



WEATHER-RESPONSIVE MANAGEMENT STRATEGIES

FACTSHEET

Source: Federal Highway Administration

Utah's and Minnesota's Snowplow Traffic Signal Preemption and Priority

Background

The Weather-Responsive Management Strategies (WRMS) initiative under the Federal Highway Administration (FHWA) Every Day Counts — Round 5 (EDC-5) program promotes the use of road weather data from mobile and connected vehicle (CV) technologies to support traffic and maintenance management strategies during inclement weather. The goal is to improve safety and reliability, as well as reduce impacts on the transportation system resulting from adverse weather.

This factsheet highlights CV technologies deployed in Utah and Minnesota on signalized corridors and agency snowplow vehicles to enable traffic signal preemption and priority for winter maintenance operations.

Utah Deployment

The Utah Department of Transportation (UDOT) initially deployed CV technologies at signalized intersections along multiple corridors in the Salt Lake City metropolitan area for use by Utah Transit Authority (UTA) buses equipped with CV onboard units (OBUs). This step enabled the buses to use transit signal priority (TSP) when they were behind schedule to receive priority (e.g., extra green-light time) at traffic signals. UDOT later launched a Snowplow Preemption Project to leverage these deployed CV technologies by equipping UDOT snowplows with OBUs, similar to those on the UTA buses. OBU-equipped snowplows can preempt an upcoming traffic signal when they are actively plowing, changing a red light to green to allow the snowplow to move through the intersection. This practice improves the efficiency of plowing operations and facilitates a faster removal of snow and ice from roadways.

Beginning in March 2019, 46 snowplows were equipped with OBUs that use dedicated short-range communications (DSRC) technology to send and receive messages from traffic signals on the five corridors, (figure 1), in the Salt Lake City metropolitan area that were equipped with DSRC roadside units. Because snowplows from each maintenance garage are used interchangeably for corridors in the shed area, UDOT equips all snowplows at a garage at the same time. By the end of 2021, UDOT had 132 equipped signalized intersections and 44 equipped snowplows from 6 maintenance garages, with plans to equip an additional 139 signalized intersections and 17 snowplows from 2 additional maintenance garages.

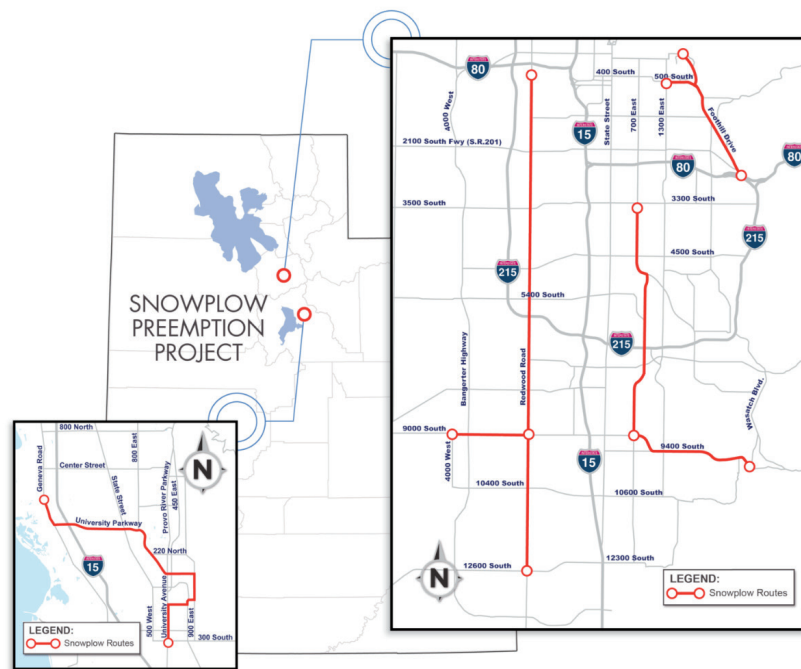
TSP and snowplow preemption differ in some ways. First, TSP provides conditional priority to a bus that is behind schedule and extends an existing green light, while snowplow preemption anticipates snowplow arrival and changes a red light to green to keep the plow moving at efficient speeds. Second, the traffic signal system grants priority to emergency, UDOT, and UTA vehicles in that order, and when multiple vehicles from the same entity are present, priority is granted to the first arrival.

Challenges

With a few exceptions, snowplow preemption only occurs when the salt or sand spreader is active. UDOT's initial intent was to link signal preemption to a plow blade being down, but they experienced technical issues with that approach. Additionally, some older plow vehicles link the snowplow preemption to the ignition, but these vehicles will soon be phased out, at which time the OBUs will be reused on other vehicles. Finally, UDOT's snowplow signal preemption works in the background, so plow operators need not take any specific actions.

Benefits

UDOT has continued to expand snowplow preemption to additional corridors and snowplows in the Salt Lake City metropolitan area. In addition to the initial 5 corridors, 10 more new or expanded signalized corridors are being equipped with CV technologies in the region. The CV ecosystem in Orem, UT, in cooperation with an electronics company, will eventually equip all signalized intersections with CV technologies for snowplow preemption. As new signalized intersections were outfitted with CV technologies, 15 additional snowplows serving those areas have been equipped, and more are planned. Additionally, UDOT is currently in the process of transitioning all UDOT and UTA vehicle and infrastructure equipment from DSRC to cellular vehicle-to-everything communications.



Source: UDOT.

Figure 1. UDOT initially deployed snowplow preemption on five signalized corridors in the Salt Lake City metropolitan area.

Minnesota Demonstration

The Minnesota Department of Transportation (MnDOT) has demonstrated snowplow signal priority as part of two different projects: the 2016–2020 Connected Corridor Project and the 2019–2022 Smart Snelling Project.

The Connected Corridor Project equipped four snowplows with OBUs and demonstrated snowplow signal priority at a single intersection equipped with a roadside unit using DSRC, which provided snowplows with the ability to request extended green or early green phases at that intersection. MnDOT experienced a variety of technical challenges getting snowplow priority to work with the signal controller at the intersection.

The Smart Snelling project equipped 16 signalized intersections on two intersecting corridors, 9 along the MnDOT-operated Snelling Avenue and 7 along Ramsey County Road B-2. Snowplow priority was enabled for two MnDOT snowplows and two Ramsey County snowplows that were specially equipped for using cellular communications technologies. Although both projects deployed snowplows at the same time, the Snelling Avenue and Road B-2 corridors functioned differently. Snowplow priority was automatically granted at all times for plows driving on the Road B-2 corridor when the plow was down. However, plow operators on the Snelling Avenue corridor had to manually request signal priority by pressing a button, and signal priority was only granted during overnight hours due to concerns by MnDOT signal operations staff. Consequently, while the Ramsey County plow operators observed benefits on the Road B-2 corridor, the MnDOT plow operators on Snelling Avenue did not, given the lack of issues at that time when signal priority was granted it was not always needed.

Overall, both MnDOT projects included testing to demonstrate the snowplow signal priority technology and concept. MnDOT experienced some technical challenges with signal controllers and different interfaces for various snowplow models. Although MnDOT was ultimately successful in getting the technology and communications to work as intended, plow operators did not significantly benefit from the effort.

Challenges

UDOT and MnDOT each noted two major challenges with deploying snowplow signal preemption and priority, respectively:

- *Different Types of Equipment*: Installing the CV technologies on different versions of the equipment was a challenge for both UDOT and MnDOT given the different capabilities and interfaces present, including different snowplow models, signal controllers, and CV technologies. However, the amount of time needed for installation was reduced once the deployers became accustomed to the installation. UDOT noted that newer plows have many electronic devices, which raises some concerns about the new CV technology causing interference with the existing technologies on the plows.
- *Route Planning*: UDOT acknowledged plow operators' experience in understanding the issues and conditions of the routes, and trusted field staff to use the technology where it was most needed. These issues were sometimes different from those initially prioritized by operations staff analysis. If plow operators said there were not issues on an identified corridor, UDOT trusted field staff to understand the conditions and issues experienced to use the technology where it was needed most.

- *Signal Coordination*: The UDOT signals group initially had concerns with granting signal preemption to plow vehicles along coordinated corridors but realized the occurrences would not be very frequent (i.e., about once per hour during a major storm) and signal coordination is not effective with vehicles traveling at slower speeds. As such, disruptions to signal coordination caused by plows were acceptable to clear the road faster and safely increase vehicle speeds. MnDOT signal operations staff had similar concerns about adjusting signal timings, but only permitted snowplow priority during overnight hours.
- *Concerns with Operator Abuse of Preemption*: UDOT staff initially had some concerns about plow operators abusing the signal preemption capability, but this concern was resolved by equipping the CV technologies to activate signal preemption automatically when the salt or sand spreader was active.

Benefits

Quick and efficient removal of snow from roadways is a key way to improve safety for the traveling public. Provision of signal preemption for snowplows that are equipped with CV technology at connected intersections when they are actively plowing snow allows the plow to keep moving through the intersection. As a result, more efficient snowplow operations can help to reduce crashes along urban corridors.

A study conducted by UDOT in 2018¹ on the five CV-equipped corridors in the Salt Lake City metropolitan area concluded that up to 89 crashes occur annually when those roads are snowy, icy, or slushy. These conditions can be mitigated sooner by improving the efficiency of snowplow operations, hopefully reducing the number of crashes. An eight-percent reduction in crashes was estimated for these initial five corridors after deploying snowplow signal preemption technologies. UDOT is currently sponsoring an evaluation to better understand the actual benefits of equipped snowplows versus those that are not equipped.

Additionally, UDOT has received positive anecdotal feedback from plow drivers. The drivers state that the technology allows easier platooning and staggering of plow vehicles on multilane roads. It also results in more efficient clearance of left-turn lanes by allowing plows to work side by side, instead of a single driver circling back.

Conclusions

Both UDOT and MnDOT implemented the snowplow signal preemption/priority efforts as part of larger projects. UDOT leveraged existing investments and experiences in CV technologies with traffic signals and transit vehicles for initial snowplow preemption efforts, which were successfully demonstrated and are now being expanded into additional corridors and maintenance garages in the State. Specifically, UDOT plans to equip an additional 17 snowplows in 2022, for a total of 61 snowplows from 8 maintenance garages that will be equipped to request signal preemption from 271 equipped intersections. MnDOT successfully demonstrated the snowplow signal priority technology and concept. However, limited benefits were realized since priority was only given during overnight hours. MnDOT has no plans at this time to further deploy this technology.

¹Safety Impacts of Snow Plow Signal Priority Status Using Dedicated Short-Range Communication – Updated", Unpublished Memorandum, Utah Department of Transportation, April 16, 2018.

UDOT noted that the upfront investments in traffic signal and CV software development, as well as experiences and lessons learned from early deployments, have significantly reduced the costs incurred to expand the applications and capabilities to additional intersections and plow vehicles. For instance, an OBU can generally be installed on a snowplow much faster if staff already have experience installing OBUs on that specific vehicle model. Additionally, UDOT felt they benefited from conversations with plow operators concerning where the preemption technology might be deployed to be more useful.

Available Resources

FHWA Road Weather Management Program website:

<https://ops.fhwa.dot.gov/weather>

UDOT Transportation Technology Group, Snowplow Preemption Project website:

<https://transportationtechnology.utah.gov/snowplow-preemption-project>

MnDOT Connected Corridor Project website:

<https://www.dot.state.mn.us/its/projects/2016-2020/connectedcorridors.html>

MnDOT Smart Snelling Project Flyer:

<http://www.dot.state.mn.us/automated/docs/smart-snelling.pdf>

www.highways.dot.gov

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FHWA-HOP-22-053