

**QWEST Communications
International Inc.
Technical Publication**

**QWEST Network Interface Specification
Mediacc® Network Management
Protocol Stacks**

NOTICE

This technical publication describes the message-based interface with the corresponding hardware and physical interface requirements to allow QWEST Communications International Inc. customers and network management system integrators Application Process-to-Application Process (AP-to-AP) access to network-based services through QWEST Mediated Access (MEDIACC®) system. These network-based services are Feature Group B, C, and D switched circuits.

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1. Introduction

1.1 MEDIated ACCess (MEDIACC®)

Mediated Access (MEDIACC®) is the service offering of a gateway which customers use to conduct electronic dialogue with various QWEST business services; i.e., Trouble Administration. The MEDIACC® Gateway supports a variety of software application functions, which include the authentication of customers, verification of resources, translation of messages, and application-to-application communications with QWEST business systems.

1.2 Purpose and Scope of Document

This document, as a Network Interface Specification, provides information, which describes basic technical requirements for network connections with the MEDIACC® Gateway. Consistent with the document's title, the Simple Network Management Protocol (SNMP) and Common Management Information Protocol (CMIP) network management protocol stacks are specified as techniques for appropriate access to MEDIACC® Gateway Services. As such, this document is distinct from other QWEST documents, which describe the higher-level network services and application functionality of various MEDIACC® Gateway Agent software modules and processes.

1.2.1 Acquisition of Documents

This document references many interrelated documents, which describe both detailed protocol stack architecture, as well as higher-level application services. These documents may be ordered as indicated in Section 6.6, Ordering Information. It is hereby noted that such explicit references are cited at the time of this publication and, hence, implicitly permit the evolution and future revision of the respective documents. Therefore, it is hereby requested that potential customers of QWEST MEDIACC® Gateway Services contact their designated QWEST Account Representative to ascertain the appropriate Gateway Service documentation list, prior to ordering and purchasing the extensive list of published documents which are referenced herein.

1.3 Document Summary

This document has been organized to indicate the necessary connectivity requirements that QWEST customers must meet in order to electronically bond, via the MEDIACC® Gateway, with various services of QWEST business systems. As a precursor to physical connectivity, the document indicates that customers must subscribe to the MEDIACC® Service and submit to an enrollment process, which includes the exchange of network information and robust security procedures. Upon completion of the enrollment process, customers establish connectivity by jointly creating a physical link to QWEST and commence an electronic dialogue by means of industry standard protocols, which include X.25/X.75/X.32, SNMP, and CMIP.

1.4 Relationship to Other Documents

This particular document is one member of a collection of documents, which provides a comprehensive guide to full service electronic bonding with QWEST. The collection is organized in the following fashion:

1.4.1 Customer Enrollment

Customer requirements, account enrollment processes and security requirements are presented in: QWEST MEDIACC® Customer Enrollment Process Guide and Forms

This documentation is obtained by arrangement with the customer's designated QWEST Account Representative.

1.4.2 Connectivity

Specifications for a network interface connection with the QWEST MEDIACC® Gateway are provided in (this document):

QWEST Network Interface Specification For MEDIACC® Network Management Protocol Stacks, Publication 77306, Issue A, March 1993.

1.4.3 Interoperability and Testing Verification

Specific details of the interoperability test suites, schedule, and verification requirements shall be disclosed and agreed upon as an adjunct of the official enrollment process and establishment of customer accounts.

In general, the customer will be assigned a QWEST MEDIACC® Representative who will coordinate testing schedules and documentation. Test procedures will assure that robust interoperability and security are achieved at each layer of the protocol stack. The coordination of such procedures necessarily includes the disclosure of Object Definitions and Protocol Data Unit (PDU) exchange sequences which are described in QWEST Management Information Base (MIB) modules and related documents.

This procedure documentation, obtained by arrangement with the customer's designated QWEST Account Representative, is described in:

MEDIACC® Customer Interoperability Test System User Guide, Publication ITCAAMEDIO0D0-38-01-00, February 1992, QWEST Information Technologies, Customer Access Applications.

1.4.4 Application-To-Application Bonding

Features of particular services which include indigenous security mechanisms, message flow, and transaction processing are contained in documents which have been tailored to the specific capabilities and needs of individual service products, for example Trouble Administration. A list of currently available documents can be acquired by contacting the customer's designated QWEST Account Representative.

Example documents include:

QWEST Guide for the Development and Implementation of Trouble Administration Applications for Simple Network Management (SNMP) Protocol Stacks, Publication IT-CAA-MEDI00D0-95B-01-00, QWEST Information Technologies, Customer Access Applications.

QWEST Guide for the Development and Implementation of Trouble Administration Applications for Common Management Information Protocol (CMIP) Stacks, Publication IT-CAA-MEDI00D0-95A-01-00, QWEST Information Technologies, Customer Access Applications.

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2. Overview of QWEST MEDIACC®

2.1 MEDIACC® Vision

The QWEST MEDIated ACCess (MEDIACC®) Gateway has been architected as a multiprotocol gateway to a common set of mediated access services. The architecture traverses several important aspects of Open Systems technology while focusing upon the provision of superior customer service. MEDIACC® provides a seminal, enterprise-wide, network access architecture which has the promise of casting sprawling Operations Support Systems (OSSs) into a framework of efficient and transparent Open Systems networks. At the heart of the enterprise-wide network architecture lie salient features of the International Organization for Standards (ISO), the International Electrotechnical Commission (IEC), Operations, Administration, Maintenance, and Provisioning (OAM&P), NM Forum and InterNet Standards Organizations recommendations. These recommended standards form an operational basis upon which the MEDIACC® Gateway facilitates a mediated Open Systems representation of proprietary OSSs.

2.2 Customer Access to the QWEST MEDIACC® Service

Customers subscribe to the MEDIACC® Service by:

- • Successfully completing the Enrollment Process.
- • Successfully establishing a connection to the QWEST MEDIACC® Gateway Environment.
- • Successfully completing the Interoperability and Test Verification Process.

Customers are designated as either a Primary Account Customer or an Agent Account Customer. Agents are customers who are able to act on behalf of other customers, as well as themselves. Agents can only be designated by a Primary Account Customer.

2.3 Security Overview

Pertinent details of the security paradigm and its administration are not revealed in this document. Such details will be disclosed between QWEST and individual customers during the enrollment process and subsequently verified during the interoperability test suite procedures.

In general, basic security checkpoints are initiated at several junctures in the protocol stack. At the physical access level, customers are required to obtain unique interfaces with QWEST DIGIPAC® network facilities. A variety of mechanisms are instituted to control access and ensure the authenticity of transactions.

2.4 MEDIACC® Network Management Protocol Access

2.4.1 Access Overview

In general, the MEDIACC® network management protocol access topology is predicated upon both Local Area Network (LAN) and Wide Area Network (WAN) fundamentals. Inherent in the Internet and ISO Layered Stack architecture is the capability to execute sophisticated and complex “higher level” protocol methods on top of a variety of robust “lower level” physical access and control methods. Such a milieu facilitates the alchemy of technological innovation and economic reasonableness over time.

2.4.2 Access Architecture

This section presents a logical illustration of the Network Management Protocol stack architecture. It is seen that the QWEST MEDIACC® Gateway is situated upon both the industry standard InterNet SNMP stack and the industry standard OSI CMIP stack. Customers may select either, or both, of these stacks. See FIGURE 2-1 for a diagram of the Access architecture.

Detailed descriptions of SNMP are found in:

RFC 1155: Structure and Identification of Management information for TCP/IP-based Internets, May 1990

RFC 1157: A Simple Network Management Protocol (SNMP), May 1990

RFC 1212: Concise MIB Definitions, March 1991

RFC 1213: Management Information Base for Network Management of TCP/IP-based internets: MIB-II, March 1991

RFC 1215: A Convention for defining Traps for use with the SNMP, March 1991

Detailed descriptions of CMIP are found in:

ISO/IEC 9595 - Information Technology- Open Systems Interconnect -Common Management Information Service Definition, 1991

ISO/IEC 9596-1 - Information Technology- Open Systems Interconnect -Common Management Information Protocol Specification - Part 1: Specification, Edition 2, 1991

Note: The Reference Section of this document, for expository purposes, contains a comprehensive list of relevant standards documents. The Ordering Information section of this document indicates how customers may obtain documentation.

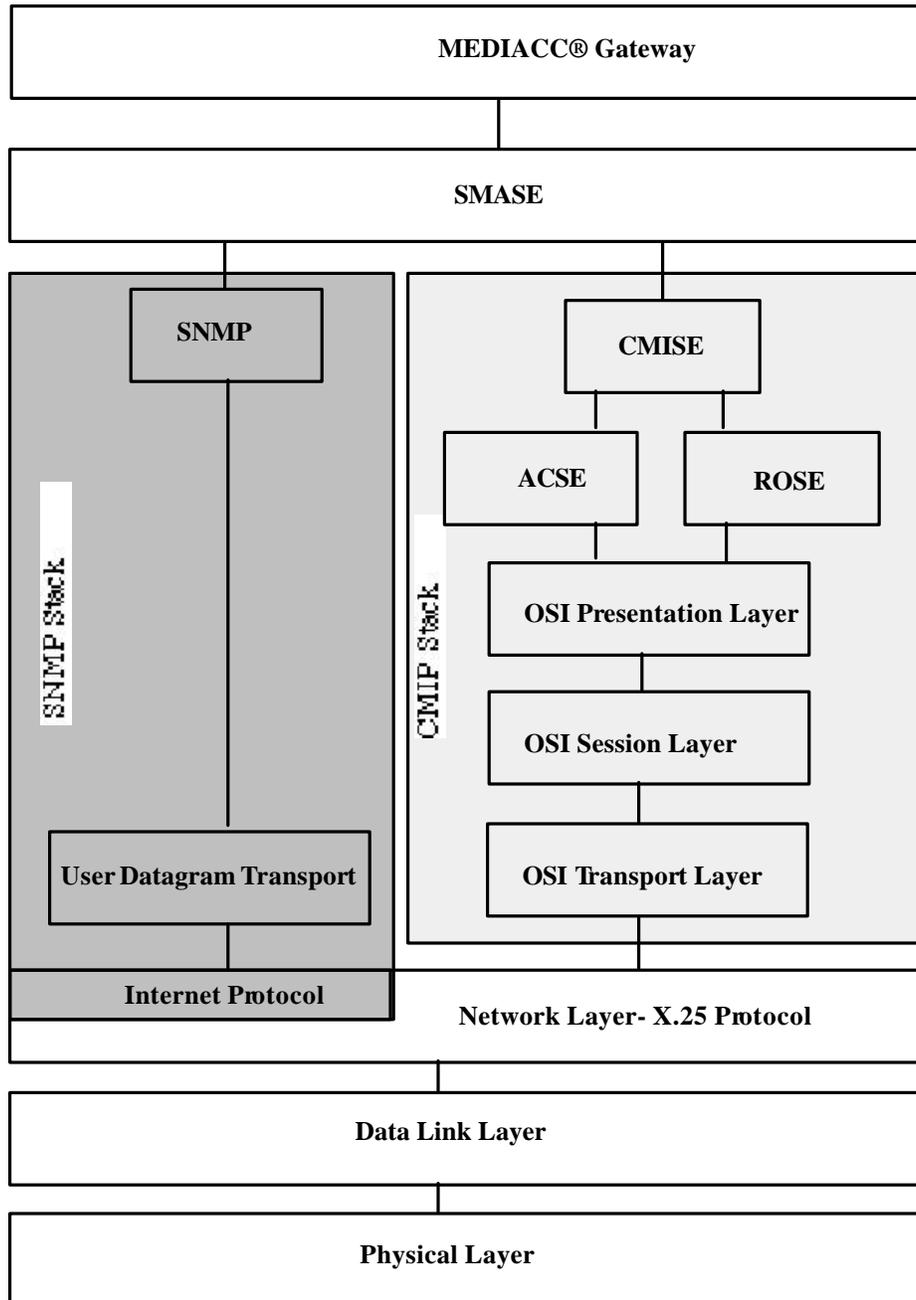


Figure 2-1: Access Architecture

2.4.3 Access Topology

QWEST presently offers logical connectivity as illustrated in Figure 2-2. Descriptions of components and configurations are referenced throughout the remaining sections of this document.

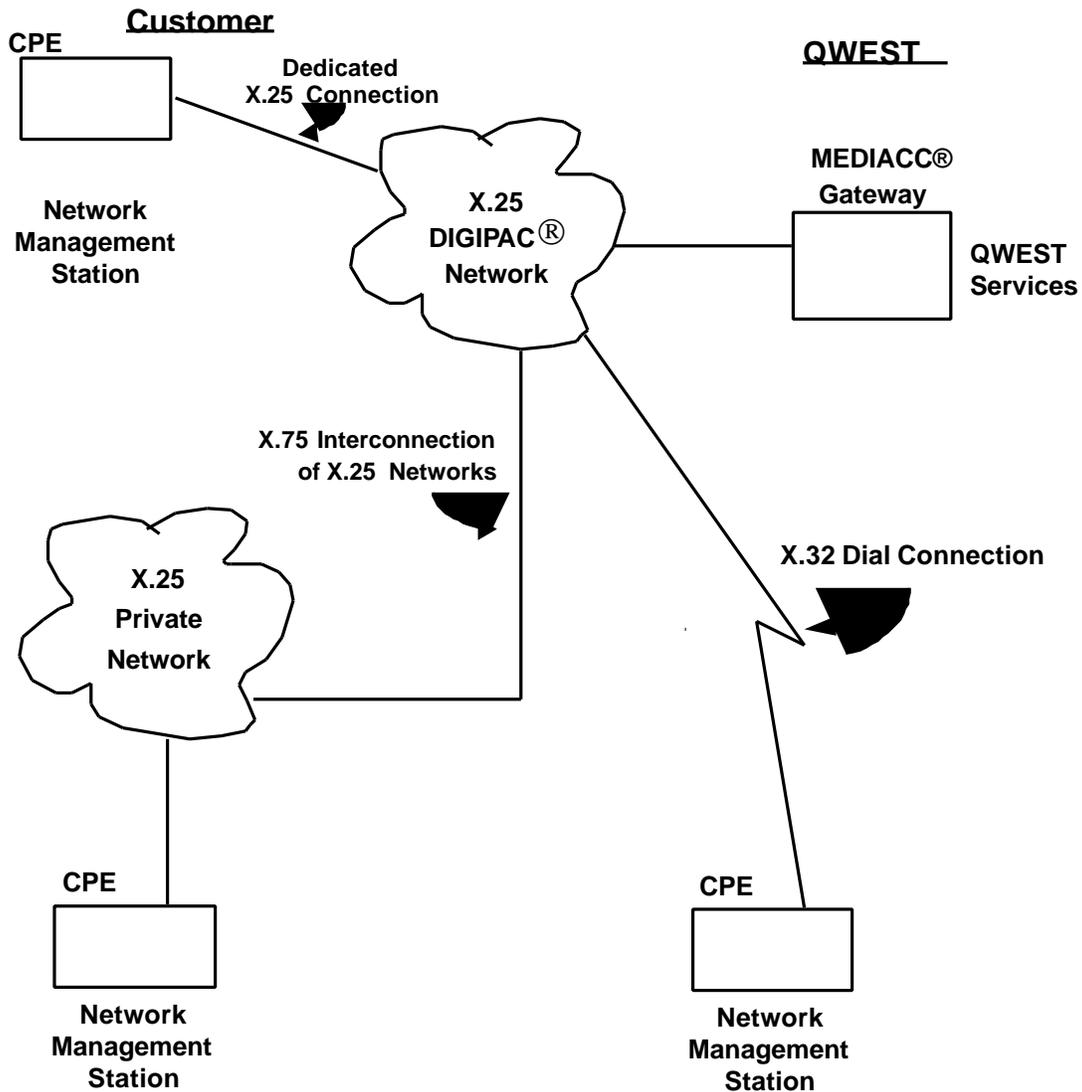


Figure 2-2: Connections To MEDIACC®

2.4.4 Making an X.25, X.75 or X.32 Connection

The use of the MEDIACC® gateway and associated services can only be gained through an X.25 packet switching network. Such access is established via QWEST's DIGIPAC® X.25 packet switching network by:

- • Obtaining a dedicated digital or analog circuit facility, in conjunction with a QWEST DIGIPAC® packet switching node, which provides synchronous system to system support of the protocol stacks defined in this document; or,

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3. SNMP Stack Functionality and Description

3.1 Overview of SNMP

The Simple Network Management Protocol (SNMP) is a well-known and widely used paradigm for the management and administration of TCP/IP Internets, devices, and applications. A manageable network is composed of one or more management systems, many network elements or agent systems, and a network management protocol.

SNMP is the shared protocol, which communicates information between a management system and an agent system. SNMP allows the management system to retrieve (get) or alter (set) management information on an agent system. SNMP also permits an agent system to notify management systems of important events (trap).

For a background on SNMP, the reader is encouraged to examine *The Simple Book*, by Marshall Rose, Prentice Hall, 1991, ISBN 0-13-812611-9.

3.1.1 SNMP Protocol Operation Summary

SNMP supports messages, which are self-contained units of information. Such a unit, or data object, contains protocol control information, such as version and security data, as well as user data. For detailed information about SNMP, refer to the following series of documents:

RFC 1155: Structure and Identification of Management information for TCP/IP-based Internets, May 1990

RFC 1157: A Simple Network Management Protocol (SNMP), May 1990

RFC 1212: Concise MIB Definitions, March 1991

RFC 1213: Management Information Base for Network Management of TCP/IP-based Internets: MIB-II, March 1991

RFC 1215: A Convention for defining Traps for use with the SNMP, March 1991

3.1.2 Structure of Management Information (SMI) and Management Information Base (MIB) Modules

The Structure of Management Information (SMI) contains the rules used to define objects that can be accessed by a network management protocol. For SNMP, the SMI is defined in:

RFC 1155: Structure and Identification of Management Information for TCP/IP-based Internets, May 1990

RFC 1212: Concise MIB Definitions, March 1991

Information available through the SNMP Agent is known as a Management Information Base, or MIB. The QWEST MEDIACC® Management Information Base has been organized into MIB Modules which reflect the recommendations of standards organizations which include ISO/IEC, IOAM&P, T1M1, NM Forum and InterNet. MIB Module definitions will be provided to QWEST MEDIACC® customers according to the particular service which a customer selects, for example Trouble Administration. Examples of QWEST MIB Modules include Mediated Access, OSI Compatibility, Generic Network Model, and Trouble Administration.

3.2 MEDIACC® SNMP Stack Description

The MEDIACC® SNMP protocol stack follows industry standard definitions which support standard SNMP operations, as described in the preceding sections. In general, the lower three layers of the stack are an interface to an X.25 Packet Switching Network. The next two layers provide for industry standard Internet Routing and Datagram services. SNMP protocol messages are encoded and decoded, to facilitate hardware independence, by the conventions of an Abstract Syntax Notation (ASN version 1). Finally, SNMP provides an interface for the Network Manager and Agent to conduct application-to-application dialog. The entire protocol stack is depicted in Figure 3-1. Comprehensive explanations of the X.25, X.75 and X.32 configuration details may be found in the QWEST DIGIPAC® Service Interface Specifications for Public Packet Switching Network, QWEST Communications, Inc., Technical Publication 77359, Issue D, November 1992.

	MEDIACC® Service
Layer 7 - Application	SNMP - Simple Network Management Protocol RFC 1157
Layer 6 - Presentation	ASN.1 and BER encode/decode ISO 8824 & ISO 8825
Layer 5 - Session	NULL
Layer 4 - Transport	UDP - Datagram Service RFC 768
Layer 3 - Network	Internet Protocol RFC 877 IP/X.25
Layer 2 - Data Link	ISO 8208 (CCITT X.25 PLP)
Layer 1 - Physical	X.25, X.32, X.75 Service ISO 7776 (CCITT LAPB) V.35 (for 56 kb/s) EIA-232 (for 2.4 to 9.6 kb/s) V.24, V.28

Figure 3-1: SNMP Protocol Stack

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4. CMISE Functionality and Description

4.1 Overview of CMISE

The Common Management Information Service Element (CMISE) defines a set of basic management services for sending and receiving management related messages. The Common Management Information Protocol (CMIP) is a peer management protocol between manager and agent. These services allow manager and agent the ability to exchange operations on managed objects and notifications. Additional functionality is provided by other components of Service Management Application Service Element (SMASE), such as, Association Control Service Element (ACSE) for peer-to-peer association between two applications and Remote Operations Service Element (ROSE) for request/response message exchange. See Figure 4-1 for a diagram of the CMISE architecture.

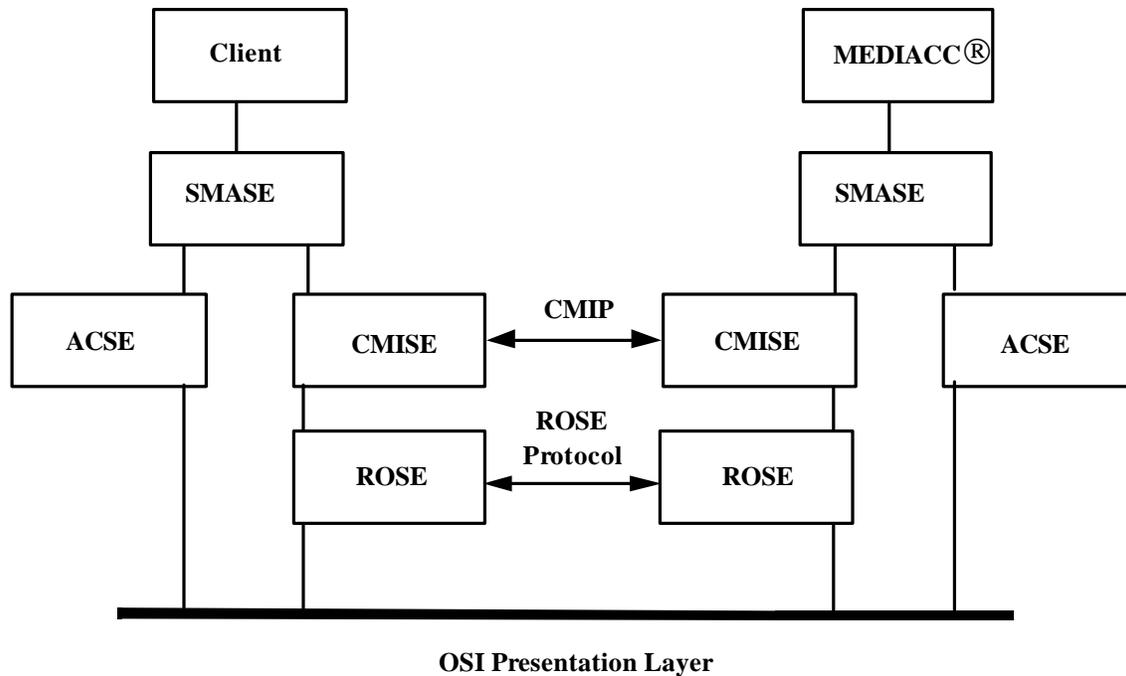


Figure 4-1: CMISE Architecture

For detailed information on CMISE and CMIP, refer to ISO/IEC 9595 and ISO/IEC 9596, respectively.

4.1.1 CMISE Architectural Description

CMISE defines a set of operations and data elements that define specific data exchange in the form of a request and response. These elements identify attributes of a managed object defined in the Management Information Base (MIB). CMISE provides two types of services, confirmed and non-confirmed. A confirmed request sent from a manager requires the agent to supply a response. A non-confirmed request does not require the agent to supply a response. See Figure 4-2 for the request/response flow in CMISE.

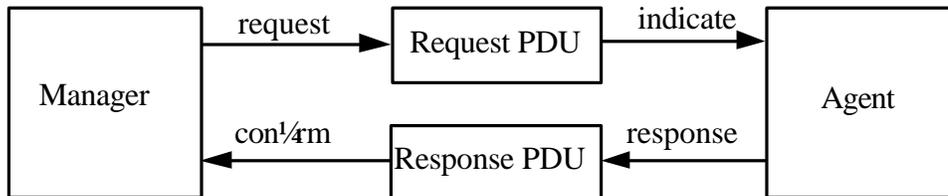


Figure 4-2: CMISE Request/Response Flow

4.1.2 CMISE Functional Units

CMISE has basic kernel and additional functional units. Functional units define capabilities of the manager and agent application. When an association between a manager and agent is established, the functional units are negotiated. The association fails if the responder does not support the functional units.

4.1.3 CMISE Services

CMISE services are used by network management processes to exchange management information. Each of the services include a set of attributes that contain application specific information i. e., access control, base object class, managed object instance, etc. The services provided by CMISE are exchanged between a manager and agent in the form of a Protocol Data Unit (PDU) as defined by CMIP. CMIP is a Remote Operations Service Element (ROSE) based protocol that maps CMISE services to a remote operation.

4.1.4 MEDIACC® CMIP Stack Description

The MEDIACC® CMIP protocol stack follows industry standard definitions which support standard CMISE operations, as described in the preceding sections. In general, the lower three layers of the stack are an interface to an X.25 Packet Switching Network. The functionality of the Transport to the Application layer conform to the OSI Network model. CMIP protocol messages are encoded and decoded, to facilitate hardware independence, by the conventions of an Abstract Syntax Notation (ASN version 1). Finally, CMIP provides an interface for the Network Manager and Agent to conduct application-to-application dialog. The entire protocol stack is depicted in Figure 4-3. Comprehensive explanations of the X.25, X.75 and X.32 configuration details may be found in the QWEST DIGIPAC® Service Interface Specifications for Public Packet Switching Network, QWEST Communications International Inc., Technical Publication 77359, Issue D, November 1992. This document, and subsequent issues, may be downloaded for free in PDF format from <http://www.qwest.com/techpub> .

4.1.5 Structure of Management Information (SMI) and Management Information Base (MIB) Modules

The Structure of Management Information (SMI) contains the rules used to define objects that can be accessed by a network management protocol. For CMISE, the SMI is defined in:

ISO/IEC 10165-4, Information Technology - Open Systems Interconnections - Structure of Management Information: Guidelines for the Definition of Managed Objects, 1992.

Information available through the CMISE Agent is known as a Management Information Base, or MIB. The QWEST MEDIACC® Management Information Base has been organized into MIB Modules, which reflect the recommendations of standards organizations, which include ISO/IEC, IOAM&P, T1M1, NM Forum and InterNet. MIB Module definitions will be provided to QWEST MEDIACC® customers according to the particular service, which a customer selects, for example Trouble Administration.

Note: The Reference Section of this document, for expository purposes, contains a comprehensive list of relevant standards documents. The Ordering Information section of this document indicates how customers may obtain documentation.

	MEDIACC® Service
Layer 7 - Application	ISO8649, ISO 9072-1, ISO 8650, ISO 9072-2 ISO 8649-1, ISO 8650-1, ISO 9595, ISO 9596 CCITT X.217, X.219, X.227, X.229 CCITT X.710, X.711
Layer 6 - Presentation	ISO 8824, ISO 8825, ISO 8822, ISO 8823 CCITT X.208, X.209, X.216, X.226
Layer 5 - Session	ISO 8326, ISO 8327 CCITT X.215, X.225
Layer 4 - Transport	ISO 8072, ISO 8073 CCITT X.214, X.224
Layer 3- Network	ISO 8348, ISO 8208, ISO 8878 CCITT X.223, X.213, X.25, X.244, X.32, X.75
Layer 2 - Data Link	ISO 7776 CCITT X.25 LAP-B
Layer 1 - Physical	CCITT V.35, V.28, V.24

Figure 4-3: CMISE Protocol Stack

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5. Definitions

5.1 Acronyms

ACSE	Association Control Service Element
AD	Amendment; for example, ISO 8327 AD2
ANSI	American National Standards Institute
ASN.1	Abstract Syntax Notation One
BASE	Base document; for example, ISO 8327
BCC	Business Control Center
BER	Basic Encoding Rules for ASN.1
CCITT	Consultative Committee on International Telegraph and Telephone
CNM	Customer Network Management
CMIP	Common Management Information Protocol
CMISE	Common Management Information Service Element
CPE	Customer Premises Equipment
CSU/DSU	Channel Service Unit/Data Service Unit
DCE	Data Circuit Terminating Equipment
DTE	Data Terminal Equipment
EIA	Electronic Industries Association
FAST	Flexible Access Service Technology
GDMO	Guidelines for the Description of Managed Objects
GNM	Generic Network Model
IEC	International Electrotechnical Commission
IP	Internet Protocol
ISO	International Standards Organization
LAN	Local Area Network
LAP	Link Access Procedure
LATA	Local Access and Transport Area
MEDIACC®	Mediated Access
MIB	Management Information Base
NM	Network Management

NMS	Network Management System
OAM&P	Operations, Administration, Maintenance and Provisioning
OSI	Open Systems Interconnection
OSS	Operations Support System
PDN	Packet Data Network
PDU	Protocol Data Unit
PICS	Plug In Control System
PLTS	Private Line Transport Services (Special Access)
RFC	Request For Comments
RDN	Relative Distinguished Names
RMA	Request for Manual Assistance
ROSE	Remote Operations Service Element
RPC	Remote Procedure Call
SAP	Service Access Point
SMI	Structure of Management Information
SMASE	System Management Application Service Elements
SNMP	Simple Network Management Protocol
SVC	Switched Virtual Circuit
TIM1	(See Glossary)
TA	Trouble Administration
TCP	Terminal Control Protocol
TMN	Telecommunications Management Network
TMNA	Telecommunications Management Network Applications
UDP	User Datagram Protocol
WAN	Wide Area Network

5.2 Glossary

Abstract Syntax Notation One (ASN.1)

The OSI language for describing abstract syntax.

Basic Encoding Rules (BER)

The OSI language for describing transfer syntax.

Layer 1

Physical Layer. Provides the transparent transmission of bit streams between systems including relaying through different media.

Layer 2

Data Link Layer. Provides the transfer of software between directly connected systems and detects any errors in the transfer. Establishes, maintains and releases software data links; handles error and flow control.

Layer 3

Network Layer. Provides routing and relaying through intermediate systems. Also handles segmenting, blocking, error recovery, and flow control.

Layer 4

Transport Layer. Provides the transparent transfer of software between end systems. Handles end to end control, multiplexing, and mapping.

Layer 5

Session Layer. Provides administration and control sessions between application processes and manages their data.

Layer 6

Presentation Layer. Provides representation, interpretation, format and code transformation of information communicated between or referred to by application processes. MEDIACC uses standard ASN.1 representations for all messages and data communicated remotely. It uses standard presentation encoding, decoding, and transfer syntaxes.

Layer 7

Application Layer. Provides a window between application processes in order to exchange meaningful information. Performs management functions.

Protocol Data Unit (PDU)

A data object exchanged by protocol machines, usually containing both protocol control information and user data.

X.25

Packet level messaging protocol. Consists of five classes of optional facilities.

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6.7 Trademarks	6-8

6. References

6.1 QWEST Publications

PUB 77359 QWEST DIGIPAC®, Service Interface Specifications for Public Packet Switching Network, Issue E, May 1994.

6.2 General Publications

ISBN 0-13-812611-9 Marshall Rose. *The Open Book: An Introduction to Management of TCP/IP-based Internets*, Prentice-Hall, Englewood Cliffs, New Jersey, 1991.

ISBN 0-13-351842-6 Adrian Tang. *Open Networking with OSI*, Prentice-Hall, Englewood Cliffs, New Jersey, 1992.

6.3 Consultative Committee International Telephone and Telegraph (CCITT) Publications

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6.6 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.

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