

*A Guidance Document of AASHTO, ITE, and NEMA*

# NTCIP 8002 Annex B1 version v01

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## National Transportation Communications for ITS Protocol Content Outline for NTCIP 1200- Series Documents (for Standards Engineering Process (SEP) Content)

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## ACKNOWLEDGEMENTS

NTCIP 8002 Annex B1 v01P was developed with input from various participants in the development of the NTCIP family of standards.

Note: Much of the content of NTCIP 8001 Annex B1 was developed circa 2007, and certain practices with respect to the representation of Systems Engineering Process (SEP) content and Systems Engineering (SE) element in NTCIP documents has changed over time. As more recent practices are validated, these are slated for incorporation in a subsequent version of NTCIP 8002 Annex B1. NTCIP 8002 Annex B1 v01 was published September 2016.

NTCIP 8002 Annex B1 was prepared with input from the NTCIP Base Standards and Profiles 2 Working Group (BSP2 WG), as well as other active participants in the development of NTCIP standards, and was ultimately developed under the auspices of NTCIP Joint Committee, of which BSP2 WG is a subdivision.

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 organizations, and provides guidance for NTCIP development.

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 Joint Program Office

## FOREWORD

NTCIP 8002 Annex B1 is Not an NTCIP standard. Rather, NTCIP 8002 Annex B1 provides guidance to those developing NTCIP standards concerning the standardized manner in which certain Systems Engineering (SE) elements are represented in NTCIP standards.

As an NTCIP Guidance document, NTCIP 8002 Annex B1 is not subject to SDO standards balloting procedures, and may be modified at any time, to reflect certain lessons learned regarding the manner in which SE elements are represented in NTCIP 1200-series Data Dictionary standards.

Note: Much of the content of NTCIP 8001 Annex B1 was developed circa 2007, and certain practices with respect to the representation of Systems Engineering Process (SEP) content and Systems Engineering (SE) element in NTCIP documents has changed over time. As more recent practices are validated, these are slated for incorporation in a subsequent version of NTCIP 8002 Annex B1.

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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](http://www.ntcip.org).

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## Approvals

As noted, NTCIP 8002 Annex B1 is a guidance document, and is not subject to SDO balloting procedures. As an NTCIP Guidance document, NTCIP 8002 Annex B1 is not subject to SDO standards balloting procedures, and may be modified at any time, to reflect certain lessons learned regarding the manner in which SE elements are represented in NTCIP 1200-series Data Dictionary standards.

## History

Work on NTCIP 8002 Annex B1 started circa 2004. Work on NTCIP 8002 Annex B1 v01 ended circa 2007.

Note: Much of the content of NTCIP 8001 Annex B1 was developed circa 2007, and certain practices with respect to the representation of Systems Engineering Process (SEP) content and Systems Engineering (SE) element in NTCIP documents has changed over time. As more recent practices are validated, these are slated for incorporation in a subsequent version of NTCIP 8002 Annex B1.

In 1992, the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section began the effort to develop the NTCIP. The Transportation Section's purpose was to respond to user needs to include standardized systems communication in the NEMA TS 2 standard, *Traffic Controller Assemblies*. 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 Intelligent Transportation Systems (ITS) network.

In September 1996, an agreement was reached among AASHTO, ITE, and NEMA to jointly develop, approve, and maintain NTCIP Standards. In late 1998, the Base Standards and Protocols Working Group was tasked with the effort to develop and maintain base standards for the NTCIP. In late 2003, the Joint Committee on the NTCIP merged the Base Standards and Protocols Working Group with the Profiles Working Group and the new group was designated the Base Standards, Protocols, and Profiles Working Group. The first meeting of the merged working group was held in January 2004.

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## **Annex B1**

### **Content Outline for NTCIP 1200-Series Documents**

#### **B1.1 Purpose and Application**

NTCIP 8002 Annex B1 defines the content outline and clause numbering for NTCIP 1200-series Device Data Dictionary standards publications. The content outline includes: the section numbering, the clause and subclause numbering, the annex numbering, the clause and subclause subject content, and the labels and tags that shall be used with each subclause.

Annex B1 applies to NTCIP 1200-series Device Data Dictionary standards publications. Until other Annex B's are developed, this Annex B1 may be used with modification to guide the outline content for other NTCIP standards publications, such as Base Standards, Message Sets, Interface Definitions, and Profiles.

Annex B1 results from the NTCIP pilot project to add systems engineering content to device data dictionaries. In June 2001, a straw poll of the NTCIP Joint Committee endorsed an expedited project plan in the focus area of DMS to restructure the NTCIP 1203 content. The plan proposed adding functionality, feature set, interface specifications, and traceability sections. Between March 2002 and January 2004, a defined "systems engineering process," or SEP, was researched and applied by the DMS WG. In May 2004, the NTCIP Joint Committee accepted the content recommendations from a March 2004 TCF meeting regarding SEP, except that all content elements be grouped in one document under one number, and a System Interface description not be included.

After issuing this Annex B1, NTCIP 8002 Section 2 will be revised. Section 2, "Parts of an NTCIP Document," will be revised to only include the numbering scheme and other specifications on the parts of NTCIP standards publications. The 8002 Annex B-series will define the content outline.

#### **B1.2 Conformance**

After December 15, 2004, all NTCIP 1200-series minor- or major-version revision draft documents, created or revised by any NTCIP WG, shall organize the document content to conform to this Annex B1.

To provide for greater uniformity among NTCIP device data dictionaries, all conforming NTCIP 1200-series standards publications shall include as mandatory all of the defined Section and Annex numbers and titles, and all of the first-order clauses (i.e., the N.N-numbered clauses) listed in this Annex, unless tagged as "[Optional]." Second-order subclauses (i.e., the N.N.N-numbered subclauses) and lower-order subclauses are also optional.

Mandatory Sections, Annexes, and clauses that do not have content defined by the responsible WG, or only have content partially developed and defined, or may not be applicable to the type of device or concept being standardized, shall include one of the following disclaimers:

<This clause intentionally left blank.>

<This clause will include additional content in future versions of this standard publication.>

<In the opinion of the responsible NTCIP working group, this clause does not apply in the context of this standard publication.>

All Sections and Annexes shall be labeled as Normative or Informative. If within a Normative Section, Annex, or clause, informative text is included, the informative text shall be separated as a separate subclause and shall be tagged as Informative. The tag shall be in square brackets after the subclause title. For example:

### 1.1.1 Subclause Title Here [Informative]

The Annexes shall be organized and numbered in an order such that annexes that could be considered for deletion in future versions shall be last.

## B1.3 Content Outline

*Within NTCIP 8002 Annex Annex B1, the subsequent Section clause numbers, subclause numbers, clause titles, and subclause titles as those that shall be used in the NTCIP 1200-series standards:*

### Front Matter

Cover Page – conforming to NTCIP 8002 Annex A1

NOTICES – conforming to NTCIP 8002 Annex A1 and current practice

    Copyright Notice – conforming to NTCIP 8002 Annex A1

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ACKNOWLEDGEMENTS – conforming to NTCIP 8002 Annex A1

FOREWARD – conforming to NTCIP 8002 Annex A1

    User Comment Instructions – conforming to NTCIP 8002 Annex A1

    Approvals – conforming to NTCIP 8002 Annex A1

    History – conforming to NTCIP 8002 Annex A1

INTRODUCTION – conforming to NTCIP 8002 Annex A1

CONTENTS – conforming to NTCIP 8002 Section 2

**Section 1 General [Informative]** – conforming to NTCIP 8002 Section 2

1.1 Scope – conforming to NTCIP 8002 Section 2

1.2 References – conforming to NTCIP 8002 Section 2

    1.2.1 Normative References – conforming to NTCIP 8002 Section 2

    1.2.2 Other References – conforming to NTCIP 8002 Section 2

1.3 General Statements – as per current practice

1.4 Terms – as per current practice

1.5 Abbreviations – as per current practice

## **Section 2 Concept of Operations [Normative]**

This section is narrative, and systematically identifies the system environment, along with operations and maintenance activities of an aggregation of users in using the system. System is defined as the device, “product”, or profile whose interface is the subject of the standard. Not all interior protocol documents (e.g., 1103, 2xxx, etc.) need a Concept of Operations. A single Concept of Operations may be prepared for a profile, or for an architectural link (i.e., center-to-field or center-to-center). There should be no obligation to reproduce what is in other standards, but there should be an obligation to show how the system relates to other standards. [Ref: IEEE Guide for Information Technology – System Definition-Concept of Operations (ConOps) Document, IEEE Std. 1362-1998]

Target Audience: Users and Consultants

2.1 Tutorial [Informative] One to two page explanation on how to use this document, including a description of how to navigate from user needs to functional requirements in the PRL to dialogs and data elements in the Requirements Traceability Matrix (RTM).

2.2 Current Situation and Problem Statement [Informative] A narrative overview of how the subject system is used and why this standard is being developed.

2.3 Reference Physical Architecture [Informative] A narrative description of the typical physical architecture for the subject system, along with a graphic that defines the scope of the interface that is the subject of this standard.

2.4 Architectural Needs A narrative description of issues and needs relative to the system architecture that have a direct impact on this standard.

2.5 Features A narrative description of user activities relative to the system. These should be systematically and logically organized. NOTE: The WG should maintain a White Paper that documents user needs that were identified but not included in the Concept of Operations.

Criteria for Well Written Needs [Christie analysis of 1211, 0801]

The following criteria are used to determine if a need is well written:

1. Uniquely Identifiable: Each need must be uniquely identified (i.e., each need shall be assigned a unique number and title).
2. Major Desired Capability (MDC): Each need shall express a major desired capability in the system, regardless of whether the capability exists in the current system or situation or is a gap.
3. Solution Free: Each need shall be solution free, thus giving designers flexibility and latitude to produce the best feasible solution.
4. Capture Rationale: Each need shall capture the rationale or intent as to why the capability is needed in the system.

2.6 Security A narrative description of issues and needs relative to system security that have a direct impact on this standard.

2.7 [Optional] Operational Policies and Constraints A narrative description of specific policies or constraints relative to the operational environment that have a direct impact on the implementation of this standard.

2.8 [Optional] Relationship to the ITS National Architecture [Informative] A narrative description of the National ITS Architecture flows addressed by this standard.

2.9 [Optional] Operation Scenarios [Informative] Narrative examples of user activities.

### **Section 3 Functional Requirements [Normative]**

This section is narrative and identifies the required expected behavior. In addition, this section identifies and describes the device, along with the use of the device. The following list provides guidance on the development of requirements:

- Requirement is defined in IEEE 610 as “A condition or capability needed by a user to solve a problem or achieve an objective.”
- Requirements should center on features and they must clearly articulate and/or reference the functionality that the interface is trying to manage, as presented in the Concept of Operations.
- Requirements are based upon expected behavior presented in the Concept of Operations
- Types of requirements include both interface requirements and performance requirements.

- Requirements describe the necessary task, action, or activity that must be accomplished.
- Requirements may also describe what the system or one of its components must do.
- Requirements should be logically organized.
- Requirements should be written for ease of use by the target audience.

When possible, existing standards containing requirements should be referenced. However, existing standards may need to be constrained or augmented. In either case, the referenced standard should be cited as a normative reference. If an existing standard containing requirements is referenced, then a description of the presumed functionality should be included in this section. [Ref: IEEE Guide for Developing System Requirements Specifications, IEEE Std. 1233-1998]

3.1 Tutorial [Informative] A discussion of the three types of requirements and how these relate to the user needs and dialogs. Also, if any figures are used, describe how these relate to the text.

3.2 Scope of the Interface [Informative] An architectural graphic may be included that defines the scope of the interface. This may be a refinement of the graphic included in the Concept of Operations to the extent that additional information is needed. Specifying text unique to the device is optional.

3.3 Protocol Requirements List (PRL) The PRL provides traceability between the user needs and the functional requirements. An initial draft of the PRL should be prepared during the development of the Concept of Operations with information included to the extent possible. The PRL can be completed after the functional requirements are included. In addition, the PRL should include all user-specified data range values.

3.3.1 Notation [Informative] A narrative description of the notation and symbols used in the PRL.

3.3.1.1 Conformance Symbols

3.3.1.2 Conditional Status Notation

3.3.1.3 Support Column Symbols

3.3.2 Instructions for Completing the PRL [informative] A narrative providing guidance for the target audience on how to use the PRL.

3.3.3 Protocol Requirements List (PRL) Table

Table headings include:

User Need ID – the number assigned to the user need statement.

User Need – a short descriptive title identifying the user need.

FR ID – the number assigned to the functional requirement statement.

Functional Requirement – a short descriptive title identifying the functional requirement.

Conformance – implementation is mandatory or optional

Support – user selectable to indicate yes or no to the requirement.

Additional Specifications – identifies other requirements that must be satisfied, including user selectable range values.

**Table 1 Example Initial Draft PRL Table**

Protocol Requirements List (PRL)						
User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specifications
2.1.2	[textHere]			[textHere]	[textHere]	[textHere]
2.1.2.1	[textHere]			[textHere]	[textHere]	[textHere]
2.1.2.1.1	[textHere]			[textHere]	[textHere]	[textHere]
		[numberHere]	[textHere]	[textHere]	[textHere]	[textHere]
		[numberHere]	[textHere]	[textHere]	[textHere]	[textHere]
[numberHere]	[textHere]			[textHere]	[textHere]	[textHere]
		[numberHere]	[textHere]	[textHere]	[textHere]	[textHere]
[numberHere]	[textHere]			[textHere]	[textHere]	[textHere]
[numberHere]	[textHere]			[textHere]	[textHere]	[textHere]
		[numberHere]	[textHere]	[textHere]	[textHere]	[textHere]
[numberHere]	[textHere]			[textHere]	[textHere]	[textHere]

Note: Table should be formatted in a landscape orientation.

3.4 Architectural Requirements Narrative text identifying the required behavior of the system, based upon the architectural needs identified in the Concept of Operations and any restrictions to general architectural requirements.

3.5 Data Exchange and Operational Environment Requirements Narrative text identifying the required behavior of the system, based upon the user needs identified in the Concept of Operations. The scope of the requirements includes that which is typically available in the industry (a reasonable set of needs). The requirements should be classified into groups, based on an ordered taxonomy, and promote traceability with other specifications in the standard.

*3.4.1 Configuration Requirements*

3.4.2 Status and Monitoring Requirements (e.g., device health and welfare)

3.4.3 Data Retrieval Requirements (e.g., sensor data)

3.4.4 Control requirements

3.6 Supplemental Non-communications Requirements Narrative text identifying additional requirements of the system that are derived from the architectural and/or functional requirements, but are not themselves architectural or functional requirements. A given supplemental requirement may relate to multiple architectural and/or functional requirements. Supplemental requirements frequently include range capabilities of the equipment (e.g., how many \_\_\_\_\_ are supported by the device). In these cases, the standard should always define a conservative (i.e., easily met, but still useful) default, but allow a specification to override the default.

## **Section 4 Dialogs [Normative]**

Target Audience: Manufacturers and System integrators

4.1 Tutorial [Informative] One to two page explanation on how to use this document, including a description of how to navigate from user needs to functional requirements in the PRL to dialogs and data elements in the Requirements Traceability Matrix (RTM).

4.2 Specified Dialogs A narrative description of the sequence of data exchange to achieve a required behavior. Diagrams and graphical representations may also be included when needed to supplement the text. However, the diagrams should not be used as a replacement for text. This clause should only include those dialogs that have special semantics or impose special restrictions on the operations that are allowed.

4.2.1 Dialogs should be included as necessary.

4.2.2 The sequence of object exchange may also include internal and external actions.

4.3 [Optional] State-Transition Diagrams State-Transition diagrams should be included, as necessary, for those objects that have states. State-Transition diagrams must be included for those objects that manage states. "State-transition diagrams describe all of the states that an object can have, the events under which an object changes state (transitions), the conditions that must be fulfilled before the transition will occur (guards), and the activities undertaken during the life of an object (actions)." (Reference: State-Transition Diagrams: Testing UML Models. Part 4 by Lee Copeland)

State-Transition Tables – listing of the possible state transitions

Legitimate Transitions – must be listed for state transition diagrams, when such diagrams are deemed necessary.

Illegitimate Transitions – must be listed for state transition diagrams, when such diagrams are deemed necessary.

4.4 [Optional] Class Diagrams Class Diagrams should be included, as necessary, for those objects that have states. "A class diagram describes the classes that make up a system and the static relationships between them. Classes are defined in terms of their name, attributes (or data), and behaviors (or methods). The static relationships are association, aggregation, and inheritance." (Reference: Class Diagrams: Testing UML Models. Part 3 by Lee Copeland)



## **Section 5 Management Information Base (MIB) [Normative]**

The MIB containing object definitions formatted in accordance with NTCIP 8004 must be present in the body of the published standard.

MIB(s) may reference supplemental information in Informative Annexes. However, this does not relieve the burden of providing clear, concise, and unambiguous object definitions and descriptions in the MIB.

5.0 MIB Header A header template used to prepare the MIB header in the MIB electronic text file, with version number and configuration management notes. Do not repeat text, such as the Distribution Notice, that appears elsewhere in the standard.

5.1 Object Definitions Formatted in the ASN.1 OBJECT-TYPE Macro, as per NTCIP 8004.

## **Annex A1 Requirements Traceability Matrix (RTM) [Normative]**

The RTM should include the requirement number and title, in addition to traceability to interface definitions (if present), dialogs, and objects.

A.1 Notation [Informative] A narrative description of the notation and symbols used in the RTM.

A.2 Instructions for Completing the RTM [Informative] A narrative providing guidance for the target audience on how to use the RTM.

A.3 Requirements Traceability Matrix (RTM) Table

Table headings include:

FR ID – the number assigned to the functional requirement statement.

Functional Requirement – a short descriptive title identifying the functional requirement.

Interface ID – the number assigned to the interface description.

Interface – a short descriptive title identifying the interface description.

Dialog ID – the number assigned to the dialog description.

Object ID – the number assigned to the object.

Object Name – the actual object name used in the MIB.

Additional Specifications – identifies other requirements that must be satisfied, including user selectable range values. (i.e., duplicated text from PRL, plus object range definitions for each sub-ranged object)

**Table 2 Example RTM Table**

Requirements Traceability Matrix (RTM)							
FR ID	Functional Requirement	Interface ID	Interface	Dialog ID	Object ID	Object Name	Additional Specifications
3.3	[textHere]						[textHere]
3.3.1	[textHere]						[textHere]
3.3.1.1	[textHere]			[numberHere]			[textHere]
3.3.1.2	[textHere]			[numberHere]			[textHere]
3.3.2	[textHere]						[textHere]
3.3.2.1	[textHere]			[numberHere]			[textHere]
		[numberHere]	[textHere]		[numberHere]	[textHere]	[textHere]
		[numberHere]	[textHere]		[numberHere]	[textHere]	[textHere]
[numberHere]	[textHere]						[textHere]
[numberHere]	[textHere]			[numberHere]			

Note: Table should be formatted in a landscape orientation.

### **Annex A2 Conformance Group Tables [Normative]**

The older Conformance Groups tables are no longer shown in the 8002 Annex B1 format outline. [Bob De Roche suggested an additional normative appendix, in the discussion to dispose of UC0429 on 1201 v02 Amendment 2. The Group table was proposed to be used to define the globalSetIDParameter, and provide guidance as to what “user-changeable static database objects” this object covers. Possibly we should even require other standards to state which objects are included / excluded from the calculation.]

### **Annex B Object Tree [Informative]**

As illustrated in NTCIP 8004, presents a graphical representation of the branch and tree structure for objects identified within the standard, with linkage back to the appropriate NEMA node.

### **Annex C Test Procedures [Normative]**

Defined as per NTCIP 8007.

### **Annex D Documentation of Revisions [Informative]**

Where an object must be deprecated, this annex should document the reason for deprecation and describe the link between the new means and the old. This annex documents the justification for changes considered by the WG.

### **Annex E User Requests**

In lieu of a separate paper, this annex documents user requests that were not included in this standard. [Optional]

### **Annex F Other Annexes**

As needed (e.g., ASCII Table, FAQ). [Optional]

### **Annex G SNMP Interface [Normative]** [This Annex should be used only until replaced by the NTCIP 2801 Communications Profiles SEP.]

A narrative description of the formal rules for the generic process by which all data is exchanged between the subject system and the entity that is being communicated with. Diagrams and graphical representations may also be included when needed to supplement the text, however, they should not be used as a replacement for text.

G.1 Generic SNMP GET Interface

G.2 Generic SNMP GET-NEXT Interface

G.3 Generic SNMP SET Interface

G.4 Variable Binding List Structure

G.5 Additional Requirements

G.5.1 Grouping of Objects in a Request

G.5.2 Support of GET

G.5.3. Support of GET-NEXT

G.5.4 Support of SET

G.5.5 Performance

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