Houston TranStar Smart Work Zone Data Requirements

The Texas Department of Transportation (TxDOT) has established requirements for any data being gathered by Smart Work Zone systems and being collected by Houston TranStar. The requirements are established for integrating the information from these systems into the existing TxDOT system at Houston TranStar. TxDOT utilizes this data for monitoring the smart work zone systems and for supplementing its existing network of monitoring equipment to meet the traffic management and traveler information functions. The data elements described in this document include data from 1) Radar Sensors, 2) Portable Changeable Message Signs, and 3) Roadside Cameras.

Any Smart Work Zone system being utilized by the TxDOT Houston District needs to conform to these data requirements. It is assumed that this data is provided to TranStar in real-time unless otherwise noted.

Data Contents

Radar Data

Identification and location information should be provided for each radar sensor. Any changes to the location of the radar sensor during the duration of the project should be reflected in the location data at the time of the change.

Data Element	Description
Identifier	A unique identifier for the radar location.
Latitude	The decimal based latitude of the radar location.
Longitude	The decimal based longitude of the radar location.

The radar data is to be provided in one minute aggregation bins for each lane covered by each radar sensor along with a summary across all lanes. The following data elements should be provided.

Data Element	Description
Lane Number	The lane number of the sensor with the lane closest to the sensor starting with the number 1.
Lane Status	The status of the lane with 1 indicating that the lane is operational and 0 indicating that the lane is not.
Total Volume	The total number of vehicles being detected by the sensor for the lane during the aggregation period.
Small Vehicle Volume	The total number of vehicles classified as small based on the vehicle length threshold on the radar sensor.
Medium Vehicle Volume	The total number of vehicles classified as medium based on the vehicle length threshold on the radar sensor.
Large Vehicle Volume	The total number of vehicles classified as large based on the vehicle length threshold on the radar sensor.
Average Speed	The average vehicle speed for the vehicles in the lane for the aggregation period.
Occupancy	The average lane occupancy percentage for the aggregation period.
Timestamp	The timestamp at which the data for the sensor is being collected and aggregated. The timestamp should have a resolution down the nearest second.

The complete lane summary should include the total volume for all lanes, average speed across all lanes (not including lanes where volume is 0), and average occupancy across all lanes.

Camera Data

Identification and location information should be provided for each camera. Any changes to the location of the camera during the duration of the project should be reflected in the location data at the time of the change.

Data Element	Description
Identifier	A unique identifier for the camera.
Latitude	The decimal based latitude of the camera.
Longitude	The decimal based longitude of the camera.

The Smart Work Zone system shall provide the status of each camera along with the web address for accessing static snapshots. The following data elements should be provided.

Data Element	Description
Status	The status of each camera indicating whether it is online or offline.
URL	The web address for access static snapshots from the camera.
Roadway	The name of the road that the camera is on.
Direction	The direction of travel (North, South, East, West) that the camera is closest to.
Sequence Number	The order of the camera, beginning with the number 1, as installed sequentially on a roadway.
Timestamp	The timestamp at which the camera snapshot was last updated. The timestamp should have a resolution down the nearest second.

Camera Snapshot Access

The URL provided by the camera data will be used by TxDOT to access snapshots made available for each camera. The URL shall be a direct link to a JPG image consisting of a camera snapshot. The JPG should display the date and timestamp that the image was captured and be a minimum resolution of 320 (width) x 240 (high) pixels. The Smart Work Zone system shall provide updates to the snapshots on the URL at a minimum of one minute. The URL shall be available for accessing the snapshots on demand.

Portable Changeable Message Sign (PCMS) Message Data

Identification and location information should be provided for each PCMS. Any changes to the location of the PCMS during the duration of the project should be reflected in the location data at the time of the change.

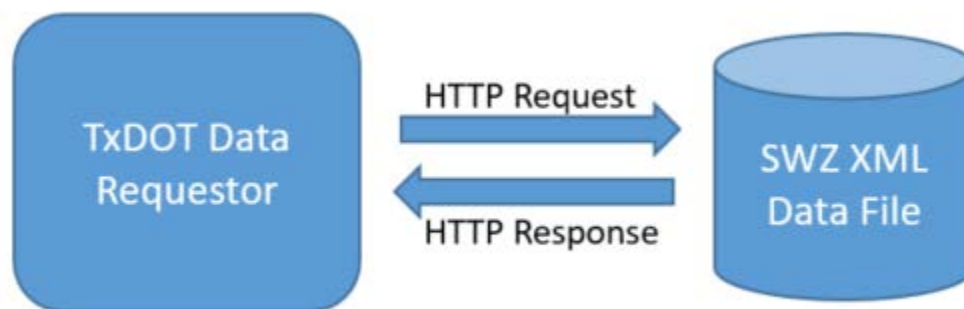| Data Element	Description
Identifier	A unique identifier for the PCMS.
Latitude	The decimal based latitude of the PCMS.
Longitude	The decimal based longitude of the PCMS.

The Smart Work Zone system shall provide the status of each PCMS, including the current message on the PCMS, every 30 seconds. The following data elements should be provided.

Data Element	Description
Status	The status of each PCMS indicating whether it is online or offline.
Message	The current message being displayed on the PCMS.
Roadway	The name of the road that the PCMS is displaying messages on.

Direction	The direction of travel (North, South, East, West) that the PCMS is displaying messages to.
Sequence Number	The order of the PCMS, beginning with the number 1, as installed sequentially on a roadway by direction.
Timestamp	The timestamp at which the PCMS message was posted. The timestamp should have a resolution down the nearest second.

Data Access

All data is to be provided via a secure Http server and accessible by TxDOT and Houston TranStar on demand using an Http request. The data requested should reflect the most current information being collected by the Smart Work Zone system. The data flow is shown in the diagram below.

Data Format

The data is to be provided to TxDOT/TranStar in a single Xml file. The Xml file should conform to the schemas shown below.

Radar Sensor Data

```xml
<xs:element name="trafficCondData">
    <xs:complexType>
      <xs:sequence>
       <xs:element name="net">
        <xs:complexType>
         <xs:sequence>
          <xs:element name="trafficCond" maxOccurs="unbounded" minOccurs="0">
           <xs:complexType>
            <xs:sequence>
             <xs:element type="xs:string" name="type"/>
             <xs:element type="xs:byte" name="volume"/>
             <xs:element type="xs:byte" name="speed"/>
             <xs:element type="xs:byte" name="occupancy"/>
             <xs:element name="lane-data">
              <xs:complexType>
                <xs:sequence>
                  <xs:element name="lane-data-item" maxOccurs="unbounded" minOccurs="0">
```

```xml
                <xs:complexType>
                 <xs:sequence>
                  <xs:element type="xs:byte" name="detector-lane-number"/>
                  <xs:element type="xs:byte" name="lane-status"/>
                  <xs:element type="xs:byte" name="lane-vehicle-count"/>
                  <xs:element type="xs:byte" name="lane-vehicle-count1"/>
                  <xs:element type="xs:byte" name="lane-vehicle-count2"/>
                  <xs:element type="xs:byte" name="lane-vehicle-count3"/>
                  <xs:element type="xs:byte" name="occupancy"/>
                  <xs:element type="xs:byte" name="lane-vehicle-speed"/>
                 </xs:sequence>
                </xs:complexType>
               </xs:element>
              </xs:sequence>
             </xs:complexType>
            </xs:element>
            <xs:element type="xs:string" name="timestamp"/>
           </xs:sequence>
           <xs:attribute type="xs:string" name="id" use="optional"/>
           <xs:attribute type="xs:short" name="netId" use="optional"/>
          </xs:complexType>
         </xs:element>
        </xs:sequence>
        <xs:attribute type="xs:short" name="id"/>
        <xs:attribute type="xs:string" name="name"/>
       </xs:complexType>
      </xs:element>
     </xs:sequence>
    </xs:complexType>
   </xs:element>
```

Radar Location Data

```xml
 <xs:element name="networkData">
     <xs:complexType>
      <xs:sequence>
       <xs:element name="net">
        <xs:complexType>
         <xs:sequence>
          <xs:element name="network" maxOccurs="unbounded" minOccurs="0">
           <xs:complexType>
            <xs:sequence>
             <xs:element name="nodeData">
              <xs:complexType>
               <xs:sequence>
                <xs:element name="node">
                 <xs:complexType>
                  <xs:sequence>
                   <xs:element type="xs:string" name="name"/>
```

```xml
                <xs:element type="xs:int" name="lat"/>
                <xs:element type="xs:int" name="lon"/>
              </xs:sequence>
              <xs:attribute type="xs:string" name="id" use="optional"/>
              <xs:attribute type="xs:short" name="netId" use="optional"/>
            </xs:complexType>
          </xs:element>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
  <xs:attribute type="xs:string" name="id" use="optional"/>
  <xs:attribute type="xs:short" name="netId" use="optional"/>
</xs:complexType>
</xs:element>
</xs:sequence>
<xs:attribute type="xs:short" name="id"/>
<xs:attribute type="xs:string" name="name"/>
</xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>
</xs:element>
```

PCMS Message and Location Data

```xml
<xs:element name="dmsData">
    <xs:complexType>
     <xs:sequence>
      <xs:element name="net">
       <xs:complexType>
        <xs:sequence>
         <xs:element name="dms" maxOccurs="unbounded" minOccurs="0">
          <xs:complexType>
           <xs:sequence>
             <xs:element type="xs:string" name="name"/>
             <xs:element type="xs:int" name="lat"/>
             <xs:element type="xs:int" name="lon"/>
             <xs:element type="xs:string" name="status"/>
             <xs:element type="xs:byte" name="rows"/>
             <xs:element type="xs:byte" name="columns"/>
             <xs:element type="xs:string" name="beaconStatus"/>
             <xs:element type="xs:string" name="message"/>
             <xs:element name="equipLoc">
              <xs:complexType>
               <xs:sequence>
                 <xs:element type="xs:string" name="roadway"/>
                 <xs:element type="xs:string" name="direction"/>
               </xs:sequence>
```

```
          </xs:complexType>
        </xs:element>
        <xs:element type="xs:byte" name="roadwayOrder"/>
        <xs:element type="xs:string" name="timestamp"/>
      </xs:sequence>
      <xs:attribute type="xs:string" name="id" use="optional"/>
      <xs:attribute type="xs:short" name="netId" use="optional"/>
    </xs:complexType>
   </xs:element>
  </xs:sequence>
  <xs:attribute type="xs:short" name="id"/>
  <xs:attribute type="xs:string" name="name"/>
 </xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>
</xs:element>
```

Camera Location Data

```
<xs:element name="dmsData">
    <xs:complexType>
     <xs:sequence>
      <xs:element name="net">
       <xs:complexType>
        <xs:sequence>
         <xs:element name="dms" maxOccurs="unbounded" minOccurs="0">
          <xs:complexType>
           <xs:sequence>
            <xs:element type="xs:string" name="name"/>
            <xs:element type="xs:int" name="lat"/>
            <xs:element type="xs:int" name="lon"/>
            <xs:element type="xs:string" name="status"/>
            <xs:element type="xs:byte" name="rows"/>
            <xs:element type="xs:byte" name="columns"/>
            <xs:element type="xs:string" name="beaconStatus"/>
            <xs:element type="xs:string" name="message"/>
            <xs:element name="equipLoc">
             <xs:complexType>
              <xs:sequence>
               <xs:element type="xs:string" name="roadway"/>
               <xs:element type="xs:string" name="direction"/>
              </xs:sequence>
             </xs:complexType>
            </xs:element>
            <xs:element type="xs:byte" name="roadwayOrder"/>
            <xs:element type="xs:string" name="timestamp"/>
           </xs:sequence>
```

```
        <xs:attribute type="xs:string" name="id" use="optional"/>
        <xs:attribute type="xs:short" name="netId" use="optional"/>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
  <xs:attribute type="xs:short" name="id"/>
  <xs:attribute type="xs:string" name="name"/>
    </xs:complexType>
  </xs:element>
  </xs:sequence>
  </xs:complexType>
</xs:element>
```

Camera Snapshot Data

```
<xs:element name="cctvSnapshotData">
  <xs:complexType>
    <xs:sequence>
      <xs:element name="net">
        <xs:complexType>
          <xs:sequence>
            <xs:element name="cctvSnapshot" maxOccurs="unbounded" minOccurs="0">
              <xs:complexType>
                <xs:sequence>
                  <xs:element type="xs:string" name="name"/>
                  <xs:element type="xs:string" name="status"/>
                  <xs:element type="xs:string" name="timestamp"/>
                  <xs:element type="xs:anyURI" name="snippet"/>
                </xs:sequence>
                <xs:attribute type="xs:string" name="id" use="optional"/>
                <xs:attribute type="xs:short" name="netId" use="optional"/>
              </xs:complexType>
            </xs:element>
          </xs:sequence>
          <xs:attribute type="xs:short" name="id"/>
          <xs:attribute type="xs:string" name="name"/>
        </xs:complexType>
      </xs:element>
    </xs:sequence>
  </xs:complexType>
</xs:element>
```

Change Management

Any changes to any element of the system during the life of the Smart Work Zone Project should be submitted to TxDOT Houston personnel in advance of the change. The Smart Work Zone vendor will notify TxDOT in writing (e-mail) describing the change and its impact. TxDOT will specify the personnel that need to be notified of the changes in advance of the project.

Examples of changes include modifications to 1) data elements, 2) sensor, camera, and PCMS locations, 3) sensor, camera, and PCMS configurations, and 4) camera URLs.

Additionally, any software changes made to the smart work zone system impacting the data contents or Xml feed location should be relayed to TxDOT Houston personnel in advance of the change.