North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.1

Integrate North Dakota, Wisconsin, and Minnesota Reporting Systems

State to State Data Exchange
Interface Control Document

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North/West Passage

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Document Overview

This document has been prepared on behalf of the North/West Passage Consortium of states. The North/West Passage states have decided to exchange traveler information data between and among states with the intent of one day offering seamless traveler information along the entire corridor.

The Use of Standards for Data Exchange

It is envisioned that the North/West Passage states will not all have the same traveler information systems / condition reporting systems, but rather a collection of several different systems. The use of a message structure based on draft National ITS Standards will facilitate the exchange of data from one system to the next (i.e., from one state to another). This will allow each state's system to be upgraded or modified while still adhering to the same XML interface, and thus promoting continued exchange of data across state boundaries.

What is contained in this document

This interface control document defines the specific use of an XML message based on the Traffic Management Data Dictionary (TMDD)[1] Full Event Update (FEU) draft standard for systems to send data to the Condition Acquisition and Reporting System (CARS) currently in use in the North/West Passage states of Minnesota and Washington, and currently being deployed in Idaho.

This document also outlines two approaches for exchanging data using the standard XML interface, as follows:

- A Web services exchange (using Simple Object Application Protocol – SOAP) is defined for situations where one system will connect to another system and push events to the other system. This offers the most real-time and efficient mechanism for exchanging data, as the receiving system only receives information about those events that have recently been created or modified.

- An XML Direct transfer where the sending system posts either one or two XML web pages and allows one or more receiving systems to pull data from the XML site. This is the most simple to implement, but requires the receiving system to continuously monitor the XML pages for any new or updated events.

The general use of this document

The primary intent of this initial document is to allow the North Dakota condition reporting system (IRIS) to send data using the FEU, and for the Minnesota CARS system to receive the data. For other North/West Passage states using different condition reporting systems, this document offers a significant step towards defining the specifics of the standards exchanges. For example, should another North/West Passage state using a different condition reporting system wish to make use of this document, a simple edit of the specific interpretations and

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[1] Strictly, the TMDD message sets are called "Message Sets for External Traffic Management Center Communications" (MS/ETMCC).

data mapping (to suit the local system) should be all that would be needed to convert this document to one that specifically supports exchanges with the other system.

Nomenclature used in the document

This document regularly refers to the interface as the CARS-TMC Data Exchange Interface (or, from the CARS perspective, the CARS Data Import Interface). In this sense, TMC is used in the generic term as this describes center-to-center exchange of data (as opposed to field to center, or center to device).

Concept of Operations

Traffic Management Centers (TMCs) and/or traveler information systems need to collect and share traffic/travel event and road condition information including current, planned and forecasted roadway reports about construction, incidents, obstructions, traffic conditions, special events, evacuations, homeland security alerts, and natural disasters. States use condition reporting systems as reporting tools for these transportation-related event and status reports. These condition reporting systems typically maintain a statewide conditions database and allow the exchange of event information with other centers and subsystems.

The intent of this document it to provide sufficient detail for the exchange of data between the North Dakota condition reporting system (IRIS), and the Minnesota condition reporting system (CARS) so as to allow the software programmers on each system to develop the formal data exchange mechanisms. However, the contents of this report should offer a general enough description of the use of an XML message based on the TMDD Full Event Update FEU draft standard to be tailored to describe the data flows between other condition reporting systems that do or will exist along the North/West Passage corridor.

The CARS-TMC data exchange interface will allow highway and traffic event reports to be imported from external TMCs like the North Dakota IRIS system into the Minnesota, Idaho, or Washington State CARS database. The appendices also define the SOAP and XML Direct methods of exchanging the XML messages. XML Direct publishing of events over http at a known URL can be used by agencies that may prefer not to use the (more complex) SOAP data exchange approach.

The CARS-TMC Data Exchange Interface uses an XML message based on the draft Traffic Management Data Dictionary (TMDD) standard to receive traffic event and condition data from external systems. This document defines the interface from the North Dakota IRIS system into CARS that is needed to meet the requirements of ongoing deployments within Minnesota. While the focus of this document is on traffic event and condition reporting, it is set within the more general context of overall travel event and status reporting based on the draft TMDD standard. The interface described within this document follows approaches used in the existing exchange of data from the New York State Winter Travel Advisory (WTA) system into CARS, as well as from the New York metropolitan area Transcom Regional Architecture data imports into CARS.

Since 1997, CARS deployments used the TMDD Committee's Event Report Message (ERM) as their primary means of importing and exporting event information with other CARS and CARS-related software modules. However, in December 2003 the ERM draft standard was superseded by a new event message set from TMDD. CARS states decided to migrate to the new message set at a Summit Meeting in Orlando, FL, February 2004. The principal message in the new TMDD event message set is called the Full Event Update message (FEU).

In adopting an XML message based on these new TMDD draft standards between condition reporting systems within the North/West Passage states and the CARS systems deployed along the corridor, the goal is to maintain compatibility with other CARS deployments and with the increasing numbers of other states' Conditions Systems in a standards-compliant way. The intention is to adopt those parts of the standards that serve the needs of the North/West Passage states in working with related software applications in various TMCs. There is no intention of implementing any aspects of the standards that are not yet required to support current or proposed functions.

CARS-TMC Data Exchange ICD - Interface Design Requirements

These requirements shall be read in conjunction with the CARS-TMC Data Exchange ICD Concept of Operations, which forms the first part of this document.

1. Approach

Traffic Management Centers need to collect and share event and status information about current, planned, and forecasted circumstances including traffic conditions, incidents, obstructions, road conditions, homeland security events, and natural disasters. An ITS center's area of responsibility may be an entire geographic region (e.g., a metropolitan region; a state; an urban area) or selected facilities within a region (e.g., all state-designated highways; a specific turnpike facility). Centers may delegate some or all of their responsibilities to other centers for specified locations and periods. In the Minnesota system, CARS serves both statewide and regional functions. Similarly, in the North Dakota system, IRIS serves both statewide and regional functions.

In this ICD, the North Dakota IRIS System—an external ITS center, viewed here as a Traffic Management Center—will generate traffic, road conditions and construction information and share these observations and plans with other ITS systems/centers—specifically, CARS—through use of event reports. Roadway-based traffic information may include traffic conditions (e.g., slow traffic, delays) affecting a particular segment of road. Construction information may include lane closures either happening at present or planned to happen in the future. Road conditions may include driving conditions or weather events.

The sending center can best control what information is exchanged. Some event report content may need to be filtered, being only sent to certain types of users. Receiving centers may also need to limit who has access to some types of content, e.g., for events that involve homeland security implications or personal details of injured people. However, road traffic information from ITS systems like IRIS is normally expected to be public domain.

Managing event information exchanges is challenging because events can be complex and may also have complex interrelationships with other events. Also, bandwidth constraints may limit the exchange of event reports, as system user numbers grow and statewide systems come to be used more intensively.[2] For these reasons, both the content and management of event report exchanges needs to be optimized.

The FEU implementation defined for this deployment provides an opportunity to revisit the various functional and standards requirements with a view to further system optimization, relative to earlier ERM deployments. In particular, it is important in SOAP deployments of this revised implementation to optimize event report exchanges by pushing FEU message exchanges only when events are new or updated. XML Direct can similarly be streamlined by publishing all events to one page, and event message *updates* to a separate page on (say) a five minute cycle. These measures serve to prevent the receiving system from having to read in every event each time an update occurs. The receiving system is responsible for monitoring the event duration or end time and for deleting time-expired events without requiring a further message exchange.

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[2] Most event reports are exchanged over wire line systems where bandwidth is relatively plentiful. However, some exchanges use wireless links where bandwidth can be a critical factor. Also, XML is now the preferred medium of exchange, because of its great simplicity and ease of application. XML is, however, less bandwidth-efficient than many earlier data formats. It is for these reasons that bandwidth can become a consideration in the design of event exchanges.

1.1 Definition of *Event*

For the purposes of event information exchange, an event includes any travel situation (any set of travel circumstances) that an agency may wish to report. For example, event reports may describe traffic conditions, incidents, construction, maintenance activities, road or weather conditions, sports events, or VIP visits. In Minnesota CARS, traffic condition reports may stand alone or may form part of other event descriptions, such as a construction event or a crash report.

Events include not only disruptions to normal travel conditions caused by construction or traffic delays but also situations that do not immediately impact travel (e.g., planned special events such as major sports events). Also, event reports can simply convey that circumstances have returned to normal, or that delays have cleared and no longer affect travel.

1.2 Structure of Event Reports

Event reports always include the event's description, its expected duration, and its location. Additional information can also be appended to these core data to meet operational needs. In the interests of efficiency, event reports need only include these additional data when operations so require.

1.2.1 Description

Event descriptions shall be built from standard phrases, causes, and related data such as quantities. Use of standard phrases instead of free text supports greater consistency of reporting; permits automated routing and machine-processing of reports; provides for easy translation into other languages such as French or Spanish; and allows the use of pre-recorded speech for dissemination of reports to end users.

FEU messages allow the descriptive phrases and other components to be exchanged and presented to users in any sequence, as specified in the event message.

1.2.2 Duration; start and end times

Each event report must include an expected duration or end time/date. In Full Event Updates, residual durations are measured from the *update time* of each successive update—or from the start time of the event, for events that have not yet started.

Inclusion of start time and date is optional in event reports. These data are only required in future events and future event elements, such as traffic forecasts and planned road construction.

The FEU differs from the ERM in that all times are exchanged as local times. UTC offset values can also be exchanged with event times in FEU, so that message management (which may take place in another time zone) can handle *start, end* and *recurrent* times correctly. By these means, for example, an event may be announced through a national 511 center only when it is in effect locally.

FEU can handle times and dates that are either clearly inside or outside of daylight saving time, so long as the sending system selects the correct UTC offsets. In all states, event times that refer to periods where daylight saving is or is not in effect shall utilize the appropriate UTC offset. For example, an event in Minnesota updated on September 15 shall have an *update time* UTC offset of -0500. If that event's end time is on November 1, 2004, the end time's UTC offset must be -0600.

One problem that remains, however, is that of *recurrent times*, e.g. of roadwork. *Recurrent times* may span a period, part of which is in daylight saving time and part of which is not. The FEU *recurrent times* UTC offset will indicate what time zone is in effect at the start of the recurrent period, but not at the end, should that period extend into or out of daylight savings. Unless affected event messages are always resent when daylight saving changes, the receiving system needs a way of knowing whether an event's location follows daylight saving time, in order to know whether to apply a correction to UTC offset when times are changed. Fully addressing these complexities would require that a receiving system shall be able to decide what time zone the event is in, and whether daylight saving time is observed at that location.

Essentially, three states do not observe daylight saving time (AZ, HI and IN). None of these is in the NW Passage. In states each with two time zones that observe daylight saving time statewide, e.g., North and South Dakota, FEU requires that the sending center must send UTC offsets appropriate to the event's location and season. Thus, event times and dates in western South Dakota require a UTC offset of -0700 in winter and -0600 in summer. Eastern South Dakota events require an offset of -0500 in summer and -0600 in winter. In order to make sense of FEU messages, both the sending and receiving systems must know when daylight saving time starts and ends.

Also, *recurrent times* of events that span a daylight savings time change needs to be adjusted automatically by the receiving system, preferably without requiring a resend of the event information with a corrected offset. In most of the nation, including all the NW Passage states, this can best be done by assuming that daylight saving time observance is the default.

1.2.3 Location

In FEU, locations can be specified in terms of latitude/longitude (geolocation), route designator and linear reference; or by named area, such as a county through use of the Federal Information Processing System (FIPS) number.

In this CARS-TMC Data Exchange ICD, all roadway-based events shall be reported using the appropriate route designator, linear reference(s), and geolocation(s). This provides receiving systems with the ability to validate the route that is (or is expected to be) affected by the traffic event. Area-based condition reports must use the FIPS number to report conditions affecting a county or causing a regional impact.

In some exchanges, the receiving system has access to predefined location tables, which allow precise geolocations and linear references to be related to nearby and easily-described landmarks. In other cases, the event report must include all the required surrounding landmark information. Both approaches are supported in the FEU, but only the former will be supported by

the Northwest Passage data imports at this time. However, the intent of FEU is to add further location information to the basic route designator, geolocation(s), and linear reference(s) when systems such as CARS and IRIS are upgraded.

1.2.4 Quantities

Event reports may include quantities such as the length of road affected by an event; the speed of traffic on the roadway; the visibility distance; the advisory speed limit for the road segment; or the number of people injured in a crash. CARS-TMC Data Exchange–conformant applications can use quantities to provide numerical details of event impacts on the highway.

For standards compliance, FEU units are always metric, although displays to users and the public are typically converted into "English" units and rounded.

1.3 Event Structure

Event reports are structured so that they can describe both simple and complex events. Features that support this requirement include:

1.3.1 Concurrent event elements

Concurrent event elements are distinct components of complex events that may co-exist and overlap in time. Each concurrent element can have its own duration, description, and location; however, they are treated operationally as component parts of a single event. For example, precipitation affecting a roadway might cause travel delays. Some agencies would treat the delays as a separate event, distinct from the precipitation. Drivers would more likely see them as related elements of a single event. FEU supports the creation of these *concurrent event elements*.

1.3.2 Related events

An alternative way of handling concurrent event elements is to treat them as related events. Events can also, of course, be entered as if they are unrelated. Deciding whether two events should be seen as related is a matter for operators' judgment, within the framework of a center's operating practices.

FEU contains pointers that allow two separate events to be treated as related. This would allow for an alternative way of handling concurrent event elements, using a separate event message for each element. However, TMC-CARS exchanges are not expected to use this feature, as it simply replicates the functionality of Section 1.3.1 above. Thus, if complex (multi-element) events are to be exchanged, they shall utilize concurrent event elements as specified in section 1.3.1.

1.3.3 Scheduled elements

Some event reports in condition reporting systems are expected to include schedules of planned or predicted future circumstances. For scheduled future events, each element of an event

schedule shall include its own expected start and end times/dates. Like ERM, FEU supports this functionality.

In CARS-TMC Data Exchange–conformant applications, this functionality may be used to provide expected impacts that planned construction may have on a roadway segment, including lane closures and other scheduled maintenance activities.

1.3.4 Split and merged events

Circumstances initially reported as separate events may turn out to be parts of a larger, single event. Conversely, situations initially reported as one event may need to be split into separate events later. Therefore, events need to be split or merged when necessary, while maintaining histories of the splits and mergers that occur.

FEU contains new provisions for tracking split and merged events using pointers to earlier event reports. However, CARS does not currently support the explicit tracking of splits or mergers. If required for NW Passage (which is thought unlikely), this functionality can be added in the future. At present, no date is scheduled for this possible enhancement.

1.4 Event Updates

Typically, centers that exchange event information undertake to pass on the most recent event details in immediate event report updates, whenever the event report is updated in the originating center. Systems using SOAP should push updates to CARS as soon as they become known. WSDL/SOAP definitions have already been defined and proven by two separate exchanges in New York (the New York Thruway import of IEEE 1512 data into CARS and the Transcom import of FEU data into CARS) for exchanging data between separate systems. A copy of this WSDL/SOAP definition is appended to this document. Where XML Direct is utilized, a regular publication cycle is typically used instead (e.g., every five minutes).

1.4.1 Irregular updates

Events occur, and are reported and updated, at irregular intervals. Therefore, an event report update gives information about a single event. Whenever an event is updated, an event update shall be pushed to subscribing systems. Each FEU message therefore relates to a single event, which typically has unique creation and update times.

1.4.2 Full or partial reporting

Alternative strategies have been proposed for updating events:

- Full reporting is an update strategy in which all details currently known about all the elements of an event are included in the report.

- Partial reports include full details of specified event elements that have been updated. Unchanged event elements are not included in a partial report. Note therefore that partial

reporting only applies to multi-element events such as construction schedules or events with concurrent event elements.

The TMDD Partial Event Update message or PEU is only able to handle one element of a complex event or schedule at a time. Therefore, on its own it is insufficient for existing CARS deployments (which use multi-element schedules and concurrent event elements). If PEU were deployed it would need to be coupled to FEU usage for handling these event types. FEU on the other hand supports both complex and simple events, which is why it has been selected by the seventeen CARS states and provinces for all event report exchanges. Thus, only FEU will be utilized in NW Passage exchanges as well.

FEU allows both full and partial reporting strategies to be used. However, currently, CARS supports only full reporting using FEU. Therefore, initial North Dakota data imports shall use full reporting within the FEU in pushing traffic data to CARS.

1.4.3 Report selection

Update procedures are usually established through face-to-face negotiations and agreements before exchanges begin. In this case, agreements may establish information selection criteria, specifying the kinds of information to be sent, for which locations, and in what level of detail. Therefore, the sending system can select and filter what is sent to particular users.

1.4.4 Exchange initiation

Once exchanges begin, the originating center should initiate an information exchange, without receiving a specific request. The sender is usually in the best position to judge the importance of a particular event, or may choose to send the information for operational reasons. FEU allows event messages to be pushed as soon as changes occur, and this pattern shall be followed in SOAP versions of Northwest Passage data exchanges. XML Direct exchanges are expected to utilize a fixed publication cycle, e.g., every five minutes.

1.4.5 Advanced requests

Optionally, in the future, advanced request procedures (using the new TMDD "Event Filter Request" message) may be used between centers that so agree, supporting requests for information selection criteria to be adjusted in real time. However, no real-time changes in event filtering are currently required in any CARS or CARS-related exchanges. At this time, no currently planned or funded CARS enhancements require use of this new message, which shall therefore not be implemented in the current Northwest Passage deployments.

1.4.6 Event deletion

Once an event report has been received by an external center, it shall be able to be edited or updated using any of these approaches:

- *Event times out:* the event report includes an expected duration or end time for the event, after which—if not updated—the receiving system shall consider the event to have ended.

Receiving systems shall track event durations and delete events automatically when their durations or end times have been reached. Most roadway events (e.g., construction, incidents, and delays) shall use this approach.

Note that with FEU, every update that uses duration must indicate the residual duration that still remains, measured from each successive update time. If an update merely repeated the original duration, the duration countdown begins again.

- *Report times out:* the event report shall specify a period of time within which the report must be reconfirmed. Receiving systems shall track expiration periods and delete events automatically when their reconfirmation period has expired—unless, of course, they were reconfirmed. This method is typically used by NWS in relation to weather predictions such as five day forecasts, and may not be needed for Northwest Passage data imports to CARS.

- *Termination by sender:* the center that created the event can distribute an update to indicate that the event has ended, or that the event report is canceled. This option is available for use in Northwest Passage data imports to CARS where events time out unexpectedly.

- *Updating by sender:* the responsible center can update the event to show that conditions have changed (including return to normal), changing the end time for the new update.

In principle, all these approaches are supported in FEU, and all may be utilized by the North Dakota IRIS system. However, #1, #3 and #4 are considered the most likely to be needed at this time.

1.5 System Needs

Systems exchanging event information have certain functional needs:

1.5.1 Need for new event reports

Originating systems need to be able to distribute reports that describe new events. Receiving systems need to be able to distinguish new event reports from updates, ends or cancellations, e.g. by means of a unique event identifier. FEU also contains an explicit status indicator, which shows whether an event is new, updated, etc. These data fields must be included in all condition reporting system to CARS data imports, labeling each event with a unique ID and flagging when an event is new, updated, cancelled, etc.

1.5.2 Need for event report updates

Originating systems need to be able to issue updates to existing event reports that supersede previous event information. Receiving systems need to be able to distinguish event report updates and ensure that earlier event details are correctly updated. FEU does this with an update counter. This counter must be utilized in NW Passage updates to existing events, including (where necessary) incrementing the counter for planned events that start today—in

which circumstances the planned event that becomes a current event shall keep the same event ID and shall have its update counter incremented.[3]

1.5.3 Need for event-ended indicator

Although most reports stored in receiving systems are ended as a result of timing-out, some events end earlier than expected. Originating systems need an efficient way to indicate that an event has ended. In FEU this can be handled by means of the status indicator, which can be set to *"ended". Event element detail* is optional to avoid the need to resend all event details when an event is ended ahead of timeout, thus minimizing bandwidth use in this scenario. However, use of the status indicator to flag the early end of an event is the *only* way to ensure that it is deleted from a receiving system in a timely fashion and must be supported in CARS data imports.

1.5.4 Need for report cancellation indicator

Originating systems may also need to cancel a report that was distributed in error. FEU contains such provisions – in FEU, using a status of *"cancelled"*. However CARS does not currently support the explicit cancellation of erroneous events, and no plans or funding currently exist for adding this function. It is not expected to be used in NW Passage data imports to CARS. Cancelled events can however be immediately ended, as noted in section 1.5.3 above.

1.5.5 Need for event report recap

A receiving system may need a complete recap of all currently valid events in order to re-synchronize its own internal database. Event recap is a function of the dialogs or "wrappers" that surround the event messages; thus, recap can be handled in the SOAP message wrapper. On-demand recap shall also be handled using an XML Direct page that lists all current events.

1.5.5.1 Current support for event report recap

The following event report recap data exchange scenario shall be supported in SOAP versions of the CARS TMC Data Exchange interface deployment.

On a 24-hour cycle, the sending center shall push an event report recap to the CARS TMC Data Import interface. By default, the recap push shall occur between the hours of midnight and 12:59:59 AM, according to the time zone in which the sending center resides. The recap will contain FEU reports for all currently valid events, including those that are scheduled to start in the future. The recap message shall be time-stamped, and the CARS TMC Data Import Interface shall acknowledge receipt of the recap using standard SOAP response protocols. The recap message shall be distinguishable from real-time event exchange messages by the "Recap" wrapper tag that surrounds it.

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[3] Note that when the start time of a planned event is reached, CARS will automatically assume that it has started. It is not necessary to send an update to this effect. An update is only required, in fact, if it didn't start on time; in which case the update would need to revise the start time.

It is the responsibility of the receiving system (i.e., CARS) to synchronize its internal database of events against the contents of the recap upon receipt of the message. Whenever CARS notices a discrepancy between the recap message and its internal database of events, it shall correct the database. Events that do not appear in the recap message but are still open in CARS shall be ended. New events that appear in the recap message but not in the CARS database shall be added, as well as updates that were not previously received. When any of these discrepancies occur, the CARS TMC Data Import Interface shall note the details in an error log. It shall also email those details to system administrators.

If the CARS TMC Data Import Interface does not receive the event report recap during the expected timeframe (default midnight–2:00 AM), it shall email system administrators.

If the sending center cannot reach the receiving system after 3 attempts to send the recap message, it shall email system administrators.

1.5.5.2 Additional support for event report recap on-demand

In future versions of the CARS TMC Data Import Interface, an on-demand event recap model shall be supported. This model will allow the receiving center to receive recaps on an as-needed basis.

In this model, when CARS needs an event report recap, it shall read an XML Direct page published by the sending center.

Note that it is the responsibility of the receiving system (initially, CARS) to buffer all FEU messages that it receives between system startup and its XML Direct read of the remote system. After receiving the database of all currently active events from in the XML Direct page, it shall compare the timestamp of each buffered FEU message to the timestamp of the XML Direct message. FEUs that are timestamped prior the XML Direct timestamp shall be ignored; FEUs that are timestamped after the XML Direct timestamp shall be reconciled against the database of currently active events.

Appendix A

Mapping FEU Messages for CARS-TMC Data Exchanges

Mapping FEU Messages for CARS-TMC Data Exchanges

This section maps the FEU to the data elements necessary for effective traffic event information transfer between condition reporting systems in the NW Passage. Lines shown in gray are optional items that are not initially expected to be used in current systems. They are included here in case a future use is identified in conditions system applications. As the data elements and data frames become necessary, they may be changed from gray to black and implemented in successive system upgrades.

The full event update can be used to exchange information about any event, including both simple and complex events, i.e. events with either single or multiple elements. In the full event update, events are described using standard phrases, causes, advice, qualifiers, quantities, related locations and additional free text. Operator comments can also be added to the full event update. Also, the full text of the event report as presented over one or more dissemination media can be optionally appended.

1. Top Level Data Frame

This frame defines the high-level structure of FEU reports, as follows:

message-header: initial information used at the start of a message (Section 1.1)
event-reference: a unique reference to the event (Section 1.2)
project-references: optionally, references to a project related to the event (Section 1.3)
event-indicators: optionally, indicators like event status, event priority (Section 1.4)
other-references: optional references to other messages (Section 1.5)
headline: the key phrase and reference to its event element (Section 1.6)
details: event description, location, times, etc. for each event element (Section 2).
operator-comments: optional operator comments, not for public use (Section 2.6)
*full-report-text*s: optionally, the full text of the event report as presented over one or more dissemination media (Section 2.7). This data frame is not proposed for implementation in NW Passage at this time.

```
FullEventUpdate::= SEQUENCE
{
    message-header          MessageHeader,
    event-reference         EventReference,
    project-references      SEQUENCE OF ProjectReference OPTIONAL,
    event-indicators        SEQUENCE OF EventIndicator OPTIONAL,
    other-references        SEQUENCE OF OtherReference OPTIONAL,
    headline                EventHeadline,
    details                 SEQUENCE OF EventElementDetail OPTIONAL,
    operator-comments       EventComments OPTIONAL,
    full-report-texts       SEQUENCE OF FullReportText OPTIONAL
}
```

The event element detail frame (which carries most of the essential information about an event) becomes optional in FEU when an event ends (using *"ended"* in the *status* within e*vent-indicators*), so that its details need not be sent again. Otherwise, it must be sent once per event element.

1.1   Message Header

This frame defines the message header for FEU reports. It contains data frames to be used as follows:

sender: the organization sending the message (Section 1.1.1)
recipients: optionally, organizations receiving the message (Section 1.1.1). This data frame is not currently proposed for use in NW Passage exchanges.
responders: optionally, organizations responding to the message (Section 1.1.1). This data frame is not currently proposed for use in NW Passage exchanges.
message-time-stamp: the date/time/zone the message was created (Section 1.1.2).
message-expiry-time: the date/time/zone after which the message content is no longer valid and shall be deleted from recipients' databases (Section 1.1.2).

```
MessageHeader ::= SEQUENCE
{
    sender                  OrganizationInformation,
    recipients              SEQUENCE OF OrganizationInformation OPTIONAL,
    responders              SEQUENCE OF OrganizationInformation OPTIONAL,
    message-type-version    Event-message-type-version,                 --3803
    message-number          Event-message-number,                       --3804
    message-time-stamp      DateTimeZone,
    message-expiry-time     DateTimeZone OPTIONAL
}
```

Sender uses the data frame OrganizationInformation.

Message type version is implemented for easing the move from older to newer versions of exchange messages. It is used to prevent legacy systems trying to read new versions of the message which they would not understand. It is to be incremented whenever the XML is changed. The initial version to be used here is Version 1.

Message expiry time shall be used to indicate when a particular event no longer applies. One example would be weather forecasts, whose period of validity often ends before the forecasts periods themselves end. For example, a 5-day forecast may be valid only until midnight tonight, by which time it should have been re-issued. The receiving system shall check that the event is still valid before the "renew by" date is exceeded.

1.1.1   Organization Information

This frame *must* be used in FEU to reference the sender agency. It may also be used to reference the original information source. It contains two data frames, to be used as follows:

last-update-time: the last time that the organization information was updated
(Section 1.1.2). This data frame is not currently proposed for use in NW Passage exchanges.

contact-details: contact details of the responsible person in the organization

(Section 1.1.1.1).

This frame will carry organization and center identifiers in FEU reports:

```
OrganizationInformation::= SEQUENCE
{
    organization-id         Organization-identifier,                    --3343
    organization-name       Organization-name OPTIONAL,                 --3344
    organization-location   Organization-location OPTIONAL,             --3104
    organization-function   Organization-function OPTIONAL,             --3354
    center-id               Organization-center-identifier OPTIONAL,    --3217
    center-name             Organization-center-name OPTIONAL,          --3355
    last-update-time        DateTimeZone OPTIONAL,
    contact-details         ContactDetails OPTIONAL
}
```

While *center-id* is optional in FEU, it is mandatory in CARS applications. So, for example, in CARS FEU messages, *organization-id* could be **NDDOT** and *center-id* could be **CENTER1, CENTER2**, etc., for the various state centers.   Most states that deploy a statewide system will likely have only one "virtual" TMC statewide.

ContactDetails will also be needed to carry the *author* information, if data from NW Passage states is entered by a defined TMC operator.

1.1.1.1 Contact Details

This frame is used to carry a *'contact identifier'* in FEU reports. All the other elements are not proposed for use in NW Passage data exchanges at this time.

```
ContactDetails ::= SEQUENCE
{
    contact-id          Contact-identifier,                         --3105
    person-name         Contact-person-name OPTIONAL,               --3206
    person-title        Contact-person-title OPTIONAL,              --3349
    organization-id     Organization-identifier OPTIONAL,           --3343
    organization-name   Organization-name OPTIONAL,                 --3344
    phone-number        Contact-phone-number OPTIONAL,              --3207
    phone-alternate     Contact-phone-alternate OPTIONAL,           --3113
    mobile-number       Contact-mobile-phone-number OPTIONAL,       --3350
    fax-number          Contact-phone-fax OPTIONAL,                 --3205
    pager-id            Contact-pager-identifier OPTIONAL,          --3346
    pager-number        Contact-pager-number OPTIONAL,              --3347
    email-address       Contact-email-address OPTIONAL,             --3204
    radio-unit          Contact-radio-unit-identifier OPTIONAL,     --3208
    address-line1       Contact-mailing-address-line1 OPTIONAL,     --3339
    address-line2       Contact-mailing-address-line2 OPTIONAL,     --3340
    city                Contact-mailing-address-city OPTIONAL,      --3338
    state               Contact-mailing-address-state OPTIONAL,     --3341
    zip-code            Contact-mailing-address-zip OPTIONAL,       --3342
    country             Contact-mailing-address-country OPTIONAL,   --3373
```

}

Where this frame occurs in *organization-id* (Frame 1.1.1), it is required to carry *"contact-id"* which references the author of the event report (see Frame 1.2).

1.1.2 DateTimeZone

This frame is required to carry time and date information in all FEU reports. All times are expressed as local times, for the sending center or the event primary location, according to context.

```
DateTimeZone ::= SEQUENCE
{
    date                    Time-local-date,                          --3398
    time                    Time-local-time,                          --3397
    utc-offset              Time-utc-offset OPTIONAL                   --3376
}
```

OPTIONAL is grayed-out in utc-offset because it is proposed that all NW Passage event exchanges include UTC Offset.

Three FEU times are expected to conform with local time at the sending center, e.g., the DOT headquarters that conceptually hosts the system:

- The *message time stamp* (Section 1.1),
- The *message expiry time* (Section 1.1),
- Where used, *last update time* (Section 1.1.1). However, this data frame is not currently proposed for use in NW Passage exchanges.

For example, in Minnesota, which uses Central Daylight Time in summer, the required UTC offsets must be -0500 (summer) and -0600 (winter).[4]

Example 1.1: First draft representation of FEU XML for Frame 1.1

The message header might look something like this in XML:

```
<full-event-update>
 <message-header>
  <sender>
   <organization-information>
     <organization-id>MNDOT</organization-id>
     <center-id>MNCARS</center-id>
     <contact-details>
       <contact-id>admin</contact-id>
     </contact-details>
   </organization-information>
```

---

[4] Note that the UTC offset of the message time stamp and the UTC offset defaults are determined by the local time in St. Paul, even though the Minnesota CARS system is actually hosted in Atlanta, GA, and Portland, OR.

```
      </sender>
      <message-type-version>1</message-type-version>
      <message-number>206</message-number>
      <message-time-stamp>
        <date>20040205</date>
        <time>095859</time>
        <utc-offset>-0600</utc-offset>
      </message-time-stamp>
    </message-header>
```

1.2   Event Reference

This frame defines the event reference in FEU reports:

```
EventReference ::= SEQUENCE
{
    event-id              Event-identifier,                          --3215
    update                Event-update,                              --3293
    response-plan-id      Event-response-plan-identifier OPTIONAL    --3269
}
```

Note that the *update* DE is an INTEGER (1 .. 65535). If an event ever reaches 65535, it shall *not* return to zero. Instead, the event must be ended, and a new event created with the same details but a new event ID number. This will ensure that later updates always have higher update numbers than earlier updates.

response-plan-id is an optional DE that is not currently implemented in CARS 3. It may be implemented in CARS 4. Any data received in this field in initial NW Passage data exchanges will be ignored.

Example 1.2: First draft representation of FEU XML for Frame 1.2

```
  <event-reference>
    <event-id>MNCARS-206</event-id>
    <update>1</update>
  </event-reference>
```

1.3   Project Reference

This data frame in FEU reports is generally used to provide information regarding construction and other related projects. This is not used in CARS 3 for traffic events and it will not be used in the initial CARS-TMC Data Exchange Interface. However, it may be implanted in CARS 4. If these data are available from other NW Passage states they can be sent so that they will become available for use in 2005/06. Or, it may be decided that this information does not need to cross state lines.

This data frame references one other data frame as follows:

project-contacts: contains contact details for the project or special event (Section 1.1.1).

```
ProjectReference ::= CHOICE
{
    project-reference        Event-project-reference,              --3807
    permit-reference         Event-planned-permit-reference,       --3379
    project-contacts         OrganizationInformation,
    project-description      Event-project-description             --3380
}
```

1.4 Event Indicator

This frame defines an event indicator in FEU reports:

```
EventIndicator ::= CHOICE
{
    category        Event-category,                    --3381
    status          Event-incident-status,             --3313
    priority        Event-description-priority-level    --3301
}
```

category is merely a mapping of the headline event type into an enumerated data element. It adds nothing that is not already conveyed elsewhere. This data frame is not currently proposed for use in NW Passage exchanges.

status is a data element that will clarify whether an event is updated, ended, canceled, etc. It must be used for status *"ended"* to signify the unexpected early ending of an event. The other status values are not currently proposed for use in NW Passage exchanges. When CARS receives the status *'ended'* it shall immediately set the end time of the event to the present time, so the event will be terminated.

priority applies to the whole event and not just to an event element (a change from ERM).

Example 1.4: First draft representation of FEU XML for Frame 1.4

```xml
<event-indicators>
  <status>ended</status>
  <priority>2</priority>
</event-indicators>
```

1.5 Other References

This data frame is not currently proposed for use in NW Passage exchanges. It contains data frames that are used in FEU as follows:

trip-reference: a pointer to a scheduled transit vehicle trip that is referenced by an event (TMDD 3952)
related-event: pointer to another event that can be viewed as part of a larger, compound event (Section 1.2)
responsible-event: a simultaneous or earlier event that can be regarded as the reason for this event

(Section 1.2)

previous-event: another event that must end before this event can start, e.g. in an evacuation sequence of a response plan (Section 1.2)

split-event: an earlier event that was split to form this event (Section 1.2)

merged-event: an earlier event that was merged to form this event (Section 1.2)

sibling-event: an event that was created by merging or splitting this event (Section 1.2)

associated-device: a field device such as a DMS or an RWIS, related to the event (Section 1.5.1)

associated-url: a URL at which additional information about the event can be found (e.g., photograph of the event or its impacts; orthophoto; maps of recommended detours).

```
OtherReference ::= CHOICE
{
    trip-reference          SCH-TripID,                              --3952
    related-event           EventReference,
    responsible-event       EventReference,
    previous-event          EventReference,
    split-event             EventReference,
    merged-event            EventReference,
    sibling-event           EventReference,
    associated-device       DeviceReference,
    associated-url          UrlReference
}
```

Northwest Passage states may decide to add some or all of these features to future data exchanges, but this data frame is not currently proposed for use.

1.5.1   Device Reference

This data frame is not currently proposed for use in NW Passage exchanges. It defines a device such as a DMS in an FEU report:

```
DeviceReference ::= SEQUENCE
{
    device-id               Device-identifier,                       --3701
    device-type             Device-type OPTIONAL                     --3747
}
```

1.5.2   URL Reference

This frame will not be used in the CARS-TMC Data Exchange Interface. For reference, this frame defines a URL in an FEU report:

```
UrlReference ::= SEQUENCE
{
    url                     Url,                                     -- new
    url-type                Url-type5 OPTIONAL                       -- new
```

---

[5]   Enumerated list: 1= still-image; 2 = video-image; 3 = 511-audio-file; 4 = HAR-audio-file; 5 = other-audio-file; 6 = map-of-suggested-detour; 7 = other-graphics-file.

}

1.6 Event Headline

This frame defines the headline (key phrase) in FEU reports. In the CARS-TMC Data Exchange Interface, this element must contain a phrase that defines the primary traffic condition that has resulted in the event being reported (e.g., accident).

The *headline element* allows any element within an FEU to be designated as the headline element. However, initially at least, the *headline-element* data element is not proposed for use in NW Passage exchanges.

This data frame uses one other frame, as follows:

headline: the key phrase within the event description (Section 1.6.1).

```
EventHeadline ::= SEQUENCE
{
    headline                    EventType,
    headline-element            Event-headline-element OPTIONAL          --3384
}
```

1.6.1 Event Type

In relation to CARS-TMC Data Exchange Interface use, many data elements within the *EventType* data frame provide eligible phrases for use in describing traffic and road construction.

```
EventType ::= CHOICE
{
    traffic-condition           Event-description-type-traffic-conditions,          --3817
    incident                    Event-description-type-incident,                    --3818
    closure                     Event-description-type-closure,                     --3819
    roadwork                    Event-description-type-roadwork,                    --3213
    obstruction                 Event-description-type-obstruction,                 --3822
    delay                       Event-description-type-delay-status-cancellation,   --3830
    unusual-driving             Event-description-type-unusual-driving,             --3831
    mobile-situation            Event-description-type-mobile-situation,            --3832
    device-status               Event-description-type-device-status,               --3833
    restriction                 Link-restriction-class,                             --3025
    response-status             Event-description-type-incident-response-status,    --3885
    disaster                    Event-description-type-disaster,                    --3880
    disturbance                 Event-description-type-disturbances,                --3884
    sporting-event              Event-description-type-sporting-events,             --3886
    special-event               Event-description-type-special-event,               --3214
    parking-information         Event-description-type-parking-information,         --3835
    system-information          Event-description-type-system-information,          --3836
    weather-condition           Event-description-type-weather-condition,           --3299
    precipitation               Event-description-type-precipitation,               --3825
    wind                        Event-description-type-wind,                        --3826
    visibility-air-quality      Event-description-type-visibility-air-quality,      --3827
```

```
    temperature               Event-description-type-temperature,              --3828
    pavement-condition        Event-description-type-pavement-condition,       --3298
    winter-driving-restriction Event-description-type-winter-driving-restrictions, --3888
    winter-driving-index      Event-description-type-winter-driving-index      --3823
}
```

Example 1.6: Draft representation of FEU XML for Frame 1.6

```
<headline>
  <pavement-conditions>surface-water-hazard</pavement-conditions>
</headline>
```

2.   Event Element Detail

Events can have one or more event elements. Simple events have only one element, while complex event descriptions are built up from multiple elements. For example, a roadwork causing delay typically has two elements: a roadwork element that lasts for weeks or months; and a delay element that lasts for minutes or hours. The full event update can be used to describe both complex and simple events.

Element-id is required if:

(1) this is a complex event with more than one concurrent event elements;
(2) this element is part of a schedule (to identify an element of a planned construction schedule).
(3) this element is part of a sequential forecast, presenting the situation as it is predicted to appear at various times into the future.

An element-id in a forecast is a reference to successive, forecast descriptions of the event as it is expected to develop through time. Higher forecast element identifiers describe the event as it is currently predicted to evolve in successively later time periods. For events with only one element, element-id shall equal "1" (the default value).

Event elements that refer to the same moment in time can be identified by their start times (for future elements) and end times or durations (which will define wholly or partly concurrent periods). Elements that refer to successive forecast situation descriptions have start and end times that define consecutive periods, or they have consecutive forecast times. It is also possible to have multiple event elements relating to time period "1", and multiple elements relating to time period "2", etc.

This data frame includes other data frames that are used as follows:

descriptions: what is happening in each event element (Section 2.1)
locations: where it is happening (Section 2.2)
times: when it is happening (Section 2.3)
lanes: optionally, one or more lanes affected (Section 2.4)
source: optionally, the original source of the event information (Section 2.5).

This frame defines an event element in FEU reports. It MUST be used at least once in all event reports except those with a status of *'ended'* or *'cancelled'*:

```
EventElementDetail ::= SEQUENCE
{
    element-id              Event-element-identifier DEFAULT 1,              --3378    confidence
                Event-description-confidence-level OPTIONAL,      --3300
    access                  Event-access-level DEFAULT 1,                    --3815
    descriptions            SEQUENCE OF ElementDescription,
    locations               SEQUENCE OF EventLocation,
    times                   EventTimes,
    lanes                   SEQUENCE OF EventLane OPTIONAL,
    source                  EventSource OPTIONAL
}
```

locations is a sequence of *EventLocation*, allowing one event to span multiple locations. Typically, this is used for multiple counties in road and weather condition reports. (Note however that a 'location' can mean either a single point or a stretch of roadway between two points.)

2.1   Element Description

This FEU frame determines how event descriptions are created in FEU messages. It includes the following data frames:

phrase: part of the description of the event element, using national ITS standard phrases. Each phrase conveys a single concept, e.g. Overturned truck (Section 1.6.1)
cause: a standard phrase that is judged to be the reason (or part of the reason) for the event, e.g. Stopped traffic due to roadwork (Section 1.6.1)
advice: additional information added to a event description for public safety or traveler information reasons,   e.g. Dense fog, keep your distance (Section 2.1.2)
qualifier: additional information added to an event description that further qualifies the description, e.g. Accident in the left lane (Section 2.1.3)
quantity: event elements can be quantified by one or more quantities (Section 2.1.4)
landmark: a named location other than that of the event, that forms part of an event description (Section 2.1.5)
detour: an alternative route, either suggested or required, e.g., Detour for traffic traveling towards New York (Section 2.1.6)
additional-text: additional description information can be added through free text for dissemination to end users (Section 2.1.7).

```
ElementDescription ::= CHOICE
{
    phrase                  EventType,
    cause                   EventType,
    advice                  EventAdvice,
    qualifier               EventQualifier,
    quantity                EventQuantity,
    landmark                Landmark,
    detour                  Detour,
```

```
    additional-text            AdditionalText
}
```

Quantities can be assigned to any point within a description. Likewise, advice, qualifiers, landmarks, free text, etc., can be used anywhere within a description.

Landmark names (that is, locations off the road network) within event descriptions were not in ERM and are not currently supported in CARS. Currently they cannot be used for data imports into CARS from other NW Passage states.

2.1.1 Event Type

These two instances of event type (in *phrase* and *cause*) are exactly the same as Frame 1.6.1.

2.1.2 Advice

This FEU frame determines how advice is added to descriptions in FEU messages.

```
EventAdvice ::= CHOICE
{
    suggestion          Event-description-advice-suggestion,          --3842
    warning             Event-description-advice-warning,             --3840
    recommendation       Event-description-advice-instruction-recommend,   --3843
    instruction         Event-description-advice-instruction-mandatory,    --3882
    alternative-route   Event-description-advice-alternate-route      --3814
}
```

2.1.3 Qualifier

This FEU frame determines how qualifiers are added to descriptions in FEU messages.

```
EventQualifier ::= CHOICE
{
    generic-qualifier    Event-description-type-qualifier-generic,          --3847
    generic-location     Event-description-type-location-generic,           --3846
    lane-roadway         Event-description-type-lane-roadway,               --3844
    transit-mode         Event-description-type-transit-mode,               --3879
    vehicles-affected    Event-description-type-vehicle-group-affected,     --3887
    travelers-affected   Event-description-type-traveler-group-affected,    --3851
    responders-affected  Event-description-type-responder-group-affected,   --3883
    response-equipment   Event-description-type-incident-response-equipment --3881
}
```

Example 2: Draft representation of FEU XML for Frame 2.1

```xml
<element-description>
  <phrase>
    <eventType>
      <visibility-air-quality>dense-fog</visibility-air-quality>
    </eventType>
```

```
        </phrase>
    </element-description>
```

2.1.4 Event Quantity

This FEU frame determines how quantities are added to descriptions in FEU messages. CARS currently supports most of these quantities (see below for details).

```
EventQuantity ::= CHOICE
{
    extent                  DataExtent,
    information             DataInformation,
    link-state              DataLinkState,
    incident-details        DataIncidentDetails,
    road-weather            DataRoadWeather,
    parking                 DataParking,
    surface-conditions      DataSurfaceConditions,
    link-restrictions       DataLinkRestrictions
}
```

All quantities must be converted to metric for conformance with data exchange standards.
It should also be noted that while the TMDD units within FEU use a version of metric units, they are not always logical units that field and data entry staff would use. Selection of appropriate GUI units (in both English and Metric systems) must be considered separately from units used in FEU exchanges.

Table 1 summarizes the conversion rules applicable to the units that are used in FEU. To calculate the value to be written in FEU, it is necessary to take the value in English units and insert it into the Condition Reporting System (CRS) variable of the conversion equation. The 'FEU' variable will equate to the quantity expressed in metric units. To convert data from metric units to English units, insert the value into the 'FEU' variable of the conversion equation and the 'CRS' value will provide the quantity in English units. A check for the conversion is also provided.

TABLE 1 Conversion for Quantities within FEU and CRS Systems

Quantity	TMDD / Metric Unit	CRS / English Unit	Conversion CRS to FEU	Conversion FEU to CRS	Conversion Check
Extent					
length-affected	Tenth of a kilometer	miles	FEU = CRS x 16.093	CRS = FEU / 16.093	1mi = 16.09344 1/10 of a km
proportion-affected	Percent	Percent	FEU = CRS	CRS = FEU	-
above-altitude	Tenth of a meter	Feet	FEU = CRS x 3.048	CRS = FEU / 3.048	1 ft = 3.048 1/10 of m
below-altitude	Tenth of a meter	Feet	FEU = CRS x 3.048	CRS = FEU / 3.048	1 ft = 3.048 1/10 of m
Quantity-range	Parts per thousand	Integer *	FEU = CRS	CRS = FEU	-
Data Information					
Frequency-am	Tenths of a kilohertz	hertz *** change to kHz.	FEU = CRS x 10	CRS = FEU x 0.1	1 kHz = 10 Tenths of kHz

Frequency-fm	Megahertz (x10)	hertz *** change to MHz	FEU = CRS x 0.1	CRS = FEU x 10	1 MHz = 0.1 Mhz x(10)
Phone-number	Str upto 32 char	Str upto 32 char	FEU = CRS	CRS = FEU	-
Channel-number	Identifier	channel *	FEU = CRS	CRS = FEU	-
Data Link State					
Delay	seconds	minutes	FEU = CRS x 60	CRS = FEU / 60	1 min = 60 sec
Headway	Seconds	integer *	FEU = CRS	CRS = FEU	-
Travel-time	Seconds	integer *	FEU = CRS	CRS = FEU	-
Capacity	vehicle/hour	Integer	n/a	n/a	-
Capacity-remaining	Percent	Percent	FEU = CRS	CRS = FEU	-
Travel-time-increase	Percent	Percent ****	FEU = CRS	CRS = FEU	-
Speed-average	km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.609344 km/h
Speed-vehicle-estimated	km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.609344 km/h
Data Incident Details					
Vehicles-involved	vehicles	Integer *	FEU = CRS	CRS = FEU	-
Cars involved	Vehicles (cars)	Integer *	FEU = CRS	CRS = FEU	-
Trucks-involved	Vehicles (trucks)	Integer *	FEU = CRS	CRS = FEU	-
Buses-involved	Vehicles (buses)	Integer *	FEU = CRS	CRS = FEU	-
fatalities	Fatalities	People	FEU = CRS	CRS = FEU	-
injuries	Injuries	People	FEU = CRS	CRS = FEU	-
Major-injuries	Persons	People	FEU = CRS	CRS = FEU	-
Minor-injuries	Persons	People	FEU = CRS	CRS = FEU	-
Data Road Weather					
Wind-direction	Degrees	Degrees	FEU = CRS	CRS = FEU	-
Wind-speed	Tenths of m/s	MPH	FEU = CRS x 4.47039	CRS = FEU / 4.47039	1 MPH = 4.4704 1/10 of m/s
Air-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32] / 0.18	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Dewpoint-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32] / 0.18	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Max-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32] / 0.18	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Min-temp	Tenths of deg Celsius	deg F	FEU = [(CRS-32] / 0.18	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Relative-humidity	percent	percent	FEU = CRS	CRS = FEU	-
Atmospheric pressure	Tenths of a milibar	Inches (of mercury)	FEU = CRS x 338.639	CRS = FEU / 338.639	1 inch of Hg = 338.639 1/10 of a mb
Precip-rate	tenths of grams per square meter per second (rain = 0.36 mm/hr)	Inches per hour	FEU = CRS x 9.144	CRS = FEU / 9.144	1 Inches/hr = 9.144 1/10 of g/m*m /second
Snowfall-accum-rate	10^7 meters per second (~0.36	Inches per hour	FEU = CRS x 9.144	CRS = FEU / 9.144	1 Inches/hr = 9.144 1/10 of gr/m2 /second

	mm/hr)				
Visibility	Tenths of meters	feet	FEU = CRS x 3.048	CRS = FEU / 3.048	1 feet = 3.048 1/10 of meters
uv-index	integer	integer	FEU = CRS	CRS = FEU	-
Probability	percent	percent	FEU = CRS	CRS = FEU	-
Data Parking					
Parking-spaces	Parking spaces	spaces	FEU = CRS	CRS = FEU	
Parking-occupancy	percent	vehicles	FEU = CRS	CRS = FEU	
Data Surface Conditions					
Water-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Adjacent-snow-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Roadway-snow-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Roadway-snow-pack-depth	centimeter	Inches	FEU = CRS x 2.54	CRS = FEU / 2.54	1 inch = 2.54 cm
Ice-thickness	millimeter	Inches	FEU = CRS x 25.4	CRS = FEU / 25.4	1 inch = 25.4 mm
Surface-temperature	Tenths of deg Celsius	deg F	FEU = [(CRS-32] * 5.555<u>5</u>	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Pavement-temperature	Tenths of deg Celsius	deg F	FEU = [(CRS-32] * 5.555<u>5</u>	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Surface-water-depth	millimeter	Inches	FEU = CRS x 25.4	CRS = FEU / 25.4	1 inch = 25.4 mm
Surface-salinity	parts per one hundred thousand	percent *	FEU = CRS	CRS = FEU	-
Surface-freeze-point	Tenths of deg Celsius	deg F	FEU = [(CRS-32] * 5.555<u>5</u>	CRS = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Mobile-friction	percent	percent	FEU = CRS	CRS = FEU	-
Data Link Restrictions					
Speed-limit-advisory	Km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.6093 km/h
Speed-limit	Km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.6093 km/h
Speed-limit-truck	Km/h	MPH	FEU = CRS x 1.6093	CRS = FEU / 1.6093	1 MPH = 1.6093 km/h
Restriction-length	centimeters	Feet	FEU = CRS x 30.48	CRS = FEU / 30.48	1 ft = 30.48 cm
Restriction-height	centimeters	Feet	FEU = CRS x 30.48	CRS = FEU / 30.48	1 ft = 30.48 cm
Restriction-width	centimeters	Feet	FEU = CRS x 30.48	CRS = FEU / 30.48	1 ft = 30.48 cm
Restriction-weight-vehicle	kilograms	Pounds	FEU = CRS x 0.4536	CRS = FEU / 0.4536	1 kg = 0.4536 lbs
Restriction-weight-axle	kilograms	Pounds	FEU = CRS x 0.4536	CRS = FEU / 0.4536	1 kg = 0.4536 lbs
Restriction-axle-count	axles	Axles	FEU = CRS	CRS = FEU	-

NOTES:

*   CRS units are internal default assigned units. CRS units should be considered same as FEU units. No conversion needed.

** CRS to input wind direction as a bearing in degrees. CRS units would then be same as FEU units. No conversion needed.

2.1.4.1 Extent

The FEU (metric) definition is:

```
DataExtent ::= CHOICE
{
    length-affected          Event-length-affected,                          --3856
    proportion-affected      Event-proportion-affected,                      --3857
    above-altitude           Event-location-coordinates-above-altitude,      --3858
    below-altitude           Event-location-coordinates-below-altitude,      --3859
    quantity-range           Event-quantity-range                            --3276
}
```

2.1.4.2 Data Information

The FEU definition is:

```
DataInformation ::= CHOICE
{
    frequency-am             Event-frequency-am,                             --3873
    frequency-fm             Event-frequency-fm,                             --3874
    phone-number             Contact-phone-number,                          --3207
    channel-number           Event-broadcast-channel-number                 --3876
}
```

2.1.4.3 Data Link State

The FEU definition is:

```
DataLinkState ::= CHOICE
{
    delay                    Link-delay,                                     --3005
    alternate-route-delay    Link-alternate-route-delay,                     --3894
    headway                  Link-headway,                                   --3892
    travel-time              Link-travel-time,                               --3038
    capacity                 Link-capacity,                                  --3003
    capacity-remaining       Link-capacity-existing,                         --3864
    travel-time-increase     Link-travel-time-increase,                      --3861
    speed-average            Link-speed-average,                             --3033
    speed-vehicle-estimated  Event-speed-vehicle-estimated,                  --3862
    description-time         Event-description-time,                         --3895
    density                  Link-density,                                   --3006
    occupancy                Link-occupancy,                                 --3020
    volume                   Link-volume                                     --3040
}
```

The grayed-out quantities are not proposed initially for NW Passage data exchanges.

2.1.4.4 Data Incident Details

The FEU definition is:

DataIncidentDetails ::= CHOICE

{

vehicles-involved	Event-incident-vehicles-involved-count,	--3318
cars-involved	Event-incident-cars-involved-count,	--3890
trucks-involved	Event-incident-trucks-involved-count,	--3891
buses-involved	Event-incident-buses-involved-count,	--3889
fatalities	Event-incident-human-fatalities-count,	--3303
injuries	Event-incident-human-injuries-count,	--3304
major-injuries	Event-incident-human-major-injuries-count,	--3865
minor-injuries	Event-incident-human-minor-injuries-count	--3866

}

2.1.4.5 Data Road Weather

The FEU definition is:

DataRoadWeather ::= CHOICE

{

wind-direction	EssAvgWindDirection,	--3910
wind-speed	EssAvgWindSpeed,	--3911
wind-gust-speed	EssMaxWindGustSpeed, -- see NTCIP ESS section 3.6.6	
air-temp	EssAirTemperature,	--3908
dewpoint-temp	EssDewpointTemp,	--3912
max-temp	EssMaxTemp,	--3914
min-temp	EssMinTemp,	--3915
relative-humidity	EssRelativeHumidity,	--3922
atmospheric-pressure	EssAtmosphericPressure,	--3909
precip-rate	EssPrecipRate,	--3920
snowfall-accum-rate	EssSnowfallAccumRate,	--3925
visibility	EssVisibility,	--3932
uv-index	Ess-uv-index,	
probability	Ess-probability	

}

2.1.4.6 Data Parking

The FEU definition is:

DataParking ::= CHOICE

{

parking-spaces	Event-parking-number-of-spaces,	--3871
parking-occupancy	Event-parking-occupancy	--3872

}

2.1.4.7 Data Surface Conditions

The FEU definition is:

```
DataSurfaceConditions ::= CHOICE
{
    water-depth              EssWaterDepth,                --3934
    adjacent-snow-depth      EssAdjacentSnowDepth,         --3907
    roadway-snow-depth       EssRoadwaySnowDepth,          --3923
    roadway-snow-pack-depth EssRoadwaySnowPackDepth,       --3924
    ice-thickness            EssIceThickness,              --3913
    surface-temperature      EssSurfaceTemperature,        --3930
    pavement-temperature     EssPavementTemperature,       --3917
    surface-water-depth      EssSurfaceWaterDepth,         --3931
    surface-salinity         EssSurfaceSalinity,           --3928
    surface-freeze-point     EssSurfaceFreezePoint,        --3927
    mobile-friction          EssMobileFriction             --3916
}
```

2.1.4.8 Data Link Restrictions

The FEU definition is:

```
DataLinkRestrictions ::= CHOICE
{
    speed-limit-advisory      Link-speed-limit-advisory,         --3863
    speed-limit               Link-speed-limit,                  --3034
    speed-limit-truck         Link-speed-limit-truck,            --3035
    restriction-length        Link-restriction-length,           --3027
    restriction-height        Link-restriction-height,           --3026
    restriction-width         Link-restriction-width,            --3029
    restriction-weight-vehicle Link-restriction-weight-vehicle,  --3028
    restriction-weight-axle   Link-restriction-weight-axle,      --3870
    restriction-axle-count    Link-restriction-axle-count        --3024
}
```

2.1.5 Landmark

This data frame references two other data frames, as follows:

Geolocation: a latitude and longitude representative of the landmark (Section 2.1.5.1)
Upward area reference: a pointer to an area location that contains the landmark
(Section 2.2.1).

The landmark data frame is not proposed initially for use in NW Passage data exchanges..

```
Landmark ::= SEQUENCE
{
    landmark-type            Event-location-landmark-type,       --3245
    landmark-name            Event-landmark-name,                --3394
    landmark-point-name      Event-landmark-point-name OPTIONAL, --3395
    location-rank            Event-location-rank OPTIONAL,       --3389
```

```
    geo-location                    GeoLocation OPTIONAL,
    upward-area-reference           AreaLocation OPTIONAL
}
```

2.1.5.1   Geolocation

For consistency with LRMS (Location Referencing Standards), the FEU defines a frame *Geolocation* as follows:

```
GeoLocation ::= SEQUENCE
{
    latitude                   Event-location-coordinates-latitude,        --3226
    longitude                  Event-location-coordinates-longitude,       --3227
    datum                      HorizontalDatum OPTIONAL,                    --3937
}
```

The datum data frame is not proposed initially for use in NW Passage data exchanges.

2.1.5.2   Area Location

See Section 2.2.1 below.

2.1.6   Detour

This data frame references two other data frames, as follows:

Landmark: a latitude and longitude representative of the landmark (Section 2.1.5)
Location-on-detour: a roadway location along the detour (Section 2.2.2).

The detour data frame is not proposed initially for use in NW Passage data exchanges. For reference, the FEU handles detours as follows:

```
Detour ::= SEQUENCE
{
    detour-type              Event-alternate-route-type,              --3218
    destination              Landmark OPTIONAL,
    location-on-detour       SEQUENCE OF LinkLocation OPTIONAL
}
```

2.1.6.1   Link Location: See Section 2.2.2.

2.1.7   Additional Text

This data frame shall be used in CARS-TMC Data Exchange Interface to carry free text information that amplifies the coded phrases / quantities in the FEU. The default language is English:

```
AdditionalText ::= SEQUENCE
{
    description                Event-description,                       --3209
```

```
    language              Event-description-language OPTIONAL          --3816
}
```

2.2   Event Location

This data frame references other data frames as follows:

area-location: an area such as a county (Section 2.2.1)
location-on-link: a point on a transportation route, or a defined stretch of a route. Stretches of route are dynamically-defined segments of named or numbered roads bounded by primary and secondary locations. Point events on links occur at a single, primary location (Section 2.2.2)
landmark: a reference to a landmark, e.g. a sports arena (Section 2.1.5). This data frame is not proposed initially for use in NW Passage data exchanges.
geo-location: an event location known only by its GPS coordinates. This location type is ONLY allowed for event exchanges where no other information is available. It shall not be used for event exchanges between other systems or centers (Section 2.1.5.1). This data frame is not proposed initially for use in NW Passage data exchanges.

The FEU defines Event Location as follows:

```
EventLocation ::= CHOICE
{
    area-location            AreaLocation,
    location-on-link         LinkLocation,
    landmark                 Landmark,
    geo-location             GeoLocation
}
```

The GeoLocation event location is intended for GPS reporting (e.g. OnStar reports or ferry tracking), where nothing is known except event coordinates. It shall not be used for NW Passage event imports into CARS, which must use *area* or *location on link*.

2.2.1   Area Location

This data frame includes one other (upward area reference) that allows an area to be specified as a subset of a larger area. For example, a county can be specified as a subset of a named region (a collection of counties) within a state. The upward area reference is a pointer to a larger area that contains the area location.

The FEU defines area locations as follows:

```
AreaLocation ::= SEQUENCE
{
    area-id                  Event-location-area-identifier,          --3809
    area-name                Event-area-name OPTIONAL,                --3388
    location-rank            Event-location-rank OPTIONAL,            --3389
    upward-area-reference    AreaLocation OPTIONAL
}
```

In the FEU, area locations may include the area name and other attributes formerly found only in the location database, as well as the area identifier (e.g. FIPS code). The additional information is not proposed initially for use in NW Passage data exchanges. Eventually, the additional attributes may be sent to other systems which may require them.

The *area-id* data element is a set of 2 to 7 numbers which form the FIPS code to uniquely identify all areas within the United States. The FIPS code is generally formed using a 2-digit code to identify the state. Counties are referenced by appending the 2-digit state code to a 3-digit county code, where 000 may be used to indicate a statewide event. Cities are referenced by appending the 2-digit state code to a 5-digit city code.

2.2.2 Link Location

This data frame references two other data frames, as follows:

Point on link: a point location on a roadway (Section 2.2.2.1)
Link-location: a roadway location specified in terms of an alternative route designator (Section 2.2.2). This addresses routes that have multiple designators and mile points, e.g., I-35 and I-80 around Des Moines, IA. This data frame is not proposed initially for use in NW Passage data exchanges.

In FEU, a link location can include the alignment (N, E, S, W) of the positive direction, an alternative route designator, and a link ID. Currently these data are not used in CARS, which *requires direction to be positive, negative, both-directions or non-directional* (relative to the direction of increasing mile points).

```
LinkLocation ::= SEQUENCE
{
    link-ownership          Link-ownership,                                --3021
    route-designator        Link-route-designator,                         --3030
    link-id                 Link-identifier OPTIONAL,                       --3012
    primary-location        PointOnLink,
    secondary-location      PointOnLink OPTIONAL,
    link-direction          Link-direction,                                --3008
    link-alignment          Link-alignment OPTIONAL,                        --3391
    linear-reference-version Link-location-linear-reference-version OPTIONAL, --3854
    alternative-designation LinkLocation OPTIONAL
}
```

2.2.2.1 Point on Link

This data frame references two other data frames, as follows:

Geolocation: the latitude and longitude of the point (Section 2.1.5.1)
Upward area reference: a pointer to an area location that contains the roadway point (Section 2.2.1). This data frame is not proposed initially for use in NW Passage data exchanges.

In FEU, points on links used to mark the primary and secondary locations are defined using geolocation (required) and linear reference (optional). In the future, additional information can also be carried that will describe other attributes of the roadway point. These grayed out data fields are not currently exchanged in CARS deployments (being already stored in the location tables):

```
PointOnLink ::= SEQUENCE
{
    geo-location              GeoLocation,
    linear-reference          Link-location-linear-reference OPTIONAL,        --3855
    link-name                 Event-location-roadway-name OPTIONAL,           --3260
    point-name                Event-point-name OPTIONAL,                      --3392
    cross-street-designator   SEQUENCE OF
                                  Event-location-cross-street-begin-identifier OPTIONAL, --3231
    cross-street-name         SEQUENCE OF
                                  Event-location-cross-street-begin-name OPTIONAL,    --3229
    signed-destination        SEQUENCE OF Event-signed-destination OPTIONAL,
                                                                              --3393
    location-rank             Event-location-rank OPTIONAL,                   --3389
    landmark-type             Event-location-landmark-type OPTIONAL,          --3245
    upward-area-reference     AreaLocation OPTIONAL
}
```

2.3 Event Times

This data frame references several other data frames, as follows:

update-time: the date/time/zone when the event element was validated, i.e. actually observed or calculated, or otherwise confirmed to be correct (Section 1.1.2).

valid-period: the time period during which the event element is valid (Section 2.3.1)

sequence-time: optionally, the date/time/zone for which a forecast has been made, in a predicted event element (Section 1.1.2).

start time: the date/time/zone when an event element is expected to start, or is said to have started. Events without a start time are effective immediately (Section 1.1.2).

alternate start time: an alternative date/time/zone when an event element will start, in the event of postponement (Section 1.1.2). This data frame is not proposed initially for use in NW Passage data exchanges.

alternate end time: an alternative date/time/zone when an event element will end, in the event of postponement (Section 1.1.2). This data frame is not proposed initially for use in NW Passage data exchanges.

recurrent times: time periods during which an event element may recur (Section 2.3.2).

The FEU contains two new elements (*alternate-start-time, alternate-end-time*), which are not planned for inclusion in CARS 3 or 4 at this time. If they are received they will not be used. If the planned start and end time of an event are changed, the new start and end times must be sent in an update message as soon as they become known.

```
EventTimes ::= SEQUENCE
{
    update-time               DateTimeZone,
```

```
    valid-period              ValidPeriod,
    sequence-time             DateTimeZone OPTIONAL,
    start-time                DateTimeZone OPTIONAL,
    alternate-start-time      DateTimeZone OPTIONAL,
    alternate-end-time        DateTimeZone OPTIONAL,
    recurrent-times           SEQUENCE OF RecurrentTime OPTIONAL
}
```

All times are expressed as local times at the primary location of the event. UTC offsets are not required for presenting times to users, as all times will be presented in terms of local time (i.e., exactly as they are exchanged). However, UTC offsets are required for use in message management in the receiving system, and must be valid for the date and time specified in the event time. For example, in the Washington State, any message time stamp that refers to the summer daylight savings period is required to have an offset of -0700 (Pacific Daylight Time).

2.3.1 Valid Period

This data frame references two other data frames, as follows:

end-time: the date/time/zone when the event element is expected to end. At this time the event element shall be deleted or archived, unless the valid period is updated before that time/date (Section 1.1.2).
duration: the expected duration of the event element, starting from the update-time. After this period the event element shall be deleted or archived, unless the valid period is updated before the duration has expired (TMDD 3279).
effective-period: one or more named periods within which the event element applies, e.g. Sunday afternoon. These are often used for weather forecast situations (Section 2.3.2.1).

The FEU definition is:

```
ValidPeriod ::= CHOICE
{
    end-time              DateTimeZone,
    duration              Event-timeline-estimated-duration,              --3279
    effective-periods     SEQUENCE OF EventPeriod
}
```

Note that durations are always measured from the latest *update time.* If an event's duration crosses over a change to or from daylight saving time, the duration should retain its specified value. For example, an event occurs in a state with daylight saving time at midnight on 10/30/2004, having a duration of four hours, will end four hours later, at 3 AM on 10/31/2004—not at 4 AM, as would be the case on any other night.

2.3.2 Recurrent Time

This data frame references one other data frame, as follows:

recurrent-period: one or more named periods within which the event element reoccurs, e.g. Sunday afternoon. These are often used for weather forecast situations (Section 2.3.2.1).

The FEU definition has:

```
RecurrentTime ::= SEQUENCE
{
    recurrent-period        EventPeriod,
    schedule-times          SEQUENCE OF
                                Event-timeline-schedule-times OPTIONAL,      --3280
    utc-offset              Time-utc-offset OPTIONAL                         --3376
}
```

As for all event times, *recurrent times* are expressed in local time for the event's primary location. When daylight saving time begins or ends, *recurrent times* expressed in local time remain unchanged.

2.3.2.1   Event Period

```
EventPeriod ::= SEQUENCE
{
    days-of-the-week        Event-timeline-schedule-days-of-the-week,       --3282
    effective-period-qualifier  Event-effective-period-qualifier DEFAULT 1, --3813
    holiday                 Event-holiday-day OPTIONAL                      --3396
}
```

In FEU, an effective period qualifier is a named period within which the situation element applies (e.g., morning, afternoon, evening). Currently, some of these data elements are not used in CARS ("morning peak," "afternoon peak," and "middayperiods"), but support for them may be added at a later date. Until then, those data elements will be treated as "not specified."

2.4   Event Lane

This data frame adds the capability to indicate lane effects in both directions, on ramps, or on parallel roadways, etc.

```
EventLane ::= SEQUENCE
{
    lanes-type              Event-lanes-type DEFAULT 1,                     --3382
    link-direction          Link-direction OPTIONAL,                        --3008
    lanes-total-original    Event-lanes-total-lanes OPTIONAL,               --3221
    lanes-total-affected    Event-lanes-total-affected OPTIONAL,            --3383
    event-lanes-affected    SEQUENCE OF Event-lanes-affected OPTIONAL   --3219
}
```

2.5   Event Source

This data frame references one other data frame, as follows:

source: the organization originally reporting the event (Section 1.1.1).

This frame defines an event source in FEU reports:

```
EventSource ::= SEQUENCE
{
    source                  OrganizationInformation OPTIONAL,
    detection-method        Event-detection-method OPTIONAL          --3302
}
```

2.5.1 Organization Information

This frame will carry source organization identifier and name in FEU reports:

```
OrganizationInformation::= SEQUENCE
{
    organization-id         Organization-identifier,                 --3343
    organization-name       Organization-name OPTIONAL,              --3344
    organization-location   Organization-location OPTIONAL,          --3104
    organization-function   Organization-function OPTIONAL,          --3354
    center-id               Organization-center-identifier OPTIONAL, --3217
    center-name             Organization-center-name OPTIONAL,       --3355
    last-update-time        DateTimeZone OPTIONAL,
    contact-details         ContactDetails OPTIONAL
}
```

Use of the data frame *ContactDetails* may be needed to carry the *source contact person name.*

2.5.1.1 Contact Details

This frame will be used to carry a *'contact identifier'* and *'person-name"* in FEU source reports. All the other elements will not be used in CARS 3 at this time.

```
ContactDetails ::= SEQUENCE
{
    contact-id          Contact-identifier,                      --3105
    person-name         Contact-person-name OPTIONAL,            --3206
    person-title        Contact-person-title OPTIONAL,           --3349
    organization-id     Organization-identifier OPTIONAL,        --3343
    organization-name   Organization-name OPTIONAL,              --3344
    phone-number        Contact-phone-number OPTIONAL,           --3207
    phone-alternate     Contact-phone-alternate OPTIONAL,        --3113
    mobile-number       Contact-mobile-phone-number OPTIONAL,    --3350
    fax-number          Contact-phone-fax OPTIONAL,              --3205
    pager-id            Contact-pager-identifier OPTIONAL,       --3346
    pager-number        Contact-pager-number OPTIONAL,           --3347
    email-address       Contact-email-address OPTIONAL,          --3204
    radio-unit          Contact-radio-unit-identifier OPTIONAL,  --3208
    address-line1       Contact-mailing-address-line1 OPTIONAL,  --3339
    address-line2       Contact-mailing-address-line2 OPTIONAL,  --3340
    city                Contact-mailing-address-city OPTIONAL,   --3338
    state               Contact-mailing-address-state OPTIONAL,  --3341
    zip-code            Contact-mailing-address-zip OPTIONAL,    --3342
```

```
    country                  Contact-mailing-address-country OPTIONAL,        --3373
}
```

Where this frame occurs in *source/organization-id* (Frame 2.5.1) it is required to carry *contact-person-name*. However, FEU also requires a source contact-id to be sent. Other lines above are currently unused in CARS. Any incoming data in these fields will be dropped. No outgoing data will use these fields.

The implication of the source/organization-id in FEU is that source would be introduced as the login-name in an automated system.

Example 2.5: First draft representation of FEU XML for Frame 2.5

```xml
<event-source>
 <source>
   <organization-information>
     <organization-id>Mn DPS</organization-id>
     <organization-name>MN State Patrol</organization-name>
     <contact-details>
        <contact-id>CapnLQ</contact-id>
        <person-name>Captain Lindquist</person-name>
     </contact-details>
     <event-detection-method>police-patrol</event-detection-method>
   </source>
 </event-source>
```

2.6   Event Comments

The FEU definition is:

```
EventComments ::= SEQUENCE
{
    notes-and-comments       Event-description-notes-and-comments,         --3210
    language                 Event-description-language OPTIONAL           --3816
}
```

2.7   Full Report Text

This data frame is not expected to be used in CARS-TMC Data Exchange Interface. However, for reference the FEU has a frame:

```
FullReportText ::= SEQUENCE
{
    report-medium            Event-report-medium,                          --3385
    description              Event-description,                            --3209
    language                 Event-description-language OPTIONAL           --3816
}
```

Appendix B

SOAP Transactions

SOAP Transactions

All data transferred between the sending centers and the CARS TMC Data Input Interface should ideally use SOAP Document/Literal messaging over a TCP/IP connection. The SOAP message payloads will consist of string lists and Extensible Markup Language (XML)-formatted messages. This appendix provides additional details about such transactions.

B1 SOAP Background Information

SOAP provides a standardized way to structure and send XML messages. It offers agreed-upon conventions for defining the types of information that shall be exchanged, the expression of the information in XML, and the delivery of the information from one system to another. Specifically:

- SOAP can be transmitted over a variety of transmission protocols (HTTP, FTP, etc.)
- SOAP defines a "wrapper" around the XML that is sent from one system to another, which ensures that the XML is received and interpreted properly by the receiving system. The wrapper consists both of standardized SOAP XML, as well as information specific to the selected transmission protocol (e.g., HTTP, FTP, etc).
- SOAP also defines what shall occur when the receiving system cannot handle the request. In that case, the SOAP server sends a "SOAP fault" back to the caller, which must handle it appropriately.
- There are two main forms of SOAP transmission: RPC/encoded and document/literal. The CARS TMC Data Input Interface shall use document/literal, as it allows for the delivery of XML data that is already in a known format (FEU).

B2 CARS TMC Data Input Transactions

The primary SOAP-based CARS TMC Data Input exchange is outlined in the following steps. Note that CARS is the SOAP Server in this data exchange and the sending system is the SOAP Client.

Step 1: After the two agencies agree to begin the data exchange, the SOAP Server (e.g., CARS) and Client (IRIS) applications are initiated.

Step 2: Whenever it is time to notify subscribers (e.g., CARS) of updates, the SOAP Client sends a SOAP Message to the CARS SOAP Server.

Step 3: The CARS SOAP Server transfers control to a SOAP Action Handler to handle the periodic or event-driven updates that it receives from the sending system.

Step 4: The CARS SOAP Action Handler finishes processing the message.

Step 5: The sending SOAP Client is notified of completion or an error is returned.

Note that the communication between Clients and Servers over HTTP is connectionless.

B3 Authorization, Authentication, and Encryption

The CARS-TMC Data Exchange interface implemented for the Stage 1 integration currently performs no authentication of the clients that connect to it. The server will assume that any SOAP client that is able to send it a correctly formatted FEU message to the appropriate port, on the appropriate IP

address, is a legitimate client. Thus, security in the current system relies only on the ability of authorized clients to connect to the service. This security model can be ensured to some degree by, for instance, setting a firewall to allow only certain trusted IP addresses to connect to the CARS-TMC Data Import server. Still, this system is potentially vulnerable to a packet sent from a "spoofed" IP address.

The following steps propose a more comprehensive security setup for the CARS-TMC server:

- Include the CARS login and password in the sent packet rather than relying on values supplied in a configuration file.
- Encrypt the connection between the sender and the CARS-TMC server (e.g., do not allow anyone "sniffing" network packets to see any of the data being sent in clear text, including the username/passwords)
- Authenticate the connection between the sender and the CARS-TMC server (e.g., ensure that the sender is genuinely authorized to connect to the server, and that their "from" address is not forged.)

The following technical implementations are suggested in order to accomplish those security functions:

- The sender (SOAP Client) shall generate a client-side SSL certificate.
- The sender shall send that certificate to the receiving system (e.g., SOAP Server or CARS) to install on its server.
- The sender shall connect to the server using the encrypted HTTPS protocol instead of the normal HTTP protocol, as it does now. Also, the sender shall pass the certificate to verify its identity, using the standard HTTPS mechanism for doing so.
- The sender shall include a CARS login and password as part of the SOAP header for the message sent.
- The CARS-TMC Data Input server shall be modified to pass the login and password that were specified as part of the SOAP header into CARS.

The following is an example of the proposed SOAP header:
(copied from an example at http://www.developer.com/net/net/article.php/2192901):

```
<soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/
envelope/">
  <soap:Header>
    <AuthHeader xmlns="http://tempuri.org/">
      <UserName>jeff</UserName>
      <Password>imbatman</Password>
    </AuthHeader>
  </soap:Header>
  <soap:Body>
    <GetQuote xmlns="http://tempuri.org/">
      <symbol>msft</symbol>
    </GetQuote>
  </soap:Body>
</soap:Envelope>
```

Appendix C

SOAP WSDL

SOAP WSDL

```xml
<?xml version="1.0" encoding="UTF-8"?>

<definitions name="FEUDefinitions"
    targetNamespace="http://www.crc-corp.com/wsdl/2004-10-01/feu"
    xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
    xmlns:tns="http://www.crc-corp.com/wsdl/2004-10-01/feu"
    xmlns:feu="http://www.dummy-temp-address"
    xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
    xmlns:xs="http://www.w3.org/2001/XMLSchema"
    xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
    xmlns="http://schemas.xmlsoap.org/wsdl/">


    <wsdl:types>
        <xs:schema targetNamespace="http://www.dummy-temp-address">
            <xs:complexType name="FullEventUpdate">
                <xs:sequence>
                    <xs:any minOccurs="0" maxOccurs="unbounded"/>
                </xs:sequence>
            </xs:complexType>
        </xs:schema>
    </wsdl:types>


    <documentation>
    This is the definition for the FEU service.
    This service accepts messages in Full-Event-Update format from an
external
    source, and forwards them on to a CARS instance.
    This service does minimal parsing of its own -- it relies on CARS
to do parsing of FEU.
    </documentation>


    <message name="FEUEvent">
        <part name="full-event-update" type="feu:FullEventUpdate"/>
    </message>


    <message name="FEUResponse">
        <part name="return" type="xs:string"/>
    </message>


    <portType name="FEUPortType">
        <documentation>FEU Port Type</documentation>
        <operation name="acceptFEUEvent" parameterOrder="full-event-
update">
            <input message="tns:FEUEvent"/>
            <output message="tns:FEUResponse"/>
        </operation>
```

```
        </portType>

    <binding name="FEUSoapBinding" type="tns:FEUPortType">
        <documentation>FEU Soap Binding</documentation>
        <soap:binding style="document"
transport="http://schemas.xmlsoap.org/soap/http"/>
        <operation name="acceptFEUEvent">
            <soap:operation soapAction="acceptFEUEventAction"/>
            <input>
                <soap:body namespace="http://www.crc-corp.com/wsdl/2004-
10-01/feu" use="literal"/>
            </input>
            <output>
                <soap:body namespace="http://www.crc-corp.com/wsdl/2004-
10-01/feu" use="literal"/>
            </output>
        </operation>
    </binding>

    <service name="FEUService">
        <documentation>FEU Web Service</documentation>
        <port name="FEUPort" binding="tns:FEUSoapBinding">
            <!--<soap:address
location="http://67.106.3.233:8080/axis/services/FEUPort"/>-->
            <soap:address
location="http://localhost:8080/axis/services/FEUPort"/>
        </port>
    </service>
</definitions>
```

Appendix D

XML Schema Definition for Event Types Defined in the ICD

XML Schema Definition for Event Types Defined in the ICD

```xml
<!--Element Event-description-type-traffic-conditions FADD_ID=3817-->
    <xs:simpleType name="Event-description-type-traffic-conditions">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value=""/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
<!--Element Event-description-type-incident FADD_ID=3818-->
    <xs:simpleType name="Event-description-type-incident">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="accident"/>
                    <xs:enumeration value="serious-accident"/>
                    <xs:enumeration value="injury-accident"/>
                    <xs:enumeration value="minor-accident"/>
                    <xs:enumeration value="multi-vehicle-accident"/>
                    <xs:enumeration value="numerous-accidents"/>
                    <xs:enumeration value="accident-involving-a-bicycle"/>
                    <xs:enumeration value="accident-involving-a-bus"/>
                    <xs:enumeration value="accident-involving-a-motorcycle"/>
                    <xs:enumeration value="accident-involving-a-pedestrian"/>
                    <xs:enumeration value="accident-involving-a-train"/>
                    <xs:enumeration value="accident-involving-a-truck"/>
                    <xs:enumeration value="accident-involving-hazardous-materials"/>
                    <xs:enumeration value="earlier-accident"/>
                    <xs:enumeration value="medical-emergency"/>
                    <xs:enumeration value="secondary-accident"/>
                    <xs:enumeration value="rescue-and-recovery-work-in-progress"/>
                    <xs:enumeration value="accident-investigation-work"/>
                    <xs:enumeration value="incident"/>
                    <xs:enumeration value="stalled-vehicle"/>
                    <xs:enumeration value="abandoned-vehicle"/>
                    <xs:enumeration value="disabled-vehicle"/>
                    <xs:enumeration value="disabled-truck"/>
                    <xs:enumeration value="disabled-semi-trailer"/>
                    <xs:enumeration value="disabled-bus"/>
                    <xs:enumeration value="disabled-train"/>
                    <xs:enumeration value="vehicle-spun-out"/>
                    <xs:enumeration value="vehicle-on-fire"/>
                    <xs:enumeration value="vehicle-in-water"/>
                    <xs:enumeration value="vehicles-slowing-to-look-at-accident"/>
                    <xs:enumeration value="jackknifed-semi-trailer"/>
                    <xs:enumeration value="jackknifed-trailer-home"/>
                    <xs:enumeration value="jackknifed-trailer"/>
                    <xs:enumeration value="spillage-occurring-from-moving-vehicle"/>
                    <xs:enumeration value="acid-spill"/>
                    <xs:enumeration value="chemical-spill"/>
                    <xs:enumeration value="fuel-spill"/>
```

```xml
                        <xs:enumeration value="hazardous-materials-spill"/>
                        <xs:enumeration value="oil-spill"/>
                        <xs:enumeration value="spilled-load"/>
                        <xs:enumeration value="toxic-spill"/>
                        <xs:enumeration value="overturned-vehicle"/>
                        <xs:enumeration value="overturned-truck"/>
                        <xs:enumeration value="overturned-semi-trailer"/>
                        <xs:enumeration value="overturned-bus"/>
                        <xs:enumeration value="derailed-train"/>
                        <xs:enumeration value="stuck-vehicle"/>
                        <xs:enumeration value="truck-stuck-under-bridge"/>
                        <xs:enumeration value="bus-stuck-under-bridge"/>
                        <xs:enumeration value="accident-cleared"/>
                        <xs:enumeration value="incident-cleared"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:union>
        </xs:simpleType>
        <!--Element Event-description-type-closure FADD_ID=3819-->
        <xs:simpleType name="Event-description-type-closure">
            <xs:union>
                <xs:simpleType>
                    <xs:restriction base="xs:integer">
                        <xs:maxInclusive value="256"/>
                        <xs:minInclusive value="1"/>
                    </xs:restriction>
                </xs:simpleType>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="closed-to-traffic"/>
                        <xs:enumeration value="closed"/>
                        <xs:enumeration value="closed-ahead"/>
                        <xs:enumeration value="closed-intermittently"/>
                        <xs:enumeration value="closed-for-repairs"/>
                        <xs:enumeration value="closed-for-the-season"/>
                        <xs:enumeration value="blocked"/>
                        <xs:enumeration value="blocked-ahead"/>
                        <xs:enumeration value="reduced-to-one-lane"/>
                        <xs:enumeration value="reduced-to-two-lanes"/>
                        <xs:enumeration value="reduced-to-three-lanes"/>
                        <xs:enumeration value="collapse"/>
                        <xs:enumeration value="out"/>
                        <xs:enumeration value="open-to-traffic"/>
                        <xs:enumeration value="open"/>
                        <xs:enumeration value="reopened-to-traffic"/>
                        <xs:enumeration value="clearing"/>
                        <xs:enumeration value="cleared"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:union>
        </xs:simpleType>
        <!--Element Event-description-type-roadwork FADD_ID=3213-->
        <xs:simpleType name="Event-description-type-roadwork">
            <xs:union>
                <xs:simpleType>
                    <xs:restriction base="xs:integer">
                        <xs:maxInclusive value="256"/>
                        <xs:minInclusive value="1"/>
                    </xs:restriction>
                </xs:simpleType>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="road-construction"/>
                        <xs:enumeration value="major-road-construction"/>
                        <xs:enumeration value="long-term-road-construction"/>
                        <xs:enumeration value="construction-work"/>
                        <xs:enumeration value="paving-operations"/>
```

```xml
                <xs:enumeration value="work-in-the-median"/>
                <xs:enumeration value="road-reconstruction"/>
                <xs:enumeration value="opposing-traffic"/>
                <xs:enumeration value="narrow-lanes"/>
                <xs:enumeration value="construction-traffic-merging"/>
                <xs:enumeration value="single-line-traffic-alternating-directions"/>
                <xs:enumeration value="road-maintenance-operations"/>
                <xs:enumeration value="road-marking-operations"/>
                <xs:enumeration value="bridge-maintenance-operations"/>
                <xs:enumeration value="bridge-construction"/>
                <xs:enumeration value="bridge-demolition-work"/>
                <xs:enumeration value="blasting"/>
                <xs:enumeration value="avalanche-control-activities"/>
                <xs:enumeration value="water-main-work"/>
                <xs:enumeration value="gas-main-work"/>
                <xs:enumeration value="work-on-underground-cables"/>
                <xs:enumeration value="work-on-underground-services"/>
                <xs:enumeration value="new-road-construction-layout"/>
                <xs:enumeration value="new-road-layout"/>
                <xs:enumeration value="temporary-lane-markings"/>
                <xs:enumeration value="temporary-traffic-lights"/>
                <xs:enumeration value="emergency-maintenance"/>
                <xs:enumeration value="road-maintenance-cleared"/>
                <xs:enumeration value="normal-road-layout-restored"/>
                <xs:enumeration value="road-work-clearance-in-progress"/>
                <xs:enumeration value="road-construction-cleared"/>
                <xs:enumeration value="normal-traffic-lanes-restored"/>
                <xs:enumeration value="road-work-cleared"/>
            </xs:restriction>
        </xs:simpleType>
    </xs:union>
</xs:simpleType>
<!--Element Event-description-type-obstruction FADD_ID=3822-->
<xs:simpleType name="Event-description-type-obstruction">
    <xs:union>
        <xs:simpleType>
            <xs:restriction base="xs:integer">
                <xs:maxInclusive value="256"/>
                <xs:minInclusive value="1"/>
            </xs:restriction>
        </xs:simpleType>
        <xs:simpleType>
            <xs:restriction base="xs:string">
                <xs:enumeration value="obstruction-on-roadway"/>
                <xs:enumeration value="object-on-roadway"/>
                <xs:enumeration value="objects-falling-from-moving-vehicle"/>
                <xs:enumeration value="debris-on-roadway"/>
                <xs:enumeration value="storm-damage"/>
                <xs:enumeration value="people-on-roadway"/>
                <xs:enumeration value="bicyclists-on-roadway"/>
                <xs:enumeration value="sightseers-obstructing-access"/>
                <xs:enumeration value="large-numbers-of-visitors"/>
                <xs:enumeration value="animal-on-roadway"/>
                <xs:enumeration value="large-animal-on-roadway"/>
                <xs:enumeration value="herd-of-animals-on-roadway"/>
                <xs:enumeration value="animal-struck"/>
                <xs:enumeration value="fallen-trees"/>
                <xs:enumeration value="downed-power-lines"/>
                <xs:enumeration value="downed-cables"/>
                <xs:enumeration value="subsidence"/>
                <xs:enumeration value="road-surface-collapse"/>
                <xs:enumeration value="pavement-buckled"/>
                <xs:enumeration value="pothole"/>
                <xs:enumeration value="flooding"/>
                <xs:enumeration value="broken-water-main"/>
                <xs:enumeration value="collapsed-sewer"/>
                <xs:enumeration value="sewer-overflow"/>
```

```xml
                    <xs:enumeration value="gas-leak"/>
                    <xs:enumeration value="snowmelt"/>
                    <xs:enumeration value="mudslide"/>
                    <xs:enumeration value="avalanche"/>
                    <xs:enumeration value="rock-fall"/>
                    <xs:enumeration value="landslide"/>
                    <xs:enumeration value="clearance-work"/>
                    <xs:enumeration value="obstruction-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-delay-status-cancellation FADD_ID=3830-->
    <xs:simpleType name="Event-description-type-delay-status-cancellation">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="delays"/>
                    <xs:enumeration value="short-delays"/>
                    <xs:enumeration value="long-delays"/>
                    <xs:enumeration value="very-long-delays"/>
                    <xs:enumeration value="delays-of-uncertain-duration"/>
                    <xs:enumeration value="delayed-until-further-notice"/>
                    <xs:enumeration value="busy"/>
                    <xs:enumeration value="very-busy"/>
                    <xs:enumeration value="crowded"/>
                    <xs:enumeration value="overcrowded"/>
                    <xs:enumeration value="cancellations"/>
                    <xs:enumeration value="route-cancelled-no-replacement"/>
                    <xs:enumeration value="service-cancelled"/>
                    <xs:enumeration value="service-suspended"/>
                    <xs:enumeration value="service-withdrawn"/>
                    <xs:enumeration value="service-fully-booked"/>
                    <xs:enumeration value="all-services-fully-booked"/>
                    <xs:enumeration value="next-departure"/>
                    <xs:enumeration value="next-arrival"/>
                    <xs:enumeration value="very-frequent-service"/>
                    <xs:enumeration value="frequent-service"/>
                    <xs:enumeration value="fairly-frequent-service"/>
                    <xs:enumeration value="regular-service"/>
                    <xs:enumeration value="irregular-service"/>
                    <xs:enumeration value="not-operating"/>
                    <xs:enumeration value="system-busy"/>
                    <xs:enumeration value="system"/>
                    <xs:enumeration value="system-crowded"/>
                    <xs:enumeration value="travel-time"/>
                    <xs:enumeration value="headway"/>
                    <xs:enumeration value="delays-clearing"/>
                    <xs:enumeration value="delays-cleared"/>
                    <xs:enumeration value="normal-services-resumed"/>
                    <xs:enumeration value="operating"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-unusual-driving FADD_ID=3831-->
    <xs:simpleType name="Event-description-type-unusual-driving">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
```

```xml
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="vehicle-traveling-wrong-way"/>
                    <xs:enumeration value="reckless-driver"/>
                    <xs:enumeration value="prohibited-vehicle-on-roadway"/>
                    <xs:enumeration value="emergency-vehicles"/>
                    <xs:enumeration value="high-speed-emergency-vehicles"/>
                    <xs:enumeration value="high-speed-chase"/>
                    <xs:enumeration value="dangerous-vehicle-warning-cleared"/>
                    <xs:enumeration value="emergency-vehicle-warning-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-mobile-situation FADD_ID=3832-->
    <xs:simpleType name="Event-description-type-mobile-situation">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="abnormal-load"/>
                    <xs:enumeration value="wide-load"/>
                    <xs:enumeration value="long-load"/>
                    <xs:enumeration value="slow-vehicle"/>
                    <xs:enumeration value="farm-equipment"/>
                    <xs:enumeration value="horse-drawn-vehicles"/>
                    <xs:enumeration value="overheight-load"/>
                    <xs:enumeration value="overweight-load"/>
                    <xs:enumeration value="tracked-vehicle"/>
                    <xs:enumeration value="vehicle-carrying-hazardous-materials"/>
                    <xs:enumeration value="slow-moving-maintenance-vehicle"/>
                    <xs:enumeration value="convoy"/>
                    <xs:enumeration value="military-convoy"/>
                    <xs:enumeration value="refugee-convoy"/>
                    <xs:enumeration value="motorcade"/>
                    <xs:enumeration value="mobile-situation-repositioning"/>
                    <xs:enumeration value="winter-maintenance-vehicles"/>
                    <xs:enumeration value="snowplows"/>
                    <xs:enumeration value="slow-moving-maintenance-vehicle-warning-cleared"/>
                    <xs:enumeration value="exceptional-load-warning-cleared"/>
                    <xs:enumeration value="hazardous-load-warning-cleared"/>
                    <xs:enumeration value="convoy-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-device-status FADD_ID=3833-->
    <xs:simpleType name="Event-description-type-device-status">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="lane-control-signs-not-working"/>
                    <xs:enumeration value="lane-control-signs-working-incorrectly"/>
```

```
                    <xs:enumeration value="lane-control-signs-operating"/>
                    <xs:enumeration value="variable-message-signs-not-working"/>
                    <xs:enumeration value="variable-message-signs-working-incorrectly"/>
                    <xs:enumeration value="variable-message-signs-operating"/>
                    <xs:enumeration value="emergency-telephones-not-working"/>
                    <xs:enumeration value="emergency-telephone-number-not-working"/>
                    <xs:enumeration value="traffic-lights-not-working"/>
                    <xs:enumeration value="traffic-lights-working-incorrectly"/>
                    <xs:enumeration value="ramp-control-signals-not-working"/>
                    <xs:enumeration value="ramp-control-signals-working-incorrectly"/>
                    <xs:enumeration value="temporary-traffic-lights-not-working"/>
                    <xs:enumeration value="temporary-traffic-lights-working-incorrectly"/>
                    <xs:enumeration value="traffic-signal-control-computer-not-working"/>
                    <xs:enumeration value="traffic-signal-timings-changed"/>
                    <xs:enumeration value="overheight-warning-system-triggered"/>
                    <xs:enumeration value="equipment-failure"/>
                    <xs:enumeration value="railroad-crossing-equipment-failure"/>
                    <xs:enumeration value="tunnel-ventilation-not-working"/>
                    <xs:enumeration value="power-failure"/>
                    <xs:enumeration value="widespread-power-outages"/>
                    <xs:enumeration value="technical-problems"/>
                    <xs:enumeration value="electronic-signs-repaired"/>
                    <xs:enumeration value="emergency-call-facilities-restored"/>
                    <xs:enumeration value="traffic-signals-repaired"/>
                    <xs:enumeration value="railroad-crossing-equipment-now-working-normally"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Link-restriction-class FADD_ID=3025-->
    <xs:simpleType name="Link-restriction-class">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="restrictions"/>
                    <xs:enumeration value="ramp-restrictions"/>
                    <xs:enumeration value="truck-restriction"/>
                    <xs:enumeration value="speed-restriction"/>
                    <xs:enumeration value="noise-restriction"/>
                    <xs:enumeration value="traffic-regulations-have-been-changed"/>
                    <xs:enumeration value="local-access-only"/>
                    <xs:enumeration value="no-trailers"/>
                    <xs:enumeration value="no-high-profile-vehicles"/>
                    <xs:enumeration value="hazardous-materials-truck-restriction"/>
                    <xs:enumeration value="no-through-traffic"/>
                    <xs:enumeration value="no-motor-vehicles"/>
                    <xs:enumeration value="width-limit"/>
                    <xs:enumeration value="height-limit"/>
                    <xs:enumeration value="length-limit"/>
                    <xs:enumeration value="axle-load-limit"/>
                    <xs:enumeration value="gross-weight-limit"/>
                    <xs:enumeration value="axle-count-limit"/>
                    <xs:enumeration value="carpool-lane-available"/>
                    <xs:enumeration value="carpool-restrictions-changed"/>
                    <xs:enumeration value="HOV 2-no-single-occupant-vehicles"/>
                    <xs:enumeration value="HOV-3-no-vehicles-with-less-than-three-occupants"/>
                    <xs:enumeration value="bus-lane-available-for-all-vehicles"/>
                    <xs:enumeration value="truck-lane-available-for-all-vehicles"/>
                    <xs:enumeration value="permits call in basis"/>
                    <xs:enumeration value="permits temporarily closed"/>
                    <xs:enumeration value="permits closed"/>
```

```xml
                    <xs:enumeration value="permits open"/>
                    <xs:enumeration value="restrictions-for-high-profile-vehicles-lifted"/>
                    <xs:enumeration value="width-limit-lifted"/>
                    <xs:enumeration value="height-limit-lifted"/>
                    <xs:enumeration value="length-limit-lifted"/>
                    <xs:enumeration value="axle-count-limit-lifted"/>
                    <xs:enumeration value="weight-limit-lifted"/>
                    <xs:enumeration value="axle-count-limit-lifted"/>
                    <xs:enumeration value="carpool-restrictions-lifted"/>
                    <xs:enumeration value="lane-restrictions-lifted"/>
                    <xs:enumeration value="ramp-restrictions-lifted"/>
                    <xs:enumeration value="motor-vehicle-restrictions-lifted"/>
                    <xs:enumeration value="restrictions-lifted"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-incident-response-status FADD_ID=3885-->
    <xs:simpleType name="Event-description-type-incident-response-status">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="unconfirmed-report"/>
                    <xs:enumeration value="initial-response-en-route"/>
                    <xs:enumeration value="follow-up-response-en-route"/>
                    <xs:enumeration value="initial-response-on-scene"/>
                    <xs:enumeration value="follow-up-response-on-scene"/>
                    <xs:enumeration value="confirmed-report"/>
                    <xs:enumeration value="scene-is-unsecured-at-this-time"/>
                    <xs:enumeration value="response-scene-secured"/>
                    <xs:enumeration value="rescue-and-recovery-work-in-progress"/>
                    <xs:enumeration value="extraction-in-progress"/>
                    <xs:enumeration value="clearance-work-in-progress"/>
                    <xs:enumeration value="body-removal-operations"/>
                    <xs:enumeration value="fire-containment-contained"/>
                    <xs:enumeration value="fire-containment-not-contained"/>
                    <xs:enumeration value="event-cleared"/>
                    <xs:enumeration value="traffic-clearing"/>
                    <xs:enumeration value="incident-closed"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-disaster FADD_ID=3880-->
    <xs:simpleType name="Event-description-type-disaster">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="flash-flood"/>
                    <xs:enumeration value="major-flood"/>
                    <xs:enumeration value="reservoir-failure"/>
                    <xs:enumeration value="levee-failure"/>
                    <xs:enumeration value="tsunami"/>
                    <xs:enumeration value="tidal-wave"/>
                    <xs:enumeration value="volcanic-eruption"/>
```

```xml
                        <xs:enumeration value="ash-fall"/>
                        <xs:enumeration value="lava-flow"/>
                        <xs:enumeration value="serious-fire"/>
                        <xs:enumeration value="forest-fire"/>
                        <xs:enumeration value="wildfire"/>
                        <xs:enumeration value="building-fire"/>
                        <xs:enumeration value="brush-fire"/>
                        <xs:enumeration value="grass-fire"/>
                        <xs:enumeration value="fire-danger-extreme"/>
                        <xs:enumeration value="fire-danger-very-high"/>
                        <xs:enumeration value="fire-danger-high"/>
                        <xs:enumeration value="fire-danger-medium"/>
                        <xs:enumeration value="fire-danger-low"/>
                        <xs:enumeration value="earthquake-damage"/>
                        <xs:enumeration value="air-crash"/>
                        <xs:enumeration value="rail-crash"/>
                        <xs:enumeration value="toxic-release"/>
                        <xs:enumeration value="toxic-leak"/>
                        <xs:enumeration value="radioactive-release"/>
                        <xs:enumeration value="radiation-hazard"/>
                        <xs:enumeration value="reactor-leakage"/>
                        <xs:enumeration value="explosion"/>
                        <xs:enumeration value="major-hazardous-materials-fir"/>
                        <xs:enumeration value="major-hazardous-materials-release"/>
                        <xs:enumeration value="disaster-cleared"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:union>
        </xs:simpleType>
        <!--Element Event-description-type-disturbances FADD_ID=3884-->
        <xs:simpleType name="Event-description-type-disturbances">
            <xs:union>
                <xs:simpleType>
                    <xs:restriction base="xs:integer">
                        <xs:maxInclusive value="256"/>
                        <xs:minInclusive value="1"/>
                    </xs:restriction>
                </xs:simpleType>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="assault"/>
                        <xs:enumeration value="crime"/>
                        <xs:enumeration value="robbery"/>
                        <xs:enumeration value="fare-dispute"/>
                        <xs:enumeration value="shooting"/>
                        <xs:enumeration value="gunfire-on-roadway"/>
                        <xs:enumeration value="suicide"/>
                        <xs:enumeration value="fight"/>
                        <xs:enumeration value="gang-fight"/>
                        <xs:enumeration value="person-harassment"/>
                        <xs:enumeration value="person-injured"/>
                        <xs:enumeration value="unruly-passenger"/>
                        <xs:enumeration value="person-intoxicated"/>
                        <xs:enumeration value="crowd-control-problem"/>
                        <xs:enumeration value="demonstration"/>
                        <xs:enumeration value="march"/>
                        <xs:enumeration value="public-disturbance"/>
                        <xs:enumeration value="riot"/>
                        <xs:enumeration value="civil-unrest"/>
                        <xs:enumeration value="civil-emergency"/>
                        <xs:enumeration value="strike"/>
                        <xs:enumeration value="public-transit-strike"/>
                        <xs:enumeration value="stampede"/>
                        <xs:enumeration value="teargas-used"/>
                        <xs:enumeration value="security-alert"/>
                        <xs:enumeration value="security-incident"/>
                        <xs:enumeration value="checkpoint"/>
```

```xml
                    <xs:enumeration value="bomb-alert"/>
                    <xs:enumeration value="terrorist-incident"/>
                    <xs:enumeration value="high-velocity-shell-fire"/>
                    <xs:enumeration value="explosives-in-use"/>
                    <xs:enumeration value="air-raid"/>
                    <xs:enumeration value="weapons-of-mass-destruction-threat"/>
                    <xs:enumeration value="military-operations"/>
                    <xs:enumeration value="security-problem-cleared"/>
                    <xs:enumeration value="traffic-disturbance-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-sporting-events FADD_ID=3886-->
    <xs:simpleType name="Event-description-type-sporting-events">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="sports-event"/>
                    <xs:enumeration value="game"/>
                    <xs:enumeration value="tournament"/>
                    <xs:enumeration value="track-and-field-event"/>
                    <xs:enumeration value="baseball-game"/>
                    <xs:enumeration value="basketball-game"/>
                    <xs:enumeration value="boxing-match"/>
                    <xs:enumeration value="football-game"/>
                    <xs:enumeration value="soccer-game"/>
                    <xs:enumeration value="golf-tournament"/>
                    <xs:enumeration value="hockey-game"/>
                    <xs:enumeration value="tennis-tournament"/>
                    <xs:enumeration value="wrestling-match"/>
                    <xs:enumeration value="road-race"/>
                    <xs:enumeration value="automobile-race"/>
                    <xs:enumeration value="bicycle-race"/>
                    <xs:enumeration value="race-event"/>
                    <xs:enumeration value="marathon"/>
                    <xs:enumeration value="horse-show"/>
                    <xs:enumeration value="rodeo"/>
                    <xs:enumeration value="water-sports-event"/>
                    <xs:enumeration value="winter-sports-event"/>
                    <xs:enumeration value="skating-event"/>
                    <xs:enumeration value="sporting-event-ended"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-special-event FADD_ID=3214-->
    <xs:simpleType name="Event-description-type-special-event">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="major-event"/>
                    <xs:enumeration value="airshow"/>
                    <xs:enumeration value="hot-air-ballooning"/>
                    <xs:enumeration value="concert"/>
```

```xml
                    <xs:enumeration value="state-occasion"/>
                    <xs:enumeration value="vip-visit"/>
                    <xs:enumeration value="show"/>
                    <xs:enumeration value="festival"/>
                    <xs:enumeration value="exhibition"/>
                    <xs:enumeration value="performing-arts"/>
                    <xs:enumeration value="outdoor-market"/>
                    <xs:enumeration value="fair"/>
                    <xs:enumeration value="carnival"/>
                    <xs:enumeration value="fireworks-display"/>
                    <xs:enumeration value="trade-expo"/>
                    <xs:enumeration value="movie-filming"/>
                    <xs:enumeration value="presidential-visit"/>
                    <xs:enumeration value="parade"/>
                    <xs:enumeration value="procession"/>
                    <xs:enumeration value="funeral-procession"/>
                    <xs:enumeration value="crowd"/>
                    <xs:enumeration value="holiday-traffic"/>
                    <xs:enumeration value="event-ended"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-parking-information FADD_ID=3835-->
    <xs:simpleType name="Event-description-type-parking-information">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="normal-parking-restrictions-lifted"/>
                    <xs:enumeration value="parking-meter-restrictions-lifted"/>
                    <xs:enumeration value="special-parking-restrictions-in-force"/>
                    <xs:enumeration value="full-parking-lot"/>
                    <xs:enumeration value="full-parking-garage"/>
                    <xs:enumeration value="all-parking-lots-full"/>
                    <xs:enumeration value="no-parking-spaces-available"/>
                    <xs:enumeration value="only-a-few-spaces-available"/>
                    <xs:enumeration value="spaces-available"/>
                    <xs:enumeration value="no-parking"/>
                    <xs:enumeration value="parking-on-one-side-of-street-only"/>
                    <xs:enumeration value="parking-on-both-sides-of-street"/>
                    <xs:enumeration value="parallel-parking-only"/>
                    <xs:enumeration value="parking-meters-not-available"/>
                    <xs:enumeration value="use-of-parking-meters-restricted"/>
                    <xs:enumeration value="event-parking"/>
                    <xs:enumeration value="handicapped-parking"/>
                    <xs:enumeration value="long-term-parking"/>
                    <xs:enumeration value="overnight-parking"/>
                    <xs:enumeration value="short-term-parking"/>
                    <xs:enumeration value="special-parking-restrictions-lifted"/>
                    <xs:enumeration value="no-parking-information-available"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-system-information FADD_ID=3836-->
    <xs:simpleType name="Event-description-type-system-information">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
```

```xml
                    </xs:restriction>
                </xs:simpleType>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="information-available-on-radio"/>
                        <xs:enumeration value="information-available-on-TV"/>
                        <xs:enumeration value="call-to-get-information"/>
                        <xs:enumeration value="information-available-via-Internet"/>
                        <xs:enumeration value="test-message"/>
                        <xs:enumeration value="no-information-available"/>
                        <xs:enumeration value="null-description"/>
                        <xs:enumeration value="information-service-is-being-suspended"/>
                        <xs:enumeration value="information-service-resumed"/>
                        <xs:enumeration value="message-canceled"/>
                    </xs:restriction>
                </xs:simpleType>
            </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-weather-condition FADD_ID=3299-->
    <xs:simpleType name="Event-description-type-weather-condition">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="overcast"/>
                    <xs:enumeration value="cloudy"/>
                    <xs:enumeration value="mostly-cloudy"/>
                    <xs:enumeration value="partly-cloudy"/>
                    <xs:enumeration value="partly-sunny"/>
                    <xs:enumeration value="mostly-sunny"/>
                    <xs:enumeration value="sunny"/>
                    <xs:enumeration value="fair"/>
                    <xs:enumeration value="clear"/>
                    <xs:enumeration value="mostly-clear"/>
                    <xs:enumeration value="mostly-dry"/>
                    <xs:enumeration value="dry"/>
                    <xs:enumeration value="uv-index-very-high"/>
                    <xs:enumeration value="uv-index-high"/>
                    <xs:enumeration value="uv-index-moderate"/>
                    <xs:enumeration value="uv-index-low"/>
                    <xs:enumeration value="uv-index-very-low"/>
                    <xs:enumeration value="barometric-pressure"/>
                    <xs:enumeration value="weather-forecast-withdrawn"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-precipitation FADD_ID=3825-->
    <xs:simpleType name="Event-description-type-precipitation">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="severe-weather"/>
                    <xs:enumeration value="blizzard"/>
                    <xs:enumeration value="heavy-snow"/>
                    <xs:enumeration value="snow"/>
```

```xml
                    <xs:enumeration value="light-snow"/>
                    <xs:enumeration value="snow-showers"/>
                    <xs:enumeration value="winter-storm"/>
                    <xs:enumeration value="ice-glaze"/>
                    <xs:enumeration value="heavy-frost"/>
                    <xs:enumeration value="frost"/>
                    <xs:enumeration value="ice-storm"/>
                    <xs:enumeration value="sleet"/>
                    <xs:enumeration value="rain-and-snow-mixed"/>
                    <xs:enumeration value="rain-changing-to-snow"/>
                    <xs:enumeration value="damaging-hail"/>
                    <xs:enumeration value="hail"/>
                    <xs:enumeration value="thunderstorms"/>
                    <xs:enumeration value="thundershowers"/>
                    <xs:enumeration value="extremely-heavy-downpour"/>
                    <xs:enumeration value="heavy-rain"/>
                    <xs:enumeration value="rain"/>
                    <xs:enumeration value="light-rain"/>
                    <xs:enumeration value="drizzle"/>
                    <xs:enumeration value="showers"/>
                    <xs:enumeration value="dew"/>
                    <xs:enumeration value="precipitation-cleared"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-wind FADD_ID=3826-->
    <xs:simpleType name="Event-description-type-wind">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="tornado"/>
                    <xs:enumeration value="hurricane"/>
                    <xs:enumeration value="hurricane-force-winds"/>
                    <xs:enumeration value="tropical-storm"/>
                    <xs:enumeration value="gale-force-winds"/>
                    <xs:enumeration value="storm-force-winds"/>
                    <xs:enumeration value="strong-winds"/>
                    <xs:enumeration value="moderate-winds"/>
                    <xs:enumeration value="light-winds"/>
                    <xs:enumeration value="calm"/>
                    <xs:enumeration value="gusty-winds"/>
                    <xs:enumeration value="crosswinds"/>
                    <xs:enumeration value="windy"/>
                    <xs:enumeration value="strong-winds-have-eased"/>
                    <xs:enumeration value="strong-wind-forecast-withdrawn"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-visibility-air-quality FADD_ID=3827-->
    <xs:simpleType name="Event-description-type-visibility-air-quality">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
```

```xml
                            <xs:enumeration value="dense-fog"/>
                            <xs:enumeration value="fog"/>
                            <xs:enumeration value="patchy-fog"/>
                            <xs:enumeration value="freezing-fog"/>
                            <xs:enumeration value="mist"/>
                            <xs:enumeration value="haze"/>
                            <xs:enumeration value="visibility-reduced"/>
                            <xs:enumeration value="white-out"/>
                            <xs:enumeration value="blowing-snow"/>
                            <xs:enumeration value="smoke-hazard"/>
                            <xs:enumeration value="spray-hazard"/>
                            <xs:enumeration value="low-sun-glare"/>
                            <xs:enumeration value="snow-glare"/>
                            <xs:enumeration value="blowing-dust"/>
                            <xs:enumeration value="blowing-sand"/>
                            <xs:enumeration value="dust-storms"/>
                            <xs:enumeration value="sandstorms"/>
                            <xs:enumeration value="air-quality-good"/>
                            <xs:enumeration value="air-quality-fair"/>
                            <xs:enumeration value="air-quality-poor"/>
                            <xs:enumeration value="air-quality-very-poor"/>
                            <xs:enumeration value="severe-exhaust-pollution"/>
                            <xs:enumeration value="smog-alert"/>
                            <xs:enumeration value="pollen-count-high"/>
                            <xs:enumeration value="pollen-count-medium"/>
                            <xs:enumeration value="pollen-count-low"/>
                            <xs:enumeration value="swarms-of-insects"/>
                            <xs:enumeration value="fog-clearing"/>
                            <xs:enumeration value="visibility-improved"/>
                            <xs:enumeration value="fog-forecast-withdrawn"/>
                            <xs:enumeration value="pollution-alert-ended"/>
                            <xs:enumeration value="air-quality-improved"/>
                        </xs:restriction>
                    </xs:simpleType>
                </xs:union>
        </xs:simpleType>
        <!--Element Event-description-type-temperature FADD_ID=3828-->
        <xs:simpleType name="Event-description-type-temperature">
            <xs:union>
                <xs:simpleType>
                    <xs:restriction base="xs:integer">
                        <xs:maxInclusive value="256"/>
                        <xs:minInclusive value="1"/>
                    </xs:restriction>
                </xs:simpleType>
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="maximum-temperature"/>
                        <xs:enumeration value="temperature"/>
                        <xs:enumeration value="minimum-temperature"/>
                        <xs:enumeration value="current-temperature"/>
                        <xs:enumeration value="heat-index"/>
                        <xs:enumeration value="extreme-heat"/>
                        <xs:enumeration value="hot"/>
                        <xs:enumeration value="hotter"/>
                        <xs:enumeration value="heat"/>
                        <xs:enumeration value="warmer"/>
                        <xs:enumeration value="warm"/>
                        <xs:enumeration value="mild"/>
                        <xs:enumeration value="cool"/>
                        <xs:enumeration value="cooler"/>
                        <xs:enumeration value="cold"/>
                        <xs:enumeration value="colder"/>
                        <xs:enumeration value="very-cold"/>
                        <xs:enumeration value="extreme-cold"/>
                        <xs:enumeration value="wind-chill"/>
                        <xs:enumeration value="dewpoint"/>
```

```xml
                    <xs:enumeration value="relative-humidity"/>
                    <xs:enumeration value="temperatures-close-to-the-seasonal-norm"/>
                    <xs:enumeration value="less-extreme-temperatures"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-pavement-condition FADD_ID=3298-->
    <xs:simpleType name="Event-description-type-pavement-condition">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="impassable"/>
                    <xs:enumeration value="almost-impassable"/>
                    <xs:enumeration value="passable-with-care"/>
                    <xs:enumeration value="passable"/>
                    <xs:enumeration value="surface-water-hazard"/>
                    <xs:enumeration value="danger-of-hydroplaning"/>
                    <xs:enumeration value="wet-pavement"/>
                    <xs:enumeration value="treated-pavement"/>
                    <xs:enumeration value="slippery"/>
                    <xs:enumeration value="mud-on-roadway"/>
                    <xs:enumeration value="leaves-on-roadway"/>
                    <xs:enumeration value="loose-sand-on-roadway"/>
                    <xs:enumeration value="loose-gravel"/>
                    <xs:enumeration value="fuel-on-roadway"/>
                    <xs:enumeration value="oil-on-roadway"/>
                    <xs:enumeration value="road-surface-in-poor-condition"/>
                    <xs:enumeration value="melting-tar"/>
                    <xs:enumeration value="ice"/>
                    <xs:enumeration value="icy-patches"/>
                    <xs:enumeration value="black-ice"/>
                    <xs:enumeration value="ice-pellets-on-roadway"/>
                    <xs:enumeration value="ice-build-up"/>
                    <xs:enumeration value="freezing-rain"/>
                    <xs:enumeration value="wet-and-icy-roads"/>
                    <xs:enumeration value="melting-snow"/>
                    <xs:enumeration value="slush"/>
                    <xs:enumeration value="frozen-slush"/>
                    <xs:enumeration value="snow-on-roadway"/>
                    <xs:enumeration value="packed-snow"/>
                    <xs:enumeration value="packed-snow-patches"/>
                    <xs:enumeration value="plowed-snow"/>
                    <xs:enumeration value="wet-snow"/>
                    <xs:enumeration value="fresh-snow"/>
                    <xs:enumeration value="powder-snow"/>
                    <xs:enumeration value="granular-snow"/>
                    <xs:enumeration value="frozen-snow"/>
                    <xs:enumeration value="crusted-snow"/>
                    <xs:enumeration value="deep-snow"/>
                    <xs:enumeration value="snow-drifts"/>
                    <xs:enumeration value="drifting-snow"/>
                    <xs:enumeration value="expected-snow-accumulation"/>
                    <xs:enumeration value="current-snow-accumulation"/>
                    <xs:enumeration value="dry-pavement"/>
                    <xs:enumeration value="snow-cleared"/>
                    <xs:enumeration value="pavement-conditions-improved"/>
                    <xs:enumeration value="skid-hazard-reduced"/>
                    <xs:enumeration value="pavement-conditions-cleared"/>
                </xs:restriction>
            </xs:simpleType>
```

```xml
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-winter-driving-restrictions FADD_ID=3888-->
    <xs:simpleType name="Event-description-type-winter-driving-restrictions">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="winter-equipment-recommended"/>
                    <xs:enumeration value="winter-equipment-required"/>
                    <xs:enumeration value="snow-chains-recommended"/>
                    <xs:enumeration value="snow-chains-required"/>
                    <xs:enumeration value="snow-chains-prohibited"/>
                    <xs:enumeration value="studded-tires-prohibited"/>
                    <xs:enumeration value="snow-tires-recommended"/>
                    <xs:enumeration value="snow-tires-required"/>
                    <xs:enumeration value="four-wheel-drive-recommended"/>
                    <xs:enumeration value="four-wheel-drive-required"/>
                    <xs:enumeration value="snow-tires-or-chains-recommended"/>
                    <xs:enumeration value="snow-tires-or-chains-required"/>
                    <xs:enumeration value="winter-driving-requirements-lifted"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
    <!--Element Event-description-type-winter-driving-index FADD_ID=3823-->
    <xs:simpleType name="Event-description-type-winter-driving-index">
        <xs:union>
            <xs:simpleType>
                <xs:restriction base="xs:integer">
                    <xs:maxInclusive value="256"/>
                    <xs:minInclusive value="1"/>
                </xs:restriction>
            </xs:simpleType>
            <xs:simpleType>
                <xs:restriction base="xs:string">
                    <xs:enumeration value="driving-conditions-good"/>
                    <xs:enumeration value="driving-conditions-fair"/>
                    <xs:enumeration value="difficult-driving-conditions"/>
                    <xs:enumeration value="very-difficult-driving-conditions"/>
                    <xs:enumeration value="hazardous-driving-conditions"/>
                    <xs:enumeration value="extremely-hazardous-driving-conditions"/>
                </xs:restriction>
            </xs:simpleType>
        </xs:union>
    </xs:simpleType>
```