occurs as described in Chapter 4, Section 4.7 of this document.

5.6 Acquisition of MIBs Supported by U S WEST CNM Option

The actual MIBs supported in the U S WEST CNM Option are available to each U S WEST CNM Option Subscriber. The MIBs are contained within individual ASCII text files, and are based on ASN.1 syntax. The MIBs are accessible to U S WEST CNM Option Customers as follows :

- Electronic Mail using SMTP (Simple Mail Transfer Protocol supporting textual electronic mail message services) from U S WEST to U S WEST CNM Option Customer
- Customer must provide adequate means for receiving e-mail from U S WEST
- Hard Copy of MIBs may be provided to U S WEST CNM Customer
- Diskette provided by U S WEST

6. Service Performance Objectives

6.1 General

This section describes the service and performance objectives for U S WEST CNM Option. For service and performance objectives associated with U S WEST Frame Relay Service and SMDS, refer to the respective technical publication.

6.2 CNM Option Service Objectives

The service parameters and objectives shown in Table 6-1 are supported for the U S WEST CNM Option. Each of the service parameters are defined below:

- The availability of a service is a measure of the time the service is usable by a customer. The availability is expressed as a percentage that the service is performing in accordance with the service performance objectives over an average 12 month period. This percentage may be represented as follows :

$$\text{Availability (\%)} = \frac{\text{(Total Time - Outage Time)}}{\text{Total Time *}} \times 100$$

* The total time is 12 months and outage time is expressed in similar units

The U S WEST CNM Option availability objective is 99.63%.

- Scheduled Service Time

  Length of time in hours that the network is expected to provide CNM Option.

- U S WEST SNMPv1 User Gateway Average Response Time

  The elapsed time from the customer's submission of an SNMPv1 GET or GET-NEXT message across the SMDS SNI or Frame Relay UNI to the customer's receipt of the corresponding SNMPv1 Get-Response message.

For the context of this service performance objective, the message is assumed to consist of only one MIB object. Under normal traffic conditions, the U S WEST CNM User Gateway should support a U S WEST SNMPv1 User Gateway Average Response Time of 5 seconds for 95% of all the SNMPv1 Version 1 GET or GET-NEXT Requests for a 1.544 Mbps access connection. The response time will be dependent upon the volume and frequency of the SNMP requests issued to the CNM user gateway. The MIBs supported in the U S WEST CNM Option organize the MIB elements in multiple lists and tables. U S WEST recommends that the MIB Objects be accessed by row in order to optimize performance.

Table 6-1 U S WEST CNM Option Service Parameters and Objectives

Service Parameter	U S WEST CNM Option Objective
Availability	99.63%
Scheduled Service Time	7 days a week, 24 hours a day
U S WEST CNM User Gateway Average Response Time	5 Seconds

7. Maintenance

7.1 Customer Responsibilities

Customer must provide, operate, and maintain the network management application software resident within the customer NMS. Customer's are responsible for providing sufficient training in order to meet the above requirements

The customer is responsible for all equipment and cable beyond the Network Interface (NI) at the customers location. The physical connector at the NI will be one of the following jacks : RJ48S, RJ48T, RJ48C, RJ48H, RJ48M, or equivalent.

In the case of service trouble, the customers or their responsible agent is responsible for sectionalizing the trouble and verifying that the trouble is not in the customer owned hardware, software (including NMS software), or cable before calling the !NTERPRISE Customer Service Center.

If the service trouble is isolated to the customer owned hardware, software, and/or cable, the customer or its responsible agent is responsible clearing trouble and restoring the service to normal operation.

In the case of degraded service (e.g., frequent slow response times, dropped SNMP packets), the customer should contact the !NTERPRISE Customer Service Center at 1-800-227-2218.

Joint testing between the customer and/or its responsible agent, and U S WEST personnel may be necessary for isolating service troubles.

7.2 U S WEST Responsibilities

U S WEST is responsible for all hardware, software, and cable on the U S WEST side (i.e., network side) of the NI at the customer location, and also for maintaining the underlying transport facilities between the customer locations, and between the Central Office (CO) Hub and the customer location.

U S WEST will furnish the customer a trouble reporting telephone number, and will commit to a two (2) hour maximum service restore time in the event of a service interruption due to an electronic component failure. If the trouble is caused by a facility failure, the maximum service restore time is eight (8) hours. The maximum service restore time in the event of a node failure is 2.5 hours.

8. Definitions

8.1 Acronyms

ACS	Advanced Communication Services
ANSI	American National Standards Institute
ASN.1	Abstract Syntax Notation One
CCITT	International Telephone and Telegraph Consultative Committee
CIR	Committed Information Rate
CNM	Customer Network Management
CPE	Customer Provided Equipment
CSU	Channel Service Unit
CRC	Cyclic Redundancy Check
DDS	Digital Data Service
DE	Discard Eligibility
DLCI	Data Link Connection Identifier
DOD	Department of Defense
DS1	Digital Signal Level 1 (1.544 Mbit/s)
DQDB	Distributed Queue Dual Bus
DSU	Data Service Unit
DTE	Data Terminal Equipment
EC	Exchange Carrier
EU	End-User
EU-POT	End-User Point of Termination
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FR	Frame Relay
FRF	Frame Relay Forum
FRS	Frame Relay Service
IETF	Internet Engineering Task Force
IC	Interexchange Carrier

IC-POP	Interexchange Carrier-Point of Presence
IP	Internet Protocol
ISDN	Integrated Services Digital Network
ISO	International Organization For Standardization
L2_PDU	Level 2_Protocol Data Unit
L3_PDU	Level 3_Protocol Data Unit
LAN	Local Area Network
LAPD	Link Access Procedure D
LATA	Local Access and Transport Area
LEC	Local Exchange Carrier
LMI	Local Management Interface
MAC	Medium Access Control
MIB	Management Information Base
NC	Network Channel
NCI	Network Channel Interface
NI	Network Interface
NMS	Network Management Station
NNI	Network-to-Network Interface
OSI	Open System Interconnection
PDU	Protocol Data Unit
POP	Point of Presence
POT	Point of Termination
PVC	Permanent Virtual Connection
RFC	Request For Comments
SDLC	Synchronous Data Link Control
SIP	SMDS Interface Protocol
SMI	Structure of Management Information
SNMP	Simple Network Management Protocol
SNMPv1	Simple Network Management Protocol Version 1
SNMPv2	Simple Network Management Protocol Version 2
SWC	Serving Wire Center
Tc	Measurement Interval

TCP/IP	Transmission Control Procedures/Internet Protocol
UDP	User Datagram Protocol
UNI	User-Network Interface

8.2 Glossary

Alternate Mark Inversion (AMI)

A one (mark) pulse which is the opposite polarity as its predecessor.

American National Standard Institute (ANSI)

An organization supported by the telecommunications industry to establish performance and interface standards.

Availability

The relative amount of time that a service is "usable" by a customer, represented as a percentage over a consecutive 12 month period.

Bandwidth

The range of frequencies that contain most of the energy or power of a signal; also, the range of frequencies over which a circuit or system is designed to operate.

Bc - Committed Burst Size (bits)

The maximum amount of subscriber data that the network agrees to transfer, under normal conditions, during a time interval Tc.

Be - Excess Burst Size (bits)

The maximum amount of uncommitted data in excess of Bc that the network will attempt to transfer during a time interval Tc.

Bipolar with 8 Zero Substitution (B8ZS)

Bipolar 8 Zero Substitution is an application of BPRZ and is an exception to the Alternate Mark Inversion (AMI) line-code rule. It is one method for providing bit independence for digital transmission by providing a minimum 1s density of 1 in 8 bits.

Bits/second (bit/s)

Bits per second; e.g., 1200bps. In data transmission, it is the number of binary zero and one bits transmitted in 1 second. Modern terminology uses "bit/s"; e.g., 1200 bit/s.

Bit Error Rate (BER)

The ratio of the number of bit errors to the total number of bits transmitted in a given time interval.

Byte

A consecutive number of bits usually constituting a complete character or symbol. If the length of the byte is not specified, it is conventionally assumed to have a length of 8 bits. In the Digital Data System, a byte refers to an arbitrary group of 8 consecutive bits; it does not correspond to a byte of customer data.

Carrier

An organization whose function is to provide telecommunications services. Examples are: Local Exchange Carrier, Interexchange Carriers, Cellular Carriers, etc.

Central Office (CO)

A local switching system (or a portion thereof) and its associated equipment located at a wire center.

Channel

An electrical or photonic, in the case of fiber optic based transmission systems, communications path between two or more points of termination.

Channel Service Unit (CSU)

This unit provided regeneration of the signal received from the network, controls the pulse shape and amplitude for transmission of the signal into the network, and possibly provided loop-back. The CSU function is frequently found within a Data Service Unit (DSU).

Character

Letter, numeral, punctuation, control figure or any other symbol contained in a message.

Committed Information Rate (CIR) bit/s

The rate at which the network agrees to transfer information, under normal conditions, during a time interval Tc.

Customers

Denotes any individual, partnership or corporation who subscribes to the services provided by U S WEST Customers are divided into two distinct and separate categories: (1) carriers, who provide interexchange services for hire for others, and (2) end-users, who request services only for their own use.

Cyclic Redundancy Check (CRC)

A method of checking the integrity of received data, where the check uses a polynomial algorithm based on the content of the data.

Customer Premises

Denotes a building or portions(s) of a building occupies by a single customer or end-user either a place of business or residence. Adjacent building and the buildings on the same continuous property occupies by the customer and not separated by a public thoroughfare, are also considered the customer's premises.

Customer Provided Equipment (CPE)

Equipment owned and maintained by the customer and located on their side of the End-user Point of Termination (EU-POT) network interface. In the U S WEST Digital Data Service application, CPE typically includes the DSU (CSU/DSU) and data terminal equipment which are connected to the channel.

Data Link Connection Identifier (DLCI)

The DLCI is located within the address field of a frame relay packet, and is used to identify each PVC.

Service Unit (DSU)

Digital, customer premises equipment used to recover timing from a baseband BPRZ signal, and which converts from BPRZ line signals to a business machine interface signal such as V.35. At 64 kbit/s and below, DSU and Channel Service Unit (CSU) functions are, in modern equipment, combined in a single unit sometimes called a General Service Unit (GSU), Basic Service Unit (BSU) or Data Service Unit -A (DSU-A) so that it is part of the Data Communications Equipment (DCE). Above 64 kbit/s, DSU functions are frequently contained in the Data Terminal Equipment (DTE). The DSU usually contains circuitry to recognize, and respond to, loop-back commands from the serving test center.

Data Terminal Equipment (DTE)

A generic term for customer terminal equipment that connects to the network through a modem or through digital Network Channel Terminating Equipment (NCTE), e.g., a computer or a PBX.

Destination Address

An 8-octet field contained within the Level 3 Protocol Data Unit which identifies a specific end point of the destination SNI.

Digital Hierarchy Level

The level in the digital hierarchy. The levels and the respective bit rates are:

Level		Bit Rate
DS0	64.	kbit/s
DS1	1.544	Mbit/s
DS1C	3.152	Mbit/s
DS2	6.312	Mbit/s
DS3	44.736	Mbit/s
DS4NA	139.264	Mbit/s
DS4	274.176	Mbit/s

Discard Eligibility (DE) Indicator bit

A single bit located within the address field of a frame relay packet which is used to indicate that a frame should be discarded in preference to other frames during a frame discarding process.

Ethernet

A packet-switched local network design (by Xerox Corporation) employing CSMA/CD as access control mechanism.

End-User (EU)

The term "end-user" denotes any customer of telecommunications service that is not a carrier, except that a carrier shall be deemed to be an "end-user" to the extent that such carrier uses a telecommunications service for administrative purposes without making such service available to others, directly or indirectly. The term is frequently used to denote the difference between a Carrier interface and an interface subject to unique regulatory requirements at non-Carrier customer premises (FCC Part 68, etc.)

End-User POT (EU-POT)

The Network Interface at the end-user's premises at which U S WEST's responsibility for the provision of service ends.

Facilities

Facilities are the transmission paths between the demarcation points serving customer locations, a demarcation point serving a customer location and a U S WEST Central Office, or two U S WEST offices.

Flow Control

The function of managing the rate at which data is received/transmitted by a receiver/transmitter.

Frame Relay Access Link

A Frame Relay access channel used to access the designated geographical U S WEST Frame Relay Service Serving Area.

Group Address Screen

Group Address Screen is used for screening destination addresses of protocol data units originating by the CPE.

Individual Address Screen

Individual Address Screens is used for screening destination addresses of Protocol Data Units (PDUs) originating by the CPE, and source addresses of PDUs delivered to the CPE.

Integrated Services Digital Network (ISDN)

A network providing or supporting a range of telecommunications services that provides digital connections between end-users.

Interexchange Carrier (IC)

Any individual, partnership, association, joint-stock company, trust, governmental entity or corporation engaged for hire in interstate or foreign communication by wire or radio, between two LATAs.

Kilobit/Second (kbit/s)

One thousand (1000) bit/second

Local Access and Transport Area (LATA)

A geographic area for the provision and administration of communications service. It encompasses designated exchanges that are grouped to serve common social, economic and other purposes.

Local Area Network (LAN)

Network permitting the interconnection and intercommunication of a group of computers, primarily for the sharing of resources such as data storage devices and printers.

Multiplexer

An equipment unit to multiplex, or do multiplexing: Multiplexing is a technique of modulating (analog) or interleaving (digital) multiples, relatively narrow bandwidth channels into single channel having a wider bandwidth (analog) or higher bit-rate (digital). The term Multiplexer implies the demultiplexing function is present to reverse the process so it is not usually stated.

Network Channel (NC) Code

The Network Channel (NC) code is an encoded representation used to identify both switched and non-switched channel services. Included in this code set are customer options associated with individual channel services, or feature groups and other switched services.

Network Channel Interface (NCI) Code

The Network Channel Interface (NCI) code is an encoded representation used to identify five (5) interface elements located at a Point of Termination (POT) at a central office or at the Network Interface at a customer location. The Interface code elements are: Total Conductors, Protocol, Impedances, Protocol, Impedances, Protocol Options, and Transmission Level Points (TLP). (At a digital interface, the TLP element of the NCI code is not used).

Network Interface (NI)

The point of demarcation on the customer's premises at which U S WEST's responsibility for the provision of service ends.

Octet

An eight (8) bit byte

Packet

A unit of data, consisting of binary digits including data and call-control signals, that is switched and transmitted as a composite whole.

Packet Switched Network

A switched network which provides connection for forwarding standard data packets between user parties.

Point of Presence (POP)

A physical location within a LATA at which an Interexchange Carrier (IC) establishes itself for the purpose of obtaining LATA access and to which U S WEST Provides access service.

Point of Termination (POT)

The physical telecommunications interface that establishes the technical interface, the test point(s), and the point(s) of operational responsibility. (See Network Interface).

Port

A place at which energy or signals enter or leave a device, circuit, etc.

Premises

Denotes a building or portion(s) of a building occupied by a single customer or end-user either as a place of business of residence.

Protocol

The rules for communication system operation which must be followed if communication is to be effected; the complete interaction of all possible series of messages across an interface. Protocols may govern portions of a network, types of service, or administrative procedures.

Protocol Data Unit (PDU)

An International Standards Organization (ISO) term referring to a packet of information exchange between two entities via a protocol.

Serving Wire Center (SWC)

The term "Serving Wire Center" denotes a U S WEST Central Office from which dial tone for the Local Exchange Service would normally be provided to the demarcation point on the property at which the customer is served.

Signaling

The transmission of information to establish, monitor, or release connections and/or provide Network Control.

Source Address

An 8-octet field contained within the Level 3_ Protocol Data Unit (L3_PDU) which identifies a specific end point of the originating SNI.

Switched Multi-megabit Data Service (SMDS) Access Connection

Allows for the transfer of information between Customer-provided compatible SMDS equipment and the ACS Network.

Switched Multi-megabit Data Service (SMDS) Data Unit

A packet which contains Customer information. Each data unit contains both the source address that identifies the originating Subscriber Network Interface and the destination address that identifies the SNI of the intended recipient.

Switched Multi-megabit Data Service (SMDS) Group Address

An address type of a set of individual address associated with one or more Subscriber Network Interfaces (SNI's).

Switched Multi-megabit Data Service (SMDS) Individual Address

An address type of a specific end point of a SNI.

Subscriber Network Interface (SNI)

The point at which CPE interfaces to the network supporting SMDS.

Tc - Committed Rate Measurement Interval(s)

A time interval for which the subscriber's committed information rate is measured. The formula used to calculate Tc is: Tc=Bc/CIR.

Transmission Control Protocol/Internet Protocol (TCP/IP)

Internetworking software suite originated on the Department of Defense's Arpanet network. IP corresponds to Open Systems Interconnection (OSI) network Level 3, TCP to OSI Layer 4 and 5.

9. References

9.1 American National Standard Institute (ANSI)

ANSI T1.602-1989 *ISDN - Data-Link Layer Signalling Specification for Application at the User-network Interface*

ANSI T1.606-1990 *ISDN - Architectural Framework and Service Description for Frame-Relaying Bearer Service*

ANSI T1.606a-1992 *ISDN - Architectural Framework and Service Description for Frame-Relaying Bearer Service (Congestion Management and Frame Size), Supplement to ANSI T1.606-1990*

ANSI T1.606b-1993 *ISDN - Supplement to Architectural Framework and Service Description for Frame-Relaying Bearer Service (Network-to-Network Interface Requirements)*

ANSI T1.617-1991 *ISDN - Signaling Specification for Frame Relay Bearer Service for Digital Subscribers Signaling Systems Number 1 (DSS1)*

ANSI T1.618-1991 *ISDN - Core Aspects of Frame Protocol for Use with Frame Relay Bearer Service*

9.2 Bellcore Documents

TR-TSV-001062 *Generic Requirements For Phase 1 SMDS Customer Network Management Service,* Issue 1, March 1993

9.3 Frame Relay Forum Documents

FRF.1.1 *The Frame Relay Forum User-to-Network Implementation Agreement (UNI)*, January 1996

FRF.2.1 *Frame Relay Network-to-Network Interface Phase 1 Implementation Agreement,* July 1995

FRF.3.1 *Multiprotocol Encapsulation Implementation Agreement,* January, 1995

FRF.6 *Final Draft - Frame Relay Service Customer Network Management Implementation Agreement,* January 13, 1994. Ratified document will be published as FRF.6.

001-208966 *Frame Relay Specifications With Extensions Based on Proposed T1S1 Standards*, Revision 1.0, September 18, 1990, Cisco Systems, Inc., Digital Equipment Corporation, Northern Telecom, Inc., and StrataCom, Inc.

9.4 Internet Engineering Task Force (IETF) Request for Comment (RFC) Documents

RFC 768 User Datagram Protocol, J. Postel, Information Sciences Institute, August 1980.

RFC 791 Internet Protocol - DARPA Internet Program Protocol Specification, Information Sciences Institute, September 1981.

RFC 1060 Assigned Numbers, J. Reynolds, J. Postel, Network Information Center (NIC), SRI International, Menlo Park, CA, March 1990.

RFC 1122 Requirements for Internet Hosts - Communication Layers, Internet Engineering Task Force, R. Braden, Network Information Center (NIC), SRI International, Menlo Park, CA, October 1989.

RFC 1155 Structure and Identification of Management Information for TCP/IP-based Internets, M. T. Rose, K. Mckloghrie, Network Information Center (NIC), SRI International, March 1991.

RFC 1157 Simple Network Management Protocol, J.D. Case, M. Fedor, M.L. Schoffstall, C. Davin, Network Information Center (NIC), SRI International, Menlo Park, CA, May 1990.

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9.5 Institute of Electrical And Electronics Engineers (IEEE)

IEEE 802.6-1990 *Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN)*

9.6 International Telephone and Telegraph Consultative Committee (CCITT)

CCITT I.122 *Framework for Additional Packet Mode Bearer Services*

CCITT Q.922 *ISDN User-Network Data Link Layer Specification*

CCITT Q.933 *DSS1 Signaling Specification for Frame Mode Basic Call Control, ITU, Geneva, 1992*

9.7 International Organization for Standardization (ISO)

IS 8824.2 Specification of Abstract Syntax Notation One (ASN.1)

IS 8825 Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)

9.8 U S WEST Technical Publications

PUB 77372 U S WEST Frame Relay Service, Issue D, April 1996

PUB 77373 U S WEST Switched Multi-megabit Data Service, Issue B, September 1993

9.9 Ordering Information

All documents are subject to change and their citation in this document reflects the most current information available at the time of printing. Readers are advised to check status and availability of all documents.

Ordering Information for Employees of U S WEST :

Manager - IRM
1801 California St., Rm. 1330
Denver, CO 80202
(303) 297-7620

The Frame Relay Forum
303 Vintage Park Drive
Foster City, CA 94404
or call: 1-415-578-6980
Facts-by-Fax service: 1-415-688-4317

OR via E-Media internal web site

Those who are not U S WEST employees may order

American National Standards Institute (ANSI) documents from :

American National Standards Institute
Attn: Customer Service
11 West 42nd Street
New York, NY 10036
Telephone: (212) 642-4900
Facsimile: (212) 302-1286

ANSI has a catalog available which describes their publications.

Bellcore and CCITT documents from :

Bellcore - Customer Services
60 New England Avenue
Piscataway, NJ 08854-4196
Telex: (201) 275-2090
Fax: (908) 699-0936
Phone: (800) 521-CORE (U.S. calls only)

U S WEST Technical Publications from :

Faison Office Products Company

3251 Revere Street
Suite 200
Aurora, Colorado 80011
Telephone: (303) 340-3672
(800) 777-3672
Fax: (303) 340-1905

Internet Engineering Task Force (IETF) Documents from :

Request for Comment (RFC) documents can be accessed via the World Wide Web site at:
http://ds.internic.net/ds/dspg1intdoc.html
or send e-mail to:
mailserv@ds.internic.net

International Organization For Standardization Documents from :

Omnicomm PPI / Phillips Business Information, Inc.
P. O. Box 59665
1201 Seven Locks Rd., Suite 300
Potomac, MD 20854
Telephone : 1-800-OMNICOM
1-301-424-3338
Fax : 1-301-309-3847

A. AT&T MIBs and Description of MIB Objects

The purpose of the appendix is to provide a brief description of all the individual MIB objects supported in the AT&T MIBs. The purpose of including this information is not to serve as a replacement of the actual MIB text files. Chapter 5, Section 5.6 describes the various methods for acquiring the actual MIB text files.

The appendix contains multiple tables which briefly describe the MIB objects contained within the actual AT&T MIBs. Each MIB object is logically organized into either a group object or a table object. In addition, each individual object has an assigned object descriptor (or object name) and an object identifier. The tables provided in this appendix depict the actual logical structure of the MIB objects within the respective AT&T MIBs.

Table A-1 below provides the list of the AT&T MIBs and the corresponding appendix table which briefly describes the individual MIB objects. For further information regarding each individual MIB object, the description clause within the actual MIB text file provides a complete description of each individual MIB object.

Table A-1 Reference Table for Individual MIB Object Descriptions

Management Information Base Name	Managed Service U S WEST Service	Appendix Table Reference
AT&T CNM MIB	Frame Relay and SMDS	A-2
AT&T DS1 MIB	Frame Relay and SMDS	A-3
AT&T DS3 MIB	SMDS	A-4
AT&T SIP MIB	SMDS	A-5
AT&T SMDS MIB	SMDS	A-6
AT&T Frame Relay MIB	Frame Relay	A-7
AT&T Enhanced Frame Relay MIB	Frame Relay	A-8

Table A-2 AT&T CNM System MIB Object Description

MIB Name	Table Name	Object Name	Description
AT&T CNM System MIB	**System Group**		**System group of objects (att-cnm-system) provide information relevant to the entire system**
		attCNMsysObjectID	Vendor's authoritative identification
		attCNMsysUpTime	Time (in hundredths of a second) since the SNMP interface portion of the system was last re-initialized
		attCNMsysContact	Contact person(s) or organization(s) for this system
		attCNMsysName	Administratively assigned name for this system. By convention, this is the system's fully-qualified domain name
		attCNMsysLocation	Physical location of this system
		attCNMsysServices	Indicates set of services offered by the managed network elements
		attCNMifNumber	Total Number of interfaces supported
	attCNMifConfigTable		**List of entries containing general information for all interfaces managed by this system**
		attCNMifConfigEntry	General configuration information for a particular interface
		attCNMifConfigIndex	Attcnmifconfigindex
		attCNMifDescr	Name of the service provider
		attCNMifType	Type of interface being managed
		attCNMifMtu	Size of the largest data pdu which can be sent/received on the interface
		attCNMifSpeed	Estimate of the interface's current nominal bandwidth in bits per second.
		attCNMifContact	Identifies the contact person(s) or organization(s) responsible for support of this interface.
		attCNMifLocation	Identifies the physical location of the switching system that terminates this interface.
		attCNMifSubscriber	Identifies the contact person(s) or organization(s) that have subscribed to this interface
	attCNMifStatusTable		**List of entries containing status information for all interfaces managed by this system**
		attCNMifStatusEntry	Entry containing status information of a particular interface
		attCNMifStatusIndex	Unique value for each interface
		attCNMifAdminStatus	Desired state of this interface
		attCNMifOperStatus	Current operational state of this interface

Table A - 3 AT&T DS1 MIB Object Description

MIB Name	Table Name	Object Name	Description
AT&T DS1 MIB	**attCNMds1ConfigTable**		**Configuration Table for DS1 Interfaces**
		attCNMds1ConfigEntry	An entry in the Configuration Table
		attCNMds1ConfigIndex	Interface Number
		attCNMds1LineType	DS1 Frame Format supported by this interface
		attCNMds1ZeroCoding	Zero code suppression/substitution used
		attCNMds1ErrorsMaxintervals	Maximum number of intervals supported for DS1 errors
		arrCNMds1ErrorsIntervalLen	Time length of each interval for DS1 errors
	attCNMds1CStatusTable		**Status for DS1 Interfaces**
		attCNMds1CStatusEntry	An entry in the Status Table
		attCNMds1CStatusIndex	Interface Number
		attCNMds1LineState	Most outstanding severe alarm condition on this interface
	attCNMds1ErrorsTable		**Errors Table for DS1 Interfaces**
		attCNMds1ErrorsEntry	An entry in the Errors Table
		attCNMds1ErrorsIndex	Interface Index
		attCNMds1ErrorsInterval	Measurement interval number for which measurement is provided
		attCNMds1ErrorsTimeStamp	Time stamp (TimeTicks) corresponding to end of specified interval
		attCNMds1ErrorsLocalTime	Time stamp (ASCII string) corresponding to end of specified interval
		attCNMds1LCVs	Line Code Violations
		attCNMds1LESs	Line Errored Seconds
		attCNMds1LSESs	Line Serverely Errored Seconds
		attCNMds1CVs	Code Violations
		attCNMds1ESs	Errored Seconds
		attCNMds1SESs	Severely Errored Seconds
		attCNMds1SEFSs	Severely Errored Framing Seconds
		attCNMds1UASs	Unavailable Errored Seconds

Table A - 4 AT&T DS3 MIB Object Description

MIB Name	Table Name	Object Name	Description
AT&T DS3MIB	**attCNMds3ConfigTable**		**Configuration Table for DS3 Interfaces**
		attCNMds3ConfigEntry	An entry in the configuration table
		attCNMds3ConfigIndex	Interface Number
		attCNMds3LineType	DS3 C-bit application supported by this interface
		attCNMds3ZeroCoding	Zero code suppression/substitution used
		attCNMds3ErrorsMaxIntervals	Maximum number of intervals supported for DS3 errors
		attCNMds3ErrorsIntervalLen	Time-length of each interval for DS3 errors
	attCNMds3StatusTable		**Status Table for DS3 Interfaces**
		attCNMds3StatusEntry	An entry in the Status Table
		attCNMds3StatusIndex	Interface Number
		attCNMds3AlarmStatus	Most outstanding severe alarm condition on this interface
	attCNMds3ErrorsTable		**Errors Table for DS3 Interfaces**
		attCNMds3ErrorsEntry	An entry in the Errors Table
		attCNMds3ErrorsIndex	Interface Index
		attCNMds3ErrorsInterval	Measurement interval number for which measurement is provided
		attCNMds3ErrorsTimeStamp	Time stamp (TimeTicks) corresponding to end of specified interval
		attCNMds3ErrorsLocalTime	Time stamp (ASCII string) corresponding to end of specified interval
		attCNMds3LCVs	Line Code Violations
		attCNMds3LESs	Line Errored Seconds
		attCNMds3LSESs	Line Severely Errored Seconds
		attCNMds3CVs	Code Violations
		attCNMds3ESs	Errored Seconds
		attCNMds3SESs	Severely Errored Seconds
		attCNMds3SEFSs	Severely Errored Framing Seconds
		attCNMds3UASs	Unavailable Seconds

Table A-5 AT&T SIP MIB Object Description

MIB Name	Table Name	Object Name	Description
AT&T SIP MIB	**attCNMsipConfigTable**		**Configuration Table for SIP Interfaces**
		attCNMsipConfigEntry	An entry in the Configuration Table
		attCNMsipConfigIndex	Interface Number
		attCNMsipMeasMaxIntervals	Maximum number of intervals supported for the SIP measurements
		attCNMsipMeasIntervalLen	Time-length of each interval for SIP Measurements
	attCNMsipMeasTable		**Measurement Table for SIP Interfaces**
		attCNMsipMeasEntry	An entry in the Measurement Table
		attCNMsipMeasIndex	Interface Number
		attCNMsipMeasInterval	Measurement interval number for which measurement is provided
		attCNMsipMeasTimeStamp	Time stamp (TimeTicks) for the end of specified interval
		attCNMsipMeasLocalTime	Time Stamp (ASCII string) for the end of specified interval
		attCNMsipReceivedL3PDUs	Number of individual and group addressed L3 PDUs received
		attCNMsipSentL3PDUs	Number of individual and group addressed L3 PDUs sent
		attCNMsipReceivedGroupL3PDUs	Number of group addressed L3 PDUs received
		attCNMsipSentGroupL3PDUs	Number of group addressed L3 PDUs sent
		attCNMsipReceivedL2PDUs	Number of L2 PDUs received
		attCNMsipSentL2PDUs	Number of L2 PDUs sent
	attCNMsipL3ErrorLogTable		**Table of Log of latest occurrence of protocol errors for SIP**
		attCNMsipL3ErrorLogEntry	An entry in the Errors log table
		attCNMsipL3ErrorLogIndex	Interface number
		attCNMsipL3ErrorType	Type of error
		attCNMsipL3ErrorSA	SMDS source address in the rejected L3 PDU
		attCNMsipL3ErrorDA	SMDS destination address in the rejected L3 PDU
		attCNMsipL3ErrorTimeStamp	Time stamp (TimeTicks) for the latest occurrence of the specified error
		attCNMsipL3ErrorLocalTime	Time stamp (ASCII string) for the latest occurrence of the specified error

Table A-6 AT&T SMDS MIB Object Description
(Page 1 of 3)

MIB Name	Table Name	Object Name	Description
AT&T SMDS MIB	**attCNMsmdsConfigTable**		**Configuration Table for SMDS Interfaces**
		attCNMsmdsConfigEntry	An entry in the SMDS table
		attCNMsmdsConfigIndex	SMDS Interface Table
		attCNMsmdsAccessClass	Currently subscribed to Access Class
		attCNMsmdsMCDUsIn	Max. no. of SMDS data units that may be transferred concurrently from CPE to network
		attCNMsmdsMCDUsOut	Max. no. of SMDS data units that may be transferred concurrently from network to CPE
		attCNMsmdsIndivScreenMode	Allowed/disallowed flag for the individual address screening table
		attCNMsmdsGroupScreenMode	Allowed/disallowed flag for the group address screening table
		attCNMsmdsAddrIndexDescr	Describes how SMDS addresses are reformatted to OIDs
		attCNMsmdsDisagreeMaxIntervals	Maximum number of intervals supported for SMDS disagreements
		attCNMsmdsDisagreeIntervalLen	Time-length of each interval for SMDS disagreements
	attCNMsmdsAddrTable		**Table of SMDS addresses for an SNI**
		attCNMsmdsAddrEntry	Entry containing SNI identifier and an SMDS address for that SNI
		attCNMsmdsAddrCountryIndex	Country Code of SMDS address
		attCNMsmdsAddrAreaIndex	Area Code of SMDS address
		attCNMsmdsAddrSubscriberIndex	Subscriber number of the SMDS address
		attCNMsmdsAddressOnSNI	One of the SMDS addresses assigned to this interface
		attCNMsmdsInterfaceIndex	Interface number
	attCNMsmdsIndivScrTable		**List of entries containing SMDS addresses and SNI identifiers that form individual address screening table**
		attCNMsmdsIndivScrEntry	An entry in the individual address screening table
		attCNMsmdsIndivScrIndex	Interface index
		attCNMsmdsIndivScrCountryIndex	Country code of the SMDS address
		attCNMsmdsIndivScrAreaIndex	Area code of the SMDS address
		attCNMsmdsIndivScrSubscriberIndex	Subscriber number of the SMDS address
		attCNMsmdsIndivScreeningAddress	SMDS address that is a member of an SNI's individual address screening table

Table A-6 AT&T SMDS MIB Object Description
(Page 2 of 3)

MIB Name	Table Name	Object Name	Description
AT&T SMDS MIB (continued)	**attCNMsmdsGroupScrTable**		**List of entries containing SMDS addresses and SNI identifiers that form the group address screening table**
		attCNMsmdsGrpScrEntry	An entry containing an SMDS address to the group screening table for an SNI
		attCNMsmdsGrpScrIndex	Interface number
		attCNMsmdsGrpScrCountryIndex	Country code of the SMDS address
		attCNMsmdsGrpScrIndexAreaIndex	Area code of the SMDS address
		attCNMsmdsGrpScrIndexSubscriberIndex	Subscriber number of the SMDS address
		attCNMsmdsGrpScreenAddress	SMDS address that is a member of an SNI's group address screening table
	attCNMsmdsMemGrpTable		**A list of entries that identify the group addresses that have a particular individual address as a member**
		attCNMsmdsMemGrpEntry	Group address entry that has a particular individual address as its member
		attCNMsmdsMemGrpMemberCountryIndex	Country Code of index
		attCNMsmdsMemGrpMemberAreaIndex	Area Code of Index
		attCNMsmdsMemGrpMemberSubscriberIndex	Subscriber number of the SMDS member address
		attCNMsmdsMemGrpGroupCountryIndex	Country Code of index
		attCNMsmdsMemGrpGroupAreaIndex	Area Code of index
		attCNMsmdsMemGrpGroupSubscriberIndex	Subscriber number of the SMDS Group Address
		attCNMsmdsMemAddress	Individual address that is a member of a group
		attCNMsmdsAssociatedGroup	Group address that identifies a group
	attCNMsmdsGrpMemTable		**Group address table**
		attCNMsmdsGrpMemEntry	Individual address that belongs to a particular group
		attCNMsmdsGrpMemGroupCountryIndex	Country Code of the SMDS Group Address
		attCNMsmdsGrpMemGroupAreaIndex	Area Code of the SMDS Group Address

Table A-6 AT&T SMDS MIB Object Description
(Page 3 of 3)

MIB Name	Table Name	Object Name	Description
AT&T SMDS MIB (continued)	**attCNMsmdsGrpMemTable (continued)**	attCNMsmdsGrpMemGroupSubscriberIndex	Subscriber number of the SMDS Group Address
		attCNMsmdsGrpMemMemberCountryIndex	Country Code of the SMDS Group Address
		attCNMsmdsGrpMemMemberAreaIndex	Area Code of the SMDS member Address
		attCNMsmdsGrpMemMemberSubscriberIndex	Subscriber number of the SMDS Member Address
		attCNMsmdsGroupAddress	SMDS Group address
		attCNMsmdsGroupMember	SMDS Individual address that is a member of a particular group
	attCNMsmdsDisagreeTable		**Entries containing SMDS disagreement counts for a specified period interval for an SNI**
		attCNMsmdsDisagreeEntry	Entry containing SMDS disagreement counts, maintained for a specified period interval for an SNI
		attCNMsmdsDisagreeIndex	Interface index
		attCNMsmdsDisagreeInterval	Measurement interval for which measurement is provided
		attCNMsmdsDisagreeTimeStamp	Time stamp (TimeTicks) corresponding to end of the specified measurement interval
		attCNMsmdsDisagreeLocalTime	Time stamp (ASCII string) corresponding to end of the specified measurement interval
		attCNMsmdsAccessClassExceededCounts	Number of L3 PDUs discarded due to Access Class esceeded
		attCNMsmdsMCDUsExceededAtIngressCounts	Number of L3 PDUs discarded due to the MCDU exceeded from CPE to network
		attCNMsmdsMCDUsExceededAtEgressCounts	Number of L3 PDUs discarded due to the MCDU exceeded from network to CPE
		attCNMsmdsSAScreenViolations	Number of L3 PDUs discarded because it violated the address screen based on source address screening for this SNI
		attCNMsmdsDAScreenViolations	Number of L3 PDUs discarded because it violated the address screen based on destination address screening for this SNI
		attCNMsmdsUnassignedSAs	Number of L3 PDUs discarded bacause source address was not assigned to this SNI
		attCNMsmdsDestinationSNIUnavailableCounts	Number of L3 PDUs discarded because destination SNI was not available

Table A-7 AT&T Frame Relay MIB Object Description
(Page 1 of 3)

MIB Name	Table Name	Object Name	Description
AT&T SMDS MIB (continued)	**attCNMsmdsDisagreeLogTable**		**Table of log of latest occurrences of SMDS disagreements encountered by an SNI**
		attCNMsmdsDisagreeLogEntry	An entry identifying the latest occurrence of a specific SMDS disagreement encountered by an SNI
		attCNMsmdsDisagreeLogIndex	Interface index
		attCNMsmdsDisagreeType	Type of disagreement
		attCNMsmdsDisagreeSA	SMDS source address in the rejected L3 PDU
		attCNMsmdsDisagreeDA	SMDS destination address in the rejected L3 PDU
		attCNMsmdsDisagreeTimeStamp	Time stamp (TimeTicks) for latest occurrence of the specified disagreement
		attCNMsmdsDisagreeLocalTime	Time stamp (ASCII string) for latest occurrence of the specified disagreement
AT&T Frame Relay MIB	**attCNMfrConfigTable**		**Configuration information for all Frame Relay interfaces managed by this system**
		attCNMfrConfigEntry	Configuration information for a particular Frame Relay interface
		attCNMfrConfigIndex	Unique value for each Frame Relay interface
		attCNMfrMeasMaxIntervals	Identifies the maximum number of measurement intervals
		attCNMfrMeasIntervalLen	Time-length of each interval for port-level measurements
		attCNMfrPVCMeasMaxIntervals	Maximum number of measurement intervals
		attCNMfrPVCMeasIntervalLen	Number of seconds that make up one complete measurement interval

Table A-7 AT&T Frame Relay MIB Object Description
(Page 2 of 3)

MIB Name	Table Name	Object Name	Description
AT&T Frame Relay MIB (continued)	**attCNMfrMeasTable**		**List of entries containing measurement counts, maintained during the specified measurement interval, for all Frame Relay interfaces managed by this system**
		attCNMfrMeasEntry	Measurement counts, maintained during the specified measurement interval
		attCNMfrMeasIndex	Unique value for each Frame Relay interface
		attCNMfrMeasInterval	Measurement interval number for which measurement is provided
		attCNMfrMeasTimeStamp	Tme stamp corresponding to the end of the specified measurement interval
		attCNMfrMeasLocalTime	Time stamp corresponding to the end of the specified measurement interval
		attCNMfrReceivedOctets	Number of bytes received by this Frame Relay interface during the specified measurement interval
		attCNMfrSentOctets	Number of bytes sent by this Frame Relay interface during the specified measurement interval
		attCNMfrReceivedFrames	Number of frames received by this Frame Relay interface during the specified measurement interval
		attCNMfrSentFrames	Number of frames received by this Frame Relay interface during the specified measurement interval
		attCNMfrBadFrames	Number of frames received by this interface that are faulty
		attCNMfrReceiverOverruns	Number of receiver overruns occurred at this interface during the specified measurement interval

Table A-7 AT&T Frame Relay MIB Object Description
(Page 3 of 3)

MIB Name	Table Name	Object Name	Description
AT&T Frame Relay MIB (continued)	**attCNMfrPVCMeasTable**		**PVC-level measurement counts, maintained during the specified measurement interval, for all the Frame Relay interfaces managed by this system.**
		attCNMfrPVCMeasEntry	Entry containing measurement counts, maintained during the specified measurement interval
		attCNMfrPVCMeasIfIndex	Unique value for each Frame Relay interface.
		attCNMfrPVCMeasInterval	DLCI number on a Frame Relay interface that identifies a unique Data Link Connection.
		attCNMfrPVCMeasTimeStamp	Time stamp corresponding to the end of the specified measurement interval
		attCNMfrPVCMeasLocalTime	Time stamp corresponding to the end of the specified measurement interval
		attCNMfrCongestionAtIngress	Number of times frames sent by this pvc had to be discarded at ingress because buffers were unavailable or congestion control was being enforced during the specified measurement interval
		attCNMfrCongestionAtEgress	Number of times frames sent by this pvc had to be discarded at egress because buffers were unavailable or congestion control was being enforced during the specified measurement interval
	attCNMfrPVCStatusTable		**Status Table for Frame Relay PVCs**
		attCNMfrPVCStatusEntry	Entry containing status information about a particular data link connection on a specific frame relay interface
		attCNMfrPVCStatusIfIndex	Unique value for each frame relay interface
		attCNMfrPVCStatusIndex	DLCI number on a frame relay interface that identifies a unique data link connection
		attCNMfrPVCAdminStatus	The desired state of this data link connection
		attCNMfrPVCOperStatus	The desired state of this data link connection

Table A-8 AT&T Enhanced Frame Relay MIB Object Description
(Page 1 of 4)

MIB Name	Table Name	Object Name	Description
Enhanced Frame Relay MIB	**attCNMefrConfigTable**		**List Of Entries Containing Configuration Information For All Frame Relay Interfaces Managed By This System**
		attCNMefrConfigEntry	Entry containing configuration information for a particular frame relay interface
		attCNMefrConfigIndex	Unique value for each frame relay interface
		attCNMefrMgmtType	Identifies the pvc management scheme being used to manage this frame relay interface
		attCNMefrPollDirection	Specifies the role the frame relay interface performs in a bi-directional pvc management scheme
		attCNMefrFullStatusPoll	Maximum number of status enquiry intervals that pass before issuance of a full status enquiry message
		attCNMefrErrorThreshold	Maximum number of errored events that can occur before declaring the frame relay interface down. (n392)
		attCNMefrMonitoredEvents	Counter is referred to as n393 in the ansi standard
		attCNMefrIntegrityTimer	Timer is referred to as t391 in the ansi standard
		attCNMefrPollVerifyTimer	Timer is referred to as t392 in the ansi Standard
		attCNMefrLMIFlowControl	Indicates whether this frame relay interface uses xon/xoff as a means of congestion avoidance
		attCNMefrSupportedPVCs	Number of dlcis currently supported on this frame relay interface
		attCNMefrMeasMaxIntervals	Identifies the maximum number of measurement intervals
		attCNMefrMeasIntervalLen	Number of seconds that make up one complete measurement interval

Table A-8 AT&T Enhanced Frame Relay MIB Object Description
(Page 2 of 4)

MIB Name	Table Name	Object Name	Description
Enhanced Frame Relay MIB (continued)	**attCNMefrMeasTable**		**List of entries containing measurement counts, maintained during the specified measurement interval, for all frame relay interfaces managed by this system**
		attCNMefrMeasEntry	An entry containing measurement counts
		attCNMefrMeasIndex	Unique value of a fr interface
		attCNMefrMeasInterval	Measurement interval number for which measurement is provided
		attCNMefrMeasTimeStamp	Time stamp corresponding to the end of the specified measurement interval
		attCNMefrMeasLocalTime	Time stamp corresponding to the end of the specified measurement interval
		attCNMefrReceivedOctets	Counter associated with the number of bytes received by this frame relay interface
		attCNMefrSentOctets	Counter associated with the number of bytes sent by this frame relay interface
		attCNMefrReceivedFrames	Number of frames received by this frame relay interface
		attCNMefrSentFrames	Frames sent by this frame relay interface during the specified measurement interval
		attCNMefrBadFrames	Number of frames received by this frame relay interface that are faulty
		attCNMefrReceiverOverruns	Number of receiver overruns
		attCNMefrIngressUtil	Utilization level of the frame relay interface in the ingress direction
		attCNMefrEgressUtil	Utilization level of the frame relay interface in the egress direction

Table A-8 AT&T Enhanced Frame Relay MIB Object Description
(Page 3 of 4)

MIB Name	Table Name	Object Name	Description
Enhanced Frame Relay MIB (continued)	**attCNMefrPVCConfigTable**		**List of entries containing configuration information for all fr interfaces managed by this system**
		attCNMefrPVCConfigEntry	Entry containing configuration information for a particular frame relay interface
		attCNMefrPVCConfigIfIndex	Unique value for each frame relay interface
		attCNMefrPVCConfigIndex	DLCI number on a frame relay interface that identifies a unique data link connection
		attCNMefrPVCServiceType	DLCI number on a frame relay interface that identifies a unique data link connection
		attCNMefrLocalCIR	Committed information rate (cir) for data transmitted on this pvc from the local device through the network
		attCNMefrLocalCommittedBurst	Committed burst (bc) for data transmitted on this pvc from the local device through the network
		attCNMefrLocalExcessBurst	Excess burst (be) for data transmitted on this pvc from the local device through the network
		attCNMefrRemoteCIR	Committed information rate (cir) for data transmitted on this pvc from the remote device, through the network, to the local device via this frame relay interface
		attCNMefrRemoteCommittedBurst	Committed burst (bc) for data transmitted on this pvc from the remote device, through the network, to the local device via this frame relay interface
		attCNMefrRemoteExcessBurst	Excess burst (be) for data transmitted on this pvc from the remote device, through the network, to the local device
		attCNMefrMulticastGroup1	Any messages addressed to this multicast dlci will be sent to this pvc and to other pvcs that belong in this group
		attCNMefrMulticastGroup2	Multicast (group) dlci that includes thisDlci as one of its members
		attCNMefrMulticastGroup3	Multicast (group) dlci that includes this dlci as one of its members
		attCNMefrMulticastGroup4	Multicast (group) dlci that includes thisDlci as one of its members
		attCNMefrPVCMeasMaxIntervals	Maximum number of measurement intervals supported for the measurements
		attCNMefrPVCMeasIntervalLen	Measurement interval in seconds

Table A-8 AT&T Enhanced Frame Relay MIB Object Description
(Page 4 of 4)

MIB Name	Table Name	Object Name	Description
Enhanced Frame Relay MIB (continued)	**attCNMefrPVCMeasTable**		**List of entries containing pvc-level measurement counts, maintained during the specified measurement interval, for all the frame relay interfaces managed by this system**
		attCNMefrPVCMeasEntry	An entry containing measurement counts, maintained during the specified measurement interval, for a particular pvc on a specific frame relay interface
		attCNMefrPVCMeasIfIndex	Unique value for each frame relay interface
		attCNMefrPVCMeasIndex	DLCI number on a frame relay interface that identifies a unique data link connection
		attCNMefrPVCMeasInterval	Measurement interval number for which measurement is provided
		attCNMefrPVCMeasTimeStamp	Time stamp corresponding to the end of the specified measurement interval
		attCNMefrPVCMeasLocalTime	Time stamp corresponding to the end of the specified measurement interval
		attCNMefrPVCReceivedFrames	Number of frames received by this frame relay pvc
		attCNMefrPVCSentFrames	Number of frames sent by this frame relay pvc
		attCNMefrDiscardEligibilityFrames	Number of ingress frames received by this pvc that exceed the committed burst size
		attCNMefrBurstSizeExceeded	Number of frames that were discarded due to exceeding the sum of bc + be
		attCNMefrCongestionAtIngress	Number of times frames received by this pvc had to be discarded due to unavailable buffers or congestion control was being enforced
		attCNMefrCongestionAtEgress	Number of times frames sent by this pvc had to be discarded due to unavailable buffers or congestion control was being enforced
	attCNMefrPVCStatusTable		**List of entries containing status information about dlcis on fr interfaces.**
		attCNMefrPVCStatusEntry	Entry containing status information about a particular data link connection on a specific frame relay interface
		attCNMefrPVCStatusIfIndex	Unique value for each frame relay interface
		attCNMefrPVCStatusIndex	DLCI number on a frame relay interface that identifies a unique data link connection
		attCNMefrPVCAdminStatus	Desired state of this data link connection
		attCNMefrPVCOperStatus	Current operational state of this data link connection

B. Cascade MIBs and Description of MIB Objects

The purpose of the appendix is to provide a brief description of all the individual MIB objects supported in the Cascade MIBs. The purpose of including this information is not to serve as a replacement of the actual MIB text files. Chapter 5, Section 5.6 describes the various methods for acquiring the actual MIB text files.

The appendix contains multiple tables which briefly describe the MIB objects contained within the actual Cascade MIBs. Each MIB object is logically organized into either a group object or a table object. In addition, each individual object has an assigned object descriptor (or object name) and an object identifier. The tables provided in this appendix depict the actual logical structure of the MIB objects within the respective Cascade MIBs.

Table B-1 below provides the list of the Cascade MIBs and the corresponding appendix table which briefly describes the individual MIB objects. For further information regarding each individual MIB object, the description clause within the actual MIB text file provides a complete description of each individual MIB object.

Table B-1 Reference Table for Individual MIB Object Descriptions

Management Information Base Name	Managed Service U S WEST Service	Appendix Table Reference
MIBII System	Frame Relay	B-2
MIBII Interface	Frame Relay	B-3
FrNetServMIB	Frame Relay	B-6

Table B-2 FR NetServMIB System Object Description

MIB Name	Table Name	Object Name	Description
MIBII System		sysDescr	- Provides information about the CNM Gateway - US WEST CNM UserGateway
		sysObjectID	- .iso.org.dod.internat.private.enterprises
		sysUpTime	- time in hundreds of seconds since process was initialized restarted).
		sysContact	- US WEST (Phone 1.800.223.2209)
		sysName	- acmspug1
		sysLocation	- 200 S. 5th Street, Minneapolis, Minnesota
		sysServices	- 2 (indicates the set of services that this entity primarily offers)

Table B-3 FR NetServMIB Interface Object Description
(Page 1 of 3)

MIB Name	Table Name	Object Name	Description
MIBII Interfaces	**ifTable**		- Provides Subscriber interface information
		ifIndex	- Unique value, greater than zero, for each interface.(1, 2, 3 etc.)
		ifDescr	- String representing the physical port type (currently blank).
		ifType	- 44
		ifMtu	- 8192
		ifSpeed	- interface's current bandwidth in bits per second.
		ifPhysAddress	- The interface's address at its protocol sub-layer. (always blank)
		ifAdminStatus	- The desired state of the interface. 1-up, 2-down, 3-test.
		ifOperStatus	- The current operational state of the interface. 1-up, 2-down, 3-test, 4-unknown, 5-dormant
		ifLastChange	- The value of sysUpTime at the time the interface entered its current operational state. If the current state was entered prior to the last re-initialization of the local network management subsystem, then this object contains a zero value.
		ifInOctects	- The total number of octets received on the interface.
		ifInUcastPkts	- The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were not addressed to a multicast or broadcast address at this sub-layer.
		ifInNUcastPkts	- The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast or broadcast address at this sub-layer.
		ifInDiscards	- The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
		ifInErrors	- For packet-oriented interfaces, the number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol. For character-oriented or fixed-length interfaces, the number of inbound transmission units that contained errors preventing them from being deliverable to a higher-layer protocol.

Table B-3 FR NetServMIB Interface Object Description
(Page 2 of 3)

MIB Name	Table Name	Object Name	Description
MIBII Interfaces (continued)	**ifTable (continued)**		
		ifInUnknownProtos -	Always zero (0)
		ifOutOctects	- The total number of octets transmitted out of the interface.
		ifOutUcastPkts	- The total number of packets that higher-level protocols requested be transmitted, and which were not addressed to a multicast or broadcast address at this sub-layer, including those that were discarded or not sent.
		ifOutNUcastPkts	- The total number of packets that higher-level protocols requested be transmitted, and which were not addressed to a multicast or broadcast address at this sub-layer, including those that were discarded or not sent.
		ifOutDiscards	- The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
		ifOutErrors	- For packet-oriented interfaces, the number of outbound packets that could not be transmitted because of errors. For character-oriented or fixed-length interfaces, the number of outbound transmission units that could not be transmitted because of errors.
		ifOutQLen	- The length of the output packet queue (in packets).
		ifSpecific	- .11.4
ifMIB	**ifXTable**		- This is a SNMPv1 version of this SNMPV2 MIB
			- This is the only ifMIB table supported. This table contains additional objects for the interface table.
		ifName	- Always blank.

Table B-3 FR NetServMIB Interface Object Description
(Page 3 of 3)

MIB Name	Table Name	Object Name	Description
ifMIB (continued)	**ifXTable (continued)**	ifInMulticastPkts	- The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer. For a MAC layer protocol, this includes both Group and Functional addresses.
		ifInBroadcastPkts	- The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer Always zero (0).
		ifOutMulticastPkts	- The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a multicast address at this sub-layer,including those that were discarded or not sent. For a MAC layer protocol, this includes both Group and Functional addresses.
		ifOutBroadcastPkts	- The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent. Always zero (0).
		ifHCInOctets	- The total number of octets received on the interface, including framing characters. This object is a 64-bit version of ifInOctets.
		ifHCInUcastPkts	- Always zero (0). Only for DS3 (not supported).
		ifHCInMulticastPkts	- Always zero (0). Only for DS3 (not supported).
		ifHCInBroadcastPkts	- Always zero (0). Only for DS3 (not supported).
		ifHCOutOctets	- Always zero (0). Only for DS3 (not supported).
		ifHCOutUcastPkts	- Always zero (0). Only for DS3 (not supported).
		fHCOutMulticastPkts	- Always zero (0). Only for DS3 (not supported).
		ifHCOutBroadcastPkts	- Always zero (0). Only for DS3 (not supported).
		fLinkUpDownTrapEnable	- Always true (1).
		ifHighSpeed	- An estimate of the interface's current bandwidth in units of1,000,000 bits per second.
		ifPromiscuousMode	- Always false (2).
		ifConnectorPresent	- Always false (2).

Table B4 - FR NetServMIB Object Description
(Page 1 of 10)

MIB Name	Table Name	Object Name	Description
FRNetServ	**frLportTable**		**"The Frame Relay Logical Port Information table."**
		frLportEntry	"An entry in the Frame Relay Logical Port Information table."
		frLportNumPlan	"The value of this object identifies the network address numbering plan for this UNI/NNI logical port. The network address is the object ifPhysAddress. The value none implies that there is no ifPhysAddress. The SNMP proxy-agent will return an octet string of zero length for ifPhysAddress. The value other means that an address has been assigned to this interface, but the numbering plan is not enumerated here."
		frLportContact	"The value of this object identifies the network contact for this UNI/NNI logical port."
		frLportLocation	"The value of this object identifies the Frame Relay network location for this UNI/NNI logical port."
		frLportType	"The value of this object identifies the type of network interface for this logical port."
		frLportAddrDLCILen	"The value of this object identifies the Q.922 Address field length and DLCI length for this UNI/NNI logical port."
		frLportVCSigProtocol	"The value of this object identifies the Local In-Channel Signaling Protocol that is used for this frame relay UNI/NNI logical port."
		frLportVCSigPointer	"The value of this object identifies the table that contains the Local In-Channel Signaling Protocol parameters and errors for this UNI/NNI logical port. See the Frame Relay Management VC Signaling Parameters and Errors Group."

Table B4 - FR NetServMIB Object Description
(Page 2 of 10)

MIB Name	Table Name	Object Name	Description
FRNetServc	**frMgtVCSigTable**		**"The Frame Relay Management VC Signaling Parameters and Errors table."**
		frMgtVCSigEntry	"An entry in the Frame Relay Management VC Signaling Parameters Errors table."
		frMgtVCSigProced	"The value of this object identifies the Local In-channel Signaling Procedure that is used for this UNI/NNI logical port. The UNI/NNI logical port can be performing only user-to-network network-side procedures or bi-directional procedures."
		frMgtVCSigUserN391	"The value of this object identifies the User-side N391 full status polling cycle value for this UNI/NNI logical port. If the logical port is not performing user-side procedures then this value is equal to noSuchName. This object applies to Q.933 Annex A and T1.617 Annex D."
		frMgtVCSigUserN392	"The value of this object identifies the User-side N392 error threshold value for this UNI/NNI logical port. If the logical port is not performing user-side procedures, then this value is equal to noSuchName. This object applies to Q.933 Annex A and T1.617 Annex D."
		frMgtVCSigUserN393	"The value of this object identifies the User-side N393 monitored events count value for this UNI/NNI logical port. If the logical port is not performing use-side procedures, then this value is equal to noSuchName. This object applies to Q.933 Annex A and T1.617 Annex D."
		frMgtVCSigUserT391	"The value of this object identifies the User-side T391 link integrity verification polling timer value for this UNI/NNI logical port. If the logical port is not performing use-side procedures, then this value is equal to noSuchName. This object applies to Q.933 Annex A and T1.617 Annex D."
		frMgtVCSigNetT392	"The value of this object identifies the Network-side N392 error threshold value (nN2 for LMI) for the UNI/NNI logical port. If the logical port is not performing network-side procedures, then this value is equal to noSuchName. This object applies to Q.933 Annex A, T1.617 Annex D and LMI."

Table B4 - FR NetServMIB Object Description
(Page 3 of 10)

MIB Name	Table Name	Object Name	Description
FRNetServc (continued)	**frMgtVCSigTable (continued)**	frMgtVCSigNetN393	"The value of this object identifies the Network-side N393 monitored events count value (nN3 for LMI) for this UNI/NNI logical port. If the logical port is not performing network-side procedures, then this value is equal to noSuchName. This object applies to Q.933 Annex A, T1.617 Annex D and LMI."
		frMgtVCSigNetN392	"The value of this object identifies the Network-side T392 polling verification timer value (nN3 for LMI) for this UNI/NNI logical port. If the logical port is not performing network-side procedures, then this value is equal to noSuchName. This object applies to Q.933 Annex A, T1.617 Annex D and LMI."
		frMgtVCSigNetnN4	"The value of this object identifies the Network-side nN4 maximum status inquires received value for this UNI/NNI logical port. If the logical port is not performing network-side procedures, or is not performing LMI procedures, then this value is equal to noSuchName. This object applies only to LMI and always has a value of 5."
		frMgtVCSigetnT3	**"The value of this object identifies the Network-side nT3 timer (for nN4 status inquires received) value for this UNI/NNI logical port. If the logical port is not performing network-side procedures or is not performing LMI procedures, then this value is equal to noSuchName. This object applies only to LMI."**
		frMgtVCSigUserLinkRelErrors	"The number of user-side local in-channel signaling link reliability errors (i.e., non-receipt of Status/Status Inquiry messages or invalid sequence numbers in a Link Integrity Verification Information Element) for this port is not performing user-side then this value is equal to noSuchName.

Table B4 - FR NetServMIB Object Description
(Page 4 of 10)

MIB Name	Table Name	Object Name	Description
FRNetServc (continued)	**frMgtVCSigTable (continued)**	frMgtVCSigUserProtErrors	"The number of user-side local in-channel signaling protocol errors (i.e., protocol discriminator, message type, call reference, and mandatory information element errors) for this UNI/NNI logical port. If the logical port is not performing user-side procedures, then this value is equal to noSuchName."
		frMgtVCSigUserChanInactive	The number of times the user-side channel was declared inactive (i.e., N392 errors in N393 events) for this UNI/NNI logical port. If the logical port is not performing user-side procedures, then this value is equal to noSuchName.
		frMgtVCSigNetLinkRelErrors	The number of network-side local in-channel signaling link reliability errors (i.e., non-receipt of Status/Status Inquiry messages or invalid sequence numbers in a Link Integrity Verification Information Element) for this UNI/NNI logical port. If the logical port is not performing Network-side procedures, then this value is equal to noSuchName."
		frMgtVCSigNetProtErrors	"The number of network-side local in-channel signaling protocol errors (i.e., protocol discriminator, message type, call reference, and mandatory information element errors) for this UNI/NNI logical port. If the logical port is not performing network-side procedures, then this value is equal to noSuchName."
		frMgtVCSignetChanInactive	"The number of times the network-side channel was declared inactive (i.e., N392 errors in N393 events) for this UNI/NNI logical port. If the logical port is not performing network-side procedures, then this value is equal to noSuchName."
	frPVCEndptTable		"The Frame Relay PVC End-Point table. This table is used to model a PVC end-point. This table contains the traffic parameters and statistics for a PVC end-point."
		frPVCEndptEntry	"An entry in the Frame Relay PVC End-Point table."

Table B4 - FR NetServMIB Object Description
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MIB Name	Table Name	Object Name	Description
FRNetServc (continued)	**frMgtVCSigTable (continued)**	frPVCEndptDLCIIndex	"The value of this object is equal to the DLCI value for this PVC end-point."
		frPVCEndptInMaxFrameSize	"The value of this object is the size in octets of the largest frame relay information field for this PVC end-point in the ingress direction (into the frame relay network). The value of frPVCEndptInMaxFrameSize must be less than or equal to the corresponding ifMtu for this Frame Relay UNI/NNI logical port."
		frPVCEndptInBc	"The value of this object is equal to the committed burst size (Bc) parameter (measured in bits) for this PVC end-point in the ingress direction (into the frame relay network)."
		frPVCEndptInBe	"The value of this object is equal to the excess burst size (Be) parameter (measured in bits) for this PVC end-point in the ingress direction (into the frame relay network)."
		frPVCEndptInCIR	"The value of this object is equal to the committed information rate (CIR) parameter (measured in bits per second) for the PVC end-point in the ingress direction (into the frame relay network)."
		frPVCEndptOutMaxFrameSize	"The value of this object is the size octets of the largest frame relay information field for this PVC end-point in the egress direction (out of the frame relay network). The value of frPVCEndptOutMaxFrameSize must be less than or equal to the corresponding ifMtu for this Frame Relay UNI/NNI logical port."
		frPVCEndptOutBc	"The value of this object is equal to the committed burst size (Bc) parameter (measured in bits) for this PVC end-point in the egress direction (out of the frame relay network)."
		frPVCEndptOutBe	"The value of this object is equal to the excess burst size (Be) parameter (measured in bits) for this PVC end-point in the egress direction (out of the frame relay network)."

Table B4 - FR NetServMIB Object Description
(Page 6 of 10)

MIB Name	Table Name	Object Name	Description
FRNetServ (continued)	**frPVCEndptTable (continued)**	frPVCEndptOutCIR	"The value of this object is equal to the committed information rate (CIR) parameter (measured in bits per second) for this PVC end-point in the egress direction (out of the frame relay network)."
		frPVCEndptOutBe	"The value of this object is equal to the excess burst size (Be) parameter (measured in bits) for this PVC end-point in the egress direction (out of the frame relay network)."
		frPVCEndptConnectIdentifier	"This object is used to associate PVC end-points as being part of one PVC segment connection. This value of this object is equal to the value of frPVCConnectIndex, which is used as one of the indices into the frPVCConnectTable. The value of this object is provided by the agent, after the associated entries in the frPVCConnectTable have been created."
		frPVCEndptRowStatus	"This object is used to create new rows in this table, modify existing rows, and to delete existing rows. To create a new PVC, the entries for the PVC segment end-points in the frPVCEndptTable must first be created. Next, the frPVCConnectTable is used to associate the Frame Relay PVC segment end-points. In order for the manage to have the necessary error diagnostics, the frPVCEndptRowStatus object must initially be set to 'createAndWait'. While the frPVCEndptRowStatus object is in the 'createAndWait' state, the manager can set each columnar object and get the necessary error diagnostics. The frPVCEndptRowStatus object may not be set to 'active' unless the following columnar objects exist in this row: frPVCEndptInMaxFrameSize, frPVCEndptInBc, frPVCEndptInBe, frPVCEndptInCIR, frPVCEndptOutMaxFrameSize, frPVCEndptOutBc, frPVCEndptOutBe, and frPVCEndptOutCIR.
		frPVCEndptRcvdSigStatus	"The value of this object identifies the PVC status received via the local in-channel signaling procedures for this PVC end-point. This object is only pertinent for interfaces that perform the bi-directional procedures. For user-to-network network side procedures, the value of this object should be none."

Table B4 - FR NetServMIB Object Description
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MIB Name	Table Name	Object Name	Description
FRNetServ (continued)	**frPVCEndptTable (continued)**	frPVCEndptInDEFrames	"The number of frames received by the network (ingress) with the DE bit set to (1) for this PVC end-point."
		frPVCEndptInFrames	'The number of frames received by the network (ingress) for this PVC end-point. This includes any frames discarded by the network due to submitting more than Bc + Be data or due to any network congestion recovery procedures."
		frPVCEndptOutFrames	"The number of frames sent by the network (egress) regardless of whether they are Bc or Be frames for this PVC end-point."
		frPVCEndptInExcessFrames	"The number of frames received by the network (ingress) for this PVC end-point which were treated as excess traffic. Frames which are sent to the network with DE set to zero are treated as excess when more than Bc bits are submitted to the network during the Committed Information Rate Measurement Interval (Tc). Excess traffic may or may not be discarded at the ingress if more than Bc + Be bits are submitted to the network during Tc. Traffic discarded at the ingress is not recorded in frPVCEndptInExcessFrames. Frames which are sent to the network with DE set to one are also treated as excess traffic."
		frPVCEndptOutExcessFrames	"The number of frames sent by the network (egress) for this PVC end-point which were treated as excess traffic. (The DE bit may be set to one.)"
		frPVCEndptInDiscards	"The number of frames received by the network (ingress) that were discarded due to traffic enforcement for this PVC end-point."
		frPVCEndptInOctets	"The number of octets received by the network (ingress) for this PVC end-point. This counter should only count octets from the beginning of the frame relay header field to the end of user data. If the network supporting Frame Relay can not count octets, then this count should be an approximation."
		frPVCEndptOutOctets	"The number of octets sent by the network (egress) for this PVC end-point. This counter should only count octets from the beginning of the frame relay header field to the end user data. If the network supporting Frame Relay can not count octets, then this count should be an approximation."

Table B4 - FR NetServMIB Object Description
(Page 8 of 10)

MIB Name	Table Name	Object Name	Description
FRNetServ (continued)	**frPVCConnectTable**		**"The Frame Relay PVC Connect table. A bi-directional PVC segment is modeled as one entry in this table."**
		frPVCConnectEntry	"An entry in the Frame Relay PVC Connect table. This entry is used to model a PVC segment in two directions."
		frPVCConnectIndex	"The value of this object is equal to the frPVCConnectIndexValue obtained to uniquely identify this PVC segment connection."
		frPVCConnectLowIfIndex	"The value of this object is equal to MIB II's ifIndex value of the UNI/NNI logical port for this PVC segment. The term low implies that this PVC segment end-point has the numerically lower ifIndex value than the connected/associated PVC segment end-point. If the value is equal to zero, then this logical port is not a Frame Relay UNI/NNI logical port."
		frPVCConnectLowDLCIIndex	"The value of this object is equal to the DLCI value for this end-point of the PVC segment. If the value is equal to zero, then this end-point of the PVC segment is not a Frame Relay connection."
		frPVCConnectHighIfIndex	"The value of this object is equal to MIB II's ifIndex for the UNI/NNI logical port for this PVC segment. The term high implies that this PVC segment end-point has the numerically higher ifIndex value than the connected/associated PVC segment end-point."
		frPVCConnectHighDLCIIndex	"The value of this object is equal to the egress DLCI value for this end-point of the PVC segment."
		frPVCConnectAdminStatus	"The value of this object identifies the desired administrative status of the bi-directional PVC segment. The active state means the PVC segment is currently operational; the inactive state means the PVC segment is currently not operational; the testing state means the PVC segment is currently undergoing a test. This state is set by an administrative entity. This value affects the PVC status indicated across the ingress NNI/UNI of both end-points of the bi-directional PVC segment. When a PVC segment connection is created using this table, this object is initially set to 'inactive'. After the frPVCConnectRowStatus object is set to 'active' (and the frPVCEndptTable have their frPVCEndptRowStatus object set to 'active'), the frPVCConnectAdminStatus object may be set to 'active' to turn on the PVC segment connection.

Table B4 - FR NetServMIB Object Description
(Page 9 of 10)

MIB Name	Table Name	Object Name	Description

FRNetServ (continued)	**frPVCConnectTable (continued)**	frPVCConnectL2hOperStatus	"The value of this object identifies the current operational status of the PVC segment connection in one direction; (i.e., in the low to high direction). The active state means it is currently operational; the inactive state means it is currently not operational; the testing state means it is currently undergoing a test; the unknown state means the status of it currently can not be determined. This value affects the PVC status indicated across the ingress NNI/UNI (low side)of the PVC segment."
		frPVCConnectH21OperStatus	"The value of this object identifies the current operational status of the PVC segment connection in one direction; (i.e., in the high to low direction). The active state means it is currently operational; the inactive state means it is currently not operational; the testing state means it is currently undergoing a test; the unknown state means the status of it currently can not be determined. This value affects the PVC status indicated across the ingress NNI/UNI (high side) of the PVC segment."
		frPVCConnectL2hLastChange	"The value of MIB II's sysUpTime object at the time this PVC segment entered its current operational state in the low to high direction. If the current state was entered prior to the last re-initialization of the proxy-agent then this object contains a zero value.
		frPVCConnectH21LastChange	"The value of MIB II's sysUpTime object at the time this PVC segment entered its current operational state in the high to low direction. If the current state was entered prior to the last re-initialization of the proxy-agent, then this object contains a zero value."

Table B4 - FR NetServMIB Object Description
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MIB Name	Table Name	Object Name	Description
FRNetServ (continued)	**frPVCConnectTable (continued)**	frPVCConnectRowStatus	"The status of this entry in the frPVCConnectTable. This variable is used to create new connections for the PVC end-points and to change existing connections of the PVC end-points. This object must be initially set to 'createAndWait'. In this state, the agent checks the parameters in the associated entries in the frPVCEndptTable to verify that the PVC end-points can be connected (i.e., the In parameters for the other PVC end-points are equal to the Out parameters for the other PVC end-point). This object can not be set to 'active' unless the following columnar object exist in this row:frPVCConnectAdminStatus.The agent also supplies the associated value of frPVCConnectIndex for the frPVCEndptConnectIdentifier instances. To turn on a PVC segment connection, the frPVCConnectAdminStatus is set to 'active'."

frAccountPVCTable - Not supported

frAccountLportTable - Not supported