Transit IDEA Program

Developing Regional Mobility Management Centers

Final Report for
Transit IDEA Project 50

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Developing Regional Mobility Management Centers

FINAL REPORT

Transit IDEA Project 50

Prepared for the
Transit IDEA Program
Transportation Research Board
National Research Council

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EXECUTIVE SUMMARY

BACKGROUND AND OBJECTIVES

Policymakers from state and federal agencies are focusing on techniques that can lead to the more cost-effective use of transportation resources. A key example is the “United We Ride” effort to coordinate transportation services which is led by the Federal Transit Administration (FTA) and supported by multiple other Federal agencies. The 2004 Executive Order for Human Service Transportation Coordination states in part that “...in too many communities, these [transportation] services and resources are fragmented, unused, or altogether unavailable” and that “Federally assisted community transportation services should be seamless, comprehensive, and accessible to those who rely on them for their lives and livelihoods” (emphasis added).

Just as the 1970s and 1980s saw a proliferation of transportation services for persons with specialized travel needs, the 1990s and later years have seen a proliferation of computerized programs from various private vendors for the administration and operation of those specialized transportation services. A large number of computer software vendors now promote their unique, proprietary transportation software products. The wide variety and dissimilar nature of many of these products often impedes the coordination needed to enhance the cost-effective delivery of specialized transportation services.

Many of these software vendors specialize in one sector of the industry, such as paratransit, but their software applications have been independently constructed and do not communicate with each other even within just one branch of the industry. The coordination of transportation services is intended to improve the cost-effectiveness of transportation services, but coordination efforts are impeded because the problem of making it possible for software programs to communicate with each other has not yet been fully addressed. Addressing this issue is a major objective of this project. Since forcing all transportation providers to use only one vendor’s software is not possible, our focus is how to integrate the information and capabilities of multiple software applications for scheduling and dispatching paratransit services so that they can transfer information seamlessly to each other.

SUPPORTING COORDINATED TRANSPORTATION SERVICES

“One-stop” regional brokerage mobility management call centers — services that accept calls from prospective riders and assign the rides to various specialized transportation providers — are seen as an effective way of creating significant cost savings over the customary “stand-alone models” of each agency or each travel mode dealing solely with its own customers. This brokerage concept is also believed to significantly increase rider accessibility and to increase the coordination and productivity of service providers.

To achieve a greater level of service coordination, basic information needs to be available to persons managing those services: who wishes to travel, when, where, and at what price? A number of proprietary software programs are each adept at handling typical transportation management issues, including client records, dispatching, scheduling, routing, trip records, maintenance management, client billing, and a host of other functions, but it is currently a significant challenge to pass data back and forth among these programs.

As shown in Figure S-1, each specialized transportation provider needs relevant information about each passenger, including his or her desired origin and destination, desired pick-up and drop-off times, and possible needs for special assistance (for certain disabilities, for example). The need for interoperable data exchange among these transportation providers is particularly great when (a) trips cross jurisdictional boundaries, (b) clients of one agency or transportation provider could possibly use the services of another transportation provider, or (c) another provider might provide more expeditious or cost-effective services.
FIGURE S-1: Flow chart of trip requests from multiple sources to multiple providers.

After the trip is taken, the provider of that trip needs to be paid, either by the rider or, if the rider’s trip is sponsored by a human service or other agency, by that agency. In the case of sponsored rides, this typically means that the transportation provider needs to provide a bill to the sponsoring agency for that person’s ride.

As can be readily seen, a comprehensive “information function” is at the heart of the one-call center concept. Archives of rider data, service provider data, and service area information need to be integrated to allow multiple transportation providers to more cost-effectively provide trips to travelers by increasing ride-sharing and minimizing trip distances. A community-wide, centralized transportation information function enables the possibility of a wider range of service provider options, including coordinated and brokered transportation services.

A UNIVERSAL DATA TRANSLATOR

Transportation providers need a consistent way to communicate between organizations and their computer systems about trips requested and trips provided. When information systems collect, store, and export client names in formats that enable them to exchange data, it is possible for an agency using their own dispatching software to send and receive trip information to another system. The goal of interoperability is to encourage the exchange of data from one agency to another without having to translate it into a new format. A universal data translator (our name for this service) is the tool that can enable such exchanges.

Without a universal data translator, each system operates in isolation, leading to a lack of good decision-making and guidelines for improvement. With a universal data translator for data exchange, there is a potential for significant cost savings across the component systems and an increased ability to determine success or take corrective actions.

Thus, the primary objective of this Transit IDEA project was to enable paratransit providers to communicate information about passengers to be able to efficiently provide more rides to more users, share
ride information across jurisdictional or geographic systems, and communicate information to receive reimbursement for rides between transportation agencies and their funding partners. This project was an initial phase in what the authors believe should be a multi-phase program to develop innovative low-cost management protocols and software that mobility management call centers can use to better organize, coordinate, schedule, dispatch, and monitor service programs which use transportation as one component of their service delivery strategy. The strategic mix of transportation solutions has the potential to increase transit ridership and generate new revenue streams for the transit industry.

INDUSTRY BENEFITS

The innovation that is the focus of this project is the development of management protocols and software packages that make transit services more attractive to multiple partners, including health care providers, in coordinated community transportation operations. Beneficiaries of these management protocols and software packages could include:

- public transit operators and the agencies that support them,
- specialized paratransit services, including those serving the elderly, persons with disabilities (eligible or not eligible for complimentary ADA paratransit services), and other special needs populations,
- Medicare Plus health maintenance organizations (HMOs) that now reimburse “timely” medical transportation as a “preventive disease management” intervention,
- Tele-health and telemedicine programs that offer low-cost “trip alternatives,” including new portable (driver carried) communications devices,
- programs delivering services directly to clients, such as meals on wheels programs for seniors,
- transportation brokerage agencies or Transportation Management Associations (TMAs) that seek to provide a holistic mix of transportation solutions, and
- private enterprises involved in delivering products such as groceries and prescriptions to customers.

The coordination of these activities could also be accomplished through a unified regional mobility management call center that accepts customer service requests and assigns transportation or other resources to meet those requests over a wide geographic area.

In the absence of universal data guidelines for transportation interchange, each software manufacturer is left to develop a proprietary software product to facilitate data exchange. A major transportation software vendor, for example, is currently developing a product that would let only users of their software products exchange data with other members of their "consortium." Unfortunately, this type of proprietary solution usually means an increased cost for users of the software and no solution for smaller systems that are unable to afford such software.

PRODUCT DEVELOPMENT

This project provides the framework for the development of new software products that will assist transportation brokers and providers to expand cooperation and coordination. This project has developed the guidelines for two “universal data translators:” one for describing inputs necessary to schedule and dispatch trips and another that describes the outputs necessary to provide information for billing and reimbursement.

Interoperability protocols provide an agreed-upon, common and consistent way to record information. They allow data to be exchanged among different information systems and for that data to have consistent meaning from system to system, program to program, and agency to agency. This kind of interoperability is already important in almost every aspect of our lives. The next step beyond this immediate project should be the development of a prototype of the universal data translator software.
OVERALL PROJECT DESCRIPTION

PROJECT OVERVIEW

The purpose of this Transit IDEA project was to carry out the initial phase of what the authors propose to be a multi-phase program to develop innovative low-cost management protocols and software that mobility management call centers can use to better organize, coordinate, schedule, dispatch, and monitor service programs which use transportation as one component of their service delivery strategy. These functions can be integrated with an array of Transportation Demand Management (TDM) strategies to significantly reduce trip costs. This “strategic mix” of transportation solutions has the potential to increase transit and ridership and generate new revenue streams for the transit and paratransit industry, particularly from payers of health and human services. The innovation that is the focus of this project is the development of management protocols and software packages that make transit and paratransit services more attractive to other partners, including health care providers, in coordinated community transportation operations. This project examined the potential of the organization and coordination of these activities to be accomplished through a unified regional mobility management call center that accepts customer service requests and efficiently assigns transportation or other resources to meet those requests.

PROBLEM STATEMENT

Policymakers from local, state, and Federal agencies are focusing on techniques that can lead to a more cost-effective coordination of transportation resources. A key example is the United We Ride effort which is led by the Federal Transit Administration (FTA) and supported by multiple other Federal agencies. “One-stop” regional brokerage mobility management call centers — services that accept calls from prospective riders and assign the rides to various transportation providers — are seen as an effective way of creating significant cost savings over the customary “stand-alone” models of each agency or each travel mode dealing solely with its own customers.

Among its stated goals, this project was intended to “begin a multi-phase program to develop innovative low-cost management protocols and software that mobility management call centers can use to better organize, coordinate, schedule, dispatch, and monitor service programs which use transportation as one component of their service delivery strategy.” Early in this project, we noted that “the strategic mix of transportation solutions has the potential to increase transit ridership and generate new revenue streams for the transit industry, particularly from payers of health and human services,” and that “the innovation that is the focus of this project is the development of management protocols and software packages that make transit services more attractive to other partners, especially health care providers, in coordinated community transportation operations.”

These goals are still valid. In fact, changes have occurred in the transportation and healthcare industries with the refinement of existing dispatching and scheduling software that make the case for greater data exchange among paratransit providers more compelling. Thus, the primary mission of this project was to:
Enable paratransit providers to more readily communicate information about passengers so as to be able to provide more rides to more users, share ride information across jurisdictional or geographic systems, and communicate information to receive reimbursement for rides between transportation agencies or systems.

The investigative tasks applied to implement this mission were to:

- Scrutinize existing software protocols that impact our core mission.
- Build a detailed data model and working conceptual software for information interchange.
- Examine the most efficient ways to implement the new data interchange ideas.

PRINCIPLES OF THE INNOVATION

Regional mobility management call centers can provide a strategic mix of cost-effective coordinated transportation services for members of the general public and persons who are elderly, disabled or chronically ill. This latter group is typically referred to as “the transportation disadvantaged.” Regional mobility management centers could provide access to low-cost, non-traditional services as well as to the usual transportation operators for such persons. As numerous studies have shown, appropriate transportation services can help prevent or delay the need for institutional care or other high-cost publicly-supported interventions. Such services (not normally provided in transportation brokerage systems as they are currently operated) might include trip alternatives and home patient services.

Multi-modal coordinated transportation brokerage services could include

- Short paratransit trips to bus or transit stops (feeder van service).
- Multi-loading ADA or agency paratransit vehicles (multi-loading increases the numbers of trips, their cost-effectiveness, and total revenues).
- “Transportation triage” services that would assign rides to the most cost-effective providers, including a range of volunteer operators.
- Computerized billing and reporting systems supporting multiple funding sources.

Trip alternatives could include

- Portable (driver carried) telemedicine monitoring devices for periodic in-home transmissions of vital signs, etc.
- Home delivery of prescription medications / pharmaceutical supplies.
- Home delivery of groceries and/or meals delivered to seniors and others.

Other home-client services could possibly include

- Periodic “mini-visits” to check on patient safety and well being.
- Remote monitoring of pill dispenser use.
- Motion detection and personal emergency detection systems.
- Telephonic disease management (probably using registered nurses).
- Periodic “telephone reassurance” or “friendly visiting” contacts that could also disseminate program information and offer referrals to community resources.

Summarizing the above ideas:

- Concept and innovation: This project has identified methods of jointly administering transportation, health care, and other resources by organizing, coordinating, scheduling, and dispatching transportation
resources in ways that are mutually beneficial to all parties. The particular innovation of this approach is in coordinating information transfer between multiple clients of transportation services and multiple providers of those services in a more cost-effective manner than now available.

- **Potential payoff for practice:** There is the potential for widespread application. Transit agencies should benefit from increased ridership and increased cost-sharing for fixed-route and ADA paratransit services. Paratransit operators should benefit from increased ridership (leading to greater revenues and lower average costs per ride). Health care operators should benefit by increased patient access to primary care services, which will reduce use of overtaxed emergency care facilities. Health care clients should experience better health care outcomes, which will lead to greater overall national productivity.

- **Product transfer and implementation:** Deployment would initially require an experimental field implementation and evaluation. Possible deployment sites should be confirmed. Dissemination to promote awareness and the results of this project should be made to appropriate Transportation Research Board committees, FTA and Federal Highway Administration (FHWA) staff, and representatives of other interest groups.

- **IDEA Product:** The key product of this project is a set of guidelines for software that is capable of transferring data between software applications used by different transit agencies, brokerages, and other providers of services. This processing and exchange of data is fundamental to the objective of having various transportation providers working together in a coordinated system of transportation providers and human service agencies.
IDEA PRODUCT:
DATA INTEROPERABILITY GUIDELINES FOR TRANSPORTATION SERVICES

The transit industry can be thought of as a hybrid. It often provides transportation services that focus on the clients of other industries, such as healthcare. Any data protocols that are developed for transit and paratransit need to generate data that is able to communicate with other software. Data may need to contain the correct terminology to facilitate insurance or agency reporting and reimbursement for medical or other cosponsored rides. In our effort to establish industry-wide software data protocols for transit providers, data protocols specified by all these organizations need to be considered.

For transit and paratransit information to be usable on all software platforms, the information needs to be cross-jurisdictional, cross-system, and able to interface with other transit data as well as data from other industries. Public information in particular cannot afford to be restricted to one make or model or manufacturer, or to cede control of its data format to private hands. Also, such information needs to reside in formats that can be reused in many different ways, as this will minimize wasted time and effort. Proprietary data formats, no matter how well documented or publicized, are simply not a cost-effective or reliable option: their control still resides in private hands; they could be changed or withdrawn arbitrarily without advance notice.

EXCHANGING TRIP TICKET INFORMATION BETWEEN ORGANIZATIONS

One of the challenges encountered when coordinating the efforts of multiple transportation providers is the process of sharing trip information among providers so that they are able to accommodate riders from various agencies at the same time on the same vehicle. This trip information, including all the details about the transportation service requested or provided — known as trip tickets — needs to be shared quickly and accurately. For many transportation providers, this process of sharing trip information may be time consuming and may result in lost trips or inaccurate assignments if the organizations use significantly different data systems for recording and processing trips and passengers.

Some persons believe that, in order to share trip ticket information electronically between organizations, all of the participating organizations need to be using the same scheduling / dispatching software. This is not true. Exchanging trip tickets electronically between organizations which are using different software products is not only possible, but can also be an accurate and highly efficient process.
Example: A Transportation Provider for Many Organizations

Transpro of Tacoma, Washington is a transportation service provider for six different agencies in the greater Puget Sound region of Washington State. Each of the six agencies uses a different scheduling and dispatching software and thus different methods of distributing trips to their service providers. At the time that Transpro installed their software of choice in the summer of 2009, only one of the six agencies could provide trip information to Transpro in a readable electronic format. Trip tickets from all of the other agencies had to be manually entered into Transpro’s software from faxed paper trip sheets or printouts from a web database. Because this was obviously a laborious and time-consuming process, Transpro’s software provider needed to design a software utility to translate and import trip tickets into Transpro’s new scheduling / dispatching software.

FIGURE 1: Schematic of data entry issues.

The Interpreter

Any software program that can import data must be able to recognize the source data and import it into the correct fields and in the proper format of the program receiving the data. The Translator reads records from the source format and writes them in the common format. The Importer is the part that creates new records in the target information system. Although the data itself may be formatted according to one of many standards, each of the programs involved might be using a different standard. For example, a date can be formatted as Mar 2, 2010, 2010-03-02, 03/02/2010 or another of many standard date formats. The software program importing this information needs to interpret and recognize whichever format is used as a date. Most persons have learned to interpret multiple data formats in various areas of our work and personal lives; software applications need to be taught how to do this.
The Data Translator

In the Transpro example, the import screen from the Import Translator looked like this:

During the development of each importer, Transpro’s software provider had to automate the process of mapping the fields in the source data file to the corresponding fields into Transpro’s transportation software.

Considerations

Here are some activities and considerations that are critical to the development and continued functionality of an importing process:
• It is important to observe the manual data entry process to determine how each piece of data could be converted into the common format.

• The method of transferring the data must be reliable and must be able to be found by the importer or the destination software.

• The source data must be well defined and must not change in layout, data fields and formatting.

• Because some fields may have different meanings in different software programs, common dispatching terms need to be applied to make sure everyone is speaking the same language. For example, what is called a “route” in one software program may not indicate the same concept as what is called a “route” in another program.

• In many instances, more data are imported into a system than necessary. Depending on reporting requirements, it may be possible to reduce the amount of data imported for each trip, which can simplify development, improve speed and reduce operating costs.

Probably the biggest challenge to the trip importing process is reprogramming the software for changes in structure or format of the exported data files.

HOW A DATA TRANSLATOR WORKS

A universal data translator works in the following steps:

1. The user selects a file containing the incoming records

2. The records are loaded into memory

3. Each value is processed into a new record set, working from a list of expected fields
   a. Values which need no modification are copied into appropriate field
   b. New values are generated from available data for fields which must be altered, parsed or composed from source fields Values which often must be manipulated, frequently because atomic pieces of data (data at the smallest level of detail) arrive in the same field:
      • Street Addresses [house numbers, apartments, city and state]
      • Client Name [first, last, middle and titles/suffixes, etc]
      • Record Identifiers [composite keys]
      • Fields containing lists of values [client needs/abilities]
      • Slight format changes [dates, character-sets]

4. The new record set is saved to a new file, matching the convention format.

When the Translator is operating, the visible user interface remains consistent regardless of the source of information, requiring only in some cases that the user (a) assist in indentifying the source format of the information and (b) initiate the processing. Additional formats are handled by engaging modules for each format that has been defined.
THE DATA DICTIONARY

Without a mutually agreed-upon set of data elements with clearly defined names and definitions, the validity and reliability of the data contained in a system are suspect at best and totally unreliable at worst. These elements are contained in a **data dictionary**. The data dictionary is the foundation of information system standards, and the central building block that supports communication across business processes. The data dictionary is a descriptive list of names, definitions, and attributes of data elements. The purpose of the data dictionary is to standardize definitions and ensure and advance interoperability.

This project provides the overall structure of a transit data dictionary for the express purpose of paratransit data exchange in Appendix A. The data dictionary combines information needed for transit and paratransit as well as interoperability for data exchange with health services.

**Data Dictionary Components**

The Data Dictionary defines the basic organization of a database and collects detailed information about database system components in one place. This information should contain:

- Data element definitions
- Program elements (stored procedures, scripts etc) used by the database to move data about or to manipulate it in some way
- System parameters
- System information
- Files and other system components
- Entity relationship diagrams
- Database schema
- Database security model.

The most crucial and most key parts of a Data Dictionary are the table definitions, the data elements within those tables, and the program elements.

The **Table Definitions** define the tables used in the database, including a brief description of their use, the key fields, the primary key and a list of the fields. Each table definition includes:

- table name
- table description
- table owner or database name
- data element, or column, or field name definitions (see below):
- key order for all the elements
- indexes
- table organisation
- duplicate rows allowed or not allowed
- table size
- security classification of the table
- the business context of the table.
The Data Elements themselves include:

- table names of the data element
- field name of the element
- related elements (which data elements are related to which other data elements?)
- data type (character, numeric, etc) and size
- data element description (what data is held in this field?)
- Is a null or empty value allowed?
- default value
- Validation rules, if any, between this element and other elements in the Data Dictionary
- database table references (where the data element is used and whether the data element is the primary key for the table, or a part of the key)
- data sources (where the data comes from, including rules used in calculations to producing data element values)
- Constraints that apply to the field How to deal with missing or incomplete information.

Program Elements include:

- stored procedures, for example, SQL scripts, that are integral to the database
- external procedures, for example, Unix scripts.

Finally, the Data Dictionary includes descriptions of each process carried by the database system, including:

- where and how data enters the system
- what is done to the data, at which stage, and why
- what are the outputs (if any) of the system
- the business context of the process.

The data dictionary is the building block of interchangeable data. It tells software developers the information that should be produced and the format the information should take. The data dictionary does not itself contain data; only information about the data that will be produced, known as metadata (data about data). Developers use the data dictionary to generate the data to be interchanged. See Appendix A for an example of the information expected to be included in a data dictionary for transit data exchange.

DATA TRANSLATORS AND PREPROCESSORS

Once there is a data dictionary, the actual data needs to be produced. Data can be contained in many formats, both open and proprietary.

Structured Query Language

Many, but not all, software providers use a Structured Query Language (SQL) compatible data format, either Microsoft SQL or its open source counterpart, mySQL. SQL databases easily read and write comma separated value (CSV) files. The data dictionary governs the file content and file naming conventions of the data files produced. (The Google Transit Data Feed specification uses CSV files). CSV files are really the "lowest common denominator" of data; easily accessible and readily available. Certain web-based software programs, however, require data in Extensible Markup Language (XML) format.
XML as a Data Translator

XML is a Web language developed for electronic business. XML enables the exchange of structured data over the Web. There are many software converters, both proprietary and shareware, that will translate information from CSV to XML formats and vice versa. The data dictionary is the fundamental component needed for this kind of data exchange.

XML can be used to describe and identify information accurately and unambiguously. XML allows documents which are all the same type to be created and handled consistently and without structural errors, because it provides a widely recognized way of describing, controlling, or allowing/disallowing particular types of document structure. It provides a robust and durable format for information storage and transmission, and provides a common syntax for messaging systems for the exchange of information between applications. Previously, each messaging system had its own format and all were different, which made inter-system messaging unnecessarily messy, complex, and expensive. If everyone uses the same syntax it makes writing these systems much faster and more reliable. XML is free: not just free of charge, but free as in open source. In order to transfer data between XML documents and a database, it is necessary to map the XML document schema to the database schema. The data transfer software is then built on top of this mapping.

There are many commercial software programs currently on the market that act as translators to and from SQL and XML. There are many convertors, both freeware and proprietary, to convert data to xml from CSV or SQL. Adoption of industry-wide data standards and conventions allow data transfer to be accomplished quickly and efficiently usually without using this kind of software.

Preprocessor programs are tools that process input data to produce output that is used as input to another program. The output is said to be a preprocessed form of the input data, which is often used by some subsequent programs. Generally speaking, the preprocessors take the raw data files and convert them to the format used for information interchange.

Figure 3 presents a simplified look at the information generation and data translation processes necessary for the exchange of files regarding transportation trip requests and trips provided. The sequence begins with an agency (or even an individual) generating a request for a ride. This request needs to be converted to a data file which is then checked for compliance with required formats. If the data file is compliant, it is transmitted to the software of the agency that will provide the ride. That agency can accept the request, assign the request to a driver and vehicle, and provide the ride. If the ride request is not fulfilled, information is sent back to the requesting agency and the sequence begins again. If the ride is provided, that information becomes part of a results code which is transmitted back to the requesting agency for their record keeping and billing.

As can be seen in this example, the error checking process is a key component of the programming needed to request, complete, and report on completed rides. The error checking process (like other system components) can have several steps. For example, the file generation itself can either succeed or fail. If it fails, it can return an error code indicating many conditions, some caused by physical circumstances (the disk might be full), and some by logical circumstances (a CSV file may not be created successfully if a data field in it contains an unexpected comma). The rigorousness of data checking of the files is assumed both by the agency requesting and the agency performing the ride. Data translators assume and regulate the error file formats as well as the input file formats.
FIGURE 3: Sequence of steps for transportation requests.

THE RIDE DATA TRANSLATOR

The Ride Data Translator provides the critical service of interpreting the source information, whether it comes as tabular text, spreadsheet or data stream, and turning it into the anticipated context-rich values expected. This step employs all of the definitions required to identify and understand the incoming values, with the business logic necessary to make sense of records from an unrelated system.
The user interface remains consistent regardless of the source of information, requiring only in some cases that the user assist in identifying the source format and trigger or schedule the process. Additional formats are handled by engaging modules for each format which has been defined and will be provided.

The operations of the Ride Data Translator depend upon a Ride Data Translator Module which contains the instructions for translating formats. Each source format must have a script or code-library containing the instructions specific to the expected format and informing the translator how to perform the conversion.

**The Ride Data Translator Module**

The Ride Data Translator uses a module specific to the system supplying the information. A programmer, and possibly a software designer, identifies the relationship between the source fields and the expected format. Many of the fields will copy directly from the source columns to the output. Some fields will have special considerations or require supplemental information which also must be made available to the translator process.

The process then copies each field from the input to the output, applying the appropriate modifications. The output can then be used in the local system in a consistent manner, regardless of the supplied format.

Appendix B presents the logical steps, called Pseudo-Code, that illustrate what the *Translate* function provided in the Ride Data Translator Module's application interface would look like. This is only an example and is not intended to be the source for an actual application.

**IMPORTING TRIP TICKETS INTO SCHEDULING / DISPATCHING SOFTWARE: AN EXAMPLE**

Passing trip tickets between scheduling/dispatching software should be standardized and as easy as receiving calendar invites. Since no standard yet exists, importing trip tickets has to go through a translation process first. Mobilitat, Inc., a software company focusing on paratransit, has shared their first data translator screens with us for this example:

Here are the steps for importing trip tickets into Mobilitat’s Easy Rides software from other software:

1. Acquire the source file for the trip tickets via download or email into the desired folder on the destination computer or workstation. This often times is in the csv (comma separated value) format.
2. Open the Translator tool
   a. Specify the source file by typing in the name or browse and select.
   b. Specify the destination or Output File Name. The Generated Name Format is set once initially and does not need to be specified each time.
   c. Click the GO button.

In Easy Rides, click on the “Trip Tickets” menu and then “Import Tickets.”
d. Double click in the blank area to specify source file for import.

Green shading indicates that the Client and addresses are already in the database and are ready for import.

Grey shading indicates an unrecognized name or address that need to be added into the database prior to import.
4. Double click on any clients or addresses that are in grey to open the appropriate form to enter them into the software.

5. After unrecognized Clients and addresses are entered, click “Import” then “Import All”.

The data translation and data import is now complete. Trip tickets will appear in the ride pool of the Easy Rides dispatching program.
INVESTIGATIONS INTO TECHNOLOGICAL SOLUTIONS FOR TRANSPORTATION MANAGEMENT

HISTORICAL PERSPECTIVE

Just as the 1970s and 1980s saw a proliferation of transportation services for persons with specialized travel needs, the 1990s and beyond have seen a proliferation of computerized programs for the administration and operation of those specialized transportation services. Decades ago, the multiplicity of transportation operators created a management challenge in terms of the cost-effective delivery of transportation services; similarly, there are now a large number of computer software vendors promoting their unique, proprietary transportation software products, and the wide variety and dissimilar nature of these products challenges the cost-effective delivery of transportation services.

To obtain a greater level of cost-effectiveness in the delivery of transportation services, options like coordination, brokerage, and consolidation have been applied to deal with the large numbers of transportation providers that operated independently of each other. The current situation of the wide variety and dissimilar nature of the software routines can serve as an impediment to coordinating transportation services and a barrier to improvements in cost-effectiveness. This issue has not yet been adequately addressed; addressing this issue is the major objective of this project.

In the initial stages of the use of electronic mail, there were many proprietary electronic mail and messaging software applications. With so many dissimilar systems, the need for interoperability was seen as critical for reducing operational cost and complexity. The Consultative Committee for International Telephone and Telegraph (CCITT), in conjunction with the International Standards Organization (ISO), developed the X.400 messaging standard as a common protocol so users of different programs could seamlessly exchange mail with each other. The X.400 standard created a conceptual protocol that provides a unified and reliable means of transporting message contents. A similar set of capabilities and practices is now needed to unify information exchange in the transit industry.

ISSUES CONCERNING CURRENT TRANSPORTATION SOFTWARE

A number of proprietary software programs are adept at handling typical transportation management issues, including client records, dispatching, scheduling, routing, trip records, maintenance management, client billing, and a host of other functions. Where problems arise is when complex travel situations require that information be transferred among several of these proprietary programs. Some of the more common of these complex situations are

- **When the rider has “dual eligibility”:** that is, when there is more than one agency that should logically participate in paying some portion of the cost of the trip for that rider. An extreme example would be a
low-income senior citizen with a disability who is traveling to an employment training program. This person could logically be a consumer of services from some or all agencies serving low-income persons, seniors, persons with disabilities, and job seekers. Which agencies should be paying what proportion of the total cost of that trip? Answering that question would be significantly easier if data concerning the traveler and the trip could be readily exchanged by all of the agencies charged with caring for that person.

• **When the trip crosses jurisdictional boundaries.** For example, in rural areas it is quite common for residents to travel extremely long distances to obtain specialized medical care. On such a trip, they may cross multiple county boundaries. Similarly, in metropolitan areas, a rider may need to cross multiple municipal boundaries to reach his or her ultimate destination. Nearly all vehicle trips are more cost-effective if they serve multiple passengers at the same time, but many localities have not figured out how to “transport County A’s passengers in County B’s vehicles” in such a way that all parties can be assured that the costs are being divided equitably. When the complexity of multiple software programs, none of them capable of communicating directly with each other, is added to this situation, the results may include excessive time or costs for the riders and uncertainties or difficulties in establishing cost sharing agreements.

• **When the trip requires access to multiple carriers.** The kinds of trips that might require a passenger to transfer from one transportation provider to another (which currently requires transferring from one vehicle to another) include the following kinds of circumstances:
  
  o A rural transportation provider brings their riders into an urban area and transfers their riders to an urban public transit system.
  o When the trip crosses jurisdictional boundaries and thus involves multiple carriers.
  o When the provider types are very different, if (for example) one provider is a volunteer-based service and the other is a public transportation operator.

  Frequently, riders of specialized transportation services will receive funding from two or more agencies, or require trips encompassing several jurisdictions. In instances like these, it is currently often difficult for transportation providers to exchange trip and client information with other providers because the providers are using disparate computer programs. This leads to decreased coordination, more difficulty funding trips, and more expensive trips.

**CURRENT ATTENTION TO THESE ISSUES**

In recent years, the concept of “one-stop shopping” has become a major organizing principle for transportation services. The Federal Transit Administration’s United We Ride and Mobility Services for All Americans programs now strongly promote the “One Vision, One Call” principle. This concept is believed to significantly increase rider accessibility and to increase the coordination and productivity of service providers.

A comprehensive “information function” is at the heart of the one-stop shopping concept. When combined with coordinated dispatching, the archive of service provider data and service area information is the feature that allows multiple transportation providers to more cost-effectively provide trips to travelers by increasing ride-sharing and minimizing trip distances. A community-wide, centralized information function enables the possibility of a wider range of organizational options for maximizing service delivery, including coordinated and brokered transportation services.
WHY DATA INTERCHANGE PROTOCOLS ARE NEEDED

“When you have common interfaces [and] common protocols, then everyone can innovate and everyone can interoperate. Companies can build their businesses, consumers can expand their choices, the technology moves forward faster, and users get more benefit...” Craig Barrett, Chairman of the Board, Intel.

Data protocols touch every area of our lives. Activities are now in some way compiled, processed, and stored as information, whether that information pertains to our travel, our health, or even just common ideas. The need for data interchange in this age of information is so great that there are entire organizations devoted to defining and maintaining protocols and standards for information exchange.

Since the advent of technology, developing protocols so that information can be exchanged among multiple parties has historically benefited the consumer and the provider. Developing interoperability protocols for data interchange between paratransit software applications will lead to more cost-effective use of transportation resources and ensure that information is quickly and reliably communicated, stored and organized. Interoperability protocols for data exchange will enable disparate software applications to communicate with each other. Technological issues should be examined from the transportation and data interchange perspectives.

Data Interchange Considerations for Transportation

Overview

Transportation agencies increasingly rely on software for maintaining client databases, scheduling, and dispatching. The 2004 Executive Order for Human Service Transportation Coordination¹ states in part that “. . . in too many communities, these [transportation] services and resources are fragmented, unused, or altogether unavailable” and that “Federally assisted community transportation services should be seamless, comprehensive, and accessible to those who rely on them for their lives and livelihoods” (emphasis added).

Our investigations identified the kinds of transportation functions that could be usefully addressed by integrated software programs. They included the following:

- **Centralized Information Services** that provide coordinated access to diverse and separately operated transportation services so that people needing transportation services are able to contact a single source, via telephone or computer, to find out how they may get a ride to meet a specific transportation need. A centralized information service should be able to tell any prospective rider about their travel choices in terms of time, destination, cost, and other factors. Significant examples of such services include FindARide.org, an on-line web site that describes transportation options in the Puget Sound area around Seattle (Washington). Another example is the Transportation Options program of the Arlington, Virginia, Area Agency on Aging (AAA) that serves as an advocate/catalyst, Information and Referral center, funder, and provider of transportation services for seniors.

- **The Coordination of Administrative and Operational Transportation Functions** in order to take advantage of resources and capabilities that may be common among the providers to create economies of scale. These common functions can include vehicle fueling; vehicle maintenance; driver training; scheduling of trips and assignment of vehicles among participating transportation providers; tracking and reporting; financial tracking, billing and payment. Coordination of such activities can improve transportation services by eliminating duplicative efforts and improving the efficiency of transportation operations, thus lowering the costs of providing services. A good example of such activities include the Sedgwick County Department on Aging (Wichita, Kansas) that administers a three-county coordinated

transit district and provides some trips and brokers others through a wide range of vendors. Multiple trip types are offered at a wide range of costs for seniors and others. Another good example is Arrowhead Transit (AT) in Virginia, Minnesota, one of the largest public rural transit providers in the United States. Arrowhead Transit is coordinating services with the Duluth Transit Authority (DTA). DTA has transfer points where Arrowhead passengers can transfer to DTA buses and vice versa. These transfer points are noted on bus schedules of both transit providers. The two systems coordinate legislatively; they draw from the same funding sources, and they jointly educate local elected officials and lobby these officials for funding.

- The task of a Transportation Broker is to function as a single point of access to transportation services for travelers, service providers, and funding agencies. The brokerage function is typically conducted at a centralized office that not only maintains and distributes information on the services available, but also attempts to match the needs of individual riders with the services available by assigning specific trips to specific providers. The broker’s function of distributing the trips that are requested to providers is greatly facilitated when comparable information is accessible about each service provider and each traveler. A significant example of transportation brokerage is Pittsburgh’s ACCESS program, one of the longest-running public paratransit programs in the country that primarily serves persons with disabilities, clients of human service agencies, and older persons. Trips are provided through contracts with eight for-profit and nonprofit authorized carriers chosen through competitive bidding. ACCESS has reduced number of transportation providers from 121 to 16, increased on-time performance and reduced complaint levels. Another notable brokerage operation is the Council on Aging and Human Services Transportation (COAST), a provider/broker in a large rural area in Washington and Idaho that coordinates with many agencies and funding sources with many types of riders and significant local tax support. COAST provides general public and specialized transit service, regional information and dispatch center, volunteer escorts, vehicle loans, insurance pool, training broker, school transportation, and mail-passenger contracts.

Inputs from Our Partners

This project included discussions and correspondence with transportation operators in a variety of locations across the United States. They strongly supported the idea of common data protocols for their scheduling and dispatching software.

The partners were asked if they had encountered problems in sharing or exchanging client, trip, or billing information with other transportation providers who were using different scheduling and dispatching software that is different from the software that used by these partners. Their responses included the following:

“At this time, we have not shared or exchanged information with other transportation providers. Currently, we email manifests done through [our software vendor] to the private providers under contract to us. We have found the private providers to be very reluctant to share data.”

We use software from [our private vendor] while our taxi provider uses another software program. Although [our private vendor] does have export capabilities (especially in Excel), we still haven't been able to send data directly into the cab company's dispatch system. This is unfortunate, particularly since most of the paratransit rides they provide are taxi-dispatch and rekeying errors do occur (including am/pm). Today, one lady wanted to go somewhere other than her usual destination, but the taxi took her to [her usual destination] anyway!

These agencies were asked if they are now involved in using client, trip, or billing data that is generated or stored in different software programs. If they were, they were asked how easy or difficult it was to use those different software programs. They reported the following:
“When we were coordinating Medicaid non emergency transportation, we had to verify eligibility each month using separate technology. It would have been much easier to set up a review of our database and flag those clients that were no longer eligible. In addition with Medicaid, there are expensive trips that require out of County travel. The availability of alternative service delivery and shared databases would offer the ability to better evaluate the least expensive method of service.”

“Yes, we are involved in such situations. All trips are booked and cancellations noted by the call center in [software from our private vendor]. Transportation providers are required to ask the Call Center for permission to no-show a passenger. Otherwise, we assume that the ride is provided on schedule. The call center reviews the bills for discrepancies and discusses those few with the provider. If the billing information was returned electronically into [our private vendor’s] database, we could sort rides between common origin/destination pairs and more easily question taxi rates above a standard variance.”

These agencies were asked if they see a need for a computer program or programs that could easily translate files from different software programs into files or reports that could be shared on a commonly understood basis. The general response was that they did see such a need; some operators were aware of such products available at this time and others were not. The responses included the following:

“We are not aware of any software that would allow for the translation files. This type of software would be beneficial to those systems that coordinate services. It would reduce the duplication of data entry. In addition, it would make the introduction of alternative service delivery much easier.”

Data Interchange Considerations in Other Disciplines

Since the early 1960s, the Federal government's information technology objectives have focused primarily on the cost-effective use of computer systems. The increased need for interoperability and open systems as a basis for information-infrastructure development demanded new goals and a different conceptual framework to guide the deployment of information technology. Government and industry's development and use of technical protocols assists in achieving systems interoperability and other broader information exchange goals:

- The International Standards Organization (ISO) is the global home for systems interoperability. ISO has many thousands of protocols and standards in about 40 broad categories, including healthcare and information technology. American National Standards Institute (ANSI) is the overseer of our national standards and works closely with ISO.

- In 1979, the American National Standards Institute chartered the Accredited Standards Committee (ASC) to develop systems interoperability standards for electronic data interchange, known as X12. The Data Interchange Standards Association (DISA) serves as the secretariat for X12 and oversees Electronic Data Interchange (EDI), the computer-to-computer exchange of business data in standard formats. The Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT) is the international standard for EDI. X12 is an ANSI standard that supplies the structure for EDI. The X12 standards are designed to work across industry and company boundaries.

- The International Electrotechnical Commission (IEC) is the world's leading organization that prepares and publishes International Standards for all electrical, electronic and related technologies, and is the standards setting branch exclusively concerned with messaging protocols.

Interoperability protocols provide an agreed-upon, common and consistent way to record information. They allow data to be exchanged among different information systems and for that data to have consistent meaning from system to system, program to program, and agency to agency. In brief, these protocols constitute universally agreed upon ways to handle data in ways that ensure interoperability.
This interoperability is important in almost every aspect of our lives. Interoperability makes it possible for us to consistently measure distances and time, get the same results from a recipe as our next door neighbor, place phone calls across the globe, and withdraw money from almost any ATM in the world. Without interoperability, the electronic exchange of information that occurs every second of every day across countless businesses and organizations would grind to a near halt.

Creating consistent ways to classify data is critical, but one also needs a consistent way to send data back and forth between organizations. When information systems collect and store client names in the same way, it is possible for one transportation system to send that data to another system, which is able to then use that information. **Being able to exchange data from information system to information system, without having to translate it into a new format, is the goal of data interoperability.**

The Need for Progress on Data Exchange

With interoperable data exchange, there is an increased likelihood of actually achieving specific interoperability objectives, an increased business knowledge that allows agencies to better determine success or take corrective action for ineffective components, and the potential for significant savings across the interoperable systems. In fact, there can be cost savings across the interoperable transit properties. Both cost and schedule “savings” can be obtained through coordination and collaboration. Although this requires a cultural change, it avoids duplicating expensive processes for each system and spreads the costs.

Without interoperable data exchange, transit systems will operate in isolation, leading to a lack of good decision making information, and reducing the ability of the agency to determine how it is performing and make necessary steps for improvement, a duplication of effort and information, and much more expensive individual rides and overall operations because shared or cross-jurisdictional rides may be unavailable.

Unless Mobility Management Centers have the ability to move trip tickets between software programs and ultimately to drivers, coordination will not occur. Ideally, "One call, one click" operators should be able to route all trips according to schedule, special needs, and cost.
CONSIDERATIONS CONCERNING DATA INTEGRATION AND INTEROPERABILITY

Interoperability includes both technical and operational capabilities. Technical capability means the ability of systems to provide information or data to and accept information or data from other systems. Technical problems can include those of connectivity between systems, specific issues of data and file exchange, and other data communication related scenarios.

Operational capability means the ability of systems to use the information that is exchanged to enable the systems to operate effectively together. Operational capability can be thought of as the value an agency can obtain from the technical capability.

The practice of ensuring interoperability necessitates recognizing the complexity of and understanding the scope of the interoperability issues with respect each particular system and the system’s level of involvement before taking action. This awareness establishes the framework for identifying all of the stakeholders and drives requirements definition, planning, and decision making for the remainder of the effort. Because of changes in the operational environment over time, interoperability is never completed. The work of evaluating the degree of interoperability among disparate systems over time and making adjustments as the technology and operational needs change is ongoing.
EXISTING DATA PROTOCOLS APPLICABLE TO TRANSIT DATA EXCHANGE

Health Data Protocols: The Electronic Medical Record (EMR) Model

In the United States, the development of data protocols for EMR interoperability is at the forefront of the national health care agenda. The data protocols problem is acute in the medical industry. An electronic medical record (also electronic patient record or computerized patient record or electronic health record) is an evolving concept defined as a “longitudinal collection of electronic health information about individual patients or populations.” It is a record in digital format that is capable of being shared within or across different health care settings. Such records may include a whole range of data in comprehensive or summary form, including demographics, medical history, medication and allergies, immunization status, laboratory test results, radiology images, and billing information. Clinical Document Architecture (CDA) specifies the syntax and supplies a framework for specifying the full semantics of a clinical document. It defines a clinical document as having the following six characteristics:

- Persistence
- Stewardship
- Potential for authentication
- Context
- Wholeness
- Human readability.

The nearly $20 billion set aside for health information technology stimulus in the American Recovery and Reinvestment Act (ARRA) won't be introduced until 2011, but the Obama administration dubbed 2009 the "Year of Healthcare Transformation." High-tech companies, hospitals and ambulatory health care centers are struggling to make the grade for future funding in order to meet the nation's health IT goals by 2014.

Medical providers must file electronic claims conforming to The Health Insurance Portability and Accountability Act (HIPAA) enacted by the U.S. Congress in 1996. The Centers for Medicare and Medicaid Services (CMS) have mandated the Electronic Data Interchange (EDI) 837 Standard for processing health care claims with data such as billing, demographic, and diagnosis information. Each state implements its own version of the EDI 837 format. All medical providers must adhere to the data protocols of their respective states for filing claim information.

In the United States, the Department of Veterans Affairs (VA) has the largest enterprise-wide health information system that includes an electronic medical record, known as the Veterans Health Information Systems and Technology Architecture (VistA). (This system follows the HL7 procedures described below.) A graphical user interface known as the Computerized Patient Record System (CPRS) allows health care providers to review and update a patient’s electronic medical record at any of the VA's more than 1,200 healthcare facilities. CPRS includes the ability to place orders, including medications, special procedures, X-rays, patient care nursing orders, diets, and laboratory tests.

Adoption of HL7 Data Protocols for the Electronic Medical Records

Founded in 1987, Health Level Seven (HL7) is a global not-for-profit, data protocols developing organization accredited by the American National Standards Institute. The HL7 organization is dedicated to providing a comprehensive framework and related data protocols for the exchange, integration, sharing, and

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2 http://www.hl7.org/documentcenter/

3 Ibid.
retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. HL7's 2,300+ members represent more than 90% of the information systems vendors serving healthcare.

HL7 data protocols provide a defined group of messages that must be formatted in a specific way. This allows medical software vendors to know what to expect when each of the message types are sent or received. For example, there is an HL7 message for adding a new patient, for updating a patient, for adding a new appointment, and for other actions.

The HL7 organizations' mission is to author consensus-based data protocols representing a broad view from healthcare system stakeholders. What this definition means from a practical standpoint is that (1) HL7 has compiled a collection of message formats and related clinical data protocols that define an ideal presentation of clinical information, and (2) together the data protocols provide a framework in which data may be exchanged. A number of countries use HL7 data protocols, including the United States, The Netherlands, Japan, Korea and Thailand.

HL7 is the ISO global data protocols for exchanging information between medical applications. This data protocols defines a format for the transmission of health-related information. The Health Insurance Portability and Accountability Act (HIPAA) refers to the specific set of ASC X12 EDI (i.e., Accredited Standards Committee standards for electronic data interchange) messages which are used for healthcare-related information exchange. The United States is in the process of converting from ANSI X12 4010 to ANSI X12 5010. (The current data protocols mandated in the U.S. for electronic medical transactions industry-wide are in the ANSI, American National Standards Institute, X12 standing committee, 4010 insurance subcommittee transaction sets. Version 5, Release 1, known as 5010, has been the official data protocol as of April 1, 2010. The 4010 standard utilized codes for the International Classification of Diseases (ICD-9). The 5010 standard utilizes a different set of diagnostic codes, ICD-10.)

The Office of the National Coordinator established the Health Information Technology Standards Panel (HITSP), a public-private partnership with broad participation across more than 300 health related organizations. HITSP operates with an inclusive governance model established through the American National Standards Institute (ANSI). The HITSP clarified national priorities and provided context for national health agenda activities by providing data protocols to its members. These data protocols included vocabularies, data elements, datasets, and technical data protocols to support the information needs and processes of Health Information Exchanges. To date, the HITSP has Developed 13 sets of Interoperability Specifications, along with consumer data protocols and specific implementation guidance, which describe how the specifications and data protocols need to be used. The datasets in this report are in compliance with these data protocols.

The HL7 data protocol is vastly more complex than what is needed to unify transportation data exchange. For instance, the HL7 data protocols encompass transfer of complicated graphic files, such as radiology images, and have much stricter security provisions then are needed for transportation. (For example, there are no security provisions for the Google Transit Data Feed, as this information is designed to be freely exchanged. More information on the Google Transit Data Feed appears later in this Chapter.) The salient point is that the HL7 data protocols are complex and that adoption of these data protocols (that were generated by a neutral non-profit organization) has enabled the creation of the EMR by many diverse software vendors who can all exchange vastly complicated data.

Transit and paratransit software providers do not currently use either HL7 data or HL7 data protocols, or include patient medical information in their records, other than information about type of assistance and attendants needed for transport. In an effort to be forward reaching and complete, this report includes typical health related fields used for diagnostic coding. These should be especially valuable for Medicaid transportation services. These can be kept as placeholders if they are not utilized by a particular provider.
HITSP Patient Demographics Query Transaction

These data protocols, also known as the HITSP/T23 subset of HL7 data protocols, contain a thoroughly defined set of data identifiers used to identify clients. Similar fields are used in our transit data exchange paradigm.

Additional Health Data Protocols

The Physicians Certification Statement (PCS)

Effective February 24, 1999, the Centers for Medicare and Medicaid Services (CMS) now require (42 CFR Part 410.40(d)), a Physician Certification Statement (PCS) from the patient’s attending physician for non-emergency ambulance transportation. In an effort for full interoperability, some fields on this form should become part of the transportation interchange standards. This form was designed to assist the healthcare professional to determine if Medical Necessity requirements for ambulance transportation had been met; the form thus contains data elements that are substantially useful for transportation providers as well as being necessary for data flow to clinicians.

Medicaid Standards for Electronic Transactions

The United States Congress included provisions to address the need for standards for electronic transactions and other administrative simplification issues in the HIPAA, Public Law 104-191, which was enacted on August 21, 1996. Through Subtitle F of Title II of that law, Congress added Title XI of the Social Security Act a new Part C, entitled, “Administrative Simplification.” On August 17, 2000, final regulations were published in the Federal Register for, “Standards for Electronic Transactions,” which became effective on October 16, 2000. The final requires compliance be met within 2 years of the rule effective date, making compliance necessary by October 16, 2002, unless covered entities have filed for an extension to the deadline. In 2001, in the Administrative Simplification Compliance Act, Congress authorized a one-year extension to October 16, 2003, for those covered and required to comply in 2002. SCDHHS has filed such an extension.

Electronic submission of claims will follow these guidelines:

- Claims currently filed on CMS-1500 or equivalent current electronic format will be filed on the 837 Professional format.
- Claims currently filed on ADA or equivalent current electronic format will be filed on the 837 Dental format except for oral surgeons who will use the 837 Professional format.
- Claims currently filed on UB-04 or equivalent current electronic format will be filed on the 837 Institutional format.

A Companion Guide includes the scope and transaction maps for the ASC X12N 837 004010X098A1 Health Care Claim Professional transaction set. The purpose of the guide is to provide support for the submission of the HIPAA-compliant 837 Professional claim and ensure proper processing of claims submitted to SC Medicaid. Fields from the current SC Medicaid Professional format have been cross-referenced to the applicable data element in the 837 Professional transaction. South Carolina Medicaid billing requirements also should be followed to ensure proper processing of claims. Specific SC Medicaid billing instructions can be found in provider manuals and monthly Medicaid bulletins.
Transit Data Protocols

The Federal Geographic Data Committee (FGDC) is an interagency committee that promotes the coordinated development and use, sharing of geospatial data on a national basis. This nationwide data publishing effort is known as the National Spatial Data Infrastructure (NSDI) and is a physical, organizational, and virtual network designed to enable the development and sharing of this nation's digital geographic information resources. FGDC activities are administered through the FGDC Secretariat, hosted by the U.S. Geological Survey. The National Spatial Data Infrastructure and the Federal Geographic Data Committee mandate the data formats governing geographic codes and geocoding standards. Transit information including valid street addresses, zip codes, county, state, and country codes, and precise longitude and latitude coordinates are important to information exchange for transportation across systems and geopolitical boundaries. Standardization of geographic codes enhances interoperability of systems. The United States Public Health Service also uses this geospatial information for tracking diseases as well as people.

TransXChange is a UK nationwide system for exchanging bus schedules. It is used both for the electronic registration of bus routes with the Vehicle Operating Services Agency (VOSA) and for the exchange of bus routes with other systems such as journey planners and real-time tracking systems. Google Transit adopted TransXchange for the Google Transit Data Feed (GTDF). This is a collection of open source (free and readily available) tools which generate transit data in the Google Transit data feed format from existing transit industry software formats.

Google is, of course, the Internet company that runs the Internet search engine of the same name, which is arguably the most important web search engine at the present time. Google defines a crucial component of its mission to offer easy to understand and comprehensive information. For example, Google strives to provide a variety of tools to allow people to explore locations worldwide through satellite imagery. Two of these highly important tools are Google Maps and Google Earth.

Google Maps is a free service application and technology that powers many map-based services including the Google Maps website, Google Ride Finder, and embedded maps on third-party websites. It offers street maps, a route planner for bicycles, pedestrians (for routes less than 6.2 miles) and cars, and an urban business locator for many countries worldwide. Google Earth is a virtual globe program that shows the earth by the superimposition of images obtained from satellite imagery, aerial photography and GIS over a 3D globe. On Google Earth, users with an Internet connection can enter an address or other location information then look at a digital image of that location on their computer screen. The interactive software then gives users many options, including the ability to zoom in from space-level to street-level, tilt and rotate the view or search for other information such as hotels, parks, ATMs or subways.

Google Transit is an Internet-based software program whose characteristics may suggest some of the features needed for the transportation data interchange that is the subject of this project. Google Transit is an outgrowth of Google Maps, which is an outgrowth of Google Earth. Google Transit is a completely free, open-source program that enables users to plan local trips in an easy, intuitive way and to do so without having to go to multiple websites. With Google Transit, commuters can access public transit schedules, routes, and plan trips using their local public transportation options. Google Transit eliminates one of the biggest obstacles to using public transit, which is the knowledge required to use it.

With the products Google Transit and Google Earth, Google has substantially contributed to the field of transit and opened the way for non-proprietary transit data files.
An Example of Possible Data Interchange Formats for the Future: The Google Transit Model

**Google Transit** is an Internet-based software program whose characteristics may suggest some of the features needed for transportation data interchange. Google is, of course, the Internet company that runs the Internet search engine of the same name, which is arguably the most important web search engine at the present time. Google defines a crucial component of its mission to offer easy to understand and comprehensive information. For example, Google has undertaken to provide a variety of tools to allow people to explore locations worldwide through satellite imagery. Two of these highly important tools are Google Maps and Google Earth.

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Some advantages of Google Transit are as follows:

- It can be used as planning and customer information tools because of the diverse gamut of information it provides (e.g., as a routing tool, Google can contour routes; as a mapping tool it can provide road level or street level data as well as public transit information).
- Google Transit provides a link to every participating agency so users can learn details about specific fares, service interruptions, or unplanned events.
- Google Transit provides a panoramic, real-time street view to allow a virtual exploration of the physical landscape. This feature enables people with disabilities to evaluate the relative accessibility of the local landscape.

Of considerable interest to us in this Transit IDEA project is the fact that an open source software project called “The Google Transit Data Feed” was developed and tested the Transit IDEA Project 58 in cooperation with Google and participating transit agencies. The Google Transit Data Feed is a collection of open source (free and readily available) tools which generate transit data in the Google Transit data feed format from existing transit industry data formats. Google thus offers tools for specialized transportation providers and small agencies which could enable them to become part of the collaborative effort which is Google Transit.

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4 This discussion is meant to highlight one example of the kinds of features needed for transportation data exchange, not to encourage the use of the products of any one particular company.
Some Technical Information on the Google Transit Model

When Google became interested in integrating public transit information with their mapping project, they decided to use TransXChange. The TransXChange is a UK nationwide system for exchanging bus schedules. It is used both for the electronic registration of bus routes with the Vehicle Operating Services Agency (VOSA) and for the exchange of bus routes with other systems such as journey planners and real-time tracking systems.

While participation in Google Transit is free of charge to the transportation provider, there are some challenges involved to integrate a system into Google Transit. One is the effort on the part of the transportation provider. For the most part, these challenges exist in the quality of the transit system data. If a transit system database is already feeding data into a sophisticated downstream system like a Computer Aided Dispatch / Automatic Vehicle Location (CAD/AVL) system, it is likely that the level of data quality is already high enough to feed Google Transit without much additional effort. On the other hand, if the quality level is relatively low, a considerable effort might be required to acquire and maintain data needed for Google Transit.

Currently, Google only works with public transit, and the Google Transit Data Feeds only accept data from transit properties with fixed routes and fixed schedules. However, Google is currently working on programs which let users compare fares for taxis with other transit options. Since paratransit agencies represent such complex and heavily regulated services, integrating paratransit into Google Transit is a longer term project. However, since Google Transit has developed the tools to freely allow transportation providers to interchange data, extending the Google Transit specifications to paratransit would allow paratransit agencies to freely exchange data with other transportation and paratransit providers without favoring the users of any particular scheduling or dispatching software application. This is seen as keenly important in the implementation of data exchange.

Implementing the Google Transit Data Feed Process

There are several steps for a transit agency to display data in an online program like Google Transit.

- The agency prepares transit data as in the Google Transit Feed Spec (GTFS) format.
- The agency hosts the transit data zip files on a standard web server and sends an email containing a link to Google containing a link to the location of the transit data.
- Google acquires the validated transit files from the agency's web server and builds a preview of the agency's data in Google Maps.
- The agency reviews the preview data and works with Google to resolve any issues.
- Google and the agency agree to make the transit data available on the Internet, and decide how often Google will check the agency's web server for feed updates.
- Transit data from the agency is posted on the Internet on google.com.
- Google acquires new files from the agency's web server on a regular basis, and updates Google Maps and other geographic applications at Google with the latest feed.

TRANSPORTATION DATA TRANSFER: A CONCEPTUAL FRAMEWORK

We've briefly looked at two different methods of information interchange. The Google Transit Data Feed model lets the public transit industry leverage their technology investment and increase ridership by providing a free public interface for their trip data. Google estimates that there are now more than 100 North American transportation systems using Google Transit, some of them involving extremely large transit properties, including San Francisco, Philadelphia, Boston, and Los Angeles. The Google Transit Data Feed has even been extended onto another platform by enabling the public to download transit data to their smart phones.
The HL7 data protocols organization estimates there are over 400 software providers internationally who provide software to thousands of laboratories, doctors offices, and hospitals utilizing HL7 data protocols. Standards for transit and paratransit software would be less complex than these standards but would involve a unique level of complexity involving private information about clients and general information about trips. Additionally, coding conventions unique to transit would need to be established and adopted across the industry. These codes are discussed in the "Data Fields" section of this report.

Within the past 10 years, the ability to securely move information between any two points on the globe has become not only feasible, but commonplace. However, the Internet does not impose data protocols on content, just on the transmission itself. Although some excellent medical communications standards exist, primarily Health Level Seven (HL7), it took the Internet to provide an appealing and affordable means of communication to make this happen. Medical data users, from solo practitioners to patients to corporations, chose voluntarily to adopt the Internet as their communication medium of choice, using the impressive medical communications and security data protocols like HL7 that were made available.

The enormous appeal of the Internet and particularly Web browsers is in part due to the fact that no one program (and thus no one vendor) is required to use the medium. The portability issues can be solved by the Internet, but the data protocols dilemma needs to be addressed by the industry in a non-proprietary, data-sharing manner.

Interoperability data protocols aim to support:

- Data transfer and sharing on much more than a local or enterprise-wide scale
- Knowledge transfer and integration
- Integration with both transit and specialized non-transit applications.

MAJOR ISSUES IN TRAVEL DATA INTERCHANGE

Why Integrate Data?

Just as Google Transit makes finding rides and routes easier for the majority of riders, creating interoperable data protocols for transit data can enable agencies, jurisdictions, and other paratransit services to maximize their services by sharing trips and passengers. Picture this common scenario:

Apple County Transit takes serves clients within the borders of Apple County. Berry County Transit serves clients within the borders of Berry County. Mrs. Stevens needs to travel for specialized medical care from Apple County to a facility in Berry County but her accustomed provider is constrained from providing a ride across county lines. How can Mrs. Stevens visit her physician once a month?

At the current time there is no mechanism to provide either this service or information about services that can assist passengers needing cross-jurisdictional services (with the exception of certain Medicaid brokerage providers). We envision a future in which paratransit providers can freely share information and assist each other's clients in arranging transportation. Figure 1 shows an example of how information exchange would ideally work in the example cited above.
Problems Involved in Sharing Client Data Information

Just thinking about what it takes to share transportation information can be complicated. The transportation provider or agency has to ensure that the client has given permission to share certain information, manage which parts of the information can be shared, and then go to work to make that happen without sharing more than the transportation provider or the rider wants to share. Software providers need to protect their intellectual trade secrets while exchanging information. Then how the information is to be sent, or what is generally called the communication method, needs to be considered, and when the exchanges will take place. Finally, the information needs to be integrated into the destination system.

What about Data Security?

Although transit providers do not need to exchange health information per se, they may need to exchange certain confidential information for billing and logistical purposes. HL7 mandates an extremely high level of data security, including multiple encryption keys. The security issues of paratransit are not so onerous, but they do involve exchanging data such as birthdates and social security numbers as well as logistical transportation information. Splitting transmission of data into multiple files which are later reassembled can provide inexpensive and readily available security; see Figure 2 for an example of how this could be structured.

The Challenge of Integrating Information from Paratransit Providers

Data exchange files could easily be created by the scheduling and dispatching software applications this project surveyed, the vast majority of whom use a SQL\(^5\) based interface. However, there is an additional element of complexity alluded to previously when logistical transportation information was described. This refers to data protocol codes that would need to be accepted describing mobility impairments, service animals,

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\(^5\) SQL (Structured Query Language) is a database/computer language designed for the retrieval and management of data in relational database. Virtually all database software programs "speak" SQL.
trip purposes, fare types, vehicle types, and trip types. Mobility impairments that pertain to transportation are not now classified in the agreed-upon data protocols for medical information for HL7 information with ICD⁶.

It is extremely important that transit software programs codes that can be recognized by other programs to describe mobility impairments, assistive devices, attendants needed, service animals needed, and boarding time increments needed. These data items do not currently exist uniformly either in transit data or health data, and are an example of the need for data protocols. These codes could include:

- **Mobility Impairments (for example):** Vision impaired, mobility impaired, hearing impaired, speech impaired, cognitively impaired, decreased level of consciousness, seizure prone, morbid obesity.
- **Assistive Devices (for example):** Manual wheelchair, electric wheelchair, walker, scooter, oxygen, cane.
- **Service Animals:** Is an animal needed (logical field); type of service animal(s) needed
- **Attendants:** Is an attendant needed (logical field)?
- **Boarding Time Increments:** How many 5-minute increments are needed for the client to board a vehicle?

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⁶ The **International Statistical Classification of Diseases and Related Health Problems** (most commonly known by the abbreviation ICD) provides codes to classify diseases and injuries. Under this system, every health condition can be assigned to a unique category and given a code, up to six characters long.
EXPECTED BENEFITS OF INTEROPERABLE SOFTWARE

BENEFITS TO VARIOUS FEDERAL PROGRAMS

Major human service and public transportation programs can both benefit from the development of unified regional mobility management call centers. The call centers can assist the fundamental missions of major human service programs as well as in their transportation functions. This chapter describes some of these benefits.

An ultimate goal of the regional mobility management call centers needs to be that of the more cost-effective utilization of transportation resources. The key do doing this is to make the best use of the most expensive resources. The most expensive resource of all is the driver’s time, and the best way to maximize the cost-effectiveness of the driver’s time is to ensure that the driver serves the maximum possible number of riders per hour.

At this time, the key human service federal transportation programs in terms of overall funding and numbers of persons served are as follows:

- Medicaid (Centers for Medicare and Medicaid Services (CMS), DHHS)
- Elderly Persons and Persons with Disabilities (FTA Section 5310, DOT)
- Temporary Assistance for Need Families (Administration for Children and Families, DHHS)
- Veterans Medical Care Benefits (Veterans Administration)
- Job Access and Reverse Commute (FTA Section 5316, DOT)
- Title IIIB Supportive Services (Administration on Aging, DHHS)
- New Freedom Program (FTA Section 5317, DOT)
- Vocational Rehabilitation Grants (Health Resources and Services Administration, DHHS).

Table 1 shows the estimated prevalence of single-passenger trips for these major Federal programs that support specialized transportation services. What this table shows is that most of these programs are providing a large number of single-passenger trips (in other words, trips that are provided by one driver for one passenger). There is a great potential for these agencies to improve the cost-effectiveness of their transportation services.
TABLE 1:  
Single-passenger trip estimates for key federal transportation programs.

<table>
<thead>
<tr>
<th>Program, Agency, and Department</th>
<th>Estimated prevalence of single-passenger trips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicaid (CMS/DHHS)</td>
<td>Moderate to high</td>
</tr>
<tr>
<td>Elderly and Disabled Program, S. 5310 (FTA/DOT)</td>
<td>Moderate</td>
</tr>
<tr>
<td>Temp Assistance for Needy Families (ACF, DHHS)</td>
<td>Fairly high</td>
</tr>
<tr>
<td>Veterans Medical Care Benefits (VA)</td>
<td>Fairly high</td>
</tr>
<tr>
<td>JARC, S. 5316 (FTA/DOT)</td>
<td>Moderate</td>
</tr>
<tr>
<td>Title III B Supportive Services (AoA/DHHS)</td>
<td>Low to moderate</td>
</tr>
<tr>
<td>New Freedom, S. 5317 (FTA/DOT)</td>
<td>Low to moderate</td>
</tr>
<tr>
<td>Vocational Rehabilitation Grants (RSA/ED)</td>
<td>Low to moderate</td>
</tr>
</tbody>
</table>

The regional mobility management call centers can enhance the cost-effectiveness of these programs by increasing the productivity (trips per hour) of their transportation services. The call centers can do this by grouping trips from similar origins to similar destinations. This process will require computerized dispatching and scheduling software and will occasionally require negotiating with prospective travelers regarding specific trip times and days.

A good example of the very substantial benefits derived from more proactive management of travel demands is the Medicaid transit pass program implemented in Dade County, Florida. This example has become famous because of its very substantial economic benefits and its win-win-win characteristics.

Florida’s Miami Dade Transit (MDT) provides an excellent example of the “bus pass” approach to moving clients to fixed route services. Since 1990, the State Medicaid office had purchased door to door paratransit trips for medical clients from the local Community Transportation Coordinator (CTC) at a cost of approximately $16. The Medicaid office analyzed their client base and found that many Medicaid eligible individuals were transit-dependent and used conventional fixed route transportation for all their daily non-medical trips. These same clients used more expensive door-to-door Medicaid paratransit trips for their medical appointments. The Metropass program was created to shift these transit dependent clients to fixed route service for their medical trips by providing them with monthly bus passes free of charge. In order to qualify for the Metropass Program, the Medicaid recipient must be able to use public transportation on a regular basis, and must make six or more Medicaid-funded round trips per month for three consecutive months. Once an individual becomes part of the Metropass program, Medicaid will no longer pay for door-to-door medical trips.

MetroPass users ride regular fixed route transit services; no operating changes were made to accommodate these riders. Thus, other than the administrative expense of handling an increased number of passes per month, MDT incurred no additional marginal costs related to transporting clients of the Medicaid program.

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Between 1993 and 1998, over 9,000 Dade County residents participated in the Metropass program for at least one month. MDT reported 4,943 registered users in the Metropass program in December 2002. Each of those registered users had been making at least 12 paratransit trips each month at a cost of $16 per trip (many Medicaid clients had been making more than 20 trips per month). Thus, in the absence of the Metropass program, transporting those clients would have cost at least $949,056 per month. Over an entire year, transporting these clients would have cost the Medicaid program $11.4 million. The cost of providing monthly bus passes for the MetroAccess clients can be calculated as $155,408 per month plus a $7.20 administrative fee for every bus pass sold to the Medicaid program, which is $35,590 per month. The total economic benefit to the Medicaid program is thus the alternative cost of paratransit trips minus the actual cost of the bus passes (direct costs plus administrative costs), or $758,058 per month, or $9,096,696 per year.

Since there were no marginal cost increases to MDT in transporting the Medicaid clients, and the administrative fee received by MDT presumably covers any increased marginal administrative costs, the total annual economic benefits to the Miami Dade Transit are derived from the sale of bus passes plus the administrative fees; the total is calculated as $190,998 per month or $2,291,976 per year. This matches the MDT estimate of revenues from Medicaid bus passes of $2,292,000.

In summary, the Medicaid program saved $9 million per year, the transit agency gained $2.2 million per year, and the Medicaid program participants in the bus pass program had monthly bus passes. By managing the demands for travel, all of these parties received significant economic benefits. We believe that the same kinds of results are possible when regional mobility management call centers coordinate the trip-making of different groups of riders.

**OTHER CALL CENTER BENEFITS**

This project also explored other benefits that might be derived from the expanded use of regional mobility management call centers. Key among these is earlier intervention in disease management, leading to improved health outcomes and reduced costs. Although not finally conclusive at this point in time, a number of studies are indicating that early treatment of disease or injury leads to better long-term outcomes. For example, a 2007 evaluation of Medicaid-eligible EPSDT clients in Texas\(^8\) collected data from a telephone survey of 5,163 randomly selected parents/guardians of Medicaid-covered children.\(^9\) Greater than one-third of urban and rural parents/guardians reported missing an appointment during the past year due to transportation-related barriers, most often leading to missed opportunities for EPSDT checkups. Among those that missed care during the past year, 22% of rural and 29% of urban parents/guardians said their child ended up needing emergency care at a later date.

Work conducted by Wallace, Hugh-Cromwick, et al.\(^10\) has indicated that about 3.6 million Americans miss or delay non-emergency medical care each year because of transportation issues. This target population of 3.6 million persons was found to have a higher prevalence of chronic diseases and a higher rate of multiple chronic conditions. The researchers found that “missed trips will potentially exacerbate the diseases and may

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8 The Early Periodic Screening, Diagnosis, and Treatment (EPSDT) Program is the child health component of Medicaid. It is required in every state and is designed to improve the health of low-income children, by financing appropriate and necessary pediatric services.


result in costly subsequent medical care (specialist visits, emergency room visits, and possibly hospitalizations). Even when this is not the case, that is, the potential to decrease subsequent utilization by more prompt care of an existing condition does not exist, quality of life concerns clearly are evident.” They then analyzed a large group of medical conditions and found 12 for which the provision of additional non-emergency transportation (NEMT) services is cost-effective; for four of these conditions, the researchers found that providing additional NEMT is actually cost saving – additional investment in transportation leads to a net decrease in total costs when both transportation and healthcare are examined. The four conditions for which additional transportation actually save costs are

- Pre-natal care
- Asthma
- Heart disease (congestive heart failure), and
- Diabetes.

Beyond such direct and immediate savings, the extent to which regional mobility call centers could become a component of other service management centers should be investigated. For example, the Administration on Aging’s Title III programs address a variety of in-home care and community-based support needs of elderly persons, including transportation. By integrating the coordination of these same services within a single call center base, AoA could assure that the elderly have access to a seamless continuum of care and support. A potential benefit of regional mobility management centers for AoA could include more seniors living independently in their own homes, thus reducing costs of unnecessary nursing home institutionalization and increasing life satisfaction for community-based seniors.

**BENEFITS TO TRANSPORTATION PROVIDERS: AN EXAMPLE**

The example of Transpro of Tacoma, Washington, a transportation service provider for six different agencies in the greater Puget Sound region of Washington State, was discussed earlier (see page 4).

**Staff Time Savings**

Prior to implementation of Transpro’s new software and its import tool, Transpro staff spent about eight hours each day to manually input trips from their brokers. Now that the importer is operational and implemented, the data importing process currently takes between five and fifteen minutes.

Staff members who were spending significant parts of their shift performing data entry are now able to focus on other tasks. This allowed rearranging the dispatch shifts for more efficient coverage. The eight hours average of labor per day saved by these importers has easily offset the initial cost of developing the translator.
Cost Savings

Transpro realized substantial cost savings resulting from the reduced labor costs. To calculate these savings, one can assume $10 per hour for labor costs. The manual process for importing trips took 8 hours per day. Transpro is a 24/7/365 operation; therefore, the cost for manually entering trips each day would add up to $29,200 each year. The labor costs for the electronic method, taking only 15 minutes per day, would be $912 per year. The combined cost to develop and deliver each of the two importers was $10,000, so the cost for developing the importers was recovered in labor savings in less than three months. The reduced labor costs are partially due to automation; a manual trip entry process is much more susceptible to recording missing or incorrect trips due to human error, missing fax pages, or other common problems.
SUMMARY: BENEFITS OF ADOPTING AND IMPLEMENTING A CONSISTENT PROTOCOL

One of the challenges encountered when coordinating the efforts of multiple transportation providers is the process of sharing trip information among providers so that they are able to accommodate riders from various agencies at the same time on the same vehicle. If the organizations use significantly different data systems for recording and processing trips and passengers, this process of sharing trip information may be time consuming and may result in lost trips or inaccurate assignments.

Some persons believe that, in order to share trip information electronically between organizations, all of the participating organizations need to be using the same scheduling and dispatching software. This is not true. Exchanging trip tickets electronically between organizations which are using different software products is not only possible, but can also be an accurate and highly efficient process because staff time can be so much more productive.

If there were common data definitions for exchanging data between brokerage / scheduling / dispatching software programs, sharing trip data among them would be much easier, robust and less expensive than it currently is. Without these common definitions, custom-built data translators are needed and they are expensive to develop. But even with the initial cost of custom software development and occasional adjustments for changes in exported trip data files, custom-built data translators can be a huge time and money saver, and they do take us another step towards greater levels of coordination in community transportation services.
PLANS FOR IMPLEMENTING COMMON DATA PROTOCOLS

HOW CAN AN INTEROPERABLE DATA SET FOR FILE TRANSFER BE ACHIEVED?

Our plan to implement common data protocols will begin with the development of a prototype of the universal data translator software. This will be a software product that will be commercially available to any interested parties.

To develop functional requirements and specifications for prototype protocols, there are at least five key steps for implementing data interchange protocols. The following basic processes are necessary components for the development and implementation of consistent data protocols:

- Stakeholders and software providers document the need for standard data fields or a universal data translator
- Stakeholders propose the Data Interchange Protocol
- Software Providers adopt the Data Interchange Protocol
- Stakeholders Implement the Protocol
- Software Providers Maintain the Protocol

This project has documented the need for standard data fields or a universal data translator and proposed the outlines of a software program that will translate data from one software application to another. Software providers could adopt the proposed data interchange protocol on their own, or could be encouraged or instructed to use the data interchange protocol by one or more key agencies.
Documenting the Need for Interoperable Data Protocols

In our research for this project and other projects, we received many anecdotal reports of the need for interoperable software. Why has the industry not lobbied software providers to provide this? It seems as though transit providers are reluctant to engage software manufacturers on this issue. Because software manufacturers can charge clients on a case by case basis for data translation, there is very little, if any, incentive for the manufacturers to provide interoperable formats. Additionally, today’s major transit software manufactures are vertically integrated: the "heavy hitters" also manufacture both transit and paratransit software programs and are invested in only providing solutions to their own clients. They can be seen as having a financial disincentive to provide translation interfaces for their software.

In at least some communities, transit and paratransit agencies are also operate in fragmented or uncoordinated fashions. Agencies within a state or geographical region frequently communicate with other service providers in their area, but jurisdictional issues may still inhibit a unified approach to services and supplies like software. The "United We Ride" dialog in November, 2009 says explicitly:

"Local paratransit agencies should better coordinate rides that cross boundaries such as county or even state lines. In large metropolitan areas such as the San Francisco Bay Area, a trip within the region can require two or even three transfers between different agencies, each of which serves only a specific county."

Many agencies who are involved in serving additional consumers but doing so with minimal expenditures don't have the time, energy, or technological literacy necessary to demand software solutions to this problem, but would welcome a software solution if it were to become available.

How does any project manager or systems developer determine when interoperability is important? If any one of the following statements is true, then there are probably some interoperability requirements that need to be identified; if more than one of these statements is true, the system(s) should be interoperable. Does the information system:

- Generate data that needs to be used by another system?
- Process or use data that is generated by another system?
- Use data that is delivered by another system?
- Use software that operates on a different platform than another system?

In more and more communities these days, these kinds of needs for interoperability are becoming more frequent.

Supporting the Data Interchange Protocol

The question of a specific agency or organization supporting new data protocols and being the "flag bearer" is an interesting one. The impetus and key supporters for the change should probably be an industry body. A single software manufacturer would probably not be able to have the necessary gravitas or neutrality to be the organizing body. We have documented the need for data interchange software in the transit and paratransit industry; however, there is currently no “Association of Transit Software Users” to begin demanding the software tools necessary to integrate data.
We have identified the following organizations that perform similar functions regarding data protocols and standards:

- **The American Public Transportation Association (APTA)** is a major transit industry association. APTA has a particularly long history of developing standards for safety and many other operational issues in the industry. APTA has played a key role in the development of the Transit Communications Interface Profiles (TCIP). TCIP is an APTA standard that includes information exchange building blocks to allow transit agencies and transit suppliers to create standardized tailored interfaces. TCIP addresses the interests of travelers, businesses, transit providers, and the communications industry in a fashion similar to that needed for the development of data interchange protocols for transit and paratransit scheduling and dispatching.

- **United We Ride**: The United We Ride (UWR) program is administered by the Federal Transit Administration (FTA) on behalf of the Federal Coordinating Council on Access and Mobility. Coordination activities might involve CCAM or UWR; alternatively, they could assign oversight of the development of data interchange protocols to an organization that they sponsor, such as the National Resource Center for Human Service Transportation Coordination.

**KEY STAKEHOLDERS IN THE DEVELOPMENT OF DATA INTERCHANGE PROTOCOLS**

The development of agreed-upon data interchange protocols will need the support of many key stakeholders. It would appear to be appropriate to form a Conceptual Data Interchange Systems Committee that would include the following:

- **Transportation software developers** would bring a technical view of interoperability to the discussion and would be able to clarify policies and conventions that will be useful in attaining the various kinds and interoperability.

- **Agency and program managers** would provide knowledge of their current and planned programs and their stakeholders capabilities and costs. Through collaboration these “stakeholders” could analyze, clarify and identify the specific (detailed) interoperability requirements that each system must meet.

**A MIGRATION PLAN FOR MAKING LEGACY SYSTEMS INTEROPERABLE**

The focus of this data translator should support the development of sensible strategies for migrating existing systems that were not initially designed for interoperability to function in new interoperable environments.

Software is increasingly embedded in society. Fewer and fewer solutions are stand-alone; hence interoperability between software from different vendors is crucial to governments, industry and the third party sector. Interoperability needs can be different — for machine-to-machine connectivity; software that needs to talk to other software; processes that need to interact with other processes; data that needs to access other data. However, achieving wide implementation or interoperability does not only depend on the openness of the process, but also on a shared conceptual system that allows all members of the consortium to interact with other data and systems in the consortium without exposing trade secrets or intellectual property of any system.

As transportation systems providers become increasingly automated, any provider who controls access to the data will have market power in being able to set the rules of data interaction. The future of transportation provider's interoperability will be to knit together a wide network of real-time data that will transform transportation as it becomes the new way of providing transportation.
CONCLUSIONS

We believe that this project has conclusively demonstrated the following:

• The competing products of current software vendors to the transit industry have not been designed for data interoperability with each other; transferring data files from one product to another is now a significant and costly challenge.

• Potential cost-effectiveness improvements to specialized transportation services through management strategies like coordination or brokerage are not being realized to their full potential due to the lack of data interoperability between scheduling and dispatching software programs now in use by various individuals and agencies needing transportation services and those organizations providing those services.

• Other industries have successfully implemented data protocols that enable data to be transmitted to and understood by users of various software applications.

• The required components of data translators and importers are known and could be developed, with sufficient support.

• There is reasonable expectation of a viable demand for such a product.

We believe that, with follow-on funding from other sources, software applications could be developed that would:

• Address the need for data interoperability for scheduling and dispatching for the paratransit and transit industry and between the industry and other industries.

• Enhance the viability of community-wide, centralized regional transportation information services, which could enable the possibility of a wider range of organizational options for maximizing transportation service delivery, including coordinated and brokered transportation services.

• Improve the cost-effectiveness of the transit and paratransit services by more fully achieving the benefits of advanced management strategies for coordination and brokerage.

• Be a useful commercial or open-source product that could provide interoperability between current and prospective commercial software applications.
INVESTIGATOR PROFILE

The Principal Investigator for this project is Mr. Jon E. Burkhardt, Senior Study Director at Westat. He may be contacted using the following information:

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Mobilitat, Inc. served as the Subcontractor for this project. Ms. Cindy Johnson, President, may be contacted using the following information.

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Cindy.Johnson@mobilitatsoftware.com
REFERENCES


APPENDIX A:
INITIAL COMPONENTS OF A 
DATA DICTIONARY 
FOR TRANSIT DATA EXCHANGE
INITIAL COMPONENTS OF A DATA DICTIONARY FOR TRANSIT DATA EXCHANGE

A BEGINNING DATA DICTIONARY FOR TRANSIT DATA EXCHANGE

SECTION 1:
FILE AND FIELD SPECIFICATIONS SPECIFICALLY FOR TRANSIT, INCLUDING COMPATIBILITY WITH GOOGLE TRANSIT DATA ELEMENTS:

<table>
<thead>
<tr>
<th>File Name</th>
<th>Field Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGENCY.TXT</td>
<td>agency_id</td>
<td>Optional. The agency_id field is an ID that uniquely identifies a transit agency. A transit feed may represent data from more than one agency.</td>
</tr>
<tr>
<td></td>
<td>agency_name</td>
<td>Required. The agency_name field contains the full name of the transit agency. Google Maps will display this name.</td>
</tr>
<tr>
<td></td>
<td>agency_url</td>
<td>Required. The agency_url field contains the URL of the transit agency.</td>
</tr>
<tr>
<td></td>
<td>agency_timezone</td>
<td>Required. The agency_timezone field contains the timezone where the transit agency is located.</td>
</tr>
<tr>
<td></td>
<td>agency_lang</td>
<td>Optional. The agency_lang field contains a two-letter ISO 639-1 code for the primary language used by this transit agency.</td>
</tr>
<tr>
<td></td>
<td>agency_phone</td>
<td>Optional. The agency_phone field contains a single voice telephone number for the specified agency.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>File Name</th>
<th>Field Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOPS.TXT</td>
<td>stop_id</td>
<td>Required. The stop_id field contains an ID that uniquely identifies a stop or station. Multiple routes may use the same stop. The stop_id is dataset unique.</td>
</tr>
<tr>
<td></td>
<td>stop_code</td>
<td>Optional. The stop_code field contains short text or a number that uniquely identifies the stop for passengers.</td>
</tr>
<tr>
<td></td>
<td>stop_name</td>
<td>Required. The stop_name field contains the name of a stop or station.</td>
</tr>
<tr>
<td></td>
<td>stop_desc</td>
<td>Optional. The stop_desc field contains a description of a stop.</td>
</tr>
<tr>
<td></td>
<td>stop_lat</td>
<td>Required. The stop_lat field contains the latitude of a stop or station.</td>
</tr>
<tr>
<td>File Name</td>
<td>Field Name</td>
<td>Details</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>stop_lon</strong></td>
<td><strong>Required.</strong> The stop_lon field contains the longitude of a stop or station.</td>
<td></td>
</tr>
<tr>
<td><strong>zone_id</strong></td>
<td><strong>Optional.</strong> The zone_id field defines the fare zone for a stop ID.</td>
<td></td>
</tr>
<tr>
<td><strong>stop_url</strong></td>
<td><strong>Optional.</strong> The stop_url field contains the URL of a web page about a particular stop.</td>
<td></td>
</tr>
<tr>
<td><strong>location_type</strong></td>
<td><strong>Optional.</strong> The location_type field identifies whether this stop ID represents a stop or station.</td>
<td></td>
</tr>
<tr>
<td><strong>parent_station</strong></td>
<td><strong>Optional.</strong> For stops that are physically located inside stations, the parent_station field identifies the station associated with the stop.</td>
<td></td>
</tr>
<tr>
<td><strong>ROUTES.TXT</strong></td>
<td><strong>route_id</strong></td>
<td><strong>Required.</strong> The route_id field contains an ID that uniquely identifies a route. The route_id is dataset unique.</td>
</tr>
<tr>
<td></td>
<td><strong>agency_id</strong></td>
<td><strong>Optional.</strong> The agency_id field contains an ID that uniquely identifies a route.</td>
</tr>
<tr>
<td></td>
<td><strong>route_short_name</strong></td>
<td><strong>Required.</strong> The route_short_name contains the short name of a route. This will often be a short, abstract identifier like “32”, “100X”, or “Green” that riders use to identify a route, but which doesn’t give any indication of what places the route serves. If the route does not have a short name, please specify a route_long_name and use an empty string as the value for this field.</td>
</tr>
<tr>
<td></td>
<td><strong>route_long_name</strong></td>
<td><strong>Required.</strong> The route_long_name contains the full name of a route.</td>
</tr>
<tr>
<td></td>
<td><strong>route_desc</strong></td>
<td><strong>Optional.</strong> The route_desc field contains a description of a route.</td>
</tr>
<tr>
<td></td>
<td><strong>route_type</strong></td>
<td><strong>Required.</strong> The route_type field describes the type of transportation used on a route.</td>
</tr>
<tr>
<td></td>
<td><strong>route_url</strong></td>
<td><strong>Optional.</strong> The route_url field contains the URL of a web page about that particular route. This should be different from the agency_url.</td>
</tr>
<tr>
<td></td>
<td><strong>route_color</strong></td>
<td><strong>Optional.</strong> In systems that have colors assigned to routes, the route_color field defines a color that corresponds to a route.</td>
</tr>
<tr>
<td></td>
<td><strong>route_text_color</strong></td>
<td><strong>Optional.</strong> The route_text_color field can be used to specify a legible color to use for text drawn against a background of route_color.</td>
</tr>
<tr>
<td><strong>TRIPS.TXT</strong></td>
<td><strong>route_id</strong></td>
<td><strong>Required.</strong> The route_id field contains an ID that uniquely identifies a route.</td>
</tr>
<tr>
<td></td>
<td><strong>service_id</strong></td>
<td><strong>Required.</strong> The service_id contains an ID that uniquely identifies a set of dates when service is available for one or more routes.</td>
</tr>
<tr>
<td></td>
<td><strong>trip_id</strong></td>
<td><strong>Required.</strong> The trip_id field contains an ID that identifies a trip. The trip_id is dataset unique.</td>
</tr>
<tr>
<td></td>
<td><strong>trip_headsign</strong></td>
<td><strong>Optional.</strong> The trip_headsign field contains the text that appears on a sign that identifies the trip's destination to passengers.</td>
</tr>
<tr>
<td></td>
<td><strong>direction_id</strong></td>
<td><strong>Optional.</strong> The direction_id field contains a binary value that indicates the direction of travel for a trip. Use this field to distinguish between bi-directional trips with the same route_id.</td>
</tr>
<tr>
<td></td>
<td><strong>block_id</strong></td>
<td><strong>Optional.</strong> The block_id field identifies the block to which the trip belongs. A block consists of two or more sequential trips made using the same vehicle, where a passenger can transfer from one trip to the next just by staying in the vehicle.</td>
</tr>
<tr>
<td>File Name</td>
<td>Field Name</td>
<td>Details</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>shape_id</td>
<td><strong>Optional.</strong> The shape_id field contains an ID that defines a shape for the trip. This value is referenced from the shapes.txt file.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>File Name</th>
<th>Field Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOP_TIMES.TXT</td>
<td>trip_id</td>
<td><strong>Required.</strong> The trip_id field contains an ID that identifies a trip. This value is referenced from the trips.txt file.</td>
</tr>
<tr>
<td></td>
<td>arrival_time</td>
<td><strong>Required.</strong> The arrival_time specifies the arrival time at a specific stop for a specific trip on a route. The time is measured from midnight at the beginning of the service date. For times occurring after midnight on the service date, enter the time as a value greater than 24:00:00 in HH:MM:SS local time for the day on which the trip schedule begins. If you don't have separate times for arrival and departure at a stop, enter the same value for arrival_time and departure_time.</td>
</tr>
<tr>
<td></td>
<td>departure_time</td>
<td><strong>Required.</strong> The departure_time specifies the departure time from a specific stop for a specific trip on a route. The time is measured from midnight at the beginning of the service date. For times occurring after midnight on the service date, enter the time as a value greater than 24:00:00 in HH:MM:SS local time for the day on which the trip schedule begins. If you don't have separate times for arrival and departure at a stop, enter the same value for arrival_time and departure_time.</td>
</tr>
<tr>
<td></td>
<td>stop_id</td>
<td><strong>Required.</strong> The stop_id field contains an ID that uniquely identifies a stop. Multiple routes may use the same stop.</td>
</tr>
<tr>
<td></td>
<td>stop_sequence</td>
<td><strong>Required.</strong> The stop_sequence field identifies the order of the stops for a particular trip. The values for stop_sequence must be non-negative integers, and they must increase along the trip.</td>
</tr>
<tr>
<td></td>
<td>stop_headsign</td>
<td><strong>Optional.</strong> The stop_headsign field contains the text that appears on a sign that identifies the trip's destination to passengers.</td>
</tr>
<tr>
<td></td>
<td>pickup_type</td>
<td><strong>Optional.</strong> The pickup_type field indicates whether passengers are picked up at a stop as part of the normal schedule or whether a pickup at the stop is not available.</td>
</tr>
<tr>
<td></td>
<td>drop_off_type</td>
<td><strong>Optional.</strong> The drop_off_type field indicates whether passengers are dropped off at a stop as part of the normal schedule or whether a drop off at the stop is not available.</td>
</tr>
<tr>
<td></td>
<td>shape_dist_traveled</td>
<td><strong>Optional.</strong> When used in the stop_times.txt file, the shape_dist_traveled field positions a stop as a distance from the first shape point. The shape_dist_traveled field represents a real distance traveled along the route in units such as feet or kilometers.</td>
</tr>
<tr>
<td>File Name</td>
<td>Field Name</td>
<td>Details</td>
</tr>
<tr>
<td>-------------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>CALENDAR.TXT</td>
<td>service_id</td>
<td>Required. The service_id contains an ID that uniquely identifies a set of dates when service is available for one or more routes.</td>
</tr>
<tr>
<td></td>
<td>monday</td>
<td>Required. The <strong>monday</strong> field contains a binary value that indicates whether the service is valid for all Mondays.</td>
</tr>
<tr>
<td></td>
<td>tuesday</td>
<td>Required. The <strong>tuesday</strong> field contains a binary value that indicates whether the service is valid for all Tuesdays.</td>
</tr>
<tr>
<td></td>
<td>wednesday</td>
<td>Required. The <strong>wednesday</strong> field contains a binary value that indicates whether the service is valid for all Wednesdays.</td>
</tr>
<tr>
<td></td>
<td>thursday</td>
<td>Required. The <strong>thursday</strong> field contains a binary value that indicates whether the service is valid for all Thursdays.</td>
</tr>
<tr>
<td></td>
<td>friday</td>
<td>Required. The <strong>friday</strong> field contains a binary value that indicates whether the service is valid for all Fridays.</td>
</tr>
<tr>
<td></td>
<td>saturday</td>
<td>Required. The <strong>saturday</strong> field contains a binary value that indicates whether the service is valid for all Saturdays.</td>
</tr>
<tr>
<td></td>
<td>sunday</td>
<td>Required. The <strong>sunday</strong> field contains a binary value that indicates whether the service is valid for all Sundays.</td>
</tr>
<tr>
<td></td>
<td>start_date</td>
<td>Required. The <strong>start_date</strong> field contains the start date for the service.</td>
</tr>
<tr>
<td></td>
<td>end_date</td>
<td>Required. The <strong>end_date</strong> field contains the end date for the service. This date is included in the service interval.</td>
</tr>
</tbody>
</table>
## SECTION 2:
FILE AND FIELD SPECIFICATIONS CONTAINING ADDITIONS FOR PARATRANSIT DATA INTERCHANGE:

<table>
<thead>
<tr>
<th>File Name</th>
<th>Field Name</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIENT</td>
<td>ClientID</td>
<td>An internal randomly numbered identification number for the client, ensuring no confidential data would be included in the file.</td>
</tr>
<tr>
<td></td>
<td>TripID</td>
<td>An internal randomly numbered identification number for the trip, used to link information to funders, drivers, etc.</td>
</tr>
<tr>
<td></td>
<td>Client_Last</td>
<td>Client’s Last Name</td>
</tr>
<tr>
<td></td>
<td>Client_First</td>
<td>Client’s First Name</td>
</tr>
<tr>
<td></td>
<td>Client_Middle</td>
<td>Client’s Middle Name</td>
</tr>
<tr>
<td></td>
<td>Address1</td>
<td>The home street address</td>
</tr>
<tr>
<td>CLIENT (cont)</td>
<td>Address2</td>
<td>Other Address</td>
</tr>
<tr>
<td></td>
<td>Cl_city</td>
<td>Client’s city</td>
</tr>
<tr>
<td></td>
<td>Cl_state</td>
<td>Client’s state</td>
</tr>
<tr>
<td></td>
<td>Cl_Zip</td>
<td>Client’s zip</td>
</tr>
<tr>
<td></td>
<td>Cl_Phone</td>
<td>Client’s primary phone</td>
</tr>
<tr>
<td></td>
<td>Cl_Emergency</td>
<td>Client’s Emergency Contact</td>
</tr>
<tr>
<td>CLIENT_TRIP</td>
<td>TripID</td>
<td>An internal randomly numbered identification number for the trip, used to link information to funders, drivers, etc.</td>
</tr>
<tr>
<td></td>
<td>ClientID</td>
<td>An internal randomly numbered identification number for the client, ensuring no confidential data would be included in the file.</td>
</tr>
<tr>
<td></td>
<td>PU_City</td>
<td>City Name of the Pick Up Address</td>
</tr>
<tr>
<td></td>
<td>DO_Address</td>
<td>The drop-off address</td>
</tr>
<tr>
<td></td>
<td>PU_Date_actual</td>
<td>The Date of the Pick Up</td>
</tr>
<tr>
<td></td>
<td>PU_City</td>
<td>City Name of the Drop Off Address</td>
</tr>
<tr>
<td></td>
<td>Cl_Phone</td>
<td>Phone Number of the client</td>
</tr>
<tr>
<td></td>
<td>PU_Time</td>
<td>The time (24 hour format) the client needs to be picked up.</td>
</tr>
<tr>
<td></td>
<td>DO_Time</td>
<td>The time (24 hour format) the client needs to be dropped off.</td>
</tr>
<tr>
<td></td>
<td>MI_1</td>
<td>Primary mobility impairment of the client</td>
</tr>
<tr>
<td></td>
<td>MI_2</td>
<td>Secondary mobility impairment of the client</td>
</tr>
<tr>
<td></td>
<td>SpecNeed_code</td>
<td>Code for any assistive devices needed for client</td>
</tr>
<tr>
<td></td>
<td>Attendents</td>
<td>Number of attendents client needed</td>
</tr>
<tr>
<td></td>
<td>Srvc_animal_code</td>
<td>Code for service animals, if any, client needs</td>
</tr>
<tr>
<td>Field</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Purpose_code</td>
<td>Primary Purpose of Trip as coded in client software</td>
<td></td>
</tr>
<tr>
<td>Purpose</td>
<td>Text Description of trip purpose, if needed</td>
<td></td>
</tr>
<tr>
<td>Funder1, etc.</td>
<td>Trip Funders</td>
<td></td>
</tr>
<tr>
<td>Provider</td>
<td>Provider of the trip</td>
<td></td>
</tr>
<tr>
<td>Rate_Type</td>
<td>Rate type of the trip</td>
<td></td>
</tr>
<tr>
<td>Rate</td>
<td>Rate</td>
<td></td>
</tr>
<tr>
<td>Funder2</td>
<td>Secondary Trip Funder</td>
<td></td>
</tr>
<tr>
<td>Other_Fund</td>
<td>Other Trip Funders</td>
<td></td>
</tr>
<tr>
<td>BT</td>
<td># of Boarding Time Increments Needed</td>
<td></td>
</tr>
<tr>
<td>Permit_code</td>
<td>Permit code of the trip</td>
<td></td>
</tr>
<tr>
<td>Drv_ID</td>
<td>Driver identifier assigned to the trip</td>
<td></td>
</tr>
<tr>
<td>Fare_Type</td>
<td>Fare type of the trip</td>
<td></td>
</tr>
<tr>
<td>Fare</td>
<td>Fare of trip</td>
<td></td>
</tr>
<tr>
<td>Base_Fare</td>
<td>Base fare value of the trip</td>
<td></td>
</tr>
<tr>
<td>Trip_date_Des</td>
<td>Desired trip date</td>
<td></td>
</tr>
<tr>
<td>Value</td>
<td>Trip Value</td>
<td></td>
</tr>
<tr>
<td>Auth_date</td>
<td>Date Trip was authorized</td>
<td></td>
</tr>
<tr>
<td>Auth_by</td>
<td>Code of agency authorizing the trip</td>
<td></td>
</tr>
<tr>
<td>Veh_ID</td>
<td>Code of special vehicle type needed for the trip, if any</td>
<td></td>
</tr>
<tr>
<td>PU Coordinate Lat</td>
<td>Specific GIS Latitude for Client Pick Up</td>
<td></td>
</tr>
<tr>
<td>PU Coordinate Long</td>
<td>Specific GIS Longitude for Client Pick Up</td>
<td></td>
</tr>
<tr>
<td>Client_ID</td>
<td>Place of Service code of the trip</td>
<td></td>
</tr>
<tr>
<td>POS_code</td>
<td>ID of the trip</td>
<td></td>
</tr>
<tr>
<td>Site_Code</td>
<td>HIPAA compliant site code of the trip</td>
<td></td>
</tr>
<tr>
<td>Fare</td>
<td>HIPAA compliant purpose of the trip</td>
<td></td>
</tr>
<tr>
<td>File Name</td>
<td>Field Name</td>
<td>Details</td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ID_DATA.TXT</td>
<td>ClientID</td>
<td>The internal randomly numbered identification number for the client from the CLIENT.TXT file, ensuring no confidential data would be included in the file.</td>
</tr>
<tr>
<td></td>
<td>SS_Num</td>
<td>Client's Social Security Number</td>
</tr>
<tr>
<td></td>
<td>Eth_ID</td>
<td>Client's Ethnic ID</td>
</tr>
<tr>
<td></td>
<td>CL_MedNum</td>
<td>Client's Medicaid Number, if appropriate</td>
</tr>
<tr>
<td></td>
<td>CL_AidNum</td>
<td>Client's Medicare Number, if appropriate</td>
</tr>
<tr>
<td></td>
<td>CL_Bdate</td>
<td>Client's Birth Date</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other identifying data, as appropriate</td>
</tr>
</tbody>
</table>
APPENDIX B:

PSUEDO-CODE FOR
A RIDE DATA TRANSLATOR MODULE
MODULE PSEUDO-CODE

Pseudo-Code presents the logical steps that make up a computer program or algorithm, written in a way that illustrates the concepts of the design, without the restrictions of computer languages. While it resembles programming language, it only serves as an example and is not intended to be the source for an actual application. It allows a programmer to see the software design and possibly implement the design in any programming language.

The following is an abbreviated example in pseudo-code, illustrating what the Translate function provided in the Ride Data Translator Module's application interface would look like. The Design for the user interface of the Ride Data Translator is not provided.

// PSEUDO-CODE FOR A RIDE DATA TRANSLATOR MODULE //

external function Translate(
    source_file_name,
    destination_file_name): result_code

external function Format: result_text

function TranslateRow(row): result_text

const
output_columns:
    'client_name'
    , 'origin_location'
    , 'origin_apartment'
    , 'origin_city'
    , 'origin_phone'
    , 'origin_depart_time'
    , 'destination_location'
    , 'destination_apartment'
    , 'destination_city'
    , 'destination_phone'
    , 'destination_arrive_time'
    , 'stop_duration'
    , 'client_status'
    , 'special_need_code'
    , 'funder_name'
    , 'provider_name'
    , 'rate_type'
    , 'fare_type'
    , 'fare'
    , 'trip_purpose'
    , 'note'
    , 'passenger_count'
    , 'attendants_count'
input_columns:
  , 'RideNumber'
  , 'ClientName'
  , 'Start' // address w/ apartment – try separate
  , 'StartCity'
  , 'StartTime'
  , 'End' // address w/ apartment – try to separate
  , 'EndCity'
  , 'EndTime'
  , 'Phone' // only one phone – use as origin phone
  , 'Disability' // infers client status and special needs
  , 'FastPassCode' // not represented in output – place in note
  , 'Fare' // infers rate, type and fare
  , 'Note'

var
myInputFile, myOutputFile, myString

function Format: result_text
begin
  result_text = "Psuedo-Code Example Format"
end

function Translate(source_file_name, destination_file_name): result_code
begin
  myInputFile = openfile(source_file_name)
  for each row in myInputFile
    write(TranslateRow(row)) to myOutputFile
  end
end

function SplitAddress_NoApartment(address): result_text
begin
  result_text = SplitString("Apt#", address)[0]
end

function SplitAddress_NoApartment(address): result_text
begin
result_text = SplitString("Apt#", address)[1]
end

function DetermineRateByFare(fare): result_text
// it is common to have these selection type of function
// working to interpret the source data when the
// required value is not supplied, but can be derived
// from the fields present based on business agreements
begin
  case fare
    when < $1: result_text = "LocalFare"
    when $1 to $10: result_text = "FixedFare"
    when > $10: result_text = "HiredFare"
    else result_text = "Unknown Fare"
  end
end

function DetermineTypeByFare(fare): result_text
begin
  case fare
    when <= $10: result_text = "Cash"
    else result_text = "Billed"
  end
end

// StatusBasedOnDisability – imported from supplemental code unit
// SpecialNeedsFromAbility – imported from supplemental code unit

function TranslateRow(row): result_text
begin
  // in the pseudo-code, the column names will be treated like
  // properties;
  // even though the declared column-name constants would likely
  // be needed to refer to the columns
  with result_text, row do
    begin
      client_name = ClientName
      origin_location = SplitAddress_NoApartment(Start)
      origin_apartment = SplitAddress_Apartment(Start)
      origin_city = StartCity
      origin_phone = Phone
      origin_depart_time = StartTime
      destination_location = SplitAddress_NoApartment(End)
      destination_apartment = SplitAddress_Apartment(End)
      destination_city = EndCity
      destination_phone = ""
      destination_arrive_time = EndTime
      stop_duration = 5
      client_status = StatusBasedOnDisability(Disability)
      special_need_code = SpecialNeedsFromAbility(Disability)
      funder_name = "SourceTransit"
      provider_name = "MyTransit"
rate_type = DetermineRateByFare(Fare)
fare_type = DetermineTypeByFare(Fare)
fare = Fare
trip_purpose = "Medical" // only medical trips sent
note = Note + FastPassCode
passenger_count = 1 // assumed
escorts_count = 0 // not specified in source
miles = 0 // calculate later – not in source
route_name = "" // not specified in source
vehicle_name = "" // not specified in source
driver_name = "" // not specified in source
created_time = now
last_modified_time = now
record_identifier = RideNumber
record_status = "new" // allows for updates

// PSEUDO-CODE //