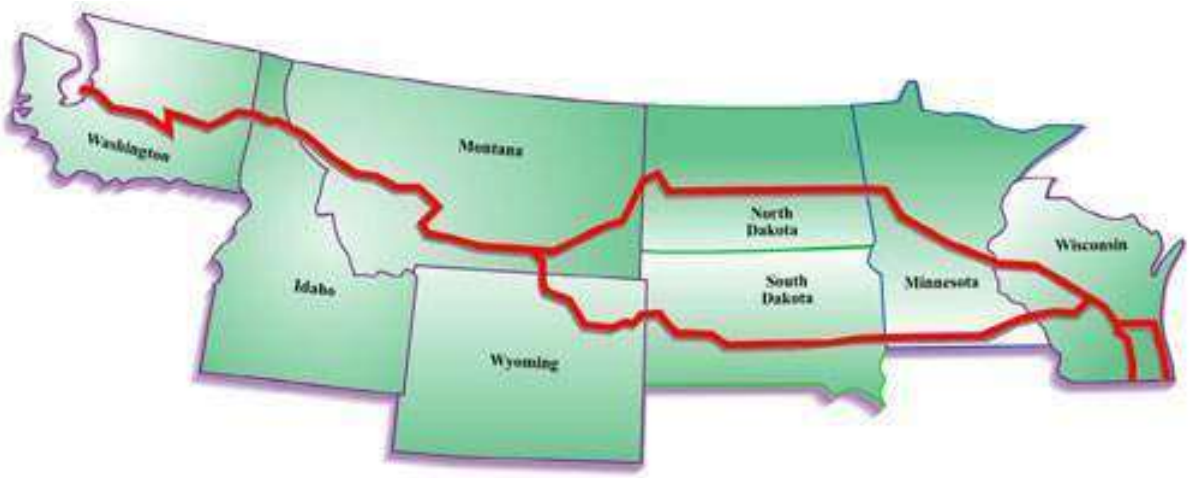

North/West Passage

Project 4.1 Traveler Information Website – Phase 2

Project 4.3 Center to Center Communications Concept of Operations

Task 4

Technical Description Document

23 August 2010 – Final Report

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1 OVERVIEW

1.1 Project Background

I-90/94 corridor crosses eight northwestern states between Wisconsin and Washington. In 2003, these eight states (Wisconsin, Minnesota, North Dakota, South Dakota, Montana, Wyoming, Idaho, and Washington) formed the North/West Passage Transportation Pooled Fund Study to focus on coordinated, cross-border collaboration for Intelligent Transportation Systems. Over the past six years, the North/West Passage has undertaken a series of projects to foster the sharing of traveler information across the corridor:

- In 2006, under Project 2.1, an ITS Integrated Corridor Strategic Plan was developed to guide future collaboration in the corridor. The plan focuses on center-to-center information sharing opportunities, includes a high-level architecture for the corridor, presents an inventory of existing systems, and identifies a coordinated deployment and operational concept for traveler information systems across state borders.
- In 2007, under Project 3.4, a corridor-wide traveler information website for travelers was designed and deployed (http://www.i90i94travelinfo.com/). This website produced the first "branded" image of the corridor to the traveling public and contains an aggregation of traveler information data from each of the eight states.

Phase 4 projects targeted for completion in 2010 continue to integrate traveler information systems and coordinate maintenance operations across state borders: The focus of this project is to assimilate corridor event data from the eight member states and expand the existing website to include these data feeds. Based on the revised scope of work for this effort, six deliverables were identified:

1. Implement the technical solution to ingest data from the member states and structure the data into a consistent, standards-based format
2. Design document describing the proposed modifications to the existing website to display event data.
3. Software modifications to existing website to allow travelers to view some notification of incidents/events, including source code and licensed as Open Source.
4. Technical document describing current data feeds available, and a recommendation for enhanced data exchanges to support web and phone integration.
5. A Technical document describing the design of the second generation website to include improved maps (and icons placed on the maps for incidents ingested from state feeds), with mock-ups and functional descriptions.
6. A detailed schedule to achieve the second generation site, outlining design and deployment; as well as development and ongoing operation costs.

1.2 Purpose

This document satisfies the fourth deliverable for the project – a technical document describing current data feeds available, and a recommendation for enhanced data exchanges to support web and phone integration.

1.3 Objectives

While the primary focus of this project is to aggregate event data from the eight member states and make the data available on the North/West Passage (NWP) Traveler Information Website (TIW), there are a series of broader objectives to be achieved. The long-term vision for the coalition is to encourage and facilitate data sharing between the states. This includes individual states expanding their 511 and traveler information offerings to include data from neighboring states (as opposed to providing links or call transfers) and seeking cost-effective ways to develop new traveler information services that leverage the data from multiple states.

In support of these broader objectives, the project team sought to implement an architecture and data processing framework around industry standards. The three primary considerations that influenced the system design are:

1. Develop a common data format that member states can use to exchange roadway event information
2. Translate event information from the native format of each state into the common format and make it available on the TIW
3. Adopt a common format that will not only support the existing website but also will support mobile web and telephony applications.

1.4 Definitions, acronyms and abbreviations

Acronyms and abbreviations used in this document appear in Table 1.

Table 1: Acronyms and Abbreviations

CSV	Comma Separated Values
ITE	Institute of Transportation Engineers
LRS	Linear Referencing System
NWP	North/West Passage
SOAP	Simple Object Access Protocol
TIW	Traveler Information Website
TMDD	Traffic Management Data Dictionary
UTM	Universal Transverse Mercator
WFS	Web Feature Service
XML	Extensible Markup Language

1.5 References

Corridor-Wide Consistent Major Event Descriptions, North/West Passage Pooled Fund Study, December 18, 2008

Traffic Management Data Dictionary, Institute of Transportation Engineers, http://www.ite.org/standards/TMDD/ accessed 4/16/10

2 TECHNICAL SOLUTION

2.1 Overview

To integrate the disparate feeds from each state's data sources, a conversion/translation engine was deployed based on the Open Roads' Data Gateway platform. The Data Gateway is a middleware solution to facilitate xml-based data exchange. For this project, the Data Gateway will act as a funnel to ingest the multiple feeds from member states and export a stream of xml data formatted to a common standard. A series of custom injectors were developed to link each states' data feed to the data gateway. On the back side, the events captured in the data gateway are translated to a common xml format to facilitate posting on the NWP website and data exchange between the member states.

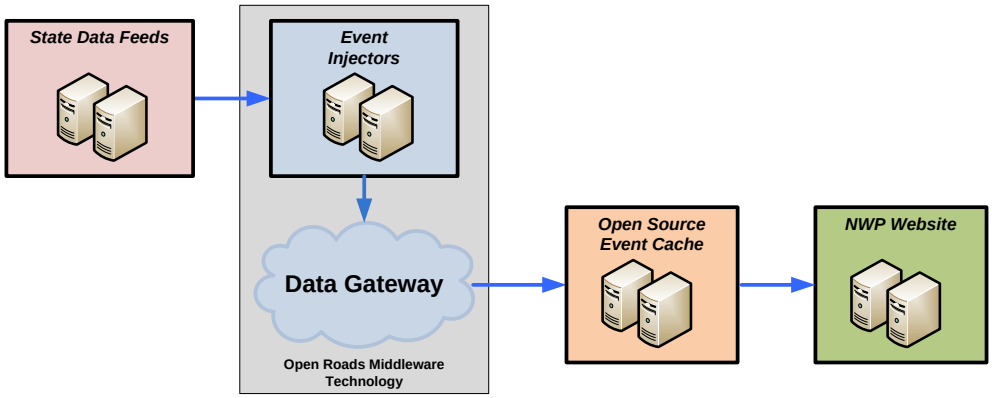

Figure 1: Conceptual Design

2.2 Logical Architecture

The logical architecture appears in Figure 2. The Integration Engine periodically pulls data from each of the sources, converts it to a common format and inserts it into the Event Container. The website accesses the event container whenever a user requests event information for a particular state.

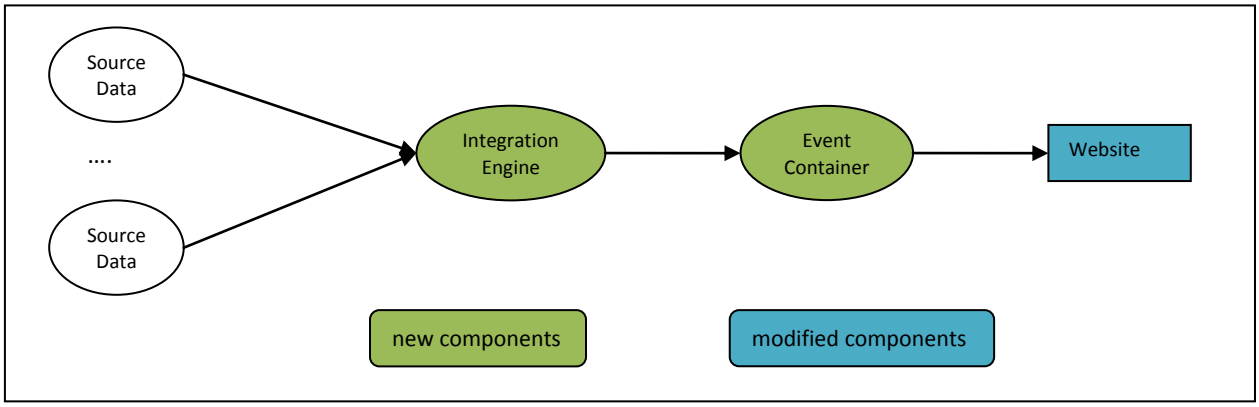

Figure 2: Logical Architecture

2.3 Common Data Format

The data format accepted by the Event Container is a subset of data fields defined by the Traffic Management Data Dictionary (TMDD). TMDD is a standard data exchange format defined by the Institute of Transportation Engineers (ITE). It provides a broad array of data fields for describing roadway event and condition information. The Event

Container uses version 3.0 of the TMDD. Not all of the TMDD fields are supported as many of the fields are not necessary for the website. An exact description of the supported fields is presented as an xml schema and is included in the code distribution for this project.

The Event Container uses the TMDD format, but does not place any restrictions on the phrases used to describe events and conditions. The NWP has previously defined a set of common phrases to use across the corridor. A possibility the coalition may want to consider is modifying the Event Container to either enforce the use of common phrases, or translate phrases into the common set.

2.4 Event container

This is a persistent store for active events. It allows other components to add, update and remove events. The reason it is a distinct component from the Consumer is so that it can be open source. The contract requires that the NWP can interact with the system using only open source software. Splitting the Consumer and Event Container provides an entry point for external state-approved/administered applications

The Event Container is responsible for defining the standard NWP event data format. This format is a subset of the FullEventUpdate element of the TMDD standard.

The Event Container is implemented as servlet, and provides the following methods:

- fetch
  - input – name of an organization (state)
  - output – HTML table of all the current events for that state
- put
  - input – event data in the NWP TMDD format
  - Adds or updates the given event
- remove
  - input – name of organization and optionally an event identifier
  - removes all events for the given org if there is no event identifier, or the individual event if there is an identifier

The Event Container maintains a persistent store for active events only. The store is a Postgres database. Only the data which is provided by the fetch method needs to be persisted.

Table 2 provides a sample of the results of a fetch operation.

Table 2: Sample of Fetch Output

Event Type	Route	Start Point	End Point	Description	Updated
closed	I-94	MM 232		closed, road maintenance operations	1/1/70 10:48 AM
rest area closed	I-94	MM 59		rest area closed	1/1/70 11:56 AM
reduced to one lane	I-90	MM 175	MM 180	reduced to one lane, major road construction, width limit, length limit	1/1/70 11:41 AM

3 INTEGRATION ENGINE

This section describes how the integration engine was deployed to ingest and process the data feeds from the member states. For each state the following areas of discussion are provided:

1. The source of the data (where and how the state makes the data feed available)
2. The format of the data
3. How the data was filtered for posting on the website
4. Specific mappings to convert the events to the standard format
5. Recommendations on how each state could enhance the data feed to support the data sharing objectives of the coalition

3.1 Idaho and Minnesota

3.1.1 Source

Both Idaho and Minnesota use the same condition reporting system, so they also publish their event data in the same manner. A TMDD formatted XML file is made available through HTTP, the Idaho file is can be found at

http://id.carsprogram.org/hub/data/feu-g.xml

The Minnesota file is at

http://mn.carsprogram.org/hub/data/feu-g.xml

Both of these URLs require a username and password, the version of TMDD returned is unknown. The chunk of XML below is an example FullEventUpdate from the Minnesota feed.

```
<feu:full-event-update xmlns:feu="http://www.northamericanhub.org">
    <message-header>
      <sender>
        <organization-id>MNSEG</organization-id>
        <center-id>MNSEG</center-id>
      </sender>
      <message-type-version>1</message-type-version>
      <message-number>30268</message-number>
      <message-time-stamp>
        <date>20100223</date>
        <time>082222</time>
        <utc-offset>-0600</utc-offset>
      </message-time-stamp>
      <message-expiry-time>
        <date>20100223</date>
        <time>162222</time>
        <utc-offset>-0600</utc-offset>
      </message-expiry-time>
    </message-header>
    <event-reference>
      <event-id>MNSEG-30268</event-id>
      <update>3</update>
    </event-reference>
    <event-indicators>
      <event-indicator>
        <status>updated</status>
      </event-indicator>
      <event-indicator>
        <priority>4</priority>
      </event-indicator>
    </event-indicators>
    <headline>
      <headline>
        <winter-driving-index>driving conditions fair</winter-driving-index>
```

```
      </headline>
    </headline>
    <details>
      <detail>
        <element-id>1</element-id>
        <descriptions>
          <description>
            <phrase>
              <winter-driving-index>driving conditions fair
              </winter-driving-index>
            </phrase>
          </description>
          <description>
            <phrase>
              <pavement-condition>icy patches</pavement-condition>
            </phrase>
          </description>
          <description>
            <phrase>
              <visibility-air-quality>blowing snow</visibility-air-quality>
            </phrase>
          </description>
        </descriptions>
        <locations>
          <location>
            <location-on-link>
              <link-ownership>Minnesota</link-ownership>
              <route-designator>US 59</route-designator>
              <primary-location>
                <geo-location>
                  <latitude>43631046</latitude>
                  <longitude>-95580080</longitude>
                </geo-location>
                <linear-reference>11.018</linear-reference>
              </primary-location>
              <secondary-location>
                <geo-location>
                  <latitude>43869763</latitude>
                  <longitude>-95592468</longitude>
                </geo-location>
                <linear-reference>28.178</linear-reference>
              </secondary-location>
              <link-direction>not directional</link-direction>
              <linear-reference-version>0</linear-reference-version>
            </location-on-link>
          </location>
        </locations>
        <times>
          <update-time>
            <date>20100223</date>
            <time>082222</time>
            <utc-offset>-0600</utc-offset>
          </update-time>
          <valid-period>
            <duration>2000000</duration>
          </valid-period>
        </times>
      </detail>
    </details>
</feu:full-event-update>
```

3.1.2 Filters

The injector filters out all events using the following rules:

- Only events from I-90 and I-94 are included.

3.1.3 Mappings

The following table shows how the injector maps data items from the source data to the common TMDD format.

Table 3: Idaho and Minnesota Data Mappings

Original Data Attribute	Destination (Common Format)	Required?
"incident" or "closure" depending on the presence of a incident or closure element in the headline	eventHeadline/headline/accidentsAndIncidents if incident, eventHeadline/headline/closures if closure	Yes
event-reference/event-id	eventReference/eventId	Yes
message-header/sender/organization-id	messageHeader/organizationSending/organizationId	Yes
details/detail/locations/location/location-on-link/route-designator	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	Yes
details/detail/locations/location/location-on-link/primary-location/linear-reference	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	Yes
details/detail/locations/location/location-on-link/secondary-location/linear-reference	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/secondaryLocation/pointName	No
details/detail/times/update-time/date	messageHeader/messageTimestamp/date	Yes
details/detail/times/update-time/time	messageHeader/messageTimestamp/time	Yes
details/detail/times/update-time/utc-offset	messageHeader/messageTimestamp/offset	Yes

3.1.4 Recommendations

- We recommend that the already-defined common terminology be adopted so that all systems produce similar data and that integrators can obtain a collection of all possible data values. The EventCategory field has what appears to be a good looking set of predefined phrases, but there is no documentation provided to show that these are the phrases defined by the Northwest Passage. This should be investigated during future phases of the website development.
- A rich GIS dataset for the state of Idaho will allow web-based systems to draw lines along the roadways between start and end points to give travels a visual representation of impacted segments.

3.2 Montana

3.2.1 Source

Montana traffic data is read from a CSV file. This file is accessed from an FTP site located at www.mdt.mt.gov, the file is roadinfo/MERIDIAN511.CSV. The following line is an example of one event in the CSV file.

```
12-07-2009/14:37:18/I/P00052/.6/600,INCIDENT,NORTHBOUND     LANE,P00052,0.6,0.6,07-08-
2009/9:30 AM,07-16-2009/,,N,LITTLE OR NO DELAY,,,,AS POSTED,,
```

The injector makes the following assumptions:

- Each line contains 17 columns
- Events with the character 'C' in column 0 are construction events
- Events with the character 'I' in column 0 are incidents
- Events whose fourth column has a value of I00090 is on I-90
- Events whose fourth column has a value of I00094 is on I-94

3.2.2 Filters

The injector filters out all events using the following rules:

- Only events from I-90 and I-94 are included.

3.2.3 Mappings

The following table shows how the injector maps data items from the source data to the common TMDD format.

Table 4: Montana Data Mappings

Original Data Attribute	Destination (Common Format)	Required?
Column 0, value between second and third '/'	eventHeadline/headline/accidentsAndIncidents if incident, eventHeadline/headline/closures if closure	No
Columns 3, 4, and 6	eventReference/eventId	No
Not provided in dataset. Hardcoded as "MT"	messageHeader/organizationSending/organizationId	N/A
Column 3	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	No
Column 4	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	No
Column 5	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/secondaryLocation/pointName	No
Column 0, values before and after first '/'	messageHeader/messageTimestamp/date	No
Column 0, values before and after first '/'	messageHeader/messageTimestamp/time	No
Column 0, values before and after first '/'	messageHeader/messageTimestamp/offset	No

3.2.4 Recommendations

- We recommend that the already-defined common terminology be adopted so that all systems produce similar data and that integrators can obtain a collection of all possible data values.
- Lack of a unique event identifier forces systems to piece together their own ID for an event using fields that are likely mutable.
- The event information contains very little descriptive information. Discrete data fields will allow IVR systems to piece together a prerecorded message that sounds natural to a human listener. It is

recommended that the already-defined common terminology be adopted so that all systems produce similar data and that vendors can obtain a collection of all possible data values up front.

- A rich GIS dataset for the state of Montana will allow web-based systems to draw lines along the roadways between start and end points to give travels a visual representation of impacted segments.

3.3 North Dakota

3.3.1 Source

North Dakota provides a WFS server with traffic event data. There are five feature layers available in the feed:

- DOT_SDE.DBO.EMERGENCIES_PT_CS
- DOT_SDE.DBO.EMERGENCIES_PT_ME
- DOT_SDE.DBO.WORK_ZONES_PT
- DOT_SDE.DBO.WORK_ZONES_LINE
- DOT_SDE.DBO.ROAD_CONDITIONS

The WFS service provides and XML based feed with event geometries and attributes. The first priority for this phase of the project is to incorporate incident data so the injector pulls data from the DOT_SDE.DBO.EMERGENCIES_PT_ME layer. The URL that the injector uses is:

http://web.appstest.nd.gov/geoserver/wfs?service=wfs&namespace=NDDOT&version=1.1.0&request=GetFeature&typeName=DOT_SDE.DBO.EMERGENCIES_PT_ME

The following is a sample of the available data feed:

```
<NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME gml:id="DOT_SDE.DBO.EMERGENCIES_PT_ME.14852">
        <NDDOT:HIGHWAY_TYPE>ND</NDDOT:HIGHWAY_TYPE>
        <NDDOT:HIGHWAY>13.0</NDDOT:HIGHWAY>
        <NDDOT:SUFFIX> </NDDOT:SUFFIX>
        <NDDOT:DIRECTION>E</NDDOT:DIRECTION>
        <NDDOT:FR_REF_PT>241.0</NDDOT:FR_REF_PT>
        <NDDOT:BEGIN_DESCRIPTION>ND 13 Mile Marker 241</NDDOT:BEGIN_DESCRIPTION>
        <NDDOT:ACTUAL_START_DATE>2010-03-31T00:00:00.055-05:00</NDDOT:ACTUAL_START_DATE>
        <NDDOT:END_DATE>2010-03-31T00:00:00.055-05:00</NDDOT:END_DATE>
        <NDDOT:WORK_CODE_DESC>Incident</NDDOT:WORK_CODE_DESC>
        <NDDOT:INCIDENT_TYPE>Informational</NDDOT:INCIDENT_TYPE>
        <NDDOT:DISTRICT>2.0</NDDOT:DISTRICT>
        <NDDOT:COMMENTS>
        ND 13, 2 miles west of Lehr, at mile marker 241, has a temporary gravel surface.  Speeds reduced
        to 20 MPH
        </NDDOT:COMMENTS>
        <NDDOT:TEXT_NUM>48</NDDOT:TEXT_NUM>
        <NDDOT:MTEXT_NUM>E-48</NDDOT:MTEXT_NUM>
        <NDDOT:WIDTH_RESTRICTION>0.0</NDDOT:WIDTH_RESTRICTION>
        <NDDOT:HEIGHT_RESTRICTION>0.0</NDDOT:HEIGHT_RESTRICTION>
        <NDDOT:COMMENTS_CHANGED>0</NDDOT:COMMENTS_CHANGED>
        <NDDOT:WIDTHHEIGHT_CHANGED>0</NDDOT:WIDTHHEIGHT_CHANGED>
        <NDDOT:Shape>
                <gml:Point srsName="urn:x-ogc:def:crs:EPSG:26914">
                        <gml:pos>469222.74260000046 5123872.041999999</gml:pos>
                </gml:Point>
        </NDDOT:Shape>
</NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME>
```

The injector makes the following assumptions:

- There is no update timestamp on individual events. There is a single timestamp associated with the entire feed and that is used as the update time for each event.
- The mile markers appearing in the feed are assumed to correspond to the posted mile markers on the highway.

- Events on I-94 will have a HIGHWAY_TYPE of 'I' and the value '94.0' for HIGHWAY.

3.3.2 Filters

The injector filters out all events using the following rules:

- Only events from I-94 are included.

3.3.3 Mappings

The following table shows how the injector maps data items from the source data to the common TMDD format.

Table 5: North Dakota Data Mappings

Original Data Attribute	Destination (Common Format)	Required?
Not provided in dataset. Hardcoded as "ND_DOT"	messageHeader/organizationSending/organizationId	N/A
wfs:FeatureCollection/gml:featureMembers/NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME@gml:id	eventReference/eventId	Yes
wfs:FeatureCollection/gml:featureMembers/NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME/NDDOT:INCIDENT_TYPE	eventHeadline/headline/accidentsAndIncidents	Yes
wfs:FeatureCollection/gml:featureMembers/NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME/NDDOT:COMMENTS	eventElementDetails/eventElementDetail/eventDescriptions/eventDescription/additionalText	Yes
./NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME/NDDOT:HIGHWAY_TYPE *and* /NDDOT:HIGHWAY *(concatenated)*	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	Yes
wfs:FeatureCollection/gml:featureMembers/NDDOT:DOT_SDE.DBO.EMERGENCIES_PT_ME/NDDOT:FR_REF_POINT	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	Yes
wfs:FeatureCollection/@timeStamp	messageHeader/messageTimestamp/date	Yes
wfs:FeatureCollection/@timeStamp	messageHeader/messageTimestamp/time	Yes
wfs:FeatureCollection/@timeStamp	messageHeader/messageTimestamp/offset	Yes

3.3.4 Recommendations

- Aside from the free-text comments attribute, which can be troublesome for IVR systems, the event information contains very little descriptive information. Discrete data fields will allow IVR systems to piece together a prerecorded message that sounds natural to a human listener. It is recommended that the already-defined common terminology be adopted so that all systems produce similar data and that integrators can obtain a collection of all possible data values.
- Instead of a single update time for the entire feed, an update time per event will allow consumers to easily identify exactly what has changed each time they inspect the feed. This will eliminate the need to

reprocess events that have not been updated and will allow travels to know whether the information they are receiving is truly up to date or is stale.

3.4 South Dakota

3.4.1 Source

Traffic information for South Dakota is pulled from 2 CSV files read from an HTTP server. One of these files contains construction information, the other contains incident data. Both of these files are formatted with the same columns. Events may span multiple lines. The construction CSV is located at

http://sddot.meridian-enviro.com/openroads/construction.csv

The incident CSV at

http://sddot.meridian-enviro.com/openroads/events.csv

The following line is an example of one event in the construction CSV file:

```
237082,090_E_,EW,I,90,I-90,no_passing,,,,59,61,1,4/12/2010                6:00,7/29/2010
5:59,0:00:00,0:00:00,0:00:00,0:00:00,0:00:00,0:00:00,0:00:00,0:00:00,0:00:00,0:00:00,0
:00:00,0:00:00,0:00:00,0:00:00,
```

The injector makes the following assumptions:

- Each line contains 29 columns

3.4.2 Filters

The injector filters out all events using the following rules:

- Only events from I-90 and I-94 are included.

3.4.3 Mappings

The following table shows how the injector maps data items from the source data to the common TMDD format.

Table 6: South Dakota Data Mappings

Original Data Attribute	Destination (Common Format)	Required?
"Construction" or "Incident" depending on the CSV file being read	eventHeadline/headline/accidentsAndIncidents if incident, eventHeadline/headline/closures if closure	No
Columns 0, 2, and 12	eventReference/eventId	No
Not provided in dataset. Hardcoded as "SD"	messageHeader/organizationSending/organizationId	N/A
Column 5	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	No
Column 10	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	No
Column 11	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/secondaryLocation/pointName	No
Not provided in dataset, is always 'now'	messageHeader/messageTimestamp/date	N/A
Not provided in dataset, is always 'now'	messageHeader/messageTimestamp/time	N/A
Not provided in dataset, GMT-5 or GMT-6 depending on time of year	messageHeader/messageTimestamp/offset	N/A

3.4.4 Recommendations

- Lack of a unique event identifier forces systems to piece together their own ID for an event using fields that are likely mutable.
- The event information contains very little descriptive information. Discrete data fields will allow IVR systems to piece together a prerecorded message that sounds natural to a human listener. It is recommended that the already-defined common terminology be adopted so that all systems produce similar data and that integrators can obtain a collection of all possible data values.
- A rich GIS dataset for the state of South Dakota will allow web-based systems to draw lines along the roadways between start and end points to give travels a visual representation of impacted segments.

3.5 Washington

3.5.1 Source

The state of Washington provides traffic data using SOAP web service over HTTP. This service requires a valid access code to make requests. The web service can be reached at

http://wsdot.wa.gov/traffic/api/HighwayAlerts/HighwayAlerts.svc

and the WSDL that describes it can be found by appending "?wsdl" to the service URL.

The injector executes the GetAlerts command against the web service and uses the Axis framework to convert the response XML to java objects. A sample alert is below.

```
<a:Alert>
  <a:AlertID>61500</a:AlertID>
  <a:County i:nil="true" />
  <a:EndRoadwayLocation>
    <a:Description i:nil="true" />
    <a:Direction>N</a:Direction>
    <a:Latitude>0</a:Latitude>
    <a:Longitude>0</a:Longitude>
    <a:MilePost>297.25</a:MilePost>
    <a:RoadName>002 </a:RoadName>
  </a:EndRoadwayLocation>
  <a:EndTime i:nil="true" />
  <a:EventCategory>Construction</a:EventCategory>
  <a:EventStatus>Open</a:EventStatus>
  <a:ExtendedDescription />
  <a:HeadlineDescription>Long term road construction with speed
    restriction, and width limit,on US-2, from FARWELL RD to State
    Route 206, since 2:31 PM, 05/18/09, until further notice.
  </a:HeadlineDescription>
  <a:LastUpdatedTime>2010-01-20T04:43:57.513</a:LastUpdatedTime>
  <a:Priority>Medium</a:Priority>
  <a:Region>Eastern</a:Region>
  <a:StartRoadwayLocation>
    <a:Description i:nil="true" />
    <a:Direction>N</a:Direction>
    <a:Latitude>47.772632599</a:Latitude>
    <a:Longitude>-117.378196716</a:Longitude>
    <a:MilePost>295.65</a:MilePost>
    <a:RoadName>002 </a:RoadName>
  </a:StartRoadwayLocation>
  <a:StartTime>2009-05-18T13:31:00</a:StartTime>
</a:Alert>
```

The injector makes the following assumptions:

- Events with the following EventCategory values are treated as incidents: `Alarm, Chemical Spill, Collision, Collision fatality, Emergency closure, Fatality or Possible Fatality, Hazardous material, Hazmat, Incident, Major incident, Medical emergency, Multi-vehicle collision, Rock Slide, Rollover, Semi Truck Involved, Snow slide, Vehicle fire, Water over Roadway`
- Events with the following EventCategory values are treated as closures: `Avalanche Control, Bridge Closed, Closure, Construction, Debris blocking, Lane Closure, Pass Closure, Road Block, Rocks - Closure, Two or more lanes closed`
- Events on I-90 will have a RoadName value of '090'.

3.5.2 Filters

The injector filters out all events using the following rules:

- Only events from I-90 are included.
- Only events with one of the EventCategory values listed above are included.

3.5.3 Mappings

The following table shows how the injector maps data items from the source data to the common TMDD format.

Table 7: Washington Data Mappings

Original Data Attribute	Destination (Common Format)	Required?
alert/eventCategory	eventHeadline/headline/accidentsAndIncidents if incident, eventHeadline/headline/closures if closure	Yes
alert/alertID	eventReference/eventId	Yes
Not provided in dataset. Configured as "WashingtonDOT"	messageHeader/organizationSending/organizationId	N/A
alert/startRoadwayLocation/roadName	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	Yes
alert/startRoadwayLocation/milePost or alert/startRoadwayLocation/description (whichever is present)	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	Yes
alert/startRoadwayLocation/milePost or alert/startRoadwayLocation/description (whichever is present)	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/secondaryLocation/pointName	No
alert/headlineDescription	eventElementDetails/eventElementDetail/eventDescriptions/eventDescription/additionalText	No
alert/lastUpdatedTime	messageHeader/messageTimestamp/date	Yes
alert/lastUpdatedTime	messageHeader/messageTimestamp/time	Yes
alert/lastUpdatedTime	messageHeader/messageTimestamp/offset	Yes

3.5.4 Recommendations

- It is recommended that the already-defined common terminology be adopted so that all systems produce similar data and that integrators can obtain a collection of all possible data values. The EventCategory field has what appears to be a good looking set of predefined phrases, but there is no documentation provided to show that these are the phrases defined by the Northwest Passage.
- A rich GIS dataset for the state of Washington will allow web-based systems to draw lines along the roadways between start and end points to give travels a visual representation of impacted segments.

3.6 Wisconsin

3.6.1 Source

Wisconsin provides a TMDD formatted XML using an HTTP server. Two separate feeds are available, one containing traffic information and another containing lane and ramp closure information. The injector only uses the traffic information feed, which is found at:

http://www.dot.state.wi.us/travel/511/Wis511.xml.gzip

The response from this feed is an XML file that has been gzipped, the TMDD version is 2.1. The feed contains FullEventUpdate elements, as well as RouteData, DMSDeviceStatus, and LinkData elements, but the injector only uses the FullEventUpdates. The following is a sample of a FullEventUpdate element:

```
<fullEventUpdate>
  <message-header>
    <organization-sending>
      <organization-id>WisDOT</organization-id>
      <center-id>WisDOT IMS</center-id>
      <center-name>Milwaukee Center</center-name>
      <contact-details>
        <contact-id>101</contact-id>
        <person-name>John Mishefske</person-name>
      </contact-details>
    </organization-sending>
    <message-type-id>FEU</message-type-id>
    <message-type-version>1</message-type-version>
    <message-number>1</message-number>
    <message-time-stamp>
      <date>20100329</date>
      <time>143059</time>
      <offset>0500</offset>
    </message-time-stamp>
  </message-header>
  <event-reference>
    <event-id>31164</event-id>
    <event-update>1</event-update>
  </event-reference>
  <event-indicators>
    <event-indicator>
      <status>current</status>
    </event-indicator>
  </event-indicators>
  <event-headline>
    <headline>
      <accidentsAndIncidents>accident</accidentsAndIncidents>
    </headline>
  </event-headline>
  <event-element-details>
    <event-element-detail>
      <element-descriptions>
        <element-description>
          <phrase>
            <accidentsAndIncidents>accident</accidentsAndIncidents>
          </phrase>
        </element-description>
        <element-description>
          <additional-text>
            <description>
2010-03-29-0020 - accident
5 impact 10 priority 10
US 12 EB @ CTH O
</description>
          </additional-text>
        </element-description>
        <element-description>
          <phrase>
            <accidentsAndIncidents>full roadway closure in both directions</accidentsAndIncidents>
          </phrase>
        </element-description>
      </element-descriptions>
      <element-locations>
        <element-location>
          <location-on-link>
            <link-ownership>WisDOT</link-ownership>
            <link-designator>US 12 EB</link-designator>
```

```
            <link-id>866</link-id>
            <primary-location>
              <geo-location>
                <latitude>42798341</latitude>
                <longitude>-88641114</longitude>
              </geo-location>
              <link-name>US 12 EB</link-name>
              <point-name>CTH O</point-name>
              <landmark-location>
                <landmark-type>access point</landmark-type>
                <landmark-name>CTH O</landmark-name>
                <landmark-point-name>866:0</landmark-point-name>
              </landmark-location>
              <upward-area-reference>
                <area-id>55127</area-id>
                <area-name>WALWORTH</area-name>
              </upward-area-reference>
            </primary-location>
            <link-direction>both directions</link-direction>
          </location-on-link>
        </element-location>
      </element-locations>
      <element-times>
        <update-time>
          <date>20100329</date>
          <time>113155</time>
          <offset>0500</offset>
        </update-time>
        <valid-period>
          <estimated-duration>180</estimated-duration>
        </valid-period>
      </element-times>
      <element-lanes>
        <lanes-total-affected>2</lanes-total-affected>
      </element-lanes>
    </event-element-detail>
  </event-element-details>
</fullEventUpdate>
```

3.6.2 Filters

The injector filters out all events using the following rules:

- Only events from I-90 and I-94 are included.

3.6.3 Mappings

The following table shows how the injector maps data items from the source data to the common TMDD format.

Table 8: Wisconsin Data Mappings

Original Data Attribute	Destination (Common Format)	Required?
/MSG_WisDOT_ITS/fullEventUpdate/event-headline/headline/accidentsAndIncidents	eventHeadline/headline/accidentsAndIncidents if incident, eventHeadline/headline/closures if closure	Yes
/MSG_WisDOT_ITS/fullEventUpdate/event-reference/event-id	eventReference/eventId	Yes
/MSG_WisDOT_ITS/fullEventUpdate/message-header/organization-sending/organization-id	messageHeader/organizationSending/organizationId	Yes
/MSG_WisDOT_ITS/fullEventUpdate/element-locations/element-location/location-on-link/link-designator	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	Yes
/MSG_WisDOT_ITS/fullEventUpdate/event-element-details/event-element-detail/element-locations/element-location/location-on-link/primary-location/pointName	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	Yes
/MSG_WisDOT_ITS/fullEventUpdate/event-element-details/event-element-detail/element-locations/element-location/location-on-link/secondary-location/pointName	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/secondaryLocation/pointName	Yes
/MSG_WisDOT_ITS/fullEventUpdate/ event-element-details/event-element-detail/element-times/update-time/date	messageHeader/messageTimestamp/date	Yes
/MSG_WisDOT_ITS/fullEventUpdate/ event-element-details/event-element-detail/element-times/update-time/time	messageHeader/messageTimestamp/time	Yes
event-element-details/event-element-detail/element-times/offset	messageHeader/messageTimestamp/offset	Yes

3.6.4 Recommendations

- We recommend that the already-defined common terminology be adopted so that all systems produce similar data and that integrators can obtain a collection of all possible data values.
- A rich GIS dataset for the state of Wisconsin will allow web-based systems to draw lines along the roadways between start and end points to give travels a visual representation of impacted segments.

3.7 Wyoming

3.7.1 Source

Wyoming provides a data feed for construction events containing a custom event XML data format and is made available through the following HTTP address.

http://www.wyoroad.info/meridian/wycon.xml

The following is a sample entry in the provided data feed.

```
<event timestamp="1277931226000">
   <construction delay_code="4" surface_code="12" length="16.28" completion="1310713200000"/>
   <location>
      <lrs_line route="ML30B" from_milepost="14.47" to_milepost="30.75"/>
   </location>
</event>
```

3.7.2 Filters

The injector filters out all events using the following rules:

- Only events from I-90 and I-94 are included.

3.7.3 Mappings

Source	Destination	Required?
Not provided in dataset. Hardcoded as "SD"	messageHeader/organizationSending/organizationId	yes
Not provided in dataset. Hardcoded as "Construction"	eventHeadline/headline/closures	yes
event/construction[@delay_code] *+* " " *+* event/construction[@length]	eventElementDetails/eventElementDetail/eventDescriptions/eventDescription/additionalText	yes
event/location/lrs_line[@route]	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/linkDesignator	yes
event/location/lrs_line[@from_milepost]	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/primaryLocation/pointName	yes
event/location/lrs_line[@to_milepost]	eventElementDetails/eventElementDetail/eventLocations/eventLocation/locationOnLink/secondaryLocation/pointName	yes
WY-$route$direction$mileMarker	eventReference/eventId	yes

3.7.4 Recommendations

- Lack of a unique event identifier forces systems to piece together their own ID for an event using fields that are likely mutable.

4 SUMMARY

4.1 Current Message Formats

Table 9 shows a summary of high level data feed characteristics for the eight states.

Table 9: Event Feed Summary

	Data Format	Event Type	Map Data
Idaho	TMDD	incidents, closures	lat/lon
Minnesota	TMDD	incidents, closures	lat/lon
Montana	CSV	incidents, closures	LRS
North Dakota	WFS	incidents	UTM
South Dakota	CSV	incidents, construction	LRS
Washington	SOAP	Incidents, closures, construction	lat/lon
Wisconsin	TMDD	incidents	lat/lon
Wyoming	XML	closures, construction	LRS

4.2 Consistent Messages

The NWP already has a thorough plan for producing consistent traveler information messages across all eight states. The implementation of that plan remains uneven across the corridor. Pushing ahead with the adoption of consistent messages will make for a more seamless experience for website users. There are two options for fully achieving the vision set forth in the consistent message study:

- The states can modify their message generation practices to be fully compliant with the consistent message plan. In some cases this would entail updating data entry tools to contain all the common phrases, as well as training operators on best practices for assembling messages.
- The Integration Engine could be augmented to translate phrases from the various source inputs into the common formats.

One consistency aspect which becomes very apparent when viewing real time events from across the corridor is that the states have very different standards for how severe an event must be to warrant reporting. Some states publish events with little or no traffic impacts, and others only publish the most severe events. To the casual reader this difference can cause a very distorted perception of the relative situations in different locations. Again, there are two choices for addressing this issue:

- The states can modify their reporting standards so that all states use the same severity threshold for reporting. Given that many states have their own internal processes which depend on the current reporting standards it seems very unlikely that all member states could make this modification.
- If the states were to include standard impact qualifiers in their messages, then the Integration Engine could filter events based on severity. The corridor wide website could limit its presentation to those severity levels supported by all states, thus providing a consistent view across all states.

4.3 Consistent Mapping Data

Mapping Points

A major goal is to plot incidents on a common map that stretches across all states. A problem arises because each state generates points using their own data, but the common map is based off of a different, national dataset. If a geo-coordinate point is generated based on one dataset there is no guarantee that when plotted against another dataset it will display in the same position relative to other features on the map. Different datasets introduce different measurement errors, so a given landmark may have slightly different coordinates in two different datasets. This means that if a state generates a point on a road using their own data, then that point may not plot directly on the road when placed against another dataset. In practice this is generally not a problem when the points are confined to interstates. Almost all modern geo-datasets are accurate enough for interstates so that there are not significant discrepancies between them. Thus if the problem is limited to interstates then all that is needed to plot points on the corridor website is for all states to provide geo-coordinates (latitudes and longitudes). Currently three of the states do not provide geo-coordinates. To plot incidents on a common map those three states would need to provide lat/lons. Should the NWP decide to begin reporting incidents on smaller roads then it will be necessary to revisit the issue of whether providing coordinates from different sets of source data will still work.

Mapping Lines

Given the sometimes harsh winter conditions along the corridor reporting road conditions is a critical issue. A common way to represent road conditions on a map is to paint the route with an overlay color. When there are multiple data sources involved, the process of painting a line is far less forgiving than drawing a point. Minor differences in datasets can cause painted overlays to look sloppy and unprofessional. In some cases combining overlays and basemaps from different sources will work, but it is generally not completely reliable. A solution is to take the road segment end points and snap them to the route in the basemap data. The next step is to generate an overlay geometry with the snapped endpoints using the basemap data. The functions for snapping points and generating overlays may or may not be standard features for a particular mapping solution. These features should be a consideration in making decisions about potential mapping solutions.

4.4 Future Directions

With the consistent event description project the NWP established a plan and approach for sharing traffic information. This project adds the infrastructure for sharing that data. It is now possible to easily and conveniently see data from all eight states in a common format and from a single source. This takes the issue of consistent messages out of the realm of an abstract problem, and makes it a concrete topic that can be wrestled with in very practical terms. The NWP has a tool which will help identify what steps they want to take to make their traveler information even more consistent. Those steps may be institutional measures such as adopting new internal tools or changing operator training practices. They may also be technological tools which provide automatic translations from individual state messages to corridor-wide consistent messages. Whatever the future steps are this data sharing infrastructure is flexible enough to grow alongside other changes.