



Tennessee DoT Pushes Fog to the Edge with IoT

Uses real-time sensor network to power instant fog alerts

“Cars don’t have to be smart to benefit from the increased safety in this vision – every car on that roadway will see that the signs are changing, and know to slow down.”

Mark Knellinger
Systems Engineer, Cisco

Business Results

- Decrease road accidents by improving traffic management in adverse weather conditions
- Improve management services via single pane-of-glass approach
- Establish foundation for secure and agile deployment of roadside services



Reduce Cost

- Eliminate high maintenance, unreliable equipment
- Reduce ongoing and emergency maintenance



Manage Better

- Simplify and increase efficiency in operations with computing on the edge
- Better manage traffic flow and related alerts thru real-time data



Improve Safety

- Keep workers safer
- Use dynamic signage to deliver real-time information on road conditions

Introduction

The Digital Transformation of Transportation is rapidly changing the way state and local governments manage traffic. From signaling and parking to maintenance and alerts, citizens are demanding more transparency and faster response on traffic related issues, so that they can make better decisions and improve safety for their families.

For the Tennessee Department of Transportation (TDOT), the Internet of Things (IoT) is enabling them to provide citizens with real-time data on road conditions. It is also empowering TDOT with new tools to manage traffic more effectively in response to changing weather conditions.

The Challenge

TDOT faced ongoing safety issues in the eastern part of the state, where mountainous conditions would result in the rapid development of fog conditions. This would drastically reduce visibility within minutes on the area's highly traveled roadways.

Dealing with an Outdated System

To address the issue, TDOT had installed a network of fog sensors along impacted roadways. Unfortunately, the technology relied upon serial connections, via a buried cable, to multiple roadside servers. This approach required regular and costly maintenance for the terminal servers.

Data would then be sent from the roadside server, over the cable, to a Regional Traffic Center. There it would require review to determine the best response, such as directing personnel to manually



alter digital signage or have field personnel manually close fog gates.

The Lack of Real-Time Capabilities

The existing system had several challenges which TDOT wished to overcome:

- Due to polling intervals, sensors often missed fog events
- The roadside terminal servers were experiencing a high failure rate, with replacement being very costly
- The system lacked automation and integration with other TDOT systems
- Fog gates, used to limit access to roadways in dangerous fog conditions, had to be manually closed, placing TDOT personnel in danger.

And worst of all, even when the system did work perfectly, the lack of real-time capabilities meant that the data gathered would often be outdated (up to two hours old) by the time action was taken.



In the end, this left TDOT with an inefficient and high cost system that failed to provide motorists the information they needed to make the best decisions for their safety.

The Solution

Updating the existing system, including the network, would be cost prohibitive for TDOT. So they turned to Cisco and our Connected Roadways solutions. In partnership with our Advanced Services team, they built an innovative solution that could use much of their existing infrastructure while delivering the results staff and citizens demanded.

The solution included:

- Industrial grade routing/switching
- Cisco Kinetic Edge Fog Processing Module as a management platform
- Field Network Director to manage the gateway
- Cisco Prime Infrastructure to simplify management of the network.

Getting Rugged

TDOT began by replacing the old high maintenance and wired roadside servers with the latest in innovative routers – the Cisco 829 Industrial Integrated Services Router. It provides secure and reliable service primarily via TDOT’s existing fiber, but can also use 3G/4G LTE WAN cellular and Wireless LAN connectivity, perfect for use along long stretches of roadways. It’s designed to be compact and “ruggedized” for harsh environments including ice, sleet, humidity and vibration. The 829 Router has even been field tested by the US Department of Defense in real life combat conditions so TDOT could rest assured it could handle their environments.

Computing at the Edge

To power a new approach, the Cisco Kinetic Edge Fog Processing Module was utilized. This allows processing and analyzing of data where it originates, at the point of action, creating a virtual machine without the need for costly new infrastructure. It features open architecture, a well-tested/validated design, and most importantly scalability to grow as TDOT needs change. Kinetic also gives TDOT capabilities to collect and act on data in a flexible and repeatable manner – critical for weather related functions.

Connectivity for TDOT and Beyond

Once connected to existing roadside fog sensors, the Cisco R829 Router is able to automate decision making on the edge. This means there is no need to send data back to

TDOT’s Regional Traffic Center for direction. However, for TDOT, the R829 does send data to the center so that it can be backed-up and used for future data analytics. Over time, that data can prove extremely valuable, helping to improve planning and efficiency of operations.

But this innovative approach goes one step further by giving local Public Safety and Public Works departments the capability to tap into the data if desired. With Cisco technology, Police officers, EMS and Fire can even access data from their own vehicles while in transit, creating increased situational awareness during heavy storm events or natural disasters.

The Benefit of Real-Time Automation

This innovative new approach also gives TDOT the capability to implement automated responses for a variety of real-world conditions by using preset policies to determine actions, if they desire. This is a key benefit of eliminating intervalled polling in favor of real-time event data, and will let



TDOT be able to alert drivers of rapidly changing conditions faster and with much more accuracy. This could also be pushed to digital road signage, smartphone alert messages and even change speed limits displayed on dynamic speed signs.

Personnel from TDOT and other agencies also benefit from improved awareness via instant messaging. And they could someday enjoy safer working conditions by avoiding the dangerous task of manually closing gates, once that task is approved to become automated by their new solution. Plus, the system is designed so that it can be easily expanded when needed, to include sensors for frost, temperature and other roadway hazards.

However, it is citizens who will gain the most. Their cars won't have to be smart to benefit from the increased safety in TDOT's vision – every driver will be able to see that the signs are changing, and know to slow down.

Results

Business Results

For TDOT, the results of partnering with Cisco to address ongoing and life-threatening conditions on the state's roadways have been very positive. For department operations, the solution has:

- Decreased road accidents by improving traffic management in adverse weather conditions
- Enhanced management services by providing personnel “single pane-of-glass” interface
- Established a foundation for secure and agile deployment of roadside services.

The solution has also given TDOT the option to automate manual operations that endangered

the lives of their personnel, such as closing gates on busy roadways. And it has empowered data analytics to power more accurate and efficient transportation planning through constant backup of all sensor data.

Plus, with the capability to easily expand the system in the future, TDOT can easily add a variety of additional sensor types, further improving data collection and roadway safety.

Citizen Results

For those travelling the state's highways, the use of Cisco routers and Kinetic Edge Fog Processing Module has dramatically improved response times in alerting them to adverse driving conditions, plus it has:

- Enhanced traffic management, making their drives safer and smarter
- Reduced the potential for deadly accidents
- Helped save lives.

Learn More

To begin your agency's Digital Transformation and learn how our innovative technologies can improve safety on your roadways, visit:

<http://www.cisco.com/c/en/us/solutions/industries/transportation/roadways.html>

Video: [How the Alaska Department of Transportation and Cisco are partnering to improve safety on remote highways.](#)



Improving Traveler Safety through Digital Transformation

Benefits

- Reduce the potential for deadly accidents
- Automatically enact responses to changing weather conditions
- Alert drivers in real-time to adverse weather conditions, via dynamic digital signage
- Enable policies that react in real-time to reduce speeds displayed on dynamic digital speed limit signage
- Enhance overall traffic management to improve driving conditions for travelers