DYNAMIC MERGE CONTROL

Description

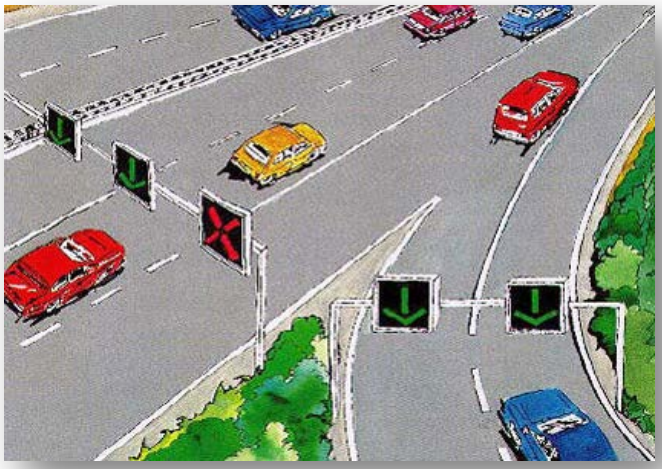
Dynamic merge control, or junction control, regulates or closes specific lanes upstream of an interchange. Agencies can modify access based on traffic demand from two entering roadways. Control strategies improve the operation of roads that have more lanes entering the merge area than leaving. A potential U.S. application of this technique would be at a two-lane entrance ramp where the left lane of the entrance ramp merges with the outside lane of the freeway. With dynamic merge control, either the outside freeway lane or the left lane of the entrance ramp would be closed upstream of the merge (depending on the traffic volume). The intent is to provide smoother traffic merging and higher speeds, which will result in more reliable travel times for the higher traffic volume. Dynamic merge control can be a permanent application at known bottlenecks, or it can be used temporarily for special events or until a downstream roadway is widened. It is a practical approach to handling varying traffic demand on the main lanes and the merging lanes to effectively utilize existing capacity.

Target Market

- Freeways or roads experiencing frequent congestion and significant merging volumes.
- Facilities with available capacity on main lanes upstream of an interchange.
- Roads where traffic volumes on two connecting roads peak at different times.

How Will This Help?

Dynamic merge control can delay the onset of congestion. By increasing capacity for the higher volume flow and encouraging more uniform speeds, traffic flows more smoothly and efficiently resulting in improved travel time reliability.



FHWA

Cost:	●●●○○
Time:	**Moderate**
Impact:	**Corridor**
Who:	**State**
Hurdles:	**Right-of-Way, Operations, Public Support, Design**

Dynamic merge control can improve safety by reducing primary incidents.

An increase in throughput can be another benefit of dynamic merge control by temporarily increasing capacity.

Implementation Examples

The German approach to dynamic merge control is applied using lane control signals to close the rightmost general purpose lane upstream of an on-ramp to allow two ramp lanes to merge onto the motorway. The Netherlands implemented merge control to optimize the merging of two facilities. Figure 1 shows an aerial view of the interchange and a schematic of the merge area.[1] The rightmost lane on the motorway is closed to facilitate the merging of two lanes from the ramp. The table below shows the results of the pilot study. Mean travel time was reduced and mean travel speed increased for both the vehicles on the ramp (as expected) and the

vehicles on the main lanes of the motorway. Both approaches also experienced a decrease in the vehicle hours of delay, with ramp vehicles experiencing a slighter greater reduction.

In the state of Washington, this measure was estimated to reduce collisions by 20 to 25 percent; the benefits of avoided collisions would most likely outweigh the primary cost in about six to eight years.[2] The late merge concept, deployed in work zones where a lane is closing, achieves similar results to dynamic merge control. The late merge is designed to encourage drivers to use all lanes until they reach the lane closure merge point rather than the "polite" approach of leaving the closed lane as soon as possible.[3]

One example of the late merge is the system developed by the Pennsylvania Department of Transportation (PennDOT). This system was implemented as a means to reduce the road rage engendered between drivers who merge into the open lane early and those who remain in the closed lane and merge into the open lane near the front of the queue at the last minute. Approximately 1.5 miles in advance of the lane closure, USE BOTH LANES TO MERGE POINT signs are placed on both sides of the roadway. These signs are followed by conventional ROAD WORK AHEAD and advance lane closed signs. Finally, MERGE HERE TAKE YOUR TURN signs are placed on both sides of the roadway near the beginning of the taper.[4] No problems have been reported with its use, and it seems to be well received by drivers. A study of its operational effects found that it increased the capacity of the merging operations by as much as 15 percent.

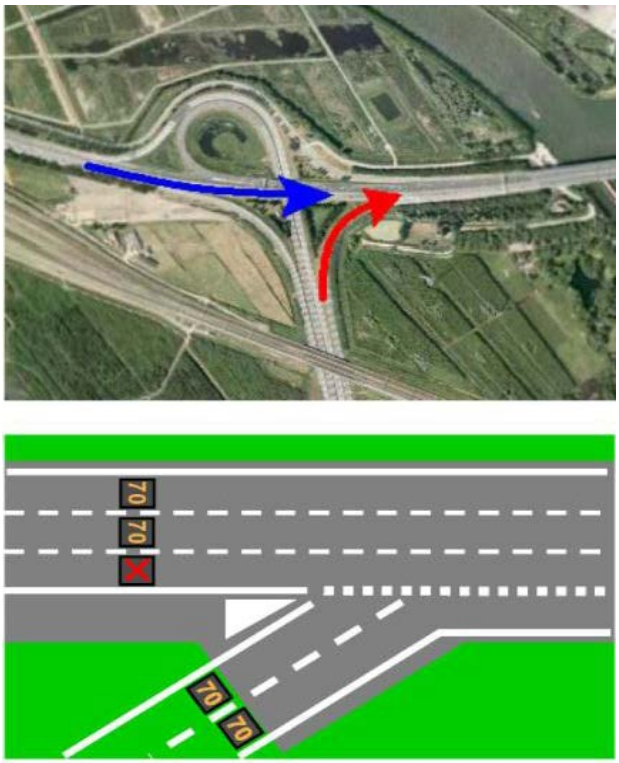


Figure 1. Netherlands: Interchange with Interchange Merge Control[1]

Application Techniques and Principles

General criteria for dynamic merge control include significant merging volumes (more than 900 vehicles per hour); available capacity on general purpose lanes upstream of the interchange that can be borrowed without generating stop-and-go traffic after implementation; and traffic volumes that peak at different times on the general purpose lanes and

Netherlands: Results of Pilot Study on Interchange Merge Control[1]

Route Meaure	Free Flow	Without Interchange Merge Control	With Interchange Merge Control	Percent Change
Red Route (Ramp)				
Mean Travel Time (min)	4.8	11.0	10.4	-8 percent
Mean Travel Speed (km/h)	98	41	45	+8 percent
Vehicle Hours of Delay		1,558	1,361	-13 percent
Blue Route (Main Lanes)				
Mean Travel Time (min)	2.8	7.1	6.6	-7 percent
Mean Travel Speed (km/h)	106	42	45	+7 percent
Vehicle Hours of Delay		1,455	1,398	-4 percent

For more information, please refer to: http://mobility.tamu.edu/mip/strategies.php.

merging lanes. Additionally, dynamic merge control also benefits from active incident management in the corridor; existing operations improvements and communication connections to a traffic management center; and in combination with shoulder use.

The following are key factors that can facilitate successful deployment:

- Effective dynamic merge control uses lane control signals on the main lanes and merging lanes of a freeway to close a lane as needed based on demand variations. It is important that these overhead signs be installed sufficiently ahead of the location to ensure advance warning to roadway users.
- An expert system that deploys the strategy based on prevailing roadway conditions without requiring operator intervention is optimal.
- To handle emergencies, a bypass lane for emergency vehicles, transit, or other identified exempt users is optimal. Dynamic merge control can be implemented in conjunction with temporary shoulder use as long as the overhead gantries with appropriate signing and lane control signals are part of the implementation.

Who Is Responsible?

The local TxDOT office bears the responsibility of developing and maintaining dynamic merge control. This agency should determine the viability of and need for the strategy along with the availability of right-of-way required for sign installation at regular intervals for adequate visibility. In addition, it should provide the adequate infrastructure for the traffic management center and other devices.

Project Timeframe

The length of dynamic merge control projects differ based on the scale of the problem and the available infrastructure. The systems should have adequate connections to the local traffic center and other supporting infrastructure and policies should be in place. Furthermore, since some additional signage will be required, a typical deployment may take between one and two years to initiate.

Cost

The cost of implementing dynamic merge control within a corridor varies considerably depending on the existing infrastructure and whether temporary shoulder use and/or variable speed limit will be deployed in conjunction with the merge control.

Data Needs

Dynamic merge control deployments require standard traffic information to evaluate the need and to operate the strategy. Data regarding maximum capacity of upstream general purpose lanes; traffic volumes on general purpose lanes and merging ramps; travel speeds on general purpose lanes and merging ramps; and incident presence and location are essential to determine the need for deployment.

Dynamic Merge Control Best Practice

- Type of Location: Freeways.
- Agency Practices: Strong program support from administrators and policy makers.
- Frequency of Reanalysis: Every three to five years or when substantial changes in traffic demand or in capacity due to nearby construction.
- Supporting Policies or Actions Needed: Possible changes to policies.
- Complementary Strategies: Variable speed limits, temporary shoulder use, queue warning.

For More Information

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2. *Active Traffic Management Feasibility Study.* Report to Washington State Department of Transportation, Urban Corridors Office. Seattle, WA: PB Americas, Carter + Burgess, EarthTech, Inc., and Telvent Farradyne, 2007.

3. McCoy, P. and G. Pesti. *Dynamic Late Merge Control Concept for Work Zones on Rural Freeways*. FHWA Integrating Operations Workshop, http://ops.fhwa.dot.gov/wz/workshops/accessible/McCoy.htm.

4. *Freeway Construction Work Zone Safety Enhancement Report*. Orth-Rodgers & Associates, Inc, 230 South Broad Street, Philadelphia, Pennsylvania, January 1995.