The Texas Freight Network Technology and Operations Plan (FNTOP) developed by the Texas Department of Transportation (TxDOT) Freight Planning Branch builds upon the goals introduced in the 2018 Texas Freight Mobility Plan (TFMP) and outlines identified strategies to guide technology and operations-related investments on the Texas Multimodal Freight Network (TMFN). The FNTOP engaged key public and private sector stakeholders throughout the development of the strategies to obtain feedback, suggest refinements, and evaluate priority levels. The establishment of priorities informed TxDOT’s selection of six strategies for Concept of Operations development, which is the next critical step to the implementation of the FNTOP.

A Concept of Operations document provides a high-level overview of a proposed technology concept that is traceable to stakeholder needs. The Safety Warning Detection System Concept of Operations that was developed as part of the FNTOP follows both Federal Highway Administration (FHWA) guidance as well as approved standards developed by the International Council on Systems Engineering (INCOSE). This document will be accessible to public and private stakeholders as a starting point for the future deployment of this technology concept.

What is a Concept of Operations?

It is a document that provides answers to the following questions:

- **WHY**—What is the problem or opportunity addressed by the system?
- **WHO**—Who are the stakeholders involved with the system?
- **WHAT**—What are the elements and the high-level capabilities of the system?
- **HOW**—How will the system be developed, operated, and/or maintained?
- **WHERE**—What is the geographic and physical extent of the system?
- **WHEN**—What is the sequence of activities that will be performed?

Overview

At a high level, the Safety Warning Detection System would be a notification system that alerts truckers and other road users of situations when a vehicle is operating beyond a safety threshold, such as being too tall, too heavy, or too fast.
**WHY** What is the problem or opportunity addressed by the system?

- **REDUCE** incidences of bridge strikes caused by overheight vehicles, which can cause extended closures for costly repairs, sometimes even forcing prolonged lane closures.
- **IMPROVE** the preservation of infrastructure assets by reducing the number of overweight vehicles on critical facilities.
- **REDUCE** the incidences of speed-related crashes by trucks where lower travel speeds are advised.
- **REDUCE** the incidences of crashes between trucks and other vehicles at intersection locations, particularly in rural areas where stop control and poor sight distance are prevalent.
- **INCREASE** the situational awareness of the Traffic Management Centers (TMCs) as events in the field occur.
- **INCREASE** the responsiveness of TxDOT in repairing infrastructure damage by using real-time notifications to quickly initiate inspections, which reduces the potential for further damage and helps reduce the risk of failure.
- **PROVIDE** real-time notifications of potential hazards ahead so that trucks can divert onto an alternative route.
- **ARCHIVE** and **ANALYZE** notification data to report on the effectiveness of the system in improving the safety of freight operations and increasing the life of infrastructure.

**WHO** Who are the stakeholders involved with the system?

**Owner**
TxDOT Divisions, TxDOT Districts

**Key Stakeholders**
TxDOT Divisions, TxDOT Districts, TxDOT TMCs, Texas Department of Public Safety (TxDPS)

**End-Users**
TxDOT Divisions, TxDOT TMCs, TxDPS, Truckers, Other Roadway Users

**WHAT** What are the elements and the high-level capabilities of the system?

<table>
<thead>
<tr>
<th>FEATURES</th>
<th>MAIN FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real-Time Notifications on Bridge Strike Events</strong></td>
<td>TMC operators would receive a notification in the Advanced Traffic Management System (ATMS) when the detection sensor in the field is triggered by an overheight vehicle. The information could be used to dispatch TxDOT District personnel for immediate inspection and repair, as well as inform law enforcement immediately to initiate an investigation.</td>
</tr>
<tr>
<td><strong>Advanced Warning on Potential Hazards</strong></td>
<td>The overspeed, overweight, intersection conflict, and overheight detection systems would immediately alert vehicles by using a flashing beacon warning sign or messages posted on dynamic message signs (DMSs). The vehicle operator could then exit safely onto an alternative route ahead of a low clearance or load restricted bridge. The operator could also take corrective action ahead of an intersection or curve.</td>
</tr>
<tr>
<td><strong>Roadside Camera to Aid Enforcement</strong></td>
<td>The optional use of roadside cameras could provide information for law enforcement to pursue violators and offenders. Upon detection, a camera would take a photo of the offending vehicle.</td>
</tr>
<tr>
<td><strong>Weigh-in-Motion Systems (WIM)</strong></td>
<td>WIM systems would be installed in advance of bridge crossings or other strategic road assets to notify of overweight conditions. The stations would provide advisory information to trucks and collect information that could aid enforcement. The deployment of the system would add coverage to more freight routes across the State and address the need for more sources of WIM and permanent count station data for planning.</td>
</tr>
</tbody>
</table>
The main anticipated benefits of the system include:

- The safety warning applications would provide notifications to trucks ahead of potential hazards, increasing safety on highways.
- The overheight and overweight vehicle detection systems may have components such as roadside cameras that could capture information that could increase enforcement of violators and help truck navigation system providers update their routing recommendations.
- The system is expected to help reduce damage to bridges, pavement, and other infrastructure, which would increase the life of the infrastructure and reduce the cost of repairs and maintenance needed.
- The system would increase data available to TxDOT for crash safety analysis. The frequency and distribution of detection events could be analyzed spatially with the TxDOT Crash Records Information System data to identify gap areas in the network where safety countermeasures are needed.

### HOW How will the system be developed, operated, and/or maintained?

The sensors for the roadside overheight, overspeed, intersection conflict, and overweight detection systems would transmit data from the field to the new Safety Warning Detection System subsystem in the ATMS platform. The new subsystem would provide a software interface that transmits alert notifications to the TMC operators when a detection sensor is triggered by an overheight or overweight vehicle. The notifications from the overheight and overweight detection systems would be shared with partner agencies such as TxDPS and the local TMCs that are affiliated with the District TMCs. With increased awareness of critical events in the field, the TMC could provide timely traveler information through the DriveTexas™ website on road closures resulting from extensive infrastructure damage caused by offending vehicles. The intersection conflict and overspeed detection systems, as well as the WIM and permanent count stations would not issue automatic notifications to the TMC, but rather log events as historical data.

### WHERE What is the geographic and physical extent of the system?

Not every part of the highway network would be instrumented with the Safety Warning Detection System. Deployments would be done strategically to focus on locations near critical infrastructure and areas with high incidences of commercial vehicle crashes.

### WHEN What is the sequence of activities that will be performed?

The table below outlines a time-phased series of activities that are needed to accomplish the planning, implementation, and eventual full deployment of the Safety Warning Detection System.

<table>
<thead>
<tr>
<th>Near-Term Actions (0-2 years)</th>
<th>Medium-Term Actions (2-5 years)</th>
<th>Long-Term Actions (5-7 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing TxDOT Program/Initial Next Steps</td>
<td>Concept of Operations</td>
<td>System Requirements</td>
</tr>
<tr>
<td>Yes; Expand the number of system deployments</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

Legend: 
- [✓] Completed 
- [ ] Need to do
OPERATIONAL SCENARIO
Overheight Vehicle Notification is Triggered

THE PROBLEM
Ana and John depart Odessa to deliver two loads to San Angelo

CONSTRUCTION AHEAD
EXPECT DELAYS

...they are rerouted off the Interstate onto local roads

Ana passes an overheight detection system that gets triggered

John gets the same warning but ignores it

Texas Department of Public Safety camera takes snapshots of both trucks after system is triggered

An engineer is immediately dispatched to inspect the damage

An engineer is rerouted and arrives in San Angelo without incident

The surge of force from the crash triggers an alarm at the TxDOT Traffic Management Center

An engineer is immediately dispatched to inspect the damage

Ana’s and John’s trucks are identified from the logged snapshots

Damage to John’s truck is consistent with the bridge strike and TxDOT is able to recoup costs for the damage

THE SOLUTION

THE APPROACH

COLLISION

Ana and John depart Odessa to deliver two loads to San Angelo

With major congestion ahead due to construction on I-20...

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