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Transportation Planning and Preparation for 2017 Solar Eclipse

Niloo Parvinashtiani, Adam Hopps, and Laurel Radow
National Operations Center of Excellence, Washington, DC 20001

Abstract.
On August 21, 2017, a total solar eclipse moved west to east across the United States, covering fourteen states. This rare special event required extensive planning by state transportation agencies across the country, not just due to the effects of darkness, but also in light of the unusual and altered travel patterns across the country's entire transportation network. Evaluating how state and local agencies managed the traffic operations, communicated with the traveling public and planned for the altered travel patterns gives us an insight around successful strategies, not just for future eclipses, but for understanding the transportation system as a whole.

1. Knowledge Transfer

A key component to the success of safely moving millions of eclipse viewers around the country was the large amount of information shared with millions of travelers. Several agencies and organizations played important roles in providing solar eclipse traveler information, through their communications, coordination, and knowledge sharing.

The Federal Highway Administration (FHWA) took on a major role in leading the preparation and planning efforts for the eclipse. In the summer of 2016, FHWA prepared and posted the 2017 Eclipse Fact Sheet, a resource designed to assist state and local Departments of Transportation (DOTs) to prepare for the surface transportation component of the eclipse. The fact sheet provided information to help guide states as they developed and implemented transportation plans for the eclipse and included information on events and festivals to alert agencies to specific locations where traffic might be congested.

Partnering with FHWA was the National Operation Center of Excellence (NOCoE). NOCoE is a non-profit organization, founded by the American Association of State Highway Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the Intelligent Transportation Society of America (ITSA), with the mission to provide knowledge and resources to assist professionals working in transportation system management and operations. In November 2016, NOCoE hosted the FHWA-organized 2017 Solar Eclipse webinar, featuring speakers from NASA and the Smithsonian, who shared with state DOT and emergency management officials on where the greatest demands were for the solar eclipse. In 2017, less than one month before the eclipse, NOCoE hosted another webinar to allow for last-minute knowledge sharing amongst agencies and updates from key weather and public communications officials.

Additionally, in April 2018, NOCoE hosted a virtual peer exchange and after action review where representatives from ten agencies within the eclipse's path of totality outlined their findings and observations. Using the knowledge shared from this event, as well as conducting ongoing knowledge sharing activities, NOCoE will create a national repository of good, solid practices for preparing for a special event of this magnitude and will remain the facilitator and the main point of reference for agencies planning for the 2024 solar eclipse.

AASHTO also played a key role in knowledge sharing activities around the eclipse, establishing two Solar Eclipse Task Forces: one with a focus on communications and another on emergency management. The Transportation Communications Subcommittee (TransComm) formed a national task force with representatives from the 14 states directly in the path of totality and the neighboring states to share information specifically regarding communications planning. The Special Committee on Transportation Security and Emergency Management (SCOTSEM) task force focused on coordination around emergency management issues necessary to address around a planned special event such as the solar eclipse.

2. Preparations for 2017 Solar Eclipse

Each of the fourteen states prepared for the eclipse independently to address the multitude of situations and regional considerations. Below is a summary of lessons learned from some of those states pre-eclipse activities.

2.1. State Departments of Transportation

Oregon Department of Transportation Beginning almost a year out, the Oregon Department of Transportation (ODOT) participated in briefings with their state's Office of Emergency Management and the other key state agencies. The ODOT Maintenance and Operations department facilitated regular working group planning meetings and gathered the plans developed by each of the divisions. All the individual plans were compiled into a Statewide Department plan for the eclipse which was published and distributed in June 2017. ODOT also activated the agency operations center and the regional emergency operations centers for the event.

Illinois Department of Transportation (IDOT) Similarly, IDOT started the planning early in the process. In preparation for the 2017 solar eclipse, Illinois state and local transportation agencies and the Illinois Emergency Management Agency held regular meetings. To enhance the traffic flow, construction projects that include lane closures were halted before and during the eclipse and the right turn and left turn movements were limited on key Illinois routes.

Wyoming Department of Transportation (WYDOT) In preparation for the solar eclipse, WYDOT activated their emergency operations center. The governor's office held a multi-agency news conference for agencies involved in solar eclipse planning to brief the media and public on the solar eclipse. To assist the public in identifying traffic congestion and minimize questions from the public during the event, WYDOT provided an interactive traveler information map linked to live webcams of the transportation system. Inbound and outbound traffic maps were also provided to assist travelers. Additionally, major cellphone companies were contacted in advance of the event to bring in Cell on Wings (COWs) to provide the most reliable cell phone and data support. A statewide public safety communications system, WyoLink was used to coordinate and

integrate communications between state, local, and federal public safety agencies. On the day of solar eclipse, although there were some connection issues on the WyoLink radio system, the advanced training and preparation helped to minimize the problem.

Tennessee Department of Transportation (TNDOT) The following describes some of the lessons learned and several planning aspects that were considered by Tennessee DOT in preparation for the solar eclipse. First, closing time at schools across the state coincided with solar eclipse totality, potentially resulting in the disruption of transportation and school pick-ups and school bus operations. To resolve this issue, the Tennessee Department of Education participated in the eclipse safety core planning team and coordinated on school closures. Another major issue in Tennessee was estimating the number of visitors and locations with mass gatherings. The Department of Tourism solved this by using hotel data to create maps to identify those locations. Finally, transportation choke points were identified by targeting parks and rest stops within five miles of highway routes of the path of totality. This information was provided to the planning team through tables and visual maps to ensure the efficient management of the overall transportation system.

2.2. Additional Preparations

Additional measures were taken by agencies to prepare the DOT staff for the solar eclipse:

Illinois DOT held training on emergency management software and limited the leave time for operations staff. Also, as part of Unified Area Command, Illinois DOT staff were embedded at the Illinois Emergency Management Agency. On the day of the event, the communications staff were stationed at the district level to support their Joint Information Centers (JIC).

At Nebraska's Homestead National Monument, the solar eclipse observers reached out to the U.S. National Park Service through phone calls, emails, and social media to ask questions about hours of operation, permission to use telescopes in the park overnight, as well as traffic plans. Additional staff was added to support the responses to the public.

The Kentucky State Police enhanced their enforcement efforts with additional personnel positioned to cover every 5-10 miles along the major routes. Also, supplemental maintenance tasks such as extra mowing cycles worked to prevent wildfires.

Additionally, several state DOTs issued warnings about oversize load travel restrictions during the solar eclipse period. Some states such as Georgia and Kentucky posed no restrictions but issued heavy traffic warnings to heavy vehicle drivers. In Kentucky, TRIMARC net alert group (Traffic Response and Incident Management Alert System) messages were used to warn truck drivers about the heavy traffic on major roads on the path of the solar eclipse. Some state DOTs such as Colorado DOT decided to restrict all oversize/overweight travel in the area affected by the solar eclipse (Northeast Colorado). Other states restricted only overweight (Missouri) or oversize (Nebraska) vehicles. One of the areas of improvement for state DOTs is to make these policy level decisions early in the process to ensure all stakeholders are aware of these decisions to save costs and reduce frustrations.

2.3. Communications

Inter-agency communications with contractors and local agencies was a key component of state DOT plans of operation. In Oregon, in the year before the eclipse, all the road

construction and work zone contracts were written with the inclusion of a solar eclipse interruption condition. Including the solar eclipse in construction contracts meant that the work zone operations affecting the traffic within the major roads were scheduled to be interrupted near, and on the day of, the solar eclipse. With the contractor being notified far in advance, the construction work stayed on schedule with minimal negative impacts on traffic.

Another example of interagency coordination was ODOT's interaction with event promoters. The event promoters are the central source of information for many planned special events. Providing clear directions, locations, and traffic plans to the participants by the event promoters are essential to traffic management efforts. ODOT regional office staff coordinated in person with the event-promoter to resolve issues regarding clear communications with the public. Two major festivals also occurred at the week of the solar eclipse; ODOT provided guidelines for people traveling from one event to the other.

Communications with the media was another principal aspect of eclipse planning. Some agencies, such as WYDOT, released statistics on traffic data daily and frequently used social media and Facebook Live to communicate with the public. One aspect of the work done by AASHTO's Communications task force was to develop a common set of taglines to share with the public in all of the fourteen states. Also, several slogans for interviews were created by state DOTs to inform the public uniformmannerly. A few examples of these taglines are:

"Arrive early, stay put, leave late" (ODOT)

"Plan to have a good time watching the eclipse. Plan ahead, so you will." (ODOT)

"This isn't a game day. Treat the eclipse as a 3-day event, not a 3-hour event." (ODOT)

"When you pack for your trip include a 5-gallon bucket of patience" (KYDOT)

"This is like the Super Bowl, but without a stadium" (KYDOT)

Safety messages for the traveling motorists and viewing public might seem obvious, but DOTs decided not to make assumptions that motorists would know what to do and created safety messages. Examples of safety messages that Missouri DOT used included:

- Don't stop along the interstate or shoulder.
- Exit the highway to view or photograph the event.
- Don't take photographs while driving.
- Turn your headlights on.
- Watch out for pedestrians.
- Prepare for congestion on the day before, the day of and the day after the eclipse.

Some of the other minor concerns for state DOTs were the significant increase in demand for everyday commodities including shortages for gas and groceries. Given the expected increase in demand for everyday commodities, local residents were advised to fill up their tanks and have groceries at home ahead of the eclipse. Also, with the influx of viewers, there was a potential shortage of medicine for people away from

home (people who forgot to bring their medicine or people who ran out of their medication). KYDOT sent announcements to business owners (e.g., convenience stores and gas stations) every couple of weeks to keep them informed about the solar eclipse visitor numbers and estimates.

Communicating traveler's information was an essential piece of many agencies' success with the solar eclipse. ODOT's consistent messaging through TV, radio, and social media helped prepare the public. Oregon's local population paid attention to the messages and changed habits based on the messaging they received. Additionally, Oregon DOT gathered real-time travel-time data through tools such as Tripcheck (ODOT near real-time traffic congestion interactive map) and iPeMS (a travel time data dashboard). These tools provided ODOT with speed and travel time data but disseminating this data to the public was harder. In the future, ODOT will work to improve methods to disseminate travel time data to the public. Communicating traveler information is essential for providing a safe environment with minimal congestion conditions for travelers. The agencies need to build their case early, as much as 24 months ahead of time and continuously communicate their messages internally and with the media.

2.4. Technology Deployments

A major success story for agencies involved the use of technology. Many state DOTs used Intelligent Transportation System (ITS) equipment such as Dynamic Message Signs (DMSs). DMSs are electronic traffic signs that give travelers information on travel times, incidents, and expected delays. For the solar eclipse event, ODOT purchased additional 40 portable DMSs and temporary cameras to install on the interstate. Similarly, Nebraska DOT used DMSs and Jersey barriers to manage the traffic efficiently.

Another solar eclipse technology deployment was the pre-staging of crash response equipment in compliance with the traffic incident management best practices. For easier and timelier access, WYDOT staged their incident response and DMSs equipment at strategic locations so they could be moved to the crash scene and reduce the clearance time for the road. Similarly, ODOT's pre-staging of incident response crews was highly beneficial and allowed for quick responses, clearing of incidents, and the relocation of portable cameras and message boards as needed.

Another innovative technology were smart message boards that were used by Illinois DOT. The smart message boards automatically collect and convey real-time travel information to the motorist by using speed detectors and traffic sensors to detect backup/queue length. IDOT uses this technology mainly in the work zone areas, but Smart Message Boards were placed along I-57 for traffic detection on the day of the solar eclipse.

3. Travel Patterns and Traffic Congestion

One of the main concerns among agencies preparing for the solar eclipse was that people would arrive at a variety of times but would all leave at the same time, immediately following the eclipse. For many states along the path of totality, the departures did occur all at once and, often within minutes of the eclipse ending. The results were that the roadways became over-saturated and congested. A nationwide bottleneck analysis study by INRIX analyzed the top 5 bottlenecks based on the duration of traffic congestion on the path of totality (between August 13, 2017 and August 26, 2017) (Trepanier,

2018). Table 1 illustrates the bottleneck location, time, duration, and maximum queue length:

Table 1. Top 5 bottlenecks based on the duration of traffic congestion on the path of 2017 solar eclipse

	Location	**From**	**To**	**Duration queue**	**Max (miles)**
1	Interstate 71/Interstate 75 North at exit 192 in Ohio	Monday, Aug. 21, 2017 5:33 am	Tuesday, August 22, 2017 4:31 am	22 h 58 m	3.51
2	US 97 South at Oregon 138/diamond lake highway in Oregon	Monday, Aug. 21, 2017 12:01 pm	Tuesday, August 22, 2017 3:53 am	15 h 34 m	69.55
3	US 276 South at South Carolina 11/Cherokee Foothills scenic highway (Cleveland) in South Carolina	Monday, Aug. 21, 2017 8:01 am	Monday, August 21 2017 7:37 pm	11 h 36 m	6.4
4	US 23 South at Georgia 13 in North Carolina	Monday, Aug. 21, 2017 2:05 pm	Monday, Aug. 21, 2017 9:48 pm	7 h 43 m	66.43
5	Wyoming 487 South at US 287/US 30/Lincoln Highway in Wyoming	Monday, Aug. 21, 2017 12:30 pm	Monday, August 21, 2017 7:49 pm	7 h 19 m	45.01

This analysis was conducted by Ted Trepanier using INRIX's core traffic data. INRIX's core traffic data combined with the traffic data in other countries who will experience a solar eclipse between now and 2024, can be used by US researchers to provide resources for better decision making for the 2024 solar eclipse.

Another critical aspect of the 2017 solar eclipse was coordination with states neighboring the states in the path of totality. In many cases, states that were not in the path were just as affected by the traffic as were the totality states. One lesson learned was that the sharing of information as early as possible could help states develop their plans to include how best to serve the traveling population trying to get to and from the event through neighboring states as a way to minimize the safety issues and traffic congestion.

Since this was the first coast-to-coast total solar eclipse in 99 years in the United States, no information was available for modeling to predict travel patterns. State DOTs relied on information such as hotel reservations, number of incoming flights, number of air passengers, and the distance from population centers to estimate traffic demand. Looking at the future, traffic data providers, such as INRIX, will be able to use the 2017 eclipse traveler data to help states predict traffic information for the 2024 solar eclipse and models can be applied to assess the drivers that move from population centers to the path of totality.

In preparations for the solar eclipse, states estimated the origin, destination, and number of solar eclipse observers. In Oregon, arrivals came from areas different than

they had assumed. Expectations were that the majority of people would come from the Portland and Puget Sound regions (3–6 hour travel) while in reality, the majority of arrivals came from the California Bay Area (8–10 hour travel).

Another example was Kentucky, who over-estimated the number of solar eclipse travelers. Their planning estimate was that up to 500,000 guests would arrive over the three days prior, whereas, in reality, about 300,000 guests arriving and mostly by driving to the eclipse sites Monday morning. Local residents stayed home, and traffic congestion mainly occurred on Monday upon exit only (exits leading to the national park). Kentucky DOT expected traffic only on primary roads, but congestion was observed on many of the secondary roads as people tried to avoid the traffic on the primary roads. Traffic counts showed an immediate jump as people headed home from their eclipse adventure, with the most significant single jump of a 222% increase in traffic on US 31 in Hart County, KY. Overall, Kentucky had visitors from approximately 47 US states and 25 countries.

In Oregon, some event planners had trouble living up to promises due to overselling events, a lack of traffic control implementation, and poor directions provided to customers. In some cases, events were over-sold double what they anticipated, and event pamphlets/tickets failed to inform customers of the correct route to use to get to the event property, based on the developed traffic control plans. The traffic control plans were developed with the aid of ODOT, but the event planners had a hard time implementing them correctly. For future events, one of the things that can be done early in the planning process is to request that event providers gather zip code data at the time of the sale of tickets. This data can be used to estimate travel origins and major routes used by the travelers.

4. Considerations for 2024 Solar Eclipse

Moving forward, many transportation agencies will capitalize on the lessons learned from the 2017 solar eclipse. The solar eclipse experience was much more effective than any tabletop exercise, and the preparation leading up to the event made agencies confident in handling multi-state planned special events. Additionally, valuable partnerships were formed that will assist with large-scale events in the future. It will also be beneficial if State and local transportation agencies are brought together with other partners early in the planning process for the 2024 solar eclipse.

There is a fine line between preparing the public for the solar eclipse and scaring them off and discouraging them from participation. Even though it can be challenging to accommodate such large number of visitors, DOTs can embrace their state's tourism goals. An example of embracing tourism goal was ODOT's messaging that was focused on being positive and prepared for the solar eclipse: "People will have a good time visiting Oregon, and will want to come back."

The National Operations Center of Excellence will continue to serve as the facilitator of information for the solar eclipse event. There are several concerns we will need to keep in mind for planning 2024 solar eclipse. Today, only six years before the next one, more people are aware of the 2024 eclipse and with for more advanced notice, than they were with the 2017 eclipse, which means they will have higher expectations for their total eclipse experience. Unlike the 2017 eclipse, much of the path of the 2024 eclipse crosses the nation's more densely populated states, so we should expect more people from across the country to travel to view the 2024 eclipse.

State DOTs will also need to plan further ahead and communicate their intentions, to allow the media ample time to communicate with their viewers, listeners, and readers. Additionally, it is very likely that some of the technologies that will be available in 2024 are unknown to us now. It will be essential to think through how planning efforts take in account future deployable technologies. Agencies directly impacted by 2024 solar eclipse will need to start planning as early as 24 months ahead of the event and form partnerships with core agencies involved in the solar eclipse preparations.

Staffing will also be a significant issue: people with roles in solar eclipse emergency and communications may not be in the same roles and with the same agency in six years, and the people responsible for planning the 2024 eclipse may not even be with the agency yet. It is vital for agencies to capture the knowledge and transfer it to the next generation of operations, communications, and emergency staff.

Weather may be more of a role in 2024 as well. During the 2017 solar eclipse, severe weather was not a factor in the entire country. The 2024 solar eclipse will occur on Monday, April 8th during early spring weather including flooding and other extreme events which may drain staffing capabilities. With several outdoor activities during the solar eclipse, a severe weather event could impact people gathering outside.

Overall, the knowledge transfer of lessons learned from the 2017 solar eclipse to the next generation of communications, emergency, and transportation professionals will help transportation agencies to prepare for the 2024 solar eclipse. The establishment of a formal knowledge sharing partnership between 2024 and 2017 states will be a key aspect of these efforts as well as the gathering of States' preparation plans and after-action plans on the NOCoE knowledge center for future reference (e.g., TransComm, Oregon, Kentucky, Colorado, and Tennessee reports). With the use of data-driven decision-making tools and the collaboration between public and private agencies, transportation agencies can aim for achieving a higher level of operational readiness for the 2024 solar eclipse.

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