NTCIP 2304:2002

National Transportation Communications for ITS Protocol

Application Profile for DATEX-ASN (AP-DATEX)

Joint Standard of AASHTO, ITE, and NEMA

version 01.08

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National Transportation Communications for ITS Protocol

Application Profile for DATEX-ASN (AP-DATEX)

September 2005

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FOREWORD

This document uses only metric units.

This publication defines an application profile for communications between management systems. It defines requirements and optional and conditional clauses that are applicable to specific environments for which they are intended. This standard contains one annex, Annex A, which is defined as normative.

This document is also known as AP-DATEX, and during initial development was also referenced as TS 3.DATEX. However, in order to provide a more organized numbering scheme the document is now referenced as NTCIP 2304.

This document is an NTCIP Application Profile. NTCIP Application Profiles define the upper three layers of the ISO seven-layer Open Systems Interconnect (OSI) Reference Model.

For more information about NTCIP standards, visit the NTCIP Web Site at http://www.ntcip.org.

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History

The technical specification of this version of NTCIP 2304 is identical to the former version, except as noted in the development history below:

NTCIP 2304 version 01.06, January 18, 2000. Accepted as a Recommended Standard in September 2000. Version 01.07 distributed for ballot in June 2001 with only title page and front matter text revisions. Approved by AASHTO in March 2002, approved by ITE in December 2002, and approved by NEMA in November 2001.

NTCIP 2304:2002 v01.08. September 2005 – Prepared document for publication.

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INTRODUCTION

This publication provides a simple NTCIP Application Profile for communications between transportation management systems.

This standard defines requirements that are applicable to all NTCIP environments and it also contains optional and conditional clauses that are applicable to specific environments for which they are intended.

The following keywords apply to this document: AASHTO, ITE, NEMA, NTCIP, application, center, C2C, profile.

The effort to develop NTCIP began in 1992 with the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section. The original effort was in response to a user need for extending the TS 2 Standard for traffic control hardware to include standardized systems communication. Under the guidance of the Federal Highway Administration's (FHWA) NTCIP Steering Group, the NEMA effort was expanded to include the development of communications standards for all transportation field devices that could be used in an Intelligent Transportation Systems (ITS) network. This effort grew to include communications between management systems dealing with transportation. As a result, in July 1996, the NTCIP Steering Group held the first workshop to address center-to-center communication issues.

In September 1996, an agreement was executed among AASHTO, ITE, and NEMA to jointly develop, approve, and maintain NTCIP Standards. One of the first actions of this joint effort was to establish the Center-to-Center Working Group. The first meeting of the C2C WG was in July 1996; the first draft of this standard was developed in December 1997.

CONTENTS

**Section 1
GENERAL**

1.1   SCOPE

This standard is applicable to communications between any two management subsystems within the Intelligent Transportation Systems (ITS) environment.

This application profile lists the requirements for a traditional approach for data exchange among systems.

1.2   GENERAL

1.2.1   OSI Reference Mode

The OSI Reference Model defines seven layers, each performing a particular role in the transmission of data over a medium. Application profiles define the upper three layers.

The top layer of the OSI seven layer model, the Application Layer, handles issues like network transparency, resource allocation, and problem partitioning. The application layer is concerned with the user's view of the network (e.g. formatting electronic mail messages). [1]

The second highest layer in the OSI seven layer model, also known as layer 6 or the Presentation Layer, performs functions such as text compression, code conversion, or format conversion to try to smooth out differences between hosts. [2]

Layer 5, the Session Layer, handles security and creation of the session.

1.2.2   Scenario

AP-DATEX should be used when there is a connection between two or more ITS management subsystems. An example of this is a traffic operations center connected to a transit operations center. Each subsystem can be viewed as consisting of the following interfaces as shown in Figure 1:

1.   Application Interface

2.   Operator Interface

3.   Communication Interface

4.   Database Interface

This standard deals with interface number (3).

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[1] Free On-Line Dictionary of Computing. http://wombat.doc.ic.ac.uk/foldoc/index.html, 12 January 1995.
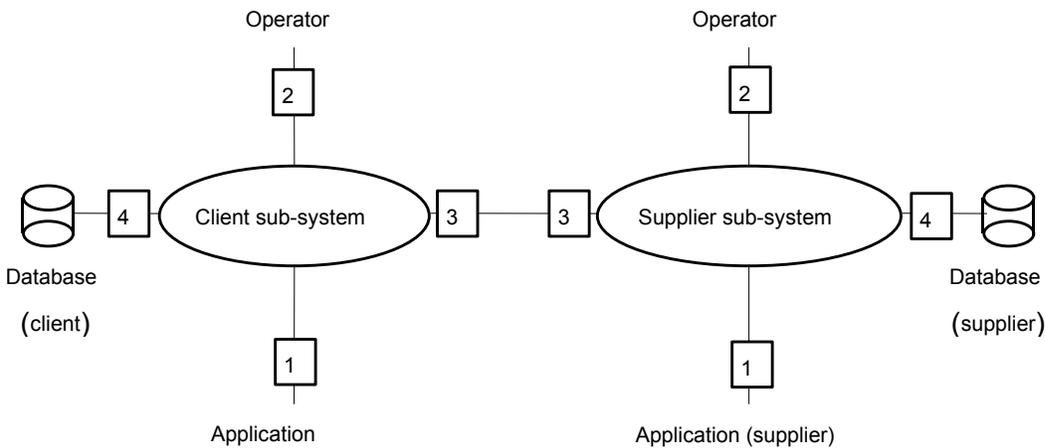[2] Ibid.

Figure 1-1
Example for this AP-Scenario

The definition of Application Profiles and their functions and responsibilities are defined within clause 2 of NTCIP 8003:1999 *Framework and Classification of Profiles*. This profile references ISO standards for the Application and Presentation Layers of the OSI Reference Model in addition to NTCIP standards. The Session Layer is defined as being NULL because the selected Application Layer handles this functionality.

ISO Layers	Base Standard	Taxonomy
APPLICATION LAYER	ISO 14827-2 DATEX-ASN	AP-DATEX Application Profile
PRESENTATION LAYER	ISO 8825-1 Basic Encoding Rules	
	NTCIP 1102 Octet Encoding Rules	
SESSION LAYER		

Figure 1-2
AP-DATEX—Application Profile Scenario

The profile will function on low speed communications links, although bandwidth was not a primary design consideration. Lower layer functionality such as routing, segmentation, packet error checking, and byte-level transmission of data packets are addressed by Transport and Subnet Profiles.

This Application Profile does not require a particular Transport Profile or Subnet Profile. It has been designed to work with connectionless Transport Profiles, but can also work with connection-oriented Transport Profiles.

At the Application Layer, Parts 1 and 2 (DATEX-ASN) of ISO 14827 are used to define the message structure and procedural rules.

The message structures defined by the Application Layer are defined using the Abstract Syntax Notation One. ISO 14827-2 requires support of Basic Encoding Rules (BER) and allows support of additional encoding rules through a negotiation scheme. This standard requires the additional support of the Octet

Encoding Rules in order to conserve communication resources while promoting a single solution throughout our industry.

1.3   REFERENCES

For approved revisions, contact:

<div align="center">

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National Electrical Manufacturers Association
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e-mail: ntcip@nema.org

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

The following standards (normative references) contain provisions which, through reference in this text, constitute provisions of this standard. Other documents and standards (other references) are referenced in these documents, which might provide a complete understanding of the entire protocol and the relations 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 below.

1.3.1   Normative References

ISO 14827-1:1999 (CD), *Transport Information and Control Systems—Data Exchanges Between Traffic Management and Information Centres—Part 1: Message Definition Requirements*

ISO 14827-2:1999 (CD), *Transport Information and Control Systems—Data Exchanges Between Traffic Management and Information Centres—Part 2: DATEX-ASN*

ISO 8825-1:1995, *Information Technology—Open Systems Interconnection—Specification of Basic Encoding Rules for Abstract Syntax Notation One (BER)*

NTCIP 1102:1999, *Octet Encoding Rules*

ISO/IEC 3309:1993, *Information technology⎯Telecommunications and information exchange between systems ⎯High-level data link control (HDLC) procedures⎯Frame structure*

1.3.2   Other References

NTCIP 8003:1999, *Framework and Classification of Profiles*

NTCIP 9001:1999, *NTCIP Guide*

ISO 7498:1984, *Information processing systems ⎯ Open Systems Interconnection ⎯ Basic Reference Model*

1.3.3   CONTACT INFORMATION

1.3.3.1   ISO/IEC STANDARDS

Members of the ISO maintain registers of currently valid ISO/IEC International Standards. For the USA, the members of ISO is the American National Standards Institute (ANSI), which may be contacted as follows:

ANSI
11 West 42nd Street, 13th Floor
New York, NY 10036
(212) 642-4900
http://www.ansi.org

1.3.3.2   NTCIP DOCUMENTS

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
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http://www.nema.org

1.4   TERMS

The following terms shall be used throughout the scope of this document.

Application Layer	That portion of an OSI system responsible for transferring information over the communications stack.
Basic Encoding Rules	The OSI language for describing transfer syntax.
datagram	A self-contained unit of data transmitted independently of other datagrams.
Data Link Layer	That portion of an OSI Reference Model (Layer 2) responsible for flow control, framing, synchronization, and error control over a communications link.
Intelligent Transportation Systems	A major national initiative to improve information, communication, and control technologies in order to improve the efficiency of surface transportation.
International Organization for Standardization	An international standards organization. ANSI is the primary interface to ISO within the United States. Often thought to be International Standards Organization because of the usage ISO for short.
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	The 7-layer model that describes the conceptual organization of protocols for communications and interconnection of computer systems.
Physical Layer	That portion of an OSI Reference Model (Layer 1) responsible for the electrical and mechanical interface between communicating systems.
port number	Identifies an application-entity to a transport service in the Internet suite of

protocols. The concept of port numbers is often present in OSI literature; however, post numbers are not inter-network standard, but exist as local network conventions only.

Transport Layer   That portion of an OSI Reference Model (Layer 4) which attempts to guarantee reliable data transfers 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
ANSI	American National Standards Institute
AP	Application Profile
ASN.1	Abstract Syntax Notation One
CORBA	Common Object Request Broker Architecture
DATEX-ASN	Data Exchange in ASN.1
FHWA	Federal Highway Administration
FTP	File Transfer Protocol
ISO	International Organization for Standardization; International Standards Organization
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	Profile Implementation Conformance Statement
TFTP	Trivial File Transfer Protocol

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Section 2
CONFORMANCE

2.1   GENERAL REQUIREMENTS

2.1.1   Stack Definition

The AP-DATEX is one of the Application Profiles defined for data exchanges between ITS management subsystems. Implementations claiming conformance to this Application Profile shall support the following elements as stated:

    a.   All of the constraints defined in Sections 2.2 through 2.4.
    b.   All mandatory requirements specified in Annex A.3.
    c.   All mandatory requirements of the standards referenced by this profile.

2.1.2   Optional Features

This profile provides an identification of specific communications requirements. It also identifies optional requirements, which, under specific circumstances, are required. End-users should assume that implementations will not support optional features unless specific references to particular circumstances are made. For example, DATEX-ASN centers are not required to support on-line subscriptions.

2.1.3   Co-residence

A particular implementation may add functions and services, but they must work in conjunction and not interfere with the capabilities stated herein. For example, if a management subsystem can meet the requirements for AP-DATEX and AP-CORBA, then it conforms to each of these APs.

2.2   APPLICATION LAYER REQUIREMENTS

The Application Layer shall conform to ISO 14827-2:1999 (Committee Draft).

Additionally, implementations claiming conformance to this standard shall be capable of negotiating to determine which encoding rules will be used for the session. Implementations shall be capable of negotiating for the use of any set of encoding rules to which the implementation claims compliance.

2.3   PRESENTATION LAYER REQUIREMENTS

The implementation shall start all Application Layer sessions using ASN.1 Basic Encoding Rules (BER) as defined in ISO 8825-1:1995, with no modifications or exceptions.

Implementations claiming Level 1 compliance shall support the following encoding rules for the session.
• ASN.1 Octet Encoding Rules (OER) as defined in NTCIP 1102:1999 (User Comment)

Implementations claiming Level 2 compliance shall support the following encoding rules for the session.
• ASN.1 Octet Encoding Rules (OER) as defined in NTCIP 1102:1999 (User Comment)
• ASN.1 Basic Encoding Rules (BER) as defined in ISO 8825-1:1995

The actual encoding rules used during a session shall be dependent upon the results of the log-in negotiation process as defined by ISO 14827-2:1999 (Committee Draft).

2.4   SESSION LAYER REQUIREMENTS

The Session Layer shall be Null as these services are provided by ISO 14827-2.

Annex A
APPLICATION PROFILE FOR DATEX-ASN
PROFILE REQUIREMENTS LIST
(Normative)

A.1 INTRODUCTION

This annex provides the Profile Requirements List (PRL) for implementations of the Application Profile for DATEX-ASN. 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.1.1 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.1.1.1 Status Symbols

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

m	mandatory
m.\<n\>	support of every item of the group labeled by the same numeral \<n\> required, but only one is active at one 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[3]
SHOULD	Mandatory[3]
MAY	Optional
SHOULD NOT	Prohibited
MUST NOT	Prohibited

A.1.1.2 Conditional Status Notation

The following predicate notations are used:

<predicate>:	This notation introduces a single item that is conditional on the <predicate>.
<predicate>::	This notation introduces a group of items, 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 means that the when the group predicate is true then the associated clause should 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.1.1.3 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.1.1.4 Footnotes

Footnotes to the pro forma 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.

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[3] 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.1.1.5 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

The standards referenced by this profile are defined in Clause 1.3.1.

A.3   PROFILE REQUIREMENTS LIST (PRL)

A.3.1   Implementation Identification

Ref	Question	Response
1	Supplier	
2	Contact point for queries about the profile	
3	Implementation Name(s) and Version(s)	
4	Date of statement	
5	Other Information: Machine Name, Operating Systems, System Name	

A.3.2   Application Layer Requirements

The following table lists the basic requirements for a AP-DATEX implementation, and asks if the listed protocols or standards have been implemented:

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
spdu1	Does the implementation conform to ISO 14827-2 DATEX-ASN?	14827-2		2.2	m	Yes
ber-init	Does the implementation start all sessions with BER?	ISO 8824-1		2.3	m	Yes
negotiate	Does the implementation support the negotiation of alternative encoding rules?	ISO 14827-2 Clause 6.3.1	M	2.2	m	Yes
ber	Does the implementation support BER? (Conformance Level 2)	ISO 8824-1		2.3	o	Yes / No

Item	Protocol Feature	Base Standard		Profile		Support
		Reference	Status	Clause	Status	
oer	Does the implementation support OER?	NTCIP 1102		2.3	m	Yes
client	Does the implementation claim to be a Client?	ISO 14827-2 Clause 6.3	O.1		o.1	Yes / No
server	Does the implementation claim to be a Server?	ISO 14827-2 Clause 6.3	O.1		o.1	Yes / No
port 355	Does the implementation start sessions using Port 355?	ISO 14827-2 Clause D.1	O		o	Yes / No
files	Does the system support the DATEX-ASN file transfer option?	ISO 14827-2 Clause 6.2	O		o	Yes / No
ftp	Does the system support the DATEX-ASN FTP option?	ISO 14827-2 Clause 6.2	files:O.2		files : o.2	Yes / No / NA
tftp	Does the system support the DATEX-ASN TFTP option?	ISO 14827-2 Clause 6.2	files:O.2		files : o.2	Yes / No / NA
dial-up	Does the implementation claim support for switched connections?	ISO 14827-2 Clause 6.4	O		o	Yes / No
reject	Does the Server reject an invalid login by transmitting a reject data packet?	ISO 14827-2 Clause 6.3.1	O.3		server : o.3	Yes / No / NA
silent-reject	Does the Server silently reject an invalid login?	ISO 14827-2 Clause 6.3.1	O.3		server : o.3	Yes / No / NA
off-line	Does the implementation support the DATEX-ASN off-line subscription feature?	ISO 14827-2 Clause 6.4.1	O.4		o.4	Yes / No
on-line	Does the implementation support the DATEX-ASN on-line subscription feature?	ISO 14827-2 Clause 6.4.1	O.4		o.4	Yes / No

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