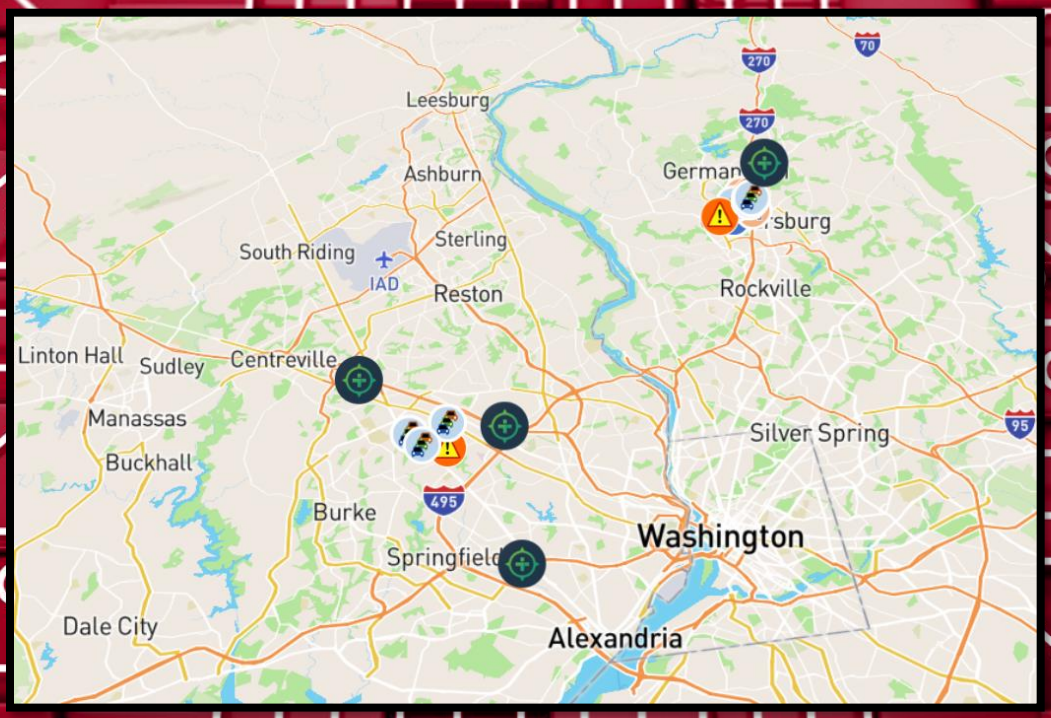

QuickRoute Mobile App and ECC

Operational Field Assessment Report

March 2021

Homeland Security
Science and Technology

NUSTL®
NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY

Approved for Public Release

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FOREWORD

The National Urban Security Technology Laboratory (NUSTL) is a federal laboratory organized within the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T). Located in New York City, NUSTL is the only national laboratory focused exclusively on supporting the capabilities of state and local first responders to address the homeland security mission. The laboratory provides first responders with the necessary services, products, and tools to prevent, protect against, mitigate, respond to, and recover from homeland security threats and events.

DHS S&T works closely with the nation's emergency response community to identify and prioritize mission capability gaps, and to facilitate the rapid development of critical solutions to address responders' everyday technology needs. DHS S&T gathers input from local, tribal, territorial, state and federal first responders, and engages them in all stages of research and development—from building prototypes to operational testing to transitioning tools that enhance safety and performance in the field—with the goal of advancing technologies that address mission capability gaps in a rapid time frame, and then promoting quick transition of these technologies to the commercial marketplace for use by the nation's first responder community.

As projects near completion, NUSTL conducts an operational field assessment (OFA) of the technology's capabilities and operational suitability to verify and document that project goals were achieved.

NUSTL's publicly released OFA reports are available at www.dhs.gov/science-and-technology/frg-publications. OFA reports deemed sensitive are available on a case-by-case basis, and can be requested by contacting NUSTL@hq.dhs.gov.

Visit the DHS S&T website, www.dhs.gov\science-and-technology\first-responder-technologies, for information on other projects relevant to first responders.

Visit the NUSTL website, www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory, for more information on NUSTL programs and projects.

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EXECUTIVE SUMMARY

First responders often use commercially available navigation software applications (apps) such as Google Maps or Waze when responding to emergency situations. However, these commercially available vehicle routing technologies abide public rules of the road from which first responders at times may be exempt. By using the same apps as the general public, first responders are not provided alternate routes that could allow for quicker response to an incident, such as using express lanes, travelling an alternate direction down a one-way road or using emergency access roads.

To provide responders with an option for more efficient routes that take into account their unique considerations during an emergency response, the U.S. Department of Homeland Security's (DHS) Science and Technology Directorate (S&T) awarded a contract to Azimuth1, LLC, to develop QuickRoute. This technology leverages existing navigation platforms and databases while customizing options specifically for first responders in order to calculate the most effective routes for emergency vehicles.

The National Urban Security Technology Laboratory (NUSTL) conducted an operational field assessment (OFA) of QuickRoute on April 10, 2019 to evaluate the technology's suitability for use by first responders and gather feedback on functionality, reliability, usability, routing and hazard alert features. This information was shared with Azimuth1, LLC and used to enhance the QuickRoute Mobile App and incorporate a dispatch function, the QuickRoute Emergency Command Center (ECC). NUSTL conducted a second OFA between September 18 – 25, 2020 focusing on assessing changes to operational experience, usability, routing and hazard mitigation. This OFA was conducted in both operational and virtual environments with four first responder evaluators from Maryland and Virginia.

Much of the feedback obtained from the first OFA was utilized to enhance the QuickRoute Mobile App. This included adding audible turn-by-turn directions, adding a method for indicating whether the user is in civilian or emergency mode, automatically transitioning the display between day and night maps based on environmental settings, enhancing routing by improving vehicle directional orientation, and allowing users to create and save customized vehicles. During the second OFA, additional feedback was provided including incorporating more descriptive audible directions (e.g., improve notifications of upcoming turns, lane placement indicators and exit numbers for highway use), and how to further hands-free operation by incorporating a mechanism to verbally confirm or clear alerts, improve notifications of upcoming turns, lane placement indicators and exit numbers for highway use, and how to further hands-free operation by incorporating a mechanism to verbally confirm or clear alerts.

Evaluators found the ECC to be useful and intuitive as it provides a visual display of all QuickRoute Mobile App users including their name, destination and availability for a response call. Evaluators suggested enhancements to improve the efficiency of the ECC including labeling or color coding icons to assist dispatchers in easily identifying users and adding confirmation notifications for both the successful transmission of the push notification as well as when the receiving user begins routing to the incident.

While the evaluators provided recommendations on how to further enhance both the QuickRoute, ECC and Mobile App, they determined that the current technology could enhance response activities.

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1.0 INTRODUCTION

Computer-aided dispatch (CAD) systems are used by public safety agencies to assign appropriate emergency response units (fire service, law enforcement, emergency medical services) to incidents as they occur. Vehicle-mounted route mapping systems are typically available to emergency response units to navigate to incidents. Discussions at the 2016 First Responder Resources Group (FRRG) Meeting revealed that many first responders use commercially available mapping software applications such as Google Maps on their cell phones to route themselves to incidents, rather than traditional Automatic Vehicle Location (AVL) systems. Responders cited the ease of use and availability, as well as the greater frequency of map updates on the cell phone applications as reasons for this preference. However, commercially available street routing technologies abide by the public rules of the road which first responders are not always subject (per jurisdictional guidance). When using the same applications as the general public, first responders are not presented with alternative navigation routes such as accessing private property, express lanes or emergency access roads; alternate directions down a one-way road; or using public transit access points (e.g., driving in a bus lane) that would likely facilitate a quicker response to an incident.

In addition to relying on commercially available navigation apps, first responders familiar with an area may rely upon their personal knowledge of transit schedules (e.g. trains, drawbridges) and regular traffic patterns (which may vary based on time of day, day of week or holidays) to maneuver to or from an incident as quickly as possible. However, delays or changes in normally expected schedules due to motor vehicle accidents, natural disasters, or road closures cannot be accounted for using knowledge from prior experiences.

To address these issues and improve responder vehicle navigation, the Department of Homeland Security's (DHS) Science and Technology (S&T) Directorate awarded a contract to Azimuth1, LLC to develop a solution. The result, QuickRoute, has two components. The first, QuickRoute's Mobile Application (hereafter, the App), enables responders to take the most efficient route that is uniquely available to them when using an emergency vehicle and responding to an emergency situation. This technology leverages existing platforms and databases while customizing options for first responders to calculate the best route for emergency vehicles. The second component is the QuickRoute ECC, which has dispatch functionality to push information about emergency situations and road outages to response vehicles.

The National Urban Security Technology Laboratory (NUSTL) conducted an operational field assessment (OFA) of QuickRoute in April 2019 that evaluated the technology's suitability for use by first responders. A second OFA, which was conducted in virtual and individual operational environments between September 19 – 25, 2020, focused on assessing those changes made to QuickRoute based on first responder feedback received during the first OFA (note that the second OFA did not assess the App's emergency routing functionality). This OFA report describes responder feedback obtained during simulated operational activities first responders may encounter when responding to an emergency situation.

1.1 Purpose

The purpose of the OFA was to assess QuickRoute's operational suitability for responders using a simulated operational environment.

1.2 Objectives

The objective of this OFA is to evaluate QuickRoute's operational suitability. The OFA assessed:

- Reliability of navigation, including deciphering vehicle direction/directional orientation
- Ability for state by state scalability
- Functionality of hands-free operations, including voice activation
- Capability for emergency vehicle customization, including the ability to route responders while taking into account limiting emergency vehicles characteristics
- Effectiveness of alert features, including ease of entering, confirming or removing obstacles, the timeliness of notifications and the display method (hierarchical view)
- Usability while responding, ease of use of screen, ability to compare provided route with an alternate route
- Capability of QuickRoute ECC to send real-time push alerts for navigation requests and alert notifications
- Ease and accuracy of QuickRoute ECC for locating and reporting the status of QuickRoute Mobile App users

1.3 Participants

Table 1-1 lists the OFA participant affiliations. Four evaluators from four different organizations participated, along with assessment team members, the technology developer and observers.

Table 1-1 OFA Participants

Role	Organization
Evaluators	• Fairfax County Fire and Rescue Department (Virginia) • Loudoun County Fire and Rescue (Virginia) • Montgomery County Fire and Rescue Service (Maryland) • Silver Spring Volunteer Fire Department (Maryland)
Program Managers and Support Staff	DHS S&T
OFA Lead and Data Collectors	DHS S&T NUSTL
Technology Developer	Azimuth1, LLC
Observers	DHS S&T

1.4 REQUIREMENTS

Table 1-2 summarizes the requirements that QuickRoute was expected to achieve and the way in which those requirements were tested during the OFA. The requirements were drawn from the *First Responder Routing Logic Guide Statement of Objectives* document [1] as well as a contract modification following the first OFA, both of which identify critical capabilities for optimal functionality.

Table 1-2 QuickRoute Requirements and Activities Matrix

Category	Requirement	Test Method
Functionality and Reliability	Capable of working on a mobile device	• Evaluators were provided access to QuickRoute on their iOS mobile devices by Azimuth1 for testing purposes. The mobile devices were used for navigation when responding to a simulated incident to test usability of the app during the scenarios. QuickRoute Mobile App was downloaded to the devices prior to the start of the OFA. • A Technology Familiarization session occurred virtually. Azimuth1 ensured the QuickRoute Mobile App was operational.
	Demonstrate state by state scalability	• Information provided and demonstrated by Azimuth1 during the Technology Familiarization session by demonstrating a sample set. • Scalability was explored by evaluators who performed simulated operational scenarios in their respective state.
	Allow for hands free operations/voice activated	• Evaluators tested the app to verify voice activation for accessing the app and for turn-by-turn routing. This included activating the app from the home screen (i.e. “Hey Siri, Open QuickRoute”) and speaking an address or destination name to be routed to. • Evaluators tested QuickRoute’s ability to provide audible turn-by-turn routing with notices of upcoming turns and alerts that allow for appropriate response times while driving the operational scenarios.
	Live tracking of nearby emergency vehicles	• This feature is not available as it has not been fully developed. It was not evaluated in this OFA.

Category	Requirement	Test Method
Emergency Vehicle Selection	Display and calculate physical vehicle properties	• Information on how to select vehicle type, enter vehicle properties, and view vehicle properties was provided and demonstrated by Azimuth1 during the Technology Familiarization session.
Efficient Emergency Routing	Incorporate direction of travel for better routing suggestions. Include direction of travel preference in routing suggestion rules.	• Throughout the operational scenarios, evaluators noted whether QuickRoute provided routing options, minimized the number of U-turns and deciphered vehicle direction/directional orientation.
	Alternate routing should account for emergency vehicle size and weight.	• Prior to driving, the evaluators opened the app, selected their vehicle type, entered or viewed the vehicle properties of their current selection, and then viewed the route. Once that route was viewed; the evaluator changed the vehicle selection or properties of the vehicle and viewed the route again to determine if the routes vary to accommodate size and weight changes.
Dispatch	Ability to push notifications from QuickRoute ECC to the mobile app	• Evaluators also served as dispatch and sent a request to another evaluator to navigate their vehicle to a destination via push notification to the mobile app. In some instances NUSTL served as dispatchers. • Evaluators confirmed relay of information and then used the mobile app to navigate to provided destination.
	Ability to add, store and activate alerts from QuickRoute ECC	• NUSTL staff and evaluators added alerts, stored them, and then activated outages. • Evaluators confirmed visibility of alerts injected via the QuickRoute ECC.
Hazard Alert (Confirm/Clear)	Users can confirm and clear reported alerts in real-time and view them in a hierarchical manner	• Evaluators viewed alerts in real-time (ensured that they were not lagging and sorted hierarchically by type) and confirmed and cleared one or more outages from the area map.

1.5 System Description

QuickRoute is a real-time routing and navigation tool comprised of a server component, a dispatch application, and a mobile application available on iOS platforms (see Figure 1-1) that can be run on mobile devices and mobile data computers mounted in vehicles.

QuickRoute's system architecture includes back-end routing services through Amazon Web Services (AWS) and Google Firebase for the user login and push notifications.

The system leverages existing platforms and databases, while customizing options for emergency response needs by calculating the best routing option for emergency vehicles based on traffic and road conditions. Route optimization accounts for responder and emergency vehicle-specific factors, including:

- Emergency traffic law exceptions afforded to law enforcement, fire and emergency medical services vehicles
- Department-level protocols for handling vehicle usage
- Size and weight restrictions of emergency response vehicles
- Specific emergency vehicle requirements for turning radius, tunnel and bridge clearance, and highway exiting.

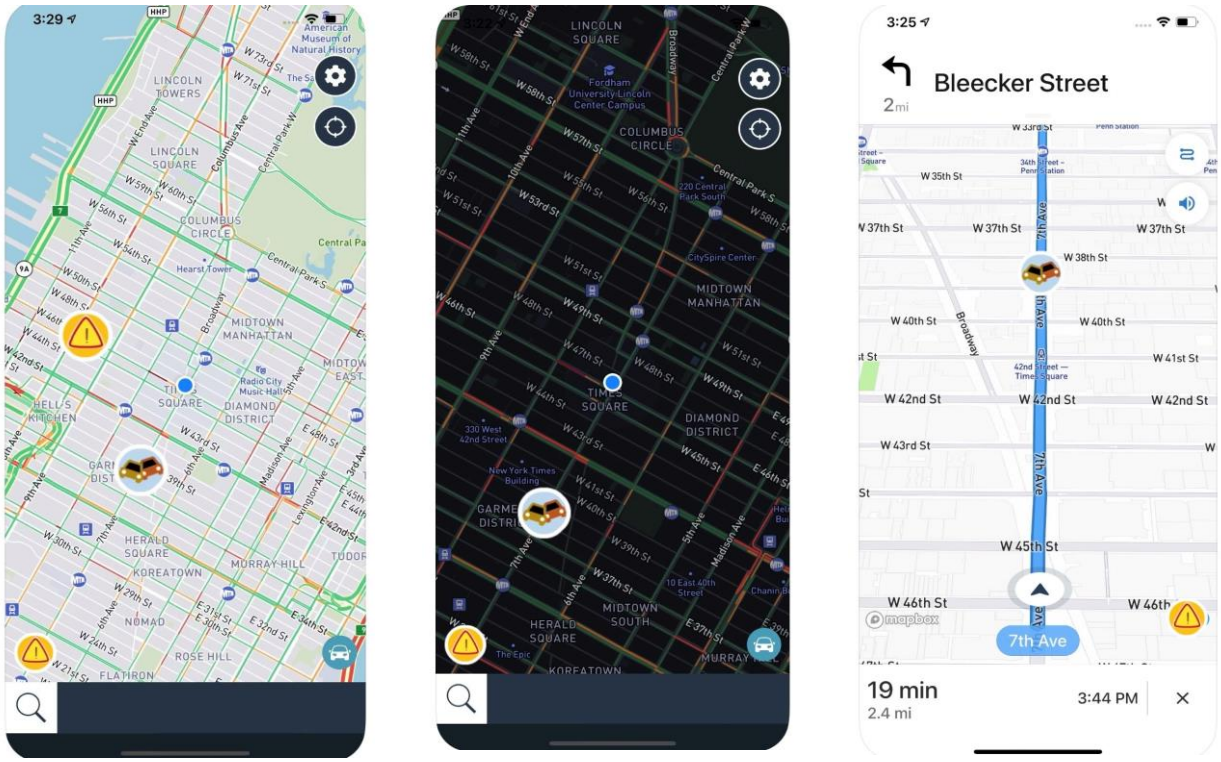

Figure 1-1 QuickRoute Navigation Displays
Courtesy of Azimuth1, LLC

QuickRoute's ECC allows users to operate as dispatchers. This web-based application can be used by public safety answering point dispatchers to send destinations to QuickRoute Mobile App users in their enterprise workgroup via push notification (See Figure 1-2). Dispatchers can see the location and availability of the mobile app users, and enter, clear or extend the duration of alerts.

QuickRoute can also generate usage reports that provide information about the time savings, advantages and disadvantages of chosen routes, and the usability of those routes in the future.

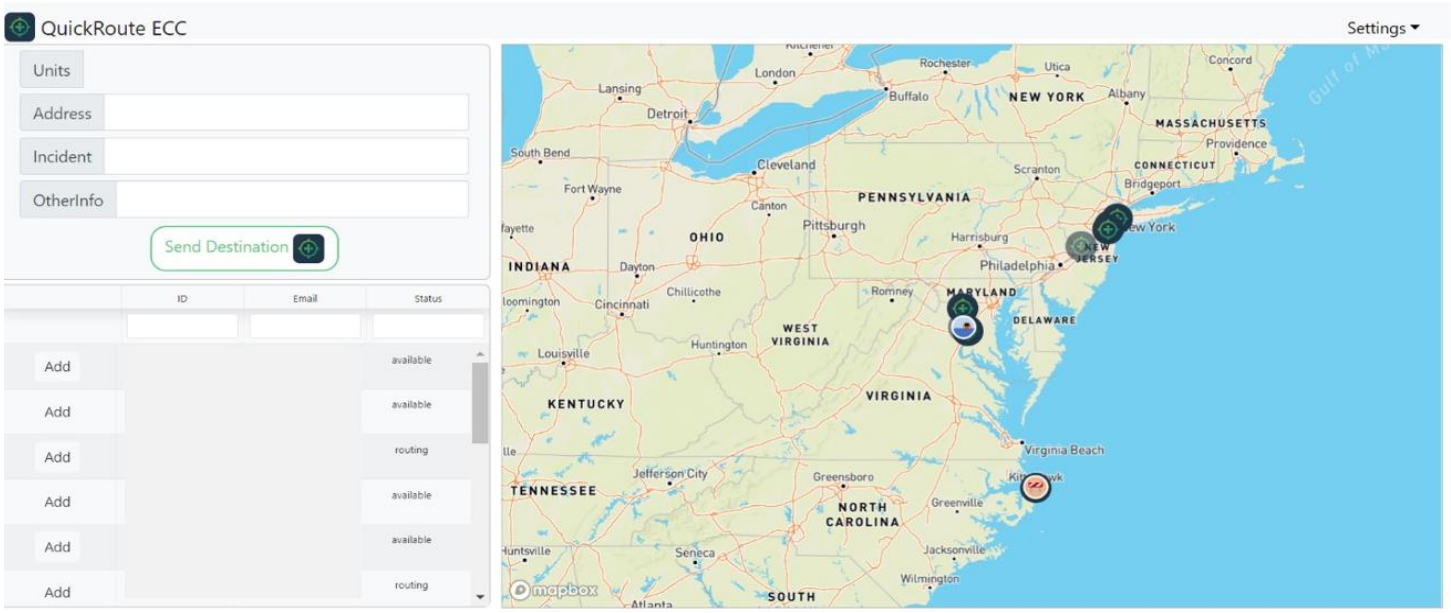

Figure 1-2 QuickRoute ECC Display

2.0 OPERATIONAL FIELD ASSESSMENT DESIGN

2.1 Event Design

During this OFA, four responders from fire service and emergency medical service disciplines in Maryland and Virginia served as evaluators to assess the functionality, capability, and usability of the QuickRoute Mobile App and ECC in response scenarios. The OFA was conducted in virtual and individual operational environments, where evaluators participated in various activities using the QuickRoute Mobile App on iOS mobile devices and QuickRoute ECC via computers or tablets.

The programmatic and project overviews, as well as the Technology Familiarization session were conducted via a web-platform (Microsoft Teams). Following these sessions, evaluators transitioned to their vehicles to begin the response scenarios using the QuickRoute Mobile App for navigation. Additionally, evaluators had the opportunity to use the QuickRoute ECC. Each evaluator was paired with a team of NUSTL data collectors who facilitated test activities via Microsoft Teams, recorded observations and comments during each activity, and used a questionnaire to gather feedback from each evaluator following the completion of all activities in a scenario. Following the completion of the operational scenarios, a group debrief was held to solicit additional feedback from the evaluators.

2.2 Scope

The OFA consisted of the following components:

2.2.1 Introductory Session

During the introductory session, NUSTL provided participants with an overview of the OFA process and the planned activities for the day. Additionally, the DHS S&T Program Manager provided information on how the capability gap was identified and the evolution of the project.

2.2.2 Technology Familiarization

Azimuth1 provided an overview of QuickRoute's Mobile App and the ECC that included background on the development of the technology and an operational familiarization session. Evaluators were able to see the QuickRoute Mobile App and ECC in use via screen sharing.

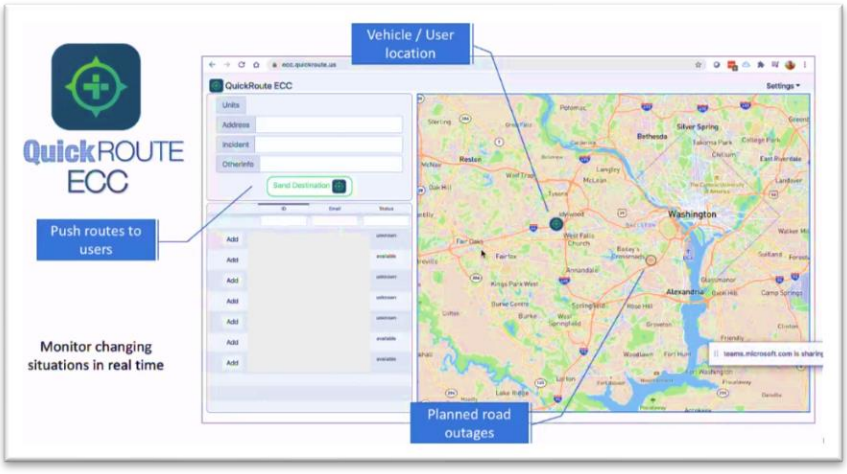

Figure 2-1 QuickRoute ECC presented by Azimuth1 during the Technology Familiarization Session

2.2.3 Assessment Activities

After the familiarization session, evaluators performed the activities listed in Table 2-1. Each evaluator worked simultaneously while a NUSTL data collector facilitated the activities via Microsoft Teams. After completing the activities for each scenario, evaluators provided direct feedback in response to questions from NUSTL data collectors. NUSTL data collectors also noted any candid feedback and comments during the activities. Full details of the event design are described in the QuickRoute Mobile App and ECC Operational Field Assessment Plan [2].

Table 2-1 Assessment Activities

Activity Title	Activity Description	Purpose
Fire Response	Evaluators select a ladder truck as their transport mode and navigate to a simulated kitchen fire.	Assess the app's ability to rely on hands-free operation, select transport mode, perform point-to-point routing based on vehicle properties, automatically reroute, and confirm and clear user-generated alerts.
Medical Response	Evaluators select an ambulance as their transport mode and navigate to a simulated overdose.	Assess the app's ability to rely on hands-free operation, select transport mode, perform point-to-point routing based on vehicle properties, automatically reroute, and confirm and clear user-generated alerts.
Dispatch – Water Main Break	Evaluators use the ECC to enter alerts and send a push notification for dispatch response.	Assess the ECC's ability to check locations and statuses of QuickRoute Mobile App users, enter alerts and guide evaluators to a specified location using navigation push notifications.
Response – Water Main Break	Evaluators create a custom vehicle within the transport mode menu and navigate to a simulated water main break.	Assess the app's ability to receive push notifications, customize vehicle physical properties, perform point-to-point routing based on vehicle properties, viewing alert display, and confirm and clear ECC-generated alerts.

2.2.4 Debrief

NUSTL's QuickRoute OFA project lead facilitated a debrief session at the conclusion of all activities with all OFA participants via Microsoft Teams. During this session, evaluators shared overarching feedback on both the Mobile App and the ECC, and had an opportunity to elaborate on their ratings.

2.3 Limitations of and Deviations from the Test Plan

2.3.1 Limitations

The COVID-19 pandemic impacted the design and execution of the OFA. This included limitations on travel that prevented the OFA from occurring in a single location with all participants physically present. As such, the OFA was conducted in both virtual and individual operational environments. This resulted in varying driving conditions and environments, limited the number of subject matter expert observers from participating, eliminated the inclusion of photography or videography elements, reduced the responders' opportunities for networking, and prevented evaluators from using the QuickRoute Mobile App in emergency response mode since a closed venue was not used.

2.3.2 Deviations

Several deviations from the QuickRoute Operational Field Assessment Plan [2] were necessary:

Multiple OFA Sessions

In order to accommodate first responder schedules, the OFA was conducted in two sessions, one week apart. Each session allowed two evaluators to assess the QuickRoute Mobile App and the QuickRoute ECC.

Schedule Modifications

Based on the experience of the first OFA session, the OFA plan was adjusted to reduce the time for overview presentations and the familiarization session. Additionally, the Dispatch – Water Main Break scenario was modified to a tabletop exercise in order to make better use of the first responders' time.

Based on first responder availability, the schedule rotations were modified so that evaluators performed the Fire and Medical Response scenarios simultaneously. This change ensured enough time for the paired Dispatch and Response activities for the Water Main Break scenario.

Purposeful Rerouting

In order to assess the QuickRoute Mobile App's ability to reroute in real-time, data collectors suggested evaluators purposefully make a wrong turn during the Medical Response and Fire Response scenarios.

3.0 RESULTS

This section contains the evaluators' responses to questionnaires and feedback given in group discussions. Evaluator suggestions for enhancements to the ECC and the Mobile App are highlighted, as well as feedback on additional areas for innovation that may improve functionality. Organized by component, this part of the report includes sections on operational experience, usability, routing and hazard mitigation as well as opportunities for improvement.

The questionnaire was structured so that evaluators selected a response of strongly agree, agree, neutral, disagree or strongly disagree to a statement and provided an opportunity for comments to explain their selection for each of the four scenarios (Fire Response, Medical Response, Dispatch – Water Main Break, and Response – Water Main Break). The neutral response was given as an option when the evaluator did not have a strong opinion, either way, about the given statement. The statement posed to the evaluators appears above the graph and the response options are listed in the key. There is a total of four possible responses per scenario, one for each evaluator.

3.1 QuickRoute ECC

3.1.1 Operational Experience

QuickRoute Mobile App users are identified by a QuickRoute icon within the ECC, as shown in Figure 3-1. All evaluators either strongly agreed or agreed that they were able to check the location of QuickRoute users. Evaluators suggested incorporating labeling or color coding the icons in order to assist dispatchers in identifying users, noting that there will typically be dozens of emergency response units available for dispatch. Being able to identify information such as username and availability at the map level could increase efficiency and result in a quicker response time than instead of hovering over each icon for user information.

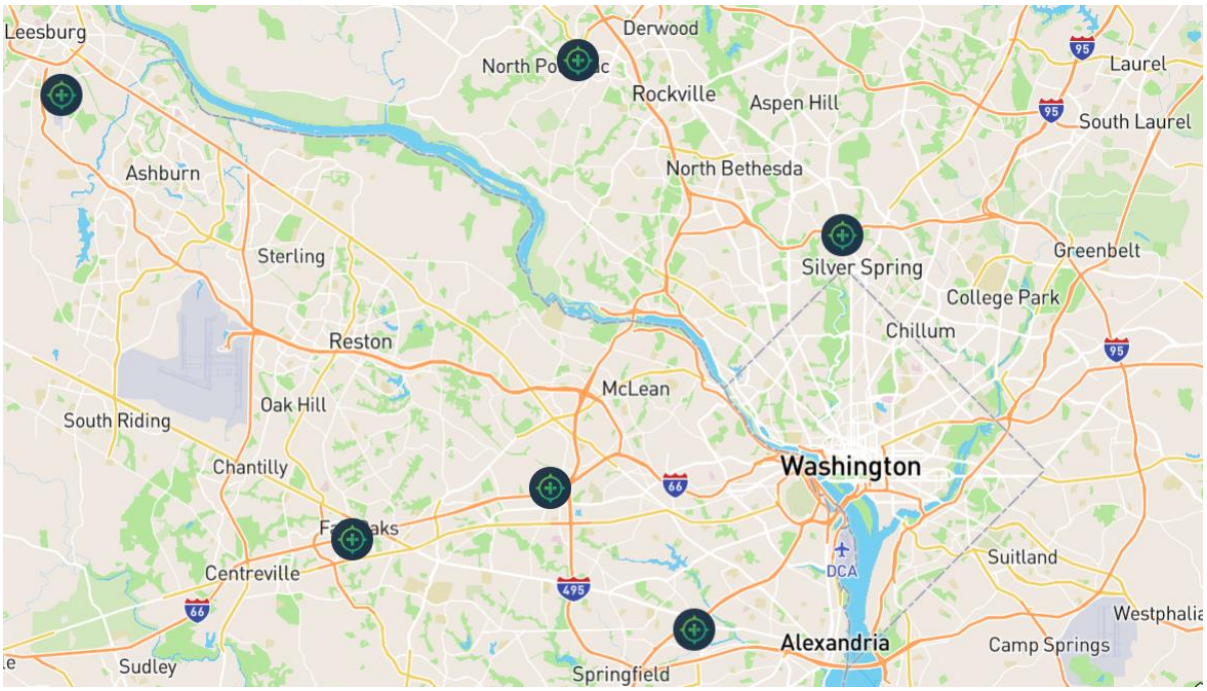

Figure 3-1 QuickRoute Mobile App User Icons Visible in the QuickRoute ECC

3.1.2 Usability

All evaluators strongly agreed that they were able to check the status of QuickRoute Mobile App Users. This information is available in a table format as shown in Figure 3-2 (note that some information has been redacted to ensure anonymity). This table can be searched and sorted by ID, e-mail or status labels indicating this functionality would enhance the user experience. The evaluators stated that in addition to the table of QuickRoute Mobile App users, a table or dashboard of alerts would be useful.

Additionally, all evaluators strongly agreed they could push a routing notification from the ECC to QuickRoute Mobile App users but would have preferred to be able to transmit details aside from the address to the Mobile App users. Evaluators suggested adding confirmation notifications for both the successful transmission of a push notification as well as when the receiving user begins routing to the incident.

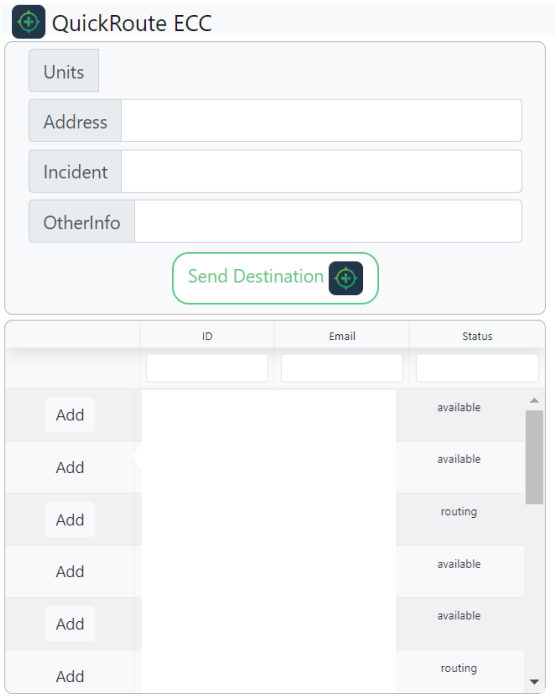

Figure 3-2 QuickRoute ECC Display of QuickRoute Mobile App User Status

In order to further enhance the usability of the QuickRoute ECC, evaluators also suggested incorporating the ability to identify the users nearest to an incident or response destination and the ability to add road closures alerts.

3.1.3 Routing

All evaluators either strongly agreed or agreed that they were able to easily inject an alert from the ECC. One evaluator noted a slight delay in the alert displaying which could be attributed to internet connection speeds.

When asked if they were able to see when an alert was confirmed by a user, the evaluators' had varied responses: two strongly agreed, one was neutral and one disagreed. The evaluator who disagreed indicated that there was not a pronounced way to see that the alert was confirmed and suggested incorporating a notification within the ECC when alerts are confirmed.

3.1.4 Opportunities for Improvement

The evaluators' recommendations to enhance the design and function of the ECC are summarized here:

Operational Experience

- Incorporate labeling or color coding to the icons in order to assist dispatchers in identifying users

Usability

- Label the user table indicating search and sort functionality for ID, E-mail and Status to enhance the user experience
- Incorporate an alerts table or dashboard
- Display app user distances to allow ECC users to identify the closest users to an incident or response destination
- Add confirmation notifications to the ECC for the successful transmission of a navigation push notification as well as when the receiving user begins routing to the incident
- Add the capability for ECC users to identify and add road closures to increase routing efficiency
- Incorporate the ability for ECC users to transmit details aside from an incident address to the Mobile App users

Routing

- Include an acknowledgement of alerts being confirmed to enhance the user experience. Currently, if a user hovers over an alert, the ECC displays the minutes remaining until the alert's expiration. This is the only way to identify a change – this takes into account knowing when an alert was initially added. Upon entry, alerts have a duration of 120 minutes. When there is confirmation of an alert, it increases the remaining time of the alert by another 120 minutes (e.g., if an alert is set to expire in 60 minutes and a user confirms it, the alert will then show as expiring in 180 minutes).

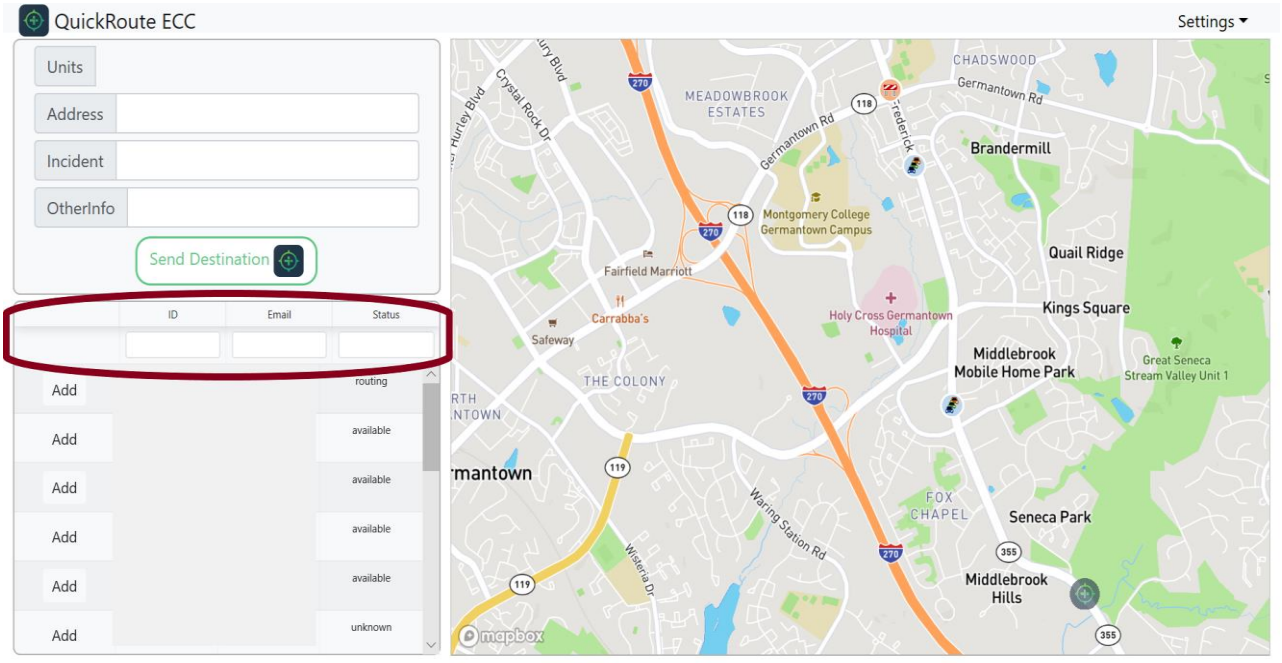

Figure 3-3 Circled Area Highlighting Suggested Area for Labeling in the ECC User Table

3.2 QuickRoute Mobile App

3.2.1 Operational Experience

To start the Fire and Medical Response scenarios, evaluators were asked to utilize the voice-activation feature to open the QuickRoute Mobile app. The majority of the evaluators strongly agreed that they were able to open the app using voice activation. One evaluator strongly disagreed as they were unable to open the app using voice-activation. NUSTL and Azimuth1 worked to troubleshoot the issue with the evaluator and determined that voice-activation, in this case Siri, will not activate when an iPhone is paired to Bluetooth in a vehicle. Once the Bluetooth was disabled the voice-activation was successful.

3.2.2 Usability

Evaluators were asked to use voice-activation to enter at least one destination during the Fire and Medical Response scenarios. The majority of evaluators either strongly agreed or agreed that they could use voice activation to enter a destination. One evaluator strongly disagreed because the app crashed the first time voice-activation was attempted. Evaluators found the app to be sensitive to the syntax used to indicate a building's number (e.g. stating an address of one-two-three Main Street vs. one-twenty-three Main Street). The app routed one evaluator to the correct street but not the intended address. Incorporating more of the most common ways of stating the numbers in an address would help mitigate this issue.

At the start of each scenario, evaluators were asked if they were able to toggle intuitively between route options. Only one route was available for each destination entered resulting in this question being interpreted differently by evaluators. Two evaluators interpreted the question as whether or not the app would reroute them if they deviated from the prescribed route. Those evaluators either strongly agreed or agreed that the app would reroute them if they went off course. One evaluator thought the question referred to navigating within the app (e.g., going from turn-by-turn to overview, etc.) and did not find moving between those options intuitive. One evaluator provided a response of not applicable because only one route option was provided.

During the Fire and Medical scenarios evaluators were asked to use audible turn-by-turn directions while navigating, an enhancement that developers made based on recommendations from the previous OFA. All evaluators either strongly agreed or agreed that they were satisfied with QuickRoute's ability to provide audible turn-by-turn directions. However, one evaluator noted there were too many pre-turn warnings and estimated distances to turns were inconsistent. Another evaluator suggested standardizing frequency of warnings for upcoming turns, starting them around 0.25 miles before and then immediately before a turn (which would result in three warnings). Other suggestions called for incorporating more descriptive audible directions including lane placement (e.g., stay in the right or center lane) as well as an audible message when approaching the final destination (e.g., your destination is on the left). An evaluator also suggested displaying the full destination address upon arrival and automatically transitioning the map to satellite view when arriving on scene to allow mobile users to clearly see surrounding areas.

All of the evaluators also strongly agreed that they could manually enter destinations in the app. One evaluator suggested adding the ability to enter the name of a location instead of an address and increasing the font size while searching for addresses (while typing characters the font size was sufficient, but the listed addresses for selection were too small).

All evaluators either strongly agreed or agreed that they were able to customize the settings to their vehicle specifications (i.e., length, width, height and weight). However, one evaluator found it difficult to follow which parameter was being changed when selecting the field to enter text, the display shifts upward to show the keyboard; this movement prevents users from seeing the data field while information is being entered.

Another evaluator indicated that their jurisdiction expresses the speed over the limit permitted by miles per hour. Currently the QuickRoute Mobile App only allows for adjusting this setting by percentage; the evaluator suggested offering the option of both.

3.2.3 Routing

To begin the Fire and Medical Response scenarios evaluators were asked to select a civilian vehicle, enter the response address, then review and screenshot the route identified within the QuickRoute Mobile App. The evaluators then changed their vehicle type – either by selecting a preset vehicle or creating a customized vehicle – and again entered the response address, viewed, and took a screenshot the identified route.

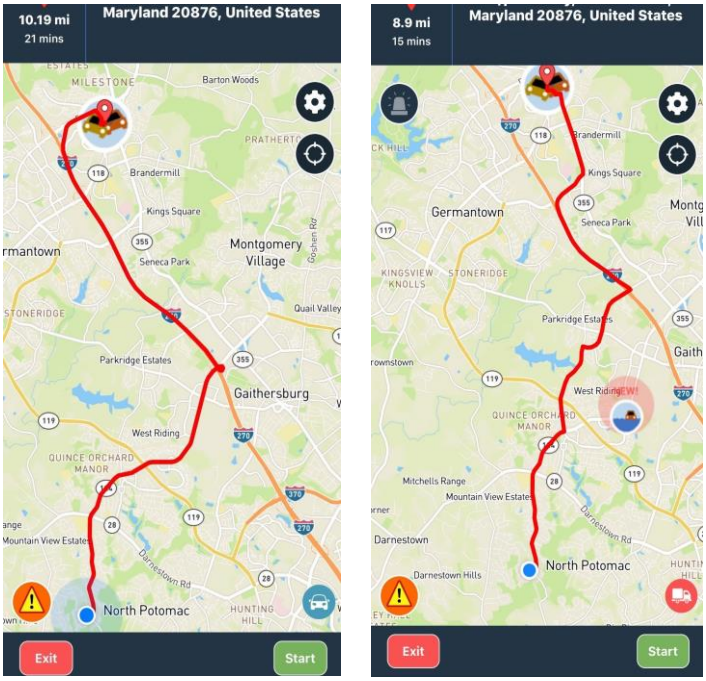

Figure 3-4 Comparison of Civilian (L) vs. Emergency Routes (R)

Figure 3-4 shows comparative routes for the Medical Response Scenario. On the left is the route for the civilian vehicle with a mileage of 10.19 miles and a duration of 21 minutes. The image on the right is for an emergency vehicle, identifiable by two visual indicators: an emergency light icon in the upper left corner (below the mileage and duration) and a red vehicle icon in the bottom right corner (above the start icon). The emergency route's mileage is 8.9 miles and a duration of 15 minutes.

While using the emergency vehicle route, one evaluator said they were routed to a very busy roadway: they opted to make a turn onto a less busy roadway instead, noting that responders often prefer two-lane roads (over a single lane) and roadways with fewer intersections. Additionally, there were instances where an evaluator expressed doubt that identified routes would be used by first responders in large emergency vehicles such as a fire truck due to the recommended roadway's characteristics (e.g., narrow, winding).

During the Dispatched Response Water Main Break Scenario evaluators were sent push notifications from the ECC, alerting them of the incident. A sample push notification display in the QuickRoute Mobile App is shown in Figure 3-5. All evaluators strongly agreed that after they acknowledged a push notification navigation, the app provided instructions to the incident address.

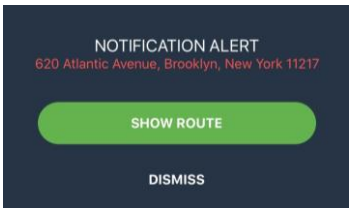

Figure 3-5 Sample Push Notification Alert on the QuickRoute Moble App

3.2.4 Hazard Mitigation

When asked if they were properly rerouted during responses all evaluators strongly agreed, agreed or were neutral for the Fire Response Scenario. One evaluator identified that rerouting did not occur for new alerts and another indicated they were able to drive through the alert locations. Evaluators suggested incorporating the ability to differentiate between alert types or levels (e.g., critical, impassable) and display alert impacts (e.g., if rerouting is required, how much travel time it will add to reaching the destination). Additional suggestions included adding auditory notifications when approaching an alert and when a new alert is reported, and increasing the size of alert icons to increase the visibility while appearing on a route as well as the ability to see the type of alert the icon represents.

During the Medical Response Scenario, one evaluator disagreed when asked if they were properly rerouted during the response. There were instances where evaluators were not rerouted when an alert was injected once their drive to the medical incident began.

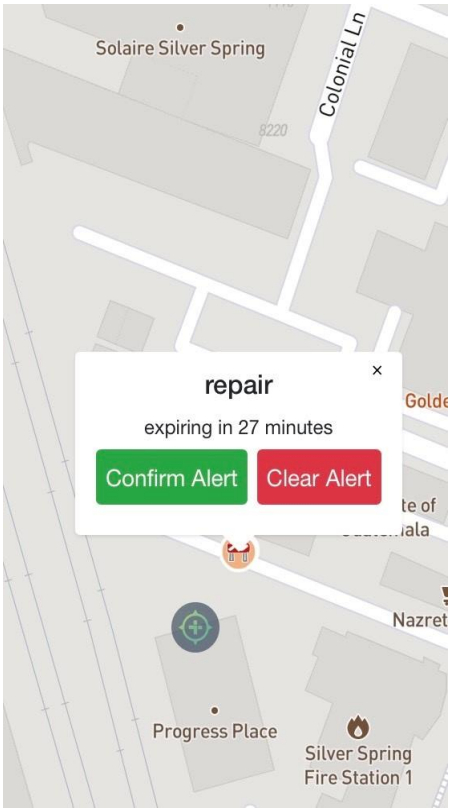

Figure 3-6 Confirm and Clear Alert Display in the QuickRoute Mobile App

Evaluators were asked to confirm or clear hazard alerts that were previously entered by evaluators and NUSTL staff members during the Fire, Medical and Dispatched Response Scenarios. Figure 3-6 shows the mechanisms for confirming and clearing alerts within the QuickRoute Mobile App. The majority of the evaluators either strongly agreed or agreed that they were able to confirm and/or clear existing alerts throughout the scenarios. During the Medical Response scenario one evaluator disagreed that they were able to confirm an alert. This was attributed to them selecting the confirm button but not seeing any type of acknowledgment of the confirmation. Evaluators suggested incorporating a mechanism (e.g. using voice activation) to audibly confirm or clear alerts for a hands-free experience. Additionally, three evaluators strongly agreed and stated that the confirm and clear processes were intuitive but could benefit from enhancements such as an acknowledgement indicating the alert has been confirmed or cleared. The other evaluator encountered difficulties attributed to a technical issue where the app's options of clearing the alert and navigating to the alert were displayed as performing the reverse actions.

3.2.5 Opportunities for Improvement

The evaluators' recommendations to enhance the design and function of the QuickRoute Mobile App are summarized here:

Usability

- Incorporate more descriptive audible directions including estimation of distance to turns (suggestions included at approximately 0.25 miles away from the turn and then as approaching (resulting in three notifications), lane placement indicators (e.g., stay in the center or right line) and exit numbers for highway use
- Label icons for turn-by-turn and overview direction functions
- Add the ability to enter a location by name instead of with a street address
- Enhance customizing vehicles functionality by displaying data field entries
- Identify speed and red light camera locations to indicate where vehicles may slow down abruptly
- Ability to integrate into CAD systems
- Add the ability to increase font size while searching for addresses
- Have the option of expressing speed above the posted limit permitted by either a percentage or in miles per hour
- Ensure function displays are not inversed and possible software issues are resolved

Hazard Mitigation

- Add an acknowledgement indicating the alert has been confirmed or cleared
- Incorporate the ability to differentiate between alert types or levels (critical, impassable, etc.) and display alert impacts (e.g., if a reroute is required, how much time it will add to your destination, etc.).
- Add auditory notifications when approaching an alert and when a new alert is reported along the users route
- Add the ability to audibly confirm or clear alerts for a hands-free experience
- Enhance visibility of alerts that are along routes
- Ensure routing around alerts that are injected during navigation

3.3 Overall Experience Feedback

Following the completion of all circuits, the evaluators reconvened and provided general feedback on their overall operational and usability experience with QuickRoute. The evaluators strongly emphasized the benefit of integrating QuickRoute into CAD systems.

All evaluators found QuickRoute to be fully functional and reliable. Feedback based on overall operational experience regarding the enhancements made to the QuickRoute Mobile App since the first OFA is summarized in the column graph in Figure 3-7 and discussed in detail below the graph. The four questionnaire statements posed to the evaluators are shown on the horizontal axis; the height of each bar represents the number of evaluator responses of strongly agree, agree, neutral, disagree and strongly disagree in black, red, dark blue, green and light blue, respectively. Each of the four statements has four responses corresponding to each evaluator.

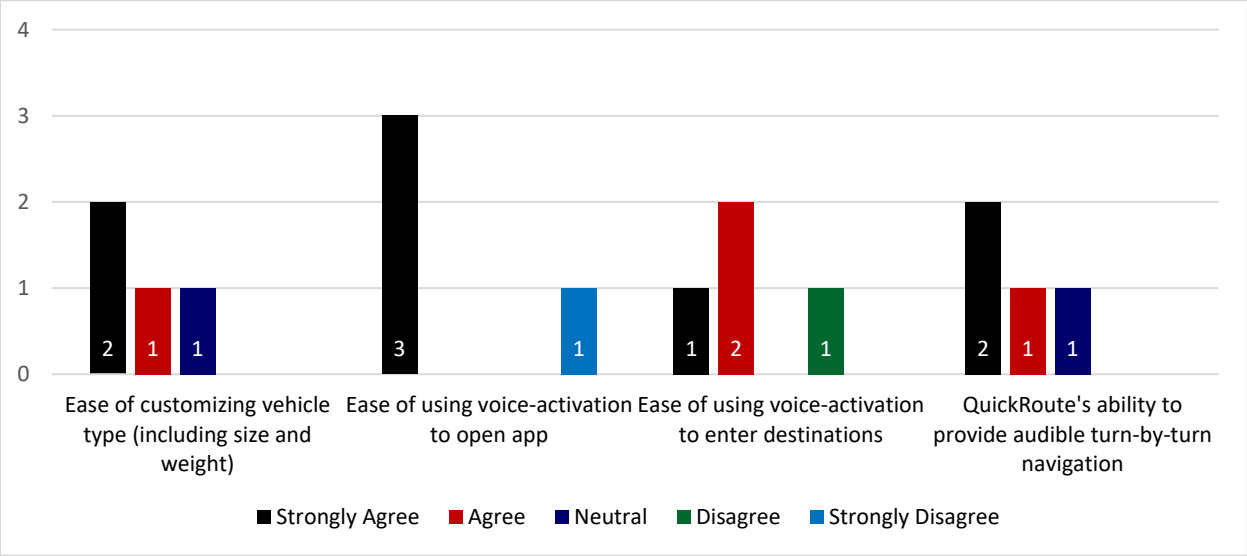

Figure 3-7 Evaluators Feedback on Overall Operational Experience

3.3.1 Customizing Vehicle Types

The QuickRoute Mobile App has been enhanced to include the ability to create a custom vehicle type. When selecting the Transport Mode icon from the home screen, the menu displayed on the right in Figure 3-8 offers a custom vehicle option. When selecting the custom vehicle option, the user can enter a vehicle name and type (car or truck), as well as vehicle parameters (height, width, length and weight) and a customized rule for the percentage of the speed limit that can be exceeded as shown in the center in Figure 3-8. Once the create vehicle is selected, the custom made vehicle will then appear in the Transportation Mode menu for future use as shown on the left in Figure 3-8. All evaluators either strongly agreed, agreed or were neutral when asked about the ease of customizing vehicle type. One of the evaluators found it cumbersome noting not being able to see which field is being added and the units used when entering the data.

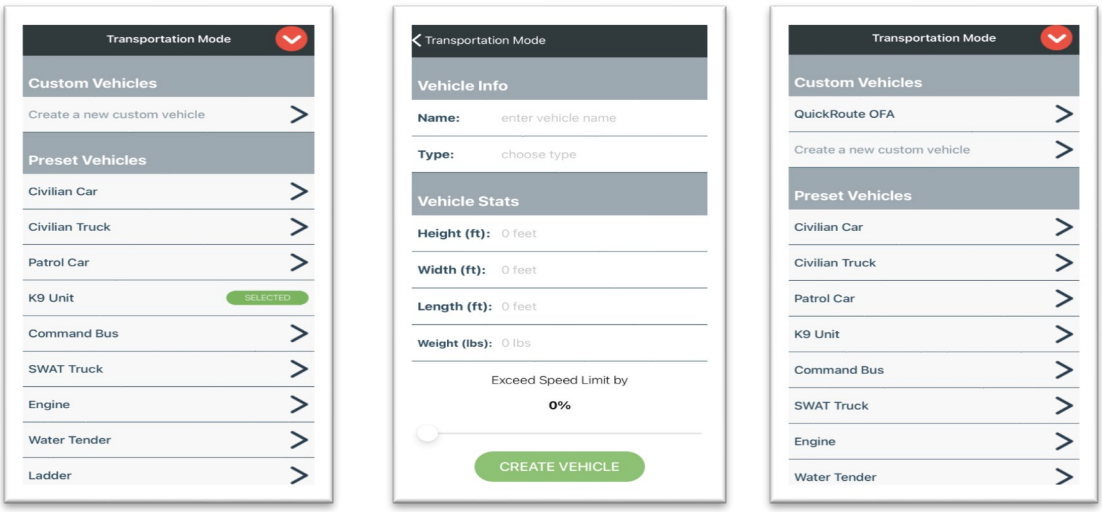

Figure 3-8 Transportation Modes within the Mobile App
Transportation Mode Presets (left), Custom Vehicle Menu (center),
Transportation Mode Showing Presets and Custom Options (right)

3.3.2 Voice Activation

Evaluator feedback varied on the ease of using voice activation for both opening the QuickRoute Mobile App and entering destinations. As previously mentioned, the evaluator who strongly disagreed was unable to open the app using voice-activation which was attributed to voice-activation, in this case Siri, not activating when an iPhone is paired to Bluetooth in a vehicle. Once the Bluetooth was disabled the voice-activation was successful. All other evaluators strongly agreed they could use voice activation to open the app.

Voice activation to enter a destination was incorporated into the QuickRoute Mobile App with the intention to make it easier for responders to quickly enter a response location. Three evaluators strongly agreed or agreed that that voice-activation was easy to use while one evaluator disagreed. The evaluator who disagreed indicated that the app was sensitive to the syntax used for the address number part of the destination, in one instance they were routed to the correct street but not the specific address.

3.3.3 Audible Turn-by-Turn Navigation

Based on feedback from the first QuickRoute OFA, Azimuth1 incorporated audible turn-by-turn navigation. This feature can be turned on or off with one touch, using the speaker icon circled in Figure 3-9.

When asked about QuickRoute's ability to provide audible turn-by-turn navigation evaluators either strongly agreed, agreed or were neutral. One evaluator suggested incorporating more descriptive audible directions including an estimation of distance to upcoming turns (e.g., at 0.25 mile away from turn and then as approaching) and lane placement (e.g., stay in the right or center lane). Adding an audible alert when nearing final destination (e.g., your destination is on the left) was also suggested.

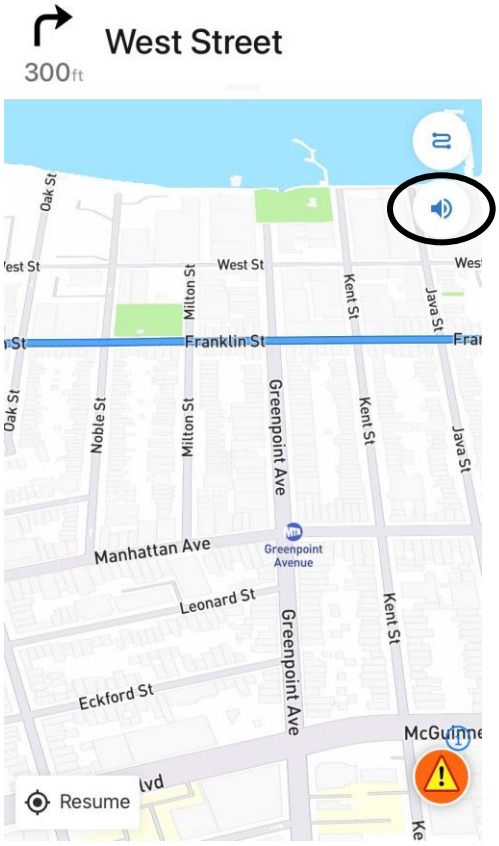

Figure 3-9 Audible Navigation Icon (circled)

Feedback based on overall usability experience is summarized in the column graph in Figure 3-10, and discussed in detail below the graph. The three questionnaire statements posed to the evaluators are shown on the horizontal axis; the height of each bar represents the number of evaluator responses of strongly agree, agree, neutral, disagree and strongly disagree in black, red, dark blue, green and light blue, respectively. Each of the three statements has four responses corresponding to each evaluator.

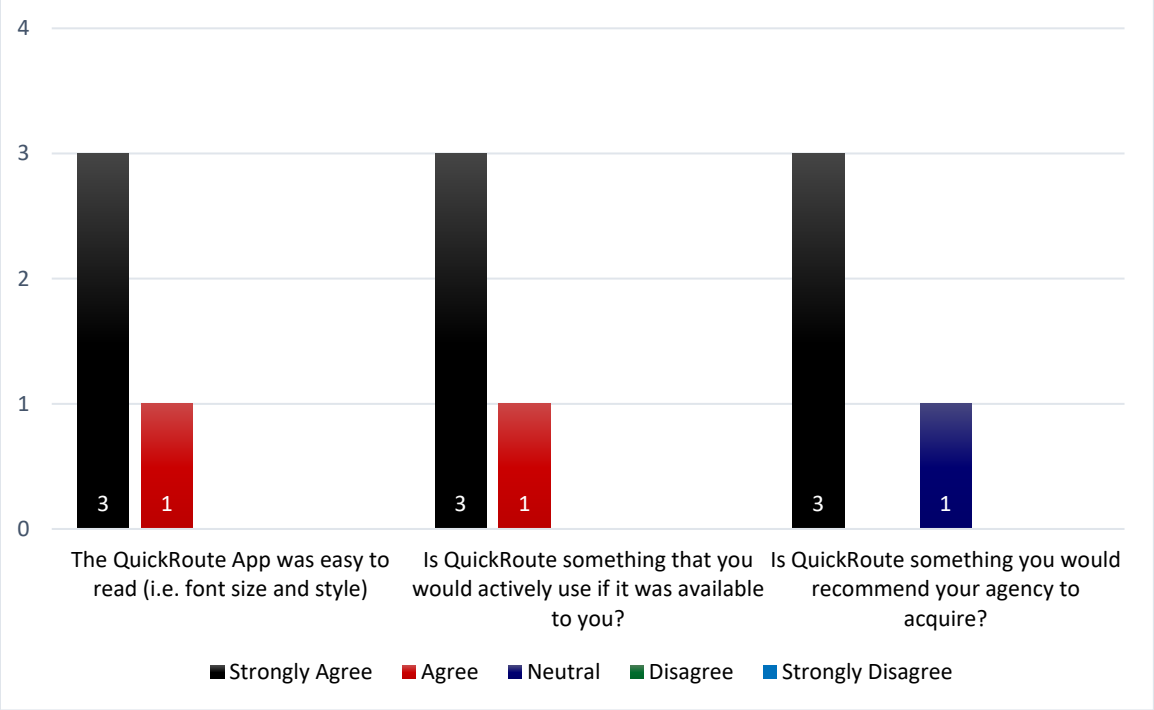

Figure 3-10 Evaluators Overall Usability Experiences

3.3.4 Display

All evaluators either strongly agreed or agreed that the QuickRoute Mobile App was easy to read. Evaluators stated the app had a clean look, and appreciated the graphics (e.g., the size of the alert icons) when stationary and en route.

3.3.5 Usability

All evaluators strongly agreed or agreed when asked if they would actively use QuickRoute if it were available to them. One of the evaluators noted that it would be beneficial as it has the potential to enhance responses. Similarly, three evaluators strongly agreed they would recommend QuickRoute to their agency; the fourth evaluator responded neutrally indicating that QuickRoute's ability to integrate into a CAD system would be the determining factor.

4.0 CONCLUSION

The intent of this OFA was to obtain responder feedback on QuickRoute ECC's operational suitability and the changes made to the QuickRoute Mobile App based on feedback from the 2019 OFA.

Evaluators found the ECC useful and intuitive. It provides a visual display of all QuickRoute Mobile App users including their name, destination and availability for a response call. ECC users have the ability to insert alerts and route users to manually entered destinations or existing alerts. The evaluators suggested improving efficiency of the ECC by labeling or color coding icons to assist dispatchers in easily identifying users and adding confirmation notifications for both the successful transmission of the push notification as well as when the receiving user begins routing to the incident. Evaluators also made recommendations on the ECC display such as including a table or dashboard of alerts and labeling the user table indicating search and sort functionalities

Much of the feedback obtained from the first OFA was utilized to enhance the QuickRoute Mobile App. This included adding audible turn-by-turn directions, adding a method for indicating whether the user is in civilian or emergency mode, automatically transitioning the display between day and night maps based on environmental settings, enhancing routing by improving vehicle directional orientation, and allowing users to create and save customized vehicles. During the second OFA, additional feedback was provided including incorporating more descriptive audible directions (e.g., improved notifications of upcoming turns, lane placement indicators and exit numbers for highway use), and how to further the hands-free operation by incorporating a mechanism to verbally confirm or clear alerts. The importance of integrating QuickRoute into existing CAD systems was also emphasized.

While the evaluators identified recommendations on how to further enhance the QuickRoute ECC and Mobile App to make them more suitable for first responder operations, they determined that this technology, in its current iteration, could enhance their response activities.

5.0 REFERENCES

[1] U.S. Department of Homeland Security, Science and Technology Directorate, "QuickRoute: First Responder Routing Logic Guide Statement of Objectives, BAA 13-012/Call 0005/SOO G," April 24, 2017.

[2] U.S. Department of Homeland Security (DHS), Science and Technology Directorate, "QuickRoute Mobile App and ECC Operational Field Assessment Plan," DHS Science and Technology Directorate, New York, NY, September 2020.