

NTCIP 2301 v02

National Transportation Communications for ITS Protocol

Simple Transportation Management Framework (STMF) Application Profile (AP) (AP-STMF)

A Joint Standard of AASHTO, ITE, and NEMA



NTCIP Standards Publication

A Joint Publication of
American Association of State Highway and Transportation Officials (AASHTO)
Institute of Transportation Engineers (ITE)
National Electrical Manufacturers Association (NEMA)

A Joint Standard of AASHTO, ITE, and NEMA

NTCIP 2301 version v02

National Transportation Communications for ITS Protocol Simple Transportation Management Framework (STMF) Application Profile (AP) (AP-STMF)

published in July 2010

Published by

American Association of State Highway and Transportation Officials (AASHTO)

444 North Capitol Street, N.W., Suite 249
Washington, D.C. 20001

Institute of Transportation Engineers (ITE)

1099 14th Street, N.W., Suite 300 West
Washington, D.C. 20005-3438

National Electrical Manufacturers Association (NEMA)

1300 North 17th Street, Suite 1752
Rosslyn, Virginia 22209-3801

NOTICES

Copyright Notice

© 2010 by the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association (NEMA). All intellectual property rights, including, but not limited to, the rights of reproduction, translation, and display are reserved under the laws of the United States of America, the Universal Copyright Convention, the Berne Convention, and the International and Pan American Copyright Conventions. Except as licensed or permitted, you may not copy these materials without prior written permission from AASHTO, ITE, or NEMA. Use of these materials does not give you any rights of ownership or claim of copyright in or to these materials.

Visit www.ntcip.org for other copyright information, for instructions to request reprints of excerpts, and to request reproduction that is not granted below.

PDF File License Agreement

To the extent that these materials are distributed by AASHTO / ITE / NEMA in the form of an Adobe® Portable Document Format (PDF) electronic data file (the “PDF file”), AASHTO / ITE / NEMA authorizes each registered PDF file user to view, download, copy, or print the PDF file available from the authorized Web site, subject to the terms and conditions of this license agreement:

- a) you may download one copy of each PDF file for personal, noncommercial, and intraorganizational use only;
- b) ownership of the PDF file is not transferred to you; you are licensed to use the PDF file;
- c) you may make one more electronic copy of the PDF file, such as to a second hard drive or burn to a CD;
- d) you agree not to copy, distribute, or transfer the PDF file from that media to any other electronic media or device;
- e) you may print one paper copy of the PDF file;
- f) you may make one paper reproduction of the printed copy;
- g) any permitted copies of the PDF file must retain the copyright notice, and any other proprietary notices contained in the file;
- h) the PDF file license does not include: 1) resale of the PDF file or copies, 2) republishing the content in compendiums or anthologies, 3) publishing excerpts in commercial publications or works for hire, 4) editing or modification of the PDF file except those portions as permitted, 5) posting on network servers or distribution by electronic mail or from electronic storage devices, and 6) translation to other languages or conversion to other electronic formats;
- i) other use of the PDF file and printed copy requires express, prior written consent.

PRL and RTM Distribution Permission

To the extent that these materials are distributed by AASHTO / ITE / NEMA in the form of a Profile Requirements List (“PRL”) or a Requirements Traceability Matrix (“RTM”), AASHTO / ITE / NEMA extend the following permission:

- a) you may make or distribute unlimited copies, including derivative works of the PRL (then known as a Profile Implementation Conformance Statement (“PICS”)) or the RTM, provided that each copy you make or distribute contains the citation “Based on NTCIP 0000 [insert the standard number] PRL or RTM. Used by permission. Original text © AASHTO / ITE / NEMA.”;
- b) you may only modify the PRL or the RTM by adding: 1) text in the Project Requirements column, which is the only column that may be modified to show a product’s implementation or the project-

- specific requirements; and/or 2) additional table columns or table rows that are clearly labeled as ADDITIONAL for project-unique or vendor-unique features; and
- c) if the PRL or RTM excerpt is made from an unapproved draft, add to the citation “PRL (or RTM) excerpted from a draft standard containing preliminary information that is subject to change.”

This limited permission does not include reuse in works offered by other standards developing organizations or publishers, and does not include reuse in works-for-hire, compendiums, or electronic storage devices that are not associated with procurement documents, or commercial hardware, or commercial software products intended for field installation.

A PICS is a Profile Requirements List that is completed to indicate the features that are supported in an implementation. Visit www.ntcip.org for information on electronic copies of the MIBs, PRLs, and RTMs.

Content and Liability Disclaimer

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

AASHTO, ITE, and NEMA standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and seeks out the views of persons who have an interest in the topic covered by this publication. While AASHTO, ITE, and NEMA administer the process and establish rules to promote fairness in the development of consensus, they do not write the document and they do not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in their standards and guideline publications.

AASHTO, ITE, and NEMA disclaim liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. AASHTO, ITE, and NEMA disclaim and make no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. AASHTO, ITE, and NEMA do not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, AASHTO, ITE, and NEMA are not undertaking to render professional or other services for or on behalf of any person or entity, nor are AASHTO, ITE, and NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

AASHTO, ITE, and NEMA have no power, nor do they undertake to police or enforce compliance with the contents of this document. AASHTO, ITE, and NEMA do not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety-related information in this document shall not be attributable to AASHTO, ITE, or NEMA and is solely the responsibility of the certifier or maker of the statement.

Trademark Notice

NTCIP is a trademark of AASHTO / ITE / NEMA. All other marks mentioned in this standard are the trademarks of their respective owners.

ACKNOWLEDGEMENTS

NTCIP 2301 v02 was prepared by the NTCIP Base Standards and Profiles 2 Working Group (BSP2WG), which is a subdivision of the Joint Committee on the NTCIP. The Joint Committee is organized under a Memorandum of Understanding among the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association (NEMA). The Joint Committee on the NTCIP consists of six representatives from each of the standards organizations, and provides guidance for NTCIP development.

When NTCIP 2301 v02 was prepared, the following individuals were members of the NTCIP BSP2WG:

- Ralph Boaz
- Bob De Roche (Chairperson)
- Bud Kent
- Robert Lopes
- Greg Mizell
- Alex Mousadi
- Peter Ragsdale
- Robert Rausch
- Joerg “Nu” Rosenbohm

Other individuals providing input to NTCIP 2301 v02 include:

- Blake Christie
- Manny Insignares
- Jean Johnson
- Jim Mahugh
- Vicki Schofield
- Ken Vaughn

In addition to the many volunteer efforts, recognition is also given to those organizations who supported the efforts of NTCIP BSP2WG by providing comments and funding, including:

- U.S. Department of Transportation,
Research and Innovative Technology
Administration, ITS Joint Program Office
- ConSysTec
- Econolite Control Products, Inc.
- Florida DOT
- National Electrical Manufacturers
Association
- Noblis, Inc.
- Pillar Consulting, Inc
- Quixote Traffic Corporation
- Robert De Roche Consulting
- Siemens ITS
- Telvent Farradyne Inc.
- Transcore, Inc.
- Trevilon Corp.
- URS Corp.
- Washington State DOT

FOREWORD

NTCIP 2301 v02, an NTCIP standards publication, defines an application profile (AP) that is a combination of standards intended to meet specific requirements for information management and information transfers to and from transportation devices in a networked environment. As an NTCIP application profile, the scope covers the application, presentation, and session layers of the OSI Basic Reference Model. NTCIP 2301 v02 contains mandatory requirements that are applicable to all devices claiming conformance to NTCIP 2301 v02. NTCIP 2301 v02 also contains optional and conditional requirements, which may be applicable to a specific environment in which a device is used. NTCIP 2301 v02 uses only metric units.

Annex A includes mandatory requirements that are defined as normative.

For more information about NTCIP standards publications, visit the NTCIP Web site at www.ntcip.org.

User Comment Instructions

The term “User Comment” includes any type of written inquiry, comment, question, or proposed revision, from an individual person or organization, about any part of this standards publication’s content. A “Request for Interpretation” of this standards publication is also classified as a User Comment. User Comments are solicited at any time. In preparation of this NTCIP standards publication, input of users and other interested parties was sought and evaluated.

All User Comments will be referred to the committee responsible for developing and/or maintaining this standards publication. The committee chairperson, or their designee, may contact the submitter for clarification of the User Comment. When the committee chairperson or designee reports the committee’s consensus opinion related to the User Comment, that opinion will be forwarded to the submitter. The committee chairperson may report that action on the User Comment may be deferred to a future committee meeting and/or a future revision of the standards publication. Previous User Comments and their disposition may be available for reference and information at www.ntcip.org.

A User Comment should be submitted to this address:

NTCIP Coordinator
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, Virginia 22209-3801
e-mail: ntcip@nema.org

A User Comment should be submitted in the following form:

Standards Publication number and version:
Page:
Section, Paragraph, or Clause:
Comment:
Editorial or Substantive?:
Suggested Alternative Language:

Please include your name, organization, and address in your correspondence.

Approvals

NTCIP 2301 v02 was separately balloted and approved by AASHTO, ITE, and NEMA after recommendation by the Joint Committee on the NTCIP. Each organization has approved NTCIP 2301 v02 as the following standard type, as of the date:

AASHTO—Standard Specification, May 2010
ITE—Software Standard, June 2010
NEMA—Standard, November 2009

History

From 1998 to 1999, a predecessor of NTCIP 2301 v02 was referenced as TS 3.AP-STMF. However, as part of an organized numbering scheme for NTCIP standards publications, the designation NTCIP 2301 v02 was developed. The technical specifications of NTCIP 2301 v02 are identical to the former reference, except as noted in the development history:

TS 3.AP-STMF v98.01.07. August 1998—Accepted as a User Comment Draft by the Joint Committee on the NTCIP. October 1998—NTCIP Standards Bulletin B0025 referred version 98.01.08 for comment.

NTCIP 2301 v99.01.07. July 1999—Accepted v99.01.06 as a Recommended Standard by the Joint Committee on the NTCIP. January 2000—NTCIP Standards Bulletin B0044 referred v99.01.07, which included typographic corrections. Approved by AASHTO in May 2000, and approved by ITE and NEMA in May 2001.

NTCIP 2301:2001 v01.08. December 2001—Reformatted for printing: incremented version number and updated date; modified and reorganized front matter to conform to NTCIP 8002; and updated headers, footers, and page numbers. All references to TS 3 Standard designations were changed to equivalent NTCIP designations.

NTCIP 2301 v02.01. January 2002—Initial draft of NTCIP 2301 version 02 started.

NTCIP 2301 v02.12. February 2006—Accepted as a User Comment Draft by the Joint Committee. December 2006—Issued for review and comment via Standards Bulletin B0113.

NTCIP 2301 v02.16. March 2008—Updated references, cross references, and created Proposed Recommended Standard. April 2008—Accepted as a Recommended Standard by the Joint Committee.

NTCIP 2301 v02.17. August 2009—From June 2008 to August 2009, NTCIP 2301 v02.17 was edited for SDO balloting and approval.

NTCIP 2301 v02.17, June 2010—From August 2009 to June 2010, NTCIP v02.18 was considered for SDO balloting and approval.

NTCIP 2301 v02.19, July 2010—From June to July 2010, NTCIP v02.19 was edited and prepared for publication.

Compatibility of Versions

To distinguish NTCIP 2301 v02 (as published) from previous drafts, NTCIP 2301 v02 also includes NTCIP 2301 v02.19 on each page header. All NTCIP standards publications have a major and minor version

number for configuration management. The version number syntax is "v00.00a," with the major version number before the period, and the minor version number and edition letter (if any) after the period.

NTCIP 2301 v02 is designated, and should be cited as, NTCIP 2301 v02. Anyone using NTCIP 2301 v02 should seek information about the version number that is of interest to them in any given circumstance. The MIB, the PRL, and the PICS should all reference the version number of the standards publication that was the source of the excerpted material.

Compliant systems based on later, or higher, version numbers MAY NOT be compatible with compliant systems based on earlier, or lower, version numbers. Anyone using NTCIP 2103 v02 should also consult NTCIP 8004 v02 for specific guidelines on compatibility.

INTRODUCTION

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.

BSP2WG is concerned with the methodology of defining profiles, and their documentation in Standards Publications. NTCIP 2301 v02 defines an application profile that is a combination of base standards intended to meet the requirements for the management of information related to the communications layers. NTCIP 2301 v02 may also be applicable to end-application information management. The objective is to facilitate the specification of ITS systems 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 (now incorporated with the Base Standards and Profile 2 Working Group) 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 Basic 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. NTCIP 2301 v02 is an application profile for use in center-to-roadside and center-to-center communications.

In December 2001, developing NTCIP 2301 v02 was started to include changes made in the underlying standards and, specifically, to incorporate SFMP.

< This page is intentionally left blank. >

CONTENTS

	Page
Section 1 GENERAL	1
1.1 Scope.....	1
1.2 Profile-Protocol-Layer Relationships	1
1.3 References	1
1.3.1 Normative References.....	1
1.3.2 Other References	2
1.3.3 Contact Information	2
1.4 Definitions and Acronyms	3
1.5 Other Abbreviations and Acronyms	4
Section 2 FUNCTIONAL REQUIREMENTS	5
2.1 General Requirements.....	5
2.2 SNMP Requirements	5
2.2.1 SNMP Interface Conformance.....	5
2.2.2 SNMP SMI Requirements.....	6
2.3 STMP Requirements	6
2.3.1 STMP Interface Conformance	6
2.3.2 STMP SMI Requirements	7
2.4 SFMP Requirements	7
2.4.1 SFMP Interface Conformance	7
2.4.2 SFMP SMI Requirements	7
Annex A AP-STMF PROFILE REQUIREMENTS LIST (PRL) [Normative]	9
A.1 Introduction	9
A.1.1 Notation	9
A.2 Standards Referenced.....	11
A.3 Profile Requirements List (PRL)	11
A.3.1 Implementation Identification	11
A.3.2 SNMP Global Statement of Conformance	12
A.3.3 STMP Global Statement of Conformance	12
A.3.4 SFMP Global Statement of Conformance	12
A.4 Basic Requirements.....	13
A.5 SNMP PRL	14
A.5.1 SNMP Protocol Summary.....	14
A.5.2 SNMP Protocol	14
A.5.3 SNMP Statistics Conformance Group	17
A.5.4 SNMP Configuration Conformance Group	18
A.6 STMP PRL.....	19
A.6.1 STMP Protocol Summary	19
A.6.2 STMP Protocol.....	19
A.6.3 STMP Dynamic Object Conformance Group	21
A.6.4 STMP Statistics Conformance Group.....	21
A.7 SFMP PRL.....	23
A.7.1 SFMP Protocol Summary	23
A.7.2 Agent/Manager Capabilities.....	23
A.7.3 SFMP Protocol Data Unit.....	24
A.7.4 OER Encoding of SFMP Message	25
A.7.5 SFMP Statistics Conformance Group.....	26
A.8 General Conformance Groups PRL	27

A.8.1	General Conformance Groups Protocol Summary.....	27
A.8.2	System Conformance Group	27
A.8.3	Security Conformance Group	27
A.8.4	Logical Names Conformance Group	28
A.9	NTCIP SMI PRL.....	29
A.9.1	SMI Protocol Summary.....	29
A.9.2	NEMA Tree Structure	29
A.9.3	Textual Conventions	30

TABLES

	Page
Table 1 AP-STMF Relationships	1
Table 2 Base Standard and Profile Status Symbols	9
Table 3 RFC Mapping to Profile	10
Table 4 Predicate Notations	10
Table 5 Support Column Responses	10

Section 1 GENERAL

1.1 SCOPE

NTCIP 2301 v02 (this application profile (AP)) is applicable to transportation devices and management systems that operate in Intelligent Transportation Systems (ITS). As an AP, NTCIP 2301 v02 specifies a set of protocols and standards applicable to the application, presentation, and session layers of the OSI Basic Reference Model. NTCIP 2301 v02 is intended to provide message authentication, information management, and data representation services for devices and management stations.

1.2 PROFILE-PROTOCOL-LAYER RELATIONSHIPS

NTCIP 2301 v02 specifies provisions for the Simple Transportation Management Framework Application Profile (AP-STMf). For information management, NTCIP 2301 v02 references the Simple Network Management Protocol (SNMPv1). The information related to communications network layers is referenced in the Structure and Identification of (Network) Management Information (SMI) and the Management Information Base for Network Management of TCP/IP-based Internets (MIB-II). Interfacing requirements are referenced to two standards for Requirements for Internet Hosts (InHost).

For information management of specific transportation-related information, NTCIP 2301 v02 also references provisions of NTCIP 1103 v02 for Simple Transportation Management Protocol (STMP) and Simple Fixed Message Protocol (SFMP). The organization and structure of transportation information is referenced to NTCIP 8004 v02 for SMI for the SMI MIB. The layers, comparable standards, and profile taxonomy that make up this profile are shown in Table 1.

Table 1 AP-STMf Relationships

OSI Model Layers	Comparable Standards	Profile
APPLICATION LAYER	IAB STD 3 (Internet Hosts)	AP-STMf
	IAB STD 15 (SNMP)	
PRESENTATION LAYER	IAB STD 16 (SMI)	
	IAB STD 17 (MIB-II)	
SESSION LAYER	NTCIP 1103 v02 (TMP)	
	NTCIP 8004 v02 (SMI)	

1.3 REFERENCES

Normative references contain provisions that, through reference in this text, constitute provisions of NTCIP 2301 v02. Other references in NTCIP 2301 v02 might provide a complete understanding of the entire protocol and the relationships between all parts of the protocol. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard listed.

1.3.1 Normative References

RFC 1122:1989 *Requirements For Internet Hosts—Communication Layers (IAB STD 3)*

RFC 1123:1989 *Requirements For Internet Hosts—Application and Support (IAB STD 3)*