Module 6: Traveler Information Standards, Part 1 of 2

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Module Description

This module (Traveler Information Standards, Part 1 of 2) is the first of two course modules on traveler information using standards. It provides the background for understanding traveler information systems and the standards that facilitate the implementation of these systems by:

1. Briefly explaining traveler information systems within the context of National ITS Architecture;
2. Describing the basic taxonomy that will help define where standards should be considered within the functions; and
3. Discussing the functions of traveler information systems to conceptualize technology implementation at an agency so that participants understand where the standards can be used.

Also explained in this module is how to best adapt the state-of-the-practice, such as systems engineering, for those functions within traveler information where standards do not exist. Knowing how traveler information systems fit within the National ITS Architecture framework will provide participants with the context necessary to consider those standards that will facilitate data exchange among various technologies within or external to a transit agency.

1. Introduction/Purpose

Traveler information systems cover customer-facing technologies that provide the public with information such as trip planning and real-time operational information. Traveler information can be generated by on-board and central systems that are typically used to monitor and manage operations (discussed in the Transit Management modules), as well as those systems that facilitate providing traveler information (e.g., itinerary planning software). Traveler information can be provided to the public through a variety of dissemination media including electronic signage located at stops/stations, mobile devices, the Internet, 511 systems, and interactive voice response (IVR) systems. Agencies can provide traveler information directly to the public and indirectly by making the underlying data readily available under open standards. Developers can use open data to create traveler information applications that are accessed by the public on mobile devices and the Internet.

Traveler information can be defined by two primary categories: static data (e.g., from schedules) and dynamic data (e.g., real-time vehicle arrival times). In addition, traveler information can be defined by where in the trip chain individuals seek the information (e.g., pre-trip, en route) and the dissemination media used to provide the information.

2. Samples/Examples

Traveler information systems cover customer-facing technologies that provide the public with information regarding trip planning and real-time operational information. Traveler information can be generated by on-board and central systems that are used typically to monitor and manage operations (discussed in the Transit Management modules [2 and 5]), as well as systems that facilitate providing Traveler information (e.g., itinerary planning software).

The Transit Traveler Information Service Package in the National ITS Architecture provides transit users at transit stops and on board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.

Figure 1 shows the Transit Traveler Information Service Package, which provides transit users at transit stops and on board transit vehicles with ready access to transit information. This service package shows five entities: The Transit Management Center, which is connected to and exchanges data with four other entities, namely, Personal Information Access, Remote Traveler Support, Information Service Provider (ISP), and Transit Vehicle. Four other entities outside of the architecture (called terminators) are also part of this Service Package: Other ISP, and the Traveler, Media, and Other Transit Management Centers.

The traveler information taxonomy includes four major categories of technologies: pre-trip systems, on-board systems, wayside systems, and third-party smartphone applications and social media. The pre-trip category covers technologies that provide information before taking a trip. The on-board category covers those technologies that provide en route transit users with static and real-time travel-related information on board a transit vehicle. The wayside category covers technologies that provide both real-time and static information. The third-party applications and social media category covers using a third party to develop static and real-time applications, and providing real-time information via social media.

The following four tables show the relationships between travel characteristics and dissemination media: Table 1 shows the relationships between travel characteristics and dissemination media highlighting media for pre-trip information; Table 2 shows the relationship between travel characteristics and dissemination media highlighting media for on-board information; Table 3 shows the relationship between travel characteristics and dissemination media highlighting media for wayside traveler information; Table 4 shows the relationship between travel characteristics and dissemination media highlighting media for third-party applications and social media.

Figure 1. Transit Traveler Information Service Package

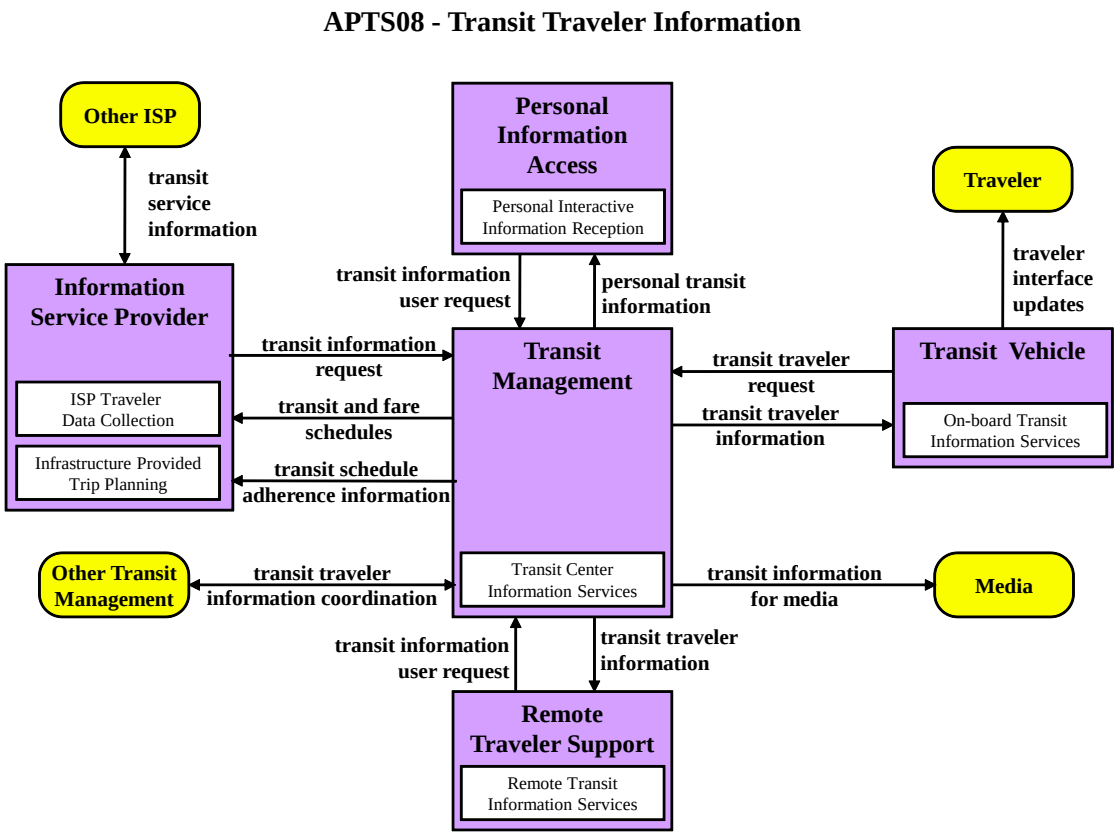

Table 1. Pre-Trip Traveler Information

	When/Where				What			How		
	Pre-trip	Wayside/En route	On-board	Mobile	Trip planning	Static information	Real-time information	Proactive	Interactive	Custom
Printed Material	X	X	X			X		X		
Telephone	X				X	X	X		X	
Mobile Phone	X	X	X	X		X	X	X	X	X
Smartphone	X	X	X	X	X	X	X	X	X	X
E-mail	X	X	X	X		X	X	X		X
Short message service (SMS)	X	X	X	X			X	X		X
Other mobile devise (e.g., iPad)	X	X	X	X	X	X	X	X	X	X
Internet/Website	X				X	X	X		X	X
Kiosk	X	X			X	X			X	
Television	X					X	X	X		
Dynamic message sign		X	X			X	X	X		
Annunciator		X	X				X	X		
Social media	X			X			X	X		
Interactive voice response	X			X	X	X	X		X	X

Table 2. On-Board Traveler Information

	When/Where				What			How		
	Pre-trip	Wayside/En route	On-board	Mobile	Trip planning	Static information	Real-time information	Proactive	Interactive	Custom
Printed Material	X	X	X			X		X		
Telephone	X				X	X	X		X	
Mobile Phone	X	X	X	X		X	X	X	X	X
Smartphone	X	X	X	X	X	X	X	X	X	X
E-mail	X	X	X	X		X	X	X		X
Short message service (SMS)	X	X	X	X			X	X		X
Other mobile devise (e.g., iPad)	X	X	X	X	X	X	X	X	X	X
Internet/Website	X				X	X	X		X	X
Kiosk	X	X			X	X			X	
Television	X					X	X	X		
Dynamic message sign		X	X			X	X	X		
Annunciator		X	X				X	X		
Social media	X			X			X	X		
Interactive voice response	X			X	X	X	X		X	X

Table 3. Wayside/En route Traveler Information

	When/Where				What			How		
	Pre-trip	Wayside/En route	On-board	Mobile	Trip planning	Static information	Real-time information	Proactive	Interactive	Custom
Printed Material	X	X	X			X		X		
Telephone	X				X	X	X		X	
Mobile Phone	X	X	X	X		X	X	X	X	X
Smartphone	X	X	X	X	X	X	X	X	X	X
E-mail	X	X	X	X		X	X	X		X
Short message service (SMS)	X	X	X	X			X	X		X
Other mobile devise (e.g., iPad)	X	X	X	X	X	X	X	X	X	X
Internet/Website	X				X	X	X		X	X
Kiosk	X	X			X	X			X	
Television	X					X	X	X		
Dynamic message sign		X	X			X	X	X		
Annunciator		X	X				X	X		
Social media	X			X			X	X		
Interactive voice response	X			X	X	X	X		X	X

Table 4. Third-Party Applications and Social Media

	When/Where				What			How		
	Pre-trip	Wayside/En route	On-board	Mobile	Trip planning	Static information	Real-time information	Proactive	Interactive	Custom
Printed Material	X	X	X			X		X		
Telephone	X				X	X	X		X	
Mobile Phone	X	X	X	X		X	X	X	X	X
Smartphone	X	X	X	X	X	X	X	X	X	X
E-mail	X	X	X	X		X	X	X		X
Short message service (SMS)	X	X	X	X			X	X		X
Other mobile devise (e.g., iPad)	X	X	X	X	X	X	X	X	X	X
Internet/Website	X				X	X	X		X	X
Kiosk	X	X			X	X			X	
Television	X					X	X	X		
Dynamic message sign		X	X			X	X	X		
Annunciator		X	X				X	X		
Social media	X			X			X	X		
Interactive voice response	X			X	X	X	X		X	X

Figure 2. Traveler Information Data Exchanges

Figure 2 shows an example of the relationships on board a transit vehicle. To provide more information about how these technologies are related to each other, Table 5 summarizes the dependencies between traveler information and transit management and other technologies.

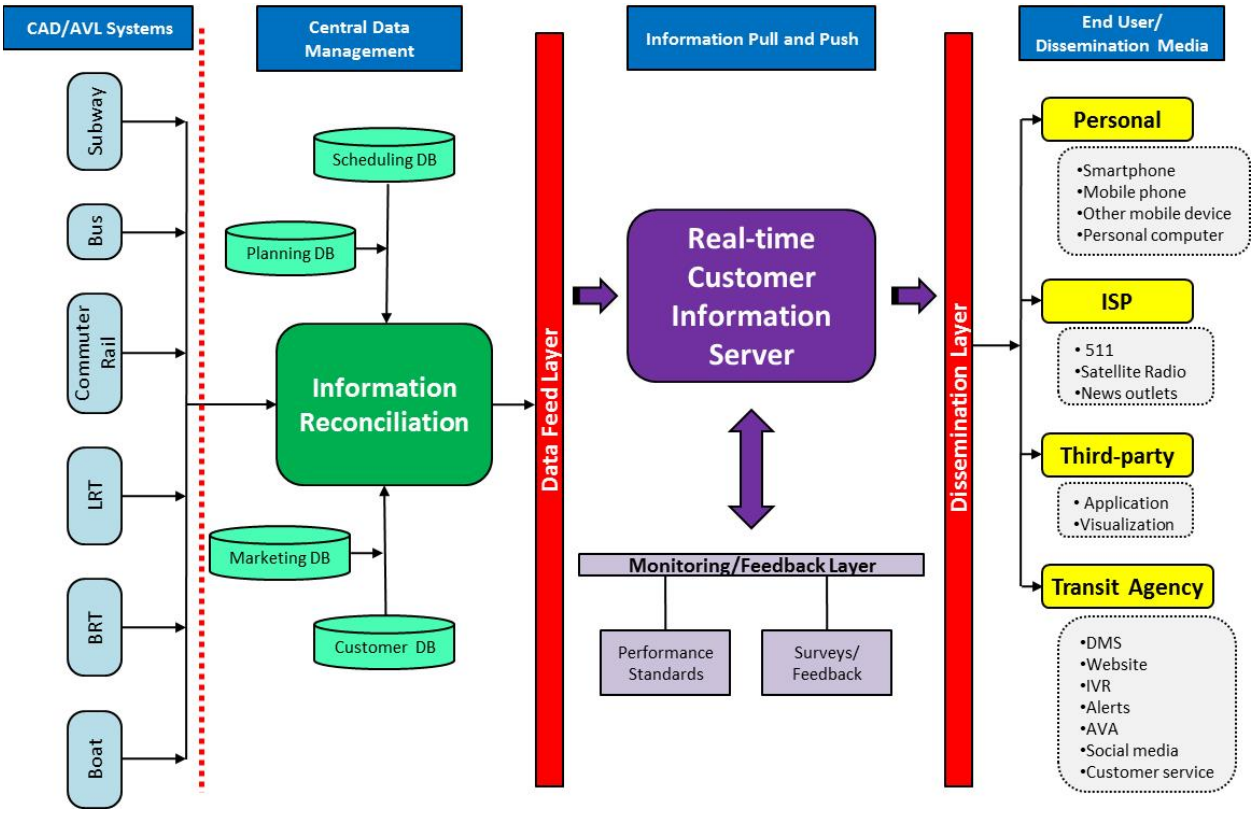

Table 5. Dependencies between Traveler Information and Transit Management and Other Technologies

Category	System/Technology	Dependent on
Traveler Information	On-board automated voice announcements (AVA)	• AVL system • Route and vehicle schedule data
	En route/wayside traveler information, including real-time arrival/departure information in a variety of dissemination media	• Route and vehicle schedule data • AVL system • CAD system • Data communications technologies
	On-board Internet access for passengers	Data communications technologies
	511, 311, and 211 systems, and Google Transit	Open data
	Third-party smartphone applications	Open data

3. Reference to Other Standards

N/A. References will be made in Module 7: Traveler Information Standards, Part 2 of 2.

4. Case Study: Example of Relating Requirements to Specific Standards

To demonstrate how functional requirements for traveler information systems can be related to specific standards, an example is provided: requiring a real-time information system to export data for use with the Google Transit Trip Planner. This requirement could be written as follows:

General Transit Feed Specifications Export (GTFS Feed) for Google Transit Trip Planner

1. The system shall provide an interface to Google Transit using the **GTFS**. The interface shall allow for the export and delivery of data fields necessary (per the transit agency's needs) for fixed-route trip planning on Google. The contractor shall work with the transit agency to decide which of the data fields described in the **GTFS** shall be included in the export.

2. The contractor shall perform or help the transit agency with the following processes required to deliver its fixed-route data to Google Transit:

- Shall prepare transit data as a zip file in **GTFS format**.
- Shall test the **GTFS** zip file using FieldValidator (http://code.google.com/p/googletransitdatafeed/wiki/FeedValidator) and ScheduleViewer (http://code.google.com/p/googletransitdatafeed/wiki/ScheduleViewer) tools to ensure that it is valid, and work with the transit agency to ensure that the schedules are accurate; and
- Shall review and perform a quality assurance check of Google's preview data (beta website) with the transit agency and work with Google to resolve any issues.

3. The contractor shall coordinate with the transit agency to ensure that any abnormal situations in trip planning, including but not limited to the following, are resolved:
   - Excessive walking to/from an origin/destination transit stop,
   - Stops connected by a straight line on the map instead of following the appropriate route trace,
   - Excessive wait-time suggested for transfers, and
   - Major and minor stop locations not marked on the map.

5. Glossary

Term	Definition
Comma-Separated Values (CSV)	A file format used as a portable representation of a database. Each line is one entry or record and the fields in a record are separated by commas. Agencies using GTFS have committed to producing and maintaining their schedule data in standardized CSV tables to display their system on Google Transit's trip planner and, increasingly, opening this data to other third-party application developers.
Communications Layer	One of three layers (along with the transportation and institutional layers) defined by the National ITS Architecture. The communications layer includes all of the communications equipment (e.g., wireline and wireless transmitters and receivers) and the information management and transport capabilities necessary to transfer information among entities in the transportation layer. The application data content and the transportation application requirements are generally transparent to the communications layer. The communication layer's view of ITS is that of many distributed users, some of them mobile, which require communication services.

Term	Definition
Equipment Package	The building blocks of the subsystems of the physical architecture subsystems. Equipment packages group similar processes of a particular subsystem together into an implementable package. The grouping also takes into account the user services and the need to accommodate various levels of functionality.
eXtensible Markup Language (XML)	The XML format is more robust than GTFS in its abilities to represent large complex models, but the approach is more common in Europe and raises standardization challenges in the face of hyper flexibility.
General Transit Feed Specification (GTFS)	The General Transit Feed Specification, originally developed by Google, contains static schedule information for transit agencies including: stop locations, route geometries, and stop times. "GTFS consists of a package of comma-delimited text files, each of which contains one aspect of the transit information and a set of rules on how to record it: six mandatory files (agency, stops, routes, trips, stops times, and calendar) and seven optional files (calendar dates, fare attributes, fare rules, shapes, frequencies, transfers and feed info)" (8, page 1).
Geo JavaScript Object Notation (GeoJSON)	GeoJSON is a format for encoding a variety of geographic data structures. Geospatial data interchange format based on JavaScript Object Notation (JSON)
GTFS-realtime	GTFS-realtime contains real-time information related to vehicle positions, service alerts, and trip updates (delays, cancellations, etc.)
Identification of Fixed Objects in Public Transport (IFOPT)	IFOPT defines a model and identification principles for the main fixed objects related to public access to Public Transport (e.g., stop points, stop areas, stations, connection links, entrances, etc.). The IFOPT Standard builds on the TransModel Standard to define four related submodels.
Institutional Layer	An integral component of the National ITS Architecture that represents the existing and emerging institutional constraints and arrangements that are the context for all ITS deployments. The transportation layer and communications layer together provide the technical framework within which interoperable systems may be implemented. The institutional layer introduces the policies, funding incentives, working arrangements, and jurisdictional structure that support the technical layers of the architecture. This institutional layer provides the basis for understanding whom the stakeholders will be and the roles these implementers could take in implementing architecture-based ITS systems.
JavaScript Object Notation (JSON)	JSON is a data-interchange and text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages (http://json.org/).

Term	Definition
Logical Architecture	The part of the National ITS Architecture that defines what has to be done to support the ITS user services. It defines the processes that perform ITS functions and the information or data flows that are shared between these processes.
Network Exchange (NeTEx)	NeTEx is intended to be a general-purpose format capable of exchanging timetables for rail, bus, coach, ferry, air, or any other mode of public transport.
Protocol Buffers	GTFS-realtime data exchange format is based on Protocol Buffers. Protocol buffers are a language- and platform-neutral mechanism for serializing structured data (think XML, but smaller, faster, and simpler). The data structure is defined in a GTFS-realtime.proto file, which then is used to generate source code to easily read and write structured data from and to a variety of data streams using a variety of languages.
Physical Architecture	The part of the National ITS Architecture that provides agencies with a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the processes and data flows defined in the logical architecture. The principal elements in the physical architecture are the subsystems and architecture flows that connect these subsystems and terminators into an overall structure.
Really Simple Syndication or Rich Site Summary (RSS)	RSS is a format for delivering regularly changing web content.
Representational State Transfer (REST)	REST is a distributed system framework that uses web protocols and technologies (40)
Resource Description Framework (RDF)	RDF is a standard model for data interchange on the web (39)
Service Interface for Real Time Information (SIRI)	SIRI is a real-time data standard predominant in Europe, but making significant inroads into the U.S. market, notably at [Metropolitan Transportation Authority] MTA in New York. Recent change proposals to the SIRI standard include the definition of a structure for SIRI web services. The SIRI standard includes a component for schedule data, but is designed for real time and is therefore more complex than some other standards.

Term	Definition
Service Package	The service packages, formerly known as market packages, provide an accessible, service-oriented perspective to the National ITS Architecture. They are tailored to fit, separately or in combination, real-world transportation problems and needs. Service packages collect together one or more equipment packages that must work together to deliver a given ITS service and the architecture flows that connect them and other important external systems. In other words, they identify the pieces of the physical architecture that are required to implement a particular ITS service. Service packages are implemented through projects (or groups of projects, aka programs) and in transportation planning, are directly related to ITS strategies used to meet regional goals and objectives.
Simple Object Access Protocol (SOAP)	SOAP is a method of transferring messages, or small amounts of information, over the Internet. SOAP messages are formatted in XML and are typically sent using HTTP (hypertext transfer protocol).
Systems Engineering	An interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem. Systems engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.
TransModel	TransModel is the European Reference Data Model for Public Transport. It provides an abstract model of common public transport concepts and structures that can be used to build many different kinds of public transport information systems, including for timetabling, fares, operational management, real-time data, etc. (43)
TransXChange (TxC)	TxC is the UK nationwide standard for exchanging bus schedules and related data. TxC provides a means to exchange bus routes and timetables between different computer systems, together with related operational data.
Transportation Layer	One of three layers (along with the communications layer and the institutional layer) defined by the physical architecture. The transportation layer shows the relationships among the transportation-related elements. It is composed of subsystems for travelers, vehicles, transportation management centers, and field devices, as well as external system interfaces (terminators) at the boundaries.

6. References

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- TransXChange, https://www.gov.uk/government/collections/transxchange
- What is GTFS-realtime? https://developers.google.com/transit/gtfs-realtime/

7. Study Questions

1. Which one of these components is NOT in the Transit Traveler Information Service Package (SP)?
    a) On-board systems
    b) Wayside systems
    c) Dynamic ridesharing
    d) Pre-trip systems

2. When on the Transit Traveler Information Service Package web page in the National ITS Architecture literature, you can click on the architecture flow and it will show you the standards associated with that data exchange.
    a) True
    b) False

3. In which location is Pre-Trip Traveler Information NOT provided?
    a) Via a mobile device
    b) On devices in dedicated locations
    c) On devices at transit stops/stations
    d) On board vehicles

4. Which type of dissemination media is NOT used to provide traveler information at the wayside/en route?
    a) Dynamic message sign (DMS)
    b) Kiosk
    c) Television
    d) Smartphone

5. Can an on-board automated voice announcement (AVA) system be used to comply, in part, with the Americans with Disabilities ACT (ADA)?
    a) Yes
    b) No

6. En route/wayside information NOT dependent on which system?
    a) Data communications technologies
    b) Open data
    c) Route and vehicle schedule data
    d) AVL system

7. Which one of these is not a basic element of a typical communication network?
    a) Backbone
    b) Local
    c) Regional
    d) Distribution

8. Which location criterion for DMS is the most prevalent amongst transit agencies?
    a) Safety considerations
    b) Availability of communication
    c) Number of transfers at stops/stations
    d) Boarding counts at stops/stations

9. Which one of these is an SAE standard?
    a) National Transportation Communications for ITS Protocol (NTCIP)
    b) Service Interface for Real Time Information (SIRI)
    c) eXtensible Markup Language (XML)
    d) International Traveler Information Systems (ITIS)

10. The systems engineering process (SEP) does not include considering user needs.
    a) True
    b) False