INNOVATIVE DEPLOYMENT OF DYNAMIC MESSAGE SIGNS IN SAFETY APPLICATIONS

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SUMMARY

The Orlando-Orange County Expressway Authority (OOCEA) has deployed two innovative DMS systems in downtown Orlando to address two safety concerns on the Authority’s system. The first is a ramp DMS to advise drivers of overspeed conditions on a tight curve at the bottom of the ramp. The second application is a DMS installed on the SR 408 mainline to provide automated congestion warnings for exit lanes to Interstate 4. In each case, full-color, full-matrix DMS were deployed to allow the advisory messages to closely resemble messages that would be displayed on MUTCD-compliant static sign panels. The warning systems were linked to microwave vehicle detection sensors that monitored traffic conditions and allowed the sign to respond in real-time.

KEY WORDS

Orlando-Orange County Expressway Authority, OOCEA, Orlando, Dynamic Message Sign (DMS), ramp queuing, speed warning, Daktronics, Wavetronix.

BACKGROUND

The Orlando-Orange County Expressway Authority (OOCEA) has been a champion of ITS technology for over a decade. Their Expressway Management System, consisting of cameras, travel time sensors, and dynamic message signs (DMS), allows staff at the Florida
Department of Transportation’s Regional Traffic Management Center to manage incidents in real time. The Authority’s automated travel time system posts up-to-the-minute travel times to the Authority’s DMS and to Florida’s statewide 511 system to inform customers of current travel conditions. However, the Authority has also decided to deploy ITS solutions to address two specific safety concerns on the Authority’s system by giving drivers automated information relevant to conditions at those specific locations.

THE PROBLEM

In 2010, the Orlando-Orange County Expressway Authority (OOCEA) identified two areas on their expressway system in need of safety improvements. Both areas involved the SR 408/I-4 interchange in downtown Orlando, which is one of the most critical systems interchanges in Central Florida, serving more than 135,000 vehicles on SR 408 per day. A picture of this complex interchange is shown in Figure 1.

![Figure 1: SR 408/I-4 Systems Interchange in Orlando, FL](image)

The Authority noticed two troubling trends emerging in the vicinity of this interchange. First, the exit ramps to I-4 from westbound SR 408 were backing up onto the SR 408 mainline during the morning peak hours. This causes a high speed differential between the slow moving traffic in the right two lanes and the freeflow traffic in the remaining lanes on SR 408. Due to limited sight distance approaching the interchange, the differential traffic speed can catch some drivers by surprise and contribute to recurring accidents. Given the critical nature
of this interchange, every accident makes a difference. The Authority needed a solution to provide automatic, real-time alerts to customers when queues were building onto the mainline so the drivers would be prepared to slow down in anticipation of congested conditions.

The other issue involved traffic in the opposite direction taking the loop ramp from SR 408 eastbound to I-4 eastbound. Due to physical constraints at the ramp location, the radius of the loop ramp decreases sharply in one section of the curve. The ramp has a posted speed limit of 25 MPH to account for this sharp curve. However, it is quite common for drivers to exceed the 25 MPH speed limit, especially since the upper section of the ramp contains only a very gradual curve. Some drivers who fail to heed the posted 25 MPH speed limit depart the ramp when entering the tight curve and skid down a shallow embankment. The Authority needed a solution that would catch the attention of drivers and cause them to slow down when necessary to maintain control in the curve.

IMPLEMENTING A SOLUTION

The Authority elected to implement a solution at each location which utilized both traditional traffic signage and innovative ITS elements. Both systems incorporated automated sensors and state-of-the-art full color MDS to address the issue. The sensors are configurable, which allows the Authority to fine-tune the performance of the systems in response to actual traffic conditions. The full matrix, high resolution color DMS give the Authority flexibility regarding which messages to post under what conditions, and gives them the ability to easily revise these messages in the future. New messages can be uploaded to the sign remotely via a fiber optic link.

SR 408 Mainline: Congestion Warning System

In the case of the SR 408 mainline, the Authority installed additional static signage and added horizontal signage to the I-4 exit lanes to provide enhanced guidance to the customers. The Authority also deployed a Daktronics color full matrix DMS (VF-2020-54x210-34-RGB) approaching the area where congestion is often observed. The sign has 34mm pixel spacing to display high quality graphics and highway shields. Figure 2 shows the locations of the sign and its supporting sensors.

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1 Interstate 4 is officially an east-west running facility and is signed as such. It begins in Tampa, FL and ends in Daytona Beach, FL. However, through downtown Orlando, Interstate 4 runs in a north-south orientation and crosses SR 408 at roughly a right angle.
By default, the DMS displays an interchange sequence image for the upcoming I-4 ramps. This image is comprised of white text on a green background and utilizes interstate highway shield graphics, similar to what would be seen on a static sign panel, as shown in Figure 3.

Two Wavetronix HD microwave vehicle detector stations are deployed downstream of the DMS to sense traffic conditions in the I-4 exit lanes. The sensors are capable of detecting vehicle travel speeds in each lane. The sensors pay close attention to the speed of traffic in the two outside lanes, which become the exit only lanes for I-4 further ahead. When the average flow of traffic in the two outside lanes slows below 45 MPH, one of two caution messages is displayed on the sign. When the congestion queue is farthest from the sign, a soft “CAUTION CONGESTION AHEAD I-4 EXITS” message is displayed on the sign, as shown in Figure 4.
When the queue backs up further and reaches the sensor closest to the sign, the message changes to a hard “BE PREPARED TO STOP HEAVY CONGESTION I-4 EXITS” message, as shown in Figure 5. When congestion clears, the message automatically returns to the default interchange sequence message, without intervention from operators at the traffic management center.
In the case of the loop ramp, additional static warning signs and chevrons were added to announce the sharp curve ahead. However, in order to capture the attention of drivers and emphasize the need to take action, a DMS system was installed at a key location along the ramp, as shown in Figure 6.

**Figure 5: System Operating with Heavy Congestion**

**SR 408/I-4 Loop Ramp: Overspeed Warning System**

In the case of the loop ramp, additional static warning signs and chevrons were added to announce the sharp curve ahead. However, in order to capture the attention of drivers and emphasize the need to take action, a DMS system was installed at a key location along the ramp, as shown in Figure 6.
The system consists of a Daktronics full-color high resolution DMS (VF-2320-48x128-20-RGB) installed over the ramp. A Wavetronix Advance sensor is used to detect speed of the oncoming traffic. Under normal conditions, the sign displays a curve graphic with a 25 MPH notation, similar to what would be displayed on a static sign panel used for the same purpose, as shown in Figure 7. The Authority selected a sign with 20mm pixel spacing to accurately render the graphic image on the small sign. If a vehicle approaches the sign faster than the designated speed, which is configured as 38 MPH, the sign automatically changes to a “CAUTION REDUCE SPEED” message, shown in Figure 8. The sign returns automatically to the default curve graphic after the vehicle has passed.
EXPERIENCE AND LESSONS-LEARNED

As of December 2011, the system has entered its burn-in and acceptance phase. In the few months the system has been active, it appears to be meeting its stated objective of improving safety by drawing the driver's attention to the potential hazards ahead. This system has received praise from traffic management center staff and appears to have had a positive effect in reducing incidents:

- On the SR 408 mainline, there were nine (9) reported incidents in the AM peak direction over the period of January 2011 - March 2011. The automated congestion alert sign was activated on January 6, 2012. During the period of January 2012 - March 2012, only five (5) accidents were reported. For the first three months of 2012, the number of accidents during the current year was lower than the corresponding months of the previous year.
On the loop ramp from SR 408 to I-4, five (5) guardrail and/or chevron hits were observed in the five (5) months prior to the activation of the loop ramp DMS. In the four (4) months since sign activation, only two (2) guardrail and/or chevron hits were recorded.

Over the coming months, the Authority will continue to track the number of incidents in the immediate area of the signs to further document any emerging trends.

This project was a visible and effective method of improving safety on the Authority's expressways. According to the morning shift lead operator at the District 5 Traffic Management Center (which operates the Authority's expressways), "there has been a noticeable decrease in the amount of incidents we have approaching those WB I-4 exits. I think the sign has been effective in letting traffic know to expect heavy delays in the area of I-4, making them more cautious when trying to take those ramps."

**CONCLUSION**

In the months since its completion, the Authority has determined this project to be a success. This project is an example of how ITS technology can be a cost-effective solution to certain on-going safety concerns, either as a permanent solution or as an effective measure until capacity improvements can be funded.