A User Comment Draft Amendment of AASHTO, ITE, and NEMA

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Amendment 1 e

Transit Communications Interface Profiles

Part of the National Transportation Communications for ITS Protocol

TCIP Framework Standard

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FOREWORD

This document uses only metric units.

This document is an NTCIP Process, Control and Information Management document. Process, Control and Information Management documents define the practices and policies used by the NTCIP Joint Committee in developing and maintaining NTCIP and TCIP standards, documents and systems. This TCIP Framework Standard was assigned document number NTCIP 1400 to be grouped with the other TCIP documents, rather than a number in the NTCIP 8000-series.

The TCIP family of standards addresses Advanced Public Transportation Systms (APTS) data interfaces and related automated transit tools and data. The standards address the business requirements of these APTS data interfaces. In some cases, specialized terms were needed to define general classes of information. For example, different business areas needed to define data elements related to time, date and footnotes. Special, constrained data types were developed so that the transit domain data concepts were consistent across business areas, while specific needs were met. These data types are defined within the TCIP family of standards and in this document.

For more information about NTCIP standards, visit the NTCIP Web Site at http://www.ntcip.org. For a hardcopy summary of NTCIP information, contact the NTCIP Coordinator at the address below.

In preparation of this NTCIP document, input of users and other interested parties was sought and evaluated. Inquires, comments, and proposed or recommended revisions should be submitted to:

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Approvals

This document will be separately balloted and approved by AASHTO, ITE, and NEMA after recommendation by the Joint Committee on the NTCIP. Each organization is expected to approve this NTCIP Information Data Dictionary Standard as the following standard type, as of the date:

AASHTO – Standard Specification; Month YYYY
ITE – Software Standard; Month YYYY
NEMA – Standard; Month YYYY

History

From 1997 to 1999, this document was referenced as ITE ST-ITS-TCIP-FRAME and/or NEMA TS 3.TCIP-FRAME. However, to provide an organized numbering scheme for the NTCIP, this document is now referenced as NTCIP 1400. The technical specification of NTCIP 1400 is identical to the former reference, except as noted in the development history:

TCIP documents version 0.1. Distributed in September 1997 for public review.

TCIP-FRAME Recommended Standard version 1.3, April 16, 1999. Proposed as a Recommended Standard of the Joint Committee on the NTCIP.

NTCIP 1400 version 01.3, April 16, 1999. Approved by AASHTO in October 1999, approved by ITE in May 2000, and approved by NEMA in April 2000.

NTCIP 1400 v01.04, December 1, 2000. Summer 2001 printing. Incremented version number and updated date; added and revised front matter; updated references to NTCIP and NEMA document numbers in References Clauses; updated references to NTCIP document numbers in Clause Conformance; updated references to ITE document numbers; and deleted Annex A Comment Form.

Draft NTCIP 1400 v01.05, September 2002. Updated references and contact information; update references to and section on National ITS Architecture; updated and revised section on the IEEE 1489 and 1488 standards; revised section on the TCIP Classification Scheme, included description of Transit Signal Priority (TSP); elaborate on Basic Concepts, change section name to “Concept of Operations”; removed references and requirement for implementation of Dynamic Object Module and deleted Annex A.

INTRODUCTION

The purpose of this document is to define the Framework for Transit Business Area objects that are supported by the Transit Communications Interface Profile (TCIP). This document introduces the background, concept of operations, and conformance requirements that apply to all TCIP business area requirements.

There are eight annexes to this document.

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

The following keywords apply to this document: AASHTO, ITE, NEMA, NTCIP, and TCIP.

In 1992, the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section began the effort to develop NTCIP. Under the guidance of the Federal Highway Administration's NTCIP Steering Group, the NEMA effort was expanded to include the development of communications standards for all transportation field devices that could be used in an Intelligent Transportation System (ITS) network.

In September 1996, a formal agreement was reached among NEMA, ITE, and AASHTO to jointly develop, approve, and maintain NTCIP Standards.

In 1997, the ITE, in cooperation with the American Public Transit Association (now referred to as the American Public Transportation Association or APTA), the U.S. DOT's Federal Transit Administration, and the U.S. DOT's FHWA, began development of the TCIP. The TCIP Technical Working Group was accepted as a subdivision of the Joint Committee on the NTCIP.

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Section 1
GENERAL

1.2.1 Normative References

-- Update references to the following:

The following normative documents contains provisions, which through reference in this text, constitute provisions of this publication. By reference herein, these publications are adopted, in whole or in part as indicated, in this publication.

ISO/IEC 8824:1998, *Abstract Syntax Notation One* (ASN.1) (ITU-T X.680 – X.690, 1998)

IEEE Std 1489-1999, *IEEE Standard for Data Dictionaries for Intelligent Transportation Systems.* 27 October 1999.

IEEE Std 1488-2000, *IEEE Trial-Use Standard for Message Set Template for Intelligent Transportation Systems*. 13 July 2000.

1.2.2 Other References

NTCIP 1401:2000 *Standard on Common Public Transportation (CPT) Objects*, Version 1.02

Draft NTCIP 1401 Amendment 1 (September 2002)

NTCIP 1402:2000 *Standard on Incident Management (IM) Objects*, Version 1.02

Draft NTCIP 1402 Amendment 1 (September 2002)

NTCIP 1403:2000 *Standard on Passenger Information (PI) Objects*, Version 1.02

Draft NTCIP 1403 Amendment 1 (September 2002)

NTCIP 1404:2000 *Standard on Scheduling/Runcutting (SCH) Objects*, Version 1.02

Draft NTCIP 1404 Amendment 1 (September 2002)

NTCIP 1405:2000 *Standard on Spatial Representation (SP) Objects*, Version 1.02

Draft NTCIP 1405 Amendment 1 (September 2002)

NTCIP 1406:2001 *Standard on On-Board (OB) Objects*, Version 1.02

Draft NTCIP 1406 Amendment 1 (September 2002)

NTCIP 1407:2001 *Standard on Control Center (CC) Objects*, Version 1.02

Draft NTCIP 1407 Amendment 1 (September 2002)

NTCIP 1408:2001 *Fare Collection Business Area Standard*, Version 1.02

Draft NTCIP 1408 Amendment 1 (September 2002)

SAE J1587 – Joint SAE/TMC Recommended Practice for Electronic Data Interchange Between Microcomputer Systems in Heavy Duty Vehicle Applications, February 2002.

Section 2
TERMINOLOGY

2.1 DEFINITIONS

-- add definitions for Event and Incident from NTCIP 1402:2000

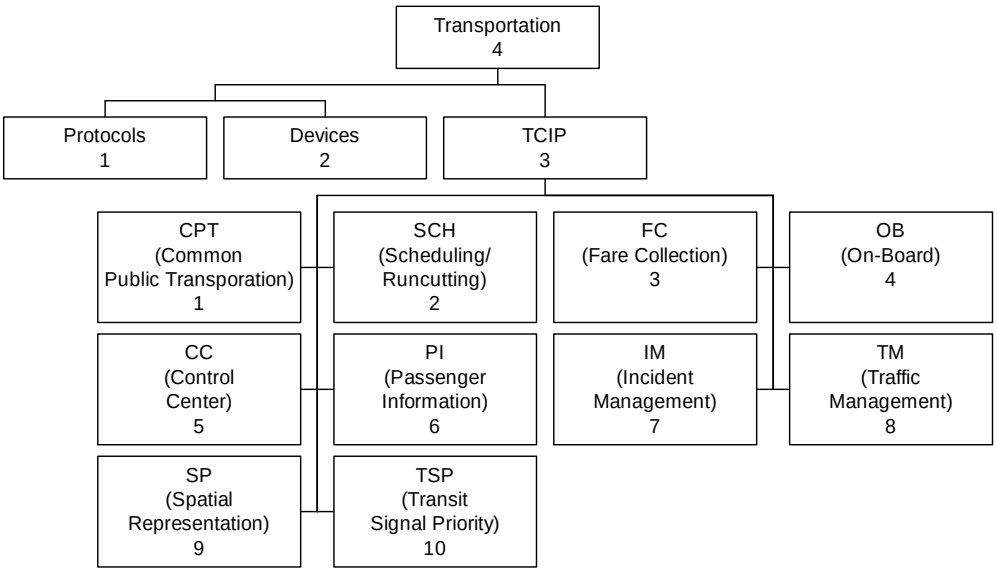
Event — A report or observation from the field about a potential or existing incident. The source of an event may be an official or "verifying" source (e.g., a transit supervisor or response agency employee) or a "non-verifying" source (e.g., a public witness). "Event" as defined by transit is not to be confused with highway organization's definition of "event" which encompasses incidents, and planned or anticipated traffic situations such as planned road closure or special events.

Incident — An unforeseen situation which negatively impacts normal transit operations and is expected to require some response action to restore operations to normal. An incident may be "verified" or "unverified".

2.4 CONVENTIONS

-- Add node for Transit Signal Priority which is soon to be under development. Remove nodes that refer to potential standards. Add note that explains classification and addressing notation.
-- Moved descriptions of Business Areas to Section 3, Concept of Operations

Figure 2.1 TCIP Classification Scheme



Each tree level is separated by a period. The prefix to the NEMA node is "1.3.6.1.4.1.1206." The TCIP is the third (3) node under NEMA's Transportation (4) node. Thus, the prefix to the TCIP node is "1.3.6.1.4.1.1206.4.3."

Each of the nodes are business areas within the transit domain. This list does not cover the entire domain, rather, these represent the ones that have been addressed by the current family of TCIP standards. The business areas are described in more detail in Section 3 Concept of Operations.

Section 3
CONCEPT OF OPERATIONS

-- Modified section title to Concept of Operations
-- Added Section 3.1 on The Family of TCIP Standards and incorporated sections describing Transit Business Areas (previous sections include: 2.4.1.1 to 2.4.1.9) including a new section on Transit Signal Priority
-- Renumbered and incremented sections from the previous version
-- Updated Sections 3.2.1 and 3.2.3

3.1 THE FAMILY OF TCIP STANDARDS

3.1.1 TCIP Standards Framework

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TCIP is a data interface standard. The contents of the family of standards provides the building blocks for supporting information flows among transit functional entities. The transit specific functions are currently divided into nine (9) business areas. The 9 business areas are illustrated in the TCIP Classification Scheme in Figure 2.1 and include the following:

- Common Public Transportation
- Control Center
- Fare Collection
- Incident Management
- On-Board
- Passenger Information
- Scheduling/Runcutting
- Spatial Representation
- Traffic Management

[Note: Ten business areas are included in the TCIP Classification Scheme including Transit Signal Priority (TSP) which will begin soon.] The first eight (8) business areas fall directly under the transit domain. The last area, Traffic Management, describes the functional requirements of transit related to Traffic Management, and incorporates by reference the Traffic Management data dictionary and message set. The data interface requirements for each of these business areas are contained in their own standard document. Together with this Framework document, these ten standards compose the Family of TCIP Standards.

The set of TCIP Business Area standards are divided into three parts which compose the elements for supporting data flows among these transit functions. The building blocks include:

- Data Elements
- Messages
- Dialogs.

Data elements are like the words we use to express ourselves. Words are listed in a dictionary with their correct pronunciation, definition, and usage. TCIP data elements must comply with definition, syntax and usage requirements as specified in the Requirements section. Each TCIP standard document includes a set of data elements compiled in a data dictionary.

Constructing messages and message sets may be likened to constructing sentences. There are rules for putting together sentences based on grammar, order and punctuation. TCIP *messages* are also based on syntax and transit business rules. Transit business rules address the types of information that are included in the message and the context in which they are used or understood. Each TCIP standard document includes a Message Set in the Requirements section.

A dialog is a meaningful exchange of information among two or more entities. Protocol and "effective listening" affect the stream of the conversation. For example, when you meet a colleague, you will often shake hands, exchange a greeting such as "Hello, how are you?" The response your colleague expects of you is "Fine, how are you?" There is an ordered sequence of assumptions, actions, and messages that are exchanged in order to hold an effective dialog. Development of dialogs will support the meaningful exchange of information. Currently, only the Control Center business area includes two templates that support dialogs. A few business areas support request-response pairs. Future documents will include additional dialog sets.

Individually or together, these building blocks may be used with existing ITS application protocol standards such as the NTCIP Center to Center standards, or as "message packets" in other information technology standards and distributed computing systems.

3.1.2 Transit Business Areas

Brief definitions of the ten business areas are included in this section. A more detailed description specific functions that are covered by these business areas are described in the respective Business Area Standard.

3.1.2.1 Common Public Transportation

The common public transportation domain covers standard data types, data elements and messages (business objects) shared by many of the other business areas. This includes representative class data types and general data concepts related to vehicle, equipment, facilities, activation/deactivation date and times, etc.

3.1.2.2 Scheduling/Runcutting

The scheduling domain covers the data needs of the functions related to scheduling and runcutting. This includes all input data needed to develop the master schedule, trip sheet, run guides, paddles, inventory files and other supplemental information. It also includes output data for several systems and information services: transit garage management, control system, on-board, transit customer information systems, incident and traffic management, paratransit, roadside devices and operating performance history databases.

3.1.2.3 Fare Collection

The fare collection domain covers the data needs of the functions related to the collection of fares from passengers. This includes all input data needed to process any form of electronic or non-electronic payment. It also includes output data for several functions: data to be transmitted from the fare transaction unit back onto the fare media; data reporting the status or health of the unit itself; data which supports the processing of financial transactions; and data which supports the planning of future service.

3.1.2.4 On-board

The on-board domain covers the data needs of the functions related to on-board applications. This includes all data needed for the communication between on-board components within a public transportation vehicle and other transit applications. The data objects defined in this specification are

critical to transit agencies because they provide information (such as AVL information) for vehicle performance monitoring and transit operations.

3.1.2.5 Control Center

The control center functions span various centers and systems within transportation and operations. In general, the control system (or Transit Management Center) acts as the clearinghouse for all operations data related to dispatching, providing, monitoring and measuring transit revenue services in real time. The control center concept merges various tasks performed by numerous individuals into a single workstation and operated by just a few technical staff. Moreover, through electronic control and network connectivity, Computer Aided Dispatch (CAD) operators may control many of the functions on-board the transit vehicle (or advise the driver to perform those tasks).

3.1.2.6 Passenger Information

The passenger information domain covers the data needs related to providing passengers and potential customers with the information they need and want in order to plan and make trips on public transportation. This includes input data associated with traveler preferences (departure time, arrival time, mode, cost, etc.), estimated time of arrival, published schedules, and other types of information related to scheduled and actual transit services. It also includes output data necessary for supporting any type of information service: trip itinerary planning, customer service telephone information centers, independent service providers (such as computer on-line services or regional [not limited to transit] traveler information services), incident and traffic management, and remote devices such as dynamic message signs and interactive information kiosks. The passenger information domain relies heavily on the transit scheduling domain for supporting data such as transit schedules, vehicle assignments to routes, etc., and on the control center domain for real-time travel information.

3.1.2.7 Incident Management

The incident management domain covers the data needs related to detecting, verifying, prioritizing, responding to, and clearing of unplanned events (i.e., accidents, weather conditions, crimes, etc.) that affect transit operations. This includes all data needed to identify the date, time, and location of an event, the source of the information about the event, codes for indicating the type of incident, the severity of the incident, detour information, and the dispatch of the emergency response team. It also includes data necessary for providing information to the traveling public about the impacts of the incident on the transportation infrastructure including the impact on transit service. To a large extent incident management data requirements within transit are the same as those within other transportation centers.

3.1.2.8 Traffic Management

Transit agencies are interested in acquiring various types of information from Traffic Management Centers (TMC). These include information about planned, temporary, or permanent changes in the roadway network that affect transit operations (e.g., construction projects). For transit operations dispatching, transit agencies need data related to real-time traffic movements, and road and weather conditions. Since these data come exclusively from TMCs, TCIP will rely heavily on data objects developed by the ITE/ITS Traffic Management Data Dictionary effort for data flowing from the TMC to the transit agency.
TMCs may be interested in data generated by transit agencies related to transit service schedules, transit facilities, availability of parking at parking lots or garages at transit stops, the types and number of transit vehicles operating within their jurisdiction, the estimated arrival time of transit services, and passenger counts. Transit vehicles can also serve as traffic flow probes when their location is provided to TMCs.

3.1.2.9 Spatial Representation

The spatial representation (SP) business area objects serve other data elements; messages defined in this business area represent the location of fixed and mobile objects. Among the APTS data interchange needs is the ability to transfer the location of transit objects. Spatial representation is a common attribute

(i.e., location reference) of a transit object. For example, a route is generally identified by a route identifier and its physical representation. A route pattern may be represented by a sequence of timepoints, nodes and links, or by a series of intersections ("on" and "at" streets).
Spatial features are composed of three primitive types: zero, one and two dimensional objects, or *point*, *line* and *polygon*. In addition, transit data elements make significant use of complex spatial objects such as linked lines or traversals, which are referred to in this standard as *routes*. These four classes of spatial representations cover most of the business area location referencing needs. These classes may be further specialized into various layers: topologic, geographic, etc. Generally, TCIP business areas use geographic, topologic and a combined geographic/topologic representations for referencing its business objects (e.g., stop point, pattern).
Each layer of representation has its various referencing methods. Translation from one layer to another is accomplished by indexing (or calibrating) key data elements between two or more layers. Definition or guidelines of data structures that ensure interoperability among location referencing methods are not within the scope of the TCIP standard; however, data elements that can accomplish the translation are contained within the SP business area standard.

3.1.2.10 Transit Signal Priority

The transit signal priority (TSP) business area domain covers the data needs related to generating priority requests from Signal Controllers. This business area works in conjunction with NTCIP 1211. NTCIP 1211 Signal Control and Prioritization describes a Priority Request Generator and a Priority Request Server . NTCIP 1211 covers the form and content of messages to be exchanged between requesters, a prioritizing entity, and a controller. The TCIP TSP business area covers the form and content of messages to be exchanged between a revenue or non-revenue transit vehicle and the traffic signal controller, that is the primary function of the Priority Request Generator.

The primary functions of the Priority Request Generator are as follows:

- To determine whether a vehicle is in need of preferential treatment (priority) at a signalized intersection according to series of user-defined criteria (i.e., lateness, occupancy level, etc.)
- To produce an estimate of the vehicles estimated time for service desired at the signalized intersection. This estimate, measured in seconds, is intended to represent the vehicles arrival time at the intersection and can range from zero (0) (representing a request for immediate service) to some time in the future.
- To communicate the vehicle's request for priority and its time of service desired to the Priority Request Server.
- To produce a log of all priority requests for processing by a fleet management agency.

Elements of the Priority Request Generator can be physically and/or logically located in many different locations and multiple Fleet Vehicles from different Fleet operations can all produce requests for priority. Each Fleet Management entity is responsible for installing, operating, and maintaining their own Priority Request Generators.

3.1.3 Relationship to Other ITS Standards

The Family of TCIP standards conforms to a larger ITS framework, the National ITS Architecture and ITS standards. The National ITS Architecture builds a framework for connections among transportation systems. The relationship between transit and the National ITS Architecture is described in Section 3.2.

TCIP is based on similar base standards as other ITS functional areas. All ITS functional area data interface standards conform to the ITS Data Dictionary and Message Set Format. The data dictionary and message set formats are specified by IEEE 1489-1999 and 1488-2000. Section 3.2.3 describes the fields, as defined by the IEEE standards, that are included in the TCIP business area standards. The section also describes usage of these fields by the Family of TCIP standards.

These standards also specify the use of Abstract Syntax Noation One (ASN.1), a data descriptive language that ensures unambiguous representation of the object. Basic concepts of the language are described in Section 3.3.

3.2 NATIONAL ITS ARCHITECTURE / IEEE DATA DICTIONARY AND MESSAGE SET TEMPLATE

-- Incremented section number

3.2.1 TCIP and the National ITS Architecture

-- Modified section title from "National ITS Architecture Data Flows" to "TCIP and the National ITS Architecture"
-- Updated section 3.2.1 to reflect The National ITS Architecture Version 4.0 and current nomenclature used to describe the National ITS Architecture. Also updated Table 3.1, Figure 3-1 and current Definitions of National Architecture Concepts (section 3.2.1.1) to accurately reflect current representation.

"The National ITS Architecture Version 4.0, A Framework for Integrated Transportation in the 21st Century" describes the physical and logical framework for providing a common structure for the design of intelligent transportation systems. To maximize the potential of ITS technologies, system design solutions must be compatible at the system interface level in order to share data, provide coordinated, area-wide integrated operations, and support interoperable equipment and services where appropriate. The National ITS Architecture provides this overall guidance to ensure system, product, and service compatibility, without limiting the design options of the stakeholder.

The National ITS Architecture defines the framework around which multiple design approaches can be developed. Each one can be specifically tailored to meet the individual needs of the user while maintaining the benefits of a common architecture. The architecture defines the processes that may be performed to implement a given user service, the subsystems where these processes reside, the architecture flows between the physical subsystems, and the communication types for the flows. In addition, it identifies the interfaces needed to support national and regional interoperability. TCIP defines transit-specific data interfaces as described in the scope of the business area. However, TCIP only addresses a subset of the transit interfaces defined in the National ITS Architecture and the requirements specified. The following table lists all the transit-specific architecture flows, together with the source and destination subsystems, as defined in the National ITS Architecture. Annex A associates these Architecture Flows with TCIP business area standards and other ITS standards.

Table 3.1 Public Transportation Architecture Flows from the National ITS Architecture [V4.0]

These architecture flows represent automated or electronic flows among ITS subsystems. Human interfaces and terminators are not included in this table.

Source	Destination	Architecture Flow
Archived Data Management	Transit Management	archive requests
Archived Data Management	Transit Management	archive status
Basic Transit Vehicle	Transit Vehicle Subsystem	transit vehicle measures
Emergency Management	Transit Management	transit emergency coordination data
Financial Institution	Transit Management	transaction status
Information Service Provider	Transit Management	demand responsive transit request
Information Service Provider	Transit Management	selected routes

Source	Destination	Architecture Flow
Information Service Provider	Transit Management	transit information request
Maintenance and Construction Management	Transit Management	current asset restrictions
Maintenance and Construction Management	Transit Management	maint and constr work plans
Maintenance and Construction Management	Transit Management	road weather information
Maintenance and Construction Management	Transit Management	roadway maintenance status
Maintenance and Construction Management	Transit Management	work zone information
Map Update Provider	Transit Management	map updates
Media	Transit Management	media information request
Multimodal Transportation Service Provider	Transit Management	multimodal service data
Other TRM	Transit Management	TRMS coord
Parking Management	Transit Management	transit parking coordination
Personal Information Access	Transit Management	transit information user request
Remote Traveler Support	Transit Management	emergency notification
Remote Traveler Support	Transit Management	secure area surveillance data
Remote Traveler Support	Transit Management	transit fare payment requests
Remote Traveler Support	Transit Management	transit information user request
Surface Transportation Weather Service	Transit Management	transportation weather information
Traffic Management	Transit Management	request transit information
Traffic Management	Transit Management	road network conditions
Traffic Management	Transit Management	traffic control priority status
Traffic Management	Transit Management	transit demand management request
Transit Management	Archived Data Management	transit archive data
Transit Management	Emergency Management	transit emergency data
Transit Management	Enforcement Agency	payment violation notification
Transit Management	Financial Institution	payment request
Transit Management	Information Service Provider	demand responsive transit plan
Transit Management	Information Service Provider	transit and fare schedules
Transit Management	Information Service Provider	transit incident information
Transit Management	Information Service Provider	transit request confirmation
Transit Management	Multimodal Transportation Service Provider	transit multimodal information
Transit Management	Maintenance and Construction Management	road network probe information
Transit Management	Maintenance and Construction Management	work plan feedback
Transit Management	Map Update Provider	map update request
Transit Management	Media	transit incidents for media

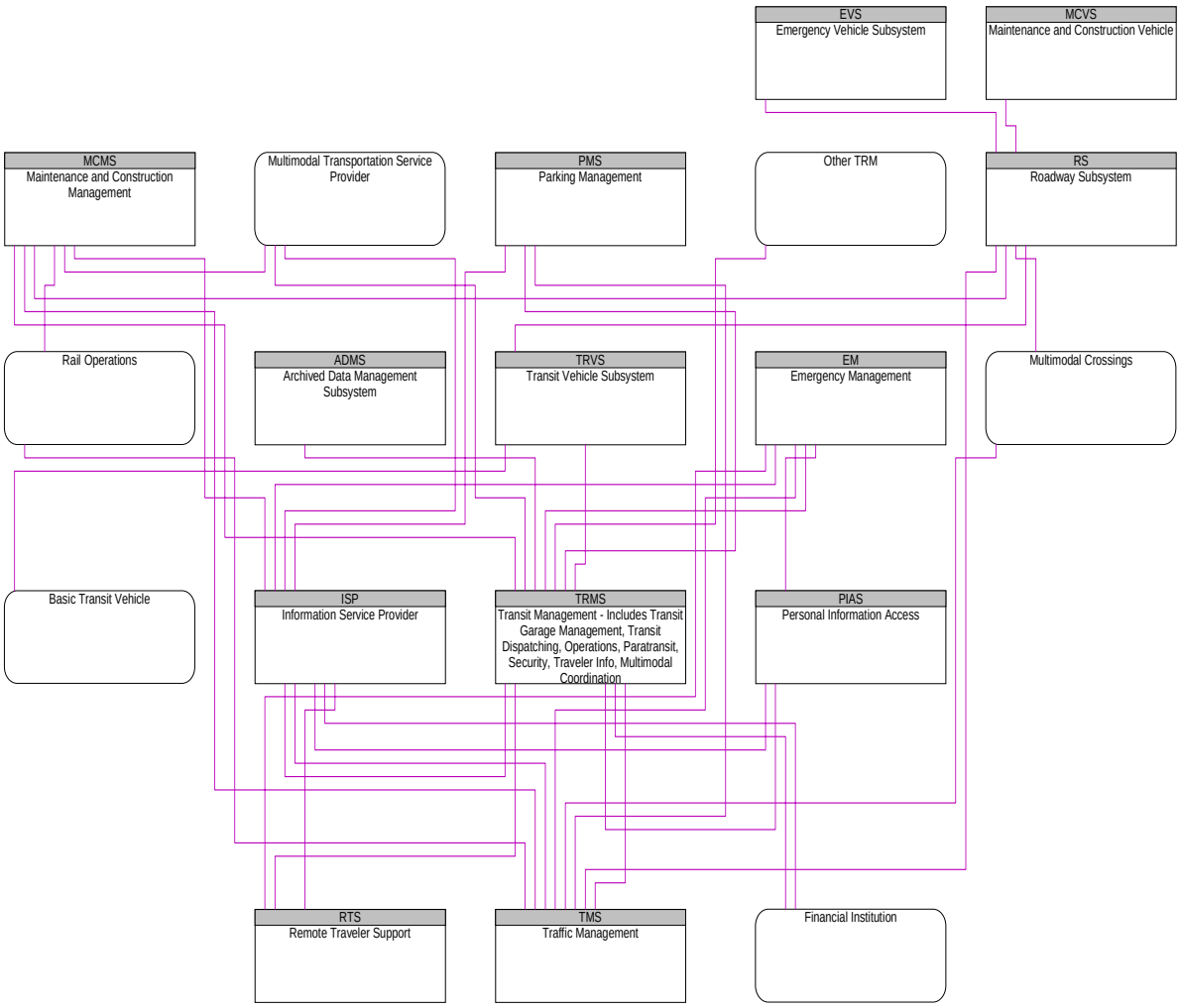
Source	Destination	Architecture Flow
Transit Management	Media	transit information for media
Transit Management	Other TRM	TRMS coord
Transit Management	Parking Management	transit parking lot response
Transit Management	Personal Information Access	personal transit information
Transit Management	Remote Traveler Support	emergency acknowledge
Transit Management	Remote Traveler Support	secure area monitoring support
Transit Management	Remote Traveler Support	transit fare payment responses
Transit Management	Remote Traveler Support	transit traveler information
Transit Management	Surface Transportation Weather Service	transportation weather information request
Transit Management	Traffic Management	request for road network conditions
Transit Management	Traffic Management	road network probe information
Transit Management	Traffic Management	traffic control priority request
Transit Management	Traffic Management	transit demand management response
Transit Management	Traffic Management	transit system data
Transit Management	Transit Vehicle Subsystem	bad tag list
Transit Management	Transit Vehicle Subsystem	driver instructions
Transit Management	Transit Vehicle Subsystem	emergency acknowledge
Transit Management	Transit Vehicle Subsystem	fare management information
Transit Management	Transit Vehicle Subsystem	request for vehicle measures
Transit Management	Transit Vehicle Subsystem	transit schedule information
Transit Management	Transit Vehicle Subsystem	transit traveler information
Transit Vehicle Subsystem	Roadway Subsystem	local signal priority request
Transit Vehicle Subsystem	Transit Management	emergency notification
Transit Vehicle Subsystem	Transit Management	environmental probe data
Transit Vehicle Subsystem	Transit Management	fare and payment status
Transit Vehicle Subsystem	Transit Management	request for bad tag list
Transit Vehicle Subsystem	Transit Management	transit traveler request
Transit Vehicle Subsystem	Transit Management	transit vehicle conditions
Transit Vehicle Subsystem	Transit Management	transit vehicle location data
Transit Vehicle Subsystem	Transit Management	transit vehicle passenger and use data
Transit Vehicle Subsystem	Transit Management	transit vehicle schedule performance
Transit Vehicle Subsystem	Traveler Card	request for payment
Transit Vehicle Subsystem	Vehicle Subsystem	traveler advisory request
Traveler Card	Transit Vehicle Subsystem	payment
Vehicle Subsystem	Transit Vehicle Subsystem	vehicle location
Weather Service	Transit Management	weather information

3.2.1.1 Definitions of National Architecture Concepts

-- Updated Figure 3.1 based on National ITS Architecture Version 4.0 and updated subsystem descriptions.

Figure 3-1 shows the interfaces to the National ITS Architecture entitities (subsystems and terminators) that fall within the transit domain. TCIP covers a subset of these interfaces; other ITS standards may address some of these interfaces.

Figure 3-1 APTS Subsystems from the National ITS Architecture



The following are definitions (taken from Version 4.0 of the The National ITS Architecture) of the subsystems and terminators, some of whose interfaces are defined by the set of TCIP standards. The referenced definitions may be found under the “Physical Entities” hyperlink of the National ITS Architecture (found at www.iteris/com/itsarch).

3.2.1.1.1 Transit Management Subsystem

“The transit management subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, planning and management functions for the transit property. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, paratransit services, and bus rapid transit (BRT) service. The subsystem's interfaces allow for communication between transit departments and with other operating entities such as emergency response services and traffic management systems. This subsystem receives special event and real-time incident data from the traffic management subsystem. It provides current transit operations data to other center subsystems. The Transit Management Subsystem collects and stores accurate ridership levels and implements corresponding fare structures. It collects operational and maintenance data from transit vehicles, manages vehicle service histories, and assigns drivers and maintenance personnel to vehicles and routes. The Transit Management Subsystem also provides the capability for automated planning and scheduling of public transit operations. It furnishes travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options, and transit routes and fares. In addition, the monitoring of key transit locations with both video and audio systems is provided with automatic alerting of operators and police of potential incidents including support for traveler activated alarms.”

3.2.1.1.2 Transit Vehicle Subsystem

“This subsystem resides in a transit vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. The Transit Vehicle Subsystem collects accurate ridership levels and supports electronic fare collection. An optional traffic signal prioritization function communicates with the roadside subsystem to improve on-schedule performance. Automated vehicle location functions enhance the information available to the Transit Management Subsystem enabling more efficient operations. On-board sensors support transit vehicle maintenance. The Transit Vehicle Subsystem also furnishes travelers with real-time travel information, continuously updated schedules, transfer options, routes, and fares.”

3.2.1.1.3 Emergency Management Subsystem

“The Emergency Management Subsystem represents public safety and other allied agency systems that support coordinated traffic incident management and emergency response. The subsystem includes the functions associated with fixed and mobile public safety communications centers includes various public safety call taker and dispatch centers operated by police, fire, and emergency medical services. This subsystem also represents other allied systems including centers associated with towing and recovery, freeway service patrols, HAZMAT response teams, mayday service providers, and security/surveillance services that improve traveler security in public areas. This subsystem interfaces with other Emergency Management Subsystems to support coordinated emergency response involving multiple agencies. The subsystem creates, stores, and utilizes emergency response plans to facilitate coordinated response.… Interface with the Transit Management Subsystem allows coordinated use of transit vehicles to facilitate response to major emergencies.”

Transit Police may be described by the Emergency Management physical entity.

3.2.1.1.4 Emergency Vehicle Subsystem

“This subsystem resides in an emergency vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient incident response.”
Transit Police Vehicles may be described by the Emergency Vehicle physical entity.

3.2.1.1.5 Archived Data Management Subsystem

"The Archived Data Management Subsystem collects, archives, manages, and distributes data generated from ITS sources for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, and research applications. The data received is formatted, tagged with attributes that define the data source, conditions under which it was collected, data transformations, and other information (i.e. meta data) necessary to interpret the data. The subsystem can fuse ITS generated data with data from non-ITS sources and other archives to generate information products utilizing data from multiple functional areas, modes, and jurisdictions. The subsystem prepares data products that can serve as inputs to Federal, State, and local data reporting systems. This subsystem may be implemented in many different ways. It may reside within an operational center and provide focused access to a particular agency's data archives…"

With implementation of advanced technologies, particularly on board the transit revenue vehicle, a significant amount of data is being thrust upon transit properties. Much of the data must be off-loaded the operational database and stored in a back-office system.

3.2.1.1.6 Parking Management Subsystem

"The Parking Management Subsystem provides electronic monitoring and management of parking facilities. It supports a DSRC communications link to the Vehicle Subsystem that allows electronic collection of parking fees. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information. This portion of the subsystem functionality must be located in the parking facility where it can monitor, classify, and share information with customers and their vehicles. The subsystem also interfaces with the financial infrastructure and broadly disseminates parking information to other operational centers in the region. Note that the latter functionality may be located in a back office, remote from the parking facility."

A transit property may be the operator or key stakeholder of the parking management subsystem. The transit property may wish to integrate the electronic collection with their fare collection processes.

3.2.1.1.7 Information Service Provider

"This subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. The subsystem can play several different roles in an integrated ITS. In one role, the ISP provides a general data warehousing function, collecting information from transportation system operators and redistributing this information to other system operators in the region and other ISPs. In this information redistribution role, the ISP provides a bridge between the various transportation systems that produce the information and the other ISPs and their subscribers that use the information. The second role of an ISP is focused on delivery of traveler information to subscribers and the public at large. Information provided includes basic advisories, traffic and road conditions, transit schedule information, yellow pages information, ridematching information, and parking information. The subsystem also provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans, and returning the calculated plans to the users. In addition to general route planning for travelers, the ISP also supports specialized route planning for vehicle fleets. In this third role, the ISP function may be dedicated to, or even embedded within, the dispatch system. Reservation services are also provided in advanced implementations. The information is provided to the traveler through the Personal Information Access Subsystem, Remote Traveler Support Subsystem, and various Vehicle Subsystems through available communications links. Both basic one-way (broadcast) and personalized two-way information provision is supported. The subsystem provides the capability for an informational infrastructure to connect providers and consumers, and gather that market information needed to assist in the planning of service improvements and in maintenance of operations."

A transit property or a regional transit planning organization (DOT, MPO or regional authority) may provide individual or regional transit customer information through web services, customer service representative centers, and interactive voice response. The information may be presented and distributed to travelers in

many different ways. The Remote Traveler Support and Personal Information Access subsystems describe other methods of customer access.

3.2.1.1.8 Remote Traveler Support

"This subsystem provides access to traveler information at transit stations, transit stops, other fixed sites along travel routes (e.g., rest stops, merchant locations), and at major trip generation locations such as special event centers, hotels, office complexes, amusement parks, and theaters. Traveler information access points include kiosks and informational displays supporting varied levels of interaction and information access. At transit stops, simple displays providing schedule information and imminent arrival signals can be provided. This basic information may be extended to include multi-modal information including traffic conditions and transit schedules along with yellow pages information to support mode and route selection at major trip generation sites. Personalized route planning and route guidance information can also be provided based on criteria supplied by the traveler. In addition to traveler information provision, this subsystem also supports public safety monitoring using CCTV cameras or other surveillance equipment and emergency notification within these public areas. Fare card maintenance, and other features which enhance traveler convenience may also be provided at the discretion of the deploying agency."

These types of functions may be provided at transit stops and/or multimodal stations.

3.2.1.1.9 Personal Information Access

"This subsystem provides the capability for travelers to receive formatted traffic advisories from their homes, place of work, major trip generation sites, personal portable devices, and over multiple types of electronic media. These capabilities shall also provide basic routing information and allow users to select those transportation modes that allow them to avoid congestion, or more advanced capabilities to allow users to specify those transportation parameters that are unique to their individual needs and receive travel information. This subsystem shall provide capabilities to receive route planning from the infrastructure at fixed locations such as in their homes, their place of work, and at mobile locations such as from personal portable devices and in the vehicle or perform the route planning process at a mobile information access location. In addition to end user devices, this subsystem may also represent a device that is used by a merchant or other service provider to receive traveler information and relay important information to their customers. This subsystem shall also provide the capability to initiate a distress signal and cancel a prior issued manual request for help."

3.2.1.1.10 Traffic Management Subsystem

"The Traffic Management Subsystem operates within a traffic management center or other fixed location. This subsystem … monitor[s] and manage[s] traffic flow. Incidents are detected and verified and incident information is provided to the Emergency Management Subsystem, travelers.., and to third party providers" such as the Transit Management Subsystem.

3.2.1.1.11 Roadway Subsystem

"This subsystem includes the equipment distributed on and along the roadway which monitors and controls traffic and monitors and manages the roadway itself. Equipment includes traffic detectors, environmental sensors, traffic signals, highway advisory radios, dynamic message signs, CCTV cameras and video image processing systems, grade crossing warning systems, and freeway ramp metering systems."

Transit signal priority interoperates with the roadway subsystem equipment to request priority treatment for transit vehicles in revenue service.

3.2.1.1.12 Other Subsystems and Terminators

Other subsystems and terminators are also depicted on Figure 3.1. They include the following:

- Maintenance and Construction Vehicles: "specialized service vehicles or equipment and provides the sensory, processing, storage, and communications functions necessary to support highway maintenance and construction"
- Maintenance and Construction Management Subsystem: "monitors and manages roadway infrastructure construction and maintenance activities"
- Multimodal Crossing: "non-road based transportation system at an interference crossing with the roadway" such as bridges and railroad grade crossings.
- Multimodal Transportation Provider: "operators of non-roadway transportation systems (e.g. airlines, ferry services, passenger carrying heavy rail) and providers of non-motorized transportation facilities."
- Other TRM: other Transit Management Systems
- Rail Operators: operators of rail systems (both freight and passenger)
- Parking Operators: operators of parking facilities
- Basic Transit Vehicle: any vehicle owned or operated by a transit service provider
- Financial Institutional: "handles all electronic fund transfer requests to enable the transfer of funds from the user of the service to the provider of the service. The functions and activities of financial clearinghouses are subsumed by this entity."

3.2.2 Classification Scheme

-- Incremented section numbering

3.2.3 Data Dictionary and Message Template Meta-Attributes

-- Changed Section name from Naming Convention to "Data Dictionary and Message Template Meta-Attributes" and incremented section numbering.
-- Replaced Section 3.2.3.1 ITS Data Dictionary Naming Requirements with the one below.
-- Added subsections to describe the meta-attributes used to describe data element and message objects. Definitions were derived or quoted from IEEE 1489-1999 and IEEE 1488-2000.
-- Added copyright statement acknowledging IEEE's copyright on IEEE 1489-1999 and 1488-2000.

3.2.3.1 ITS Data Dictionary Naming Requirments [from IEEE 1489-1999]

-- update reference to IEEE ITS Data Dictionary Standard in title and page references.

Entity type terms
"An entity type term is written as a singular noun in all capital letters" [IEEE 1489-1999, A.2.1]

Property terms
"A property term indicates the information of interest about the entity type relevant to a data element (that is, the 'something of interest' about the entity type). The information of interest may be a fact, proposition, or observation about the entity type…The property term is written in singular noun form in initial capital letters, with any modifiers also written in initial capital letters without separators." [IEEE 1489-1999, A.2.2]

Representative class terms
"A representative class term is a term that indicates, precisely and unambiguously, the format and syntactic form for data element instance values…The representative class term is a single word written in all lower case letters. Representative class terms shall not contain any modifiers. For example, the representation class term 'date' is the name for a specific representational form and format for a date, such as that specified by ANSI X3.30-1997, an explicit and unambiguous value domain associated with this particular representation class term." [IEEE 1489-1999, A2.3]

3.2.3.2 Meta-Attributes for ITS data dictionaries and message sets

The format for the TCIP Business Area document data dictionary and message set (NTCIP 1401-1408) are based on a standard format developed to guarantee consistency across all ITS functional area data

dictionaries. The IEEE Standard for Data Dictionaries for Intelligent Transportation Systems (IEEE Std 1489-1999) and the IEEE Trial-Use Standard for Message Set Template for Intelligent Transportation Systems (IEEE Std 1488-2000) provide the descriptions for the fields or meta-attributes that describe TCIP objects (data elements or messages). A short description extracted from the IEEE standards and a discussion on the usage of those fields by TCIP are included below.

[Note: for more information on the ITS Data Dictionary and Message Set Template requirements see IEEE 1489-1999 and IEEE 1488-2000.]

3.2.3.2.1 Meta-attributes for TCIP data dictionaries

[Referenced sections are from IEEE 1489-1999, Section 5, pp., 7-13]

3.2.3.2.1.1 Descriptive name

"Definition: A descriptive word or group of words that labels a data concept"

TCIP Usage: The name that is used to encapsulate the content and format of the data element.

TCIP Example: SCH_PassengerMiles_qty / NTD where qty is the representation class term and NTD (National Transit Database) is the data source and base standard upon which the format is based.

3.2.3.2.1.2 Descriptive name context

"Definition: A designation of the ITS functional-area within which the descriptive name is relevant."

TCIP Usage: TCIP falls within the "Manage Transit" functional area, so all TCIP data element are designated with that label.

3.2.3.2.1.3 Definition

"Definition: A statement in natural-language text form that expresses the essential meaning of a data concept and assists humans in differentiating the data concept from all other data concepts."

TCIP Usage: In some cases the definition indicates issues related to data element usage.

3.2.3.2.1.4 Formula

"Definition: A rule or other expression in mathematical form that represents the semantics of the data concept and, where appropriate, the mechanism for determining legal instances of a value domain."

3.2.3.2.1.5 Source

"Definition: The origin of the data concept."

TCIP Usage: When a data element is imported from another source, the source is cited. This occurs for all data elements that are imported from the Vehicle Area Network standard, SAE J1708/J1587 family of standards.

3.2.3.2.1.6 Class name

"Definition: The name of a group into which this data concept can be meaningfully categorized"

TCIP Usage: TCIP objects are assigned class names that refer to the TCIP Business Area under which they are documents. Currently ten business areas are designated:

CC Control Center
CPT Common Public Transportation (infrastructure and policy)
FC Fare Collection
IM Incident Management
OB On-Board

PI Passenger Information
SCH Scheduling / Runcutting
SP Spatial Representation
TM Traffic Management
TSP Transit Signal Priority

3.2.3.2.1.7 Classification scheme name
"Definition: The designator (e.g., the title or number) of a classification scheme that contains the Class Name."

TCIP Usage: The Classification scheme is described in this document (NTCIP 1400, Section 2.4). As such, the content of this field is "TCIP".

3.2.3.2.1.8 Classification scheme version
"Definition: The version number of the classification scheme that contains the Class Name."

TCIP Usage: The Classification scheme is described in this document (NTCIP 1400, Section 2.4). As such, the content of this field is this document: NTCIP 1400:200x.

3.2.3.2.1.9 Data concept type
"Definition: A categorization of the kind of data concept"

3.2.3.2.1.10 Keyword
"Definition: A significant word useful for search and retrieval, or indexing, of a data concept."

3.2.3.2.1.11 Related data concept
"Definition: The name of another data concept(s) related in some way to the data concept being specified."

3.2.3.2.1.12 Relationship type
"Definition: A word or phrase that expresses the nature of the relationship between a data concept and its Related Data Concept."

3.2.3.2.1.13 Remarks
"Definition: Comments or other information pertinent to the data concept."

TCIP Usage: Typically, the remarks field is used to provide guidance on using the data element and/or related data elements.

3.2.3.2.1.14 Symbolic name
"Definition: The name of a data element as used in an application program(s)."

TCIP Usage: This field is used to define the hierarchical tree address which is defined as an ASN.1 OBJECT IDENTIFIER (see Section 2.4, Figure 2.1 TCIP Classification Scheme).

3.2.3.2.1.15 Symbolic name usage
"Definition: The name(s) of the application(s) within which the data element symbolic name is used."

TCIP Usage: This document provides information on Symbolic name usage.

3.2.3.2.1.16 ASN.1 name (ASN1 name)
"Definition: The name of a data element expressed using ASN.1 syntax and naming conventions, which shall be unique within the ITS community."

TCIP Usage: The field name in the data dictionary is labeled ASN1 name. This is the name used to index the data element in the ITS Data Registry.

TCIP Exmaple: SCH-PassengerMiles

3.2.3.2.1.17 Representation layout

"Definition: The logical layout for representation of the data element, generic property domain, or representation class term (and value domain reference, where applicable) in relation to interchange data."

TCIP Usage: This field defines layout and codes associated with the data element. Rules for interpreting the layout are also included in this field.

TCIP Example:

-- types are not mutually exclusive

1 Open lot -- uncovered or surface lot
2 Garage
3 Permit parking
4 Contract Parking
5 Free Parking
6 Paid Parking
7 Other
8-149 Reserved for standard codes
150-255 Reserved for local use

3.2.3.2.1.18 Constraints

"Definition: Any textual statement of any constraint other than those explicitly addressed by other meta-attributes described in this standard."

3.2.3.2.1.19 Value domain

"Definition: A specific and explicit physical representation form for data element or generic property domain values."

TCIP Usage: When appropriate, the value domain derived from the representation class term are included in this field. A set of value domain terms are defined in IEEE 1489-1999, Annex C.

3.2.3.2.1.20 Data type

"Definition: The type of the data for purposes of data interchange."

TCIP Usage: This field describes the ASN.1 types. The TCIP data dictionary also allows TCIP Subtype and Type Reference definitions that are constrainted ASN.1 universal types.

3.2.3.2.1.21 Representation class term

"Definition: The name of a type of value domain."

TCIP Usage: A set of valid representation class terms are defined in IEEE 1489-1999, Annex C.

3.2.3.2.1.22 Valid value rule

"Definition: A valid value rule may be in the form of a "from-to" range, a list, or a function or algorithm."

TCIP Usage: Defines the ASN.1 type reference definition for the data element

TCIP Example:

```
      PI-ParkingType    ::=   INTEGER
```



```
{open         (1),   -- Open lot
 garage      (2),
 permit       (3),
 contract       (4),
 free          (5),
 pay         (6),
 other          (7),
  -- 8-149 reserved
  -- 150-255 local use
} (0..255)
```

3.2.3.2.2 Meta-Attributes for TCIP Message Set

[Referenced sections are from IEEE 1488-2000, Section 5, pp., 8-18 and Section 4.5.2]

3.2.3.2.2.1 Message Identifier

"Definition: A unique ASN.1 object identifier for the message in accordance with Annex A [of 1488-2000]."

TCIP Usage: This field describes the address of the TCIP message in the TCIP Classification Scheme and relevant Business Area Classification Tree.

3.2.3.2.2.2 Metadata source

"Definition: Indicates where the metadata resides that is used to describe and interpret the data elements, the value of which comprise the instance in the body of the message."

TCIP Usage: The ITS Message Set Template is valid for three types of sources. All TCIP messages are described as "Direct", that is that the message structure is known in advance.

3.2.3.2.2.3 Descriptive name

"Definition: A descriptive word or group of words that labels a message."

TCIP Usage: All the objects in the message set are messages (versus data frames) and contain a suffix of _message. Further, each message contains a prefix that associates the name with its Business Area.

TCIP Example: PiTripRequest_message

3.2.3.2.2.4 Descriptive name context

"Definition: A designation of the ITS functional-area within which the descriptive name is relevant."

TCIP Usage: See explanation in 3.2.3.2.1.2.

3.2.3.2.2.5 Definition

"Definition: A text-based, natural language description of a message that provides insight into the purpose and use of the message. This should define the requirements for exchanging the data (i.e., does the message expect a response, does it require functionality to be performed by the receiving system, etc.) and may include data about the functional areas and/or applications that send and/or receive the message, based, for example, on the data flows from the National [ITS] Architecture."

TCIP Usage: See explanation in 3.2.3.2.1.3.

3.2.3.2.2.6 Source

"Definition: The origin of the message."

TCIP Usage: See explanation in 3.2.3.2.1.5.

3.2.3.2.2.7 Class name

"Definition: The name or number of a message set into which the message can be meaningfully classified."

TCIP Usage: See explanation in 3.2.3.2.1.6.

3.2.3.2.2.8 Classification scheme name

"Definition: The designator (e.g., the title or number) of a classification scheme that contains the Class Name."

TCIP Usage: See explanation in 3.2.3.2.1.7.

3.2.3.2.2.9 Classification scheme version

"Definition: The version number of the classification scheme that contains the Class Name."

TCIP Usage: See explanation in 3.2.3.2.1.8.

3.2.3.2.2.10 Data concept type

"Definition: A categorization of the type of data concept."

3.2.3.2.2.11 Keyword

"Definition: One or more significant words used for search and retrieval of the message."

3.2.3.2.2.12 Related data concept

"Definition: The name of another data concept(s) related in some way to the message being specified."

3.2.3.2.2.13 Relationship type

"Definition: A word or phrase that expresses the nature of the relationship between a data concept and its Related data concept."

3.2.3.2.2.14 Remarks

"Definition: Comments or other information pertinent to the message."

TCIP Usage: See explanation in 3.2.3.2.1.13.

3.2.3.2.2.15 Symbolic name

"Definition: The name of a message as used in an application and/or communications program(s)."

3.2.3.2.2.16 Symbolic name usage

"Definition: The name(s) of the application programs within which the symbolic name is used.:

3.2.3.2.2.17 ASN.1 name (ASN1 name)

"Definition: The name of the message expressed using ASN.1 syntax and naming conventions."

TCIP Usage: See explanation in 3.2.3.2.1.16.

3.2.3.2.2.18 Constraints

"Definition: Any textual statement of any constraint other than those explicitly addressed by other meta-attributes described in this standard."

3.2.3.2.2.19 Message body

"The packaging or grouping of data concepts (data elements, data frames, and/or other data concept types) into messages…"

TCIP Usage: This field describes the message as an ASN.1 Type Reference which conforms to the ASN.1 syntax rules.

TCIP Example:

```
CptAgency::=SEQUENCE{
  agency    CPT-AgencyID,
  agencyName   NAME,
  headquarters   SpAddresspoint,
  hdqtTelephone   TELEPHONE
}
```

Referenced sections are from IEEE Std.1488-2000. Copyright 2000 IEEE. All rights reserved.

3.3 ABSTRACT SYNTAX NOTATION ONE BASIC CONCEPTS

-- Incremented section numbering
-- Removed Figure 3.3 NEMA Tree from document

Section 4
CONFORMANCE

4.2.1 Conformance Level 1

-- Removed references to Dynamic objects (third bullet)
-- Removed references to Annexes

4.4 CONFORMANCE CRITERIA

-- Replaced Section number with 4.5. Conformance Criteria shall read:

Conformance to a TCIP business area will be certified after 100 percent successful completion of conformance tests as described in Section 4.5.

Level 1 conformance will be certified when a component successfully completes the Level 1 test suite.
Level 2 conformance will be certified when a component successfully completes the Level 2 test suite.
Level 3 conformance will be certified when a component successfully completes the Level 3 test suite.

4.5 TEST METHODS

-- Added note

[NOTE: The “institute” will be defined by the APTA Standards Activities]

Annex A
Transit Specific Architecture Flows Associated with TCIP Objects

(Informative)

-- Removed Annex A Dynamic Object Module Definition.
-- Added new section associating TCIP objects and Architecture Flows of the National ITS Architecture.

This section associates transit-specific architecture flows from the National ITS Architecture, as listed in Table 3-1 in Section 3.2 with corresponding standards that meet its interface requirement. Each architecture flow corresponds to one or more standard documents. TCIP business area standards are highlighted. The TCIP Business Area (TCIP BA) column corresponds to one or more of the primary TCIP business area standards.

Source	Destination	Architecture Flow	TCIP BA
Archived Data Management	Transit Management	archive requests	---
Archived Data Management	Transit Management	archive status	---
Basic Transit Vehicle	Transit Vehicle Subsystem	transit vehicle measures	OB
Emergency Management	Transit Management	transit emergency coordination data	IM
Financial Institution	Transit Management	transaction status	FC
Information Service Provider	Transit Management	demand responsive transit request	---
Information Service Provider	Transit Management	selected routes	PI
Information Service Provider	Transit Management	transit information request	PI
Maintenance and Construction Management	Transit Management	current asset restrictions	TM
Maintenance and Construction Management	Transit Management	maint and constr work plans	TM
Maintenance and Construction Management	Transit Management	road weather information	---
Maintenance and Construction Management	Transit Management	roadway maintenance status	TM
Maintenance and Construction Management	Transit Management	work zone information	TC
Map Update Provider	Transit Management	map updates	SP
Media	Transit Management	media information request	---
Multimodal Transportation Service Provider	Transit Management	multimodal service data	SCH; CPT
Other TRM	Transit Management	TRMS coord	All
Parking Management	Transit Management	transit parking coordination	PI
Personal Information Access	Transit Management	transit information user request	PI
Remote Traveler Support	Transit Management	emergency notification	IM
Remote Traveler Support	Transit Management	secure area surveillance data	OB, CPT
Remote Traveler Support	Transit Management	transit fare payment requests	PI

Source	Destination	Architecture Flow	TCIP BA
Remote Traveler Support	Transit Management	transit information user request	PI
Surface Transportation Weather Service	Transit Management	transportation weather information	---
Traffic Management	Transit Management	request transit information	TM
Traffic Management	Transit Management	road network conditions	TM
Traffic Management	Transit Management	traffic control priority status	---
Traffic Management	Transit Management	transit demand management request	TM
Transit Management	Archived Data Management	transit archive data	SCH; CC/ OB; CPT
Transit Management	Emergency Management	transit emergency data	IM
Transit Management	Enforcement Agency	payment violation notification	CC/OB; IM
Transit Management	Financial Institution	payment request	IM
Transit Management	Information Service Provider	demand responsive transit plan	---
Transit Management	Information Service Provider	transit and fare schedules	SCH; FC; PI
Transit Management	Information Service Provider	transit incident information	IM; CC/OB
Transit Management	Information Service Provider	transit request confirmation	PI
Transit Management	Multimodal Transportation Service Provider	transit multimodal information	SCH; PI
Transit Management	Maintenance and Construction Management	road network probe information	OB, TM
Transit Management	Maintenance and Construction Management	work plan feedback	---
Transit Management	Map Update Provider	map update request	---
Transit Management	Media	transit incidents for media	---
Transit Management	Media	transit information for media	---
Transit Management	Other TRM	TRMS coord	All
Transit Management	Parking Management	transit parking lot response	PI
Transit Management	Personal Information Access	personal transit information	PI
Transit Management	Remote Traveler Support	emergency acknowledge	(dialogs)
Transit Management	Remote Traveler Support	secure area monitoring support	IM
Transit Management	Remote Traveler Support	transit fare payment responses	FC
Transit Management	Remote Traveler Support	transit traveler information	PI
Transit Management	Surface Transportation Weather Service	transportation weather information request	---
Transit Management	Traffic Management	request for road network conditions	---
Transit Management	Traffic Management	road network probe information	OB

Source	Destination	Architecture Flow	TCIP BA
Transit Management	Traffic Management	traffic control priority request	OB
Transit Management	Traffic Management	transit demand management response	---
Transit Management	Traffic Management	transit system data	OB/CC; CPT
Transit Management	Transit Vehicle Subsystem	bad tag list	FC
Transit Management	Transit Vehicle Subsystem	driver instructions	OB/CC; IM
Transit Management	Transit Vehicle Subsystem	emergency acknowledge	IM
Transit Management	Transit Vehicle Subsystem	fare management information	FC
Transit Management	Transit Vehicle Subsystem	request for vehicle measures	OB/CC
Transit Management	Transit Vehicle Subsystem	transit schedule information	OB/CC; SCH
Transit Management	Transit Vehicle Subsystem	transit traveler information	PI
Transit Vehicle Subsystem	Roadway Subsystem	local signal priority request	OB
Transit Vehicle Subsystem	Transit Management	emergency notification	IM
Transit Vehicle Subsystem	Transit Management	environmental probe data	---
Transit Vehicle Subsystem	Transit Management	fare and payment status	FC
Transit Vehicle Subsystem	Transit Management	request for bad tag list	FC
Transit Vehicle Subsystem	Transit Management	transit traveler request	PI
Transit Vehicle Subsystem	Transit Management	transit vehicle conditions	OB
Transit Vehicle Subsystem	Transit Management	transit vehicle location data	OB
Transit Vehicle Subsystem	Transit Management	transit vehicle passenger and use data	OB/CC; FC
Transit Vehicle Subsystem	Transit Management	transit vehicle schedule performance	OB/CC
Transit Vehicle Subsystem	Traveler Card	request for payment	FC
Transit Vehicle Subsystem	Vehicle Subsystem	traveler advisory request	OB/CC
Traveler Card	Transit Vehicle Subsystem	payment	FC
Vehicle Subsystem	Transit Vehicle Subsystem	vehicle location	OB
Weather Service	Transit Management	weather information	---

Annex B to Annex H
BUSINESS AREA CONFORMANCE REQUIREMENTS

(Normative)

-- Conformance requirements will be inserted after User Comments are included to reflect changes to dependent objects.