A Joint Standard of AASHTO, ITE, and NEMA

NTCIP 2103 version v02

National Transportation Communications for ITS Protocol

Point-to-Point Protocol over RS-232 Subnetwork Profile

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American Association of State Highway and Transportation Officials (AASHTO)
444 North Capitol Street, N.W., Suite 249
Washington, D.C. 20001

Institute of Transportation Engineers (ITE)
1099 14th Street, N.W., Suite 300 West
Washington, D.C. 20005-3438

National Electrical Manufacturers Association (NEMA)
1300 North 17th Street, Suite 1752
Rosslyn, Virginia 22209-3806

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At the time that NTCIP 2103 v02 was prepared, the following individuals were members of the NTCIP BSP2 WG:

- Ralph Boaz
- Bob De Roche (Chair)
- Bud Kent
- Jim Mahugh
- Greg Mizell
- Alex Mousadi
- Robert Rausch
- Joerg “Nu” Rosenbohm
- Kenneth Vaughn

Other individuals providing input to NTCIP 2103 v02 include:

- Steven Alonge
- Bob Barrett
- Joey Baumgartner
- Jas Bhullar
- Russ Brookshire
- Thomas Bryer
- Blake Christie
- Doug Crawford
- Ken Earnest
- Bob Force
- Dave Kingery
- Chuck Knoles
- Paul Lim-Hing
- Gene Martin
- Bob Martindale
- Amit Misra
- Don Ninke
- Brian Paulsmeyer
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- Skyline Products
- Southwest Research Institute
- Transcore
- Trevilon
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- VHB
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- Washington Department of Transportation

FOREWORD

NTCIP 2103 v02, a standards publication, is also an NTCIP Subnetwork Profile. Subnetwork Profiles provide the rules and procedures for exchanging data over a single physical communications link by referring to one or more base standards. NTCIP 2103 v02 uses only metric units.

NTCIP 2103 v02 defines the rules and procedures for using the point-to-point protocol over RS-232 like circuits. NTCIP 2103 v02 defines requirements that are applicable to all NTCIP devices that exchange data over this type of communications circuit. NTCiP 2103 v02 also contains optional and conditional clauses that are applicable to specific environments for which they are intended.

There are three normative and three informative annexes in this document.

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National Electrical Manufacturers Association
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Approvals

This standards publication was separately balloted and approved by AASHTO, ITE, and NEMA after recommendation by the Joint Committee on the NTCIP. Each organization has approved this standard as the following standard type, as of the date:

AASHTO—Standard Specification; May 2006
ITE—Software Standard; August 2006
NEMA—Standard; April 2006

History

In 1996, an agreement was executed among AASHTO, ITE, and NEMA to jointly develop, approve, and maintain the NTCIP standards. In August 1997, the Joint Committee on the NTCIP formed a new working group to develop communications profiles that were more modular in order to meet the varied needs of different communication environments. The Profiles WG first met in September 1997.

The first task of the NTCIP Profiles Working Group was to develop the overall structure of profiles. After research into how national and international standards organizations combine protocols and standards to address all seven layer of the OSI Basic Reference Model, the committee adopted the approach defined in NTCIP 8003. Following that approach, a protocol stack is specified by Information, Application, Transport, and Subnet profiles. An Information Profile defines the data that an end system is required to support. An Application Profile addresses the Application, Presentation, and Session Layers of the OSI Basic Reference Model. A Transport Profile addresses the Transport and Network Layers. A Subnet Profile addresses the Data Link and Physical Layers.

Once the rules for defining profiles were established, work began on a series of profiles for different environments, in order of their assigned priority by the NTCIP Joint Committee. Work on the *Subnet Profile for the Point-to-Point Protocol over RS-232* (SP-PPP) began in June 1998. NTCIP 2103 v02 was previously referenced as TS 3.SP-PPP. However, in order to provide a more organized numbering scheme, NTCIP 2103 v02 is now the reference.

NTCIP 2103 v01.05. November 1999—Accepted as a User Comment Draft by the Joint Committee on the NTCIP. April 2000—NTCIP Standards Bulletin B0050 sent NTCIP 2103 to AASHTO, ITE, and NEMA for comment.

NTCIP 2103 v01.13. September 2001—Version 01.12 was accepted as a Recommended Standard by the Joint Committee on the NTCIP. February 2002—NTCIP Standards Bulletin B0069 sent version 01.13 to AASHTO, ITE, and NEMA for ballot.

NTCIP 2103 v01 to v02. The BSP2 WG drafted a major version revision, which included:

Subclause 1.3.1 Normative References
ANSI 574, RFC 1317, and the ITU-T standards V.90, V92, and V.250 were added.

Subclause 1.3.2 Other References
Several Internet references regarding modems were added.

Clause 2.2 Multilink Operations
A reference to the configuration of type 22 was deleted.

Subclause 2.2.7 Modem Configuration and Control Protocol; subclause was added.

Clause 2.3 Physical Layer Requirements and following subclauses
Significant information related to modems was added.
Miscellaneous tabled were reformatted.

Annex A PRL
Significant information related to modems was added.
RS232 Asynchronous and Interfaces Object Group were added.

Annex B PPP MIB; Header was added.

Annex D Modem MIB; MIB was added.

Annex F Typical Modem Dialogs; Dialogs were added.

NTCIP 2103 v02.04, January 2005—Accepted as a User Comment Draft by the Joint Committee on the NTCIP. June 2005—NTCIP Standards Bulletin B0102 sent NTCIP 2103 to AASHTO, ITE, and NEMA for comment.

NTCIP 2103 v02.06, December 2005—Accepted as a Recommended Standard by the Joint Committee on the NTCIP. January 2006—after editing front matter and v01-to-v02 changes, NTCIP Standards Bulletin B0110 referred v02.06b for balloting.

NTCIP 2103 v02.07, December 2008—Prepared standard for publication; edited format, front matter, and style.

Compatibility of Versions

To distinguish NTCIP 2103 v02 (as published) from previous drafts, NTCIP 2103 v02 also includes NTCIP 2103 v02.07 on each page header. All NTCIP Standards Publications have a major and minor version number for configuration management. The version number syntax is "v00.00a," with the major version number before the period, and the minor version number and edition letter (if any) after the period.

NTCIP 2103 v02 is designated, and should be cited as, NTCIP 2103 v02. Anyone using NTCIP 2103 v02 should seek information about the version number that is of interest to them in any given circumstance. The MIB, the PRL, and the PICS should all reference the version number of the standards publication that was the source of the excerpted material.

Compliant systems based on later, or higher, version numbers MAY NOT be compatible with compliant systems based on earlier, or lower, version numbers. Anyone using NTCIP 1104 should also consult NTCIP 8004 v01 for specific guidelines on compatibility.

INTRODUCTION

NTCIP 2103 v02 defines a subnetwork profile that is a combination of standards intended to meet specific requirements for data transfers to and from processors in direct-connect or circuit-switched environments. The purpose of NTCIP 2103 v02 is to provide the information necessary to establish a connection using the Point-to-Point Protocol (PPP) via an RS-232 interface and/or a dial-up modem. This profile is a subnetwork specification and uses protocols and standards to address the Physical and Data Link Layers (i.e., Layers 1 and 2 of the OSI Basic Reference Model). NTCIP 2103 v02 can be used in combination with a variety of upper layer protocols. NTCIP 2103 v02 is a subnet profile for use in center-to-roadside and center-to-center communications.

NTCIP 2103 v02 contains mandatory requirement statements that are applicable to all devices claiming conformance to NTCIP 2103 v02. It also contains options and conditional requirements, which may be applicable to a specific environment in which a device is used.

The following keywords apply to NTCIP 2103: AASHTO, Dial-up, ITE, NEMA, NTCIP, PPP, Point-to-Point, RS-232, Subnetwork Profile.

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CONTENTS

Section 1
GENERAL

1.1 Scope

NTCIP 2103 v02 is applicable to transportation related devices that operate in a point-to-point configuration where exactly two devices (called peers) are connected by a logical Physical Layer communications link. As a subnetwork profile, NTCIP 2103 v02 specifies a set of protocols and standards applicable to the Data Link and Physical layers of the Open Systems Interconnect (OSI) Basic Reference Model. The Subnet Profile for the Point-to-Point Protocol over RS-232 is intended to provide an interoperability standard for the Physical and Data Link Layer aspects of communications in transportation related devices for dialed-up circuits.

The protocol stack described in NTCIP 2103 v02 is appropriate for the reliable exchange of data between processing equipment on switched data networks. The primary feature of this profile is reliable data transfer with security between directly connected devices.

1.2 Scenario

The OSI Basic Reference Model defines seven layers within a communications stack, each performing a particular role in the transmission of data over a medium. Communication standards typically relate to one or more portions of the OSI Model.

NTCIP 8003 defines how to combine base standards to produce a variety of *profile* standards. Profile standards reference base standards and may restrict options within the base standards in order to encourage the development of fully compatible implementations. NTCIP 2103 v02 is a Subnet Profile, which is defined to be a combination of standards specifying the requirements for the first two layers of the OSI Basic Reference Model.

The first layer, the Physical Layer, deals with how the bits of information are transmitted over a communications channel. This layer deals with the mechanical and electrical interfaces, and the physical transmission medium.

The second layer, the Data Link Layer, has the task of transforming the information that came in over the wire into data that appears to be free of transmission errors. This layer should incorporate mechanisms to ensure the integrity of the data and provide a method of ensuring that no data is lost.

This subnet profile is based on the Point-to-Point Protocol over an RS-232 or dial-up modem link. The profile provides a peer-to-peer relationship between the connected devices. The profile requires full-duplex circuits and is independent of the bit rate of the circuit. SPs do not address higher layer functionality such as routing, segmentation, and re-transmission of data packets, nor is it concerned with the application(s) residing in the device.

This Subnet Profile provides a mechanism to identify higher layer protocols by means of the PPP Protocol Field. This provides a mechanism to permit “multiplexing” messages generated by multiple protocols using a single communications link. The values for the Protocol Field are assigned internationally by the Internet Assigned Numbers Authority (IANA, www.iana.org).

The layers, base standards, and profile taxonomy that make up this profile are shown in Figure 1. The Data Link Layer is defined by a variety of standards specifying various sub-layer components.

<table>
<tr><th>ISO LAYERS</th><th colspan="2">BASE STANDARDS</th><th>PROFILE</th></tr>
<tr><td rowspan="4">DATA LINK LAYER</td><td>(Network configuration)</td><td>RFC 1332 (IPCP)
NTCIP 2201 (T2 Profile)</td><td rowspan="5">PPP - Subnet Profile</td></tr>
<tr><td>(authentication)</td><td>RFC 1994 (CHAP)</td></tr>
<tr><td>(DL configuration & multiplexing)</td><td>RFC 1570 (LCP Extensions)
RFC 1661 (PPP)</td></tr>
<tr><td>(framing)</td><td>RFC 1662 (HDLC-Like Frame)</td></tr>
<tr><td>PHYSICAL LAYER</td><td colspan="2">ANSI/TIA/EIA-232-F
and/or
ITU-T V.34</td></tr>
</table>

Figure 1 Subnet Profile for PPP Scenario

1.3 References

The following standards (normative references) contain provisions that, through reference in this text, constitute provisions of NTCIP 2103 v02. Other documents and standards (other references) are referenced in these documents, which might provide a complete understanding of the entire protocol and the relations between all parts of the protocol. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on NTCIP 2103 v02 are encouraged to investigate the possibility of applying the most recent editions of the standard listed below.

1.3.1 Normative References

ANSI/TIA/EIA-232-F-1997	*Interface Between Data Terminal Equipment and Data Circuit-Termination Equipment Employing Serial Binary Data Interchange*
ANSI/TIA/EIA-574-90	*9-Position Non-Synchronous Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*
RFC 1317	*Definitions of Managed Objects for RS-232-like Hardware Devices*
RFC 1321	*The MD5 Message-Digest Algorithm*
RFC 1332	*The PPP Internet Protocol Control Protocol (IPCP)*
RFC 1381	*SNMP MIB Extension for the X.25 Packet Layer*
RFC 1570	*PPP LCP Extensions*
RFC 1659	*Definitions of Managed Objects for RS-232 like Hardware Devices using SMIv2*
IAB STD 51	*RFC 1661, The Point-to-Point Protocol (PPP)* *RFC 1662, PPP in HDLC-like Framing*
RFC 1994	*PPP Challenge Handshake Authentication Protocol (CHAP)*
RFC 2153	*PPP Vendor Extensions*
ITU-T V.34	*A modem operating at data signaling rates of up to 33 600 bit/s for use on the general switched telephone network and on leased point-to-point 2-wire telephone-type circuits*
ITU-T V.90 (1998)	*A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signaling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream.*
ITU-T V.92 (2000)	*Enhancements to Recommendation V.90*

ITU-T V.92 Amendment1 (2001)	*Amendment 1 to Recommendation V.92 - Enhancements to Recommendation V.90*
ITU-T V.250 (5/99)	*SERIES V: DATA COMMUNICATION OVER THE TELEPHONE NETWORK-Control procedures - Serial asynchronous automatic dialing and control*

NOTE—A V.34 modem may work on either switched telephone and/or leased lines.

1.3.2 Other References

AASHTO / ITE / NEMA NTCIP 2201:2003	*Transportation Transport Profile* published September 2005
AASHTO / ITE / NEMA NTCIP 2202:2001	*Internet (TCP/IP and UDP/IP) Transport Profile* published December 2001
AASHTO / ITE / NEMA NTCIP 9001 v03	*NTCIP Guide* published October 2002
AASHTO / ITE / NEMA NTCIP 8003	*Profiles Framework*
RFC 1663	*PPP Reliable Transmission*
RFC 1717	*The PPP Multilink Protocol (MP)*
RFC 2125	*The PPP Bandwidth Allocation Protocol (BAP) / The PPP Bandwidth Allocation Control Protocol (BACP)*
ISO/IEC 3309:1993	*Information technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures -- Frame structure*
ISO/IEC 4335:1993	*Information technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures -- Elements of procedures*

The following are additional informative references that may be helpful in further understanding the operations and requirements of current state-of-the-art modems.

The Hayes Modem Technical Reference Manual, 1990
http://www.totse.com/en/technology/telecommunications/trm.html, 10/14/04

Modem Initialization Strings, http://www.modemhelp.org/inits/, 10/14/04

An Overview of Analog Dialup Modem Performance, Environments, and Impairments. Compaq Computer Corporation Communication Products Division, Revised 7/20/98, ftp://ftp.compaq.com/pub/supportinformation/papers/prt005a0798.doc , 8/9/02

1.3.3 Contact Information

1.3.3.1 NTCIP Standards

For revision information on this NTCIP standard, contact:

NTCIP Coordinator
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209-3806
e-mail: ntcip@nema.org

For draft revisions to this NTCIP standard, and recommended revisions of the NTCIP Joint Committee, visit www.ntcip.org .

1.3.3.2 ANSI/TIA/EIA, ITU-T, ISO/IEC Standards

Members of the ISO maintain registers of currently valid ISO/IEC International Standards. For the USA, the member of ISO is the American National Standards Institute (ANSI), which may be contacted as follows:

ANSI
11 West 42nd Street, 13th Floor
New York, NY 10036
www.ansi.org

1.3.3.3 RFC Documents

Obtain Request for Comment (RFC) electronic documents from several repositories on the World Wide Web, or by “anonymous” File Transfer Protocol (FTP) with several hosts. Browse or FTP to:

www.rfc-editor.org
www.rfc-editor.org/repositories.html
for FTP sites, read ftp://ftp.isi.edu/in-notes/rfc-retrieval.txt

1.4 Terms

For the purposes of NTCIP 2103 v02, the following terms and definitions apply. For terms not defined in this clause, English words are used in accordance with their definitions in the latest edition of *Webster's New Collegiate Dictionary*. Electrical and electronic terms not defined in this clause or in *Webster's New Collegiate Dictionary* are used in accordance with their definitions in Institute of Electrical and Electronic Engineers (IEEE) Std 100-1996.

authentication	The process whereby a message is associated with a particular originating entity.
bit	Binary Digit. A single basic computer signal consisting of a value of 0 or 1, off or on.
byte	A group of bits acted upon as a group, which may have a readable ASCII value as a letter or number or some other coded meaning to the computer. It is commonly used to refer to 8-bit groups.
data	Information before it is interpreted.
Data Link Layer	That portion of an OSI Basic Reference Model (Layer 2) responsible for flow control, framing, synchronization and error control over a communications link.

datagram	A self-contained unit of data transmitted independently of other datagrams.
data packet	Another term for “information field” (as used within NTCIP 2103 v02). This term is mainly used with Network Layer Protocol describing all information that is passed from the Network Layer to the Data Link Layer.
Intelligent Transportation Systems (ITS)	A major national initiative to improve information, communication and control technologies in order to improve the efficiency of surface transportation.
Internet	A large collection of connected networks, primarily in the United States, running the Internet suite of protocols. Sometimes referred to as the *DARPA Internet, NSF/DARPA, Internet*, or the *Federal Research Internet.*
Internet Protocol (IP)	The network protocol offering a connection-less mode network service in the Internet suite of protocols.
IP address	A 32-bit quantity used to represent a point of attachment in an internet.
MD5 Hashing Algorithm	A hashing algorithm defined by the Internet Engineering Task Force (IETF) in RFC 1321. The algorithm is used to provide authentication services. It allows a system to challenge another system with a random string of characters. The receiving system appends a “secret” (i.e., a previously agreed code) to the challenge, along with other defined information in order to produce a 16-byte code. This new code is passed back to the challenging system and is verified. Experience has proven that it is very difficult for a third party to reverse engineer the secret, even if the third party observes a large number of valid challenges and responses.
network	A collection of subnetworks connected by intermediate systems and populated by end systems.
Network Layer	That portion of an OSI Basic Reference Model (Layer 3) responsible for data transfer across the network, independent of both the media comprising the underlying subnetworks and the topology of those subnetworks.
Physical Layer	That portion of an OSI Basic Reference Model (Layer 1) responsible for the electrical and mechanical interface between communicating systems.
point-to-point	A form of communications where data is transmitted between two devices without any other devices existing on the communication circuit.
proforma	A guide provided in advance to prescribe form or describe items.
protocol	A system of rules and procedures governing communications between two devices. File transfer protocols in a communications program refer to a set of rules governing how error checking is performed on blocks of data.
reserved	Reserved for future designation by the NTCIP standards effort.
Simple Network Management Protocol (SNMP)	A communications protocol developed by the IETF, used for configuration and monitoring of network devices.
Simple Transportation Management Framework (STMF)	Describes the organization of the information within devices and the methods of retrieving or modifying any information within the device. STMF also explains how to generate and use computer readable information organization descriptions.
subnet	A physical network within a network. All devices on a subnetwork share a common physical medium.
subnetwork	See subnet.

Subnetwork Profile	A suite of protocols combined in a profile that specifies the lower layers of the OSI Basic Reference Model. The only layers addressed within the SP are the Physical and the Data Link layer.
Transport Layer	That portion of an OSI Basic Reference Model (Layer 4) which attempts to guarantee reliable data transfers between two end-systems, using flow control and error recovery, and may provide multiplexing.

1.5 Abbreviations and Acronyms

For the purposes of NTCIP 2103 v02, the following acronyms apply.

ACCM	Asynchronous Control Character Map
bps	Bits per Second
CCITT	International Telegraph and Telephone Consultative Committee, now being referred to as ITU
CHAP	Challenge-Handshake Authentication Protocol
DARPA	Defense Advanced Research Projects Agency
DCE	Communications Equipment (i.e. modem)
DTE	Data Terminal Equipment (i.e. computer)
FCS	Frame Checking Sequence
FTP	File Transfer Protocol
HDLC	High Level Data Link Control Protocol
IAB	Internet Activities Board
IANA	Internet Assigned Numbers Authority
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPCP	Internet Protocol Control Protocol
IPI	Initial Protocol Identifier
LCP	Link Control Protocol
MD5	Message Digest 5
MIB	Management Information Base
MRU	Maximum Receive Unit
NCP	Network Control Procedure
NEMA	National Electrical Manufacturers Association
NTCIP	National Transportation Communications for ITS Protocol
NTCITS IPI	National Transportation Communications for ITS Initial Protocol Identifier. This is the acronym that was recorded by IANA for the original NTCIP protocol identifier within PPP; due to the restructuring of NTCIP documentation; this now equates to the IPI for T2.
OSI	Open Systems Interconnection
PICS	Profile Implementation Conformance Specification
PPP	Point-to-Point Protocol
PRL	Profile Requirements List
RFC	Request for Comments
SNMP	Simple Network Management Protocol
SP	Subnetwork Profile

STD	Standard
STMF	Simple Transportation Management Framework
T2	Transportation Transport (Profile)
TCP	Transport Control Protocol
UDP	User Datagram Protocol

Section 2
CONFORMANCE

2.1 General Requirements

A Profile is a standard that combines one or more base standards and selects appropriate options or functions within them. A profile does this by referencing the base standard or standards and not by repeating the referenced text. A base standard may be a "standard" or another profile that references standards.

Combining standards into standardized profiles provides a number of benefits. Profiles can be used to specify major functional elements of a system that meets an end-user's specific needs. This enables system specifiers, implementers, and procurement agents to specify and quantify products or the functions of a product in terms of the desired needs, not the technical details. This abstraction allows a more general functional view.

The definition of a profile is used to:

a) Document the functional requirement and the scenario in which they are required.
b) Select the appropriate base standard(s).
c) Select any appropriate sets of options or subsets from the base standards or profiles.
d) Combine compatible base standards, by reference, to create a profile that meets a specific set of requirements.

Implementations claiming conformance to NTCIP 2103 v02 shall support the following elements as stated:

a) All requirements in the remainder of this Section.
b) All of the constraints specified in Annex A, Annex B, and Annex D (normative).
c) All mandatory requirements of the standards referenced by this profile (unless specifically indicated otherwise in this profile).

2.2 Data Link Layer Requirements

The Data Link Layer for the Point-to-Point Protocol Profile is divided into a variety of sub-layers as follows:

a) Network Control Protocol (NCP) for Internet Protocol (IP)
b) Challenge-Handshake Authentication Protocol (CHAP)
c) Link Control Protocol (LCP)
d) Point-to-Point Protocol (PPP)
e) High Level Data Link Control Protocol (HDLC)-Like Framing
f) Modem Configuration and Control Protocol

Except for modem control and configuration, all data exchanged over the link shall be placed into a PPP packet (see Section 2.2.5, which shall be contained within an HDLC-Like Frame (see Section 2.2.6). Before any information is sent over the link, a connection must be made. If the communication is through a dial-up modem, a simple ASCII character stream is used to configure and setup the connection. Once the connection is made, the link shall be established through the use of LCP (see Section 2.2.4). Implementations conforming to this profile shall then authenticate the peer using CHAP (see Section 2.2.3). Finally, before any end-application data is exchanged, the implementation shall configure the chosen transport profile through the use of the appropriate NCP (see Section 2.2.1 and Section 2.2.2). An

implementation shall implement at least one of the transport profiles referenced within this section.

2.2.1 Network Control Protocol for Transportation Transport Profile

Implementations may exchange Transportation Transport (T2) Profile packets directly over PPP. Support for T2 Profile packets is optional, but if implemented shall conform to the requirements in this section.

NOTE—It is envisioned that most implementations are not bandwidth constrained and therefore use the Internet Transport Profile to be as consistent as possible with computer industry standards; however, the Transportation Transport Profile is defined for completeness.

2.2.1.1 General

Before any T2 Profile packets may be communicated, PPP must reach the Network-Layer Protocol phase. The Network Control Protocol for the T2 Profile, known as the T2 Control Protocol, is a null protocol and shall always be considered to be in the Opened state.

2.2.1.2 Sending T2 Profile Data Packets

Exactly one T2 Profile packet is encapsulated in the Information field of PPP Data Link Layer frames where the Protocol field indicates type 0x00C1 (NTCITS IPI).

The maximum length of a T2 Profile packet transmitted over a PPP link is the same as the maximum length of the Information field of a PPP data link layer frame. Larger packets must be embedded into a Transport Profile that supports fragmentation and reassembly.

2.2.2 Network Control Protocol for IP

If an implementation supports the exchange of IP packets over PPP, the implementation shall conform to the requirements in this clause.

Before exchanging any IP datagrams, PPP must send Internet Protocol Control Protocol (IPCP) packets to configure the IP layer.

2.2.2.1 IPCP General Procedures

There are no additional requirements to the IPCP General Procedures as defined in Clause 2 of RFC 1332.

2.2.2.2 IPCP Configuration Options

There are two IPCP options that may be applicable to this profile. Use of the IP-Addresses Option is not allowed by this profile as it has been deprecated in RFC 1332 by the IP-Address option as indicated below.

2.2.2.2.1 IP Compression Protocol Option

The IP-Compression-Protocol option allows the use of Van Jacobson Compression on the link. This compression algorithm is processor intensive and is not recommended for links with field devices, but may be useful for center-to-center dial-up links. If implemented, there are no additional requirements to the requirements defined in Clauses 3.2 and 4 of RFC 1332.

NOTE—This is an exception to RFC 1332. RFC 1332 recommends the use of this option (and thus would normally be translated as mandatory within NTCIP 2103 v02); however, NTCIP 2103 v02 recommends against this option for field devices and is silent as to its use for centers.

2.2.2.2.2 IP-Address Option

The IP-Address option allows negotiation of the IP address to be used on the local end of the link. An implementation conforming to this profile shall support and may use this option, as defined in Clause 3.3 of RFC 1332.

2.2.3 Challenge Handshake Authentication Protocol

LCP allows a PPP implementation to negotiate an Authentication Protocol for authenticating its peer. This profile requires support for CHAP. CHAP uses a random challenge, with a cryptographically hashed response that depends upon the challenge, the challenge identifier, and a secret key.

Implementations claiming compliance to NTCIP 2103 v02 shall conform to all of the requirements for CHAP as specified in RFC 1994. In addition, this profile places several restrictions on the implementation of this protocol as defined below.

2.2.3.1 Packet Format

There are no additional requirements to the Packet Format (and associated procedure) requirements as defined in Clause 4 of RFC 1994.

2.2.3.2 Name

The name field shall be used as an index to locate the proper secret in a table of secrets. This makes it possible to support more than one name/secret pair per system, and to change the secret in use at any time during the session.

For field devices, the names and secrets shall be stored as SNMP objects as defined in Annex B.

2.2.3.3 Secret

The secret shall be at least 16 octets long according to the recommended practice indicated in Clause 2.3 of RFC 1994 and shall be distinct for each direction of the PPP link.

For field devices, the names and secrets shall be stored as SNMP objects as defined in Annex B.

2.2.3.4 Hashing Algorithm

LCP allows the negotiation of a hashing algorithm. All implementations conforming to this profile shall support the Message Digest 5 (MD5) hash algorithm. There are no additional requirements to the MD5 hash algorithm requirements as defined in RFC 1321.

2.2.3.5 Timing of Challenges

There are no additional timing requirements to those defined in RFC 1994. Implementations shall challenge the other device during link establishment. Implementations shall be prepared to receive a challenge at any time after the link has been established.

2.2.4 Link Control Protocol

The Data Link Layer is managed through the use of the Link Control Protocol (LCP). Management includes:

a) establishing and terminating the link
b) negotiating various options for the link

Data frames are initially exchanged according to the default settings as defined by the various standards referenced by this Profile. These default settings may be modified through the use of various Configuration Options that have been defined for LCP and as discussed in Section 2.2.4.3.

2.2.4.1 LCP Packet Formats

Implementations shall support all LCP Packet formats as defined in Clause 5 of RFC 1661 and shall additionally support the Identification LCP packet defined in Clause 1.1 of RFC 1570.

2.2.4.1.1 Configure-Request

There are no additional requirements to the Configure-Request requirements as specified in Section 5.1 of RFC 1661.

2.2.4.1.2 Configure-Ack

There are no additional requirements to the Configure-Ack requirements as specified in Section 5.2 of RFC 1661.

2.2.4.1.3 Configure-Nak

There are no additional requirements to the Configure-Nak requirements as specified in Section 5.3 of RFC 1661.

2.2.4.1.4 Configure-Reject

There are no additional requirements to the Configure-Reject requirements as specified in Section 5.4 of RFC 1661.

2.2.4.1.5 Terminate-Request and Terminate-Ack

There are no additional requirements to the Terminate-Request and Terminate-Ack requirements as specified in Section 5.5 of RFC 1661.

2.2.4.1.6 Code-Reject

There are no additional requirements to the Code-Reject requirements as specified in Section 5.6 of RFC 1661.

2.2.4.1.7 Protocol-Reject

There are no additional requirements to the Protocol-Reject requirements as specified in Section 5.7 of RFC 1661.

2.2.4.1.8 Echo-Request and Echo-Reply

There are no additional requirements to the Echo-Request and Echo-Reply requirements as specified in Section 5.8 of RFC 1661.

2.2.4.1.9 Discard-Request

There are no additional requirements to the Discard-Request requirements as specified in Section 5.9 of RFC 1661.

2.2.4.1.10 Identification

An LCP Identification packet, as specified in Section 1.1 of RFC 1570, shall be sent whenever:

a) a Configure-Reject is sent or received,
b) as a final message when negotiation fails to converge, and
c) when LCP reaches the Opened state.

The Identification packet shall contain the make, model, and version of the implementation. This information should be identical to that contained in the Configuration Conformance group of NTCIP global objects and the sysDescr object of MIB-II.

2.2.4.2 Establishing and Terminating the Link

RFC 1661 defines a number of events, actions, phases, and states during the process of configuring, maintaining, and terminating a link. This profile recommends full conformance to these procedures; however, many of these procedures are internal to an implementation and can not be easily tested. This profile is only concerned with the interface that is expected to be presented across a physical interface; therefore, it only requires conformance to those procedures dealing with the exchange of data packets.

2.2.4.2.1 Link Establishment

There are no additional requirements to the Link Establishment requirements as specified in Sections 3.4 and 4 of RFC 1661.

These sections require an implementation to support the receipt/transmission of Configure-Request packets and the transmission/receipt of the appropriate response (i.e., a Configure-Ack, Configure-Nak, or Configure-Reject). Once a Configure-Ack has been both sent and received, the implementation moves to the authenticate phase. All non-LCP data packets received during link establishment are discarded. Requirements for supporting the various configuration options are defined in Section 2.2.4.3.

2.2.4.2.2 Authentication

Sections 3.5 and 4 of RFC 1661 allow an implementation to authenticate its peer through a negotiated authentication protocol. This profile requires the use of the CHAP authentication protocol with the MD5 hashing algorithm.

An implementation shall authenticate the peer during the authentication phase. An implementation may also challenge a peer during the network protocol phase. This profile recommends that a management station should not challenge an agent during the network protocol phase due to the extra processing burden this would impose on the device. An agent, however, may wish to challenge a management station under certain conditions that are implementation specific. A pair of central systems may authenticate each other at any time.

If authentication fails, an implementation shall proceed to the link termination phase.

RFC 1661 allows LCP, authentication protocol (in this case CHAP), and link quality monitoring packets to be exchanged during this phase; all other packets are silently discarded. This profile does not impose any additional requirements upon this feature.

2.2.4.2.3 Network Layer

In addition to the Network Layer Protocol Phase requirements as specified in Sections 3.6 and 4 of RFC 1661, implementations claiming compliance to this profile shall support the T2 and/or IP "network" layers. The Network Control Protocol requirements for these "network" layers are defined in Sections 2.2.1 and 2.2.2. Support for other "network" layers, as defined by the Internet Assigned Numbers Authority, is

optional.

NOTE 1—The Internet Assigned Numbers Authority has recorded the PPP Protocol number for the T2 Profile under the name NTCITS IPI, which stands for National Transportation Communications for ITS Initial Protocol Identifier.

NOTE 2—The T2 Profile is indicated by a value of 0xC1 in the Protocol Field; the Internet Profile is indicated by a value of 0x21 in the Protocol Field.

2.2.4.2.4 Link Termination

In addition to the Link Termination requirements as specified in Sections 3.7 and 4 of RFC 1661, a dial-up implementation claiming conformance to this profile shall disconnect the physical layer after exchanging terminate packets.

2.2.4.3 LCP Configuration Options

LCP has a number of Configuration Options defined in several different documents; additional options may be added in the future. Implementations shall be able to establish a PPP link with the indicated default for each Configuration Option, unless otherwise indicated below. Support for negotiating a non-default value is optional for each Configuration Option, unless otherwise indicated below.

2.2.4.3.1 Vendor Specific

RFC 2153 defines a configuration option (Type 0) to support proprietary vendor-specific extensions for the LCP configuration options. If any such feature is implemented, the feature shall comply with the requirements as defined in RFC 2153.

2.2.4.3.2 Maximum Receive Unit

RFC 1661 defines a configuration option (Type 1) to allow negotiation of the Maximum Receive Unit (MRU). All implementations shall support the default MRU of 1500 bytes. If this Configuration Option is implemented, the implementation shall comply with the requirements as defined in Clause 6.1 of RFC 1661.

2.2.4.3.3 Async-Control-Character-Map

RFC 1662 defines a configuration option (Type 2) to allow negotiation of the Asynchronous Control Character Map (ACCM). This feature allows the peers of a PPP link to negotiate which bytes must be byte-stuffed and which bytes may be sent in the clear. By default, the values 0x00 through 0x1F, 0x7D and 0x7E are all byte stuffed. Support for negotiating the value for this feature is mandatory and shall comply with the requirements as defined in Clause 7 of RFC 1662.

Because ITS data packets frequently contain data values in the range of 0x00 through 0x1F, it is recommended that each peer negotiate for minimal byte-stuffing (i.e., only 0x7D and 0x7E).

2.2.4.3.4 Authentication-Protocol

RFC 1661 defines a configuration option (Type 3) to allow negotiation of the Authentication Protocol. Support and use of this feature is required and the negotiated authentication protocol shall be CHAP with MD5. The negotiation shall comply with the requirements as defined in Clause 6.2 of RFC 1661 and Clause 3 of RFC 1994. The implementation shall not support the default authentication protocol (i.e., none) and shall fail attempts to bypass the authentication.

2.2.4.3.5 Quality-Protocol

RFC 1661 defines a configuration option (Type 4) to allow negotiation of a Quality Protocol. If this feature is implemented, the implementation shall comply with the requirements as defined in Clause 6.3 of RFC 1661.

2.2.4.3.6 Magic-Number

RFC 1661 defines a configuration option (Type 5) to allow detection of looped back links and other Data Link Layer anomalies. If this feature is implemented, the implementation shall comply with the requirements as defined in Clause 6.4 of RFC 1661.

2.2.4.3.7 Protocol-Field-Compression

RFC 1661 defines a configuration option (Type 7) to allow negotiation for the compression of the Protocol Field of the PPP data packet. When compression is activated, some Protocol Field values may be compressed into a single octet. Support and use of this feature is recommended, but optional. If this feature is implemented, the implementation shall comply with the requirements as defined in Clause 6.5 of RFC 1661.

2.2.4.3.8 Address-and-Control-Field-Compression

RFC 1661 defines a configuration option (Type 8) to allow negotiation for the compression of the Address and Control Fields of the HDLC-Like Frame used in this profile. When compression is activated, the two fields are compressed (i.e., omitted). Support and use of this feature is recommended, but optional. If this feature is implemented, the implementation shall comply with the requirements as defined in Clause 6.6 of RFC 1661.

2.2.4.3.9 FCS-Alternatives

RFC 1570 defines a configuration option (Type 9) to allow negotiation for the Frame Checking Sequence (FCS) algorithm used by the HDLC-Like Frame used in this profile. Implementations claiming conformance with this profile shall not use this feature; they shall use the default International Telegraph and Telephone Consultative Committee (CCITT) 16-bit FCS.

2.2.4.3.10 Self-Describing-Pad

RFC 1570 defines a configuration option (Type 10) to allow negotiation for the addition of self-describing padding. Implementations claiming conformance with this profile shall not use this feature.

2.2.4.3.11 Numbered-Mode

RFC 1663 defines a configuration option (Type 11) to allow negotiation for reliable transmission over the HDLC link. This feature uses the Address and Control fields in a numbered mode to provide reliable transmission services (e.g., for message sequencing). Implementations claiming conformance with this profile shall not use this feature.

2.2.4.3.12 Callback

Clause 2.3 of RFC 1570 defines a configuration option (Type 13) to allow a call-back feature. This feature shall not be used.

NOTE—Flaws were found with this feature and it was designed for use with numbered HDLC. If a callback option is desired (e.g., to save on toll calls or to provide added security) the functionality should be provided by software outside of this layer.

2.2.4.3.13 Multilink Options

RFC 1717 defines a method for splitting, recombining and sequencing datagrams across multiple logical data links; several configuration options are defined for these services (i.e., Types 17, 18, and 19). This profile does not address multilink services and as such these services are not required.

2.2.4.3.14 Bandwidth Allocation Protocol Options

RFC 2125 defines a method to manage the dynamic bandwidth allocation of implementations supporting the PPP multilink protocol. As indicated above, this profile does not address multilink services and therefore the configuration option (Type 23) specified in this RFC is not required.

2.2.4.3.15 Deprecated Options

LCP Configuration Options in Table 1 have been deprecated by the Internet community and shall not be used by implementations complying with this profile:

Table 1 Deprecated LCP Configuration Options

Type	Name
6	DEPRECATED (Quality Protocol)
12	DEPRECATED (Multi-Link-Procedure)
14	DEPRECATED (Connect-Time)
15	DEPRECATED (Compound-Frames)
16	DEPRECATED (Nominal-Data-Encapsulation)

2.2.4.3.16 Other Options

Table 2 identifies several other LCP Configuration Options that the Internet Assigned Numbers Authority (IANA) has assigned for specific purposes. Support for and use of such options are optional.

Table 2 IANA-Assigned LCP Configuration Options

Type	Name
20	Proprietary
21	DCE-Identifier
24	LCP-Authentication-Option
25	Consistent Overhead Byte Stuffing (COBS)
26	Prefix elision

2.2.5 Point-to-Point Protocol

All data exchanged over the link shall be encapsulated as specified in Section 2 of RFC 1661. This encapsulation includes three fields: Protocol, Information, and Padding.

2.2.5.1 PPP Protocol Field

Implementations conforming to this profile shall recognize and properly handle the Protocol values for both LCP (0xC021) and CHAP (0xC223). In addition, implementations must support those protocols selected in Section 2.2.4.2.3. Other protocols may be supported.

2.2.5.2 PPP Information Field

There are no additional requirements to the PPP Information Field requirements as specified in Section 2 of RFC 1661.

2.2.5.3 PPP Padding Field

Compliant implementations shall not use any padding. Beyond this, there are no additional requirements to the Information PPP Padding Field requirements as specified in Section 2 of RFC 1661.

2.2.6 HDLC-Like Framing

The Point-to-Point Protocol data packet shall be transported in HDLC-Like framing as described in RFC 1662.

2.2.6.1 Frame Format

There are no additional requirements to the Frame Format requirements as specified in Section 3.1 of RFC 1662.

2.2.6.2 Modification of the Basic Frame

There are no additional requirements to the Modification of the Basic Frame requirements as specified in Section 3.2 of RFC 1662.

2.2.6.3 Octet-Stuffed Framing

There are no additional requirements to the Octet-Stuffed Framing requirements as specified in Section 4 of RFC 1662.

NOTE—RFC 1662 requires compliant implementations to byte stuff any byte that has been selected in the associated ACCM (see Section 2.2.4.3.3); it *allows* an implementation to stuff other bytes. Therefore, implementations are required to be able to decode any byte that has been stuffed, regardless of the current ACCM value. The benefit of negotiating for minimal byte stuffing is that it *allows* an implementation to make more efficient use of the communications network when sending a message.

2.2.6.4 Bit-Stuffed Framing

This Profile does not address bit-synchronous links; therefore, the requirements of RFC 1662, Clause 5 do not apply. However, implementers are encouraged to follow this clause if implementing within this environment.

2.2.6.5 Asynchronous to Synchronous Conversion

This Profile does not address bit-synchronous links; therefore, the requirements of RFC 1662, Clause 6 do not apply. However, implementers are encouraged to follow this clause if implementing within this environment.

2.2.7 Modem Configuration and Control Protocol

The protocol used when configuring and controlling a modem is an ASCII character stream followed by a terminator character. The terminator character is, by default, a <lf> (line feed).

2.3 Physical Layer Requirements

An implementation shall conform to either the serial interface as specified in Section 2.3.1 or the modem interface as specified in Section 2.3.2.

An implementation may support a serial communications interface and/or internal modem interface. If an implementation supports a serial communications interface, it is considered Data Terminal Equipment (DTE). If an implementation supports an internal modem, it is considered Data Communications Equipment (DCE).

If an implementation is considered a device (DTE) and is to be connected to another device (DTE) directly through a "Null Modem Cable", the implementation shall conform to Section 2.3.1.

If an implementation is considered a device (DTE) and is to be connected to an external modem (DCE), the implementation shall conform to Section 2.3.1, 2.3.3, and 2.3.4. For dial-up operation it shall also support Section 2.3.5.

NOTE—This implies that any external modem (DCE) connected to the device (DTE) also conforms to Sections 2.3.1, 2.3.3, and 2.3.4. For dial-up operation, the modem also supports Section 2.3.5.

If an implementation is considered a modem (DCE), the implementation shall conform to Sections 2.3.2 and 2.3.3.

2.3.1 Serial Communications Interface

2.3.1.1 Physical Interface

The serial communications physical interface shall consist of an ANSI/TIA/EIA-232-F (25 Pin) or ANSI/TIA/EIA-574-90 (9 Pin) serial interface with pin designations as indicated in NTCIP 2101. The interface shall support, as a minimum, the signals identified in Table 3.

Table 3 Supported Signals

TX	Transmitted data
RX	Received data
RTS	Request to send
CTS	Clear to send
SG	Signal ground
DCD	Data carrier detect

NOTE—Support of CTS is not required by V.250 but is required by NTCIP 2103 v02. Support of RI (Ring Indicator) is required by V.250 but is NOT required by NTCIP 2103 v02.

An interconnecting cable that additionally supports RI (Ring Indicator), DSR (Data Set Ready), and DTR Data Terminal Ready is optional.

The gender of the connectors shall be appropriate for the device or modem.

2.3.1.2 RS-232 Data Rate and Programmable Bit Rates

The requirements for the data rate and programmable bit rates are based on the NTCIP 2101. At a minimum, the interface shall support full-duplex at the following data rates:

a) 1200 bits per second (bps),

b) 2400 bps
c) 4800 bps,
d) 9600 bps, and
e) 19200 bps

Higher data rates may be supported.

2.3.2 Internal Modem Interface

An internal modem shall support the mandatory requirements of ITU-T V.34. The modem may additionally support the ITU-T V.90 interface.

The internal interface, modem configuration, and control requirements between a device and an internal modem are outside the scope of NTCIP 2103 v02. However, Section 2.4 applies.

2.3.3 Modem to Modem Interface

The modem-to-modem interface shall as a minimum meet the requirements of a Bell Type 3002 unconditioned, voice grade, public switched telephone network, circuit. The physical interface to the circuit shall be an RJ11.

2.3.4 External Modem Interface

An external modem shall support the mandatory requirements of ITU-T V.34. The modem may additionally support the ITU-T V.90 interface.

2.3.5 External Dial-up Modem Configuration and Control Requirements

An implementation shall meet the requirements of ITU-T V.250 but with the exceptions as noted in Sections 2.3.5.1 through 2.3.5.7.

2.3.5.1 Introduction

ITU-T V.250 is an international standard that formalizes a subset of the popular "Hayes AT Command" set that most modem manufacturers support and agree upon. The ITU standard also introduces a new set of "+" commands and controls that formalizes and extends the command set to address those that are supported but whose format differed from manufacturer to manufacturer. The following clauses are meant primarily to highlight the differences between the ITU-T V.250 and the original command set. However, some additional requirements and exceptions are addressed.

2.3.5.2 Functions

2.3.5.2.1 Buffered Mode and Leadin

Support of Buffer Mode wherein the data transfer rate over the line and the modem (DCE) to device (DTE) communications rate can be different is mandatory. Use of Buffer Mode is optional.

Except as noted in Section 2.3.5.5.1, the use of the “+” character is reserved for use with the extended V.250 commands.

2.3.5.2.2 Circuits

Table 4 provides a mapping between common mnemonics, common description, circuit terminology used in ITU-T V.250 and that used in Section A.4.2.2.

Table 4 V.250 Signal Mapping

Common Mnemonic	Common Description	V.250 Description	V.250 (CCITT) Reference	DB 25 Pin Number	DB 9 Pin Number
SG	Signal Ground/ Logic Ground	Signal Common	102	7	5
TX	Transmit Data	Transmitted Data	103	2	3
RX	Receive Data	Received Data	104	3	2
RTS	Request To Send	Request to Send	105/133	4	7
CTS	Clear To Send	Clear to Send	106	5	8
DSR	Data Set Ready	DCE Ready	107	6	6
DTR	Data Terminal Ready	DTE Ready	108/1, 108/2	20	4
DCD	Data Carrier Detect	Received Line Signal Detector	109	8	1
RI	Ring Indicator	Ring Indicator	125	22	9

2.3.5.2.3 Character Formatting

A conforming modem shall meet the general characteristics as defined in Clause 4.2 of ITU-T V.250. However, the only required format shall be 8 data bits, no parity, and 1 stop element. All basic action and parameters commands shall use this format.

2.3.5.2.4 Data Rates

To be conformant to NTCIP 2103 v02, a modem (DCE) shall be able to accept commands at 2400, 4800, 9600, and 19.2K bit/s. Higher data rates may be supported.

2.3.5.3 Syntax and Procedures

2.3.5.4 Alphabet

There are no additional requirements related to the alphabet (IA5 String) used in commands as defined in ITU-T V.250 Clause 5.1.

2.3.5.4.1 Device (DTE) Command Lines

As defined in ITU-T V.250, Subclause 5.2.1, the modem (DCE) shall be capable of accepting at least 40 characters in the body of a command excluding the termination character.

2.3.5.4.2 Extended Syntax Commands

Any requirement for or the use of any extended syntax command is expressly prohibited.

2.3.5.5 Modem (DCE) Responses

2.3.5.5.1 Online Command State

As defined in ITU-T V.250, Clause 3.2, "Online Command State may be entered from Online Data state by a mechanism defined in 6.2.9 or by other manufacturer-defined means." Subclause 6.2.9 defines the operation of the &D DTE-DCE interface command. After an &D1 interface command is sent to the modem (DCE), an on-to-off transition DTR (circuit 108/2) will put the modem (DCE) in the online

command state but any call will not be disconnected. Since DTR may not be supported, this method cannot be relied upon. However, this is the equivalent of what is often referred to as the "escape sequence". The "escape sequence" (one second of silence, +++, followed by another one second of silence) puts the modem (DCE) in the online command state and does not require any on-to-off transition of DTR.

The most common use of the "escape sequence" is to enable the call to be terminated by issuing the H command. An existing connection remains established until the carrier signal is lost or an internal inactivity time-out is exceeded. In other words, a called modem could continuously send data and control the line unless there was a means to return to the command state so that the H command could be issued.

Since ITU-T V.250 does not mandate support of &D1, an implementation shall support the "escape sequence". This may be done through the use of "register S2" but the default character "+"' shall not be changed.

2.3.5.5.2 Responses

Table 5 is a "Results Codes" table copied from ITU-T V.250. Support of the last result code (CONNECT <text> is not required and, therefore, the modem shall support a configuration command that limits the responses to the first eight (Numeric Codes 0..4 | 6..8).

Table 5 ITU-T V.250 Result Codes

Verbose Code	Numeric Code	Description
OK	0	Acknowledges execution of command
CONNECT	1	A connection has been established; the modem (DCE) is moving from the command state to the online data state
RING	2	The modem (DCE) has detected an incoming call signal from the network
NO CARRIER	3	The connection has been terminated or the attempt to establish a connection has failed
ERROR	4	Command not recognized, command line maximum length exceeded, parameter value invalid, or other problem with processing the command line.
NO DIALTONE	6	No dial tone detected
BUSY	7	Engaged (busy) signal detected
NO ANSWER	8	"@" (Wait for Quiet Answer) dial modifier was used, but remote ringing followed by 5 seconds of silence was not detected before expiration of connection timer (S7)
CONNECT <TEXT>	manufacturer specific	Same as CONNECT, but includes manufacturer-specific text that may specify device (DTE) speed, line speed, error control, data compression, or other status

NOTE—Device (DTE) support of the CONNECT <text> Result Code is not required.

The following behavioral differences as defined in ITU-T V.250 Subclause 5.8.2 are constrained, modified, or eliminated as follows:

a) Result codes shall be limited to those defined in Table 5 .
b) No characters shall appear in a dial string after a semicolon.
c) All dial strings shall contain a P or T dial modifier.

2.3.5.5.3 Manufacturer-Specific Characteristics

Any requirement for or the use of any manufacturer-specific characters or extensions, except as stated herein, is prohibited.

2.3.5.6 Commands and Controls

Except for the Interface Command Restrictions defined in Section 2.3.5.6.1, the modem shall support all the mandatory commands and controls as defined in ITU-T V.250 Subclauses 6.1.1 through 6.7.2.17. The command and controls are organized into Generic Modem (DCE) Controls, DTE-DCE Interface Commands, Call Controls, Modulation Control Commands, Error Control Commands, Data Compression Commands, and Modem (DCE) Testing Commands. NTCIP 2103 v02 Section A.4.3.4 provides a listing of all the commands and controls and whether they are mandatory or optional commands.

2.3.5.6.1 Interface Command Restrictions

The following restrictions on interface commands shall be followed:

All default setting shall conform to the ITU-T V.250 recommended default settings.

Factory Default shall be as follows:

a) S0 (Answer on Ring) shall be 0x00 (Answer Disabled). [V.250 Recommended]
b) S2 (Escape Character) if supported shall be 0x2F (Plus Sign). [Not defined in V.250]
c) S3 (Command Line Termination Character) shall be 0x0D (Carriage Return). [V.250 Mandatory]
d) S4 (Response Formatting Character shall be 0x0A (Line Feed). [V.250 Recommended]
e) S5 (Command Line Editing Character) shall be 0x08 (Back Space). [V.250 Recommended]
f) Q (Result Code Suppression) shall be 0x00 (Transmit Result codes). [V.250 Recommended]

The following commands shall be issued when initializing or dialing:

a) The value of the E (Command Echo) shall be changed to a 1 (No Echo) as part of the modem initialization process.
b) The value of V (Modem (DCE) Response Format) shall be changed to a 0 (Numeric Result Codes) as part of the modem initialization process.
c) The value of X (Result Code Selection and Call Progress Monitoring Control) shall be changed to a 0 (CONNECT [no Text]) as part of the modem initialization process.
d) Set S0=0 to ensure that auto-answer is disabled.
e) Set Q0 to ensure that result codes are transmitted.

It is recommended that the following be also issued when initializing or dialing:

a) &D0 so that DTR interface signal is ignored
b) &C0 so that DCD interface signal is ignored.

2.3.5.7 Miscellaneous

The material defined in ITU-T V.250 Appendix I through III shall be treated as informative and/or not required. Annex F provides modem (DCE) configuration, dialing, and reporting sequence diagrams.

2.4 MIB Requirements

Devices claiming conformance to NTCIP 2103 v02 AND to NTCIP 2301 shall support objects as specified in NTCIP 2101. The Interfaces Group of RFC 1213 is optional.

Devices claiming conformance to the CHAP requirements of NTCIP 2103 v02 AND to SNMP shall support the objects as specified in NTCIP 2103 v02 Annex B.

Devices claiming conformance to the Dial-up requirements of NTCIP 2103 v02 AND to SNMP shall support the objects as specified in NTCIP 2103 v02 Annex D.

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Annex A
PROFILE REQUIREMENTS LIST
(Normative)

A.1 Introduction

This annex provides the Profile Requirements List (PRL) for implementations of the Subnet Profile for PPP in the form of a proforma. A Profile Implementation Conformance Specification (PICS) for an implementation is generated by an implementer or supplier by indicating the appropriate level of support provided by an implementation.

To claim conformance with this profile, an implementation shall satisfy the mandatory conformance requirements of this profile.

An implementation's completed PRL is called the PICS. The PICS states which capabilities and options of the protocol have been implemented. The following can use the PICS:

a) The protocol implementer, as a checklist to reduce the risk of failure to conform to NTCIP 2103 v02 through oversight.
b) The supplier and user, as a detailed indication of the capabilities of the implementation.
c) The user, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking can never be guaranteed, failure to do so can often be predicted from incompatible PICSs).
d) A user, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

A.1.1 Notation

The following notations and symbols are used to indicate status and conditional status in the PRL and PICS within all NTCIP standards. Not all of these notations and symbols may be used within NTCIP 2103 v02.

A.1.1.1 Status Symbols

The symbols in Table 6 are used to indicate base standard and profile status:

Table 6 Base Standard and Profile Status Symbols

m	mandatory
m.<n>	support for every item of the group labeled by the same numeral <n> is required, but only one is active at a time
o	optional
o.<n>	optional, but support for at least one of the group of options labeled by the same numeral <n> is required
c	conditional
n/a	not-applicable (i.e. logically impossible in the scope of the profile)
x	excluded or prohibited

The o.<n> notation is used to show a set of selectable options (i.e., one or more of the set shall be implemented) with the same identifier <n>. Two character combinations are used for dynamic conformance requirements. In this case, the first character refers to the static (implementation) status, and the second refers to the dynamic (use); thus "mo" means "mandatory to be implemented, optional to be used." Base standard requirements are shown using the equivalent notations in upper case (e.g., M, O, X).

The classification of the requirements and options in Internet RFCs does not correspond to the convention described above, and shall be mapped into the profile as indicated in Table 7.

Table 7 RFC to Profile Mapping

RFC	Profile
MUST	Mandatory
SHOULD	Mandatory
MAY	Optional
SHOULD NOT	Prohibited
MUST NOT	Prohibited

NOTE—In the course of adapting communications industry standards to the transportation industry, there may be exceptions where specific mandatory requirements are not applicable to the new environment. Where these exceptions are made, a justification shall be provided.

A.1.1.2 Conditional Status Notation

The following predicate notations may be used:

<predicate>:	This notation introduces a single item that is conditional on the <predicate>.
<predicate>::	This notation introduces a table or a group of tables, all of which are conditional on the <predicate>.

The <predicate>: notation means that the status following it applies only when the PRL or PICS states that the feature or features identified by the predicate are supported. In the simplest case, <predicate> is the identifying tag of a single PICS item. The <predicate>:: notation may precede a table or group of tables in a clause or subclause. When the group predicate is true, then the associated clause shall be completed. The symbol <predicate> also may be a Boolean expression composed of several indices. "AND", "OR", and "NOT" shall be used to indicate the Boolean logical operations.

A.1.1.3 Support Column Symbols

This profile is in the form of a PICS and, therefore, includes a support column. An implementer claims support of an item by circling the appropriate answer (Yes, No, or N/A) in the support column, as indicated in Table 8.

Table 8 Support Column Notation

Yes	Supported by the implementation.
No	Not supported by the implementation.
N/A	Not applicable

A.1.1.4 Footnotes

Footnotes to the proforma are indicated by superscript numerals. The footnote appears on the page of the first occurrence of the numeral. Subsequent occurrences of a numeral refer to the footnote of the first occurrence.

A.1.1.5 Instructions for Completing the PRL

A Profile implementer shows the extent of compliance to a Profile by completing the PRL. The implementer indicates whether mandatory requirements are complied with, and whether optional functions are supported. The resulting completed PRL is called a PICS. Where this profile refines the features of the base standards, the requirements expressed in this PRL shall be applied (as indicated in PRL items with no "Profile Support" column) to constrain the allowable responses in the base standard PICS proforma. When this profile makes additional requirements, the "Support" column for such PRLs shall be completed. In this column, each response shall be selected either from the indicated set of responses, or it shall comprise one or more parameter values as requested. If a conditional requirement is inapplicable, use the Not Applicable (NA) choice. If a mandatory requirement is not satisfied, exception information shall be supplied by entering a reference Xi, where i is a unique identifier, to an accompanying rationale for the noncompliance. When the profile requirement is expressed as a two-character combination (as defined in A.1.1 above), the response shall address each element of the requirement; e.g., for the requirement "mo," the possible compliant responses are "yy" or "yn."

A.2 Standards Referenced

This profile specifies the provision of a PPP link over which transport and/or application profiles may reside. This profile references the standards identified in Section 1.3.

A.3 PICS Requirements List

A.3.1 Implementation Identification

Ref	Question	Response
1	Supplier	
2	Contact point for queries about the profile	
3	Implementation Name(s) and Version(s)	
4	Date of statement	
5	Other Information: Machine Name, Operating Systems, System Name	
6	Amendments or revisions to the base standards or profiles that are applicable.	

A.3.2 Global Statement of Conformance

Are all mandatory requirements met for:

Ref	Standard	Response
1	IAB STD 51 - Point-to-Point Protocol	
2	RFC 1570 - PPP LCP Extensions	
3	RFC 1994 - PPP Challenge Handshake Authentication Protocol	
4	IP or T2 Protocol Upper Layer Interface	
5	**ANSI/TIA/EIA-232-F Interface**	
6	**Optional ANSI/TIA/EIA-574-90 Interface**	
7	**ITU-T V.34 Modem**	
8	Optional support of ITU-T V.90 Modem	
9	RFC 1213 Interface Object Definitions subset	
10	RFC 1381 LapB Object Definitions subset	
11	RFC 1317 RS-232 Object Definitions subset	
12	CHAP Object Definitions per NTCIP 2103 v02	
13	Optional V.250 support for Dial-up	
14	Modem Object Definitions per NTCIP 2103 v02	

A.4 Basic Requirements

The following table lists the basic requirements for a compliant Point-to-Point Protocol over RS-232 Subnetwork implementation, and asks if the listed protocols or standards have been implemented. Additionally, questions regarding supported higher layer protocols are asked, since the different layer protocols interact and because this interaction has an effect on items that shall be supported on the data link layer if these higher layer protocols are implemented.

Index	Protocol/Element	Clause of Profile	Profile Status	Support
ap-stmf	Does the implementation support NTCIP 2301?	2.3	o	Yes No
t2p	Does the implementation support Transportation Transport Profile?	2.2.4.2.3	o.1	Yes No
ip	Does the implementation support IP data packets?	2.2.4.2.3	o.1	Yes No
ipcp	Does the implementation support IPCP?	2.2.4.2.3	ip:m	Yes N/A
chap	Does the implementation support CHAP authentication?	2.2.4.2.2	m	Yes
lcp	Does the implementation support LCP?	2.2.4	m	Yes
ppp	Does the implementation support PPP?	2.2.5	m	Yes
hdlc	Does the implementation support HDLC-Like Framing?	2.2.6	m	Yes
rs232	Does the implementation support the ANSI/TIA/EIA-232-F or ANSI/TIA/EIA-574-90 interface without exceptions?	2.3.1	o.2	Yes No
v.34	Does the implementation support the V.34 interface?	2.3.3	o.2	Yes No
v.90	Does the implementation support the V.90 interface?	2.3.3	o	Yes No
mib	Does the implementation support the required management objects?	2.4	snmp: m	Yes N/A
v.34M	Does the internal modem support the V.34 characteristics and interface?	REF	o.3	Yes No
v.90M	Does the internal modem support the v.90 characteristics and interface?	REF	o.3	Yes No
v.42M	Does the internal modem support v.42 error correction procedures or data compression?	REF	o	Yes No
ipNet	Does implementation use ipNetToMediaTable for IpAddress to telephone number conversion?	D.1.3 and Annex E	o	Yes No
V.250	Does the implementation support the V.250 compliant modem interface?	2.3.5	M	Yes No

A.4.1 PICS Proforma for Data Link Layer

A.4.1.1 Protocol Summary

Have any exceptions been required? (Note: A YES answer means that the implementation does not conform to the Data Link Layer. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.	Yes_____ No_____
Date of Statement	

A.4.1.2 T2 Profile

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
1.1	T2 Profile encapsulated with a Protocol Field of 0x00C1?	www.iana.org	M	2.2.1.2	t2p:m	Yes

A.4.1.3 IP Control Protocol

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
2.1	IP packets supported before IPCP reaches the opened state?	RFC 1332 Clause 2	M	2.2.2	ip:m	No N/A
2.2	IPCP General Procedures supported?	RFC 1332	M	2.2.2.1	ip:m	Yes
2.3	IP Compression Protocol supported?	RFC 1332 Clause 3.2 and 4	O	2.2.2.2.1	ip:o	Yes No
2.4	IP Address Option supported?	RFC 1332 Clause 3.3	O	2.2.2.2.2	ip:m	Yes

A.4.1.4 CHAP

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
3.1	Full support for the defined packet formats?	RFC 1994 Clause 4	M	2.2.3.1	m	Yes
3.2	Does the implementation require the password to be at least 16 octets?	RFC 1994 Clause 4	O	2.2.3.2	m	Yes
3.3	Does the implementation support different passwords for each direction of the PPP link?	RFC 1994 Clause 4	O	2.2.3.2	m	Yes
3.4	Does the implementation support the MD5 hash algorithm?	RFC 1321	O	2.2.3.4	m	Yes

A.4.1.4.1 LCP

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
4.1	Support for all data packets defined in RFC 1661?	RFC 1661 Clause 5	M	2.2.4.1	m	Yes
4.1.1	Support for Configure-Request packets?	RFC 1661 Clause 5.1	M	2.2.4.1.1	m	Yes
4.1.2	Support for Configure-Ack packets?	RFC 1661 Clause 5.2	M	2.2.4.1.2	m	Yes
4.1.3	Support for Configure-Nak packets?	RFC 1661 Clause 5.3	M	2.2.4.1.3	m	Yes
4.1.4	Support for Configure-Reject packets?	RFC 1661 Clause 5.4	M	2.2.4.1.4	m	Yes
4.1.5	Support for Terminate-Request and Terminate-Ack packets?	RFC 1661 Clause 5.5	M	2.2.4.1.5	m	Yes
4.1.6	Support for Code-Reject packets?	RFC 1661 Clause 5.6	M	2.2.4.1.6	m	Yes
4.1.7	Support for Protocol-Reject packets?	RFC 1661 Clause 5.7	M	2.2.4.1.7	m	Yes
4.1.8	Support for Echo-Request and Echo-Reply packets?	RFC 1661 Clause 5.8	M	2.2.4.1.8	m	Yes
4.1.9	Support for Discard-Request packets?	RFC 1661 Clause 5.9	M	2.2.4.1.9	m	Yes
4.1.10	Support for Identification packets?	RFC 1570 Clause 1.1	O	2.2.4.1.10	m	Yes
4.2.1.1	Does the implementation correctly support the Link Establishment Process?	RFC 1661 Clauses 3.4 & 4	M	2.2.4.2.1	m	Yes
4.2.1.2	Does the implementation discard all non-LCP packets during the Establishment phase?	RFC 1661 Clause 3.4	M	2.2.4.2.1	m	Yes

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
4.2.2.	Does the implementation correctly support the Authentication Process?	RFC 1661 Clauses 3.5 & 4	M	2.2.4.2.2	m	Yes
4.2.2.1	Is CHAP with MD5 required by the implementation?	RFC 1661 Clause 6.2	O	2.2.4.2.2	m	Yes
4.2.2.2	If authentication fails, does the implementation proceed to the link termination phase?	RFC 1661 Clause 3.5	M	2.2.4.2.2	m	Yes
4.2.3	Does the implementation correctly support the Network Process?	RFC 1661 Clauses 3.6 & 4	M	2.2.4.2.3	m	Yes
4.2.4	Does the implementation correctly support the Termination Process?	RFC 1661 Clauses 3.7 & 4	M	2.2.4.2.4	m	Yes
4.2.4.1	Disconnect physical layer after exchanging terminate packets?	RFC 1661 page 8	O	2.2.4.2.4	v.34:m; rs232:o	Yes No
4.3	Does the implementation support the default value for each option, except as noted?	RFC 1661 Clauses 3.4 & 5	M	2.2.4.3	m	Yes
4.3.1	All LCP packets with code value set to 1-7 sent with default options?	RFC 1661 Clause 5	M	2.2.4.3.1	m	Yes
4.3.2	Support of 1500 byte Maximum Receive Unit?	RFC 1661 Clause 6.1	M	2.2.4.3.2	m	Yes
4.3.2.1	Support for negotiating other MRU sizes?	RFC 1661 Clause 6.1	O	2.2.4.3.2	o	Yes No
4.3.2.2	What is the maximum MRU supported?	RFC 1661 Clause 6.1	at least 1500 bytes	2.2.4.3.2	at least 1500 bytes	_____
4.3.3	Support for byte stuffing 0x00 – 0x1F and 0x7D and 0x7E?	RFC 1662 Clause 7	M	2.2.4.3.3	m	Yes
4.3.3.1	Support for negotiating byte-stuffing for bytes between 0x00 and 0x1F?	RFC 1662 Clause 7	O	2.2.4.3.3	m	Yes
4.3.3.2	Which byte values are negotiable?	RFC 1662 Clause 7	O	2.2.4.3.3	m	_____ _____
4.3.4	Support for negotiating Authentication Protocol?	RFC 1661 Clause 6.2	O	2.2.4.3.4	m	Yes
4.3.4.1	Support for null authentication?	RFC 1661 Clause 6.2	O	2.2.4.3.4	x	No
4.3.4.2	Support for PAP?	RFC 1661 Clause 6.2	O	2.2.4.3.4	x	No
4.3.4.3	Support for CHAP?	RFC 1661 Clause 6.2	O	2.2.4.3.4	m	Yes
4.3.5	Support for a Quality Protocol?	RFC 1661 Clause 6.3	O	2.2.4.3.5	o	Yes No
4.3.6	Support for a Magic Number?	RFC 1661 Clause 6.4	O	2.2.4.3.6	o	Yes No

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
4.3.7	Support for Protocol Field Compression?	RFC 1661 Clause 6.5	O	2.2.4.3.7	o	Yes No
4.3.8	Support for Address and Control Field Compression?	RFC 1661 Clause 6.6	O	2.2.4.3.8	o	Yes No
4.3.9	Support for alternative FCS algorithms?	RFC 1570 Clause 2.1	O	2.2.4.3.9	x	No
4.3.10	Support for Self-describing Pad?	RFC 1570 Clause 2.2	O	2.2.4.3.10	x	No
4.3.11	Support for Numbered Mode?	RFC 1663	O	2.2.4.3.11	x	No
4.3.12	Support for Call-back?	RFC 1570 Clause 2.3	O	2.2.4.3.12	o	Yes No
4.3.13	Support for Multi-link options?	RFC 1717	O	2.2.4.3.13	o	Yes No
4.3.14	Support for Bandwidth Allocation Protocol?	RFC 2125	O	2.2.4.3.14	o	Yes No

A.4.1.5 PPP

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
5.1	Support for transmission/receipt of encapsulated data?	RFC 1661 Clause 2	M	2.2.5	m	Yes
5.1.1	Does encapsulation always include Protocol Field?	RFC 1661 Clause 2	M	2.2.5.1	m	Yes
5.1.2	Does encapsulation always include Information Field	RFC 1661 Clause 2	M	2.2.5.2	m	Yes
5.1.3	Is any padding included in transmissions?	RFC 1661 Clause 2	O	2.2.5.3	x	No
5.1.4	Support padded receptions?	RFC 1661 Clause 2	M	2.2.5.3	m	Yes

A.4.1.6 HDLC-Like Framing

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
6.1	Frame Format	RFC 1662 Clause 3.1	M	2.2.6.1	m	Yes
6.2	Modification of the Basic Frame	RFC 1662 Clause 3.2	M	2.2.6.2	m	Yes
6.3	Octet-Stuffed Framing	RFC 1662 Clause 4	M	2.2.6.3	m	Yes

A.4.2 PICS Proforma for Physical Layer

A.4.2.1 Summary

Have any exceptions been required? (Note: A YES answer means that the implementation does not conform to the Physical Layer. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.	Yes_____ No_____
Date of Statement	

A.4.2.2 RS-232 Conformance List

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
dataRate	Data Rate	ANSI/TIA/EIA 232-F	-	2.3.1.2		
BaseData Rates	1200 bps 2400 bps 4800 bps 9600 bps 19200 bps	-	-		m m m m m	Yes Yes Yes Yes Yes
OtherData Rate	Higher Data Rates (indicate bps)	-	-		o	Yes No _____
sync async	***Type of Data Communications:*** synchronous asynchronous	ANSI/TIA/EIA 232-F	O	2.2.6.5	 x m	 No Yes
duplex	***Duplexing***					
halfDupl	Half Duplex	ANSI/TIA/EIA 232-F	O.6	2.3.1.2	o.6	Yes
fullDupl	Full Duplex		O.6		o.6	Yes No
232A	***INTERCHANGE CIRCUITS FOR ANSI/TIA/EIA 232-F***				o.7	Yes No
P1	Pin 1 – shield (earth ground)	ANSI/TIA/EIA 232-F	M	2.3.1.1	232A:o	Yes No
P2	Pin 2 – Transmitted Data (transmit data)	ANSI/TIA/EIA 232-F	M		232A:m	Yes
P3	Pin 3 – Received Data (receive data)	ANSI/TIA/EIA 232-F	M		232A:m	Yes
P4	Pin 4 – Request to Send	ANSI/TIA/EIA 232-F	M		232A:m	Yes
P5	Pin 5 – Clear to Send	ANSI/TIA/EIA 232-F	M		232A:m	Yes
P6	Pin 6 – DCE Ready (Data set ready)	ANSI/TIA/EIA 232-F	M		232A:o	Yes No

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
P7	Pin 7 – Signal Common (logic ground)	ANSI/TIA/EIA 232-F	M		232A:m	Yes
P8	Pin 8 – Received Line Signal Detector (data carrier detect)	ANSI/TIA/EIA 232-F	M		232A:m	Yes
P9	Pin 9 – Reserved for Testing	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P10	Pin 10 – Reserved for Testing	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P11	Pin 11 – Unassigned	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P12	Pin 12 – Secondary Received Line Signal Detector (secondary DCD)	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P13	Pin 13 – Secondary Clear to Send	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P14	Pin 14 – Secondary Transmit Data	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P15	Pin 15 – Transmitter Signal Element Timing (Synchronous Mode Transmit Clock) – DCE	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P16	Pin 16 – Secondary Received Data	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P17	Pin 17 – Receiver Signal Element Timing (Synchronous Mode Receive Clock)	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P18	Pin 18 – Local Loopback	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P19	Pin 19 – Secondary Request to Send	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P20	Pin 20 – DTE Ready (Data Terminal Ready)	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P21	Pin 21 – Remote Loopback	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P22	Pin 22 – Ring Indicator	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P23	Pin 23 – Data Signal Rate Selector	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P24	Pin 24 – Transmit Signal Element Timing (Synchronous Mode Transmit Clock) – DTE	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
P25	Pin 25 – Test Mode	ANSI/TIA/EIA 232-F	M		232A:o	Yes No
232B	***INTERCHANGE CIRCUITS FOR ANSI/TIA/EIA 574***				o.7	Yes No
P1	Pin 1 – Received Line Signal Detector (data carrier detect)	ANSI/TIA/EIA 574-90	M	2.3.1.1	232B:m	Yes
P2	Pin 2 – Received Data (receive data)	ANSI/TIA/EIA 574	M		232B:m	Yes

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
P3	Pin 3 – Transmitted Data (transmit data)	ANSI/TIA/EIA 574	M		232B:m	Yes
P4	Pin 4 – DTE Ready (Data Terminal Ready)	ANSI/TIA/EIA 574	M		232B:o	Yes No
P5	Pin 5 – Signal Common (logic ground)	ANSI/TIA/EIA 574	M		232B:m	Yes
P6	Pin 6 – DCE Ready (Data set ready)	ANSI/TIA/EIA 574	M		232B:o	Yes No
P7	Pin 7 – Request to Send	ANSI/TIA/EIA 574	M		232B:m	Yes
P8	Pin 8 – Clear to Send	ANSI/TIA/EIA 574	M		232B:m	Yes
P9	Pin 9 – Ring Indicator	ANSI/TIA/EIA 574	M		232B:o	Yes No

A.4.3 PICS Proforma for MIB Objects

A.4.3.1 Summary

Have any exceptions been required? (Note: A YES answer means that the implementation does not conform to the MIB. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.	Yes_____ No_____
Date of Statement	

A.4.3.2 HDLC Group

HDLC Group								
Item	Object Definition			Base Standard		Profile		Support
	Object	Syntax	Access	Reference	Status	Clause	Status	
7.1	Support of lapbAdmnTable and lapbOperTable?					2.4	snmp:o	Yes No
lapb AT	lapbAdmnTable	SEQUENCE OF lapbAdmn Entry	Not-accessible	RFC 1381 Section 4	M		7.1:m	Yes
lapb AE	lapbAdmnEntry	LapbAdmn Entry	Not-accessible		M		7.1:m	Yes
lapb AI	lapbAdmnIndex	INTEGER (IfIndex Type)	read-only		M		7.1:m	Yes
lapb TNFS	lapbAdmn TransmitN1 FrameSize	INTEGER (Positive Integer)	read-write		M		7.1:m	Yes
lapb RNFS	lapbAdmn ReceiveN1 FrameSize	INTEGER (Positive Integer)	read-write		M		7.1:m	Yes
lapb T1	lapbAdmn T1AckTimer	INTEGER (Positive Integer)	read-write		M		7.1:m	Yes
lapb T2	lapbAdmn T2AckDelayTimer	INTEGER (Positive Integer)	read-write		M		7.1:m	Yes
lapb OT	lapbOperTable	SEQUENCE OF lapbOper Entry	Not-accessible	RFC 1381 Section 4	M		7.1:m	Yes
lapb OE	lapbOperEntry	LapbOper Entry	Not-accessible		M		7.1:m	Yes
lapb OI	lapbOperIndex	INTEGER (IfIndex Type)	read-only		M		7.1:m	Yes
lapb Ooid	lapbOperPortId	OBJECT IDENTIFIER	read-only		M		7.1:m	Yes

A.4.3.3 RS232 Asynchronous Group

RS232 Group						
RFC 1317	**Object Name**	**Object Type**	**Object Status**	**Object Support**	**Allowed Values**	**Supported Values**
rs232	**RS232 GROUP**	--	O	Yes / No	----	---
rs232.1	rs232Number	S	rs232 : M	Yes	INT	
rs232.2	rs232PortTable	--	rs232 : M	Yes	---	---
	rs232PortEntry	--	rs232 : M	Yes	---	---
rs232.2.1	rs232PortIndex	S	rs232 : M	Yes	INT	
rs232.2.2	rs232PortType	S	rs232 : M	Yes	1..5	
	other(1)	--	---	Yes / No	---	---
	rs232(2)	--	---	Yes / No	---	---
	rs422(3)	--	---	Yes / No	---	---
	rs423(4)	--	---	Yes / No	---	---
	v35(5)	--	---	Yes / No	---	---
rs232.2.3	rs232PortInSigNumber	S	rs232 : O	Yes / No	INT	
rs232.2.4	rs232PortOutSigNumber	S	rs232 : O	Yes / No	INT	
rs232.2.5	rs232PortInSpeed	P	rs232 : M	Yes	INT	
rs232.2.6	rs232PortOutSpeed	P	rs232 : M	Yes	INT	
rs232.3	rs232AsyncPortTable	--	rs232 : M	Yes	---	---
	rs232AsyncPortEntry	--	rs232 : M	Yes	---	---
rs232.3.1	rs232AsyncPortIndex	S	rs232 : M	Yes	INT	
rs232.3.2	rs232AsyncPortBits	P	rs232 : O	Yes / No	5..8	
	five(5)	--	---	Yes / No	---	---
	six(6)	--	---	Yes / No	---	---
	seven(7)	--	---	Yes / No	---	---
	eight(8)	--	---	Yes / No	---	---
rs232.3.3	rs232AsyncPortStopBits	P	rs232 : O	Yes / No	1..4	
	one(1)	--	---	Yes / No	---	---
	two(2)	--	---	Yes / No	---	---
	one-and-half(3)	--	---	Yes / No	---	---
	dynamic(4)	--	---	Yes / No	---	---
rs232.3.4	rs232AsyncPortParity	P	rs232 : O	Yes / No	1..5	
	none(1)	--	---	Yes / No	---	---
	odd(2)	--	---	Yes / No	---	---
	even(3)	--	---	Yes / No	---	---
	mark(4)	--	---	Yes / No	---	---
	space(5)	--	---	Yes / No	---	---
rs232.3.5	rs232AsyncPortAutobaud	P	rs232 : O	Yes / No	1..2	
	enabled(1)	--	---	Yes / No	---	---
	disabled(2)	--	---	Yes / No	---	---
rs232.3.6	rs232AsyncPortParityErrs	S	rs232 : O	Yes / No	Counter	
rs232.3.7	rs232AsyncPortFramingErrs	S	rs232 : M	Yes	Counter	
rs232.3.8	rs232AsyncPortOverrunErrs	S	rs232 : M	Yes	Counter	

A device may require the rs232PortInSpeed and rs232PortOutSpeed to be the same value. Therefore, a SET of rs232PortInSpeed may automatically SET rs232PortOutSpeed to the same value and vice-versa.

A.4.3.4 Interfaces Group

Interfaces Group						
RFC 1213	**Object Name**	**Object Type**	**Object Status**	**Object Support**	**Allowed Values**	**Supported Values**
If	**INTERFACES GROUP**	--	O	Yes / No	----	---
if.1	ifNumber	S	if : M	Yes	---	
if.2	ifTable	--	if : M	Yes	---	---
	ifEntry	--	if : M	Yes	---	---

Interfaces Group						
RFC 1213	**Object Name**	**Object Type**	**Object Status**	**Object Support**	**Allowed Values**	**Supported Values**
if.2.1	ifIndex	S	if : M	Yes	INT	
if.2.2	ifDescr	S	if : M	Yes	string	
if.2.3	ifType	S	if : M	Yes	INT	
if.2.4	ifMtu	S	if : M	Yes	INT	
if.2.5	ifSpeed	S	if : M	Yes	gauge	
if.2.6	ifPhysAddress	S	if : M	Yes	PhysAddress	
if.2.7	ifAdminStatus	C	if : O	Yes / No	INT	
if.2.8	ifOperStatus	S	if : M	Yes	INT	
if.2.9	ifLastChange	S	if : O	Yes / No	TimeTicks	
if.2.10	ifInOctets	S	if : O	Yes / No	counter	
if.2.11	ifInUcastPkts	S	if : O	Yes / No	counter	
if.2.12	ifInNUcastPkts	S	if : O	Yes / No	counter	
if.2.13	ifInDiscards	S	if : O	Yes / No	counter	
if.2.14	ifInErrors	S	if : O	Yes / No	counter	
if.2.15	ifInUnknownProtos	S	if : O	Yes / No	counter	
if.2.16	ifOutOctets	S	if : O	Yes / No	counter	
if.2.17	ifOutUcastPkts	S	if : O	Yes / No	counter	
if.2.18	ifOutNUcastPkts	S	if : O	Yes / No	counter	
if.2.19	ifOutDiscards	S	if : O	Yes / No	counter	
if.2.20	ifOutErrors	S	if : O	Yes / No	counter	
if.2.21	ifOutQLen	S	if : O	Yes / No	gauge	
if.2.22	ifSpecific	S	if : O	Yes / No	OID	

A.4.3.5 Chap Secrets Group

Chap Group								
Item	**Object Definition**			**Base Standard**		**Profile**		**Support**
	Object	**Syntax**	**Access**	**Reference**	**Status**	**Clause**	**Status**	
8.1	Support of chapSecretTable ?			N/A		2.1.3	snmp:m	Yes No
chap Table	chapSecretTable	SEQUENCE OF chapSecret Entry	Not-accessible		M		8.1:m	Yes
chap Entry	chapSecretEntry	ChapSecret Entry	Not-accessible		M		8.1:m	Yes
chap CN	chapName	OCTET STRING	read-write		M	2.1.3.2	8.1:m	Yes
chap CS	chapSecret	OCTET STRING	read-write		M	2.3.1.3	8.1:m	Yes
chap CMS	chapMaxSecrets	INTEGER	read-write		M	2.1.3	8.1:m	Yes

A.4.3.6 Modem Group

Modem Group						
Item	**Object Name**	**Object Type**	**Object Status**	**Object Support**	**Allowed Values**	**Supported Values**
modem	**Modem MIB**	--	O	Yes / No	----	---
D.1.1	mdmIfIndex	S	modem NOT ipNet:M	Yes	1..255	
D.1.2	maxDialStrings	S		Yes	1..255	
D.1.3	mdmDialStringTable	--	modem NOT ipNet:M	Yes	---	---
D.1.3.1	mdmDialStringEntry	--	D.1.2:M	Yes	---	---
D.1.3.1.1	mdmRowIndex	S	D.1.2:M	Yes	1..255	
D.1.3.1.2	mdmDialString	P	D.1.2:M	Yes	string	

Modem Group						
Item	**Object Name**	**Object Type**	**Object Status**	**Object Support**	**Allowed Values**	**Supported Values**
D.1.3.1.3	mdmNetAddress	P	D.1.2:M	Yes	IpAddress	
D.1.4	mdmInitString1	P	modem:M	Yes	string	---
D.1.5	mdmInitString2	P	modem:M	Yes	string	---
D.1.6	mdmInitString3	P	modem:M	Yes	string	---
D.1.7	mdmBufferDelay	P	modem:M	Yes	---	---
	enabled (1)	--	---	Yes	1	---
	disabled (2)	--	---	Yes	2	---
D.1.8	mdmCommandBuffer	S	modem:M	Yes	string	
D.1.9	mdmResponseBuffer	S	modem:M	Yes	string	---

A.4.4 PICS Proforma for Modem Requirements

A.4.4.1 Summary

Have any exceptions been required? (Note: A YES answer means that the implementation does not conform to the Modem Requirements. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.	Yes_____ No_____
Date of Statement	

A.4.4.2 Features and Functions

Index	Protocol Feature	Base Standard		Profile		Support
		V.250 Clause	Status	Clause	Status	
1.1	**Buffer and Lead-in**					
1.1.1	Buffer and Leadin	3.6	M	2.3.5.2	m	Yes
1.1.2	Escape Sequence <+++>	3.2	--	2.3.5.5.1	m	Yes
1.3	**Character Formatting**					
1.3.1	8 Data Bits, No Parity, 1 Stop Bit	4.2	O.3	2.3.5.2.3	m	Yes
1.3.2	7 Data Bits, Even Parity, 1 Stop Bit		O.3		x	--
1.3.3	7 Data Bits, Odd Parity, 1 Stop Bit		O.3		x	--
1.3.4	7 Data Bits, Space Parity, 1 Stop Bit		O.3		x	--
1.3.5	7 Data Bits, Mark Parity, 1 Stop Bit		O.3		x	--
1.3.6	7 Data Bits, No Parity, 2 Stop Bits		O.3		x	--
1.4	**Data Rates (Command)**					
1.4.1	1200 BPS	4.3	M	2.3.5.2.4	m	Yes
1.4.2	2400 BPS		O		m	Yes
1.4.3	4800 BPS		O		m	Yes
1.4.4	9600 BPS		M		m	Yes
1.4.5	19200 BPS		O		m	Yes
1.4.6	Other data rates		O		o	Yes No
1.5	**Data Rates (Online)**					
1.5.1	up to 33600 BPS	4.3	V.34:M	2.3.5.2.4	V.34:m	Yes No
1.5.2	up to 56000 BPS		V.90:M		V.90:m	Yes No
1.6	**Result Codes**					
1.6.1	0 – OK	5.7.1	M	2.3.5.5.2	m	Yes
1.6.2	1 - Connect		M		m	Yes
1.6.3	2 – Ring		M		m	Yes
1.6.4	3 – No Carrier		M		m	Yes

Index	Protocol Feature	Base Standard		Profile		Support
		V.250 Clause	Status	Clause	Status	
1.6.5	4 – Error		M		m	Yes
1.6.6	5 – Not Defined		N/A		x	--
1.6.7	6 – No Dialtone		M		m	Yes
1.6.8	7 – Busy		M		m	Yes
1.6.9	8 – No Answer		M		m	Yes
1.6.10	Manufacturer Specific Result Codes		O	2.3.5.5.3	x	--

A.4.4.3 External Modem Configuration and Control Requirements

In the following table, the Command / Reply column indicates the valid NTCIP values that may be sent to a modem and the responses. In the case of the "+" commands, some responses may be preceded by text (e.g. +GCI: (<country code> [, ...]). In a number of commands, a general query "?" or "=?" may also be used to get the current value or a list of supported values.

Index	Protocol Feature	Base Standard		Profile		Cmd / Reply	Support
		V.250 Clause	Status	Clause	Status		
2.1	**Generic Modem (DCE) Control**						
2.1.1	Z (Reset) supported	6.1.1	M	2.3.5.6	m	-- / 0 | 4	Yes
2.1.2	&F (Factory Default) supported?	6.1.2	M		m	0.. / 0 | 4	Yes
2.1.3	I (Request ID Info) supported?	6.1.3	0		x	--	Yes
2.1.4	+GMI – Request Manufacturer Identification	6.1.4	M		m	-- / 0	Yes
2.1.5	+GMM – Request Model Identification	6.1.5	M		m	-- / 0	Yes
2.1.6	+GMR – Request Revision Identification	6.1.6	M		m	-- / 0	Yes
2.1.7	+GSN – Request Product Serial Number Identification	6.1.7	O		o	-- / 0	Yes No
2.1.8	+GOI – Request Global Object Identification	6.1.8	O		o	-- / 0	Yes No
2.1.9	+GCAP – Request Complete Capabilities List	6.1.9	M		x	--	Yes
2.1.10	+GCI – Country of Installation	6.1.10	C		o	-- / 0..255 [,0..255]	Yes No
2.2	**Device (DTE) - Modem (DCE) Interface Commands**						
2.2.1	S3 Register (Command Line Termination)	6.2.1	M	2.3.5.6	m	0x2F (CR) / 0 | 4	Yes
2.2.2	S4 (Response Formatting Character)	6.2.2	M		m	0x0A (LF) / 0 | 4	Yes
2.2.3	S5 (Command Line Editing Character)	6.2.3	M		m	0x08 (BS) / 0 | 4	Yes

Index	Protocol Feature	Base Standard		Profile		Cmd / Reply	Support
		V.250 Clause	Status	Clause	Status		
2.2.4	E (Echo Command)	6.2.4	M		m	1 (No Echo) / 0 | 4	Yes
2.2.5	Q (Result Code Suppression)	6.2.5	M		m	0x00 (results codes) / 0 | 4	Yes
2.2.6	V (DCE Response Format)	6.2.6	M		m	0 (numeric) / 0 | 4	Yes
2.2.7	X (Result Code Selection and Call Progress Monitoring Control)	6.2.7	M		m	0 (connect) / 0 | 4	Yes
2.2.8	&C (Circuit 109 (Received line signal detector) Behavior)	6.2.8	M		m	0..1 / 0 | 4	Yes
2.2.9	&D (Circuit 108 (Data terminal ready) Behavior)	6.2.9	M		m	0,2:M 1:O / 0 | 4	Yes Yes No
2.2.10	+IPR – Fixed DTE Rate	6.2.10	O		o	"0.<rate>" / 0 | 4	Yes No
2.2.11	+ICF – DTE-DCE Character Framing	6.2.11	O		o	"3,0" / 0 | 4	Yes No
2.2.12	+IFC – DTE-DCE Local Flow Control	6.2.12	v.42 OR buff:M		v.42 OR buff:m	"2,2" / 0 | 4	Yes No
2.2.13	+ILRR – DTE-DCE Local Rate Reporting	6.2.13	M		m	0..1 / 0 | 4	Yes
2.2.14	+ICLOK – Select Sync Transmit Clock Source	6.2.14	O		o	0 / 0 | 4	Yes No
2.2.15	+ILSD – Select Long Space Disconnect Option	6.2.15	O		o	0 / 0 | 4	Yes No
2.2.16	+IDSR – Select Data Set Ready Option	6.2.16	O		o	0..2 / 0 | 4	Yes No
2.2.17	+IRTS – Select Synchronous Mode RTS Option	6.2.17	O		o	0..1 / 0 | 4	Yes No
2.3	**Call Control**						
2.3.1	D (Dial Command)	6.3.1	M	2.3.5.6	m	<0123456789ABCD,TP!W@> <S=0..> / 0..4 | 5..8	Yes
2.3.1	T (Use Tone Dialing)	6.3.2	M		m	"T"	Yes
2.3.2	P (Use Pulse Dialing)	6.3.3	M		m	"P"	Yes

Index	Protocol Feature	Base Standard		Profile		Cmd / Reply	Support
		V.250 Clause	Status	Clause	Status		
2.3.3	Ring (Ring Indication)	6.3.4	M		m	-- / 2	Yes
2.3.4	A (Answer)	6.3.5	M		m	"A" / 0 | 3 | 4	Yes
2.3.5	H (Hangup)	6.3.6	M		m	0 / 0 | 4	Yes
2.3.6	O (Return to Online State)	6.3.7	M		m	0 / 0 | 3 | 4	Yes
2.3.7	S0 (Automatic Answer)	6.3.8	M		m	0..255 / 0 | 4	Yes
2.3.8	S6 (Pause before Dialing)	6.3.9	M		m	2..10 / 0 | 4	Yes
2.3.9	S7 (Connection Complete Timeout)	6.3.10	M		m	1..255 / 0 | 4	Yes
2.3.10	S8 (Comma Dial Modifier Time)	6.3.11	M		m	0..255 / 0 | 4	Yes
2.3.11	S10 (Automatic Disconnect Delay) supported?	6.3.12	M		m	1..254 / 0 | 4	Yes
2.3.12	L (Monitor Speaker Loudness) supported?	6.3.13	M		m	0..3 / 0 | 4	Yes
2.3.13	M (Monitor Speaker Mode) supported?	6.3.14	M		m	0..2 / 0 | 4	Yes
2.3.14	+ASTO (Store Telephone Number)	6.3.15	n/a		o	See V.250 Clause 6.3.15	Yes No
2.4	**Modulation Control Commands**						
2.4.1	+MS – Modulation Selection	6.4.1	M	2.3.5.6	m	See V.250 Clause 6.4	Yes
2.4.2	+MA – Modulation Automode Control	6.4.2	O		o		Yes No
2.4.3	+MR – Modulation Reporting Control	6.4.3	M		m		Yes No
2.4.4	+MV18S – V.18 Selection	6.4.4	C		o		Yes No
2.4.5	+MV18R – V.18 Reporting Control	6.4.5	C		o		Yes No
2.4.6	+MV18AM – V.18 Answering Message Editing	6.4.6	C		o		Yes No
2.4.7	+MV18P Order of Probes	6.4.7	C		o		Yes No
2.4.8	+MSC – Seamless Rate Change Enable	6.4.8	v.34:M		v.34:m		Yes No
2.4.9	+MSCR – Seamless Rate Change Report	6.4.8	v.34:M		v.34:m		Yes No
2.5	**Error Control Commands**						
2.5.1	+ES Error Control Selection	6.5.1	V.42:M	2.3.5.6	v42:m	See V.250 Clause 6.5	Yes No
2.5.2	+EB Break Handling in Error Control Operation	6.5.2	V.42:M		v42:m		Yes No
2.5.3	+ESR – Selective Repeat	6.5.3	O		o		Yes No

Index	Protocol Feature	Base Standard		Profile		Cmd / Reply	Support
		V.250 Clause	Status	Clause	Status		
2.5.4	+EFCS – 32-Bit Frame Check Sequence	6.5.4	V.42:M		v42:m		Yes No
2.5.5.	+ER – Error Control Formatting	6.5.5	V.42:M		v42:m		Yes No
2.5.6.	+ETBM – Call Termination Buffer Management	6.5.6	V.42:M		v42:m		Yes No
2.5.7	+EWIND – Window Size	6.5.7	O		o		Yes No
2.5.8	+EFRAM – Frame Length	6.5.8	O		o		Yes No
2.6	**Data Compression Commands**						
2.6.1	+DS – Data Compression	6.6.1	V.42bis: M	2.3.5.6	v.42bis: m	See V.250 Clause 6.6	Yes No
2.6.2	+DR – Data Compression Reporting	6.6.2	V.42bis: M		v.42bis: m		Yes No
2.7	**Modem (DCE) Testing**						
2.7.1	+T140 – Enable Remote Loopback	6.7.2.1	O	2.3.5.6	o	0..1 / 0 | 4	Yes No
2.7.2	+T141 – Enable Local Loopback	6.7.2.2	O		o	0..1 / 0 | 4	Yes No
2.7.3	+TERDL – Enable Digital Loopback	6.7.2.3	O		o	0..1 / 0 | 4	Yes No
2.7.4	+TEPDL – Enable Front Panel Digital Loopback	6.7.2.4	O		o	0..1 / 0 | 4	Yes No
2.7.5	+TEPAL – Enable Front Panel Analog Loopback	6.7.2.5	O		o	0..1 / 0 | 4	Yes No
2.7.6	+TALS – Analog Loop Status	6.7.2.6	O		o	0..3 / 0..4	Yes No
2.7.7	+TDLS – Digital Loop Status	6.7.2.7	O		o	0..4 / 0 | 4	Yes No
2.7.8	+TRDLS – Remote Digital Loop Status	6.7.2.8	O		o	0..4 / 0 | 4	Yes No
2.7.9	+TADR – Local V.54 Address	6.7.2.9	O		o	See V.54	Yes No
2.7.10	+TMODE – Set V.54 Mode	6.7.2.10	O		o	0..1 / 0 | 4	Yes No
2.7.11	+TTER – Test Error Rate	6.7.2.11	O		o	See V.250 Clause 6.7.11	Yes No
2.7.12	+TNUM – Error Bit and Block Counts	6.7.2.12	O		o	See V.250 Clause 6.7.12	Yes No
2.7.13	+TLDL – Local Digital Loop	6.7.2.13	O		o	0..1 / 0..1	Yes No
2.7.14	+TRDL – Request Remote Digital Loop	6.7.2.14	O		o	0..1 / 0..1 | 4	Yes No

Index	Protocol Feature	Base Standard		Profile		Cmd / Reply	Support
		V.250 Clause	Status	Clause	Status		
2.7.15	+TAL – Local Analog Loop	6.7.2.15	O		o	See V.250 Clause 6.7.15	Yes No
2.7.16	+TSELF – Self Test	6.7.2.16	O		o	0..1 / 0..1 | 4	Yes No
2.7.17	+TRES – Self Test Result	6.7.2.17	O		o	0..2 / 0..2 | 4	Yes No

Annex B
MANAGEMENT INFORMATION BASE FOR PPP
(Normative)

B.1 CHAP MIB Header

```
--
-- Filename:    2103v0207 CHAP.mib
-- Description: This MIB defines objects represents the data elements that
--              support CHAP
-- Source:      NTCIP 2103v0207
--
-- MIB Revision History:
-- 10/14/04     Created header and MIB inside Word Document
-- 09/15/05     Changed definition of chap node to import form NTCIP 8004
--              Renamed file to match current version of document
-- 12/30/08     Renamed file to match current version of document
--
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--
*******************************************************************************

CHAP-MIB1     DEFINITIONS ::= BEGIN

IMPORTS
    OBJECT-TYPE
              FROM RFC-1212
    layers, chap
              FROM NTCIP8004-A-2004;

-- All nodes underneath the chap node shall only be accessible by the
-- administrator community name.

-- NOTE—These objects should only be exchanged when the connection is known to
-- be private, i.e. the connection should either be physically secure from
-- outside monitoring (e.g., locally connected through a direct null-modem
-- cable) or the connection should ensure privacy through a well designed
-- encryption scheme such as Secure Sockets Layer (SSL).  Users should be
-- aware that dial-up connections and wireless technologies are not private
-- unless some sort of encryption layer is used.
```

B.2 Maximum Secrets Parameter

```
chapMaxSecrets   OBJECT-TYPE
   SYNTAX   INTEGER (1..255)
   ACCESS   read-only
   STATUS   mandatory
   DESCRIPTION
   "The number of rows that are listed in the Chap Secrets Table."
   ::= { chap 1 }
```

B.3 CHAP Secret Table

```
chapSecretTable   OBJECT-TYPE
   SYNTAX   SEQUENCE OF ChapSecretEntry
   ACCESS   not-accessible
   STATUS   mandatory
   DESCRIPTION
   "A table containing the names and secrets for the CHAP authentication
   protocol."
   ::= { chap 2 }

chapSecretEntry OBJECT-TYPE
   SYNTAX   ChapSecretEntry
   ACCESS   not-accessible
   STATUS   mandatory
   DESCRIPTION
```



```
   "This object defines an entry in the CHAP Secrets Table"
   INDEX { chapName }
   ::= { chapSecretTable 1 }

ChapSecretEntry ::= SEQUENCE {
   chapName      OCTET STRING,
   chapSecret    OCTET STRING }

chapName OBJECT-TYPE
   SYNTAX   OCTET STRING (SIZE (8..20))
   ACCESS   read-write
   STATUS   mandatory
   DESCRIPTION
   "The name of a peer system (or user) as it would be recorded in a CHAP
   challenge."
   ::= { chapSecretEntry 1 }

chapSecret   OBJECT-TYPE
   SYNTAX   OCTET STRING (SIZE (16..64))
   ACCESS   read-write
   STATUS   mandatory
   DESCRIPTION
   "This object contains the secret used for the associated name when using
   the CHAP authentication protocol."
   ::= { chapSecretEntry 2 }

END
```


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Annex C
Typical CHAP Dialog
(Informative)

Figure 2 indicates a typical CHAP dialog that might occur during the Authentication Phase of link establishment.

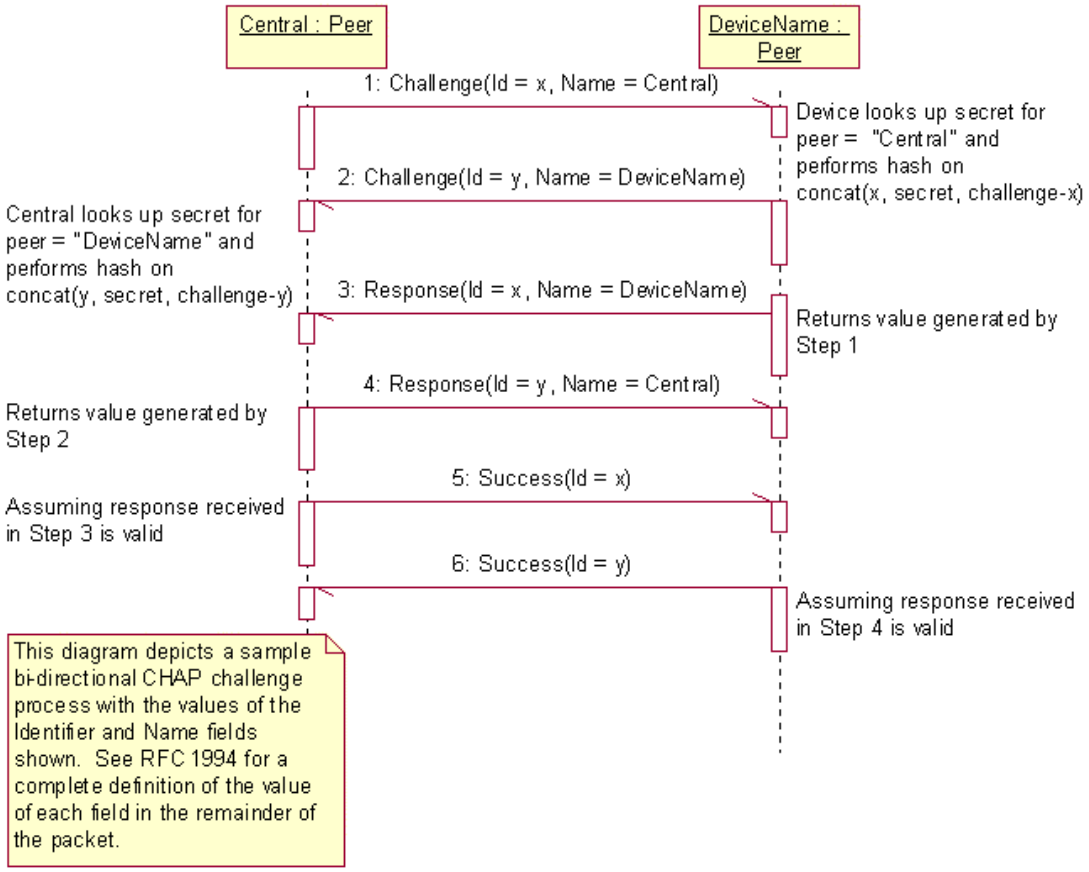

Figure 2 Typical CHAP Dialog

Either peer may issue the challenge first; in fact, during the Authentication phase they often transmit near-simultaneously. As a result, the response and success/failure messages for the two authentication processes are typically interwoven with each other as shown above. A single thread can be viewed by only considering the odd or even messages in Figure 2.

The challenge is transmitted in a message that contains the name of the sender. This name can then be used to look up the appropriate secret from the look-up table, thereby allowing a given peer to allow access from a virtually unlimited number of other peers, each with a unique secret.

Once the receiver of a challenge finds the correct secret for a given peer, it performs the MD5 hash algorithm per the rules in the standard and returns the response with its own name in the name field. The name of the responding system allows the sender of the challenge to look-up the secret assigned to the name of the remote device; thereby allowing each challenger to support connections with a virtually unlimited number of peers.

While either peer may initiate a challenge, there is only one secret for the pair of peers. Thus, the same secret is used regardless of which peer initiated the challenge.

Assuming the response is valid, the challenger issues a success command and proceeds to the Network-Layer Protocol Phase, but as the CHAP RFC indicates, the peer is still prepared to accept duplicate response messages as well as being able to respond to a challenge at any subsequent point during the Network-Layer Protocol Phase.

Annex D
MANAGEMENT INFORMATION BASE FOR MODEM
(Normative)

D.1 Modem MIB Header

```
--
-- Filename:    2103v0207 MOD.mib
-- Description: This MIB defines objects represents the data elements that
--              support dial-up modem configuration and control
-- Source:      NTCIP 2103 v0207
--
-- MIB Revision History:
-- 10/14/04     Created header and MIB inside NTCIP 2103 v02.01.
-- 10/15/04     Made Corrections to the IMPORTS and mdmNetAddress OID value
-- 09/15/05     Updated MIB to 2103v0206
-- 12/30/08     Updated MIB to 2103v0207
--
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--
*******************************************************************************

NTCIP-Modem-MIB DEFINITIONS ::= BEGIN

IMPORTS
    OBJECT-TYPE
        FROM RFC-1212
    DisplayString
        FROM RFC1213-MIB
    Counter, IpAddress
        FROM RFC1155-SMI
    modem
        FROM NTCIP8004-A-2004;
```

D.1.1 Modem Interface Index

```
mdmIfIndex OBJECT-TYPE
    SYNTAX      INTEGER (1..255)
    ACCESS      read-write
    STATUS      mandatory
    DESCRIPTION
            "<Definition> The value of ifIndex for the port to which
            the modem is connected or resident. By convention
            and if possible, hardware port numbers map directly
            to external connectors.  The value for each port must
            remain constant at least from one re-initialization
            of the network management agent to the next.

            <DescriptiveName> DialString.ifIndex:number
            <DataConceptType> Data Element "

    ::= { modem 1 }
```

D.1.2 Maximum Dial Strings

```
maxDialStrings  OBJECT-TYPE
    SYNTAX      INTEGER (1..255)
    ACCESS      read-only
    STATUS      mandatory
    DESCRIPTION
            "<Definition> The maximum number of dial strings (telephone
            numbers) that this unit supports.

            <DescriptiveName> DialStrings.max:quantity
            <DataConceptType> Data Element"
```



```
    ::= { modem 2 }
```

D.1.3 Dial String Table

```
-- The Dial String table contains a collection of objects that
-- describe the dialing string (telephone number) to use when trying to
-- connect to an entity through a dialup modem interface.
--
-- Note. This table is intentionally structured to provide services similar
-- to the ipNetToMediaTable.  If the ipNetToMediaTable is used to convert an
-- IpAddress to a dial string and this table is
-- instantiated, then one should ensure that the appropriate entries in the
-- ipNetToMediaTable mirror this one.  The use of the ipNetToMediaTable for
-- converting an IpAddress to a dial string is predicated
-- by the PPP's HDLC address field always be equal to "0xff".

mdmDialStringTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF MdmDialStringEntry
    ACCESS      not-accessible
    STATUS      mandatory
    DESCRIPTION
            "<Definition> A table of stored dial strings(telephone
            numbers).

            <DescriptiveName> DialStringTable
            <DataConceptType> Entity Type
            <TableType> Static"

    REFERENCE   "V.58 telephone Numbers"
    ::= { modem 3 }
```

D.1.3.1 Modem Dial String Entry

```
mdmDialStringEntry OBJECT-TYPE
    SYNTAX      MdmDialStringEntry
    ACCESS      not-accessible
    STATUS      mandatory
    DESCRIPTION
            "<Definition> A dialing string number indexed
            by row, interface number and/or IpAddress.

            <DescriptiveName> DialStringEntry
            <DataConceptType> Entity Type"

    INDEX  { mdmRowIndex }
    ::= { mdmDialStringTable 1 }

MdmDialStringEntry ::= SEQUENCE {
    mdmRowIndex            INTEGER,
    mdmDialString          DisplayString,
    mdmNetAddress          IpAddress }
```

D.1.3.1.1 Modem Dial String Row

```
mdmRowIndex OBJECT-TYPE
    SYNTAX      INTEGER (1..255)
    ACCESS      read-only
    STATUS      mandatory
    DESCRIPTION
```



```
            "<Definition> The row number of an entry in the
            mdmDialStringTable.
            The value may not exceed maxDialStrings.

            <DescriptiveName> DialString.rowIndex:number
            <DataConceptType> Data Element "

    ::= { mdmDialStringEntry 1 }
```

D.1.3.1.2 Modem Dial String

```
mdmDialString OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..40))
    ACCESS      read-write
    STATUS      mandatory
    DESCRIPTION
            "<Definition> A dialing string to send to the
            modem for it call in order to reach the desired host computer.

            The value of this object shall begin with the attention
            command 'AT' followed by the dial command 'D('T'or 'P' for tone
            or pulse), be followed by the telephone number, and be terminated
            with a carriage return and linefeed characters.

            <DescriptiveName> DialString.string:text
            <DataConceptType> Data Element "

    ::= { mdmDialStringEntry 2 }
```

D.1.3.1.3 Modem Network Address

```
mdmNetAddress OBJECT-TYPE
    SYNTAX      IpAddress
    ACCESS      read-write
    STATUS      mandatory
    DESCRIPTION
            "<Definition> The IpAddress of the desired host computer
            associated with the dialing string.

            <DescriptiveName> DialString.address:number
            <DataConceptType> Data Element "

    ::= { mdmDialStringEntry 3 }
```

D.1.4 Modem Initialization String 1

```
mdmInitString1 OBJECT-TYPE
    SYNTAX  DisplayString (SIZE (0..40))
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
           "<Definition> An initialization string that will be sent to the
            modem each time the modem is rebooted.  A list of manufacturer-
            specific initialization strings can be found at
            http://www.modemhelp.org/inits/

            <DescriptiveName> Init.string1:text
            <DataConceptType> Data Element "
```



```
   DEFVAL   { "AT &F<cr><lf>" }
    ::= { modem 4 }
```

D.1.5 Modem Initialization String 2

```
mdmInitString2 OBJECT-TYPE
    SYNTAX  DisplayString (SIZE (0..40))
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
           "<Definition> A second initialization string that is to be sent to
            the modem each time the modem is rebooted.

            <DescriptiveName> Init.string2:text
            <DataConceptType> Data Element "

   DEFVAL   { "AT E0Q0V0X0S0=0&D0&C0<cr><lf>" }
   ::= { modem 5 }
```

D.1.6 Modem Initialization String 3

```
mdmInitString3 OBJECT-TYPE
    SYNTAX  DisplayString (SIZE (0..40))
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
           "<Definition> A third initialization string that is to be sent to
            the modem each time the modem is rebooted.

            The DEFVAL field does not include <cr> and <lf> symbols that
            must be present if the string is to be sent.

            <DescriptiveName> Init.string3:text
            <DataConceptType> Data Element "

   DEFVAL   { "" }
    ::= { modem 6 }
```

D.1.7 Modem Buffer Delay

```
mdmBufferDelay OBJECT-TYPE
    SYNTAX  INTEGER (0..255)
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
           "<Definition> The time in tenth seconds between
           when a response is received and the sending of a subsequent
           command for the purpose of visibility during diagnostics.

           <DescriptiveName> Buffer.delay:code
           <DataConceptType> Data Element "

    ::= { modem 7 }
```

D.1.8 Modem Command Buffer

```
mdmCommandBuffer OBJECT-TYPE
    SYNTAX  DisplayString (SIZE (0..40))
    ACCESS  read-only
```



```
    STATUS  mandatory
    DESCRIPTION
            "<Definition> This object contains an image of any command sent to
            a modem.  When the DTE is about to send a command to a modem the
            mdmResponseBuffer is set equal to null and the command is copied
            here.

            <DescriptiveName> Buffer.command:text
            <DataConceptType> Data Element "

    ::= { modem 8 }
```

D.1.9 Modem Response Buffer

```
mdmResponseBuffer OBJECT-TYPE
    SYNTAX  DisplayString (SIZE (0..40))
    ACCESS  read-only
    STATUS  mandatory
    DESCRIPTION
            "<Definition> This object contains an image of any response
            received from a modem.

            <DescriptiveName> Buffer.response:text
            <DataConceptType> Data Element "

    ::= { modem 9 }

END -- NTCIP-Modem-MIB
```


Annex E
TRANSLATING AN ADDRESS TO A TELEPHONE NUMBER
(Informative)

NTCIP 2103 v02 does not prescribe the method of translating an address into a telephone number. The following, however, is one possible technique. In a communications stack where the Network Layer provides routing services, the IpAddress of the ultimate destination is passed to the Network Layer and it converts it to the IpAddress of the host (next hop) that it can directly communicate with and through which the ultimate destination can be reached. In the case where the Network Layer does not provide routing services (such as T2), the IpAddress of the ultimate destination is always the IpAddress of the next hop. The Network Layer then passes the next hop's IpAddress down to a table that converts the IP Addresses into physical addresses and the logical number of the Data Link Layer to be used to send the data packet. This table is referred to as the ipNetToMediaTable.

The ipNetToMediaTable is defined in MIB-II and has a row structure as indicated in Table 9 and Table 10.

Table 9 ipNetToMediaTable Row Structure

ipNetToMediaEntry		
ipNetToMediaIfIndex	[INDEX]	: Integer = ifIndex
ipNetToMediaPhyAddress		: OCTET STRING
ipNetToMediaNetAddress	[INDEX]	: IpAddress
ipNetToMediaType		: Integer = 1..4

Table 10 ipNetTo Media Table Row Structure (continued)

«enumeration» **ipNetToMediaType**	
other	= 1
invalid	= 2
dynamic	= 3
static	= 4

The ipNetToMediaIfIndex is the logical number of the ifIndex assigned to the appropriate physical interface.

NOTE—Some Internet RFC Data Link Layer MIBs are not defined correctly. In the case of RFC 1317 - Definitions of Managed Objects for RS-232-like Devices, the object rs232Number is used as an index to point to a particular interface. It can be interpreted as the number of RS-232 interfaces 1.X. As indicated in RFC 1659 Definitions of Managed Objects for RS-232-like Hardware Devices using SMIv2, the description of the equivalent object has been corrected to say that rs232Number is the ifIndex value that points to "an" interface. The word "an" means any interface not just RS-232 interfaces. Consider, a case where an implementation has 3 interfaces, a local RS-232 interface for a laptop computer, an Ethernet interface for peer-to-peer communications, and another RS-232 interface that connects to dialup modem. While there are two RS-232 interfaces, there are a total of three interfaces. The ifIndex for each of these could be defined as 1, 2, and 3 respectively. Even though the RS-232 interface to the dialup modem is the second RS-232 interface, it is ifIndex 3.

The ipNetToMediaPhyAddress is the destination address in the Data Link Layer PDU that goes out on the wire. The ipNetToMediaNetAddress is the IpAddress of the host to connect to (next hop). The ipNetToMediaType is a status/control object used to invalidate a row and designate whether this is static or dynamic assignment (see Address Resolution Protocol).

For a given ipNetToMediaNetAddress, the table can be searched to determine what logical interface (ipNetToMediaIfIndex) to send a PDU out on and what physical address (ipNetToMediaPhyAddress) goes in the Data Link Layer's address field.

If the ipNetToMediaIfIndex pointed to an Ethernet interface, the ipNetToMediaPhyAddress would be something like: "08 00 90 03 4C F1". If it pointed to a PMPP interface, it would be something like "01". Since PPP's physical address is always "FF", the ipNetToMediaPhyAddress for a PPP interface could be set to "845-6154" or "9, 1 979 845-6145".

As stated earlier, this is one possible technique for converting an IpAddress used at the Application Layer to a specific telephone number used in a PPP Data Link (and Physical) Layer. This technique ensures layer independence by decoupling any need for the Application Layer to consider how an ultimate destination can be reached and what type of interface and physical address is used to reach it.

The use of the ipNetToMediaTable for converting an IpAddress to a dial string or telephone number is predicated on the PPP's HDLC address field always be equal to "0xff"

Annex F
Typical Modem Dialogs
(Informative)

F.1 Modem Reset

This use case applies when resetting the modem. See Figure 3.

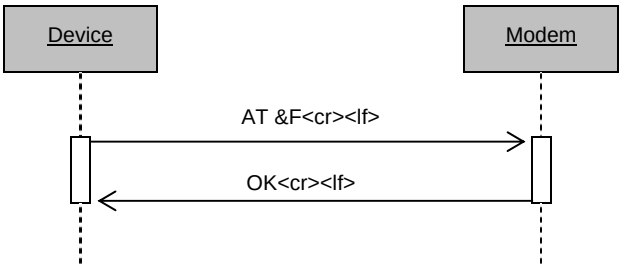

Figure 3 Use Case—Modem Reset

Before issuing any other commands to the modem, it is advisable to issue an &F or Z command (See mdmInitString1) to the modem as the first step in the initialization process. No specific response should be anticipated. The modem may be set up to return numeric, or no result codes. The following points should be considered:

a) Give the modem time. Some modems do a lengthy reset process and may take up to 3 seconds before returning a result. Also be aware that the default may be Q1 or V0 mode.
b) Following an OK result, wait another 1 second. Some modems do the reset process after they respond and do not accept additional commands during that time.

After the modem is reset, the second initialization string should be issued.

NOTE—The response values shown in the dialogue represent the verbose response codes for clarity. In the non-verbose mode (V0), the "OK<cr><lf>" response would be "0<cr>".

F.2 Modem Initialization

This use case applies when initializing the modem. See Figure 4.

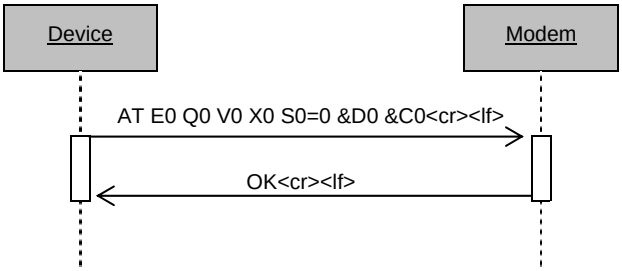

Figure 4 Use Case—Modem Initialization

In the above, spaces are used for readability. However, the use of spaces between commands is not recommended. The following is a description of each command:

a) AT—ATtention indicates the start of a command
b) E0—Turn off echo mode to avoid having command echoes pass through the result code scanner.
c) Q0—Enable result codes to ensure that commands are being processed, and to synchronize with the modem command processor
d) V0—Use numeric result codes. Most modems initialize in the verbose mode but NTCIP 2103 v02s requires the mode be changed to numeric.
   NOTE—When V0 is used, result codes do not include a <cr> character.
e) X0—Only "CONNECT" result code is returned.
f) S0=0—So the auto-answer is disabled.
g) &D0—So that the DTR interface signal is ignored
h) &C0—So that the DCD interface signal is constantly on and does not react to lose of carrier.

Once this initialization command (See mdmInitiString2) has been sent, and the OK response returned, the device may issue any additional initialization command (See mdmInitiString3) and then go on to the originate or answer process.

A device should anticipate an ERROR result codes in response to a command.

NOTE—The response values shown in the dialogue represent the verbose response codes for clarity. In the non-verbose mode (V0), the "OK<cr><lf>" response would be "0<cr>".

F.3 Modem Telephone Number Dialing

This use case applies when attempting to dial a telephone number. See Figure 5.

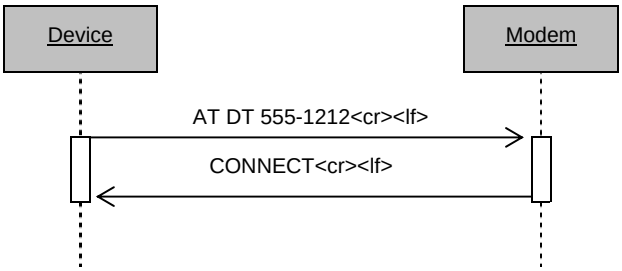

Figure 5 Use Case—Modem Telephone Number Dialing

The mdmDialString (ATDT<telephone number>) attempts to establish a connection. A device should anticipate any of the result codes being returned.

NOTE—The response values shown in the dialogue represent the verbose response codes for clarity. In the non-verbose mode (V0), the "CONNECT<cr><lf>" response would be "1<cr>".

F.4 Answering a Call

This use case applies to answering a call. See Figure 6.

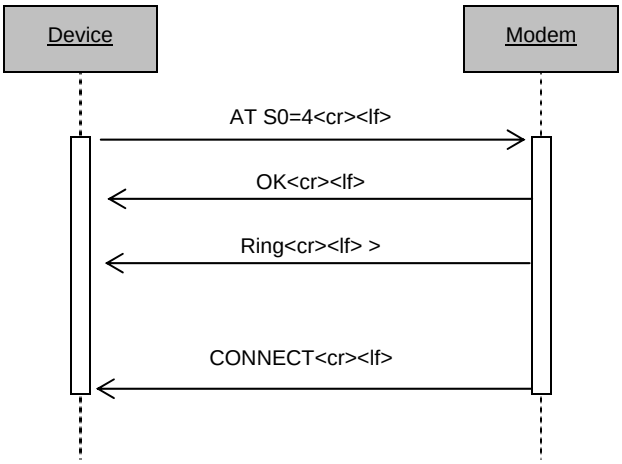

Figure 6 Use Case—Answering a Call

The simplest technique for answering an incoming call is to set S0 to a non-zero value and wait for a CONNECT result. You may get several RING results, and possibly a NO CARRIER result if a caller hangs up before connecting. These results should not cause the device to abort. Continue to wait for a CONNECT result code.

If the device sets S0, the device should set it back to zero after the call to prevent inadvertent answering when it is not prepared to do so. By setting S0 to the number of rings desired before the modem answers, ring detection technology built-in to the modem is used.

An alternative technique to connecting is issuing an A command. The issuance of an A command after receiving a RING result code should be properly timed because the command may collide with another RING result code and be missed. In some areas, the RING results may be generated in pairs depending on the ringing cadence of the phone system.

Monitoring the DCD interface signal is another technique for carrier detection in answer or originate mode. This assumes that &C1 has been set and the cable is wired properly. If the device uses DCD, it does not know when the modem has given up waiting for the carrier, or why. Because of the inherent problems with these two techniques, the S0 method is recommended.

NOTE—The response values shown in the dialogue represent the verbose response codes for clarity. In the non-verbose mode (V0), the "OK<cr><lf>", "Ring<cr><lf>", and "CONNECT<cr><lf> >" responses would be "0<cr>", "1<cr>", and "2<cr>", respectively

F.5 Changing from Online State to Command State

This use case applies when it is necessary to return to the command state when in the online state. See Figure 7.

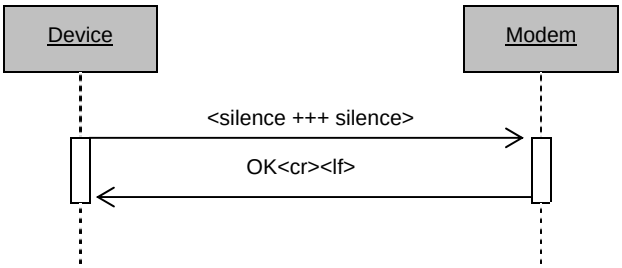

Figure 7 Use Case—Changing from Online State to Command State

To "escape" the modem, the controller first delays the escape guard time (specified by S12), then issue the escape character three times (specified by S2), then wait for an OK result. Once the OK result is received, the modem has entered command state. The device can then issue a hang-up command

NOTE—The response values shown in the dialogue represent the verbose response codes for clarity. In the non-verbose mode (V0), the "OK <cr><lf>" response would be "0<cr>".

F.6 Hanging Up

This use case applies when the modem is in the command state and it is desired to hang up the phone line. See Figure 8.

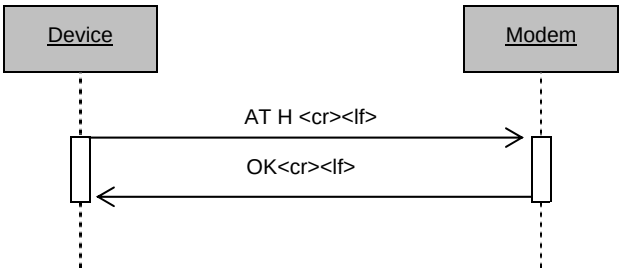

Figure 8 Use Case—Hanging Up

When a device needs to terminate a connection, it puts the modem back in command state and issue the hang-up (H) command.

NOTE—The response values shown in the dialogue represent the verbose response codes for clarity. In the non-verbose mode (V0), the "OK<cr><lf>" response would be "0<cr>".

§

