NTCIP 2301 v03.04

National Transportation Communications for ITS Protocol

Simple Transportation Management Framework Application Profile

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Minor Version Revision History for NTCIP 2301 v03

Revision	Date	Author	Description (latest on top)
04	08/30/2024	Vaughn	Editorial changes
03	02/13/2023	Vaughn	Updated status to proposed User Comment Draft; updated copyright year to 2023.
02	11/20/2022	Vaughn	Updates to front matter and Section 1 boilerplate.
01	10/26/2022	Vaughn	Initial draft document to incorporate security improvements as recommended by NTCIP 9014 and the Infrastructure Standards Security Assessment (ISSA) Project.

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FOREWORD

This publication defines an application profile 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 Reference Model. This publication contains mandatory requirements that are applicable to all devices claiming conformance to this standard. This publication also contains optional and conditional requirements which may be applicable to a specific environment in which a device is used.

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

> AASHTO – Standard Specification
> ITE – Software Standard
> NEMA – Standard

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History

Version	Date	Description (latest on top)
v03	<mark>TBD</mark>	Updated to enhance the security of the profile based on recommendations contained in NTCIP 9014, namely by updating to use SNMPv3 with the transport security model, the TLS transport model, and (D)TLS
v02	July 2010	Incorporation of SFMP and along with updated structure of standards with formalization of OER
v01	July 1999	Original version additionally approved by AASHTO and ITE to become NTCIP 2301
v01	August 1998	Original version published as NEMA TS 3.AP-STMF

INTRODUCTION

This standard 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. This standard 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.

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. The *NTCIP Simple Transportation Management Framework- Application Profile* (AP-STMF) is an application profile for use in center-to-roadside and center-to-center communications.

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

The following keywords apply to this document: AASHTO, ITE, NEMA, NTCIP, profile, application, SNMP, DTLS, TLS, TLSTM.

This document uses only metric units.

CONTENTS

Section 1
GENERAL

1.1   SCOPE

This standard is applicable to transportation devices and management systems that must operate in Intelligent Transportation Systems. As an application profile, it specifies a set of protocols and standards applicable to the application, presentation, and session layers of the open systems interconnect (OSI) reference model; it also defines aspects of the management and security entities of the ITS station architecture.

NOTE: This application profile relies upon services of the transport profile to authenticate the peer entity. While in theory this service could be provided by any secure transport profile as of the development of this document, the only two connections to transport services have been defined: transport layer security (TLS) over transmission control protocol (TCP) and datagram transport layer security (DTLS) over user datagram protocol (UDP). As a result, at present, there is an implicit expectation that this application profile will be deployed over one of these two stacks — both of which are formally defined in NTCIP 2202 v02.

NOTE: This document is equivalent to ISO 15784-2.

1.2   REFERENCES

The following documents are referenced by this document. At the time of publication, the editions indicated were valid.

1.2.1   Normative References

Normative references contain provisions that, through reference in this text, constitute provisions of this document. 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.

ISO 15784-2 PRL[1]	*Protocol Requirements List for Intelligent transport systems (ITS) — Data exchange involving roadside modules communication — Part 2: Centre to field device communications using SNMP*, available at https://standards.iso.org/iso/15784/-2/ed-2/en/iso15784-2-PRL.docx

1.2.2   Other References

IAB STD 58
     RFC 2578   Structure of Management Information Version 2 (SMIv2), April 1999
     RFC 2579   Textual Conventions for SMIv2, April 1999
     RFC 2580   Conformance Statements for SMIv2, April 1999
IAB STD 62
     RFC 3411   An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks, December 2002
     RFC 3412   Message Processing and Dispatching for the Simple Network Management Protocol (SNMP), December 2002
     RFC 3413   Simple Network Management Protocol (SNMP) Applications, December 2002

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[1] Under development; not yet available on the website

	RFC 3414	User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3), December 2002
	RFC 3415	View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP), December 2002
	RFC 3416	Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP), December 2002
	RFC 3417	Transport Mappings for the Simple Network Management Protocol (SNMP), December 2002
	RFC 3418	Management Information Base (MIB) for the Simple Network Management Protocol (SNMP), December 2002
IAB STD 78		
	RFC 5343	Simple Network Management Protocol (SNMP) Context EngineID Discovery, September 2008
	RFC 5590	Transport Subsystem for the Simple Network Management Protocol (SNMP), June 2009
	RFC 5591	Transport Security Model for the Simple Network Management Protocol (SNMP), June 2009
	RFC 6353	Transport Layer Security (TLS) Transport Model for the Simple Network Management Protocol (SNMP), July 2011
IETF RFC 3826		The Advanced Encryption Standard (AES) Cipher Algorithm in the SNMP User-based Security Model, June 2004
IETF RFC 7860		HMAC-SHA-2 Authentication Protocols in User-Based Security Model (USM) for SNMPv3, April 2016
IETF RFC 9456		Updates to the TLS Transport Model for SNMP, November 2023.
ISO/IEC 7498-1:1994		Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model
ISO 26048-1:2024		Intelligent transport systems — Field device Simple Network Management Protocol (SNMP) data interface — Part 1: Global objects
ISO 21217:2020		Intelligent transport systems — Station and communication architecture

1.2.3 Contact Information

1.2.3.1 Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)

The Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) may be viewed online at the following webpage:

www.arc-it.net

ARC-IT is the US ITS reference architecture and includes all content from the (now deprecated) National ITS Architecture v7.1 and the Connected Vehicle Reference Implementation Architecture (CVRIA) v2.2.

1.2.3.2 Internet Documents

Obtain Request for Comment (RFC) electronic documents from several repositories online at:

www.rfc-editor.org

1.2.3.3 ISO, IEC, and ISO/IEC Standards

ISO, IEC, and ISO/IEC Standards can be purchased online in electronic format or printed copy from:

Techstreet
Ann Arbor, MI 48108
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www.techstreet.com

1.2.3.4   NTCIP Standards

Copies of NTCIP Standards may be obtained from:

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www.ntcip.org
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Draft amendments, which are under discussion by the relevant NTCIP Working Group, and amendments recommended by the NTCIP Joint Committee are available.

1.3   GENERAL STATEMENTS

This application profile specifies the Simple Transportation Management Framework Application Profile (AP-STMF). In addition to specifying the standards to be used for the application, presentation, and session layers of the OSI reference model, as defined in ISO/IEC 7498-1, it also addresses aspects of management (e.g., managing the operation of these protocols) and security (e.g., access control). The ITS station architecture, as defined in ISO 21217, enhances the traditional OSI reference model and provides a more complete picture of how these features relate to one another. The ITS station architecture combines the OSI application, presentation, and session layers into a single "facilities layer," combines the OSI transport and network layers into a "networking and transport" (a.k.a., "transnet") layer, and combines the OSI data link and physical layers into a "subnet layer." It also adds a management entity and a security entity that can interact with any of the layers and an application entity that can interact with the facilities layer, the management entity, and the security entity.

Figure 1 depicts the ITS station architecture and identifies the standards used by this application profile within each relevant portion of the ITS station architecture. The application entity, transnet layer, and subnet layer are subjects of other NTCIP standards.

At the facilities layer, this profile uses the Simple Network Management Protocol version 3 (SNMPv3), as defined by RFCs 3411 through 3416.[2] The protocol services are managed using management information defined in the ISO 26048-1 and the SNMP MIB bundle, which includes the MIBs defined in RFC 3411-3413, RFC 3415-3416, RFC 3418, RFC 4807, RFC 5591, RFC 6353). All of this data is defined according to the rules in the second version of the structure and identification of management information (SMIv2), which is defined in RFC 2578-2580. Finally, the security entity provides access control to the managed information by using the transport layer security transport model (TLSTM, RFC 6353), which relies upon the advanced encryption standard (AES, RFC 3826) and the secure hash algorithm 2 (SHA-2, RFC 7860). As a backup, deployments are also required to support the user-based security model (USM, RFC 3414), which also uses AES and SHA-2; but access using the USM should be configured to provide limited access as it is less secure than the TLSTM.

Previous versions of this document specified the use of SNMPv1 and the Simple Transportation Management Protocol (STMP). SNMPv1 and STMP do not provide adequate security for modern ITS deployments and they are no longer supported by this version of AP-STMF.

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[2] SNMPv3 is formally defined by RFCs 3411-3418, but within the NTCIP, RFC 3417 is considered to be a part of the transnet layer and RFC 3418 is considered to be part of the management entity.
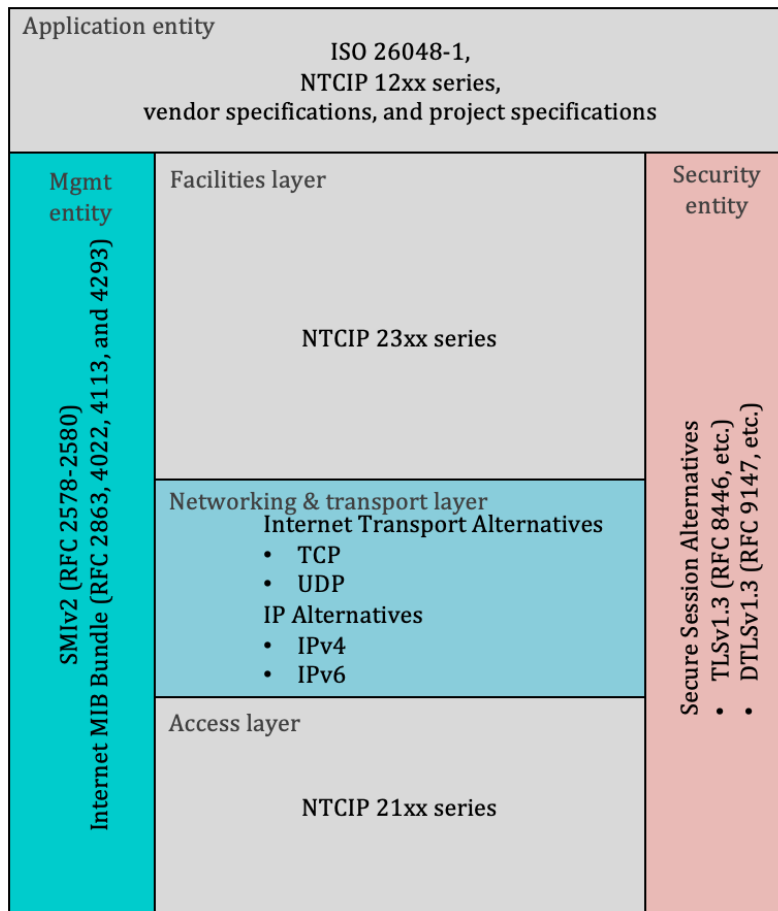
Figure 1. STMF - Application Profile Relationship.

1.4   TERMS

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

Application entity	A portion of the ITS station architecture that resides above the OSI reference model and represents the end application.
Application layer	That portion of the OSI Reference Model (Layer 7) that provides access to the communications services.
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.
Facilities layer	A portion of the ITS station architecture that is equivalent to the Session, Presentation, and Application Layers of the OSI reference model
Intelligent transportation systems	A major national initiative to apply information, communication, and control technologies in order to improve the efficiency of surface transportation.
Management entity	A portion of the ITS station architecture that provides management functionality of the communications stack and the application entity.
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.
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.
Security entity	A portion of the ITS station architecture that provides security services to the communication stack and the application entity.
Session layer	That portion of an OSI Reference Model (Layer 5) which manages a series of data exchanges between end-system applications.
Subnet layer	A portion of the ITS station architecture and logically represents a physical network within a network. All devices on a subnet share a common physical and data link layer.
Transnet layer	A portion of the ITS station architecture that resides above the subnet and provides equivalent functionality to the Network and Transport layers of the OSI reference model.
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.

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
AP   Application Profile
ISO   International Organization for Standardization
ITE   Institute of Transportation Engineers
ITS   Intelligent Transportation Systems
NEMA   National Electrical Manufacturers Association
NTCIP   National Transportation Communications for ITS Protocol
OSI   Open Systems Interconnection
PICS   Protocol Implementation Conformance Statement
RFC   (Internet) Request for Comments
SNMP   Simple Network Management Protocol
STD   (Internet) Standard
STMF   Simple Transportation Management Framework

Section 2
CONFORMANCE

2.1.1 Generation of Profile Implementation Conformance Statement (PICS)

All implementations of this standard shall be supplied with a PICS generated by the implementer or supplier by using the protocol requirements list available at https://standards.iso.org/iso/15784/-2/ed-2/en/ using the file named ISO_15784-2_PRL.docx to indicate the appropriate level of support provided by the implementation.

2.1.2 Evolution of Standards

Within many standards organizations, updates are achieved by issuing an amendment or creating a new edition of the standard, which is assigned the same document identifier with a new version and/or date. While the Internet Architecture Board (IAB) follows this approach with standards (i.e., those with STD designations), the Internet Engineering Task Force (IETF) assigns a new (typically sequential) number to each RFC published, even when it replaces an existing RFC. While updates and revisions of RFCs are listed at the top of an official RFC, there are many secondary sites from which RFCs can be downloaded. For the more recent update and revision information, RFCs should be downloaded from the https://www.rfc-editor.org/ website.

The STDs and RFCs referenced by this document define a baseline definition of conformance based on the standards published at the time that this document was developed. This document is intended to promote interoperability and unambiguously defining the scope of RFCs covered; it is not intended to restrict the implementation of updates or revisions to these RFCs. Parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent updates and revisions in a manner that will promote secure interoperability of ITS equipment.

2.2 TRANSPORT LAYER REQUIREMENTS

2.2.1 User Datagram Protocol (UDP)

2.3 GENERAL REQUIREMENTS

Implementations claiming conformance to the Simple Transportation Management Framework Application Profile shall conform to ISO 15784-2. The protocol requirements list (PRL) for ISO 15784-2 is provided at https://standards.iso.org/iso/15784/-2/ed-2/en/. At the time that this document was published, the file had the name ISO_15784-2_PRL.docx

NOTE — Deployments should disable access via prior versions of SNMPv3 and should provide minimal access via the user-based security model (USM) as might be needed during times of network stress, which can limit the access via the transport security model (TSM).

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