Dynamic Mobility Application Policy Analysis

Policy and Institutional Issues for Integrated Dynamic Transit Operations (IDTO)

www.its.dot.gov/index.htm
Final Report — July 07, 2015
FHWA-JPO-14-134

Photo Sources: (Top) Thinkstock (Bottom) Jeffrey Katz

U.S. Department of Transportation

Produced by the John A. Volpe National Transportation Systems Center
U.S. Department of Transportation
Intelligent Transportation Systems Joint Program Office

Notice

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.
The U.S. Government is not endorsing any manufacturers, products, or services cited herein and any trade name that may appear in the work has been included only because it is essential to the contents of the work.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-JPO-14-134		

4. Title and Subtitle	5. Report Date
Dynamic Mobility Applications Policy Analysis: Policy and Institutional Issues for Integrated Dynamic Transit Operations (IDTO)	July 07, 2015
	6. Performing Organization Code
7. Author(s) Caitlin Bettisworth, Josh Hassol, Cynthia Maloney, Amy Sheridan, Suzanne Sloan	**8. Performing Organization Report No.**
9. Performing Organization Name And Address U.S. Department of Transportation John A. Volpe National Transportation Systems Center 55 Broadway Cambridge, MA 02142	**10. Work Unit No. (TRAIS)**
	11. Contract or Grant No. HW4AA8 and HW4AA9
12. Sponsoring Agency Name and Address U.S. Department of Transportation Intelligent Transportation Systems Joint Program Office 1200 New Jersey Ave., S.E. Washington D.C. 20590	**13. Type of Report and Period Covered** Policy analysis white paper, Summer 2012 – Fall 2014
	14. Sponsoring Agency Code HOIT-I

15. Supplementary Notes
Thank you to Walter During, FHWA, Ronald Boenau, FTA, Tom Timcho, Battelle, Sean Puckett and Lee Biernbaum, Volpe Center, and Mike McGurrin, Noblis, for their help in reviewing this document.

16. Abstract
This report documents policy considerations for Integrated Dynamic Transit Operations (IDTO). IDTO applications provide individualized trip planning, transfer protection, and ridesharing options. The analysis identified the following potential policy issues:

- Data Privacy. Certain personally identifiable information (PII) appear necessary for the operations of some IDTO apps. Like all of the dynamic mobility application bundles, IDTO will undergo additional analysis related to privacy issues and risks. In addition, each IDTO deployment should carefully consider privacy issues during design, implementation, and operations.
- Data Sharing. Participating agencies will need to establish formal data-sharing agreements specifying which data elements are going to be shared, under what circumstances, and for what purposes. Data sharing between different agencies will require advanced planning.
- Multi-Agency Coordination. Differing agendas among agencies, and even among modes within agencies, may make multi-modal coordination more difficult. The necessary cross-agency agreements can be difficult to negotiate and implement.
- Data Interoperability. Regional IDTO deployments will need interoperability of operational data and the systems handling it will. Achieving interoperability will be largely a technical challenge, but it will involve significant policy hurdles as well. For example, participating agencies will need to agree on common data formats, and establish data sharing protocols.
- Regulatory Status of Rideshare. The legal / regulatory status of transportation network companies is rapidly evolving. These concerns are not immediately applicable to IDTO, but, such regulations are likely to be widely variable. USDOT needs to remain attuned to the implications of state regulations of transportation network companies and the potential impact to the use of D-RIDE by transit agencies.
- Social Equity. Social equity is a potential concern with IDTO, but is considered low since it is not yet clear if the system will be preferential to some users, or will instead improve travel times for all travelers regardless of their access to the applications.

- D-RIDE Passenger Safety. This is considered a low priority since the entities interfacing with the D-RIDE providers' systems will only be sharing dynamic transportation service options available and will not be involved in the acceptance or rejection of any given ride and online reviews of dynamic transportation services will help eliminate bad actors.
- Increased Travel Times and Route Complexity. Dynamic routing and protected transfers have the potential to increase transit route service times. It is expected that transit agencies will develop business rules to specify schedule and route conditions under which protected transfers are and are not acceptable to the system.

Other than addressing known security and privacy concerns, the policy team does not foresee a need for any new policies to be enacted or foresee any major issues that will stand in the way of successful deployment and use by agencies. Ultimately, guidance on installation, integration, operations, and maintenance will be produced by the technical teams when completing their technology transfer to the public sector.

17. Key Words	18. Distribution Statement		
Connected vehicles, transit, intelligent transportation systems, transportation			
19. Security Classif. (of this report)	**20. Security Classif. (of this page)**	**21. No. of Pages**	**22. Price**
Unclassified	Unclassified	29	

Table of Contents

List of Tables

List of Figures

Executive Summary

Dynamic Mobility Applications Program

The Dynamic Mobility Applications (DMA) Program is prototyping applications that are anticipated to be transformative to public sector transportation system management and modal integration. This technical research is a part of the U.S. Department of Transportation's (USDOT) research into new technologies supporting the emergence of an intelligent and connected vehicle (CV) environment[1].

The objective of the DMA research is to foster the release of high-value, open-source applications that use synthesized, multisource Intelligent Transportation Systems (ITS) data to transform surface transportation management and information. The DMA Program research is also focused on developing tools (for instance, an open source portal), metrics, and concepts to support additional application development.

The Intelligent Transportation Systems Program's role within the USDOT is to facilitate high-risk/high-reward research in cooperation with industry and academia to meet transportation needs. Investments in new research are based on policy analysis that determines that the technology concepts meet the following threshold criteria:

- They advance the state-of-the-practice and, if successful, will deliver transformational transportation benefits to the Nation.
- They are unlikely to be pursued in industry given the nature of the risks compared to the required investment.
- The advancements are desired by stakeholders, who will champion the transfer of results into use.
- The advancements are significant enough to take precedence over other investment choices.

A decision to pursue research is followed by the development of prototypes and demonstration and testing under real-world conditions. Successful results advance the process of transferring new technologies into market adoption and use. They set the stage for planning and preparing for technology implementation, operations and maintenance, and, eventually, upgrades and evolution. Throughout this technology life cycle, policy and institutional issues can often become the major stumbling blocks to realizing success.

[1] A Connected Vehicle Environment is defined as: "A connected, data-rich travel environment. The network captures real-time data from equipment located on-board vehicles (automobiles, trucks, and buses) and within the infrastructure. The data are transmitted wirelessly and are used by transportation managers in a wide range of dynamic, multi-modal applications to manage the transportation system for optimum performance." http://www.its.dot.gov/connected_vehicle/connected_vehicle.htm accessed July 1st, 2014.

Thus, identification of, and research into, the policy issues and practical options and solutions is an important step that raises the assurance that the Federal investment will result in adoption and use by agencies, organizations, the private sector, and travelers. It is an iterative process with the technical research teams—identification of policy challenges early in the development stage can change the nature of technical decisions; envisioning and addressing policy challenges throughout the life cycle supports preparation for robust technology transfer to the market.

Purpose of this Report: Document IDTO Policy Issues

The Connected Vehicle Mobility Policy team (herein, policy team) developed this report to document policy considerations for the Integrated Dynamic Transit Operations, or IDTO. IDTO comprises a "bundle" of mobility applications that leverage existing and new connected vehicle data sets to provide transit travelers with trip planning based on an expanded range of modal options.

The analysis is based on the policy team's review of a wide range of materials that include:

- The IDTO Concept of Operations (ConOps),
- The Connected Vehicle Reference Implementation Architecture (CVRIA) diagrams for IDTO[2],
- Discussions with the technical team overseeing development of the prototype applications within the IDTO bundle and a review of the prototype documents, and
- Industry best practices and standards in information technology, security and privacy, and data exchange.

As policy or institutional issues were identified during the review, they were categorized as high, medium, or low priority. Some of the issues were also recognized as applying to more than one of the DMA bundles, and categorized as common issues. Finally, some issues were characterized as *emerging*, indicating they will likely require attention and possible USDOT research as IDTO implementations advance.

Policy Issues Common to IDTO and Other Mobility Applications

The following policy issues are shared by IDTO and applications in other DMA bundles.

High Priority Common Issue

- Data Privacy. Certain personally identifiable information (PII) appear necessary for the operations of some IDTO apps. Like all of the dynamic mobility application bundles, IDTO will undergo additional analysis related to privacy issues and risks. In addition, each IDTO deployment should carefully consider privacy issues during design, implementation, and operations. However, given the fact that IDTO requires the use of PII, additional measures may be needed such as an opt-in capability so riders are aware of the use of their personal

[2] See Appendix A, reference 8.

information. Also, attention will need to be paid to erasing PII from data files prior to their being archived for research purposes.

- Data Sharing. Participating agencies[3] will need to establish formal data-sharing agreements specifying which data elements are going to be shared, under what circumstances, and for what purposes. Data sharing between different agencies and private sector firms will require advanced planning on interoperability, data quality and data ownership.

  This institutional concern is something that will need to be addressed by agencies considering IDTO deployments. USDOT can assist transit agencies and their partners by providing technical assistance and/or guidance on best practices for data sharing with both the public and private sector entities.

Emerging Priority Common Issues

Two issues common to other DMA bundles may emerge in importance as deployments of IDTO expand:

- Multi-Agency Coordination. As IDTO supports the development of more multimodal trip planning, differing agendas among all parties' agencies, and even among modes within agencies, may make coordination more difficult. The policy analysis indicated that this is unlikely to be a major issue in early, simple deployments but it is likely to emerge as deployments get more geographically and administratively complex. The necessary cross-agency agreements can be difficult to negotiate and implement.
- Data Interoperability. As adoption of IDTO expands, transit agencies with adjacent service areas may wish to deploy IDTO jointly. To enable this, operational data and the systems handling it will need to be interoperable. Achieving interoperability will be largely a technical challenge, but it will involve significant policy hurdles as well. For example, participating agencies will need to agree on common data formats, and establish data sharing protocols.

Low Priority Common Issue

The following potential policy issue was identified, but determined to be of low priority as it has a clearly identified solutions. This same policy issue was raised with the EnableATIS bundle.

- Social Equity. Social equity is a potential concern with IDTO, but is considered low as it is not yet clear if the system will be preferential to some users, or will instead improve travel times for all travelers regardless of their access to the applications. Like with other mobility bundles, USDOT can stay aware of any equity challenges, and offer guidance to address it.

Policy Issues Unique to IDTO

The policy team documented three issues unique to IDTO.

[3] It should be noted that this document focuses on the concerns of deployment in public agencies; however, these concerns are not bound to the public sector only.

Emerging Priority Unique Issue

One issue unique to IDTO may emerge in importance as deployments of IDTO expand:

- Regulatory Status of Rideshare. The legal / regulatory status of transportation network companies is rapidly evolving. These concerns are not immediately applicable to IDTO, as the application would be acting as a broker or feeder to dynamic transportation services but will not be providing the actual ride and will not be collecting revenues. However, such regulations are likely to be widely variable. USDOT needs to remain attuned to the implications of state regulations of transportation network companies and any potential impact to the use of D-RIDE by transit agencies.

Low Priority Unique Issues

The following potential policy issues were identified early in the analysis, but subsequently determined to be of low priority. They are either resolved or to have clearly identified solutions:

- D-RIDE Passenger Safety. This is considered low since the D-RIDE providers' systems will only be making rideshare options available and will not be involved in the acceptance or rejection of any given ride, and online reviews of rideshare services will help eliminate bad actors.
- Increased Travel Times and Route Complexity. Dynamic routing and protected transfers have the potential to increase transit route service times. It is expected that transit agencies will develop business rules to specify schedule and route conditions under which protected transfers are and are not acceptable to the system.

Conclusions and Next Steps

With this report, the policy team has documented policy issues and strategic decisions that have been made regarding USDOT support for private sector IDTO development. Two high priority, three emerging, and three low-priority policy issues have been documented in this report. No major challenges appeared during analysis that were perceived to present obstacles to deployment and use for IDTO.

It is expected that this report will support a dialogue with stakeholders. Stakeholders may comment on:

- Any additional policy or institutional issues that may present challenges to successful deployment of IDTO technology and practice, which are not documented but for which new or additional research and analysis is recommended.
- Whether policy options identified for resolution of the issues are appropriate.

Finally, it should be noted that data privacy and security have been raised as key policy concerns for all of the dynamic mobility applications. Research is ongoing in this area to develop options to address these new applications as well as to standardize security for future applications that have yet to emerge. To develop optional approaches for security and privacy, analysis is underway using National Institute of Standards and Technology,

commonly referred to as NIST, standards (Special Publication 800-53[4] Rev 4) to assess any policy or institutional challenges[5]. This analysis explores the minimal data set that is necessary for IDTO functionality, and to assess any public concerns or policy challenges associated with the data set. Notably, IDTO applications will be transferred to market adopters and the private sector is expected to play a major role in setting privacy and data access policies. However, if IDTO is used by Federal agencies, there will likely be additional reviews of practices for data collection, access, and storage; handling of any PII; and/or security practices.

[4] http://nvlpubs.nist.gov/nistpubs/SpecialPublications/A.SP.800-53r4.pdf
[5] USDOT research and analysis results are made available through the ITS Joint Programs Office website at www.its.dot.gov.

Chapter 1 Introduction

This report documents policy considerations for Integrated Dynamic Transit Operations, or IDTO. The IDTO program is funding projects that aim to improve transit function and connectivity by integrating multisource, multi-agency data and facilitating interagency transfer requests.

IDTO is one of several mobility application bundles that the Intelligent Transportation Systems Joint Program Office (ITS JPO) of the U.S. Department of Transportation (USDOT) and its partners are prototyping as part of its Connected Vehicle Program. The ITS JPO is advancing new connected vehicle technologies through innovative research, and the IDTO transit mobility technologies are being studied through two exploratory research projects.

Dynamic Mobility Applications

In the future, cars, trucks, buses, roads, and smartphones will talk to each other. They will share valuable safety, mobility, and environmental information over a wireless communications network that is already transforming our transportation system as we know it. This system of connected vehicles, mobile devices, and roads will provide a wealth of transportation data, from which innovative applications will be built. These applications will make travel not only safer, but more efficient and environmentally friendly.

The USDOT's Dynamic Mobility Applications program is exploring these possibilities, specifically focusing on reducing delays and congestion and thus significantly improving mobility. The following six mobility application bundles are being prototyped to make this possible:

- *Enabling Advanced Traveler Information Systems (EnableATIS)* provides a framework to develop multisource, multimodal data into new advanced traveler information applications and strategies.
- *Freight Advanced Traveler Information System (FRATIS)* provides freight-specific route guidance and optimizes drayage operations so that load movements are coordinated between freight facilities to reduce empty-load trips.
- *Integrated Dynamic Transit Operations (IDTO)* facilitates passenger connection protection, provides dynamic scheduling, dispatching, and routing of transit vehicles, and promotes dynamic ridesharing.
- *Intelligent Network Flow Optimization (INFLO)* aims to optimize network flow on freeway and arterials by: informing motorists of existing and impending queues and bottlenecks; providing target speeds by location and lane; and allowing the capability to form ad hoc vehicle platoons of uniform speed.
- *Multi-Modal Intelligent Traffic Signal Systems (MMITSS)* is a comprehensive traffic signal system for use on complex arterial networks that include passenger vehicles, transit, freight, and emergency vehicles, as well as pedestrians.

- *Response, Emergency Staging and Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.)* involves advanced vehicle-to-vehicle safety messaging over dedicated short-range communications (DSRC) to improve the safety of emergency responders and travelers.

The USDOT's Connected Vehicle Mobility Policy team is performing the analysis needed to document policy and institutional issues and recommend options for resolution for each of these bundles in separate reports.

Policy Considerations for New Connected Vehicle Technologies

Throughout the process of developing new connected vehicle technology, various policy or institutional issues can become stumbling blocks. Examples include changes brought about by an application and its operations that could possibly affect established norms for liability; governance; interoperability of hardware, software, and data; and other issues that may preclude adoption and use by industry.

Policy analysis is an iterative process that proceeds in concert with research and development. Hence, identification of policy challenges early in the development stage can change the nature of technical decisions. Envisioning policy challenges throughout the life cycle enables smooth technology transfer and system deployment.

This remainder of this report is structured as follows:

- Chapter 2 Description of IDTO
- Chapter 3 Policy Analysis Approach for Analyzing New Connected Vehicle Applications
- Chapter 4 Policy Analysis Results on IDTO Applications
- Chapter 5 Conclusion
- Appendix A Source Materials
- Appendix B List of Acronyms

Chapter 2 Description of IDTO

The IDTO bundle intends to improve individual travelers' transit experience by using both static and real-time vehicle location, performance, and loading data to provide:

- Expanded trip planning, including transit and rideshare options,
- Opportunities for door-to-door service,
- Increased likelihood of successful transfers, and
- In-trip notifications to improve the travel experience.

Travelers will use handheld nomadic devices (e.g., personal mobile: devices, phones, or computers) to enter route and timing information and to request efficient transfers. The system will be able to track individual travelers and vehicles and will provide travelers with updates on available vehicles from all participating area transit providers.

While these services exist to some extent today, they are not unified into a seamless, timely system that includes both private and public transit offerings. The three apps in this bundle are:

Transit Connect (T-CONNECT)

This application will provide travelers using location-aware mobile devices, and who have pre-planned and saved specific route information in the IDTO system, with enhanced features to help ensure successful transfers, particularly between modes and/or providers. T-CONNECT will use real-time data[6] to examine the arrival status of a transit vehicle and to transmit a "hold" message to a second vehicle (in the same or another mode), in order for the traveler to make a successful transfer from one vehicle to another.

T-CONNECT will be designed to work in both single agency and multi-agency environments and across single or multiple modes of transportation. Transfers will be possible between both transit and non-transit (e.g., shared ride) modes. T-CONNECT will track individual travelers' progress on their requested trips. The system will also take into account a specific traveler's preferences or priorities, should that individual choose to furnish such data to the T-CONNECT system.

While determining feasibility of a given transfer request, T-CONNECT will take into account the overall state of the transportation system, including requests made by other travelers as well as real-time and historical travel conditions for the services affected. It will consider pre-determined connection

[6] Real time data from transit vehicles involves gathering schedule performance, loading data, transfer requests, user information (as entered via transit card or transfer request devices) and data from travelers consisting of trip plan and transfer request(s). A transit management center (TMC) or other entity then integrates those data with information on road network conditions and with similar data from other agency TMCs, exchanging service requests and responses.

protection rules agreed upon by the participating agencies and transit modes. The system will continue to monitor the situation and provide connection protection status to notify agency dispatchers and travelers regarding any updates to the connection protection requests. T-CONNECT will be integrated with the two other IDTO applications to:

- Provide trip alternatives to travelers for whom a connection cannot be protected
- Provide connection opportunities to the users of T-DISP and D-RIDE, described below.

Dynamic Transit Operations (T-DISP)

This application will provide a broad range of candidate trip plans to travelers requesting trips on a nomadic device or personal computer. T-DISP will match traveler requests with available services, based on real-time vehicle availability information and predefined business rules. Trip plans will include specific routing information and instructions for each segment of the trip and may also include information and reservations for additional services (e.g., parking) along the route.

Candidate trip plans will be returned to the traveler via the device used to make the request. Trip plans would make use of multiple public and private transportation modes, including transit, ride-shares, private transportation services, biking, and walking. The traveler will be able to select and confirm a given trip plan, which will generate a series of transportation requests or reservations.

T-DISP will expand on existing technology[7] to incorporate business and organizational structures that will coordinate transportation services throughout a region. A transportation information center would dynamically schedule and dispatch trips, basing optimal plans on current traffic and road conditions, transit schedules and vehicle location data, and recorded preferences and needs of the requesting traveler. Travelers using T-DISP would set up user accounts, including: personal identification, travel preferences, any special needs, device information, and information to support payment.

Dynamic Ride Sharing (D-RIDE)

This application will allow travelers to arrange relatively near-term carpool trips via a nomadic device, personal computer, or kiosk equipped with an automated ride-matching system. D-RIDE will allow travelers to reach destinations not serviced by transit or outside the range of the area transit system.

Potential drivers and passengers will need to establish user accounts that include: personal identification, travel preferences, any special needs, device information, and information to support payment. A central transportation information center will collect data from potential drivers and passengers, identify optimal pairings, connect confirmed pairs, and identify a route that will serve both parties' origin and destination locations.

Trip plans will be passed to drivers via in-vehicle systems, while passengers will receive plans via the device used to make the request. Travelers will be asked for post-trip feedback, to improve both users' experience for future trips. D-RIDE will be a subsystem of both T-CONNECT and T-DISP, providing an alternate mode of travel when transit is not available or convenient for a requested trip.

[7] Such as computer-aided dispatch/automated vehicle location systems and automated scheduling software.

IDTO Demonstrations

Ohio Demonstration. An IDTO demonstration conducted in Columbus, Ohio operated between May and December 2014. System integration and interfaces among participants were implemented by Battelle, which also developed and marketed a smartphone application.

T-CONNECT was deployed via two fixed-route public agency bus services and a private sector provider:

- The Central Ohio Transit Agency (COTA) provided service to Columbus and central Ohio. Specific routes associated with their fixed-route/fixed-schedule service were included in the demonstration. COTA agreed to honor the request to hold the outbound bus, when conditions allow.
- Ohio State University's (OSU) Campus Area Bus System (CABS) has a fleet equipped with real-time automated vehicle location (AVL) capability and served as the inbound segment of the multi-modal T-CONNECT enabled transfers.
- The private-sector Capital Transportation provided demand-response shuttle service to the Defense Supply Center Columbus military base and also served as the inbound segment of the COTA –service T-CONNECT transfers.

The trip planning components of T-DISP were implemented, first using the above providers, and eventually expanding to include the D-RIDE provider. Using T-DISP, travelers could plan and schedule trips that included CABS, COTA, CABS to COTA and eventually, Zimride (demonstration only).

The demonstration ran from the beginning of May until the end of November 2014. The demonstration recruited OSU students and other travelers to use the application to assist with travel from locations on campus to locations off of campus around the city of Columbus. The travelers provided search criteria, and then saved the trips in the system. These trips were then analyzed by the system for transfers at certain locations between CABS and COTA, identifying T-CONNECT opportunities. If a trip was found to have a T-CONNECT opportunity, the trip was then monitored and a T-CONNECT request sent to the COTA dispatcher, assuming all other conditions were met. The dispatcher would then accept or reject the request, advise the driver, and the traveler would be notified if their connecting bus would be held.

The demonstration also included a private on-base shuttle service operating at the Defense Supply Center Columbus military base. The group boarded the shuttle bus and the current COTA schedule overview was provided for driver who would in turn use the provided MDT (Mobile Data Terminal) to schedule trips in the system, and then, functioning similar to the personal traveler above, the system would monitor the inbound shuttle and coordinate T-CONNECT opportunities with COTA, as necessary.

D-RIDE services were later demonstrated under limited, controlled conditions by integrating rideshare requests to Zimride, a nationally recognized rideshare service provider, as part of the available transportation service offerings in the Central Ohio region. Trips that used D-RIDE exclusively, or a combination of D-RIDE and COTA were demonstrated.

Florida Demonstration. The IDTO bundle was deployed in a second location in conjunction with several agencies / partners in Central Florida. This demonstration was intended to evaluate the transferability of the IDTO concepts from region to region. This demonstration did not include an operational period where data form real system users was collected. Similar to the Central Ohio region, the demonstration in Central Florida proved to be most successful with respect to the T-CONNECT application, as supported by T-DISP. D-RIDE was not demonstrated in Central Florida.

For the demonstration in Florida, the following agencies served as transit agency partners.

- The Central Florida Regional Transportation Authority, more commonly known as LYNX, provides service to Orange, Osceola and Seminole counties in central Florida. Schedule data from their fixed-route/fixed-schedule service offering was integrated into the IDTO software bundle, and was used to demonstrate the feasibility of T-CONNECT.
- The University of Central Florida (UCF) has an on-campus fleet equipped with real-time AVL capability and served as an inbound provider to demonstrate multi-modal T-CONNECT enabled transfers with LYNX.
- SunRail, a recently operational commuter rail service in the region, was also equipped with real-time AVL capability and when coupled with scheduled-service data, served as an inbound provider for T-CONNECT enabled transfers, adding a rail provider into the feasibility mix.

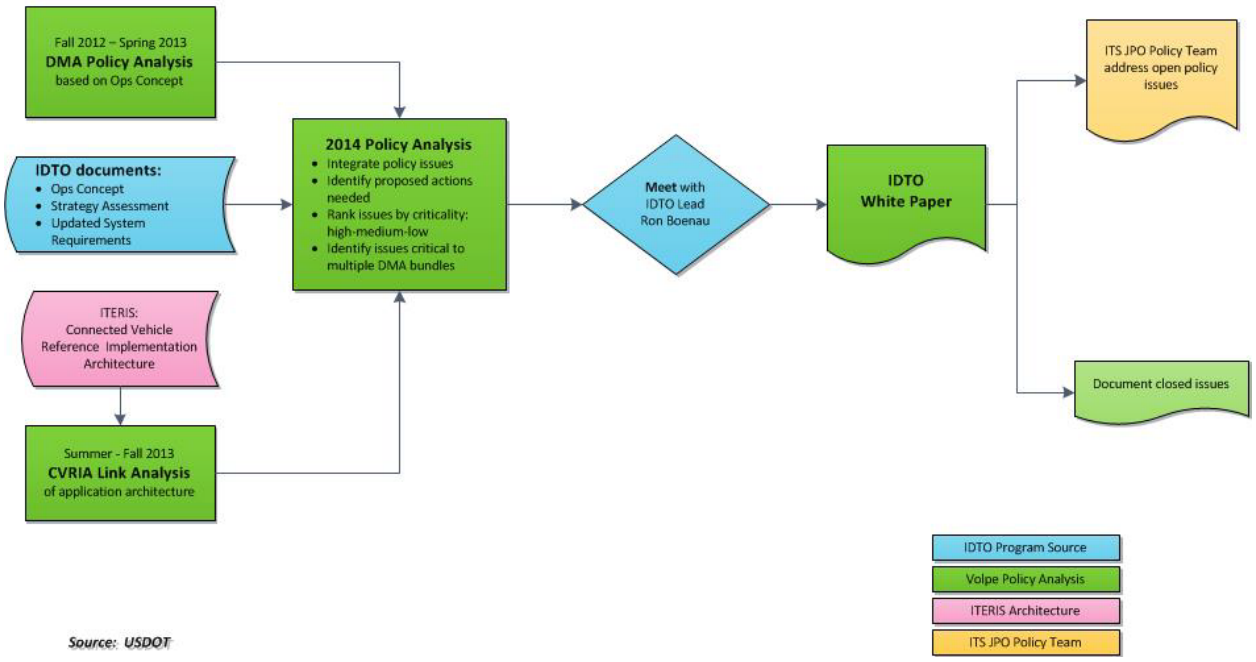
As in Central Ohio, the trip planning components of T-DISP were implemented using the local providers. Using T-DISP, travelers could plan and schedule trips that included UCF to LYNX and SunRail to LYNX, as well as other combinations (not demonstrated).

And finally, the D-RIDE services were limited to the demonstration only associated with the Columbus partners, and were not demonstrated in Florida.

Chapter 3 Policy Analysis Approach for Analyzing New Connected Vehicle Applications

The policy analysis for this report was conducted in the steps outlined in this section and illustrated in Figure 3-1.

Figure 3-1. IDTO Policy Analysis Process



1. Review Operational Concept: The Volpe Center policy team reviewed the original Operational Concept for IDTO. The team documented potential policy issues at each stage of the development and deployment process, identified known policy options and solutions, and recommended areas for further investigation. The final Operational Concept was also reviewed to see if new policy issues had emerged, and to see if identified issues were still present or had been resolved.

2. Review Connected Vehicle Reference Implementation Architecture: The policy team conducted a detailed analysis of the Connected Vehicle Reference Implementation Architecture[8]. The CVRIA provides a set of system architecture viewpoints that describe the functional, physical, and logical interfaces; enterprise relationships; and communications dependencies for each technology and application within the connected vehicle environment. These viewpoints serve as a common reference to help identify and prioritize standards development and to support policy considerations for the connected vehicle environment.

   The policy team used the CVRIA viewpoints to identify the entities sharing data in each application, and the specific data elements being transmitted. By doing so, the team was able to surface potential issues for IDTO.

3. Integrate Results: Having completed the Operational Concepts analysis and the CVRIA analysis, the policy team undertook a process of integrating the results of those two efforts. This was important because the Operational Concepts analysis tended to focus on broader issues, while the CVRIA analysis in many cases identified issues that related to specific types of data being exchanged between specific entities within a given application. Integrating the results from both analyses enabled the policy team to develop a complete picture of all the potential issues for the IDTO bundle.

4. Review New Materials: Additional materials for IDTO were reviewed and assessed against the results of the first level analysis. An updated Operational Concept was reviewed, along with a Report on Stakeholder Input, the System Requirements documentation, and a Functional Requirements analysis.

5. Eliminate Non-Policy Challenges: After integrating the results of the two efforts, the policy team identified and eliminated any issue that was purely technical or logistical in nature and therefore did not have direct policy impacts. For example, the issue of malicious hacking of hardware or software is not included in the analysis because it is a common issue in today's world, there are technological solutions to addressing the problem, and market forces will determine the cost tradeoff between greater security and an appropriate level of acceptable risk. Levels of security may be highly variable for each DMA and within each DMA bundle. Similarly, institutional issues such as data storage policies, governance policies, and access policies will be determined at the user level. If any of these had a potential impact on the trust or security of the connected vehicle environment, the issue was added to the prioritized list and discussed in this document.

6. Prioritize Policy Issues: The team assigned a priority to each of the remaining issues on the following basis:

   - *High priority* issues need immediate attention and resolution as they may obstruct deployment.
   - *Medium priority* issues have potentially serious consequences but clear, if challenging, paths to resolution. These should be resolved prior to technology transfer.
   - *Low priority issues* have policy implications but also have solutions underway. These solutions can likely be implemented before IDTO applications are introduced to the marketplace.

[8] https://www.standards.its.dot.gov/DevelopmentActivities/CVReference

- *Emerging* issues have some probability of obstructing deployment over time, as IDTO implementations grow in complexity or geographic coverage.

7. Identify Issues Common to Other DMA Bundles: The team differentiated between policy issues that were unique to a single DMA bundle, and issues common to multiple DMA bundles. Issues common to multiple DMA bundles may need to be resolved at the level of the DMA program or the Connected Vehicle program (e.g., privacy policy), rather than within the individual bundle development efforts.
8. Meet with Technical Team: After completing the preceding steps, the policy team summarized the policy issues in table form and discussed them with the IDTO technical lead. This provided the opportunity to agree or disagree about the veracity and priority of each issue, and to provide more information on each issue—information the policy team used to refine the policy analysis and conclusions.
9. Stakeholder Outreach: Once the results were discussed with the technical team, the draft report was shared with external stakeholders for validation. All comments were incorporated into this final draft.
10. Document Results: This report includes the results of that analysis and identifies issues that have been resolved and concerns that are recommended for additional USDOT research.

Chapter 4 Policy Analysis Results on IDTO Applications

This chapter describes the policy issues identified for the IDTO bundle. Two *high priority* issues—which could potentially impede the development or implementation of the IDTO mobility bundle if left unresolved—were identified by the analysis. Three *emerging* issues may present challenges to IDTO deployment over time, as implementations grow in complexity. The remaining, *low priority,* issues are being resolved or have clear paths to resolution.

The following table provides an inventory of IDTO policy issues:

Table 4-1. IDTO Policy Issues

Issue	Priority	Common to Other DMA Bundles?
Data Privacy	High	Yes
Data Sharing	High	Yes
Multi-Agency Coordination	Emerging	Yes
Data Interoperability	Emerging	Yes
Regulatory Status of Rideshare	Emerging	No
Social Equity	Low	Yes
D-RIDE Passenger Safety	Low	No
Increased Travel Times and Route Complexity	Low	No

Policy Issues Common to IDTO and Other Mobility Applications

Certain policy issues are relevant to mobility applications in multiple bundles. While these issues impact the ultimate success of IDTO, USDOT is working to resolve them within each bundle and also across all mobility applications simultaneously.

High Priority Common Issue

The analysis identified two high priority issues, common to other bundles, which will need to be addressed as IDTO deployments expand:

- Data Privacy. While data privacy in principal is common to other DMA applications, the IDTO apps are unique in that they must be able to associate an individual traveler's location, and if implemented, fare payment source, in order to provide the appropriate transfers and trip planning features. PII will therefore be necessary for IDTO transactions. The reference implementation architecture for IDTO shows that users provide 'user profiles' to central system components. These profiles include personal identification as well as financial and special needs information. Some or all of the user profile information must be passed to third party providers. Additionally, data will be archived for research purposes, and the apps (as currently implemented) do not include a capability for erasing personal data.

  Protecting PII is a high priority policy issue, given the current public concern about use of personal information. USDOT can consider guidelines for data sharing and privacy protection in the final apps before they are widely promoted. Understanding the use and protection of PII is an issue that is common to multiple DMA bundles (as well as to other connected vehicle applications). Like all of the dynamic mobility application bundles, IDTO will undergo additional analysis related to privacy issues and risks. In addition, each IDTO deployment should carefully consider privacy issues during design, implementation, and operations. However, given the fact that IDTO requires the use of PII, additional exploration of alternatives to mandatory use may be required. Voluntary models – either opt-in or opt-out – may be necessary to mitigate potential concerns so riders are aware of the uses of their personal information.

- Data Sharing. Two types of data are intended to be shared as part of IDTO. The first is static data—such as routes and schedules—used for planning. If this information is broader than fixed route schedules, which are typically published, the data may be considered proprietary by private sector service providers, raising questions about confidentiality and competitive advantages. The second type of data that is shared by IDTO apps is automated vehicle location (AVL) data. This type of data can be examined to evaluate performance—as a result, the notion of sharing this data may not appeal to transit operators and may even violate existing drivers' and dispatchers' union rules. Having public access to AVL data may also raise security concerns, as it becomes much easier to pinpoint the location of various vehicles.

  To allay concerns it will be important to clarify which entities (public and private) will have access to data generated by other entities. Participating agencies will need to establish formal data-sharing agreements specifying which data elements are going to be shared, under what circumstances, and for what purposes. As the scope of IDTO expands, data sharing between different agencies will require advanced planning to ensure data quality and standards are established.

  This institutional concern will need to be addressed by agencies considering IDTO deployments. USDOT can assist transit agencies and their partners by providing technical assistance and/or guidance on best practices for data sharing, including examples of successful data sharing among public and private sector entities.

Emerging Priority Common Issues

Two common policy issues may emerge as deployment of IDTO expands over time.

- Multi-Agency Coordination. Initially, coordination among agencies may follow existing ad hoc lines of communication that have evolved along with the development of simple transfer and ride-share services. However, as IDTO supports the development of more multimodal trip planning, differing agendas among agencies, and even among modes within agencies, may make coordination more difficult. For example, will a train delay its start to wait for a late bus bearing a passenger who wants a transfer to the train? And if the train were to delay its start, what would be the agency's process for ensuring the train operator knew the passenger had boarded the train? The policy analysis indicated that this is unlikely to be a major issue in early, simple deployments but it is likely to emerge as deployments get more geographically and administratively complex. The necessary cross-agency agreements can be difficult to negotiate and implement. This institutional concern would benefit from USDOT technical assistance and best practices support.
- Data Interoperability. While transit agencies use similar/identical types of information to monitor and direct their fleets, they may use a range of hardware, software, and data formats to generate and manage such information. As adoption of IDTO expands, transit agencies with adjacent service areas may wish to deploy IDTO jointly. To enable this, operational data and the systems handling it will need to be interoperable. Achieving interoperability will be largely a technical challenge, but it will involve policy hurdles as well. For example, participating agencies will need to agree on common data formats, and establish data sharing protocols. Such agreements will need to be codified in memoranda of understanding between the agencies. The development of data sharing guidelines and examples of successful multi-agency data sharing will assist transit agencies wishing to deploy IDTO on a coordinated, regional basis.

Low Priority Common Issues

Two common policy issues were identified initially, but further research indicated these issues have already been resolved or have clear paths to resolution:

- Social Equity. Social equity is a potential concern with IDTO, but is considered low since it is not yet clear if the system will be preferential to some users, or will instead improve travel times for all travelers regardless of their access to the applications. Particular attention should be paid to how the system provides dynamic scheduling and dispatch of demand-response services to passengers using the T-DISP application, without increasing wait times for others – particularly if the others lack nomadic devices and therefore the system has no information about their locations. Transit agencies must not provide preferential service to riders using IDTO applications. However, T-DISP may not necessarily result in inequitable service. By helping demand-response services operate more efficiently, T-DISP could improve service for all customers, including those not using the application.

Policy Issues Unique to IDTO

The policy team documented three issues unique to IDTO.

Emerging Priority Unique Issue

One unique policy issue may emerge as deployment of IDTO expands over time.

- Regulatory Status of Rideshare. The legal / regulatory status of transportation network companies is rapidly evolving. There is a dynamic exchange over regulation of ridesharing among states, the insurance industry, and taxicab advocates with no clear resolution at this time. These concerns are not immediately applicable to IDTO, as the application will be acting as a broker or feeder to dynamic transportation services but will not be providing the actual ride and will not be collecting revenues. However, regulation and terminology of both rideshare and e-hailing companies may impact deployment and the services available in a given State. This is a fast changing area of public policy and USDOT needs to remain attuned to changes and the implications of state regulations on transportation network companies as these could impact the implementation and use of D-RIDE by transit agencies.

  Additionally, there have been no studies to date to see if the current business model of using a broker for D-RIDE will work going forward. USDOT should consider an evaluation of effective business models for D-RIDE and assess them against the current regulations for transportation network companies to see if they are feasible, and to ascertain the risks to transit agencies in using those models.

Low Priority Unique Issues

Two unique policy issues were identified; they are considered low priority as they have been resolved or have clear paths to resolution:

- D-RIDE Passenger Safety. Drivers and passengers have the potential to be threatened or harmed by strangers, as they connect to share rides. While this issue is serious, it is gradually being addressed by state regulatory and insurance systems. For the purposes of D-RIDE, the agencies implementing the app will only be making rideshare options available and will not be involved in the acceptance or rejection of any given ride. Rideshare providers maintain review boards on the internet which serve as a guide to positive ride experiences and allow the companies to bar bad actors. This issue is therefore considered low priority.
- Increased Travel Times and Route Complexity. Dynamic routing and protected transfers have the potential to increase transit route service times. Transit operations may become more complex as agencies seek to service user needs dynamically, thereby extending the length of any given transit trip, and potentially increasing bus operating costs. However, this issue is considered low priority because it is expected that transit agencies will develop business rules to specify schedule and route conditions under which protected transfers are and are not acceptable to the system.

Chapter 5 Conclusion

The policy team has documented five not-yet-resolved potential policy issues for IDTO, two of them high-priority. In summary, the five issues and recommended next steps include:

- PII privacy—will be studied through analysis being conducted on privacy issues. Particular attention may be needed to ensure the deletion of PII from agency computer systems.
- Data sharing—analyze whether data on individual IDTO users will actually be shared with system operators, or aggregated for analysis and planning. The development of guidance on data sharing may be beneficial.
- Data interoperability—will be resolved by technical teams, but also embodies significant institutional policy challenges, such as the development of data sharing agreements.
- Regulatory status of rideshare – continue to monitor ridesharing legislation nationally.

The mobility application development process is responsive to numerous considerations; some of these are purely technical in nature, while others are policy-related. The final versions of the applications in each bundle will represent the optimal solutions to address all the issues. This report represents an important step in documenting the decisions that have been made throughout the application development process, so that stakeholders will be able to understand the history of how and why particular choices were made regarding application functionality, data sources, and other important factors.

The policy issues identified in this report as having been resolved or having identified solutions will not be pursued further. They are documented herein in case stakeholders raise them in the future and need to know how the DMA program has addressed them.

The remaining, open, issues—those unique to IDTO, those shared by multiple bundles, and those that may emerge in importance as IDTO deployment expands—are also documented in this report. These issues will be the focus of additional policy research, outreach, and other steps, including detailed privacy and security analyses.

It is expected that this report will support a dialogue with stakeholders. Stakeholders may comment on whether:

- There are additional policy or institutional issues that may present challenges to the successful deployment of IDTO and that are not documented but for which new or additional research and analysis is recommended.
- The policy options identified for resolution of the issues are appropriate.

APPENDIX A. Source Materials

In conducting this analysis, the policy team used the following documents and information sources about IDTO:

1. *Report on Assessment of Relevant Prior and Ongoing Research for the Concept Development and Needs Identification for Integrated Dynamic Transit Operations. November 7, 2011.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Science Applications International Corporation (SAIC).

2. *Report on Stakeholder Input on Transformational Goals, Performance Measures and User Needs for Integrated Dynamic Transit Operations. Final Report. March 7, 2012.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Science Applications International Corporation (SAIC).

3. *Integrated Dynamic Transit Operations (IDTO) Concept of Operations. May 11, 2012.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Science Applications International Corporation (SAIC).

4. *Report on Functional and Performance Requirements and High-Level Data and Communications Needs for Integrated Dynamic Transit Operations (IDTO). July 2, 2012.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Science Applications International Corporation (SAIC).

5. *Policy Analysis for the Connected Vehicle Dynamic Mobility Applications. Draft Report. April 12, 2013.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Volpe National Transportation Systems Center.

6. *Report on Functional Requirements and Software Architecture for the IDTO Prototype: Phase I Demonstration Site (Columbus). Final Report. August 30, 2013.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Battelle Memorial Institute.

7. *System Design and Architecture for the IDTO Prototype: Phase I Demonstration Site (Columbus). Final Report. November 19, 2013.*

   Prepared for the United States Department of Transportation, Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office. Prepared by Battelle Memorial Institute.

8. *IDTO Connected Vehicle Reference Implementation Architecture physical viewpoints, at: http://www.iteris.com/cvria/html/applications/applications.html*

APPENDIX B. List of Acronyms

AVL	Automated Vehicle Location
CABS	Campus Area Bus Service
ConOps	Concept of Operations
COTA	Central Ohio Transit Agency
CV	Connected Vehicles
CVRIA	Connected Vehicle Reference Implementation Architecture
DMA	Dynamic Mobility Applications
D-RIDE	Dynamic Ride Sharing
DSRC	Dedicated Short-Range Communications
EnableATIS	Enable Advanced Traveler Information Systems
FHWA	Federal Highway Administration
FRATIS	Freight Advanced Traveler Information System
IDTO	Integrated Dynamic Transit Operations
INFLO	Intelligent Network Flow Optimization
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
LYNX	Central Florida Regional Transportation Authority
MMITSS	Multi-Modal Intelligent Traffic Signal Systems
PII	Personally Identifiable Information
R.E.S.C.U.M.E	Response, Emergency Staging and Communications, Uniform Management and Evacuation
T-CONNECT	Transit Connect
T-DISP	Dynamic Transit Operations
TMC	Transit Management Center
UCF	University of Central Florida
USDOT	United States Department of Transportation

This Page is Intentionally Left Blank

U.S. Department of Transportation
ITS Joint Program Office-HOIT
1200 New Jersey Avenue, SE
Washington, DC 20590

Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

FHWA-JPO-14-134

U.S. Department of Transportation