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A Next Generation Advanced Traveler Information Precursor System (ATIS 2.0 Precursor System) Use Cases Report

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16. Abstract

Advanced Traveler Information Systems (ATIS) have experienced significant growth since their initial inception in the 1990s. Technologies have continued to evolve at a rapid pace, enabling the integration of advanced solutions for traveler information purposes.

As a result of the rapid evolution of technologies and tools available, the Federal Highway Administration (FHWA) has initiated new technical initiatives to investigate, plan, develop, design and implement 'Next Generation' or ATIS 2.0 solutions. This includes the investigation and design of new systems suitable for the collection and aggregation of traveler intent data for the use by system managers.

This Use Cases Report describes the process and results used to identify and document potential use cases where suitably processed traveler data might be used to improve current transportation system management practices. A group of diverse stakeholders provided insight on the potential use of disaggregate traveler itinerary/decision/mode data for enhanced transportation system management. The findings and insights gained in the stakeholder engagement effort included eight (8) draft uses cases, which were further refined into a combined total of five (5) use cases recommended for further analysis.

Ultimately, the new ATIS 2.0 Precursor System will advance the state-of-the-practice for ATIS by incorporating traveler intent data to provide congestion prediction systems for use by system managers.

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Revision History

Revision	Date	Change Description	Pages Affected
1.0	January 28, 2015	Initial draft	All
2.0	March 11, 2015	Addressing of FHWA and partner notes	All
3.0	May 7, 2015	Added Appendix D. Revised Use Cases	Appendix D

Chapter 1. Introduction

This document presents a list of use cases developed to support the Next Generation Advanced Traveler Information Precursor System (ATIS 2.0 Precursor System) project. Use cases were developed with the input of highway, transit and multimodal system managers and other industry stakeholders, as a foundation for the development and testing of a system that seeks to use advanced traveler information to benefit system management functions. In short, the goal of this process was to develop a list of use cases that focus on enhancements to system management functions and serve to provide insight into the information exchange, policies, and partnerships necessary to support system requirements.

This document provides background on the methods by which use cases were developed and evaluated in order to be included in this report.

The United States Department of Transportation (USDOT) Dynamic Mobility Applications (DMA) Program seeks to create and study transformative change in the area of advanced traveler information systems (ATIS). Within the DMA structure, the Enabling Advanced Traveler Information Systems (EnableATIS) concept focuses on the potential benefits of truly multi-modal trip planning and traveler information. The ATIS 2.0 Precursor System presents an opportunity to develop EnableATIS concepts and a framework within which to develop and test truly advanced traveler information collection and dissemination. Developing the requirements and testing mechanisms advancing traveler information is a foundational need for an ATIS 2.0 system and the focus of this project.

Over the past several years the focus within the traveler information arena has been on the development and deployment of systems that provide direct information and benefit to the traveler. A variety of systems and applications, which can offer tremendous benefit to the traveling public, have been and are being developed and operated by both the private and the public sector. The emphasis of the ATIS 2.0 Precursor project is to focus on a loop information flow from and to system managers to improve system performance, and to develop and test a system to obtain and manage this information. Underlying questions driving development might be: “What is the improvement generated by the system?” and “Does the precursor system allow system managers enhanced tools to identify and manage the transportation network?”

At the highest level, this project seeks to create and test the mechanisms of taking disaggregate data from multiple sources, including data that provides traveler intent, and combining them in new and innovative ways that allow system managers to make decisions for system response (actions) that are not possible today.

The development of use cases is a foundational activity to the progress of this project. The use cases developed, along with the accompanying hypotheses, will frame and guide system testing, and the obtainment of data that is expected to further the goals of ATIS 2.0. Development of the use cases presented in this document utilizes a discovery approach, and is intended to serve as a step conducted in parallel with stakeholder engagement activities.

The goal of developing the use cases presented in this report is to identify one or more testable hypotheses that is sufficiently robust to be further developed in later tasks and included as part of a six-month ATIS 2.0 precursor system field test. The precursor system use cases will focus on the delivery of user data to system managers so that those managers can better operate their systems. In short, the hypothesis developed for each use case focuses on the potential that the precursor system can enhance the functionality of an ATIS 1.0 system by adding new and innovative data capture and transformation techniques, thereby creating new functionality for ATIS 2.0. For each use case, a few basic questions were posed: “How does this use case improve the capture of data to improve system operations?”, “Who are the users?”, and “What role(s) does the system manager play?” Rather than employing the need to develop new software, the intent in developing testable use cases was to use an iterative integration approach that uses existing systems and data. Illustrating how existing frameworks, software and data can be used to facilitate the goals of ATIS 2.0 is at the core of the project intent.

Following this task, the project team will next select one or more of the use cases developed during the workshop and presented in this document. Further evaluation and selection of a use case will be completed based on the evaluation scores and the viability of the use case to support development of a precursor ATIS 2.0 system. An assessment will be made that takes into account existing infrastructure in the proposed field location, data that can be made available by data partner INRIX, and the degree to which real-time situational awareness can be recorded and interpreted for use.

Reference Documents

Item	Description
[1]	Battelle Proposal OPP116838 / A Next Generation Advanced Traveler Information Precursor System (ATIS 2.0), August 25, 2014
[2]	EnableATIS Strategy Assessment / Final Report – February 2014, U.S. Department of Transportation
[3]	Vision and Operational Concept for Enabling Advanced Traveler Information Services / Final Report – May 13, 2012, U.S. Department of Transportation

Chapter 2. Development of Stakeholder Group

The development of use cases was driven by the identification and engagement of a group of project stakeholders, culled from a variety of disciplines and sectors. The benefits of ATIS 2.0, anticipated to be proven within the confines of this project, are expected to have the greatest impact on system managers, therefore the development of use cases had to include the thoughtful input of representatives of the group who are expected to be the most positively impacted. In addition to system managers, professionals from other disciplines involved in traveler information were also invited to participate.

The project team identified a need to obtain participation from a variety of stakeholders; therefore, before potential names were identified, the project team developed several categories in two major areas:

Discipline and Type. Discipline refers to the type of work for which a stakeholder is primarily responsible.

Five general Disciplines (as well as a category for category overlap) were identified:

- Traffic Management
- Transit Management
- Parking Management
- Maintenance and Construction
- Emergency Management
- Multi-discipline

A distribution among sectors, or types of agencies and/or companies was felt to be necessary. The four types of participants desired were:

- Public agency
- Private company
- Educational
- Non-governmental Organization (NGO)

Development of a list of potential stakeholders was initiated from the project team's proposal, subsequent conversations with Federal Highway Administration (FHWA), and internal project staff knowledge and contacts within the traveler information community. The initial list of potential stakeholders who were contacted and invited to participate in the discussion is presented in Appendix B.

As the list of potential participants was developed, a running list of members within each Type and Discipline were likewise recorded. The goal of keeping a list of distribution by Type and Discipline was to ensure that the distribution was as wide as possible, with no one category being too heavily represented at the expense of others. The breakdown by Type and Discipline are presented in Table 1 and Table 2.

Table 1. Discipline Distribution: Potential / Invited Stakeholder List

Discipline	Totals
Traffic Management	17
Transit Management	6
Parking Management	2
Maintenance and Construction Management	4
Emergency Management	2
Multi-Discipline	10
Total	**41**

Table 2. Type Distribution: Potential / Invited Stakeholder List

Type	Totals
Public	24
Private	8
Educational	6
NGO	3
Total	**41**

The initial list of stakeholders was then delivered to USDOT for review. Discussions followed between USDOT and Battelle project staff regarding the viability and proper distribution of the list of potential stakeholders. After the list was finalized, an email was drafted with the purpose of introducing the project, setting expectations for stakeholders, and inviting recipients to participate. The email, distributed on November 17, 2014 read:

Subject: Stakeholder Participation Requested for FHWA ATIS 2.0 Precursor System Project

Dear Traveler Information Professional –

The United States Department of Transportation (USDOT) has been developing an initiative called "Enabling Advanced Traveler Information Systems (EnableATIS)" as a high priority application area of the Dynamic Mobility Applications (DMA) program. EnableATIS promotes multimodal, end-to-end trip planning, increased data collection, fusion, and sharing, predictive analytics, and intelligent decision support to create an operational environment that provides personalized information services to users. The overall vision and concept of the EnableATIS program can be found online at http://ntl.bts.gov/lib/45000/45900/45929/Final_Package_FHWA-JPO-12-052_508.pdf.

Under the DMA program, the Battelle Memorial Institute is working to develop a next generation ATIS 2.0 Precursor System. Hypotheses and use cases will be tested that successfully integrate disaggregate traveler behavior data into actionable information for system users and managers, with the overall goal a possible improvement in transportation system management practices.

It is regarding the development of use cases for which we are reaching out to you. We seek the participation of stakeholders from a variety of market areas and disciplines; from the private and public sector, with unconventional approaches, who can help define valuable and testable use cases. We are hoping you might consider becoming a project stakeholder and in doing so, provide your valuable input to the development of this project.

Our first engagement is a Workshop being held on Monday, December 8th at the Battelle offices in Arlington, VA as well as via WebEx. The Workshop will run from 10:30 am to 4:30 pm, and will be dedicated to developing a set of use cases that can be enabled through the capture of expanded traveler information data as envisioned for ATIS 2.0.

If you are indeed interested in participating, please respond directly to me via email. We will provide location and additional details about the Workshop.

If you have any questions regarding this email or the project itself, please feel free to contact the government task manager for this project, Bob Rupert from FHWA at 202-366-2194 or Robert.Rupert@dot.gov, or Michael Waisley, Battelle Project Manager at 703-413-7818.

Thank you very much.

Those invitees who responded in the positive were provided with a "stakeholder packet". The packet contained an explanation of the goals and objectives of the ATIS 2.0 project overall, a list of all invitees, an agenda for the Workshop, links to several supporting documents, and explanation of what would be asked of the participants.

Chapter 3. Stakeholder Workshop

The Stakeholder Workshop to facilitate the development of use cases was held as scheduled on December 8, 2014. A majority of attendees participated by phone/webinar. Those invitees who were local to the D.C. area and were able, attended in person at Battelle's offices in Crystal City, VA.

The agenda distributed for the meeting included the following line items:

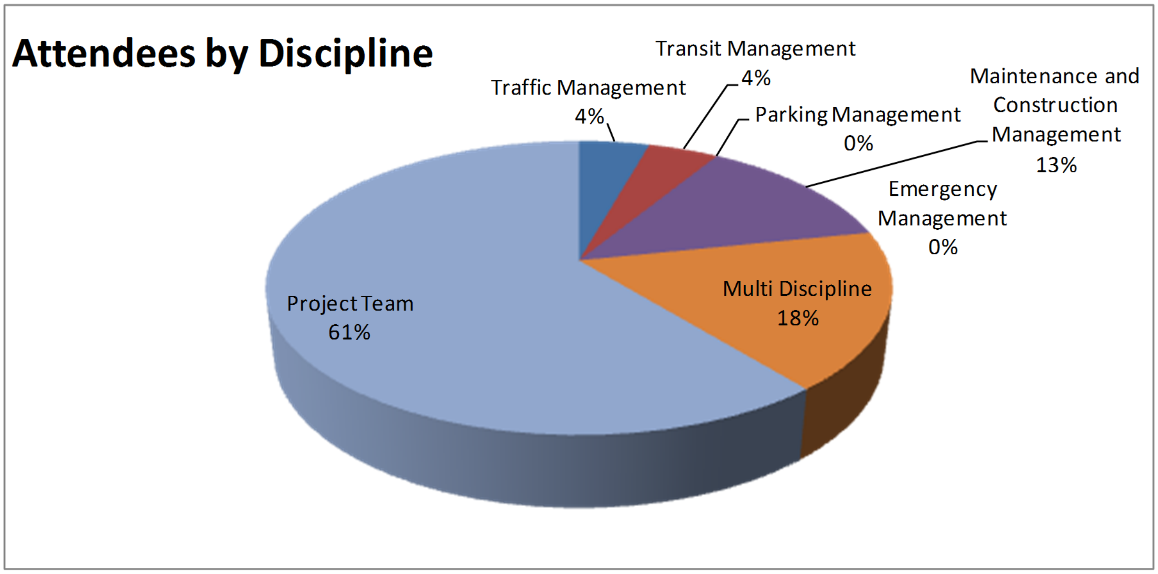
- Welcome, introductions, and objectives
- Project overview / background
- Data infrastructure review
- Stage 1: Brainstorming new use case ideas
- Stage 2: Development of use cases list
- Stage 3: Ranking and selections of 5 – 10 use cases
- Stage 4: Development of 5 – 10 use cases
- Conclusions / next steps

Many of the invited potential stakeholders did attend the Workshop. Some substitutions were made where an invited guest was unable to attend, but provided an alternate instead. The list of attendees presented in 0 includes participating stakeholders as well as USDOT, FHWA, and Battelle project staff. Note that the attendees who are project team members have no data in the "Discipline" column as the categorization was not relevant for this subgroup of attendees.

The breakdown of Workshop attendees by Discipline are presented in Table 3 and Figure 1.

Table 3. Discipline Distribution: Workshop Attendees

Discipline	Totals
Traffic Management	1
Transit Management	1
Parking Management	0
Maintenance and Construction Management	3
Emergency Management	0
Multi-Discipline	4
Project Team	14
Total	**23**



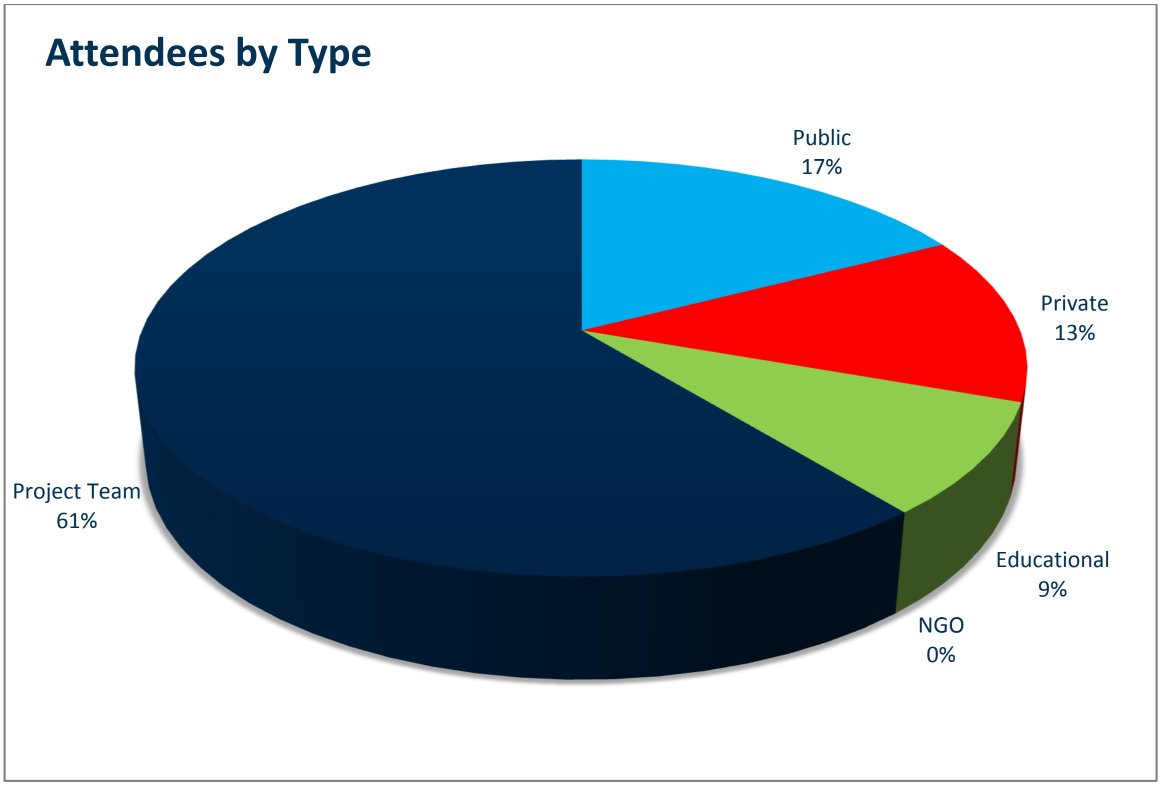
Source: Battelle

Figure 1. Workshop Attendees by Discipline

The breakdown of Workshop attendees by Type is presented in both Table 4 and Figure 2.

Table 4. Type Distribution: Workshop Attendees

Type	Totals
Public	4
Private	3
Educational	2
NGO	0
Project Team	14
Total	**23**



Source: Battelle

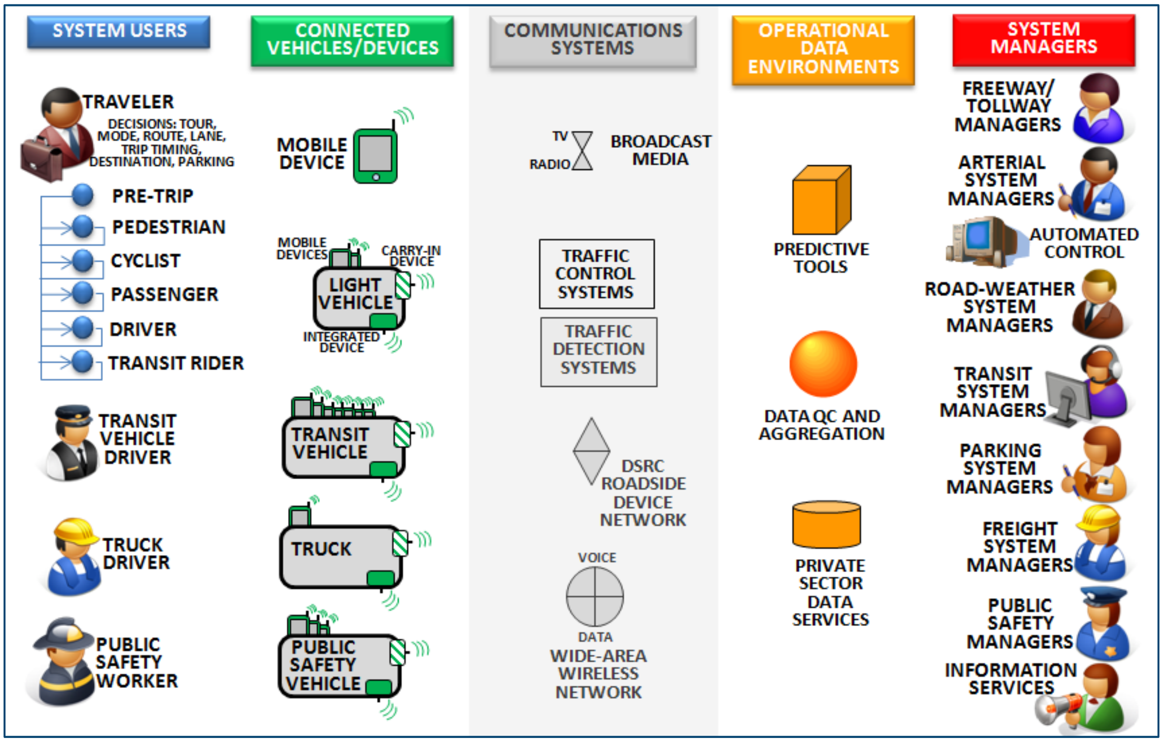
Figure 2. Workshop Attendees by Type

The agenda for the meeting was developed with the intention of providing a brief background on the project goals and framing those goals for use in the development of use cases. A general definition of use case, for the purposes of this project, was provided:

"Use Case: A scenario where suitably processed itinerary/decision/mode data might be used to improve current transportation system management practices."

Much of the background and the anticipated process to develop use cases was illustrated by the review of the DMA decision framework, provided in Figure 3. It was explained to Workshop attendees that for the purposes of this project where the focus is on the system manager, the genesis of use cases would stem from the rightmost column entitled "system managers". From there, elements of the use case involving system users, connected vehicles / devices (where applicable), communications systems, and operational data environment would be documented. A good use case was described as a 'win-win for both the system operator and the traveler.'

Challenges to implementing a system based on the developed use cases was a topic of conversation. As the stakeholder group embarked on developing the ideas that would turn into use cases, it was mentioned that privacy may be an issue and should be considered during the discussion. It was assumed that most systems would require some sort of opt-in process on behalf of the user (traveler). The degree to which the user may be concerned with the privacy of his or her data, even to the point of not participating, was identified as a salient issue. In addition, the number of users necessary to develop a statistically significant sample was identified as a possible risk. Different use cases were expected to require a different number or percentage of participants to be useful, and those that would ultimately require a lower percentage of buy-in or participation would likely be considered "lower hanging fruit".



Source: U.S. DOT

Figure 3. DMA Decision Chain Framework Diagram

Using the DMA Decision Chain Framework Diagram to develop use cases, it was suggested to attendees that the following elements be considered during the evaluation of each idea:

- What elements of the DMA Decision Chain Framework are covered?
- What problem(s) are being identified?
- Will the use case address traveler needs?
- How can the solution be developed?
- What are the benefits?
- Are there both immediate and long-term effects?

The core activities planned for this Workshop were encompassed by the four stages, following the agenda. Those stages are described below, along with a brief explanation of each:

- Stage 1: Brainstorming new use case ideas – The goal of stage 1 was to facilitate an open discussion where stakeholders could brainstorm ideas for potential use cases. During this stage, stakeholders were asked to not limit their suggestions based on assumptions of cost or resource availability. The idea in overseeing an open discussion was to solicit ideas unconstrained by real-world restrictions. It was generally agreed during the planning stages of the Workshop that ideas too broad or otherwise not viable can easily lead, in a spirited discussion, to additional ideas that might be more appropriate and viable. The intent in Stage 1 was to develop a large list of potential use cases, knowing that only a few would likely be chosen ultimately for inclusion in the final list.

- Stage 2: Development of use cases list – After an open discussion that generated various ideas and fragments of ideas, a list of use cases was developed, taking the best and most viable ideas from the open discussion. Those use cases, simple titles, or descriptions, were then separated out and prepared for the next stage.
- Stage 3: Ranking and selections of 5 – 10 use cases – The ultimate goal of the Workshop was to define a short set of 5 – 10 use cases from which the project team could further refine the list to one or two testable concepts later in the project. Therefore, it was presented to attendees that Stage 3 would evaluate the longer, initial list that would then provide a short list of viable, preliminarily-vetted list of ideas to be fully developed in Stage 4.
- Stage 4: Development of 5 – 10 use cases – The final stage in the process involved a dedicated, thorough review and evaluation of the short list of 5 – 10 use case ideas.

To have a consistent evaluation of each use case, a list of evaluation, or rating criteria was developed. Those criteria were selected from evaluation documents supporting similar projects at the federal level, and refined with the help of stakeholder input. The project team came to the Workshop with a list of six criteria, which were discussed, debated and refined during discussion. The six evaluation criteria ultimately developed were:

- Measurable Outcomes (Testability) – The core quality that allowed a use case to be selected was the extent to which the use case, or the hypothesis derived from that use case, could be objectively tested. Various ideas were presented that, in the abstract, appeared to be useful and viable candidates. However, upon application of this preliminary metric, it was discovered that the viability of the idea was significantly reduced if there was not a way to measure some sort of outcome.
- Solving a Local Problem – The extent to which the data derived from a use case could solve a local problem was deemed a metric by which to measure the idea. The project team identified a need to be able to test the hypothesis for each use case, while staying within the confines of the project budget and schedule, and limiting results to a local problem was a way to achieve that goal. The team evaluated ideas based on how they addressed not only some kind of problem, i.e., a justification for development, but evaluation using this metric focused on that which could be understood and used to benefit users and managers at a local level.
- Geographic Reach – Originally labeled “Scalability”, this metric focuses on the likelihood that the use case under discussion could potentially be replicated, or used as a model in other deployments. Understanding that scalability has its own built-in constraints, e.g., a use case involving the transit network could not be replicated in an environment with no transit options, an idea that can be used in similar environments would receive a higher score in this area.
- To ATIS 2.0 – The element, idea, or characteristic that distinguishes the use case under discussion as an ATIS 2.0-ready idea takes into account how much the idea captures traveler intent and provides a feedback data loop. (Contrast ATIS 2.0 with ATIS 1.0, which only provides current transportation system status to travelers and system managers.) ATIS 2.0 envisions an operational scenario where data generated by one user group (travelers) does not stop with those travelers, but is delivered to system managers so that they too can benefit

by using that information to affect change to the transportation network. This metric was used to evaluate how well each use case adheres to the principles of using and reusing data for the benefit of all user groups.

- Builds on Existing / Connected Vehicle Infrastructure – It was important to the project sponsor that infrastructure: equipment, software, code, and developed applications, be used as much as possible to reduce the cost of design and deployment. Use cases that made better or greater use of existing infrastructure, including those dedicated for use in connected vehicle applications, were ranked higher.
- Plan for Long-Term Use – Longevity was seen as a critical point of evaluation for use cases. A use case for a system that could be useful in other deployments, in long-term use, would amass a higher score than those that did not have these characteristics.

Chapter 4. Use Cases

A traditional use case presents a list of steps that describes and defines the relationships and interactions between the actor, which can be a person, a system, a period of time, etc., and the system that is acted upon, to achieve an outcome or goal. A use case, in software and systems engineering, is generally represented in a diagram that illustrates the interaction between user, or actor, and system and describes communication or interaction, conditions, and constraints.

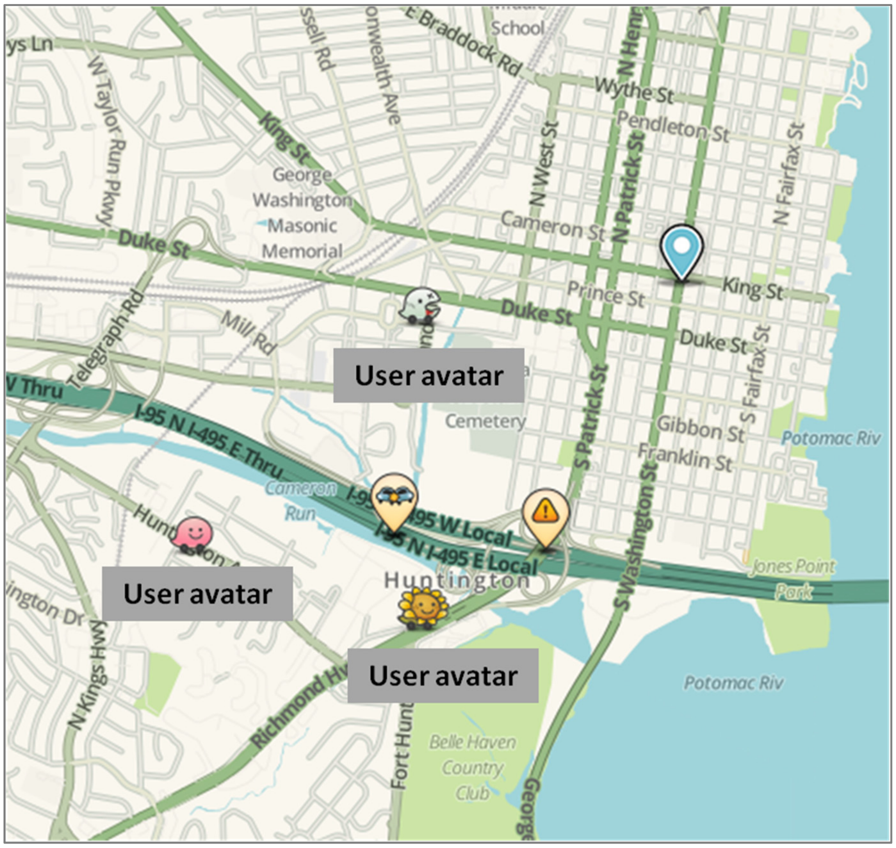
For the purposes of this project, the DMA Decision Chain Framework, illustrated in Figure 3, was used as the conceptual basis of a use case diagram format. Users in these scenarios are represented by the first column, System Users, and the last column, System Managers. The elements that comprise communication, interaction, conditions and constraints are represented in the middle three columns: “Connected Vehicles / Devices”, “Communications Systems” and “Operational Data Environments”.

The use cases that proceeded to Stage 3, selection of a list of potentially viable ideas, are presented in this section. To ensure consistency among the use cases during development, each use case is presented using a consistent set of elements:

- Title /short description
- Hypothesis
- Full description
- Comparison of ATIS 1.0 and ATIS 2.0 functionality

Development of Use Cases for this project involves significant conceptualization, as the ATIS 2.0 Precursor System has yet to be developed. A cross-cutting issue presented in the discussion of many of the use cases is incentive; in other words, how will users be incentivized to perform an action that provides data to the system, regarding user intent? While the details of how users will interact with the system have not yet been determined, it is generally assumed the system will offer some sort of incentive to users.

One way to offer incentive is to develop an element of “gamification” in the system design. The term, as it relates to the design of the precursor system, refers to the use of game design and techniques to capture the attention of and reward the user for continued or increased use of the product. The concept is illustrated in Figure 4. The screenshot is from Google’s Waze traffic information application, showing a view of Alexandria, VA. The three icons labeled “User avatar” illustrate how Waze users are able to select different avatars. New users are assigned the same avatar, but with use and by interfacing with the applications in different ways (reporting traffic, sending in a picture attached to a report, ‘confirming’ an existing report) that user receives points, and with additional points can select from an increasing selection of icons.



Source: Waze

Figure 4. Waze Screenshot

In terms of the ATIS 2.0 Precursor project, the element of game design that the system would benefit from is a non-financial reward system.[1] A non-financial award might be points, new icons or avatars available to the user, or a place on real-time competitive “leader boards.” The ability to capture user intent is a critical part of this project, and several of the use cases involve the use of rewards to entice users to offer data on their own intent.

Potential use cases were developed for the Battelle proposal for this project. While these use cases were not discussed during the Workshop, one of these uses cases may still be considered and is presented here using the same categories as those that were developed with stakeholder input.

[1] Certainly, a financial reward system could be part of project design, however it is assumed that financial rewards to users is out of the scope of this project.

Use Case #1: Providing Travel Conditions Information and Receiving System User Feedback

Short Description

Enhancing the system conditions information available to system managers will lead to improvements in system operation and traveler perceptions.

Hypothesis

System users provide information to system managers, who in turn use the data to improve the roadway network conditions.

Expanded Description

The purpose of this use case is to describe how system users can provide real time travel conditions to system managers, who can use feedback to improve the operations of their roadway network and provide valuable information back to the system users. Data collected can be quantitative and include weather, incidents, debris, congestion, speeds, travel times, toll plaza slowdowns, road conditions and related roadway network data. These data describe the system conditions that exist on the roadway network. In addition, as connected vehicles start to deploy, large quantities of data will become available and could include vehicle positional data, real-time road conditions (e.g., wet), real-time weather (e.g., rain), route, and schedules. Other quantitative data might include when a vehicle started a trip, expected arrival times, route choice, and dwell times. Across the spectrum of the transportation system, conditions are expected to come from different data sources.

System users can also provide valuable feedback to system managers using qualitative data. Qualitative data are more about perceptions of how acceptable conditions are at their location or on their route; basically the overall status. Examples might include social media posts pertaining to system quality, comparison of conditions from one route or mode choice to another, customer satisfaction, and similar measures. System managers can use one or more of the communication mechanisms to create a two-way conversation between the System manager and system users.

Example Scenario

A traveler finds himself within the transportation network; for instance, a rider on a bus. The user sees that there is a change in normal conditions; such as, there is congestion which can be observed visually by the passenger, and/or the transit vehicle has slowed or stopped. Quantitative data include the slowing of the vehicle and an increase in travel time based on the vehicle's trip origin time and expected arrival time. Qualitative data include the perception of a lengthening travel time, as well as the traveler seeing information regarding the situation. The traveler wonders, "Why has the bus slowed?" The traveler's experience and satisfaction with the trip/vehicle/system manager is reduced.

Using the precursor system, the traveler's location (automatically via global positioning system (GPS)), is collected. In addition, the behavior of the traveler in terms of interaction with the precursor system is captured, as he checks conditions, finds an alternate route, etc. The system may offer an incentive to the user, so that interactions result in the user adding value to his account. Once the traveler interacts with the precursor system, the data collected during that transaction is delivered to the transit system manager. According to the hypothesis being tested, the system manager, now equipped with that data, can better understand in real time not only real time system conditions, but be able to anticipate conditions in the future. The data chain would allow that manager to adjust the system and/or use the information from the app. The manager may respond by adding a new bus due to volume, posting an electronic message imparting relevant information at the bus station(s).

Table 5. Use Case #1 Comparison Table

ATIS 1.0 System	ATIS 2.0 System
A bus experiences non-recurring congestion.	In response to a degradation in current conditions, a traveler checks his device to find additional information or alternate modes of travel.
Monitoring the ITS infrastructure, the system manager takes available action to manage the network impact.	Speed and location data are delivered to the system manager in real time. The system interface offers the user points or upgraded status to provide information on his intent, in terms of changing any part of his trip, or confirming he will act on the information provided by the application.
	The transit system manager also obtains information from private sector information service providers (ISP).
	The transit system manager develops a message geared towards the transit rider, and disseminates that message on the precursor system, via private sector ISPs and using physical infrastructure such as message signs at bus stops and stations within the vicinity of the event.

Use Case #2: Trip Planning With Dynamic Arrival Time

Short Description

The ATIS 2.0 Precursor System allows arrival times to be adjusted based on real-time conditions experienced by the traveler. This use case can conceivably include all modes of travel.

Hypothesis

Trip planning with accurate arrival time prediction allows for better asset planning, better performance metrics, increased ridership, increased reliability, and increased throughput.

Expanded Description

This scenario describes a feedback loop of data between system users and system managers. The precursor system provides travel times based on origin and destination points chosen by the user, and the interface offers the user an incentive to provide his or her trip choice via the app.

Added to the data collected by system users/testers, the precursor system ingests route and travel time information from a private partner, i.e., INRIX. The precursor system then uses the large dataset generated by the INRIX mobile application and combines it with data regarding precursor system user intent. As system managers receive real-time transportation network data, estimated arrival times are updated and pushed to the traveler using the precursor system. Therefore, the arrival time predictions delivered to the traveler are more accurate and meaningful as the incoming data are used to adjust arrival times in real time. Managers achieve better asset planning and are able to maintain transit ridership.

Example Scenario

A cyclist uses the ATIS 2.0 precursor system to plan a combination bike and transit bus trip (using a bus bike rack), from the north end of an urban environment to the south end. The cyclist uses an application that recommends a route and an estimated travel time. As the cyclist embarks on the bike trip, the arterial system manager receives real-time data regarding a collision on an arterial on the cyclist's route. Based on the real-time information, received after the cyclist started his trip, an alert is pushed to him, updating his estimated arrival time and offering an alternate transit bus route.

Table 6. Use Case #2 Comparison Table

ATIS 1.0 System	ATIS 2.0 System
A traveler uses an application / website / other method to get travel times on a specified route(s).	System manager uses precursor system data, as well as existing ITS infrastructure to monitor travel network conditions.
Travel time is static, calculated based on information gathered at the time of route generation.	As conditions change, the precursor system app provides updated, real-time travel time estimates.
	System manager gets crowd sourced data feeding back on arrival times.

Use Case #3: Point-to-Point Cost Evaluation

Short Description

Users of the ATIS 2.0 precursor system have access to information that compares different routes/trips in terms of cost in one or more categories, including financial, tolls, time, calories, carbon, and potentially other measures.

Hypothesis

When system operators are able to inform/incentivize travelers with options comparing the cost of their trip to viable alternatives, the net effect is trips that are cheaper, healthier, faster, and better for the environment.

Expanded Description

Trip planning that informs users of the relative cost of trips achieved through different modes or during different times is a current ATIS functionality. The added element that characterizes this use case as ATIS 2.0 is the collection of decision information that follows from the cost information distributed. The ATIS 2.0 precursor system offers cost-based information by route, and it receives data regarding the decision made, as well as the results of that decision. End users must be provided with all pertinent information about those cost categories, so managers can manage and incentivize.

Example Scenario

The commercial vehicle operations (CVO) industry operates on thin profit margins, and opportunities to decrease costs and/or increase efficiency are highly valued. A commercial truck company who allows its dispatchers to use the ATIS 2.0 precursor system may load it with current planned routing information. In contact with his drivers, the dispatcher can guide and reroute drivers to the route that offers the lowest estimated gas cost. Rather than a gaming paradigm, this scenario would use the data regarding reduced cost as the incentive for the user (dispatcher). Data regarding the real-time re-routing of truckers in this scenario is captured by the system, and used for real-time highway and roadway management.

Table 7. Use Case #3 Comparison Table

ATIS 1.0	ATIS 2.0
Travelers have little information regarding the cost of a trip. Miles per gallon and cost of fuel can be calculated. Some mobile applications for smartphones offer cost as a metric to evaluate different choices for travel.	Travelers are presented with an estimated unit cost, by mode, of a trip. Cost is presented in terms of finances, tolls, time, calories, carbon, and/or other measures.
	System managers, aware of cost information, can provide incentives to travelers to shift mode, departure time, etc.
	Travelers have enhanced information with which to choose a mode of travel and departure time, and a possible incentive to change modes and departure time.
	The mode choice is recorded and that data is delivered to system managers.
	Data from users' tools is used to calculate calories.
	Gaming can be used to incentivize modes.

Use Case #4: Real-time Changes in Service, Payment and Mode Availability

Short Description

Real-time changes in service availability, payment options and mode options are made based on real-time demand.

Hypothesis

Operators will be able to predict/fill demand for services and payment methods needed by users with the availability of that demand information. In addition, the information will help operators meet regulatory/compliance/political requirements, such as the Americans with Disabilities Act (ADA) or Leadership in Energy and Environmental Design (LEED).

Expanded Description

System managers receive information about the demand for accessibility, e.g., wheelchair or bicycle-accessible, stairs, elevator, escalator, access to wireless communications, and available forms of payment. Those system managers are then able to answer that demand, and possibly predict demand in the future. A baseline may be used in this use case, setting a level of regular demand at a certain time. Real time data adjusts this baseline capacity, and allows for system managers to adjust capacity/availability. One example may be a disabled user in a wheelchair who is able to request additional time to cross the street.

This use case may also provide benefit to system planners, in the areas of:

- Special events, evacuations, and other emergencies
- Standard Operating Procedures (SOP) development
- Value when historical data are not available
- Better managing substantial fleets of special use transit vehicles (sometimes privately held)

Example Scenario

A traveler may need to know: does Fairfax County Transit take the Washington Metropolitan Area Transit Authority (WMATA) card? Is a smart card required? Do transit vehicles in Fairfax County offer the same services to disabled users that those users receive when they use WMATA? Users of the application/precursor system would be able to get that information in real time, as well as request additional forms of payment.

Table 8. Use Case #4 Comparison Table

ATIS 1.0	ATIS 2.0
System managers collect data regarding use of services and use that for future planning.	Users are able to request services in advance or at the time of need.
Travelers either find out the availability of services when they are present, or obtain information before their trip.	System managers collect data in real time regarding the use of services.
	Availability of services is adjusted in real time, based on demand.

Use Case #5: Special Events Management

Short Description

Special events management includes load balancing, trip prediction, evacuation, and weather events.

Hypothesis

During situations where there is a dense population of travelers driven by sporting events, concerts, or other large gathering that affect traffic, system managers and emergency managers can tailor information and system controls to minimize traveler delay and event distribution of travelers by utilizing individual traveler intent, decision, and position data.

Expanded Description

Both planned and unplanned disruptions can impact operations, such that the system does not operate normally and evolves rapidly. System managers want to get information to travelers about available capacity, and travelers in turn need that information to make informed decisions. The traveler also needs to know what options are available. Should the traveler delay or cancel the trip? Travelers will use the precursor system to document intent in the form of requests for alternate route or mode choices, then receive the real-time instruction about the most advantageous way to proceed, and telegraph their choice in return. Even if the users ignore the advice, system managers could capture that decision.

An example can be experienced using Google Maps or Waze. These applications give the user three possibilities, from which the user can select the preferred route. The addition in this use case would be the presence of real-time data that affects, and changes if necessary, the advice given by the application.

Example Scenario

An attendee at a well-attended professional football game arrived at the venue by car. An unexpected problem occurred during the middle of the game, such as a power outage that shuts off all the lights and causes the game to be postponed. Thousands of people trying to leave the stadium at the same time crowd the parking lot exits, adjacent arterials, and nearby transit stops. A portion of those attendees are using the ATIS 2.0 Precursor System, which is receiving data about many users at the venue exits and high usage of the transportation network at that location. Users are returning to the system, or app, to request information on alternate routes, modes, and times of travel. System managers, receiving data regarding those requests, are able to answer demand in real-time by adding transit vehicles to the network, using existing electronic signs to disseminate information regarding alternate routing, having field staff redirect arterial traffic, and/or etc.

Table 9. Use Case #5 Comparison Table

ATIS 1.0	ATIS 2.0
Travelers during a special event are provided information on congestion, or heavy load on the transit network.	System managers are given additional real time information about demand and capacity and are able to address the congestion, by adding transit capacity, or changing placement of traffic cones for outgoing drivers / pedestrians.
Travelers can use mobile applications to review and assess conditions.	Large traffic generators, such as parking lot owners, are able to better redirect users to the best exit path and are able to better manage staff resources during events.
	Local police in communication with system managers reroute traffic in “real-time”.
	System managers offer incentives to travelers who delay their travel offsite.

Use Case #6: Parking – Space Availability, Reservation, and Rates

Short Description

Provision of parking information, space availability, reservations and rate adjustments based on real-time load information.

Hypothesis

Increased user data capabilities in parking allows the operator to better balance loading, manage pricing, and maximize profit/revenue.

Expanded Description

Different types of parking venues and systems, convention and special event facilities, on-street metered parking, transit park-and-ride lots, and small surface lots in dense urban areas are potential sites of the ATIS 2.0 precursor system development.

Variable parking space pricing is based on availability of spaces and current load. Users are able to use the precursor system to make reservations, and those data are sent to system managers. The source of information for parking availability applications include sensors, meters, payment type accepted (cash only, credit cards, Apple pay), vehicles, etc. This data may also include availability of infrastructure in a specific parking location such as availability of electrical charging data.

Example Scenario

A concert is scheduled in a downtown (urban) venue. There are several parking options including valet parking, a covered parking garage, open-air on-street parking, and self-pay parking. The cost for parking varies from the most expensive being near the venue, decreasing in cost as the parking options get further from the venue. As attendees arrive downtown, they utilize a parking application to determine parking availability and parking rates. A system manager at one of the parking facilities close to the venue notices their facility is not filling as fast as it normally does. The system manager decides to offer a discount to the next twenty-five attendees to park at their facility. Attendees receive the notice on their smart phone, as well as their distance from the facility.

Table 10. Use Case #6 Comparison Table

ATIS 1.0	ATIS 2.0
Individual parking data may be available in some situations.	Parking availability is more readily available from more sources. Parking lots have more infrastructure integrated for measuring spaces. System managers obtain transportation network prediction through parking user advance reservations.
Data are distributed and uncoordinated between the different facilities.	More on-street parking information is available electronically, and there is more data available at a zone level for parking. Historical parking user data can be tracked and used to predict future parking and transportation network conditions.
Space availability is displayed at the facility.	On-street and parking lot data are integrated and updated for users and operators.
	System operators can use knowledge about parking space availability to encourage mode choices.
	Demand based pricing is available.
	Redirecting travelers to a specific area away from congestion or to facilities.

Use Case #7: On-Demand Dispatch

Short Description

On-demand dispatch, ride sharing, routing, scheduling, of specialized vehicles /home pick-up transit vehicles.

Hypothesis

Jurisdictions may make an informed policy decision to implement a 100% demand-responsive cordon augmented by user intent, decision, and position data that improves accessibility, reduces carbon, and costs less for everybody.

Expanded Description

For personalized transit, this application would allow on-demand dispatch, ridesharing, routing, scheduling, of specialized vehicles/home pick-up transit vehicles. With integration of user data, agencies could execute better cost analyses for this type of ride share. Integration of data would allow consideration of roadway conditions including traffic and weather conditions to help predict expected departure and arrival time.

Example Scenario

A local transit agency implemented on-demand transit on one of its routes. The transit agency provides potential riders with access to schedule a pickup via their website, a smart phone app or contacting the transit call center. People request a ride providing their location, destination, and time they wish to be picked up. The transit agency deploys several vehicles to service the ridership. The agency determines which vehicle will accept the request and notifies the vehicle driver of the requested location and time to arrive. The rider is notified of the anticipated arrival time and transit time to their destination.

Table 11. Use Case #7 Comparison Table

ATIS 1.0	ATIS 2.0
Private transit systems are disaggregated and independently operated, sometimes several organizations for a single transit agency.	Riders request to be picked up at the home or business.
Transit vehicles are fixed route and pick up riders at fixed stops.	Transit vehicles are dynamically routed based on demand.

Additional Use Case: Adaptation of Signal-timing Plan

Short Description

Adaptation of signal-timing plan based on planned usage.

Hypothesis

Predictive data received and evaluated from the ATIS 2.0 Precursor System will allow a signal-timing plan to be adapted to predicted usage, and the adjustments made will create better mobility and increased safety.

Expanded Description

Data available through the Precursor System includes predictive analytical information. This data, identified by system managers can be used to adjust signal-timing based on estimated traffic conditions and also be shared with the system users through travel information services.

Example Scenario

City traffic engineers currently use historical data, traffic studies, and predictive data to help develop arterial signal timing plans. Plans are updated based on several factors, most significantly the performance of the network during previous periods. Baseline metrics would be established such as traffic counts, and average travel time through a corridor. Once baseline data has been collected, a signal timing plan is developed and put into use in the chosen corridor. Data are collected in that corridor over an established period of time. The ATIS 2.0 precursor system is deployed in the corridor, which allows the collection of large amounts of data that are then delivered to the system manager, who can adjust the signal timing plan in real time based on those data. Data are again collected using the same metrics of traffic counts and average travel time.

Table 12. Proposed Use Case: Comparison Table

ATIS 1.0 System	ATIS 2.0 System
Arterial system managers use historical and some predictive data to develop signal timing plans.	Increased quantitative data such as traffic volume, speed, and average travel time are collected via the ATIS 2.0 Precursor System and delivered to the system manager.
	The system manager is able to use the enhanced data to implement an improved signal timing plan in real time for that corridor, resulting in reduced travel times.

Chapter 5. Evaluation of Use Cases

The final portion of the Stakeholder Workshop involved applying a rating process to the list of use cases, using the categories presented in Chapter 2

- Measurable Outcomes
- Solving a Local Problem
- Scalability
- To ATIS 2.0
- Builds on Existing / Connected Vehicle Infrastructure
- Plan for Long Term Use

It was decided that the process of evaluation would rely on general consensus achieved through discussion. If it became apparent that there was disagreement regarding the evaluation of any of the use cases, the project team would conduct follow-up engagements with stakeholders. However, this problem did not materialize and all use cases were successfully evaluated during the Workshop.

Each rating criterion was discussed individually for each use case. A scoring system of 0-5 was used, with 0 indicating the evaluation category was not likely to be addressed by development of the use case, and 5 indicating the category would be well addressed by development of the use case.

Prior to providing the ratings, stakeholders had some discussion regarding the uncertainty in using a variable rating scale. A few participants preferred simple yes/no answer to the rating question: "Is development of an ATIS 2.0 precursor system based on a use case likely to achieve measurable outcomes category, or not?" It was decided that the 0-5 scoring rubric would remain, and if additional development or discussion was necessary, it could be achieved offline in follow-up discussions.

It was decided during evaluation discussions that the Payment and Mode Availability Use Case, was similar to, and could be addressed within the confines of Use Case #4. Therefore, those use cases were combined.

The topic of weighting categories was discussed. The evaluation process contained six metrics by which all use cases were measured and scored. For instance, it might be argued that the likelihood that the category "Measurable Outcomes" may ultimately be more important, and therefore should be more heavily weighted, than "Builds on Existing Connected Vehicle Structure" or "Plan for Long Term Use". After the initial scores were computed, the discussion amongst the project team continued, regarding the value of weighting scores. It was decided that the project team would not apply any weighting to the categories at this point. In keeping with the goal of consistent evaluation, the team did not want to introduce the amount of subjectivity necessary to decide how categories are weighted. Only through discussion and consensus would it be decided how each category should be weighted, by how much and in what proportion to other categories. In addition, it became apparent that the initial scores were distinct enough, e.g., there was enough space between scores that there was no need to assign different weights to categories at this point. No two use cases were so close in scoring that any additional process was necessary to further distinguish them.

The option of weighting categories might be employed as the project team progresses further into the final evaluation of the use cases that will be selected for deployment for this project. The results of the discussion and scoring are presented in Table 13.

Table 13. Use Case Scores

#	Use Case	Criteria for Use Cases (0 - 5)							
		Measurable Outcomes	Solving a Local Problem	Scalability	To ATIS 2.0?	Builds on Existing/CV Infrastructure	Plan for Long-term Use	Totals for Use Case	Ranking
6	Parking – Space Availability, Reservation and Rates	4	4	4.5	4.5	5	4.5	26.5	**1**
1	Providing Travel Conditions Information and Receiving System User Feedback	3.5	5	5	2.5	4	5	25	**2**
3	Point-to-point Cost Evaluation	2.5	5	5	4	4	4	24.5	**3**
5	Special Events Management	2	5	3	4	5	5	24	**4**
4	Real-time Changes in Service, Payment and Mode Availability	2	2	5	4	5	5	23	**5**
2	Trip Planning with Dynamic Arrival Time	2.5	4	4	4	3	5	22.5	**6**
7	On-Demand Dispatch	1	2	2	5	4	3	17	**7**

Chapter 6. Conclusion

Development of a set of use cases was completed with the input of stakeholders from a variety of disciplines within the transportation community representing the private, public, and educational sectors. As the project overall is based on a discovery approach, the process to develop the list of use cases presented in this document was intended to be completed in iterative steps, with the input of project stakeholders from the transportation and traveler information community. The ultimate goal, expressed often during the day-long discussion that resulted in the list of use cases, is to develop a precursor system that tests the viability and application of the ATIS 2.0 principles.

The use cases developed during the Workshop rely on a few central principles:

- Associated hypotheses are clearly stated, giving the project team a concrete goal for development and testing;
- Costs are managed by making use, to the greatest extent possible, of existing infrastructure, software, hardware, and other system elements;
- The test developed around the use case will provide, if successful, an example of the real-world effects and benefits of ATIS 2.0 principles.

The project team will next select one or more of the use cases developed during the workshop and presented in this document. Further evaluation and selection of a use case will be completed based on the evaluation scores and the viability of the use case to support development of a precursor ATIS 2.0 system. An assessment will be made that takes into account existing infrastructure in the proposed field location, data that can be made available by data partner INRIX, and the degree to which real-time situational awareness can be recorded and interpreted for use.

Appendix A. List of Acronyms

ADA	Americans with Disabilities Act
ATIS	Advanced Traveler Information System
CVO	Commercial Vehicle Operations
DMA	Dynamic Mobility Applications
EnableATIS	Enabling Advanced Traveler Information Systems
FHWA	Federal Highway Administration
GPS	Global Positioning System
LEED	Leadership in Energy and Environmental Design
NGO	Non-governmental Organization
SOP	Standard Operating Procedures
USDOT	United States Department of Transportation
WMATA	Washington Metropolitan Area Transit Authority

Appendix B. Potential Stakeholder List

First Name	Last Name	Organization	Discipline	Type
Sean	Barbeau	Center for Urban Transportation Research (CUTR)	Multi-Discipline	Educational
Elizabeth	Birriel	Florida Department of Transportation (FDOT)	Traffic Management	Public
Susan	Chrysler	National Advanced Driving Simulator (U of Iowa)	Multi-Discipline	Educational
Chris	Cole	Central Ohio Transit Authority (COTA)	Transit Management	Public
Steve	Cook	Michigan Department of Transportation (MDOT)	Multi-Discipline	Public
John	Corbin	Iowa Department of Transportation (IDOT)	Maintenance and Construction Management	Public
Peter	Cranny	National Transport of Ireland	Traffic Management	Public
Mark	Demidovich	Georgia Department of Transportation (GDOT)	Traffic Management	Public
Francois	Dion	University of California at Berkeley (UC Berkeley)	Multi-Discipline	Educational
James	Dreisbach-Towle	San Diego Association of Governments (SANDAG)	Traffic Management	Public
Di-Ann	Eisnor	Google	Multi-Discipline	Private
Iain	Fairweather	Los Angeles County Metropolitan Transportation Authority	Traffic Management	Public
Yingling	Fan	University of Minnesota	Multi-Discipline	Educational
Doug	Ham	Federal Emergency Management Agency (FEMA)	Emergency Management	Public
Dave	Hanson	City of Green Bay	Traffic Management	Public
Mark	Heavey	New York Metropolitan Transportation Administration (MTA)	Traffic Management	Public

First Name	Last Name	Organization	Discipline	Type
Brian	Hoeft	Las Vegas Freeway and Arterial System of Transportation (FAST)	Traffic Management	Public
John	Howley	Minneapolis Metro Transit	Transit Management	Public
Brent	Isenberg	Skyline	Traffic Management	Private
Jay	Jayakrishnan	School of Engineering, University of CA, Irvine	Multi-Discipline	Educational
Paul	Keltner	Wisconsin Department of Transportation (WisDOT)	Maintenance and Construction Management	Public
Scott	Kolber	Roadify	Transit Management	Private
Dave	Maxell	National Emergency Management Association (NEMA)	Emergency Management	NGO
Andrew	Maximous	City of Santa Monica, CA	Parking Management	Public
Bibiana	McHugh	TriMet (Portland, OR)	Transit Management	Private
Paul	Misticawi	TrafficCast	Traffic Management	Private
Alysha	Nachtigall	Metropolitan Transportation Commission (MTC), San Francisco, CA	Traffic Management	Public
Jake	Nelson	Automobile Club of America (AAA)	Traffic Management	NGO
Andy	Oberlander	Texas Department of Transportation (TXDOT)	Traffic Management	Public
Michael	Pack	University of Maryland (UMD)	Traffic Management	Public
Kajal	Patel	Southeast Michigan Council of Governments (SEMCOG)	Traffic Management	Public
Todd	Plesko	Dallas Area Rapid Transit (DART)	Traffic Management	Public
David	Potts	American Trucking Associations (ATA)	Multi-Discipline	NGO
Landon	Reed	Atlanta Regional Commission	Transit Management	Public
Karen	Roter-Davis	Urban Engines	Traffic Management	Private
Faisal	Saleem	Maricopa County Department of Transportation (MCDOT)	Maintenance and Construction Management	Public

First Name	Last Name	Organization	Discipline	Type
Joshua	Siegle	Massachusetts Institute of Technology (MIT)	Multi-Discipline	Educational
Sinclair	Stolle	Iowa Department of Transportation (IDOT)	Maintenance and Construction Management	Public
Ken	Voss	Streetline	Parking Management	Private
Jim	Wright	American Association of Highway Transportation Officials (AASHTO)	Multi-Discipline	Public
Mia	Zmud	Metropia	Transit Management	Private

Appendix C. Workshop Attendee List

First Name	Last Name	Organization	Discipline	Type
Jeff	Adler	Open Roads	(Project Team)	Project Team
Bob	Brydia	Texas Transportation Institute (TTI)	(Project Team)	Project Team
Susan	Chrysler	National Advanced Driving Simulator (U of Iowa)	Multi-Discipline	Educational
Jimmy	Chu	Federal Highway Administration (FHWA)	(Project Team)	Project Team
Steve	Cook	Michigan Department of Transportation (MDOT)	Multi-Discipline	Public
Matt	Cuddy	Volpe Center	(Project Team)	Project Team
Brent	Isenberg	Skyline	Traffic Management	Private
Paul	Keltner	Wisconsin Department of Transportation (WisDOT)	Maintenance and Construction Management	Public
Scott	Kolber	Roadify	Transit Management	Private
Suzanne	Murtha	Atkins	(Project Team)	Project Team
Craig	Nelson	Steer Davies Gleeve	(Project Team)	Project Team
Chris	Poe	Texas Transportation Institute (TTI)	(Project Team)	Project Team
Bob	Rupert	Federal Highway Administration (FHWA)	(Project Team)	Project Team
Faisal	Saleem	Maricopa County Department of Transportation (MCDOT)	Maintenance and Construction Management	Public
Jeremy	Schroeder	Battelle	(Project Team)	Project Team
Sinclair	Stolle	Iowa Department of Transportation (IDOT)	Maintenance and Construction Management	Public

First Name	Last Name	Organization	Discipline	Type
Phil	Tarnoff	Noblis	(Project Team)	Project Team
Stacy	Unholz	Atkins	(Project Team)	Project Team
Prachi	V	Rideamigos	Transit Management	Private
Mike	Waisley	Battelle	(Project Team)	Project Team
Phil	Winters	Center for Urban Transportation Research	Multi-Discipline	Educational
Karl	Wunderlich	Noblis	(Project Team)	Project Team
Robert	Zimmer	Battelle	(Project Team)	Project Team

Appendix D. Revised Use Case List

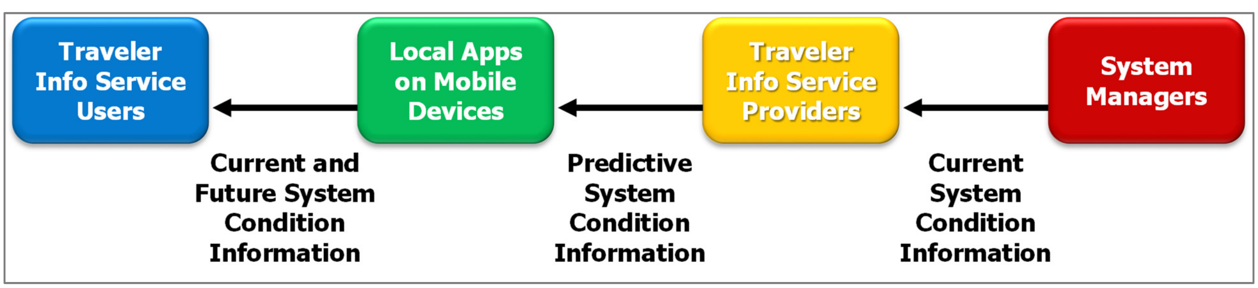
This appendix provides revised use cases for the ATIS 2.0 precursor system. The revised use case list takes into account the limitations of stakeholder proposed use cases and the degree to which real-time situational awareness can be recorded and interpreted for use by system managers. In addition to the high-level use cases, more detailed user scenarios are also presented for each use case.

Limitations of Stakeholder Proposed Use Cases

To design the use cases for ATIS 2.0 precursor system, it is important to distinguish between use cases for a Traveler (requiring information feedback to a traveler) and a System Manager (not requiring feedback to the traveler). According to the SOW, "it is neither the intention of the ATIS 2.0 Precursor System to tailor a flow of information from system managers to travel information service providers regarding the predicted future state of the system, nor to develop methods of providing tailored information advisories based on predicted future system states." The ATIS 2.0 Precursor System distinguishes itself from current traveler information systems (ATIS 1.0) in utilizing or leveraging disaggregate traveler behavioral data and focusing on providing information to System Managers.

To further this discussion it is helpful to define the differences between an ATIS 1.0 and an ATIS 2.0 Precursor System. Figure 5 depicts the basics of an ATIS 1.0 system. In summary, ATIS 1.0 provides:

- Current (real-time) information on transportation conditions
- Limited predictions of future conditions based on historical data (e.g., travel times)

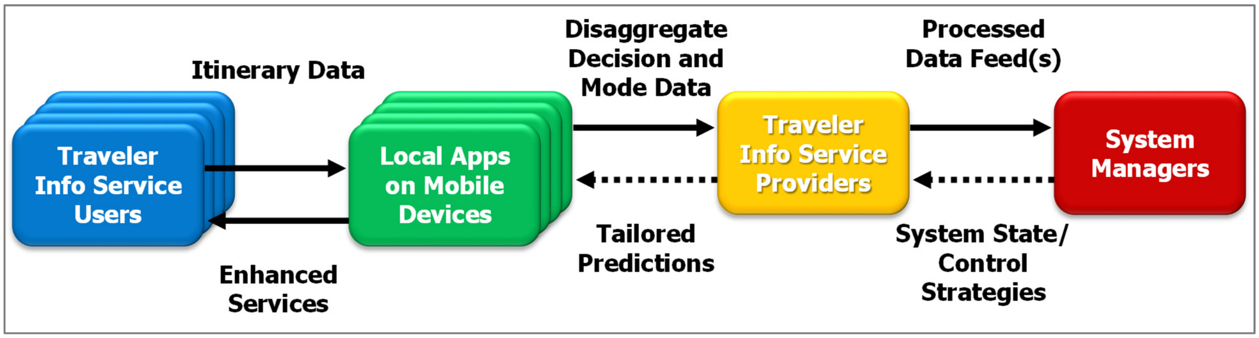


Source: U.S. DOT

Figure 5. ATIS 1.0 Diagram

The ATIS 2.0 precursor system emphasis is indicated in Figure 6 by solid arrows linking elements within the system. In summary, ATIS 2.0 provides:

- Better prediction of the system future state (i.e., congestion) through the aggregation of readily-available individual data
- More effective system performance monitoring/management tools for system managers—that is, being able to prevent or reduce congestion before it occurs
- Enhanced information services for travelers–ATIS 2.0 Precursor System will not complete feedback loop (dashed lines)



Source: U.S. DOT

Figure 6. ATIS 2.0 Precursor System Focus within the Traveler Information Value Chain

Note that in the figure above, the lines depicting feedback to the traveler are dashed, which denotes that while this a viable information path, but it is not planned as part of the ATIS 2.0 Precursor System project. The purpose of the ATIS 2.0 Precursor System is to enable system managers to predict and prevent (or reduce) transportation network congestion before it happens.

With that, it is necessary to re-examine the use cases proposed by stakeholders and find those that can be accomplished by the system managers without feedback to the traveler via a mobile device. Table 14 shows whether a use case requires system manager action and/or can be accomplished without feedback to the traveler. The ranking is carried forward from the stakeholder meeting results shown previously in Table 13.

Table 14. Stakeholder Proposed Use Cases and ATIS 2.0 Context

#	Use Case	Ranking of Use Cases and ATIS 2.0 Context		
		Ranking	ATIS 2.0 capable with System Manager Action	ATIS 2.0 capable without Feedback to Traveler Mobile Device
6	**Parking – Space Availability, Reservation and Rates**	**1**	✓	✓
1	Providing Travel Conditions Information and Receiving System User Feedback	2	✓	
3	Point-to-point Cost Evaluation	3	✓	
5	**Special Events Management**	**4**	✓	✓
4	Real-time Changes in Service, Payment and Mode Availability	5	✓	
2	Trip Planning with Dynamic Arrival Time	6	✓	
7	**On-Demand Dispatch**	**7**	✓	✓

Unfortunately, many of stakeholder proposed use cases require information feedback to the traveler via a mobile device, and thus are not ideal for the ATIS 2.0 Precursor System project—though they still fall within the ATIS 2.0 concept. Use Case numbers 5, 6, and 7 can affect travel conditions with just system manager actions. Use Case 6 would likely be more effective with information feedback directly to a traveler’s mobile device; however, a limited ATIS 2.0 concept could be tested by relaying traveler information to all drivers via DMS or other means. As a result, Use Cases 5, 6, and 7 will be carried forward for consideration in the precursor system.

Additional Proposed Use Cases

Given the now limited selection of stakeholder-provided use cases available for the project, two additional use cases have been added. Table 15 provides a summary of the three original uses cases that have moved forward from the stakeholder meeting along with the two new use cases. The original case numbers will be maintained while the new use cases are identified by A and B. Use case 6 was renamed from Parking – Space Availability, Reservation and Rates to Event/Central Business District (CBD) Parking.

Table 15. Selected Use Cases

ID	Use Case	Description
5	Special Events Management – Outflow	Special events management – outflow considers travelers leaving an event and includes trip prediction, load balancing, evacuation, and weather events
6	Event/CBD Parking	Provision of parking information using space availability, reservations and rate adjustments based on real-time load information and trip prediction.
7	On-Demand Dispatch	On-demand dispatch includes ride sharing, routing, scheduling, of specialized vehicles /home pick-up transit vehicles.
A	Peak Hour Traffic Management	Manage peak hour traffic proactively to prevent/release highway congestion based on real-time and predicted traffic demand information.
B	Dynamic Transit Addition	Dynamically reduce headways or add buses to routes to account for increased demand.

The next two sections provide detailed descriptions on of the two new use cases (‘A’ and ‘B’).

Use Case ‘A’: Peak Hour Traffic Management

Short Description

Manage peak hour traffic proactively to prevent/release highway congestion based on real-time and predicted traffic demand information.

Hypothesis

Predictive data received and evaluated from the ATIS 2.0 Precursor System will alert System Mangers to non-recurring major congestion events, which are caused by dramatic demand increases during peak hours. Proactive management will help to prevent or release congestion and thus improve the mobility and safety performance of the highway system.

Expanded Description

Highway systems during peak hours are vulnerable and very sensitive to the traffic demand increase due to heavy traffic volume already in the system and near saturated conditions. In an ideal ATIS 2.0 Precursor System scenario, System Managers would be able to proactively prevent major congestion. The ATIS 2.0 information will allow System Managers to foresee the possible congestion and make timely and effective decisions to address the issues.

Example Scenario

A city attracts large number of visitors every summer. Traditionally, its highway system has much higher traffic during peak hours than non-peak hours. The additional demand from non-commuters/visitors worsens the traffic condition during summer peak hours. The ATIS 2.0 Precursor System can use disaggregate traveler behavior data (i.e., pre-route planning information) from both commuters and non-commuters to estimate the new traffic demand, and thus alert System Managers before the major congestion events happen. With this predictive information, the System Manager can proactively manage traffic through DMS, signal control, ramp metering, or any other proper traffic control strategies.

Table 16. Use Case 'A' Comparison Table

ATIS 1.0 System	ATIS 2.0 System
System managers use historical traffic data to develop peak hour traffic management plans.	System managers are given additional predictive system data based on capturing traveler intent, as well as existing ITS infrastructure data to monitor and predict travel network conditions.
Estimated peak hour traffic pattern is static and based on the average of historical data and current traffic conditions.	If the current and predicted conditions vary greatly with recent trends, the ATIS 2.0 precursor system will alert system managers to the possible outcome of these variations.
	System managers will have a better understanding regarding the sources of the increased traffic demand, and thus are able to provide more effective solutions.

Use Case 'B': Dynamic Transit Capacity Addition

Short Description

Dynamically reduce headways or add buses to routes to account for increased demand.

Hypothesis

The ATIS 2.0 Precursor System will identify the time and location of high transit service demands. The transit system managers would therefore have the ability to increase transit capacity dynamically.

Expanded Description

System managers receive information about the demand for transit service by time and location. Those system managers are then able to evaluate the current transit system's capability to answer the demand. If the demand exceeds the current capacity under existing operation settings, system managers can dynamically reduce headways or add buses to routes whenever and wherever is necessary.

Example Scenario

Due to severe weather conditions, many drivers decide to switch to public transit for commuting to work. The ATIS 2.0 Precursor System captures this trend because there is a significant increase in the request volume through the transit agency's trip planner tools (e.g., smartphone app, website, and phone). The system manager is able to obtain information regarding the predicted ridership on specific routes and/or transit stations. Knowing that the current schedule of a route may not be able to serve the rush hours' demand, the system manager decides to provide an additional bus on that route.

Table 17. Use Case 'A' Comparison Table

ATIS 1.0 System	ATIS 2.0 System
The system manager uses historical ridership data for transit operation planning.	Besides historical data, current and predicted future transit service demand information will be available to system mangers to update the transit operation and management planning.
Once a route schedule is created, transit system managers may need a substantial additional effort and time to update the schedule.	Availability of services is adjusted in real time, based on predicted future demand.
	It will be more important to consider the interaction between highway and transit systems when planning transit operation.

Selected Use Cases and Example Scenarios

Table 18 shows the proposed use cases and some example scenarios. Note that one use case could have multiple scenarios. It is expected that the ATIS 2.0 system will provide the same type of information to System Managers for scenarios within the same use case.

Table 18. Additional Proposed Use Cases and Scenarios

Use Case	Scenario	Decision Action in Question	What would Trigger Action (Metric)
A. Peak Hour Traffic Management	A.1. Highway traffic during am or pm rush periods. The timing on the ramps entering the highway are throttled back to limit the number and timing of vehicles permitted on the highway	**Ramp Metering Timing** – limit the number and pace of vehicles entering the highway from specific ramps	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway
A. Peak Hour Traffic Management	A.2. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Changing DMS** to divert traffic around commuter corridors	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway
A. Peak Hour Traffic Management	A.3. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Variable Speed Limits (VSL)** – Post speed reductions warnings to reduce secondary accidents	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway
A. Peak Hour Traffic Management	A.4. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Decentralized Transit and Parking-** dynamic pricing of commuter parking and/or transit	Prediction of number of available parking spaces begins to fill; prediction of number of vehicles “in-system” seeking parking spaces
A. Peak Hour Traffic Management	A.5. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Traffic Signal Control** - dynamically change signal phase and timing to relieve congestion on Freeway	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway
A. Peak Hour Traffic Management	A.6. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Transit signal priority/shoulder lanes**	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway

Use Case	Scenario	Decision Action in Question	What would Trigger Action (Metric)
A. Peak Hour Traffic Management	A.7. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Dynamically adjust HOV lane restrictions** to open to all traffic.	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway
B. Dynamic Transit Capacity Addition	B.1. Morning/evening commute/rush hour on Traditional Heavy Traffic Day	**Dynamic Transit Capacity Additions** – reducing headways or adding buses to routes to account for increased demand	Prediction of mainline (Freeway) traffic nearing capacity with reduced speed and throughput; incident or accident reducing capacity of highway
5. Special Events Management-Outflow	5.1. "Unplanned" large event release (i.e., Traffic Slug) of traffic into the system (e.g., major employer in region closes offices unexpectedly due to an office condition)	**Traffic Signal Control** - dynamically change signal phase and timing to relieve congestion on arterial	Prediction of congestion on mainline arterial traffic
5. Special Events Management-Outflow	5.2. "Unplanned" large event release (i.e., Traffic Slug) of traffic into the system (e.g., major employer in region closes offices unexpectedly due to an office condition)	**Changing DMS** to divert traffic around commuter corridors	Prediction of congestion on mainline arterial traffic
6. Event/CBD Parking	6.1. Planned large event (i.e., Concert, Football Game) in CBD areas	**Dynamic Parking Pricing**	Prediction of number of available parking spaces begins to fill; prediction of number of vehicles "in-system" seeking parking spaces
7. On-Demand Dispatch	7.1. A local transit agency implements on-demand transit on one of its routes	**Dynamic Transit Routing**	Large number of requests at certain locations (predicting future demand)

Ranking of Combined Use Cases

This section presents the ranking of the combined use cases. It is important to focus on use cases that are testable in a limited ATIS 2.0 Precursor System Test and have a measurable impact large enough to demonstrate that the prediction and System Manager decision had the desired effect. At this point, three criteria were applied to rank the selected use cases shown in Table 19, including: Measurable Outcomes, ATIS 2.0 Testable, and Scalability. The ranking will be re-examined in iterative steps in later tasks. In these later tasks, as more information becomes available, more criteria could be included (e.g., Data Availability).

Table 19. Selected Use Case Scores and Ranking

#	Use Case	Measurable Outcomes	ATIS 2.0 Testable	Scalability	Totals for Use Case	Ranking
A	Peak Hour Traffic Management	3	5	5	13	**1**
6	Event/CBD Parking	4	4	4.5	12.5	**2**
5	Special Events Management – Outflow	2	5	3	10	**3**
B	Dynamic Transit Capacity Addition	2	2	4	8	**4**
7	On-Demand Dispatch	1	2	2	5	**5**

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