

A Recommended Standard of the Joint Committee on the NTCIP

NTCIP 1209 version v02.17

National Transportation Communications for ITS Protocol Object Definitions for Transportation Sensor Systems (TSS)

v02.17 December 2010

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1201 v03	<i>GO</i>	Norm.	1209 v02 needs 1201 v03. Changed refs to 1201 v03. May 2010 = repl RS accepted by JC. May 2010 = out for SDO ballot. Dec 2010 = JA	Off HOLD May 2010
2301 v02	<i>AP-STMf</i>	Norm.	2008 = RS; 2009 = out for ballot; 2010 = JA. Sept 2010 = Published	Off HOLD
8004 v02	<i>SMI</i>	Other	2009 = out for ballot; June 2010 = JA; Aug 2010 = Published	Off HOLD

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At the time that NTCIP 1209 v02 was prepared, the following individuals were members of the NTCIP TSS Working Group:

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FOREWORD

NTCIP 1209 v02 defines the Transportation Sensor System (TSS) data elements that are supported by the National Transportation Communications for ITS Protocol (NTCIP). A TSS is defined as any system capable of detecting and communicating certain traffic parameters using NTCIP.

The effort to develop NTCIP began with the 3-TS Transportation Management Systems and Associated Control Devices Section of the National Electrical Manufacturers Association (NEMA). Their original desire was to address a user need for extending the TS 2 standards 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 Intelligent Transportation Systems (ITS) networks.

In September 1996, a formal agreement was reached among NEMA, ITE, and AASHTO to jointly develop, approve, and maintain NTCIP standards. Under guidance of a Joint AASHTO / ITE / NEMA Committee on NTCIP, a Working Group was created to develop data element definitions for Advanced Systems Sensors. The first meeting of the Working Group was in August 1997. Discussions within the Working Group lead to renaming of the Working Group to Transportation Sensor Systems.

The predecessor of NTCIP 1209 v02, NTCIP 1209:2005, *NTCIP Data Element Definitions for Transportation Sensor Systems*, defined data elements in ASN.1 using the SNMP Object Type Macro for devices that sense the presence or similar characteristics of vehicles. These definitions are intended for detection devices that range from smart inductive loop amplifiers to technologies such as machine vision.

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Approvals

NTCIP 1209 v02 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, as of the date:

AASHTO—Standard Specification; **** 2011

ITE—Software Standard; **** 2011

NEMA—Standard; **** 2011

History

A brief history of NTCIP 1209 follows:

NTCIP 1209:2005 v01.19—Between 1999 and 2002, two user comment drafts were issued for review. In 2003, v01.18 was accepted as a Recommended Standard of the Joint Committee. In 2005, and after disposition of ballot comments, v01.18e was Jointly Approved. In November 2005, NTCIP 1209 v01.19 was published as NTCIP 1209:2005.

NTCIP 1209 v02—Between 2004 and 2007, the TSS WG developed drafts with additional Systems Engineering content, and support for machine vision detection technology. In August 2007, the User Comment Draft NTCIP 1209 v02.10 was issued for user review and comment. In April 2008, after disposition of user comments, the NTCIP 1209 v02.15 was accepted as a Recommended Standard. In October 2010, after lifting a hold imposed by Normative References, NTCIP 1209 v02.17 was edited for SDO balloting and approval. In December 2010, v02.17 was issued with NTCIP Standards Bulletin B0141.

Compatibility of Versions

To distinguish NTCIP 1209 v02 (as published) from previous drafts, NTCIP 1209 v02 also includes NTCIP 1209 v02.17 on each page header. All NTCIP Standards Publications have a major and minor version number for configuration management. The version number syntax is "v00.00a," with the major version number before the period, and the minor version number and edition letter (if any) after the period.

NTCIP 1209 v02 is designated, and should be cited as, NTCIP 1103 v02. Anyone using NTCIP 1103 v02 should seek information about the version number that is of interest to them in any given circumstance. The MIB, the PRL, and the PICS should all reference the version number of the standards publication that was the source of the excerpted material.

Conformant systems based on later, or higher, version numbers MAY NOT be compatible with conformant systems based on earlier, or lower, version numbers. Anyone using NTCIP 1209 v02 should also consult NTCIP 8004 v02 for specific guidelines on compatibility.

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Section 1 GENERAL

1.1 SCOPE

Communication between an ITS Management Center or portable computer and a Transportation Sensor System (TSS) is accomplished by using NTCIP Application Layer services to convey requests to access or modify values of TSS data elements resident in the TSS via an NTCIP network. An NTCIP message consists of a specific Application Layer service and a set of data elements. An NTCIP message may be conveyed using any NTCIP defined class of service that has been specified to be compatible with the Simple Transportation Management Framework (STMF).

The scope of NTCIP 1209 v02 is limited to the functionality related to TSS within a transportation environment. NTCIP 1209 v02 defines data elements that are specific to TSS and also defines standardized data element groups that can be used for conformance statements. The limits and descriptions of the parameters are established to give the user maximum flexibility to operate TSS that either existed when NTCIP 1209 v02 was developed or may exist in the future.

1.2 REFERENCES

Normative references contain provisions that, through reference in this text, constitute provisions of NTCIP 1209 v02. Other references in NTCIP 1209 v02 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.

1.2.1 Normative References

IAB Std. 16 / RFC 1155	<i>Structure and Identification of Management Information for TCP/IP-based Internets</i>
IAB Std. 16 / RFC 1212	<i>Concise MIB Definitions</i>
ISO/IEC 8824-1:2008	Information Technology—Abstract Syntax Notation One (ASN.1): Specification of Basic Notation
AASHTO / ITE / NEMA NTCIP 1103 v02	<i>Transportation Management Protocols (TMP)</i> July 2010 edition published in October 2010
AASHTO / ITE / NEMA NTCIP 1201 v03	<i>Global Object (GO) Definitions</i> December 2010 edition to be published in 2011
AASHTO / ITE / NEMA NTCIP 2301 v02	<i>Simple Transportation Management Framework (STMF) Application Profile (AP) (AP-STMF)</i> July 2010 edition published in September 2010

1.2.2 Other References

IAB Std. 17 / RFC 1213	<i>Management Information Base for Network Management of TCP/IP-based internets:MIB-II</i>
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ISO/IEC 8825-1:2008	<i>Information Technology—ASN.1 Encoding Rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)</i>
AASHTO / ITE / NEMA NTCIP 8004 v02	<i>Structure and Identification of Management Information (SMI)</i> published June 2010
AASHTO / ITE / NEMA NTCIP 9001 v04	<i>The NTCIP Guide</i> published July 2009
RFC 1157	<i>Simple Network Management Protocol (SNMP)</i>
David Perkins & Evan McGinnis	<i>Understanding SNMP MIBs</i> , New Jersey, Prentice Hall PTR, 1997, ISBN 0-13-437708-

1.2.3 Contact Information

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1.3 GENERAL STATEMENTS

No general statements are included.

1.4 TERMS

For the purposes of NTCIP 1209 v02, the following terms and definitions (with acronyms, where appropriate) apply. For terms not defined in this section, English words are used in accordance with their definitions in the latest edition of Webster's New Collegiate Dictionary. Electrical and electronic terms not

defined in this section or in Webster's New Collegiate Dictionary are used in accordance with their definitions in IEEE Std 100-2000.

Arming Enable	A selected state of an arming input bit or Arming Pin of the TSS that can be used to modify its operation.
Arming Input Bit	An external event that is reported to the TSS using this protocol and used to modify its operation.
Arming Pin	A physical input to the TSS that can be monitored and used to modify its operation.
class	A subdivision of collected historical sample data. NOTE—How the sample data is subdivided is manufacturer-specific and is, therefore, kept generic in NTCIP 1209 v02.
ConOps	Concept of Operations
CTime	CTime is a function that converts a long integer, pointed to by a clock function, representing the time in seconds since the Epoch (00:000:00 UTC, January 1, 1970), and returns a pointer to a 26-character string of the form Www Mmm dd hh:mm:ss yyyy \n\0 (e.g., Thu Nov 24 18:22:48 2001\n\0) with Www being weekday, Mmm being month, dd being day, hh being hour, mm being minute, ss being second, yyyy being year, \n being a new line control code, and \0 being a null-character control code. All fields have a consistent width. Time zone and daylight saving time (DST) corrections are made before string generation.
delay	A feature that allows the detection output from a TSS detector to be deferred for a user set time period.
deprecated	In the context of a MIB, 'deprecated' is an object STATUS value that indicates the object is valid in limited circumstances and may have been replaced by another. NOTE—To maintain multi-version interoperability (MVI-backward compatibility) for legacy NTCIP implementations, objects with a STATUS value of 'deprecated' may require support. When necessary to support legacy NTCIP implementations, required support for objects with a STATUS value of 'deprecated' is indicated using the Profile Implementation Conformance Statement (PICS), Protocol Requirements List (PRL). From NTCIP 8004 v02.
DST	Daylight Saving Time
extension	A feature that allows the detection output from a TSS detector to be lengthened for a user set time period.
Fail-Safe Mode	Capable of compensating automatically and safely for a failure, as a mechanism or power source.
feature	A service provided by or behavior of the TSS.
Firmware Version	A manufacturer specified description for identifying the software currently embedded in the TSS.

Hardware Version	A manufacturer specified description for identifying the electronic components that comprise the TSS.
interchangeability	A condition that exists when two or more items possess such functional and physical characteristics as to be equivalent in performance and durability, and are capable of being exchanged one for the other without alteration of the items themselves, or adjoining items, except for adjustment, and without selection for fit and performance. (National Telecommunications and Information Administration, U.S. Department of Commerce)
interoperability	The ability of two or more systems or components to exchange information and use the information that has been exchanged. NOTE—From IEEE <i>Standards Dictionary, Glossary of Terms and Definitions</i>.
Live Data	A specific operational network configuration between the management station and the TSS where the information exchange can be performed without the need for initiating and terminating a physical network connection between the management station and TSS. From a network perspective, this configuration is an 'always on' connection, where the management station has access to the 'current' information available in the TSS.
LSB	Least Significant Bit
Management Information Base (MIB)	A structured collection or database of related managed objects defined using Abstract Syntax Notation One (ASN.1). NOTE—The information is provided in Abstract Syntax Notation 1 (ASN.1) format. From NTCIP 8004 v02 and ISO/IEC 8824-1:2008 and ISO/IEC 8825-1:2008."
Management Station	A remote computer (e.g., Traffic Management Center), local computer (e.g., Laptop), or local controller (e.g., Traffic Controller).
MSB	Most Significant Bit
MVI	Multi-Version Interoperability (backward compatibility)
Near Real-Time Data	Data that depicts an event as it existed at the current time less the processing time. The data varies from real time data because it is dependent on the type and speed of transmission. This data is useable for identifying changes in traffic flows.
normalized	Process of reducing sample data to a common denominator to accommodate comparison of the measured data.
obsolete	In the context of a MIB, 'obsolete' is an object STATUS value that indicates the definition is no longer valid, was found to be flawed, redundant, or was not useful. NOTE—In the next (or some future) edition of the standard, the object or group with a STATUS value of 'obsolete' may be removed. This definition is modified from Understanding SNMP MIBS. From NTCIP 8004 v02.

occupancy	A measurement of vehicle presence within a zone of detection, expressed in seconds of time a given point or area is occupied by a vehicle.
output	The condition of an on/off status generated by a change of state.
Output Mode	There are two common modes, Presence and Pulse. In the presence output mode, a detection of a vehicle is output constantly while the vehicle is in the zone. In the pulse output mode, a detection is output for 125 milliseconds ($\pm$ 25 milliseconds) and then the zone is retuned.
Output Group	Represents a multiple of eight (8) sequentially numbered outputs. Output Group 1 consists of Outputs 1 to 8, Output Group 2 consists of Outputs 9 to 16, etc.
PRL	Protocol Requirements List
protocol	A specific set of rules, procedures, and conventions defining the format and timing of data transmissions between devices that are accepted and used to understand each other. NOTE—From NTCIP 8004 v02.
Protocol Version	A standardized description for identifying the version of the TSS standard to which the TSS is designed to conform.
Requirement	A condition or capability to which a system must conform, either derived directly from the user needs, or stated in a contract, standard, specification, or other formally imposed document. A desired feature, property, or behavior of a system.
Requirements Traceability	The ability to follow or study the logical progression among the needs, requirements, and design details in a step-by-step fashion.
RTC	Real Time Clock
RTM	Requirements Traceability Matrix
Sample Period	Duration of time in seconds when data for the zone is being collected.
Sensitivity	The ability of the TSS to react to incoming signals, expressed as the minimum input signal required to produce an output signal.
Sensitivity Mode	A characteristic of the loop detector being used. It is defined as either $\Delta L/L$, $\Delta L/\sqrt{L}$, or ΔL .
Sensor	A physical device used for sensing traffic.
SEP	Systems Engineering Process
SNMP	Simple Network Management Protocol
Transportation Sensor System (TSS)	Any system capable of sensing and communicating near real-time traffic parameters using NTCIP.
User	A person who will utilize the system that is developed.

User Need	The business or operational problem (opportunity) that must be fulfilled in order to justify purchase or use. While this is termed a 'user need' within the NTCIP community, it reflects needs of all stakeholders.
Virtual Zone	A logical combination of one or more zones to create a new zone with its own conditioning and Arming Enables. This is useful in combining zones to a single zone to provide one output from many zones. This can also be used to alias a zone so that the same zone can provide multiple outputs, each with different conditioning parameters, sample periods, and/or trigger usage.
Zone	An area in which traffic parameters can be measured and/or traffic data can be generated. NOTE—A zone may denote or represent a lane of a freeway, a left turn lane, or even a multiple lane area. The zone may be either physical or non-intrusive. Examples of this are a physical loop cut into the roadway or a spot on a roadway where a video image processor is measuring data or detecting presence. In NTCIP 1209 v02, a Zone is independent of the underlying technology used to measure and collect its data. Further, the term 'sensor zone' is used interchangeably with the term 'zone,' because a predecessor of NTCIP 1209 v02 used the term 'sensor zone,' and using the term 'zone' throughout would have necessitated changes in OBJECT-TYPE, and possible deprecation. Therefore, both terms are used interchangeably.
Zone Options	Special settings for controlling the behavior of zones.

Section 2

CONCEPT OF OPERATIONS

[Normative]

Section 2 defines the user needs that subsequent sections address. Accepted System Engineering Process (SEP) details that requirements should only be developed to fulfill well-defined user needs. The first stage in this process is to identify the ways in which the system is to be used. For NTCIP 1209 v02, this entails identifying the various ways in which transportation operations personnel may use TSS information to fulfill their duties.

This concept of operations (ConOps) provides the reader with:

- a) A detailed description of the scope of NTCIP 1209 v02;
- b) An explanation of how a TSS is expected to fit into the larger context of an ITS system;
- c) A starting point in the procurement process; and
- d) An understanding of how NTCIP 1209 v02 is designed.

Section 2 is intended for all readers, including:

- a) Transportation operations managers
- b) Transportation operations personnel
- c) Transportation engineers
- d) System integrators
- e) Manufacturers

For the first three categories of readers, Section 2 provides a useful understanding of how TSS equipment can be used in the reader's system. For this audience, Section 2 serves as the starting point in the procurement process, enabling readers to become familiar with each NTCIP 1209 v02 feature and determine whether that feature is appropriate for their implementation. If it is, then an agency's procurement specification should require support for that feature and all of the mandatory requirements related to that feature.

For the last two categories of readers, Section 2 is useful to gain a more thorough understanding as to why the more detailed requirements (specified in subsequent sections) exist.

2.1 TUTORIAL

The size and technical level of detail contained in NTCIP 1209 v02 might be a bit intimidating. Therefore, Section 2.1 has been added to provide a more manageable overview.

A Concept of Operations (ConOps) describes a proposed system from the user's perspective. Typically, a ConOps is used on a project to ensure that system developers understand user needs. In NTCIP standards, the ConOps documents the intent of each feature for which an NTCIP standard supports a communications interface. It also serves as a starting point for users to select which features may be appropriate for their project.

The ConOps starts with a discussion of the current situation and issues that have led to the need to deploy systems covered by the scope of an NTCIP standard, and to the development of an NTCIP standard itself. This discussion is presented in lay terms so that both potential users of the system and system developers can understand and appreciate the situation.

The ConOps then documents key aspects about the proposed system, including the:

- a) Reference physical architecture—The reference physical architecture defines the overall context of the proposed system and defines the specific interface addressed. The reference physical architecture may be supplemented with one or more samples that describe how the reference physical architecture may be realized in an actual deployment.
- b) Architectural Needs—Architectural needs discuss the issues and needs relative to the system architecture that have a direct impact the subject area.
- c) Features—The features identify and describe the various functions that users may want the TSS to perform. These features are derived from the high-level user needs identified in the problem statement, but are refined and organized into a more manageable structure that forms the basis of the Protocol Requirements List (PRL) and Requirements Traceability Matrix (RTM) contained in Section 3 and Annex A, respectively.

The architectural needs and features are collectively called user needs. Section 3 uses these user needs in the analysis of the system to define the various functional requirements of a TSS. Each user need is required to trace to one or more functional requirements, and each functional requirement is required to derive from at least one user need. This traceability is shown in the PRL in Section 1.1.1.

While NTCIP 1209 v02 is intended to standardize communications across a wide range of deployments, it is not intended to mandate support for every feature for every deployment. Therefore, the PRL also defines each user need and requirement as mandatory, optional, or conditional. The only items marked mandatory are those that relate to the most basic functionality of the TSS. To obtain a TSS that meets specific needs, the user first identifies which optional needs are necessary for the specific project.

Each requirement identified is then presented in the RTM in Annex A, which defines how the requirement is fulfilled through the standardized dialogs and data element definitions provided in Section 4 and Section 5, respectively.

2.1.1 Background

NTCIP 1209 v02 is a standard that specifies the logical interface between Transportation Sensor Systems (TSS) and the host systems that control them (commonly referred to as central systems). NTCIP 1209 v02 describes the supported TSS interface functionality in terms of user needs and requirements.

As for limitations, NTCIP 1209 v02 defines data that could be transmitted between a central system and a conformant TSS, but it does not define the functionalities and functions available within a TSS or a central system. Also, NTCIP 1209 v02 does not claim to address all potential capabilities of a TSS or a controlling/monitoring central system, because such a claim would not permit progress (i.e., if the possibility of defining extensions is precluded, no additional functionalities could be added, either by subsequent versions of NTCIP 1209 v02 or by vendors or agencies).

It is also of utmost importance to understand that not all of the functionalities have to be supported by a TSS (or a central system) to claim conformance to NTCIP 1209 v02. Instead, the project-specific agency specifications that reference and incorporate desired applicable functionalities from NTCIP 1209 v02 are the guiding requirements that determine compliance. See NTCIP 9001 v04 for further information about the relationship between conformance to a standard, and compliance with an agency specification.

2.1.2 Who are You?

In developing NTCIP 1209 v02, certain assumptions were made about readers and readers' needs. Target readers for NTCIP 1209 v02 include those who:

- a) Have heard about NTCIP and are interested in its applicability for deploying TSS;
- b) Are involved in writing agency specifications to procure TSS;
- c) Are involved in reviewing submittals to procure TSS;
- d) Are involved in software development, be it the firmware of a sensor or the software of the central system;
- e) Are involved in testing sensors or central systems; or

- f) Are involved in the operational use of these types of sensors.

2.1.3 NTCIP 1209 v02 Organization

NTCIP 1209 v02 contains the following sections:

- a) Section 1—General—This section provides the user with references, terms, and other information.
- b) Section 2—Concept of Operations (ConOps)—This section provides a description of user needs (needs for features and needs related to the operational environment) applicable to TSS.
- c) Section 3—Functional Requirements—This section defines the functional requirements that address the user needs identified in the ConOps. It includes a Protocol Requirements List (PRL) that defines conformance requirements, thereby allowing users to select the desired options for a particular project.
- d) Section 4—Dialogs—This section describes how each functional requirement is fulfilled. Dialogs define the standardized procedures for a central system to manage a sensor. Interface specifications define the operations that are allowed by the sensor and how data elements are interrelated.
- e) Section 5—Management Information Base (MIB)—This section defines the data elements (object definitions) exchanged during communications, and includes a Management Information Base (MIB).
- f) Annex A—Requirements Traceability Matrix (RTM)—This annex provides a table that traces each requirement to a dialog, one or more interfaces, and its associated list of objects.
- g) Annex B—Object Tree—This annex provides a depiction of the high-level object tree showing the nodes and some of the scalar objects. This object tree provides the user with a high-level orientation tool to navigate the data elements.
- h) Annex C—Test Procedures—This annex is a placeholder for standardized test procedures that address TSS needs and requirements. No test procedures are yet provided; however, when developed and accepted, Annex C is designated for test procedures.
- i) Annex D—Documentation of Revisions—This annex documents significant revisions between NTCIP 1209 v02, and its predecessor NTCIP 1209:2005.

2.1.4 Sections for Specific Audiences

NTCIP 1209 v02 has been designed for different audiences. The following guidance identifies the most relevant NTCIP 1209 v02 section(s) for a specific audience. For example, Agency Specification Writers / Purchasers, may benefit from an understanding of functional and operational requirements and contexts for which the overall technical requirements of the TSS are to be used. In contrast, Submittal Reviewers, Firmware/Software Developers, and/or Tester, may wish to additionally focus on agency specifications, many elements of which may be derived from selected sections of NTCIP 1209 v02. Specific audiences are encouraged to focus on the sections indicated:

- a) General Interest—Review Sections 1 and 2.
- b) Specification Writers/Purchasers—Review Sections 1, 2, and 3.
- c) Submittal Reviewers—Review Sections 1, 2, and 3, and Annex A (RTM).
- d) Firmware/Software Developers—Review all Sections and Annexes.
- e) Testers—Review all Sections and Annexes.
- f) Operators—Review Sections 1 and 2.

2.2 CURRENT SITUATION AND PROBLEM STATEMENT

Transportation system managers use TSS in a variety of ways to improve transportation system operations. To facilitate efficient movement within a transportation system, system operators need timely and accurate information on traffic flow within the system. This is typically accomplished by measuring traffic parameters at desired locations within the transportation system.

2.3 REFERENCE PHYSICAL ARCHITECTURE

NTCIP 1209 v02 addresses the communications interface between a management station and a TSS. The following paragraphs further explain the typical physical architectures used in conjunction with TSS and addressed by NTCIP 1209 v02.

2.3.1 Typical Physical Architecture

Once installed, a management station is able to communicate with the TSS through one or more of the following three mechanisms:

- Remote Computer**—This type of operation configures operational parameters and retrieves measured traffic parameters from a computer located at a remote location, such as a Traffic Management Center (TMC). This is known as either 'central' or 'remote' operation.
- Local Controller**—This type of operation configures operational parameters and retrieves measured traffic parameters through a local controller such as a traffic controller.
- Local Computer**—This type of operation performs the same functions as a remote computer, but uses a portable (e.g., laptop) computer connected directly to a port on the TSS. This port may be the same port used for the other communications mechanisms, or may be a dedicated port for this purpose.

Several management stations may communicate with the same TSS. The user should ensure that only one management station at a time configures the operational parameters of the TSS. All management stations may retrieve measured traffic parameters.

The connection between the remote computer and a TSS runs over a telecommunications network, which can be either wireline or wireless in nature.

NTCIP 1209 v02 is only concerned with the interface between an external computer and the TSS. To fulfill all of the end-user services, additional requirements may be necessary for the external management stations.

Figure 1 depicts the typical physical architecture of the key components related to TSS.

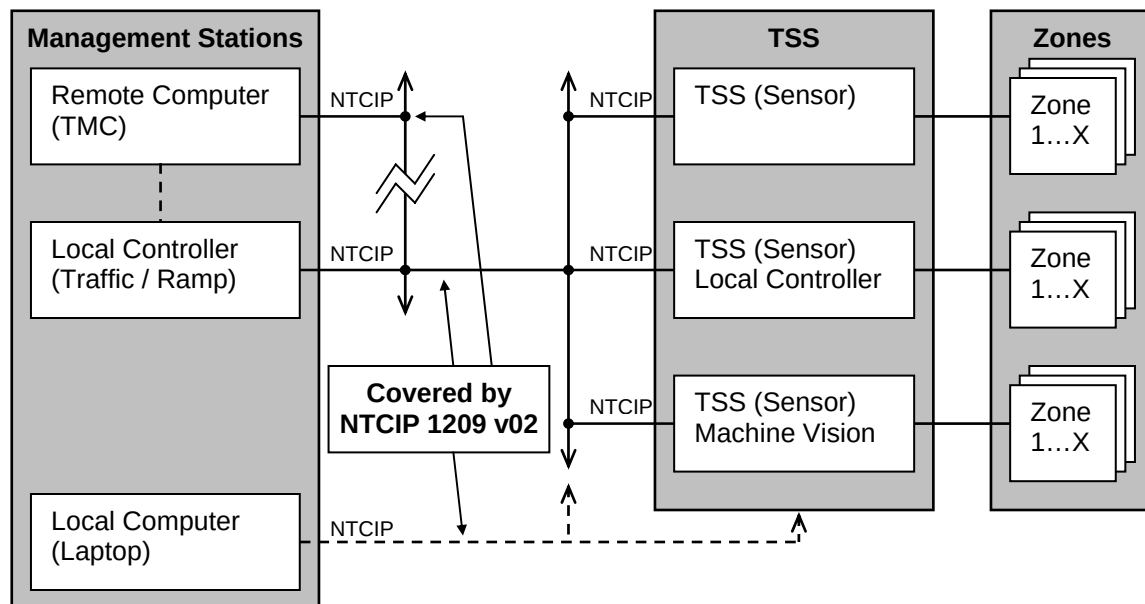


Figure 1 Typical Physical Architecture

2.3.2 Transportation Sensor Systems (TSS)

The selection of Transportation Sensor System (TSS) as a name for what was originally regarded as 'advanced sensors' stemmed from the realization that modern sensors extend well beyond the simple detection of automobiles and now include light-rail vehicles, pedestrians, and many other modes of transportation. In addition, modern detection devices are now viewed as sensing systems, rather than simple sensors or detectors. As a result, the name Transportation Sensor System (TSS) has evolved to identify a class of technology that is used for detection within the transportation community.

A TSS is defined as any system capable of sensing and communicating near real-time traffic parameters using the NTCIP. See Section 1.4.

In its simplest form, a TSS could be a single loop detector that is capable of communicating using NTCIP. Other more elaborate systems can include visual image processing systems that are used for sensing and communicating a variety of traffic parameters. The key factor that sets a TSS apart from a simple detector is the ability to communicate. Ultimately, one can envision a scenario where a combination, including a simple detector and some sort of remote processing unit with communications capabilities, could be configured as a TSS (examples include a traffic signal controller, ramp metering controller, etc.) However, traffic signal controllers and ramp metering controllers (as examples) might use their own detection-related data elements that are designed specifically to address their primary function.

2.3.2.1 Description of Zone

A zone is an area within which traffic parameters can be measured. A zone is an abstract representation of area that is independent of technology. TSS data elements allow up to 255 zones per TSS.

Traditionally, the terminology 'sensor' and 'detector' were used in a variety of ways that often referred to the physical device used for detection or the area where the detection was occurring. Sometimes these terms meant an inductive loop amplifier or some other device used for measuring traffic parameters, and other times these terms defined the area where the traffic measurements were being taken, as is the case with some visual image processing systems. The use of the term 'zone' as a descriptor for any entity capable of sensing or measuring traffic parameters and/or gathering traffic data is an effort to move away from technology dependencies and ambiguous terminology.

2.3.2.2 Description of Virtual Zone

A virtual zone is the term used in NTCIP 1209 v02 to identify a zone that is created as the result of logical combinations of physical zones. For example, in the case of an 'OR' combination of three detector zones mapped to one output, the three physical zones are logically grouped to a fourth zone that exists only to provide the resultant output. This fourth zone might be referred to as a virtual zone since it has no direct sensing capability. This virtual zone is the result of the logical combination of other zones and would otherwise have all the characteristics associated with a physical zone. There is no differentiation in this standard between 'zone' and 'virtual zone', since all zones have identical characteristics and can be used in either fashion. The concept of virtual zones is presented here only as a means of describing the ConOps for logically combining zones.

2.3.3 TSS Technologies

TSS can be based on many different sensing technologies. Each sensing technology has strengths and weaknesses. Not all sensing technologies can measure all traffic parameters. The configuration requirements for sensing technologies differ and are addressed on a technology-by-technology basis. Although all sensing technologies can operate within the TSS framework, each sensing technology may require separate configuration information. Discussions of sensing technologies included in NTCIP 1209 v02 follow.

2.3.3.1 Inductive Loop

Inductive loop vehicle detectors have existed since the 1950s and are the most used technology for vehicle detection. Inductive loop detectors sense changes in a magnetic field created by a coil (loop) of wire embedded in the driving surface. As electrically conductive material enters the loop, the amount of energy that can be stored in the magnetic field (inductance) of the loop is decreased. This decrease in inductance is measured by the detector and, when a predetermined amount of change has been sensed, a detect signal is output. Current inductive loop detectors are microprocessor-based and implement advanced algorithms to provide accurate, dependable, and effective vehicle detection.

2.3.3.2 Machine Vision (Video)

Machine vision is a detection technology where video is processed to determine various elements of vehicle detection. Analog or digital video cameras are mounted above ground and provide images of vehicle traffic to a video processor. Video is processed through the use of various algorithms to determine the presence or non-presence of vehicles as well as to calculate various traffic parameters, such as counts, speeds, and lane occupancy.

2.4 ARCHITECTURAL NEEDS

2.4.1 Fundamental Needs Driving TSS Deployment

Access to timely and accurate traffic parameters provides the information necessary to facilitate efficient movement within a transportation system.

2.4.2 Operational Environment

NTCIP 1209 v02 addresses the interface between a TSS and a management station. To enable communications between these components, the management station needs to establish a communications link with the desired TSS.

2.4.2.1 Live Data Exchange

The typical operational environment allows the management station to monitor and control the TSS by issuing requests (e.g., requests to access and/or alter configuration parameters or requests to access measured traffic parameters). In this environment, the TSS responds to requests from a management station immediately (e.g., through the provision of the requested parameters or success/failure notice of configuration changes). Information from one TSS can be requested by many management stations (e.g., intersection control, ramp metering, traffic management center).

2.4.2.2 Support Batched Off-Line Data Logs

Some TSS operational environments do not have always-on connections (e.g., dial-up links). In such environments, a transportation system operator may wish to define conditions under which data is placed into a log, which can then be uploaded at a later time.

2.5 FEATURES

Section 2.5 identifies and describes the various standard features that may be offered by a TSS. Section 3 uses these features in the analysis of the system to define the various functional requirements of a TSS. A conformant TSS may offer additional features, as long as they are conformant with NTCIP 1209 v02 requirements.

NOTE—Off-the-shelf interoperability and interchangeability are achieved through well-documented features broadly supported by the industry as a whole. Designing a system that uses features not standardized or not typically deployed in combination with one another inhibits the goals of interoperability and interchangeability, especially if the documentation of these features is not available for distribution to system integrators. NTCIP 1209 v02 and other standards allow the use of additional features to support innovation, which is constantly needed within the industry, but users should be aware of the risks to interoperability when doing so.

The operation of a TSS can be categorized into four major areas:

- a) Configure the TSS
- b) Control the TSS
- c) Monitor the TSS
- d) Collect data from the TSS

2.5.1 Configure the TSS

The various sub-features for managing the TSS configuration include:

- a) Determine the TSS Identity
- b) Determine TSS Capabilities
- c) Determine the Sequence of Sample Periods
- d) Determine the Age of Sample Data
- e) Configure Zones
- f) Configure Outputs
- g) Configure Arming Enables
- h) Configuration Files

These sub-features are detailed subsequently.

2.5.1.1 Determine the TSS Identity

The type of sensor technology determines what specific features may be available. The manufacturer, firmware version, and hardware version allow the management station to determine what equipment is in the field to facilitate preventive maintenance and upgrades. The TSS version allows the management station to properly communicate with the TSS.

This feature allows the management station to determine basic information about the TSS, such as the sensor technology, manufacturer, model, firmware version, hardware version, TSS protocol version, and TSS standards revision.

2.5.1.2 Determine TSS Capabilities

The capabilities of the TSS are needed to determine how to configure and manage the TSS.

This feature allows the management station to determine the capabilities of the TSS, such as the maximum number of zones, maximum number of historical data entries per zone, maximum number of sample periods per zone, maximum number of outputs, maximum number of output groups, type of occupancy used, maximum number of classes (subdivisions of collected data), maximum number of characters for labels, availability of a Real Time Clock (RTC), and whether the RTC supports DST.

2.5.1.2.1 Determine TSS Support for Sampling

This feature allows the management station to determine if the TSS supports sampling. Support for the sampling feature indicates that the TSS is capable of collecting sample data and storing it for retrieval.

2.5.1.2.2 Determine TSS Support for Timing

This feature allows the management station to determine if the TSS supports timing functions. Support for the timing feature indicates that the TSS is capable of modifying the operation of zones and outputs through user-specified timing parameters.

2.5.1.2.3 Determine TSS Support for Speed

This feature allows the management station to determine if the TSS supports speed functions. Support for the speed feature indicates that the TSS is capable of providing (measuring or estimating) vehicle speed and storing it for retrieval through the sampling functions.

2.5.1.2.4 Determine TSS Support for Real Time Clock (RTC)

This feature allows the management station to determine if the TSS supports an RTC. Support for the RTC feature indicates that the TSS is capable of providing actual local time.

2.5.1.3 Determine the Sequence of Sample Periods

This feature allows the management station to determine the sequence of sample periods so that aggregate data can be used to identify changes in traffic.

2.5.1.4 Determine the Age of Sample Data

This feature allows the management station to determine the age of sample period data so that the relevance of the data to current traffic conditions can be determined.

2.5.1.5 Configure Zones

This feature allows the management station to configure the sampling period, a sensing zone (e.g., identifying label, number of classes, combination of multiple zones into a single zone, sequencing of zones), and other zone options (e.g., enabled or disabled, fault detection thresholds). Also, this feature allows the management station to configure the paired zone settings (e.g., leading placement, trailing placement, method of estimating speed if one zone of the pair fails) that may be used in speed calculations within the TSS.

This feature also allows for specific technologies of TSSs to have additional operational parameters. For inductive loops, this would include additional parameters such as sensitivity mode, sensitivity, and frequency setting.

2.5.1.6 Configure Arming Enables

This feature allows the management station to configure the Arming Enables that are used to modify an output and its delay and extension timing (e.g., Arming Pins, Arming Input Bits).

NOTE—Previously, some detection devices provided inputs that could be used to modify the operation of the detection device. These modifications usually dealt with delay and extension timing and were referred to in many ways (phase green inputs, delay inhibits, green inputs, etc.). A typical use of these inputs would be a right turn only lane that allows right turn on red at a signalized intersection. The input would be controlled by the green for the phase that would be active when the right turn lane would have a green display. The detection device for the right turn lane would then be programmed to have some amount of delay. This would keep the traffic controller from receiving a detection from vehicles that arrived and then turned right on red unless a vehicle stayed in the right turn lane for at least the delay time. When the phase for the right turn is green, the delay needs to be turned off so that the phase can extend correctly. Arming Enables are a logical enhancement to these inputs to allow greater flexibility in the control and the use of these inputs. Arming Enables are made up of Arming Pins and Arming Input Bits. Arming Pins are the physical inputs into the TSS, and Arming Input Bits are external status that are reported to the TSS using this protocol. For features that use Arming Enables, the ON or the OFF state of each Arming Enable can be used to activate a feature. Arming Enables that do not have an ON or OFF state set as an enable are ignored. If the Arming Pin inputs are dc, then a low input is an ON and a high input is an OFF. If the Arming Pin inputs are ac, then a low input is an OFF and a high input is an ON.

2.5.1.7 Configure Outputs

This feature allows the management station to configure the outputs to report the state of zones. (e.g., assigning an output to a zone, conditioning of outputs to include delay and extension, assigning fail-safe / fail-secure mode of operation, force output on/off).

NOTE—The fail-safe or fail-secure modes of operation determine how a TSS outputs for a zone when it fails. In the fail-safe mode, the TSS outputs a constant detect during a zone failure. In the fail-secure mode, the TSS outputs a no detect during a zone failure.

2.5.1.8 Manage Pending Configuration File Name

This feature allows the management station to transfer, validate, and execute a configuration file.

2.5.2 Control the TSS

The various sub-features for controlling the TSS include:

- a) Reset the TSS
- b) Initiate Sensor Diagnostics
- c) Synchronize the TSS
- d) Update Arming Input Bits of the TSS
- e) Manage the Camera
- f) Manage the RTC

2.5.2.1 Reset the TSS

This feature allows the management station to set the TSS to a known condition such as restart, reinitialize the user settings, or retune. This feature also allows a management station to cause the TSS to execute, abort, or validate a pending configuration file.

2.5.2.2 Initiate Sensor Diagnostics

This feature allows the operator to initiate sensor diagnostic routines.

2.5.2.3 Synchronize the TSS

This feature allows the TSS to set the baseline reference for the sampling period.

2.5.2.4 Update Arming Input Bits of the TSS

This feature allows a management station to update the status of the Arming Input Bits of the TSS. Arming input bits are updated so that the TSS can monitor external events without the need to physically connect an input of the TSS to a point that would allow it to monitor the desired event. This is especially desirable if the event to be monitored is not controlled at the same physical location as the TSS (e.g., the Red, Yellow, and Green states of a traffic signal, lane control signals, and preemption).

2.5.2.5 Manage the Camera

This feature allows a management station to enable or disable detection for a particular camera location. This feature would allow a camera that is normally used for detection to be disabled and then panned or zoomed to a new location for other uses such as surveillance. This feature also helps a management station verify that a camera is working and is pointing at the correct detection area. A management station can retrieve the original image used to set up the detection and compare it to a current image to verify a camera is properly aimed and has not moved. The image can be retrieved untouched to help diagnose camera issues or with the zone or zones overlaid to help verify camera aiming. The image may be available in different formats ranging from highest quality for images to be sent to the manufacturer for analysis to highly compressed to reduce bandwidth on the network and storage requirements to archive the image. To aid the management station, the TSS can associate a name with each of its cameras. This feature also allows the management station to determine the number of cameras and their video formats.

This feature also allows a management station to command the camera to build an image file that can be transferred to a management station via FTP.

2.5.2.6 Manage the Real Time Clock (RTC)

This feature allows a management station to configure an RTC for the purpose of providing a timestamp for sample data. The clock should be able to support Daylight Saving Time (DST) adjustments.

2.5.3 Monitor Current TSS Status

The various sub-features for monitoring the current status of the TSS include:

- a) System Status
- b) Sensor Status
- c) Output States
- d) Zone Status

2.5.3.1 Monitor System Status

This feature allows the management station to monitor the system status of the TSS such that the management station identifies that the system is operating normally (the TSS has not identified a hardware or configuration error) or initializing.

2.5.3.2 Monitor TSS Sensor Status

This feature allows the management station to monitor the status of each sensor within the TSS. In NTCIP 1209 v02, only the sensor status of inductive loop and machine vision sensors are defined.

For inductive loops, this feature allows the operator to monitor inductance, frequency, inductance change, fault history, and fault count.

For machine vision, this feature allows the operator to monitor video format, image reception diagnostics, and contrast loss, along with retrieving a snapshot to verify camera field of view (checking for camera movement/alignment issues).

2.5.3.3 Monitor Output States

This feature allows the management station to retrieve the states of multiple outputs of the TSS. The outputs need to be read often without overloading the communications link, and retrieving multiple outputs in the same action helps reduce the communications load.

2.5.3.4 Monitor Zone Status

This feature allows the management station to monitor the status of each zone.

2.5.4 Collect Data from TSS

The various sub-features for collecting data from the TSS include:

- a) Retrieve In-Progress Sample Data
- b) Retrieve Most Recently Completed Sample Data
- c) Retrieve Historical Sample Data

2.5.4.1 Retrieve In-Progress Sample Data

This feature allows the management station to obtain the data from the in-progress (started but not yet completed) sample period for use in identifying changes in traffic flow. This data includes the length of elapsed time in the reported sample period, volume, percent of occupancy, speed, and zone status during the sampling period.

NOTE—As a TSS may support the Boolean AND and OR operations to combine existing zones into a new virtual zone, the sample data reported by a virtual zone has limitations. If any AND logic is used, volume is the number of times that the output for the zone was activated. If just OR logic is used, volume is the additive total of the volumes of all of the zones that make up the virtual zone. Occupancy is the percent of time that the output for the zone was activated. Speed is reported as 65535 as it is not straightforward to calculate speed from logically combined zones. Zone Status only shows 'OK' if the status of all of the logically combined zones was 'OK' for the entire sample period. If any zone has a status other than 'OK' during the sample period, the last status other than 'OK' that is identified is the

status reported.

2.5.4.2 Retrieve Current Sample Data

This feature allows the management station to obtain the data from the current sample period for use in identifying changes in traffic flow. This data includes when the sample period ended, volume, percent of occupancy, speed, and zone status during the sampling period.

2.5.4.3 Retrieve Historical Sample Data

This feature allows the management station to retrieve historical sample data from previous sample periods for use in identifying changes in traffic flow. This is necessary to deal with communications failures and management station startup.

2.5.5 Multi-Version Interoperability (MVI-Backward Compatibility)

With the development and publication of newer versions of various NTCIP standards, the need to address and ensure multi-version interoperability (MVI—often referred to as ‘backward compatibility’ with a previous version, or interoperability to a defined extent with future versions) arises. Section 2.5.5 provisions are designed to allow MVI.

NTCIP 1209 v02 is newer than its predecessor, NTCIP 1209:2005. In NTCIP 1209 v02, some objects have been deprecated since NTCIP 1209:2005. It is important that these objects still be supported to provide interoperability with existing legacy systems. If the implementation does not require interoperability with existing legacy systems, then support for the deprecated objects is optional.

NOTE—NTCIP 1209:2005 is the predecessor of NTCIP 1209 v02. Since NTCIP 1209:2005 did not include a major+minor version number as part of the document designation, NTCIP 1209:2005 is referred to as NTCIP 1209:2005 (version v01) or NTCIP 1209:2005 v01.

2.5.5.1 NTCIP 1209:2005 (version v01) Conformant

This feature allows the management station to support objects in conformance with NTCIP 1209:2005 v01.

2.5.5.1.1 Retrieve NTCIP 1209:2005 (version v01) Conformant Most Recent Sample Data

This feature allows the management station to retrieve the most recent sample data from a TSS that is compliant with NTCIP 1209:2005 v01.

2.5.5.1.2 Retrieve NTCIP 1209:2005 (version v01) Conformant Historical Sample Data

This feature allows the management station to retrieve historical sample data from previous sample periods from NTCIP 1209:2005 v01 TSS for use in identifying changes in traffic flow.

2.5.5.1.3 Loop Output Conditioning

This feature allows a management station to configure for NTCIP 1209:2005 v01 conformance.

2.6 SECURITY

NTCIP 1209 v02 does not address any security issues. Any security pertaining to protecting the communications with a TSS should be implemented either physically by protecting the communications access points, or logically by enabling security features associated with the underlying communications protocols.

2.7 OPERATIONAL POLICIES AND CONSTRAINTS/ASSUMPTIONS

Operational policies are agency-specific and need to be determined and implemented by the agency operating the TSS. NTCIP 1209 v02 does not cover this topic, but instead provides a set of common functions that can support an agency's operational policies.

If assumptions pertaining to the operations of a TSS have been made, they have been stated clearly at the locations where they apply.

2.8 RELATIONSHIP TO THE NATIONAL ITS ARCHITECTURE FLOWS

There are three National ITS Architecture Flows associated with the operation of a TSS. These are:

- a) Traffic Flow
- b) Traffic Sensor Control
- c) Roadway Equipment Coordination

Each Architecture Flow is associated with one or more interfaces identified within the National ITS Architecture as:

- a) Between the TSS (Roadway Subsystem (RS)) and the Traffic Management Subsystem (TMS)
- b) Between the TSS (Roadway Subsystem (RS)) and Other Roadway Subsystem (ORS)

The main user need groups (features), as identified previously, are related to the National ITS Architecture Flows as indicated in Table 1.

Table 1 User Needs and National ITS Architecture Flows

User Need Group	Source	Architecture Flow	Destination
Configure the Sensor	TMS	Traffic Sensor Control	RS
	ORS	Roadway Equipment Coordination	RS
	RS	Roadway Equipment Coordination	ORS
Monitor the Sensor	TMS	Traffic Sensor Control	RS
	RS	Traffic Flow	TMS
	ORS	Roadway Equipment Coordination	ORS
Retrieve Data	RS	Roadway Equipment Coordination	RS
	RS	Traffic Flow	TMS
	ORS	Roadway Equipment Coordination	RS
	RS	Roadway Equipment Coordination	ORS

Section 3

FUNCTIONAL REQUIREMENTS

[Normative]

Section 3 defines the Functional Requirements based on the user needs identified in Section 2. Section 3 includes:

- a) A tutorial
- b) The Protocol Requirements List (PRL)—A Functional Requirement is a requirement of a given function and therefore is only required to be implemented if the associated functionality (e.g., user need) is selected through the use of the PRL. The PRL also indicates which of the items are mandatory, conditional, or optional. The PRL can be used to specify the desired features of a TSS or can be used to document the features supported by a manufacturer's implementation.
- c) Operational Environment Requirements—These requirements relate to the Operational Environment user needs defined in Section 2.4.2.
- d) Data Exchange Requirements—These are requirements related to the features identified in Section 2.5 that can be realized through a data exchange. For example, this includes the requirement to be able to determine the output states of the TSS.

Section 3 is intended for all readers, including:

- a) Transportation operations managers
- b) Transportation operations personnel
- c) Transportation engineers
- d) System integrators
- e) Manufacturers

Section 3 is useful to the first three categories of readers useful to understand the details of TSS requirements. Section 3.2.8 is particularly useful in preparing agency specifications, and the PRL enables mapping from its rows to more detailed text in other sections.

For the last two categories of readers, Section 3 is useful to fully understand what is required of equipment conformant with NTCIP 1209 v02 as an interface. Section 3.2.8 may also be used to document the capabilities of particular TSS implementation.

3.1 TUTORIAL [INFORMATIVE]

Section 3 defines the requirements that are intended to fulfill the user needs identified in Section 2. This is achieved through a PRL that traces each user need to one or more requirements. The details of each requirement are then presented following the PRL. Functional requirements are presented in three broad categories as follows:

- a) Architectural Requirements—These requirements define the required behavior of the system in exchanging data across the communications interface, including any restrictions to general architectural requirements, based on the architectural needs identified in Section 2.
- b) Data Exchange Requirements—These requirements define the required behavior of the system in exchanging data across the communications interface based upon the features identified in Section 2.
- c) Supplemental Requirements—These requirements define additional requirements of the system that are derived from the architectural and/or data exchange requirements but are not themselves architectural or data exchange requirements. A given supplemental requirement may relate to multiple architectural and/or data exchange requirements. Supplemental requirements frequently include range capabilities of the equipment (e.g., how many sample periods is a TSS required to

support).

3.2 PROTOCOL REQUIREMENTS LIST (PRL)

The PRL, provided in the table in Section 3.2.8, maps the user needs defined in Section 2 to the requirements defined in Section 3. The PRL can be used to:

- a) Indicate which requirements are to be implemented in a project-specific implementation.
- b) (As a checklist) to reduce the risk of failure to conform to NTCIP 1209 v02 through oversight.
- c) Provide a detailed indication of the capabilities of the implementation.
- d) (As a basis) to initially check the potential interoperability with another implementation.

3.2.1 User Needs Column

The PRL is based on the user needs defined in Section 2. The section number and user need name are indicated in this column.

3.2.2 Requirements Column

The PRL provides traceability by identifying the requirements defined in Section 3 that are associated with the user needs. The section number and functional requirement name are indicated in this column.

3.2.3 Conformance Column

The following notations and symbols are used to indicate status and conditional status in the PRL in all NTCIP standards. Not all of these notations and symbols may be used NTCIP 1209 v02.

3.2.3.1 Status Symbols

The symbols in Table 2 are used to indicate status.

Table 2 Status Symbols

Symbol	Status
M	Mandatory
M.#	Support of every item of the group labeled by the same numeral # required, but only one is active at a time
O	Optional
O.#	Part of an option group. Support of the number of items indicated by the '(range)' is required from all options labeled with the same numeral #
C	Conditional
N/A	Not applicable (i.e., logically impossible in the scope of the standard)
X	Excluded or prohibited

The O.# (range) notation is used to show a set of selectable options (e.g., O.2(1..*) would indicate that one or more of the option group 2 options shall be implemented). Two character combinations are used for dynamic 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.'

3.2.3.2 Conditional Status Notation

The predicate notations in Table 3 may be used.

Table 3 Predicate Notations

Predicate	Notation
<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>.
(predicate)	This notation introduces the first occurrence of the predicate. The feature associated with this notation is the base feature for all options that have this predicate in their conformance column.

The <predicate>: notation means that the status following it applies only when the PRL states that the feature or features identified by the predicate are supported. In the simplest case, <predicate> is the identifying tag of a single PRL item. The <predicate>:: notation may precede a table or group of tables in a section or subsection. When the group predicate is true, then the associated section shall be included. 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.

Table 4 maps the predicates used in NTCIP 1209 v02 to its sections.

Table 4 Predicate to NTCIP 1209 v02 Section Mapping

Predicate	Section
Loop (Inductive Loop)	Indicates that the PRL item applies to Inductive Loops as identified by Section 2.5.1.1
Video (Machine Vision)	Indicates that the PRL item applies to Machine Vision as identified by Section 2.5.1.1
RTC (Real Time Clock)	Indicates that the PRL item applies to RTCs as identified by Section 2.5.1.2.4
Speed	Indicates that the PRL item applies to Speed as identified by Section 2.5.1.2.3
Timing	Indicates that the PRL item applies to Timing as identified by Section 2.5.1.2.2
Sample	Indicates that the PRL item applies to Sampling as identified by Section 2.5.1.2.1
Version01 or Version1	Indicates that the PRL item applies to objects required to maintain MVI with NTCIP 1209:2005 v01 as identified by Section 2.5.5.1

3.2.4 Support / Project Requirements Column

The support column can be used in an agency specification to identify the required features for a specific implementation or by an implementer to identify which features have been implemented. In either case, the user circles the appropriate answer (Yes, No, or N/A) in the support column. See Table 5.

Table 5 Support / Project Requirement Column Entries

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

3.2.5 Additional Specifications Column

The 'Additional Specifications' column may be used in an agency specification to provide additional notes and requirements for the specified implementation, or may be used by an implementer to provide any additional details about the implementation. In some cases, default text may already exist in this column,

which the user should complete to fully specify the equipment. However, additional text can be added to this field as needed to fully specify a feature.

3.2.6 Instructions for Completing the PRL

In the 'Project Requirements' column, each response shall be either selected from the indicated set of responses (e.g., Yes / No / N/A), or entered as indicated.

If a conditional requirement is inapplicable, use the Not Applicable (N/A) choice. If a mandatory requirement is not satisfied, exception information shall be supplied by entering a reference Xi, where i is a unique identifier, to an accompanying rationale for the non-conformance. When the status is expressed as a two-character combination (as defined in Section 3.2.3.1), the response shall address each element of the requirement; e.g., for the requirement 'mo', the possible compliant responses are 'yy' or 'yn.'

3.2.7 Conformance Definition

To claim 'Conformance' to NTCIP 1209 v02, the TSS shall minimally satisfy the mandatory requirements as identified in the PRL table. In addition, a conformant TSS may offer additional (optional) features, as long as they are conformant with the requirements of this standard and the standards it references.

NOTE—'Conformance' to NTCIP 1209 v02 should not be confused with 'compliance' to an agency specification. NTCIP 1209 v02 is as broad as possible to allow a very simple TSS to be 'conformant' to NTCIP 1209 v02. An agency specification needs to identify the requirements of a particular project and needs to require support for those requirements. An agency specification should match the requirements of a project with the corresponding requirements defined in NTCIP 1209 v02 to achieve interoperability. This means that functions and requirements defined as 'optional' in NTCIP 1209 v02 might need to be selected in an agency specification (in effect made 'mandatory').

A conformant TSS may offer additional features, as long as they are conformant with the requirements of NTCIP 1209 v02 and requirements contained in other standards that NTCIP 1209 v02 references (i.e., NTCIP 2301 v02, and NTCIP 8004 v01). For example, a TSS may support data that has not been defined by NTCIP 1209 v02; however, when exchanged via one of the NTCIP 2301 v02 protocols, the data shall be properly registered with a valid OBJECT IDENTIFIER under the Global ISO Naming Tree.

NOTE—Off-the-shelf interoperability and interchangeability can only be obtained through well-documented features broadly supported by the industry as a whole. Designing a system that uses features not defined in a standard or not typically deployed in combination with one another inhibits the goals of interoperability and interchangeability, especially if the documentation of these features is not available for distribution to system integrators. Standards allow the use of additional features to support innovation, which is consistently needed in the industry, but users should be aware of the risks involved with using such features.

3.2.8 Protocol Requirements List (PRL) Table

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.4	Architectural Needs					
2.4.1	Fundamental Needs Driving TSS Deployment					
2.4.2	Operational Environment					
2.4.2.1	Live Data Exchange					
		3.3.1.1	Retrieve Data	M	Yes	
		3.3.1.2	Deliver Data	M	Yes	
		3.3.1.3	Data Retrieval and Data Delivery Action Performance	M	Yes	
2.4.2.2	Support Batched Off-Line Data Logs					
		3.3.2.1	Retrieve Historical Sample Data	Sample:M	Yes/ N/A	
2.5	Features					
2.5.1	Configure the TSS					
2.5.1.1	Determine the TSS Identity					
		3.4.1.1.1 (Loop) (Video)	Determine Sensor Technology	M	Yes	If the sensor technology indicates that it is Inductive Loop, then the predicate 'Loop' is true and conformance should include those requirements indicated by the Loop predicate. If the sensor technology indicates Machine Vision, then the predicate 'Video' is true and conformance should include those requirements indicated by the Video predicate.
		3.4.1.1.2	Determine Manufacturer	M	Yes	
		3.4.1.1.3	Determine Model	M	Yes	
		3.4.1.1.4	Determine Firmware Version	M	Yes	
		3.4.1.1.5	Determine Hardware Version	M	Yes	
		3.4.1.1.6	Determine Protocol Version	M	Yes	
		3.4.1.1.7	Determine Standards Revision Version	M	Yes	
2.5.1.2	Determine TSS Capabilities					
		3.4.1.2.1	Determine Maximum Number of Sensor Zones	M	Yes	
		3.4.1.2.2	Determine Maximum Number of Historical Data Entries per Sensor Zone	Sample:M	Yes/ N/A	
		3.4.1.2.3	Determine Maximum Number of Outputs	M	Yes	
		3.4.1.2.4	Determine Maximum Number of Output Groups	M	Yes	
		3.4.1.2.5	Determine Type of Occupancy Used	M	Yes	
		3.4.1.2.6	Determine Availability of a Real Time Clock (RTC)	M	Yes	
		3.4.1.2.7	Determine if Real Time Clock (RTC) Supports Daylight Saving Time (DST)	M	Yes	

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
		3.4.1.2.8	Determine Maximum Number of Classes	Sample:M	Yes/ N/A	
		3.4.1.2.9	Determine Maximum Number of Characters for Labels	M	Yes	
		3.4.1.2.10	Determine Optional Features	M	Yes	
2.5.1.2.1 (Sample)	Determine TSS Support for Sampling					
		3.4.1.2.10	Determine Optional Features	M	Yes	If the features indicate that support for Sampling is required, then the predicate 'Sample' is true and conformance should include those requirements indicated by the Sample predicate.
2.5.1.2.2 (Timing)	Determine TSS Support for Timing					
		3.4.1.2.10	Determine Optional Features	M	Yes	If the features indicate that support for Timing is required, then the predicate 'Timing' is true and conformance should include those requirements indicated by the Timing predicate.
2.5.1.2.3 (Speed)	Determine TSS Support for Speed					
		3.4.1.2.10	Determine Optional Features	M	Yes	If the features indicate that support for Speed is required, then the predicate 'Speed' is true and conformance should include those requirements indicated by the Speed predicate.
2.5.1.2.4 (RTC)	2.5.1.2.4 Determine TSS Support for Real Time Clock (RTC)					
		3.4.1.2.6	Determine Availability of a Real Time Clock (RTC)	M	Yes	If the features indicate that support for Real Time Clock (RTC) is required, then the predicate 'RTC' is true and conformance should include those requirements indicated by the RTC predicate.
2.5.1.3	Determine the Sequence of Sample Periods					
		3.4.3.1.6	Get Historical Sequence Number	Sample:M	Yes/ N/A	
2.5.1.4	Determine the Age of Sample Data					
		3.4.3.1.1	Get Historical Sample End Time	Sample:M	Yes/ N/A	
2.5.1.5	Configure Zones					
		3.4.1.5.1	Get Zone Options	M	Yes	
		3.4.1.5.2	Get Zone Options Status	M	Yes	
		3.4.1.5.3	Get Zone Sample Period	Sample:M	Yes/ N/A	
		3.4.1.5.4	Get Zone Label	O	Yes/No	
		3.4.1.5.5	Get Zone Boolean AND Zones	O	Yes/No	
		3.4.1.5.6	Get Zone Boolean OR Zones	O	Yes/No	

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
		3.4.1.5.7	Set Zone Options	M	Yes	
		3.4.1.5.8	Set Zone Sample Period	Sample:M	Yes/ N/A	
		3.4.1.5.9	Set Zone Label	O	Yes/No	
		3.4.1.5.10	Set Zone Boolean AND Zones	O	Yes/No	
		3.4.1.5.11	Set Zone Boolean OR Zones	O	Yes/No	
		3.4.1.5.12	Get Paired Zone	Speed:M	Yes/ N/A	
		3.4.1.5.13	Get Paired Zone Options	Speed:M	Yes/ N/A	
		3.4.1.5.14	Get Paired Zone Spacing	Speed:M	Yes/ N/A	
		3.4.1.5.15	Get Speed Correction Factor	Speed:M	Yes/ N/A	
		3.4.1.5.16	Set Paired Zone	Speed:M	Yes/ N/A	
		3.4.1.5.17	Set Paired Zone Options	Speed:M	Yes/ N/A	
		3.4.1.5.18	Set Paired Zone Spacing	Speed:M	Yes/ N/A	
		3.4.1.5.19	Set Speed Correction Factor	Speed:M	Yes/ N/A	
		3.4.1.5.20	Get Sensor Zone Average Vehicle Length	Speed:M	Yes/ N/A	
		3.4.1.5.21	Get Sensor Zone Length	Speed:M	Yes/ N/A	
		3.4.1.5.22	Set Sensor Zone Average Vehicle Length	Speed:M	Yes/ N/A	
		3.4.1.5.23	Set Sensor Zone Length	Speed:M	Yes/ N/A	
		3.4.1.5.24	Get Sensor Zone Loop Layout	Loop:M	Yes/ N/A	
		3.4.1.5.25	Set Sensor Zone Loop Layout	Loop:M	Yes/ N/A	
		3.4.1.5.26	Set Zone Sensitivity Mode	Loop:M	Yes/ N/A	
		3.4.1.5.27	Set Zone Sensitivity	Loop:M	Yes/ N/A	
		3.4.1.5.28	Set Sensor Zone Frequency Range	Loop:M	Yes/ N/A	
		3.4.1.5.29	Get Zone Sensitivity Mode	Loop:M	Yes/ N/A	
		3.4.1.5.30	Get Zone Sensitivity	Loop:M	Yes/ N/A	
		3.4.1.5.31	Get Sensor Zone Frequency Range	Loop:M	Yes/ N/A	
		3.4.1.5.32	Get Zone Output Mode	M	Yes	
		3.4.1.5.33	Get Output Max Presence Time	Timing:M	Yes/ N/A	
		3.4.1.5.34	Get Output Delay Time	Timing:M	Yes/ N/A	
		3.4.1.5.35	Get Output Extension Time	Timing:M	Yes/ N/A	
		3.4.1.5.36	Set Zone Output Mode	M	Yes	
		3.4.1.5.37	Set Output Max Presence Time	Timing:M	Yes/ N/A	
		3.4.1.5.38	Set Output Delay Time	Timing:M	Yes/ N/A	
		3.4.1.5.39	Set Output Delay Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.40	Set Output Extension Time	Timing:M	Yes/ N/A	
		3.4.1.5.41	Set Output Extension Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.42	Get Output Delay Mode	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.43	Set Output Delay Mode	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.44	Get Output Extension Mode	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.45	Set Output Extension Mode	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.46	Get Zone Output Sequenced	Timing:O	Yes/No/ N/A	
		3.4.1.5.47	Set Zone Output Sequenced	Timing:O	Yes/No/ N/A	
		3.4.1.5.48	Get Output Delay Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.49	Get Output Extension Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.50	Get No Activity Fault Time	M	Yes	
		3.4.1.5.51	Get Max Presence Fault Time	M	Yes	
		3.4.1.5.52	Get Erratic Counts Fault Time	M	Yes	
		3.4.1.5.53	Get Erratic Counts Threshold	M	Yes	
		3.4.1.5.54	Set No Activity Fault Time	M	Yes	

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
		3.4.1.5.55	Set Max Presence Fault Time	M	Yes	
		3.4.1.5.56	Set Erratic Counts Fault Time	M	Yes	
		3.4.1.5.57	Set Erratic Counts Threshold	M	Yes	
2.5.1.6	Configure Arming Enables					
		3.4.1.3.11	Get External Arming Inputs	Timing:O.3	Yes/No/ N/A	
		3.4.1.3.12	Set External Arming Inputs	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.39	Set Output Delay Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.41	Set Output Extension Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.48	Get Output Delay Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.5.49	Get Output Extension Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.6.9	Get Output Arming Mode	Timing:O.3	Yes/No/ N/A	
		3.4.1.6.11	Set Output Arming Mode	Timing:O.3	Yes/No/ N/A	
2.5.1.7	Configure Outputs					
		3.4.1.6.1	Get Output Sensor Zone	M	Yes	
		3.4.1.6.2	Get Output Failsafe Mode	M	Yes	
		3.4.1.6.3	Get Output Mode Status	M	Yes	
		3.4.1.6.4	Get Output Label	O	Yes/No	
		3.4.1.6.5	Set Output Sensor Zone	M	Yes	
		3.4.1.6.6	Set Output Failsafe Mode	M	Yes	
		3.4.1.6.7	Set Output Label	M	Yes	
		3.4.1.6.8	Get Output Arming Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.6.9	Get Output Arming Mode	Timing:O.3	Yes/No/ N/A	
		3.4.1.6.10	Set Output Arming Enables	Timing:O.3	Yes/No/ N/A	
		3.4.1.6.11	Set Output Arming Mode	Timing:O.3	Yes/No/ N/A	
2.5.1.8	Manage Pending Configuration File Name					
		3.4.1.3.13	Set Pending Configuration File Name	O.1	Yes/No	
		3.4.1.3.14	Get Pending Configuration File Name	O.1	Yes/No	
2.5.2	Control the TSS					
2.5.2.1	Reset the TSS					
		3.4.1.3.1	Restart the TSS	M	Yes	
		3.4.1.3.2	Reinitialize User Settings	M	Yes	
		3.4.1.3.3	Restore Factory Defaults	M	Yes	
		3.4.1.3.4	Retune	M	Yes	
		3.4.1.3.8	Execute Pending Configuration	O.1	Yes/No	
		3.4.1.3.9	Abort Pending Configuration	O.1	Yes/No	
		3.4.1.3.10	Validate Pending Configuration	O.1	Yes/No	
2.5.2.2	Initiate Sensor Diagnostics					
		3.4.1.3.6	Short Diagnostics	M	Yes	
		3.4.1.3.7	Full Diagnostics	M	Yes	
2.5.2.3	Synchronize the TSS					
		3.4.1.3.5	Resynchronize Sampling Periods	Sample:M	Yes/ N/A	
2.5.2.4	Update Arming Inputs of the TSS					
		3.4.1.3.11	Get External Arming Inputs	Timing:O.3	Yes/No/ N/A	
		3.4.1.3.12	Set External Arming Inputs	Timing:O.3	Yes/No/ N/A	
2.5.2.5	Manage the Camera					
		3.4.1.7.1	Set Disable Detection	Video:O	Yes/No/ N/A	
		3.4.1.7.2	Get Disable Detection	Video:O	Yes/No/ N/A	
		3.4.1.7.3	Set the Build Image Parameter	Video:O.2	Yes/No/ N/A	
		3.4.1.7.4	Set Cancel Build In-Progress	Video:O.2	Yes/No/ N/A	

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
		3.4.1.7.5	Get Baseline Image Status	Video:O.2	Yes/No/ N/A	
		3.4.1.7.6	Get Camera Image Formats Supported	Video:O.2	Yes/No/ N/A	
		3.4.1.7.7	Set Image Zone Number	Video:O.2	Yes/No/ N/A	
		3.4.1.7.8	Get Image Zone Number	Video:O.2	Yes/No/ N/A	
		3.4.1.7.9	Set Image Type	Video:O.2	Yes/No/ N/A	
		3.4.1.7.10	Get Image Type	Video:O.2	Yes/No/ N/A	
		3.4.1.7.11	Set Image Overlay Type	Video:O.2	Yes/No/ N/A	
		3.4.1.7.12	Get Image Overlay Type	Video:O.2	Yes/No/ N/A	
		3.4.1.7.13	Set Image Quality	Video:O.2	Yes/No/ N/A	
		3.4.1.7.14	Get Image Quality	Video:O.2	Yes/No/ N/A	
		3.4.1.7.15	Set Camera Image Format	Video:O.2	Yes/No/ N/A	
		3.4.1.7.16	Get Camera Image Format	Video:O.2	Yes/No/ N/A	
		3.4.1.7.17	Get Camera Name Label	Video:O	Yes/No/ N/A	
		3.4.1.7.18	Set Camera Name Label	Video:O	Yes/No/ N/A	
		3.4.1.7.19	Get Maximum Camera Count	Video:M	Yes/ N/A	
2.5.2.6	Manage Real Time Clock (RTC)					
		3.4.1.4.1	Get Date and Time	RTC:M	Yes/ N/A	
		3.4.1.4.2	Get Daylight Saving Time (DST) Mode	RTC:M	Yes/ N/A	
		3.4.1.4.3	Set Date and Time	RTC:M	Yes/ N/A	
		3.4.1.4.4	Set Daylight Saving Time (DST) Mode	RTC:M	Yes/ N/A	
2.5.3	Monitor Current TSS Status					
2.5.3.1	Monitor System Status					
		3.4.2.1	Get System Status	M	Yes	
2.5.3.2	Monitor TSS Sensor Status					
		3.4.2.2.1	Get Zone Inductance	Loop:M	Yes/ N/A	
		3.4.2.2.2	Get Zone Frequency	Loop:M	Yes/ N/A	
		3.4.2.2.3	Get Zone Inductance Change	Loop:M	Yes/ N/A	
		3.4.2.2.4	Get Zone Fault History	Loop:M	Yes/ N/A	
		3.4.2.2.5	Get Zone Fault Count	Loop:M	Yes/ N/A	
		3.4.2.2.6	Get Zone Status	M	Yes	
		3.4.2.2.7	Get Image Reception Diagnostics	Video:M	Yes/ N/A	
		3.4.2.2.8	Get Image	Video:O.2	Yes/No/ N/A	
		3.4.2.2.9	Get Zone List for Camera	Video:M	Yes/ N/A	
		3.4.2.2.10	Get Zone Percent Inductance Change	Loop:M	Yes/ N/A	
		3.4.2.2.11	Get Image Status	Video:O.2	Yes/No/ N/A	
2.5.3.3	Monitor Output States					
		3.4.2.3.1	Get Output Group Output State	M	Yes	
2.5.3.4	Monitor Zone Status					
		3.4.2.2.6	Get Zone Status	M	Yes	
2.5.4	Collect Data from TSS					
2.5.4.1	Retrieve In-Progress Sample Data					
		3.4.3.1.1	Get Historical Sample End Time	Sample:M	Yes/ N/A	
		3.4.3.1.2	Get Historical Sample Volume	Sample:M	Yes/ N/A	
		3.4.3.1.3	Get Historical Sample Percent Occupancy	Sample:M	Yes/ N/A	
		3.4.3.1.4	Get Historical Sample Speed	Sample:O Speed:M	Yes/No/ N/A Yes/ N/A	

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
		3.4.3.1.5	Get Historical Sample Zone Status	Sample:M	Yes/ N/A	
		3.4.3.1.6	Get Historical Sequence Number	Sample:M	Yes/ N/A	
		3.4.3.1.7	Get Zone Class Label	Sample:M	Yes/ N/A	
		3.4.3.1.8	Get Number of Sample Data Entries	Sample:M	Yes/ N/A	
		3.4.3.1.9	Get Number of Sensor Zone Classes	Sample:M	Yes/ N/A	
2.5.4.2	Retrieve Current Sample Data					
		3.4.3.1.1	Get Historical Sample End Time	Sample:M	Yes/ N/A	
		3.4.3.1.2	Get Historical Sample Volume	Sample:M	Yes/ N/A	
		3.4.3.1.3	Get Historical Sample Percent Occupancy	Sample:M	Yes/ N/A	
		3.4.3.1.4	Get Historical Sample Speed	Sample:O Speed:M	Yes/No/ N/A Yes/ N/A	
		3.4.3.1.5	Get Historical Sample Zone Status	Sample:M	Yes/ N/A	
		3.4.3.1.6	Get Historical Sequence Number	Sample:M	Yes/ N/A	
		3.4.3.1.7	Get Zone Class Label	Sample:M	Yes/ N/A	
		3.4.3.1.8	Get Number of Sample Data Entries	Sample:M	Yes/ N/A	
		3.4.3.1.9	Get Number of Sensor Zone Classes	Sample:M	Yes/ N/A	
2.5.4.3	Retrieve Historical Sample Data			Sample:M	Yes/ N/A	
		3.4.3.1.1	Get Historical Sample End Time	Sample:M	Yes/ N/A	
		3.4.3.1.2	Get Historical Sample Volume	Sample:M	Yes/ N/A	
		3.4.3.1.3	Get Historical Sample Percent Occupancy	Sample:M	Yes/ N/A	
		3.4.3.1.4	Get Historical Sample Speed	Sample:O Speed:M	Yes/No/ N/A Yes/ N/A	
		3.4.3.1.5	Get Historical Sample Zone Status	Sample:M	Yes/ N/A	
		3.4.3.1.6	Get Historical Sequence Number	Sample:M	Yes/ N/A	
		3.4.3.1.7	Get Zone Class Label	Sample:M	Yes/ N/A	
		3.4.3.1.8	Get Number of Sample Data Entries	Sample:M	Yes/ N/A	
		3.4.3.1.9	Get Number of Sensor Zone Classes	Sample:M	Yes/ N/A	
2.5.5	Multi-Version Interoperability (Backward Compatibility)					

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
2.5.5.1 (Version01)	NTCIP 1209:2005 (version v01) Conformance			O	Yes/No	NOTE—Some objects defined in NTCIP 1209:2005 (version v01) were deprecated and replaced by newer objects that have a wider scope or have other features to ease implementation. It is considered the default condition for NTCIP 1209:2005 (version v01) objects to be required, the 'Version1' predicate to be true, and conformance should include those requirements indicated by the Version1 predicate. If the user does not want conformance with NTCIP 1209:2005 (version v01), then 'No' should be in the project requirement column and the statement below shall be checked. Place a checkmark here _____ if the TSS is NOT required to support backward compatibility with NTCIP 1209:2005 (version v01).
2.5.5.1.1	Most Recent NTCIP 1209:2005 (version v01) Conformant Data Sample			Version1:M	Yes/ N/A	
	3.5.1.1	Get Sample End Time		Version1:M	Yes/ N/A	
	3.5.1.2	Get Volume		Version1:M	Yes/ N/A	
	3.5.1.3	Get Percent Occupancy		Version1:M	Yes/ N/A	
	3.5.1.4	Get Speed		Version1:M	Yes/ N/A	
	3.5.1.5	Get Zone Status		Version1:M	Yes/ N/A	
2.5.5.1.2	Retrieve NTCIP 1209:2005 (version v01) Conformant Historical Sample Data			Version1:M	Yes/ N/A	
	3.5.2.1	Get Sample End Time		Version1:M	Yes/ N/A	
	3.5.2.2	Get Volume		Version1:M	Yes/ N/A	
	3.5.2.3	Get Percent Occupancy		Version1:M	Yes/ N/A	
	3.5.2.4	Get Speed		Version1:M	Yes/ N/A	
	3.5.2.5	Get Zone Status		Version1:M	Yes/ N/A	
2.5.5.1.3	Loop Output Conditioning			Version1:M	Yes/ N/A	
	3.5.3.1	Get Output Mode		Version1:M	Yes/ N/A	
	3.5.3.2	Get Max Presence Time		Version1:M	Yes/ N/A	
	3.5.3.3	Get Output Delay Time		Version1:M	Yes/ N/A	
	3.5.3.4	Get Output Extend Time		Version1:M	Yes/ N/A	
	3.5.3.5	Get Output Delay Enable		Version1:M	Yes/ N/A	
	3.5.3.6	Get Output Extend Enable		Version1:M	Yes/ N/A	
	3.5.3.7	Set Output Mode		Version1:M	Yes/ N/A	
	3.5.3.8	Set Max Presence Time		Version1:M	Yes/ N/A	
	3.5.3.9	Set Output Delay Time		Version1:M	Yes/ N/A	

User Need Section Number	User Need	FR Section Number	Functional Requirement	Conformance	Support / Project Requirement	Additional Specifications
		3.5.3.10	Set Output Extend Time	Version1:M	Yes/ N/A	
		3.5.3.11	Set Output Delay Enable	Version1:M	Yes/ N/A	
		3.5.3.12	Set Output Extend Enable	Version1:M	Yes/ N/A	

3.3 OPERATIONAL ENVIRONMENT REQUIREMENTS

Requirements for communications capabilities follow.

3.3.1 Support Live Data

Requirements for specifying capabilities of a TSS to provide live data to a TSS management station follow.

3.3.1.1 Retrieve Data

The TSS shall allow the management stations to retrieve data from the sensor system.

3.3.1.2 Deliver Data

The TSS shall allow the management stations to deliver data (e.g., configuration data, commands, etc.) to the sensor system.

3.3.1.3 Data Retrieval and Data Delivery Action Performance

The TSS shall process SNMP Get/Set/GetNext commands in response to data retrieval and data delivery actions performed by the management stations on the TSS in accordance with the performance criteria for the SNMP commands established in NTCIP 1103 v02.

3.3.2 Support Batched Data

The following requirements define the functions needed to support the exchange of data between the TSS management station and the TSS in cases where the TSS is not sharing a live data connection with the management stations, but is instead storing data offline for periodic retrieval by the management station.

3.3.2.1 Retrieve Historical Sample Data

The TSS shall allow the management stations to retrieve historical sample data from the sensor system.

3.4 DATA EXCHANGE REQUIREMENTS

The operation of a TSS has been categorized into three major areas:

- Manage the TSS configuration
- Monitor the current status of the TSS
- Retrieve historical sample data from the TSS

In Section 2, each of these major areas was broken down into sub-items. The Data Exchange Requirements also follow this structure.

3.4.1 Manage the TSS Configuration

Requirements for managing TSS configuration follow.

3.4.1.1 Identify TSS

Requirements for identifying the TSS follow.

3.4.1.1.1 Determine Sensor Technology

The TSS shall allow a management station to determine its sensor technology (such as inductive loop or

video). This information can then be used to determine if this TSS supports additional data elements that are technology specific.

3.4.1.1.2 Determine Manufacturer

The TSS shall allow a management station to determine its manufacturer. This shall be as defined in the Global Module Object in NTCIP 1201 v03 Section 2.2.3. This information can be useful in creating a TSS physical inventory.

3.4.1.1.3 Determine Model

The TSS shall allow a management station to determine its model. This shall be as defined in the Global Module Object in NTCIP 1201 v03 Section 2.2.3. This information can be useful in creating a TSS physical inventory.

3.4.1.1.4 Determine Firmware Version

The TSS shall allow a management station to determine its firmware version. This shall be as defined in the Global Module Object in NTCIP 1201 v03 Section 2.2.3. This information can be useful in creating a TSS physical inventory or determining where firmware upgrades may be needed in the TSS.

3.4.1.1.5 Determine Hardware Version

The TSS shall allow a management station to determine its hardware version. This shall be as defined in the Global Module Object in NTCIP 1201 v03 Section 2.2.3. This information can be useful in creating a TSS physical inventories.

3.4.1.1.6 Determine Protocol Version

The TSS shall allow a management station to determine the TSS protocol version that it complies with. This shall be as defined in the Global Module Object in NTCIP 1201 v03 Section 2.2.3. This information can then be used to determine the correct way of communicating with the TSS.

3.4.1.1.7 Determine Standards Revision Version

The TSS shall allow a management station to determine the version of the TSS standard that it conforms to. This shall be as defined in the Global Module Object in NTCIP 1201 v03 Section 2.2.3. This information can then be used to determine the correct way of communicating with the TSS.

3.4.1.2 Determine TSS Capabilities

Requirements for determining capabilities of the TSS follow.

3.4.1.2.1 Determine Maximum Number of Sensor Zones

The TSS shall allow a management station to determine the maximum number of sensor zones that the TSS supports. This information can then be used to ensure that the management station does not waste time querying the TSS for sensor zones that it does not support.

3.4.1.2.2 Determine Maximum Number of Historical Data Entries per Sensor Zone

The TSS shall allow a management station to determine the maximum number of historical data entries (sample periods) per sensor zone that the TSS supports. All sensor zones shall support the same number of sample periods.

3.4.1.2.3 Determine Maximum Number of Outputs

The TSS shall allow a management station to determine the maximum number of outputs that the TSS supports. This information can then be used to ensure that the management station does not waste time querying the TSS for outputs that it does not support.

3.4.1.2.4 Determine Maximum Number of Output Groups

The TSS shall allow a management station to determine the maximum number of output groups that the TSS supports. This information can then be used to ensure that the management station does not waste time querying the TSS for output groups that it does not support.

3.4.1.2.5 Determine Type of Occupancy Used

The TSS shall allow a management station to determine the type of occupancy reported by the TSS. This information can be useful in determining the correct way to use the occupancy data provided by this TSS.

3.4.1.2.6 Determine Availability of a Real Time Clock (RTC)

The TSS shall allow a management station to determine if the TSS has an RTC. This information can then be used to determine how to interpret End Time data that is returned for data collection items. If an RTC is available, the End Time is the actual date/time when the sample period ended. If an RTC is not available, the End Time is the elapsed time since the last power up or reset when the sample period ended.

3.4.1.2.7 Determine if Real Time Clock (RTC) Supports Daylight Saving Time (DST)

The TSS shall allow a management station to determine if the TSS has an RTC that supports DST. This information can then be used to determine how to interpret End Time data that is returned for data collection items. If DST is supported, then the End Time is already correct and no further adjustment is needed to the returned End Time. If DST is not supported, then the End Time would need to be adjusted for DST if appropriate. If an RTC is not available, this item should always return DST as not supported.

3.4.1.2.8 Determine Maximum Number of Classes

The TSS shall allow a management station to determine the maximum number of classes that the TSS supports.

3.4.1.2.9 Determine Maximum Number of Characters for Labels

The TSS shall allow a management station to determine the maximum number of characters for labels that the TSS supports. This information can then be used to ensure that the management station does not try to send labels that are too long for the TSS to receive.

3.4.1.2.10 Determine Optional Features

The TSS shall allow a management station to determine which optional features, if any, that the TSS supports. This information can then be used to ensure that the management station does not try to use features that are not supported by the TSS. The currently supported optional features are sampling, timing, and speed.

3.4.1.3 Control the TSS

Requirements for resetting and synchronizing the TSS follow.

3.4.1.3.1 Restart the TSS

The TSS shall allow a management station to cause the sensor system to perform a restart that resets and initializes the number of seconds since the most recent initialization to zero. This command shall perform the same function as cycling power to the TSS.

3.4.1.3.2 Reinitialize User Settings

The TSS shall allow a management station to cause the sensor system to reinitialize the user settings to their user-defined defaults and flush all historical data.

3.4.1.3.3 Restore Factory Defaults

The TSS shall allow a management station to cause the sensor system to reset all settings to preset

factory defaults.

3.4.1.3.4 Retune

The TSS shall allow a management station to cause the sensor system to perform a retune (recalibrate unit background settings) for all zones without resetting or flushing of any historical data.

3.4.1.3.5 Resynchronize Sampling Periods

The TSS shall allow a management station to cause the sensor system to synchronize all sampling period clocks within one second of receiving the command. This command is only needed in TSSs that do not support an RTC. This command shall cause the TSS to end all sample periods in-progress, reset and initialize the number of seconds since the most recent initialization to zero, and start the next sampling period.

3.4.1.3.6 Short Diagnostics

The TSS shall allow a management station to cause the sensor system to perform a vendor-specific short diagnostic test. This command shall cause the TSS to go through an abbreviated vendor-specific diagnostic routine, which may be the same as full diagnostics for some vendors.

3.4.1.3.7 Full Diagnostics

The TSS shall allow a management station to cause the sensor system to perform a vendor-specific full diagnostic test. This command shall cause the TSS to go through a complete vendor-specific diagnostic routine, which may be the same as short diagnostics for some vendors, causing a reset and initialization of the number of seconds since the most recent initialization to a value of zero.

3.4.1.3.8 Execute Pending Configuration

The TSS shall allow a management station to execute the current uploaded configuration changes that may result in a system reboot, system reinitialization, and a loss of historical data.

3.4.1.3.9 Abort Pending Configuration

The TSS shall allow a management station to abort the currently pending configuration changes. This command shall not result in a system reboot, system reinitialization, or loss of historical data.

3.4.1.3.10 Validate Pending Configuration

The TSS shall allow a management station to check the pending configuration file to ensure that it is a valid configuration file.

3.4.1.3.11 Get External Arming Inputs

The TSS shall allow a management station or other device capable of using this protocol to determine the status of the external arming inputs that the TSS supports. This information can then be used to verify that the external arming inputs are being activated correctly.

3.4.1.3.12 Set External Arming Inputs

The TSS shall allow a management station or other device capable of using this protocol to individually set or clear the states of the external arming inputs that the TSS supports. This information can then be used to modify the operating characteristics of the TSS.

3.4.1.3.13 Set Pending Configuration File Name

The TSS shall allow a management station to set the file name of the file to be used as the next configuration file for the TSS.

3.4.1.3.14 Get Pending Configuration File Name

The TSS shall allow a management station to get the file name of the file to be used as the next

configuration file for the TSS.

3.4.1.4 Manage Real Time Clock (RTC)

Requirements for managing RTC of the TSS follow.

3.4.1.4.1 Get Date and Time

The TSS shall allow a management station to get the current sensor system date and time. The sensor date and time shall be defined in accordance with the Global Time Object defined in NTCIP 1201 v03 Section 2.4.1.

3.4.1.4.2 Get Daylight Saving Time (DST) Mode

The TSS shall allow a management station to get the current DST mode. The current DST mode shall be defined in accordance with the Global Daylight Saving Object defined in NTCIP 1201 v03 Section 2.4.2.

3.4.1.4.3 Set Date and Time

The TSS shall allow a management station to set the sensor system date and time to within one second of receiving the command. The current date and time shall be defined in accordance with the Global Time Object defined in NTCIP 1201 v03 Section 2.4.1.

3.4.1.4.4 Set Daylight Saving Time (DST) Mode

The TSS shall allow a management station to set the DST mode. The current time value shall be defined in accordance with the Global Daylight Saving Object defined in NTCIP 1201 v03 Section 2.4.2.

3.4.1.5 Manage Sensor Zones

Requirements for managing sensor zones of the TSS follow.

3.4.1.5.1 Get Zone Options

The TSS shall allow a management station to determine the value of the last 'Set Zone Options' command.

3.4.1.5.2 Get Zone Options Status

The TSS shall allow a management station to determine the current status of zone options.

3.4.1.5.3 Get Zone Sample Period

The TSS shall allow a management station to determine the sample period length for a zone.

3.4.1.5.4 Get Zone Label

The TSS shall allow a management station to determine the label assigned to a zone.

3.4.1.5.5 Get Zone Boolean AND Zones

The TSS shall allow a management station to determine the zones a Boolean AND operation is performed on for a zone.

3.4.1.5.6 Get Zone Boolean OR Zones

The TSS shall allow a management station to determine the zones a Boolean OR operation is performed on for a zone.

3.4.1.5.7 Set Zone Options

The TSS shall allow a management station to set zone options.

3.4.1.5.8 Set Zone Sample Period

The TSS shall allow a management station to set the sample period of a zone in one minute increments.

3.4.1.5.9 Set Zone Label

The TSS shall allow a management station to assign a label to a zone.

3.4.1.5.10 Set Zone Boolean AND Operator

The TSS shall allow a management station to set the zones a Boolean AND operation is performed on for a zone.

3.4.1.5.11 Set Zone Boolean OR Operator

The TSS shall allow a management station to set the zones a Boolean OR operation is performed on for a zone.

3.4.1.5.12 Get Paired Zone

The TSS shall allow a management station to determine the Paired Zone for a zone.

3.4.1.5.13 Get Paired Zone Options

The TSS shall allow a management station to determine the Paired Zone Options for a zone.

3.4.1.5.14 Get Paired Zone Spacing

The TSS shall allow a management station to determine the Paired Zone Spacing between a zone and its paired zone.

3.4.1.5.15 Get Speed Correction Factor

The TSS shall allow a management station to determine the Speed Correction Factor for a zone.

3.4.1.5.16 Set Paired Zone

The TSS shall allow a management station to set the Paired Zone for a zone.

3.4.1.5.17 Set Paired Zone Options

The TSS shall allow a management station to set the Paired Zone Options for a zone.

3.4.1.5.18 Set Paired Zone Spacing

The TSS shall allow a management station to set the Paired Zone Spacing between a zone and its paired zone.

3.4.1.5.19 Set Speed Correction Factor

The TSS shall allow a management station to set the Speed Correction Factor for a zone.

3.4.1.5.20 Get Sensor Zone Average Vehicle Length

The TSS shall allow a management station to get the Sensor Zone Average Vehicle Length.

3.4.1.5.21 Get Sensor Zone Length

The TSS shall allow a management station to get the Sensor Zone Length.

3.4.1.5.22 Set Sensor Zone Average Vehicle Length

The TSS shall allow a management station to set the Sensor Zone Average Vehicle Length.

3.4.1.5.23 Set Sensor Zone Length

The TSS shall allow a management station to set the Sensor Zone Length.

3.4.1.5.24 Get Sensor Zone Loop Layout

The TSS shall allow a management station to determine the zone configuration of a TSS zone. This information can then be used to ensure that the correct zone configuration has been set for each zone of the TSS.

3.4.1.5.25 Set Sensor Zone Loop Layout

The TSS shall allow a management station to set the zone configuration of a TSS zone. This information can be used by the TSS to determine how to use the information being received from the zone sensor.

3.4.1.5.26 Set Zone Sensitivity Mode

The TSS shall allow a management station to set the current sensitivity mode of a zone.

3.4.1.5.27 Set Zone Sensitivity

The TSS shall allow a management station to set the current sensitivity of a zone.

3.4.1.5.28 Set Sensor Zone Frequency Range

The TSS shall allow a management station to set the frequency range for a sensor zone of a TSS.

3.4.1.5.29 Get Zone Sensitivity Mode

The TSS shall allow a management station to determine the current sensitivity mode of a zone.

3.4.1.5.30 Get Zone Sensitivity

The TSS shall allow a management station to determine the current sensitivity of a zone.

3.4.1.5.31 Get Sensor Zone Frequency Range

The TSS shall allow a management station to determine the frequency range for a sensor zone of a TSS.

3.4.1.5.32 Get Zone Output Mode

The TSS shall allow a management station to get the current mode of output.

3.4.1.5.33 Get Output Max Presence Time

The TSS shall allow a management station to get the output max presence time.

3.4.1.5.34 Get Output Delay Time

The TSS shall allow a management station to get the output delay time.

3.4.1.5.35 Get Output Extension Time

The TSS shall allow a management station to get the output extension time.

3.4.1.5.36 Set Zone Output Mode

The TSS shall allow a management station to set the output mode.

3.4.1.5.37 Set Output Max Presence Time

The TSS shall allow a management station to set the max presence time.

3.4.1.5.38 Set Output Delay Time

The TSS shall allow a management station to set the output delay time.