KENTUCKY TRANSPORTATION CENTER
176 Raymond Building, University of Kentucky
859. 257. 4513 www.ktc.uky.edu

Synthesis of Kentucky's Traveler Information Systems

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Kentucky Transportation Center
176 Oliver H. Raymond Building
Lexington, KY 40506-0281
(859) 257-4513

www.ktc.uky.edu

Research Report
KTC-16-17/SPR16-56-2-1F

Synthesis of Kentucky's Traveler Information Systems

by

Chris Van Dyke, PhD
Research Scientist

Jennifer Walton, PE
Program Manager

and

James Ballinger, PE
Research Engineer

Kentucky Transportation Center
College of Engineering
University of Kentucky
Lexington, Kentucky

in Cooperation with

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Chris Van Dyke, Jennifer Walton, James Ballinger

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16. Abstract
After the United States Department of Transportation (USDOT) petitioned the Federal Communications Commission (FCC) to establish a dedicated phone number for real-time travel information services, the abbreviated 511 dialing code was founded in July 2000. The FCC reasoned that 511 services could reduce traffic congestion, air pollution, and the inefficient use of fossil fuels. 511 would, in turn, improve traveler safety. In 2010, the Federal Highway Administration (FHWA) mandated a set of requirements for systems that deliver real-time traffic information to the public. States DOTs were asked to comply with this mandate by November 2014. Many states, in addition to maintaining websites, also have dedicated mobile apps and a social media presence (e.g., one or multiple Twitter accounts) that communicate data on traffic and road conditions. Analysis of 511 usage data indicated that the number of phone calls received has dropped sharply since the mid-2000s. Conversely, the amount of traffic handled by KYTC's websites and mobile apps has increased. Like the phone system, websites and mobile apps garner the most traffic during the winter months. Discussions with KYTC 511 stakeholders revealed that phone system will be less relevant — although necessary to maintain, particularly in rural areas. There was significant consensus among KYTC stakeholders about the strengths of the state's current approach to delivering traffic information, and a number of improvements were put forward to enhance it in the future. A survey of Kentucky drivers revealed that a majority get their traffic information through digital content providers. Services such as Google and Waze are popular for retrieving maps and driving directions, while television and radio play an important role still, especially for the provision of information during hazardous weather. Government-provided services (i.e., 511, TRIMARC) are less popular among drivers, and only garner a fraction of the traffic of online services and traditional media. Discussions with other state DOTs revealed that many other states are currently in the process of rethinking their 511 and traveler information systems. Many plan to retool these over the next 2–3 years. While there was agreement among state DOTs that they will continue to provide authoritative traveler information, how they carry out this mandate is somewhat unclear.

17. Key Words
Real-time traffic information system, Kentucky 511, travel information, incident reporting, mobile traffic apps

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Executive Summary

After the United States Department of Transportation (USDOT) petitioned the Federal Communications Commission (FCC) to establish a dedicated phone number for real-time traveler information services, the abbreviated 511 dialing code was founded in July 2000. The FCC reasoned that 511 services could reduce traffic congestion, air pollution, and the inefficient use of fossil fuels. 511 would, in turn, improve traveler safety.

No further regulations on traffic information emerged from the federal government until 2010, when, pursuant to Section 1201 of the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users*, the Federal Highway Administration (FHWA) mandated that state departments of transportation must develop systems that deliver real-time traffic information to the public. State DOTs were instructed to alert travelers of construction activities, roadway-blocking incidents, weather observations, and travel time information. Furthermore, traffic information should be available within 10 minutes of a closure or reopening in metropolitan areas, and within 20 minutes for roadways located elsewhere. States were asked to comply with this mandate by November 2014, but this has since been extended until 2016. The federal government has issued only two rulings related to the provision of traveler information services over the past 15 years. Yet, many states have taken the initiative to developed sophisticated 511 traveler information systems that integrate phone and website operations, or deliver information via mobile apps and social media.

While some states have not finished implementing 511, all of them have some capability to report traffic information. Many states, in addition to maintaining websites, also have dedicated mobile apps and a social media presence (e.g., one or multiple Twitter accounts) that communicate data on traffic and road conditions.

This report benchmarks Kentucky's current efforts on delivering real-time traffic information. The hope is to inform decision making about the future of the 511 program.

The objective of the study was to:

- Synthesize information about the current operations of Kentucky's 511 traveler information systems
- Discuss ongoing developments with the state's 511 traveler information systems (primarily its website and mobile apps) and how data are integrated on different platforms
- Analyze interviews with stakeholders at the Kentucky Transportation Cabinet (KYTC) to anticipate how the 511 system's multiple information delivery platforms (i.e., phone, website, and mobile apps) will evolve in the future
- Identify other states that have developed exemplary advanced traveler information systems and describe what sets them apart
- Analyze results from a survey of Kentucky residents to characterize how they are most likely to access information about roadway conditions

When Robinson et al. (2012) surveyed and interviewed state transportation agencies, there was overwhelming agreement (98%) that communicating travel information to the public leads to drivers making more informed and better travel decisions. Despite this finding, only 30% of the agencies surveyed had performance data attesting to the effectiveness of their travel information systems. Past research suggests that the use of state-based traveler information services are not travelers' preferred method to access traffic and road conditions. Increasingly, drivers have turned to Google Maps and other resources for traffic data. Research studies carried out on behalf of two states — Iowa and Minnesota — suggest that attracting drivers to state-based travel information services calls for an aggressive marketing strategy alongside the continued refinement and improvement of websites and apps. This raises an interesting paradox — on the one hand, a number of states have sought to include more information from Google and other providers, but on the other hand they also view these services as competitors. Public agencies must determine whether it is financially feasible to upgrade technology so that travelers receive accurate, reliable data.

In 2014, the State of Kentucky spent $467,564 to operate and maintain its 511 traffic information systems. This figure includes expenses for the phone system as well as website services. The State of Kentucky's 511 systems consist of two parts — internal user applications and public-facing components. Kentucky's 511 system currently includes a phone operation, full-featured and streamlined websites, mobile apps, the Public Messenger service, and a social media presence (i.e., Twitter). Analysis of 511 usage data indicated that the number of phone calls received has dropped sharply since the mid-2000s. The websites and phone system experience the most traffic during the winter months.

The functionality between third-party web and mobile maps (Google, Waze, Beat the Traffic, Here, and Apple Maps) was compared and contrasted with KYTC's 511 products. Some apps offer crowdsourcing gimmicks or don't adequately include traffic incidents and the state's 511 information. The third-party apps do not summarize traffic information at the same level of detail as on the state's websites and apps, and often depend on app users to report incidents. Kentucky's 511 system is far superior at reporting winter driving conditions.

The research team conducted interviews with a number of stakeholders at KYTC. All of the interviewees were asked a standard set of questions (see Appendix A). There were numerous points on which KYTC stakeholders had common ground. All believed that 1) KYTC should continue to have a role in delivering authoritative traveler information to consumers; 2) Kentucky's traveler information systems have improved in quality, although enhancements are still possible; 3) manual data entry sometimes prevents the Cabinet from getting information out as quickly as it could; 4) identifying performance measures remains a challenging but also worthwhile task; 5) KYTC's partnership with Waze has improved the delivery of information to consumers, but that there are areas in which it could be improved; and 6) the importance of the 511 phone system will continue to decline, although maintaining it will be important for the state. There were a variety of other opinions expressed by stakeholders about how to improve the system, including 1) increasing the availability of real-time information on KYTC's traveler information systems; 2) developing metrics to verify the performance of Waze; 3) having the Cabinet increase its efforts to distribute the data it collects to private, third-party vendors; 4) developing marketing campaigns to increase the public's awareness of the traveler information systems Kentucky offers; and 5) improve public-facing products to encourage wider adoption. Figure 2.6 provides readers with a condensed summary of KYTC stakeholder opinions.

To gauge what outlets Kentuckians rely on most to acquire traffic information, we included several questions as part of KYTC's Customer Maintenance Survey focused on this issue. A majority of survey respondents indicated a preference for getting traffic information through digital content providers. For driving directions, respondents frequently turn to online services such as Google Maps and Waze. Although drivers rely on Google and Waze for information on traffic conditions as well, television and radio continue to play a significant role. Respondents named television and radio as their most important sources of travel information in general, and they also depend on them for breaking news during severe weather events. Most germane for this study, only a fraction of respondents said government sources (i.e., 511, TRIMARC) were their most trusted outlet for traffic information (13 percent). Similarly, only 9 percent of participants said they relied on government services during hazardous weather.

We also interviewed representatives from a number of other state DOTs to get their impression on the future of 511 and traveler information systems. The state representatives we spoke were confident that DOTs would continue to have an authoritative and central role in distributing traveler information. However, there is more uncertainty about what kind of data delivery model will provide the most benefits to travelers and DOTs alike. While representatives from Florida, Iowa, and Montana appeared to endorse state DOTs maintaining robust public-facing websites, officials in Utah expressed ambivalence, and were most concerned with drivers getting the most accurate and timely information possible — even if through a third-party vendor. All of the DOTs we had conversations with are either retooling website and mobile apps to improve their look and functionality or completely redesigning them over the next 2–3 years. It is unclear whether any of the states plan to bring more of traveler information system development in-house, but with the large number of contractors involved this seems unlikely. While there have been efforts to market traveler information systems, their ability to attract new users seems limited, although there are not reliable data on it.

1. Introduction and Background

A. Overview

After being petitioned by the United States Department of Transportation (USDOT) to establish a dedicated phone number for travelers seeking real-time traveler information services, in July 2000 the Federal Communications Commission (FCC) designated the abbreviated 511 dialing code for this purpose. The FCC reasoned that 511 services could lead to reductions in traffic congestion, air pollution, and the inefficient use of fossil fuels, while also improving traveler safety. Other than setting aside the 511 number, the FCC's order contained limited guidance on implementation. No further regulations pertaining to the distribution of traffic information emerged from the federal government until 2010, when, pursuant to Section 1201 of the *Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users*, the Federal Highway Administration (FHWA) issued a mandate for state departments of transportation—that they develop systems that deliver real-time traffic information to the traveling public. This rule instructed state DOTs to alert travelers of construction activities, roadway-blocking incidents, weather observations, and travel time information. However, reporting guidelines differ for highways located outside metropolitan areas versus those within metropolitan areas. For example, states must deliver traffic information related to construction or roadway blockages within 10 minutes of a closure or reopening in metropolitan areas; they must deliver the information within 20 minutes for non-metropolitan roadways. States were asked to comply with this mandate by November 2014.

Although the federal government has issued only two rules related to the provision of traveler information services over the past 15 years, many states have developed increasingly sophisticated 511 systems that integrate phone and website operations as well as content distributed via mobile apps and social media (e.g., Twitter).

This report has several objectives. It:

- Synthesizes information about the current operations of the State of Kentucky's 511 traveler information systems
- Discusses ongoing developments with the state's 511 traveler information systems (primarily the website and mobile apps) and how data are integrated on different platforms
- Draws from interviews with various stakeholders at the Kentucky Transportation Cabinet (KYTC) to anticipate how the 511 system's multiple information delivery platforms (i.e., phone, website, and mobile apps) will evolve in the future
- Identifies other states that have developed advanced traveler information systems that are viewed as exemplary and as state of the art and describes what sets them apart from other states' efforts
- Analyzes results from a survey of Kentucky residents to characterize how they are most likely to access information about roadway conditions

It is important to underline that this report is a *synthesis*. Its purpose is not to recommend that KYTC adopt a particular 511 program strategy. However, by outlining the 511 system's operations and the practices of other states, this report benchmarks Kentucky's current efforts and can be used to inform decision making about the future of the 511 program. The remainder of this section briefly discusses recent studies that examined features of other states' 511 programs. A broad range of topics are discussed, from 511 system architecture to usage statistics. As such, this discussion is narrow and only focuses on the most recent work available. The technologies that underpin 511 travel information systems have — and are — evolving quickly. Including research published before 2012 would not accurately portray the performance of 511 systems, their effectiveness, or how they presently communicate traffic conditions to drivers.

B. Current Status of State Traveler Information Services and Review of Previous Research

The purpose of this section is twofold: to characterize how each state operates traveler information services, and to discuss recent studies that focused on state 511 services. First, a summary table captures the current operational profiles of each state's traveler information services (Table 1.1). While some states have not finished implementing 511, all of them have some capability to report traffic information. Many states, in addition to maintaining full fledged and mobile websites, also have dedicated mobile apps and a social media presence (e.g., one or multiple Twitter accounts) that are used to communicate data on traffic and road conditions. This table was based on a review of state traveler information websites; the review was conducted in July and August 2015. Second, this section outlines recent studies that have looked — individually or collectively — at states' 511 traveler information systems. Analysis of this research suggests that the use of state-based traveler information services are not travelers' preferred method to access traffic and road conditions. Increasingly, drivers have turned to Google Maps and other resources for traffic data. Research studies carried out on behalf of two states — Iowa and Minnesota — suggest that attracting drivers to state-based travel information services calls for an aggressive marketing strategy alongside the continued refinement and improvement of websites and apps. Whether this plan is sustainable or financially workable over the long term remains unclear.

Table 1.1 Summary of State DOT 511 Capabilities

State	Main Internet Access Point for Travel Information	Phone Service	Text Alerts	Interactive Web Map (High Bandwidth)
Alabama	http://alitsweb2.dot.state.al.us/its/	N (Receiving Planning Assistance)	N	Y
Alaska	http://511.alaska.gov	Y	Y	Y
Arizona	http://www.az511.gov	Y	N	Y
Arkansas	http://www.idrivearkansas.com/	N	N	Y
California	http://quickmap.dot.ca.gov/	Y	N	Y
Colorado	http://www.cotrip.org/	Y	Y	Y
Connecticut	http://www.dotdata.ct.gov/iti/master_iti.html	N (Receiving Planning Assistance)	N	Y
Delaware	http://www.deldot.gov/information/travel_ad-visory/	N (Receiving Planning Assistance)	N	Y
Florida	http://www.fl511.com/	Y	Y	Y
Georgia	http://www.511ga.org/	Y	Y	Y
Hawaii	http://www.goakamai.org/home	Y (Honolulu Only)		Y
Idaho	http://511.idaho.gov/	Y	Y	Y
Illinois	http://www.gettingaroundillinois.com/	N (Receiving Planning Assistance)	Y	Y
Indiana	http://pws.trafficwise.org/pws/	N (Receiving Planning	N	Y
Iowa	http://www.511ia.org/	Y	Y	Y
Kansas	http://511.ksdot.org/	Y	N	Y
Kentucky	http://511.ky.gov/	Y	Y	Y
Louisiana	http://www.511la.org/	Y	N	Y
Maine	http://www.511maine.gov/	Y	N	Y
Maryland	http://www.md511.org/	Y	Y	Y
Massachusetts	https://mass511.com/	Y	Y	Y
Michigan	http://michigan.gov/drive	N (Receiving Planning Assistance)	N	Y
Minnesota	http://www.511mn.org/	Y	Y	Y
Mississippi	http://www.mdottraffic.com/	Y	Y	Y

Streamlined Web Map (Low Bandwidth)	Dedicated Mobile Site	Online Travel Cameras	iOS App	Android App	Twitter Feed (Y/N)/ Handle	Is Google Basemap Provider?
N	Y	Y	N	N	N	Y
N	Y	Y	Y	Y	Y/@alaska511	N
N	N	Y	N	N	Y@ArizonaDOT	N
N	Y	N	Y	Y	Y/@AHTD	Y
N	Y	Y	N	N	Y (Multiple)	Y
N	Y	Y	Y	Y	Y/@ColoradoDOT	Y
N	N	Y	N	N	Y (Multiple)	Y
N	N	Y	Y	Y	Y/@DelawareDOT	Y
N	N	Y	Y	Y	Y (Multiple)	Y
N	N	Y	Y	Y	Y (Multiple)	Y
N	Y	Y	Y	Y	N	N
Y	Y	Y	Y	Y	Y (Multiple)	Y
N	N	Y	N	N	N	N
N	N	Y	N	N	Y/@TrafficWise	N
Y	Y	Y	Y	Y	Y (Multiple)	Y
N	N	Y	N	N	Y (Multiple)	N
Y	N	Y	Y	Y	Y/@KYTC511	Y
Y	Y	Y	Y	Y	Y (Multiple)	Y
Y	N	Y	N	N	N	Y
N	N	Y	N	N	Y/@MD511State	Y
N	N	Y	N	N	Y/@MassDOT	Y
N	Y	Y	Y	Y	Y (Multiple)	N
Y	N	Y	Y	Y	Y (Multiple)	Y
N	Y	Y	Y	Y	Y/@MississippiDOT	Y

State	Main Internet Access Point for Travel Information	Phone Service	Text Alerts	Interactive Web Map (High Bandwidth)
Missouri	http://traveler.modot.org/map/	N (Receiving Planning Assistance)	Y	Y
Montana	http://www.mdt.mt.gov/travinfo/	Y	N	Y
Nebraska	http://www.511.nebraska.gov/	Y	Y	Y
Nevada	http://nvroads.com/	Y	Y	Y
New Hampshire	http://www.nhtmc.com/	Y	N	Y
New Jersey	http://www.511nj.org/	Y	N	Y
New Mexico	http://nmroads.com/	Y	N	Y
New York	https://511ny.org/	Y	N	Y
North Carolina	http://www.ncdot.gov/traffictravel/	Y	N	Y
North Dakota	http://www.dot.nd.gov/travel-info-v2/	Y	Y (5am-9pm)	Y
Ohio	http://www.ohgo.com/	N (Receiving Planning Assistance)	N	Y
Oklahoma	http://www.oktraffic.org/	N (Receiving Planning Assistance)	N	N
Oregon	http://www.tripcheck.com	Y	N	Y
Pennsylvania	http://www.511pa.com/	Y	N	Y
Rhode Island	http://511.dot.ri.gov/	Y	N	Y
South Carolina	http://www.511sc.org/	Y	Y	Y
South Dakota	http://www.safetravelusa.com/sd/	Y	Y	Y
Tennessee	https://smartway.tn.gov/traffic/v/	Y	N	Y
Texas	http://www.drivetexas.org/	N (Receiving Planning Assistance)	N	Y
Utah	http://udottraffic.utah.gov/	Y	Y	Y
Vermont	http://vtransmaps.vermont.gov/	Y	N	Y
Virginia	http://www.511virginia.org/	Y	Y	Y
Washington	http://www.wsdot.com/traffic/	Y	N	N
West Virginia	http://www.wv511.org/	Y	N	Y
Wisconsin	http://www.511wi.gov/	Y	N	Y
Wyoming	http://map.wyoroad.info/	Y	Y	Y

Streamlined Web Map (Low Bandwidth)	Dedicated Mobile Site	Online Travel Cameras	iOS App	Android App	Twitter Feed (Y/N)/ Handle	Is Google Basemap Provider?
N	N	Y	Y	Y	Y (Multiple)	N
Y	Y	Y	Y	Y	Y/@mdtroadreport	Y
Y	Y	Y	Y	Y	Y/@NDOR	Y
N	Y	Y	Y	Y	Y/@nevadadot	N
N	N	Y	N	N	Y (Multiple)	Y
N	N	Y	N	N	Y/@511nyNJ	Y
N	Y	Y	Y	Y	Y (Multiple)	N
N	Y	Y	Y	Y	N	Y
N	Y	Y	N	N	Y (Multiple)	N
N	N	Y	Y	Y	N	N
N	Y	Y	N	N	Y/Multiple	N
Y	N	N	N	N	Y/@OKDOT	Y
Y (Old Version of Website)	Y	Y	N	N (Non-DOT Version Available)	Y (Multiple)	N
N	N	Y	Y	Y	Y (Multiple)	Y
N	N	Y	N	N	Y/@RIDOTNews	Y
N	N	Y	Y	Y	Y/Multiple	Y
N	N	Y	Y	Y	Y/@SDClearPath511	N
N	Y	Y	N	N	Y/@TN511	Y
N	N	Y	Y	N	Y (Multiple)	Y
N	Y	Y	Y	Y	Y/@UDOTTRAFFIC	Y
N	Y	Y	N	N	Y/@511VT	N
N	Y	Y	Y	Y	Y (Multiple)	Y
Y	Y	Y	Y	Y	Y/@wsdot	N
N	N	Y	N	N	Y/@WV511	Y
Y	N	Y	Y	Y	Y (Multiple)	Y
Y	Y	Y	N	N	Y (Multiple)	Y

NCHRP Research

The results of NCHRP Project 02-82 (*Development, Use and Effect of Real-Time Traveler Information Systems*) were published in 2012 (Robinson et al., 2012). It updated the findings of an earlier study, *Real-Time Traveler Information Systems: A Synthesis of Highway Practice* (Deeter, 2009).

Deeter focused principally on 511 phone system use and to a lesser extent, websites. Because the report was written in 2009, prior to the accelerated development and widespread adoption of smartphone platforms, Deeter has little to say on this topic. Deeter argued that 511 traveler information systems — at that time — played a vital role in getting traffic information to the public. As would be expected, 511 phone systems received the most significant use in densely populated metro areas (e.g., San Francisco, Miami, Seattle). Cities with larger populations are vulnerable to experiencing significant traffic congestion, which explains this correlation. Deeter also queried public agencies about how they could improve their websites. Some of the suggested improvements and problems observed are still germane today. Many agencies worried that accidents and other traffic events were not loaded in a timely manner onto their websites, potentially leaving the public without knowledge of incidents. Others felt that state-maintained maps quickly grew outdated, and that using Google Maps for their base layers would greatly improve users' experience (given that over 30 states today use Google Maps in some capacity, this was a perceptive foresight). Lastly, other agencies reported struggling with data integration, and hoped to make this more seamless in the coming years.

Robinson et al.'s (2012) work combined surveys and interviews of state transportation agencies with field studies at six sites to assess the impacts of traveler information systems on driver behavior and road networks. Among the public agencies, there was overwhelming agreement (98%) that communicating travel information to the public leads to drivers making more informed and better travel decisions. Despite this intuition, just 30% of the agencies surveyed had performance data attesting to the effectiveness of their traveler information systems. At the time of the Robinson report, many transportation agencies expressed interest in using social media and smartphones to streamline the delivery of information to the public. As Table 1.1 highlights, the overwhelming majority of agencies have since taken advantage of these platforms. A primary concern of many agencies was the availability of funding. This remains a challenge today — 511 systems are often underfunded, and as noted in Chapter 2, some agency employees feel that third-party providers, such as Google and Waze, are better positioned to inform the public about road conditions because they are heavily capitalized and have the resources to invest money in new product development. State transportation agencies have difficulty keeping pace, given their limited financial resources and human capital.

Public surveys indicated that people most frequently received traveler information from the radio, followed by smartphone apps, highway variable message signs, and websites. As Figure 1.1 illustrates, the likelihood that individuals will change their trip plans varies according to the information they obtain. The survey asked respondents to identify what types of traffic information they consulted before changing a trip over the preceding three-day period. Traffic incidents, travel times, alternate routes, construction zones and lane closures were most often cited. Traffic cameras, special events, and safety information rarely prompted a change in travel plans.

The public surveys also asked what features people wanted in a real-time traveler information system. Among the features cited were:

- Reliable, real-time, and accurate information
- Information available for specified travel corridors
- Automated alerts
- Suggestion of alternate routes to improve decision making
- Information available from a variety of sources
- Dedicated apps, radio stations, and television stations
- Time-stamped information
- Detailed information on lane closures and viewable traffic cameras

- Access to multimodal and transit information

The surveys also pulled out points of agreement between agencies and the traveling public. Both groups felt that traveler information systems should: 1) provide information targeted to consumers; 2) be readily accessed and user-friendly, even when driving; 3) distribute information about special events, construction activities, and emergencies; 4) provide information that is clear, concise, and trustworthy; and 5) use a variety of widely available technologies to communicate information to the public.

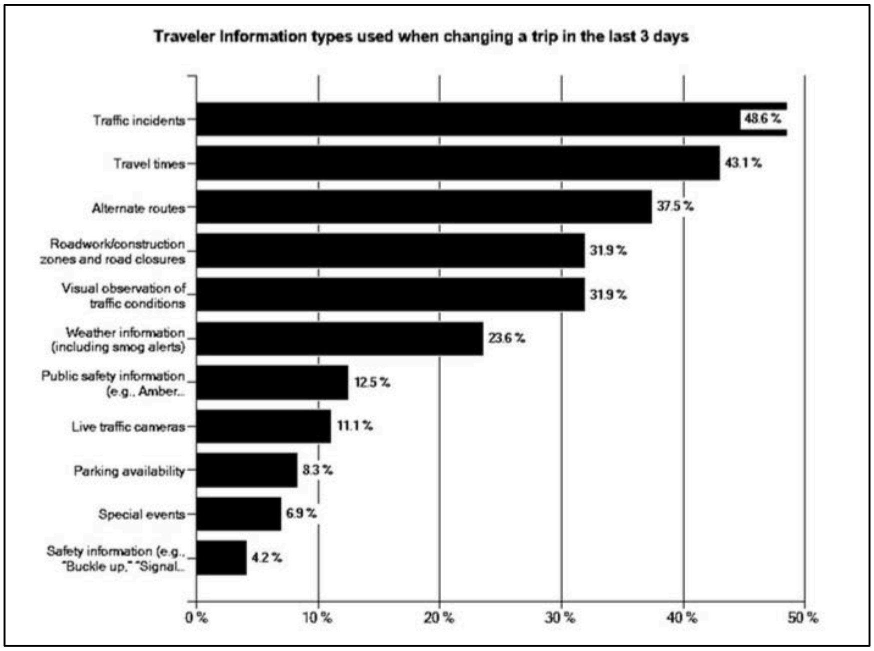

Figure 1.1 Survey Results from NCHRP 08-82. These numbers summarize what travel information drivers use to change trip plans.

As Robinson et al. (2012) noted, different travelers have different information needs, and it is not absolutely critical that state agencies assume all responsibility for getting reports to the public. It was recommended that public agencies develop targeted strategies to distribute travel information, and that while providing a usable website and reliable data must be a priority, they should explore partnerships with third parties to ensure that traffic conditions are communicated effectively to the public. Robinson et al. (2012) closed with recommendations for improving traveler information systems in the future. Despite being three years old, many of the suggestions remain salient today. First, they argued for enhancing public agencies' capacity to supply accurate and reliable data they collect to the public. Doing so gives developers, media outlets, researchers, and others the chance to acquire and use those data without hassle, potentially leading to new innovations in how information is presented. Second, they contended that states should explore public-private partnerships (P3s). Kentucky's recent agreement with Waze is an example of a public-private partnership. P3s can lead to the establishment of new, free services, and can potentially generate new revenue for states[1]. Next, the authors proposed that agencies should seek out new sources of data and explore partnerships with other transportation agencies. Kentucky is a member of the Condition Acquisition Reporting System (CARS) Consortium, and while this does not fuse data into a single operational picture, the partnership has reduced the costs associated with maintaining its 511 systems. Fourth, public agencies must continuously improve the quality of travel information and how it is distributed. Lastly, Robinson et al. (2012) were adamant that agencies devise performance measures that let them evaluate the user experience of traveler information systems. This may involve surveys or other methods of collecting information, however, relying on simple count data (i.e., number of

[1] Neither the State of Kentucky nor Waze/Google receive direct financial benefits from this partnership.

phone calls, number of webpage visits) can be misleading and will not highlight whether users have benefited from these systems (see also Deeter, 2009). Taken alone, they are not a sufficient performance measure.

Federal Highway Administration

Schumann et al. (2015) examined prospects for traveler information centers over the next five years. As consumers have become increasingly demanding about the performance of traveler information systems, wanting them customized to fit their individual needs, it has left many state DOTs in a position of uncertainty about their future development. This is particularly true of 511 phone systems, which the authors observed are, in all likelihood, nearing the end of their lifecycle. A key challenge of public and private entities in the coming years is handing the increased pace and amount of data collection. The speed of data collection has accelerated, making it imperative for stakeholders to identify effective way of storing, processing, and managing it. The increased availability of data has led to expanded delivery, with traveler information systems adding new features, such as arterial travel times as well as information on parking, predictive estimates for the amount of time it will take a driver to navigate a route, and the possibility of measuring environmental impacts. It is recommended that state DOTs undertake a gap analysis that compares the existing functionality of their traveler information systems to unmet needs. Table (x) summarizes the current trends in formation delivery identified by Schumann et al., with mobile technologies on the ascendance while in-vehicle systems appear on the decline. While this profile may not align with the experience of all states, it is consistent with the state DOT representatives we spoke with (see Chapter 5)

Taking note of global trends in the procurement and distribution of traveler data, Schumann et al. remarked that public-private partnerships will become increasingly common, with the private sector sharing data with public agencies, and vice versa. For example, Waze's Connected Citizen's Program exemplifies this approach. And indeed, state DOTs are likely to need robust connections with the private sector is they are to offer products that remain current and useful for travelers. The technologies integrated into traveler information systems and how information is delivered to consumers is rapidly evolving. There are a number of public sector business models state DOTs can draw from to strengthen their relationships with private businesses that collect and present traffic data. The first of these is selling or bartering the travel data they do collect to private businesses. However, based on our interviews, this seems unlikely given that many states freely distribute information from their 511 systems to private sector partners. As such, it is unclear whether this is a practical step. Another option for states to pursue is selling or bartering personal data, however, given the immense privacy concerns associated with this practice, it is effectively off limits. A third business model entails selling advertisements or sponsorships on state websites and mobile apps. A few public agencies have experimented with this approach, however, it has been met with limited success. This is understandable given that many of these platforms have limited user bases. A final way for states to generate new value is through the selling and bartering of physical assets. This encompasses public agencies making rights-of-way and/or infrastructure available to the private sector in exchange for data. Again, the obstacles to using this model would seem insurmountable. Alongside gap analysis, Schumann et al. suggest that state DOTs evaluate the cost of collecting and distributing data — if outsourcing data collection is less expensive than conducting it in-house, and the quality and coverage of externally sourced data are equal to or better than the products they generate, DOTs need to seriously look at whether continuing it is worthwhile. Irrespective of the role public and private entities occupy at the moment, Schumann et al. commented that: "Roles in the traveler information value chain will likely change in the future. Private traffic data providers have the technology to process large volumes of new traffic data and develop profitable business models. Public authorities will, however, retain a key role in assuring societal interests in the value chain." These sentiments align with comments from state DOTs — even if public agencies reduce their involvement in the collection and distribution of data, they will continue to serve as an authoritative source of traffic information. What remains uncertain at the moment is what the consequences will emerge from this.

State of Minnesota

Morris et al. (2014) appraised the State of Minnesota's 511 traveler information systems with an eye toward identifying features that "would allow [it] to remain competitive with other state's 511 applications" (p 6)." This included a discussion of various media (e.g., websites, apps) and how they could be improved to provide travelers with a user-friendly and informative experience.[2] Researchers looked at 511 systems in 26 states, however, this represents a fraction of the data they obtained from state DOTs and other sources (see above). After sampling reviews for Google Play Store mobile apps, the authors summarized the pros and cons of traveler information apps designed and managed by state DOTs. Among the features users preferred were: customization, filtering, hands-free operation, and the availability of traffic cameras. Customization refers to users being able to input pre-defined routes or selectively view information based on parameters of their choosing. Apps managed by state agencies also came with problems, however. Users lamented that some apps required too much attention or were text heavy, were slow running and prone to crashes, and that navigating between different screens was tedious and unintuitive. The researchers summarized reviews for proprietary travel applications as well (e.g., Google Maps), with most users complimenting the navigation and routing, information accuracy, and customizability. Conversely, users often disliked the clumsiness of voice commands and navigation as well as their cluttered or complex interfaces. Based on this comparison, the researchers argued for Minnesota to incorporate more features into its 511 apps that are currently exclusive to proprietary apps (e.g., voice commands, save places, route guidance, and travel time estimates). Modifications to public-agency-managed 511 apps should minimize driver distractions. Design overhauls must balance information delivery and usability so that drivers are not placed at risk by using an app.

Following this analysis, researchers discussed what features a next generation traveler information system should have. These recommendations emerged from scrutinizing Minnesota's current website and mobile apps to identify their deficiencies. The current apps have several problems, including cluttered maps that display poorly when new layers are added to them, inconsistent icon display and screen layouts, and the absence of multi-modal features like interactive maps and audible alerts. Morris et al. (2014) discussed numerous strategies to correct these issues: redesigning interfaces, and either hiring software developers to create a turn-by-turn navigation system, or embedding Minnesota's data within an existing service (such as Google Maps). The report is not explicit about the best way to achieve these goals; it maintains an agnostic position over whether future software development should be done in-house or be outsourced to more established entities so that Minnesota becomes more of a data broker than a direct provider.

State of Iowa

Iowa State University's Center for Transportation Research and Education, supported by the Iowa Department of Transportation, published a report in July 2015 that evaluated Iowa's 511 system (Sharma et al., 2015). This report leveraged survey results and usage data to determine the public's reliance and consciousness of the state's 511 system. Unlike the state of Minnesota project covered in the previous subsection, this study, while advancing some recommendations about improving the 511 system, did not take system architecture or functionality as its primary focus. Researchers conducted a survey of the driving public at driver's license stations throughout Iowa, which yielded 850 responses. A second survey was also administered via email to users of the 511 system and Iowa DOT employees. However, approximately 82% of the respondents were people affiliated with Iowa's DOT. Thus while the survey provides a useful snapshot of DOT employees' practices, it is not representative of the traveling public. Because this sample is not representative, the ensuing discussion avoids drawing any lessons or inferences from this portion of the research.

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[2] As noted in later sections, the idea of states competing with other states' 511 systems or applications developed by Google and other companies is both confusing and startling.
The purpose of a 511 system is to provide information to drivers within the boundaries of a particular state. This is not to suggest that states have no incentive to collaborate with other states to provide a more seamless experience across apps, rather, it is to point out the slight absurdity of the underlying premise: that, for example, if a state does not remain competitive with other states it will somehow lose 511 market share. Or that Iowa will suddenly decide to introduce a new 511 app focused on Minnesota. The idea of competition is startling because this premise undermines the idea that 511 systems are meant to provide a public service. While creating a smooth user experience is critical for a system's success, we should ask whether public agencies need to dedicate the resources and energy to bolstering their competitive edge (see below). This disposition seems to miss the point of what a 511 system is supposed to accomplish.

Statistics indicated that use of Iowa's 511 system peaks during the winter months. Correlation analysis revealed these peaks occurred simultaneously for all mediums (i.e., phone system, low- and high-bandwidth websites, mobile web, and mobile apps). From May 2013 – May 2015, the state's 511 websites and mobile apps registered an average of 4,000 users daily, with the low- and high-bandwidth websites receiving the greatest number of hits. Over this same period, over 50% of website visits originated from mobile devices, which included phones and tablets. Usage was significantly influenced by discrete severe weather events — this encompassed snowfall and precipitation events, however, the report did not specify whether other forms of severe weather (e.g. severe thunderstorms) increased the system's usage. Although these statistics are valuable, they elide, in part, the questions of whether the traveling public is conscious of Iowa's 511 system and if a majority of drivers rely on 511 services to get traffic information.

The survey conducted at Iowa Motor Vehicles Division's driver's license stations shed further light on the public's awareness of 511. Of the 850 survey respondents, 598, or 70%, had never used Iowa's 511 services. Among the 30% of respondents who reported using the 511 system, 51% had visited the state's 511 websites, 37% took advantage of the phone system, and 22% said they had only used the phone service. People who used the 511 system indicated that their primary reason for doing so was to use the Road Report, a feature that contains information on roadwork, closures, restrictions, and warnings. Other reasons for visiting the 511 website: viewing traffic speeds, obtaining camera images, acquiring travel times, and learning about the messages posted on dynamic message signs.

The survey also asked respondents to identify alternative outlets from which they secured traffic information, and specifically what data they sought out from them. Half (49%) of all respondents claimed that they had used alternative traffic information services to learn about traffic congestion, road construction, and closures. Most of these people obtained their data from Google Maps or in-car navigation systems. Further, 60% of the respondents reported getting weather-related information, most frequently from television, radio stations. and phone apps other than the state's 511 mobile app. Lastly, 69% of respondents indicated using alternative services to learn about travel times, with Google Maps being the service most often used. Further statistical analysis demonstrated that Google Maps was the preferred app for drivers between 18 and 30 years old. Use of Google Maps was similarly high among respondents between 31 and 40, although this group was also more likely to use in-car navigation systems. As the study's authors observed, Iowa's 511 system is the only service that contains all of the information sought by travelers.

The study advanced several proposals to improve Iowa's 511 system. For example, researchers contended that new users would be attracted by improving the 511 system's ease of use, accessibility, and graphic design. This includes enhancing the integration of other applications (e.g., Waze, Google Maps) so that users have the ability to acquire reliable, real-time information. Another area of concern highlighted by the report is 511's lack of coverage of country and and local roads. Drivers who navigate these roads extensively rely on alternative sources to find this information. This is not a problem unique to Iowa, as Kentucky's 511 system also lacks coverages of local roads. Other recommendations proposed by the study included establishing a robust marketing campaign to expand the public's awareness of 511 services. It is also imperative, the study's authors confirmed, to be responsive to consumer demands by developing strategies to provide reliable, real-time traffic information with more expansive coverage. Like the report focused on Minnesota, the Iowa one treats other services, such as Google Maps and Waze, as competitors. This raises an interesting paradox — on the one hand, a number of states have sought to include more information from Google and other providers (as we indicated above, many states rely on Google and Microsoft for basemap layers and travel time data), but on the other hand they also view these services as competitors. Whether or not this is a judicious or prudent attitude to adopt is beyond the scope of this report, but we do raise the question of whether viewing Google and other multinational corporations with access to large quantities of data and resources — in comparison — to state governments' traffic operation units is an appropriate and sustainable position.

Costs and Benefits of Traveler Information Systems Meta-Analysis (New Zealand)

Raine et al. (2014) performed a meta-analysis of previous research studies that attempted to quantify the costs and benefits of traveler information systems. Although their work was conducted on behalf of the New Zealand Transport Agency, they drew heavily from research related to 511 systems in the United States. This is because the United States is densely saturated with traveler information systems, whereas they are comparatively scarce in other regions of the world — Japan is one notable exception to this generalization. The researchers concluded that it is relatively straightforward to estimate the costs associated with traveler information systems. Different components of these systems have clearly defined upfront costs and rolling expenses associated with maintaining them. Establishing a website or mobile app comes with a fixed cost, however, those resources must be maintained and refreshed over time, which adds to the financial obligations borne by public agencies. Calculating benefits is more challenging, largely because of the complexity involved in isolating and quantifying *direct benefits* of traveler information systems. Many of the benefits derived from these systems accrue to individual users and not to the public agencies responsible for maintaining them.

Raine et al. (2014) identified numerous benefits of traveler information systems, including improvements in travel efficiency, road safety, public transport services, and freight management; enhanced security and safety (lower crash rates); a reduction in environmental impacts (e.g., lower emissions and fuel use); strengthened road traffic planning; and cost savings that stem from shorter travel times. There is the potential for government agencies who manage road networks to enjoy benefits if utilization of the road network is evened out by redistributing vehicles across more links in the network. The authors suggested that websites represent low-cost investments that can effectively and efficiently distribute information to the traveling public, but at the same time public agencies must earn the public's trust by producing a reliable product — this especially holds true for website features such as the display of dynamically calculated travel times. If travel times are inaccurate, the public may quickly lose confidence in public agencies' ability to provide traffic information. The main takeaway from this study is that government agencies have recourse to affordable options (e.g., websites) to relay traffic data to the media and public, but whether this will produce significant long-term economic gains for those agencies — or even travelers — remains unclear. Dynamically updated travel information is valuable for travelers and agencies alike, but placing a monetary figure on those benefits remains an elusive task.

C. Conclusions

The overwhelming majority of states manage 511 traveler information systems. Even those that have not fully implemented the phone service typically have websites and mobile apps dedicated to traffic reporting. Although 511 systems are ubiquitous, many drivers — as evidenced by the Iowa study — are either unaware they exist or prefer alternative platforms to receive information on traffic conditions and drive times. Robinson et al. (2012) underlined the importance of providing travelers accurate data in an easy-to-use format. They viewed the future of 511 systems as being intimately tied to technological innovations (e.g., smartphone apps and social media), data transparency, and the establishment of P3s. A review of public agencies' websites indicated over 30 states now rely on information provided by Google. In some cases, this is restricted to using Google's maps as a basemap layer against which state-specific data are plotted. Other states, including Kentucky, have more fully integrated Google data into their 511 websites and mobile apps, incorporating guidance about travel speeds and driving directions. Although the two recent studies from Iowa State and the University of Minnesota discussed the importance of their respective states working on new, innovative features for their websites and apps to keep them competitive with other information providers, neither study elaborated on why this is actually important, or even why public agencies in separate states with managerial responsibilities that do not extend beyond state boundaries should strive for a competitive edge. This is not to dismiss the importance of public agencies providing reliable information to the traveling public, it is to raise questions about what business case an agency having exclusive oversight of travel information systems could make to justify continual innovation when, as Raine et al. (2014) convincingly demonstrated, the long-term benefits of traveler information systems are unclear. Future research on the benefits that accrue to users and public agencies alike is necessary to determine what the cost-to-benefit ratios are.

2. Overview of Kentucky's 511 Travel Information Systems

In 2014, the State of Kentucky spent $467,564 to operate and maintain its 511 traffic information systems, including expenses for the phone system and website services. This chapter gives readers a general overview of Kentucky's 511 system. The focus is on the outward-facing (i.e., publicly accessible) components of the system — the state-maintained website and mobile apps, the phone system, and public messenger. Although we briefly discuss, when warranted, issues of data input, the underlying system architecture is not our primary focus. Once we have summarized the system components, we report on medium-term usage trends for the phone system and website (i.e., the past 5–10 years). Statistical analyses were used to discern whether significant changes in use patterns occurred over this period. Because of limited data availability, these analyses look at the phone system and website usage. For the mobile apps and public messenger, data are lacking or cover an insufficient period of time to generate valid statistical results. After covering the 511 system's features and usage patterns, we summarize interviews with 511 stakeholders who are employed by KYTC. Appendix A contains a complete list of questions asked during these sessions. To maintain the objective and neutral tone this report strives for, we do not attribute opinions or comments to specific people. Maintaining anonymity is critical for letting the reader impartially evaluate their position on what the future holds for Kentucky's traveler information services.

A. Features of Kentucky's Traveler Information Systems

The State of Kentucky's traveler information systems consist of two parts — internal user applications and public-facing components. Only KYTC staff can access internal user applications; they manage and run the public-facing elements and populate them with data. Kentucky's public-facing system consists of: 1) 511 phone operations, which drivers can access via landline and cellular connections; 2) a website that provides access to full-featured and basic maps (the latter are static maps and ideal for users with slow internet connections and limited bandwidth); 3) a Twitter account (@KYTC511); 4) mobile apps for iOS and Android smartphones and tablets; and 5) Public Messenger, which lets registered users receive email and text alerts about an event. However, Public Messenger will not provide travelers with updates on routine traffic delays. Collectively, these resources assist the state in complying with the FHWA's requirements to provide real-time traffic information to the public, although several interview respondents mentioned the state still struggles to meet the objectives laid out by the FHWA. Our primary focus in this section is on the website, mobile apps, and public messenger, as these have undergone significant development over the past year.

Website

When users visit 511.ky.gov they have two options: a full-featured map or a basic streamlined map. The full-featured map is scalable and lets users navigate to a location of their choosing. Conversely, users opting for the basic map only have access to a statewide view and a number of pre-selected regional and local views. This report discusses the full-featured map in detail and follows up with comments about the streamlined version. Both websites provide traffic conditions and incidents on major roadways (Interstates, Parkways, and selected primary-rated U.S. Routes and State Highways). The site does not report traffic conditions on county roads, city streets, and the majority of U.S. Routes and State Highways.

When a user clicks on the full-featured map, they view a zoomed-out map that shows road reports throughout Kentucky — this is shown in the top panel of Figure 2.1. The map is slightly cluttered, but users can rescale the map to closely examine what traffic events are impacting a location of interest. The legend defines the type of event or incident. The map displays road closures, restrictions, crashes, and warnings, all of which are issued by the Cabinet. When users click on an icon, a new box appears that contains a map and written description of the event. For example, if road maintenance operations are underway, the screen graphically displays where the event takes place, what type of maintenance is being performed, the start time, and the anticipated end time. The full-featured map also contains incidents and problems observed by travelers and reported through the Waze app. In February 2015, KYTC established a partnership with Waze, a real-time crowdsourced navigation app owned by Google, via its Waze Connected Citizens Program. Waze is available for iOS and Android, and it lets drivers report inclement weather, traffic congestion, construction activity, hazards, and other accidents — these dynamic updates allow drivers to get the most up-to-date information possible on traffic flow. Beginning in August 2015, Waze reports were made available on the website and on mobile apps. Because KYTC is part of the CARS consortium, which has purchased a Google Enterprise license, users can also view travel speeds on major roads. The middle panel of Figure 2.1 captures this feature. The roads are shaded different colors based on the prevailing traffic speed (green indicates unimpeded traffic flow, whereas orange and red denote slower speeds). As the bottom panel of Figure 2.1 reveals, users can specify a route and receive turn-by-turn directions (that are supplied by Google) as well as an estimated travel time. After selecting a route, a listing of events and incidents is provided in the left panel.

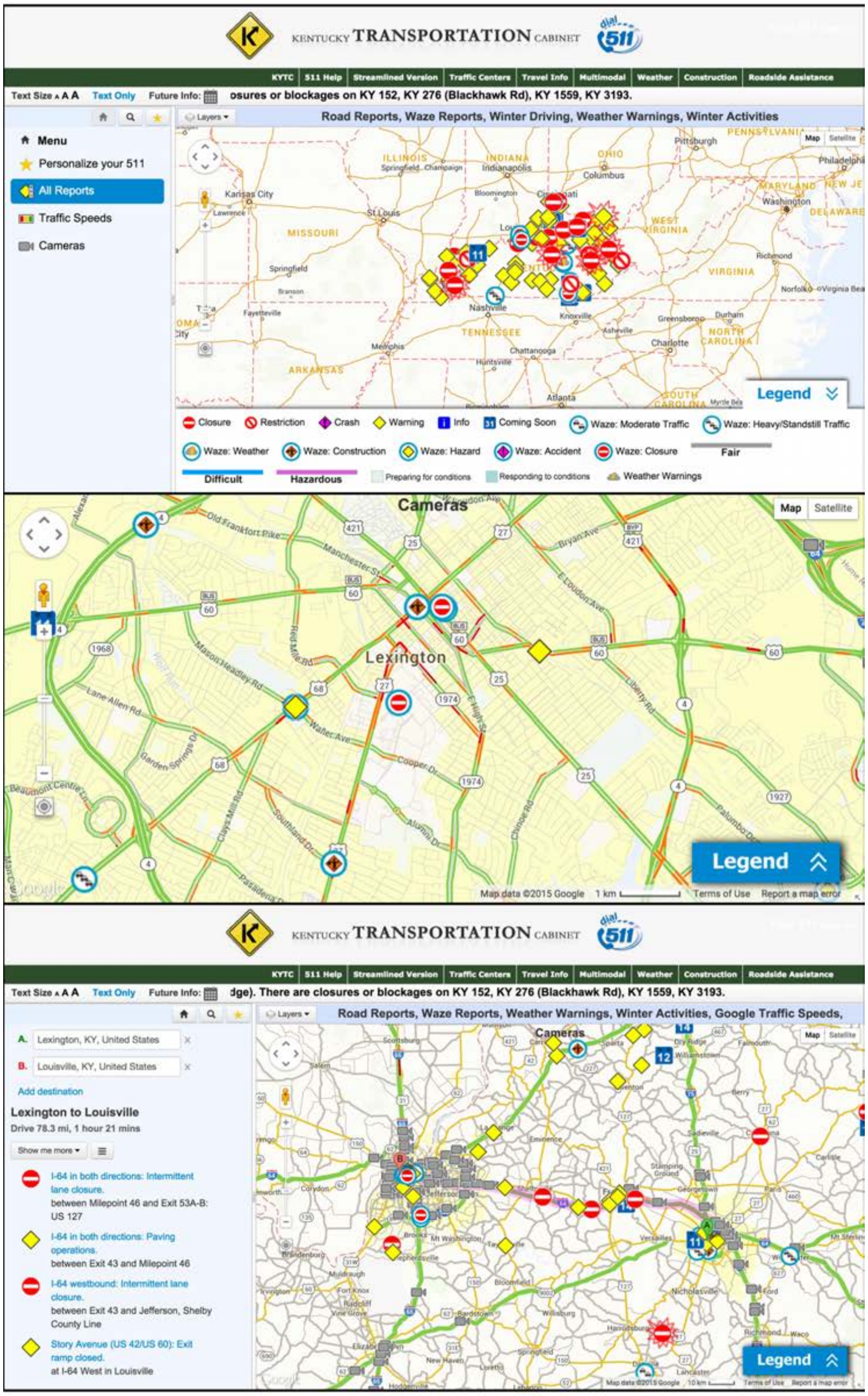

Figure 2.1 Images of KYTC's Full-Featured 511 Website. The top panel depicts a statewide view; the middle panel zooms into Lexington and reveals road closures, user-reported incidents, and travel speeds, (sourced from Google); the bottom panel illustrates the website's ability to route a driver and indicate where incidents have occurred along that route.

The full-featured map is fully customizable; users may select what layers they would like displayed. There is a feature to view reports for future events, current events, current and future events, and a range of dates can be specified. The site also lets users select a particular route (e.g., I-75, I-275) and pull up all the event/incident information available for it. Registered users can also save favorite routes or easy access routes. Traffic cameras can be displayed on the map so that visitors get a real-time snapshot of the current traffic flow. The full-featured map contains winter weather information, and in late 2014, a new layer went live: a tracker for snow plows installed with automatic vehicle location (AVL). This layer depicts what roads each snow plow has treated over the preceding two-hour period. Locations that have been treated more recently are marked with a bright, prominent symbol; this symbol will begin to fade as time elapses, until eventually it disappears.

The streamlined map shares many features with the full-featured version. As noted above, the map is not dynamically scalable, meaning that users can only access a limited number of regional or local views. Users can view all road reports, incidents, and traffic cameras (including information reported by Waze users). However, users cannot obtain driving directions or view travel speed data. Whereas the full-featured map can display current, future, or current and future events, the streamlined map enables toggling between current reports and future plans.

iOS and Android Apps

People can download Kentucky's 511 iOS or Android app for their smartphone or tablet from either Apple's App Store or Google Play. In many respects, the app is a scaled down version of the full-featured website, although it does not have the same functionality. Like the website, the map is fully scalable, letting users dynamically zoom into and out of different portions of the state. The map symbology is also the same as the website, and although traffic speed is available, users cannot get turn-by-turn directions. Users can adjust what layers the map displays, although options are limited compared to the website; they can view road reports, Waze reports, traffic speeds, and traffic cameras, but data related to winter weather are currently unavailable. Rest stops are also absent from the mobile app. Users have the option to search by location or by roadway for traffic conditions. Once a user has selected a place or road of interest, they are redirected to the map. If a road is selected, the entire route will be highlighted; if a location (e.g., Lexington) is chosen, the map will zoom into that area, letting the user view all of the ongoing incidents and events. As with the full-featured website, if a user selects a particular incident or event by tapping on it, the event expands to summarize its nature — where it is located, the expected duration (if it is, for example, a road closure or maintenance project), and other details. Figure 2.2 contains three panels that show different facets of the mobile app. The left panel depicts a statewide view, while the middle panel illustrates traffic conditions (including travel speed) around the Lexington area. The right panel is an example of an expanded report, in this case road construction observed by a Waze user. If a user closes the app and then reopens it, the user will return to the same view as when it was closed (with the map scaled to the same dimensions). Users cannot specify whether they view only current, only future, or current and future event reports — which is available on the full-featured website.

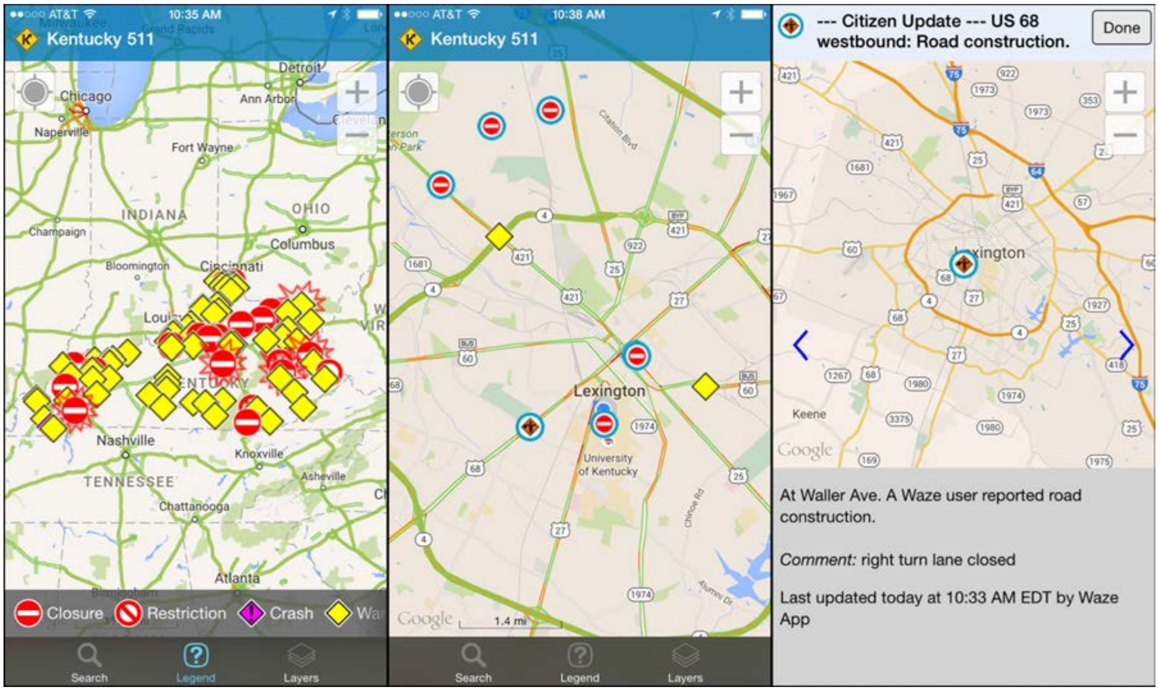

Figure 2.2 Kentucky's 511 iOS App. Each panel captures a slightly different view. The left panel and middle panels show a statewide and local view, respectively, while the right panel offers an example of an incident report.

Phone System

The phone system, historically, has served as the backbone of 511. However, use of 511 has declined in recent years. This reduction likely stems from people relying more on web-based and smartphone navigation apps (see statistical analyses below). For people without access to smartphone technologies while on the road, the 511 number remains a valuable source of traffic information. When a user dials 511, they receive an automated greeting and a list of menu options. Currently the seven menu choices are: 1) Route Reports, 2) Regional Reports, 3) Nearby 511 States, 4) Roadside Assistance, 5) Tourism Information, 6) Traffic Incident, and 7) Comment. Each option can be accessed either through voice-activated commands or by punching in the number on a phone's keypad. Like the website and mobile apps, the 511 phone system has information available for major roadways — Interstates, Parkways, and selected primary-rated U.S. Routes and State Highways. It does not describe traffic conditions on county roads, city streets, and the majority of U.S. Routes and State Highways. But drivers can request information for particular roads (e.g., I-75) through voice commands or by using their telephone's keypad.

Email Alerts and Public Messenger

The final component of Kentucky's traveler information systems is the email alert and public messenger service offered by the Cabinet. After a user creates an account on 511.ky.gov, they have the option of receiving notifications about traffic problems on specified routes, via email or text. Users can sign up for emails by clicking an icon next to one of their chosen routes. The Public Messenger component sends traffic updates to users via text message. Figure 2.3 depicts the screen displayed for text message signups. Users input their phone number, wireless carrier, and specify what types of reports they would like to receive. Conversations with stakeholders revealed that Public Messenger cost approximately $60,000 to implement, and somewhere between 1,200 and 1,700 people have signed up for the service. One potential issue with accessing the Public Messenger service is that the website does not clearly point users toward the sign-up screen. They must click the gear icon at the top right corner of the page with the full-featured map, however, there are no directions that indicate this. As we noted above, Public Messenger will not alert drivers to routine delays. It only sends texts about particular events. As such, KYTC views Public Messenger as a key piece for meeting the FHWA's requirements about issuing real-time traffic update.

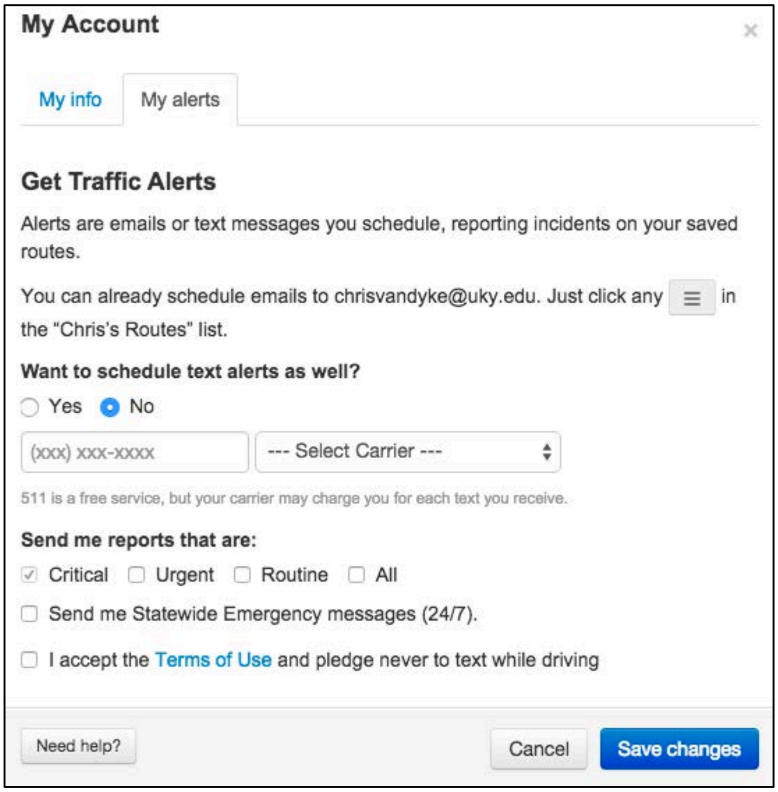

Figure 2.3 Sign-Up Screen for the Public Messenger Service

B. Traveler Information System Usage Data

Phone System Usage

Since inception, KYTC has implemented two generations of 511 phone service. The second generation phone system was introduced in late 2008 and early 2009. While the first generation 511 system used pre-recorded, static prompts, the second generation system relied on text-to-speech technologies. The research team obtained full-year usage statistics for 2004–2007 and 2011–2014. Partial-year, incomplete data were available for 2003 and 2008, however, they were omitted from analysis. When interpreting results, we recalled that the 2004–2007 data represented the first generation phone system. Despite the switch to new technologies, the team was confident that the Table 1 summary statistics were trustworthy. Data revealed that the number of calls has dropped significantly since the mid-2000s. This confirms stakeholders' observation (see next section) that the 511 phone system has declined in importance with the emergence of smartphone technologies. Nonetheless, the call volume remains significant, and the service is critical, given the large rural population in Kentucky.

Table 2.1 Number of 511 Calls by Year

	Total Number of Calls	**Average Monthly Call Volume**
2004	770,023	70,411
2005	506,365	42,197
2006	514,348	42,862
2007	526,943	43,911
2011	444,295	37,024
2012	352,173	29,347
2013	284,723	23,727
2014	311,771	25,981

In addition to summary statistics, we also used one-way analysis of variance (ANOVA) to detect differences in the mean number of calls between seasons. This revealed the means cannot be assumed equal (F (3, 91) = 4.1169, p = 0.0087). Further analysis using Tukey's honest significant different test verified that call volumes in winter are significantly different than during other seasons ($p < 0.05$ for all comparisons). This validated our prediction that people are more likely to seek out traffic data during the winter months, when snow, ice, and sleet create potentially hazardous conditions. Figure 2.4 illustrates the ANOVA results.

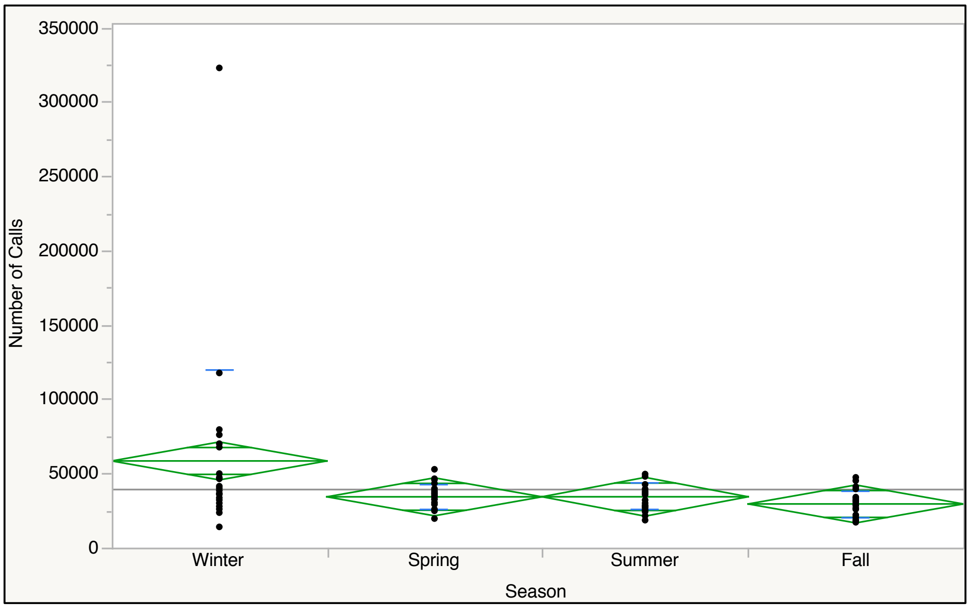

Figure 2.4 ANOVA Results for Seasonal Call Volumes. Black dots are individual data points that represent the number of calls in individual months. The width of green diamonds represents differences in sample size, and the center line of each diamond is the sample mean for each group. The top and bottom point of each diamond mark are the boundaries of the 95% confidence interval. The horizontal lines near the top and bottom of the diamonds are overlap marks, and are used to visually compare group means.

Website Usage

KYTC introduced its first traveler information website in 2000. The second generation website rolled out in 2010, and the most recent third generation website launched in 2014. While complete visitor data to the high bandwidth website was available from 2011 to 2014, numbers for the low bandwidth site were available for 2011 through 2013. As such, the statistical analysis focused on trends in visitors to the high bandwidth site, although summary data for the low bandwidth version is summarized below in Table 2.3.

Table 2.2 High Bandwidth Website Summary Statistics (2011–2014)

	Total Visits	Average Monthly Visits	Maximum Monthly Visits	Minimum Monthly Visits
2011	251,983	20,999	51,132	12,150
2012	220,040	16,837	45,293	8,281
2013	284,723	20,284	40,943	12,147
2014	311,771	30,658	72,250	12,671

Table 2.3 Low Bandwidth Website Summary Statistics (2011–2013)

	Total Visits	Average Monthly Visits	Maximum Monthly Visits	Minimum Monthly Visits
2011	128, 998	10,750	30,923	5,647
2012	112,916	11,918	30,101	5,967
2013	228,004	19,000	33,526	12,068

There is no clear trend in the number of visits to the high bandwidth website, with total visitors fluctuating between 220,000 and 311,000. For the low bandwidth site, visitor numbers nearly doubled over the previous two years, however, it is unclear what drove this increase. Overall, traffic to both websites has trended upward. To analyze whether web traffic varies across seasons, the research team again used one-way ANOVA. The ANOVA indicated that the mean number of visitors was not equal across all seasons (F (3, 44) = 7.2975, p = 0.0004). As illustrated in Figure 2.5, the website received more visitors during the winter months than during spring, summer, and autumn months. This was confirmed using Tukey's honest significant difference test (p < 0.05 for all comparisons). These data echo the analysis of phone usage — people tend to rely on 511 services more frequently in the winter, when hazardous weather is more likely to negatively impact roads.

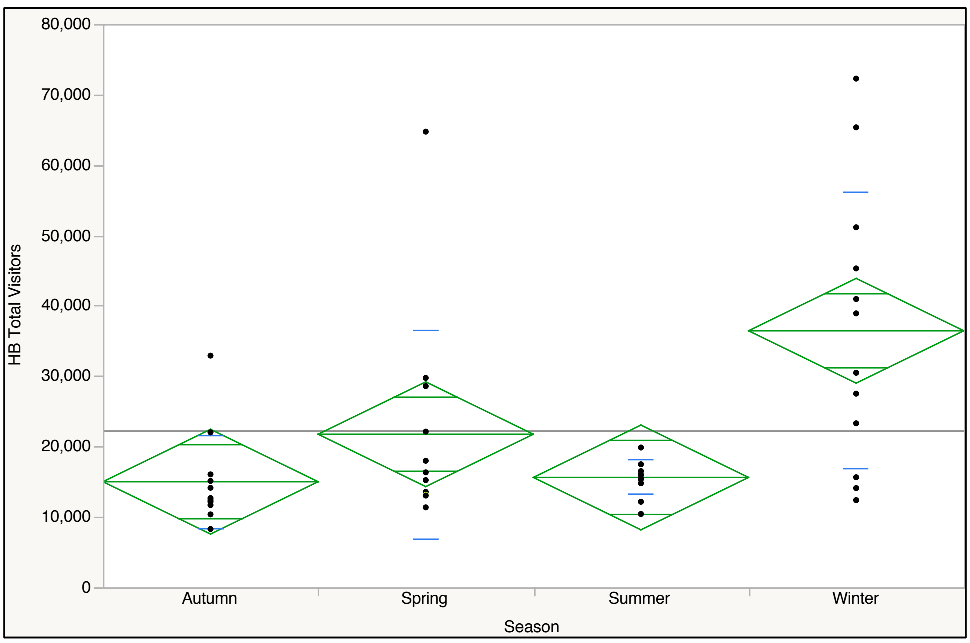

Figure 2.5 ANOVA Result for Website Visitors. As in Figure 2.4, black dots are individual data points that represent the number of website visitors for each month. The width of green diamonds represents differences in sample size, and the center line of each diamond is the sample mean for each group. The top and bottom point of each diamond mark the boundaries of the 95% confidence interval. The horizontal lines neat the top and bottom of the diamonds are overlap marks, and are used to visually compare group means.

C. Prospects for Kentucky's 511 System

In August 2015, the research team spoke with KYTC stakeholders who have been involved in development, management, or oversight of the 511 system. The interviews were semi-structured —each person was asked ten questions (the full list of questions is in Appendix A). Often, these questions prompted the interviewees to discuss other concerns or issues. Stakeholders were allowed to pursue those lines of thought and were asked follow-up questions when necessary. This section summarizes key messages from these interviews. Although stakeholders have divergent opinions on some topics, the discussion highlights the commonalities among the different parties. Future development of the state's traveler information systems will require a cooperative and coordinated effort among all stakeholders. Accentuating the opinions that are shared among all stakeholders demonstrates the common ground that can serve as a foundation during future system development. As in other sections of the report, the purpose is to synthesize the information and to refrain from drawing prescriptive conclusions or siding with one group of stakeholders over another. Figure 2.6 presents a concise summary of the survey findings and forms the basis of the ensuing discussion. After examining the commonalities among stakeholders, the team found additional recommendations for improving traveler information systems that did not come up during interviews.

Stakeholders felt that KYTC needs to have an authoritative role in delivering traffic information. Although third-party vendors provide reliable products, ultimately the Cabinet cannot directly oversee or regulate their use of 511 data. KYTC should maintain some outlet to ensure that accurate traffic information be delivered to the public. With more and more people relying on websites and smartphone apps to receive traveler information, it is imperative that accuracy continue to improve. All of the stakeholders observed that the timeliness and accuracy of the systems have gotten better over the years, however, a key challenge confronting the Cabinet is enhancing the quality of traffic information. Several stakeholders felt that Kentucky's 511 system has often sacrificed timeliness in favor of accuracy. This is due to the high level of manual data entry required to input new events into the website and mobile apps. Shifting away from manual data entry could accelerate delivery. One stakeholder remarked that the public receives the most benefit when data are available quickly, and that the Cabinet has the option to revise data after it has been publicized. However, there is no clear answer regarding what programming changes or modifications to system architecture would be needed to make these improvements. This issue merits further exploration by all stakeholders.

A particular challenge with Kentucky's traveler information systems is determining whether or not their performance is optimal. Currently, there is no universal metric used by the Cabinet to assess performance. Moving forward, stakeholders agreed that KYTC should define what it takes for traveler information systems to perform well. Although the federal government (see Rule 23 CFR 511) now requires states to create a real-time traffic information program that reports on construction activities, incidents that block lanes or entire roadways, travel-time data, and observations of roadway weather conditions within a fixed period of time (which varies depending on the circumstance), it is unclear whether KYTC's traveler information systems are in full compliance with this rule (which is required by November 2016). As the Cabinet decides on appropriate performance measures, the federal government's requirements could be adopted as a baseline. However, there may be uncertainty about when a traffic event actually begins, and a significant amount of time may elapse between an event's occurrence and when it is verified. While the 23 CFR 511 pertains to verified data, KYTC needs to narrow the gap between event occurrence and verification.

The stakeholders were enthusiastic about KYTC's emerging partnership with Waze. Everyone agreed that integrating Waze data into the state's traveler information systems added value. Stakeholders observed, however, several drawbacks to Waze's operational model. First, Waze is primarily concerned with getting real-time traffic data to the public. Although the Cabinet should strive to get this information to drivers, Waze's feed does not currently recognize future events. A critical part of the state's mission is to document scheduled road maintenance activities that have not started, which will cause lane closures or route detours. Because Waze does not support the display of this information, it limits usefulness for drivers who are principally concerned with these activities. As one stakeholder noted, Waze exercises discretion over what material is viewable in the app — while the Cabinet may supply Waze with data, Waze is under no obligation to input that data into its system. Although a few stakeholders commented on the app's relatively small user base (estimated at 75,000–80,000 in Kentucky) as problematic, they observed that the additional information received from these *mobile traffic sensors* can enhance the state's reporting. All stakeholders expressed some discomfort over the accuracy of Waze data — and questions have arisen in the past over validating this. Another common theme among stakeholders was the importance of streamlining the integration of Waze data into Kentucky's traveler information systems. Likewise, Waze needs to develop strategies (potentially through collaboration with the Cabinet and other DOTs) to integrate future events into its system.

There was a consensus among stakeholders that the 511 phone system will continue to diminish in importance. This is not to imply the phone system has become irrelevant. Among the 14-state CARS Consortium, Kentucky uses 29% of the IVR resources. However, as noted earlier in the chapter, the volume of calls received by 511 declined 60% from 2004 to 2014. Because a large proportion of Kentucky's population lives in rural areas, sometimes with limited or slow internet access, the phone system will remain necessary. Not all drivers have smartphones, and the phone system may be the only way for some citizens to access real-time traffic information.

Although many of the stakeholders were united by common sentiments, there were additional recommendations that only one or two interviewees mentioned. Readers should not take this to mean other stakeholders disagreed with these positions. Because of a compressed interview schedule, there was not time to ask each person about all of the recommendations put forward[3]. First, stakeholders felt that KYTC's website and apps could make improvements in the availability of real-time incident information. This suggestion goes along with the issues noted previously about traveler information systems sometimes prioritizing accuracy over timeliness. Increasing the amount of real-time data will involve programmatic changes to reduce the system's reliance on manual data entry. Another area that stakeholders thought warranted improvement was KYTC's efforts to distribute traffic information via third-party vendors (e.g., Google, Waze, Beat the Traffic). Not all drivers in Kentucky have KYTC's 511 app installed on their smartphones. Knowing this, it makes sense to ensure that KYTC's traffic information — which it has validated and authorized — is available to as many drivers as possible, irrespective of how they choose to acquire travel data. One way to increase the saturation of KYTC-approved data would be to develop marketing campaigns that raise the public's awareness and knowledge of the state's traveler information systems. Many states have implemented marketing campaigns to showcase their products. And while there is little data on the success of these efforts, there are a number of low-cost solutions the Cabinet could attempt. Although marketing will increase the public's consciousness of the state's traveler information systems, it is equally important — in stakeholders' eyes — to maintain and enhance the public-facing products distributed by the Cabinet. If the public does not find KYTC's website and apps compelling, thoughtfully designed, and accurate, rigorous marketing will have little effect on increasing their user bases.

In synthesizing the feedback heard during interviews, the team highlighted what stakeholders had in common, instead of minor points of disagreement. Illuminating these similarities will be productive for opening up new lines of conversation among stakeholders. All stakeholders are firm in their belief that the Cabinet will play an integral role in delivering traffic information to the public. Anticipating long-term effects and what implications the recommendations will have for the public-facing components and backend operations remains challenging. But stakeholders may find this summary useful as they collaborate with one another and work to map the way forward.

[3] In this paragraph, interviewees are collectively "the stakeholders," even if only two or three people mentioned a particular suggestion. The aim is not to confuse the reader; rather, it is to preserve the anonymity of the respondents. From a narrative perspective, this is the most parsimonious way to describe additional recommendations without attributing them to a specific person. Thus, the reader should bear in mind that these were not consensus opinions.

Common Opinions Among Cabinet Stakeholders

- The Kentucky Transportation Cabinet should play a role in delivering authoritative traffic information

- Although the quality of traveler information systems has improved over the years, timeliness and accuracy remain issues

- Manual data entry hampers the Cabinet's efforts to deliver traveler information quickly

- Identifying measures that provide an accurate interpretation of system performance remains challenging

- The Cabinet's partnership with Waze has added value to traveler information systems

- Integration of Waze data could be improved; Waze needs to identify strategies to incorporate future events into its systems

- Although use of the 511 phone system will continue falling, the state will need to maintain it

Additional Stakeholder Recommendations for Improving Kentucky's Traveler Information Systems

- Increase the availability of real-time incident information on KYTC's website and mobile apps
- Develop measures to verify the accuracy of Waze data
- Increase efforts to distribute traffic information to third-party vendors
- Develop marketing campaigns to raise the public's awareness of the state's traveler information systems
- Maintain and enhance public-facing products to encourage more use

Figure 2.6 Summary of KTC Stakeholder Perspectives on Kentucky's Current and Future Traveler Information Systems

D. Conclusions

Kentucky's 511 system currently includes phone operation, full-featured and streamlined websites, mobile apps, the Public Messenger service, and a social media presence (i.e., Twitter). Analysis of 511 usage data indicated that the number of phone calls received has dropped sharply since the mid-2000s. The websites and phone system experience the most traffic during the winter months, due to snow, freezing rain, and sleet events causing the most problems for drivers. There have been year-after-year increases in web traffic since 2011. However, numbers do not reveal who is visiting the site and how often repeat visitors access information. Discussions with KYTC 511 stakeholders revealed there are many points of agreement among staff. These are summarized in Figure 2.6. While there was not universal agreement among stakeholders about the future development of Kentucky's traveler information systems, they were all confident that the Cabinet would continue to play an active role in delivering authoritative traffic data to the public. KYTC will need to identify strategies to improve the timeliness and accuracy of the information it puts out. This will demand a collaborative effort from all stakeholders working alongside one another to enhance product delivery.

3. Third-Party Websites and Applications

A number of third-party vendors provide traffic information to the public. This chapter highlights the biggest players in the market including Google, Waze, Beat the Traffic, Here, and Apple Maps. The team focused on vendors that maintain web maps and mobile apps rather than companies that sell in-car navigation devices (e.g., TomTom and Garmin). The websites and apps discussed here are freely available, whereas manufacturers of in-car navigation devices require an upfront cost for their units. Further, the discussion centers on travel information services and does not summarize all of the data (e.g., points of interest, restaurants) each site catalogues. Where appropriate, the functionality between third-party web maps and mobile apps and KYTC's products was compared and contrasted. Table 3.1, located at the end of this chapter, summarizes the different capabilities of each product.

A. Google Maps

Google Maps includes full-featured desktop view, mobile websites, and a mobile app — they all provide access to the same information, however. Most users access the full-featured website from a desktop or laptop computer. Figure 3.1 represents a typical view from this site. It contains live traffic flow down to the level of major city streets (Figure 3.2 represents the level of detail available at this scale). Data on typical traffic flows are available as well. Users can zoom into a particular area, then select day of the week and time of day (Figure 3.3). Google Maps does not estimate how long delays associated with pockets of traffic congestion are expected to last. Users have to infer this from the color codes. Green indicates there are no traffic delays, while orange and deepening shades of red mark locations with delays (the deeper the shade of red, the longer the delay). Additionally, the Google Maps platform is scalable, and the amount of information displayed hinges on the scale a user zooms into. Users can receive directions on Google Maps as well as estimated travel times for their different route options.

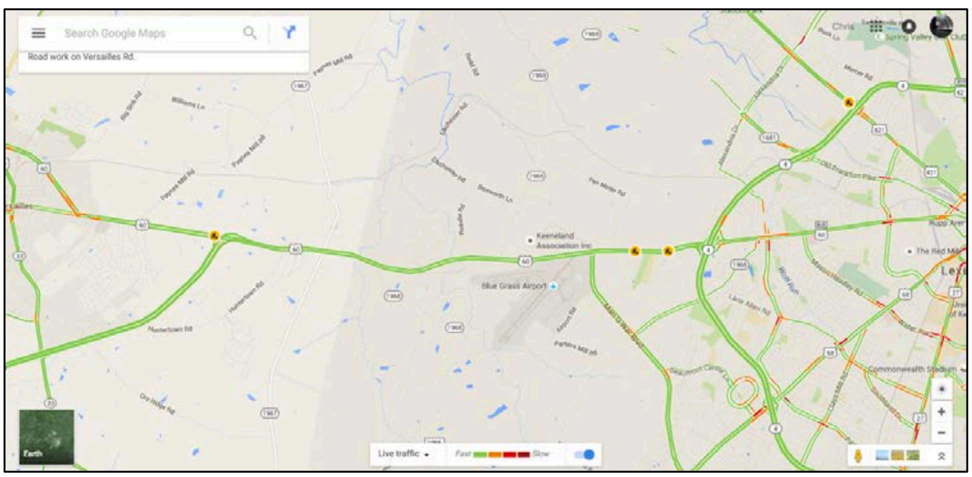

Figure 3.1 View of Google Maps. Highlighting US 60, West of Lexington.

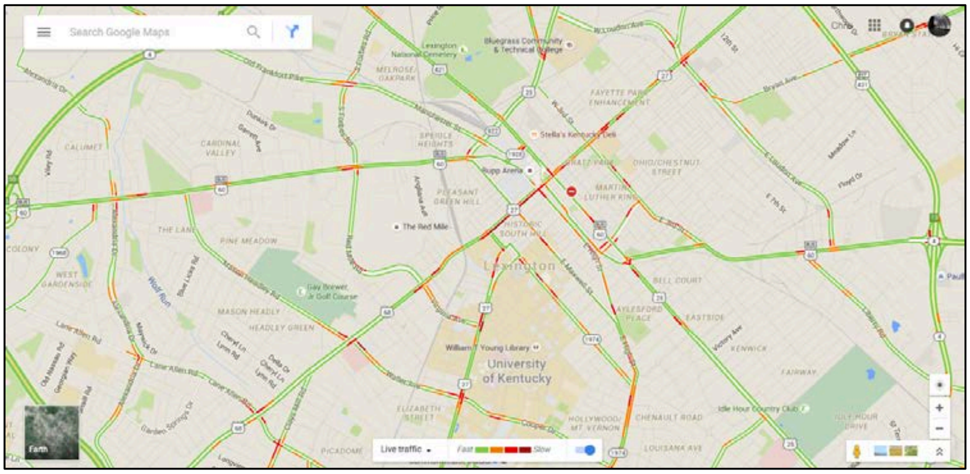

Figure 3.2 Live Traffic Speeds on Google Maps. Speeds are available for major roads (i.e., Interstates, US Highways) as well as principal urban arterials.

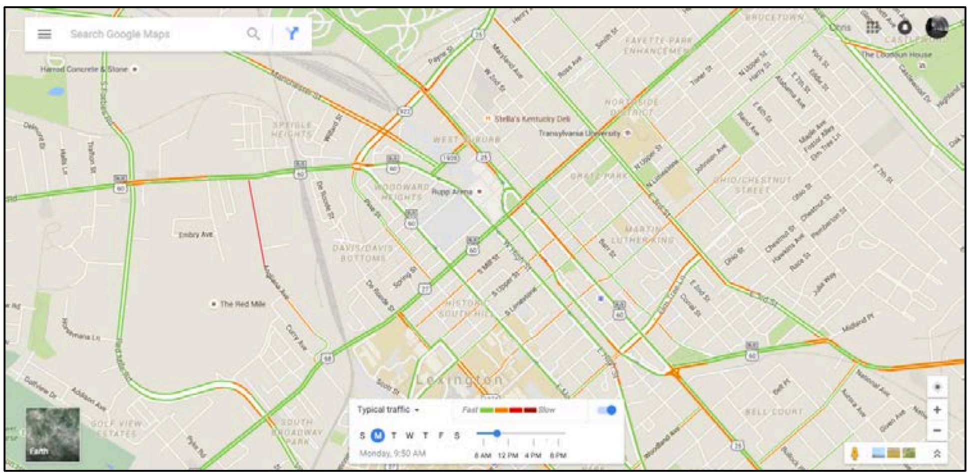

Figure 3.3 Data for Typical Traffic Flows on Google Maps. Predictions are based on historical data; users have the ability to select the day and time of day that interests them.

In addition to current and historical traffic data, Google Maps also displays traffic incidents reported through Waze (including road closures and construction zones). Like the other third parties discussed in this section, it appears this information has been pulled directly from the State of Kentucky's 511 data feed. However, traffic incidents and 511 information are not summarized at the same level of detail as on the state's websites and apps. For example, Figure 3.4 illustrates the display users see when they click on a map icon signifying construction work on US-60. Google Maps depicts where the construction is taking place, but this is only accompanied by a brief description — "Road Work on US-60 E." Users cannot see what type of construction work is happening, the exact location, or the expected duration. This information is accessible in the 511 websites and mobile apps (Figure 3.5 shows what users see when they click on the same point in the 511 full-featured map). Interestingly, even though Google Maps relies on Waze for traffic incident reports, Kentucky's 511 website and apps pick up a larger number of Waze events. It is unclear why this discrepancy exists — we can only speculate that Google Maps is not integrating as much data from Waze into its products as KYTC.

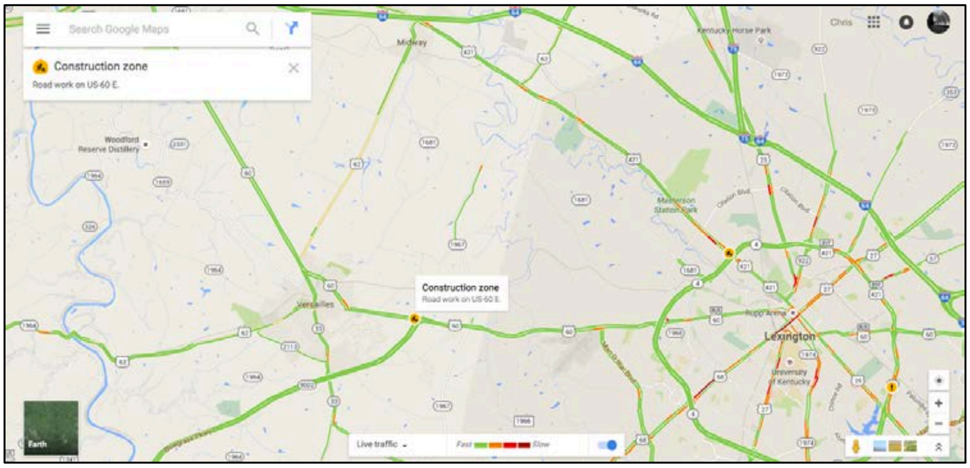

Figure 3.4 Traffic Incident/511 Information Display on Google Maps

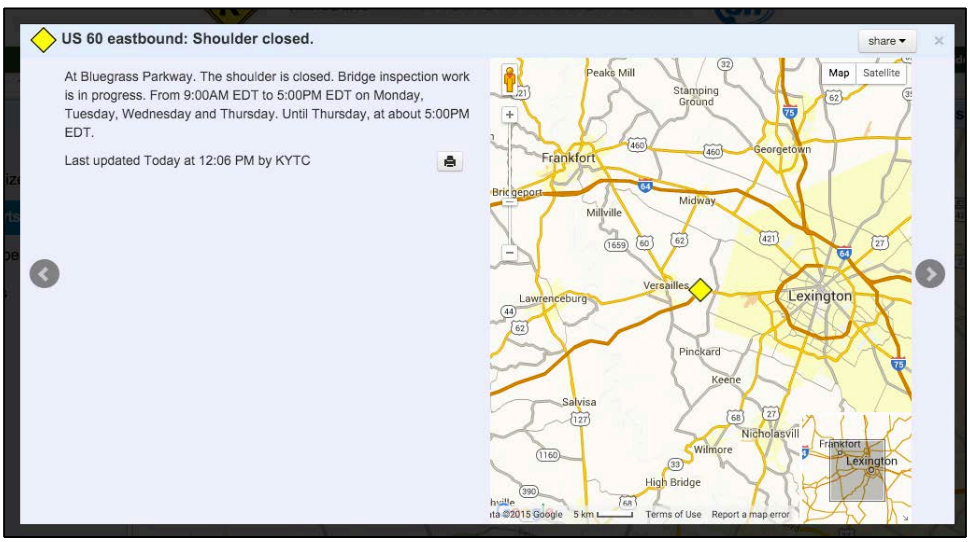

Figure 3.5 Traffic Incident/Activity View on Kentucky's 511 Full-Featured Website. The event narrative is much more thorough compared to what is available on Google Maps.

The Google Maps mobile app is available on multiple platforms. It is a GPS navigation app that lets users view the same information as on the full-featured site. When users drive, they passively contribute traffic data to Google. When Google Maps calculates the expected duration of a trip, it relies on a combination of historical and real-time traffic information. Figure 3.6 includes three panels; each panel captures a different facet of the mobile app. The left panel depicts a suggested route from Lexington, Kentucky to Louisville, Kentucky. In addition to driving directions, users can also identify areas with traffic congestion and the location of events or incidents. At the map scale represented in the left panel, only traffic conditions along Interstate 64 are visible. The middle panel displays traffic conditions around Lexington, including traffic flows and events. The right panel shows the incident/event information for construction work on US 60 (discussed above). As with the full-featured website, the mobile app includes a small amount of information about the event, but it lacks a detailed narrative, which is available from Kentucky 511 as well as from some other third-party websites.

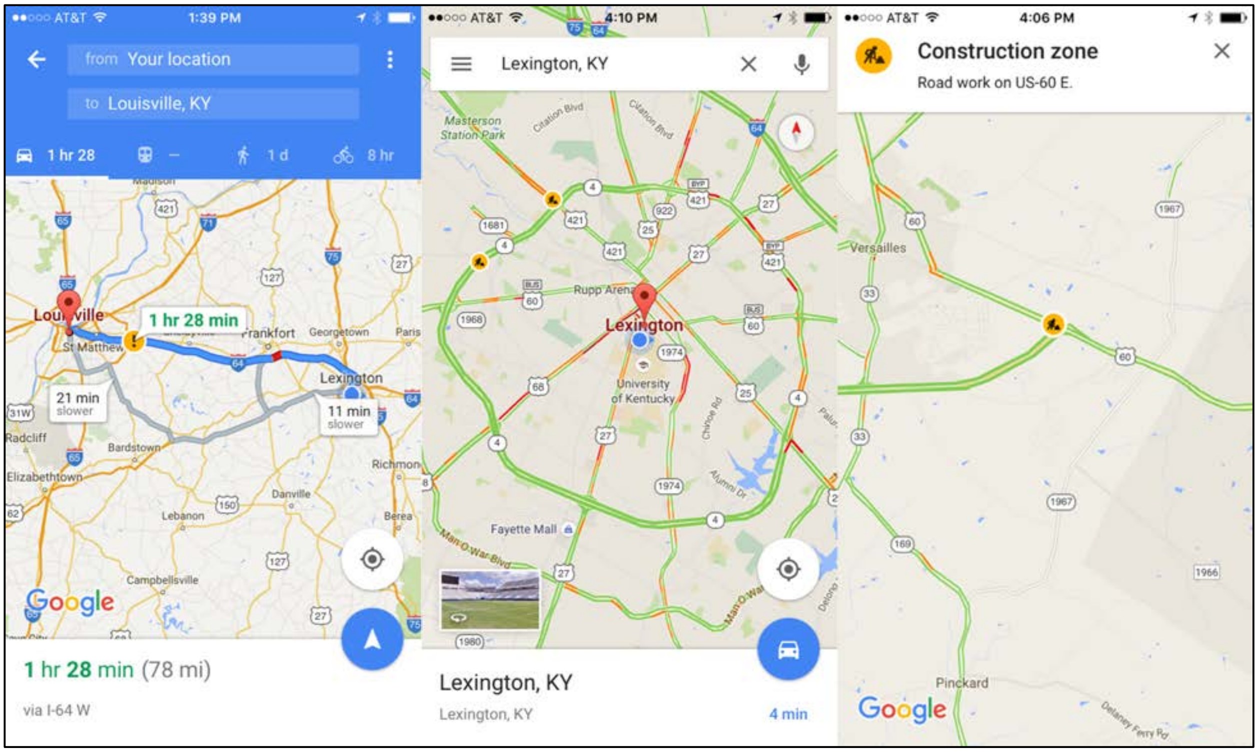

Figure 3.6 Google Maps Mobile App for iOS. Each panel displays a different view and set of capabilities — driving directions, traffic flow, and 511 incidents/events.

B. Beat the Traffic

Beat the Traffic is owned by Pelmorex, a Canadian company headquartered in Oakville, Ontario. It offers many of the same features provided by other third-party vendors: a full-featured website and mobile apps. The site includes information on traffic flow, construction (obtained from Kentucky's 511 system), access to traffic cameras, and weather. Users can get directions, and once they register with Beat the Traffic they can save favorite trips and traffic cameras — providing quicker access. Like Google, Beat the Traffic uses a simple color coding scheme to report traffic flows, with roads shaded in green not experiencing delays and roads in oranges and reds signaling more congestion and slower vehicle speeds. Using the city of Lexington, Figure 3.7 illustrates the differences in traffic flow data between Google Maps and Beat the Traffic. While Beat the Traffic lets users see the conditions on principal arterials, Google Maps offers traffic flow data on a greater number of roads in urban areas, making it more valuable to drivers.

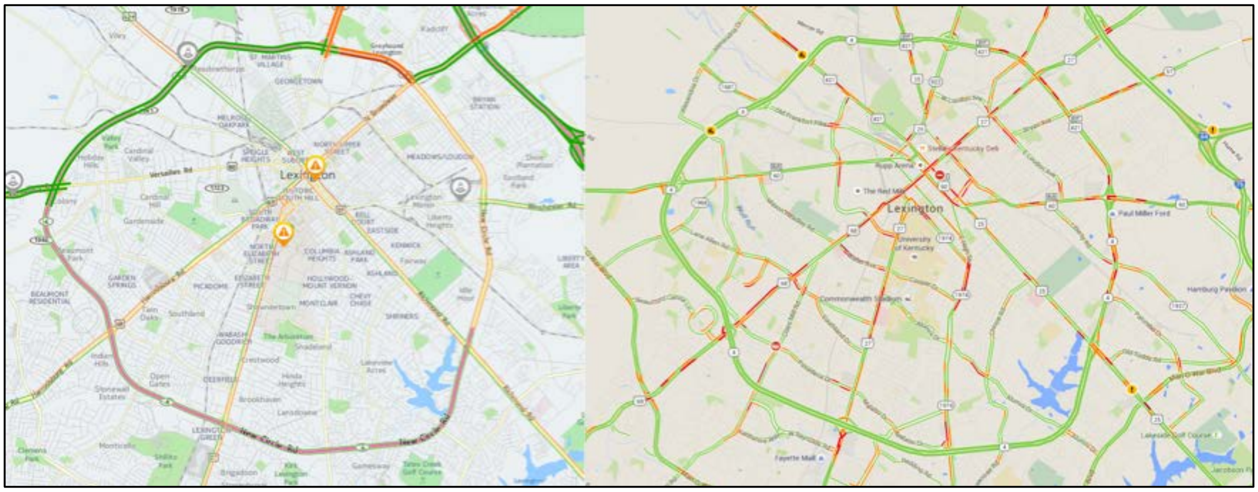

Figure 3.7 Comparison of Lexington Traffic Flow Data Available from Beat the Traffic (left) and Google Maps (right)

While Google Maps does report construction activity and traffic incidents, it does not gauge the anticipated impacts on traffic. Beat the Traffic offers this function, classifying traffic impacts as minor, moderate or major (Figure 3.8). While these categories do not correspond to specific time estimates, drivers could find them valuable for identifying roads to avoid.

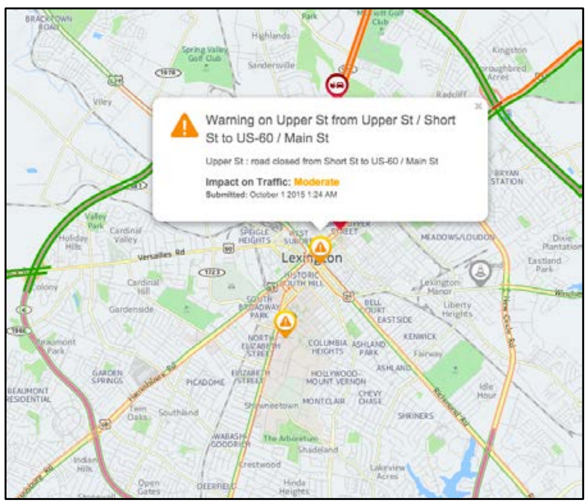

Figure 3.8 Screen Grab from Beat the Traffic. Data on traffic events and incidents describe their effect on traffic flow and congestion.

Beat the Traffic's mobile app provides the same functionality as its full-featured website. Users can specify and store particular routes, get directions, view traffic cameras, locate incidents and events, obtain incident details, and view traffic speeds. Users can also report several types of incidents — accidents, hazards, construction, police presence, and weather-related issues. However, Beat the Traffic only includes incident reports from people using their service and Kentucky's 511 system. As such, the reliability and detail of the information is contingent upon the installed user base and the frequency of reporting. Figure 3.9 presents three views of Beat the Traffic's iOS app. The left panel is the familiar urban-scale map of Lexington, with traffic flow data adopting the same color-coding scheme as the full-featured website. Incidents and events are shaded to indicate their severity. Grey markers denote incidents with a low impact on traffic; markers that are orange signify a moderate impact on traffic; and red markers signify high-impact events. The app also lets users access a listing of incidents taking place nearby (middle panel). One unique element of Beat the Traffic is its "shake-to-report" feature. A user can be on home page (left panel) and shake their phone if they identify an incident in progress. Then, the app brings up the Report Incident screen (right panel). Here, a user can select the appropriate incident type, and alert other drivers of impending traffic problems.

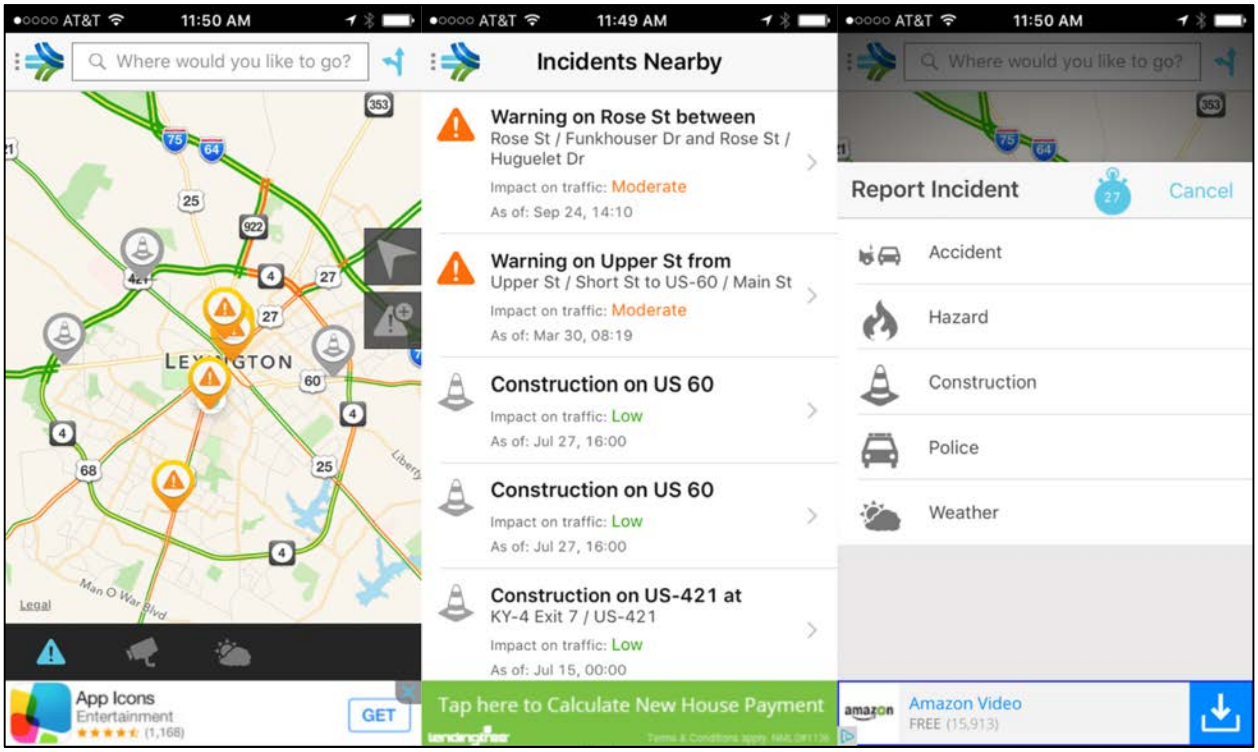

Figure 3.9 Interface of Beat the Traffic's Mobile App for iOS. Users can access maps that display traffic flow data and the location of incidents, see a listing of nearby incidents, and report an incident.

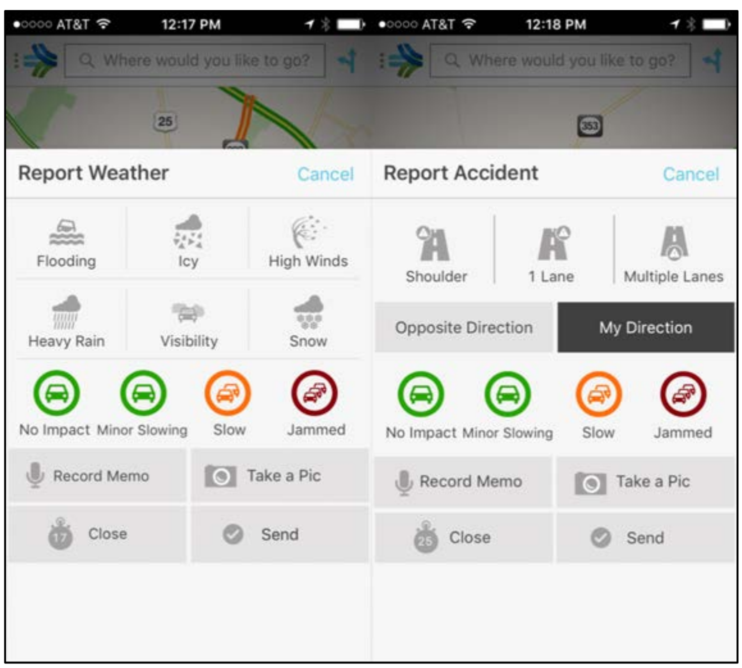

Figure 3.10 Detailed Incident Reporting Screen on Beat the Traffic's Mobile App

After the user selects what type of incident they want to report, they are taken to a new screen, where they can enter detailed information. Figure 3.10 shows the incident reporting screens for accidents and hazardous weather. For example, when a user reports an accident they specify its location, what portions of the road are affected, and the severity of traffic impacts. Additionally, users can record a memo and take a picture of the event to share.

C. Waze

Waze is a GPS navigation app that is available for iOS, Android, Windows Phone 8, BlackBerry 10, Symbian, and Windows Mobile[4]. It leverages crowdsourced information from users and comprehensively reports on traffic conditions in the U.S. and internationally. Users contribute by either leaving the Waze app running in the background, which produces real-time traffic information, or by actively reporting on traffic, accidents, police traps, blocked roads, and hazardous weather conditions. Reports are not weighted equally in Waze. A full discussion is beyond the scope of this report, but in general, users earn points the more they drive and the more reports they submit. When other users vote for (i.e., confirm) another user's report, that person accumulates points. Travelers can also earn points through their passive contributions. If they have Waze turned on during their trip, they earn points for each mile they drive (not all roads are treated equally — for example, a driver traveling on a newly paved road receives many more points than drivers on typical roads). Users are ranked based on the number of points they amass. There are five levels, with Baby Wazer being the lowest rank (which is applied to new members before they have driven 100 miles,) and Waze Royalty occupies the top of the rankings (this includes the top 1 percent of drivers in a region). For some incidents and events, multiple users have to confirm a report before it becomes visible on the Waze app. With a road closure, the number of reports needed for the event to appear on Waze varies according to the road's weight, a user's rank, and the country[5].

The four panels of Figure 3.11 depict some of the features Waze users can access. The upper-left panel shows the home screen shown when the app is opened. This map is fully scalable, can be rotated 360°, can be viewed in 2D or 3D mode, shows where visible Waze users are located (the ghost-shaped icons), and indicates the location of incidents. Unlike the other apps discussed in this section, Waze does not show traffic flow throughout the road network. Slowdowns are only reported for locations where GPS data have been received from active Waze users. The upper-right panel of Figure 3.11 illustrates a traffic incident screen. The view contains the location of the incident as well as the impacts on traffic — in this case, a construction zone on E. Main Street is present. Even though passive data collection is integral to Waze's operational model, user reports are critical for highlighting ongoing incidents. The bottom panels display the reporting screens. When a report is entered, users can select from ten event types — traffic jam, police presence, accident, hazard, gas prices, map chat, map issues, place, camera, and closure. The bottom-right panel captures incident reporting screen. For example, with a hazard, users select from three options — on-road, shoulder, and weather.

Similar to Beat the Traffic, users can submit a picture and comment on the impacts to traffic flow. Waze also incorporates information from KYTC's 511 data stream. Like Google Maps, Waze does not include a complete narrative of the event. For example, if construction work is scheduled to intermittently shut down lanes, users will be able to see that. However, they will not have access to the exact location, the type of construction or maintenance work being conducted, or the expected duration of activity. As KYTC stakeholders noted, even though Waze can display a current 511 event, it cannot load future events — everything that goes into Waze is treated as an ongoing event.

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[4] Support for some of these platforms (e.g., Windows Phone) is limited, and Waze does not plan on making future updates to the software.

[5] A primer on how points are assigned is available on the Waze wiki: https://wiki.waze.com/wiki/Your_Rank_and_Points (link last accessed October 6, 2015).

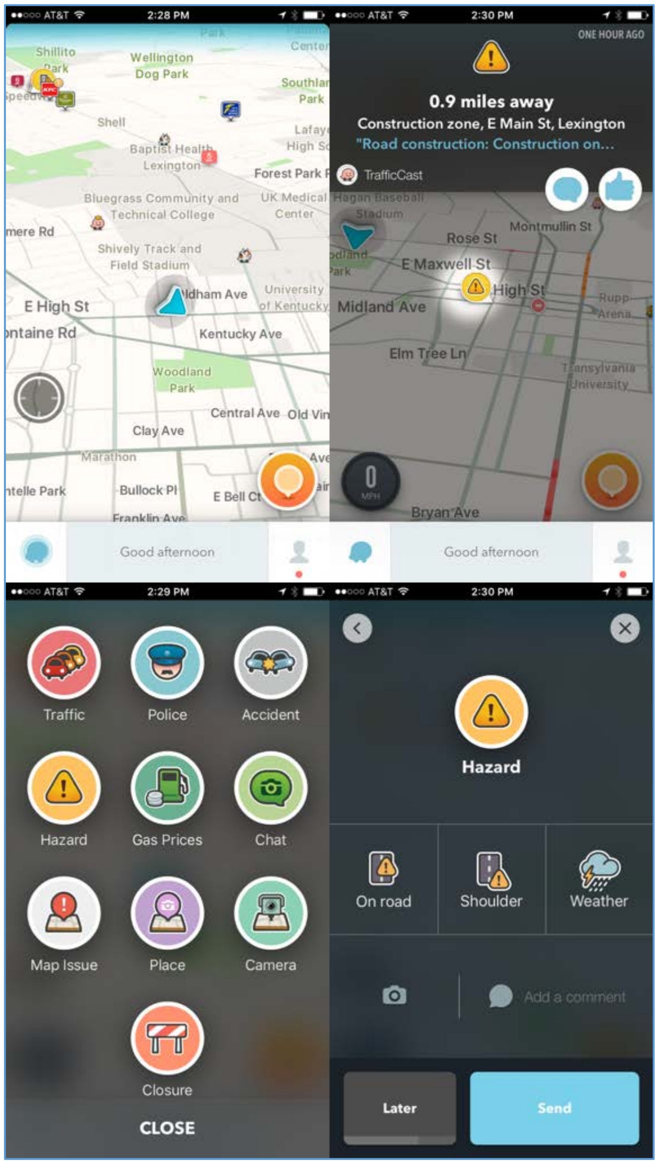


Figure 3.11 User Interface of Waze for iOS.

D. Inrix Traffic XD

Inrix XD is a mobile app available on a variety of platforms that reports on traffic data in the United States and internationally. It contains a standard array of features, such as real-time traffic flow data, mapping of traffic incidents and events, driving directions, traffic cameras, and the incident reporting. When users register they are able to create custom profiles and save routes, such as trips to and from work. There is also a premium option that lets users store an unlimited number of destinations, receive an unlimited number of alerts, view gas prices, and improve integration between the mobile app and in-vehicle head unit.

The resolution on traffic flow maps is comparable to what Google provides, with data available for major roads and highways, principal arterials, and most urban streets. Inrix HD uses the familiar color coding scheme — of green, orange, and red — to define traffic flow and areas of congestion. It also includes historical travel data, so users can select their time of departure to gauge what traffic conditions will be like at that time of day. Unlike the other apps described above, Inrix XD does not include information from Kentucky's 511 data stream. All reports of traffic incidents are user generated. Figure 3.12 includes three panels that illustrate different elements of Inrix XD. The left panel shows a typical map view focused on the Lexington area. Different icons denote incident types: a white circle with a red dash highlights a road closure, whereas an overturned car indicates an accident. If there are multiple incidents or events in one location, a box with a number appears — the number denotes how many incidents have taken place. As users zoom into a more local area, the resolution becomes sufficiently fine-grained such that the exact location of each event appears — even if they are located on the same street. When users tap on an event icon, a new screen is brought up that describes the nature of the event, the distance between the event and the user, and its duration (middle panel, Figure 3.12). There is an option to confirm that the event is ongoing, that it is over, the road has cleared, or that normal traffic operations have resumed. The right panel of Figure 3.12 depicts the incident reporting screen. Users can report police presence, accidents, hazards, or construction (a subsequent dialogue box asks user to specify what side of the road an incident has occurred on). Users can also report whether the traffic flow information displayed in the app is correct. By tapping on "Wrong Traffic Color," users anonymously submit data that is then used to refine traffic maps.

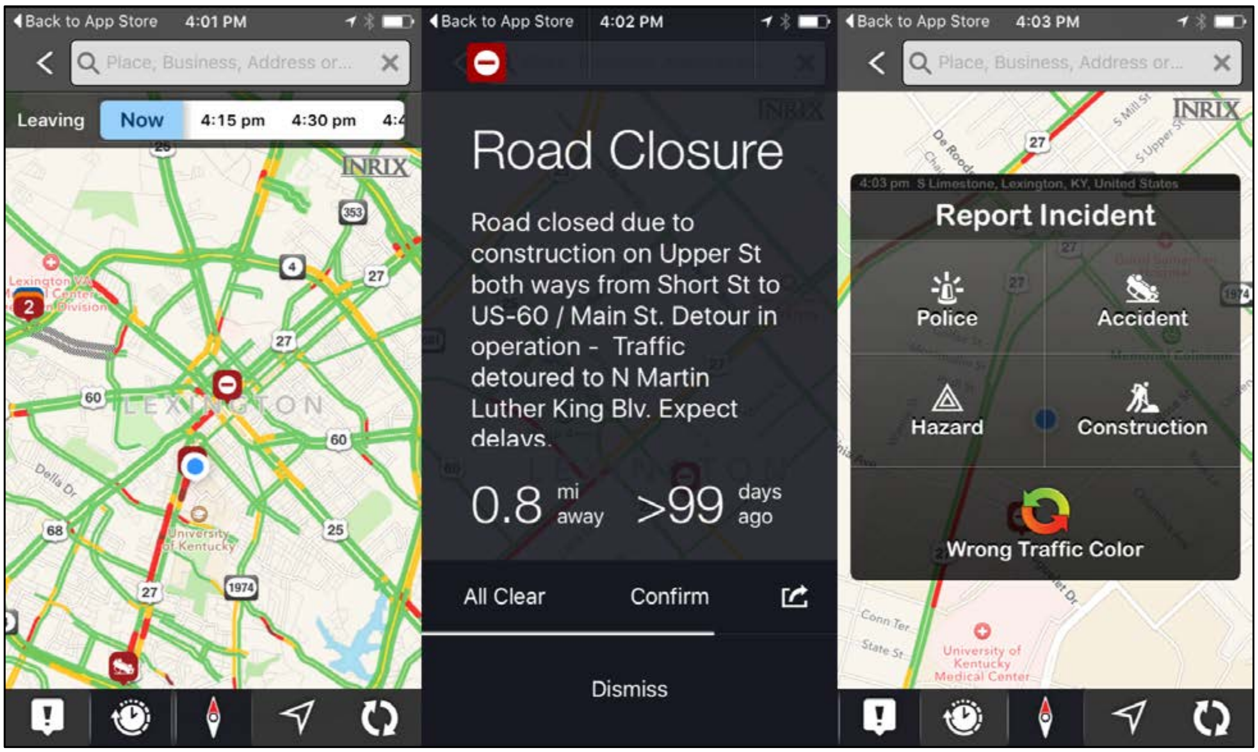


Figure 3.12 User Interface of Inrix Traffic XD for iOS

E. Here Maps

Here maintains a full-featured website and mobile apps. Both the website and apps provide users access to the same suite of features — detailed maps, traffic flow data, driving directions, and traffic incidents. Compared to the websites and apps discussed previously, Here Maps only stores a limited number of events and incidents. There is no mechanism for letting a traveler report on traffic incidents or congestions, which places Here at a competitive disadvantage. Traffic flow data are relatively coarse-grained, with information only being available for interstates, major highways, and principal arterials. Here Maps does not cover major urban streets, which Inrix and Google both offer. Figure 3.13 is a screen capture of the full website. Here Maps adopted the same color coding scheme as other companies to report on traffic flow (green, orange/yellow, and red). Interestingly, for the two events noted on the map, a brief description is accompanied by a start and estimated end time, which is information that other systems do not provide. However, as a travel information system, Here Maps lacks the functionality of other services. Drivers using it may be able to track vehicle flows on a limited number of roads; however, Here's ability to report events is more limited than other applications.

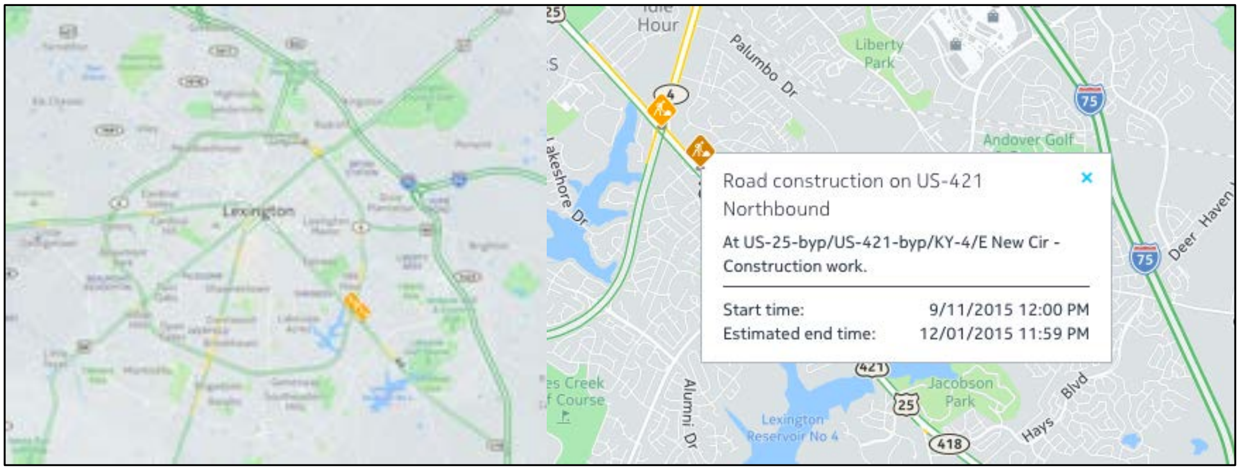


Figure 3.13 Screen Capture of Here Maps Full-Featured Web Map

F. Conclusions

This chapter reviewed travel information products offered by five third-party vendors. Most websites and apps have overlapping capabilities, although some have traffic flow maps that reach down to smaller scales than others (e.g., Google Maps). While Google Maps and Inrix stand out in this area, it is critical to note the apps have different intended purposes. Waze, although able to provide driving directions and other mapping features, is primarily used as a crowdsourcing platform that enables travelers to report on current traffic conditions. Google Maps, on the other hand, integrates some data from Waze, but does not let drivers issue active reports — data used to derive traffic flows are acquired through passive monitoring of travelers. Three vendors now incorporate a significant number events from Kentucky's 511 data stream (i.e., Google, Waze [ongoing events only], Beat the Traffic). It appears that third parties, namely Google and Beat the Traffic, offer much of the same functionality that is currently available on the state's 511 websites and mobile apps. Two differences stand out: 1) Kentucky's 511 system provides targeted information on winter driving conditions, and 2) it does not appear that the third-party apps exhaustively catalogue and present all 511 data.

4. Kentucky Drivers' Preferred Sources of Travel and Traffic Information

To understand what services Kentucky drivers rely on to acquire travel and traffic information before and during their trips, we asked people who responded to KYTC's Customer Maintenance Survey to answer several questions about what sources they most frequently to turn to when they need up-to-date reporting. In total, the survey contained six questions about traveler information services (Table 4.1). The purpose of the survey was to understand drivers' behavior from the planning stage to the activities they engage in during the trip itself. There were 970 people who took part in the survey, however, because some of the questions let participants chose more than one answer, the number of responses for each question ranged from 970 to 1,694. To obtain a geographically representative sample, respondents were sought out in each of Kentucky's 12 Highway Department Districts, and the number of respondents in each district was roughly proportional to the total number of residents (as a percentage of the state's total population) who live in them. Thus, 488 of the respondents were located in Districts 5, 6, and 7 (which are home to the Louisville, Lexington, and Cincinnati/Northern Kentucky metropolitan areas). The other 50 percent of survey respondents came from the Cabinet's remaining nine districts. Table 4.1 lists each of the questions included in the survey and the answers respondents could select from.

Table 4.1 List of Survey Questions

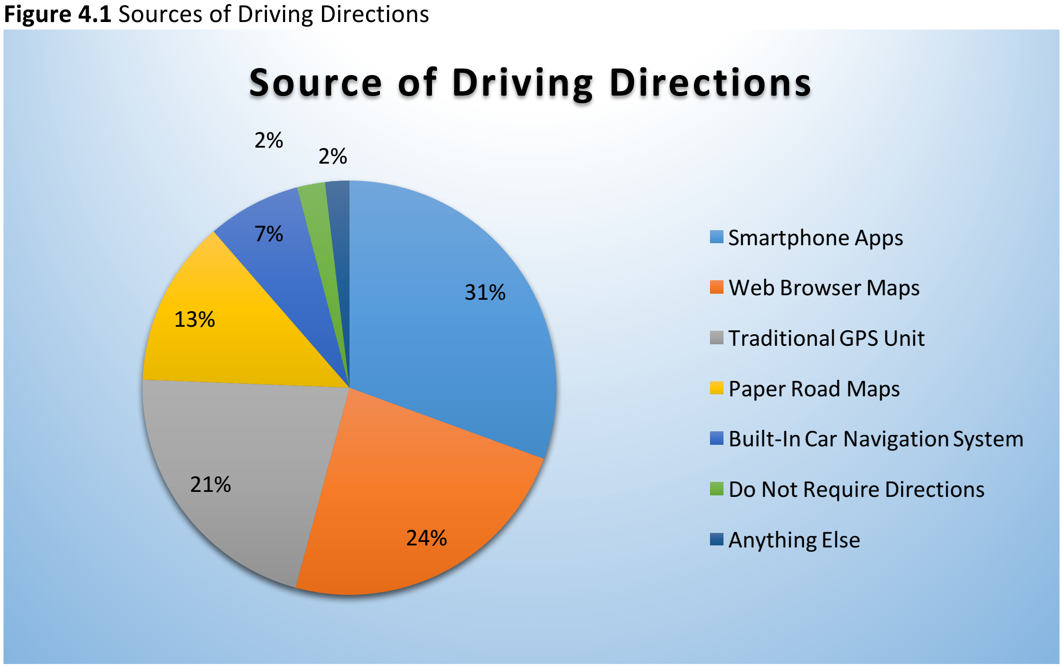
Number	Question
1.	When you need to find driving directions, which of the following do you use (enter all that apply)? - Paper Road Maps - Web Browser Maps - Smartphone Apps - Traditional GPS Units - Built-In Car Navigation System - Anything Else - Do Not Require Directions
2.	Do you ever use or look for traffic condition information when traveling? - Yes - No
3.	During what types of travel do you use this information (enter all that apply). - Normal Daily Travel - Local Trips Not Part of Daily Travel - Traveling on Long Trips - Stuck in Traffic
4.	Which of the following do you most trust to provide accurate and timely traffic conditions? - Media (TV or Radio) - Online Services (Google, Waze) - Government Services (511, TRIMARC) - Built-In Car Navigation Services - Social Media (Twitter, Facebook) - Other Services
5.	How would you *prefer* to get traffic control information? - Media (TV or Radio) - Personal/Table Computer - Smartphone - Landline - Phone Call - Roadside Message Signs - Other
6.	If you want to check on road conditions affected by weather, such as snow or flooding, where do you currently get your information (enter all that apply)? - Media (TV or Radio)

	- Online Services (Google, Waze) - Government Services (511, TRIMARC) - Built-In Car Navigation Services - Social Media (Twitter, Facebook) - Other Services

A. Findings

Figure 4.1 illustrates the results of Question 1. To obtain driving directions, respondents overwhelmingly preferred technologically sophisticated platforms, including web-based maps, smartphone apps, traditional GPS units, and built-in car navigation systems. Paper maps still garner some users, however, its user base is fractional compared to digital and web-based options. Only a small percentage of respondents indicated they never require directions or leverage a service not included among the possible responses. Since respondents had the option to select multiple answers, the percentages for each mode of acquisition do not reflect the proportion of respondents choosing it — it is the proportion of *responses* indicating a specific delivery mode.

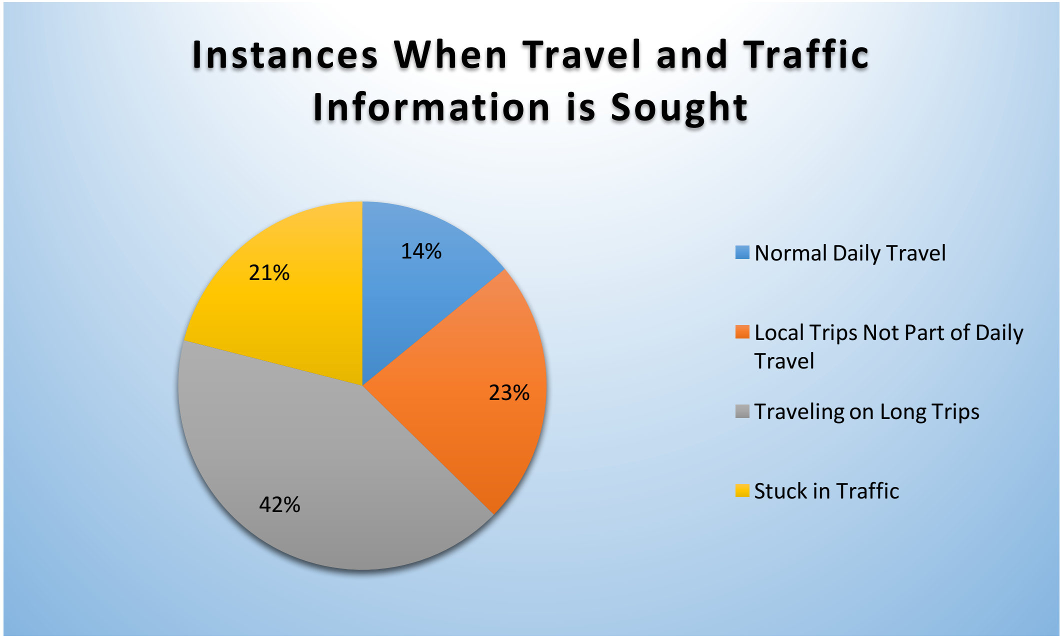
Figure 4.1 Sources of Driving Directions



n = 1,694

Question 2 asked respondents whether they look for or use traffic condition information when they travel — 61 percent of the participants replied affirmatively, while 38 percent said they do not seek out this information (one percent did not respond). Building on this, Question 3 asked respondents who replied *yes* to Question 2 during which types of travel they use traffic condition information. Again, participants had the option of selecting more than one answer. Drivers most commonly search for details on traffic conditions when they go on long trips. They also tend to look for this guidance when they are stuck in traffic or go on local trips that take them beyond their usual routes or destinations. This is understandable given that drivers who lack familiarity with a particular route are less likely to have detailed knowledge of traffic patterns and what events are likely to cause delays (Figure 4.2).

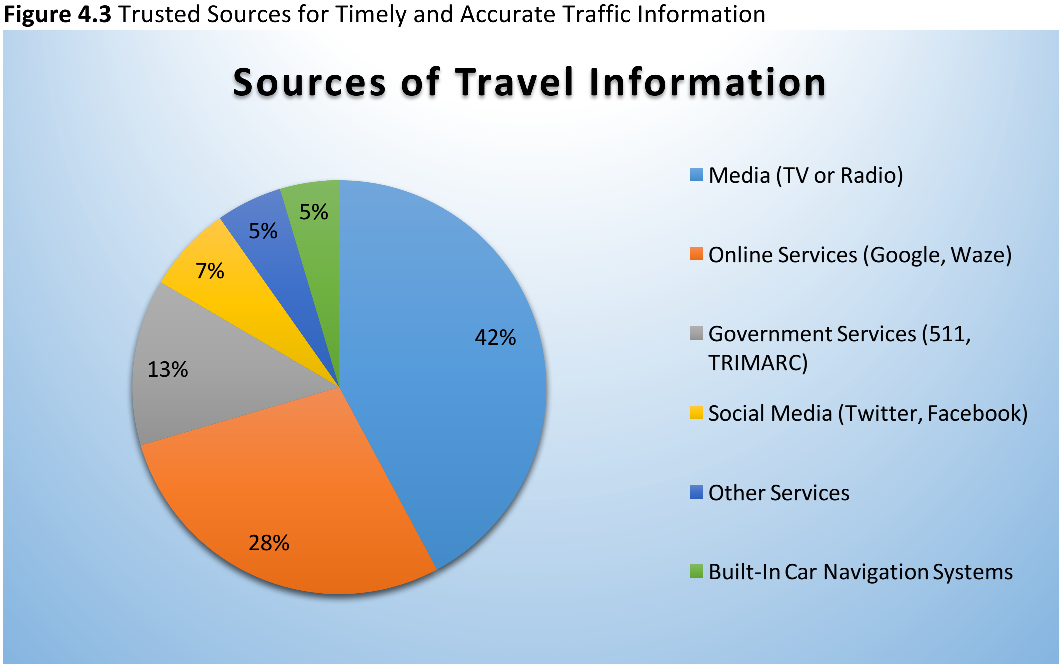
Figure 4.2 Types of Trips that Prompt Acquisition of Traffic Data



n = 1,122

Questions 4, 5, and 6 turn to the sources drivers use to obtain traffic information on traffic conditions, traffic control, and when hazardous weather impacts roadways. Question 4 queried respondents on the issue of trust. Interestingly, a plurality of respondents said they most trusted traditional media sources (TV, radio) to get accurate and timely data on traffic conditions (≈ 42 percent). This probably speaks to most drivers having a long-standing habit of consuming traffic data from these outlets. Online services, like Google and Waze, were next in popularity, with ≈ 28 percent of respondents finding them most dependable. Approximately 13 percent of respondents said they most trusted government services (511 or TRIMARC) to get information on traffic conditions. Figure 4.3 has a complete breakdown of responses.

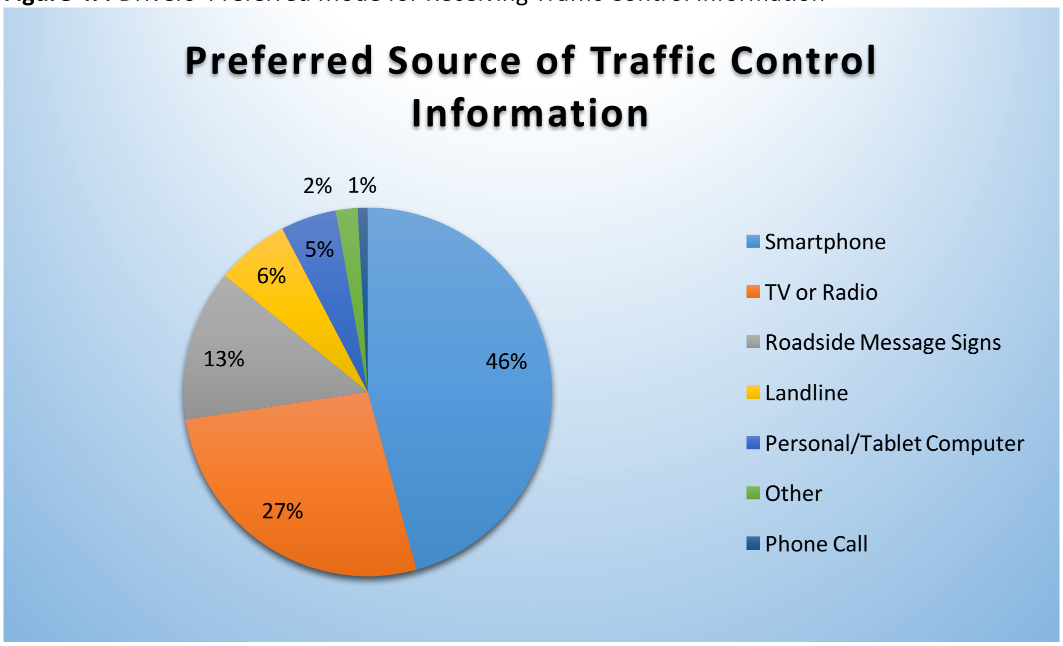
Figure 4.3 Trusted Sources for Timely and Accurate Traffic Information



n = 562

Question 5 asked respondents to identify their preference for obtaining traffic control information. Approximately 46% of respondents answering this question said they prefer using their smartphone to get this data. This was followed by 27% of survey participants who opt for TV or radio. The remaining modes of delivery were less popular, with 13% citing roadside message signs as their preferred mode. Telephone calls, as well as personal and tablet computers, were not frequently mentioned. This makes sense given that most drivers need traffic control data when they are getting ready to leave or are already on the go. Smartphones and traditional media provide the most convenient (and fastest) means of procuring this information. Figure 4.4 shows the division of responses.

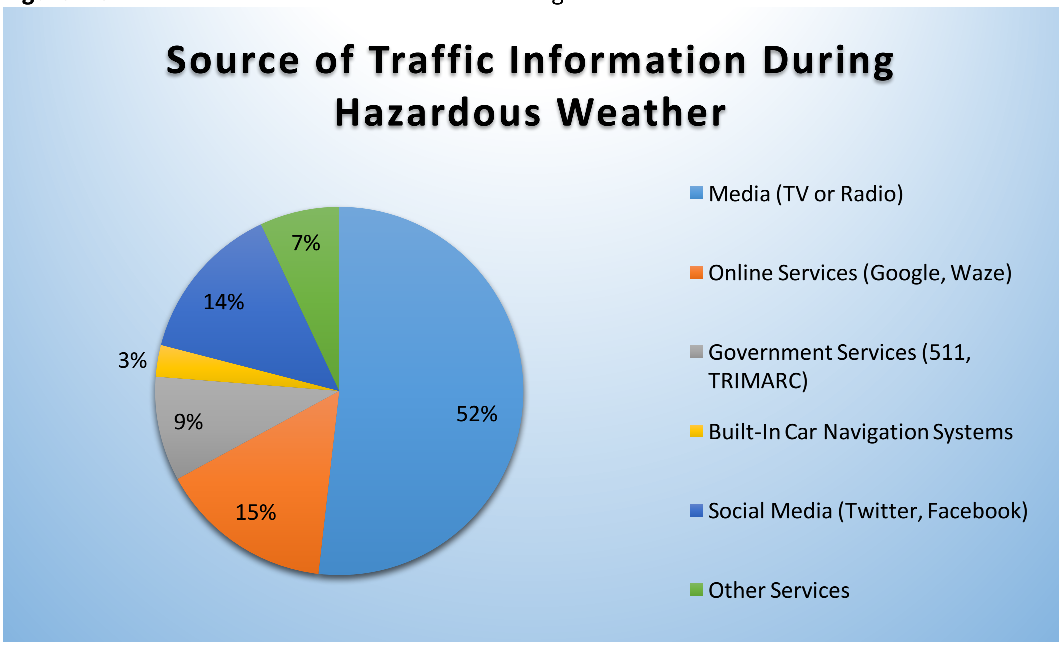
Figure 4.4 Drivers' Preferred Mode for Receiving Traffic Control Information



n = 574

The final question asked respondents to select all of the sources they rely on for traffic information during hazardous weather events (e.g., snowstorms, severe weather, flooding). Again, because the question let the respondents select more than one mode of delivery, the number of responses was greater than the number of respondents (n = 1,330). Over 50 percent of the responses indicated TV and radio were essential sources of traffic information during hazardous weather. This was followed by online services (≈ 15%) and social media (≈ 14%). Just 9% of the responses were for government-maintained services like 511 and TRIMARC. Figure 4.5 illustrates the response breakdown.

Figure 4.5 Where Drivers Obtain Traffic Data During Hazardous Weather



n = 1,330

B. Conclusions

The survey results demonstrate that a large percentage of Kentuckians rely on digital content delivery methods to receive their traffic information. Unsurprisingly, to obtain driving directions, we received a small number of responses indicating the use of traditional paper maps — web-based maps (e.g., Google Maps), smartphone apps, and GPS units are the go-to services for this information. Although the prevalence of smartphone apps and online services is unmistakable, it is critical to note that many people still rely on traditional outlets, such as TV and radio, to acquire traffic information. Because there are no previous data to compare these survey results to, we cannot say for sure whether the popularity of these outlets is on the decline. Future research may want to revisit this question to see if the consumers' shift away from cable and network television services impacts their dependence on them for traffic data. From the perspective of this study, what is most striking is the relatively small number of people who regard government services like 511 and TRIMAC as their most trusted source to learn about traffic conditions. Only 13 of respondents viewed them in this way. Just 9.2 percent of the responses indicated that they used these services to access traffic information during hazardous weather events. Because Kentuckians appear increasingly dependent on smartphone apps and web-based services for traffic data, it is reasonable to conclude that KYTC's 511 app could gain market share if it had greater visibility. If the Cabinet conducts future in-depth research on the public's use of its 511 services, more detailed survey questions that ask about specific 511 system components and the public's knowledge of them should be included.

5. Synthesis of Other State DOT 511 Operations

To acquire insights into the design and operation of traveler information services elsewhere in the U.S., we conducted interviews with a number of state DOT stakeholders. We asked interviewees about their state's current traveler information systems, whether their user base is expanding or contracting, and whether any design and/or operational changes were planned for the systems' public-facing components. Although the list of questions we used more or less the same for each state, some adjustments were made to reflect their individual context. Appendix B contains a sample list of questions that were submitted to the Utah DOT.

A. Florida

The State of Florida provided us with detailed usage statistics for their phone system, website, mobile apps, and Twitter page views. Table 5.1 summarizes these numbers. Florida's 511 phone system launched in 2009; the number of phone calls received peaked in 2010, at approximately 2.7 million. Since then, use of the phone system has steadily declined, with 1.7 million calls made to it in 2014. Comparable to Kentucky, the number of website sessions has been climbing since 2009 (also its launch date). During its first full year of operation, the site recorded approximately 690,000 hits. This increased to 961,000 in 2014. There has been explosive growth in the number of text messages sent via the state's automated alert system. In 2010, approximately 2.8 million SMS alerts were sent. This declined to 1.7 million in 2013, however, it sharply increased to 4.5 million in 2014. In 2015, from January to August, this system sent travelers 8.4 million text alerts. The state's Android and iOS mobile apps were launched in 2013 and 2014, respectively. Although the short time period prevents us from making robust generalizations about usage, the number of sessions on both apps over nine months in 2015 more than doubled the total number in 2014. Florida's DOT has a marketing contractor that promotes the state's traveler information systems. To raise awareness of these services, the DOT coordinates media events with districts, distributes press releases, and posts social media alerts focused on major traffic impacts. The marketing contractor also does outreach to universities and professional sports teams to demonstrate how the state's services can improve the experience of attendees. Currently, the DOT is reevaluating the role of this contractor to decide if they should be involved in promoting future iterations of the state's traveler information systems.

Florida's website and mobile applications are designed and maintained with the assistance of contractors and subcontractors. The state has made an aggressive push to incorporate Waze data into its traveler information systems. What is particularly noteworthy is how the state handles new data intercepted from Waze. Given that the State of Kentucky is in the early stages of working with information from Waze, Florida's procedures could serve as a reference point for Kentucky. Data received from Waze is incorporated into the Florida's SunGuide software, which in turn feeds traveler information systems. To prevent the distribution of questionable data, the DOT has set a threshold for the number of reports that need to be received for a single event before it is communicated to the state's operations staff. After operations staff receives this information, they will examine it and decide whether it provides new information that has previously gone unreported. If staff decides the information warrants reporting, they will create an event in SunGuide and attribute the date to Waze. However, as our point of contact in Florida observed, Florida's traveler information systems cover interstates and major U.S. and FL routes. These roads have dense coverage of ITS infrastructure (including closed-circuit televisions, detectors, and Road Rangers). Because of this, DOT staff has noted that many events reported by Waze are detected by the DOT before the Waze data makes it to operations staff. As the state looks to expand the range of its traveler information systems in the future to include arterials — which do not have the same density of ITS coverage — DOT staff anticipate that Waze may play an increasingly important role in distributing information to the public.

Florida anticipates making changes to its traveler information systems, and it currently has a request for proposals (RFP) soliciting bid from contractors that focuses on all of its dissemination tools. One of the state's primary goals is to reconfigure their dissemination tool so they offer more push technologies. DOT officials believe system use will increase if the traveler information systems actively push data to the users rather than requiring them to search it out on their own. The new system will also overhaul the 511 phone system's interactive voice response (IVR) menu. The state wants to enable the IVR system to learn a user's preferences and report information on the routes of greatest interest to them. This type of framework will prevent users from navigating elaborate, complex menu options. There are plans to have mobile apps monitor a driver's location, and when they near an incident they will be alerted of it automatically. Because of Florida's aging demographics, the state is exploring design changes that will assist older drivers in procuring the information they need. DOT officials believe that improving its mobile apps and Twitter feeds hold great promise for enhancing the delivery of traveler information. They have observed the benefits to the state's media partners as well in delivering traffic information to the public.

Although state officials believe the DOT will continue to play an instrumental role in distributing travel information, they are unsure what the future holds. Florida is currently investigating what platforms offer the greatest return on investment. While there have been internal discussions over whether the state should outsource the delivery of all traffic information to third-party vendors, the state is skeptical about the prudence of that route. Private companies are typically interested in only a fraction of traveler information the state generates. And while third-party vendors have expressed a willingness to provide extensive coverage of major urban areas, they have been less interested in doing the same for rural areas. To ensure that travel information is exhaustively reported, state officials believe the DOT should continue to be involved. Exhaustive reporting is necessary to deliver personalized and locally relevant information to all drivers.

B. Iowa

Iowa, like Kentucky, is a member of the CARS Consortium. As such, the Kentucky and Iowa traveler information systems have many similarities. Because of this, the interview questions were more narrowly focused than those directed toward other DOTs. We began our interview with Iowa's state officials by asking about the strengths and weaknesses of the state's traveler information systems. A key strength is the DOT's relationship with Castle Rock, the company that designs websites and mobile apps for all of the CARS states. Iowa views Castle Rock as being very responsive and willing to update its products when requested to do so. Updates and improvements benefit not only Iowa, but all members of the consortium. State officials have confidence in Castle Rock's approach to system design and development and have been pleased with recent additions to the system (i.e., snow and ice reports). Officials did not cite any glaring weaknesses with traveler information systems. There have been slight obstacles with implementation in the past and levels of service could be expanded, but there are no major issues with the state's traveler information systems. Current work is focused on making back-end improvements, some of which will enhance public-facing system components. The state is developing an app notification feature, which will push alerts to drivers, and CARS Delay will be rolled out soon. CARS Delay (which will be available in all CARS states) can be used by travelers to identify where travel delays are likely. The feature estimates the delay's duration.

Like Kentucky, Iowa includes Waze data on its mapping applications. Iowa recently joined Waze's Connected Citizens Program, with the aim of enhancing real-time traffic information. Waze has used the state's traveler information data for two years, and officials are brainstorming new ways to strengthen integration between Waze and its websites and mobile apps. There have been preliminary discussions (which KYTC has participated in) to add snowplow data into Waze (in Iowa, this would include linking to cameras that have been installed on snowplows). During the winter of 2014–2015, the state piloted a new citizens reporting program that let participants submit reports to the DOT's website on hazardous weather conditions. State officials plan to expand that program in 2015 and also incorporate reports submitted by state highway patrols. Data received via Twitter are sometimes input into the state's traveler information systems. However, before an event appears on websites and apps, the traffic operations center must verify that an event is ongoing. After confirming an event's authenticity, the state will retweet posts related to it.

Chapter 2 discussed a recent study conducted by Iowa State University researchers that documented and analyzed traveler information system usage statistics. They recommended increasing marketing efforts to expand public awareness, and consequently, overall usage. We asked state officials about public outreach strategies, and they responded that Iowa has done a considerable amount of publicity of Iowa's traveler information systems. Three years ago, the state allocated $20,000 for a marketing campaign. This included ads in travel magazines and at rest area kiosks, press releases, and social media outreach. Radio advertisements were also used to target older drivers.

Although there is no longer a dedicated marketing budget, the state plans to opportunistically highlight its traveler information systems on social media and other low-cost platforms. It also views social media (i.e., Twitter) as a useful outlet for distributing up-to-date traffic information.

Amidst an evolving technological landscape, Iowa's state officials believe that the DOT will continue to play a critical role in getting authoritative traffic information to the public. Maintaining public-facing websites and mobile apps is instrumental for accomplishing this goal. As such, officials appeared skeptical about completely withdrawing public-facing products. Their argument is this — if the state only acts as a data facilitator that passes information to the public using data feeds, it cannot verify whether data are presented in an accurate and thorough manner. Currently, 94 entities have agreements with Iowa to use its 511 data feed. However, the terms and conditions of those agreements place minimal restrictions on how data are used. Knowing this, state officials believe it is vital to maintain an authoritative presence to ensure the reliability and veracity of traffic data — at least over data visible on Iowa's website and apps.

C. Montana

Like Kentucky, the number of phone calls received by 511 has been in a state of decline, while website visits have increased steadily. The state has developed both its website and mobile app in-house. The mobile app and interactive (i.e., high-bandwidth) website combine a Google base map with superimposed data layers that contain information on road incidents, construction, traffic cameras, and road conditions. Montana does not have a partnership with Waze, although the department of transportation (MDT) is exploring different options to implement citizen reporting. Over the short-term, the most significant change coming to Montana's traveler information systems is the inclusion of images from snowplows on the websites and mobile app. While MDT does maintain a presence on Twitter and Facebook, because the majority of state traffic occurs on rural roads, travel times and traffic incidents are less significant than in more urbanized states. Most of the reporting challenges MDT faces relate to winter weather conditions. Although MDT has promoted its travel information services through social media, press releases, and public outreaches, there has not been a large marketing campaign since 2003, when 511 first launched. There are no current plans to ramp up marketing.

Moving forward, the state has plans to overhaul traveler information services in the next 2–4 years, and MDT is currently performing a statewide assessment to identify its optimal strategy. One MDT representative felt confident that MDT, and state DOTs in general, will continue to play an authoritative role in distributing travel information. They felt that third-party vendors can provide a valuable service by packaging and adding value to data, but that it is unlikely Montana and other states would abandon their traveler information systems in the near future. While traveler information systems confer benefits to the public, Montana's representative noted that states often use travel information to assist with winter maintenance decisions and most states have integrated multiple services and technologies, including AVL, mobile data collection, and mobile decision support systems (MDSS).

D. Utah

Utah's DOT (UDOT) officials noted that although the call volumes have declined slightly in the state, they rebound during winter months, when snowstorms lead to a higher volume of accidents and produce hazardous driving conditions. Over the past five years, the number of visits to Utah's website have increased slightly. In November 2011 the UDOT's app was launched. Since then, it has been downloaded over 325,000 times. As with the phone system and website, usage tends to peak during periods of inclement weather. There also tends to be peaks around the holidays because more drivers hit the roads then. Like other states, Utah receives significant support from third-parties in developing and maintaining its traveler information systems. The state has an on-call consultant responsible for most website and mobile app development. Indeed, while the state employs some in-house developers, the state's mobile and internet platforms are predominantly supported by consultants. In October 2014 UDOT's signed an agreement with Waze. Currently, Utah submits data to Waze, and it is currently updating and improving its control room to deliver more information to Waze. While none of Utah's traveler information products integrate Waze data, there are plans to begin this process in spring 2016.

Looking ahead, UDOT plans to finish remodeling its traffic website and apps in spring 2016. This redesign will add functionality while modernizing their look and fee. Some of the key improvements Utah is making to these products are: adding freight information, developing an app tutorial, reorganizing menu items, and enhancing mapping capabilities. Along with these changes, UDOT is currently developing a social media strategy. UDOT has six Twitter accounts, with a main account including real time traveler information. Ideally, officials would like to add new personnel to oversee UDOT's social media accounts, however limited resources have prevented this from occurring. With respect to marketing, there are no ongoing programs. However, traveler information services underwent a rebranding in 2012 — from CommuterLink to UDOT. Doing so increased public recognition of the section, but it is unclear if this had any effect on usage rates. And while officials believe the state will continue to play a critical role in delivering authoritative traffic information, they are not wedded to one model of product delivery over others. UDOT is interested in getting information to the public so they can adjust their travel plans accordingly — whether this occurs through UDOT's products or external vendors (e.g., Google, Waze) is not a point of contention among government stakeholders. Indeed, officials believe there is a good possibility that the state will grow into more of a data broker, with its primary role being to manage UDOT's data stream.

E. Conclusions

The state representatives we spoke were confident that DOTs would continue to have an authoritative and central role in distributing traveler information. However, there is more uncertainty about what kind of data delivery model will provide the most benefits to travelers and DOTs alike. While representatives from Florida, Iowa, and Montana appeared to endorse state DOTs maintaining robust public-facing websites, officials in Utah expressed ambivalence, and were most concerned with drivers getting the most accurate and timely information possible — even if through a third-party vendor. All of the DOTs we had conversations with are either retooling website and mobile apps to improve their look and functionality or completely redesigning them over the next 2–3 years. It is unclear whether any of the states plan to bring more of traveler information system development in-house, but with the large number of contractors involved this seems unlikely. While there have been efforts to market traveler information systems, their ability to attract new users seems limited, although there are not reliable data on it. State-managed traveler information systems face the same limitations of third-party vendors' in that traffic coverage is limited spatially restricted areas (e.g., major interstates, highways, arterials, and urban streets). Arguably, the type of system that is implemented will vary from state to state based on each state's particular needs.

6. Conclusion

While it may be overreaching to argue that traveler information services are in a state of upheaval, they are most certainly going through a period of rapid transition. As this report has documented, the proliferation of online services — which includes those run by private companies as well as state transportation agencies — has made travel information readily available to drivers whenever they need it. There is near-universal agreement among state transportation agencies that having quickly accessible data on traffic conditions improves drivers' decision-making and can potentially alleviate congestion throughout road networks. Rehashing all the specific features inherent to different traveler information services is beyond the scope of this chapter, and readers are encouraged to consult Chapters 2 and 3 for more details.

Like other states, Kentucky has to decide what direction to take the design and development of its traveler information systems in the coming years. As our analysis of 511 phone usage data shows, there has been a sharp drop off in the number of calls received by the phone system over the past 10 years. On the other hand, visits to Kentucky's 511 websites have steadily climbed (including downloads of its iOS and Android apps) over this period, which is not surprising given consumers' preferences for digital content delivery. Our statistical analysis revealed that website visitors and calls to the 511 number spike during the winter months, when hazardous weather is a pressing concern for drivers around the Commonwealth. These trends are consistent with the observations made in other states. Although some states are currently in the midst of redesigning their traveler information systems (e.g., Utah), others plan to implement newly configured systems in the next 2-3 years (e.g., Florida, Montana). And there is still uncertainty among these state transportation agencies over the type of design and management framework that makes the most financial and operational sense. Some states have investigated strengthening their partnerships with private third-party vendors, but it is unclear whether this will entail a deeper commitment to privatizing traveler information systems. Even transportation agency officials in states that are considering a stronger role for private companies have reaffirmed their belief that DOTs will have an important function in the future — distributing and/or brokering authoritative traffic information so that drivers receive it in a timely manner.

A survey of Kentucky's drivers revealed that most depend on traditional outlets (i.e., television and radio) and online content providers (e.g., Google, Waze) to obtain information on traffic conditions. Most drivers tend to look for traffic information or driving directions when they take longer trips or select local routes they are unfamiliar with. When asked about their favored source of traffic control information, 13 percent of our respondents said governmental services, such as 511 or TRIMARC. Similarly, on a question about what sources drivers rely on during hazardous weather, just 9.2 percent of the responses mentioned 511 or TRIMARC. These findings appear somewhat consistent with those described in the Iowa State University study we reported on in Chapter 2, which revealed 70 percent of respondents in Iowa had never used or heard of 511. However, because our survey did not ask participants whether they *had ever used* Kentucky's 511 system, we cannot make a direct comparison between states. Nevertheless, even if a majority of the state's residents have heard of or used Kentucky's 511 services, it appears that drivers preferred sources for travel information are television, radio, and online services (inclusive of smartphone apps). This observation should not be construed as a normative argument about the inherent value of Kentucky's traveler information systems.

The KYTC stakeholders we spoke with regarding the future of traveler information systems were in broad agreement on a number of points. All felt that KYTC, regardless of the direction future system development takes, should continue to play a role in delivering authoritative traffic information to the public. They also observed that while traveler information systems have become more accurate over the past several years, problems remain. This is a salient point for KYTC's traveler information system because it still relies on manual data entry, which can slow down the delivery of information. All of the stakeholders we spoke with felt that the Cabinet's partnership with Waze has added value to its traveler information system, however, they also argued for improving the integration of Waze's data. Stakeholders also made a number of other suggestions for improving the Kentucky's traveler information systems, such as increasing the availability of real-time incident data on KYTC's website and mobile apps, developing measures to validate the accuracy of Waze data, ramping up efforts to distribute traffic data to third-party vendors, conducting marketing campaigns to increase drivers' knowledge of available systems, and working to enhance the quality of the Cabinet's public-facing products.

As we noted at the outset, the purpose of this report has been to synthesize information about traveler information systems — both those maintained by state transportation agencies and those developed by third-party vendors. Our goal is not to advance suggestions about reimagining Kentucky's traveler information systems. However, with this report's information in hand, we are confident that the Cabinet will be able to deliberate pragmatically as it decides on an appropriate path for the future of its traveler information systems.

Appendix A 511 Study — KYTC Stakeholder Interview Questions

Question 1 — What is your role in the 511 program at KYTC?

Question 2 — Can you explain how 511 information is currently distributed in Kentucky?

Question 3 — Do local radio and television stations (or other outlets) rely on 511 information for any part of their traffic reporting?

Question 4 — What do you think are the strengths of the methods Kentucky *currently* uses to distribute traffic information?

Question 5 — What do you think are the weaknesses of the methods Kentucky *currently* uses to distribute traffic information?

a. Are there any states that you consider exemplarily in their delivery of 511 information?
b. If so, which states; what makes their programs stand out?

Question 6 — Should some pieces of information be distributed differently because they are better suited to a particular delivery method (now and in the future)?

Question 7 — Earlier this year the Cabinet and Waze (a mobile app that drivers can use to share and obtain traffic information) formalized a partnership. How does this partnership work?

a. Does the Cabinet use information acquired from Waze users to update its 511 system?

Question 8 — What changes do *you* think the state could make to improve the distribution of 511/traveler information in the future?

a. More generally, how do you anticipate the traffic information delivery evolving in the future (e.g., over the next 5–10 years)?

Question 9 — What are the 511 program's main source of funding?

a. Do you envision funding sources changing in the future?
b. Will these changes be related to the evolving nature of traffic information delivery and consumer demand?

Question 10 — What performance measures does the Cabinet use (or that you think would be appropriate to use) to gauge the success of Kentucky's 511 service?

a. How much use does the 511 service receive? (S)
    a. For example, number of phone calls, web page hits, app download figures and use statistics, and people signed up for email/text alerts.

Question 11 — What costs (one-time and ongoing) does the Cabinet shoulder to provide the 511 service? (S)

Question 12 — Are you aware of other travel information services available to the public?

Question 13 — Can you share with us how the information is gathered and shared with the public? (S)

(S) – Denotes a Specific question that may be asked to only some of the stakeholders

Appendix B — Sample Questions Asked of Other DOT Stakeholders

The questions we asked representatives from other state DOTs varied. We adjusted our core questions based on the features of individual state traveler information systems. However, all of the states received a questions that were thematically similar and attempted to elicit the same content. The questions listed below were presented to a representative from Utah's DOT.

- From 2004 to 2014, the number of phone calls made to Kentucky's 511 system fell approximately 60%. Has Utah experienced a comparable drop in call volume?
- Kentucky has seen the number of visits to its 511 websites gradually increase over the past 5 years. Have visits to Utah's websites (and mobile apps) increased, decreased, or held steady over the past 5 years?
- Does Utah DOT perform all website and mobile app development in-house, or is any portion contracted out to third-party vendors?
- Kentucky has partnered with Waze through its Connected Citizen Programs, and now integrates Waze data into its online maps and mobile apps. Does Utah plan to integrate Waze-generated information into its systems in the future?
- What design/operational changes are planned for Utah's travel information systems' outward-facing components over the next 2-3 years (website, mobile apps)?
- Utah's DOT has an active presence on social media (e.g., the @UTAHDOTTRAFFIC Twitter account, which data are integrated into the 511 mobile app). Where does social media into the state's long-term 511 strategy?
- Has the state conducted marketing campaigns to increase awareness about its travel information systems? If so, was there an increase in website visits or downloads/use of Utah's DOT's mobile app following this campaign?
- Do you think that states will continue to play an important role in maintaining public-facing websites that make travel information available to the public?
    - Moving forward, what role do you see third-party vendors having in the dissemination of travel information?
    - What do you think are the major limitations of websites and apps developed and operated by third-party vendors?

- Are there any other thoughts you'd like to share on Utah's DOT's current travel information systems?

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