A Recommended Standard of the Joint Committee on the NTCIP

NTCIP 2202 v02.04a

National Transportation Communications for ITS Protocol

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

January 9, 2025

Published by

American Association of State Highway and Transportation Officials (AASHTO)
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Washington, D.C. 20004

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Minor Version Revision History for NTCIP 2202 v02

Revision	Date	Author	Description (latest on top)
04a	01/09/2025	Vaughn	Minor editorial changes for RS ballot
04	08/30/2024	Vaughn	Minor editorial changes for pRS
03	05/17/2023	Vaughn	Update Acknowledgments section to fix page numbering
02	11/20/2022	Vaughn	Update 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.

NOTICES

storage devices that are not associated with procurement documents, or commercial hardware, or commercial software products intended for field installation.

A PRL 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.

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ACKNOWLEDGEMENTS

NTCIP 2202 was prepared by the NTCIP Base Standards and Profiles Working Group (BSP2 WG), which is a subdivision of the Joint Committee on the NTCIP. The Joint Committee on the NTCIP 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 development organizations(SDOs) and provides guidance for NTCIP development.

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- Kenneth Vaughn
- Sankeer Vulupala
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In addition to the many volunteer efforts, recognition is also given to those organizations that supported the efforts of BSP2 WG by providing comments and funding, including:

- U.S. Department of Transportation, Research and Innovative Technology Administration
- U.S. Department of Transportation, Federal Highways Administration
- AECOM
- Applied Information
- City of Anaheim, CA
- Consensus Systems Technologies
- Caltrans
- Daktronics
- Econolite Control Products, Inc.
- Florida Department of Transportation
- Georgia DOT
- Kapsch
- KLD Engineering
- Michigan DOT
- Minnesota DOT
- Nevada DOT
- Noblis
- Parsons

- Pillar Consulting
- Q-Free
- Siemens ITS
- Signalisation Ver-Mac, Inc.
- TransCore
- Transport Canada
- Trevilon
- Washington State DOT
- WSP

FOREWORD

This publication defines a transport profile that is a combination of standards intended to meet specific requirements for transport services in transportation devices and management centers in a networked environment. The scope covers the transport and network layers of the OSI Reference Model. This publication contains mandatory requirement statements that are applicable to all devices claiming conformance to this standard. This publication also contains optional and conditional requirements that 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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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.

History

Version	Date	Description (latest on top)
v02	TBD	Updated to add requirements for Datagram Transport Layer Security (DTLS) and Transport Layer Security (TLS) along with general maintenance updates to reference the latest RFCs and a simplification of the presentation.
v01	December 2001	Original version.

Version 1 did not include any mention of transport layer security; version 2 requires support of DTLS for UDP and TLS for TCP; version 2 prohibits implementations that do not support DTLS or TLS.

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INTRODUCTION

This standard defines a transport profile that provides connectionless and connection-oriented transport services over a connectionless network service and is based upon the Internet TCP/IP Protocol Suite. The objective is to facilitate the specification of ITS 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 Internet (TCP/IP and UDP/IP) Transport Profile* (TP-Internet) is a transport 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, transport, internet, IP, TCP, UDP, DTLS, TLS.

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 a transport profile, it specifies a set of protocols and standards applicable to the transport and network layers of the open systems interconnect (OSI) reference model. The set of protocols provides a secure connectionless or connection-oriented transport service over a connectionless network service. This standard is intended to provide secure message transport and delivery services between transportation devices and a management station or among multiple centers. This standard applies to end systems concerned with implementing the TCP/IP protocol suite.

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.

IAB STD 3	*(RFC 1122: 1989, Requirements For Internet Hosts - Communication Layers, RFC 1123: 1989, Requirements For Internet Hosts - Application and Support)*
IAB STD 5	*RFC 791: 1981, Internet Protocol, RFC 792: 1981, Internet Control Message Protocol, RFC 919: 1984, Broadcasting Internet datagrams, RFC 922: 1984, Broadcasting Internet datagrams in the presence of subnets, RFC 950: 1985, Internet standard subnetting procedure, RFC 1112: 1989, Host extensions for IP multicasting)*
IAB STD 6	*(RFC 768: 1980, User Datagram Protocol)*
IAB STD 7	*(RFC 9293: 2022, Transmission Control Protocol)*
IAB STD 86	*(RFC 8200: 2017, Internet Protocol, Version 6 (IPv6) Specification)*
RFC 1349	Type of Service in the Internet Protocol Suite, July 1992
RFC 2236	Internet Group Management Protocol, November 1997
RFC 2863	The Interfaces Group MIB, June 2000
RFC 4022	Management Information Base for the Transmission Control Protocol (TCP), March 2005
RFC 4113	Management Information Base for the User Datagram Protocol (UDP), June 2005
RFC 4291	IP Version 6 Addressing Architecture, February 2006
RFC 4293	Management Information Base for the Internet Protocol (IP), April 2006
RFC 4443	Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification, March 2006
RFC 4884	Extended ICMP to Support Multi-Part Messages, April 2007
RFC 6298	Computing TCP's Retransmission Timer, June 2011
RFC 6633	Deprecation of ICMP Source Quench Messages, May 2012
RFC 6864	Updated Specification of the IPv4 ID Field, February 2012
RFC 6918	Formally Deprecating Some ICMPv4 Message Types, April 2013

1.2.2 Other References

Other references are included to provide a more complete understanding of this document and its relationship to other documents.

ISO/IEC 7498-1:1994	*Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model*
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:

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
www.rfc-editor.org/repositories.html

1.2.3.3 NTCIP Standards

Copies of NTCIP standards may be obtained from:

NTCIP Coordinator
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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 transport profile specifies the Internet Transport Profile. In addition to specifying the standards to be used for the transport and network 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., authentication). The ITS station (ITS-S) 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.

This transport profile specifies the provision for connectionless or connection-oriented transport service between two facility layer services via a common access layer.

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, facilities layer and subnet layer are subjects of other NTCIP standards.

For the ITS-S transnet layer, this profile provides the major options that are used on the Internet:

1. For the OSI transport layer, the protocol can be either
    a. transmission control protocol (TCP)
    b. user datagram protocol (UDP)
2. For the OSI network layer, the protocol can be either
    a. internet protocol version 6 (IPv6)
    b. internet protocol version 4 (IPv4)

Either transport layer can be coupled with either network layer. In addition, this profile requires the use of transport layer security (TLS), if the transport protocol is TCP and the use of datagram transport layer security (DTLS), if the transport protocol is UDP. Thus, there are a total of four options, as follows:

1. TLS/TCP/IPv6
2. TLS/TCP/IPv4
3. DTLS/UDP/IPv6
4. DTLS/UDP/IPv4

Support for DTLS over UDP is required. Two implementations are compatible only if they share support for a common set of options (e.g., they both support TLS/UDP/IPv4 and the same access layer).

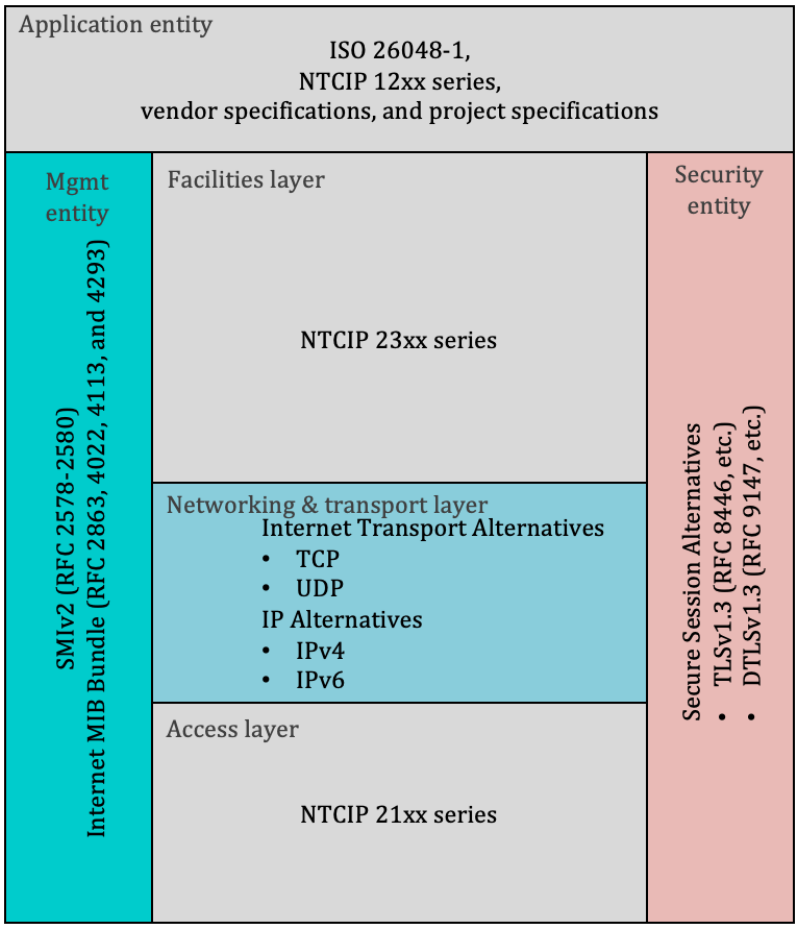

Figure 1: Internet Transport Profile Relationships

Finally, the protocol services are managed through the use of management information defined in the Internet MIB bundle, which includes the MIBs defined in RFCs 2863, 4022, 4113, and 4293. This data is defined according to the rules defined in the second version of the structure and identification of management information (SMIv2), which is defined in RFC 2578-2580.

Previous versions of this document did not include the use of TLS or DTLS (which are jointly referred to as "(D)TLS"). Implementations without transport layer security do not provide adequate security for modern ITS deployments and the omission of (D)TLS is no longer supported by this transport profile.

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.
datagram	A self-contained unit of data transmitted independently of other datagrams.
end system	The source or destination of an information exchange.
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.
intermediate system	A system that participates in an information exchange but is not the source or destination of the exchange.
internet	Any collection of connected networks where information can be passed form one network to another.
Internet protocol	The network protocol offering a connectionless mode network service in the Internet suite of protocols.
Internet Protocol Suite	A collection of computer-communication protocols originally developed under DARPA sponsorship.
Management entity	A portion of the ITS station architecture that provides management functionality of the communications stack and the application entity.
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.
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.

subnetwork	A physical network within a network. All devices on a subnetwork share a common physical medium.
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
IAB STD Internet Advisory Board Standard
IP Internet Protocol
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
TCP Transmission Control Protocol
TP Transport profile
UDP User Datagram Protocol

Section 2
CONFORMANCE

2.1 GENERAL REQUIREMENTS

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 contained in Annex A 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)

A conforming implementation of this profile shall support DTLS/UDP by conforming to:

a. RFC 9147
b. IAB STD 6 (RFC 768),
c. RFC 1122, Clause 4.1,
d. RFC 4113 with support for `udpMIBCompliance2`.

A conforming UDP server shall require certificate-based client authentication.

A conforming UDP client shall support certificate-based client authentication and post-handshake authentication.

Annex A.4 summarizes the requirements of the above references.

2.2.2 Transmission Control Protocol (TCP)

A conforming implementation of this profile may support TLS/TCP. Implementations claiming conformance to TCP shall conform to:

a. RFC 8446
b. IAB STD 7 (RFC 9293);
c. RFC 1122, Clause 4.2, as updated by RFC 6298 and RFC 9293
d. If IPv4 is supported, RFC 1191;

e. If IPv6 is supported, RFC 1981;
f. RFC 4022 with support for `tcpMIBCompliance2`.

A conforming TCP server shall require certificate-based client authentication.

A conforming TCP client shall support certificate-based client authentication and post-handshake authentication.

A TCP implementation may support RFC 4821.

Annex A.5 summarizes the requirements of the above references.

2.3 NETWORK LAYER REQUIREMENTS

2.3.1 Internet Protocol Version 4

A conforming implementation of this profile may support IPv4. Implementations claiming conformance to Ipv4 shall support the following elements as stated:

a. IAB STD 5, including:
   i. RFC 791, as updated by RFC 1349, RFC 6864, and errata;
   ii. RFC 792, as updated by RFC 950, RFC 4884, RFC 6633, RFC 6918, and errata;
   iii. RFC 919;
   iv. RFC 922;
   v. RFC 950, as updated by RFC 6918;
   vi. RFC 1112, as updated by RFC 2236;
b. RFC 1122, Section 3, as updated by RFC 1349, RFC 6633, and RFC 6864;
c. RFC 2863, as updated by RFC 8892 and errata, with support for `ifCompliance3`; and
d. RFC 4293 with support for `ipMIBCompliance2`.

Annex A.6 summarizes the requirements of the above references.

2.3.2 Internet Protocol Version 6

A conforming implementation of this profile may support IPv6; an implementation that does not support IPv4 shall support IPv6. Implementations claiming conformance to IPv6 shall support the following elements as stated:

a. IAB STD 86 (RFC 8200);
b. RFC 4443, as updated by RFC 4884;
c. RFC 1122, Section 3;
d. RFC 2863, as updated by RFC 8892 and errata, with support for `ifCompliance3`; and
e. RFC 4293 with support for `ipMIBCompliance2`.

An IPv6 implementation may support RFC 4821.

Annex A.7 summarizes the requirements of the above references.

Annex A
TCP/ IP AND UDP/IP - TRANSPORT PROFILE REQUIREMENTS LIST
(Normative)

A.1 INTRODUCTION

A.1.1 General

This annex provides the Profile Requirements List (PRL) for implementations of the Internet (TCP/IP and UDP/IP) – Transport Profile. A Profile Implementation Conformance Specification (PICS) for an implementation is generated by an implementer or supplier by indicating the appropriate level of support provided by an implementation.

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

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

a. The protocol implementer, as a checklist to reduce the risk of failure to conform to the standard through oversight.

b. The supplier and user, as a detailed indication of the capabilities of the implementation.

c. The user, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking can never be guaranteed, failure to do so can often be predicted from incompatible PICSs).

d. A user, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

A.1.2 Notation

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

A.1.2.1 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
n/a	not-applicable (i.e., logically impossible in the scope of the profile)
x	excluded or prohibited

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

The classification of the requirements and options in internet RFCs does not correspond to the convention described in above, and 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.1.2.2 Conditional Status Notation

The following predicate notations may be used:

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

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

A.1.2.3 Support Column Symbols

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

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

A.1.2.4 Footnotes

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

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

A.1.2.5 Instructions for Completing the PRL

A Profile implementer shows the extent of compliance to a Profile by completing the PRL. The implementer indicates whether mandatory requirements are complied with, and whether optional functions are supported. The resulting completed PRL is called a PICS. Where this profile refines the features of the base standards, the requirements expressed in this PRL shall be applied (as indicated in PRL items with no "Profile Support" column) to constrain the allowable responses in the base standard PICS proforma. When this profile makes additional requirements, the "Support" column for such PRLs shall be completed. In this column, each response shall be selected either from the indicated set of responses, or it shall comprise one or more parameter values as requested. If a conditional requirement is inapplicable, use the Not Applicable (NA) choice. If a mandatory requirement is not satisfied, exception information 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 STANDARDS REFERENCED

This profile references the following standards:

IAB STD 3 *(RFC 1122: 1989, Requirements For Internet Hosts - Communication Layers, RFC 1123: 1989, Requirements For Internet Hosts - Application and Support)*

IAB STD 5 *RFC 791: 1981, Internet Protocol, RFC 792: 1981, Internet Control Message Protocol, RFC 919: 1984, Broadcasting Internet datagrams, RFC 922: 1984, Broadcasting Internet datagrams in the presence of subnets, RFC 950: 1985, Internet standard subnetting procedure, RFC 1112: 1989, Host extensions for IP multicasting)*

IAB STD 6 *(RFC 768: 1980, User Datagram Protocol)*

IAB STD 7 *(RFC 9293: 2022, Transmission Control Protocol)*

IAB STD 86 *(RFC 8200: 2017, Internet Protocol, Version 6 (IPv6) Specification)*

RFC 1349 Type of Service in the Internet Protocol Suite, July 1992
RFC 2236 Internet Group Management Protocol, November 1997
RFC 2863 The Interfaces Group MIB, June 2000
RFC 4022 Management Information Base for the Transmission Control Protocol (TCP), March 2005
RFC 4113 Management Information Base for the User Datagram Protocol (UDP), June 2005
RFC 4291 IP Version 6 Addressing Architecture, February 2006
RFC 4293 Management Information Base for the Internet Protocol (IP), April 2006
RFC 4443 Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification, March 2006
RFC 4884 Extended ICMP to Support Multi-Part Messages, April 2007
RFC 6298 Computing TCP's Retransmission Timer, June 2011
RFC 6633 Deprecation of ICMP Source Quench Messages, May 2012
RFC 6864 Updated Specification of the IPv4 ID Field, February 2012
RFC 6918 Formally Deprecating Some ICMPv4 Message Types, April 2013

A.3 PICS REQUIREMENTS LISTS

A.3.1 Implementation Identification

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

A.3.2 Basic Requirements

The following table lists the major requirements for a TCP/IP or UDP/IP implementation, and asks if the listed protocols and object definition groups have been implemented:

Index	Protocol	Clause of Profile	Profile Status	Support
tcp	IAB STD 7 (RFC 793), TCP and IAB STD 3 (RFC 1122), InHost Section 4.2, implemented?	2.2.2	o	Yes No
udp	IAB STD 6 and IAB STD 3, RFC1122, Section 4.1, UDP, implemented?	2.2.1	m	Yes
ipv4	IAB STD 5 and IAB STD 3, RFC 1122, Section 3, IP, implemented?	2.3.1	o.1 (1..*)	Yes
ipv6	IAB STD 5 and IAB STD 3, RFC 1122, Section 3, ICMP, implemented?	2.3.2	o.1 (1..*)	Yes
plpmtud	Packetization Layer Path Maximum Transmission Unit (MTU) Discovery	2.3.1 2.3.2	o	Yes No

A.4 UDP PICS PROFORMA

A.4.1 UDP Protocol Summary

Protocol Version	
Addenda Implemented	
Amendments Implemented	
Have any exceptions been required? (Note: A YES answer means that the implementation does not conform to the Transmission Control Protocol/User Datagram Protocol. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming.	Yes _____ No _____
Date of Statement	

A.4.2 UDP General/Major Capabilities

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
dtls	Datagram Transport Layer Security Version 1.3	RFC 9147	M	2.2.1	m	Yes
udp	User Datagram Protocol	RFC 768	M		m	Yes
udpauth	UDP certificate-based client authentication	RFC 9147	O		m	Yes
udphost	Internet Hosts -- UDP	RFC 1122, Clause 4.1	M		m	Yes
udpmib	udpMIBCompliance2	RFC 4113	M		m	Yes

A.5 TCP PICS PROFORMA

A.5.1 TCP Protocol Summary

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

A.5.2 TCP General/Major Capabilities

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
tls	Transport Layer Security Version 1.3	RFC 8446	M	2.2.2	m	Yes
tcp	Transmission Control Protocol	RFC 9293	M		m	Yes
tcpauth	TCP certificate-based client authentication	RFC 8446	O		m	Yes
host	Internet Hosts -- TCP	RFC 1122, Clause 4.2	M		m	Yes
timer	Computing TCP's Retransmission Timer	RFC 6298	M		m	Yes
pmtud	Path MTU Discovery for IP Version 4	RFC 1191	ipv4: M		ipv4:m	Yes NA
pmtudv6	Path MTU Discovery for IP Version 6	RFC 1981	ipv6: M		ipv6:m	Yes NA
plpmtud	Packetized Layer Path MTU Discovery	RFC 4821	O		o	Yes No
tcpmib	tcpMIBCompliance2	RFC 4022	M		m	Yes

A.6 IPV4 PICS PROFORMA

A.6.1 IPv4 Protocol Summary

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

A.6.2 IPv4 General/Major Capabilities

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
ipv4	Internet Protocol	RFC 791	M	2.3.1	m	Yes
icmp	Internet Control Message Protocol	RFC 792	M		m	Yes
broad	Broadcasting Internet Datagrams	RFC 919	M		m	Yes
b-subnet	Broadcasting Internet Datagrams in the Presence of Subnets	RFC 922	M		m	Yes
subnet	Internet Standard Subnetting Procedures	RFC 950	M		m	Yes
host-m	Host Extensions for IP Multicasting	RFC 1112	M		m	Yes
ipv4-host	Requirements for Internet Hosts -- IP	RFC 1122	M		m	Yes
type	Type of Service in the Internet Protocol Suite	RFC 1349	M		m	Yes
igmp	Internet Group Management Protocol, Version 2	RFC 2236	M		m	Yes
e-icmp	Extended ICMP to Support Multi-Part Messages	RFC 4884	M		m	Yes
quench	Deprecation of ICMP Source Quench Messages	RFC 6633	M		m	Yes
update	Updated Specification of the IPv4 ID Field	RFC 6864	M		m	Yes
dep-icmp	Formally Deprecating Some ICMPv4 Message Types	RFC 6918	M		m	Yes
if-mib	The Interfaces Group MIB - ifCompliance3	RFC 2863	M		m	Yes
ip-mib	MIB for IP - ipMIBCompliance	RFC 4293	M		m	Yes

A.7 IPV6 PICS PROFORMA

A.7.1 IPv6 Protocol Summary

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

A.7.2 IPv6 General/Major Capabilities

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
ipv6	Internet Protocol, Version 6 (IPv6) Specification	RFC 8200	M	2.3.2	m	Yes
icmpv6	Internet Control Message Protocol	RFC 4443	M		m	Yes
ipv4-host	Requirements for Internet Hosts -- IP	RFC 1122	M		m	Yes
e-icmp	Extended ICMP to Support Multi-Part Messages	RFC 4884	M		m	Yes
if-mib	The Interfaces Group MIB - ifCompliance3	RFC 2863	M		m	Yes
ip-mib	MIB for IP - ipMIBCompliance	RFC 4293	M		m	Yes

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