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National Transportation Communications for ITS Protocol

Profile Framework

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FOREWORD

This document uses only metric units.

This document is an NTCIP Process, Control, and Information Management Policy document. Process, Control, and Information Management Policy documents define the practices and policies used by the Joint Committee on the NTCIP in developing and maintaining NTCIP standards and documents. PCIMP documents are approved for publication by AASHTO, ITE, and NEMA after recommendation by the Joint Committee on the NTCIP.

The text includes mandatory requirements in Annex A that are defined as normative.

For more information about NTCIP standards, visit the NTCIP Web Site at http://www.ntcip.org. For a hardcopy summary of NTCIP information, contact the NTCIP Coordinator at the address below.

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History

From 1997 to 1999, this document was referenced as TS 3.PRO. However, to provide an organized numbering scheme for the NTCIP documents, this document is now referenced as NTCIP 8003. The technical specifications of NTCIP 8003 are identical to the former reference, except as noted in the development history below:

TS 3.PRO v97.01.08. December 1997 – Accepted as a User Comment Draft by the Joint Committee on the NTCIP.

NTCIP 8003 v01.07. July 1999 – Version 01.05 accepted as a Recommended Standard by the Joint Committee on the NTCIP. In January 2000, the NTCIP Standards Bulletin B0047 reported that typographic corrections were included in v01.06. Approved by AASHTO in May 2000. Version 01.07 approved by ITE and NEMA in May 2001 after disposition of a Letter Ballot comment.

NTCIP 8003 v01.08. December 2001 – Reformatted for printing: incremented version number and updated date; modified and reorganized front matter to conform to NTCIP 8002; updated headers, footers, and page numbers.

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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.

The Profiles Working Group is concerned with the methodology of defining profiles and their documentation in Standards Publications. The purpose of this standard is to provide the principles and a classification scheme for the development of NTCIP profiles. This standard also defines aspects of the formatting and technical content of profiles that conform to this standard. The objective is to facilitate the specification of ITS characterized by a high degree of interoperability and interchangeability of its components.

In 1992, the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section began the effort to develop the NTCIP. Under the guidance of the Federal Highway Administration's 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 ITS network.

In September 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 a method for organizing class profiles. The Profiles WG first met in September 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 Profile Framework.* Following that approach, a protocol stack is specified by application, transport, and 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.

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Section 1
GENERAL

1.1 SCOPE

This standard is applicable to traffic control and transportation related devices which must operate in an Integrated Transportation System. This standard develops the terminology, content, structure, and organization of standardized profiles.

1.2 REFERENCES

For approved amendments, contact:

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For draft amendments 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 documents and standards may provide a more complete understanding of the structure and use of profiles.

Guide to Open System Specifications - The Taxonomy of Profiles, European Workshop for Open Systems, http://www.ewos.be/common/taxonmy.htm, February 16, 1999

Guide to Open Systems Specification - Conformance, Interoperability and Testing, European Workshop for Open Systems, http://www.ewos.be/ct/eguide.htm, February 16, 1999

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

American National Standards Institute (ANSI)
11 West 42nd Street, 13th Floor
New York, NY 10036

ISO/IEC TR 10000-1:1995 *Information Technology—Framework and Taxonomy of International Standardized Profiles -- Part 1: General Principles and Documentation Framework*

ISO/IEC TR 10000-2:1995 *Information Technology—Framework and Taxonomy of International Standardized Profiles -- Part 2: Principles and Taxonomy for OSI profiles*

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NEMA NS 1-1995 *Guide for Preparation of NEMA Standards Publications*

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 standards listed above.

1.3 DEFINITIONS

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

Application Layer: That portion of the OSI Reference Model (Layer 7) that provides access to the communications services.

data: Information before it is interpreted.

Data Link Layer: That portion of the OSI 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.

end-application: A process or program using the communications stack.

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

host: (Internet usage) The physical and/or logical part of the end-system's application. A computer attached to one or more networks that supports users and runs application programs.

Intelligent Transportation Systems: A major national initiative to apply 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.

internetwork: The ability of devices to communicate across multiple networks.

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

Network Layer: That portion of an OSI 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.

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: A widely accepted structuring technique that provides an abstract representation of the communication process that is divided into seven basic, functional layers.

Physical Layer: That portion of an OSI Reference Model (Layer 1) responsible for the electrical and mechanical interface between communicating systems.

Presentation Layer: That portion of an OSI Reference Model (Layer 6) responsible for converting and organizing data from one format to another.

proforma: A guide provided in advance to prescribe form or describe items.

Session Layer: That portion of an OSI Reference Model (Layer 5) which manages a series of data exchanges between end-system applications.

subnetwork: A physical network within a network. All devices 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 the OSI Reference Model that organizes the communications process into 4 layers. It consists of host-to-network, internet, transport, and application layers.

Transport Layer: That portion of an OSI Reference Model (Layer 4) which attempts to guarantee reliable data transfer between two end-systems, using flow control and error recovery, and may provide multiplexing.

transportation management: Short for the management of networks of transportation devices such as roadside devices as well as vehicles and the communications network itself.

1.4 ABBREVIATIONS AND ACRONYMS

The acronyms 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
ASN Abstract Syntax Notation
CORBA Common Object Request Broker Architecture
CP Class Profile
CSMA/CD Carrier Sense Multiple Access with Collision Detection
DARPA Defense Advanced Research Projects Agency
DATEX Data Exchange

DISA	Defense Information Systems Agency
DP	Device Profile
EIA	Electronic Industries Association
FDDI	Fiber Data Distributed Interchange
FSK	Frequency Shift Keying
FTP	File Transfer Protocol
IAB	Internet Advisory Board
IEC	International Electro-technical Commission
IEEE	Institute of Electrical and Electronic Engineers
InP	Information Profile
IP	Internet Protocol
ISO	International Organization for Standardization
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
LAN	Local Area Network
NEMA	National Electrical Manufacturers Association
NIST	National Institute of Standards and Technology
NTCIP	National Transportation Communications for ITS Protocol
OSI	Open Systems Interconnection
PICS	Protocol Implementation Conformance Statement
PMPP	Point to Multi-Point Protocol
PPP	Point-to-Point Protocol
PRL	Profile Requirements List
RFC	(Internet) Request for Comments
SNMP	Simple Network Management Protocol
SP	Subnetwork Profile
STD	(Internet) Standard
STMF	Simple Transportation Management Framework
TCIP	Transit Communications Interface Profiles
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TP	Transport Profile
TR	Technical Report
UDP	User Datagram Protocol

Section 2
PRINCIPLES AND FRAMEWORK OF NTCIP PROFILES

2.1 PROFILES

A Profile is a standard that combines one or more base standards and selects appropriate options or functions within them. It does this by referencing the base standard or standards instead of 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, and not the technical details. This abstraction allows a more general functional view.

The definition of a profile is used to:

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

2.1.1 Relationship to Base Standards

Profiles promote interoperability and interchangeability by defining how base standards are combined to meet specific functionalities and/or environment. Where there are options or range specifications in a base standard, they can be further limited or refined to meet the intended application. With very few exceptions based on specific needs, profiles shall not override base standards. Profiles make choices where options and ranges of values exist. Limitations and refinements should be made to achieve a high degree of success in meeting the objectives of the profile.

2.1.2 Principles of Profile Content

A profile shall consist of the following elements:

- A concise definition of the scope of the functionality that the profile is intended to meet
- The scenario and conditions under which the profile is applicable
- Normative references to the base standards or profiles that are used
- Specifications for application of each normative reference that enumerates the options, subsets, ranges of values, etc.
- A statement defining the requirements to be observed by systems claiming conformance to the profile.

A profile may include:

- Informative references to any other relevant source documents

2.1.3 The Meaning of Conformance to a Profile

The purpose of a profile is to specify the use of standards or sets of standards to provide clearly defined functionality. This implies conformance to the referenced standards. There can also be conformance requirements imposed when base standards are combined. Conformance requirements may be:

- mandatory

- optional

Conformance requirements may also be specified as:
- unconditional
- conditional

Conformance requirements may also be stated as:
- positively - they state what is required to be done
- negatively - they state what is required not to be done

2.1.4 Conformance Requirements of Profiles

The conformance requirements of a profile shall be related to conformance requirements defined in a base standard as follows:
- Mandatory requirements shall remain mandatory.
- Unconditioned options in a base standard may retain that status or be modified to:
  - mandatory
  - conditional
  - not applicable
  - prohibited
- If the conditions of a conditional option are fully elaborated, the status may be retained or modified to:
  - unconditional mandatory requirements
  - unconditional options
  - not applicable
  - prohibited

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.

2.2 PRINCIPLES DEFINING FORMAT AND CONTENT

This standard follows ISO/IEC TR 10000-1 in stating that the requirements for content and format of Standardized Profiles are based upon the following principles:
- Profiles shall be directly related to base standards. Conformance to a profile shall imply conformance to reference base standards.
- Standardized Profiles are intended to be concise documents and shall not repeat the text of the referenced documents. The reliance on reference to base standards and the use of registered names are thus essential for the production of concise Standardized Profiles
- Profiles making identical use of particular base standards shall be consistent.
- The definition of one profile may include a reference to the definition of another profile in part or in total.

2.3 ISO/IEC PROFILE STANDARDS

The ISO/IEC has published a number of standards related to profiles. In order to decouple the representation of objects from the communications protocol, and application-related protocols from subnetwork types, the OSI defines the following four classes of profiles:

Interchange Format and Representation Profiles
Application Profiles
Transport Profiles
Relay Profiles

Interchange Format and Representation Profiles deal with the structure and/or content of information being exchanged by Application profiles. The information would relate to a specific end-application such as medical imaging or data dictionaries. For example, the OSI Computer Graphic Metafile Interchange Format profiles deal with the interchange of picture information. The OSI Directory Data Definition Format profiles deal with the properties of Object Classes, Attribute Types, and Attribute Syntaxes.

Application profiles deal with the transfer function that the Interchange profiles would use to convey the information. They define the use of protocol standards for the OSI application, presentation, and session layers. OSI Application profiles have been created for File Transfer, Access, and Management and Message Handling (e-mail).

Transport Profiles deal with the procedure and methods for exchanging data packets between end systems and passing them through intermediate systems. They define the use of protocol standards for the OSI transport, network, data link, and physical layers. The Transport Profiles are subdivided into multiple parts. The first part deals with subnetwork-independent requirements, which are essentially just the transport and network layers. The subsequent parts deal with specific subnetwork-dependent requirements which primary relate to the data link and physical layers. OSI Transport profiles have been defined for combinations of connection oriented and connectionless transport and network services over many different subnetworks.

Relay Profiles specify relaying functionality to enable systems using different transport profiles to internetwork. A relay function may operate at any of the four lower layers. Relay profiles address the functional requirements associated with routing and/or fragmentation and reassembly. Whereas a transport profile would address the requirements for a host to support network communication, a relay profile would address the requirements to route information through the lower communications layers at that host.

2.4 NTCIP STANDARDIZED PROFILES

Based upon the ISO/IEC profile model, standardized profiles in NTCIP shall fall into one of the following categories:

Device Profile	DP
Information Profile	InP
Application Profile	AP
Transport Profile	TP
Subnetwork Profile	SP
Communications Class Profile	CP

The following figure shows the relationship between the OSI Reference Model layers, the end application, and the various profiles.

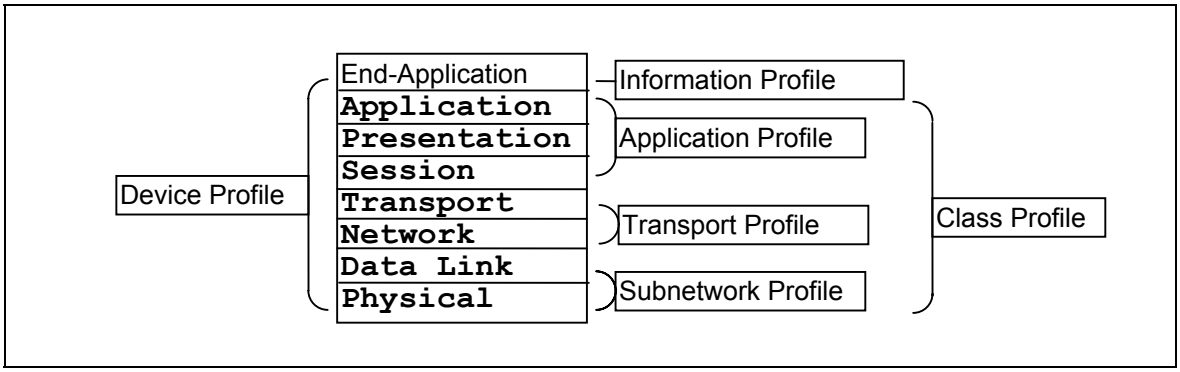

Figure 2-1
Profile Relationships

A Device Profile (DP) references the informational and communications standards that are applicable to a specific type of device such as a traffic controller or dynamic message sign. A DP would cite one or more Information Profiles to define the information content of the device, one or more Application Profiles to define the application layer services to exchange the information between end systems, one or more Transport Profiles to convey the information through the network, and one or more Subnetwork Profiles to specify the requirements of the subnetwork or media layers.

An Information Profile (InP) is analogous to an ISO/IEC Interchange Format and Representation Profile. It shall reference standards and/or profiles that are applicable to the structure, content, and meaning of the information related to a specific end application such as traffic controller or dynamic message signs. InPs, in general, reference one or more object definition, data dictionary, and/or message set standards. The references organize the objects (programming entries, status indications, and control variables) into conformance groups and these groups serve as the basic unit of conformance to the standard or a profile. InPs either explicitly or implicitly define the services of an AP to format this information into suitable messages for exchange between two devices.

An Application Profile (AP) shall reference a set of standards and/or profiles that are applicable to the application, presentation, and session layers of the communication stack. It is equivalent to the ISO/IEC Application Profile. An AP defines Information Management Services. These services include the means of representing, formatting, and authenticating information that is to be exchanged between end systems. Whereas an InP deals with the definition and identity of the information that is available, an AP deals with how the information is organized into messages and then conveyed to and from the intended recipient. Information exchanges will also take place between APs that are concerned with Network Management Services. In ITS systems, the "transportation network" may consist of devices that traditionally have been the responsibility of a "network administrator." These non-traditional devices contain layer management information that requires support. An AP may also define Security Services. In the OSI model, the emphasis on security takes place primarily at layer 7. However, the model has been updated to show the architecture for Upper and Lower Layer security.

A Transport Profile (TP) shall define the appropriate combinations of connection-oriented and connectionless transport and network protocols. It is analogous to Part One of an OSI Transport Profile. Transport services provide a mechanism for the exchanges of data between end or host systems. Connection-oriented transport services provide a reliable delivery service for APs. This type of service is referred to as reliable because each message or segment of a message is explicitly acknowledged. Connectionless transport services provide a similar mechanism for the exchanges of data but they are considered unreliable because each message or segment is not explicitly acknowledged. Whereas transport services deal with end-to-end delivery, network services deal with the translation of the end-to-end delivery service to the point-to-point delivery service of the lower layers. Both connection-oriented and connectionless network protocols exist.

A Subnetwork Profile (SP) shall reference protocols and /or other profiles related to data link and physical layers. It is comparable to one of the secondary parts of an OSI Transport Profile. SPs are defined to reduce the complexity of procuring interoperable systems. The functions of a data link layer include providing the network layer with a well-defined service interface, determining how the bits of the physical layer are grouped into frames, checking for transmission errors, and regulating the flow of frames. The services provided by the data link layer will generally be classified as either unacknowledged connectionless, acknowledged connectionless, or acknowledged connection-oriented service.

In an SP, the function of a physical layer is to transport a raw bit stream over the transmission media. Given the technology choices available in today's computer industry, there will be numerous SPs.

Twisted pair, baseband and broadband coaxial cable, optical fiber, and numerous wireless transmission media are all in popular use. There are usually several data link protocols appropriate to each media. The numerous LAN Protocols for an ISO/IEC 8802 (IEEE 802) interface are good examples. The reverse is also true. For example, one SP could reference the use of PMPP over an RS-232 interface while another could reference PMPP over an FSK modem interface.

For historical reasons, the concept of a Communications Class Profile (CP) is retained but its use is discouraged. Because the original class profiles referenced all seven layers of the OSI Reference Model, a change at any layer required a change in the communications class designation. From a standards point of view, if one wanted to substitute an Ethernet interface in place of the EIA-232 (RS-232) interface, then a new designation would have to be created.

A CP shall encompass the application, presentation, session, transport, network, data link, and physical layers. A CP references a set of communications standards or profiles that provide specific types of information management services and the communication services needed by them. A CP shall also call for a specific subnetwork (or subnetworks). However, it does not cover the standards and/or profiles that are applicable to the structure, content, and meaning of the information related to a specific end-application.

NTCIP does not have an equivalent classification of ISO/IEC Relay Profiles.

2.5 NTCIP PROFILE CLASSIFICATION

The inclusion of a specific profile designation in the following classification is mainly for the purpose of assigning a unique and meaningful identifier. A reference to a specific profile identifier does not imply that the profile is under development or will be developed in the future. The list shall not be viewed as all inclusive.

2.5.1 NTCIP Device Profiles

The classification and definition of device profiles is beyond the scope of the NTCIP at this time. The DP designation, however, serves as a placeholder for future development.

2.5.2 NTCIP Information Profiles

An InP covers the object definitions that are standardized and specific to a particular device or function. An InP may require the use of specific application and transport profiles. The following list defines potential profiles.

InP - ASC	Actuated Traffic Signal Controller
InP - HAR	Highway Advisory Radio
InP - DMS	Dynamic Message Sign
InP - ESS	Environmental Sensor Systems
InP - RMC	Ramp Meter Controller Unit
InP - C2C	Center-to-Center
InP - TCIP	Transit Communication Interface Profiles
InP - DCM	Data Collection and Monitoring Devices

2.5.3 NTCIP Applications Profiles

An AP references the base standards and/or other profiles that are applicable to the upper three OSI layers. The following list defines potential profiles.

AP - STMF	Simple Transportation Management Framework
AP - TFTP	Trivial File Transfer Protocol

AP - FTP	File Transfer Protocol
AP - RMON	Remote Network Monitoring
AP - DATEX	Center-to-Center DATEX.ASN Profile
AP - CORBA	Center-to-Center CORBA Profile

2.5.4 NTCIP Transport Profiles

NTCIP is based upon the use of the TCP/IP Protocol Suite at the transport and network layers. As such, there are only three basic variations. However, each profile deals with functionality that determines how it is managed and how it operates in a network environment. The following naming convention may apply.

TP - Internet	Connectionless Transport (UDP) and Connection-oriented Transport (TCP) Services over Connectionless Network (IP) Service based
TP - Null	Subnetwork-Only Service

2.5.5 NTCIP Subnetwork Profiles

The following list of subnetwork profiles serves to identify some of the potential data link and physical layer protocols and interfaces that would be defined in a subnetwork profile.

SP - PMPP232	Point-to-MultiPoint Protocol over RS-232 Service
SP - PMPPFSK	Point-to-MultiPoint Protocol over FSK Service
SP - PPP	Point-to-Point Protocol
SP - Ethernet	Ethernet (IEEE 802.3)
SP - FDDI	Fiberoptic

2.5.6 NTCIP (Communications) Class Profiles

For historical reasons, the following CP classification scheme helps to identify and cross reference class profiles that have been discussed in previous documents and standards.

CP - A	Class A (AP-STMF, TP-Internet (UDP/IP only), and SP-PMPP/RS-232)
CP - B	Class B (AP-STMF, TP-Null, and SP-PMPP/RS-232 or FSK)
CP - C	Class C (AP-STMF, AP-FTP, TP-Internet, and SP-PMPP/RS-232)

Annex A
RULES FOR DRAFTING AND PRESENTATION OF STANDARDIZED PROFILES

(Normative)

A.1 INTRODUCTION

This annex is concerned with the content and layout of NTCIP Standardized Profiles. The contents of this annex shall be binding on all submissions of profiles. The NEMA Guide for Preparation of NEMA Standards Publications (NS 1) may be used to help define the format and style of Standardized Profile Publications.

A.2 STRUCTURE OF STANDARDIZED PROFILES

The Standardized Profile document structure is outlined in the following table. Each profile should include a Profile Test Specification. It can either be included as part of the profile itself or be a free-standing profile with an explicit reference to the profile definition.

Foreword
Introduction
1. Scope
2. Normative References
3. Definitions
4. Abbreviations
5. Conformance
6. Clauses defining requirements related to each base standard

Normative Annexes
Informative Annexes

In addition to specification material, a Standardized Profile may include an Informative Annex containing the rationale for the technical choices. The use of an annex for this facilitates the use, reuse, and maintenance of the Standardized Profile and the profile it specifies.

A.3 PRELIMINARY ELEMENTS

A.3.1 Title Page

The title page shall be in the standard format as defined by the Joint AASHTO/ITE/NEMA Committee on the NTCIP. The title page of this standard shall serve as a template.

A.3.1.1 PRL or PICS Copyright Notice

Every profile shall include a Profile Requirements List (PRL). The PRL is meant to be copied by an implementer to create a Profile Implementation Conformance Statement (PICS) and develop conformance test specifications. As such, the following text shall appear in the document:

NTCIP Profile Requirements List
REPRODUCTION NOTICE

AASHTO / ITE / NEMA extend permission to the purchaser of this standards publication to make and/or distribute unlimited copies (including derivative works which will then be known as PICS) of the excerpt identified as the Profile Requirements List, including copies for commercial distribution, provided that

each copy made or distributed contains the notice “Based on an NTCIP Profile Requirements List. Used by permission of AASHTO / ITE / NEMA.”

In the document footer:

“Do Not Copy Without Written Permission”

shall be replaced with

“Copy Per PRL Reproduction Notice.”

A.3.2 Table of Contents

A table of contents shall be included and should list all clauses and annexes. The full title of a clause or annex shall be used.

A.3.3 Foreword

All profiles shall contain a foreword. It shall consist of information related to the responsible organization, to NTCIP Standards in general, and the following as appropriate:

- an indication of the organization or committee that prepared the profile
- information regarding the approval of the profile
- a statement about which annexes are normative and which ones are informative.
- a statement about what the profile may cancel or replace
- a revision history statement about significant changes to the document

A.3.4 Introduction

An introduction clause shall be included after the Foreword. The introduction shall provide an "executive summary" of the profile.

A.4 GENERAL NORMATIVE ELEMENTS

A.4.1 Scope

All profile standards shall include a statement of the user requirements that the profile is intended to meet and, where appropriate, the "scenario" for the profile.

A.4.2 References

The list of normative references shall not include documents that have merely served as reference in preparation of the Profile, i.e. this standard.

It is expected that some normative references will be "de facto" and do not necessarily conform to the formal wording of a "standard." The classification of the requirements and options of an Internet RFC shall be mapped into the profile as follows:

RFC	Profile
MUST	Mandatory[1]
SHOULD	Mandatory[1]
MAY	Optional
SHOULD NOT	Prohibited
MUST NOT	Prohibited

A.5 TECHNICAL NORMATIVE ELEMENTS

A.5.1 Definitions

If terms in the profile require definition, the definitions shall be included after the references clause.

A.5.2 Abbreviations (and Acronyms)

Any abbreviation or acronym used or coined in the text shall be included in the abbreviations (and acronyms) list.

A.5.3 Requirements

This section shall start with a clause entitled "Conformance," which shall state the requirements specified in the Standardized Profile. It shall indicate in general terms, the conformance that an implementation shall make. The information shall not repeat the text of the base standards or profiles but shall define the choices made in the profile for classes, options, and ranges of parameter values. It shall be expressed in the form of conformance requirements.

A.5.4 Interoperability Subclause

It is intended that multiple profiles be able to reside in the same physical unit. Multiple profiles may exist at the same layer or many layers. A subclause shall clearly state the expected interoperability characteristics of the profile.

A.5.5 Normative Annexes

Normative annexes are integral parts of a profile. The fact that an annex is normative shall be noted in the foreword and in any reference to it in the text. The annex shall also carry the notation "Normative" in parentheses directly after the title.

Every Standardized Profile shall contain at least one normative annex. This first normative annex shall be the Profile Requirements List (PRL). This shall provide identification, conformance, and requirements information in tabular form. The preferred form of the PRL is:

A.5.5.1 Implementation Identification

An implementation identification clause shall provide a form for providing background information about a potential supplier and the components that are intended to conform to this profile. The preferred form for the Implementation Identification is:

[1] In the course of adapting communications 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.

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.5.5.2 Global Statement of Conformance

A global statement of conformance clause shall enumerate all applicable base standards and profiles and ask if an implementation meets are all mandatory requirements for each of them. The preferred form for the Global Statement of Conformance follows.

Are all mandatory requirements met for:

Ref	Standard	Response
1	[standard cited]	

A.5.5.3 Basic Requirements

A basic requirements clause shall provide a list of all the major capabilities and options in the profile or base standards. An implementer or potential supplier would indicate support for each item by circling or checking the appropriate response. The preferred form for the Basic Requirements is:

Index	Protocol	Clause of Profile	Profile Status	Support
[abc]	[standard name and clause] implemented?	[cross reference]	[status]	Yes / No

A.5.5.4 PICS Proforma

Application, transport, and subnetwork profiles should contain one or more Protocol Implementation Conformance Specifications (PICS) Proforma. The purpose of the PICS Proforma is to provide a detailed list of all mandatory, optional, and conditional functions, elements of procedure, parameters, PDUs, multi-specification dependencies and other capabilities identified in the base specification. An implementer or potential supplier would indicate support for each item by circling or checking the appropriate response in the support column. The preferred form of a PICS Proforma for function requirements is:

Index	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
[label or predicate]	[feature description]	[cross reference to base standard]	[status symbol for standard]	[cross reference in profile]	[status symbol for profile]	[Yes or Yes No or N/A]

In some cases, a PICS Proforma may need to reference information (object definitions) that is related to managing and monitoring specific protocols. References to object definitions should use the following format.

Item	Object Definition			Base Standard		Profile		Support
	Object	Syntax	Access	Reference	Status	Clause	Status	
[label or predicate]	[name of object]	[object syntax]	[allowed access]	[cross reference to base standard]	[status symbol for std]	[cross reference in profile]	[status symbol for profile]	[Yes or Yes No or N/A]

A.5.6 Notation

The following notations and symbols shall be used, as appropriate, to indicate status and conditional status in the PRL(s). If the profile includes a PICS Proforma, the support column symbols shall be used. Additional keys may be added to enhance understanding and clarity. A key list shall appear in each profile.

A.5.6.1 Status Symbols

The following symbols shall be 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> is required, but only one is active at a 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
n/a	non-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 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.5.6.2 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.5.6.3 Support Column Symbols

If a profile provides the requirements list in the form of a PICS Proforma, the support of every item as claimed by the implementer is stated 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.6 SUPPLEMENTAL ELEMENTS

A.6.1 Informative Annexes

Informative annexes that provide additional information but are not part of the profile shall be designated as informative. This shall be stated in the foreword and by a statement at the head of the annex text. The word "Informative" shall be placed in parentheses directly after the title of the annex.

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