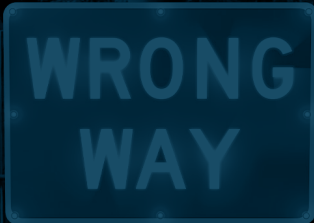




IMPROVING WRONG-WAY ALERT SYSTEMS WITH SOFTWARE



Wrong-way driving fatalities continue to rise. Reducing them requires a holistic approach and continuous system optimization.

Discover how to accomplish that – and, ultimately, protect drivers' lives – with data and insights from the experts.

When someone drives the wrong way on a highway off-ramp, every road user around them is immediately at tremendous risk of injury or death. In fact, wrong-way driving collisions have a fatality rate 12 times greater than all other accidents on controlled-access highways, according to the California Department of Transportation (Caltrans).¹

Reducing wrong-way driving requires a combination of expertise, hardware and software, the latter of which is too often ignored.

With this white paper, TAPCO aims to provide data-backed insights from knowledgeable organizations and our many years of hands-on experience so transportation professionals can make more informed decisions about wrong-way alert systems and software. More informed decisions equal more lives saved.




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DEADLY DRIVING

Discover how prevalent and
deadly wrong-way driving is.



WRONG
WAY

WRONG
WAY



Wrong-way driving collisions were responsible for an average of 500 deaths per year in the United States from 2015 to 2018. This is up 34 percent from 2010 to 2014 when there was an average of 375 wrong-way deaths per year.²

While wrong-way driving accounts for just three percent of collisions on high-speed divided highways, it is disproportionately deadly because collisions are frequently head-on.

In fact, Caltrans found wrong-way driving to have a fatality rate 12 times greater than all other accidents on controlled-access highways.³ A Virginia study found the fatality rate to be 27 times greater.⁴

DEFINING WRONG-WAY DRIVING

The National Transportation Safety Board defines wrong-way driving as vehicular movement on a travel lane in a direction opposite to the legal flow of traffic.⁵

WHY WRONG-WAY DRIVING OCCURS

**Most wrong-way drivers fit into
one of three categories.**



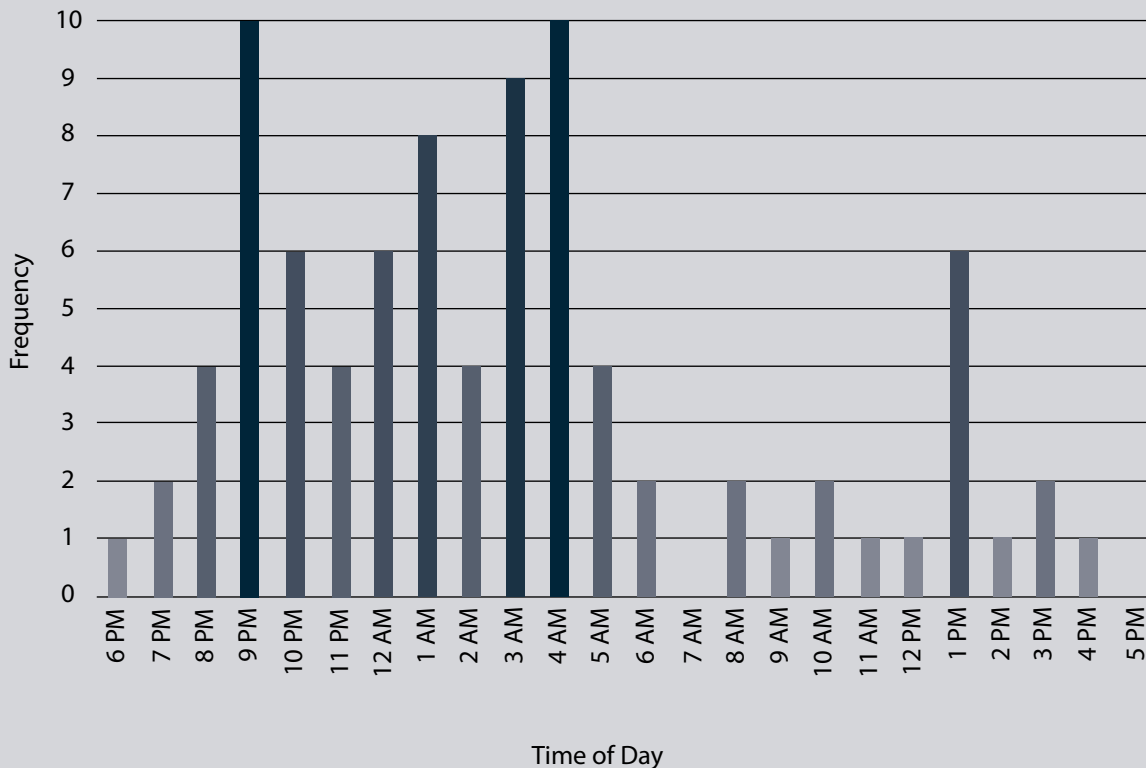
IMPAIRED DRIVERS

The number one cause of wrong-way driving is impaired driving, which includes both drugs and alcohol. While data is lacking about the extent of drugged driving,⁶ studies show that about six out of ten wrong-way collisions involve a drunk driver — though this may actually be higher due to missing blood alcohol content (BAC) data.⁷

In addition, nine percent of wrong-way drivers were convicted of driving while intoxicated or impaired (DWI) in the three years prior to their wrong-way collision.⁸

Because drunk driving is more common at night, it is not surprising that 78 percent of fatal wrong-way collisions occur between 6:00 p.m. and 6:00 a.m., according to the National Transportation Safety Board.⁹ When the Iowa State University Institute for Transportation collected data along the U.S. 30 corridor from 2014 to 2017, it found the same pattern.¹⁰

Wrong-Way Driving Incidents on U.S. 30 Corridor, 2014-17



[According to the Iowa State University Institute for Transportation](#)

ELDERLY DRIVERS

The advanced age of a driver also increases risk. While drivers over 70 make up less than three percent of right-way drivers in fatal wrong-way collisions, they make up nearly 15 percent of wrong-way drivers in these collisions.¹¹

The elderly population also continues to grow. By 2025, about 20 percent of the driving population will be 65 or older.¹²



CONFUSED DRIVERS

Many wrong-way drivers, even those unimpaired by alcohol and under 70 years old, are simply confused about which way is right. This is typically due to:

- Poor highway ramp geometry
- Unfamiliar locations
- Poor weather
- Low light conditions

THE BENEFITS OF THE BUDDY SYSTEM

A report by AAA found that 87 percent of wrong-way drivers do not have a passenger in their vehicle, perhaps because passengers are likely to notify drivers when they are about to go the wrong way or alert them after the error has occurred, allowing drivers to self-correct right away.¹³

WHERE WRONG-WAY DRIVING OCCURS

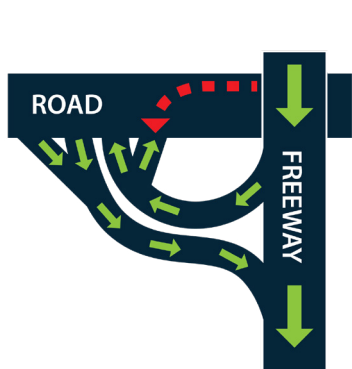
Certain roadway configurations are proven hotspots for wrong-way driving.



Determining the origin of wrong-way drivers is nearly impossible with traditional, static countermeasures. A 2003 study by the Texas A&M Transportation Institute (TTI) found that for nearly 70 percent of documented crashes, the point of origin could not be identified.¹⁴

It is not uncommon for drivers to be spotted traveling the wrong way for multiple miles before a collision or traffic stop occurs.

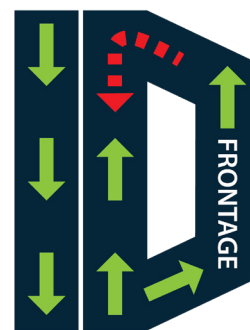
However, given available data, there are five locations where wrong-way driving most commonly starts:



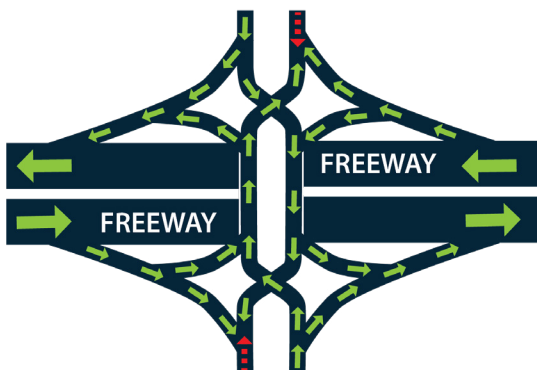
Side-by-side (partial cloverleaf) highway entrances and exit ramps



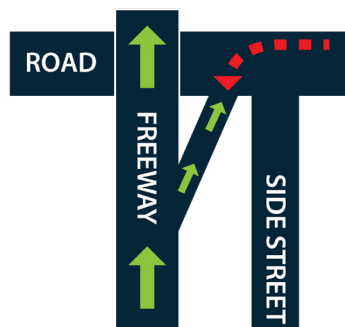
Any poorly lit entrance and exit ramp



Frontage roads / slip ramps



Diamond interchanges



Exit ramps near side streets



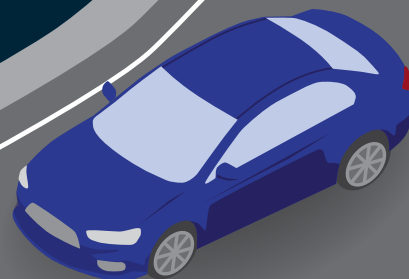
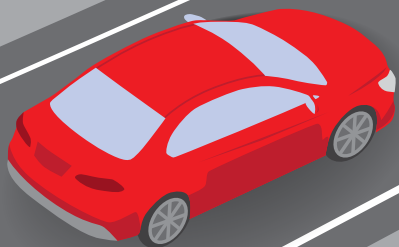
500 people die in wrong-way driving collisions each year in the U.S. alone

NEARLY 15%

of wrong-way drivers in fatal collisions are over 70, yet they make up less than 3% of right-way drivers

SIX OUT OF TEN

wrong-way driving collisions involve a drunk driver



THE REACTIVE APPROACH

Many wrong-way driving response efforts start and end a similar way.





This is the common, reactive approach to wrong-way driving remediation efforts:

1. Quickly deploy a standard wrong-way alert system in reaction to a highly visible fatality
2. Conduct minimal maintenance and management on that system
3. Forgo utilization of event management software for data collection and mining
4. Bypass valuable after-incident actions and “lessons learned” analyses
5. Avoid collaborating with highway police, the state DOT or other states to share knowledge and optimize the system

The result? Gradual performance degradation and an unsatisfactory impact on wrong-way driving incidents and fatalities. This leaves the agency questioning system effectiveness and struggling to justify additional deployments.

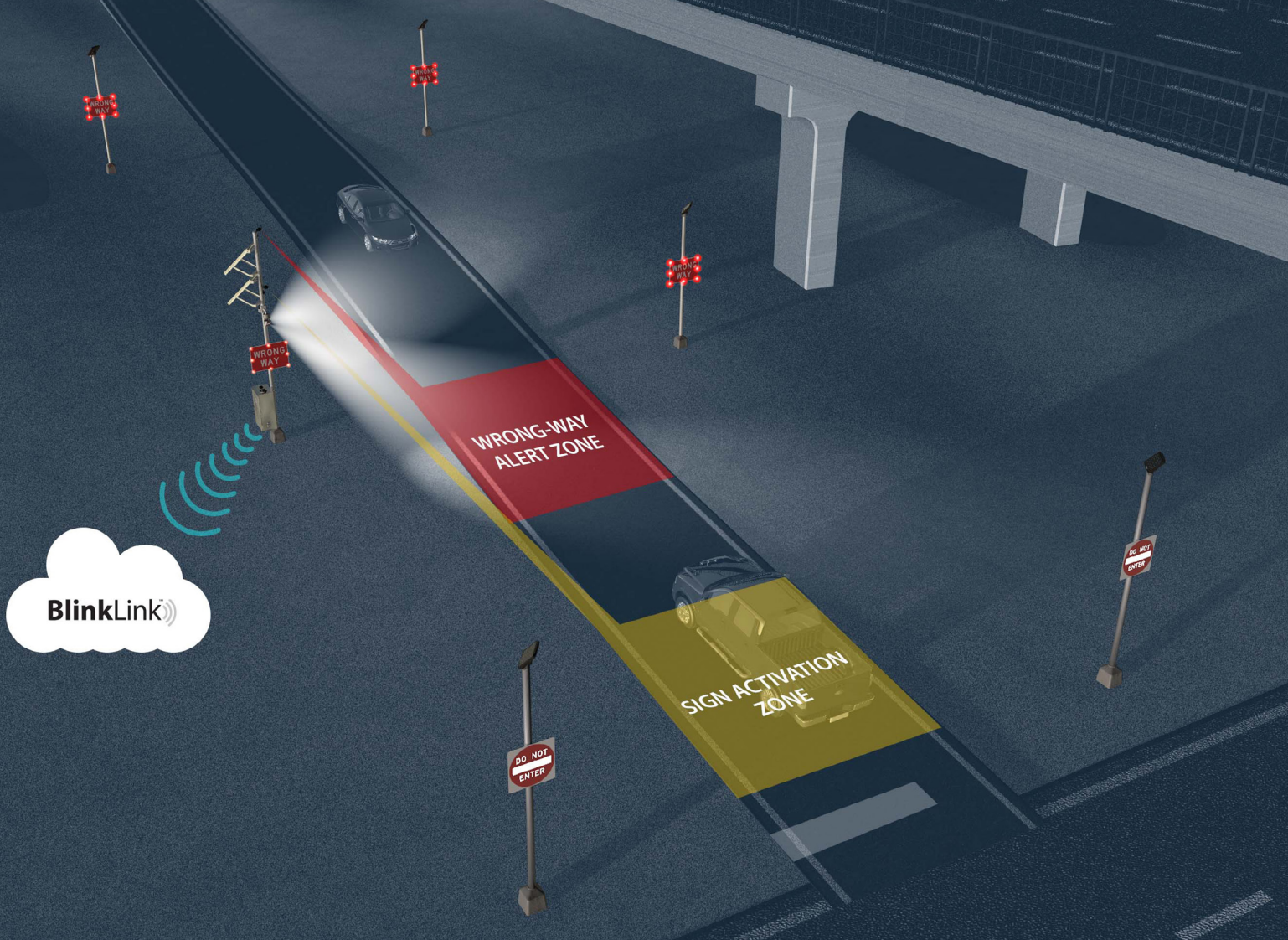
Wrong-way alert systems are a valuable tool for reducing wrong-way driving, but incorporating that tool into a holistic approach is where the true improvements are realized. That’s why a combination of hardware and software, with additional servicing and multi-party collaboration, is required to generate or establish the most lifesaving impact.

HARDWARE: WRONG-WAY ALERT SYSTEMS

These systems are an increasingly popular way to reduce wrong-way driving.



WRONG
WAY



The TAPCO Wrong-Way Alert System features two distinct zones.

[Wrong-way alert systems](#) from companies like TAPCO are a popular wrong-way driving solution. They work by detecting wrong-way vehicles using a variety of methods (see page 15). Detection of wrong-way vehicles then activates flashing LED-enhanced warning alerts (see page 16), which command drivers' attention and warn them they are traveling the wrong way.

Wrong-way drivers then have the opportunity to self-correct. After all, the goal of the system is to remediate the behavior before it progresses any further.

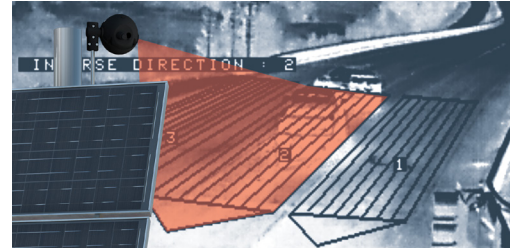
Then, a high-efficiency LED illuminator and high-definition camera activate to provide high-quality visual verification of the wrong-way event.

If wrong-way drivers continue in the wrong direction past a pre-determined point, most wrong-way alert systems monitor them with thermal sensors and a high-speed camera, ensuring accuracy in all weather and light conditions. In addition, a high-priority alert is transmitted to agencies via cellular modem or fiber optic cable (see page 22).

ALERT ACTIVATION OPTIONS

Thermal Sensors:

[Thermal sensors](#) offer next-level, directional precision and accuracy in all roadway configurations, reducing false positives. FLIR sensors, offered by TAPCO, can monitor up to four lanes of traffic over a stretch of several hundred feet.



Radar Sensors:

[Radar sensors](#) use radar technology to detect wrong-way vehicles on simple ramp configurations.



Inductive Loop:

[Inductive loops](#) are installed beneath the surface of the road to detect wrong-way vehicles that pass over them.



24/7 Operation:

[24/7 flashing alerts](#) do not need to be activated because they are always operating.



Scheduled Operation:

[Scheduled flashing alerts](#) are standalone solutions that only activate during specified times, such as from dusk to dawn, via time clock functionality from companies like TAPCO.



ALERT OPTIONS

Once a wrong-way incident has occurred, the best possible outcome is for the driver to realize it and safely turn around without delay, so choosing a system that warns drivers via flashing alerts is critical.

Alert options aimed at wrong-way drivers fall into one of three categories:

LED-Enhanced Signs:

Traffic signs can feature flashing LEDs in the perimeter of the sign face, such as the [BlinkerSign®](#), or non-flashing LEDs in the legend, such as the [LegendViz™ Traffic Sign](#). LegendViz™ Signs are even shown to increase sign legibility distance by as much as 100 percent, according to a closed-course trial by TTI. [LegendViz™ BlinkerSigns](#) are also available.



RFBs:

RFB light bars are rectangular flashing beacons placed above and below a traffic sign that flash in a wig-wag pattern.



Beacons:

Large, round LED beacons like the [BlinkerBeacon™](#) flash above a traffic sign to warn drivers.



Alert options aimed at right-way drivers fall into one of two categories:

Blank-Out Signs:

In wrong-way driving applications, LED blank-out signs feature a single message warning right-way drivers of a wrong-way driver up ahead, with the LEDs turned on or off as needed.



Dynamic Message Signs:

With changeable messages, [dynamic message signs \(DMS\)](#) display a variety of warnings to right-way drivers about a wrong-way driver.



POWER OPTIONS

Most wrong-way alert systems can be AC or solar powered. TAPCO, for example, offers AC power via 120VAC or streetlight power and a variety of solar power options, including top-of-pole self-contained control cabinets.

Solar-powered systems are ideal if:

1. The installation location is too far from an AC power grid
2. The costs of connecting to an AC power grid – trenching and metering, for example – are prohibitive
3. Long-term power usage is a concern due to cost or the environment



AC-powered systems are ideal if:

1. The locations have lower light levels due to tree shading, heavy cloud coverage and/or the geographic region
2. An AC power grid is readily available

ENHANCEMENT OPTIONS

In-Road Warning Lights:

[In-Road Warning Lights \(IRWL\)](#) are embedded in the pavement and oriented to face wrong-way traffic. They flash in unison to alert drivers of their wrong-way movement.



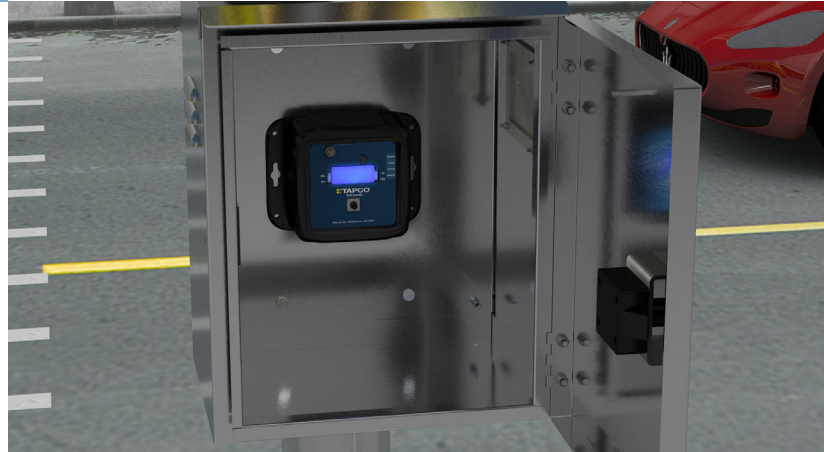
Additional CCTV Cameras:

To capture additional details, such as continuation behaviors and the direction of origin, extra cameras can be integrated into most wrong-way alert systems.



Connected Vehicle Interface:

Forward-looking agencies can add another layer of safety with a [Connected Vehicle Interface](#), which communicates information about wrong-way drivers via connected vehicle roadside units, delivering in-vehicle alerts to those in connected vehicles.



You can read about [connected vehicle technology] and go to conferences and educate yourself, but sometimes you have to do an installation and actually see this technology demonstrated in the real world.

- Greg Mack, Assistant Director of IT & Toll Systems for the Central Texas Regional Mobility Authority

SOFTWARE

Learn how software can
optimize your hardware.



SOFTWARE

Many reputable wrong-way driving studies ignore or barely mention software. However, software has been transforming wrong-way driving reduction efforts in many communities for years and continues to evolve.

With software, users get more out of their wrong-way alert systems with:



1. **Timely event awareness via configured alerts** sent to Traffic Management Centers (TMC). The alerts can include images, video and event streaming, enabling officials to intervene in real time.



2. **Incidents categorized and quantified by location and time**, helping users identify areas and regions with heightened activity in need of greater attention.



3. **Invaluable data about wrong-way drivers**, such as their vehicles' color, make and model, what direction they are coming from and, most importantly, the system's performance rate. With this information, users can conduct a cost-benefits analysis and make more informed safety decisions.



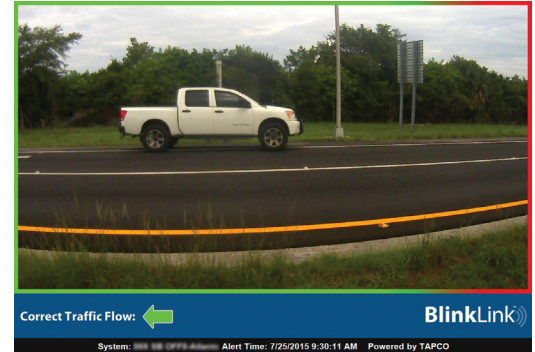
4. **System health and diagnostic alerts** automatically sent to maintenance teams to minimize downtime and enable proactive, efficient system maintenance.

There are three network options for wrong-way alert systems that make this possible.

EVENT MANAGEMENT SOFTWARE

Agencies use cloud-based event management software like [BlinkLink](#)® to manage, schedule, identify, quantify and monitor singular or holistic Intelligent Warning System deployments, including wrong-way alert systems. By collecting real-time data, the software enables transportation officials to:

- Manage one or many systems remotely with ease
- Identify and track wrong-way driving incidents via voice, email and SMS notifications
- Quantify system effectiveness, ramps of interest and additional investments needed
- Evaluate system health and diagnostics, such as the status of cameras and sensors
- Capture images and video, as well as facilitate live streaming, if cameras are incorporated

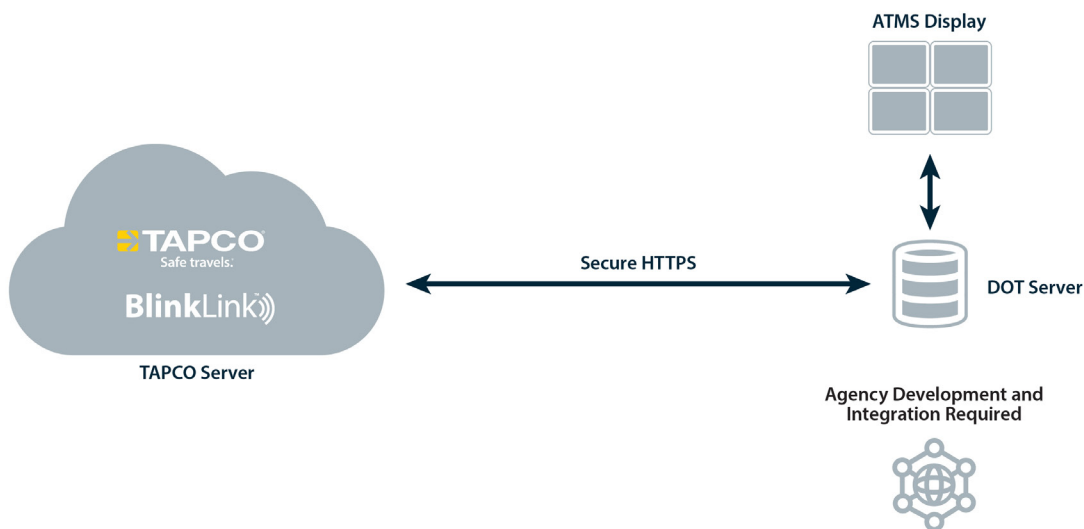


After deploying BlinkLink and the TAPCO Wrong-Way Alert System at four locations, Greg Mack, the Assistant Director of IT & Toll Systems for the Central Texas Regional Mobility Authority, said, “We were surprised at the [amount of \[wrong-way driving\] alerts](#) we’ve had... If you don’t think you have a wrong-way problem, it’s because you don’t have the detection equipment counting it.”

BlinkLink communication is secured through various network configurations and may be integrated with third-party software.

APPLICATION PROGRAMMING INTERFACE (API)

An API enables two or more application software to be integrated, communicating information seamlessly. Thus, a wrong-way alert system can be connected with existing software. This allows agencies to leverage BlinkLink for data collection and wrong-way alert system management while still operating the state enterprise system — all from a single platform.



ADVANCED COMMUNICATION CONTROLLER

With the multi-functional Advanced Communication Controller, users can easily configure the communication of the TAPCO Wrong-Way Alert System by securely integrating it with an Advanced Traffic Management System (ATMS) or with BlinkLink on any network via a customer-supplied modem or fiber connection.

The Advanced Communication Controller has its own secure, credentialed web interface, providing the ability to:

- Visually monitor the status of sensor inputs
- Confirm activation relay outputs
- Review system operational indicators for troubleshooting and field service needs
- Monitor system statuses, such as temperature, system voltage and activation counts

There is also an optional API available for third-party software integration.

DIRECT ATMS INTEGRATION

Another option is to connect a wrong-way alert system directly with an ATMS, if available. ATMSs are traditionally designed to manage large networks of technologies and negate the ability to manage specific systems.

While direct ATMS integration requires no additional software, that also means users miss out on the many features and benefits offered by event management software. On top of that, users cannot proactively manage deployments or leverage an API, and DOTs must lead the majority of the integration work; it cannot be outsourced.



RIGHT-SIZING YOUR SOLUTIONS

Find out how to ensure your solutions
are just the right size.





Some organizations want the most comprehensive wrong-way solutions available, and others want simpler solutions before potentially upgrading. Either way, having the flexibility to right-size the solutions by scaling up or down as needed is pivotal.

For example, some government agencies simply leverage inductive loops that trigger wrong-way BlinkerSigns to flash. The Indiana Toll Road, on the other hand, has deployed two TAPCO Wrong-Way Alert Systems and BlinkLink, as well as integrated BlinkLink with its TMC via an API integration. It uses the software to measure the effectiveness of the systems and determine if changes or upgrades are needed.

In addition, collaboration can help agencies identify opportunities for improvement and right-size their solutions. After all, other agencies that have deployed wrong-way driving solutions have invaluable experiences to share. The Indiana Toll Road talked with departments of transportation and other toll road organizations about their experiences and even created a focus group before deciding what solutions to deploy.

I think most technology that's deployed gets you probably 95 percent of the way there. The other five percent is always going to be small adjustments.

- Rick Fedder, Chief Operating Officer for the Indiana Toll Road

OKLAHOMA DOT RIGHT-SIZES WITH STRATEGIC PILOT PROGRAM

After a series of wrong-way driving incidents, the Oklahoma DOT decided to launch a wrong-way driving reduction pilot program covering 76 highway ramps along the IH-40 corridor in the eastern part of the state. On top of enhancing delineation, the DOT implemented safety solutions like wrong-way LegendViz™ Traffic Signs and BlinkerSigns, and it hopes to install TAPCO Wrong-Way Alert Systems in the future. Everything is designed to be scalable and upgradeable.

“We knew at the Department that we had to start somewhere when addressing wrong-way driver prevention, and this corridor seemed to be the best place to start when comparing all of the rural highway construction plans and maintenance operations,” said Kyle Stevens, Oklahoma DOT Traffic Field Operations Manager.

The DOT intends to gather five years of data on what works and what doesn't, then use that information to adjust their techniques and solutions. For example, the DOT is considering adding dynamic message boards to key problem areas, but first the DOT must understand where exactly those areas are and which are the most practical for applications.

Making more data-driven decisions will maximize safety while also saving taxpayer dollars.

When you're using limited safety funds, you have to be very strategic about where you spend money.

- Kyle Stevens, Traffic Field Operations Manager for the Oklahoma DOT



PREVENTATIVE MAINTENANCE

Discover how to increase system
performance and longevity.





Preventative maintenance is absolutely critical for maximizing wrong-way alert system performance, accuracy and longevity. Maintenance should include:

- Power source testing (solar package or AC and DC power supplies)
- Calibration of existing detection equipment
- Calibration of existing video equipment
- Alignment and testing of warning equipment
- Verification of activation and system updates
- Verification of alerting and BlinkLink operation
- Certification of complete system by drive testing
- A system warranty extension

If this preventative maintenance is not possible due to available resources, a service agreement can help. Companies like TAPCO offer service agreements that enable agencies to outsource preventative maintenance entirely, and the agreements even come with extended system warranties, guaranteed regulatory compliance, discounted software subscriptions and detailed records after every maintenance visit.

If we have a wrong-way solution that's 99.9 percent effective but don't maintain it, and it goes down to maybe 85 or 87 percent effectiveness, we're now not living up to our obligation of keeping people as safe as we possibly can.

- Rick Fedder, Chief Operating Officer of Indiana Toll Roads



GOING THE EXTRA MILE

With stretched-thin resources, tight budgets, a lack of time and intense pressure to deliver, reducing wrong-way driving can be a challenge. Fortunately, TAPCO is here to help, with nearly seven decades of experience working with governments at every level to tackle their toughest traffic safety challenges.

TAPCO offers a robust portfolio of wrong-way solutions:

- Wrong-Way Alert System
- BlinkLink event management software
- BlinkerSigns, LED-enhanced signs popularized by TAPCO
- LegendViz™ Traffic Signs, legend-illuminated signs invented by TAPCO
- Rectangular Flashing Beacons (RFBs)
- In-Road Warning Lights
- Connected Vehicle Interface
- TAPCO-provided preventative maintenance via service agreements

Get started by visiting the TAPCO website or requesting a quote.

REDUCING WRONG-WAY DRIVING THE RIGHT WAY

With a holistic approach and continuous system optimization, traffic safety professionals can use wrong-way alert systems and software to drastically reduce the amount of people who die in wrong-way driving collisions each year.

[Learn more about wrong-way safety solutions here >](#)

1. <https://searchworks.stanford.edu/view/2463491>
2. <https://newsroom.aaa.com/2021/03/heading-the-wrong-way-with-wrong-way-driving/>
3. <https://searchworks.stanford.edu/view/2463491>
4. https://www.virginiadot.org/vtrc/main/online_reports/pdf/72-r41.pdf
5. <https://www.nts.gov/safety/safety-studies/Documents/SIR1201.pdf>
6. <https://www.nts.gov/safety/safety-studies/Documents/SIR1201.pdf>
7. <https://newsroom.aaa.com/2021/03/heading-the-wrong-way-with-wrong-way-driving/>
8. <https://www.nts.gov/safety/safety-studies/Documents/SIR1201.pdf>
9. <https://www.nts.gov/safety/safety-studies/Documents/SIR1201.pdf>
10. https://intrans.iastate.edu/app/uploads/2019/04/wrong-way_driving_investigation_w_cvr.pdf
11. <https://www.nts.gov/safety/safety-studies/Documents/SIR1201.pdf>
12. <https://www.sciencedirect.com/science/article/abs/pii/S0001457510002897>
13. <https://newsroom.aaa.com/2021/03/heading-the-wrong-way-with-wrong-way-driving/>
14. <https://static.tti.tamu.edu/tti.tamu.edu/documents/4128-1.pdf>