

Survey of Transit and Rail Freight Interaction

FINAL REPORT
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Submitted by

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16. Abstract <p>This study surveyed 59 transit entities in North America to identify the best practices and key factors that contribute to the successful interaction between transit agencies and freight railroads. A total of 47 agencies including commuter rail, heavy rail, and light rail transits responded, which derives a response rate of 80 percent. This study produced a best practice catalog, based on the survey responses and subsequent data analysis, which may be referenced by transit agencies when dealing with passenger and freight rail interaction issues. Besides the catalog, we also examined critical issues and concerns of both transit and rail freight industries when they share track, right of way, facility, or a corridor with each other.</p> <p>The majority of the transit agencies put frequent communication and good faith negotiation as the most important factors that facilitate successful interaction between transit and rail freight. Other factors mentioned include: competent dispatchers and improved training of dispatchers, integrated schedules, transparency in sharing cost, regulatory leverage to offset freight railroad intransigence, bottlenecks caused by train density and funding constraints to alleviate them, ownership and a genuine will by both parties to make the shared use succeed.</p>			
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Some of the information in this report comes from World Wide Web, where a large number of transit agencies and freight railroads have their own web pages. When photographs, maps, or graphs are taken from the Internet, we usually reference the website. However, since most of the material is in the public domain and was not noted as copyrighted, in many cases the authorship is not indicated.

The team members have produced a large amount of photographs, tables, and figures based on the information collected. The authors regret any errors or oversights in crediting copyrighted material. Of course, any other errors, omissions, and oversights are the responsibility of the authors.

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LIST OF ACRONYMS

AAR	Association of American Railroads
ACE	Altamont Commuter Express
ADA	American with Disabilities Act
AMTRAK	National Railroad Passenger Corporation
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance Association
ASCE	American Society of Civil Engineers
ATR	Above the Top of Rail
BART	San Francisco Bay Area Rapid Transit District
BNSF	Burlington Northern Santa Fe
CAA	Clean Air Act Amendments
CLRL	Central Light Rail Line
CN	Canadian National
CP	Canadian Pacific
CSXT	CSX Transportation
CTC	Central Traffic Control
DART	Dallas Area Rapid Transit
DBED	Department of Business and Economic Development
DRPA	Delaware River Port Authority
DOT	Department of Transportation
EIS	Environmental Impact Statement
GAO	General Accounting Office
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
ISTEA	Intermodal Surface Transportation Efficiency Act
ITE	Institute of Transportation Engineers
LACMTA	Los Angeles County Metropolitan Transportation Authority
LRT	Light Rail Transit
LRV	Light Rail Vehicle
MARC	Maryland Rail Commuter
MBTA	Massachusetts Bay Transportation Authority
MDOT	Maryland Department of Transportation
MGT	Million Gross Tons
MNR	Metro North Railroad
MOW	Maintenance of Way
MTA	Maryland Transit Administration
MTDB	Metropolitan Transportation Development Board
MUNI	San Francisco Municipal Railway
NICTD	Northern Indiana Commuter Transportation District
NJDOT	New Jersey Department of Transportation
NJIT	New Jersey Institute of Technology
NTP	Notice to Proceed
NVTC	Northern Virginia Transportation Commission
PAT	Port Authority of Allegheny County

PATCO	Port Authority Transit Corporation
PCC	Presidential Conference Cars
PI	Principal Investigator
PM	Project Manager
PRTC	Potomac and Rappahannock Transportation Commission
RFP	Request for Proposal
RFS	Rail Freight Services
RSIP	Research Selection and Implementation Panel
SCRRA	Southern California Regional Rail Authority
SD&IV	San Diego & Imperial Valley Railroad
SEPTA	Southeastern Pennsylvania Transportation Authority
SLE	Shore Line East
SOV	Single Occupancy Vehicle
STB	Surface Transportation Board
SWG	Shared-Use Working Group
TEA 21	Transportation Equity Act 21
TRE	Trinity Railway Express
TRF	Transportation Research Forum
TRIS	Transportation Research Information Systems
UTA	Utah Transit Authority
VDC	Voltage Direct Current
VRE	Virginia Railway Express
VTA	Santa Clara Valley Transportation Authority
WMATA	Washington Metropolitan Area Transit

EXECUTIVE SUMMARY

Congestion on highways and urban streets has stimulated renewed interest in commuter rail, light rail, and other types of guideway transit in a large number of American cities. As potential guideway transit projects appear on the drawing board or join the existing transit systems in service, more and more commingling of freight and passenger trains is being proposed or implemented. The inevitable trend of railroad and transit shared use stirs up a greater concern about the safety of these services when they share common track, right of way, or corridor. It also raises concerns of scarce track capacity.

As a result of this dilemma, NJ TRANSIT has commissioned New Jersey Institute of Technology (NJIT) to undertake a nationwide Survey of Transit and Rail Freight Interaction so that they will be in a more informed position in terms of the interaction between the transit agencies and freight railroads. This survey contacted transit entities in North America to identify the best practices for passenger and rail freight interaction and key factors that contribute to a successful relationship between freight railroads and transit operators.

This study considered three types of transit systems operating in North America. These are: commuter rail, heavy rail, and light rail transit (LRT). The latter two interact with freight to a lesser extent than commuter services, however there is some interaction. Heavy rail transits often use the freight railroad right of way to build their exclusive tracks. LRT build tracks along jointly used alignments also, but freight trains are separated by time when operating on the same tracks.

Research Objective

The transit agencies often have to pay an access fee to the private entities to obtain access to the freight track network. This access fee can vary greatly due to the wide variations of the service density, track quality, and dispatching arrangements. Therefore, to provide New Jersey Department of Transportation (NJDOT) and NJ TRANSIT with a better-informed position, the research team was charged to accomplish the following objectives:

1. Survey transit entities around the nation and identify the best practices for passenger and freight rail interaction.
2. Identify impediments, including legal, administrative and physical, that hinder shared use of freight and passenger rail service.
3. Produce a catalog that may be referenced by the NJ TRANSIT staff to develop strategies for rail network expansion and negotiation with freight railroads.
4. Reveal the key factors that contribute to the successful interaction between freight railroads and transit operators.

5. Highlight a few selected agencies, approaches, or “hot leads” that may be investigated further, should NJ TRANSIT deem it necessary, to prepare for the negotiation with freight railroads.

Project Tasks

1. Undertake an extensive literature search to develop an understanding of the problem and identify the appropriate questions to ask of the transit operators.
2. Develop a questionnaire for submission to the transit operators that would identify the best practices for passenger and freight interaction.
3. Survey the transit agencies in North America including commuter rail, light rail, and heavy rail transit service providers.
4. Analyze and tabulate the survey responses and highlight four selected metropolitan areas or transit agencies using case studies to demonstrate the complex issues involved in the transit and rail freight interaction.
5. Prepare a final report.

The results of each task are documented in four different Technical Memoranda for the project and are represented in the following final report. The extensive literature review was undertaken so that the survey effort proposed for this project would not duplicate any study that is already completed. We determined that no existing catalog, survey results, or best practice documents are available that would substitute for the scope of this study. Therefore, it was deemed necessary to conduct the survey and related procedures in order to gain the necessary information for network expansion and access to freight networks for NJ TRANSIT. It also became apparent that a survey of various commuter rail, light rail, as well as heavy rail operations was necessary.

The questions and issues that most concerned our client, NJ TRANSIT, dominated the questionnaire design. The purpose of the survey was to acquire the physical characteristics of the passenger and freight operations as defined by the types of services, equipment, and shared arrangements. It addressed the types of transit services, such as commuter rail, light rail, or heavy rail and whether the interaction was by shared track and mixed operations, time-separated or just shared right of way with through freight, local freight, yard operations, or none-active freight services. Information on ownership of the rail tracks or right of way, track charts or schematic maps, the protocols of dispatching and prioritizing trains, and performance measures was requested. Questions on safety and liability issues of shared operations were included. Information on changes made to the transportation system to accommodate the joint operation and whether these changes were effective was also acquired. Questions on the cost of acquisition and shared usage and any agreed incentives for effective operations were also included. In addition to a general overview of shared operation we requested transit authorities to identify critical

issues encountered in the shared operation, solutions for joint use as well as their success stories.

The survey was designed around the Internet media to fully utilize the modern communication technology and save time for data processing. Most of the questionnaires were completed electronically. The research team identified and contacted 59 transit agencies in North America. Of these, 21 were commuter rail, 23 light rail and 15 heavy rail.

Survey Results

A total of 47 transit entities responded to our survey. A response rate of 80 percent is fantastic by any survey standard. The team contacted many transit systems more than once, first to identify the right recipient and then to elicit the answers by explaining the purpose of the questionnaire and ensuring an understanding of each question. Follow-up contacts were made and once the completed questionnaire had been received, the implications of the replies were analyzed.

The responses from the transit systems were positive in terms of interaction with freight railroads. Transit service providers frequently mentioned several critical issues, such as dispatching and scheduling, freight management and employee attitude to service integration, capacity constraints, communications, insurance and liability, and funding problems. Sufficient communication with freight railroads was generally recognized as the key factor to successful joint operation. Most transit professionals gave their own suggestion on how to improve passenger and freight interaction.

This research also produced a catalog of the best practices of peer transit agencies sharing passenger operations with freight railroads, as presented in Table 1. The results that do not fit into a simple pattern or list, such as the attitude of management and staff of freight railroad companies to the concept of interaction with passenger service, dispatching and so on, are presented in the final report.

Main Findings

While the survey demonstrated that each particular system has its own characteristics, degree of integration and solutions, the following observations have become evident while examining the study results.

Commuter rail, with its almost total commingling between freight and passenger service, is the most affected transit system. Good communication and a positive attitude to make both services work efficiently are mentioned often in replies to the questionnaire. For example, Commuter rail network in Montreal deems “mutual respect” as the key factor to the success of shared operation.

Table 1. A catalog of options for shared operations

Issues	Options	Descriptions
Platform Access Level	High Level Platform	Provides level boarding required by ADA, but inconvenient for wider freight load
	Low Level Platform	Cannot provide level boarding, but good for freight clearance. Slower boarding
	Mini High Platform	An accessibility solution. A wheelchair can roll over a bridge plate onto the rail car. FTA's judgment is unfolding
	Retractable Platform	The front two feet of the platform can be retracted along the entire length of the platform to let a wide freight through
Type of Interaction	Shared Track and Mixed Operation	Transit trains and freight trains are separated by headway intervals measured in minutes in an operating schedule, adopted by most commuter rail services
	Shared Track and Time-separated Operations	Both transit and freight trains utilize the same track but are separated by time windows, adopted by a few light rail transits
	Shared Right of Way	Defines the arrangement that the track center spacing between the freight track and adjacent transit track is less than 25 feet, adopted by various transit agencies
	Shared Corridor	Track center separated by more than 25 feet, and less than 200 feet, adopted by some transit service providers
	Shared Facility	Shared yards or stations
Freight Types	Through Freight	Mainline or class I Railroad. Most commuter rail interact with both through freight and local freight
	Local Freight	Local, regional, or shortline railroads. A few light rail transits interact with local freight
	Yard Operation	Some commuter rails share yard operation with a freight railroad, a few are seen in light rail transit and heavy rail transit
	No Active Freight	Abandoned or sold freight tracks
Ownership of Shared Assets	Transit Owns	Right of way owned by transit agency or state DOT
	Freight Owns	Right of way owned by freight railroad
	Transit/Freight Owns Different Sections	Both transit and freight railroad own partial segments of the corridor
Clearance Between Tracks	<60 feet	Distance between track centerlines in feet
	60-100 feet	Prevalent
	>100 feet	
	Varies	

Issues	Options	Descriptions
Dispatching Right	Freight Conduct	A few freight operators might give the dispatch priority to its own time sensitive cargoes
	Transit Conduct	Easier for transit to control the dispatch
	Freight/Transit Conduct Independently	Freight and Transit dispatch on the right of way owned by itself
	Third Party	ACE
Dispatch Protocol	Transit Priority Throughout the Day	Using operation rules, time table, trackage right agreement, sometimes depending on freight railroad's judgment call
	Transit Priority Only During Peak Hours	Transit operators enjoy dispatching priority during the rush hours
Performance Incentive	Yes	A certain dollar amount is given to or deducted from freight railroad fee for reaching a certain level of on time performance or delay caused by freight railroad
	No	No extra money is given or deducted to freight railroad
Separation Measures	Fence	Required whenever adjacent to third rail system
	Intrusion Detection	Used to notify central control that a train has derailed
	None	
Insurance Liability	Transit Bears Full Liability	Freight railroads are held "harmless"
	Transit and Freight Shares the Liability	Both transit and freight contribute to the premium of insurance
Critical Issues	Physical Constraints	Double track, siding, or flyover to increase capacity
	Dispatching and Scheduling	Training dispatchers to understand both transit and freight priorities, coordinating schedule
	Communications and Mutual Understanding	Improve communication, conduct cross training to develop mutual understanding of each others' business
	Freight Attitude and Regulation	It is debatable whether more government regulation should be added but the support for more government involvement is loud and clear from the transit agencies
	Insurance and Liability	Share risk and investment

The Federal Railroad Administration (FRA) crash worthiness regulation dictates that there will be no physical service interaction between freight and LRT, which means that freight and passenger trains using the same track must be separated by time. Operating protocols rigidly enforce this regulation. However, there are minor occasions, in Canada, where this is not the case. The interaction occurs where trains cross freight tracks to access the service and maintenance facility. The danger of physical contact in these cases is addressed by the signal system. By the time we are finalizing this report, two minor cases where FRA rules are relaxed have occurred in the United States: one in San Diego Trolley and another River Line in south New Jersey.

Heavy rail transit generally is powered by a 750V third rail at ground level. Total separation is required, with a fence and in some instances intrusion detection devices, to ensure that employees and the public do not come into contact with the dangerous third rail. This has the effect that the only interaction between heavy rail and freight is shared right of way, corridor, facility, or grade crossing, which explains why no trackage is shared between rail freight and subway or metro systems.

The historical perspective is critical to the attitude of both the freight and transit authorities. Many commuter services in the major conurbations have been running since the turn of the twentieth century; therefore these operators have little concern with the interaction of the two services. It is normal to overcome difficulties as part of the job. New systems require “freight only” attitudes to be relinquished and a mutually cooperative approach adopted.

The size of the freight railroad may also play a role in the transit and rail freight interaction. The situations of transit agency interaction with more than one freight railroad of different classes presented opportunities for us to examine the differential attitudes. In the case it was not explicitly indicated, but implied, by the person we interviewed that the interaction with the Class I railroad may be characterized as “tolerable co-existence”, while with the regional railroad is much more positive. It is clear to us, from the frequent communications, timely responses, and diligent performance of priority dispatching, that the local presence of the Guildford Railway Systems has made positive contributions to the transit and rail freight interaction.

It is also evident that there are different attitudes to the interaction from different regions of the country. Systems on the West Coast seem to have a more collegial relationship than those on the East Coast. This may be due to the high publicity of the accidents between freight and passenger trains in Washington DC in 1996 and Chase, MD in 1991. East Coast freight railroads tend to insist on maintaining the authority to dispatch trains and require a physical separation between their freight traffic and light or heavy transit lines. This can adversely affect the passenger service when priority freight is not running on time.

One of the major issues for freight railroads in sharing trackage or right of way with transit services is the increased safety and liability concerns. Thus, when the freight railroad owns the infrastructure, they require legislation or an agreement holding them harmless regardless of fault before yielding their track space to a transit system. When the transit service providers own the trackage or right of way and the freight railroads are not the "owning or controlling party", a detailed agreement on the issue of insurance and liability is usually reached.

It is pleasing to note that accidents related to joint operation or shared use have been very few. Of course, one is one too many! Among the 47 systems that responded, nine of them had had accidents, with six being collisions and three derailments. Damages involved include a passenger fatality, employee fatality, employee injury and property damage. Though the number of injuries and casualties is not large, the issue does raise substantial fear among joint operators.

Critical issues encountered in the shared operation include: dispatching priority, freight railroad's attitude, capacity constraints, insufficient funding, cost and liability allocations, communications, regulation, the problem of being a tenant instead of owner of the trackage, and the long braking distance for the slow freight railroad trains. Among which, the most frequently mentioned issues are capacity constraint followed by dispatching priority. Capacity constraint relief, by providing service separation at bottlenecks, was also highlighted as critical. Unfortunately such separation is limited by funding constraints.

The majority of the agencies put adequate communication and good faith negotiation as important factors for smooth running. Other factors mentioned include: competent dispatchers and improved training of dispatchers (so that they understand the requirements of both types of service), integrated schedules, transparency in sharing cost, regulatory leverage to offset freight railroad intransigence, train density, the need to reduce physical bottlenecks with extra sidings and flyovers, ownership parameters and a genuine will by both parties to make the transit system succeed.

Future Perspective

While it has become evident through this study that many problems for effective and efficient integration of freight and passenger operations are solved locally, this study has identified some problems that are common to all systems. The implementation of the ideas set forth here may make possible further local improvements. Further study and solutions are needed in areas such as the legislative framework, equipment integration, and maintenance cost sharing. A review of usage agreements between transit agencies and freight railroads will give more detailed information of the actual deals between the two parties, helping the industry to set up an interaction standard. Also, a survey of proposed systems at different stages of their planning, negotiation, and construction would reveal more information on how to negotiate with freight railroads.

1. INTRODUCTION

Challenged by increasing ridership along the rail corridors, a number of transit agencies, such as New Jersey Transit (NJ TRANSIT) have come up with a number of innovative ways to improve operational efficiency and service quality. However, efficiency can only improve capacity to a certain extent. Network expansion is inevitable for transit systems to continuously attract and serve transit riders, to maintain the leading position in the share of the transit market, and to improve service quality. When facing the complex issues and concerns related to the passenger and freight rail interaction, transit agencies are usually left in the dark since there is no government agency or national policy to guide or facilitate the negotiations between transit agencies and freight railroad companies.

In order to address this subject and understand how other agencies have solved their problems, NJ TRANSIT has commissioned New Jersey Institute of Technology (NJIT) to undertake a nationwide Survey of Transit and Rail Freight Interaction. The Division of Research and Development, New Jersey Department of Transportation (NJDOT) is the direct sponsor, Nancy Ciaruffoli is the Agency Project Manager, and the NJIT research team, led by Dr. Rongfang (Rachel) Liu, conducted the survey and subsequent analyses.

1.1 Problem Statement and Background

Passenger rail can be an attractive alternative for commuters frustrated with heavy traffic on the roadways. As congestion on our roadways increases, one alternative is to provide extra capacity on our rail lines especially in the Northeast Corridor of the United States, where the population density is high and quality transit services are needed. Rail transit is much more fuel-efficient than Single Occupancy Vehicle (SOV), less pollutant emitting, and less costly for moving the same amount of people and goods.

There is a vast rail network in New Jersey. Since the first railroad was chartered in North America in 1827, the rail industry has been a vital player in the economy of New Jersey. More than two thousand miles of rail tracks stretch from the Pennsylvania boarder to the Jersey Shore and from the north to the south of New Jersey. Railroads are one of the major transporters of the goods that are important to our daily lives.

Among the extensive coverage of rail tracks in New Jersey, the passenger rail network only makes up a small percentage of route miles. Over the years, through mergers and consolidations, numerous low density or redundant lines have been abandoned or sold. Since 1980, the Class I railroads have increased their traffic (ton-miles) by 60 percent, while their network (miles of road owned) has declined by 40 percent (AAR, 1998). From an efficiency point of view, it is

logical to convert duplicate rail lines and branches to passenger services in order to improve transit services and relieve congestion along the highways. Historically, relationships between freight and passenger service providers were difficult. Such a difficulty may be understandable and can be eased if we look into the underlining reasons for the reluctance of freight railroads to grant access to passenger services. It is clear that shared access with peer freight railroads not only takes away existing capacity from the owner railroad but also undercuts the market share of the railroad. Furthermore, when sharing access with passenger services, the owner of the freight railroad not only loses its priority in terms of traffic movement, but may also be threatened by the increased safety and liability concerns.

Recent mergers and acquisitions of rail companies have left only seven Class I freight railroad companies in North America. When faced with all the issues stated above, track owners find little incentive to share their tracks with passenger services even when the tracks are not utilized fully for freight services.

When examining the efficiency of multimodal transportation systems as a whole, it is not difficult to discover that rail transit service is inevitable and far more superior to other modes of transportation in terms of moving large amounts of commuters along densely developed corridors and in terms of fuel efficiency. As one of the leading transit agencies in North America, NJ TRANSIT is taking a proactive approach in identifying potential possibilities for future transit corridors or rail network expansions (NJ TRANSIT, 2002). Shared use with the freight rail network is an alternative that must inevitably be explored if rail passenger services are to be expanded to serve new markets.

Exposed to the issues and concerns related to the passenger and freight rail interaction, NJ TRANSIT is not deterred from its quest for rail network expansion but motivated to approach this issue from a comprehensive perspective. It has hence commissioned a survey of peer transit agencies in the United States and Canada to learn from others' experiences and lessons. This project is intended to help NJ TRANSIT identify best practices implemented by other agencies, which may provide understanding and background information to NJ TRANSIT staff when interacting with freight railroad companies.

1.2 Research Objectives

The State of New Jersey has to pay an access fee to the private entities to obtain access to the freight network. Due to the wide variations of the service density, track quality, and dispatching arrangements, the access fee can vary a great deal. To provide NJDOT and NJ TRANSIT with better knowledge of the interaction between transit services and freight railroads, the research team is charged to accomplish the following objectives:

- Survey transit entities around the nation and identify the best practices for passenger and freight rail interaction.
- Identify impediments, including legal, administrative and physical, that hinder shared use of freight and passenger rail service.
- Produce a catalog that may be referenced by the NJ TRANSIT staff to develop strategies for rail network expansion in shared use corridors.
- Reveal the key factors that contribute to the successful interaction between freight railroads and transit operators
- Highlight a few selected agencies, approaches, or “hot leads” that may be investigated further, should NJ TRANSIT deem necessary, to prepare the negotiation with freight railroads.

1.3 Research Method

The core element of this research is to survey transit agencies in the United States and Canada. In today’s practice, where it is a challenge for all project managers to keep a general project on time and within budget, the challenges to keep a survey project on track may be manifold. That is, a large portion of the survey project is beyond the control of the project team. The responses and the validity of the responses are largely dependent on the good will of the surveyed agencies and contact persons. Therefore, major efforts were focused on selecting the appropriate contact persons, designing a proper questionnaire, and processing the data collected.

Being aware of the real challenges, this research team developed and followed a well-thought out, logical research plan. The critical milestones and division of tasks served as measurements of our task performance. They also helped to remind the Principal Investigator (PI) and Project Manager (PM) of the likelihood of project delays or derailments from its main course.

The research was accomplished via five major tasks and the entire project was completed within 15 months, from January 2003 to March 2004. The first task, Literature Review, was accomplished within the first three-month period. Task 2 through Task 4, Survey and Interview, Result Analyses, and Case Studies occupied the bulk of the project schedule, about nine months. The last three months of the project were used to compile the final project report and present the final results and findings to the NJDOT and NJ TRANSIT.

As staged results of this research, four independent Technical Memoranda were produced, one for each task from Task One to Task Four. As the final report of this research, this document records the “Transit and Rail Freight Interaction Survey”, presents the results of survey and related statistical analyses, and summarizes critical issues and concerns raised by the stakeholders in the following sections. This report also highlights a few success stories and lessons learned in the area of shared operations of passenger and freight as well as the interaction and coordination between transit agencies and freight railroads.

2. LITERATURE REVIEW

An initial literature search during the proposal stage yielded a limited list of publications addressing the topic of passenger and rail freight interaction. A significant number of academic papers (Rolle, 1997 and Dennis, 2000) address monopoly, rate calculation, and demand computations for freight transporters. Another group of publications fall into the category of implication for policies related to the subject.

A limited collection of literature obtained via the American Society of Civil Engineers (ASCE), Transportation Research Forum (TRF), American Railway Engineering and Maintenance Association (AREMA) provides useful information for improving the passenger and freight rail interaction or operation once the passenger service provider gains access to the freight railroad. Among the improvements mentioned in the publications we reviewed were: positive train control, modern communication and information systems to increase train efficiency, concrete slab tracks for mixed use, and safety and security measures for mixed freight and passenger operations. The Association of American Railroad (AAR) provides detailed and timely overall rail operation and system statistics.

Besides the few anecdotal reports about individual railroads dealing with shared passenger and freight operations, we have found that the few case studies or surveys of transit agencies sharing access with rail networks are out dated or of limited scope. For example, Intelligent Transportation Engineering (ITE) Technical Committee 6A-28 conducted a national survey of "Transit, Commuter, and Freight Usage of Rail Right of Way" in 1982 (ITE, 1985). This telephone survey collected information on the type of services shared, length of service and agencies involved. A few cases, such as San Diego, Chicago and European experiences, were examined. The study concluded that shared use of railroad track and right of way for passenger and freight service was alive and well in number of cities. However, like most efforts done by volunteers, this survey did not provide a complete picture of all shared-use experiences.

After receiving the Notice to Proceed (NTP) from NJDOT, the research team conducted a detailed in-depth literature review via the Van Houten Library at NJIT; the Transportation Research Information Systems (TRIS) hosted by Transportation Research Board, the research library of NJDOT and the Internet. Due to the limited quantity and time lag of the formal publications, the research team also examined alternative sources such as unpublished project reports, agency memoranda or briefings, as well as personal communications and project experiences.

Joint operation of passenger and freight railroad services is not a revolutionary concept. It has a long tradition in the United States over the last century and

widely practiced in Europe, Asian, and other parts of world (Vigrass, 1995 and Transportation Research Board, 1999).

In the 19th and early 20th centuries the culture of most railroads was to have an integrated freight and passenger service. It was not until the 1950/60s when buses and automobiles became available to the majority of the population that passenger traffic declined that the railroad companies withdrew their services. The present culture of freight railroad personnel would prefer to be unencumbered by passenger operations. However, senior management of the railroad companies realize that the public demand for commuter services must utilize their tracks to provide services into the major cities.

The availability of contiguous real estate corridors and high capital costs of constructing new track exclusively for passenger service is prohibitive so that majority of the commuter rail services use existing railroad tracks for their operations. As documented by Vigrass (1995), joint operation was not limited to sharing railroad tracks where both freight and passenger trains can be accommodated on the same track. Shared right of way, time-separated operations, shared or contracted dispatching services are all part of interaction between passenger and freight operations. Agreement between freight railroad and passenger railway operating over the same tracks must consider design and track maintenance issues, as well as frequency of the service for both railroad and passenger railway (Transportation Research Board, 1999). Traffic density for both sides represents a major factor because number of trains is directly proportional to demand generated along the route.

During 1980s and 1990s, the demand for light rail transit (LRT) surged in the United States and LRT operators became interested in both abandoned and active freight rail properties. The major advantages of LRT include relatively lower implementation cost than exclusively separated heavy rail and the flexibility to use existing right of way (Phraner, 2000). Besides the definition of joint operations in a much broader scope, Phraner also presented an overview of joint operations between LRT and freight railroad.

On July 10, 2000, Federal Railroad Administration (FRA) and Federal Transit Administration (FTA) jointly issued the statement entitled "Joint Statement of Agency Policy Concerning Shared Use of the General Railroad System by Conventional Railroads and Light Rail Transit Systems" (the Joint Policy Statement). The Joint Policy Statement explains how the two agencies will coordinate their safety authority with regard to the sharing of track by rail transit and conventional railroads. On the same date, FRA issued its statement entitled "Statement of Agency Policy Concerning Jurisdiction over the Safety of Railroad Passenger Operations and Waivers Related to Shared Use of the Tracks of the General Railroad System by Light Rail and Conventional Equipment" (Policy Statement). The Policy Statement gives policy guidance and explains the legal

basis for safety jurisdiction and agency policy on exercising the same in a shared use context.

The Joint Policy Statement is general and procedural in nature, while FRA's Policy Statement contains more substantive guidance and practical details. According to FRA, transit operations that will share use of the general railroad system trackage will have either to comply with the FRA's safety rules or seek a waiver. FRA will be more likely to waive many of its rules where "temporal separation" is in effect and the petitioner demonstrates that its system safety program and state safety oversight program address relevant safety issues (Schulte, 2001). If the transit and conventional railroads operate simultaneously on shared tracks, the petitioners will face a steep burden of demonstrating that extraordinary safety measures are taken to adequately reduce the likelihood of a collision between conventional and light rail equipment. Where a rail transit line shares only a common right of way with a general system railroad line, FRA does not consider that situation to involve shared use, and a waiver is not necessary.

American Public Transportation Association (APTA) formed a Shared-Use Working Group (SWG) in 1999 when the Joint FRA/FTA Policy Statement was under development. Its purpose was to press for consistent and flexible regulation of transit operations in corridors shared with the general railroad system. SWG brought together general managers of transit agencies, federal officials and technical specialists for a series of energetic, well-attended meetings. APTA is reviving SWG with John English (Utah Transit Authority) and Pete Tereschuck (San Diego Trolley) as co-chairs to address a number of emergent issues.

During the course of our survey, two transit and rail freight interaction studies have emerged. One is commissioned by FRA (Zeta-tech Associates, 2002) and another by the General Accounting Office (GAO, 2004). By the time we are preparing this particular report, the former study has submitted its final report and the latter is still in the process of data analysis. Through conversations with the team members of these two projects, we have obtained the synopses of each study, which are included in Appendix A.

As the initial concerted effort of this research, the literature review was completed by the end of the first three months. The principal investigator, Dr. Liu, presented the findings of the literature review to the Research Selection and Implementation Panel (RSIP). The result of literature search is also documented in the Technical Memorandum I of this project: Literature Review of Transit and Rail Freight Interaction.

3. SURVEY OF TRANSIT SERVICE PROVIDERS

The objective of this research is to survey transit entities and identify the best practices for passenger and freight rail interaction. The survey summary, key factors, and success stories of transit and rail freight interaction, are important to equip our clients, NJDOT and NJ TRANSIT, with national criteria and experiences for better knowledge of the joint operations between freight railroads and transit systems. Meanwhile, the research process, including survey method, sample selection, and data processing, is a critical element in assessing the relevancy, accuracy, and validity of the conclusions of the end products of this study.

3.1 Select Survey Candidate

The first step in this process was to compile a list of potential transit providers to be surveyed. According to APTA (2003A), Internet sources, and various project reports, there are about 131 existing and proposed guideway transit systems in the United States and Canada. To identify the appropriate survey candidates, we divided these 131 transit systems into different categories according to the types of services, shared use arrangements, and various development stages as demonstrated in Figure 1.

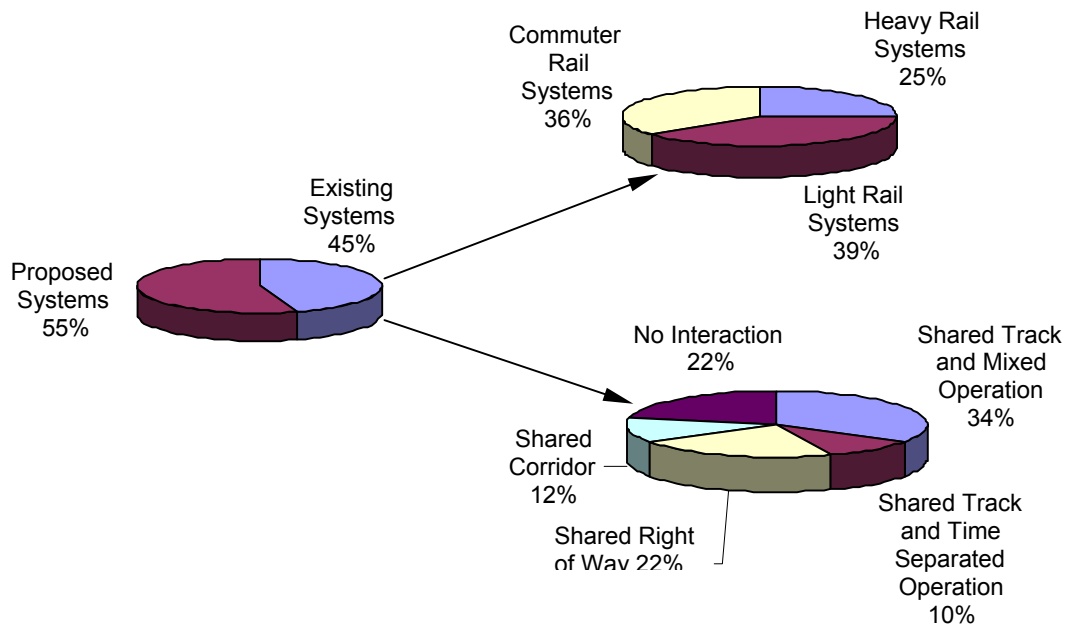


Figure 1. Types of transit by services, stages, and shared operations

Passenger transit has a number of different types operating in North America. These are:

- Commuter Rail, also called metropolitan rail, regional rail, or suburban rail, is an electric or diesel propelled railway for urban passenger train service consisting of local short distance travel operating between a central city and adjacent suburbs (APTA, 2003B). It is developed from passenger railroads of the early 20th century. It is characterized by long trains that have adequate buff strength to be operated on the same tracks as freight trains. These services usually extend 70 to 80 miles from the city it serves and stops only at main population centers. Figure 2A depicts the typical commuter rail service in New Jersey.
- Heavy Capacity Rail, also called metro, subway, rapid transit or rapid rail, is an electric railway with the capacity for a heavy volume of traffic. It is characterized by high speed and rapid acceleration passenger rail cars operating singly or in multi-car trains on fixed rails, separate right of way from which all other vehicular and foot traffic are excluded, sophisticated signaling, and high platform loading (APTA, 2003B). They often operate at headways down to as little as 90 seconds. These systems interact with freight only where there is adequate exclusive right of way along side a freight railroad. The photograph in Figure 2B represents typical heavy rail systems between New York City and New Jersey.
- LRT system, also called streetcar, tramway, or trolley, is a system with passenger rail cars operating singly or in short, usually two-car, trains on fixed rails in right of way that is not separated from other traffic for much of the way. Light rail vehicles (LRV) are generally driven electrically with power being drawn from an overhead electric line via a trolley pole or a pantograph (APTA, 2003B). Diesel LRTs are beginning to be installed in the United States. These, too, interact only within the same right of way, except under special circumstances when either the LRT or freight has exclusive occupancy of the tracks. The picture in Figure 2C depicts the typical modern LRT. Streetcars, which generally operate singly in city streets, are treated, in this study, as one of the LRT variations. The only instance where they interact with an operating freight railroad is when crossing a right of way at grade. In these rare instances there is significant signal control to ensure complete safety.

A combination of an Internet search, selected telephone interviews with representatives of several proposed systems, and discussions among the project team members concluded that a better use of the limited resources of this project is to concentrate on those existing transit systems with various shared use arrangements among all three service types: commuter rail, light rail, and heavy rail. As included in Appendix B, 59 transit systems were identified as our initial contact candidates for the survey.

A. Commuter rail



Source: M. Rosenthal, Photographer, NJ TRANSIT

B. Heavy rail



C. Light rail



Figure 2. Examples of various transit types

Among those various transit systems, not all of them interact with freight railroads. We have classified the shared transit and freight operations into four different categories:

- Shared track and mixed operations
- Shared track and time-separated operations
- Shared right of way only, or
- Shared corridor.

The categories are defined as the followings:

- **Shared Track and Mixed Operation:** transit trains and freight trains are separated by headway intervals measured in minutes in an operating schedule. Though this approach occurs in Europe and Japan for all sorts of transit operations, it is only approved for commuter services governed by rigid FRA rules in the United States. Joint operation between LRT and freight railroad operation is not allowed.
- **Shared Track and Time-Separated Operations:** both transit and freight trains utilize the same track but are separated by time windows. In North America, the common practice is to operate transit during the day and freight at night, generally in the early morning hours.
- **Shared Right of Way** is similar to the definition of “adjacent tracks” by FRA (FRA, 1999). The term “shared right of way” defines the arrangement that the track center spacing between the freight track and adjacent transit track is less than 25 feet.
- **Shared Corridor:** The track center spacing between the freight track and transit track is more than 25 feet but less than 200 feet.

As depicted in Figure 3, a recent study (Zeta-tech Associates, 2002) indicated that among all existing shared transit operations in the United States, about 45% are shared right of way, including all heavy rail and some LRTs; 34% share the corridor, generally LRT, and some exclusive commuter lines; and 21% share

track which involves most commuter services. Those numbers are in terms of route miles. The large portion of

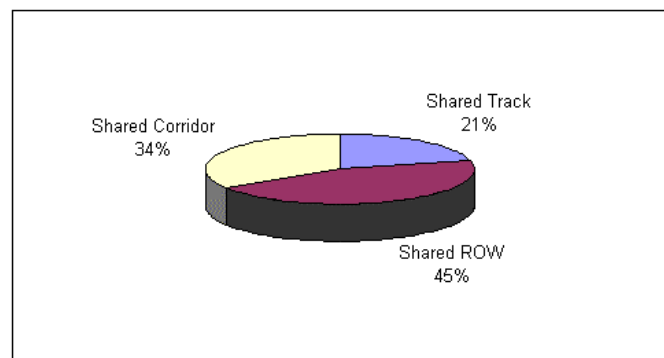


Figure 3. Shared operation arrangements among existing transit systems in the U.S. by route miles

Source: Zeta-tech Associate. Inc, 2002

shared right of way among existing transit systems is one of the reasons for our expansion of the shared operation definition. In addition, a number of transit agencies that are in the process of initiating or expanding LRT services have to deal with liability and insurance issues when the LRT track is in the close proximity of freight tracks. The survey information indicated that shared right of way and shared corridor have broad appeal to transit agencies around the country.

3.2 Design Survey Questionnaire

Concurrent with the process of identifying survey candidates, the research team worked with NJ TRANSIT to develop the survey questionnaire. Taking the initial questions posed in the Request for Proposal (RFP) as the beginning point, the research team developed a complete questionnaire to cover the key areas of interest, as attached in Appendix C.

The survey was designed around the Internet media to fully utilize the modern communication technology and save time for data processing. The questionnaire could be completed either electronically or through paper media. Among the electronic media; web-based, Email based, as well as individual electronic file transfer all could be and were used.

As presented in Figure 4, the electronic questionnaire was hosted on the NJIT website and sent to the survey participants via an email link. The website was developed and maintained by NJIT staff. The website contains an explanation of the survey and information requested as well as a link to the actual survey (<http://transportation.njit.edu/freightsur/index.asp>). Compared to the traditional mailing or telephone surveys, web-based survey has the following advantages:

1. Technical Assistance. Each question can be explained or elaborated via a “Help” button so the persons who fill-out the questionnaire will be clear on what they are asked.
2. Multiple Response Types. The survey design may implement various response types, including single choice, multiple choices, matrix questions, text, date, free-form text, numeric, sliding scale and pull-down list.
3. Rapid Response Time. The answers are channeled into a database as soon as the person fills the questionnaire. This procedure reduces or eliminates the data entry and processing time. It also ensures the accuracy when handling the data.
4. Unlimited Space for Response. The web version of the questionnaire provided unlimited space for narrative answers, which is ideal for the data

we are interested in, such as usage agreements, access fees, and strategies and tactics for mixed traffic operations.

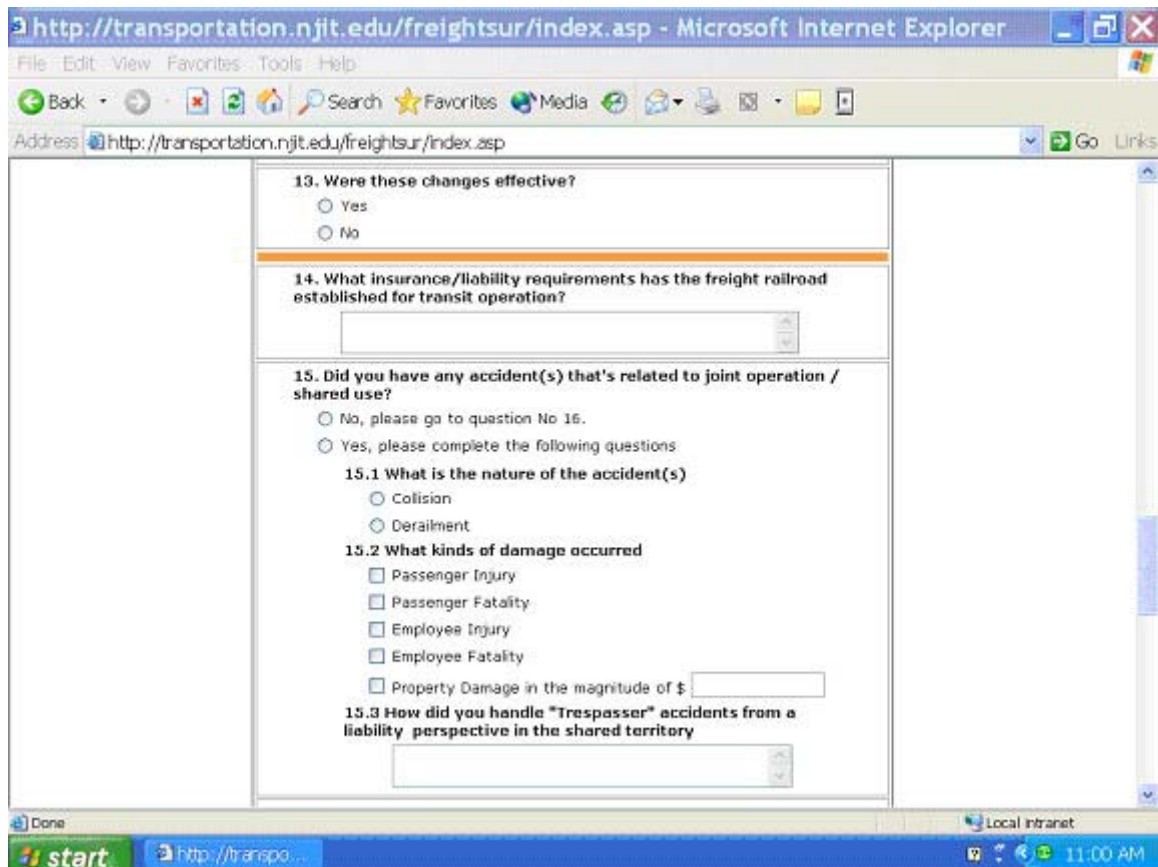


Figure 4. Sample survey screen

3.3 Survey Transit Agencies

Once the survey candidates were identified, it was critical to locate the appropriate person or division to contact within a transit agency. Combining the system profiles, Internet sources, and the APTA system directory, the research team selected one or more contact persons for each transit system that were classified as a survey candidate.

The overall responses from the transit agencies were cooperative. Some agencies expressed their interest in the research with recognition of the problems that exist between themselves and the freight railroads.

Since most commuter rail operations shared track and mixed operated with freight, it was easier to get the survey understood by commuter rail operators than those in light and heavy rail transit. Some LRT operators did not realize they

actually shared corridor with freight operators since they are quite far apart. For many light rail agencies, the initial response were “We have no interaction with freight operation; therefore we cannot answer most of the questions in the survey”. However, the contacted systems were believed to have some interaction with freight operation after a preliminary search by the team. Having got a negative answer from the agencies, the research team conducted more concentrated research and contacted the operators again.

The research team also supplemented the mailing/telephone survey at a national conference: APTA Annual Commuter Rail Conference held from April 14 to 16th, 2003 in Chicago. Attended by Chief Operating Officers, Managers, and Chief Engineers of most of the commuter rail services in North America, this conference provided a concentrated site to access many key personal.

During the conference period the PI, talked with various managers of commuter rail systems, consultants, and government officials. A few in-depth interviews were conducted and the results are included in the next section.

It is noted later that when contacts were established at the Commuter Rail Conference in Chicago, it was much easier to get a response. In contrast, those contacts that were located via Internet without personal interaction took much longer and required more effort to respond or, in some cases, they did not respond at all.

To accomplish one of the objectives of this research, namely, to provide key factors and successful stories of interaction between transit and rail freight, we interviewed those transit agencies who have extensive interaction with freight railroads, who have accumulated exceptional interaction practices, or who have experienced very frustrating experiences, which may be lessons for others.

The visit with a Vice President of CSX, responsible for passenger operations, one of the main freight railroads, proved to be very productive. In addition to the specific information on system configuration, access price, and basic agreements of various contracts that CSX had negotiated with various transit services, the in-depth interview also obtained the railroad perspective in regard to the passenger services: This visit provided an insight into the criteria that a freight railroad insisted on when being asked to integrate commuter services and sharing the right of way with LRT and heavy rail.

In-depth interviews were also conducted with MBTA in Boston, Metro North Railroad (MNR) in New York, TRAX in Salt Lake City, Caltrain in Bay area of California, Tri-Met in Portland, Oregon and New Jersey Transit in Newark, New Jersey. Factors affecting the selection of candidates for in-depth interviews were decided by the general surveys collected. Both telephone conversation and face-to-face meeting were utilized for the in-depth interviews.

4. SURVEY RESULT ANALYSES

The study team contacted 59 existing transit rail operations in North America. Among these, 21 are commuter rail services, 23 are LRT, and 15 heavy rail transit operations. After numerous attempts using various communication media, the research team obtained great responses from the transit community. As depicted in Figure 5, all of the commuter rail services and the majority of the light rail and heavy rail systems responded to our survey. The overall response rate was about 80 percent. Among those transit systems that responded to our survey, almost half, 45 percent, are commuter rail services, 32 percent LRT, and 23 percent heavy rail systems.

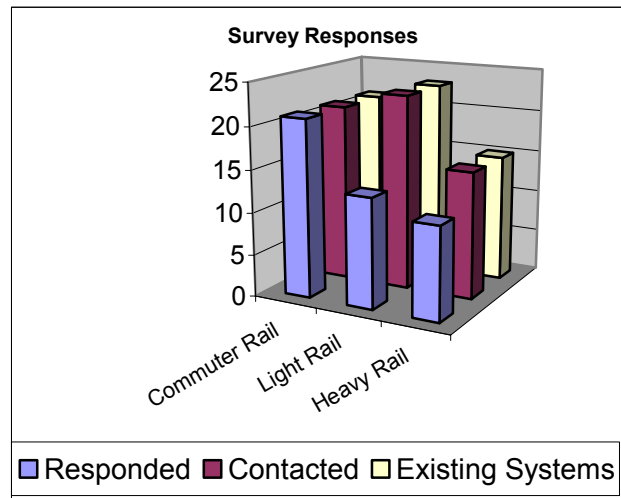


Figure 5. Survey response and service distribution

4.1 General Survey Results

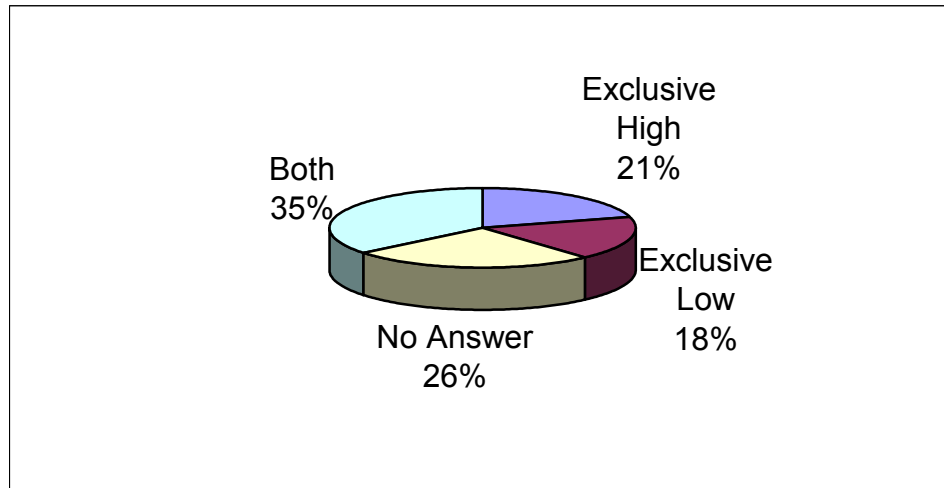
The objective of this survey is to collect information on transit and rail freight interaction in North America. Besides the physical characteristics of the passenger and freight operation, such as track geometry, signal and communication, and operating and maintenance schedule, we were also interested in the organizational issues, such as dispatching arrangements, fee structures associated with trackage rights and leasing agreements, and sharing the liability insurance cost between passenger and freight railroads.

4.1.1 Physical Characteristics

The first part of the survey was designed to collect information on the physical characteristics of the existing rail transit systems. Besides the type of operations of transit service, we also enquired about the types of equipment used for transit services, the type of freight operations using shared track or right of way, and types of interaction with freight operations as we have defined earlier.

As for the types of equipment for transit services, we included two categories: platform levels and single or bi-level cars. Among all the transit systems that answered this particular question (29), eight transit systems use exclusive high level platform and seven transit systems use exclusive low level platforms. Fourteen of them utilize both high and low level platforms, as shown in Figure 6A. Figure 6B is an example of high level platform employed by NJ TRANSIT.

A. Platform levels for transit services



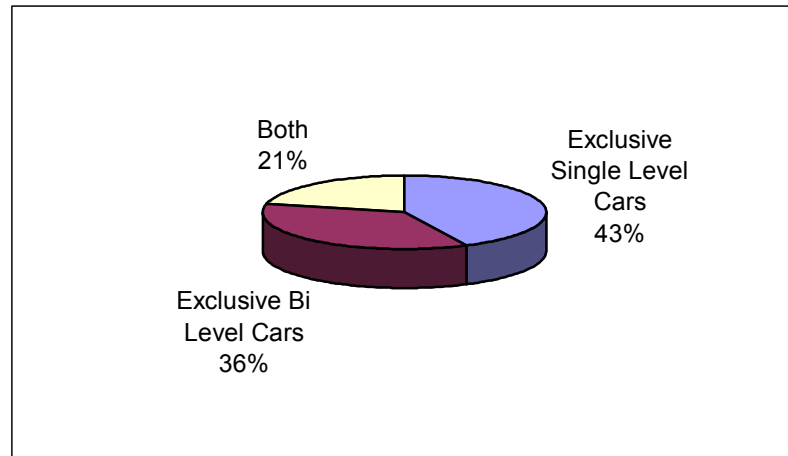
B. Example of high level platform



Figure 6. Platform levels for transit services

Regarding the rolling stock, both single level and bi-level cars are prevalent in operation. Among the 28 transit systems that responded to this particular question, 12 of them have exclusive single level cars and ten exclusive bi-level cars. Six systems use both single and bi-level cars as demonstrated in Figure 7A. Figure 7B is an example of multi-level car used in Sounder Commuter Rail in, Washington.

A. Types of rolling stock for transit services



B. Example of multi-level car used in Sounder Commuter Rail



Figure 7. Types of rolling stock for transit services

As explained earlier, we categorized the interaction between transit and freight railroad into four groups. The definition of each group was explained and embedded with each choice in the internet survey questionnaire. An additional choice of “shared facilities such as yard, station etc.” was included in the questionnaire to capture those shared facilities. As depicted in Figure 8, almost half, 53 percent, of the transit systems share their tracks and mix operations with freight railroad. Almost one fifth of the systems, 19 percent, share their tracks with a freight railroad but operate by temporal separations. One sixth of the transit systems marked the choice of “shared right of way with the freight railroad,” which indicates that the distances between the passenger and freight rail tracks are less than 25 feet as defined earlier in this research. About 14 percent of transit systems surveyed share facilities, either yard or station, with a freight railroad.

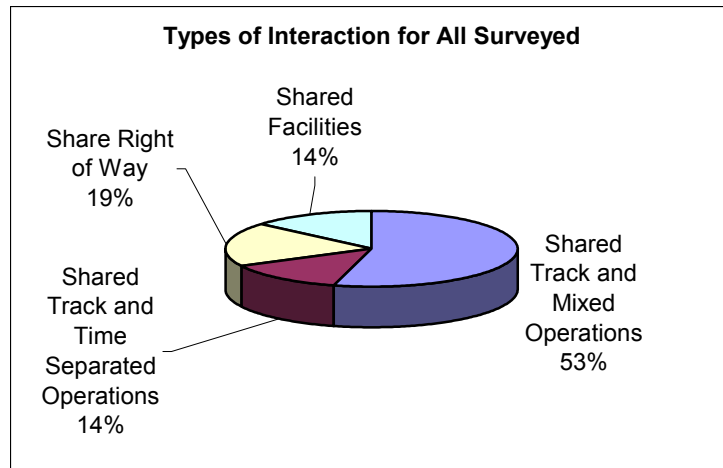


Figure 8. Transit and freight rail interaction

Initially, it was puzzling for the research team to see a “zero” response under the category of “shared corridor” or “close proximity”, as we named them in the survey questionnaire. As defined in the early stage of the survey, “shared corridor” includes those transit and freight interaction where the distance between the passenger and freight rail tracks vary between 25 and 200 feet. A detailed examination of the answers and follow-up conversations with the people who filled out the surveys indicated that this concept may not be very well understood: we have entertained a number of answers as “no interaction” even though data from other sources show that the distance between transit and freight rail track is less than 200 feet. For example, the staff of Tri-Met in Portland, Oregon, insisted “there is no interaction with freight railroad since their tracks are so far apart”, while we were informed from other sources that the freight railroad is less than 200 feet from the LRT tracks along certain segments of their system (Zeta-tech Associates, 2002).

The responses in this regard may not be accurate as an academic exercise, however they are an accurate reflection of reality: there is little concern for transit and freight interaction when their tracks are far apart enough to be unaffected by a train derailment. Freight railroads like to see something greater than 50 feet, being half the length of a standard car. An analysis of serious derailment indicates that a train generally takes up a fan or concertina configuration about the track it was running on.

The distribution within the types of freight operations is rather diverse. As depicted in Figure 9, the largest share of freight operations among all respondents is local freight (38%), the second place is through or mainline freight and another one fifth of the systems shared yard, station, or other facilities with the freight railroad.

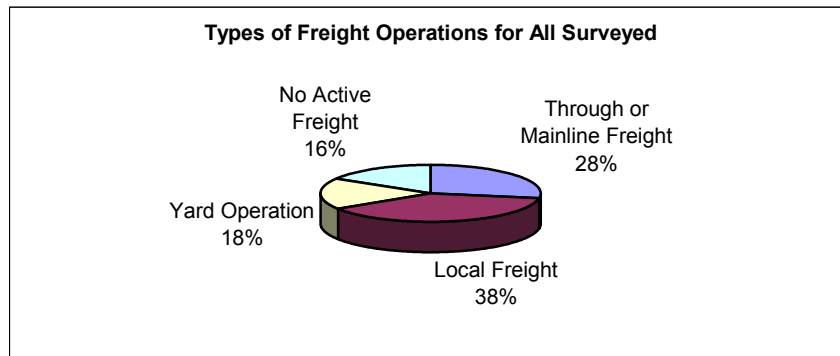


Figure 9. Types of freight interacting with transit

The survey also collected information on clearances between transit and rail freight tracks to verify the interaction types. As shown in Figure 10, the total width of jointly used right of way ranges from 30 to 200 feet, according to the survey. However, the width of jointly used right of way mostly falls between 60 and 100 feet. It is also important to note that those numbers may represent the most prevalent width of shared right of way since some systems have various widths along different segments of the track. The track center spacing between a freight track and the adjacent transit track varies between 13 to 25 feet with the most concentration around 13 to 15 feet. Among those who responded to this particular question, about one third of transit systems have different lateral clearances at bridges.

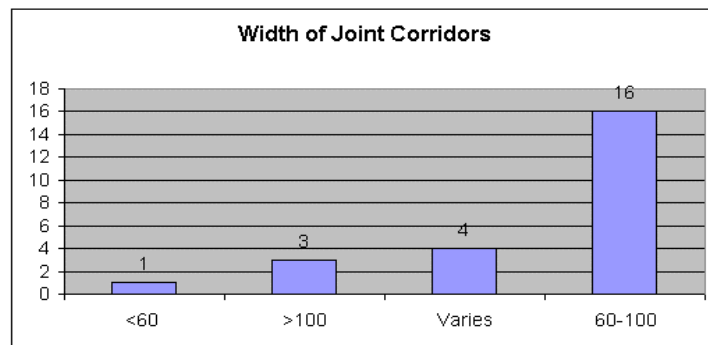


Figure 10. Lateral clearance (in feet)

4.1.2 Operating Privilege

When asked about the ownership of the shared assets, among the 24 valid answers, there are nine systems whose shared assets are owned by freight railroad, eleven whose shared assets are owned by the transit operator or State Department of Transportation, and four whose shared assets are mixed owned, with part of the tracks belonging to freight railroads and part to transit or National

Railroad Passenger Corporation (Amtrak). The share of ownership is presented in Figure 11.

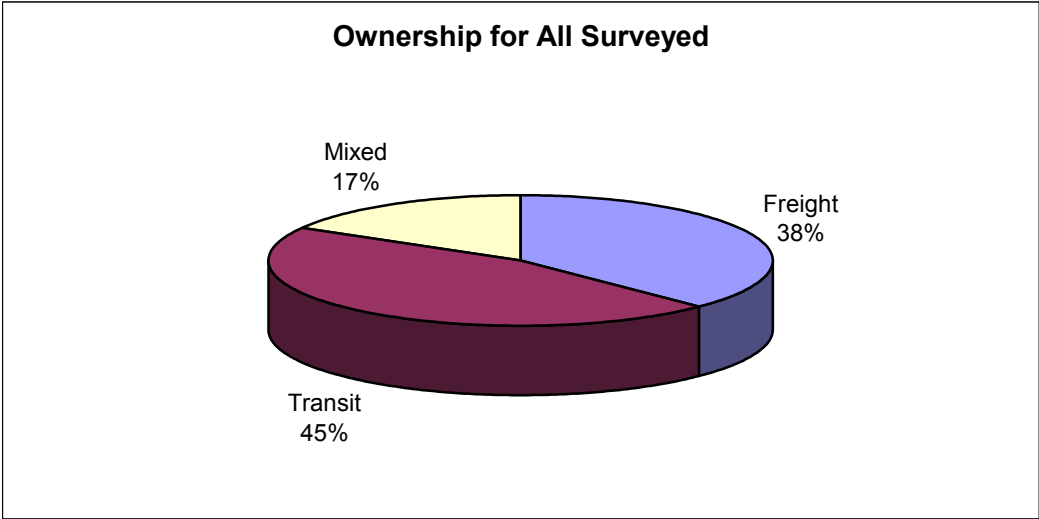


Figure 11. Ownership of shared assets

The responsibility for train dispatching for transit rail operations is critical for efficiency and a high level of on-time performance. It is generally believed that dispatching authority flows with ownership of right of way, which conforms to most of the cases in the survey, as demonstrated in Figure 12. However, there are a few exceptions. For example, the right of way of Tri-Rail is owned by the Florida Department of Transportation, and the system is dispatched by freight railroads.

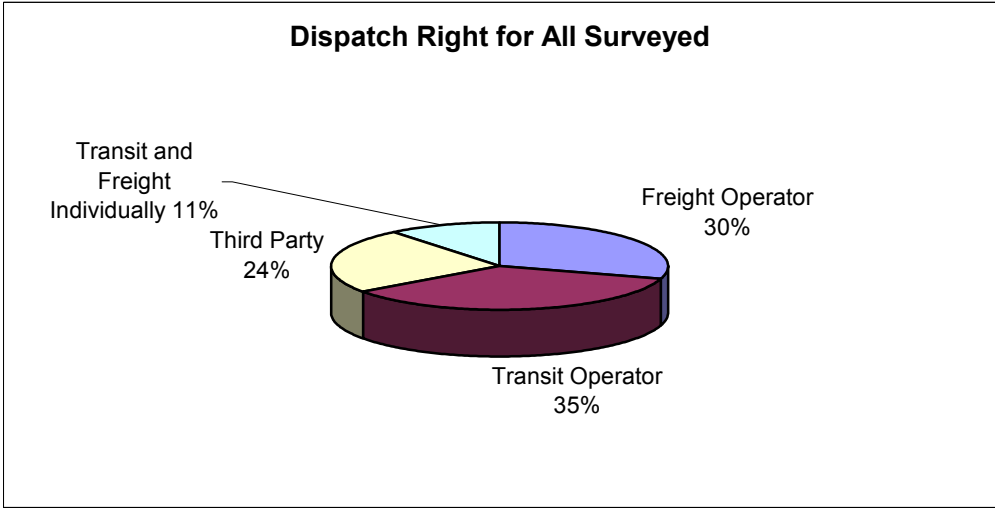


Figure 12. Dispatch rights for transit services

When the right of way is owned by more than one entity, the dispatching right can be more complicated. For example, one system in the west is dispatched by “whoever owns the right of way” on different routes. There are also cases where third party, such as Amtrak, conducts dispatching.

As for protocols regarding dispatching, some agencies are disciplined by an agreement and some systems have a priority sequence. Among the former category, Tri-Rail in South Florida has “Joint Participation Agreement”, SEPTA in Pennsylvania uses “Trackage Right Agreement” and Maryland Rail Commuter (MARC) in Baltimore uses a “time table”. For the latter category, commuter railroad has the first priority, followed by Amtrak and lastly freight. A commuter system in Canada sets protocol as commuter over freight; fastest inter-city train over commuter; express over all-stop commuter.

4.1.3 Insurance and Liability

One of the major issues for freight railroads to share trackage or right of way with transit services is the increased safety and liability concerns. Freight railroads can easily go bankrupt should there be an accident involving major passenger casualties. Thus, one of the strong voices we heard from freight railroads is to pass legislation or work out an agreement to hold them harmless, regardless of fault, in order to yield their track space to a transit system.

The survey result shows that in most cases, transit systems are required to hold freight operators harmless if the trackage or right of way belongs to freight railroads. Examples include commuter rail services in Canada and the Northeast Corridor. When the transit service providers own the trackage or right of way and the freight railroads are not the “owning or controlling party”, a detailed agreement on the issue of insurance and liability is usually reached. For example, the agreement for Metrolink in Southern California is \$150 million per occurrence for general liability with \$5 million deductible; and another railroad worked out \$100 million per occurrence for general liability with \$1 million deductible, as shown in Figure 13.

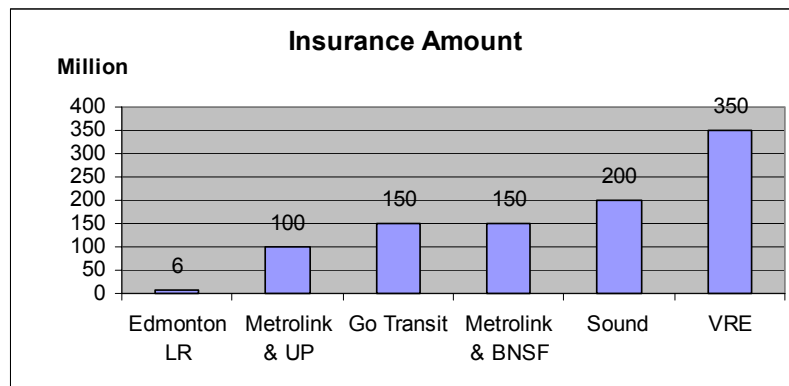


Figure 13. Insurance and liability for all surveyed

The research team also enquired if there have been any accidents related to joint operation or shared use. Among the 46 systems who responded to this question, nine of them had had accidents, with six being collisions and three derailments. Damages involved include a passenger fatality, employee fatality, employee injury and property damage. Though the number of injuries and casualties is not large, the issue does raise substantial fear among joint operators. The magnitude of property damage ranges from \$6,600 to \$25 million for these accidents as exhibited in Figure 14.

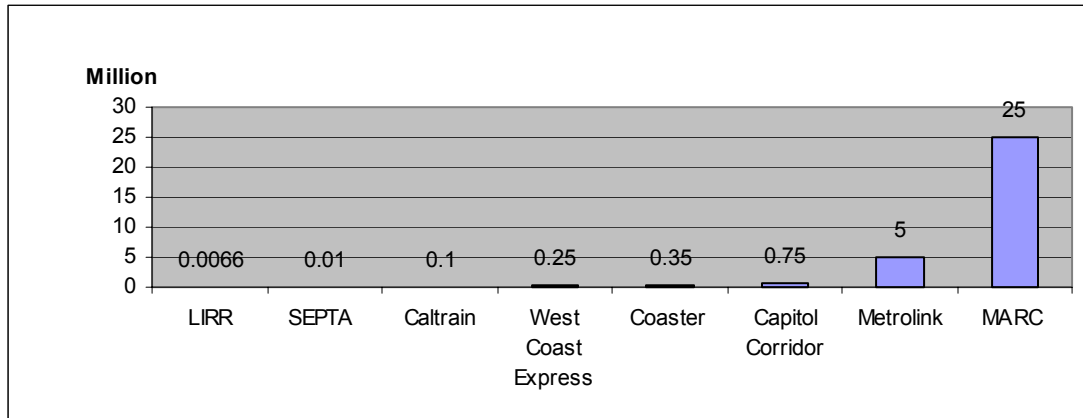


Figure 14. Accident damages

4.1.4 Right of Access and Its Cost

We also asked about how the non-owning (tenant) user gets access to the corridor in order to understand the arrangements of shared use. As shown in Figure 15, two of the transits indicate that the access is provided through easement, five by property lease, and most access privileges to the shared assets are settled by trackage right agreements or a contract between the tenant and owner. There are various names, but we define trackage right or operating agreement as a right obtained, generally for a fee, by one railroad to operate its trains over the tracks of another railroad. Property lease is a rental agreement to use property.

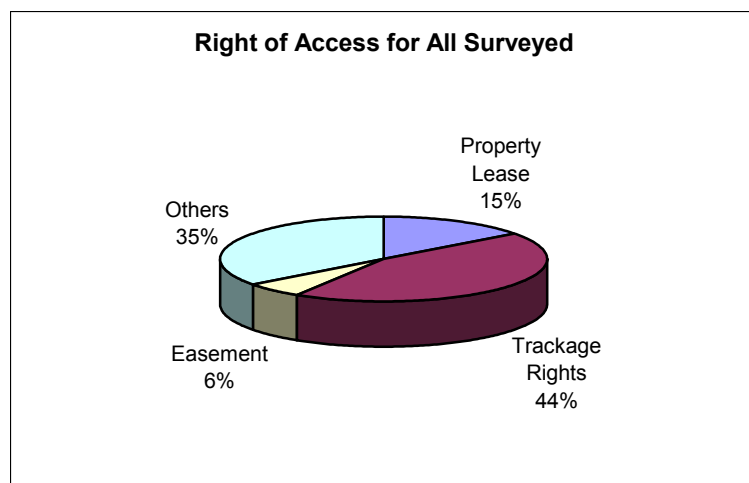


Figure 15. Right of access for all surveyed

One of the ways to improve on time performance is the adoption of the incentive or a financial penalty system. The majority of transit systems we surveyed do not have any incentive plan for improving shared use of railroad tracks, right of way, or facilities. About one fifth of respondents do have specific incentive plans in place to reward time performance or punish delays. Table 2 presents a few examples of incentive or penalty ranges.

Table 2. Incentive plans

Transit Agency	Freight Entity	Owner of Track	Incentive/ Penalty	On Time Standard
Altamont Commuter Express	Union Pacific	Freight	Reduction in the dispatching fee	<92%
Commuter Train in Montreal	Canadian Pacific Railway	Freight	\$6000/month incentive \$6000/month penalty	>97% <95%
Sounder Commuter	BNSF	Freight	\$4.29 per train mile	95%
			\$5.85 per train mile	100%
			\$0	<85%
Metrolink	BNSF & UP	Joint	Freight railroads receive an incentive for commuter train on-time performance on territories they dispatch and maintain	

In addition to a general overview of shared operation in North America, this study was also charged to identify critical issues encountered in the shared operation and identify success stories of shared operations. The last group of questions in the survey was developed to address critical issues that must be solved in order to introduce joint use of the right of way or trackage and key factors that contribute to a successful interaction between freight and transit operators.

Various issues were brought up when asked about the most critical issues that must be solved for the introduction of joint use. Issues such as dispatching priority, freight railroads' attitude, capacity constraints, insufficient funding for infrastructure modification to obviate bottlenecks, cost and liability allocations, communications, regulation, problem of being a tenant instead of owner of the trackage, and the long braking distance for the slow freight railroad trains were mentioned. The most frequently mentioned issues are capacity constraints, followed by dispatching priority. Capacity constraint relief, by providing service separation at bottlenecks was also highlighted as critical in our discussions with a FRA representative. Unfortunately such separation is expensive to implement.

Regarding the key factors that contribute to a successful interaction between freight and transit operators, the majority of the agencies put adequate communication and good faith negotiation as the most important key factors. Other key factors mentioned include: competent dispatcher, schedule, transparency in sharing cost, regulatory leverage to offset freight railroad intransigence, train density, ownership parameters and a genuine will, by both parties, to make the transit services succeed.

As for the impediment issues to the joint operation, 14 agencies picked physical constraints, 12 agencies choose legal issues and eight agencies consider administrative issues. The result is documented in Figure 16. The above choices are overlapping. Other identified impediments include: freight monopoly attitude; schedule constraints in track development; dealing with the track window

availability for freight operations; capital investment responsibility; and lack of dispatcher training.

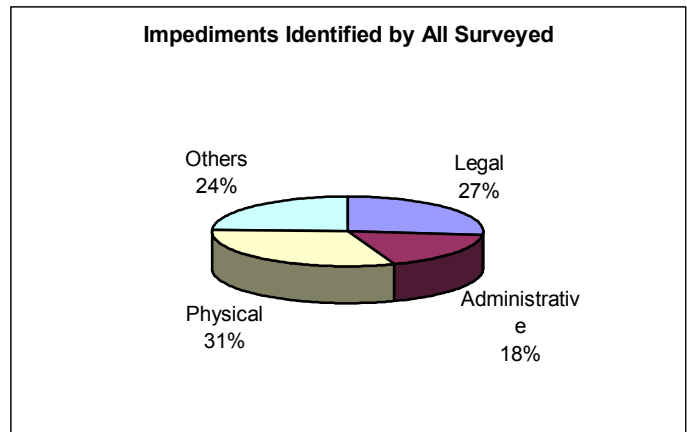


Figure 16. Impediments identified by all surveyed

4.2 Landscapes of Transit and Rail Freight Interaction

As mentioned earlier, rail transit has a number of modes operating in North America: commuter rail operations, LRT, and heavy rail transit. All three modes are present in the transit service providers we surveyed. The following section depicts the general landscape of rail freight interaction with each type of services.

4.2.1 Commuter and Freight Rail Interaction

The transit and rail freight interaction is most prevalent among commuter rail operations. According to APTA, all of the 18 existing and 38 proposed commuter rail services in the U.S. operate on shared tracks with freight railroads. Regarding the types of freight operations the commuter systems are interacting with, 17 out of 21 commuter systems shared tracks with both mainline and local freight railroad, only two commuter systems shared tracks with exclusive mainline freight and one with exclusively local freight. One system shared yard operation with a freight railroad, as exhibited in Figure 17.

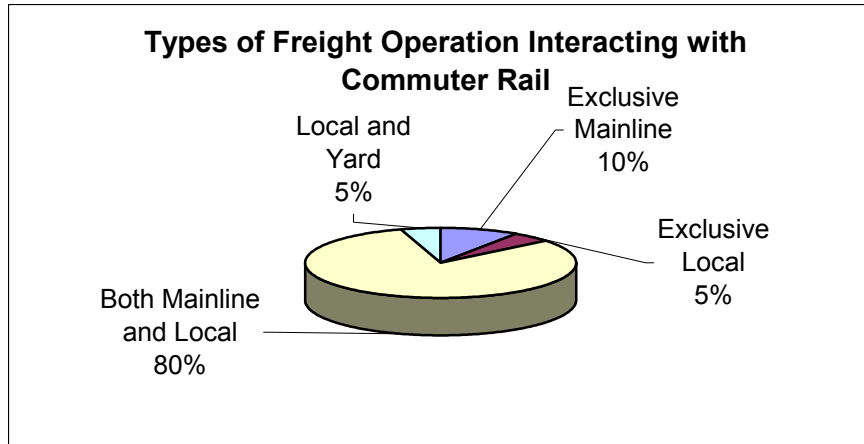


Figure 17. Types of freight operation interacting with commuter rail

As shown in Figure 18, ownership of shared assets of commuter rail is quite diversified. Except for four systems that did not respond to the question, freight railroads own about one third of the shared tracks, transit owns about one seventh, and the rest are jointly owned. The research found that most tracks of all three commuter systems in Canada are owned by their parent freight railroad. For example, the tracks of the commuter trains network in Montreal and most tracks for GO Transit in the Toronto area are owned by the Canadian National (CN) Railway. The track of West Coast Express in British Columbia is owned by Canadian Pacific (CP).

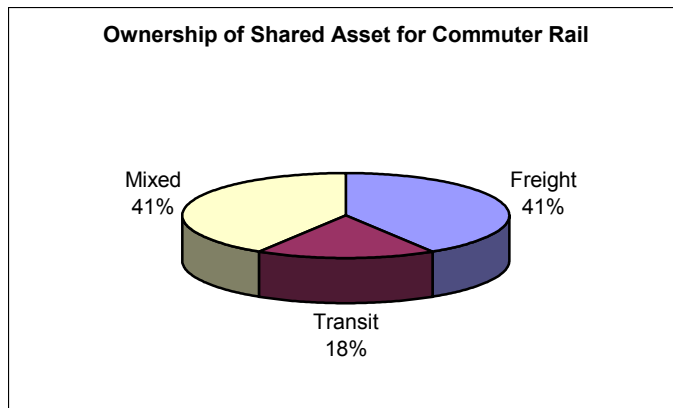


Figure 18. Types of freight interacting with commuter rail

Shared tracks used by commuter systems in the United States are owned by various parties. Some are owned by transit or state Department of Transportation some are owned by freight railroads, some are owned by local short line railroads and others are jointly owned.

Class I carriers who own the shared tracks of commuter systems include Union Pacific, which owns the track of Altamont Commuter Express (ACE) and most part of Capitol Corridor Intercity Train Service in northern California; Norfolk Southern, CSX, which owns part of the track of VRE; and BNSF, which owns the track of Sounder Commuter Rail.

Tracks owned by transit agencies include Dallas Area Rapid Transit (DART) in Texas, Tri-Rail in Florida, the Coaster in San Diego County, California, and South Shore Commuter Railroad in northwest Indiana. Tracks with mixed freight and transit agency ownership include VRE, Caltrain, Metrolink, SEPTA and GO Transit.

The large concentration of commuters, especially during the peak hours in the peak direction demand, forces commuter service providers use bi-level rolling stocks, the easiest method of increasing train capacity without requiring the additional expense of station platform extensions. For example, among 21 commuter services who responded to the question of rolling stock, 10 use bi-level cars, five use single level cars, and six use both bi-level and single level cars, as shown in Figure 19.

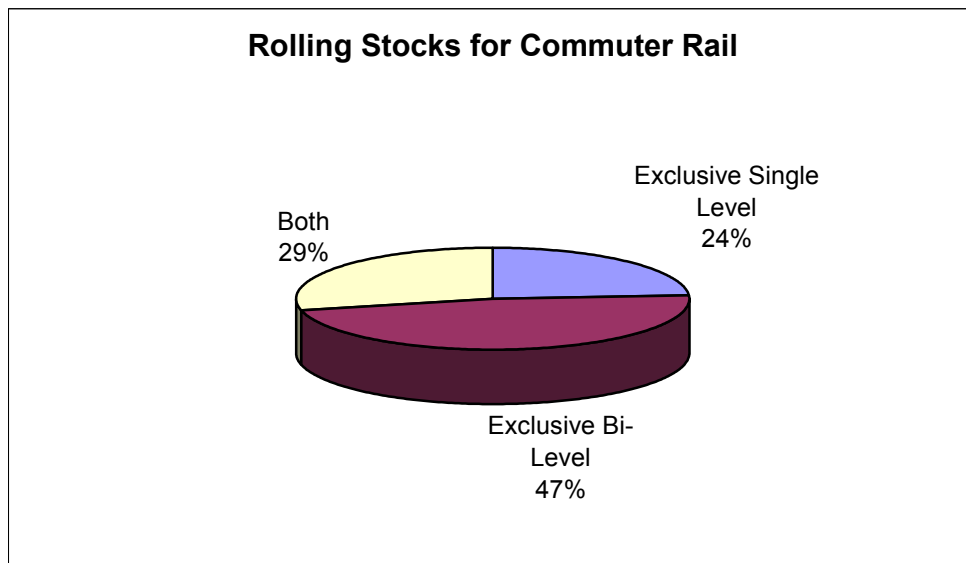


Figure 19. Rolling stocks for commuter rail

Choices of low or high platform configurations are dictated generally by rolling stock equipment or by operator policy. Low-level platforms are more preferable to freight railroads and are less expensive to build. However, the American with Disabilities Act (ADA) provisions on accessibility require level boarding, and high-level platforms facilitate train passengers through level boarding. In joint operation, the major problem encountered with high-level platforms is the encroachment on freight car clearances. For those not familiar with the various types of railroad station platforms, Figure 20 presents the basic types (Trainweb, 2002). Plate B shows the AAR clearance diagram for unlimited interchange. Plate F and E shows an AAR clearance diagram for limited interchange.

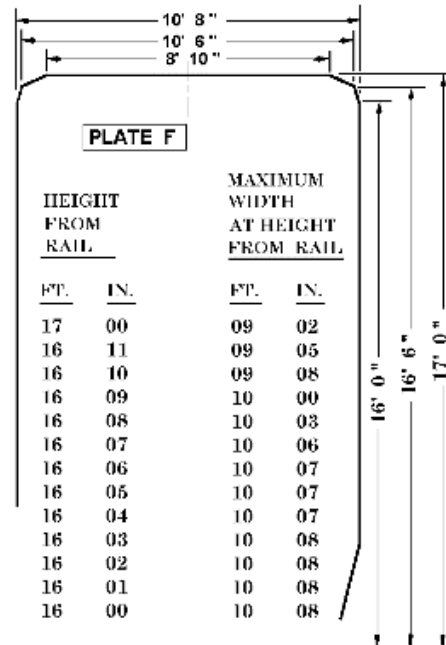
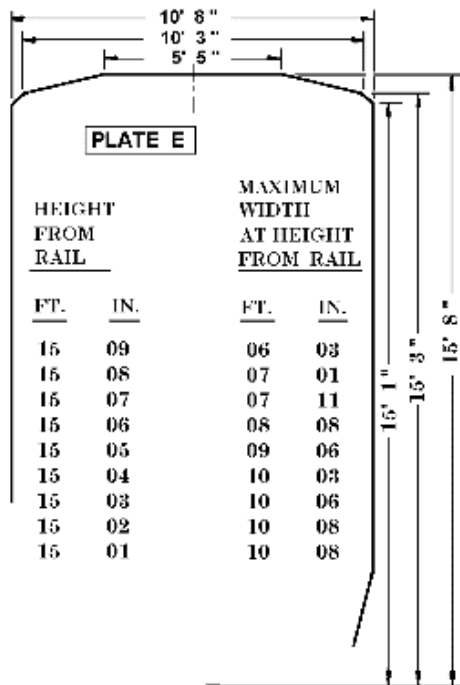
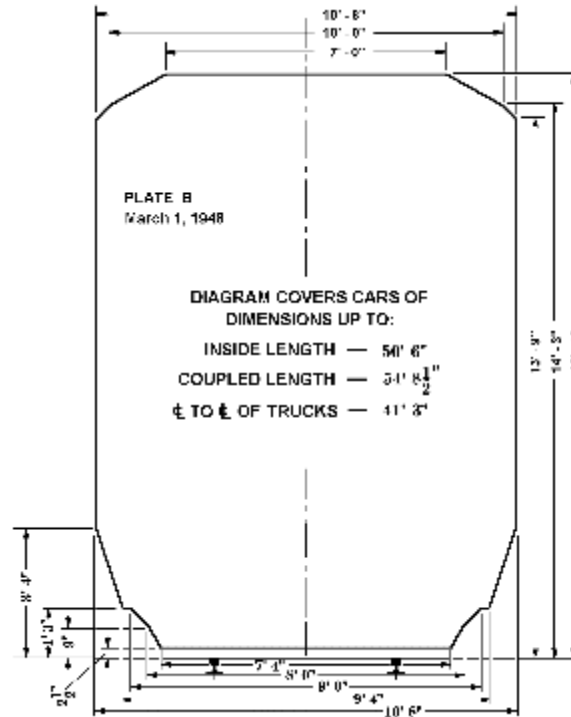


Figure 20. AAR clearance plate diagrams

Source: Trainweb, 2002.

Judging from the acceptance of high-level platforms, we learned that the commuter and rail freight interaction may have impeded the implementation of high platforms. Eleven commuter systems use both high and low level platforms, as shown in Figure 21, among which, many stations are still served by low-level platforms.

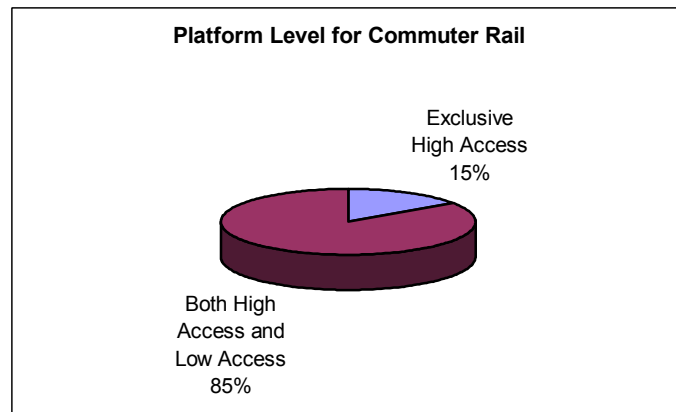


Figure 21. Platform level for commuter rail

A large number of the commuter rail services, 43%, are dispatched by freight railroads, as demonstrated in Figure 22. Five are dispatched by transit agencies, four by third parties, and the rest three are dispatched by freight railroad and transit agencies independently.

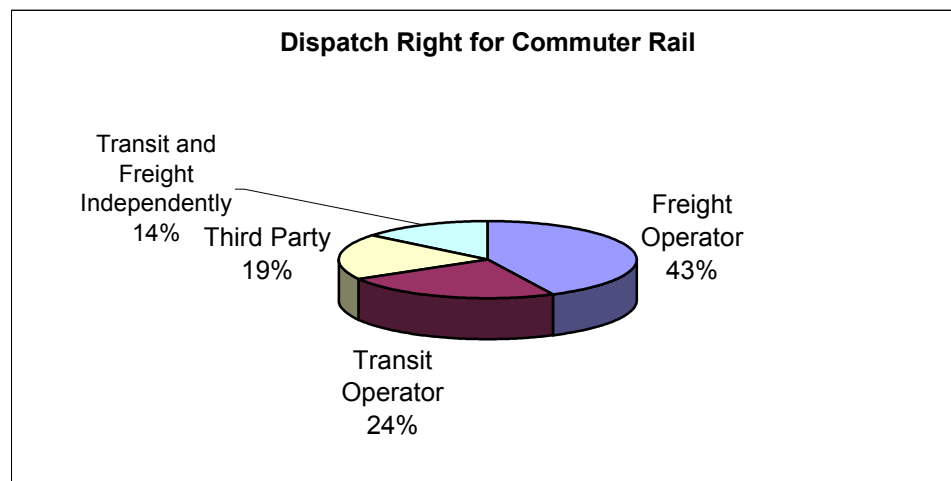


Figure 22. Dispatch right for commuter rail

Most commuter systems enjoy the dispatching priority over the freight railroads. However, a few commuter systems do not have such favorable treatment, such as GO Transit in Canada and VRE in Virginia. This is a real point of contention, especially during the rush/peak hours. The protocols for some are written into the agreement or timetables, but for others, the protocols are just maintained by current practices. Only one transit operator in California indicated that dispatching priority depends on the current conditions, since it is the freight railroad's judgment call.

A detailed examination of dispatching protocols reveals that eight commuter systems have different dispatching protocols during peak and off-peak periods and 13 commuter systems do not have such differences. Those that have different dispatching protocols during the peak and off-peak periods mentioned three situations that are considered. One of the situations is that transit will enjoy less priority during the off-peak time periods, such as Commuter Trains in Montreal, Metrolink, and NJ TRANSIT. Another situation is that the freight is not allowed to operate at all during the peak periods. Examples include MNR in New York and the Coaster in San Diego County, California. The last situation is that commuter systems do not operate at all during the off-peak periods, such as West Coast Express in Vancouver, British Columbia. Caltrain's basic time split with the freight railroad is between 10 am and 3 pm, while at least one thirty-minute window is provided for freight trains and intercity passenger service between midnight and 5 am, and at least one mainline is always available for freight service and intercity passenger service.

The survey enquired whether any incentive plans are used for freight railroad cooperation. Nine of the systems do have such plans and 12 systems do not. In most cases, if transit agencies own the railroad, there is no need for such an incentive plan. An example is the Coaster in San Diego County where the track and right of way of the system is also owned by transit agency itself. The user freight, Burlington Northern Santa Fe (BNSF), pays a fee based on train miles to the commuter rail agency and there is no incentive plan.

Incentive plans are more widely used when the corridor is owned or dispatched by freight railroad or a third party. Some of the incentive plans are real "incentives", others are penalties, while the rest include both "incentives" and penalties. For instance, the agreement between Metrolink in Southern California and freight railroads dictates that "freight railroads (BNSF & Union Pacific RR (UPRR) receive an incentive for commuter train on-time performance on territories they dispatch and maintain".

ACE in California, dispatched by Union Pacific, uses a penalty: "the delays which lower ACE on-time performance below 92 percent that are attributable to Union Pacific dispatching allow for a reduction in the dispatch fee". The commuter trains in Montreal, dispatched by Canadian National Railway, adopted a different incentive plan: \$6,000 per month per line incentive if more than 97 percent of trains are on time, within 5 minutes, and \$6,000 per month per line penalty if less than 95 percent of trains are on time. Capitol Corridor Intercity Train Service in northern California mentioned that "if trains are run to the agreed on-time performance standard, the UPRR is eligible to receive an on-time performance incentive payment." The Sounder Commuter Rail has an incentive of \$4.29 per train mile at 95 percent on time performance and \$5.85 for 100 percent on time performance and zero dollars for 85 percent or less. Others who use incentive plans include VRE, METRA in northeast Illinois, South Shore Commuter Railroad in northwest Indiana, and the Shore Line East in Connecticut.

The settlement of insurance and liability issues between the commuter rail systems and the freight railroads can be categorized into the following two major groups: 1) operators or transit systems maintain the insurance and hold freight harmless, and 2) insurance liability is settled by trackage agreement or service contract.

Among the 16 valid answers, 12 instances involve operators or transit agencies bearing the risks or insurances. For example, SEPTA, dispatched by a third party, mentioned that the operators bear all the risks. MARC in Maryland mentioned that "MARC holds CSX harmless; whereas Amtrak is only responsible for gross negligence". Some systems spell out detailed insurance requirements between the two parties. For instance, GO Transit in Toronto covers \$150 million and is liable everywhere except in the hub terminal, which they own. The insurance amount for Tri-Rail in Florida is \$125 million, the insurance cap for the Sounder Commuter Rail is \$200 million, and the amount for METRA is between \$250 and \$500 million. West Coast Express in Vancouver said: "this is a complex question, but in general, on the liability side, the railway requires us to carry a \$100 million liability policy". Caltrain in California mentioned that "each party covers liability for property damage by and personal injury of its invitees, up to \$25 million/year; after \$25 million/year, UP will pay the share of Caltrain liabilities. Caltrain and UP must each carry insurance for at least \$100,000 per incident."

As we can see, the range of terms and liability caps vary greatly. According to the GAO (2004), in 1997 Congress limited the aggregate damages that may be awarded to all passenger claims from a particular rail accident to \$200 million and permitted providers of rail transportation to enter into indemnification agreements. However, there was some confusion within the commuter and freight rail community as to whether the liability cap be applied to commuter rail agencies, which could result in problems during negotiations. After reviewing the legislation, the GAO concluded that the liability cap applies to commuter rail operations, which is certainly a good base for commuter service providers to cap their liability insurance at \$200 million per accident. On the other hand, the \$200 million cap may not apply to third party damages aside from parties directly involved in the rail interaction accidents. Moreover, since such a clause has not been tested in the courts, we would like to suggest that commuter service providers consult their general counsel or other legal and regulatory channels before refusing any liability insurance above \$200 million.

As for the accidents that occur as a result of joint operation, it seems that all the "yes" answers were made by commuter rail services. The questionnaire did not specify a time span, so the answers collected in the survey include all the accidents that ever happened that are related to joint operations. Among the 21 commuter systems, nine of them have had accidents, six being collisions and three being derailments. An accident happened on Metrolink that involved a passenger fatality, an accident on the Long Island Railroad involved employee injury, and one on SEPTA involved an employee fatality. All the accidents

involved property damages. The damage amount ranges from \$6,600 to \$25 million.

Only two systems answered the question about how to deal with trespasser accident. SEPTA said: the “operator will be responsible” and the Long Island Railroad said all the operating parties on the shared asset would share the responsibility.

As most of commuter rail services are concentrated in large metropolitan areas where, freight services tend to have higher demand for capacity too, it is critical to assess the legal and financial arrangements of shared use of commuter tracks, especially in the bottleneck areas. Among the 21 commuter rails, 11 non-owning users get access to the corridor through trackage rights, only two by property lease and one by easement. Other major ways to get access to the corridors include operating contracts, shared use agreements, and franchises. In the case of Metro Link, which is owned by a consortium of transit agencies, the access to the corridor is obtained through operating rights purchase, sale agreements, and shared use agreements. Transit member agencies paid for operating rights over the right of way that freight owns. Member agencies also purchased the right of way from freight and the operating right along that right of way were included in the sale price. Capitol Corridor Intercity Train Service got the access to the corridor through ACE's access. Property lease for stations and a maintenance facility were part of the State of California's procurement of right of perpetual access for a specified number of daily trains in exchange for capital investment and expansion of facilities.

Five commuter systems responded regarding the cost of access. Among the five corridors, three have mixed ownership by freight and transit or state departments of transportation, two are owned exclusively by freight railroads. As shown in Figure 23, the access cost ranges from 15 million to 212 million due to different access arrangements, sizes of operations and covering period.

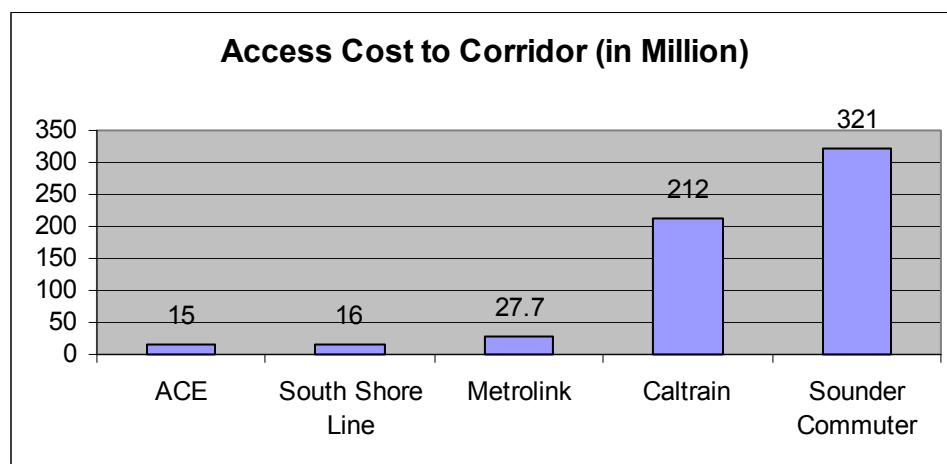


Figure 23 Access Cost to Corridor (in Million)

The Alaska railroad, which was also surveyed, does not really fit into the category of “Commuter Rail”. It is a full service railroad in the traditional sense of the term. It operates freight and passenger service and will soon operate a commuter service into Anchorage. The State of Alaska owns the tracks and right of way and all dispatching is under the control of the railroad. A fence has been installed as a measure to separate passenger and freight operation in the Anchorage area.

4.2.2 Light Rail Transit and Freight Rail Interaction

The difference between propulsion power, capacity, and operating characteristics determined that LRT have different interaction issues from those of commuter rail, even though they may share certain legal, administrative, and organizational issues. The research team contacted 23 LRT and 15 responded.

Among the five valid answers, all of them use single level cars. High-level platforms are more prevalent in LRTs. However, the type of high-level platform is different from that of commuter rail services. A more appropriate description of platform access may be better defined by the “low floor” versus “high floor” configuration. In the case of low-floor access, the LRT vehicle floor is flush with the station platform so wheel chairs or strollers can roll on to the vehicle directly. When high-floor LRT vehicles are used in operation with low platforms, the LRT vehicle floor is one or two steps higher than the station platform, so wheel chairs have to be aided by a lift to roll onto the vehicle. Often, mini high-level platforms are situated at the end of the platform so that they can be operated by the train driver when required. Some transit operators have elevators mounted on the car itself.

A precise demonstration of both may be observed in Tri-MAX in Portland, Oregon. Due to the different ages and manufactures of the fleet, Tri-MAX currently operates both high and low-floor vehicles. The agency's practice of coupling one high-floor vehicle to a low-floor one ensures adequate access for wheel chair users at all times and in all locations.

As shown in Figure 24, more than half of LRTs use low floor access. The reasons for this are threefold:

1. Only a portion of LRTs share tracks with freight
2. When sharing tracks, freight movement tends to be very light and less predominant as discussed in the previous section, and
3. High platforms provide speedy access for passengers and so reduce journey times.

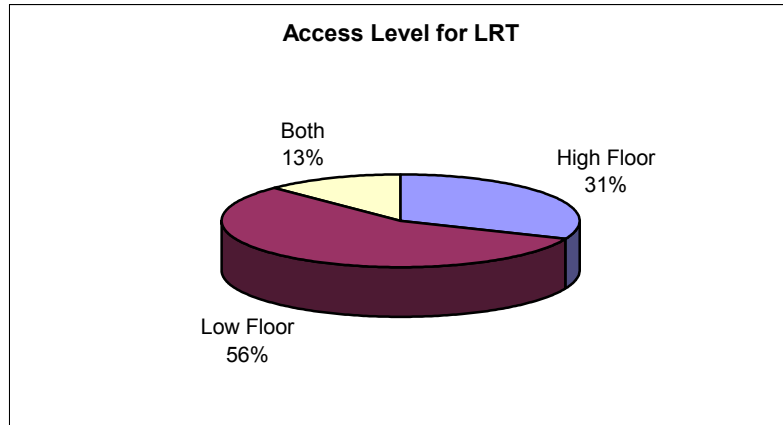


Figure 24. Access level for LRTs

About a quarter of the surveyed LRTs have no interaction with freight railroad. These include the Hiawatha LRT in Minneapolis, the Port Authority of Allegheny County in Pittsburgh (PAT), the San Francisco Municipal Railway (MUNI), and Santa Clara Valley Transportation Authority (VTA) in California. As depicted in Figure 25, the majority of the surveyed LRTs, 61 percent, interact exclusively with local freight. One LRT, SEPTA, interacts exclusively with mainline freight. It is interesting to note that, in the case of Edmonton LRT, the interaction with main line has diminished due to the change of freight operations since it was built in 1978. At that time, the LRT route was located between main-line tracks. Now the alignment is a rarely used freight spur.

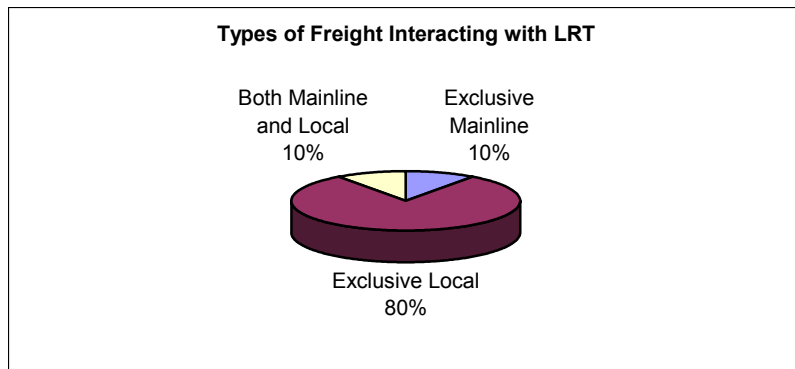


Figure 25. Types of freight interacting with LRT

The degree of shared operation in LRT varies as evidenced in Figure 26. None of the LRTs operate simultaneously with freight railroad, due to FRA regulation. The majority of the LRTs share track but temporally separate from freight operations. Examples include LACMTA LRT, TRAX in Salt Lake City, the Baltimore LRT, San Diego Trolley, and Newark Subway in New Jersey. LRTs usually operate during the day, while freight operations operate from midnight until early in the morning. For example, in the case of TRAX in Salt Lake City, “freight has the alignment between the hours of midnight and 5:00 am Sunday through Thursday”.

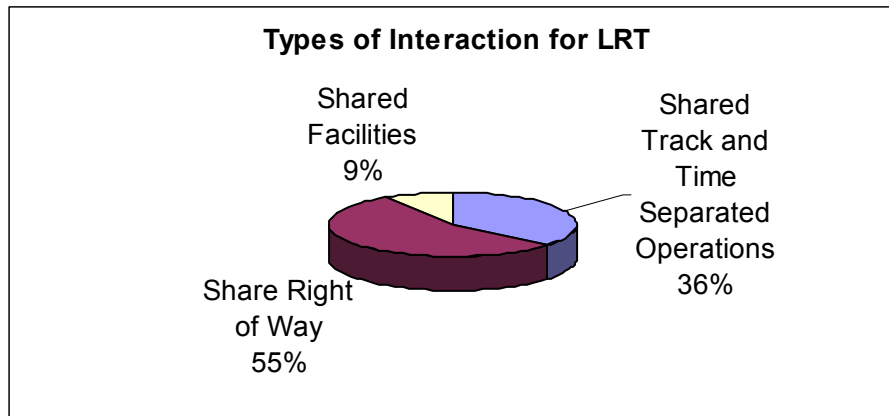


Figure 26. Light rail and freight rail interaction

Three LRTs share right of way with freight. These include the New Orleans Streetcar, SEPTA LRT, and Hudson Bergen LRT. Only the Metro Blue, Green and Red LRT Lines in LACMTA and Edmonton Transit have some shared facilities with freight, but no joint usage.

In contrast to the mixed ownership of tracks used for commuter rail operations, the ownership of LRT tracks is fairly clear. Among the five valid answers, two corridors are owned by freight railroad and three are owned by the transit agency. In general, the LRT either uses tracks abandoned by a freight railroad or has acquired the abandoned railroad tracks to preserve transit corridors.

As documented in Figure 27, most of the LRTs are dispatched by transit agencies themselves, such as Newark Subway, South Jersey LRT, Edmonton LRT, San Diego Trolley, SEPTA LRT, Baltimore LRT and Metro Blue, Green and Red lines in Los Angeles. According to the survey responses, two systems are dispatched by third parties. These include TRAX in Salt Lake City and Hudson Bergen LRT in New Jersey.

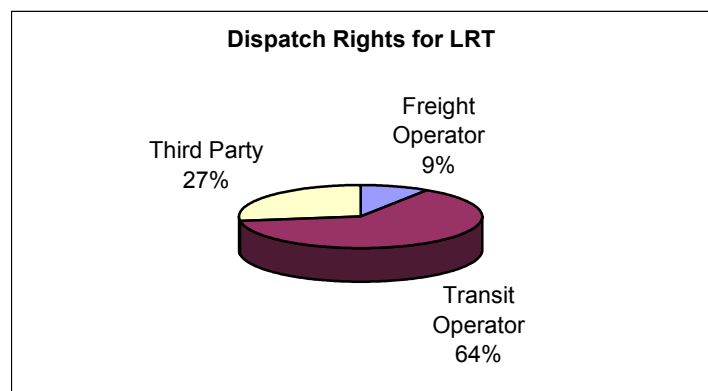


Figure 27. Dispatch right for LRT

The dispatching protocol and operating incentives, predetermined by “shared track time-separated operation”, are less predominant in LRT operations. In contrast to the commuter rails that have different dispatching protocols during

peak and off-peak periods, the majority of LRTs implement the same dispatching priority timetable during their operating period.

None of the surveyed LRTs have any incentive plans for better coordination between freight and transit operations. The obvious reason for this is that LRT operators are less affected by freight operation, except during the time window that is allocated. TRAX said in the survey that incentive plans are unnecessary since it works well with the freight railroad.

One of the questions included in the survey was what measures are provided to separate transit and freight operations. The results indicate that most LRT operations have no physical barriers to separate LRT and freight operation when they are in the close proximity. Of the 10 valid answers, seven have no separation measures, two use fences, and one uses both fence and intrusion detection.

The preliminary survey results revealed that few changes were made to the transportation system to accommodate passenger operation of LRTs. For most systems, changes entailed just separating the service schedules. Edmonton LRT, where the LRT tracks were originally in the center with mainline tracks on both sides, provided details on how it accommodated LRT operation:

- CN tracks were temporarily relocated during the construction of a shared LRT/CN bridge. Also CN grade crossing gates were connected to an LRT signals system to allow shared use of the gates.
- Crossing 'gate call-on' provided on the CN line was extended and tied into the LRT crossing 'call on' signal to allow gates called on by LRT to stay down if a CN train was approaching.
- CN's DC signal system was modified to ensure no interference by the LRT DC traction power return. A diamond crossing was installed on the CN track to enable the LRT line to cross into its yard located across the CN westbound track.

All of the above was paid for by the City of Edmonton. Since its construction the main line freight service has moved from the joint right of way.

The settlement of insurance and liability issues between the LRTs and the freight railroads is quite similar to that of commuter rails. The size of LRT services and strict separation of services defined the insurance premium, liability, and deduction, which are generally smaller than for commuter rail services. For example, the insurance and liability issues for San Diego Trolley were handled through agreement with Metropolitan Transportation Development Board (MTDB), which owns both the freight railroad and San Diego Trolley, Inc. In the case of the Baltimore LRT, the state Maryland Transit Administration (MTA) holds CSX harmless. As for the insurance amount, Edmonton LRT is an example: \$5 million liability insurance covering persons using LRT and CN

passenger service, \$1 million liability insurance to cover third parties arising from utilization by the City of the premises, and all premiums are paid by City of Edmonton. The City waives its rights against CN for damages arising from occupation or use of the leased premises, except if caused by the negligence of CN.

No accidents were recorded in the survey for LRTs. This result may reflect the separated operation safety precaution. Moreover, LRTs have been in operation only for a relative short period. The oldest LRT operation in the United States is the San Diego Trolley, which is only 23 years old. Compared with the century-old commuter rail operations, it is not surprising the number of accidents is low or zero.

Similar to commuter rail operations, LRTs generally obtain their access right via trackage right, property lease, and usage agreement. According to the survey, Baltimore LRT, TRAX in Salt Lake City and South Jersey LRT gains corridor access through trackage right; Edmonton LRT and Newark Subway property lease; SEPTA LRT a highway crossing agreement between the state and the railroad, and San Diego Trolley via a contract with MTDB.

4.2.3 Heavy Rail Services and Freight Rail Interaction

Heavy rail has the least interaction with freight, compared with the commuter rail and LRT. Among the 15 systems we have contacted, 11 responded. Seven said they had no interaction with any freight operation. Washington Metropolitan Area Transit (WMATA), MBTA in Boston, and San Francisco Bay Area Rapid Transit District (BART) share facilities with freight. Delaware River Port Authority (DRPA) high speed line shares right of way with both mainline and local freight. All heavy rail systems use high platform exclusively. The rolling stock for heavy rail systems is mainly single level cars.

Most heavy rail transits surveyed did not answer the question about the ownership and shared assets. Port Authority Transit Corporation (PATCO), owner of the DRPA High Speed Line, which shares right of way with freight, gave the details of the shared alignment: There are two places where DRPA shares an alignment with a railroad, as depicted in Figure 28. In the first place, DRPA shared assets with Conrail. Both DRPA and Conrail own the portion of right of way beneath the PATCO tracks. In the second place, DPRA shares the asset with NJ TRANSIT's Atlantic City Line. DRPA owns the right of way under both sets of tracks. In this case, the freight operator, namely Conrail, and transit operators, namely PATCO and NJ TRANSIT, dispatch independently.

In terms of dispatching, BART in San Francisco and WMATA in the Washington D.C. area are dispatched by a third party. Boston MBTA heavy rail is dispatched by the transit operator. Similar to LRT operation, no incentive plans are adopted by heavy rail agencies for joint operations.

WMATA installed intrusion detection devices, which were added after a derailment by the freight railroad. BART had the experience of a derailment related to joint operation. However, the magnitude of the accident was not given in the survey.

Little information was collected regarding the insurance and liability issues between the heavy rail and freight railroads. Only DRPA mentioned that DRPA-NJT Agreements has a "hold harmless" clause.

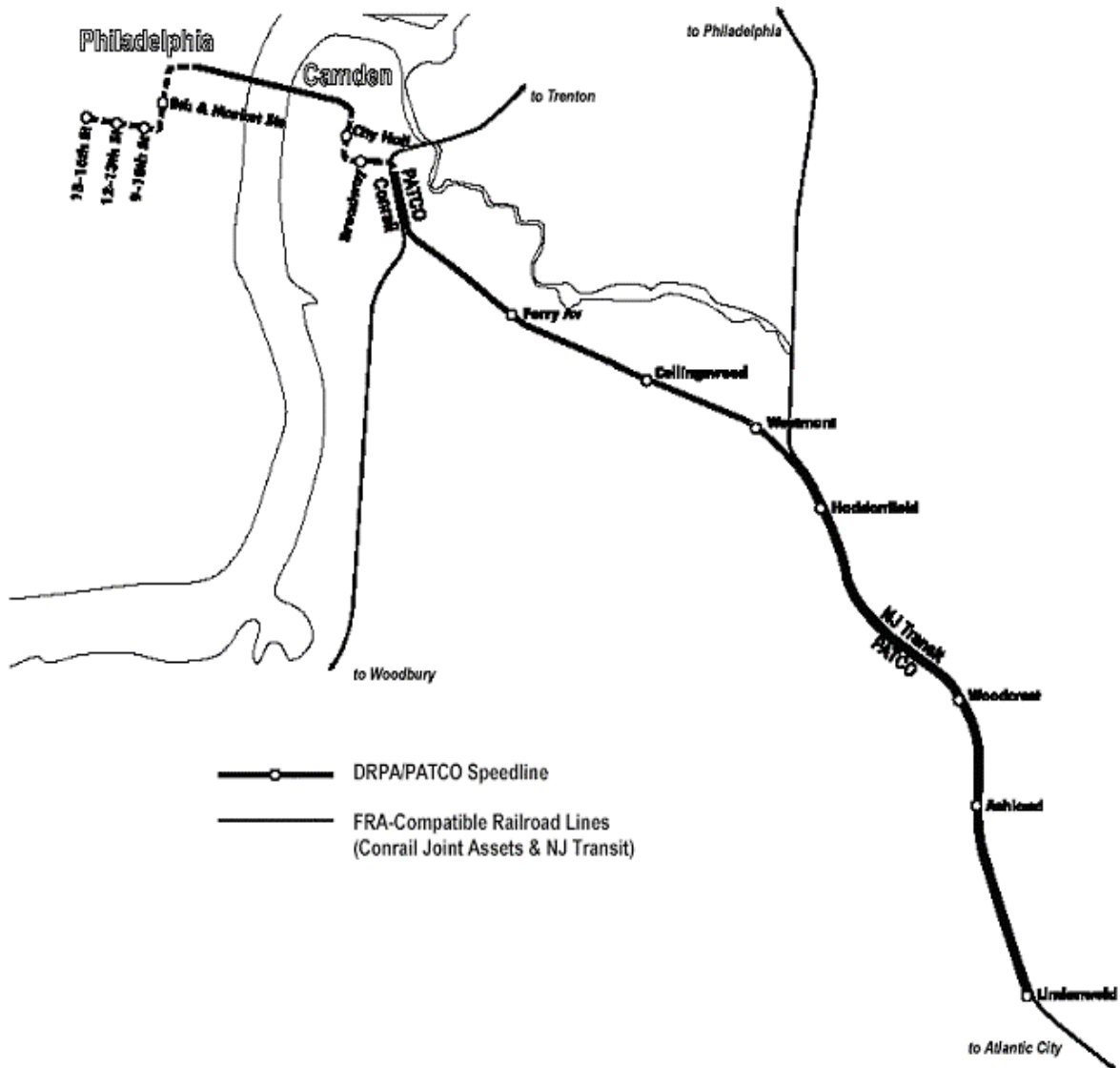


Figure 28. Heavy rail transit in Delaware River Port Authority
Source: PATCO, 2003.

5. CASE STUDIES

As mentioned in the scope of the project, besides the general survey of all the guideway transits in North America, the research team selected several regions to explore the transit and rail freight interaction at a more detailed level. Based on the general survey results and the transit agencies' willingness to cooperate, we selected the following areas:

- Boston Area, Massachusetts
- Greater Washington D.C. Region, including Baltimore and northern Virginia
- Los Angeles County Metro, and
- TRAX in Salt Lake City, Utah.

Deciding on which system to focus was difficult, given the limited time and staff resources and diversified issues encountered in the areas of transit and rail freight interaction. As discovered in this research and a few other concurrent studies in the same subject area, a formula for successful interaction of transit and freight does not exist. Each system has its unique physical networks, operating schedules, local travel demand, as well as individual interacting partners. The purpose of presenting these particular case studies is not to simplify issues related to the shared use of rail infrastructure, but to showcase the diversity of shared arrangements in use, the wide variety of issues and concerns encountered, and the innovative solutions revealed in the survey.

The four case studies described in Appendix D through G represent just a few among many interacting relationships that exist between transit and freight railroads. Further in-depth investigation may be equally enlightening.

Each individual case or arrangement demonstrated useful strategies and tactics in interacting with freight railroads. The study convinced us that each case is unique and needs its own approach to identify an optimum working arrangement. The degree of cooperation maybe influenced by the history of track owners' experiences with passenger services, the classification of the railroad or the arrangement of dispatching. The most pointed comment we heard was that of a Class I railroad representative that their desire is to ensure passenger services "invisible" from the freight operation.

The case studies highlighted the ubiquitous existence of interaction issues from MBTA, the oldest transit systems in the country, to TRAX, the newest LRT. The transit and rail freight interaction issues have been considered not only by a single entity in a large metro area, such as LACMTA, but also by various diversified agencies, operators, and private companies, such as that in Greater Washington D.C. Region. There is no exact formula for success since each transit system has its unique historical development process, its diversified patronage profile, and individualized interacting partner. However, there are

certain patterns or general approaches to be followed as we have encountered throughout the survey.

The scope of this project has focused on the general survey of peer transit agencies sharing access with freight railroad. This particular task has zoomed into a few transit agencies in the country to highlight the individual arrangements and unique issues they have encountered when interacting with rail freight. This research has presented only four transit systems due to the limitations of the budget and staff resources, however, it is believed that further case studies, in a manner initiated by this study, will provide enormous benefit for transit agencies and freight railroads.

6. CRITICAL ISSUES RELATED TO SHARED OPERATIONS

The main objective of this research is to reveal the key factors that make transit and rail freight interaction successful. In addition to the general survey, the research team conducted in-depth interviews of key persons in order to acquire a complete picture of the unique processes of acquisitions or negotiations. The ultimate goal was to unmask the relationships between the freight and transit operators. This goal was accomplished by examining the historical development of each operation, the operational arrangement, the contract between owner and operator, and background to the agreement, i.e. legislation or negotiation. Through detailed review and analysis of peer transit agencies' practices, the research team gleaned useful information and uncovered some key issues and concerns of interaction between transit and rail freight operation.

6.1 Physical Constraint

The dilemma faced by both freight railroads and transit operators is that rail segments, where passenger service providers require additional capacity, are often bottleneck areas of freight operations. To compete with an aggressive trucking industry, freight railroads have to meet or exceed the speed and reliability of the truck lines to retain revenue. This fact can make it even more difficult to share tracks between freight and passengers.

The FRA and quite a few transit operators, on both the east and west coasts, realize that capacity constraint is the critical issue of joint operation. These transit operators mentioned concerns such as future capacity needs and sufficient existing capacities to satisfy all users. One response suggested that on high volume corridors freight and passenger need to be separated.

Also, a commuter agency in the Northeast Corridor suggested that the size and braking distance required by freight trains make freight railroad inappropriate to operate during passenger service hours. The track capacity constraint is highlighted in the shared track operating at higher speed. In 1985, Don Eisele outlined the fundamental conflicts between trains with different speed profiles and stopping patterns suggested that additional tracks should be constructed to allow passenger trains operation. This idea is confirmed by today's practices, as several agencies have added additional tracks and flyovers in bottleneck areas. One commuter rail suggested that it would double, or even triple, tracks in areas that are heavily utilized by both passenger and freight rail operations.

The platform height is another constraint issue presented in the interaction of transit and rail freight. As explained earlier, most commuter services employed low platforms when they are part of or share operation with rail freight. With the decreasing amount of freight presence or oversized freight load, increasing demand on service quality or boarding speed at stations, specific requirements of

the ADA, more and more high level platforms become part of the commuter service scene.

When high-level platforms are not feasible, some commuter service providers used various alternative compliances, which include mini-high platforms, gauntlet tracks, or retractable platforms. Transit agencies have to present credible evidence that supports the construction of alternative compliances deviating from the “level boarding at passenger boarding stations” required by FTA (Goldstein, 2004). According to Goldstein, “the evidence must support a finding that good-faith efforts were made by the grantee to obtain a waiver from the rail clearance requirement; that alternatives were evaluated to provide level boarding without encroaching on clearances, that such alternatives were structurally and operationally feasible, that accessible service will be provided, regardless of whether a level boarding or mini-platform is constructed, and that good-faith efforts were made to obtain accessible used rail vehicles and that despite these effort, the grantee was unable to do so.”

The recent close scrutiny of Sounder Commuter Rail in Seattle, Washington, and the proposed commuter service in Nashville, Tennessee, may shed some light on the intricacies of this issue. As presented in the previous section, Sounder Commuter Rail, operated by Sound Transit, has been in operation for three years between Seattle and Tacoma and operates with low platform for non-disabled passengers and with ramped mini-high platforms for those who cannot step up into the train. One of the justifications for mini-high platforms was that the “owner of the railroad, BNSF, will not permit the constructing of full high-level platforms.” As Martin Minkoff, Director of Sounder Commuter Rail, explained: “The decision to utilize mini-high platforms was made in the initial planning stages for Sounder service and was based on our need to accommodate freight operations on the BNSF tracks. Our operating agreement specifies that Sounder platforms not infringe on the dynamic envelope and clearance necessary for freight operations.” These requirements are further clarified in the property leases with BNSF: “Lessee further agrees said platform shall be constructed, maintained, and operated eight inches above top of rail (8” ATR) and no closer than five feet four inches (5’4”) from centerline of lessor’s track.

As demonstrated by the strict waiver requirement and legal bindings of the property lease or operating agreement with freight owners, the transit agencies are clearly placed between “a rock and a hard place”. While the final conclusions on the result of those two agencies are still unfolding, we may also consider the alternatives employed by other agencies, such as Northern Indiana Commuter Transportation District (NICTD), which uses gauntlet tracks, and New Jersey Transit, which employs mini high platform and retractable edges along platforms.

In the case of NICTD, the configuration of the station and distance between platforms are sufficient to allow the construction of gauntlet tracks. As shown in Figure 29, gauntlet tracks allow freight trains to be shifted slightly away from the

main track, and hence from the platform, to maintain the clearance envelop. When touring the NICTD facilities the PI of this project enquired about how frequently the gauntlet tracks are used. The answer was indeterminate!



Figure 29. Gauntlet Track at Union Station, NJ

When retractable edges were employed at a number of stations of New Jersey Transit, it allows high platforms on both sides of the two tracks of stations to be shared with a freight railroad. As pictured in Figure 30, the front two feet of the platform could be retracted along the entire length of the platform when necessary to let a wide freight through. Meanwhile it is barely noticeable from the surface of the platform. The retractable portion is made of many 8-foot sections, which cover the entire length of the platform.

There are certainly other innovations, such as retractable entranceways (Morlok, 2003), besides these current practices. However, a concern raised via this survey is that more information or analyses are needed to justify the mandate for preserving the extra lateral clearance and to specify particular configurations to provide level boarding. Rail accessibility specialists (Pace Publication, 2004) stated that the extra lateral clearance demanded by freight railroad is defined by the possibility that wide freight may have to come through someday. In reality, there are no statistics on the usage of the extra lateral clearance envelope and two anecdotal notes demonstrated very little usage.

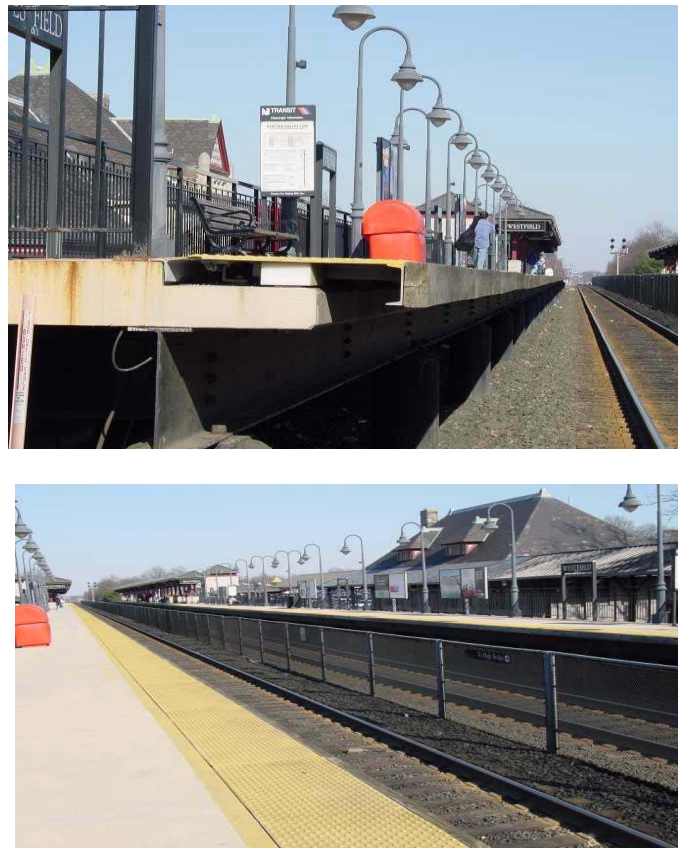


Figure 30. Retractable Edges

In short, it is important to anticipate the national defense need of mobilizing heavy equipment, such as large generator for power plants. It is also critical to preserve the continuity of the national railway network. Meanwhile, operational efficiency is also part of the performance measurement each transit system or private company strives to achieve. One of the important conclusions or confirmations derived from this survey is that we certainly need more detailed data and analysis on both passenger and freight demand, their respective share of rail capacity, and overall allocations of those precious capacity or capital resources in the larger picture of overall passenger and freight movement efficiencies.

Compared to the commuter rail services, LRTs use temporal separation to minimize the conflicts of mixed operations. However, the separation rules have not solved the capacity constraints or the clearance requirement. In fact, the rules may exacerbate the situation for the certain operators since they have less time to serve their customers unless passing capacity is improved. Yet, other entities may waste access or time or use them less efficiently during their separation windows. The separation is largely decided upon as a safety precaution, not for operating efficiencies.

Moreover, additional infrastructure construction is constrained by the availability of funding and “political will”, mentioned by a few transit service providers. One of them said: “Funding at State & Federal levels should be earmarked to allow future projects to move ahead for mutual benefit.”

6.2 Dispatching and Scheduling

While safety is paramount for passenger services, reliability and on time arrival are also vital in retaining customers for commercial success. As a transit agency on the east coast mentioned, the fact that approximately one train in ten will be late is not attractive to commuters, or to the transit operators. Some transit operators are frustrated by not having the dispatching priority. One of the commuter rail said that when the dispatch is conducted by freight railroads, they give priority to their own time-critical trains.

As operating rights and other privileges are granted to freight railroads, the value of the right of way to transit operators is reduced and vice versa. Generally, dispatching authority goes with ownership of right of way. It is important for the transit agency, when negotiating for access right, to focus on not only the physical property, but also the various operating privileges, such as dispatching rights. Even when the freight railroad has the dispatching authority, transit services can still negotiate for dispatching priority, at least for the period of peak hours. That is the exact case with one of the commuter services in California. When asked about who does the dispatching, the commuter rail agent said: “whoever owns the right of way.” He continued, “in general, commuter trains have priority during morning and afternoon peak period.”

An efficient schedule, which can accurately reflect the differences in speed of the various classes of traffic, is another important factor assuring transit’s high level of reliability. Such a schedule needs to be worked out by all parties involved in the joint operation. Several commuter railroads identified “schedule” as the key factor of joint operation. One of the commuter services sees schedule constraints in track development and dealing with the track window available for freight operations as the major impediment of joint operation.

Traditionally, it is the “owner” railroad that takes the lead in preparing the schedule, working with all of the tenant carriers on a mutually agreeable plan. However, the problem is that freight railroads do not often operate trains on a precise or reliable schedule. Random or flexible operation of freight trains often results in cascading delays, which are a nightmare for passenger services. A commuter rail in Canada suggested that it is important for better joint operation to have railways understand that planned and on time freight is more efficient for both freight and transit services.

In reality, it is not possible always to be on time. When freight trains are not able to adhere to their schedule, it is essential for the transit operators to recover from

delays. That is why several commuter rails have identified “experienced dispatcher” as another key factor in joint operation. For instance, one commuter rail in the Northeast Corridor suggested more dispatcher training and familiarization with the relevant issues surrounding the corridor they are dispatching. Another commuter service representative thinks an experienced dispatcher should be familiar with the corridor and all types of operation and should have the ability to “stuff” the late train or the non-critical freight train into a siding, allowing for the faster, more urgent commuter train to go by unimpeded.

6.3 Communications and Mutual Understanding

In the absence of a legislation to provide access, what would be the best way for new starts to gain access from freight railroads? One of the overwhelming responses the research team received from the transit agencies is to recognize of the importance of good and frequent communication.

A few transit providers emphasize the importance of “communication” or “mutual understanding” for improving passenger and freight interaction. “Each discipline must understand the workings of the other operation. This helps performance and communication in both areas.” “Communication must be established and maintained between the operational managers,” said one of the commuter rail agents in Northeast Corridor. Another commuter rail representative said “get transit agencies to understand the nature of freight rail business. Get freight railroads to understand the requirements for public funding of transit projects (lengthy time, many steps, public review and comment, etc).” Other transit agencies mentioned that transit operators should maintain a healthy dialogue with the freight railroads, and should adopt good faith continuously in negotiations.

Ensuring high standards of employee qualifications and performance is important in joint operations. Cross training might be helpful to enhance mutual understanding of both operational environments. Since passenger and freight operations have different operating characteristics, employees from a transit background may not be familiar with freight rail operation and vice versa. In some cases, the emphasis among rail transit planning and operations staff has developed from a transit background rather than rail and, conversely, many freight operators are unfamiliar with transit operations. It is important for professionals from both sides to have mutual understanding, not only the dispatchers.

6.4 Freight Attitudes and Regulation

In this survey, “freight attitude” is one of the frequently mentioned impediments to joint operation, such as “monopoly attitude of [the freight] railway”, “attitude, freight sees commuter as a free way to upgrade their infrastructure”, “owner’s attitude to priority freight”. One transit agency suggested using “regulatory

leverage to offset railway monopoly attitude” and, in total, six transit operators think” that "legal issues" are a major impediment to ideal joint operation.

Historically, both freight railroad and passenger rail service, including employees, maintenance and equipment, were operated by a single entity. However, highway development has encouraged automobile traffic, leaving rail passenger service no longer profitable. Recent deregulation separated management and ownership of freight and passenger services, with profitable freight retained by the private sector and passenger responsibilities by the public sector. This situation has complicated use and control of the resources by increasing competition for track access. Intermodal rail with a single management entity was changed to a host/tenant relationship. So, rather than the former full-service railroad companies competing with one another for business, specialized, market-dominant rail users now compete for track space and capacity, with the host carrier making decisions (Transportation Research Board, 1999).

The freight railroad's attitude is understandable since transit services not only take existing capacity from the owner railroad, but also undercut the market share of the railroads, without generating compensating revenue for them. However, railroads have to face reality. Rail passenger transportation has been recognized as part of the solution to national, regional, and local transportation challenges and environmental concerns. Passage of the Clean Air Act Amendments (CAAA, 1994) and Intermodal Surface Transportation Efficiency Act (ISTEA, 1991) and Transportation Equity Act 21 (TEA 21) has exhibited national commitment to rail passenger transportation. Limited availability of contiguous real estate corridors and the high construction cost of new tracks can be prohibitive to the new starts. Sharing track or right of way with a freight railroad is part of a solution to frustrated rail transit operators. Gillespie (2000) indicated that with hundreds of new starts making an effort to negotiate an honest deal, it would be a mistake for the railroad industry to ignore the consequences of hundreds of angry commuters going to Congress for help on projects that Congress has already blessed. Cutting a deal with transit agencies for infrastructure improvement by asset sharing gives freight railroads more benefit than being forced to share that asset due to strict legislation.

On the other hand, transit operators need to understand the freight railroads' working environment. The freight railroad industry is subject to several industry-specific laws, The Railroad Retirement Act, The Railroad Unemployment Insurance Act, The Railway Labor Act and The Federal Employers Liability Act, which mean regulatory burdens and higher operating expenses. Recent mergers have, for a short term, presented many of the Class I railroads with operating problems. Unlike rail transit operators, whose primary mission is to improve and to provide cost effective transit service for the public, freight railroad owners are looking for return on private investment through competitive freight service.

A freight railroad executive highlighted the fact that passenger services represented 25 percent of his company's train miles, 17 percent of its train starts, while only half a percent of their revenue. The fact that rail transit is "unprofitable" simply cannot satisfy freight railroad's obligation to their shareholders. Meanwhile, freight industry is blossoming too. The passage of the Transportation Equity Act for the 21st Century, coupled with increased demand of supply chain management, have increased attention on the nation's efficient and reliable freight movement. Where passenger service providers demand additional capacity, particularly in freight operation bottleneck areas, it is hard for rail transit operators to get track access without providing some incentives.

Most transit agencies realize the importance of incentives, but some are frustrated with funding issues. A commuter service in Canada expressed its concern that a railroad may take advantage of the situation by using the "commuter as a free way to upgrade infrastructure." Other transit agencies expressed their willingness to fairly share the cost of infrastructure upgrade.

Will legislation help offset freight railroad's attitude? The freight railroads would strongly oppose such legislation, as demonstrated in the AAR policy statement (AAR, 2004). On the other hand, even if legislation helped transit operators deal with the railroad trackage access issue, will the legislation continue to foster a healthy, long-term relationship between both parties? Will a legislated agreement be better than the power of freedom to negotiate? Or what kind of strategies should regulators adopt to facilitate continued acquisition and use of railroad right of way by rail transit? These questions remain open and need further investigation.

6.5 Insurance and Liability – Shared Responsibilities

In North America, liability is the single biggest institutional obstacle to joint operations between freight and passenger trains operated by separate entities (TRB, 1999). In spite of many concerns arising from joint operations, one of the primary fears is a catastrophic event resulting in major loss of life and property damage. Thus, an important condition for freight railroads to yield their track space to a transit agency is for them to be held harmless, regardless of fault. For example, in order for VRE to share the mainline tracks within the same right of way of Conrail, Congress was required to indemnify Conrail, even though the passenger service is fully FRA-compliant.

The level of risk can influence the level of liability. As risk increases, the necessity for liability increases. Where passengers are involved, risk increases dramatically and liability can become excessively heavy. Freight railroads generally strive to minimize the risk to their assets while looking for return on investment. Joint operations are only attractive when the risk levels are balanced or offset by investment returns or liability insurances.

Another major issue mentioned in this survey by the existing transit service systems is how to share the maintenance cost between transit service and freight railroad. One commuter rail identified cost allocation of maintenance of way (MOW) expense as the critical issue of joint operation and suggested that government should regulate the calculation of shared cost and use. Another commuter rail operator in Canada also mentioned that transparency in sharing cost for the joint use of the track is the key factor to the success of joint operation.

Existing track construction and maintenance standards for passenger services are costly and time-consuming. Passenger operations require a higher level of maintenance and more frequent inspections. Heavier freight loadings and traffic tend to degrade track structure more quickly and accelerate frequency of maintenance. Track maintenance impact both transit and freight rail. A poorly maintained freight corridor can affect suspension of rolling stock, accelerate wear and tear on passenger equipment, and degrade passenger comfort.

Current payment methods are traditionally based on the share of car-miles used by each entity. There are potential equity problems when different size and characteristics of rail cars shared the same right of way. This situation is further complicated by “double stack” or high/wide loads. Some research addresses the intricate issues of allocating track maintenance costs on shared rail facilities. Lopez-Pita (2001) tried to weigh the proportion of wear and tear more fairly for passenger operation or the speed differentiation more fairly for freight operation. Resor and Patel suggested that a cost allocation model might be used to derive the fair share of maintenance costs of a shared asset (2002).

7. SUMMARY

Beside this final report, this study produced a series of Technical Memoranda. Those documents may serve as a roadmap in surveying transit agencies around North America. This research also generated and recorded comprehensive profiles for a few selected transit properties that share transit rail operations with the freight railroads.

In addition to the technical memoranda, final report, and technical catalog, the survey results and research findings of this project were presented in a number of national conferences. The project team will continue its effort in publishing its findings and soliciting interest by discussing the interaction of transit and rail freight. It is our sincere hope that it will be of great benefit to all parties if the interaction issues are moving up along the priority list of leading officials, scholars and practitioners. Only then we will be able to reach consensus and solutions to improve coordination and, hence, the overall efficiency of transportation systems.

7.1 Transit and Rail Interaction Catalog

As an effort to identify best practices and current impediments to joint operations between passenger and freight rail interaction, the research team, composed of NJDOT, NJ TRANSIT, and NJIT, has surveyed many transit agencies in North America. The result is partly summarized in the best practice catalogs presented in Table 3, 4, and 5.

The overall responses from the transit service providers were positive in terms of interaction with freight railroads. Transit service providers frequently mentioned several critical issues, such as dispatching and scheduling, freight management and employee attitude to service integration, capacity constraints, communications, insurance and liability, and funding problems. Sufficient communication with freight railroads was generally recognized as the key factor to a successful joint operation.

7.2 Implementation and Training Plan

The objective of this research is intended to provide transit agencies with better knowledge of joint operation between freight railroads and transit agencies. In obtaining usage right of freight right of way for passenger services and vice versa, we believe that successful negotiations depend on the ability for each party to understand each other's issues, concerns, and requirements. To ensure such understanding, we would suggest a series of forums in which rail service providers can discuss specific issues concerning freight and passenger service use on common tracks. From these discussions, we propose generating a checklist of features that could be examined prior to negotiating shared track usage.

Table 3. A best practice catalog for commuter rail transit and rail freight interaction

Issues	Options	Observations	Applications
Platform Access Level	High Level Platform	Provide level boarding required by ADA, but may impede for wider freight load	MNR in New York, Caltrain in California
	Low Level Platform	Cannot provide level boarding, but in compliance with freight clearance	Most conventional commuter rail services
	Both High and Low Level Platform	Provide level boarding in selected key locations where wider freight load may be alternately accommodate	MBTA in Boston, Commuter Trains Network in Montreal, Trinity Railway Express in Dallas, SEPTA in Pennsylvania, MARC in Baltimore, Shore Line East in Connecticut, South Shore Line in Indiana, VRE, METRA in Illinois
	Mini High Platform	An accessibility solution. A wheelchair can roll over a bridge plate onto the rail car. FTA's judgment is unfolding	Sounder Commuter Rail in Washington
	Retractable Platform	The front two feet of the platform could be retracted along the entire length of the platform to let a wider freight through	NJ TRANSIT
Types of Interaction	Shared Track and Mixed Operation	Transit trains and freight trains are separated by headway intervals measured in minute in an operating schedule.	All the surveyed commuter rail systems except ACE in California
	Shared Right of way	Defines the arrangement that the track center spacing between the freight track and adjacent transit track is less than 25 feet, adopted by various transit agencies	ACE in California
	Yard Operations		MBTA in Boston, ACE in California, Commuter Trains Network in Montreal, TRE in Dallas, SEPTA in Pennsylvania, Tri-Rail in Florida, LIRR in New York, Caltrain in California, VRE, METRA in Illinois, NJ TRANSIT

Issues	Options	Observations	Applications
Freight Types	Through and Local Freight	Most commuter rail interact with both through freight and local freight	MBTA in Boston, ACE in California, Commuter Trains Network in Montreal, MNR in New York, GO Transit in Toronto, TRE in Dallas, SEPTA in Pennsylvania, Tri-Rail in Florida, Coaster in California, Shore Line East in Connecticut, Metrolink in California, Caltrain in California, VRE, West Coast Express in Vancouver, NJ TRANSIT
	Through Freight Only	Mainline or class I Railroad.	Sounder Commuter Rail in Washington, MARC in Baltimore
	Local Freight Only	Local, regional, or shortline railroads.	Long Island Railroad in New York, South Shore Line in Indiana,
Ownership of Shared Assets	Transit Agencies	Right of way owned by transit agency, state DOT, regional consortium	TRE in Dallas, Tri-Rail in Florida, Coaster and Metrolink in California
	Freight Railroads	Right of way owned by freight railroad	ACE in California, Commuter Trains Network in Montreal, MNR in New York, LIRR in New York, Sounder Commuter Rail in Washington, West Coast Express in Vancouver
	Mixed Ownership	Both transit system and freight railroad own partial segments of the corridor	MBTA in Boston, GO Transit in Toronto, SEPTA in Pennsylvania, Caltrain in California, South Shore Line in Indiana, VRE, NJ TRANSIT
Dispatching	Freight Railroads	Freight railroads dispatch all traffic	ACE in California, Commuter Trains Network in Montreal, GO Transit in Toronto, Tri-Rail in Florida, MARC in Maryland, Sounder Commuter Rail in Washington, VRE, West Coast Express in Vancouver
	Transit Operators	Transit operators dispatch all traffic	MNR in New York, Caltrain in California, South Shore Line in Indiana, NJ TRANSIT
	Freight and Transit Conduct Independently	Freight/Transit dispatch on the right of way owned by itself	MBTA in Boston
	Third Party	A third party other than transit or freight railroad, such as ACE	Trinity Railway Express in Dallas, SEPTA in Pennsylvania, COASTER in California, Shore Line East in Connecticut

Issues	Options	Observations	Applications
Dispatching Protocol	Transit Priority	Passenger services are generally granted priority during peak hours	MBTA in Boston, Commuter trains network in Montreal, Metro North Railroad in New York, GO Transit in Toronto, SEPTA in Pennsylvania, Tri-Rail in Florida, Coaster and Metrolink in California, South Shore Line in Indiana, Sounder Commuter Rail in Washington, West Coast Express in Vancouver
	Special Arrangement		ACE in California
Performance Incentives	Yes	Monetary reward or penalty for on time or delayed performances	ACE in California, Commuter trains network in Montreal, Shore Line East in Connecticut, Metrolink in California, Sounder Commuter Rail in Washington, VRE, METRA in Illinois
	No		MBTA in Boston, Metro North Railroad in New York, GO Transit in Toronto, Trinity Railway Express in Dallas, SEPTA in Pennsylvania, Tri-Rail in Florida, MARC in Maryland, Coaster in California, Long Island Railroad in New York, West Coast Express in Vancouver, NJ TRANSIT
Insurance Liability	Transit Bears Full Liability	Transit agencies bear all insurance cost or hold freight harmless	Commuter trains network in Montreal, MBTA in Boston, ACE in California, GO Transit in Toronto, SEPTA in Pennsylvania, MARC in Maryland, METRA in Illinois
	Transit/Freight Shares the Liability	Each purchases its own insurance and hold liable	Coaster, Metrolink and Caltrain in California

Table 4. A best practice catalog for LRT and rail freight interaction

Issues	Options	Observations	Applications
Car Access Level	Low Floor Rolling Stock	The floor of the vehicle flush with the boarding platform	NJ TRANSIT
	High Floor Rolling Stock	The floor of the vehicle is higher than the boarding platform	Green Line in Chicago
Type of Interaction	Shared Track and Time-separated Operations	Both transit and freight trains utilize the same track but are separated by time windows	TRAX in Utah, MTA LRT in Baltimore, San Diego Trolley in California, Newark Subway in New Jersey
	Shared Right of Way	Defines the arrangement that the track center spacing between the freight track and adjacent transit track is less than 25 feet	New Orleans Street Car in Louisiana, Light Rail System in Edmonton, SEPTA in Pennsylvania
	No Interaction		PAT in Pennsylvania, LRT system in Buffalo, NY, LRT in San Jose
Freight Types	Local Freight		MTA LRT in Baltimore, TRAX in Utah, San Diego Trolley in California, New Orleans Street Car, LRT in Edmonton
	Yard Operations		HBLRT and River Line in New Jersey
	No Active Freight		Hiawatha LRT in Minneapolis, PAT in Pennsylvania
Ownership of Shared Assets	Transit Agencies	Right of way owned by transit agency, state DOT, regional consortium	MTA LRT in Maryland, San Diego Trolley in California, SEPTA in Pennsylvania
	Freight Railroads	Right of way owned by freight railroad	TRAX in Utah, LRT System in Edmonton
Clearance Between Passenger and Freight Rail Tracks	<60 feet		TRAX in Utah
	60-100 feet		MTA LRT in Maryland, SEPTA in Pennsylvania
	>100 feet		LRT in Edmonton

Table 5. A Best Practice Catalog for Heavy Rail Transit and Rail Freight Interaction

Issues	Options	Observations	Applications
Type of Interaction	Shared Right of Way	Defines the arrangement that the track center spacing between the freight track and adjacent transit track is less than 25 feet	DRPA High Speed Line in Philadelphia
	Shared Facility	Shared yards or stations	WMATA in Washington DC, MBTA in Boston, BART in San Francisco
	No Interaction		MTA subway in New York, Staten Island Railway in New York, Miami-Dade Transit Agency, LRT in Toronto, BC Transit in Vancouver
Dispatch Rights	Freight/Transit Conduct Independently	Freight/Transit dispatch on the right of way owned by itself	DRPA High Speed Line in Philadelphia
	Transit Conduct	Easier for Transit to control the dispatch	MBTA in Boston
	Third Party		WMATA in Washington DC, BART in San Francisco
Separation Measures	Fence	Metal, wood or chain fences between transit and freight tracks	WMATA in Washington DC, MBTA in Boston, DRPA High Speed Line in Philadelphia, BART in San Francisco
	Intrusion Detection		WMATA in Washington DC

This study may be a helpful tool for identifying the topics and stimulating the forum discussions. As a researcher of the academic community, the PI, or person with a similar capacity may serve as a facilitator or organizer for these forums. Familiar with all the issues, concerns, and best practices around North America, the facilitator should be able to help focus the dialogue to a win-win situation for both transit service providers and freight railroads.

7.3 Further Studies

It has become evident through this study that many problems affecting the effective and efficient integration of freight are solved locally. However, this study has identified areas that are common to all systems, and the implementation of the ideas set forth may make possible further local improvements. Further research and discussion should address issues such as the legislative framework, equipment integration, and maintenance cost sharing. A review of usage agreements between transit agencies and freight railroad will give more detailed information on the actual deals between the two parties, helping the industry to set up an interaction standard. Also, a survey of proposed transit services in different stages of planning, negotiating, and construction may reveal more information about how to negotiate with freight railroads.

As suggested by one of the survey responses, it could benefit the country if priority issues of freight versus passenger services can be worked out at a national level.

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APPENDIX A. CONCURRENT STUDIES

The FRA bears the responsibility for the development and enforcement of safety regulations for the United States railroad industry. It is concerned that the operations of a freight railroad, in close proximity to a heavy or LRT line, could present risks to each entity. Facing very limited or total lack of information about these operations that share right of way or common corridors, FRA has commissioned a study titled: "Catalog of Common Use Rail Corridors" (Zeta-tech Associates, 2002).

The objectives of this study is primarily to determine how many miles of common corridors exist in which light or heavy rail transit facilities are parallel to, and within 200 feet or less of, active freight rail lines. The result of the survey includes

- The extent of "common corridors" in terms of route mileage,
- The types of protections between transit and freight railroad tracks,
- Any shared "minor" facilities, and
- Locations where level crossings or track connections exist.

The research team contacted both existing and proposed transit properties that have potential shared operations with freight railroads. However, the study eliminated commuter rail operation since its main concern is "common corridor", not "shared track". According to the research team (Zeta-tech Associates, 2002), the "initial response to the survey was very poor", which was reflected in the final report of the project, which stated that the overall response rate was very low. Large portions of this study were devoted to the physical description of each transit system.

Judging by the limited project scope, confined operational entities, and poor response rate, it may be too easy to disregard this study. However, given the lack of information on shared operations and scarce documentation in the current literature, we have to credit this study as one of the initial steps to face and comprehend the shared operations. It provided a useful source for our research team to select and finalize the survey candidates. This study stopped short on the analytical front of shared operations between transit and freight railroads, but it provides ample information on individual transit systems.

The United States GAO has commissioned a survey of 18 existing and 19 proposed commuter service providers and seven Class I freight railroads. This study was adequately funded to enable ten full time GAO Physical Infrastructure Issues staff members to visit eight commuter rail services and four Class I Railroads from June to November 2003.

The objective of this survey is to provide information and guidance to help facilitate commuter and freight rail access negotiations as requested by James L.

Oberstar, a Ranking Democratic Member, Committee on Transportation Infrastructure, House of Representatives from the state of Minnesota.

The survey team examined the following three issues in order to accomplish the overall objective of their survey:

1. Challenges that commuter rail agencies and freight railroads face when negotiating and sharing right of way,
2. The actions that help facilitate mutually beneficial arrangements between commuter rail agencies and freight railroads, and
3. The role the federal government plays in negotiations between commuter rail agencies and freight railroads.

The GAO survey concentrated on the area of commuter rail. It did not include LRT or heavy rail transit and it is limited, geographically, to the United States. One of the common issues highlighted by this survey is the insurance/liability burden when passenger and freight movement share the same track. The GAO study also confirmed our conclusion that there is no exact formula for success. Officials from commuter rail agencies and freight railroad identified actions that can help facilitate mutually beneficial arrangements, understand each other's position, using incentives to leverage cooperation, securing adequate and flexible funding, and establishing good lines of communication.

This survey also explored the appropriate role for the federal government in negotiating access or resolving disputes between commuter rail agencies and freight railroads. In fact, the FTA, FRA and Surface Transportation Board (STB) have responsibility for different aspects of rail transportation, but none of the three agencies play a role in commuter rail access negotiations. Therefore, they have not provided any guidance or information to commuter rail agencies or freight railroads to facilitate informed negotiations.

As the result of this survey, the GAO recommends that Federal DOT and STB determine whether it would be appropriate for them to provide guidance and information, such as best practices and information on the applicability of the federal liability cap, to commuter rail agencies and freight railroads.

APPENDIX B. SURVEY CANDIDATES

ID	System Name	Agency	Primary Serving City	Primary Serving State	Type	Share Type
1	Alaska Railroad	Alaska Railroad Corporation	Anchorage	AK	Commuter Rail	Shared Track and Mixed Operation
2	Altamont Commuter Express (ACE)	Altamont Commuter Express	Stockton	CA	Commuter Rail	Share Right of way
3	Caltrain	Peninsula Corridor Joint Powers Board (PCJPB)	San Carlos	CA	Commuter Rail	Shared Track and Mixed Operation
4	COASTER	North County Transit District (NCTD)	Oceanside	CA	Commuter Rail	Shared Track and Mixed Operation
5	GO TRANSIT	GO TRANSIT	Toronto	Canada	Commuter Rail	Shared Track and Mixed Operation
6	Long Island Railroad (LIRR)	Metropolitan Transit Authority	New York	NY	Commuter Rail	Shared Track and Mixed Operation
7	MARC	Maryland Transit Administration, MTA	Baltimore	MD	Commuter Rail	Shared Track and Mixed Operation
8	MBTA	Massachusetts Bay Transportation Authority	Boston	MA	Commuter Rail	Shared Track and Mixed Operation
9	METRA	Northeast Illinois Regional Commuter Railroad Corporation	Chicago	IL	Commuter Rail	Shared Track and Mixed Operation
10	METROLINK	Southern California Regional Rail Authority	Los Angeles	CA	Commuter Rail	Shared Track and Mixed Operation
11	Metro-North Railroad (MNR)	Metropolitan Transit Authority	New York	NY	Commuter Rail	Shared Track and Mixed Operation
12	NJ TRANSIT	New Jersey Transit Corporation	NY-NJ	NJ	Commuter Rail	Shared Track and Mixed Operation
13	SEPTA	Southeastern Pennsylvania Transportation Authority	Philadelphia	PA	Commuter Rail	Shared Track and Mixed Operation
14	Shore Line East (SLE)	Connecticut Department of Transportation	New Haven	CT	Commuter Rail	Shared Track and Mixed Operation
15	Sounder Commuter Rail	Central Puget Sound Regional Transportation Authority	Seattle	WA	Commuter Rail	Shared Track and Mixed Operation

ID	System Name	Agency	Primary Serving City	Primary Serving State	Type	Share Type
16	South Shore Line	Northern Indiana Commuter Transportation District (NICTD)	Chesterton	IN	Commuter Rail	Shared Track and Mixed Operation
17	Commuter Trains Network	Metropolitan Transportation Agency	Montreal	Canada	Commuter Rail	Shared Track and Mixed Operation
18	Trinity Railway Express (TRE)	Dallas Area Rapid Transit (DART) and the Fort Worth Transportation Authority (the T)	Dallas-Fort Worth	TX	Commuter Rail	Shared Track and Mixed Operation
19	Tri-Rail	Tri-County Commuter Rail Authority	Miami	FL	Commuter Rail	Shared Track and Mixed Operation
20	Virginia Railway Express (VRE)	VRE Operations Group	Alexandria - Washington, DC	VA	Commuter Rail	Shared Track and Mixed Operation
21	West Coast Express	TransLink	Vancouver	Canada	Commuter Rail	Shared Track and Mixed Operation
22	NFTA-Metro	Niagara Frontier Transit Metro System	Buffalo	NY	Light Rail	No Interaction
23	Hiawatha LRT	Metro Transit	Minneapolis	MN	Light Rail	No Interaction
24	SEPTA Light Rail Transit Division	Southeastern Pennsylvania Transportation Authority (SEPTA)	Philadelphia	PA	Light Rail	No Interaction
25	Port Authority of Allegheny County	Port Authority of Allegheny County	Pittsburgh	PA	Light Rail	No Interaction
26	San Francisco Municipal Railway (MUNI)	San Francisco Municipal Railway	San Francisco	CA	Light Rail	No Interaction
27	Greater Cleveland Regional Transit Authority	Greater Cleveland Regional Transit Authority	Cleveland	OH	Light Rail	Shared Corridor
28	Los Angeles County Lines Metropolitan Transportation Authority	Los Angeles County Metropolitan Transportation Authority	Los Angeles	CA	Light Rail	Shared Corridor
29	MAX	Tri-County Metropolitan Transportation District of Oregon	Portland	OR	Light Rail	Shared Corridor

ID	System Name	Agency	Primary Serving City	Primary Serving State	Type	Share Type
30	MBTA LRT	Massachusetts Bay Transportation Authority	Boston	MA	Light Rail	Shared Right of Way
31	DART LRT Red Line / Blue Line	Dart Area Rapid Transit Authority	Dallas	TX	Light Rail	Shared Right of Way
32	Denver LRT C Line/ D Line	Regional Transportation District	Denver	CO	Light Rail	Shared Right of Way
33	ETS LRT	Edmonton Transit System	Edmonton	Canada	Light Rail	Shared Right of Way
34	Hudson-Burgen LRT	New Jersey Transit Corporation	Jersey City	NJ	Light Rail	Shared Right of Way
35	Sacramento Regional Transit LRT	Sacramento Regional Transit District (RT)	Sacramento	CA	Light Rail	Shared Right of Way
36	Metrolink (BSDA)	Bi-State Development Agency	Saint Louis	MO	Light Rail	Shared Right of Way
37	VTA LRT	Santa Clara Valley Transportation Authority	San Jose	CA	Light Rail	Shared Right of Way
38	MTA LRT	Maryland Transit Administration	Baltimore	MD	Light Rail	Shared Track and Time Separated Operation
39	Newark City Subway	New Jersey Transit Corporation	Newark	NJ	Light Rail	Shared Track and Time Separated Operation
40	TRAX	Utah Transit Authority	Salt Lake City	UT	Light Rail	Shared Track and Time Separated Operation
41	San Diego Trolley (SDT)	San Diego Trolley Inc (SDTI)	San Diego	CA	Light Rail	Shared Track and Time Separated Operation
42	South Jersey LRT	New Jersey Transit Corporation	Trenton	NJ	Light Rail	Shared Track and Time Separated Operation
43	Calgary LRT	Calgary Transit	Calgary	Canada	Light Rail	Shared Right of Way
44	O-Train	Public Transit in Ottawa	Ottawa	Canada	Light Rail	Shared Right of Way
45	BART	San Francisco Bay Area Rapid Transit District (BART)	San Francisco	CA	Heavy Rail	No Interaction
46	MARTA	Metropolitan Atlanta Rapid Transit Authority	Atlanta	GA	Heavy Rail	Shared Corridor

ID	System Name	Agency	Primary Serving City	Primary Serving State	Type	Share Type
47	Metro Subway	Maryland Transit Administration	Baltimore	MD	Heavy Rail	Shared Corridor
48	the "T" Subway	Massachusetts Bay Transportation Authority	Boston	MA	Heavy Rail	No Interaction
49	METRA	Chicago Transit Authority	Chicago	IL	Heavy Rail	Share Right of Way
50	Red Line	The Greater Cleveland Regional Transit Authority	Cleveland Ohio	OH	Heavy Rail	Shared Right of Way
51	PATH	Port Authority Trans-Hudson	Jersey City	NJ	Heavy Rail	No Interaction
52	DRPA High Speed Line	Port Authority Transit Cooperation of PA & NJ	Linenwood	NJ	Heavy Rail	Shared Right of Way
53	Red Line	Los Angeles County Metropolitan Transportation Authority	Los Angeles County	CA	Heavy Rail	No Interaction
54	Metrorail	Miami –Dade Transit Agency	Miami	FL	Heavy Rail	No Interaction
55	NYC Transit Subway	MTA New York City Transit	New York	NY	Heavy Rail	Shared Corridor
56	SEPTA Subway	Southeastern Pennsylvania Transportation Authority (SEPTA)	Philadelphia	PA	Heavy Rail	No Interaction
57	Ride the Rocket	Toronto Transit Commission	Toronto	Canada	Heavy Rail	No Interaction
58	SkyTrain	Rapid Transit Project	Vancouver	Canada	Heavy Rail	No Interaction
59	Metro	Washington Metropolitan Area Transit Authority	Washington, DC	DC	Heavy Rail	Shared Corridor

APPENDIX C. SURVEY INSTRUMENT

Survey Cover Letter

April 1, 2003

Subject: Passenger Freight Rail Interaction Survey

Dear _____

New Jersey Institute of Technology is retained by New Jersey Transit to conduct a survey of the problems and concerns experienced by agencies when running Transit and Commuter Rail operations on, or adjacent to, freight railroad. I am the Principal Investigator of this project: Survey of Passenger and Rail Freight Interaction and earnestly request your participation in this survey.

I have included the questionnaire and will be grateful if you would please have it completed and returned to me. If you will have someone in your organization complete it on your behalf, please kindly respond to this message and advise the person so we will contact him/her accordingly.

To express our appreciation for your participation in this survey, we will be able to provide a summary of the survey results if interested.

Should you have any questions, please contact me.

Thank you in anticipation of your cooperation.

Sincerely:

Dr. Rongfang (Rachel) Liu,

Department of Civil and Environmental Engineering
New Jersey Institute of Technology
University Heights, Newark NJ 07102
Tel: 973-596-5884
Fax: 973-596-5790
Email: rliu@adm.njit.edu

Passenger and Freight Rail Interaction Survey

ID. _____ Surveyer: _____

Date: _____ Contact: _____

Name of the Transit System: _____

Operating Agency: _____

Service Region: _____

1. Type of Transit Services:

- . Commuter Rail
- . Light Rail
- . Heavy Rail

2. Type of Equipment for Transit Services:

- . High Access
- . Low Access
- . Single Level Cars
- . Bi Level Cars

3. Type of Freight Operations Using Shared Tracks or Right of Way:

- . Through (Mainline) Freight
- . Local Freight
- . Yard Operations
- . No Active freight

4. Type of Interaction with Freight

- . Shared Track and Mixed Operations
- . Shared Track and Time-separated Operations
- . Shared Right of Way Only
- . Shared Facilities (yard, station, etc.)
- . Close Proximity

5. Owner of the Shared Asset, if available please attach any map, track chart, or schematic maps?

_____, _____

_____, _____

_____, _____

6. Clearances Between Tracks,

6.1. Total width of the jointly used right of way _____

6.2. The distance between track centerlines in feet _____

6.3. Do lateral clearances differ at bridges?

No

Yes, please specify _____

7. Who conducts dispatching of the Corridor?

Freight operator

Transit operator

Third Party, Please Identify _____

8. What protocols are in place regarding Dispatching? Preference?

9. Do the dispatching protocols differ during peak and off-peak periods?

No.

Yes, Please elaborate _____

10. Are there any performance incentives for the owning/operating Railroad?

No.

Yes, Please elaborate _____

11. What measures (if any) are provided to separate transit and freight operations?

Fence

Intrusion Detection

Crash Wall/Barrier

Other, please identify _____

12. What changes were made to the transportation system to accommodate passenger operation and Why?

13. Were these changes effective?

- . Yes
- . No

14. What insurance/liability requirements has the freight railroad established for transit operation?

15. Did you have any accident among the interaction of passenger and freight rail operations?

- . No, please go to question No 16.
- . Yes, please complete the following questions

15.1 What is the nature of the accidents

- . Collision
- . Derailment

15.2 What kinds of damage occurred

- . Fatality
 - . Property Damage in the magnitude of _____
-

16. By what arrangement does the non-owning (tenant) user have access to the corridor?

- . Property Lease?
 - . Trackage Rights?
 - . Other, please Specify _____
-

17. How much did it cost to acquire the usage right?

18. Did the agreed upon cost for the right of usage include any compensation to the freight carrier for loss of future freight business due to the presence of a transit operation?

- . No.
- . Yes, please give the estimated percentage _____.

19. Do you consider that the working arrangement is beneficial for your business objectives?

- Yes.
- No.

20. What do you consider is the most critical issue that must be solved in order to introduce joint use of the right of way or trackage?

21. What are the key factors that contribute to a successful interaction between freight and transit operator?

22. What are the impediments to the ideal operation?

- Legal
- Administrative
- Physical
- Other, please specify _____

23. Do you have any suggestions for improving passenger and rail freight interactions?

24. Thank you very much.

APPENDIX D. BOSTON AREA, MASSACHUSETTS

According to APTA (2003B), The Massachusetts Bay Transportation Authority (MBTA) is the fifth largest transit agency ranked by passenger miles. In year 2001, the MBTA network carried 1.8 billion passenger miles in the Boston metropolitan area. MBTA is not only one of the largest mass transit systems in the United States but it is also the oldest. In 1997 the MBTA celebrated its 100th anniversary of the nation's first subway, the Green Line. The Tremont Street Subway, service under Boston Common between Park Street and Boylston, was inaugurated in 1897 and it is still used by the Green Line LRVs today.

D.1 Railway Network

The MBTA railway network is composed of two distinct operations: the commuter rail which operates under the MBTA logo and the light and heavy rail that are referred to as the "T". Including the bus services, the MBTA serves a patronage of 2.6 million in 175 cities and towns within an area of 1,038 square miles (Earth Tech, 2003).

D.1.1 Heavy and Light Rail Network.

Compared to other transit operation in North America, the "T" is characterized by the diversified transit lines and equipment, and various ages of the subsystems. The five separate transit lines of the "T" are composed of 32.4 miles of light rail and 46.4 miles of heavy rail lines. Their propulsion sources vary from catenary, trolley wire, to third rail and even the voltage varies between 600 Voltage Direct Current (VDC) to 650 VDC. The following describes the two lines that have interaction with freight railroad network:

- Red Line, operating from Alewife Station in the northwest section of Cambridge, through city center to two branch lines in the southeast section of the metro area, is a heavy rail with high platforms and third rail current collection at 650 VDC. The Ashmont Line, the west branch running from JFK/UMASS Station to Mattapan, is actually a LRT functioning as an extension using trolley wire at 600 VDC. This extension is also called Mattapan High Speed Line. The Red line intercepts with the Green Line and the Orange Line at Park Street Station and Downtown Crossing Station, respectively.
- Orange Line, originating at Oak Grove Station in the northern part of Malden extends to the Forest Hills Station in the south. This is a north-south heavy rail line with third rail power supply at 650 VDC and has high platforms. The Orange line is linked to the other rail lines through State Station and Downtown Crossing Station in downtown Boston. It shares right of way with Amtrak and commuter services for some of its route.

The “T” employs a modified hub-and-spoke system, which makes it necessary to get to a hub in order to switch to another line. Most trains run about every 10-15 minutes except on the Orange Line, which runs to a posted schedule. The first trains start early in the morning between 5 and 5:30 am and last trains finish between midnight and 12:50 am, depending on the stop. Most stations have signs that indicate the time of the last train each night.

D.1.2 Commuter Rail Network

In addition to the “T”, there is also a commuter rail network serving eastern Massachusetts that covers 402.4 miles. The commuter rail is divided into North and South Side systems by the Charles River. The North Side Commuter Rail is composed of 5 branches: Rockport, Ipswich, Haverhill, Lowell, and Fitchburg. The South Side lines include eight different branches: Attleboro, Stoughton, Framingham/Worcester, Needham, Franklin, Farimont, Middle Borough/Lakeville, and Plymouth/Kingston. Amtrak, the intercity rail service, also has major presence in the Boston Metro Area. CSX and Guilford Rail System are two major freight railroads interacting with the transit systems in Boston area.

The commuter rail services usually operate between 6 to 8 peak hour trains depending on the branch line and station locations. The peak hour headway is around 20 minutes.

D.2 Passenger and Freight Volumes

A general pattern, revealed in the survey, shows that most metro areas where passenger rail demands capacity, the freight railroads also tend to have a high demand for their track usage. A simple overview of the passenger and freight volumes may be an effective tool to specify capacity constraints to solve the conflicts between passenger and freight movements.

As one of the major metropolitan areas in the Northeast, more than 15 million population resides in the Boston Metropolitan area and MBTA carries more than one million riders daily (MBTA, 2003). The commuter rail operates 466 trains on a regular weekday and carries 132,800 commuters and more than 600,000 riders are serviced by the “T” light and heavy rail systems.

The rail network in Massachusetts also provides essential connections for the domestic and international trade in the Northeast. Ten rail freight carriers, one a class I railroad, two class II, and seven local railroads, provide service on more than 1,000 route miles throughout Massachusetts. Among the 1,000 miles, 42% is publicly owned. According to FHWA (2002A), rail carried 14 million tons of freight to, from, and within Massachusetts in 1998. The rail freight volume is projected to rise to 20 million tons by 2010 and 25 million tons by 2020. The value of the freight moved by rail was eight billion dollars in 1998, and is projected to be 12 billion in 2010 and 19 billion in 2020.

D.3 Transit and Rail Freight Interaction in Boston

There are a few different types of transit and rail freight interaction in Boston area. The commuter rail is largely shared track and mixed operation with freight railroads. The "T" has small sections of shared track and time-separated operations along Red and Orange Lines. In addition, there are a few shared facilities by both the commuter rail and the "T". The following section highlights the interaction for both systems.

D.3.1 Commuter Rail

The oldest and most commonly shared use in the Boston area is along the commuter rail lines. Two major railroads, CSX and Guilford Rail Systems, interact with the MBTA commuter rail network. Comparing its presence to the rest of the country, the freight movement by CSX in Boston area, especially along the tracks owned by the MBTA, is relatively light. The shared operation along Worcester Branch, about 40 miles, is dispatched by CSX although the MBTA owns the majority of the track.

The interaction between MBTA and Guilford, previously a Class I railroad and now a regional railroad, is extensive. The shared operations spread to more than half of the MBTA commuter rail branch lines. There are also a few shared yard and other facilities. Freight trains move along the railway network all day on most of the tracks, even during the peak hour. Actually, one local intermodal train passes through the commuter rail network at 6 pm everyday. In general, the bulk freight gives way to passenger trains, especially during the peak hour. However, time sensitive commodities, such as intermodal freight or perishable food trains have priority.

Most of the station platforms are low-level access due to the major presence of the freight movements. However; there are a small percentage of high-level platforms. About one third of the MBTA commuter rail trains are bi-level Kawasaki cars and the rests are single level cars.

Performance incentive for on time performance has not been adopted for the freight railroad largely because MBTA is the owner of the track and freight movement is relatively confined to certain sections of the massive commuter rail network. The freight movement by Guilford is more spread out than that of CSX, but due to Guilford's local corporate presence and cooperating history of the two entities, both services interact adequately.

According to a representative of MBTA, the interaction between MBTA and freight railroad may be characterized as "tolerable co-existence". The existing operation arrangements are largely inherited from status quo, when MBTA took over responsibility for commuter passenger services. There are some cost-

sharing advantages for both entities when freight leases or purchases trackage rights from MBTA. However, the revenue from the shared operation is fairly small, around \$3 million per annum.

The critical issues in the case of MBTA and freight railroads may be labeled as physical. Anna Barry, Director of Railroad Operations, explained that she would like to see the single track sections eliminated and signals installed if and when funding becomes available. MBTA is also planning a few expansion projects for its commuter rail services. It is expected that new commuter services will be introduced to South East Boston or the Big Ben area within 10 or 20 years.

D.3.2 The “T”

There was no shared operation or shared right of way between the “T” and rail freight thirty years ago. However after a series of extensions and replacements, the “T” started to utilize a few track segments to supplement the overall network. The interaction between “T” and freight is largely an indirect result of sharing corridors with commuter rail or Amtrak which itself shares tracks with freight.

Initially, the segment from South Bay to Ashmont on the Redline was connected to the a right of way formerly occupied by the Old Colony Railroad, which provided commuter rail service from the South Shore to Boston. The commuter service was abandoned in 1959, but a single railroad track was preserved for the Red Line relocation. As part of the same project, a new Red Line Branch to Quincy was opened in 1971 and later extended to Braintree. Provision for a single railroad track for possible future commuter rail use was included in this project. In 1995, when commuter service to the South Shore was revived, the Red Line between South Bay and Braintree became part of a corridor shared by “T”, Commuter Rail, and Amtrak. The single track on the north is for commuter rail service. It should be noted also that a fence separating the commuter track from the third rail powered heavy rail system was installed.

The only true interaction with rail freight for “T” is along the Orange Line. In 1975, the Orange Line north of the Charles River was relocated adjacent to an MBTA commuter rail line, and the aging elevated structure was demolished. In 1981 the Orange Line reached Malden and Oak Grove. Finally, in 1987 the Orange Line elevated structure in South Boston was demolished and the tracks were relocated into a five-track open cut called the “Southwest Corridor”. This project provided a high-speed right of way for Amtrak trains between Readville and Boston, and accommodated local service by Orange Line transit vehicles between Forest Hill and Back Bay. About 5.4 miles of Orange Line, from Community College Station to Malden Station, are also shared with commuter services and limited freight movement.

APPENDIX E. GREATER WASHINGTON D.C. REGION

As the Nation's Capital, Washington D.C. is not only the political center for the country but also an important employment and recreational center for adjacent Maryland and Virginia cities. Naturally, it is also a transportation hub, where all modes of transportation, light rail, heavy rail, commute rail, bus, as well as thousands of miles of highways, provide extensive transportation services.

E.1 Railway Network

All three types of rail transit are present in the Greater Washington D.C. - Maryland -Virginia region. Multiple jurisdictions and organizations have caused the region to be served by different public agencies. However, they have developed an integrated transportation system that connects the whole region from Perryville MD in the north, Martinsburg WV in the west and Fredericksburg VA to the south. The following section records the general network of each transportation services and their interaction with the freight railroads.

E.1.1 Light Rail Transit

The only LRT in the Greater Washington D.C. region is the Baltimore LRT. The Baltimore LRT, known as the Central Light Rail Line (CLRL) was opened in May 1992, running from Dorsey Road (now Cromwell Station) to Timonium. Further extensions were completed in 1997 that provided service from Hunt Valley in Baltimore County and Pennsylvania Station to BWI airport. Today, the LRT is 27 miles long. Most of the trackage is on exclusive right of way. However, it runs on the street between Camden Station and Mount Royal, mostly on Howard Street.

E.1.2 Heavy Rail Transit

There are two heavy rail systems in the Greater Washington D.C. area. One is the single line Metro in Baltimore and the other, the 103 mile WMATA system in Washington DC. Baltimore Metro operates a single line from Owings Mills to John Hopkins Hospital. After three phases of extension in 1983, 1987, and 1995; the Baltimore Metro Line is now 15.5 miles long and serves fourteen stations. The Baltimore Metro service is separated from other rail traffic (MTA, 2001). The average travel time from one end of the Metro Line to the other is about 30 minutes, operating at an average speed of 30 mph. The Metro operates from 5 am to 12:30 am from Monday to Saturday and from 10 am to 8 pm during Sunday and holidays with 10-minute headways in the peak hour. There is no direct connection between the heavy rail and light rail services.

The fleet consists of 100 heavy-rail cars in 50 married pairs. The cars are standard gauge and are powered through a collector shoe, which draws power from the 750 VDC "third" rail. Train protection is provided by a multi-aspect ATC system.

The WMATA operates the second largest rail transit system in the United States. The system serves a population of 3.5 million in a 1,500 square-mile area, which includes the District of Columbia, two suburban counties in both Maryland and Virginia. It transports more than one third of the DC federal government employees to work and millions of tourists to the landmarks in the Nation's Capital. WMATA consists of five lines: Red, Blue, Orange, Yellow and Green Lines. The service operates from 5 am to 2 am during the weekdays and 8 am to midnight during the weekends.

The WMATA network is 103 mile long and has 83 stations. Among them, 50.05 miles and 47 stations are subway, 43.75 miles and 31 stations are surface, and 9.22 miles and five stations are on aerial structures. Most of the freight interaction, sharing right of way, is on the surface, but there are short sections adjacent to the subway or aerial structure.

E.1.2 Commuter Rail

One important component of the rail network in the Greater Washington D.C. area is MARC, operating in Maryland and West Virginia, under contracts with Amtrak and CSX Transportation. There are three routes:

- The Penn Line uses Amtrak's Northeast Corridor; the former Pennsylvania Railroad electrified main line, between Washington, Baltimore, and Perryville, Maryland.
- The Camden Line uses the CSX route, formerly the Baltimore and Ohio Railroad, between Washington, Laurel, and Baltimore.
- The Brunswick Line uses the CSX route, formerly Baltimore and Ohio Railroad, between Washington; Brunswick, MD; and Martinsburg, WV. A branch line between Point of Rocks and Frederick MD began operation in December 2001 to help to relieve to traffic congestion on I-270.

On weekdays, trains run hourly through the morning and afternoon on the Penn Line between Washington and Baltimore. Service is less frequent on the Camden, Brunswick and Penn Line, between Baltimore and Perryville. Trains on these lines serve only rush-hour commuter traffic, inbound in the morning and outbound in the afternoon,

Another significant commuter rail service to Downtown Washington DC is the VRE. VRE service is provided by a transportation partnership of the Northern Virginia Transportation Commission (NVTC) and the Potomac and Rappahannock Transportation Commission (PRTC). The VRE commuter rail service operates weekdays during morning and evening rush hours and connects Northern Virginia with Washington, DC. There are two VRE lines:

- Fredericksburg Line operates north/south between Fredericksburg and Union Station in DC.
- Manassas Line operates east/west between Manassas Airport and Union Station.

The VRE equipment roster includes 100-seat MAFERSA Cab cars and 161-seat Bombardier Coaches. There are two different kinds of bi-level coaches, Kawasaki Bi-level and Pullman Bi-level coaches. The system still keeps its initial ten locomotives, which are Road Passenger RP39-2C's rebuilt by Morrison Knudsen. VRE has another five remanufactured locomotives, two are leased from Amtrak and two leased from Sound Transit.

E.2 Passenger and Freight Volumes

The passenger services are fed by integrated bus services terminating at transit and commuter rail stations together with large park-and-ride lots at most of the outlying stations. Freight is generated by the Port of Baltimore, the second largest port on the east coast, with freight movements to and through the region.

E.2.1 Travel Demand from Baltimore, MD Region

MTA, an agency of the Maryland Department of Transportation (MDOT), provides a network of bus, commuter bus, subway, light rail, commuter trains, and para-transit services, serving the Baltimore and Washington, D.C. suburbs. The MTA also supports rail freight service throughout the State by the office of Rail Freight Services (RFS), an office embedded within MTA's Statewide and Communications Group.

The CLRL system in Baltimore carries about 27,000 passengers each weekday in 2000 (Maryland Transit Administration, 2000) and this number is projected to grow. About 44,000 average weekday boardings are projected for year 2020. To accommodate the projected growth, the MTA is currently working on a 9.4 miles of a double track project to upgrade designated areas of the CLRL that are presently single track sections.

The Metro heavy rail system in Baltimore has a ridership of 48,000 per weekday, and 24,000 on Saturday in 2000 (MTA, 2001) and WMATA metro system in DC area carried 181 million people in year 2002 (WMATA, 2002), which maybe corrected roughly at total of 580,000 passengers per weekday.

According to recent statistics (Maryland DOT, 2003), MARC has recorded an average of more than 27,000 passengers per month in March, April, and May of 2003. This is the first time in MARC's history that average ridership had surpassed the 26,000-passengers plateau. The previous high for average monthly ridership was 25,563 in February 2003. Among the three MARC lines, the Penn Line, MARC's most traveled rail line, with an average of 16,252 daily boardings in July, 2003. The Brunswick Line was the second most traveled line,

with an average of 5,962 daily passengers. The Camden Line was third, with an average of 3,744 passengers daily (Maryland MTA, 2003A).

Though there is an increase in the transit ridership in Baltimore region, highway congestion is still significant and getting worse. A recent study by Wendell Cox Consultancy (2001) mentioned that based on the congestion cost index derived by the Texas Transportation Institute, the economic costs of congestion to the Baltimore area were estimated at \$860 million annually, more than 1.5 times the \$560 million estimated for 1990. It is estimated that 75 million gallons of gasoline and diesel fuel were wasted in the area due to congestion, also more than 1.5 times the 1990 figure of 49 million. The study proposed to use railways to relieve the congestions.

E.2.2 Travel Demand along VRE Lines

The ridership of VRE has been growing steadily, with a forecast of continuous growth. The average daily passenger trip for Manassas Line in January 2004 is 6,809, an eight percent increase from the same period last year. The average daily passenger trips for Fredericksburg is 7,729, another five percent increase compared to the same period 2003 (VRE, 2004).

The midweek daily passenger ridership is approaching 15,000, significantly exceeding the designed capacity of 10,000 passenger trips per day. The ridership increase promises a bright future for VRE, but at the same time, it has created some growing pains. VRE has already increased its capacity by adding more bi-level cars and the length of the trains. Eventually, VRE will need to replace its aging fleet and acquire more to replace its leased cars from Amtrak and Sound Transit.

E.2.3 Passenger Travel within WMATA Systems

Washington D.C metropolitan area has the second highest transit use nationally. It carries 18% of all peak period passengers and 40% of trips are to the region's core, with an average of 545,000 trips per weekday in 2000. Between the two major modes of transportation that WMATA provides 50% of the riders use rail, 21% use both bus and rail, and only 29% use buses only. Like all other systems WMATA Metro rail is also experiencing an increase in ridership. From 1998 to the first three months of 2000, 44,000 more trips were carried by the system.

WMATA's role in the region's economic development has been positive. In 1980s, 40% of the region's office and retail space was built within walking distance of a Metrorail Station. Since 1990s, about 20% of office and retail space has been constructed at Metrorail Stations.

E.3 Transit and Rail Freight Interaction in Greater Washington D.C. Region

The interaction between transit and rail freight in the Greater Washington D.C. Region covers the full range of patterns we have defined due to the diversified service types and extensive transit service networks in the area. We have grouped those shared operations by the transit service categories and included each in the following section.

E.3.1 Baltimore Light Rail: Shared Track and Time-separated Operation

The CLRL shares track with Norfolk Southern for almost 11 miles from North Avenue to Timonium. Baltimore LRT was granted a waiver from the FRA for sharing track; however the passenger service must be temporally separated from freight movement. The system was constructed on former railroad right of way both north and south of downtown, as shown on Figure 31. Freight service on the northern part of the line is still active and is provided by Conrail, via a track connection to the storage yard and shop at North Avenue. When the line first opened, service to one shipper on the south end was provided via a connection from the CSX Curtis Bay Subdivision. This shipper has since relocated (Zeta-tech Associates, 2002).

Each light rail train is controlled by one operator and consists of one to three cars. The LRT uses 750 VDC overhead catenary wires or single trolley wire. Vehicles have a maximum speed of 55 mph. Wayside signals, with enforcement, control train movements. Connections to the general railroad network are protected with derailleurs that are locked and their use must be authorized by the dispatcher. Each car holds up to 150 passengers. The light rail line grade crossing protection is maintained in accordance with FRA standards so that freight can use the line.

E.3.2 Heavy Rail: Limited Interaction

The heavy rail system in Baltimore operates on a single line from Owings Mills to John Hopkins Hospital. It is underground from John Hopkins to Mondawmin, where it runs on the surface for about a half mile south of the West Cold Spring Station, where it is in a corridor with the former Western Maryland Railroad (now the CSX Hanover Subdivision), then ascends to an aerial structure. The rest of the route to Owings Mills is elevated.

The major section of shared operation of the heavy rail and rail freight is from a point south of West Cold Spring Station to the Baltimore Beltway (I-695). The heavy rail line parallels the former Western Maryland Railroad main line for about seven miles along this stretch. The transit line is only briefly at grade in this corridor with the CSX line, and is generally at least 50 to 100 feet away from the rail line and on an elevated structure. The CSX rail line sees one local freight

train per day, originating from Baltimore and making a return trip to Hanover, PA. Maximum timetable speed for this train is 25 MPH, and the line is not signalized.

There is a track connection between the heavy rail maintenance shop and the CSX Hanover Sub-division. It is protected with derailleurs and switching locks. There are no grade crossings on the heavy rail line.

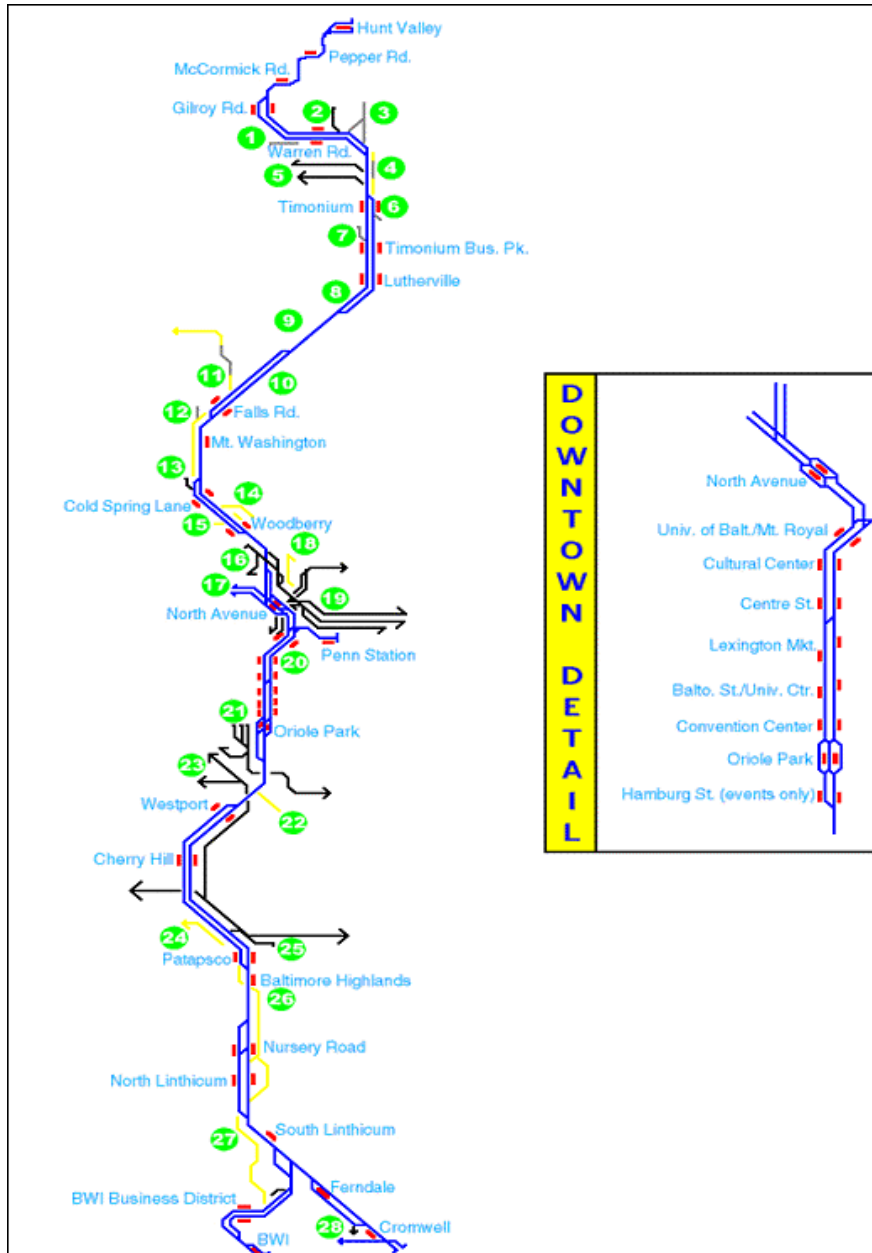


Figure 31. Baltimore light rail and freight interaction.

WMATA is a standard-gauge heavy rail transit system, completely grade separated. Like Baltimore metro system, WMATA crosses over tracks used by freight and commuter rail services. Many lines reach far into the Maryland and Virginia suburbs, which make extensive use of railroad right of way. All trackage in shared corridors is fenced, and the fences are equipped with intrusion detectors. The intrusion detectors are wired directly into the train control system, so that an intrusion alert will stop trains on the affected track section. Inspections, to confirm that the intrusion devices are active and effective, are carried out jointly by WMATA and the railroad personnel. Now, both parties do the inspection separately, but close relationship is still maintained.

Table 6 shows the shared corridors of WMATA and freight railroad. Most of the freight lines that are shared with WMATA are busy lines. For example, the right of way that Orange Line and Blue Line shares with CSX Alexandria Subdivision and RF&P Subdivision, are part of the major north/south freight routes on the east coast, carrying more than 40 million gross tons (MGT) per year.

Table 6: WMATA shared corridors

From	To	Distance (mile)	Notes
White Flint	Shady Grove	5.2	Red Line, CSX Metropolitan Subdivision
Union Station	Silver Spring	7.4	Red Line, CSX Metropolitan Subdivision
National Airport	Franconia/ Springfield	8.7	Blue Line, CSX RF&P Subdivision, NS Alexandria Subdivision
Dean Avenue	New Carrollton	5.5	Orange Line, CSX Alexandria Subdivision, Amtrak Northeast Corridor
West Hyattsville	Greenbelt	5.3	Green Line, CSXT Capital Subdivision
Total WMATA Shared Corridors		32.1	

Source: Zeta-tech Associates, Inc., 2002.

E.3.3 Commuter Rail: Shared Track and Mixed Operations

Passenger services have actually operated since the 19-century on all three lines of MARC. In fact, the line from Baltimore to Ellicott city was the first railway in the United States. The service now operated by CSX was formerly the Baltimore and Ohio Railroad's local passenger train service (Camden and Brunswick lines). The Penn Line service, currently operated by Amtrak under a State contract, was the local train service of the Pennsylvania Railroad, and later, Penn Central, then Conrail.

In the mid 1970's, Maryland DOT decided to assist the local railroad companies by setting up an agreement with B&O and Conrail to pay the total operating deficit for the passenger trains and enable them to provide the rolling stock. After deregulation in 1980, the railroads were relieved of their responsibility to operate local passenger rail services and Maryland DOT entered into an agreement with Amtrak to continue the service. The name, MARC, was given in 1983. Train crews remained with their employers and wear either CSX or Amtrak's uniforms. MARC reimburses the railroads for the crew cost via a rate per train mile.

The main freight mover interacting with MARC today is CSX; however there are occasional freight movements along Amtrak's Penn Line. CSX owns all the other tracks on which MARC provides service. Train crews are still provided by CSX and all dispatching is from their headquarters in Jacksonville, FL. The relationship between CSX and MARC is difficult, since CSX have experienced two serious accidents with passengers operations at Chase, MD on the Penn line and in Montgomery County, MD on the CSX Metropolitan Subdivision. This has made CSX very cautious and their desire to maintain total control of all movements on their territory. Consequently, they will not consider performance incentives and demand that commuter services are kept as far as possible or "invisible" to freight operations.

Though there is such a strong historical relationship between MARC and freight railroad, the most frustrating issue for MARC today, is not having the dispatching priority. The dispatching is carried out by CSX and there is no performance incentive for on time performance, therefore, the freight railroad give priority to time critical trains. MARC identified the key factors that contribute to a successful interaction between freight and transit as "to get timed windows for commuter trains." Presently, MARC is suffering many delays. As pointed out by a MARC representative that "with approximately one train in ten is late, it is not attractive to commuters".

The impediments to the ideal passenger operation in MARC's opinion is that "owners attitude and tight control of priority freight." MARC also mentioned that the problem of funding additional infrastructure, e.g. more passing sidings and fly-overs, to make passenger services "invisible to freight" is constrained by available funding and political will. MARC suggested that incentives be provided to the freight railroad, however, by doing so it will cause an additional funding requirement "which presently is not available".

Another point worth mentioning is the Office of RFS, which is embedded within the Maryland Transit Administration's Statewide and Communications Group. RFS works closely with Maryland Department of Business and Economic Development. The objective of RFS is to protect and enhance the benefits of rail freight and to help the state to achieve a well balanced and competitive use of each transportation mode. RFS has the advantage of accessibility to many valuable resources, such as legal, financial, engineering, and planning. To

achieve their objective, RFS maintains a strong working relationships and manage statewide issues with all the local rail entities, which includes CSX, Norfolk Southern, seven short line railroads and the 220 miles of state rail right of way. RFS manages and executes current capital funding programs as defined in Maryland State Capital Transportation Program, which are designed to selectively enhance and upgrade state owned network to help the state to sustain economic growth. As appropriate, RFS also administer Federal rail funds for short-line railroad improvements.

VRE, the other commuter rail service in the Greater Washington D.C. area, uses both high level and low level platforms. It interacts with Norfolk Southern, CSXT and Amtrak. Figure 32 pictures an evening southbound VRE train as it passes CSX Q-413 on track 3, North Alexandria, just before the Alexandria Station. The shared corridor is 66 feet wide and track center spacing is 13 feet wide. VRE is dispatched by the freight operator and the protocol of the dispatching priority is; first Amtrak, then VRE, and lastly freight services. VRE adopts a reward plan for on time performance. There are no separation measures between VRE and freight services.

More interlockings have been added by CSXT to accommodate VRE services. VRE considers the changes are “effective”. The insurance amount ranges from 250 to 500 million for VRE. The critical issues identified by VRE is “closer spacing of interlockings so slow freight may be passed by passenger trains” and the key factor to successful operation is “dispatcher training and familiarization with passenger operations.” The most bothering impediment, to VRE, is not legal, administration, or physical, but lack of dispatcher training.



Figure 32. Shared right of way between VRE and CSX

APPENDIX F. LOS ANGELES METRO, CALIFORNIA

Los Angeles County Metropolitan Transportation Authority (LACMTA) is unique among the nation's transportation agencies. It serves as transportation planner, coordinator, designer, builder, and operator for one of the country's largest, most populous counties. More than 9 million people; one-third of California's residents; live, work, and play within its 1,433-square-mile service area.

F.1 Railway Network

Besides operating over 2,000 peak-hour buses on an average weekday, the MTA has also designed, built, and now operates 73.1 miles of Metro Rail service. Los Angeles is now developing a large and complex rail transit network. There are three parts to the system:

- The heavy rail: Red Line
- Three light rail lines: Metro Blue Line, Green Line, and Gold Line.
- An expanding commuter rail network, over trackage owned in part by the State of California and in part by various freight railroads.

In total, the Metro Rail system serves 62 rail stations, in addition to the commuter rail network. The rail network extends from Long Beach to downtown Los Angeles to Hollywood, Universal City, and North Hollywood in the San Fernando Valley, from downtown Los Angeles to Pasadena, and from Norwalk to El Segundo and all points in between. All these Metro lines use cab signaling with speed enforcement and 750 VDC power supply. Maximum operating speed is 55 MPH. The Red Line, the heavy rail system, meets the Blue Line in Los Angeles and provides service through Downtown, between Union Station, the Mid-Wilshire area, Hollywood and the San Fernando Valley. The system operates from 5 am until 12:30 am. The heavy rail high platform subway trains have stainless steel exteriors and are powered through a third rail. The size of the train car is 75 feet long, 10 feet wide, and 12 feet high. Each car has 59 seats, with a total capacity of 180.

The Blue Line runs north and south between Long Beach and Los Angeles, partially operating in street trackage and the Green Line operates entirely on elevated right of way.

The Blue Line is a "conventional" light rail line. As shown in Figure 33, it begins in downtown Los Angeles at a two-level subway station, 7th & Flower Street, shared with the Red Line. It proceeds toward Long Beach first via a short subway, and then street-level running in the median of Washington Avenue to Long Beach Avenue to Long Beach.

The Metro Green Line crosses the Blue Line, running east and west between Norwalk and Redondo Beach, curving south near the Los Angeles International Airport. The Metro Gold Line connects to the Red Line at Union Station, and runs northeast to Pasadena. The 750 VDC electric trains are powered through overhead wires. The cars, measured at 87 feet long, 8 feet 3-3/4 inches wide, and 12 feet 3 inches high and are able to hold 76 seats with a total capacity of 230 per car.

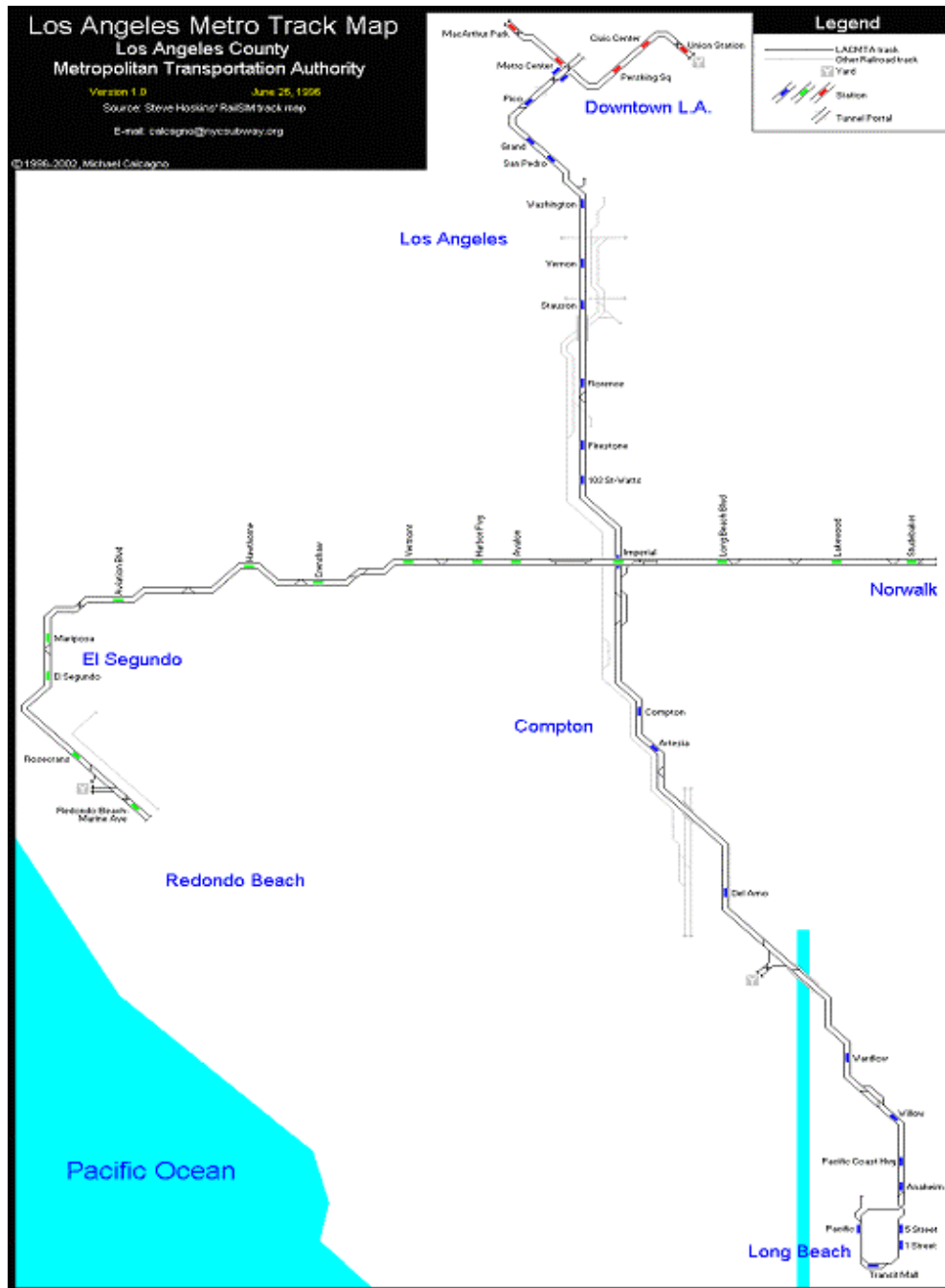


Figure 33. Los Angeles Metro rail track chart

During the 13 years since the Blue Line was completed, the metro rail system has developed into the seventh largest urban rail system in the United States. The Blue Line service between Downtown and Long Beach is the second busiest light rail line in the country. Completion of the Green Line in 1995 and Red Line in 2000 significantly increased the destinations served. Average weekday Rail boardings now exceed 200,000.

Several new extensions to the Metro Rail and Metro Rapid Transitway system are proposed, which focus on cost-effective light rail and transitway projects that fit within existing arterial roadways or abandoned railroads. The Pasadena Gold Line was opened in 2003 and the Eastside Extension will open in 2009, adding 20-miles of new services to the system. These two lines will join in Downtown Los Angeles to form a single, operating line extending from the San Gabriel Valley to East Los Angeles. At Union Station, they will connect with the Red Line and be linked to the rest of the Metro system.

In addition, preliminary engineering will soon be initiated for the first segment of the Exposition Light Rail project, between downtown Los Angeles and Culver City. While preliminary engineering will be completed over the next year, construction of this project will not be completed until after 2009, unless additional funding becomes available.

F.2 Passenger and Freight Volumes

The Red Line, heavy rail service, which operates underground and moved over 100,000 passengers each weekday at its peak service in year 2001. The Green Line service that runs on its own right of way moves over 30,000 passengers each weekday. The Blue Line service moves about 70,000 passengers daily. However, the passenger volume on the whole Metro rail system has been decreasing.

Los Angeles has become one of the most important worldwide freight destinations in the U.S. serving as a distribution center for the rest of the country. The ability to efficiently move freight through Los Angeles County's transportation network is crucial to the mobility and economic vitality for the County, the State, and the Nation. The freight industry is responsible for sustaining and moving \$339 billion of domestic goods and delivering \$230 billion worth of international trade to local and national destinations. For example, 60 percent of the imported goods to the Chicago area are shipped through the Ports of Los Angeles and Long Beach. Over 2.5 million jobs around the nation are linked to this international trade (LACMTA, 2003). In Los Angeles County alone, the freight industry employs 500,000 people, which is a core component of the local economy.

The LACMTA recognizes the importance of freight transportation. The Short Range Plan for the Metropolitan area (LACMTA, 2003) mentioned that it will develop a Freight Strategic Action Plan for freight ground transportation and intermodal access needs for 2007. The plan will include working with freight industry partners and other stakeholders to secure additional track capacity along freight rail lines for both freight and commuter rail. It will develop a new dedicated freight infrastructure funding source, and craft creative solutions to improve the operations of the freight industry and the transportation network. It is also intended to support federal proposals to generate additional funding for freight needs beyond existing funding sources. The MTA in this initiative is making a concentrated effort to separate freight and passenger traffic as much as possible.

F.3 Transit and Rail Freight Interaction in Los Angeles

The Metro Red Line is completely underground except for the maintenance shop, therefore there is no interaction with freight railroads. Shared operations in Los Angeles are found only with the LRT. Figure 34 shows, in gray, the freight lines adjacent to the Blue and Green lines. There is a minor industrial trackage south of Dominguez Junction, in Carson CA, on the Wilmington Subdivision, which does not show on the map.

There is significant interaction between passenger and rail freight along the Blue Line. From the Washington Avenue Station, the Blue Line is paralleled by active freight tracks, sometimes on both sides of the right of way, for 15.9 miles, to a point between Wardlow and Willow Stations where the LRT line goes toward Long Beach and the freight continues south to the port (Zeta-tech Associates, 2002). Among the 15.9 miles, 11 miles belong to the Union Pacific Wilmington Subdivision, and the rest, 4.9 miles, is an industrial track. The Union Pacific Wilmington Subdivision has Central Traffic Control (CTC) as far as Watts Junction, 5.1 miles, and is unswitched beyond. The maximum speed for the signaled portion is 40 mph and 25 mph for the unswitched portion. Currently, the Wilmington Subdivision carries about 10 MGT per year, mainly for Port of Los Angeles and Long Beach. However, with the opening of Alameda Corridor in April 2002, traffic on the Wilmington Subdivision may be expected to decrease as trains re-routed. There were track connections between the Blue Line and the general railroad network at Washington Boulevard and near Long Beach Avenue.

At Slauson Junction, the light rail line avoids crossing freight tracks at grade by means of a four-block elevated section. However, north of Slauson Junction, there is a level crossing with a BNSF line, which crosses the Wilmington Subdivision as well as the Blue Line. It is protected by signals and derailleurs. It is an industrial track; therefore traffic is light. The Blue Line shared corridor is entirely fenced, with a sturdy wrought-iron fence. Figure 34 shows a southbound view from the Green Line platform, near Watts; with a southbound double stack train being overtaken by a Blue Line LRT train.



Figure 34. Shared operation on Blue Line near Watts

Source: Zeta-tech Associates, Inc., 2002.

The Green Line, in contrast to the Blue Line, runs entirely on an elevated structure, with the exception of a short segment next to the yard and maintenance facility in El Segundo. Generally, the Green Line runs in the median of the Century Freeway (I-105), however, it runs along the BNSF Harbor Subdivision to Marine Avenue in the north east corner of Redondo Beach for 1.6 miles. Figure 35 shows the BSNF freight tracks adjacent to an elevated section at the end of the Green Line at Marine Avenue Station, looking northeast. The Green Line descends off the structure and runs at grade adjacent to the Harbor Subdivision briefly before returning to an elevated structure where it diverges toward Los Angeles International Airport.

The opening of the Alameda freight Corridor will affect the BNSF Harbor Sub division in the same way that it will affect the UP Wilmington Subdivision. Most traffic will be diverted to the Alameda Corridor. The Harbor Subdivision, which now handles about six MGT annually, will see only local traffic.

Gold Line, a light rail line recently opened in 2003, makes use of a former Atchison Topeka & Santa Fe rail line for two tracks from Los Angeles Union Station for two station tracks to Pasadena. The only shared corridor on this line is approximately two thousand feet in Union Station itself, where the Gold Line are adjacent to tracks used by Metra Southern California Regional Rail Authority

(SCRRA) commuter trains. There is no freight rail service between Pasadena and Union Station.

LACMTA has just completed an alternatives analysis for a 26-mile extension of the Gold Line or a transit service connecting to the Gold Line to Claremont, CA. East of Pasadena, the former Santa Fe line still carries local freight for BNSF. East of Cambridge Junction, between Pomona and Claremont, the line carries Metra SCRRA commuter trains as well. A “locally preferred alternative” has yet to be selected, and nor has Federal funding has been secured. Options being investigated include a double-track light rail line shared with freight trains, an exclusive light rail line with a separate single track for freight, and a busway.



Figure 35. Green Line and Harbor Subdivision from Marine Avenue Station

Source: Zeta-tech Associates, Inc., 2002.

Appendix G. Salt Lake City, Utah

Utah Transit Authority (UTA) operates both bus service and a LRT, named TRAX. The construction of the 15-mile TRAX line between Sandy and downtown Salt Lake City began in 1997 and was completed in December 1999. An east/west extension was added in 2003. TRAX operates from approximately 5:30 am to 11:00 pm daily. The UTA also plans to bring commuter rail to the Wasatch Front as part of their 30-year plan.

G.1 Railway Network

TRAX has two segments. The North/South Blue Line running between Sandy and Delta Center in downtown Salt Lake City. There are a total 16 stations running on this segment between Sandy and Delta Center Station. The new extension, East/West University Line runs from Delta Center to the University of Utah Stadium with eight stations. The 24 LRVs are maintained at a single facility. The capacity of a regular train is 300 passengers.

G.2 Passenger and Freight Volumes

The LRT in Salt Lake City are hauling an average of 31,000 riders daily, which is 66% above original projections of 18,700 (Salty Lake Tribune, 2003). The actual ridership numbers placed TRAX in the upper end of systems that exceeded expectations in terms of actual-versus-projected ridership.

According to the FHWA (2000B), rail carried 35 MGT million tons of freight in 1998, and is projected to carry 51 MGT in 2010 and 65 MGT in 2020 in the State of Utah. However, most of the freight in Utah was transported by truck. The trend is projected to continue with the expectation that truck traffic is going to have a larger share, in terms of total freight movement by 2020.

G.3 Transit and Rail Freight Interaction in Salt Lake City

The East/West Red Line operates principally on the extremely wide streets in mixed traffic. The North/South Blue Line operates on streets from Delta Center to 1300 South on streets. The TRAX vehicles share tracks with freight trains from 1300 South to the south end of the UTA line at Sandy. About 12 out of the 15.3 route miles are on shared trackage with Utah Railway, for which the UTA has been granted a waiver by FRA for time-of-day separation of operations. Figure 36 pictures a freight siding protected by a derailer along TRAX LRT.

There is a level crossing with a Utah Railway spur at 2400 South, protected by signals and derailleurs. There is another freight connection at Atwood, 8900 South. The freight line continues south of Sandy, eventually reaching a junction with the UP main line southwest of Provo, UT. Figure 37 demonstrates a freight lead connection to LRT tracks in the TRAX network.



Figure 36. Freight siding along TRAX LRT



Figure 37. Freight lead connection to LRT tracks

The UTA line has train control by conventional block signals without enforcement. Power is supplied through a 750 VDC catenary system. Operating speeds are unusually high for a light rail line, as high as 65 MPH on parts of the line. Freight is restricted to 35 MPH. Typically one freight train operates, per day, in the early morning hours to provide switching services to a number of industries located along the light rail line. There are 33 grade crossings. All UTA maintenance is performed in accordance with FRA standards, since so much of the line is shared trackage with freight.

The basic arrangement for UTA trackage is that freight has the alignment between the hours of midnight and 5:00 am Sunday through Thursday. Dispatching is provided by TRAX controllers using basic radio communication. Utah Railways contacts the controller in the same way that LRT trains are dispatched during daytime including both peak and non-peak hours of the operations.

During the relatively short period since TRAX began operation in 2001, it appears that both freight and LRT work very well together. The survey reply that we received is very positive. They responded to our question "Are there any performance incentives for the owning/operating railroad?" with "No need, as we worked well together."

It is also indicated in the survey that the freight railroad "had to change their delivery times to accommodate transit operations" along the same rail line. They also "fix any problems that they have caused" to meet the insurance and liability requirements or burdens created by the shared operation.

The overwhelming concern is clearly safety, even though there is no accident history since its commissioning. As for key factors contributing to successful interaction between LRT and freight railroad, TRAX staff clearly credited "communication and willingness to work as a team."