

**North American Hub FEU-g
Data Exchange Interface**

Interface Control Document (ICD)

**castle
rock.**

Prepared for:
North American Hub Receiving Centers

Version tracking

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1. Message Definition (FEU Version 2.2)

This section specifies the FEU data elements and data structures to be supported by the North American Hub. FEU 2.2 material that is not included below will not be included in North American Hub data exchanges.

The top-level data frame defines the overall structure of FEU messages, as follows:

FullEventUpdate ::= SEQUENCE

```
{
  message-header      MessageHeader,
  event-reference     EventReference,
  event-indicators    SEQUENCE OF EventIndicator OPTIONAL,
  headline            EventHeadline,
  details             SEQUENCE OF EventElementDetail OPTIONAL,
  operator-comments   EventComments OPTIONAL
}
```

This frame may contain the following data structures:

<i>message-header</i>	Initial information used at the start of a message
<i>event-reference</i>	A unique reference to the event
<i>event-indicators</i>	Optionally, indicators such as event status and event priority
<i>headline</i>	The key phrase (determines the event's icon or painted road color).
<i>details</i>	Details of each event element (its description, location, times, etc.).
<i>operator-comments</i>	Free text remarks, not for dissemination to the public.

Note that in North American Hub exchanges, event *details* are **required**, unless the purpose of this message is to indicate that the event has ended.

In North American Hub exchanges, it is expected that the headline phrase will be the first phrase from Event Element 1.

An example of XML for this frame is as follows:

```
<feu1:full-event-update xmlns:feu=" http://www.northamericanhub.org2">
  <message-header>
    <!-- Message Header goes here --!>
  </message-header>
  <event-reference>
    <!-- Event Reference goes here --!>
  </event-reference>
```

¹ The "feu:" form of the top-level element is required because the current FEU.xsd schema uses the "elementFormDefault='unqualified'" feature of XML, indicating that the subelements of the full-event-update element need not (and must not) be qualified with a namespace, while the top-level element *must* be qualified.

² This exact namespace must be used in FEU XML submitted to the Hub, or the Hub will not accept the incoming message.

```

<event-indicators>
  <!-- Event Indicators go here --!>
</event-indicators>
<headline>
  <!-- Headline goes here --!>
</headline>
<details>
  <detail>
    <!-- contents of each Detail go here --!>
  </detail>
</details>
</feu:full-event-update>

```

1.1 Message Header

This data frame must be used at the start of every FEU message.

MessageHeader ::= SEQUENCE

```

{
  sender           OrganizationInformation,
  message-type-version Event-message-type-version,           --3803
  message-number   Event-message-number,                     --3804
  message-time-stamp DateTimeZone,
  message-expiry-time DateTimeZone OPTIONAL
}

```

The frame shall contain the following data:

<i>sender</i>	The organization sending the message
<i>message-type-version</i>	The version of the message used in this exchange (always “1”)
<i>message-number</i>	An effectively unique number referencing a specific message publication
<i>message-time-stamp</i>	The date and time of the message publication
<i>message-expiry-time</i>	Optionally, the date and time after which the message content is no longer valid. At this time, the sending system should stop sending the message. Also, the receiving system should delete the event from its active events database.

An example of XML for this frame is as follows:

```

<message-header>
  <sender>
    <organization-id>MEDOT</organization-id>
    <center-id>MEDOTCARS</center-id>
  </sender>
  <message-type-version>1</message-type-version>
  <message-number>103206</message-number>
  <message-time-stamp>
    <date>20080208</date>
    <time>095859</time>

```

```

    <utc-offset>-0400</utc-offset>
  </message-time-stamp>
</message-header>

```

1.1.1 Organization Information

This data frame must be used in the Message Header to reference the sender agency.

OrganizationInformation ::= SEQUENCE

```

{
  organization-id      Organization-identifier,          --3343
  organization-name    Organization-name OPTIONAL,      --3344
  center-id           Organization-center-identifier    --3217
}

```

Note that “—3343” (etc.) are references to data element definitions in the TMDD Version 2 Data Dictionary.

The data frame contains the following data:

<i>organization-id</i>	Identifies the organization sending the message.
<i>organization-name</i>	Optionally, the name of the organization sending the message.
<i>center-id</i>	Identifies the system sending the message (e.g., MATS).

Note that *center-id* is optional in TMDD, but is mandatory in North American Hub data exchanges. An example of the XML for this data frame is given later.

1.1.2 DateTimeZone

The ASN.1 definition for this data frame is as follows:

DateTimeZone ::= SEQUENCE

```

{
  date      Time-local-date,          --3398
  time      Time-local-time,         --3397
  utc-offset Time-utc-offset         --3376
}

```

This data frame contains the following data:

date	The local date, in the format "YYYYMMDD".
time	The local time, in the format "HHMMSS".
utc-offset	Defines the local time zone, in the format "+HHMM" or "-HHMM".

In Maine, for example, the UTC offsets are -0400 (summer) and -0500 (winter).³ An event in Maine updated on September 15 shall have an update time UTC offset of -0400. If that event's end time is on November 1, 2008, the end time's UTC offset should be -0500.

An example of the XML for this data frame is given below:

```
<date>20080208</date>
<time>095859</time>
<utc-offset>-0400</utc-offset>
```

1.2 Event Reference

The ASN.1 definition for this frame is as follows:

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

This data frame comprises:

event-id	A unique identifier for this event and its updates.
update	The sequential number of the update being reported in this message.

The North American Hub requires *event-id* to be in the form "<sender>-<integer>", for example "MEDOT-4622".

When the event report is first created, its initial *update* number is 1. The update number of an event (with a given *event-id*) shall be incremented with each *update*. If the update number reaches 65535, it shall not return to zero. Instead, the event must be ended, and a new event created with a new *event-id*.

An example of XML for this frame is as follows:

```
<event-reference>
  <event-id>MECARS-3206</event-id>
  <update>1</update>
</event-reference>
```

³ Note that the UTC offset of the message time stamp and the UTC offset defaults are determined by the local time for that agency.

1.3 Event Indicator

The ASN.1 definition for this frame is as follows:

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

Each instance of this frame contains one of the following data elements:

<i>status</i>	An enumerated value indicating the event's status. (See FEU.xsd for the valid values of this enumeration). Currently, it is used in North American Hub exchanges only to signify that an event has ended.
<i>priority</i>	The priority of the event (1 to 10, with 1 highest priority).

An example of XML for this frame (used twice) is as follows:

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

1.4 Event Headline

The ASN.1 definition for this frame is as follows:

```
EventHeadline ::= SEQUENCE
{
  headline          EventType
}
```

The frame uses one other data frame, as follows:

<i>headline</i>	The key phrase within the event description.
-----------------	--

An example of XML for this frame is as follows. Note that there are two uses of the word 'headline', one inside the other. Both are mandatory.

```
<headline>
  <headline>
```



```

    <pavement-condition>surface water hazard</pavement-condition>
  </headline>
</headline>

```

1.4.1 Event Type (Headline)

The ASN.1 definition for this frame is as follows:

```

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
  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
}

```

An example of XML for this data frame is as follows.

```

<pavement-condition>surface water hazard</pavement-condition>

```

1.5 Event Element Detail

This frame must be used at least once in all event reports except those with a status of *'ended'*: Its ASN.1 definition is:

EventElementDetail ::= SEQUENCE

```
{
  descriptions          SEQUENCE OF ElementDescription,
  locations             SEQUENCE OF EventLocation,
  times                EventTimes,
  source               EventSource OPTIONAL
}
```

Simple events have only one element detail, while complex event descriptions are built up from multiple element details. 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.

This data frame may include the following data structures:

<i>descriptions</i>	What is happening in this event element.
<i>locations</i>	Where it is happening.
<i>times</i>	When it is expected to start and/or end.
<i>source</i>	Optionally, the original source of the event information.

With reference to the FEU.xsd for this data frame:

Where multi-element events are sent via the North American Hub, it will be assumed that the first element detail has an *element id* of 1, the second detail 2, etc.

All event reports exchanged via the North American Hub will be assumed to have an access level of 1 (public domain). Event reports that are not public domain should not currently be exchanged via the Hub.

An example of the XML for a two-element event is as follows:

```
<details>
  <detail>
    <descriptions>
      <!-- Descriptions go here --!>
    </descriptions>
    <locations>
      <!-- Locations go here --!>
    </locations>
    <times>
      <!-- Times go here --!>
    </times>
    <source>
      <!-- Source goes here --!>
    </source>
  </detail>
</details>
```

```

    </source>
  </detail>
</detail>
  <descriptions>
    <!-- Descriptions go here --!>
  </descriptions>
  <locations>
    <!-- Locations go here --!>
  </locations>
  <times>
    <!-- Times go here --!>
  </times>
  <source>
    <!-- Source goes here --!>
  </source>
</detail>
</details>

```

1.5.1 Element Description

The ASN.1 definition for this frame is as follows:

```

ElementDescription ::= CHOICE
{
  phrase           EventType,
  cause            EventType,
  advice           EventAdvice,
  qualifier        EventQualifier,
  quantity         EventQuantity,
  detour           Detour,
  additional-text  AdditionalText
}

```

Each event-element detail contains a sequence of element descriptions. Each element description comprises **one** of the following data frames:

<i>phrase</i>	Part of the description of the event element. Each phrase conveys a specific component of an event, e.g. "Overtaken truck."
<i>cause</i>	A phrase that is considered to be the reason (or part of the reason) for the event element, e.g. "due to fog"
<i>advice</i>	Further guidance added for safety or public information reasons, not meaningful if used alone; e.g. "Dense fog, <i>keep your distance</i> "
<i>qualifier</i>	Additional information that further qualifies the description, e.g. "Crash <i>in the left lane</i> "
<i>quantity</i>	A quantity that forms part of the event element..
<i>detour</i>	A description of a currently active detour.
<i>additional-text</i>	A free text comment added to an event description, for dissemination to the public.

At least one *phrase* (the headline phrase) must be present in each event report. At least this same phrase must be present in each event element detail.

1.5.2 Event Type (Phrase and Cause)

These two uses of event type (in *phrase* and *cause*) are exactly the same as that of *headline*, presented previously. Each instance shall contain one phrase or cause that constitutes part of the event description.

1.5.3 Advice

Each instance of this data frame shall contain one advice phrase that constitutes part of the event description. The ASN.1 definition for this frame is as follows:

```
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
}
```

An example of XML for this frame is as follows.

```
<descriptions>
  <!-- other descriptions may occur here --!>
  <description>
    <advice>
      <warning>repairs in progress</warning>
    </advice>
  </description>
  <!-- other descriptions may occur here --!>
</descriptions>
```

1.5.4 Qualifier

Each instance of this data frame shall contain one qualifier phrase that constitutes part of the event description. The ASN.1 definition for this frame is as follows:

```
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
}
```

An example of XML for this frame is as follows.

```

<descriptions>
  <!-- other descriptions may occur here --!>
  <description>
    <qualifier>
      <travelers-affected>cars and light vehicles</travelers-affected>
    </qualifier>
  </description>
  <!-- other descriptions may occur here --!>
</descriptions>

```

1.5.5 Event Quantity

Each instance of this data frame shall contain one quantity that constitutes part of the event description. The ASN.1 definition for this frame is as follows:

```

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

```

Table 1 summarizes the conversion rules applicable to the units that are used in FEU. To convert data from English units to FEU (quasi-metric) units, insert the value in English units into the ‘English’ variable of the conversion equation. The ‘FEU’ variable is the quantity as expressed in FEU. To convert data from FEU (quasi-metric) units to English units, insert the value into the ‘FEU’ variable of the conversion equation and the ‘English’ value will provide the quantity in English units. A check for the conversion is also provided.

TABLE 1 Conversion of Quantities between FEU and English Units

Quantity	TMDD / Metric Unit	English Unit	Conversion English to FEU	Conversion FEU to English	Conversion Check
Extent					
Length-affected	Tenth of a kilometer	Miles	FEU = ENG x 16.093	ENG = FEU / 16.093	1mi = 16.09344 1/10 of a km
Data Link State					
Delay	Seconds	Minutes	FEU = ENG x 60	ENG = FEU / 60	1 min = 60 sec
Headway	Seconds	Integer	FEU = ENG	ENG = FEU	-
Travel-time	Seconds	Integer	FEU = ENG	ENG = FEU	-
Data Incident Details					
Vehicles-involved	Vehicles	Integer	FEU = ENG	ENG = FEU	-
Cars-involved	Vehicles (cars)	Integer	FEU = ENG	ENG = FEU	-
Trucks-involved	Vehicles (trucks)	Integer	FEU = ENG	ENG = FEU	-
Buses-involved	Vehicles (buses)	Integer	FEU = ENG	ENG = FEU	-

Data Road Weather					
Wind-direction	Degrees	Degrees	FEU = ENG	ENG = FEU	-
Wind-speed	Tenths of m/s	MPH	FEU = ENG x 4.47039	ENG = FEU / 4.47039	1 MPH = 4.4704 1/10 of m/s
Air-temp	Tenths of deg Celsius	Deg. F	FEU = [(ENG-32) / 0.18]	ENG = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Relative-humidity	Percent	Percent	FEU = ENG	ENG = FEU	-
Visibility	Tenths of meters	Feet	FEU = ENG x 3.048	ENG = FEU / 3.048	1 feet = 3.048 1/10 of meters
Data Parking					
Parking-spaces	Parking spaces	Spaces	FEU = ENG	ENG = FEU	-
Parking-occupancy	Percent	Vehicles	FEU = ENG	ENG = FEU	-
Data Surface Conditions					
Water-depth	Centimeter	Inches	FEU = ENG x 2.54	ENG = FEU / 2.54	1 inch = 2.54 cm
Adjacent-snow-depth	Centimeter	Inches	FEU = ENG x 2.54	ENG = FEU / 2.54	1 inch = 2.54 cm
Roadway-snow-depth	Centimeter	Inches	FEU = ENG x 2.54	ENG = FEU / 2.54	1 inch = 2.54 cm
Roadway-snow-pack-depth	Centimeter	Inches	FEU = ENG x 2.54	ENG = FEU / 2.54	1 inch = 2.54 cm
Ice-thickness	Millimeter	Inches	FEU = ENG x 25.4	ENG = FEU / 25.4	1 inch = 25.4 mm
Pavement-temperature	Tenths of deg Celsius	Deg F	FEU = [(ENG-32) * 5.5555]	ENG = [(FEU x 0.18) + 32]	-40F = -400 1/10 of C 86F = 300 1/10 of C
Data Link Restrictions					
Speed-limit-advisory	km/h	MPH	FEU = ENG x 1.6093	ENG = FEU / 1.6093	1 MPH = 1.6093 km/h
Speed-limit	km/h	MPH	FEU = ENG x 1.6093	ENG = FEU / 1.6093	1 MPH = 1.6093 km/h
Speed-limit-truck	km/h	MPH	FEU = ENG x 1.6093	ENG = FEU / 1.6093	1 MPH = 1.6093 km/h
Restriction-length	Centimeters	Feet	FEU = ENG x 30.48	ENG = FEU / 30.48	1 ft = 30.48 cm
Restriction-height	Centimeters	Feet	FEU = ENG x 30.48	ENG = FEU / 30.48	1 ft = 30.48 cm
Restriction-width	Centimeters	Feet	FEU = ENG x 30.48	ENG = FEU / 30.48	1 ft = 30.48 cm
Restriction-weight-vehicle	Kilograms	Pounds	FEU = ENG x 0.4536	ENG = FEU / 0.4536	1 kg = 0.4536 lbs
Restriction-weight-axle	Kilograms	Pounds	FEU = ENG x 0.4536	ENG = FEU / 0.4536	1 kg = 0.4536 lbs
Restriction-axle-count	Axles	Axles	FEU = ENG	ENG = FEU	-

1.5.5.1 Extent

The ASN.1 definition for this frame is as follows:

```
DataExtent ::= CHOICE
{
  length-affected          Event-length-affected          --3856
}

```

1.5.5.2 Data Link State

The ASN.1 definition for this frame is as follows:

```
DataLinkState ::= CHOICE
{
  delay                    Link-delay,                    --3005
  headway                  Link-headway,                  --3892
  travel-time              Link-travel-time              --3038
}

```

1.5.5.3 Data Incident Details

The ASN.1 definition for this frame is as follows:

```
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
}

```

1.5.5.4 Data Road Weather

The ASN.1 definition for this frame is as follows:

```
DataRoadWeather ::= CHOICE
{
  wind-direction           EssAvgWindDirection,           --3910
  wind-speed               EssAvgWindSpeed,               --3911
  air-temp                 EssAirTemperature,             --3908
  relative-humidity        EssRelativeHumidity,           --3922
  visibility                EssVisibility,                 --3932
}

```

1.5.5.5 Data Parking

The ASN.1 definition for this frame is as follows:

```
DataParking ::= CHOICE
{
  parking-spaces          Event-parking-number-of-spaces,      --3871
  parking-occupancy      Event-parking-occupancy          --3872
}

```

1.5.5.6 Data Surface Conditions

The ASN.1 definition for this frame is as follows:

```
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
  pavement-temperature  EssPavementTemperature            --3917
}

```

1.5.5.7 Data Link Restrictions

The ASN.1 definition for this frame is as follows:

```
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
}

```

1.5.6 Additional Text

Each instance of this data frame shall contain one set of additional (web site) text that constitutes part of the event description on a specified medium. The ASN.1 definition is as follows:

```
AdditionalText ::= SEQUENCE
{
  description            Event-description,                  --3209
  language              Event-description-language OPTIONAL --3816
}

```

This frame contains the following data:

<i>description</i>	A free-form textual description of the event.
<i>language</i>	Optionally, the language in which the description is written. The default language is English.

An example of XML for web site additional text this data frame is as follows:

```

<descriptions>
  <description>
    <additional-text>
      <description> A 9' lane width will be in effect with two-day openings provided every 30 days.</description>
    </additional-text>
  </description>
</descriptions>

```

1.5.7 Event Location

The ASN.1 definition for this frame is as follows:

```

EventLocation ::= CHOICE
{
  area-location          AreaLocation,
  location-on-link      LinkLocation
}

```

This data frame contains one of the following:

<i>area-location</i>	A named area such as a county.
<i>location-on-link</i>	An event's location on a transportation route (at a point, or along a defined stretch of a single designated route).

An example of XML for this frame is as follows:

```

<locations>
  <location>
    <!--area or location-on-link goes here --!>
  </location>
</locations>

```

1.5.7.1 Area Location

The ASN.1 definition for this frame is as follows:

```

AreaLocation ::= SEQUENCE
{
  area-id          Event-location-area-identifier          --3809
}

```

This data frame contains the following data element:

area-id A Federal Information Processing Standards (FIPS) code identifying the area being referenced; or a dummy FIPS code known to the sending and receiving systems.

The FIPS code uses a 2-digit code to identify the state. Counties are referenced by following the 2-digit state code with a 3-digit county code. Cities are referenced by following the 2-digit state code with a 5-digit city code.

A statewide event can be indicated by simply using the 2-digit state code by itself. A county-wide event is indicated using the 2-digit state code followed by a 3-digit county code.

An example of XML for this frame is as follows:

```
<locations>
  <location>
    <area-location>
      <area-id>36021</area-id>
    </area-location>
  </location>
</locations>
```

1.5.7.2 Link Location

The ASN.1 definition for this frame is as follows:

LinkLocation ::= SEQUENCE

```
{
  link-ownership          Link-ownership,          --3021
  route-designator       Link-route-designator,     --3030
  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
}
```

This data frame may contain the following data:

<i>link-ownership</i>	The agency responsible for operating the roadway, e.g., MEDOT. A local or out-of-state road can be indicated by the value “Other”.
<i>route-designator</i>	The official designator of the roadway, e.g., I-95; US 2; ME100. For local roads, the road name is given here, e.g., Main Street.
<i>primary-location</i>	One end of the event’s location on the roadway.
<i>secondary-location</i>	For extent events, the other end of the event’s location on the roadway.
<i>link-direction</i>	Optionally, the affected travel direction(s) along the roadway.

link-alignment Optionally, the cardinal direction of positive-direction travel on a road, e.g., N, or E. This shall be included for events on both local and state roads.

linear-reference-version Optionally, the version number of the distance referencing system (e.g., mile marker system) being used by the state or county.

Link direction may contain "positive direction", "negative direction", "both directions" or "not directional", relative to the direction of increasing mile points. The default value is "not directional." On local roads, *link-direction* relates to the positive direction specified in *link alignment*.

An example of XML for this frame and those defined next are as follows:

```
<location-on-link>
  <link-ownership>MEDOT</link-ownership>
  <route-designator>I-95</route-designator>
  <primary-location>
    <geo-location>
      <latitude>43000000</latitude>
      <longitude>-73000000</longitude>
    </geo-location>
    <linear-reference>121.378</linear-reference>
  </primary-location>
  <link-direction>not directional</link-direction>
</location-on-link>
```

1.5.7.2.1 Point on Link

The ASN.1 definition for this frame is as follows:

```
PointOnLink ::= SEQUENCE
{
  geo-location          GeoLocation,
  linear-reference      Link-location-linear-reference OPTIONAL,      --3855
  cross-street-name     SEQUENCE OF
                        Event-location-cross-street-begin-name OPTIONAL --3229
}
```

This data frame may contain the following data:

geo-location The latitude and longitude of the point.

linear-reference Optionally, a distance marker reference to the point, on a roadway.

cross-street-name For local roads, the name of a street intersecting with the designated local route, or any named point on the designated route.

On state routes, geo-locations and linear references can be expected. On local roads, geo-locations and cross-street names are typically provided.

1.5.7.2.1.1 Geolocation

The ASN.1 definition for this frame is as follows:

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

This frame contains the following data:

latitude	The latitude of a point, expressed as an integer in micro-degrees.
longitude	The longitude of a point, expressed as an integer in micro-degrees. Note that this value is negative in almost all of North America, indicating points west of the Prime Meridian.

An example of XML for this frame is as follows:

```
<geo-location>
  <latitude>45000000</latitude>
  <longitude>-120000000</longitude>
</geo-location>
```

1.5.8 Event Times

The ASN.1 definition for this frame is as follows:

```
EventTimes ::= SEQUENCE
{
  update-time      DateTimeZone,
  valid-period     ValidPeriod,
  start-time       DateTimeZone OPTIONAL,
  recurrent-times  SEQUENCE OF RecurrentTime OPTIONAL
  active-periods  SEQUENCE OF ActivePeriod OPTIONAL
}
```

This data frame may contain the following data:

<i>update-time</i>	The date/time/zone when the event element was validated, i.e. actually observed or calculated, or otherwise confirmed to be correct
<i>valid-period</i>	The time period during which the event element is valid
<i>start-time</i>	Optionally, 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, as of the <i>update-time</i> .
<i>recurrent-times</i>	Optionally, one or more time periods during which an event element may recur, in terms of the days of the week and the times on those days that the event occurs.

active-periods

Optionally, one or more time periods during which an event element may be active, in terms of the date/time/zone when the event starts and the date/time/zone the event ends.

All times shall be expressed as local times at the primary location of the event. UTC offsets must be valid for the date and time specified in the event time. For example, in Maine, any message time stamp that refers to the summer daylight savings period is required to have an offset of -0400 (Eastern Daylight Time).

An example of XML for this frame is as follows:

```
<times>
  <update-time>
    <date>20080625</date>
    <time>201225</time>
    <utc-offset>-0400</utc-offset>
  </update-time>
  <valid-period>
    <!-- The valid period goes here --!>
  </valid-period>
  <start-time>
    <date>20080625</date>
    <time>201222</time>
    <utc-offset>-0400</utc-offset>
  </start-time>
  <recurrent-times>
    <!-- The recurrent times go here --!>
  </recurrent-times>
  <active-periods>
    <!-- The active periods go here --!>
  </active-periods>
</times>
```

1.5.8.1 Valid Period

The ASN.1 definition for this frame is as follows:

```
ValidPeriod ::= CHOICE
{
  end-time          DateTimeZone,
  duration          Event-timeline-estimated-duration    --3279
}

```

This data frame must contain one of the following data structures:

end-time The date/time/zone when the event element is expected to end. At this time, the element detail will be considered to have ended. The event element shall be deleted or archived, unless the valid period is updated before that time/date.

duration The expected duration of the event element, measured in minutes starting from the update-time (or the *start-time*, if it is specified and is

later than 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).

If an event's duration crosses over a change to or from daylight saving time, the duration will retain its specified time interval. For example, an event occurs in a state with daylight saving time at midnight on 10/30/2008, having a duration of four hours, will end four hours later, at 3 AM on 10/31/2008—not at 4 AM, as would be the case on any other night.

An example of XML for the 'end time' choice is as follows:

```
<valid-period>
  <end-time>
    <date>20080624</date>
    <time>201222</time>
    <utc-offset>-0400</utc-offset>
  </end-time>
</valid-period>
```

An example of XML for the 'duration' choice is as follows. Note that the duration is specified in minutes:

```
<valid-period>
  <duration>30</duration>
</valid-period>
```

1.5.8.2 Recurrent Time

The ASN.1 definition for this frame is as follows:

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

This data frame may contain the following data:

<i>recurrent-period</i>	One or more named periods within which the event is in effect, e.g. Sundays.
<i>schedule-times</i>	Optionally, a sequence of times during which the event is in effect.
<i>utc-offset</i>	Optionally, the offset of the scheduled times from Coordinated Universal Time.

This data frame is used to describe a series of recurring time periods during which an event is active, For instance, an event might be active on Mondays and Wednesdays from 2:00pm to 3:00pm, and Fridays from 5:00pm to 7:00pm.

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.

An example of XML for this frame is as follows:

```
<recurrent-time>
  <recurrent-period>
    <days-of-the-week>
      <day-of-the-week>Monday</day-of-the-week>
      <day-of-the-week>Tuesday</day-of-the-week>
    </days-of-the-week>
  </recurrent-period>
  <schedule-times>
    <schedule-time>01300515</schedule-time>
    <schedule-time>09301615</schedule-time>
  </schedule-times>
  <utc-offset>-0600</utc-offset>
</recurrent-time>
```

1.5.8.2.1 Event Period

Optionally, this frame can be used one or more times to describe the days of the week upon which an event is in effect. For instance, it could contain Mondays, Wednesdays, and Fridays.

The ASN.1 definition for this frame is as follows:

```
EventPeriod ::= SEQUENCE
{
  days-of-the-week    SEQUENCE OF Event-timeline-schedule-days-of-the-week,
                                                              --3282
}

```

This frame contains the following data:

days-of-the-week One or more days of the week to which the event applies. (See FEU.xsd for the valid values of this enumeration.)

1.5.8.3 Active Period

The ASN.1 definition for this frame is as follows:

```
ActivePeriod ::= SEQUENCE
{
  period-start-time   DateTimeZone,
  period-end-time     DateTimeZone
}

```

This data frame must contain the following data structures:

period-start-time The date/time/zone when the active period starts.
period-end-time The date/time/zone when the active period is expected to end.

An example of XML for this frame is as follows:

```

<active-periods>
  <active-period>
    <period-start-time>
      <date>20080624</date>
      <time>201222</time>
      <utc-offset>-0400</utc-offset>
    </period-start-time>
    <period-end-time>
      <date>20080625</date>
      <time>201222</time>
      <utc-offset>-0400</utc-offset>
    </period-end-time>
  </active-period>
</ active-periods>

```

1.5.9 Event Lane

This data frame allows users to indicate lane effects in one or both directions, on various types of lanes. If desired, it is also possible to say how many lanes are affected *without* specifying which ones.

The ASN.1 definition for this frame is as follows:

```

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
  lanes-impact-type    Event-lanes-impact-type OPTIONAL,
  event-lanes-affected SEQUENCE OF Event-lanes-affected OPTIONAL --3219
}

```

This frame may contain the following data:

<i>lanes-type</i>	Optionally, the type of lanes that are described by this element. (See FEU.xsd for the valid values of this enumeration)
<i>link-direction</i>	Optionally, the direction of travel of the affected lanes.
<i>lanes-total-original</i>	Optionally, the original number of lanes available in this direction and of this type, prior to this event.
<i>lanes-total-affected</i>	Optionally, the number of these lanes affected by this event.
<i>lanes-impact-type</i>	Optionally, the type of impact this event has on the affected lanes. (See FEU.xsd for the valid values of this enumeration)
<i>event-lanes-affected</i>	Optionally, one or more specific lanes affected by this event.

Each element of the *event-lanes-affected* sequence is either a "1" (indicating that the lane is affected by this event) or a "0" (indicating that it is not affected). Lanes are referenced from left to right.

If *lanes-total-original* is specified along with *event-lanes-affected*, the *event-lanes-affected* sequence must have the same number of elements in it as is specified in *lanes-total-original*. Also, if *lanes-total-affected* is also specified, then this sequence must have the same number of "1" entries as is specified in *lanes-total-affected*.

An example of XML for this frame is as follows:

```
<lanes>
  <lane>
    <lanes-type>through lanes</lanes-type>
    <lanes-total-original>5</lanes-total-original>
    <lanes-total-affected>3</lanes-total-affected>
    <lanes-impact-type>closed</lanes-impact-type>
    <event-lanes-affected>
      <event-lanes-affected-item>1</event-lanes-affected-item>
      <event-lanes-affected-item>1</event-lanes-affected-item>
      <event-lanes-affected-item>1</event-lanes-affected-item>
      <event-lanes-affected-item>0</event-lanes-affected-item>
      <event-lanes-affected-item>0</event-lanes-affected-item>
    </event-lanes-affected>
  </lane>
</lanes>
```

1.5.10 Detour

This data frame allows users to describe a currently active detour.

The ASN.1 definition for this frame is as follows:

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

This frame may contain the following data:

<i>detour-type</i>	The type of detour that is described by this element. (See FEU.xsd for the valid values of this enumeration)
<i>destination</i>	Optionally, the destination of the detour.
<i>location-on-detour</i>	Optionally, one or more points on the detour route.

An example of XML for this frame is as follows:

```
<detour>
  <detour-type>proposed alternate route</detour-type>
  <location-on-detour>
    <location-on-detour-item>
      <link-ownership>local road</link-ownership>
      <route-designator>unknown local road</route-designator>
      <primary-location>
```

```

    <geo-location>
      <latitude>41232015</latitude>
      <longitude>-95837816</longitude>
    </geo-location>
  </primary-location>
  <link-direction>both directions</link-direction>
</location-on-detour-item>
</location-on-detour>
</detour>

```

1.5.10.1 Landmark

The ASN.1 definition for this frame is as follows:

```

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
}

```

This data frame may contain the following data:

<i>landmark-type</i>	The type of landmark that is described by this element. (See FEU.xsd for the valid values of this enumeration)
<i>landmark-name</i>	The name of the landmark.
<i>landmark-point-name</i>	Optionally, the name of the point within the landmark.
<i>location-rank</i>	Optionally, ranking of the location (10 being highest).
<i>geo-location</i>	Optionally, the location of the landmark.
<i>upward-area-reference</i>	Optionally, the area in which the landmark is located.

An example of XML for this frame is as follows:

```

<landmark>
  <landmark-type>rail yard</landmark-type>
  <landmark-name>Iowa Interstate Railroad, Council Bluffs Yard</landmark-name>
  <landmark-point-name>Entrance</landmark-point-name>
  <location-rank>5</location-rank>
  <geo-location>
    <latitude>41231923</latitude>
    <longitude>-95834936</longitude>
  </geo-location>
  <upward-area-reference>
    <area-id>1916860</area-id>
    <area-name>Council Bluffs</area-name>
    <location-rank>3</location-rank>
  </upward-area-reference>
</landmark>

```

2. XML Direct Interface

2.1 Overview

When carried out using XML Direct, data transferred between the Hub and sending/receiving centers will use a web server to publish documents that represent the current state of relevant traffic events, using the HTTP protocol (Hypertext Transport Protocol, which is the protocol normally used to communicate between web servers and web browsers). The message payloads will consist of Extensible Markup Language (XML)-formatted messages.

Note that the XML Direct interface can be used either to publish data from the Hub so that external clients may access it; or to provide a mechanism for inserting data into the Hub.

2.2 Output Interface

To provide data to external systems using XML Direct interface, the Hub will be set up to periodically publish its data to a specific file (one per data type per agency) that is accessible by a web server. As part of this configuration, a time interval will be specified to determine how frequently this output file will be overwritten with new data—typically, every 30-60 seconds.

The Hub will publish the contents of each file so that it is accessible via a specified Uniform Resource Locator (URL). This publishing is performed in a similar fashion to the way that ordinary web pages (written in HTML—Hypertext Markup Language) are deployed. However, in this case, the contents of the document being published are not an HTML page, but an XML document instead.

Receiving systems shall use an HTTP 'GET' command (as opposed to a "POST" command) to the designated URL shall be used to retrieve the contents of the XML document, which will be in the following format:

```
<FEUMessages>
  <full-event-update xmlns='http://www.northamericanhub.org'>
    <!-- body of first full-event-update message goes here -->
  </ full-event-update>
  <full-event-update xmlns='http://www.northamericanhub.org'>
    <!-- body of second full-event-update message goes here -->
  </ full-event-update>
</FEUMessages>
```

Note that spaces and newlines were inserted in the above example for readability. The actual document contains no whitespace between adjacent XML elements.

Systems that publish data for the Hub to retrieve may follow the same model, but in reverse.

2.3 Authorization, Authentication, and Encryption

The Hub shall require a unique username/password from the client as part of an attempt to download XML documents from the web server. IP “whitelisting” shall not be used as a means of authentication or restricting access.