RESEARCH

As part of our vision for Connected Vehicle Research, Development, and Deployment (RD&D), one of the projects we are planning to implement is in Knoxville, TN. We will test the usefulness and value of connected vehicle applications meant to improve mobility, safety and the environment. The vision of the pilot deployment is to test next-generation ATIS with incident management and work zone management technologies in real-world situations to determine their efficacy in achieving mobility, safety and environmental goals of the Region.

The University of Tennessee at Knoxville and surrounding areas offer a good setting for early adoption and testing of CV technologies because of the mobility, safety, and environmental issues in the region:

- As of 2015, most of the Knoxville region is a non-attainment area for ground-level ozone and fine particulate matter (Figure 1).
- The area has substantial number of fatal and non-fatal crashes (Figure 2).
- The Interstates in the region are congested and have a substantial number of incidents, including crashes to justify 77 miles of service patrol coverage, typically responding to about 24,000 incidents yearly.
- The University of Tennessee campus is a primary special event generator in the region, with student enrollment of 28,000+ and approximately 10,000 faculty and staff. Special events that need substantial management resources include football games at Neyland Stadium (102,455 person capacity) and basketball games at the Thompson-Boling Arena (21,678 person capacity). The transit services on campus are provided by First Transit with a fleet of 20 buses. Students pay a transportation fee each semester for the service.

![Figure 1: Air quality non-compliance in Knoxville areas (Source: EPA)](image-url)
One of the most important issues we face in the region is when first responders are killed or injured when responding to incidents (Table 1). Notably, 1,658 people have been injured (some fatally) in the last four years (2010-2014) in Tennessee, costing hundreds of millions of dollars in damages (the cost of a fatality alone is estimated at $9.2 million by USDOT). The fatalities among highway incident responders are higher than that of fatality rates for ambulance, fire-trucks, and police. Additionally, more than 30 pedestrian first responder personnel were injured or killed on Tennessee roads during the last four years. These data point to the need for improving safety of not only those involved in traffic incidents but also of the first responders.

Table 1: First Responders Injured/Killed on TN Roads by Special Use Unit Types

Several technologies are relevant to solving issues faced by the Knoxville region. Similar technologies are also appropriate for the State of Tennessee and the Southeast. Based on the regional long-range plan, the University of Tennessee campus master plan, TDOT’s TMC and
HELP service patrol, and the ITS architecture, the next generation of ATIS technologies, incident management and work zones management are likely to have high impacts. Major Technology Deployment Initiatives (MTDIs) in Knoxville will revolve around these technologies, as mentioned below:

**Next generation ATIS**

Advanced Traveler Information Technologies or ATIS are not new. However their new incarnations that take advantage of Big Data and computational power of new computers is a transformative concept because it will provide new forms of information that supports travelers’ decisions. The ATIS test is anticipated to involve hundreds of users, who will enhance their mobility by storing users’ decisions and other contextual trip information and used to provide customized information/advice about future decisions, e.g., selection of mode, destinations, routes, and departure times. In addition, volatility in driving can be reduced by alerts and warnings (Khattak & Liu, 2015). The team will develop an ATIS mobile phone application that can use the second-by-second basic safety message (BSM) data to generate warnings and alerts that will be helpful to drivers. The warnings will encourage calm (less aggressive) driving, which has been linked to higher chances of collisions (Khattak and Liu 2015). The ATIS application will also help with the collection of Origin-Destination data.


**Incident Management**

Incidents typically cause about 50% - 60% of the congestion in urban areas, and Knoxville is no exception. Certain incidents, especially crashes, can cause multiple lane closures and substantially degrade network capacity. Responding to and clearing the incidents sooner has obvious benefits in terms of reductions in incident durations, and associated delays, higher throughput, reduction in secondary incidents/improved safety, lower energy use and lower emissions. HELP service patrols are one of the least expensive and most effective strategies for addressing incident-induced congestion. However, incidents that are of moderate to high severity often require response by other agencies such as law enforcement, fire departments, ambulance, and towing. TDOT facilitates interagency teams across the state to discuss response procedures for incidents that adversely affect traffic. The teams coordinate to respond promptly to incidents and increase the safety of motorists and emergency responders during traffic incidents. However, coordination and communications between various response vehicles can facilitate interagency cooperation, lowering the duration of traffic incidents, reducing lane blockage and secondary crashes.

A fleet of vehicles from the TDOT HELP, regional fire, regional ambulance, and police services
will be equipped with the Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (Figure 3). This application will provide input to responder vehicle routing, staging and secondary dispatch decisions, increase operational efficiency of agencies to respond to large-scale incidents and also help with improved incident management through shorter response and clearance times. Situational awareness of responders while they are en-route will also increase by this deployment.

![Screenshot from incident management application](image)

**Figure 3**: Screenshot from incident management application


**Work Zone Alerts for Drivers and Workers**

Work zones are hazardous environments where crash frequencies typically increase, and construction workers are at a high risk of being struck by vehicles (than in other professions). Work zones in the United States have approximately 600 traffic-related fatalities and about 85,000 crashes every year, costing additional billions of dollars in damages annually. The Knoxville area has aging infrastructure that requires substantial reconstruction, repair, and maintenance activities. It is important to evaluate how various features in work zone impact driving behavior and safety of workers.

This application will warn on-scene workers of vehicles with trajectories or speeds that pose a high risk to their safety. It also warns drivers passing an incident zone if they need to slow down, stop, or change lanes. The application will be helpful in construction projects in or near the UTK campus, especially the Cumberland Avenue, the main thoroughfare through the campus that will soon undergo major reconstruction.

It is important to note the “Protect the Queue” campaign launched by TDOT in June of 2013.
State DOTs like TDOT can prevent crashes in queues and better alert drivers of the slow-moving traffic ahead. Work zones are a major cause of queues on TN highways.


REFERENCES