ADDCO
SMART Traffic Solutions™

SMART LANE MERGE

Lane Closures

Lane closures are frequently used to provide a work space for road maintenance and construction crews. They are also used in advance of median crossovers where a roadway is closed to traffic to provide a work space. Two-lane, two-way traffic is maintained on the other roadway.

In developing a merge solution ADDCO recognizes the dynamic nature of traffic conditions. Traffic conditions can vary based on time of day, events in the area, weather, and other factors. Because of the constantly changing conditions we have developed the industry's most flexible solution to support lane closures, the SMART Lane Merge.

Our objectives are to reduce:

- Incidents
- Travel time
- The number of stops and their duration
- Aggressive driver maneuvers

In 2002, California had the second highest number of fatalities stemming from work zone motor vehicle crashes in the United States. Of the 1181 fatalities nationwide, 10 percent of them occurred in California. When work zone accidents are compared to all accidents, studies have found that work zone accidents are more severe and result in more fatalities per accident on average.

Most Common Method

In the Static Early Merge traffic control plan traditionally deployed at lane closures drivers are advised of the lane closure by advance LANE CLOSED signs placed on both sides of the roadway 1 mile and ½ mile in advance of the taper. In addition, lane reduction symbol signs are placed on both sides of the roadway at 1,500 feet in advance of the taper and a flashing arrow panel is usually placed at the beginning of the taper.

This control plan works well when traffic demand is below lane capacity, but when capacity is exceeded it creates congestion and lengthy queues in the open lane. This often leads to dangerous speed mismatches between lanes, frustration by those being passed by drivers in the closing lane or those being blocked by slower traffic when merging into the open lane. Often queue length will extend prior to the

LANE CLOSED signs. This leads to frustration as motorists lack information as to why traffic is stopped, which lane is closed, and the distance to the closure. It also increases the likelihood of rear-end collisions because there is no prior notification to slow down before arriving at the extended queue.

Alternatives

The Dynamic Early Merge encourages drivers to merge into the open lane before reaching the end of the congestion queue and creates a dynamic length no passing zone. It has been successfully demonstrated to cause motorists to merge earlier and reduce the number of forced merges. Using queue detectors to detect speed, volume, and occupancy, dynamic message signs with two strobes attached stating, "NO PASSING WHEN FLASHING" are deployed at ¼ to ½ mile intervals at up to 2.5 miles in advance of the lane closure. As a queue builds the information is transmitted to the sign upstream which causes its beacons to flash preventing motorists in the closing lane from passing the open lane and to merge earlier.

Of concern with the Dynamic Early Merge is that as traffic increases during high volume periods, such as rush hour, traffic volume can exceed the system's capability and queue storage capacity in the open lane.

The Late Merge encourages drivers to use both lanes until they reach a merge point at the lane closure taper effectively doubling the queue storage capacity. Signs are posted 1.5 miles in advance stating, "USE BOTH LANES TO MERGE POINT". At the merge point signs are posted saying, "MERGE HERE TAKE YOUR TURN" where motorists effectively execute a "zipper merge". Motorists from each lane take turns merging into the open lane. The Late Merge also has an increased throughput of roughly 20 percent. Motorists tend to perceive this method as fairer because they can chose to use the lane with the shortest queue.

Worth noting with the Late Merge is that in off-peak hours traffic will not be traveling as uniformly and will be moving at higher speeds. This creates the potential for accidents at the merge point as the right of way becomes less clearly defined.

The SMART Lane Merge

ADDCO's solution brings together the best of the possible merge methods. By using ADDCO's portable Dynamic Message Signs with integrated queue detection and wireless communications messages and merge methodologies can be updated as conditions warrant. Studies have shown that effective use of these methods and Dynamic Message Signs greatly reduce the number of incidents while simultaneously increasing safety and throughput through the work zone.

During off-peak traffic hours the system scheduler defaults to the Dynamic Early Merge configuration. For example, with a right lane closure, DMS's deployed 1.5

miles out display the message sequence, “RIGHT LANE CLOSED 1.5 MILES, MERGE LEFT”, DMS’s 1 mile out display “RIGHT LANE CLOSED 1 MILE, MERGE LEFT”, and so on at the ½ and ¼ mile locations.

If the system detects a queue forming .5 mile from the lane closure point the system notifies the sign upstream at the 1 mile out location which changes its message to “NO PASSING, RIGHT LANE CLOSED 1 MILE, MERGE LEFT”. This effectively encourages motorists to merge prior to encountering the existing pinch point and relieves the congestion buildup at the .5 mile location.

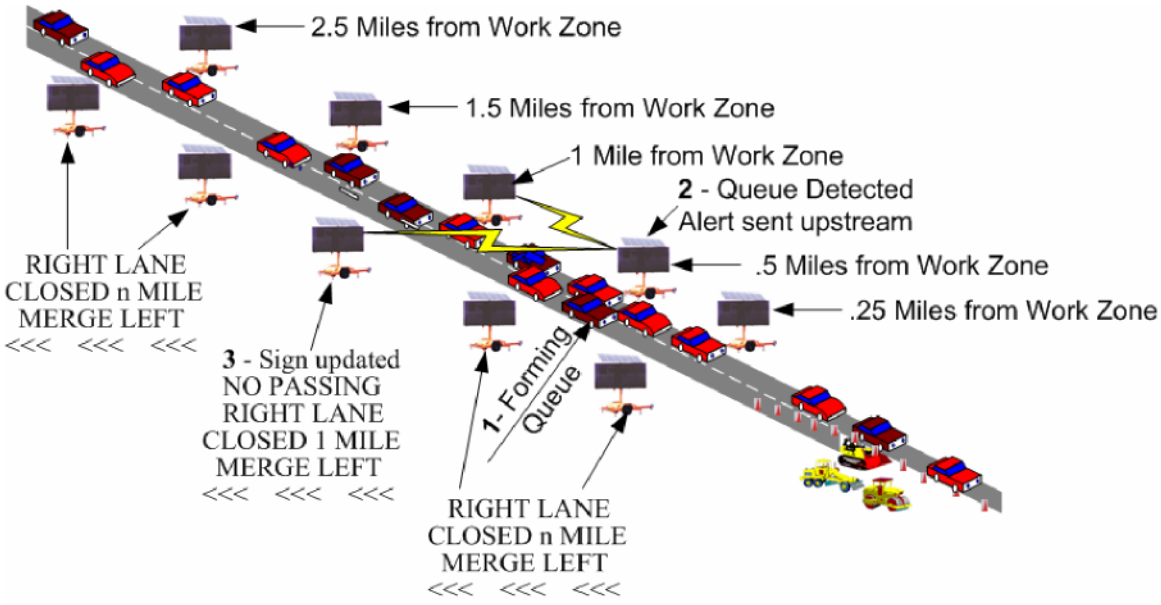

Figure 1 – Dynamic Early Merge

As previously discussed regarding the Dynamic Early Merge, as traffic increases during high volume periods, such as rush hour, traffic volume could potentially exceed the system’s capability and queue storage capacity in the open lane. This can lead to a reduction in throughput at the work zone and a push the queue beyond the notification boundaries creating safety concerns.

To prevent this, during peak traffic hours the system scheduler transitions to running a Dynamic Late Merge. Vehicles transition to using both lanes, shortening the queue length by approximately 50 percent.

The DMS’s placed at the 1.5 mile location displays the sequence, “MERGE POINT 1.5 MILES, USE BOTH LANES TO MERGE POINT”, DMS’s 1 mile out display “MERGE POINT 1 MILE, USE BOTH LANES TO MERGE POINT”, DMS’s .5 miles out display “MERGE POINT .5 MILES, USE BOTH LANES TO MERGE POINT”. The DMS’s at the ¼ mile location displays the sequence, “MERGE POINT, MERGE HERE, TAKE YOUR TURN.”

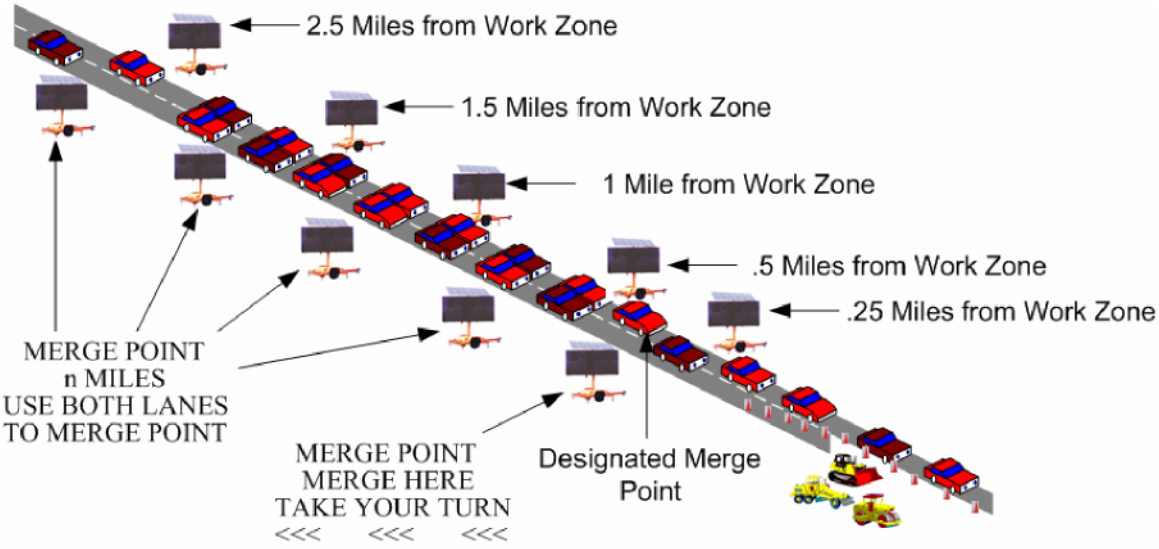

Figure 2 – Dynamic Late Merge

At the end of the peak traffic hours the scheduler returns the system to the Dynamic Early Merge state. The system can also be configured to extend or automatically transition to the Dynamic Late Merge state based on existing traffic conditions to maximize the available throughput or lane occupancy requirements. Both system merge states can have messages added to their sequences to discourage lane straddling and can actively display travel delays based upon collected sensor data.

ADDCO is committed to providing the most efficient, flexible and safe SMART Lane Merge solution. ADDCO's commitment to product excellence translates to the highest quality traffic solutions available.

References

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2. A. Tarko, S. Kanipakapatman, and J. Wasson. *Modeling and Optimization of the Indiana Lane Merge Control System on Approaches to Freeway Work Zones.* Final Report, FHWA/IN/JTRP- 97/12. Purdue University, West Lafayette, Indiana. 1998.

3. F.R. Hanscom.. "Effectiveness of Changeable Message Signing at Freeway Construction Site Lane Closures." *Transportation Research Record* 844. 1982.