**Joint AASHTO / ITE / NEMA Standards Publication TS 3.CP-CLA - 1998**

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*NATIONAL TRANSPORTATION COMMUNICATIONS FOR ITS PROTOCOL (NTCIP)*
*Class A and Class C*
*Class Profiles*

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NTCIP Profile Requirements List and or Profile Implementation Distribution
Notice

# Contents

# Foreword

This publication defines two communication class profiles, Class A and Class C, which are a combination of other profiles and standards intended to meet specific requirements for information management and information transfers to and from roadside devices in a networked environment. The Class A and Class C Profiles provide the definition of the protocols and standards to form a complete communication stack. They contain mandatory requirement statements that are applicable to all device claiming conformance to one or both of the class profiles. They may, also, contain optional and conditional requirements which may be applicable to a specific environment in which they are intended.

This standards also provides an informative annex describing the NEMA TS 3.3 NTCIP Class B Profile in terms of Application, Transport, and Subnetwork Profiles. It is not intended to supercede or replace the TS 3.3. It purpose is to outline requirements when integrated or interoperating with implementations of the Class A or Class C Profile.

The text includes mandatory requirements in Annex A and Annex C which are defined as normative.

The text in Annex B is informative.

The effort to develop NTCIP began in 1992 with the 3-TS Transportation Management Systems and Associated Control Devices Section of the National Electrical Manufacturer's Association (NEMA). Their original desire was to address a user need for extending the TS-2 Standards for traffic control hardware to include standardized systems communication. Under the guidance of the Federal Highway Administration's (FHWA) NTCIP Steering Group, the NEMA effort was expanded to include the development of communications standards for all transportation field devices that could be used in an Intelligent Transportation Systems (ITS) network.

In September 1996, a formal agreement was reached among NEMA, ITE, and AASHTO to jointly develop, approve, and maintain NTCIP Standards. Under guidance of a Joint AASHTO/ITE/NEMA Committee on NTCIP, a Working Group was created in order to develop a method for organizing Class Profiles. The first official meeting of the working group was in August 1997.

After research into how national and international standards organizations combine protocols and standards to address all seven layers of the ISO-OSI Reference Model, the committee adopted the approach defined in the *NTCIP Framework and Classification of Profiles.* Following that approach, a protocol stack or class profile is specified by reference to application, transport, subnetwork profiles. An application profile addresses the application, presentation, and session layers. A transport profile addresses the transport and network layers. A subnetwork profile addresses the data link and physical layers. The *NTCIP Class A and Class C – Class Profiles* (CP-A and CP-C) define combinations of protocols and standards for the full set of communications functions and services prescribed by the reference model. It is applicable to center-to-roadside communications.

In preparation of the Standards Publication, input of users and other interested parities was sought and evaluated. Inquires, comments, and proposed or recommended revisions should be submitted to:

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# Introduction

The context of the NTCIP is one part of the Intelligent Transportation Systems standardization activities covering base standards, profiles, and registration mechanisms.

- Base Standards define procedures and rules for providing the fundamental operations associated with communications and information that is exchanged over fixed-point communications links.

- Profiles define subsets or combinations of base standards used to provide specific functions or services. Profiles prescribe particular subsets or options available in base standards necessary for accomplishing a particular function or service. This provides a basis for the development of uniform, nationally recognized conformance.

- Registration Mechanisms provide a means to specify and uniquely identify detailed parameters within the framework of base standards and/or profiles.

Within the Joint AASHTO/ITE/NEMA NTCIP Committee, the Profiles Working Group is concerned with the methodology of defining profiles, and their documentation in Standards Publications. This standard defines two communication class profiles, Class A and Class C, which are a combination of base standards and/or other profiles intended to meet specific requirements for information management and information transfer in roadside devices in a networked environment. This standard also discusses methods for integrating the existing Class B Profile with new profiles. The objective is to facilitate the specification of ITS systems characterized by a high degree of interoperability and interchangability of its components.

# Section 1
# General

## 1.1 Scope

This standard is applicable to transportion devices concerned with operating in a network environment. It specifies a combination of NEMA, Internet, and OSI standards which collectively provide information management services over connectionless and connection-oriented transport and connectionless network services. It also provides a reference to the type of subnetwork to which these services are to be attached.

## 1.2 Scenario

This standard specifies the provisions of the NTCIP Class A and Class C Profiles. Class profiles define standards and/or other profiles that descibe the complete functionality of a communications stack. The concept of a communication stack is based upon the OSI Reference Model and consists of seven layers. These layers represent the logical grouping and functional organization of communciations processing. For the purposes of organization and reuse, the requirements for implementation of these layers are organized into application, transport, and subnetwork profiles. An application profile addresses the services and protocols associated with the application, presentation, and session layers. A transport profile addresses the services and protocols associated with the transport and network layers. A subnetwork profile addresses the services and protocols associated with the data link and physical layers.

<table>
<tr><th>ISO Layers</th><th>Base Standards</th><th colspan="2">Profile Taxonomy</th></tr>
<tr><td>APPLICATION LAYER</td><td rowspan="3">IAB STD 15 (SNMP)<br>IAB STD 33 (TFTP)</td><td rowspan="3">AP-STMF<br>AP-TFTP<br>Application<br>Profiles</td><td rowspan="8">CP – A<br>Class Profile</td></tr>
<tr><td>PRESENTATION LAYER</td></tr>
<tr><td>SESSION LAYER</td></tr>
<tr><td>TRANSPORT LAYER</td><td>IAB STD 6 (UDP)</td><td rowspan="2">TP – INTERNET<br>Transport Profile</td></tr>
<tr><td>NETWORK LAYER</td><td>IAB STD 5 (IP)</td></tr>
<tr><td>DATA LINK LAYER</td><td>ISO/IEC 3309<br>ISO/IEC 4335<br>ISO/IEC 7809<br>TS 3.3 Class B Profile</td><td rowspan="2">SP-PMPP232<br>Subnetwork<br>Profile</td></tr>
<tr><td>PHYSICAL LAYER</td><td>EIA/TIA 232-E</td></tr>
</table>

**Figure 1**
**Class A - Class Profile Scenario**

The Class A Profile consists of the Simple Transportation Management Framework (STMF) and Trivial File Transfer Protocol (TFTP) Application Profiles, the User Datagram Protocol (UDP/IP) configuration of the Internet Transport Profile, and the Point-to-Multipoint Protocol using RS-232 (PMPP232) Subnetwork Profile. The STMF Profile provides basic information management services. The TFTP Application Profile provides a simple connectionless, block or file transfer mechanism. The UDP/IP configuration of

the Internet Transport Profile provides connectionless transport and network services. The PMPP232 Profile provides an unacknowledged connectionless delivery service on a serial interface subnetwork. The layer, base standards, and profile taxonomy that make up this profile are shown in Figure 1.

The Class C Profile consists of the STMF and FTP Application Profiles, the Transmission Control Protocol (TCP/IP) and UDP/IP configuration of the Internet Transport Profile, and the PMPP232 Subnetwork Profile. The STMF Profile provides basic information management services. The FTP Application Profile provide a connection-oriented file transfer mechanism. The TCP/IP configuration of the Internet Transport Profile provides connection-oriented transport and connectionless network services. The UDP/IP configuration of the Internet Transport Profile provides connectionless transport and network services. The PMPP232 Profile provides an unacknowledged connectionless delivery service on a serial interface subnetwork.

The Class C Profile requires implementation of the SNMP portions of the STMF Profile and UDP/IP for the purposes of managing the communications stack. SNMP is used to set up and modify the programming entries for the communications layers. It is also used for monitoring the statistical information related to how messages are being processed by the communications layers. The layer standards and profile taxonomy that make up this profile are shown in Figure 2.

<table>
<tr><th>ISO Layers</th><th>Base Standards</th><th colspan="2">Profile Taxonomy</th></tr>
<tr><td>APPLICATION LAYER</td><td rowspan="3">IAB STD 15 (SNMP)<br>IAB STD 9 (FTP)</td><td rowspan="3">AP-STMF<br>AP-FTP<br>Application<br>Profiles</td><td rowspan="6">CP – C<br>Class Profile</td></tr>
<tr><td>PRESENTATION LAYER</td></tr>
<tr><td>SESSION LAYER</td></tr>
<tr><td>TRANSPORT LAYER</td><td>IAB STD 7 (TCP)<br>IAB STD 6 (UDP)</td><td rowspan="2">TP – INTERNET<br>Transport Profile</td></tr>
<tr><td>NETWORK LAYER</td><td>IAB STD 5 (IP)</td></tr>
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<tr><td>PHYSICAL LAYER</td><td>EIA.TIA 232-E</td></tr>
</table>

**Figure 2**
**Class C - Class Profile Scenario**

It is important for a user or specifier to understand the distinction between these two profiles. The Class A Profile is based upon the connectionless delivery service. This service moves data across a network on a best effort basis. It ensures that no erroneous data will be delivered, but offers no other guarantees. Data may be lost or arrive out of order and the sender cannot query the service as to whether the data got there or not. Messages are simply sent and received with no relationship to any other message.

A connect-oriented delivery service guarantees that all data sent will be received correctly and in order. It does this by establishing a virtual circuit between the sender and intended recipient. The network may experience some fault condition where that circuit is broken, but the sender will be able to find out that the data was not delivered.

Both connectionless and connection-oriented services have their uses. Connectionless delivery minimizes overhead and requires less processing. Connectionless services can provide a broadcast capability wherein a message is sent to multiple recipents. This is not possible with a connection-

oriented service. Connection-oriented services require additional overhead to establish and tear down the virtual circuit.

### 1.3 References

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For draft revisions of this document, which are under discussion by the relevant NTCIP Working Group, and recommended revisions of the NTCIP Joint Committee, visit the World Wide Web at http://www.ntcip.org.

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

#### 1.3.1 Normative References

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Joint AASHTO / ITE / NEMA Standards Publication TS 3.AP-TFTP – 1998 *NATIONAL TRANSPORTATION COMMUNICATIONS FOR ITS PROTOCOL (NTCIP) Trivial File Transfer Protocol - Application Profile*

Joint AASHTO / ITE / NEMA Standards Publication TS 3.AP-STMF – 1998 *NATIONAL TRANSPORTATION COMMUNICATIONS FOR ITS PROTOCOL (NTCIP) Simple Transportation Management Framework - Application Profile*

Joint AASHTO / ITE / NEMA Standards Publication TS 3.TP-INTERNETI – 1998 *NATIONAL TRANSPORTATION COMMUNICATIONS FOR ITS PROTOCOL (NTCIP) Internet (TCP/IP and UDP/IP) - Transport Profile*

Joint AASHTO / ITE / NEMA Standards Publication TS 3.SP-PMPP232 – 1998 *NATIONAL TRANSPORTATION COMMUNICATIONS FOR ITS PROTOCOL* (NTCIP) Point-to-MultiPoint Protocol using RS-232 Connections- Subnetwork Profile

### 1.3.2 Other References

*Guide to Open System Specifications*, European Workshop for Open Systems, http://www.ewos.be/goss/top.htm, June 9, 1997

US-DOD Internet Related Standardized Profiles, DISA Internet Librarian, http://www-library.itsi.disa.mil/org/mil_std.html, October 31, 1997

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### 1.4 Definitions

For the purposes of this standard, the following definitions apply:

**Application Layer**: That portion of an OSI system responsible for transferring information over the communications stack.

**data**: Information before it is interpreted.

**Data Link Layer**: That portion of an OSI system responsible for transmission, framing, and error control over a single communications link.

**datagram**: A self-contained unit of data transmitted independently of other datagrams.

**end-application** : The primary function of the host.

**end system**: The source or destination of an information exchange

**host**: (Internet usage) An end-system's application.

**Intelligent Transportation Systems**: A major national initiative to improve information, communication and control technologies in order to improve the efficiency of surface transportation.

**intermediate system**: A system that participates in an information exchange but is not the source or destination of the exchange.

**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**: The network protocol offering a connectionless mode network service in the Internet suite of protocols.

**Internet suite of protocols**: A collection of computer-communication protocols originally developed under DARPA sponsorship.

**network**: A collection of subnetworks connected by intermediate systems and populated by end systems.

**Network Layer**: That portion of an OSI system responsible for data transfer across the network, independent of both the media comprising the underlying subnetworks and the topology of those subnetworks.

**network management**: The technology used to manage a network, usually referring to the management of devices that contain information about setup, control, and status of the layers in a communications stack. The term refers to all devices, both intermediate and end systems, that are present on the network or internetwork.

**Open Systems Interconnection**: An international effort to facilitate communications among computers of different manufacture and technology.

**OSI Reference Model**: The 7-layer model that describes the conceptual organization of protocols for communications and interconnection of computer systems.

**Physical Layer**: That portion of an OSI system responsible for the electro-mechanical interface to the communications media.

**Presentation Layer**: That portion of an OSI system responsible for adding structure to the units of data that are exchanged.

**Profile**: A combination of base standards or other profiles to meet a higher level of functionality.

**Session Layer**: That portion of an OSI system responsible for adding control mechanisms to the data exchange.

**subnetwork**: A physical network within a network. All device on a subnetwork share a common physical medium.

**taxonomy:** A classification scheme for referencing profiles or sets of profiles unambiguously

**TCP/IP Reference Model**: An alternate to OSI reference model that organizes communication protocols into 4 layers. It consists of host-to-network, internet, transport, and application layers.

**Transport Layer**: That portion of an OSI system responsible for the reliability and multiplexing of data transfers between end nodes.

**transportation management**: Short for the management of networks of transportation devices and the network itself.

### 1.5 Abbreviations and Acronyms

The abbreviations used in this Standard Publication are defined as follows:

AASHTO American Association of State Highway and Transportation Officials

| | |
|---|---|
| ANSI | American National Standards Institute |
| AP | Application Profile |
| CP | Class Profile |
| EP | End-Application Profile |
| EIA | Electronic Industries Association |
| FTP | File Transfer Protocol |
| IEC | International Electro-technical Commission |
| IEEE | Institute of Electrical and Electronic Engineers |
| IP | Internet Protocol |
| ISO | International Organization for Standardization |
| ITE | Institute of Transportation Engineers |
| ITS | Intelligent Transportation Systems |
| LAN | Local Area Network |
| MIB | Management Information Base |
| NEMA | National Electrical Manufacturers Association |
| NTCIP | National Transportation Communications for ITS Protocol |
| OSI | Open Systems Interconnection |
| PICS | Protocol Implementation Conformance Statement |
| PMPP | Point to Multi-Point Protocol |
| PMPP232 | Point to Multi-Point Protocol using RS-232 |
| PPP | Point-to-Point Protocol |
| PRL | Profile Requirements List |
| RFC | (Internet) Request for Comments |
| SMI | Sturcture of Management Information |
| SNMP | Simple Network Management Protocol |
| SP | Subnetwork Profile |
| STD | (Internet) Standard |
| STMF | Simple Transportation Management Framework |
| STMP | Simple Transportation Mangment Protocol |
| TCP | Transmission Control Protocol |
| TFTP | Trivial File Transfer Protocol |
| TMIB | Transportation Management Information Base |
| TSMI | Trnasportation Structure of Management Information |
| TP | Transport Profile |
| UDP | User Datagram Protocol |

# Section 2
# Conformance

## 2.1 General Requirements

Implementataions claiming conformance to the Class A Profile shall support the following elements as stated.

a. All requirements as specified in Annex A
b. All constraints defined in Section 2.4.1 through 2.4.3, 2.5.2 through 2.5.6, and 2.6.1 through 2.6.3.
c. All manadatory requirements of the profiles referenced by this profile.

Implementataions claiming conformance to the Class C Profile shall support the following elements as stated.

a. All requirements as specified in Annex C
b. All constraints defined in Section 2.4.1 through 2.4.3, 2.5.1 through 2.5.6, and 2.6.1 through 2.6.3.
c. All manadatory requirements of the profiles referenced by this profile.

## 2.2 Trivial File Transfer Protocol (TFTP) Application Profile

Support of TFTP as defined in AP-TFTP, Section 2.1 is NOT required for conformance to either the Class A or Class C Profile. It is optional in the Class A Profile.

In addition to mandatory requirements, the TFTP Application Profile references optional features and functions that have been standardized but are not applicable to all implimentations. If any of those options are desirable or needed, all computers, devices, etc. must implement the same set or subset of options to have these features and functions interoperate.

TFTP is a connectionless file transfer protocol for exchanging files between host systems. It employs a simple and easy to implement transfer mechanism. Its only functions are to read and write files or named blocks of memory from or to a remote server. An implementation may act as either a client, server, or both. It cannot list directories, and has no provisions for user authentication.

## 2.3 File Transfer Proctocol (FTP) Application Profile

Support of FTP as defined in AP-FTP, Section 2.1 is NOT required for conformance to either the Class A or Class C Profile. It is optional in the Class C Profile.

In addition to mandatory requirements, the FTP Application Profile references optional features and functions that have been standardized but are not applicable to all implimentations. If any of those options are desirable or needed, all computers, devices, etc. must implement the same set or subset of options to have these features and function interoperate.

FTP is a connection-oriented file transfer protocol for exchanging files between host systems. Both text and binary file transfers are supported. It uses two TCP connections; one for control and the other for data. It defines a user interface that can list directories and has provisions for user authentication.

## 2.4 Simple Transportation Management Framwork (STMF) Application Profile

The STMF Application Profile references a number of protocols and standards related to information management services and the information to be managed. The information being managed is

specifically related to a protocol stack. It references the Simple Network Management Protocol (SNMP) and defines the Simple Transportation Management Protocol (STMP). The information to be managed is referenced to the Structure of Management Information (SMI), the Management Information Base for (Network) Management of TCP/IP-based Internets (MIB-II). STMF also defines information related to STMP. The structure and identification of transportation management information are defined in NEMA_SMI. STMP object definitons are defined in TMIB.

### 2.4.1 SNMP Protocol

A device conforming to the Class A or Class C Profile shall meet the mandatory requirements of SNMP as defined in AP-STMF, Section 2.2.

SNMP is the connectionless Application Layer Protocol used for information management. It uses a simple store and fetch model to set and retrieve prameters of a device.

### 2.4.2 Network Structure of Management Information (Network SMI)

A device conforming to the Class A or Class C Profile shall meet the mandatory requirements of Network SMI as AP-STMF Section 2.3. That section defines the details of support for the Internet Standard SMI.

### 2.4.3 Network Management Information Base (Network MIB)

An implementation conforming to the Class A or Class C Profile shall meet the mandatory requirements of AP-STMF, Section 2.4.

### 2.4.4 STMP Protocol

Support for STMP is NOT required for conformance to either the Class A or Class C Profile.

The Class A and Class C Profiles do not contain any mandatory requirements for STMP. STMP is standardized but is not applicable to all implementations. If support of this protocol is needed or desirable, an implementation must conform to AP-STMF, Section 2.5 for interoperability.

### 2.4.5 Transportation Structure of Management Information (TSMI)

Support for TSMI is NOT required in either the Class A or Class C Profile.

TSMI defines the structure and identification of transportation related information. While standardized, it is not applicable to all implimentations. If support of transportation related information is needed or desirable, an implementation must conform to AP-STMF, Section 2.6 for interoperability.

### 2.4.6 Transportation Management Information Base (TMIB)

Support for TMIB is NOT required for conformance to either the Class A or Class C Profile.

TMIB defines dynamic object variables related to STMP. TMIB has been standardized but is not applicable to all implimentations. If conformance this section of the standard is needed or desirable, all computers, devices, etc. must meet the requirements of AP-STMF, Section 2.7 for interoperability.

## 2.5 Internet (TCP/IP and UDP/IP) Transport Profile

The TUI Transport Profile references a number of protocols and standards related to end-to-end and intermediate exchanges of information. It references TCP and UDP as two possible Transport Layer Protocols. TCP is the connection-oriented transport protocol and UDP is the connectionless transport protocol. It references a common Network Layer Protocol as IP and an ancillary error reporting protocol as ICMP. The standards for interfacing to other profiles are referenced to Internet Host Requirements (InHost).

The TCP Protocol specifies the provisions for connection-oriented transport service between an end system connected to a subnetwork and another compatible end system through the IP connectionless network service. The UDP Protocol specifies the provisions for connectionless transport service between an end system connected to a subnetwork and another compatible end system through the IP connectionless network service. ICMP is common to both the connection-oriented and the connectioless transport mechanisms.

### 2.5.1 Transmission Control Protocol (TCP)

A device conforming to the Class C Profile shall meet the mandatory requirements for TCP as defined in TP-INTERNET, Section 2.2.1.

The TCP Protocol specifies the provisions for connection-oriented transport service between end systems.

### 2.5.2 User Datagram Protocol (UDP)

A device conforming to the either Class A and Class C Profile shall meet the mandatory requirements for UDP as defined in TP-INTERNET, Section 2.2.2.

The UDP Protocol specifies the provisions for connectionless transport service between end systems.

### 2.5.3 Internet Protocol (IP)

An implementation conforming to either the Class A or Class C Profile shall support the IP Protocol as defined in TP-TUI, Section 2.3.1.

The IP Protocol specifies the provisions for connectionless network service between connected systems. IP is used to route messages across a network of interconnected subnetworks.

### 2.5.4 Internet Control Message Protocol (ICMP)

A device conforming to either the Class A or Class C Profile shall support the ICMP Protocol as defined in TP-TUI Section 2.3.2.

ICMP is an integral part of the Internet Protocol and is used to handle error and control messages. Specifically, hosts use ICMP to sent probem reports back to an original sender. ICMP includes an echo request/reply mechanism (PING) used to test whether a destination is reachable and responding.

### 2.5.5 Host Interfaces (Inhost)

An implementation conforming to either the Class A or Class C Profile shall support the Host Interface requirements as defined in TP-TUI Sections 2.2 and 2.3.

The interfaces between the application and transport profiles and the transport and subnetwork profiles are defined by the InHost standard.

### 2.5.6 Tranport Profile MIB Objects

An implementation conforming to either the Class A or Class C Profile shall meet the mandatory requirements of TP-INTERNET, Sections 2.2.2.2.2.3 (UDP), 2.3.1.3.4 (IP), 2.3.2.3.3 (ICMP), 2.4.1 (Interfaces), and 2.4.2 (Address Tanslation)

An implementation conforming to the Class C Profile shall also meet the mandatory requirements of TP-INTERNET, Section 2.2.1.3.2.14 (TCP).

### 2.6 Point to Multi-Point Protocol using RS-232 Connections Subnetwork Profile

A device conforming to either the Class A or Class C Profile shall meet the mandatory requirements defined in the PMPP232 Subnetwork Profile.

The PMPP232 Subnetwork Profile contains specific requirements for :

1. Point-to-MultiPoint Protocol
2. EIA/TIA-232-E Interface
3. Data Link and Physical Layer Management Information Base Object Definitons

#### 2.6.1 Point to Multi-Point Protocol

An implementation conforming to either the Class A or Class C Profile shall meet the mandatory requirements as defined in Section SP-PMPP232, Section 3.3.

Section 3.3 of SP-PMPP232 defines a Data Link Layer protocol used to provide connectionless delivery service between two devices on a single subnetwork. It provides framing, addressing, control, and error detection services. It is designed for operation in an unbalanced environment with a single primary station and two or more secondary stations.

#### 2.6.2 RS-232 Intereface

An implementation conforming to either the Class A or Class C Profile shall meet the mandatory requirements as defined in Section SP-PMPP232, Section 3.2.

Section 3.2 of SP-PMPP232 defines an EIA/TIA 232-E Interface as the physical layer standard for interfacing between data terminal equipment and data communications equipment. It defines the means of providing a serial exchange of information between the two types of equipment. It provides the mechanical and functional description of the interface circuits. It also descibes the electrical signal characteristics of the inputs and outputs.

#### 2.6.3 Subnetwork Profile MIB Objects

An implementation conforming to either the Class A or Class C Profile shall meet the mandatory requirements of SP-PMPP232, Section 4.2.1.

Section 4.2.1 references object definitions related to PMPP and the RS-232 Interface.

# Annex A
# Class A Profile Requirements List

## (Normative)

### A.1 Introduction

This annex provides the Profile Requirements List (PRL) for implementations of the Class A Profile. An implementation shall satisfy the mandatory requirements of the base standards and profiles referenced in this profile.

## <ADD USES Paragraph>

### A.1.1 Notation

The following notations and symbols are used to indicate status and conditional status in the PRL and PICS.

#### A.1.1.1 Status Symbols

The following symbols are used to indicate base standard and profile status:

| | |
|---|---|
| m | mandatory |
| m.<n> | support of every item of the group labeled by the same numeral <n> required, but only one is active at time |
| o | optional |
| o.<n> | optional, but support of at least one of the group of options labeled by the same numeral <n> is required |
| c | conditional |
| - | non-applicable (i.e. logically impossible in the scope of the profile) |
| x | excluded or prohibited |
| I | out of scope of profile (left as an implementation choice) |
| d | deprecated (listed for compatibility with older systems) |

In addition, the symbol "•" is used to indicate an option whose status is not constrained by the profile (status in the base standard). The o.<n> notation is used to show a set of selectable options (i.e., one or more of the set must be implemented) with the same identifier <n>.

Two character combinations may be 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).

#### A.1.1.2 Support Column Symbols

This profile is in the form of a Profile Implementation Cocformance Specification (PICS) and, therefore, includes a support column. An implementor claims support of an item by circling the appropriate answer (Yes, No, or N/A) in the support column:

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

#### A.1.1.3 Instructions for Completing the PRL

A Profile implementor shows the extent of compliance to a Profile by completing the PRL; that is, compliance to all mandatory requirements and the options that are not supported are shown. 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 must 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 Profiles and/or Standards Referenced

This profile specifies the provision for simple information management and file transfer services using connectionless transport services over point-to-point circuits in a transporation roadside to management station environment. It references the following standards:

| | |
|---|---|
| AP-STMF | NTCIP Simple Transportation Management Framework Applications Profile |
| AP-TFTP | NTCIP Trivial File Transfer Protocol Applications Profile |
| TP- INTERNET | NTCIP Internet (TCP/IP and UDP/IP)Transport Profile |
| SP-PMPP/RS-232 | NTCIP Point to Multi-Point Protocol using RS-232 Connections Subnetwork Profile |

### A.3 Profile 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 | |

#### A.3.2 Global Statement of Conformance

Are all mandatory application, transport, and subnetwork profile requirements met for:

| Ref | Question | Response |
|---|---|---|
| 1 | AP-STMF | |
| 2 | TP-TUI (UDP/IP Configuration) | |

| | | |
|---|---|---|
| 3 | SP-PMPP232 | |

### A.3.3 Basic Requirements

The following table lists the detailed requirements for a Class A implementation, and asks if the listed protocols have been implemented:

| Index | Protocol | Clause of Profile | Profile Status | Support |
|---|---|---|---|---|
| tftp | TFTP per AP-TFTP implemented? | 0 | o | Yes |
| snmp | SNMP per AP-STMF implemented? | 0 | m | Yes |
| smi | SMI per AP-STMF implemented? | 0 | m | Yes |
| mib-II | System and SNMP Group Objects per AP-STMF implemented? | 0 | m | Yes |
| stmp | STMP per AP-STMF implemented? | 0 | o | Yes No |
| nema-smi | NEMA-SMI per AP-STMF implemented? | 0 | o | Yes No |
| tmib | TMIB per AP-STMF implemented? | 0 | o | Yes No |
| rs232-mib | RS232 Group Objects per SP-PMPP232 implemented? | 0 | m | Yes |
| lapb-mib | LapB Group Objects per SP-PMPP232 implemented? | | m | Yes |
| udp | UDP per TP-TUI implemented? | 0 | m | Yes |
| ip | IP per TP-TUI implemented? | 0 | m | Yes |
| icmp | ICMP per TP-TUI implemented? | 0 | m | Yes |
| inhost | InHost per TP-TUI implemented | 0 | m | Yes |
| pmpp | PMPP per SP-PMPP232 implemented? | 0 | m | Yes |
| rs232 | RS-232 per SP-PMPP232 implemented? | 0 | m | Yes |

# Annex B
# Class B Profile Description

# (Informative)

## B.1 Introduction

The standard for the NTCIP Class B Profile has already been published. That standard, however, does not express requirements in terms of references to application, transport, and subnetwork profiles. This annex provides an **informative and preliminary** Class B Profile Requirements List for implementations of the Class B Profile to show possible relationships to the Class A and/or Class C Profiles. A user or potential user may wish to use the PRL as a basis for initially checking the possibility of interworking with another implementation.

<table>
<tr><th>ISO Layers</th><th>Base Standard</th><th colspan="2">Profile Taxonomy</th></tr>
<tr><td>APPLICATION LAYER</td><td rowspan="3">IAB STD 15 (SNMP)</td><td rowspan="3">AP-STMF<br>Application<br>Profile</td><td rowspan="7">CP – B<br>Class Profile</td></tr>
<tr><td>PRESENTATION LAYER</td></tr>
<tr><td>SESSION LAYER</td></tr>
<tr><td>TRANSPORT LAYER</td><td rowspan="2">Null</td><td rowspan="2">TP – SUB<br>Transport Profile</td></tr>
<tr><td>NETWORK LAYER</td></tr>
<tr><td>DATA LINK LAYER</td><td>ISO/IE 3309<br>ISO/IEC 4335<br>ISO/IEC 7809</td><td rowspan="2">SP-MPP/RS232<br>or<br>SP-PMPP/FSK<br>Subnetwork<br>Profile</td></tr>
<tr><td>PHYSICAL LAYER</td><td>EIA.TIA 232-E<br>Bell 202T</td></tr>
</table>

**Figure 3**
**Class B Class Profile Scenario**

The standards reference in this annex may not be available or developed by the time this standard is published.

### B.1.1 Notation

The following notations and symbols are used to indicate status and conditional status in the PRL.

#### B.1.1.1 Status Symbols

The following symbols are used to indicate base standard and profile status:

| | |
|---|---|
| m | mandatory |
| m.<n> | support of every item of the group labeled by the same numeral <n> required, but only one is active at time |
| o | optional |

| | |
|---|---|
| o.<n> | optional, but support of at least one of the group of options labeled by the same numeral <n> is required |
| c | conditional |
| - | non-applicable (i.e. logically impossible in the scope of the profile) |
| x | excluded or prohibited |
| I | out of scope of profile (left as an implementation choice) |
| d | deprecated (listed for compatibility with older systems) |

In addition, the symbol "•" is used to indicate an option whose status is not constrained by the profile (status in the base standard). The o.<n> notation is used to show a set of selectable options (i.e., one or more of the set must be implemented) with the same identifier <n>.

Two character combinations may be 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).

#### B.1.1.3 Support Column Symbols

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

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

#### B.1.1.5 Instructions for Completing the PRL

A Profile implementor shows the extent of compliance to a Profile by completing the PRL; that is, compliance to all mandatory requirements and the options that are not supported are shown. 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 must 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 B.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."

## B.2 Standards Referenced

This profile specifies that the provision for simple information management and connectionless ransport services over point-to-point circuits is a transporation roadside to management station environment. It uses the following standards:

| | |
|---|---|
| AP-STMF | NTCIP Simple Transportation Management Framework Applications Profile |
| TP – SUB | NTCIP Null Transport Profile |
| SP-PMPP/RS-232 | NTCIP Point to Multi-Point Using RS-232 Connections Subnetwork Profile |
| SP-PMPP/FSK | NTCIP Point to Multi-Point Using FSK Connections Subnetwork Profile |

## B.3 Profile Requirements List

### B.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 | |

### B.3.2 Global Statement of Conformance

Are all mandatory requirements met for:

| Ref | Question | Response |
|---|---|---|
| 1 | Class B Profile | |
| 2 | TP-SUB | |
| 3 | SP-PMPP232 | |
| | | |

### B.3.3 Basic Requirements

The following table lists the detailed requirements for a Class B implementation, and asks if the listed protocols have been implemented:

| Index | Protocol | Clause of Profile | Profile Status | Support |
|---|---|---|---|---|
| snmp | SNMP per AP-STMF implemented? | 0 | m | Yes |
| smi | SMI per AP-STMF implemented? | 0 | m | Yes |
| mib-II | MIB-II per AP-STMF implemented? | 0 | m | Yes |
| stmp | STMP per AP-STMF implemented? | 0 | o | Yes No |
| nema-smi | NEMA-SMI per AP-STMF implemented? | 0 | o | Yes No |
| tmib | TMIB per AP-STMF implemented? | 0 | o | Yes No |
| rs232-mib | RS232 MIB per AP-STMF implemented? | 0 | m | Yes |
| lapb-mib | LapB MIB per AP-STMF implemented? | 0 | m | Yes |
| null | NULL per TP-NULL implemented? | N/A | m | Yes |
| pmpp | PMPP per SP-PMPP232 implemented? | 0 | m | Yes |
| rs-232 | RS-232 per SP-PMPP232 implemented? | 0 | o.1 | Yes No |
| fsk | FSK per SP-PMPP/FSK implemented? | N/A | o.1 | Yes No |

# Annex C
# Class C Profile Requirements List

## (Normative)

### C.1 Introduction

This annex provides the Profile Requirements List (PRL) for implementations of the Class C Profile. An implementation shall satisfy the mandatory conformance requirements of the base standards referenced in this profile.

A user or potential user of the implementation, as a basis for initially checking the possibility of interworking with another implementation. Note that, while interworking can never be guaranteed, failure to internetwork can often be predicted from incompatible PICSs).

### C.1.1 Notation

The following notations and symbols are used to indicate status and conditional status in the PRL.

#### C.1.1.1 Status Symbols

The following symbols are used to indicate base standard and profile status:

| | |
|---|---|
| m | mandatory |
| m.<n> | support of every item of the group labeled by the same numeral <n> required, but only one is active at time |
| o | optional |
| o.<n> | optional, but support of at least one of the group of options labeled by the same numeral <n> is required |
| c | conditional |
| - | non-applicable (i.e. logically impossible in the scope of the profile) |
| x | excluded or prohibited |
| I | out of scope of profile (left as an implementation choice) |
| d | deprecated (listed for compatibility with older systems) |

In addition, the symbol "•" is used to indicate an option whose status is not constrained by the profile (status in the base standard). The o.<n> notation is used to show a set of selectable options (i.e., one or more of the set must be implemented) with the same identifier <n>.

Two character combinations may be 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).

#### C.1.1.3 Support Column Symbols

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

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

### C.1.1.5 Instructions for Completing the PRL

A Profile implementor shows the extent of compliance to a Profile by completing the PRL; that is, compliance to all mandatory requirements and the options that are not supported are shown. 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 must 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 C.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."

## C.2 Standards Referenced

This profile specifies that the provision for simple information management and connectionless transport services over point-to-point circuits is a transporation roadside to management station environment. It uses the following standards:

| | |
|---|---|
| AP-TFTP | NTCIP File Transfer Protocol Applications Profile |
| AP-STMF | NTCIP Simple Transportation Management Framework Applications Profile |
| TP-TUI | NTCIP Internet (TCP/IP and UDP/IP) Transport Profile |
| SP-PMPP/RS-232 | NTCIP Point to Multi-Point Protocol Using RS-232 Connections Subnetwork Profile |

## C.3 Profile Requirements List

### C.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 | |

### C.3.2 Global Statement of Conformance

Are all mandatory application, transport, and subnetwork requirements met for:

| Ref | Question | Response |
|---|---|---|
| 1 | AP-TFTF | |
| 2 | AP-STMF | |
| 3 | TP-TUI | |
| 4 | SP-PMPP232 | |

### C.3.3 Basic Requirements

The following table lists the basic requirements for a Class C Profile implementation, and asks if the listed protocols have been implemented:

| Index | Protocol | Clause of Profile | Profile Status | Support |
|---|---|---|---|---|
| ftp | FTP per AP-FTP implemented? | 0 | m | Yes |
| snmp | SNMP per AP-STMF implemented? | 0 | m | Yes |
| smi | SMI per AP-STMF implemented? | 0 | m | Yes |
| mib-II | MIB-II per AP-STMF implemented? | 0 | m | Yes |
| stmp | STMP per AP-STMF implemented? | 0 | o | Yes No |
| nema-smi | NEMA-SMI per AP-STMF implemented? | 0 | o | Yes No |
| tmib | TMIB per AP-STMF implemented? | 0 | o | Yes No |
| rs232-mib | RS232 MIB per AP-STMF implemented? | 0 | m | Yes |
| lapb-mib | LapB per AP-STMF implemented? | 0 | m | Yes |
| tcp | TCP per TP-TUI implemented? | 0 | m | Yes |
| udp | UDP per TP-TUI implemented? | 0 | m | Yes |
| ip | IP per TP-TUI implemented? | 0 | m | Yes |
| icmp | ICMP per TP-TUI implemented? | 0 | m | Yes |
| inhost | InHost per TP-TUIimplemented? | 0 | m | Yes |
| pmpp | PMPP SP-PMPP232 implemented? | 0 | m | Yes |
| rs232 | RS-232 per SP-PMPP232 implemented? | 0 | m | Yes |

❑

## Garbage Collecter

>>>>>>
**Simple Transportation Management Framework (STMF) Application Profile**

A device conforming to the Class A Profile shall meet the mandatory requirements as defined in AP-STMF. AP-STMF cites the requirements for:

1. Simple Network Management Protocol (SNMP)
2. Simple Transportation Management Protocol (STMP)
3. Structure of (Network) Management Information (SMI)
4. (Network) Management Information Base (MIB-II)
5. Structure of (Transportation) Management Information (NEMA-SMI)
6. Transportation Management Information Base (TMIB)
7. Point-to-MultiPoint Management Information Base (LAPB)
8. RS232 Management Information Base
9. Well Known Port Numbers

This standard specifies the provisions for the NTCIP Class A and Class C Profiles. The class profiles reference other profiles to define the complete functionality of a communications protocol stack. A communication protocol stack is based upon the ISO-OSI Reference Model and consists of seven layers. Each layer peforms some specific function or service. For the purposes of ease of understanding, simplification, and reuse, class profiles reference only application, transport, and subnetwork profile. It does not restate the details of the underlying protocols and standards applicable to each layer . An application profile addresses the services and protocols associated with the application, presetnation, and session layers. A transport profile addresses the services and protocols associated with the transport and network layers. A subnetwork profile addresses the services and protocols associated with the data link and physical layers.

Class profiles are defined to meet different levels or classes of service. To understand the differences between the class profiles, one does not need to know the specifics of the underlying protocols and standards. What one does have to understand is the different services they provide.

The Class A Profile references the requirements of:

a. STMF Application Profile
b. TFTP Applications Profile
c. UDP/IP configuration of the Internet Transport Profile
d. PMPP Using RS-232 Subnetwork Profile

The STMF Application Profile provides connectionless information management services. It is the tool for configuring and monitoring information associated with communications function. Communications related information includes such things as Physical Layer data rate, Data Link Layer CRC errors, Network layer routing parameters. Transport Layer port number assignments, and Application Layer failed logins. STMF information services are generic and may also be used by the end-application or non-communications functions in an implementation. For example, in the case of a traffic controller, they could be to configure phase timing or report events. In the case of a variable message sign, they could be used to set the text that is displayed. In a management subsystem computer, it could define the software provider information.

The TFTP Application Profile provides connectionless file or large block transfer services. The elements in the profile do not use TFTP. Is it a service provided to the end-application. There are no requirements to perform transfers. If transfer function is needed, however, TFTP is the common method to be used.

The UDP/IP configuration of the Internet Transport Profile provides connectionless transport services. UDP provides a best effort delivery end-to-end message service. IP provides addressing, routing, and hop-to-hop services. Through a well known port number interface, STMP and TFTP use UDP to exchange information with other implementations. For example, a Transyt Management Subsystem may need to analyse why e-mail messages are not getting through. In this case, a network administrator could use UDP to send SNMP messages to check whether routing table information is set correctly . In a Freeway Management Subsystem, UDP could be used by TFTP to upload traffic count records from a count station log file. Since UDP only deals with end-to-end message delivery services, it calls upon IP to provide the services necessary to thread a message through the network.

In the UDP/IP configuration, IP is used by UDP to route messages to their intended recipients. A recipent may not be directly connected to the sender. What IP does is send the messare to someone who is closer to the intended recipitent and asks him to forward it on. IP operates like a fire bucket brigade. A bucket of water (a message) is passed hand-to-hand (subnetwork-to-subnetwork) until it is delivered to the fire (intended recipeint).

The PMPP using RS-232 Subnetwork Profile provides a connectionless subnetwork message delivery mechanism. It provides an error-free message delivery service but only to implimentations that are directly connected to the physical interface. Whereas UDP is end-to-end, PMPP is point-to-point. IP uses PMPP services to get a message to the next reachable IP layer. PMPP uses the RS-232 Physical Layer interface to convert the computer bits and bytes to electrical signals appropirate to a serial cable connection between devices. Even though an RS-232 Interface is point-to-point and limited as to distance, it is assumed that some type of external device will provide the point-to-multipoint conversion and meet any specific distance requirements.

The Class C Profile references the requirements of the
a. STMF Application Profile
b. FTP Applications Profile
c. TCP/IP and UDP/IP configuration of the Internet Transport Profile
d. PMPP Using RS-232 Subnetwork Profile

The STMF Application Profile, in the context of the Class C Profile, provides the exactly the same information management services as descibed in Class A Profile description. It is common to both classes because both have information related to the communications function. In the Class C Profile is used to manage the TCP configuration and check operational status.

The FTP Application Profile provides connection-oriented file or large block transfer services. The elements and protocols in the Class C Profile do not use FTP. It is a service provided to the standardize potential end-application functionality There are no requirements to perform transfers. If a connection-oriented transfer function is needed, however, FTP is the common method to be used.

The TCP/IP configuration of the Internet Transport Profile provides connection-oriented transport services. The UDP/IP configuration provides connectionless transport services. Because SNMP is the tool for managing communications related information and it uses UDP/IP as the its transport mechanism, UDP appears in both the Class A and Class C Profiles. TCP is added to provide guarenteed delivery services. This delivery service is analogous to certified mail. In regular mail, you do not know if a letter reached a destination unless an answer is sent back. In certified mail, the service notifies you that a letter was delivered. The recipient may never sent an answer back, but you know the recipient received it. Since FTP relies on TCP for delivery, TCP is required. Its use is not limited to FTP, however. It is a service that other application protocols or profiles may use. For example, two ITS subsystems may implement e-mail. Most e-mail uses TCP/IP as the transport service. At the Network Layer, IP is used by TCP and UDP for routing messages across a network of interconnected subnetworks.

The PMPP using RS-232 Subnetwork Profile provides the same connectionless subnetwork message delivery mechanism as descibed in Class A. By definition, a class profile must include a

reference to specific subnetwork profile. For the Class C Profile, the PMPP using RS-232 Subnetwork Profile is cited.