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FINAL REPORT FOR

UWR/MSAA DEMONSTRATION OF COORDINATED HUMAN SERVICE TRANSPORTATION MODELS:

PHASE I – SYSTEM DEVELOPMENT AND DESIGN

M-ITS: MART'S INTEGRATED TRAVELER SERVICES

AUGUST 31, 2008

REPORT NUMBER: FTA-MA-26-7114-2008.1

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PREPARED BY:
MONTACHUSETT REGIONAL TRANSIT AUTHORITY
R1427 WATER STREET
FITCHBURG, MA 01420
WWW.MRTA.US

REPORT NUMBER: FTA-MA-26-7114-2008.1

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13. ABSTRACT (Maximum 200 words)

This paper presents the results of a sixteen month project for system development and design of a model for a Travel Management Coordination Center (TMCC) utilizing ITS capabilities. The system was designed as a tool to facilitate the exchange of knowledge and data, enabling seamless coordination of transportation across geographic regions, programs, funding entities, private/public/non-profit providers, care-givers and travel coordinators. This project involved discussions and meetings, extensive research, card-board modeling and numerous verification sessions during which stakeholders throughout Massachusetts and portions of New Hampshire defined and ratified system requirements, which were later organized into potential sub-systems representing 'functional' system components. The M-ITS core subsystems are: 1) Brokerage & Booking, 2) Scheduling & Dispatching, 3) Vehicle Tracking, 4) Operations Management, 5) Fare Payment and Billing Management and 6) a Trip Planner. The system design process resulted into a practical, scalable product that can be replicated in multiple scenarios without difficulty by any entity using mostly off-the-shelf components (with some customization) and deployed in its entirety over the given 12 months through six concurrent phases, provided funding is available for all the phases.

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Foreword

This purpose of this Final Report is to present the results of a sixteen month project for the system development and design of a model for a Travel Management Coordination Center (TMCC) utilizing Intelligent Transportation System (ITS) capabilities. The report includes: 1) a summary of the project, 2) background information on the user needs which motivated our participation in this project as well as information on MART and the project Stakeholders, 3) the approach to the project, 4) the results of the work done during the development and design phase, and 5) lessons learned during the project. This report is intended for all interested readers but includes information particularly relevant to the United We Ride / Mobility Services for All Americans (UWR/MSAA) initiative, federal transportation officials, transit agency representatives, transit information technology staff and our project stakeholers.

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LIST OF ACRONYMS

UWR – United We Ride
MSAA – Mobility Services for All Americans
TMCC – Transportation Management Coordination Center
MART – Montachusett Area Regional Transit Authority
ITS – Intelligent Transportation Systems
M-ITS – MART's Integrated Traveler Services
TSP – Transportation Services Portal
IT – Information Technology
AVL – Automatic Vehicle Location
MDT/C – Mobile Data Terminal/Computer
PDA – Personal Device Assistant
ADA – American Disabilities Act
ETA – Estimated Time of Arrival

Executive Summary

The Montachusett Area Regional Transit Authority (MART) provides transportation thru Fixed Route and Paratransit Operations throughout three cities (and partially in two other towns) in North Central Massachusetts. MART's extensive Brokerage Operations also allows us to broker/coordinate Human Service Transportation in four regions (73%) of the State of Massachusetts. MART has had the privledge over the past sixteen months to be involved in a project thru the United We Ride / Mobility Services for All Americans (UWR/MSAA) Initiative and sponsored by the U.S. Department of Transportation Federal Transit Administration (USDOT/FTA). Phase I of this research project was the development and design of a model for a Transportation Management Coordination Center (TMCC). We have named our model M-ITS: MART's Integrated Traveler Services. The effort in this project involved countless discussions, meetings, research, card-board modeling, and verification sessions. The entire team worked in this project for almost sixteen months and was able to translate a 'vision' into a practical product that once built can be implemented in multiple places without difficulty. The project has been designed keeping in mind that the design can be implemented by any entity using mostly off-the-shelf components (with some customization). Care has been taken to design a system that has SIX concurrent phases so that it can be implemented in its entirety in the given twelve months, provided funding is available for all the phases. This contrasts with a typical sequential phasing, in that in the past such projects run into serious motivational issues, and since the demand on low cost transportation is increasing rapidly, waiting to complete this project over 3-4 years won't meet the challenge.

The system design effort involved a large number of different types of user groups each with unique requirements, throughout the state of Massachusetts and areas in New Hampshire. The resulting needs analysis, ratified by these stakeholders, was later used to create a list of system requirements. These system requirements were later organized based on 'potential' sub-systems that represented 'functional' components of the M-ITS design.

The system architecture and high level design was an effort that required research of existing systems that perform coordination, and three systems were identified: a) cooperative distributed processing (used in Financial systems), b) Blackboard systems (used by US Navy) and c) Airline Reservation System (e.g. SABRE), that were close to what the TMCC vision requires. It was determined that a mixed blend of the three approaches would form the core architecture of M-ITS, as by themselves each approach had pros and cons.

The key to the M-ITS system is it is designed to be a repository of knowledge together with the tools to access that knowledge, but participation is not conditional and the information does not become property of the system. M-ITS is not a gatekeeper of coordination but a facilitator of knowledge and data exchange enabling seamless coordination of transportation across regions, geographies, programs, Government entities, and across private, public and non-profit providers and care givers, and travel coordinators.

M-ITS truly is an ever enlarging, encompassing and fluent opportunity for the industry to truly coordinate transportation.

1. BACKGROUND

MART's Interactive Traveler System (M-ITS) project is being developed as the **choice coordinated human service transportation system** to provide the three high level goals stated below:

- Provide a **simple point of access**, through a travel management coordination center (TMCC)
- **Simplify transportation services** for low income, older adults and persons with disabilities
- Develop a **TMCC** that can be **scaled** to add more services and **replicated** to other regions in the Nation.

MART and many of its stakeholders, in partnership with the Commonwealth of Massachusetts' Human Service Transportation Office, have been coordinating transportation services across multiple funding programs, multiple communities and multiple demographics since 2001.

MART's partners are varied and spread across the entire spectrum of transportation –private, public, for profit, non-profit, quasi-Government, Government, volunteer, etc. These partnerships have been in place and rules of governance have already been cast in the form of MOUs, contracts and other legal documents.

The demography that MART and its partners support cover not only the elderly and disabled, but also school children, low income individuals and employment seekers.

The fact that MART and its partners have formed relationships over the last several years, and that MART has increasingly taken over responsibilities of other entities and communities clearly speaks of the '**scalability'** capabilities. The richness in the variety of transportation services and the demography supported gives M-ITS a head start in the area of **replication** for the 'model' across the country.

The MART model has been the aspiration of multiple states from New Hampshire, Maryland and Washington to South Carolina, Idaho, Mississippi and Missouri. Several teams from these states have visited MART's three operational centers and its technology usage, to evaluate their options vis-à-vis coordinated transportation. Clearly, MART's operational model on which the M-ITS is based is striking a chord on a **national** scale, and consequently has all the elements for **nationwide deployment**. It is our intent in this project to prove this capability.

1.1. MOTIVATION

The M-ITS team has done numerous meetings, as well as spent significant time discussing and evaluating a cross section of transportation service needs and partner requirements with various stakeholders and partners. We have then applied common sense rules to simplify the access paradigms and modalities, keeping in view the legal, contractual and financial constraints that might arise during actual deployment. The results of these evaluations have been framed in a high (organizational) level as well as 'operational' (user) level details and described at a conceptual level in this document.

1.1.1. Simple Access to Transportation Services & Information Portal

M-ITS brings to the United States transportation industry its first true Transportation Services Portal (TSP) that not only provides information but also allows one to avail transportation services through it. It is, in a true sense, a web portal much like Orbitz or eBay, where the service providers can publish

their services and the consumers (riders) can avail the services by paying for it on-line. It also is similar to SABRE – the airline reservation system, in that it allows 'agents' to do the travel planning and booking. This concept is much bigger in scope than what Google Transit is proposing (or at least what they have opened up so far) or what individual Urban Trip Planners can do.

1.1.2. Not just an Urban Trip Planner

M-ITS' Traveler Services Portal extends the definition of Trip Planner to include a) demand response routes, b) volunteer services, and c) brokered transportation. A typical Trip Planner is designed to handle 'Fixed' routes only, mostly because it is easy. Adding demand response, volunteer and brokered trips increases the complexity of Trip Planning and requires a new way of thinking. M-ITS represents that new way of thinking – Trip Coordination.

1.1.3. Simple, Unified Customer User Interface

The M-ITS customer front-end is a simple screen with source/destination/time/travel date information. M-ITS extends the Trip Planner Front-end concept to become a universal front-end format – whether it is web, PDA, Kiosk, or even a Phone. Once a rider is familiar with one mode, they can use any other. The M-ITS concept includes the unification of screen labels, prompts, and messages across all forms of communication. So a message that indicates no itinerary found will read and sound the same. In M-ITS model, the unified front end will allow all levels of its users to use the same screen to plan trips for themselves or their patrons. The same front end will support the multitudes of funding sources, its contractual restrictions and its various service providers. Another front end is the 'tactical' information – such as vehicle location information and schedule information that may be obtained via an AVL/MDT system. The M-ITS system proposes to use web based maps (Google, Yahoo etc.) to display vehicle locations within M-ITS. Similarly vehicle location information can also be obtained by phone, cell phones, PDAs, kiosks, etc., by calling the same number.

1.1.4. Simple, Unified Service Provider Interface

The service providers shall obtain work, schedule trips and perform billing transactions using the same front end. This allows the service providers - small, big, for-profit, non-profit, Government, private, quasi-Government – to be part of the transportation network. In other words, service providers can expect the same level of simplicity in accessing the system that a rider will and can participate in the coordinated human services transportation effort, no matter its affiliation, no matter its size. A central billing system is the third center piece of M-ITS. This ties together the planning, paying for trips, billing an agency and collection of revenue aspects of transportation. It also streamlines audit and reporting processes.

1.1.5. Scalability and National Replicability

M-ITS' imperative is to meet the scalability and national replicability goals and be a system such as Orbitz and SABRE. In the simplest possible form, the concept of scalability can be defined as follows:

- any provider with any type of existing software/hardware can join the network
- any provider operating with paper and pencil can join and grow the network
- any existing program may add more riders to the program
- any transportation coordination effort or an existing program can join the network
- any individual rider or group can join irrespective of 'qualification'

Each of the cases can bring in its constraints that need to be incorporated in M-ITS.

The national replicability, on the other hand may have the following definition:

- Any state or 'region' with its own 'peculiarities' may join; however, this puts a very large burden on purveyors of the system and technology, mostly because of vastly different reporting criteria and eligibility criteria.
- Any software/hardware system required to replicate the model elsewhere, can be easily deployed and customized. This has funding challenges.
- The methodologies developed for 'coordination' can be accepted universally across the country. Given that each transportation entity in the country claims to be unique, this is the toughest challenge at hand.

1.2. M-ITS PARTNERSHIPS

The M-ITS concept has had the opportunity of being conceived as a partnership between the Commonwealth of Massachusetts Human Services Transportation (HST) Office (established by the Executive Office of Health and Human Services, in coordination with the Executive Office of Transportation and Public Works), and the Montachusett Area Regional Transit Authority.

The HST office was originally tasked with reducing the cost of the funded transportation programs of three agencies, while maintaining their service levels, by better coordinating the transportation across a spectrum of providers.

MART has opted for innovative methods to lead the way in coordination, including opening up service delivery to anyone who is qualified without a pre-set fixed contract period. If the service providers are cost effective they get work, if not they don't. MART maintains a group of service level inspectors who are always on the road inspecting vehicles, drivers etc. MART also offers operational and financial support in various forms to its vendors. With its methods, MART has created a community of transportation providers, seekers, brokers, and funding agencies by using cutting edge, advanced technologies enabling this community to interact via the Internet.

This pre-formation of coordination positions MART as a strong contender for the partner that DOT seeks, (as stated by Federal MSAA management team members)

*"…to test the **technical** and **institutional feasibility** of a coordinated human service transportation models with **enhanced accessibility** features…."*

*"The USDOT intended to partner with local communities and/or systems that already possess existing policies and partnership for transportation service coordination, and have **some levels** of **existing ITS infrastructure*** and ***deployment**, such as wireless communications, in place to support human service transportation improvements."*

MART offers a unique opportunity to 'view' how the futuristic TMCC may be built mostly because MART has had an advanced coordinated transportation system in place for the last 4-5 years, that

1) manages seventeen (17) different funding sources and associated regulations
2) manages seventy-one percent (71%) of Massachusetts brokered HS transportation
3) has its own fleet of approximately 180 vehicles
4) has access to approximately 1,200 vehicles through its approximately 200 vendors
5) has 230+ users linked to its web-based coordination and billing system state-wide
6) performs automated, web-based invoicing functions for its approximately 200 vendors

7) has an AVL/MDT system on its Paratransit vehicles
8) has an Intermodal Transportation Center to implement M-ITS

1.2.1. M-ITS Foundation: A Unique Blend of Physical & Technology Infrastructure

MART has an expansive physical and technical infrastructure. MART's physical infrastructure is fully supported by a sophisticated technology infrastructure monitored by its 4 person IT staff, and a 4-5 person ITS technology consulting staff.

Additionally, MART's technology infrastructure is "industrial" strength and very scalable, as has been proven over the last 5-6 years with an ever increasing volume of trips, vehicles, and contracts. The system has been able to absorb information and still perform at peak speeds with no degradation in response times. MART's technology infrastructure implements several transportation applications that are ITS Application packages like the Automated Scheduling and Dispatching Application, or non ITS packages – such as the Vendor Portal – which is the basis for the OpsMgmt and Billing components of M-ITS. A more detailed description of current ITS implementation is described in a later section.

1.2.2. MART's Existing ITS Implementation

MART's ADA Para-transit Operations has been utilizing ITS technologies for six years. We started as an AVL pilot program with fifteen vehicles, expanded our coverage to thirty vehicles two years ago, and will have expanded coverage to our entire fleet including fixed route buses by the end of 2008. Over the last six years we have matured the program from using the feature of 'Transit Vehicle Tracking' and made it into a comprehensive 'Demand Response and Para-transit Operations'. The following ITS technologies in place are:

- Automated routing/scheduling system – maximize vehicle capacity
- Computer-aided dispatch – sending demand response requests to vehicle
- Transit Security – emergency signal from vehicle to dispatch message center
- ITS Data Mart – archive of all vehicle and scheduling data
- Weather Information Distribution – in to dispatch to vehicle thru message center
- Incident Management System – for tracking driver/client incidents and relaying to authorities

MART has also deployed a customized application that integrates with the phone switching system at MART.

- The application is an Integrated Voice Response system integrated with the consumer database, allowing consumers to use an automated system to confirm and review scheduled trips. This reduces queue times for consumers and allows availability twenty-four hours a day. This should be considered a part of 'Transit Traveler Information' (APTS8) in the Regional Architecture.

1.2.3. MART Regional ITS Architecture Leadership

On June 8, 2004, the very first meeting of the guidance committee for the development of the Central Massachusetts Regional Architecture was held. The architecture was created and is maintained by the Massachusetts Executive Office of Transportation's Office of Transportation Planning (EOT-OTP). MART was invited to be a member of the guidance committee. Over the course of the next ten months the committee continued to meet on a monthly basis to develop and compose the Central MA Regional Architecture. MART had the same representative present at every meeting. EOT considered us a major

stakeholder, since we are the second largest Transit Authority in the State and already had existing partnerships with other vital stakeholders. The final version was published in March 2005.

During this time MART had recently completed a pilot program of an ITS project, and was preparing to submit our grant application for the second phase to expand and integrate more ITS features and partners. MART realized that being a part of the development of the Regional ITS Architecture would not only ensure our place as a stakeholder in the architecture, but that it would also help us to understand how the ITS Architecture was a key piece in the maturing of our existing ITS Infrastructure.

MART is a key stakeholder/component in thirty-two of the forty fully developed Central MA Regional Architecture Market Packages. The National Architecture has eighty-five, the rest of which are listed in our regional architecture but not yet fully developed for our region. We are also a part of 9 out of the 34 subsystems. The maintenance plan for the Central MA Regional Architecture requires that we reconvene the guidance committee three years after the release of the original document. This means that very soon MART will once again be a part of this invaluable document. This project alone opens up the avenue for MART to become a component in two more of the existing market packages.

1.3. M-ITS STAKEHOLDER PARTICIPATION

The initial excitement among stakeholders notwithstanding, getting them to congregate at the same time on the same day has been a Herculean effort, so we adopted a different technique, we met them separately over several weeks, and multiple times. Then we followed up with questionnaire's we sent via email and then further followed up with them via phone.

1.3.1. MART

MART's operational environment has been a major attraction for several other agencies in different states and several of them have visited MART, and have praised the 'level' of coordinated transportation and the usage of technology to meet the coordinated transportation needs.

1.3.2. New Hampshire DHHS Office

They have visited MART multiple times, and have adopted a MART like model for its coordinated transportation effort involving Health and Human Services and Department of Transportation.

1.3.3. HST Office

The HST Office has shown keen interest in involving themselves from multiple angles, a) making the four programs it manages part of the M-ITS design consideration – allowing the team to get 'real' data, b) encouraging the concept of centralized billing to be a 'state' level capability so 'other' programs can be incorporated into it, and c) bringing other state initiatives related to transportation (especially employment related) into the mix for the purpose of getting a proper design done, and later having these agencies benefit from the deployment of M-ITS.

The HST Office is taking its own initiative to set up UWR meetings to discuss inclusion of multiple parties. The HST office is also discussing the option of 'supporting' the project once the implementation is complete.

1.3.4. Volunteer Agencies like Senior Care of Gloucester, MA

This agency has been longing for a concept such as M-ITS and has shown keen desire to play a significant role in working on the volunteer driver component.

1.3.5. Fitchburg COA and Leominster COA

These agencies have gone beyond the talk; in that they have agreed to 'test' drive our concept by replacing their current tools with M-ITS concept tools (that are designed to bring the COAs into the M-ITS environment). MART's current procurement of ITS technologies may include an IVR system that the COA wants to leverage.

1.3.6. Kiessling Transit

Kiessling Transit is a Private provider for Southern Massachusetts. Kiessling Transit Inc. maintains two facilities. Its corporate headquarters are located in Norfolk, MA. This fully equipped maintenance facility is the centralized area for their "Fixed Route" operations. The second facility is located in Braintree, MA and is contracted with the MBTA to provide services for The South Area RIDE (a "Demand-Response" service). Kiessling has had a long history of using and testing cutting edge IT tools to do business. Currently Kiessling is deploying web based scheduling, dispatching and AVL/MDC tools.

Kiessling Transit sees the M-ITS project as a way to increase business by participating in creating a coordination tool that will identify currently unmet transit needs and allow Kiessling to have access to these markets. "Our goal is to sell more seats on our down time." – Lars Kiessling

1.3.7. Management Transportation Services, Inc.

MTS, the current operator of MART, has been working with us on designing the 'Back office' component of the M-ITS' OpsMgmt module.

MTS is a provider/operator of Paratransit and ADA, as well as brokered trips, in the Fitchburg/Leominster area. They also operate fixed route buses in this region. In addition to Fitchburg, they provide brokered transportation in Worcester, Boston and Springfield, MA. MTS is a stakeholder in the project focusing on the needs of private operators providing services to regional transportation authorities.

MART's intent is that MTS lead the effort in implementing the sub-systems that focus on public transportation elements, using the technology to find a balance between dwindling fixed route ridership and increasing demand response services. Their goal is to use M-ITS tools, including AVL/MDC and M-ITS Trip Planner, to help transfer Paratransit riders to fixed route so that the cost of operations can be greatly reduced.

1.3.8. Central West Regional Employment Solutions Team (CWREST)

Provides transportation for individuals served by DMR in employment and community based day programs. C/W REST provisions transportation among all stakeholders including individuals, families, service providers, public transit and other transportation providers and all levels of government.

1.3.9. Massachusetts EOHHS Office

The Massachusetts Executive Office of Health and Human Services (EOHHS) through their Human Services Transportation Division supervise 6 brokers to take care of 4 different programs. Each entity has its own system. This project would provide an opportunity for EOHHS and other similar funding sources to create a centralized repository of billing information as well as a transaction system to conduct real time billing. Their office is the executive branch of the following state offices:

- **Massachusetts Human Services Transportation**
- **Massachusetts Office for Refugees and Immigrants**
- **Massachusetts Department of Labor and Workforce Development**
- **Massachusetts Department of Mental Retardation**
- **Massachusetts Commission for the Blind**
- **Massachusetts Department of Transitional Assistance**
- **Massachusetts Department of Mental Health**

1.3.10. UMASS/CHPR MI-CEO

The mission of the Center for Health Policy and Research (CHPR) is to promote and conduct applied research, evaluation, and education aimed at informing policy decisions that improve the health and well-being of people served by public agencies.

1.3.11. CATA (Cape Ann Transit Authority)

Cape Ann Transportation Authority (CATA) is a public agency serving the City of Gloucester and Towns of Rockport, Essex and Ipswich. CATA provides two types of transportation services. One is the Fixed Route and Para-transit (dial-a-ride) transportation provided for the four member communities by Cape Ann Transportation Operating Company (CATOC), a management company contracted by CATA. The second type of service is a contractual brokerage arrangement to provide transportation for qualified health care recipients. CATA also contracts with the City of Beverly for their "Business Express." There is also a "shopping bus" from Gloucester to the Liberty Tree and North Shore Malls on Saturdays.

To meet these transportation demands, CATA fleet now has 18 buses, 3 trolleys, 12 vans and 3 vehicles for maintenance and administrative staff. The number of employees has increased from one full time employee to over 35 full time and part time employees.

1.3.12. Veterans Shuttle

Local Veterans Shuttle service, typically providing medical transportation to VA centers.

1.3.13. Easter Seals, NH/RI/ME/VT/NY

Community transportation provider experienced in working with underserved populations and advocates. They have a proven track record for success in community service, public-private partnerships and systemic change initiatives. Community transportation provider in 5 States: New Hampshire, Vermont, Maine, Rhode Island and New York.

1.3.14. WRTA (Worcester Regional Transit Authority) / CMRPC (Central Mass Planning Commission)

WRTA and CMRPC are working together, and are interested in pursuing implementing a prototype kiosk at Union Station with WRTA schedules. We would like to also include schedules from Greyhound, Peter Pan and Amtrak. Other than WRTA, the other transportation providers have not been informed about this venture.

1.3.15. PVTA (Pioneer Valley Transit Authority)

The Pioneer Valley Transit Authority is a larger regional transit authority in Massachusetts with 177 buses, 175 vans and 24 participating member communities including Agawam, Amherst, Belchertown, Chicopee, Easthampton, East Longmeadow, Granby, Hadley, Hampden, Holyoke, Leverett, Longmeadow, Ludlow, Northampton, Palmer, Pelham, South Hadley, Springfield, Sunderland, Ware, Westfield, West Springfield, Wilbraham and Williamsburg.

1.3.16. HB Software Solutions (HBSS)

HB Software Solutions is an Intelligent Transport Solutions Company. Established in 1997 with its international headquarters at North Andover, MA.HB Software Solutions has chartered itself to provide solutions built around state-of- the-art technology for Regional Transit Authorities and for the transportation industry in general.

HB Software Solutions has focused heavily on the RTA sector since its inception. All HBSS solution development has been geared towards generating value for our customers by both increasing top-line revenues as well as reducing bottom line costs of an RTA operation. HBSS has been able to generate tremendous value for our customers through solutions that are innovative and continuously upgraded with additional functionality based on real needs.

The philosophy of the organization has been to build and deploy solutions, which are value-driven and not just features-driven.

2. APPROACH

This effort followed the formal execution of the System Engineering Methodology as it applied to the 'Demonstration of Enhanced Human Service Transportation Models.' Additionally, we were required to stay within the PHASE 1 scope which included Needs Assessment, Requirements Gathering, and High Level Design only. The Overall project was guided by standard Gantt-based project management planning. We also employed a project tracking mechanism to facilitate the capture of meetings, studies, and external issues.

2.1. GOALS

The MART's Interactive Traveler System (M-ITS) project is being developed as **the prototype coordinated human service transportation system** able to provide three high level goals stated by the United We Ride Program under the Mobility Services for All Americans initiative:

- Provide a **simple point of access**, through a travel management coordination center (TMCC)
- **Simplify transportation services** for low income, older adults and persons with disabilities
- Develop a **TMCC** that can be **scaled** to add more services and **replicated** to other locations in the Nation.

The goals of the participating stakeholders and agencies are to improve efficiency of operations so that they can sustain the service levels or even improve without increasing the budgets. At the state levels spending cuts are almost at the crisis level.

2.2. PROJECT STAFFING

An important part to approaching a research project is to have the appropriate personnel contributing to the project. The following key personnel were in involed in Phase I:

Bruno Fisher, MART Chief Operating Officer – was responsible for all aspects of Project Management for Phase I: System Development and Design.
Bonnie J. Mahoney, MART, Technical Program Manager and ITS Specialist – contributed her practical technical expertise to making sure the system being developed was meeting stakeholder requirements and was compliant to the Regional ITS architecture.
Dr. Himanshu Bhatnagar, Technical Specialist (APTS and Transport Planning), HBSS - An external consultant, advisor on APTS technologies and was responsible for demographic analysis, service use analysis, service marketing, and on team for inter-agency discussions.
Dr. Charles Kosta, Technology Specialist, and HBSS - An external consultant, advisor Internet technologies, contributed his expertise in the communication technologies being considered as part of this project.
Sarah Porter, Marketing and Training, HBSS – An External Consultant who was responsible for Public Relations between MART, HBSS & the Stakeholders

2.3. PROJECT TRACKING

We have employed a project tracking document that provides a current status on important tasks, and open issues. The open issues are typically limited to questions that can not be answered by our own team and require outside direction. Other internal issues are typically listed as 'TAS' or under study. Milestones are items that have been promised or expected by the team, FTA, or external entity.

2.3.1. Assigned Tasks from Master Gantt Chart

No	Description	Priority	Responsible Resource	Expected Due Date
A	Project Plan	High	ALL	05/30/07 – Done
A1	Revise Plan based on feedback	High	ALL	08/24/07 - Done
B	TMCC Con Ops	High	ALL	11/05/07 - Done
B1	Revised TMCC Con Ops	High	ALL	01/15/08 - Done
C	Systems Requirement Doc	High	ALL	2/14/08 - Done
D	System Architecture Doc	Med	ALL	5/30/08 - Done
E	Gap Analysis Doc	Med	ALL	5/30/08 - Done
F	HL System Design Doc	High	ALL	6/30/08 - Done

Table 1: Project Tasks

2.3.2. Issues and Progress made during Phase 1

TI Legend
TAM - (T)ask (A)ction, (M)eeting
TAS - (T)ask (A)ction, (S)tudy & Analyze
TAP - (T)ask (A)ction, (P)roject Mgmt.
TAT - (T)ask (A)ction, (T)echnical Assistance

No.	Description	Type	Status (open, closed, activity)	Resolution Date
1.	Local Meeting 1. Attended by Bruno Fisher, Rebecca Badgley, Bonnie Mahoney, Himanshu Bhatnagar. Follow up HBSS meeting with Himanshu Bhatnagar Chuck Kosta, Shalabh Bhatnagar. 2. Sections 2.2 assigned to CK + RB Sections 2.4 assigned to CK + SB + BM 3. HB/BF to do rest of the sections and be advisors on 2.2 and 2.4 4. BF/HB to develop timesheets for reporting project hours (MART timesheet attached – HBSS to revise for their use). 5. BF/HB to develop Task & Issues Document. 6. BF/HB to start communication with other partners.	TAM	DONE	03/27/07
2.	1. CK & RB to study and analyze Sections 2.2 of the proposal. 2. CK & RB Review the entire proposal and prepare questions for next internal meeting	TAS	DONE	04/02/07
3.	1. CK, BM, SB to study and analyze section 2.4 of the proposal. 2. CK, BM, SB to review the entire proposal	TAS	DONE	04/02/07
4.	CK, SB, HB to explain process to other HBSS team members.	TAS	DONE	04/02/07
5.	BF,HB to develop Time Control	TAP	DONE	04/02/07
6.	BF,HB to develop a Task & Issues Document (easy to follow) - to be later converted to more formal tools	TAM	DONE	04/02/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
7.	BF/HB to talk to partners. 1. HB visited Franklin County (Greenfield, MA) and discussed with FRTA possibility of joining the project. 2. HB visited LRTA (Lowell, MA) and discussed with LRTA the possibility of joining the project. (FRTA, MART, LRTA and CATA are adjoining brokerage areas - very suitable for future statewide plan). 3. HB arranged a presentation with MA state legislature involved with Transportation. BF & HB participated and presented the concepts of this project along with potential benefits to the Commonwealth from this project and the potential technology to be implemented in the next phase. 4. BF to meet with HST office this week to discuss their participation.	TAM	DONE	04/02/07
9.	Meeting on 04/02/07 to discuss status of last week's tasks and agenda for 04/03/07 meeting with TransSystem and FTA liason. Attendees: CK/BF/HB + Follow up at HBSS with SB/CK/HB. Highlights: 1. All stated tasks for this week completed. 2. BF - Partner interaction to be increased as so far Commonwealth transportation players were involved in HST RFR for brokerage. The announcements came on 03/20/07 (MART chosen to broker all 4 regions bid). 3. HB - Control documents in place of time management and task/issue management. 4. CK - will we select a Formal Project Management tool and transfer information from this doc (?) 5. SB - Will start putting time estimates for the technology team based on tasks in 2.4	TAM	DONE	04/02/07
10.	BF/HB met to discuss things needed from TA team: 1. Preferred format for partner interaction- Webinars? Seminars? One on one? Group meetings? 2. Project Time Tracking – How detailed? 3. Town-hall formats for citizen interaction. 4. Project Management tool selection? 5. Web based discussion forum? APTA forum sufficient? 6. What about 'security and protection' - since it is a competition, do we share our information with others that gives us the competitive edge? 7. Can we use other tools - HICS (?) ***Yes.***	TAT	DONE	04/03/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
11.	BF/HB/CK/SB 1. Several Project Planning meetings were required to complete the project plan. 2. The project plan submitted will need to be revised after the Con Ops report is submitted	TAM	DONE	05/14/07 – 05/31/07
12.	BF/HB met several times in the last 3 weeks to discuss operational level issues with MART's current ITS implementation. 1. Analysis of MART's AVL system and its integration with 'other' entities. 2. Analysis of MART's partners' AVL capabilities. 3. Analysis of Integration points with AVL. 4.Analysis of MART's Processes for 'assignment' of new rides to 'routes', e.g. MART's DMR trip assignment and MART's Subscription Van assignment systems. 5. Analysis of MART's trip verification system. 6. Analysis of MART's text-based messaging system for communication with Drivers and Vendors. 7. Layout agenda for Mini-Summit on June 7th and 8th.	TAS	DONE	05/21/07 – 06/06/07
13	HB/BF met with Kiesling Transit (A private vendor) to discuss participation in the project, and their requirements.	TAM	DONE	06/01/07
14.	HB/BF met with MART's operating company to discuss the project and participation. Specifically the following were discussed: 1. Trip Completion and reconciliation challenges 2. Schedule Adherence issues and resulting complaints – we believe that will be critical in implementing coordination across multiple vendors and agencies 3. On Board Incident handling challenges and reporting mechanisms	TAS	DONE	06/04/07
15.	HB/BF met with operations team of Lowell Regional Transit Authority to discuss their operations. Next Step to propose to LRTA to join the project	TAM	DONE	06/18/2007
16	HB/CK/SB met to discuss the technical elements of the various components in the system. Specifically spent time on 1. MBTA trip planner, Washington Trip Planner. 2. Credit Card Payment systems 3. Vehicle/Driver Inventory management systems	TAS	DONE	06/04/07-06/06/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
17.	Mini-Summit 06/07/07-06/08/07 Attended by: HB/BF/RB/BM/SB/CK(Phone)/SP(Phone)/MP/KC(LRTA)/AC(CATA) Accomplishments: 1. Discussed User Needs 2. Analyzed MART's operational details 3. Analyzed Partner operations details 4. Analyzed various ITS components from TMCC perspective including: Reservations, Scheduling, Dispatching, AVL, Incident Management System, Archival System, Reports, Billing System, Vendor Portal, Vehicle/Driver Inventory Management. 5. Discussed the potential challenges for extending these capabilities in a TMCC environment with 'other' non-MART partners accessing data. 6. Analyzed Integration and Architectural issues w.r.t. various modules potentially needed to implement such a system. 7. Discussed potential partner participation modalities and shared experiences of dealing with vendors. 8. Discussed Security and availability issues with using Internet. 9. Discussed possible vehicle tracking on Google maps. 10. Report on Summit is due 06/22/07	TAS	DONE	06/07/07-06/08/07
18.	BF busy most of June on MART and end of year related projects. 1. HB/BF discussed setting up of Partner meeting for Needs Assesment. 2. HB/BF identified participants for the meeting. 3. BF to coordinate meeting - plans to send invitations this week. 4. Tentative target to complete summit before site visit 7/31/07	TAM	DONE	07/27/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
19.	CK while on an HBSS visit to CA, spent time studying a highly rural California site for ideas on 'communication' and 'GPS' issues on 'real' long distance trips (3.5-4 hour long one-way trips). Specifically 1. Issues of losing connectivity and regaining connectivity 2. Data store and forward issues. 3. GPS signal and logging issues 4. Fare handling issues 5. Passenger mile reporting issues	TAS	DONE	06/15/07
20	HB/SP/CK have prepared an initial user requirements and needs assessment for Fare card implementation for this project. Specifically considered are: 1. Type of Fare Card suitable. 2. HIPAA issues related to storing information 3. Communication issues regarding fare information. 4. On-board fare card enhancements. 5. Cash and Card payment allocation. 6. Voucher system integration with fare cards. 7. Handling of John Doe trips.	TAS	DONE	06/22/07
21.	HB/SB/MP analyzed the DB architecture for fare card implementation. Specifically 1. Client Accounting System 2. Fare Card augmentation and management 3. Cash and Card Fare separation and integration with Trips Management System. 4. Fare Card interface with Voucher System. 5. Fare Card reporting requirements.	TAS	DONE	06/25/07
22	CK/SP/MP analyzed the Fare Card implementation on an AVL/MDT. Specifically 1. Information on the Fare Card 2. Printing Fare Cards 3. Renewing Fare Cards	TAS	DONE	06/29/07
23	CK/HB/SB analyzed in greater details AVL tracking access via Web (maps.google.com).	TAS	DONE	07/06/07
24	BM/CK/HB/BF/RB Met with Evaluation Team	TAM	DONE	07/25/07
25	BM/CK/HB/BF/RB Met with Technical Advisory Team	TAM	DONE	07/31/07
26	CK/HB/BF researched additional TMCC background as per Technical Team	TAS	DONE	08/02/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
27	CK Working to find appropriate Systems Engineering guidance from Internet repositories. (http://www.12207.com/, http://www.stsc.hill.af.mil/crosstalk/1996/08/isoiec.asp, http://www.abelia.com/docs/12207cpt.pdf) **Basic Approach: Waterfall** • Business Modeling & Analysis • Requirements • Design • Implementation • Test • Deployment **Alternate Approach: RUP/Agile** • Inception, • Elaboration, • Construction, • Transition, • Production, • Retirement See Systems Engineering Document from fhwa and http://www.incose.org/ site	TAP	DONE	08/28/07
28	SP/CK/HB Review final user needs assessment related to TMCC Fare Management	TAS	DONE	09/04/07
29	SB/MP/HB Discuss and enumerate issue related to Design and Architecture needs for the TMCC related to Fare Management	TAS	DONE	09/04/07
30	SP/CK/Kiessling New Partner online meetings review of COA and Trips Scenarios	TAM	DONE	09/08/07
31	SB/HB/CK Con Ops Document Review	TAM	DONE	09/10/07
32	BF/BM/SB/CK/MP Systems Engineering Presentation at Tran-Systems	TAM	DONE	09/12/07
33	HB/CK Con Ops First Pass	TAM	DONE	09/20/07
34	HST Meeting Director HST, and Program Manager EIP • Centralized Billing • UWR Implementation Roles • Comm. of Mass. would sponsor MITS Hosting	TAM	DONE	09/24/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
35	HST Meeting w/ EOHHS Undersecretary, MART COO, MART Director of Operations, Operations Manager and the Director of the HST office and Director of Transit for EOT (Executive Office of Transportation). • Brokerage • Statewide AVL and ITS • UWR Goals and statewide discussion of unmet needs	TAM	DONE	09/26/07
36	CK/SP AVL/Manifest Functions Write Up for Con Ops	TAS	DONE	10/15/07
37	SB/MP/SP Scheduling and Dispatching Write Up	TAS	DONE	10/15/07
38	HB/BF Traveler Information Write Up	TAS	DONE	10/15/07
39	BF/RB/BM/CK Use Cases, Stakeholders, and Systems	TAS	DONE	10/22/07
40	BF/RB/BM/CK Sent out multiple questionnaires to Stakeholders and Partners	TAS	DONE	10/10/07
41	BM/HB/BF Call Stakeholders and Partners to complete questionnaire spreadsheet. We have about 60% response rate.	TAS	CLOSED	01/31/08
42	BF Determine the ITS Gaps document dates and delivery schedule	TAP	DONE	10/22/07
43	HICS Portal used to communicate ConOps document with Partners	TAM	DONE	10/2207
44	ALL - Reviewed responses from ConOps Review by Partners	TAT	DONE	10/29/07
45	ALL – ConOps Completion	TAS	DONE	11/05/07
46	CK/SB Meeting review system requirements gathering	TAM	DONE	11/20/07
47	SP/HB/CK– Strawman Trip Planner Requirements	TAS	DONE	11/21/07
48	SB/BF/HB – Discussion of IssueTracker system for use to collect requirements and tracability	TAS	DONE	11/28/07
49	BF/HB/SB Meeting at MART to review system requirements processes and documents	TAM	DONE	12/03/07
50	CK/SP System Requirements Webinar	TAM	DONE	12/04/07
51	BF/HB/SB System Requirements Webinar	TAM	DONE	12/07/07
52	HB/BF/SB/CK/RB – IssueTracker Training	TAS	DONE	12/07/07
53	Review of ConOps with MART Stakeholders	TAP	DONE	12/12/07
54	Review of ConOps with External Stakeholders via phone conference	TAM	DONE	12/13/07
55	HB/BF – Central Billing Requirements	TAP	DONE	12/18/07
56	CK/SP/MP – Transit Provider and MDT System Requirements	TAM	DONE	12/27/07
57	HB/SB/CK – Cellular Bandwidth Study	TAS	DONE	12/28/07

No.	Description	Type	Status (open, closed, activity)	Resolution Date
58	BF/SB/MART – Requirements Document Review	TAM	DONE	01/04/08
59	HB.BF – EOT, Human Services Meeting	TAM	DONE	01/08/08
60	EOH, DMR, CRWEST Stakeholders Mini Summit – Requirements and Scenarios Review	TAM	DONE	01/15/08
61	SeniorCare, KIESSLING, Stakeholders Mini Summit – Requirements and Scenarios Review	TAM	DONE	01/16/08
62	BF/HB/CK – Con Ops revisions Meeting	TAM	DONE	01/11/08
63	BF/CK – Con Ops revisions 1	TAS	DONE	01/14/08
64	BF/HB – Requirements Submitted for Comments	TAT	DONE	01/15/08
65	BF/HB – Con Ops revisions final	TAP	DONE	01/18/08
66	EOH, DMR, CRWEST Stakeholders Mini Summit Follow Up– Requirements and Scenarios Review	TAM	DONE	01/25/08
67	SeniorCare, KIESSLING, Stakeholders Mini Summit Follow Up – Requirements and Scenarios Review	TAM	Done	02/07/08
68	Team Meeting to discuss the slides and how to put together the design document	TAM	DONE	02/22/08
69	HB/BF gave a PowerPoint presentation on the trip planning/billing software that is being developing for UWR. This project is in the design stage and we hope to make it a comprehensive trip planning tool that includes both fixed and non-fixed transportation options built in.	TAM	DONE	02/25/08
70	Jonathan Church, Community development Manager and Central Massachusetts Regional Planning Commission were guests at this meeting to discuss working with the subcommittee on JARC initiatives. JARC (Job Access and Reverse Commute Funding) provides one year of small scale funding to grant applicants throughout the state. Three areas (Worcester, Springfield, and Cape Cod) can distribute this money, as can EOT. The JARC work group discussed two major initiatives that they hope to accomplish this year:	TAM	DONE	02/25/08
71	JARC AND EOH to revisit the presentation at the next meeting and Maura to e-mail the subcommittee's contact list to Himanshu.	TAP	Open	02/25/08
72	SP/MP/HB AVL Design Activity, data schema, market packages, scheduling needs	TAS	DONE	02/29/08
73	HB/BF New Stakeholders Meeting with CMPC – Central Mass Regional Planning Commission	TAM	Done	03/06/08
74	HB/BF Worcester RTA - New Stakeholders Meeting	TAM	Done	03/06/08
75	SP/HB/BF – Determine how to present the Trip Planner to WRTA	TAS	Done	03/13/08
76	CK/BF – Final Timelines for deliverables	TAM	Done	03/25/08

No.	Description	Type	Status (open, closed, activity)	Resolution Date
77	HB/BF – Discussion of adding new stakeholders late in phase I but needed for phase II.	TAM	Done	03/27/08
78	BF/HB/CK/BM -- Review comments from System Requirements Documents	TAT	Done	04/02/08
79	MART/HBSS – UWR progress meeting to determine what's next and whom should get which tasks	TPM	Done	04/09/08
80	BF/SB/BM/CK/HB - Monthly conference call	TAT	Done	04/15/08
81	BF/HST – Requirements review of Centralized Billing, Sustaining funding for TMCC (via Centralized Billing)	TAM	Done	04/17/08
82	SP/BM – Fitchburg COA review of Standing Orders Screens, Trip Booking Screens, and related Web Based Interfaces.	TAS	Done	04/30/08
83	BF/HB/BM – Onsite Vists by Central Mass Planning and Worcester RTA	TAM	Done	04/30/08
84	SP/BF/HB – Stakeholder Involvement Meeting to determine letters of commitment and related topics.	TAM	Done	05/05/08
85	SP/BF – Stakeholder Newsletter development Meeting	TAM	Done	05/05/08
86	SP/MP – Stakeholder Newsletter, Stakeholder access to web prototypes	TAM	Done	05/08/08
87	SP/BF – Meeting in worcster, michelle harris, sarah. BF – SRD review	TAM	Done	05/12/08
88	HB/BF – Meeting with HST and DTA (Dept of Transitional Assistance) on Processes and Procedures for Centralized billing and transitional employment transportation programs.	TAM	Done	05/15/08
89	MART – Review UWR requirements with Trapeze software to determine integration points and feature coverage.	TAS	Done	05/22/08
90	BF – Stakeholder involvement by Pioneer valley transit (PVTA)	TAM	Done	05/22/08
91	CK/HB/BM/BF -- Review feedback from gap analysis and architecture documents.	TAT	Done	05/28/08
92	BF/BM – Meeting with provider of electronic fare box for integration into M-ITS.	TAS	Done	06/05/08
93	MART/HBSS – All day workshop with MART TMCC Stakeholders and future internal. TMCC roles on processes and implementation issues related to transitioning MART staff to TMCC functions.	TAS, TAM	Done	06/06/08
94	SB/BF/BM/HB - Monthly conference call	TAT	Done	06/10/08
95	BM/BF/HST -- Central billing process flows and employment transportation funding sources	TAM	Done	06/12/08
96	BF – Review of UWR design with PVTA	TAM	Done	06/18/08

No.	Description	Type	Status (open, closed, activity)	Resolution Date
97	MART/HBSS – Review feedback from HL Design	TAT	Done	06/22/08
98	ALL – Final Edits of HL design Document at MART	TAM	Done	06/28-30/08
99	SP/HB/MART – Newsletter Final Review	TAM	Done	06/30/08

Table 2: Project Activity Tracking

2.3.3. Milestones from Phase 1

No	Description	Status	Expected Due Date
ML1	Meeting with State Legislature (Transportation)	Done	03/26/07
ML2	HBSS/MART Meeting	Done	03/27/07
ML3	HBSS Trip to FRTA	Done	03/28/07
ML4	HBSS/MART Meeting	Done	04/02/07
ML5	FTA Meeting	Done	04/03/07
ML6	Partner Meeting	Done	04/27/07
ML7	Mini-summit	Done	01/14/08
ML8	First Revision of Project Plan (Internal Presentation)	Done	05/18/07
ML9	Mini-summit Result	Done	01/25/08
ML10	First Revision of Project Plan to TA/FTA	Cancelled	05/31/07
ML11	Final Draft for TA/FTA Review	Cancelled	06/29/07
ML12	Completion and Submission of Project Plan to FTA	Done	05/31/07
ML13	Review of Project Plan with TA	Done	06/12/07
ML14	Mini-Summit	Done	06/08/07
ML15	Mini Summit Report	Cancelled	01/31/08
ML16	Partner Meeting- Kiessling Transit	Done	06/01/07
ML17	Partner Meeting: LRTA operations	Done	06/04/07
ML18	Follow up Meeting Kiessling Transit	Done	07/16/07
ML19	Fare Management Discussion	Done	07/17/07
ML20	Gloucester Volunteer Meeting	Done	07/24/07
ML21	Evaluation Team meeting	Done	07/25/07
ML22	TA Team Review Meeting	Done	07/31/07
ML23	Project Plan Comments Review Meeting	Done	08/09/07
ML24	Unfulfilled Needs Meeting (COAs, Volunteer group, VNA)	Done	10/15/07
ML25	Con Ops Brain Storming Meeting	Done	08/13/07
ML26	Con Ops Documentation Structure Review without TA	Done	09/20/07
ML27	Preliminary Discussion on XML as interface medium	Postponed until after Phase I	
ML28	Draft Con Ops Document	Done	10/15/07

No	Description	Status	Expected Due Date
ML29	Pink Team Review Con Ops	Done	10/22/07
ML30	Con Ops Document Due Date	Done	11/05/07
ML31	Central Billing Meeting - State	Done	12/17/07
ML32	Web Portal Meeting – RTA	Done	12/27/07
ML33	Unfulfilled Requirements Meeting (COAs, Volunteer group, Employment, DMR)	Done	01/09/08
ML34	Partner Meeting- Kiessling Transit	Done	01/16/08
ML35	Gloucester Volunteer Meeting	Done	01/11/08
ML36	Pink Team Review System Requirements	Done	01/15/08
ML37	Central Billing Meeting - GMTA	Done	01/18/07
ML38	Washington Workshop	Done	01/23/08
ML39	Partner Meeting Requirements Review- Kiessling Transit	Done	02/06/08
ML40	System Requirements Document Due	Done	02/14/08
ML41	Central Billing Meeting – MART, EOH, STATE	Done	02/25/08
ML42	CMRPC tour of MART	Done	04/30/08
ML43	WRTA review of Trip Planning Design	Done	04/30/08
ML44	CMRPC Follow Up Meeting	Done	05/30/08
ML45	GAP Analysis Document	Done	05/30/08
ML46	Architecture Document	Done	05/05/08
ML47	HL System Design	Planned	07/03/08
ML48	FTA Site Visit	Planned	07/15/08
ML49	Stakeholder Meeting	Planned	07/15/08
ML50	Stakeholder Newsletter	Done	06/30/08

Table 3: Project Milestones

2.3.4. Closed Issues from Phase 1

No	Description	Priority	Status (open, closed, activity)	Resolution Date
1	Partner meetings - *Need more time, due to RFR related activity in the Commonwealth. This is being done.*	MED	CLOSED	07/31/07
2	Preferred format for partner interaction- Webinars? Seminars? One on one? Group meetings? *Got some feedback from Technical Liaisons. Web based will save on travel costs; but will have some level of face-2-face meetings for full involvement.*	MED	CLOSED	07/31/07
3	Timesheets for reporting project hours. HBSS will use MART's format so that the reporting mechanism is all the same.	HIGH	CLOSED	04/27/07

No	Description	Priority	Status (open, closed, activity)	Resolution Date
4	Is the Web based discussion forum on the APTA site sufficient for our own TMCC partners? *No, we will use our own tools.*	HIGH	CLOSED	04/27/07
5	*What Structured design and development approach should be used? How will it be disseminated to the group? Originally we assumed ISO 12207 as it is an applicable, acceptable standard*	MED	CLOSED, See Issue 9.	06/22/07 (Tabled), 7/31/07
6	*When should we switch from this project tracking mechanism to a project plan? Will probably happen once we have a draft plan or we may continue to have both. One for long term planning and one for Issues and Daily operations.*	LOW	TABLED – Will Continue with this format	09/20/07
7	*Losing two months of time which was originally scheduled, to deliver a full project plan is a problem. Most likely the result will be 'smaller' and we may still need until 6/30 to complete the more comprehensive version*	HIGH	CLOSED	05/31/07
8	Selection of a most suitable approach for Con Ops Documentation. See http://www.its.dot.gov/msaa/TMCC_ConOps.htm	HIGH	CLOSED	09/20/07
9	Determining the nature of System Engineering in what appears to be a Systems Integration effort. We are expecting some liaison with TA team to help resolve this. Since the main focus is currently on Con Ops, the priority of this issue is set as only Medium, but needs to be addressed soon. See Issue #5. **Follow the Systems Engineering Documents as Provided.**	MED	CLOSED	09/20/07
10	What is the set of all pre-existing systems that have to feed into the TMCC? This has to drive the draft Concept of Operations. Do we have to look at other systems Regionally or Nationwide to determine this or only within MART? If only regionally why? How does this relate to the comment from the project plan review "Please clarify how the proposed system will interface with other software systems?" **- The solution must absolutely be National in scope, with a regional sample implementation which we call M-ITS. Interfaces and Interchange are Via ITS architecture and ITS standards.**	HIGH	CLOSED	10/22/07

No	Description	Priority	Status (open, closed, activity)	Resolution Date
11	How do we compare our list from Issue 10 with other "Core Elements" Nationally? **Would that be a TA thing? We should focus on how M-ITS compares against the Regional ITS Architecture.**	**MED**	CLOSED	09/28/07
12	Need to determine what the actual project goals are that need evaluating based on draft evaluation plan with evaluation team. Are we trying to increase ridership? Meet needs of those who do not use the system? Need to review that actual goals of having a TMCC to see flow downs from goals to metrics. 09/28/07 – Need to Contact SAIC. 10/31/07 – ConOps clearly states the answer **The goal of this work is to provide a design for deployment ready TMCC system that is scalable, replicable across the country. Its three main objectives are: Simple Access (Single Point, Multiple Modes) to Information; Simple Access to Transportation; Seamless use of Technology Across Multiple Entities**	**MED**	CLOSED	10/31/07
13	Need to get some handle on the evaluation criteria from the evaluation team, we have identified the goals in #12, but have not gotten guidance on how metrics would be assigned to those goals**. It appears the evaluation team participated in changes to the goals of the Phase II to include the additional metrics that we told them did not exist in Phase I.**	**LOW**	CLOSED	06/30/08
14	Need to Address the Requirements Document format. As per the System Engineering guidelines and the sample provides and the Tutorial provided by the TA team; there are of course small 'differences' that need to ironed out. **We will wait until the external review in Jan for feedback. Selected simpler tables with reduced duplication.**	**MED**	Closed	01/15/08
15	Need to determine system design document format. We have the tutorial, two online examples to choose from**. An outline was provided and we put the information we had already developed under the slightly different section titles. The missing sections we simply added to the end.**	**Med**	CLOSED	06/30/08

No	Description	Priority	Status (open, closed, activity)	Resolution Date
16	SeniorCare Is looking to drop out as a stakeholder, concerned that the cost of software and people time could be too much for them. **It is a new way of business that people are not yet used to, so there is a lot of training and marketing that needs to be considered.**	**High**	CLOSED	04/15/08
17	What should be in the Gap analysis report? **An outline was provided.**	**High**	CLOSED	05/30/08
18	Should we use Unified Modeling Language (UML) or Data Flow Diagrams DFD for the Architecture Document? **Not required. Will probably require this of the detailed design team**.	**Med**	CLOSED	06/30/08

Table 4: Closed Issues

3. RESULTS

The Systems Engineering Methodology requires various artifacts to be produced during each phase of the effort. The documents that were a result of this effort include the 'Concept of operations' document, the Systems Requirements Document, and the High-Level Design Document. Additionally, as this is an ITS related project, an ITS Gap Analysis and Architecture Document was produced. The following figure 5 provides an overview of the Systems Engineering Methodology. (http://ops.fhwa.dot.gov/publications/seitsguide/index.htm)

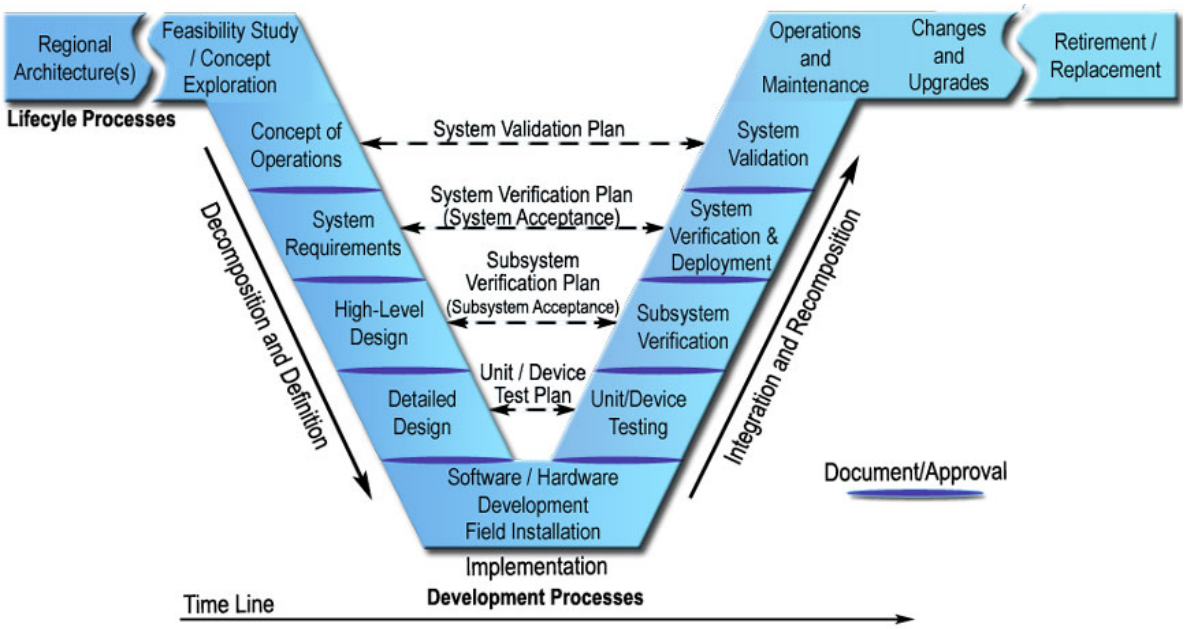

Figure 1: Systems Engineering

One of the first major activities was that of mobilizing stakeholders. To illustrate the range of possible users and stakeholder see figure 2 below.

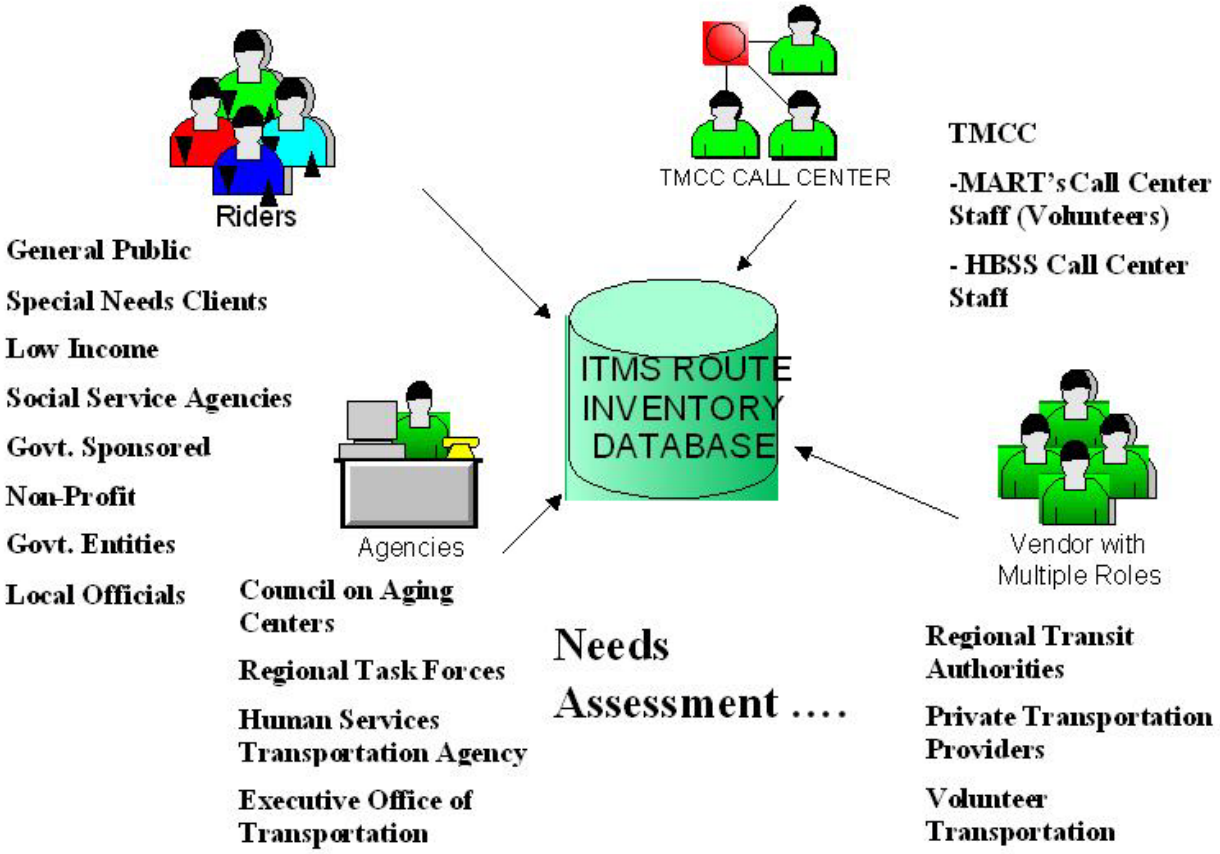

Figure 2: Stakeholder Communities

1.1. STAKEHOLDER NEEDS ASSESSMENT

During the Concept of Operations (ConOps) phase the stakeholders determine the who, what, where, when, why and how of the system, including *stakeholder needs* and constraints. One of the key purposes of the ConOps is to capture a clear definition of the stakeholders' needs and constraints that will support system requirements development in later steps. Stakeholder needs were captured using a variety of techniques including: interviews, workshops and surveys. The ConOps is a tool for the team to use to think about the way the system will behave and how it will interact with external systems. The operational scenarios created covered at least one major issue for each stakeholder. Table 3 below shows how the different expressed needs are shared by the stakeholders.

Need ID	User Need	Related Requirement IDs	User Service/Related National ITS	Councils on Aging – Fitchburg & Leominster	Volunteer Services	Kiessling Transit. MTS	MART Subscription	MART	LRTA, CATA	Veterans Shuttle	EOHHS & the Human Services Transportation Office	Central West Regional Employment Solutions Team (CWREST)
N1	Ability to handle wildly scattered populations	R1.1, R1.7	1.1									X
N2	ADA Tickets	R2.1	3.1(2)					X				
N3	Affordable Technology	R7.1			X	X				X		
N4	Determine Availability	R1.3, R3.2	1.1, 1.4, 2.1				X					
N5	Information Storage and Retrieval	R4.6, R7.3	7				X				X	
N6	Cash Management	R3.4,R5.5					X	X	X			
N7	Contract Based Transportation	R2.3,R3.1	1.4, 2.1					X	X			
N8	Cost Allocation if Multiple Funding Sources Involved	R4.8, R2.3	2.1				X					X
N9	Cost Management and Expense Planning	R4.6, R4.9	2.1								X	
N10	Current Fleet and Driver Pool	R4	2.1						X			
N11	Determining Cancellation Status	R1	1.1, 2.1							X		
N12	Determining Efficient Frequencies	R2	2.1					X		X		
N13	Balanced Dispatching Rules	R3.2, R3.3	2.1, 2.2						X			
N14	Dispute Resolution	R2.4			X	X		X	X			
N15	Distribution Centers	R2.1, R2.2						X				
N16	Driver Verification	R5.1	2.1(3)		X	X			X			

Need ID	User Need	Related Requirement IDs	User Service/Related National ITS	Councils on Aging – Fitchburg & Leominster	Volunteer Services	Kiessling Transit. MTS	MART Subscription	MART	LRTA, CATA	Veterans Shuttle	EOHHS & the Human Services Transportation Office	Central West Regional Employment Solutions Team (CWREST)
N17	Fixed Route Service	R3.3, R1.1, R1.3	2.1					X	X			
N18	Extended Dial-A-Ride Feeder Service	R1.3, R3.1, R1.1	2.1							X		
N19	External Bus Pass & Ticket Coordinator	R2.1, R2.2, R4.3						X				
N20	Fare Collection	R1.5, R4.3			X	X			X			
N21	Fixed Route Passes	R2.1, R4.3	3.1(2)					X	X			
N22	Fixed Route Schedule Sharing	R1.1	1.1, 2.1						X			
N23	Fixed Route Trip Planner	R1.3, R1.5	1.1	X	X				X			
N24	Flexible Trip Times	R3.1,R3.2, R3.6	1.1									X
N25	Full Interoperability with the “Charlie Card” in the Future	R7.1, R4.3, R7.4	3.1(4)					X	X			
N26	Identification of Riders	R2.5					X	X				
N27	Demand on Paratransit Service	R1.3,R3.2	2			X	X	X	X			
N28	Internal Bus Pass & Ticket Coordinator	R2.1						X				
N29	John Doe Trips & Cards	R2.2	3.1					X				

Need ID	User Need	Related Requirement IDs	User Service/Related National ITS	Councils on Aging – Fitchburg & Leominster	Volunteer Services	Kiessling Transit. MTS	MART Subscription	MART	LRTA, CATA	Veterans Shuttle	EOHHS & the Human Services Transportation Office	Central West Regional Employment Solutions Team (CWREST)
N30	Mixing Public and Private Transportation	R1.1, R1.3	1.1, 1.4									X
N31	Manage Private Providers	R2.6, R4.8	1.4						X			X
N32	Multiple Denominations, Multiple Paper	R2.1, R3.5						X				
N33	Need for Common Systems	R4.9, R7.1									X	
N34	Off-Hours Transportation	R1.3, R1.4, R7.2	1.1	X						X		
N35	On Line Purchases of Bus Passes & Tickets	R1.5, R2.2	1.1					X				
N36	On Time Performance	R1.2,R2.3, R3.2, R3.3	1.1, 1.5, 2.1				X					
N37	Operations Management	R5.1, R5.5, R7.3	2.1				X	X	X			
N38	Out of Region Travel	R1.3, R3.1, R3.2	1.1				X					
N39	Private Trip	R1.3, R4.8				X		X				
N40	Proper Vehicle Management	R5.2	2.1, 4.4				X	X	X			
N41	Provider Rate Specification	R4.8	2.1,		X	X						
N42	Reduced Information Provisioning Lag	R4.9									X	

Need ID	User Need	Related Requirement IDs	User Service/Related National ITS	Councils on Aging – Fitchburg & Leominster	Volunteer Services	Kiessling Transit. MTS	MART Subscription	MART	LRTA, CATA	Veterans Shuttle	EOHHS & the Human Services Transportation Office	Central West Regional Employment Solutions Team (CWREST)
N43	Rider Accounting System	R4.5, R1.5	1.1, 1.5					X			X	
N44	Safety	R2.3, R6.3, R3.2	5.1, 6.5									X
N45	Same Day Dispatch for COAs	R1.2, R3.4, R2.7	1.4, 2.1	X								
N46	Scheduling Across Multiple Providers and Regions	R3.2, R2.3	1.8, 2.1									X
N47	Shuttle Tickets	R2.1	2.1					X		X		
N48	Subscription Service	R3.2, R2.8	2.1				X					
N49	Subsidized Services	R2.3, R3.2	2.1						X			
N50	Sufficient Passengers to Meet Costs	R1.1, R4.6	1.1, 2.1							X		
N51	Technology Integration	R7.1							X			
N52	Trip Booking	R2.8	2.1	X	X	X	X	X	X			X
N53	Trip Coordination	R3.3, R3.4, R7.4	2.1		X	X			X			
N54	Where is My Bus?	R1.2, R3.4, R7.2	4.1		X	X		X				

Need ID	User Need	Related Requirement IDs	User Service/Related National ITS	Councils on Aging – Fitchburg & Leominster	Volunteer Services	Kiessling Transit. MTS	MART Subscription	MART	LRTA, CATA	Veterans Shuttle	EOHHS & the Human Services Transportation Office	Central West Regional Employment Solutions Team (CWREST)
N55	Volunteer Trip Offering	R3.6, R7.3	2		X							X
N56	Provider Payment Management	R4.4			X	X		X		X		
N57	Billing Management	R4.4		X	X	X	X	X	X	X	X	X
N58	Provider Ratings	R6.5	1.1	X	X							X
N59	Driver Complaints about Passengers	R6.2, R6.4				X		X		X		
N60	Flexible Rate System (peak, off-peak, vehicle, gov rates)	R3.6, R4.8	2.1		X	X	X	X				X
N61	Gas and Mileage Reimbursement for Volunteers	R4.10			X			X				X
N62	Prequalification of trip requests	R2.5	2.1	X	X							X
N63	Non-Availability of Seats	R1.4						X				

Table 5: User Needs

3.2. M-ITS CORE ELEMENTS

In this section we have provided an overview of the core areas that became the basis for our Concept of Operations which we have termed M-ITS (MART INTEGRATED TRAVELER SERVICES). The M-ITS approach is our proposed first step toward a TMCC. The core elements represent an overview of the high level design which is available in a separate document.

3.2.1. Transportation Services Portal

M-ITS brings to the United States transportation industry its first true Transportation Services Portal (TSP) that not only provides information but also allows one to access transportation services too. See Figure 3 on the next page for a visual presentation.

M-ITS Brokerage & Booking System

M-ITS will allow for multiple points of access to booking and booking information. Riders will be able to book trips on the web, live on the phone, and via rider advocacy partners such as Councils on Aging, Social Services Offices and similar citizen outreach locations. Trips that are booked will then be validated and made available to transit providers in the regions that the trips have been requested. Transit providers could include one or more Brokers, private transportation fleets, non-profit volunteers and possibly other forms of managed vehicles. The M-ITS TMCC Travel Specialist, the assigned transit provider (possibly including its Broker), and booking partners will all have visibility into the reservation system for providing trips information. Brokerage is an essential part of the booking system as it allows to the management of trips at the time of booking to the most available providers. The policies and procedures that govern the booking (or reservation) system will provide for coordination between agencies, and providers across as many jurisdictions as is feasible.

M-ITS Scheduling & Dispatching and Vehicle Tracking

Trip scheduling and dispatching capabilities will attempt to optimize vehicles and drivers based on information given by the transit providers. Utilization of drivers, and minimizing customer wait and travel time are important factors. Schedulers will have the ability to define vehicle characteristics, and driver availability. Automated, manual, and semi-automated scheduling will be available. The dispatcher will have visibility into daily trips (manifests), vehicles location tracking and vehicles incident management.

- Trip Visibility, AVL Tracking, Manifest Downloads,
- Automated Scheduling
- Segments, Drivers
- Automated distributed dispatching service

M-ITS Operations Management

The system will provide asset tracking, incident and complaint management. Transit providers, TMCC Staff, and Travelers will have visibility into select knowledge elements of the system including: the current schedule for flex route buses, real time location of allowed public program vehicles, arrival progress of route segments and runs, ETA and adherence information; road hazards and reporting by vehicle and drivers.

The vehicles can connect to various safety and security subsystem to provide facility, vehicle and passenger safety. These include on-board Digital Video Recorders, Incident Management, Panic and Emergency buttons, Route Deviation and Speed alerting, Facility cameras, and automated activation of information and lights. There will be an on-line and off-line complaint system for tracking issues on the bus and having those trips and times associated with available video and traffic information.

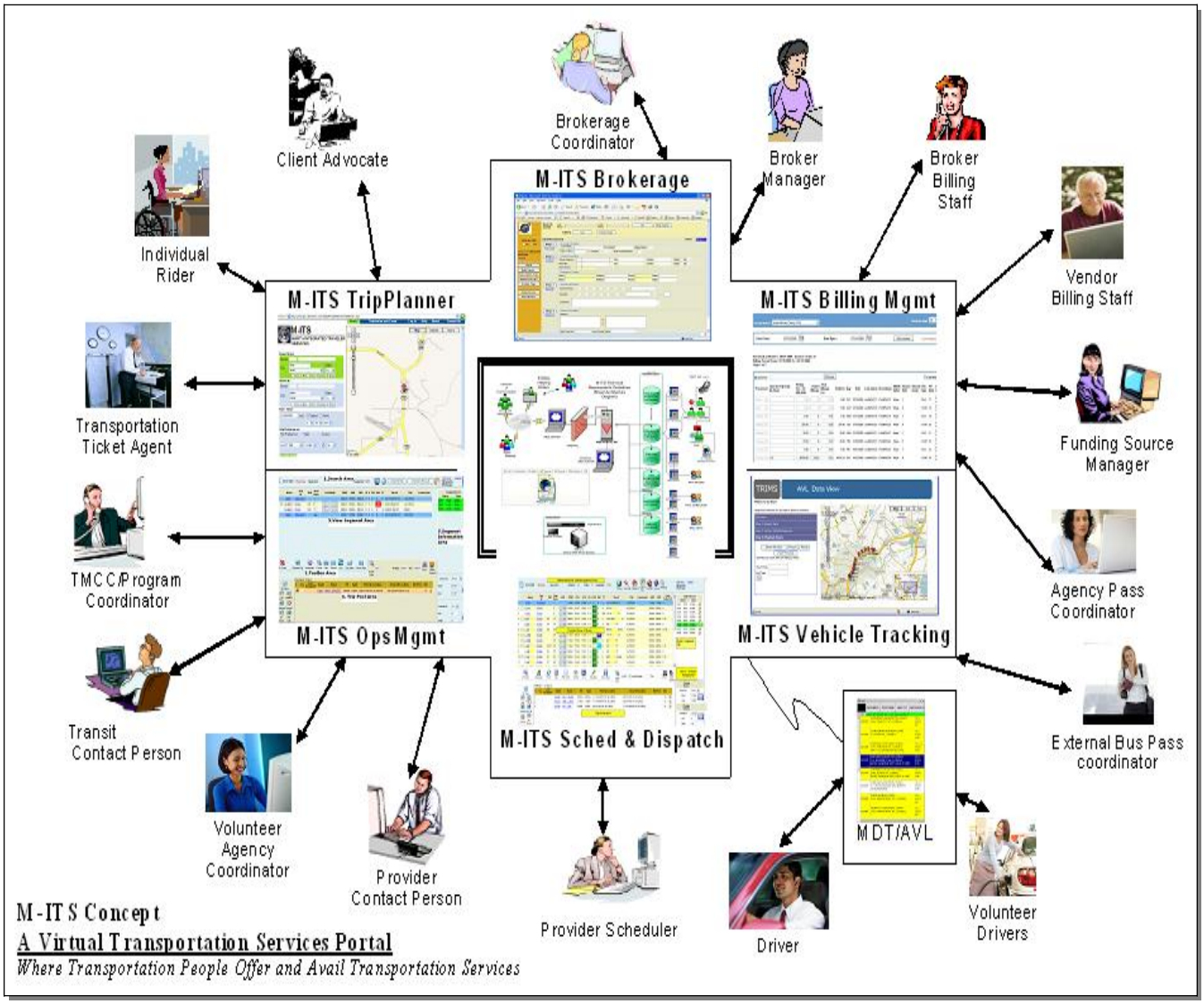

Figure 3: M-ITS TSP Concept Diagram

M-ITS Fare Payment and Billing Management System

Fare eligibility will be determined via policies, legal requirements, and driver guidance. The fares will be determined in advance via flow charts, software restrictions, and automatically via a question and answer system to assist in the determination based on available eligibility requirements. On-board and data driven systems will automatically deducts fare payment based on passenger eligibility for program

subsidies as connected with specific trips. The M-ITS system will provide for program management, [SMART] Fare Cards, recurring Subscriptions Trips, and employee-based Pre-Paid Services.

The invoicing subsystems will automatically allocate costs across pre-approved programs based on pre-agreed formulae. Transit providers will be given an opportunity to validate and correct travel mileage and fixed fee fares. Invoicing reports will be automatically generated to minimize preparation time and errors. The billing system will allow for:

- Shared Rides
- Provider/Vendor Approval
- Trip Mileage Confirmation

M-ITS Trip Planner: The Traveler Information System

M-ITS will provide systems to control in-terminal Kiosks for up to date management of personalized trips; large panel LCD displays for displaying fixed and flex route data, and ETA system that will provide expected arrive times for use on the LCD displays, the Web, and via Interactive Voice Response. The Web interface will provide a complete trip planner for determining best route of multiple transportation methods (train, bus, private, special programs and taxis). The Kiosks and the website will be backed up by online and phone based travel specialists so that a live human can pick up a travel request and help the rider get the information they need.

M-ITS' Traveler Services Portal extends the definition of Trip Planner to include a) demand response routes, b) volunteer services, and c) brokered transportation. A typical Trip Planner is designed to handle 'Fixed' routes only, mostly because it is easy. Adding demand response, volunteer and brokered trips increases the complexity of Trip Planning and needs a new way of thinking. M-ITS represents that new way of thinking – Trip Coordinator.

3.3. HIGH LEVEL DESIGN

The high-level design must meet the system requirements available in the produced System Requirements Document; it defines key interfaces and standards.

The system architecture and high level design was an effort that required research of existing systems that perform coordination, and three systems were identified: a) cooperative distributed processing (used in Financial systems), b) Blackboard systems (used by US Navy) and c) Airline Reservation System (e.g., SABRE), that were close to what the TMCC vision requires. It was determined that a mixed blend of the three approaches would form the core architecture of M-ITS, as by themselves each approach had pros and cons. The hybrid approach selected uses a centralized database to store inventory of all possible routes, and then uses a trip planner type tool to discover travel options given source/destination/date/ time. The itineraries discovered are presented to the user and the selected itinerary is sent to the selected provider. If the provider does not respond in time the trips are posted on a web based trip portal where anyone else can bid for the trips. In addition, hooks shall be provided for all third party transportation software systems to 'interact' 'directly' with the system and poll new trips and requests and bid for them automatically or offer electronic confirmation using the cooperative distributed processing paradigm. Another aspect of flexibility is the internet based telephone system, which allows a call center to exist but only virtually and different entities can provide phone support via the internet.

The factors considered for narrowing down the list of strategies related to the objectives of the TMCC included:

- **scalability** – allowing hundreds of thousands of users to simultaneously access information
- **reliability** – system being fault tolerant, resilient and self-recovering
- **heterogeneous applications** – allowing different forms of functions to be carried out simultaneously where users are organized by roles
- **seamless integration** with multiple entities – so different agencies can participate in electronic activity
- **information security** – so the various entities that participate in electronic activity do not have to worry about losing proprietary knowledge
- **coordination workflow management** – various users can 'operate' on the same transaction, doing their part, all the while the end user may view it as a single transaction
- **on-line financial transaction** – users can conduct commerce electronically making payments via bank cards and receiving payments via electronic deposits
- **immediate exchange of information** – users can read/access information almost as soon as it is posted; closeness to coordination problem

Each of the three approaches selected addressed most of the above mentioned criteria strongly, but none of them had all the aspects covered. However, all three of the strategies map closely to the coordination problem at hand.

3.3.1. ITS Standards

ITS Standards are fundamental to the establishment of an open ITS deployment. This is one goal originally envisioned by the U.S. Department of Transportation (USDOT). In general standards should help facilitate interoperability of systems at regional and national levels. We have identified the following organizations who participate in ITS standards activities that should be reviewed further for the detailed design phase:

- AASHTO (American Association of State Highway and Transportation Officials)
- ANSI (American National Standards Institute)
- APTA (American Public Transportation Association)
- ASTM (American Society for Testing and Materials)
- IEEE (Institute of Electrical and Electronics Engineers)
- ITE (Institute of Transportation Engineers)
- NEMA (National Electrical Manufacturers Association)
- SAE (Society of Automotive Engineers)

3.3.2. New Standards Work that should be reviewed for this effort:

- Universal Transit Fare Standards (UTFS)
- Transit Communication Interface Profiles (TCIP)
- FTA Security Standards

3.3.3. ITS Equipment Packages

Solutions that are acquired via COTS and those that may need to be developed internally must conform to a wide variety of ITS requirements and descriptions. The following table represents the specific regional equipment packages that must be in conformance by the detailed design.

The following ITS Equipment Packages are incorporated by reference here, each package is associated with the listed sub-systems of M-ITS. Equipment packages determine the scope and constraints which ITS places on the detailed design to follow.

Equipment Package	Sub-System
	Trip Planner
Basic Information Broadcast	
Infrastructure Provided Dynamic Ridesharing	
Interactive Infrastructure Information	
Transit Center Fixed-Route Operations	
Transit Center Information Services	
Transit Center Multi-Modal Coordination	
Transit Center Paratransit Operations	
	Scheduling and Dispatch
Interactive Vehicle Reception	
Vehicle Location Determination	
On-board Fixed Route Schedule Management	
On-board Maintenance	
On-board Paratransit Operations	
On-board Transit Fare and Load Management	
On-board Transit Information Services	
On-board Transit Security	
On-board Transit Trip Monitoring	
Remote Transit Fare Management	
Remote Transit Information Services	
Transit Center Fare and Load Management	
Transit Center Security	
Transit Center Tracking and Dispatch	
Transit Data Collection	
	Centralized Billing
ITS Data Repository	
Virtual Data Warehouse Services	

Table 6: ITS Equipment Package & M-ITS Sub-systems

3.3.4. Laws, Acts of Congress and Federal Policy

Certain activities outside the ITS architecture play a prominent role in the detailed design. While this is not a comprehensive list of applicable legal restraints, we have identified these as a good representative sample for further compliance:

- HIPAA (http://www.hhs.gov/ocr/hipaa/)
- Digital Millennium Copyright Act (http://www.copyright.gov/legislation/dmca.pdf)
- Sarbanes-Oxley Act (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_public_laws&docid=f:publ204.107)
- FHWA Rule 940 and the FTA National ITS Architecture (http://ops.fhwa.dot.gov/publications/seitsguide/section1.htm and http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf)

3.4. REFERENCED SYSTEM ENGINEERING DELIVERABLES

[1] M-ITS Concept of Operations Document. MART. (2007)
[2] M-ITS Systems Requirement Document. MART. (2008)
[3] M-ITS Gap Analysis Architecture Document. MART. (2008)
[4] M-ITS High Level Design Document. MART. (2008)
[5] M-ITS System Phasing and Implementation Plan. MART. (2008)

4. LESSONS LEARNED

4.1. A key lesson learned was that small groups are

easier to organize and collect input from rather than large group meetings, unless there is already an established group in place. The logistics and advance set-up needed have made these meetings very difficult to organize and the project team has shifted to one-on-one (with specific agencies and larger stakeholders) interviews and small group meetings (with advocacy groups, existing committees in the region etc).

4.2. Associating with similar teams adds synergy

Central West Regional Employment Solutions Team, a committee comprised of human service and government agencies, as well as advocacy groups focusing on transportation for employment is comprised of a similar mix of stakeholders: regional administration, state agencies, and vendors.

4.3. Advocacy groups are needed to represent riders

These include Council of Aging, small groups of seniors and volunteers, representatives and advocates from Department of Mental Retardation, local ADA dial-a-ride etc.

4.4. High level support is important

It makes small stakeholders get involved. The project teams has had high-level meetings with state agencies, including the Massachussetts Executive Office of Transportation (EOT) and Office of Human Service Transportation (HST), and with elected officials (i.e. state senator who chairs the transportation committee) which have helped bring the project to the forefront in the region.

4.5. The webinars were very useful for the TA team

However, not many transit stakeholders could participate over the internet at high bandwidths.

4.6. We found the Systems Engineering (SE) process to be a bit confusing

It is not in wide use in ALL sectors of the government and good sample documents were not easy to find on the internet. Additionally, the SE Process is vague in places and allows the 'practitioner' choose between two or more competing prior standards such as ISO 12207, IEEE 1233 and others. While the focus on Stakeholders is refreshing and modern, there is a tendency to forget that there are under-represented roles in the system. As an example, your stakeholders' send a contract manager to the meetings, therefore 'Contract Management' needs are well addressed; but few if any Dispatcher needs are ever covered. There is a need to address the 'coverage' of defined 'Roles' by one or more stakeholder (there should also be more than one stakeholder for any Role represented in the stakeholder pool).

4.7. We have found that it has been difficult acquiring

actual end-users (including individual riders and groups representing the mobility challenged) in the design process. One idea was to include good local riders, another idea was a survey for the general public, and specifically high volume users of "subscription services" that are very familiar with and use multiple services. To date, the advocacy groups have provided extremely useful feedback as they deal with large numbers of diverse end users groups.

Office of Research, Demonstration and Innovation
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

www.fta.dot.gov/research

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