



Developing Consistency in ITS Safety Solutions – Intersection Warning Systems

Workshop #1 Summary

July 28-29, 2011

Best Western – Bloomington, MN

Purpose – Project and Workshop #1

Bringing together organizations that have developed and deployed intersection warning systems, the purpose of this project is to develop a consistent approach for accelerated, uniform deployment and further evaluation of intersection warning systems, and to recommend preliminary standards for MUTCD consideration. This work will be initiated through a webinar and two in-person workshops. Participants will include ENTERPRISE pooled fund states, other states that have deployed systems, FHWA, NCUTCD, AASHTO and NACE.

The purpose of Workshop #1 is to **discuss the content of a preliminary standard** building off the challenges identified during Webinar #1 and **to develop a roadmap for reaching standardization**. For example, further evaluation of these systems will likely be needed before complete standards can be recommended for the MUTCD. The roadmap will identify gaps in information needed to develop complete standards.

Deployment Challenges

Prior to this workshop, Webinar #1 was held on June 23 to share lessons learned from systems that have been developed and field-tested, and to identify challenges with deploying systems. Following is a list of the deployment challenges were identified by June 23 webinar participants.

- Warrants/Function
- Liability
- Placement
- Failsafe/Reliability
- Design
- Capital and Operating Costs
- Effectiveness
- Connected Vehicle
- Quality Control

These challenges were incorporated into four areas of standardization to be discussed at this workshop – function, placement, sign size and message set. A summary of characteristics associated with currently deployed intersection warning systems was used as a reference for each area of standardization. The summary included sign illustrations, roadway/intersection characteristics, sign/detection placement, message set, results and other notes about each minor, major and minor/major road oriented systems. Existing guidance from the Manual on Uniform Traffic Control Devices and states' experience with intersection warning systems were also referenced in each area of standardization. The discussion for each area of standardization was structured around the following questions:

- What do we know?
- What gaps or conflicts do we believe exist?
- What suggestions can we make for the gaps or conflicts?

Issues raised outside of the four primary areas of standardization were recorded and held for discussion at another point. Those issues included:

- Potential for tort liability if formalized as a standard in the MUTCD and some states deploy while others do not
- Acceptable failsafe
- Structural considerations, especially for signs when detection is attached to them
- Implications of the Connected Vehicle program for in-vehicle warnings
- Capital and operating cost considerations differentiated between research phase and eventual commercial phase

Standard Area 1: Function

Function of the system should address under what conditions the system may be used and what the desired outcomes are for the deployment of the system. Conditions that may warrant an intersection warning system include:

- High occurrence of right angle crashes; found primarily to be caused by poor gap acceptance or limited sight distance
- Ineffectiveness or inappropriateness of other safety improvements (i.e., lighting, static warning signs, etc.) to address crash problem

The system may function as a minor road, major road or combination minor/major road alert. Some may be designed to provide information (i.e., which direction a vehicle may be approaching from) vs. enhanced warning (i.e., flashing beacon to enhance warning sign conspicuity). In keeping with the function of warning signs, these systems indicate unsafe conditions or situations not readily apparent to drivers and as such they do not function as regulatory devices.

The desired outcome upon deployment of a system is to impact driver behavior in such a way that it prevents drivers from choosing unsafe gaps in traffic and provides drivers with enhanced warning of approaching vehicles. The ultimate outcome desired after deploying these systems is a reduction in right angle crashes and crashes overall.

Intersection warning systems should be considered in conjunction with other intersection safety measures such as lighting, enlarged sign size, pavement markings, etc. These systems should be viewed as a substantial vs. nominal safety measure.

The following summary statement was proposed in regard to overall function of intersection warning systems.

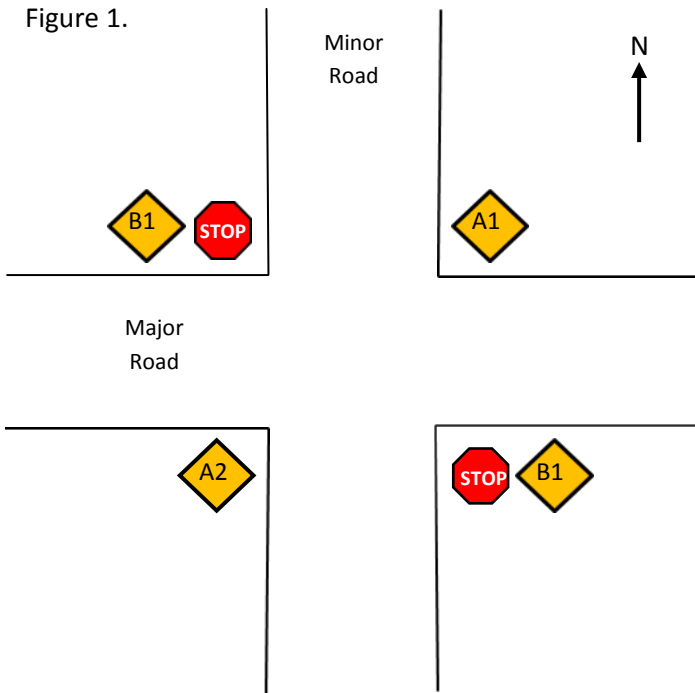
Provide real-time, dynamic information about intersection conditions to support driver decision and, ultimately, reduce right angle crashes.

Standard Area 2: Placement

Sign placement was discussed in relation to physical placement at the intersection. Physical placement of signs at the intersection is based on several factors including which driver (minor or major road) receives the warning, sight distance and roadway characteristics. Engineering judgment will remain essential until more is known about any potential human factor implication for sign placement,

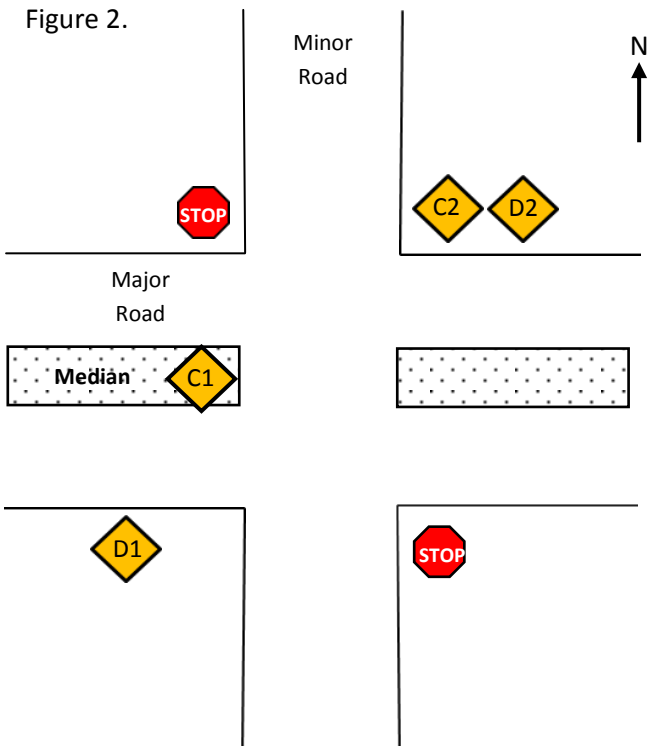
There are two placement options used most frequently for minor road warning signs on 2-lane/2-lane roadways as illustrated in Figure 1. They are typically placed on the far-side corner (A1, A2) from STOP or far-side opposite corner (B1, B2) from STOP.

Figure 1.



For minor road alerts at 2-lane/4-lane intersections there are two additional placements typically used as illustrated in Figure 2. Note that the rotation of sign D1 is oriented toward the northbound minor road driver while at the STOP looking for eastbound traffic.

Figure 2.



Sign placement for major road warning signs has typically been consistent with MUTCD guidance for static intersection warning signs. As further noted in the FHWA publication, “Stop-Controlled Intersection Safety – Through Route Activated Warning System,” one sign on the right side is recommended for single lane roadways. Dual signs – one on the left and one on the right – are recommended for multilane roadways with a median.

It was noted there are some experimental systems that have placed two warning signs in succession on the major road and it is unclear if this enhances the warning or potentially leads to the warning becoming overused and ineffective.

Sign placement will vary depending on intersection characteristics. Consideration should first be given to 2- and 4- lane roadways, with and without medians. Placement should be further based on characteristics impacting sign distance – vertical/horizontal curves, heavy vegetation, etc.

Standard Area 3: Sign Size

Discussion of this subject was limited to the group agreeing that sign size should follow current standards in MUTCD Table 2C-2. Warning Sign and Plaque Sizes.

Standard Area 4: Message Set

Message sets vary in wording and symbols as well as passive vs. active warnings. There was discussion about whether or not warning signs should have an action orientation such as LOOK FOR TRAFFIC. It was agreed that more human factors research would be needed to determine if passive vs. active signs would be more effective.

It was also agreed that message selection should also consider the implied or unintended message that may be conveyed when a system is not functioning. The use of WHEN FLASHING in conjunction with flashing beacons and the warning VEHICLES APPROACHING was highlighted as an example of the unintended message that may be conveyed if power is lost to the system rendering the beacons inoperable.

The use of flashing beacons was also discussed in terms of its appropriateness as a dynamic warning. This was particularly questionable in states where flashing beacon use is more common than others. The group agreed that overuse of the beacons could diminish its effectiveness as a dynamic warning. It was also acknowledged that volume could influence the effectiveness of the beacon as a dynamic warning. Higher volume roads could cause the beacon to flash almost constantly and that could also decrease its effectiveness.

Message sets for these devices should fundamentally convey unsafe (vs. safe) conditions. They should provide the substantial vs. nominal warning a driver may need in conditions where gap acceptance and sight distance are poor. It was agreed that human factors research into length of message and the use of words vs. symbols (or both) may be needed to understand what will best achieve the desired driver behavior.

Roadmap and Workshop #2

There was considerable discussion about the roadmap to standardization. It was agreed that a standard in the MUTCD would eventually be best for these systems but near-term, preliminary standards should be developed as recommended practice. Minnesota’s Intelligent Work Zone Toolbox (<http://www.dot.state.mn.us/trafficeng/workzone/iwz/MN-IWZToolbox.pdf>) was reviewed as an example of how recommended practices for intersection warning systems could be presented. Such guidance would include background on the intended function of and conditions that may warrant these systems, as well as placement, message set and criteria for evaluating system effectiveness. This would support greater consistency in future deployments and further assessment of the impacts these systems have on

intersection safety. The roadmap should illustrate how documentation of recommended practice may be used to:

- Engage further human factors research
- Support further statistical analysis of system results across state boundaries
- Identify any changes that may be required to provide for interim compliance with existing MUTCD standards
- Allow for continued experimentation and data collection
- Brief the NCUTCD and AASHTO SCOTE to initiate their formal processes

Workshop #2 will be designed to **review the preliminary guidance** proposed for MUTCD consideration, **develop an evaluation framework** that may be used in future deployments for experimentation, and **discuss plans for future experimentation and coordination**. The group agreed that it would also be useful to include ATSSA in the discussion about future experimentation to get their insight on product availability.

There were several conflicts noted for the proposed timing of Workshop #2 and as such the week of September 12 will be explored for the meeting. Minnesota will be the likely meeting location, with North Carolina as a potential alternate location if necessary to accommodate travel.

This summary of Workshop #1 and all supporting materials will be posted to the project web site at http://www.enterprise.prog.org/Projects/2010_Present/developingconsistency.html. For further information about this project, please contact Jon Jackels, Mn/DOT at jon.jackels@state.mn.us or 651.234.7377.

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