

NTCIP 1601 v01.05

National Transportation Communications for ITS Protocol Traffic Management System Interface Standard for Center-to-Center Communications

July 2002

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FOREWORD

This document uses only metric units.

This publication defines an interface which traffic management centers may offer to other systems in order to provide information regarding various traffic-related events. The interface offers base services as well as optional extensions. These interfaces may be implemented by a variety of protocols, including CORBA and DATEX-ASN. This standard deals with information exchanges at a level above the conventional ISO OSI Reference model, and in the NTCIP Framework, it addresses issues that are a part of the Information Level. There is one normative annex to this document that provides the IDL code in order to implement the documented design within CORBA systems.

Some of the issues addressed by this standard were previously addressed in the Message Set for External Traffic Management Center Communications standard by ITE. This standard extends this previous standard using real-world implementation experience and provides the definition in a format which is compatible with multiple protocols.

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.

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AASHTO – Standard Specification; ***TBD***
ITE – Software Standard; ***TBD***
NEMA – Standard; ***TBD***

History

From XXXX to XXXX, this document ***TBD***. The technical specifications of the highest version number are identical to the former version, except as noted in the development history below:

NTCIP 1601 v01.05. April 2002 – Version 01.04 accepted as a User Comment Draft by the Joint Committee on the NTCIP. July 2002 – Version 01.05 front matter and introduction text revised for distribution for user comments.

INTRODUCTION

This publication provides the definition of an interface by which Traffic Management Centers are able to provide information services related to events affecting the traffic network.

This standard 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, protocol, message, transportation, dialog.

In 1992, the NEMA 3-TS Transportation Management Systems and Associated Control Devices Section began the effort to develop the NTCIP. The Transportation Section's purpose was to respond to user needs to include standardized systems communication in the NEMA TS 2 standard, *Traffic Controller Assemblies*. Under the guidance of the Federal Highway Administration's NTCIP Steering Group, the NEMA effort was expanded to include the development of communications standards for all transportation field devices that could be used in an Intelligent Transportation Systems (ITS) network.

In September 1996, an agreement was reached among NEMA, ITE, and AASHTO to jointly develop, approve, and maintain NTCIP Standards. The Center-to-Center Working Group was formed to standardize the protocols of Traffic Management Center-to-Center communications. The first meeting of the C2C WG was in July 1996. The first draft of this document was developed in December 2001.

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Joint AASHTO, ITE, and NEMA
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1. GENERAL

1.1 SCOPE

In order to improve traffic flow over an entire region, it is imperative that the various Traffic Management Centers (TMCs) have the ability to exchange data. On a basic level, TMCs may wish to communicate information about planned or unplanned traffic events, or about device status. As the need to inter-operate increases, center-to-center communication also encompasses remote management of ITS equipment. The ability for one TMC to manage traffic signals and dynamic message signs normally controlled by another TMC provides maximum flexibility in regional transportation planning and management.

This document is intended to standardize the mechanism by which various computer systems interact in order to conduct such center-to-center communications. Specifically, it will address the exchange of event information, the monitoring of event details, the remote management of traffic signals, the remote management of message signs, as well as the base processes to support such functions, such as login/logout, data translation, etc.

1.2 REFERENCES

UML	Unified Modeling Language, Version 1.4, Object Management Group, 2001, http://www.omg.org/technology/documents/formal/uml.htm
National ITS Architecture	National ITS Architecture, Version 3.0, Federal Highway Administration, 2001, http://itsarch.iteris.com/itsarch/
ITE TM1.03	Traffic Management Data Dictionary, Version 1.0, Institute of Transportation Engineers, 1999.
IEEE 1512	Standard for Common Incident Management Message Sets for Use by Emergency Management Centers, Version 1.0, Institute of Electrical and Electronics Engineers, 2000.

1.3 TERMS

Actor – An actor is an entity that is external to the subject system that receives information from the system and/or provides information to the system.

Use Case – A use case describes one specific service provided by the subject system. The mechanisms by which the services are provided are internal to a use case.

1.4 ACTORS

1.4.1 Requesting_System

The System that requests data from a Remote System via the ITS Network or that requests a change in the operation of a Remote System and/or some of its components. A Requesting System may monitor data from Remote Systems in order to perform automatic management of its own components, to provide automatic traveler information, and/or to automatically manage the components of the Remote System. In addition, a Requesting System may automatically issue requests to a Remote System in response to conditions within its own system.

1.4.2 Owning_Operator

An operator directly connected to the management system that has primary control responsibility of an entity of interest (e.g., a traffic signal, a message sign, an incident, etc.). This operator may perform direct operations on the entity and may additionally approve or veto the requests of others to perform operations on the entity.

Technically, this is most properly defined as the system abstraction of the operator, i.e., the software module(s) related to providing the operator with access to the system. But it is termed the "operator" in order to provide the reader with a better logical representation of the system.

1.4.3 Owning_System

An Owning System has primary control of the component of interest. An Owning System may monitor the operations of its components, perform automated management of these components, provide data about these components to other systems, and execute remote control commands from other Systems if they are approved.

1.4.4 Requesting_Operator

An operator who requests data from the ITS Network or who requests to change the operation of one or more ITS components that are remotely connected. The operator may merely monitor the other sub-systems for proper operation, or may be responsible for remote management of the sub-system(s) and/or connected components.

Technically, this is most properly defined as the system abstraction of the operator, i.e., the software module(s) related to providing the operator with access to the system. But it is termed the "operator" in order to provide the reader with a better logical representation of the system.

1.5 ACRONYMS

CORBA – Common Object Request Broker Architecture

IDL – Interface Definition Language

ITS – Intelligent Transportation Systems

NTCIP – National Transportation Communications for ITS Protocol

UML – Unified Modeling Language

1.6 LAYOUT OF DOCUMENT

This document is presented in 5 major sections plus one normative annex.

This section provides general information about the standard.

Section 2 explains how the systems are expected to operate. The discussion of these operational concepts lead to the identification of certain key services that must be provided by the center-to-center interfaces.

Section 3 explicitly identifies these services and how they interact with the various parties that interact with the systems. A context is provided for each service along with an overview of the process steps in order to fulfill the service.

Section 4 completes the definition of each service defined in Section 3. In some cases, multiple Section 3 services may be fulfilled by a single Section 4 solution.

Section 5 defines each specific class, data element and method referenced in Section 4.

The Annex provides the formal Interface Definition Language (IDL) code that can be used in CORBA systems in order to implement the designs defined in this document.

2. CONCEPT OF OPERATIONS

2.1 BASE SERVICE USE CASES

The base services of a traffic management system include those services that are used by a variety of other components within the system. These include:

- System Login – Traffic management centers manage devices related to public safety and therefore must manage access to systems. The System Login feature is a single service that ensures any connection to the system is authorized.
- System Logout – Likewise, upon completion of a session or timeout, users must be logged out through the System Logout service.
- Listing the types of entities supported by the system – This service allows remote systems to dynamically discover what types of devices and information might be supported by the owning system.
- The general process to access information from an entity or group of entities – Once a requesting system is aware that an owning system supports a certain type of entity; it may wish to discover more information about specific entities. This service allows for the dynamic discovery of what specific entities are registered within a system and how to request information about them.
- The process to translate a location into a different location profile – Different systems use different map database subsystems and they are not always compatible. The location translation service is designed to provide mapping between different standardized ways to express location.
- The general process used to subscribe for changes in entity information – Much of the information exchange needs between centers consists of event-driven notifications when things change. The subscription service allows a requesting center to subscribe for changes to information. The general service describes how the generalized mechanism works, but this is further customized for each type of data within each of the later sections of this standard.

2.2 EVENT USE CASES

When a planned or unplanned event occurs that disrupts a transportation facility, a large number of stakeholders may be affected, including: transportation agencies, delivery firms, emergency personnel, event promoters, the traveling public at large, etc. In order to mitigate the effects of such events, there is a need to quickly spread all known information about the event, so that relevant parties can make appropriate decisions. This document is intended to standardize the mechanism by which various computer systems can interact in order to exchange information about these events.

When an unplanned event occurs on a transportation facility, one or more management centers may detect the event and enter it, along with all known information about the event, into their systems. Once this occurs, there is a need to notify other ITS subsystems about the event. However, this notification can become quite complex due to the various potential views of an event. The process must take into account that a remote ITS subsystem may

- (1) Have already detected the same event; thus there must be a mechanism to merge two separate events into a single definition.
- (2) Have detected another associated event that either caused the newly reported event or perhaps was caused by the newly reported event; thus there is a need to allow descriptive associations among various events.
- (3) Have a different perspective about the event and may either wish to view the new event as one piece of a larger event or as a superset of multiple events; thus there is an additional need to allow descriptive associations among various events.
- (4) Have realized that there is a need to separate the one reported event into multiple distinct events; thus there is a need to allow a splitting action on an event.

Planned events, by their definition, should be known in advance and can be programmed into a system in advance of their impacting the transportation system. Thus, the interface definition must allow the exchange of the start and stop times of an event as well as queries for active events. Further, the scheduling data that can be stored for an event must be able to accommodate recurring events, such as construction occurring at stated times for a period of several months.

Once entered and recognized by each system, there is an abundance of information that may be recorded about each event, including: its location, type, severity, description, related response information, relevant times, etc. In order to properly manage the loading of communication infrastructure of some systems, a mechanism is needed to allow the filtering and summarizing of data before transmission. The filter should allow a remote system to define the areas, types of events, and severity of events of potential interest. The summarizing feature should allow a remote system to retrieve only a summary report containing information appropriate to display on a system map, such as location, type, and severity, while also providing the ability to retrieve complete details through subsequent requests.

2.3 SIGN USE CASES

This section describes how a center requests DMS services from another center. The services covered by this standard involve control of signs, requesting configuration information from signs, and requesting status information from signs. Before performing any of these operations, the requesting center must log into the owning system and be properly authenticated.

2.3.1 Control

This standard defines three basic control services that an owning center can provide to a requesting center: the ability to post a message on a sign, the ability to activate a pixel test, and the ability to remotely reset the sign.

2.3.1.1 Messaging

An owning center may allow a requesting center to display a message on a sign. The message may be generated locally or selected from a list of existing messages. The list of existing messages may include messages that are stored within the owning center in addition to any messages that may be stored in the sign controller itself. Once an owning center receives a request, it shall process the request to determine whether the message should be posted immediately, queued for later posting, or rejected; the exact logic of this process is implementation specific and may be fully automated or require manual authorization from a system operator. In response to the request, the owning center will notify the requesting system of the result of this process as well as providing a unique identifier so that the requester can monitor the status of the request.

2.3.1.2 Pixel Test

An owning center may also allow a requesting center to command any sign to conduct a pixel test in the owning centers' control. An implementation specific algorithm that may include operator interaction in order to authorize the request may process any such request. If this feature is provided, the owning center must allow access to pixel test results via a request from another central.

2.3.1.3 Sign Reset

An owning center may allow a requesting center to command any sign to conduct a software reset in case the sign behavior becomes abnormal. An implementation specific algorithm that may include operator interaction in order to authorize the request may process any such request.

2.3.2 Configuration Information

Owning centers should also allow requesting centers to discover configuration information about its connected signs.

2.3.2.1 System Information

An owning center must allow the ability to request information about an owning centers' sign configuration. The owning system must provide upon request:

1. A list of signs that the owning center controls
2. Status of each sign (Indication of operational status)
3. Identification of each sign (Identifier, location, manufacturer, make, model, and version)
4. Owning organization

5. Contact information for maintenance and operations of the sign
6. The controlling operations center

2.3.2.2 Sign Configuration

An owning center must allow access to sign configuration. A requesting center can utilize this information to replicate how a message appears on a sign or can predict how a message will appear on a sign. This information includes:

1. Sign size in pixels
2. Sign technology (LED, Flip Disk, Fiber Optic...)
3. Sign type (VMS, CMS, BOS, Portable)
4. Beacon type
5. Legend
6. Font information (Number of fonts, character size, number of characters, spacing)
7. Default MULTI tags
8. Maximum number of pages
9. Maximum MULTI string length

2.3.2.3 Message Library

An owning center must allow access to messages stored on individual signs. The owning center will return all messages located in the sign to include messages of all memory types.

2.3.3 Monitoring

An owning center should also allow requesting centers to monitor various types of status information about each of its signs.

2.3.3.1 Current Message

An owning center should allow access to the current message status of an individual sign to a requesting center. The information that must be returned includes:

1. MULTI string
2. Beacon state
3. Message owner
4. Pixel service
5. Expected end time of message (message time remaining parameter)

2.3.3.2 Sign Status

An owning center must allow access to the status of individual signs. The status of a sign includes diagnostic information and state of sign. The information that must be returned include:

1. Lamp Status
2. Lamp Test Active Status
3. Beacon State
4. Owner
5. Pixel Service
6. Pixel Status
7. Pixel Test Active Status
8. Operational Status
9. Error Status
10. Control Mode

2.3.3.3 Message Queue

An owning center must allow access to the requested message queue. The message queue includes messages that have been requested by other centers. The owning center will return the following information about the message queue:

1. Message owner
2. DMS the message is to be displayed
3. Message ID
4. Message status (pending, processing, active, and invalid)

The message ID is the same identifier that is returned when a message is suggested by a requesting center. This message ID can be used to cancel a suggested message if the requesting center is the

center that requested the message.

2.4 SIGNAL USE CASES

The management of traffic signals is a complex task. The services offered dealing with signals are divided into two major areas: those related to individual intersections and those related to groups of intersections, known as sections.

For an intersection, a requesting user may wish to

- View the controller's configuration (e.g., the local timing parameters),
- Monitor the operation of the controller (e.g., which phases are green),
- Synchronize the controller's clock with the central system, or
- Issue a command such as:
 - o Changing the current timing plan,
 - o Changing the special function outputs, or
 - o Changing the intersection control mode.

The requesting user may also be interested in services at a section level, including:

- Viewing the section configuration,
- Monitoring the section operation, or
- Issuing a command to
 - o Change the section control mode, or
 - o Change the section timing plan.

These services are described in more detail in Section 3.4.

3. FEATURES

This section provides the functional requirements for the various features defined in this standard. If a given feature is required for a project, the related requirements for that feature shall be mandatory.

Each feature is presented in the form of a UML use case in clauses 3.1-3.4. UML is the primary language for modeling, visualizing and documenting software systems today. UML consists of a variety of diagrammatic techniques in order to convey the requirements structure and operational design in a relatively easy-to-understand format without losing important details. Most importantly, the diagrams can be designed to only depict the information of interest, thereby allowing the developers to depict a complex system through a series of relatively simple diagrams.

For these reasons, UML is being widely adopted by the ITS standards community as the tool of choice. The figures in this section are Use Case diagrams that represent the interactions between Use Cases - services offered by the ADMS - and Actors, entities such as users or outside systems. Use Cases are denoted by ovals while Actors are symbolized by stick figures.

Solid lines with arrowheads indicate the direction of the logical initial contact between objects; however, in some cases the bulk of the data flow may be provided in the opposite direction (for example, consider a system subscribing for data; the initial request may be made from a requesting system, but the bulk of the data is passed from the owning system back to the requesting system). A solid line without an arrowhead signifies that the request initiation can occur from either side of the association.

The definition of each Actor is provided in Clause 1.3. The definition of each Use Case is provided after the presentation of each Use Case Diagram within this Section. Note that some Use Cases are more completely defined as per the focus of this initial effort, however all identified Use Cases are shown so that the reader is aware of topics to be addressed by future versions of the standard. This provides the full system context and ensures traceability to the National ITS Architecture.

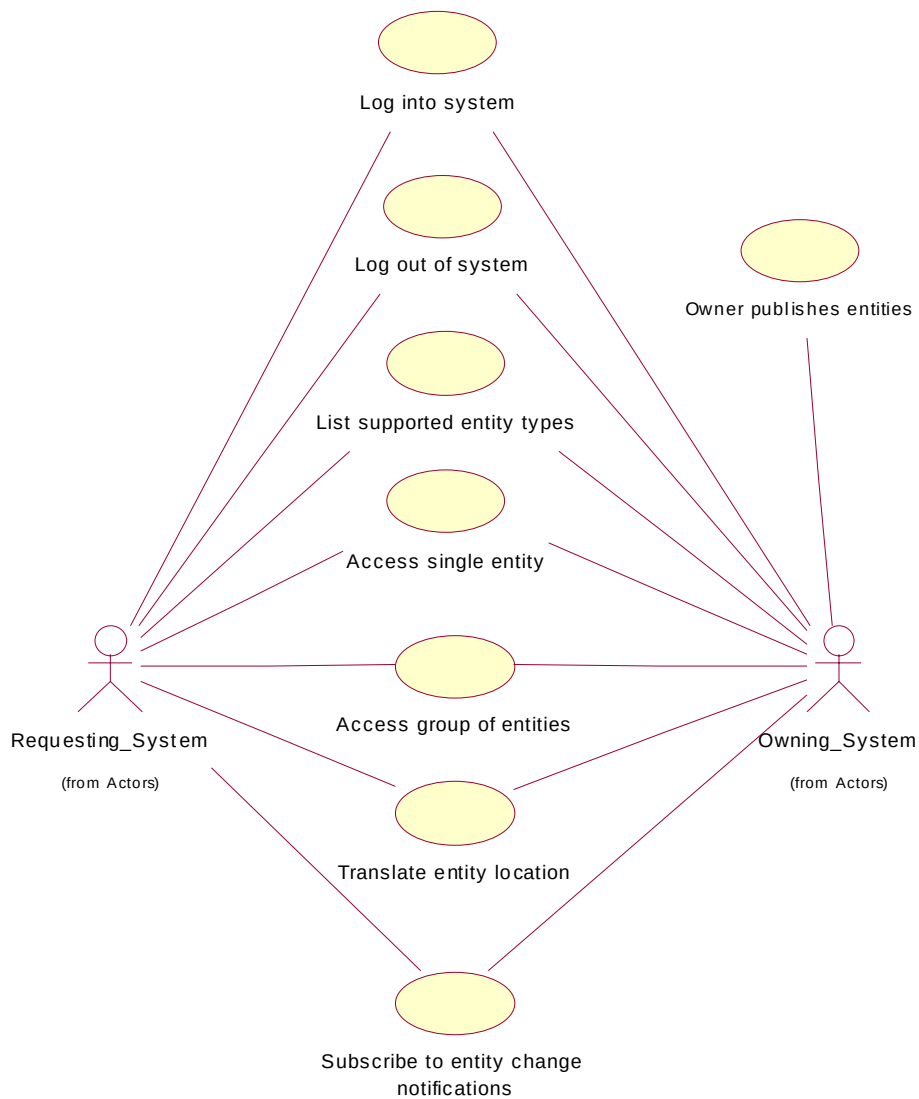
This specification does not include any details about system redundancy, data backup or reliability in general. However, in order for the a system to provide continued value, an infrastructure must be created to address reliability concerns. Additional requirements that apply to all features are defined in Clause 3.5.

NOTE—For more information on use case diagrams, see *Applying Use Cases*.

3.1 BASE SERVICE USE CASES

3.1.1 Base Services Use Case Model

Figure 1: Base Services Use Case Model



Base services use cases.
Use cases describing basic
interactions between centers.

3.1.1.1 List supported entity types Use Case

3.1.1.1.1 Definition

Get a list of all entity types provided by this system to other systems. Entity types include intersection controllers, detectors, count stations, dynamic message signs, planned events, incidents, and other devices and services provided by intelligent transportation systems.

3.1.1.1.2 Context

In order to retrieve information from an entity, the retrieving system must understand what entities exist within the owning system. This service allows dynamic discovery of this information.

3.1.1.1.3 Flow of Events

Primary flow:

1. Requesting system requests that the owning system provide a list of all entity types that it publishes to other centers.
2. The requesting system's login token is successfully validated.
3. Owning system returns a list of all its published entity types.

Alternative flow:

1. Requesting system requests that the owning system provide a list of all entity types that it publishes to other centers.
2. The requesting system's login token is invalid.
3. An exception is raised, access not granted.

3.1.1.1.4 Pre-Conditions

Login token is valid

3.1.1.1.5 Post-Conditions

Requesting system has a list of the entity types published by the owning system.

3.1.1.1.6 Realization

Systems claiming compliance to this feature shall support the List Supported Entity Types Realization Use Case Realization.

3.1.1.2 Access single entity Use Case

3.1.1.2.1 Definition

This use case provides a reference to an entity supported by a system by ID. The requesting system must pass the entity type, entity ID and a user login token to the owning system.

3.1.1.2.2 Context

In order to access information from an entity in an object-oriented system, the requesting system must have a distinct reference to the specific entity from which the information is desired.

3.1.1.2.3 Flow of Events

Primary flow:

1. Requesting system requests a reference to a particular entity by type and ID.
2. Owning system returns a reference to the entity with the requested ID.

Alternative flow:

1. Requesting system requests a reference to a particular entity by type and ID.
2. Owning system does not publish the requested entity, raises exception.

3.1.1.2.4 Pre-Conditions

Login token is valid.

3.1.1.2.5 Post-Conditions

Requesting system has reference to the entity that it requested

3.1.1.2.6 Realization

Systems claiming compliance to this feature shall support the Access One or More Entities Use Case Realization.

3.1.1.3 Log into system Use Case

3.1.1.3.1 Definition

The requesting system logs into owning system for remote access to its system entities. This is required for all other access to the owning system methods. Lasts until the requesting system logs out or the owning system invalidates the login token.

The requesting system may log into the owning system multiple times. The owning system considers each login to be independent.

3.1.1.3.2 Context

In order to interact with an owning system, the requester must first log into the system.

3.1.1.3.3 Flow of Events

Primary flow:

1. Requesting system sends user identity to owning system
2. Owning system successfully validates user identity
3. Owning system returns user token

Alternative flow:

1. Requesting system sends user identity to owning system
2. Owning system determines that the user identity is invalid
3. An exception is raised, access not granted

3.1.1.3.4 Pre-Conditions

None

3.1.1.3.5 Post-Conditions

Requesting system may perform other actions with the owning system.

3.1.1.3.6 Realization

Systems claiming compliance to this feature shall support the Log Into System Realization Use Case Realization.

3.1.1.4 Subscribe to entity change notifications Use Case

3.1.1.4.1 Definition

The requesting system subscribes to event-driven notifications of changes to an entity or set of entities administered by the owning system.

Systems often need to know when the conditions of other devices or systems change. They may request notification of the changing of certain aspects of some or all of the entities published by another system.

3.1.1.4.2 Context

A requesting system may wish to monitor the state of any variety of data.

3.1.1.4.3 Flow of Events

1. Requesting system subscribes for changes in specified types of information.

2. Owning system provides updates as they occur.

3.1.1.4.4 Pre-Conditions

Login token is valid

3.1.1.4.5 Post-Conditions

The Requesting System is subscribed for data.

3.1.1.4.6 Realization

Systems claiming compliance to this feature shall support the Subscribe to Entity Change Notifications - Realized Use Case Realization.

3.1.1.5 Log out of system Use Case

3.1.1.5.1 Definition

The requesting system ends access to the entities of the owning. The owning system invalidates the login token.

If the requesting system has logged into the owning system multiple times, the logout request affects only the login token used in this use case.

3.1.1.5.2 Context

In order to maintain system security the owning system must properly manage access and properly log users off of the system as appropriate.

3.1.1.5.3 Flow of Events

Primary flow:

1. Requesting system sends login token to owning system
2. Owning system invalidates login token

Alternative flow:

1. Requesting system sends login token to owning system
2. Owning system determines login token is already invalid, raises exception

3.1.1.5.4 Pre-Conditions

Login token is valid

3.1.1.5.5 Post-Conditions

Requesting system may no longer use the login token to access the owning system's resources.

3.1.1.5.6 Realization

Systems claiming compliance to this feature shall support the Log Out of System Realization Use Case Realization.

3.1.1.6 Translate entity location Use Case

3.1.1.6.1 Definition

Translate the location for an entity from one supported location format to another. The requesting system must pass the entity location and a user login token to the owning system.

3.1.1.6.2 Context

This is an optional service, but a center must follow a standard format if it supports this service.

3.1.1.6.3 Flow of Events

Primary flow:

1. Requesting system requests the owning system to translate a location in a given format to another format.
2. Owning system returns a translated location.

Alternative flow:

1. Requesting system requests the owning system to translate a location in a given format to another format.
2. Owning system does not support requested source or target location format OR the input location is invalid.
3. Owning system unable to return a translated location.

3.1.1.6.4 Pre-Conditions

Login token is valid, requested location is in a supported format and in an area supported by the owning system.

3.1.1.6.5 Post-Conditions

Requesting system has a translated location.

3.1.1.6.6 Realization

Systems claiming compliance to this feature shall support the Translate Entity Location Realization Use Case Realization.

3.1.1.7 Access group of entities Use Case

3.1.1.7.1 Definition

Obtain a reference to a group of entities that match a given criterion or set of criteria. The requesting system must pass the entity criteria and a user login token to the owning system.

3.1.1.7.2 Context

In order to access information from an entity in an object-oriented system, the requesting system must have a distinct reference to the specific entity from which the information is desired.

3.1.1.7.3 Flow of Events

Primary flow:

1. Requesting system requests a list of references to entities that match a certain set of criteria.
2. The requesting system's login token is successfully validated.
3. Owning system returns a list of references to entities that meet the requested criteria.

Alternative flow:

1. Requesting system requests a list of references to entities that match a certain set of criteria.
2. The requesting system's login token is invalid.
3. An exception is raised, access not granted.

3.1.1.7.4 Pre-Conditions

Login token is valid

3.1.1.7.5 Post-Conditions

Requesting system has (possibly empty) list of references to the entities that it requested.

3.1.1.7.6 Realization

Systems claiming compliance to this feature shall support the Access One or More Entities Use Case Realization.

3.1.1.8 Owner publishes entities Use Case

3.1.1.8.1 Definition

The owning system publishes entities that it will allow other centers to access. It must provide access to the entities directly, and through the use of the CORBA naming service. It may optionally provide access to entities using the CORBA trader service. It may also provide event-driven notification of changes to some or all of the entities that it publishes.

When the owner destroys the published entities, it retracts publication of the objects in the reverse order in which it published them originally.

3.1.1.8.2 Context

This is performed by an owning system in response to a subscription.

3.1.1.8.3 Flow of Events

Primary flow:

1. The owning system locates the naming service
2. Owing system publishes one or more objects derived from the System class to the naming service.
3. Owing system publishes all of its entity objects to the naming service.
4. Owing system may publish its System objects and entity objects to the trader service.
5. Owing system may connect to the NRTDS to provide event-driven updates for its entities.

Alternative flow:

1. The owning system waits to find the naming service.
2. The owning system locates the naming service.
3. Owing system publishes one or more objects derived from the System class to the naming service.
4. Owing system publishes all of its entity objects to the naming service.
5. Owing system may publish its System objects and entity objects to the trader service.
6. Owing system may connect to the NRTDS to provide event-driven updates for its entities.

3.1.1.8.4 Pre-Conditions

None

3.1.1.8.5 Post-Conditions

System and entity objects are published to the naming service.

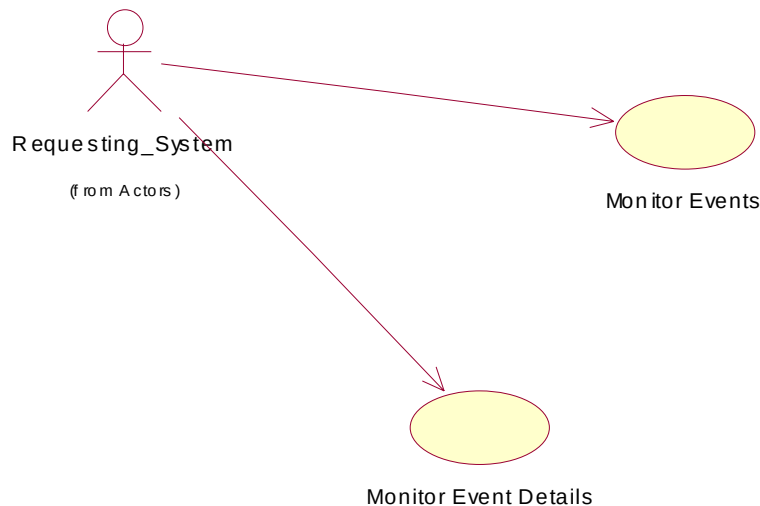
3.1.1.8.6 Realization

TBD

3.2 EVENT USE CASES

3.2.1 Event Use Case Model

Figure 2: Event Use Case Model



3.2.1.1 Monitor Events Use Case

3.2.1.1.1 Definition

The Monitor Events Use Case is designed to allow an Operator and/or a System to obtain a listing of active Events meeting a certain criteria.

3.2.1.1.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator and system to obtain commonly exchanged information regarding events affecting the transportation network such that the information can be displayed on a system map.

3.2.1.1.3 Flow of Events

Primary Flow:

1. The TMC receives a subscription for event information. This request may be constrained by criteria such as geographical boundaries and types of events.
2. The TMC determines which active events meet the subscription requirements
3. The TMC provides an initial response to the subscription including event identity, event location, event type, and event severity.
4. The TMC provides updates as new information becomes available.

Alternative Flow:

1. The TMC receives a request for one-time event information.
2. The TMC determines which active events meet the request.
3. The TMC responds to the request.

3.2.1.1.4 Pre-Conditions

None

3.2.1.1.5 Post-Conditions

None

3.2.1.1.6 Realization

Systems claiming compliance to this feature shall support the Monitor Events - Realized Use Case Realization.

3.2.1.2 Monitor Event Details Use Case

3.2.1.2.1 Definition

The Monitor Event Details Use Case is designed to allow an Operator to obtain detailed information regarding an active Event.

3.2.1.2.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to become fully aware of all known details for which he is authorized to know regarding an event affecting the transportation network.

3.2.1.2.3 Flow of Events

Primary Flow:

1. The TMC receives a subscription for detailed event information regarding a specific event.
2. The TMC locates the event; if the event is not found, an error is returned.
3. The TMC provides an initial response to the subscription providing all known information regarding the event for which the user is authorized.
4. The TMC provides updates as new information becomes available.

Alternative Flow:

1. The TMC receives a request for one-time detailed event information.
2. The TMC locates the event; if the event is not found, an error is returned.
3. The TMC responds to the request with all known information for which the user is authorized.

3.2.1.2.4 Pre-Conditions

None

3.2.1.2.5 Post-Conditions

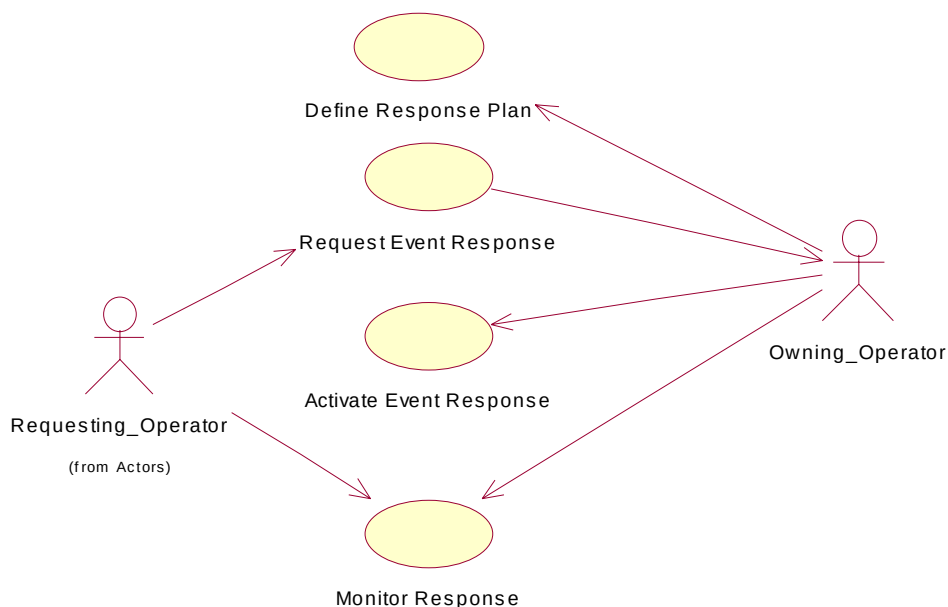
None

3.2.1.2.6 Realization

Systems claiming compliance to this feature shall support the Monitor Events - Realized Use Case Realization.

3.2.2 Future Event Response Use Case Model

Figure 3: Future Event Response Use Case Model



3.2.2.1 Monitor Response Use Case

3.2.2.1.1 Definition

The Monitor Response Use Case is designed to allow an Operator and/or a System to obtain information regarding the response to a traffic event.

3.2.2.1.2 Context

The design of this Use Case is based on providing information regarding event response activities to enable users to monitor the progress of the response.

3.2.2.1.3 Flow of Events

Primary Flow:

1. The TMC receives a subscription for event response information for a specific event response.
2. The TMC locates the event response; if the event response is not found, an error is returned.
3. The TMC provides an initial response to the subscription providing all known information regarding the response for which the user is authorized.
4. The TMC provides updates as new information becomes available.

Alternative Flow:

1. The TMC receives a request for one-time event response information for a specific response
2. The TMC locates the event response; if the event response is not found, an error is returned.
3. The TMC responds to the request.

3.2.2.1.4 Pre-Conditions

None

3.2.2.1.5 Post-Conditions

None

3.2.2.1.6 Realization

The realization of this use case is contained in the Events Interface.

3.2.2.2 Activate Event Response Use Case

3.2.2.2.1 Definition

The Activate Event Response Use Case allows an authorized actor to implement a defined response plan.

3.2.2.2.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator and system to select and activate a pre-defined response to an event.

3.2.2.2.3 Flow of Events

Main Flow:

1. The actor requests a list of available response plans.
2. The system provides the list, if the user is authorized.
3. The actor selects the desired response plan.
4. The system activates the selected plan, if the user is authorized.

NOTE-This step may check to see if the entire plan can be implemented prior to implementing any portion.

5. The system notifies the user of the status of the response implementation.

3.2.2.2.4 Pre-Conditions

User must be logged into system

3.2.2.2.5 Post-Conditions

Event Response Plan is Active

3.2.2.2.6 Realization

TBD

3.2.2.3 Request Event Response Use Case

3.2.2.3.1 Definition

The Activate Event Response Use Case allows an authorized actor to request an activation of a defined response plan.

3.2.2.3.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator and system to select and request activation for a pre-defined response to an event.

3.2.2.3.3 Flow of Events

Main Flow:

1. The actor requests a list of available response plans.
2. The system provides the list, if the user is authorized.
3. The actor selects the desired response plan.
4. The system notifies the appropriate party that a request has been made to activate the selected plan.
5. The system notifies the user of the status of the response implementation.

3.2.2.3.4 Pre-Conditions

User must be logged-in.

3.2.2.3.5 Post-Conditions

Appropriate party is notified that a request has been made to select an event response.

3.2.2.3.6 Realization

TBD

3.2.2.4 Define Response Plan Use Case

3.2.2.4.1 Definition

The Define Response Plan Use Case allows an authorized actor to implement a defined response plan.

3.2.2.4.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to create and store a pre-defined response to an event.

3.2.2.4.3 Flow of Events

1. User will request to draft a response plan.
2. System shall provide template for user to submit plan.
3. User will submit response plan.
4. System shall appropriately format plan.
5. System shall store plan.

3.2.2.4.4 Pre-Conditions

User must be logged-in.

3.2.2.4.5 Post-Conditions

The response plan is stored in the system.

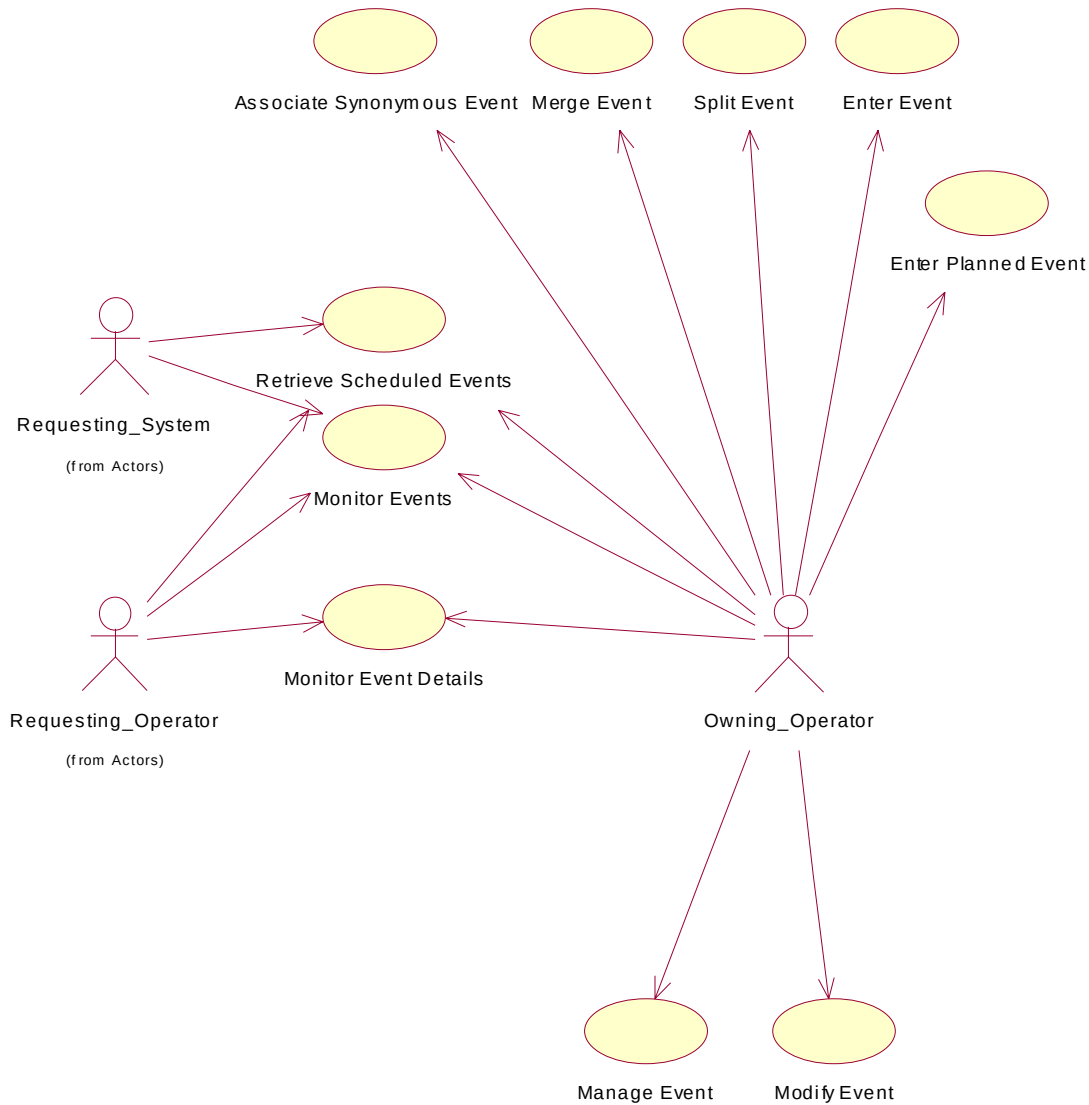
3.2.2.4.6 Realization

TBD

3.2.3 Future Event Use Case Model

This provides the user with the capability to modify event information.

Figure 4: Future Event Use Case Model



3.2.3.1 Enter Event Use Case

3.2.3.1.1 Definition

The Enter Planned Event Use Case allows an authorized user to enter into the system details about an event.

3.2.3.1.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to enter event details into the system.

3.2.3.1.3 Flow of Events

1. User will request to enter an event.
2. System shall provide template for user to submit event.
3. User will submit event.
4. System shall perform error checking and appropriately format event
5. System shall store event.

3.2.3.1.4 Pre-Conditions

User must be logged-in.

3.2.3.1.5 Post-Conditions

Event stored in system.

3.2.3.1.6 Realization

TBD

3.2.3.2 Split Event Use Case

3.2.3.2.1 Definition

The Split Event Use Case allows an authorized user to split a large event into smaller individual events.

3.2.3.2.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator and system to split one larger event into smaller events.

3.2.3.2.3 Flow of Events

Main flow:

1. User will request to split events.
2. If the user is authorized, the TMC shall provide a list of events
3. User will select which event to split and specify how many events to split the event into.
4. The TMC shall create an appropriate number of new event records. Details from the selected event will be exported into the new record.

3.2.3.2.4 Pre-Conditions

User must be logged-in.

3.2.3.2.5 Post-Conditions

Several new events created.

3.2.3.2.6 Realization

TBD

3.2.3.3 Merge Event Use Case

3.2.3.3.1 Definition

The Merge Event Use Case allows an authorized user to merge individual events into one larger event.

3.2.3.3.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator and system to merge sub-events into one larger event.

3.2.3.3.3 Flow of Events

Main flow:

1. User will request to merge events.
2. If the user is authorized, the TMC shall provide a list of events
3. User will select which events to merge.
4. The TMC shall create a new event record. Details from the selected events will be imported into the new record. Fields containing duplicate data will not be imported.

3.2.3.3.4 Pre-Conditions

User must be logged-in.

3.2.3.3.5 Post-Conditions

New event stored into TMC.

3.2.3.3.6 Realization

TBD

3.2.3.4 Associate Synonymous Event Use Case

3.2.3.4.1 Definition

The Associate Remote Event Use Case allows an actor to associate a defined event with one or more other roughly synonymous events that are typically stored in one or more remote systems. In general, each primary user of the system should have their own instance of an event that they manage. Users of the network should be allowed to monitor information for which they are authorized, but are unable to edit any information other than their own copy of the event.

The need to bring together data from various sources is left to implementation specific mechanisms. This may be achieved:

- manually by each user,
- manually by a single master user,
- in some automated fashion by a software algorithm
- or some combination of the above.

3.2.3.4.2 Context

A user interested in events will likely subscribe for event notifications from multiple systems. Upon being notified of a new event in a remote system, the user may conclude that:

1. The remote event is identical to an event already defined within his local system and may choose to associate the two events as synonyms.
2. This event does not relate to one defined within his system, but one which he is likely to store his own information about. In this case, he would create a new local event that is based on the event definition in the remote system and the two would be defined as synonyms.
3. The event is not an event for which he is likely to record information and no synonyms are necessary.

3.2.3.4.3 Flow of Events

Main Flow:

1. The actor receives notifications about events from remote system.
2. If an event matches a similar event, the user may choose to associate the two events.
3. The system notifies the user of the status of the association.

3.2.3.4.4 Pre-Conditions

User must be logged into system

3.2.3.4.5 Post-Conditions

Synonymous events associated.

3.2.3.4.6 Realization

TBD

3.2.3.5 Monitor Events Use Case

3.2.3.5.1 Definition

The Monitor Events Use Case is designed to allow an Operator and/or a System to obtain a listing of active Events meeting a certain criteria.

3.2.3.5.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator and system to obtain commonly exchanged information regarding events affecting the transportation network such that the information can be displayed on a system map.

3.2.3.5.3 Flow of Events

Primary Flow:

1. The TMC receives a subscription for event information. This request may be constrained by criteria such as geographical boundaries and types of events.
2. The TMC determines which active events meet the subscription requirements
3. The TMC provides an initial response to the subscription including event identity, event location, event type, and event severity.
4. The TMC provides updates as new information becomes available.

Alternative Flow:

1. The TMC receives a request for one-time event information.
2. The TMC determines which active events meet the request.
3. The TMC responds to the request.

3.2.3.5.4 Pre-Conditions

None

3.2.3.5.5 Post-Conditions

None

3.2.3.5.6 Realization

Systems claiming compliance to this feature shall support the Monitor Events - Realized Use Case Realization.

3.2.3.6 Monitor Event Details Use Case

3.2.3.6.1 Definition

The Monitor Event Details Use Case is designed to allow an Operator to obtain detailed information regarding an active Event.

3.2.3.6.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to become fully aware of all known details for which he is authorized to know regarding an event affecting the transportation network.

3.2.3.6.3 Flow of Events

Primary Flow:

1. The TMC receives a subscription for detailed event information regarding a specific event.
2. The TMC locates the event; if the event is not found, an error is returned.
3. The TMC provides an initial response to the subscription providing all known information regarding the event for which the user is authorized.
4. The TMC provides updates as new information becomes available.

Alternative Flow:

1. The TMC receives a request for one-time detailed event information.
2. The TMC locates the event; if the event is not found, an error is returned.
3. The TMC responds to the request with all known information for which the user is authorized.

3.2.3.6.4 Pre-Conditions

None

3.2.3.6.5 Post-Conditions

None

3.2.3.6.6 Realization

Systems claiming compliance to this feature shall support the Monitor Events - Realized Use Case

Realization.

3.2.3.7 Retrieve Scheduled Events Use Case

3.2.3.7.1 Definition

The Retrieve Scheduled Event Response Use Case allows an authorized actor to retrieve scheduled events.

3.2.3.7.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to retrieve scheduled event information.

3.2.3.7.3 Flow of Events

1. User will request to retrieve scheduled events.
2. The TMC will display a list of scheduled events, based on user access level.
3. User will select which events to retrieve.
4. The TMC shall display selected events.

3.2.3.7.4 Pre-Conditions

User must be logged-in.

3.2.3.7.5 Post-Conditions

Selected scheduled events are displayed.

3.2.3.7.6 Realization

TBD

3.2.3.8 Modify Event Use Case

3.2.3.8.1 Definition

The Modify Event Use Case allows an authorized user to modify details about an event.

3.2.3.8.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to modify existing event details.

3.2.3.8.3 Flow of Events

1. User will request to modify an event.
2. The TMC shall display a list of modifiable events, based on user access level.
3. User will modify event criteria.
4. System shall perform error-checking on updated fields.
5. System shall store event.

3.2.3.8.4 Pre-Conditions

User must be logged-in.

3.2.3.8.5 Post-Conditions

Event record is updated.

3.2.3.8.6 Realization

TBD

3.2.3.9 Manage Event Use Case

3.2.3.9.1 Definition

This allows the local user to specify who is in charge and who specifies the response to take.

3.2.3.9.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to specify who is in charge and who specifies the response to take.

3.2.3.9.3 Flow of Events

Main flow:

1. User will request to manage an event.
2. If the user is authorized, the TMC shall provide a list of parties
3. User will select which party is directing the response, if the party is not on the list, the user will enter in a new organization.
4. The TMC shall record responsible party.

3.2.3.9.4 Pre-Conditions

User must be logged-in.

3.2.3.9.5 Post-Conditions

Responsibility assigned to appropriate party.

3.2.3.9.6 Realization

TBD

3.2.3.10 Enter Planned Event Use Case

3.2.3.10.1 Definition

The Enter Planned Event Use Case allows an authorized user to enter into the system details about a planned event.

3.2.3.10.2 Context

The design of this Use Case is based on providing the necessary services to enable an operator to enter planned event details into the system.

3.2.3.10.3 Flow of Events

1. User will request to enter a planned event.
2. System shall provide template for user to submit planned event.
3. User will submit event.
4. System shall perform error-checking and appropriately format planned event.
5. System shall store planned event.

3.2.3.10.4 Pre-Conditions

User must be logged-in.

3.2.3.10.5 Post-Conditions

Planned event stored in system.

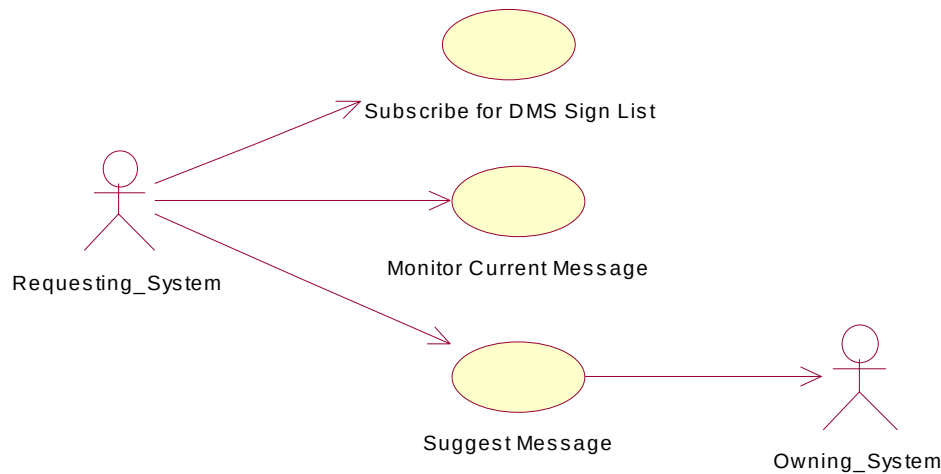
3.2.3.10.6 Realization

TBD

3.3 SIGN USE CASES

3.3.1 Sign Use Case Model

Figure 5: Sign Use Case Model



3.3.1.1 Suggest Message Use Case

3.3.1.1.1 Definition

A requesting operator or system that provides the proper security credentials may suggest a message to be displayed on a DMS. A message suggestion will include MULTI text, beacon state, IP address of requestor, and the activation priority that the suggesting operator feels should be applied to the message. However, the owning system is not obligated to pass this priority through to the device. It is taken only as an indication of how important the requesting system feels the message is. The owning system is free to map this to any run-time priority desired. The owning system returns an indication of how the suggestion is being handled. A return of accepted indicates the message has been put on the sign. A return of pending indicates the message has been entered into a queue and may later be put on the sign. This method may also throw exceptions to indicate that the message will not be placed on the sign. These exceptions include: Invalid message content, Device not available, and General Failure. If the suggestion is accepted and the return type is pending, an identifier will also be returned. This identifier can be used to later query the status of the suggestion or revoke the suggestion.

- Notice of acceptance/rejection
- Notice of posting
- Notice of Termination

3.3.1.1.2 Context

In response to some transportation event, an operator may wish to post a message on a sign controlled by another system.

3.3.1.1.3 Flow of Events

Primary Flow:

1. The requesting operator requests to post a message.
2. The requesting system sends a request for a list of pre-defined messages for the subject sign.
3. The owning system ensures that the user is authorized to receive such information.
4. The owning system provides the current list of pre-defined messages.
5. The requesting system displays the list to the operator
6. The requesting operator either selects a pre-defined message or chooses to propose his own message.
7. The requesting system relays the request.
8. The owning system ensures that the user is authorized to submit a suggestion.
9. The owning system allows an owning operator or other algorithm to accept or reject the suggestion
10. If authorized, the owning system implements the message on the sign.

11. The owning system notifies the requesting system of the status of the suggestion.

3.3.1.1.4 Pre-Conditions

The requesting system must be logged on to the owning system and possess the appropriate authorization to retrieve the information.

3.3.1.1.5 Post-Conditions

Suggested message may be active on the DMS or may be pending within the owning system.

3.3.1.1.6 Realization

Systems claiming compliance to this feature shall support the Suggest Message - Realized Use Case Realization.

3.3.1.2 Subscribe for DMS Sign List Use Case

3.3.1.2.1 Definition

A requesting system may request a list of all DMSs managed by the system. Although the same information could be obtained from the naming or trading service, obtaining this information from the service provides some benefits. If the service is not currently running, the remote system may determine this once and not bother with calling each individual object. The return will include:

- Sign ID
- Sign Description
- Sign Location

3.3.1.2.2 Context

A system may wish to monitor the list of signs in order to add new signs to the system map as they are added to the network and to provide system operators the capability of monitoring their displays and/or suggesting new displays.

3.3.1.2.3 Flow of Events

Primary Flow:

1. The owning system receives a request to monitor the list of signs.
2. The owning system ensures that the user is authorized to receive such information.
3. The owning system provides the current list of DMSs.
4. The system provides updates as new information becomes available.

3.3.1.2.4 Pre-Conditions

The requesting system must be logged on to the owning system and possess the appropriate authorization to retrieve the information.

3.3.1.2.5 Post-Conditions

None

3.3.1.2.6 Realization

Systems claiming compliance to this feature shall support the Subscribe DMS Information - Realized Use Case Realization.

3.3.1.3 Monitor Current Message Use Case

3.3.1.3.1 Definition

A requesting user that provides the proper security credentials may monitor the display of one or more signs within the owning system. The information monitored by this use case shall include the MULTI string, beacon state, message owner, pixel service, and expected end time (based on the message time remaining parameter).

3.3.1.3.2 Context

A remote user or system may wish to monitor the display of one or more signs in order to provide the

system operators a better understanding of the information being presented to the driving public at any point in time.

3.3.1.3.3 Flow of Events

Primary Flow:

1. The owning system receives a request to monitor the message on one or more signs.
2. The system ensures that the user is authorized to receive such information.
3. The system provides the current message on all of the selected signs.
4. The system provides updates as new information becomes available.

Alternate Flow:

1. The owning system receives a request for the current status of one or more signs.
2. The system ensures that the user is authorized to receive such information.
3. The system responds with the list of messages.

3.3.1.3.4 Pre-Conditions

The requester must be logged into owning system and have authorization to view the information.

3.3.1.3.5 Post-Conditions

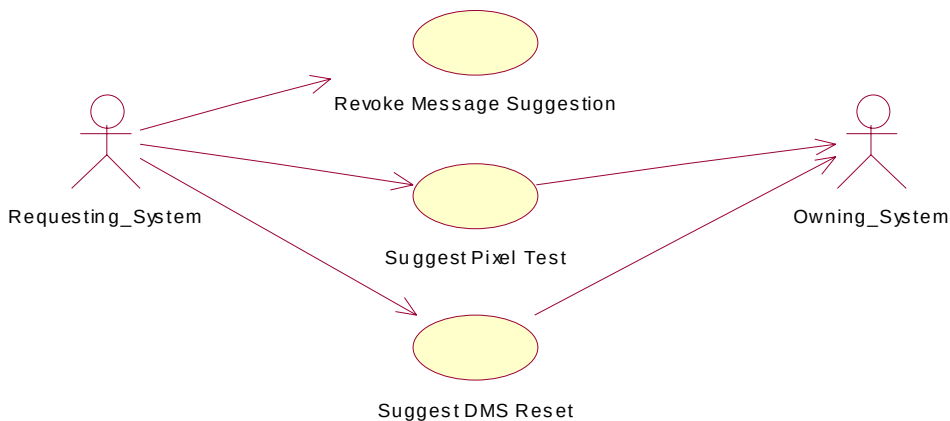
None

3.3.1.3.6 Realization

Systems claiming compliance to this feature shall support the Subscribe DMS Information - Realized Use Case Realization.

3.3.2 Future Control Sign Use Case Model

Figure 6: Future Control Sign Use Case Model



3.3.2.1 Revoke Message Suggestion Use Case

3.3.2.1.1 Definition

A requesting operator or system that provides the proper security credentials may revoke a message which it previously suggested be put on a DMS. The suggestion may only be revoked by the remote system that made the suggestion. Additionally, the remote system must provide the identifier which was returned from the DMS when the suggestion was made. If the suggestion is no longer pending, an exception will be thrown.

3.3.2.1.2 Context

TBD

3.3.2.1.3 Flow of Events

3.3.2.1.4 Pre-Conditions

3.3.2.1.5 Post-Conditions

3.3.2.1.6 Realization

TBD

3.3.2.2 Suggest Pixel Test Use Case

3.3.2.2.1 Definition

A remote system that provides the proper security credentials may activate the pixel test.

3.3.2.2.2 Context

TBD

3.3.2.2.3 Flow of Events

3.3.2.2.4 Pre-Conditions

3.3.2.2.5 Post-Conditions

3.3.2.2.6 Realization

TBD

3.3.2.3 Suggest DMS Reset Use Case

3.3.2.3.1 Definition

A software interface to initiates a controller reset. The execution of the controller reset shall set this object to the value 0. Value zero (0) = no reset, value one (1) = reset.

3.3.2.3.2 Context

TBD

3.3.2.3.3 Flow of Events

3.3.2.3.4 Pre-Conditions

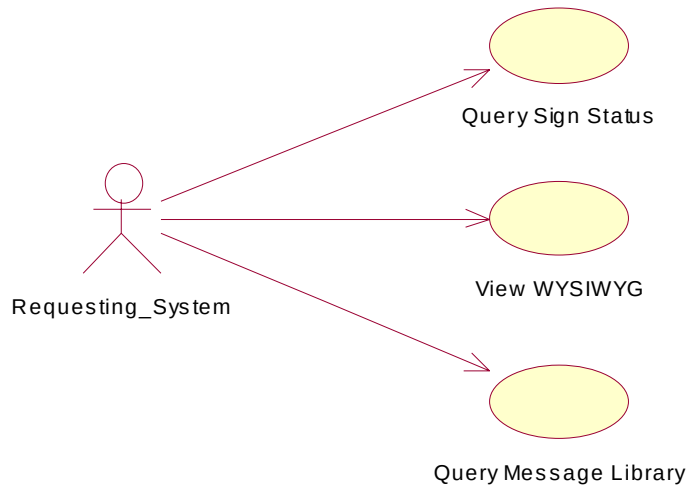
3.3.2.3.5 Post-Conditions

3.3.2.3.6 Realization

TBD

3.3.3 Future Monitor Sign Use Case Model

Figure 7: Future Monitor Sign Use Case Model



3.3.3.1 Query Sign Status Use Case

3.3.3.1.1 Definition

A requesting system or operator that provides the proper security credentials may query for the status of one or more signs. The owning system will provide information including:

- Lamp Status
- LampTestActiveStatus
- Beacon State
- Owner
- Pixel Service
- Pixel Status
- Pixel Test Active Status
- Operational Status
- Error Status
- Control Mode

3.3.3.1.2 Context

TBD

3.3.3.1.3 Flow of Events

3.3.3.1.4 Pre-Conditions

3.3.3.1.5 Post-Conditions

3.3.3.1.6 Realization

TBD

3.3.3.2 View WYSIWYG Use Case

3.3.3.2.1 Definition

A requesting operator or system that provides the proper security credentials shall be able to retrieve the data necessary to display a WYSIWYG view of a message (either a current or proposed message). The information retrieved by this operation may include the following parameters, as needed:

- Beacon Type

- Character Height
- Character Width
- Legend
- MaxPages
- Sign Height Pixels
- Sign Width Pixels
- Sign Technology
- Sign Type
- Font definition
- Default MULTI Tags

3.3.3.2.2 Context

An operator may wish to verify that a proposed message will appear correctly on a sign prior to suggesting it to the remote system; alternatively, an operator may be interested in seeing what the current display looks like.

3.3.3.2.3 Flow of Events

1. The requesting operator requests a WYSIWYG view of a message for a given sign
2. The requesting system retrieves the following information about the subject sign
 - Beacon Type
 - Character Height
 - Character Width
 - Legend
 - MaxPages
 - Sign Height Pixels
 - Sign Width Pixels
 - Sign Technology
 - Sign Type
 - Default MULTI Tags
3. For each font used by the message, the requesting system then retrieves the definition of the font.
4. The requesting system generates the requested display.

3.3.3.2.4 Pre-Conditions

The requesting system must be logged onto the owning system and have proper authorization to retrieve the information.

3.3.3.2.5 Post-Conditions

None

3.3.3.2.6 Realization

TBD

3.3.3.3 Query Message Library Use Case

3.3.3.3.1 Definition

A requesting system that provides the proper security credentials may query the available messages stored in a DMS. This will return all permanent, changeable, and volatile messages stored in the sign controller.

3.3.3.3.2 Context

TBD

3.3.3.3.3 Flow of Events

3.3.3.3.4 Pre-Conditions

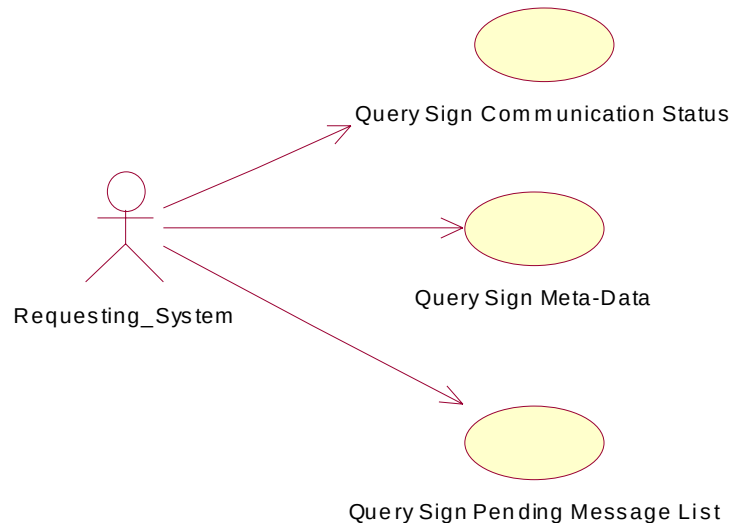
3.3.3.3.5 Post-Conditions

3.3.3.3.6 Realization

TBD

3.3.4 Future Query Sign Meta-Data Use Case Model

Figure 8: Future Query Sign Meta-Data Use Case Model



3.3.4.1 Query Sign Communication Status Use Case

3.3.4.1.1 Definition

A requesting operator or system that provides the proper security credentials may query or monitor the operational status of a particular DMS. Possible return values are: Online, Offline, Communications failed and Hardware failed. Also returned is a timestamp indicating the time and on which the last successful communications occurred with a particular DMS.

3.3.4.1.2 Context

In order to monitor system performance, a requesting system may wish to determine if a given sign is properly communicating.

3.3.4.1.3 Flow of Events

Primary Flow:

1. The requesting system submits a subscription for communications status for one or more signs.
2. The owning system verifies that the requester is authorized to receive the information.
3. The owning system provides an update any time the data changes.

Alternative Flow:

1. The requesting system submits a request for communications status for one or more signs.
2. The owning system verifies that the requester is authorized to receive the information.
3. The owning system provides the information to the requesting system.

3.3.4.1.4 Pre-Conditions

The requesting system must be logged on to the owning system and possess the appropriate authorization to retrieve the information.

3.3.4.1.5 Post-Conditions

None

3.3.4.1.6 Realization

TBD

3.3.4.2 Query Sign Meta-Data Use Case

3.3.4.2.1 Definition

A requesting operator or system that provides the proper security credentials may request meta-data about a sign, including:

- Owning organization
- Contact information for the maintenance and operations of the sign
- The controlling operations center
- System information

3.3.4.2.2 Context

A requesting operator may be notified about a problem with a sign outside of its jurisdiction and wish to contact the correct authority via e-mail or phone in order to relay the information.

3.3.4.2.3 Flow of Events

Primary Flow:

1. The requesting system submits a request for the meta-data for one sign.
2. The owning system verifies that the requester is authorized to receive the information.
3. The owning system returns the requested data.

3.3.4.2.4 Pre-Conditions

The requesting system must be logged on to the owning system and possess the appropriate authorization to retrieve the information.

3.3.4.2.5 Post-Conditions

None

3.3.4.2.6 Realization

TBD

3.3.4.3 Query Sign Pending Message List Use Case

3.3.4.3.1 Definition

A requesting system or operator that provides the proper security credentials may query for a list of pending message suggestions for a particular DMS. The DMS will return each message suggestion that is awaiting display on the DMS, the message owner that suggested the message, the message ID and a status for that message. Possible status values include pending, processing, active and invalid. The message ID can be used to revoke the message suggestion.

3.3.4.3.2 Context

A system operator may wish to cancel a message suggestion or to find out if someone has already suggested a message for display.

3.3.4.3.3 Flow of Events

Primary Flow:

1. The requesting system submits a request for the pending message list for one sign.
2. The owning system verifies that the requester is authorized to receive the information.
3. The owning system returns the requested data.

3.3.4.3.4 Pre-Conditions

The requesting system must be logged on to the owning system and possess the appropriate authorization

to retrieve the information.

3.3.4.3.5 Post-Conditions

None

3.3.4.3.6 Realization

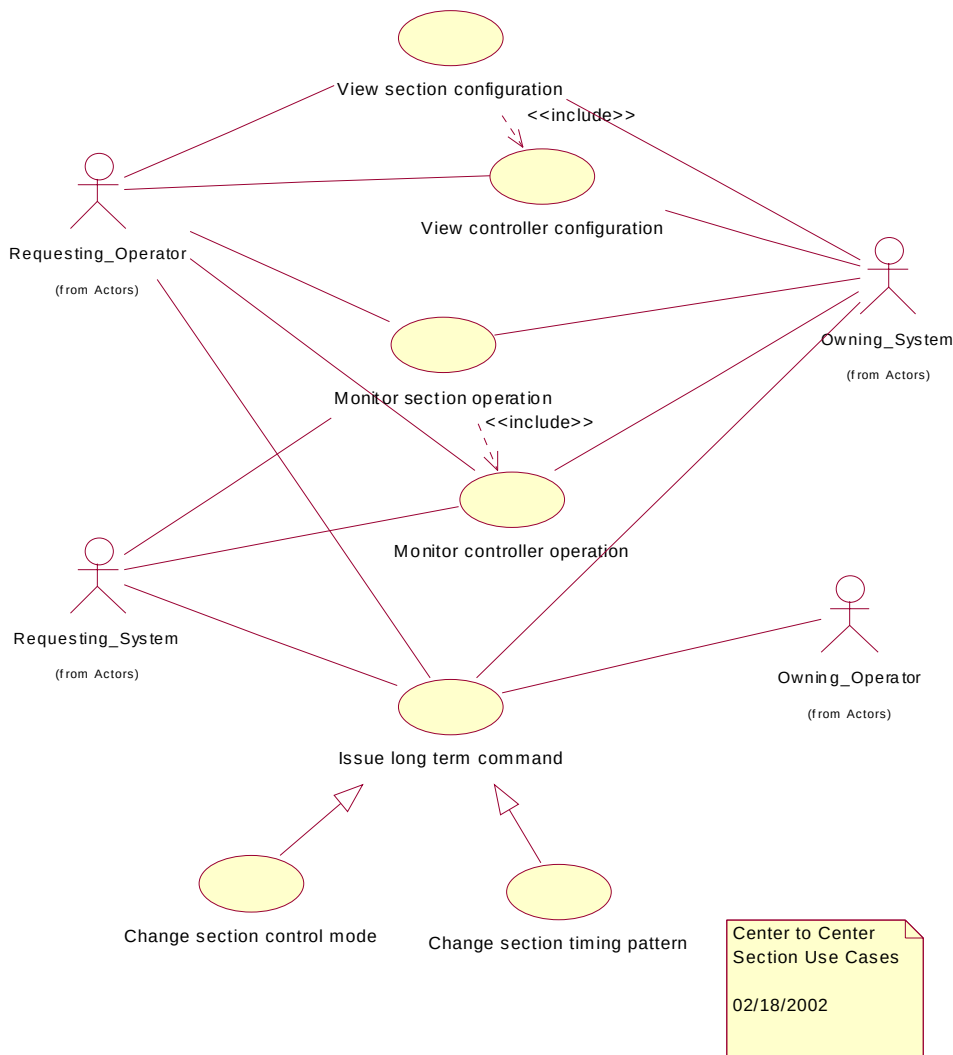
TBD

3.4 SIGNAL USE CASES

3.4.1 Main

3.4.2 Section Use Cases

Figure 9: Section Use Cases



3.4.2.1 Change section control mode Use Case

3.4.2.1.1 Definition

The requesting center requests the owning center to change the control mode for a section so that its intersections will select timing patterns that better match current circumstances. This use case applies to remote management of a system or cross-boundary coordination of signals.

3.4.2.1.2 Context

A requesting operator or system may wish to change the control mode of a section so that the timing plans better match current traffic demands.

3.4.2.1.3 Flow of Events

Primary flow:

1. Specific section command is change control mode
2. Section control changed

Alternative flow:

1. Specific section command is change control mode
2. Command rejected because the command parameters are invalid, external changes of section control mode are not allowed for the requested section, the requesting operator has insufficient privilege to change the section's control mode, or an operator at the owning center rejects the command request

3.4.2.1.4 Pre-Conditions

Owning center permits external commands for the section

3.4.2.1.5 Post-Conditions

Effects of the command have ended

3.4.2.1.6 Realization

TBD

3.4.2.2 Change section timing pattern Use Case

3.4.2.2.1 Definition

An operator or TCS in the requesting center requests a change in the timing pattern for a section owned by another center. This use case applies to remote management of a system.

3.4.2.2.2 Context

A requesting operator or system may wish to change the control mode of of an section so that the timing plans better match current traffic demands.

3.4.2.2.3 Flow of Events

Primary flow:

1. A center requests change in timing pattern for a section owned by another center
2. The owning center validates request
3. An owning center operator may approve change
4. The owning center executes request if valid
5. The owning center notifies operator of result
6. Section command terminates

Alternative flow:

1. A center requests change in timing pattern for a section owned by another center
2. The request is rejected because the command parameters are invalid, external changes to the section's timing pattern are not allowed, the requesting operator's privileges are insufficient, or an operator at the owning center rejects the request.

3.4.2.2.4 Pre-Conditions

Owning center has enabled external changes to the section's timing pattern

3.4.2.2.5 Post-Conditions

Effects of the command have ended

3.4.2.2.6 Realization

TBD

3.4.2.3 View controller configuration Use Case

3.4.2.3.1 Definition

An operator at a traffic management center wishes to view the configuration information for an intersection at a different center. This use case will be applied when coordinating intersections across system boundaries and remote management of intersections.

Standard intersection configuration information includes owning system, contact information, intersection name, type, and location, controller device type, intersection layout (number of legs and configuration of legs), number of system and actuation detectors, location information for detectors (legs and lanes, distance from intersection), timing patterns (consisting of pattern number, label, cycle length, offset, phase count, and split times), and time of day schedules (a list of pairs of 24-hour times of day and pattern numbers).

3.4.2.3.2 Context

TBD

3.4.2.3.3 Flow of Events

Primary flow:

1. Operator requests intersection configuration information from another center
2. Owning center validates request
3. Owning center returns request results to requesting center

Alternative flow:

1. Operator requests intersection configuration information from another center
2. Owning system rejects request because the intersection ID is wrong, is not made visible or the requesting operator is not authorized to view the intersection's information.

3.4.2.3.4 Pre-Conditions

Owning center makes intersection configuration visible

3.4.2.3.5 Post-Conditions

Requesting center receives request status

3.4.2.3.6 Realization

Systems claiming compliance to this feature shall support the View Controller Configuration Realization Use Case Realization.

3.4.2.4 Monitor controller operation Use Case

3.4.2.4.1 Definition

An operator or Traffic signal Control System (TCS) at a requesting center monitors the operation of intersections at the owning center.

3.4.2.4.2 Context

This may be done to monitor intersection controller operation, or to check for traffic or equipment problems. It may also be done to determine how to operate intersections run by requesting center.

3.4.2.4.3 Flow of Events

Primary flow:

1. A center requests controller information from another center
2. Owning center validates request
3. Owning center returns results to requesting center

Alternative flow:

1. A center requests controller information from another center
2. Owning center rejects request because the request parameters are incorrect, the requested intersections are not made visible to external centers, or the requesting operator or TCS is not authorized to view data on the requested intersections

3.4.2.4.4 Pre-Conditions

Owning center makes the requested intersections visible to other centers

3.4.2.4.5 Post-Conditions

Owning center sends request result information to requesting center

3.4.2.4.6 Realization

Systems claiming compliance to this feature shall support the Monitor Controller Operation Realization Use Case Realization.

3.4.2.5 View section configuration Use Case

3.4.2.5.1 Definition

3.4.2.5.2 Context

TBD

3.4.2.5.3 Flow of Events

3.4.2.5.4 Pre-Conditions

3.4.2.5.5 Post-Conditions

3.4.2.5.6 Realization

Systems claiming compliance to this feature shall support the View Section Configuration Realization Use Case Realization.

3.4.2.6 Monitor section operation Use Case

3.4.2.6.1 Definition

A requesting operator or TCS monitors the operation of a section controlled by a TCS at another center. Monitored data may include the section command mode, timing pattern, and intersection controller operation information for intersection controllers included in the section.

3.4.2.6.2 Context

This may be done to monitor section controller operation, or to check for traffic or equipment problems. It

may also be done to determine how to operate sections run by requesting center.

3.4.2.6.3 Flow of Events

Primary flow:

1. Requesting center operator requests section information
2. Owning center validates the request
3. Owning center returns the request result to requesting center

Alternative flow:

1. Requesting center operator requests section information
2. Operation rejected if request parameters are incorrect, the owning center has not made the section's operational information visible to other centers, or if the requesting operator does not have sufficient privileges to view the section's information.

3.4.2.6.4 Pre-Conditions

Owning center exports operation data for the section

3.4.2.6.5 Post-Conditions

Requesting center receives status of request

3.4.2.6.6 Realization

TBD

3.4.2.7 Issue long term command Use Case

3.4.2.7.1 Definition

The requesting center requests the owning center to change the operation of a section for a relatively long time (hours), so that the operation of its intersections will better match current circumstances. This use case applies to remote management of a system or cross-boundary coordination of signals.

3.4.2.7.2 Context

A requesting system may desire long-term control in order to respond to a major incident or in order to implement operations when the owning system is not directly managed (e.g., night or weekend operations).

3.4.2.7.3 Flow of Events

Primary flow:

1. A center requests another center to make a long-term change to a section
2. The owning center validates the section request
3. An owning center operator may approve section change
4. The owning center executes section command if valid
5. Owning center notifies requesting center of result of long-term section command
6. Section command terminates

3.4.2.7.4 Pre-Conditions

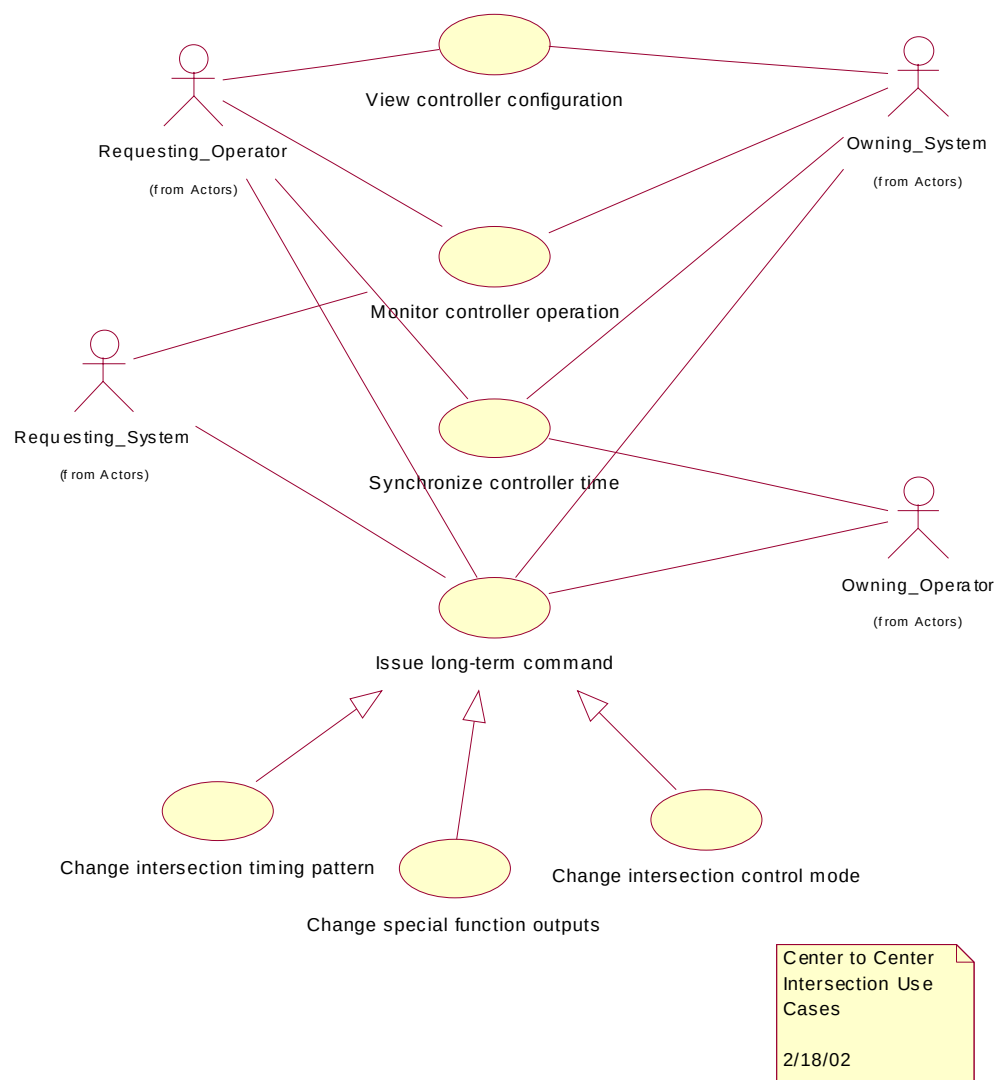
3.4.2.7.5 Post-Conditions

3.4.2.7.6 Realization

Systems claiming compliance to this feature shall support the Issue Long-Term Command Realization Use Case Realization.

3.4.3 Intersection Use Cases

Figure 10: Intersection Use Cases



3.4.3.1 Change intersection timing pattern Use Case

3.4.3.1.1 Definition

An operator or TCS at the requesting center requests the owning center to change the timing pattern for one of its intersections. Command parameters include operator ID, intersection ID, pattern number, and maximum duration.

3.4.3.1.2 Context

A requesting operator or system may wish to change the control mode of an intersection so that the timing plans better match current traffic demands.

3.4.3.1.3 Flow of Events

Primary flow:

1. Specific long term-command is change timing pattern
2. Timing pattern changed

Alternative flow:

1. Specific long term-command is change timing pattern
2. The owning center rejects the command because the parameters are incorrect, the requesting operator has insufficient privileges, the owning center has not enabled remote control of the requested intersection, or if an operator at the owning center rejects the command.

3.4.3.1.4 Pre-Conditions

Owning center has enabled remote control of the intersection

3.4.3.1.5 Post-Conditions

Effects of the command have ended

3.4.3.1.6 Realization

TBD

3.4.3.2 Change special function outputs Use Case

3.4.3.2.1 Definition

An operator at the requesting center requests the owning center to change the state of the special function outputs of an intersection controller. This provides a standard method of controlling specialized equipment attached to the intersection controller.

3.4.3.2.2 Context

An operator at the requesting center may wish to change the state of the special function outputs of an intersection controller in order to control specialized equipment attached to the intersection controller.

3.4.3.2.3 Flow of Events

Primary flow:

1. Specific long-term command is to change special function outputs
2. Special function outputs changed.

Alternative flow:

1. Specific long-term command is to change special function outputs
2. The owning center rejects the command request because the command parameters are invalid, the requesting operator has insufficient privileges to execute the requested command, or an owning center operator rejects the command

3.4.3.2.4 Pre-Conditions

Owning center enables other centers to control the int.'s special fns

3.4.3.2.5 Post-Conditions

Effects of the command have ended

3.4.3.2.6 Realization

TBD

3.4.3.3 Change intersection control mode Use Case

3.4.3.3.1 Definition

Change the control mode for an intersection so that it will select timing patterns that better match current circumstances. This change may be requested by a human operator or by another TCS. Requires control mode change privileges be granted to the requesting operator by the owning center.

3.4.3.3.2 Context

A requesting operator or system may wish to change the control mode of an intersection so that the timing plans better match current traffic demands.

3.4.3.3.3 Flow of Events

Primary flow:

1. Specific long-term command is change control mode
2. Intersection switched to a new control mode.

Alternative flow:

1. Specific long-term command is change control mode
2. The owning center rejects the command request if the command parameters are invalid, if the requesting operator has insufficient privileges to execute the requested command, or if an operator at the owning center rejects the command.

3.4.3.3.4 Pre-Conditions

Owning center enables other centers to control the intersection

3.4.3.3.5 Post-Conditions

Effects of the command have ended

3.4.3.3.6 Realization

TBD

3.4.3.4 View controller configuration Use Case

3.4.3.4.1 Definition

An operator at a traffic management center wishes to view the configuration information for an intersection at a different center. This use case will be applied when coordinating intersections across system boundaries and remote management of intersections.

Standard intersection configuration information includes owning system, contact information, intersection name, type, and location, controller device type, intersection layout (number of legs and configuration of legs), number of system and actuation detectors, location information for detectors (legs and lanes, distance from intersection), timing patterns (consisting of pattern number, label, cycle length, offset, phase count, and split times), and time of day schedules (a list of pairs of 24-hour times of day and pattern numbers).

3.4.3.4.2 Context

TBD

3.4.3.4.3 Flow of Events

Primary flow:

1. Operator requests intersection configuration information from another center
2. Owning center validates request
3. Owning center returns request results to requesting center

Alternative flow:

1. Operator requests intersection configuration information from another center
2. Owning system rejects request because the intersection ID is wrong, is not made visible or the requesting operator is not authorized to view the intersection's information.

3.4.3.4.4 Pre-Conditions

Owning center makes intersection configuration visible

3.4.3.4.5 Post-Conditions

Requesting center receives request status

3.4.3.4.6 Realization

Systems claiming compliance to this feature shall support the View Controller Configuration Realization Use Case Realization.

3.4.3.5 Monitor controller operation Use Case

3.4.3.5.1 Definition

An operator or Traffic signal Control System (TCS) at a requesting center monitors the operation of intersections at the owning center.

3.4.3.5.2 Context

This may be done to monitor intersection controller operation, or to check for traffic or equipment problems. It may also be done to determine how to operate intersections run by requesting center.

3.4.3.5.3 Flow of Events

Primary flow:

1. A center requests controller information from another center
2. Owning center validates request
3. Owning center returns results to requesting center

Alternative flow:

1. A center requests controller information from another center
2. Owning center rejects request because the request parameters are incorrect, the requested intersections are not made visible to external centers, or the requesting operator or TCS is not authorized to view data on the requested intersections

3.4.3.5.4 Pre-Conditions

Owning center makes the requested intersections visible to other centers

3.4.3.5.5 Post-Conditions

Owning center sends request result information to requesting center

3.4.3.5.6 Realization

Systems claiming compliance to this feature shall support the Monitor Controller Operation Realization Use Case Realization.

3.4.3.6 Synchronize controller time Use Case

3.4.3.6.1 Definition

An operator at a remote center requests that the owning center synchronize the intersection controller's clock with the local traffic control system's clock.

An operator at a center may do this when that operator is responsible for the operation of an intersection owned by another center, and the operator suspects that the intersection's clock has drifted away from the traffic control system's clock.

3.4.3.6.2 Context

TBD

3.4.3.6.3 Flow of Events

Primary flow:

1. An operator requests an intersection resynchronize its time
2. The owning center validates the request