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PREFACE

This document was prepared for the Federal Highway Administration (FHWA) Intelligent Transportation Systems Joint Program Office (JPO) and presents the findings of a six month study undertaken by Anne Aylward, a senior transportation consultant to the Volpe National Transportation Systems Center (Volpe Center). Michael Onder was the FHWA project manager. The conclusions and recommendations represent the views of the author and not necessarily those of the FHWA.

This report is considered an informal technical document and is intended to improve working level communication. Because of its informal nature, the report may be subject to change as it is reviewed by industry experts and as more information becomes available. It is the author's hope that the report will contribute to dialogue between the Federal government and the intermodal freight transportation industry. If private and public sector can agree on transportation priorities it will be easier to identify advanced information technologies which may contribute to solutions.

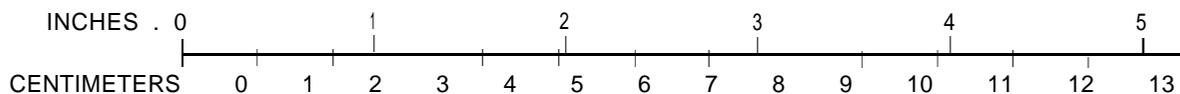
Many people have contributed to this report. Managers of intermodal terminals and operations have been generous with their time and candid opinions. Industry associations and committees have welcomed our participation in their meetings and deliberations. Public officials have been open in discussing their concerns and thoughts about opportunities. Their contributions have all enriched this report.

The author wishes to acknowledge these contributions and to thank her colleagues at the Volpe Center who assisted with editing and preparing the report, particularly Michael Wolfe and Simon Prensky. All factual errors and omissions remain solely the responsibility of the author.

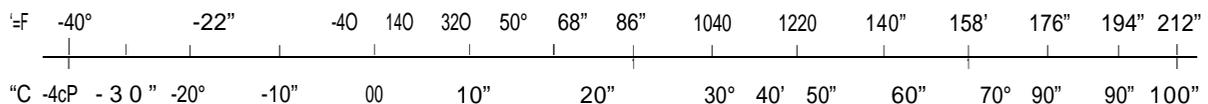
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INTERMODAL FREIGHT TRANSPORTATION AND ITS

EXECUTIVE SUMMARY

The purpose of this paper is two fold: First to provide background information to the U.S. Department of Transportation's Intelligent Transportation Systems Joint Program Office (JPO) to support a deeper understanding of the business perspectives, operations, and technologies used in the intermodal freight industry. Second, to suggest courses of Federal action that will improve communications with the commercial intermodal freight sector and enhance the interface between the ITS program and industry initiatives.

The Problem: Since the 1991 passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) the Federal government has invested extensively in development of the Intelligent Transportation System (ITS), applying advanced technologies to enhance the effectiveness and efficiency of the nation's transportation system. The Commercial Vehicle Information Systems Network program (CVISN) is an important component of the ITS program.

In the past decade, responding to the requirements of the emerging global marketplace, shippers have pressed for improved transportation service at lower cost. Many transportation service providers have turned to new technologies to meet shipper needs. Application of advanced technology has transformed the freight transportation industry, as individual companies have invested in state-of-the-art technology to maintain profitability in an increasingly competitive international marketplace.

This paper describes the various advanced technologies already in use in the intermodal freight transportation industry which must be considered during the deployment of the ITS CVISN program. It addresses the opportunity for improved communication between the public and private sector regarding technology applications to the freight transportation system that could enhance the capacity of the system as a whole.

Research Methodology: This paper is an informal technical document intended to improve working level communication between the Federal government and industry about the application of advanced information technologies to intermodal freight transportation.

The findings of the paper are based on:

- Extensive interviews -- formal and informal -- with industry representatives and staff of Federal, state, and local government transportation agencies;

- Site visits to intermodal terminals and freight facilities to view technology;
- Participation in industry association and committee meetings and deliberations; and
- Review of technical literature and industry press.

Summary of Findings:

The efficient movement of freight is essential to the economy of the United States and to the quality of life and standard of living of its citizens. In the last 25 years, the United States has moved into an increasingly global economy. Imports and exports now comprise twenty percent of the U.S. gross domestic product and are expected to triple over the next 25 years. If United States products are to compete effectively in international markets, the nation must continue to support an efficient, cost-effective freight transportation system. To maximize the capacity of the nation's transportation infrastructure, it is important to plan and manage transportation assets as a *system*.

The *modes of transportation* that comprise the U.S. transportation system developed independently. Each mode is a separate system that consists of a network of line-haul infrastructure, terminals that connect with other modes, and vehicles that carry cargo. Today the modes operate in parallel and sometimes cooperatively, but each largely retains its own distinct ownership, operating patterns, and financing sources.

The *intermodal "system"* is in fact not a system at all, but a collection of systems that have been variously linked together. Managers of each mode understand their own operation but no one is responsible for integrating the overall system. Information and communication technologies have enormous potential to strengthen the links between the separate modal systems.

Intermodal interchange takes place at physical points of transfer, such as terminals, sidings, and border crossings where freight and equipment are transferred from one mode to the next. The physical interchange should not be allowed to impede intermodal transport as a result of poor access, incompatible equipment, etc. Intermodal transportation also depends upon an electronic interface to transmit the information required to transfer the cargo from its origin to destination. Information technologies and telecommunications are employed in innovative ways to improve customer service and achieve transport cost savings. A market niche has developed for third party operators to create services in intermodal transportation that benefit both the shipper and the transportation provider by linking the modal systems.

National investment in both the physical links that allow cargo to move between modes and the technology links that enable the intermodal exchange of information is critical. Advanced information and communication technologies applied across the intermodal system offer important opportunities to increase system capacity.

Shippers' transportation requirements have changed in response to increasing competition. Shippers have pressed for cost reductions and service improvements. Shipper requirements include frequent, reliable, and fast service; global service and management capacity; door-to-door intermodal service; dedicated (or available pooled) equipment; full logistics services including cargo tracking, just-in-time inventory management, warehousing and distribution; and the ability to exchange information electronically to handle bookings, cargo status, billing and other data interchange.

The transportation industry's response to these shipper requirements has resulted in higher quality value-added service. Deregulation has allowed carriers to be more responsive to customers and to develop individualized services. The most important current trends include movement toward end-to-end service; supply chain integration; new partnerships and alliances; outsourcing of logistics functions; sharing of equipment and other assets; paperless exchange of information; and adjustment to the changing role of government in freight transportation. In the last decade enormous savings have been achieved through deregulation and greater efficiency in the freight and logistics systems. Terminal operators and third party companies have developed services that link the modal systems.

Advanced technology has revolutionized transportation. Transportation service providers widely use advanced technologies to identify and track cargo and equipment in real time and to transact business electronically. Industry has adopted technology solutions to solve specific business problems. Before any investment is made in technology, it is critical that the business problem to be solved be clearly understood so that the technology selected will be appropriate to improve the situation.

The intermodal freight industry has set the pace in transportation for use of advanced technology. Private freight carriers have made substantial use of information technology to enhance the productivity of their own operations. These technological systems were initially developed as *closed corporate systems* without regard to the efficient operation of the broader intermodal freight system. More recently, these systems have begun to provide links with customers and intermodal partners.

Exchanging freight information electronically, carriers and shippers are able to automate and integrate a broad range of billing, data entry, and cargo tracking functions. Automation has allowed carriers to enhance their transportation service by providing the shippers and multiple trading partners with real-time information on the movement of the vehicle and the cargo.

Advanced communication technologies have transformed intermodal transportation in the past decade, however the question of *system-wide data interchange* remains problematic. System interoperability and the compatibility of existing systems and the ITS CVISN program will be key.

The traditional *role of the Federal government in freight transportation* is the funding of infrastructure for some modes and the execution of regulatory, safety and environmental oversight of the system. Since the passage of ISTEA in 1991 the Federal government has aggressively engaged in a broader partnership in the efficient movement of freight. Both public sector and

industry leaders have made a major commitment to outreach, education and partnership. The current public sector interest in freight transportation is an opportunity to create a shared vision of the future needs of international intermodal freight transportation in the United States.

The U.S. Department of Transportation (DOT) has responsibility for providing *leadership for technology applications to transportation* and for encouraging technologies which allow the seamless exchange of information between modes and between the public and private sectors.

Summary of Recommendations

Private freight carriers have made substantial use of information technology to enhance the productivity of their own operations. Public investment in ITS systems can further improve the productivity and safety of intermodal freight operations. The current public interest in freight transportation policy creates an opportunity to develop a shared vision of the future needs of international intermodal freight transportation in the United States. The Federal government can impact this vision by taking action in the following areas:

Provide Infrastructure Funding to Support Efficiency and Global Competitiveness. The private sector cannot provide seamless intermodal freight transportation services to support domestic and international trade without the underlying physical and information infrastructure provided by the Federal government. This is a crucial Federal role in transportation.

Action: Build on the programs begun under ISTEA by providing funding for the physical infrastructure essential to the intermodal transportation system, including terminal access roads and port navigation channels.

Action: Provide sufficient funding to support federal programs essential to the information infrastructure including weather information, the global positioning system, navigation information, and the full communication spectrum.

Support Regional and Corridor Efforts. Intermodal freight transportation is international in scope. Supporting the smooth flow of freight is in the national interest. Many issues transcend the local or state level. It is important to sustain corridor ("truck shed") activities such as those underway in the I-75 Advantage program, the I-95 Corridor and the HELP program and to fully involve the freight community, particularly port and terminal operators in those efforts.

Action: Encourage, facilitate and participate in regional and corridor efforts. Establish regular funding mechanisms for these public-private alliances.

Understand the Freight Sector and Develop a Shared Vision of Technology Benefits. The complexity of the freight sector, the multitude of stakeholders involved, and their divergent priorities have created a conflicted vision of what the freight sector might gain from ITS technologies. The Federal government is positioned to provide leadership, to develop a shared vision of the capabilities of technology applied to global transportation and its benefit to the

nation, to the private sector and to state and local governments, and to incorporate into this vision knowledge derived by Department of Defense (DOD) as a major user of the system. To effectively meet the needs of the intermodal freight transportation sector it is necessary to understand freight transportation operations and priorities, including current awareness about the state of the art applications of information technologies.

Action: Participate actively in industry meetings, activities and working groups.

Action: Provide the Office of Intermodalism with the necessary authority and funding to serve as an effective advocate for intermodal freight issues, regardless of mode, and as a technical resource for the ITS Joint Program Office in addressing private sector ITS issues.

Action: Work with representatives of the intermodal freight industry to create an Intermodal Freight Carrier Leadership Council to meet with the Secretary quarterly and provide input on the impact of the ITS program on the freight industry, as well as such other freight policy issues as may be of mutual interest.

Lead Transportation Technology Efforts of Federal Agencies. Transportation technology initiatives which impact the movement of intermodal freight are underway in several Federal agencies. The current regulatory and reporting system for commercial transportation operators is complex and duplicative. ITS offers significant opportunities for single point electronic delivery of information to government agencies.

Action: Lead Federal transportation technology policy initiatives, particularly the work of the National Science and Technology Council's Transportation Committee.

Action: Coordinate transportation technology policy amongst Federal agencies, particularly border crossing initiatives.

Action: Coordinate DOT/DOD/industry efforts to adopt interoperable transportation technologies, particularly for tagging and tracking of cargo.

Action: Support Commercial Vehicle Operations (CVO) operational and corridor tests.

Action: Use technology to simplify the current regulatory and reporting system for commercial intermodal operators by providing single point electronic delivery of information to Federal and state agencies.

Maintain Commitment to Open ITS Architecture. Participants in intermodal transportation are reluctant to absorb the cost of implementing technology if there is a fear that the technology adopted will rapidly become obsolete or incompatible. This is of particular concern in the interface between private sector and government operated systems, e.g. toll facilities and border crossings.

Action: Facilitate private sector efforts to adopt industry-wide performance standards and data protocols.

Action: Address issues of data exchange and interoperability among commercial users and Federal agencies including the Departments of Transportation and Defense and the U.S. Customs Service.

Action: Involve port and intermodal freight terminal operators in ITS/CVISN deployment to identify opportunities and problems at the interface between ITS and the existing intermodal freight systems.

I. INTRODUCTION

Since the passage of the Intermodal Surface Transportation Efficiency Act in 1991, the U.S. Department of Transportation has invested in development of a national Intelligent Transportation System (ITS). Recognizing that the nation's transportation system, particularly for the movement of freight, encompasses multiple modes, the U. S. DOT has requested this exploration of the relationship of the ITS program to the nation's intermodal freight transportation system.

The purpose of the paper is twofold:

(1) Educational: to provide background information to the U.S. Department of Transportation's Intelligent Transportation Systems (ITS) Joint Program Office (JPO) to support a deeper understanding of the business perspectives, operations, and technologies used in the intermodal freight industry.

(2) Prescriptive: to suggest courses of Federal action that will improve communications with the commercial intermodal freight sector and enhance the interface between the ITS program and industry initiatives.

Background:

Efficient, effective and safe transportation plays a key role in the U.S. economy and national security. The transportation system provides mobility for the nation's commerce. It provides access to raw materials, labor and markets and ensures shippers the means to reach regional, national and international markets at competitive costs. The goal of our transportation policy is to provide mobility for passengers and freight, regardless of the mode.

American businesses are the primary consumers of freight transportation services. In an increasingly global economy, American business must compete internationally. Freight transportation is a key component of the logistics system that supports international trade. American companies must establish efficient distribution systems to compete effectively. Distribution costs can be as much as 30%-40% of a product's cost and in the past decade companies have made every effort to decrease distribution costs while requiring improved performance from transportation service providers.

Global trade is projected to nearly triple in the next 25 years. Environmental and fiscal resources are limited. If the nation is no longer willing to construct vast new infrastructure, the existing infrastructure must be managed more efficiently to create additional capacity. The system works only as well as its weakest link. New investment should focus on improving the system as a whole, regardless of mode. Advanced information and communication technologies applied consistently across the intermodal system offer important opportunities to increase system capacity.

In 1991, with the passage of the Intermodal Surface Transportation and Efficiency Act (ISTEA), Congress focused national transportation priorities on Intermodalism and on Intelligent Transportation Systems (ITS):

Intermodalism describes an approach to planning, building, and operating transportation that emphasizes optimal utilization of transportation resources and connections between modes. The focus of this paper is intermodal *freight* activity, although it is important to recognize that with the passage of ISTEA, the term intermodal was broadened to include intermodal passenger movements. An intermodal freight movement is the coordinated and sequential use of two or more modes of transportation for the completion of a trip, where the responsibility is usually assumed, or coordinated by, a single party. Intermodal freight moves door-to-door from shipper to consignee, optimizing its use of transportation modes, involving ocean, air, rail or highway as best suited to the customer's requirements.

Intelligent Transportation Systems (ITS) similarly take an integrated approach to transportation, linking individual transportation elements -- the vehicle, the infrastructure, and the user -- and joining them through use of information and communication technologies into a single system. ITS offers the opportunity to optimize use of our existing transportation system, generating additional capacity from the existing physical infrastructure. The Federal program began as the Intelligent Vehicle Highway System. Its name was changed to recognize the importance of a systemic intermodal perspective.

In the past decade intermodalism has grown dramatically. Doublestack trains, intermodal terminals and other hardware improvements have provided enormous efficiencies to users of the nation's transportation system. Modifications to physical infrastructure will continue, particularly at the links between modes. However it appears that the greatest opportunity for system improvements over the next three decades will come from advances in micro-electronics. This will appear in improved use of communications and data accuracy.

The U.S. Department of Transportation (DOT) plays two significant roles with respect to the application of advanced information technology to transportation:

The first role is to provide technology focus to the transportation system, to promote efficiency and consistency *across* modes. This has been the focus of work by the Transportation R&D Committee of the National Science and Technology Council (NSTC). The Committee, chaired by Deputy DOT Secretary Mortimer Downey, has called for an interagency task force to identify and prioritize transportation information technology topics, cutting across modes and markets and to propose a set of targeted investigations. The cross-cutting topics proposed for examination include:

- Transportation Information Infrastructure Vulnerability and Reliability;
- Data Communications and Spectrum Requirements;
- Global Navigation, Positioning and Tracking Systems;
- Incident Management and Emergency Response;
- Transportation Related Weather Service Requirements;

- Global Harmonization of Standards and Technology; and
- Deployment Decision and Planning Knowledge Base

It is critical that U. S. DOT continue to provide leadership in this area.

DOT's second role is to encourage interoperability and a seamless interface of information technology *between modes and between DOT, DOD, and commercial transportation operations*. This paper focuses on this second role. Its particular focus is the relationship of the Federal ITS program to intermodal freight transportation. It addresses:

- The current extent of deployment of advanced information and communication technologies in intermodal freight transportation.
- The potential contribution of the Federal government's ITS initiative to the efficient movement of intermodal freight and the need to include intermodal freight activities in the program.

This paper builds on the work of the National Commission on Intermodal Transportation, recent work completed for the Federal Highway Administration by Cambridge Systematics on the Impediments to Intermodal Transportation, and the strategic work of the ITS America Intermodal Task Force. It draws on the private sector efforts of groups such as the Intermodal Association of North America's Electronic Business Committee and the X12 Transportation subcommittee of the American National Standards Institute (ANSI).

II. FREIGHT TRANSPORTATION

Freight transportation service in the United States is largely provided by the private sector. This is in sharp contrast to passenger transportation, where the Federal government is actively involved in nearly all aspects of the system. The traditional role of the Federal government in freight transportation has been to provide infrastructure funding through modal trust funds and to tax and regulate use of the system.

Since the passage of ISTEA in 1991, public sector planners and policy makers have increasingly recognized the importance of freight movement and searched for opportunities to create new partnerships and to streamline the public sector presence in freight movement. Government officials at the Federal, state, and metropolitan levels have initiated efforts to better integrate freight transportation policy and planning into their programs. Leaders in the freight sector have also recognized the importance of closer cooperation and have initiated efforts in major metropolitan areas to establish freight stakeholders networks to work with MPO and state officials.

The nation's freight system has developed mode by mode over the last 300 years as geography, history and technology have offered new opportunities for economic development. Managers of each mode understands their own operations but no one is responsible for integrating the overall system. Price integrates the development and use of the system through corporate initiative. The development and current status of this modal transportation system are described below.

A. *Background: Components of the Freight Transportation System*

The coastal waterways and river systems were the backbone of colonial transportation; the 19th century saw the development of the canal and transcontinental railroad systems; the 20th century brought highway and aviation transportation. Today these disparate modes operate in parallel and sometimes cooperatively, but each largely retains its own distinct ownership and operating patterns. Each mode is a system which is comprised of:

- A network of infrastructure: roads, rails, waterways;
- Terminals where cargo transfers between modes; and
- Vehicles which carry cargo
- Each mode also has its own Federal and state regulatory framework and funding system.

The components of each modal system are described below.

(1) Maritime Transportation:

The Federal role in transportation began in 1789 with harbor improvements. Since then, the nations' waterways and shipping channels have been regularly maintained by the U.S. Army Corps of Engineers. Since 1986 channel maintenance costs have been paid from the Harbor Maintenance Trust Fund which is financed by ad valorem cargo user fees.

Terminals in the maritime transportation system are variously owned by the private sector (primarily bulk terminals) or state or local authorities (primarily container and general cargo terminals). Public terminals may be operated by the local port authority, by a private terminal operator, or by an ocean shipping line.

The deregulation of the shipping industry, trends toward consolidation of ocean carriers, merger of Class 1 railroads, and introduction of larger ships and of stack trains have all resulted in the concentration of commerce in a limited number of large and highly competitive "load center" ports. Marine ports, by definition, are located on the coast and often at the center of an urban area. As port areas become more congested the development of connected inland terminals and sorting/distribution yards may become more economically viable.

The ships and barges calling at the nation's ports are all privately owned. Trade between U.S. ports is restricted to U.S. vessels. Trade to international ports is open to international vessels. Regulatory oversight of maritime transportation is divided among several Federal agencies. The Coast Guard has regulatory authority for waterway management, while the Federal Maritime Commission has regulatory oversight of maritime agreements. U.S. Customs and the Immigration and Naturalization Service (INS) have jurisdiction over international cargo and passenger entry, respectively.

(2) Rail Transportation:

The rail system developed to meet the needs of the nation's westward expansion beginning in the 1820's. The Federal government encouraged rail development by granting rights-of-way and adjacent land development rights. The rail industry was substantially deregulated by the Staggers Act in 1980. U.S. DOT has continuing regulatory and safety responsibilities. The introduction of doublestack container trains in 1984 transformed the economics and performance of rail transportation of containers and helped spur intermodal traffic growth. Intermodal has been a growth area for railroads in the past decade. However it is still a small part of the industry's overall business and for most railroads has shown a thin profit margin.

Today the entire Class 1 rail system -- track, trains, and terminals -- is privately owned and operated. However, some short lines, abandoned by the major railroads, have been purchased by local government to maintain service. Since the passage of ISTEA some state and local governments have used Congestion Management Air Quality (CMAQ) funds to build intermodal rail terminals or connections. Rail track, particularly in metropolitan areas, is shared with Amtrak and/or passenger commuter rail operations.

Rail terminals historically were located in center cities. Many of these older terminals have been modernized to handle intermodal traffic, particularly from nearby seaports. Several railroads are also making major investments to build large intermodal terminals at new "greenfield" sites on the fringe of major metropolitan areas. Examples include the Santa Fe's investment in a nearly 600 acre terminal on the outskirts of Fort Worth, and Norfolk Southern's new 800 acre terminal west of Atlanta. Rail terminals are often managed by private contractors.

Rail equipment is entirely privately owned. Ownership can take one of several forms: by the railroad itself, by a third party lessor or pool, or by the ocean carrier using the equipment. Because no railroad has a transcontinental network, exchange of equipment (interline transfer) between railroads is common practice.

(3) Pipelines:

Since the 1860's pipelines have been used to transport fuel products, primarily petroleum and natural gas. Pipeline development and operation is almost entirely a function of the private sector. The only Federal role is regulatory to insure safe operation and rate oversight. Because pipelines, by their nature, move the product from point to point they do not usually interchange with other modes of transportation. Pipeline transportation, although important, will not be further addressed in this paper.

(4) Highway Transportation:

Building and regulating the roads for public use has traditionally been a public responsibility in the United States. The Federal government provides substantial funding for highway programs which are, for the most part, executed by the states. Funding is derived from general revenues and funds from the Highway Trust Fund (financed with gas tax revenues) or from state and local funds often derived from fuel taxes and other user fees. The Federal-Aid Highway Program was established in 1916 to provide a nation-wide system of arterial roads based on uniform standards. It allowed the commercial trucking industry to emerge as a competitor to rail for inter-city freight movement beginning in the 1920's. The National System of Interstate and Defense Highways (the Interstate System), first funded in 1956, transformed the intercity movement of freight.

Truck transportation is the most flexible mode of transportation for providing door-to-door service. It is also the most expensive mode of transportation, except for air. Truck companies and terminals are entirely privately owned. Like rail terminals, many truck terminals have moved to the periphery of the metropolitan area to take advantage of lower land costs and less congested distribution corridors. Truck companies include a wide range of size and technical sophistication. Long haul trucking companies are very different from the drayage operators who provide local pick-up and delivery.

The last two decades have seen a trend toward larger and longer trucks. Opposed by safety advocates and some railroads, these larger vehicles provide shipper efficiencies, but restrict access to older urban areas with bridge and tunnel height restrictions. Accommodating these larger trucks around urban port and rail terminals raises serious issues for road design, construction and funding.

Intermodalism was initially viewed by many truckers as a loss of business to the railroads. More recently, with the rise in gas prices and shortage of qualified long distance drivers, trucking companies have come to see intermodal partnership with the railroads as a new market opportunity. Regardless of the linehaul mode, trucks are typically used for local pick-up and delivery. Most intermodal freight is handled at some point in its journey by a truck. It is not an

exaggeration to say that trucking provides the connections in the intermodal system--the glue that holds the system together.

(5) Air Transportation:

Significant volumes of freight first began to move by air in the 1960's. Larger passenger planes provided the additional cargo space in their bellies to carry significant amounts of cargo. Air freight still represents a small share of overall freight tonnage (less than 1% of domestic tonnage), but in terms of value, its position is more significant: nearly 20% of international trade--by value--moves by air. Nearly all air freight is intermodal since local pick-up and delivery is provided by trucks.

The nation's airspace is public and regulated by the Federal Aviation Administration through the Air Traffic control function, a system of radar facilities, radio-navigation systems, precision landing systems, weather information and communication links.

Major airports are typically owned by local or state governments, with capital construction funds available from the Federal Airport and Airway Trust Fund financed by a ticket tax and locally generated Passenger Facility Charges. Airports were developed primarily for passenger transportation. Cargo facilities are often developed and owned by the public authority and leased to private operators. Airports which have been constructed as small-package (UPS/FedEx) express hubs are very different from traditional airports. Aircraft using the system are privately owned.

The Federal Aviation Administration (FAA) has general regulatory and safety oversight of the industry, while Customs, INS, and the Department of Agriculture all have jurisdiction at international gateways. Aviation's primary participation in intermodal freight operations is through the local delivery of high value air cargo shipments, including operations such as FedEx and UPS.

Summary

The roles of the public and private sector in the operation of the transportation system are depicted in the table below:

Public/Private Involvement by Mode in the Freight Transportation System				
Mode	Line Haul/ Network	Terminals	Vehicles	Regulatory
Marine	Federal	State/Local	Private	Federal
Railroad	Private	Private	Private	Federal
Pipeline	Private	Private	Private	Federal
Highway	Federal/State	Private	Private	Federal
Aviation	Federal	Federal/State/Local	Private	Federal

As indicated in the table above, the principal role of the Federal government in freight transportation is the funding and development of infrastructure (for some modes) and execution of regulatory, safety, and environmental oversight of the system. These activities principally reside within the Department of Transportation (and as noted above, the Customs Service, INS, and the Corps of Engineers). While it is not the focus of this paper, it is important to recognize that the Federal government is also a major freight *shipper*. Agencies such as the Post Office, the Energy Department, and particularly the Department of Defense are all major users of the nation's transportation system.

Further, from the beginning of the nation, Federal government has had an acknowledged interest in interstate commerce, supporting actions that benefit the states collectively but cannot logically be undertaken by the states separately. Historically this has included support of interstate infrastructure such as canals, railroads, and the air and interstate highway system. Beyond infrastructure, there is a national benefit in standardization of regulations and physical dimensions across state lines.

B. Intermodal Freight Transportation

The modes of transportation described on the previous pages have each developed independently, without great concern to connection between the modes. To maximize the capacity of the nation's entire transportation system it is critical to invest in the physical links to exchange cargo between the modes and to invest in technology for exchanging information intermodally.

Containerization has been a key ingredient in the development of integrated intermodal transportation service. The introduction of standardized 20 (and later 40) foot containers for the movement of freight revolutionized the movement of freight. Containerization had its beginnings with international traffic arriving and departing by ship through port gateways. For the first decade, the use of containers was limited to ocean carriage and local truck pick-up and delivery. At the same time railroads were beginning to carry substantial numbers of truck trailers on flatbed cars (TOFC). In 1979 American President Lines made a strategic decision to limit its ocean

service to the Pacific. It initiated dedicated trains to transport containers from West Coast ports to Midwest and East Coast destinations to serve those important markets. This "land bridge" movement shortened transit time from Asia to the East Coast by as much as two weeks. Control and coordination of ship and rail schedules by a single party made for smoother transfers of equipment and cargo.

Transportation deregulation in the 1980's and easing of labor restrictions allowed integration of the separate modes, resulting in optimization of transportation and logistics operations, minimizing total system costs. Specifically, rail deregulation by the Staggers Act in 1980 followed by the de-regulation of intermodal through-rates for international cargo by the 1984 Shipping Act moved intermodalism forward, creating new opportunities for more customer-focused marketing and pricing partnerships. Stacktrains with the ability to carry containers stacked two high, were introduced in 1984, offering a smoother ride and substantial cost savings over traditional trailer and container on flatcar (TOFC and COFC) moves.

Domestic containerized service from interior U.S. points back to port centers using ocean containers began in the mid-eighties on key intermodal corridors. The initial objective was to reposition marine equipment back to port gateways. Domestic intermodalism has offered benefits to all partners in the transaction such as:

- Ocean carriers generate revenue by moving domestic cargo instead of simply repositioning empty containers;
- Railroads win back long haul business lost to trucking;
- Truck operators, facing higher fuel costs and drivers shortages, can concentrate on the more attractive short haul business;
- Intermodal Marketing Companies (IMCs) have found market opportunities in matching carrier equipment to domestic shipper needs.

While containerization offers benefits even in single mode movements, one of its major benefits is that it makes the transfer of cargo between modes -- at ports, rail yards, and truck terminals -- faster, easier, cheaper and safer. The use of the same equipment for sea, rail, and truck operations has considerable appeal for efficient operations. However practical problems exist. Standard ocean containers are 20, 40 or 48 feet long. Domestic shippers have pressed for larger containers and trailers: 48 and 53 foot containers are commonly used in domestic movements. The different nature of the intermodal partnership is another important distinction between international and domestic intermodal activity - one is cooperative, the other is competitive:

- International cargo, moving to and from North America, has no choice. It *must* move intermodally. To provide door-to-door transoceanic service inevitably requires the cooperative partnership of more than one mode.

- Domestic cargo, on the other hand, has a choice. A single mode move, usually by truck can often be most efficient and cost effective. It has therefore taken longer for truckers and railroads to reconsider their naturally competitive relationship and recognize that, in some instances, they will both benefit by offering shippers an intermodal service.

The need to integrate the disparate and not always cooperative modal systems has encouraged the development of a range of third party services to link the linehaul modal services into a seamless, door-to-door operation. Intermodal Marketing Companies (IMCs), for example, have emerged to augment the freight carrier's own capabilities, notifying customers of freight status and monitoring freight payments. Railroads in particular often choose to use these third-party agents as extensions of their limited sales staff.

Value-added-networks offer mechanisms for the electronic exchange and manipulation of transportation information. Other examples of third party services include management of container, chassis, and railcar pools, resulting in significant improvement in equipment utilization. Port authorities and independent terminal operators have similarly developed a range of value-added services to smooth the transition between modes.

The transportation of smaller freight packages intermodally has been transformed by companies such as United Parcel Service (UPS) and Federal Express. Beginning in 1987 UPS offered service to every address in the United States, and currently delivers more than 11 million parcels daily. To coordinate its transportation system UPS has developed sophisticated information technology that is able to monitor the precise status and location of shipments. Using the Internet and their own computers customers are able to track the status of their shipments.

Figure 1 illustrates the relative roles of the modal transportation actors in the provision of intermodal services.

C. Profile of the Intermodal Movement of Freight and Information

The door-to-door movement of freight from the shipper to the consignee involves:

- The movement of cargo,
- The movement of vehicles, and
- The movement of information.

Figure 2 illustrates the steps involved in a typical international intermodal freight shipment.

[Figures 1 and 2 go here]

The domestic part of the trip would be similar to that of a domestic container or trailer. The sequence is as follows:

- (1) Container Pick Up from Shipper:
 - a) If the freight is a full container it is picked up from the overseas shipper for direct delivery to the port by a local trucker.
 - b) If the freight is a less-than-container-load (LCL) shipment it is delivered to a consolidator to be grouped with other freight with the same destination and then trucked to the port.
- (2) Port Storage: The container is stored with other containers for the same destination, awaiting arrival of a scheduled container ship.
- (3) Vessel Loading: The container is loaded onto the vessel which sails to the United States.
- (4) Vessel Discharge: At the U.S. port the container is discharged either:
 - a) directly onto a waiting doublestack train for rail shipment inland,
 - b) into the yard to await pickup by a local trucker for direct delivery to the consignee, or delivery to a nearby (off-dock) railyard for rail shipment inland, or
 - c) into the yard to await barge transshipment to a coastal or river terminal.
- (5) Delivery to Inland Terminal: The train, barge, or long-haul truck delivers the container to the inland terminal where it is stored for pick-up by a local drayman. (In some cases the long haul truck will make direct delivery.)
- (6) Delivery to the Consignee

At each of these steps when the container and its accompanying documentation change hands there is an opportunity for delay -- a *seam* in the intermodal system. It is clear from studying these chains of activity that the intermodal "system" is in fact not a system at all, but a collection of systems which have been variously linked together by users. In some cases this has involved purchase of all elements of the transportation chain, allowing direct vertical integration (as in the case of Federal Express and UPS). At the other end of the spectrum are disconnected modal activities which have created a market for integrators (third party operators) to package the modal elements into a seamless system. Between the two are alliances and partnerships which effectively create specialized systems to meet shipper demands for door-to-door fast, reliable, and cost effective services.

The flow of information takes a parallel but somewhat more complex route. Information transactions might include container booking requests, Customs clearance information, fund transfer documentation, vessel stowage plans, among others. The documentation required,

particularly for international freight transportation varies widely depending on the commodity, countries of origin and destination, and terms of sale.

While taking advantage of an intermodal shipment, shippers expect to deal with a single set of documentation, negotiating with a single carrier. Because each mode has its own documentation and liability requirements, facilitating the necessary documentation for an intermodal freight movement can be daunting. The services of IMCs to facilitate required linkages is invaluable to smaller shippers and transportation providers. The information flow required to support a typical international import freight shipment might include the following:

- (1) U.S. importer contacts overseas shipper, opens a purchase order, and arranges a letter of credit for the foreign bank. Shipper sends an invoice and packing list.
- (2) Consolidator or Shipper issues a Freight Cargo Receipt to the Ocean Carrier or Non-Vessel Owning Common Carrier (NVOCC) which issues a bill of lading to the overseas shipper.
- (3) Ocean carrier or NVOCC sends the Bill of Lading to the shipper and a copy of the Bill of Lading with the invoice and packing list to the U. S. broker.
- (4) The original Bill of Lading and Freight Cargo Receipt are sent to the overseas bank by the shipper.
- (5) Ship transmits its Manifest to U.S. Customs electronically.
- (6) Overseas bank sends a bill to the U.S. bank.
- (7) A copy of the Bill of Lading, Freight Cargo Receipt are sent to the importer.
- (8) Importer pays U.S. bank.
- (9) U.S. bank sends the Bill of Lading to the broker, on behalf of the shipper.
- (10) Broker arranges for a cargo release from Customs.
- (11) Broker issues a delivery order to the motor carrier, authorizing freight pick-up.
- (12) Overseas bank pays the shipper.

The use of advanced communications technologies to place orders, convey cargo status information, and transmit invoices and make electronic payments has dramatically changed the freight industry. Increased standardization of communication across modes will offer even greater efficiencies.

D. Trends in Intermodal Freight Transportation

Increasingly the economy of the United States depends on international trade. Over the past twenty years imports and exports have grown to the point that they now comprise twenty percent of the U.S. gross domestic product. International trade is expected to triple over the next 25 years as a result of global market trends unless transportation infrastructure is insufficient to support the market.

The shift towards greater interdependence of the world's economies has had enormous impact on the demand for transportation services. Increasingly products cannot be easily labeled "domestic" or "foreign". Production of labor intensive component parts has shifted to countries with lower cost labor markets requiring further transportation for assembly of the manufactured product. This decentralized manufacturing and assembly, involving multiple locations has increased both transportation and information management requirements. Shippers require global transportation coverage. Global markets increase the importance of international standards for transportation equipment and documentation. Over the next decade the distinction between "domestic" transportation and "international" transportation will continue to blur.

America's economy has changed in response to this globalization of commerce. This has been reflected in changes in shippers' transportation requirements. Grappling with the imperatives of international competition, shippers continue to press freight transportation providers for cost reductions and service improvements. Major shipper requirements include:

- Frequent, reliable, and fast service;
- Global service and management capacity;
- Door-to-door intermodal service;
- Dedicated (or available pooled) equipment;
- Full logistics services including tracking, warehousing, and distribution; and
- Ability to exchange information electronically to handle bookings, cargo status, billing and other commercial transactions

The transportation industry has responded to these shipper requirements by providing higher quality value-added service, often involving more than one mode of transportation. Deregulation has allowed carriers to be more responsive to customers and to develop individualized services. If United States products are to compete effectively in international markets, the nation must continue to support an efficient, cost-effective freight transportation system. In the last decade enormous savings have been achieved through deregulation and greater efficiency in the freight and logistics systems. The most important current trade and transportation trends affecting intermodal freight transportation include:

Industry Structural Change: Deregulation of the modal transportation sectors has permitted mergers and consolidations, creation of multimodal companies, and strategic alliances between companies. This has allowed both vertical integration through creation of multi-modal companies--ownership of the entire transportation chain by a single company, as with the acquisition by CSX railroad of an ocean carrier (SeaLand) and intermodal trucking company

(Overnight Transportation) and a barge line (American Commercial Lines) -- and horizontal integration--where companies enter into capacity agreements and market alliances to offer the full range of intermodal service, as with the agreements between railroads and major truckers such as J.B. Hunt and Schneider National.

Trend to Larger Vehicles: One outcome of the restructuring of transportation providers and their search for greater efficiencies has been the trend toward larger vehicles: larger, deeper ocean going vessels, doublestack trains, longer, heavier trucks, wide body airplanes. These larger vehicles have tended to concentrate freight activity at hubs or load centers, placing demands on the infrastructure at those hubs. In the past decade demand has grown for deeper channels, greater tunnel and bridge clearances, reconfigured intersections. Surges of cargo volume resulting from larger ships or longer trains have generated demand for larger and more efficient terminals with better access.

Shared Assets: Pooling of equipment to allow greater efficiency and utilization of assets has become increasingly common as transportation service providers in all modes seek to cut costs while improving service. Examples include vessel sharing agreements between ocean carriers, neutral chassis pools used by truckers hauling ocean containers, the neutral container pools recently introduced by the railroads among others. Shippers increasingly expect a dedicated pool of equipment sufficient to meet peak demand.

Supply Chain Integration: Traditional methods of manufacturing and distribution are being replaced by more efficient integrated manufacturing and distribution systems. Businesses have responded to competition and financial pressures by using advanced technologies to integrate shipper and carriers systems and services. Purchase orders go directly from the retail outlet to supplier's manufacturing facility. The cycle time from production to sale has been dramatically shortened, heightening the imperative for shorter, more efficient transit time to permit corporate competitive agility.

End-to-End service: Shippers increasingly require service from door-to-door, requiring carriers to develop agreements and alliances which allow them to offer this "seamless" service. Shippers are increasingly emphasizing quality and reliability. They are no longer concerned with specific cargo routing, as long as it arrives on time, on cost, in good condition. The emphasis, driven by commercial profitability, is on end-to-end service.

Outsourcing: Focus on a company's "core competencies" has been another trend. Railroads for example, have decided to focus on provision of line haul services and contract out marketing and intermodal interface to third party experts. Many shippers, even major international corporations, have "outsourced" their transportation and logistics operations, contracting with experts to route their products.

Paperless Information Exchange: The need to transmit information from mode to mode creates an enormous paper flow. Paperwork has been a major obstacle to "seamless" intermodal transportation. The trend toward computerized communications will eventually result in fully integrated information systems that address operations, tracking, billing and other corporate

needs. This information is not only of value to the transportation carriers, but can also update the customers on a real time basis to monitor shipment status. The explosion of access to the Internet and the World Wide Web offer nearly endless new possibilities for communication and information exchange and are transforming transportation and logistics management.

Changing Role of Government: With the passage of ISTEA in 1991 public transportation officials at all levels of government have become more aware of the role of freight transportation. Retraining staff to understand the importance of freight and the need to accommodate it within the national, regional, state and local systems has required significant cultural change within public sector transportation agencies. Private sector freight transportation providers and shippers have similarly had to learn the art of working with their local Metropolitan Planning Organization (MPO) and state officials. New partnerships and communications with the commercial sector need continuing attention.

These trends have combined in the past decade to create a challenging environment for companies providing freight transportation service. Faced with customers pressing for improved service at lower cost many companies have turned to new technologies to meet their needs. Application of advanced technology has transformed the freight transportation industry in the past decade as individual companies struggled to succeed in an increasingly competitive marketplace. These applications are discussed in the next section.

III. APPLICATION OF ADVANCED TECHNOLOGIES TO INTERMODAL FREIGHT TRANSPORTATION

Effective intermodal shipment of freight requires not only the transfer of the cargo itself but also the transfer of information between transportation modes. The container revolution and development of new information systems have been significant improvements in the past few decades. In the coming decade advanced technology is likely to improve transportation productivity with:

- New equipment and vehicle systems which increase the capacity of the modal line-haul network;
- New state-of-the art terminals using advanced technology for cargo interchange and handling to reduce transfer cost and time; and
- New information and communication technologies which offer the opportunity to generate additional system capacity through sophisticated management of existing transportation infrastructure.

This section first describes the generic technology and then explores current technology application to modal and intermodal transportation.

A. *Advanced Transportation Technologies*

Advanced technology, particularly information technology, has had a revolutionary impact on physical distribution of freight. It has heightened competition by providing tools for sharper, leaner, more focused operations. At the same time it has provided the tools for strategic partnerships and new supply chain relationships. Paradoxically, technology advances enhance both competition and cooperation. Generic applications which are similar across modes are described below:

(1) **Cargo and Equipment Tracking Technologies:**

Global transportation and logistics are rapidly being transformed by the ability to use communication technology to identify and monitor cargo and equipment in real-time virtually anywhere in the world. These technologies have been applied both to line haul activities and to intermodal transfer operations. The most prominent technology applications include:

Radio Frequency (RF) technology: The use of passive back scatter for automated equipment identification (AEI) relies on radio signals between passive tags and active interrogators. The technology was first marketed in the mid-1980's and is widely used in the port and rail industries. This technology has been used extensively in warehousing and manufacturing applications and with improved reliability, durability and effectiveness it has gained acceptance at terminals to

manage traffic flow through gates and to track yard equipment for improved cycle time and productivity.

Active RF consists of battery powered minicomputers that provide active monitoring of inventory and inventory state in transportation. The Department of Defense is experimenting with alternate RF technologies that use active read/write RF tags able to hold a complete container manifest. DOD is a large shipper with specialized needs to meet its requirements in combat conditions. It must be able to access information about container contents in a combat environment without certainty of access to a secure external communications network.

Cellular : Other companies, such as UPS, have chosen to install cellular phone communications systems rather than GPS to maintain direct two-way contact with their drivers allowing them to provide real-time information to their customers.

Bar Codes: One dimensional bar codes are arrays of parallel narrow rectangular bars and spaces which represent single characters in a particular symbology and are arranged in a particular order as defined in the symbology. Bar codes are printed, scanned, decoded and transferred to a host computer. The technology relieves the user of the tedious and error-prone task of reading a label and transcribing the information manually onto a form or key-entering it into a computer. Bar codes are extensively used in transportation for identifying equipment. *Two dimensional bar codes* use multiple dots or other arrays that carry larger amounts of data and can be used for personal identification (e.g. photograph) or bills of lading. Other forms of two dimensional bar codes are used by express shippers for high speed sorting of small packages.

Smart Cards are integrated circuit cards the size and shape of a credit card which contain an electronic chip allowing them to process as well as store information, currently in the 2K to 8K range. Smart cards can contain read-only memory, read/write memory, or a combination. Smart cards are increasingly used in freight transportation as part of gate transactions to identify the driver and trucking company. Other application include toll and gas payment and related transactions, and by extension, vehicle tracking.

Satellite-based Location Determination and Communication technologies are used for location determination and navigation. They provide global coverage and unprecedented accuracy. As further discussed below, applications range from aviation and maritime navigation to vehicle and cargo tracking which provides one and two way digital communications between truck dispatcher and driver. (a) *Global Positioning Satellites (GPS)* are a DOD owned constellation of 24 satellites which enable position determination for location and navigation with global coverage and, if Differential GPS is used, with unprecedented accuracy. (b) *Geosynchronous Orbital Satellites* are used to relay positional data on cargo or equipment movement for inventory control and security. (c) *Low Earth Orbit Satellites (LEOs)* promise in the near future to substantially lower cost while providing similar functions as Geosynchronous orbital satellites.

(2) **Information Exchange and Communication Technologies:**

In the last two decades, following the leadership of banking and financial institutions, transportation companies began to recognize that considerable savings could be realized by the electronic exchange of data. Further, as companies re-engineered their business procedures, many of those historically internal procedures were outsourced, creating a further need to exchange information and communicate electronically beyond the bounds of the individual corporation.

The interchange of information is as important to the intermodal movement of freight as the interchange of the freight itself or the equipment on which it is moving. Historically, the documentation associated with the movement of freight, particular international freight, created vast amounts of paperwork, enormous opportunities for errors in transmission and data entry and re-entry, and resulted in routine delays while cargo waited for the necessary documentation for clearance to move to the next stage of its journey. The application of advanced information and communication technologies to enhance "electronic commerce" has allowed significant improvements in the provision of efficient seamless service through use of a full including the full range of computer-to-computer links for the exchange of business information.

A specific, and particularly important, aspect of electronic commerce is Electronic Data Interchange (EDI) - the transfer of data between business partners using very specific industry standards, data sets, and protocols. In 1968 the Transportation Data Coordinating Committee (TDCC) was formed by major carriers in collaboration with shippers, financial institutions, and other partners in the shipping process, to standardize the way information about freight transactions was handled. TDCC issued the first draft transaction standards for ocean, air, rail, and truck industry documents in 1975.

In 1979 the American National Standards Institute (ANSI) accredited the X12 Standards Committee to develop standard industry formats. It released the first official EDI standard, ANSI X12 in 1983. International standards were introduced in 1987 when the United Nations Commission on Western Europe formally adopted EDI for Administration, Commerce and Transport (EDIFACT) as a standard. EDIFACT's role is similar to ANSI X12 but with wider jurisdiction.

While EDIFACT and ANSI X12 are not directly compatible in terms of transaction sets and software, translation software can be used to convert one protocol to the other. While carriers involved primarily in U.S. domestic trade continue to use the ANSI X12 standards, those working in international commerce are moving to adopt international standards developed using EDIFACT formats. Currently documents prepared in ANSI X12 formats are more numerous, however this will change as international trading partnerships expand and demand grows.

The U.S. Customs Service significantly accelerated adoption of automated billing and cargo manifesting by introduction of its own automated systems. Beginning in 1984, Customs introduced an automated system for ocean (and later air) cargo. Introduction of the automated broker interface (ABI) and automated manifest system (AMS) facilitated electronic filing of the cargo manifest, bill of lading, vessel arrival times, "in-bond" movement, status notifications, and a variety of other information of value to shippers and other participants in the system.

Customs' initial use of information technology was based on a proprietary EDI format. However major ocean carriers insisted on the use of ANSI X12 transaction sets and new X12 transaction sets were created for Customs applications. The US Customs Service is now supporting X12 on a permanent basis and also supports several EDIFACT format transactions. It is committed to supporting both standards.

The Automated Manifest System (AMS) network has been in place for more than ten years. Participants include 131 ocean carriers, 37 data processing service centers, 18 port authorities, 15 secondary notify parties, 9 software vendors, 49 direct discharge ports and 135 inland ports. Today there are more than 2000 participants in Customs' Automated Broker Interface (ABI) System. Customs automation has resulted in quicker freight release time, since electronically transmitted cargo information can be reviewed and status notifications provided up to five days in advance of cargo arrival in the United States.

The relationship between Customs and the trade community may provide lessons for the ITS program. From an inauspicious start in the 1980's when the trade community was informed that it must automate or perish, a more productive relationship has developed. Customs has become actively involved in the industry's EDI discussions and several years ago began to attend the X12 meetings. In 1994 the X12 Transportation Sub-Committee created a Customs Task Group (I/TG9) which has actively involved U.S. and Canadian railroads and truckers. An ocean-rail sub-group has been formed to promote EDI intermodal cooperation.

The North American Free Trade Agreement (NAFTA) has also resulted in intense interaction between government agencies and with the rail and trucking community with regard to land border crossings. The lessons learned there may translate back to the nation's ocean and air borders.

B. *Modal Applications of Technology*

Information and communication technologies have been in use for some time to enhance productivity in the air, marine, trucking, and rail transportation modes. Technology applications have enhanced: (a) the performance of the infrastructure, (b) the utilization of equipment, and (c) the flow of information in each mode. The experience in the major freight modes -- ocean, rail, air, and highway -- and at their terminal interfaces -- is summarized below to provide background knowledge for the discussion of the intermodal applications of technology.

(1) *Marine Transportation*

(a) *Infrastructure:* The nation's waterways and shipping channels are maintained by the U.S. Army Corps of Engineers and regulated by the U.S. Coast Guard. The Coast Guard has installed Vessel Traffic Systems (VTS) in some of the nation's busiest ports and proposes extending the program to other ports. These automated systems can both enhance safety and increase productivity. VTS, common in ports in Europe and Asia, use advanced information technology to guide vessel operations and docking and to minimize the possibility of vessel grounding.

Differences in navigation, geography, tides, and weather from port to port suggest a program which creates incentives for developing unique local systems within a nationally consistent framework.

(b) *Equipment Utilization:* Some ocean carriers have installed fully integrated shipboard computer systems which are used for stowage planning, management of hazardous materials, equipment utilization, and communication with shore-side computers. Technology has also enhanced vessel navigation. It is not uncommon for ships and barges to be equipped with GPS technology. The International Maritime Organization is finalizing standards for the use of ECDIS (Electronic Chart Display and Information Systems) in place of paper charts. ECDIS is a combination of information streams that yield a console based real-time model of ship location, as well as the location of the bottom, dock, shore, and navigation obstacles. ECDIS is based on a digital vector-based nautical chart, which can reveal layers of information. Typically ECDIS includes a gyrocompass, a depth sounder, radar and other navigational equipment. ECDIS integrates all these tools and information streams in an on-board computer and displays the composite image on a color screen.

The Shipping Act of 1984 substantially relaxed regulation of ocean carriers operating in U.S. waters. Specifically it allowed ocean carriers to enter into partnership both with inland carriers (truck and rail companies) and with other ocean carriers. Domestically this has resulted in vertically integrated companies such as CSX and American President Companies (owners and/or operators of ocean, rail, truck, and terminal operations). Internationally it has resulted in a trend toward consortia and other vessel and equipment sharing agreements between ocean carriers.

While vessel sharing agreements and consortia result in a substantially more efficient system, they have inadvertently created temporary barriers to the implementation of advanced technology. Carriers had tagged their containers and equipment based on the internal corporate requirements of a closed transportation system. When they entered industry partnerships, sharing equipment and terminals, they returned to manual systems because their partner ocean carriers had not yet adopted compatible technology.

(c) *Information Flow:* Historically ocean carriers have undertaken cooperative applied research through the Cargo Handling Cooperative Program (CHCP), an industry research and technology consortium of U.S. flag ocean transportation carriers sponsored by the Maritime Administration. It has served to develop and promote innovations in maritime cargo handling such as an equipment location system, using DGPS for real time cargo location and RF readers for AEI identification of container tags; and an automated stevedore system using hand-held pen-based computers for stowage and yard storage.

In 1991, a group of major ocean carriers formed the International Shipping Agreement (ISA) to develop data sets that carriers can use for electronic exchange of data with shippers, forwarders, terminal operators, and others. The ISA published a series of implementation guides for EDI transactions with ocean carriers for booking, bill of lading instructions, arrival notices, cargo status and vessel schedules. It offers software to transportation partners and customers for an initial cost of less than \$2000. The ISA experience has underlined the importance of agreeing

upon industry standards since the use of EDI requires communication of strictly standardized data -- for example a standard voyage number and a standard definition of loading and discharge port.

The ISA has had to grapple with the multiple standards currently used by their industry: in 1992 they published guidelines covering TDCC standards; a guide for application ANSI X12 rules was produced in 1993; and a guide for communication under international EDIFACT standards published in 1994.

(2) Rail Transportation

The freight rail industry made early use of information technology because much of its freight and equipment is transferred internally within the industry, between railroads. The need for accurate information on equipment location led to development of the Car Location Messages (CLM). In 1981, the Association of American Railroads (AAR) created RAILINC as a wholly-owned for-profit subsidiary to make the rail industry more competitive, more efficient, and a more attractive provider of transportation by creating and maintaining a centralized information service using computer and telecommunications technology and permits transmittal of bill of lading information as well as communicating other electronic business.

Railroads are increasingly making use of AEI and other rail automation systems to stay competitive. However, because railroad computer systems were installed to meet internal company and industry needs without considering the needs of their partners in intermodal transportation. Systems have developed primarily to handle internal data processing and communication with other railroads. The development of protocols which make the railroads compatible with other modes is a pressing issue for intermodal transportation. It needs to become a pressing issue for the railroads.

(a) Infrastructure: The development of model intermodal container transfer facilities (ICTFs) which link port, rail and highway cargo transportation demonstrate the importance of handling ocean cargo, port trucking and intercontinental rail within the port area to minimize the negative environmental impact on the local residential area. Historically, intermodal rail terminals have been created by re-developing older urban rail yards. New state-of-the art on-dock rail terminals or intermodal rail terminals being developed on the circumference of metropolitan areas minimize negative traffic impacts to their host cities.

Technologies such as Automated Train Control Systems (ATCS) or Automatic Train Supervision (ATS) technologies which are widely used on Europe and Japan's more densely used rail networks are still being explored by railroads in North America. These systems permit the same track system to handle increased operations - both freight and passenger. In partnership with Federal regulators, the industry continues to move forward with technology based infrastructure safety improvements such as real-time grade crossing warning systems.

(b) Equipment Utilization: AAR has managed an industry wide program which has resulted in tagging 97% of all cars with Amtech tags (the other 3% of cars are not in full service). There are 1500 readers distributed every 150 to 300 miles along the railbed. In this AEI system, active

since 1992, scanned information from car tags is sent by each railroad to the nationwide AAR network which shippers or their tracking companies then access by computer. The tag and scanning system cost the railroads about \$250 million.

Enhancements will include more seamless tracking of cars through urban rail yards from one railroad to another. It now takes up to three days to move a car ten miles across town from one railroad to another. Until recently terminal operators used exclusively manual monitoring of cargo and freight movement.

Railroads are utilizing technology to improve operation of their individual systems and to improve utilization of pooled industry equipment. Examples of improved utilization of pooled equipment are the Equipment Management Program (EMP) and North American Container System (NACS). EMP is jointly sponsored by Conrail, Norfolk Southern, and the Union Pacific which contributed 7000 new 48 foot containers to a neutral pool. Users book equipment through a computerized reservation system (REZ1) managed by TIE Logistics of Newton MA.

The program began in October 1994 and since that time has improved container utilization from 2.2 to nearly 3 turns per month. The program also offers exception reports, cost allocation and control, and billing for the participating carriers. The billing program has also reaped revenue benefits for the participants: historically 50% of rail carrier bills were paid within 60 days; EMP increased billing accuracy and improved information provided to customers. It now reports 99.6% payment in under 30 days! Building on the success of EMP, the NACS program began this spring offering a similar service for other major rail carriers.

(c) Information Flow: Railroad executives agree that better management of information can improve efficiency: pre-loading and advance pickup information, advance delivery information, shipment management including early warning of late trains, efficient fleet management, better storage logistics, more efficient rail transit, and use of information systems to better deliver data to customers -- all allow improved rail system utilization. Managing operations on the street aggressively will improve terminal operations.

In 1992 the AAR and Railway Association of Canada established the Rail Customs EDI Task Force to work with U.S. Customs to develop an automated manifest system. The Task Force developed Rail EDI Customs Guidelines which set forth transaction sets and operational guidelines for an AMS interface with Customs in X12 syntax. Rail AMS came on line in September 1995 in Champlain, New York. Noyse, MN, Portal ND and International Falls MN are now on line. The Great Lakes rail gateways will be next and eventually, with participation from southern railroads, the Mexican border rail crossings.

The Rail AMS system was designed so that all the information can be directly downloaded to the recipient, saving the railroad a duplicate transmission and eliminating faxes and document handling. This means that the Customs and commercial systems can be fully integrated.

AAR reports that more than 50% of rail industry business is conducted with information originated by PC generated waybills. However since individual railroads are still heavily invested

in proprietary software there is a reluctance to reinvest in an intermodal industry standard. Intermodal business is a small (and not the most profitable) segment of business for most U.S. railroads. Railroads have set priorities for their MIS staffs far more profitable than re-programming for intermodal interoperability.

Individual railroads are investing substantially in information technology. For example, in 1995 the Burlington Northern opened a new complex in Fort Worth Texas able to manage the railroad's 22,000 mile network. It provides centralized dispatching, locomotive management, crew management, maintenance of way activities, communication and signals and customer service. The system is based on real-time information about equipment location, displayed on real-time maps of the railroad's operations. At the time of its opening experts estimated that it would increase the railroad's capacity by 20%.

(3) Highway Transportation

As with other modes, information technology provides the trucking industry with the ability to improve internal efficiency and services offered to customers.

(A) Infrastructure: As observed above, the public sector is substantially involved in all aspects of highway transportation, including applications of information technology to transportation infrastructure through the ITS program. The ITS Program is evaluating several promising technologies through interstate corridor operational tests. Tests to evaluate the productivity and safety enhancement potential of these technologies are being conducted as part of the HELP program in the western states, the I-75 Advantage Program (using MACS, the Mainline Automated Clearance System) and the I-95 CVO program. These tests assume an open architecture and system inter-operability which will facilitate industry communication and global market penetration. Global standards and harmonization of U.S. domestic and international standards for marine, rail, highway and air modes are key to a seamless intermodal transportation system.

Analysis of truck freight movements recognizes that commercial flows tend to operate within interstate "trucksheds" that define the normal use pattern for freight movements within a region. Unfortunately the national transportation system does not include a unit defined as a "region" or "corridor" or "truckshed". Funds are transferred from Washington to the state highway (or transportation agency. Often, even at the state level, it is another agency which executes safety and transportation regulatory improvements. Changes need to be made in the institutional structure to encourage the regional, corridor, and "truck shed" improvements needed to facilitate freight improvements.

(b) Equipment Utilization: Long haul truckers have invested in significant technology to track their equipment and maximize its utilization. The market has utilized several types of satellites to provide locational information. A major industry leader is Qualcomm which offers a widely used two-way communication and tracking system (Omnitracs) (EutelTracs is the European version). The system provides fleet management, vehicle monitoring information, diagnostics, driver

performance, dispatch instructions, and other equipment utilization information. Other vendors, including Eaton, ALK, and Rockwell, provide variations on this package.

(c) Information Flow: Information flow in the trucking industry involves fleet management, communication with customers and communication with regulating Federal and state agencies. As described above, major commercial vehicle operators have invested significantly in fleet management technologies to improve their equipment utilization. However, the trucking industry is extremely diverse including major companies which have invested in sophisticated information technology and electronic linkages with their intermodal partners and smaller, usually local drayage, companies which have historically lagged in the use of electronic information technology. Local draymen tend to be at the end of the intermodal food chain and are at the mercy of the cost and performance demands of their intermodal "partners".

At the Federal level, DOT's ITS Commercial Vehicle Operators (CVO) program addresses facilitation of communication between truckers and the regulating government bodies. It has undertaken major re-engineering in three regulatory categories; driver credentials, safety inspection, and electronic weigh station clearance. The program has moved from a series of operational tests to a comprehensive integration of services in a model deployment activity the Commercial Vehicle Information Systems and Networks program called CVISN. The current model deployment project is expected to be complete in 1998.

One reason for this DOT activity is that information systems supporting CVO operations have not kept pace over the years. Many of the systems supporting CVO are manual processes requiring redundant data entry which cannot share information within and among states and customers. Additionally, state safety and administrative responsibilities for commercial vehicles are projected to increase over the next several years while state budgets are anticipated to remain stable or face reductions. To address these issues, the U.S. Department of Transportation (DOT), through the Federal Highway Administration (FHWA) intends to support model deployment of CVISN in seven pilot states. CVISN is designed to link existing systems at the Federal, state, and industry level.

CVISN will utilize existing infrastructure and will enable government agencies, the motor carrier industry, and other parties engaged in CVO safety and regulation to exchange information and conduct business transactions electronically. The purpose of investing in model deployment of CVISN in pilot states is (1) to facilitate the development and deployment of ITS services that will increase the safety and productivity of CVO; and (2) to educate the general public and key state and industry decision makers on the costs and benefits of ITS for CVO.

The I-95 Corridor Coalition's Truck Desk is an example of the potential of the electronic exchange of information between the public and private sectors to enhance intermodal freight movement. Truck Desk is being developed jointly by the motor carrier industry and the states as a value-added repackager of traffic information. Truck Desk will collect information on highway traffic conditions, construction activity, traffic accidents, and incidents from state transportation agencies and other sources. It will then repackage, market, and deliver the information to motor carrier dispatchers and drivers to help them make timely and cost-effective routing and

dispatching decisions. Truck Desk will build electronic links to the region's toll and transportation agencies, utilizing the I-95 Corridor Coalition's Information Exchange Network (IEN) and commercial value-added network.

(4) Air Transportation

Information technology has been key to the growth of integrated air cargo carriers and in particular to the growth of small package express services. The aggressive use of information technology throughout their operations is key to their competitive service. Sophisticated information services manage the delivery of packages by integrated carriers such as United Parcel Service and Federal Express. UPS introduced DIAD (delivery information access devices) which are hand held computers which allow information about a shipment to be input at the point of pick-up or delivery. Air cargo companies also use bar coding to track package movement and share that information with their customers.

(a) Infrastructure: U.S. air space and airport approaches are controlled by sophisticated air traffic control systems based on radar and increasingly incorporate GPS and other satellite technologies. The system developed by the military is increasingly used by commercial operators for global positioning.

(b) Equipment Utilization: To date, air cargo operators are operating separate corporate systems, utilizing internal systems to maximize corporate productivity. In most cases, air cargo movements require a truck move at each end. Use of information technology for equipment control has not reached the same level of service as in other modes.

(c) Information Flow: Cargo Media, was created by the International Air Transport Association (IATA) in May 1995 to develop and promote application of information technology throughout the air cargo industry. Seventeen carriers which handle 75% of the world's scheduled air cargo are participating in the industry effort. U.S. participants include American Airlines and United Airlines. Scitor, an electronic communications affiliate of IATA, enables freight forwarders and airlines to exchange messages concentrating on shipment tracking.

The growing integration of air cargo with other transportation modes is an important area to monitor. One early example of Federal, state, local, and industry partnership is the North Carolina Global TransPark Authority, a planning effort partly funded by the FAA and North Carolina. Its goal is to integrate an air cargo airport within a unique intermodal infrastructure and logistics environment, linking the Research Triangle with available regional transportation infrastructure.

C. Intermodal Applications of Technology

As described above, technology applications were most often initially developed to streamline the internal business processes of an individual company -- its billing system, payroll, or inventory, for example. Communications external to the company, with customers, suppliers, or regulatory

agencies continued to be transacted on paper. While some effort has been made to standardize data sets and information protocols, these efforts have largely been limited to individual modes of transportation, often working through modal trade associations, sometimes in cooperation with the modal regulatory agency.

The growth of intermodal freight activity has increased pressure to improve the efficiency of the transfer of both cargo and information between modes. As discussed below, terminal operators and intermodal facilitators have become important players in improving the "seamless" transfer between modes. While creative application of advanced technology has been at the heart of their success, they have also had to grapple with the problems caused by the disparity between individual corporate systems.

(1) Terminals:

Terminals are the interface points in the intermodal system, where freight, equipment, and information are transferred from one mode to the next. Terminals include maritime ports at which freight is transferred from container ships to truck, rail and barges; rail yards where containers are transferred to and from trucks; truck terminals where vehicles are exchanged between long haul truckers and draymen for local delivery; and air cargo terminals where air freight is transferred to truck for local delivery. Terminals are often the "black-hole" in the system, where cargo can be delayed for days for lack of clearance or problems in communication between the parties.

(a) Marine (Port) Terminals: As transfer points between the land and ocean modes of transportation marine (port) terminals are, by definition, intermodal. Because most ports are publicly owned but operate to serve commercial clients, they are accustomed to the concept of public-private partnerships and have a unique perspective on intermodal freight movement and the intermodal freight community. Most ports have long standing relationships with their local and regional truckers and should be included as key players in the application of ITS to "their" CVO communities. Their experience in meeting the challenge of U.S. Customs automation may be of value to the ITS program.

Infrastructure: Historically, ports took responsibility for operation of their own port facilities. To meet current market trends, port facilities are growing bigger, cranes heavier, and channels deeper. An extraordinarily competitive market environment has led ports to focus increasingly on improvements to their access infrastructure: on the waterside the need to keep access channels dredged to depths necessary to handle the larger next generation vessels; and on the landside to build adequate highway connections to the Interstate System and to adjust railroad clearances and yards to handle doublestack railcars.

Equipment Utilization: In the past decade, ports have also worked with local terminal operators to install automated gate and terminal operating systems. The InfoTech Committee of the American Association of Port Authorities and TOPAS (Terminal Operator and Port Authority subcommittee of the Transportation Data Coordinating Committee (TDCC) have provide industry leadership in these areas. These port gate systems and their user communities offer an important opportunity for state and corridor ITS/CVO

implementers. For example, SeaLand has installed a state-of-the-art Terminal Automation System at its terminals in Charleston and Port Elizabeth. The systems are based on wireless LAN, using RF, declassified military technology with a 300 yard reach. It has five components which control the gate, the yard, equipment inspection, marine operations, and yard inventory. Maher Terminals in Port Newark is an industry leader in port terminal technology applications. Port terminals have learned that they must take the responsibility for developing the interface to accept disparate data formats from their customers. They report that insisting on a standard format is useless.

Most recently, ports and terminal operators have introduced "smart cards" at terminal gates to identify truck drivers and the companies they represent. One example is the SEALINK Driver Identification System which provides registered drivers access to Port Newark and Port Elizabeth terminals. This card positively identifies the driver receiving containers.

Information Flow: During the 1980's Customs continued to change the protocols for its automated system, requiring costly and aggravating adjustments within the port, carrier, and broker communities. Currently active port systems range from the ORION system developed in 1982 in Charleston, SC which has a full community cargo system to the ACES system in New York which offers an electronic mail-box to the port community, leaving the rest to the user. South Carolina estimates that use of the ORION system results in 2 to 3 days faster cargo clearance from the port.

(b) Truck and Rail Terminals: Introduction of information technology to truck and rail terminals is constrained by the culture of those operations. The cost of buying into an intermodal electronic network can seem insurmountable to a small terminal operator, despite the almost immediate savings even the small operator might realize in increased equipment and driver utilization. Truck and particularly rail terminal operations are frequently operated by contractor or contract labor. This creates barriers of communications and information flow between the line haul and terminal operations. Since the passage of ISTEA in 1991 public transportation officials and private sector freight terminal operators have initiated a variety of efforts to improve communications. Outreach to terminal operators should be a key component of the ITS/CVO deployment, since it is at these terminals that the CVO program will interface with existing EDI based programs already in use within the freight sector. Regular communication with companies involved in terminal operations will be of value to all parties.

(2) Third Party Companies - Facilitators:

Third Party Companies have stepped forward to create a service in intermodal transportation which serves both the shipper and the transportation provider by filling in the gaps and linking the modal systems. Intermodal facilitators include non-vessel owning common carriers (NVOCCs), shippers' councils, brokers, forwarders, intermodal management companies, and consolidators among others. Value Added Networks, such as Kleinschmidt, transmit information between the customers and the transportation carriers' computer systems. Kleinschmidt connects with

companies all over the world, collecting information for major and short line railroads and major rail shippers. Shippers use Kleinschmidt not only to check cargo location but also to produce bills of lading, advance shipment notices, purchase orders and other information forms.

Intermodal Marketing Companies fill in where other partners in the intermodal chain fall short, notifying customers of freight status and monitoring freight payment by the ultimate customer. International shipments generally are geared to coincide with a particular sailing date and shippers are able to plan accordingly. Intermodal service falls down when a drayage company isn't familiar with railroad requirements. Things get worse when a trucker lacks the ability to communicate electronically with other parties involved in the move. Whenever more than two parties are involved in the cargo move the risk of someone dropping the ball increases.

Third parties play an increasingly vital role in arranging intermodal moves, especially for small ocean carriers which prefer to limit their service to port-to-port transportation. Larger lines will continue to offer an all-inclusive intermodal service on their own bill of lading. Advanced information technology can offer international market opportunities.

D. Intermodal Experiences and Technology Issues

The frequently used term "intermodal industry" can be misleading. It suggests an organization and coherence that is notably absent in the rapidly changing intermodal freight transportation sector. In each mode, and across modes, transportation service operators have reacted differently to the new imperatives of shippers' global transportation requirements.

At one end of the spectrum are carriers that have custom built new, efficient (and usually much larger) equipment to serve modern intermodal terminals in which they have invested and which are often managed by their own intermodal company or a contractor specialized in intermodal movements. They have considerable financial resources, have invested in multi-modal capacity, purchased their own equipment and operate worldwide computer networks to coordinate their activities. They are able to link electronically with their customers and partners to offer cargo tracking and reliability. They are industry leaders.

At the other end of the spectrum are small companies which have identified a market niche which allows them to survive in the fiercely competitive environment. They may have identified a particular geographic location, unserved by major carriers. They may be national flag carriers, or have a special relationship with a commodity shipment, or with a labor union. They are more likely to lease equipment (usually not state-of-the-art) and work through common-user terminals. They are far slower to adopt new information technologies, and do so when pressed by customers only for market survival. Between these two extremes are most transportation providers. They lack the resources of the industry leaders, but are not as niche focused as the small companies. They may be most vulnerable to technology change.

Regardless of their position on this spectrum, transportation companies have aggressively taken advantage of information and communication technologies to improve the performance of their

systems. The weakness in the system continues to be at the links, the hand-off from one mode to another. A container can travel between Los Angeles and Chicago in 48 hours only to require an additional 40 hours for local delivery because of lack of pre-notification.

Recognizing the key role of information and communications technologies in providing a seamless and efficient intermodal freight service, a number of groups are working to address the coordination of EDI/ITS across the freight and logistics industries and to improve interoperability of the existing systems.

From the modal perspective, the American Trucking Association, American Association of Port Authorities, and Association of American Railroads have each established a committee charged with addressing EDI efforts within the respective mode and with government regulatory agencies. The Electronic Business Processes Committee of the Intermodal Association of North America and the ANSI X12 Transportation subcommittee have taken on the task of facilitating communication across the modes, encouraging dialogue between the various participants in the intermodal freight cycle.

By its very nature intermodalism requires the exchange of equipment, cargo and information. This means that the interoperability of equipment and information systems is a daily challenge:

- What happens when a western railroad hands-off a car or container to an eastern railroad in Chicago?
- How do two ocean carriers that enter into a consortium agreement to share ships and terminals address the fact that only one carrier's containers have the RF tags required by the terminal gate and yard tracking system?
- How does a port design its cargo release information system when some customers base their corporate information systems on the container number while others use the bill of lading number?
- Is there a solution for the local drayman when each terminal in the port requires him to use a different driver "smart card" as identification at the gate? Or the long haul trucker faced with different systems at each port and rail terminal where he does business and each toll facility and bridge on his route?
- Status codes used by players involved in the shipment of freight are similar but not identical -- how does the status code on a Car Locator Message (CLM) used by the railroads translate into an ocean terminal status message? Is the cargo ready for delivery or not?

The ability to communicate electronically can connect the multiple participants in the intermodal movement and facilitate the smooth hand-off of cargo from one mode to another. Advanced communication technologies have transformed intermodal transportation in the past decade. For example, shipment information now need only be entered once, at the beginning of the transaction

and from there forward simply updated as the shipment moves through the intermodal chain to its destination.

By exchanging freight information electronically, carriers and shippers are able to automate a broad range of billing, data entry, and cargo tracking functions. Automation has allowed carriers to enhance their transportation service by providing their customers and multiple trading parties with real-time information on the movement of the vehicle and the cargo.

The application of advanced information and communication technologies to the intermodal movement of freight has created significant opportunities for improved service and savings of time and money. Integration of tracking, control and communication technologies have led to the success of integrated carriers like UPS and Federal Express. The concept of integrated logistics is being widely adopted by trucking firms and other distribution service providers

Intransit visibility (ITV) throughout the journey is of increasing importance in both commercial and defense transportation. Combinations of automatic identification technologies (such as bar codes and radio frequency tags), information and telecommunication technologies have been transforming management of the intermodal freight transportation. Most major intermodal freight carriers and shippers have developed information systems utilizing some combination of the technology described above to provide real-time information regarding cargo location at all points in the intermodal transaction.

International competition is pushing industry to turn to ***electronic commerce*** to cut costs and improve service. Information technology has been introduced to reduce cycle time, forward documents, manage inventory, plan schedules and purchase electronically. Basic service consists of communication and translation software to read and write messages, a mail box or computer link for transmission provided by a proprietary system or through a Value Added Network (VAN); auxiliary services such as encryption translation, and mailing or faxing of information to businesses not yet on-line. In addition, the rapid growth of Internet communications opens unexplored new opportunities.

Rail and truck operators are taking advantage of information technologies to better manage their equipment and achieve greater utilization. Technology application combined with neutral equipment pools and equipment sharing by all modes of carriers have resulted in ***improved fleet management and equipment utilization***.

Ports have achieved considerable gains in ***improved terminal gate and yard capacity*** through application of advanced information systems such as smart cards and RF readers and tags at their gates. Similar improvements are being introduced as state-of-the-art terminals are built for other modes, resulting in over-all capacity improvements for the intermodal system.

These improvements by the private sector to the intermodal freight transportation system also contribute to ***enhanced national defense***. It is national policy to rely on U.S. carriers to move military cargo except under very unusual circumstances. Defense logistics leaders understand that they must rely upon the capabilities of the commercial transportation providers to move military

cargo. Through organizations such as the National Defense Transportation Association, military and civilian transportation professionals regularly come together to ensure that the commercial intermodal transportation system can meet the nation's defense transportation needs. A companion document "An Intermodal Tour of the DOD" provides an informal overview of DOD roles and relationships for intermodal issues and containerization. It is attached as an appendix for those interested in understanding the organization of intermodal transportation decision-making within DOD.

Information and communication technologies have enormous potential to strengthen the links between the individual transportation modes. The challenge of the next decade is to realize this potential to create a unified transportation system. Whether or not the freight sector is ready for the next generation of intermodal technology applications depends to a large extent on how these technologies are marketed, who is asked to pay for them, and how compatible they are with the advanced information systems currently in use.

E. Intermodal Opportunities

Freight transportation in major urban areas is increasingly congested. Cities which host major international sea and airport terminals experience particular congestion, both in local freight delivery by draymen and by local delivery of containers to rail terminals for shipment to inland destinations. If intermodal freight mobility is to be maintained it is essential to:

- Reduce traffic congestion in and around urban freight terminal access thoroughfares;
- Improve door-to-door visibility of intermodal freight for shippers, receivers, and transportation companies;
- Better manage the flow of truck and intermodal containers to ports and other urban terminal operations.

It is essential that national commitment to funding and constructing improved access to ports, both by land and water, be continued. In addition to these important physical improvements, ITS provides opportunities to mitigate these urban transportation problems of international gateway cities. The ITS program offers opportunities to apply concepts of dynamic flow control, as developed in the aviation and rail transportation systems, to enhance urban freight mobility.

Dynamic flow control can be defined as the active, intelligent balancing of transportation and logistics demand and supply to minimize congestion and maximize capacity and flexibility. It requires: real-time (or near real-time) data on vehicle location and network conditions; powerful analytic capabilities; and the management ability to affect or control operations.

The ITS program and the I-95 Corridor Coalition project are proposing a test which will provide an opportunity to address these needs in the New York/New Jersey region at the Port Elizabeth and Port Newark terminals. The test would develop an intermodal container location system

(ICLS) to better manage and track the flow of trucks and intermodal containers, to provide dynamic flow management. A description of this proposal will illustrate the opportunities which ITS offers to improving freight movement in urban areas and the opportunities for cooperation between the public and private sectors.

The volume of truck traffic at the marine intermodal terminals is large. For example, SeaLand's terminal generates over 2,000 truck moves per day or about 150 truck moves per hour. The adjacent Maher terminal, the largest public terminal at the port complex, generates over 4,000 truck moves a day, or 300 truck moves per hour. Each truck arriving at the marine terminal must stop at the entry gates for processing - matching truck and container numbers to shipping orders, identifying the driver for security, and assigning a pick-up or delivery location for the container or chassis.

The visibility of intermodal truck operations could be improved at reasonable cost by piggybacking on the dedicated short range communication (DSRC) systems being installed on the regional highway network by the public sector for toll collection and weigh station pre-clearance. These systems identify passing trucks and add location, date, and time stamps to create an observation record that could be used by terminal operators to manage inbound traffic flows, and by shippers and receivers to improve the visibility of the truck portion of intermodal shipments, especially long-haul drayage.

The proposed ICLS would use the I-95 Corridor Coalition's Truck Desk described above as a clearinghouse to collect and screen the truck location observations. The ICLS would expand on this capability, allowing it to collect data from toll authorities and electronic clearance services for the ICLS. The ICLS operational test would seek to demonstrate the following benefits as a minimum:

- For I-95 Corridor Coalition toll authorities and state departments of transportation - the reuse and resale value of truck data from toll and weigh station transactions. This would leverage the investment made by these agencies in toll collection and ITS systems.
- For Truck Desk - a value-added information service for intermodal truck operators and public sector agencies that minimizes costs and hassles for toll agencies and carriers; better data on traffic flows for eventual reuse and possibly resale.

This operational test can become a reality as a partnership between the U. S. DOT, the I-95 Corridor Coalition, the terminal operators, trucking firms, and logistic companies. Early discussion has found interest among these entities. This is a clear example of opportunities which exist for public-private freight partnerships. It also illustrates the critical importance of inter-state regions and corridors for freight transportation.

IV. RECOMMENDATIONS FOR FEDERAL ACTION

Private freight carriers have made substantial use of information technology to enhance the productivity of their own operations. There are still areas where public investment in ITS systems can further improve the productivity and safety of intermodal freight operations. The current public interest in freight transportation policy creates an opportunity to develop a shared vision of the future needs of international intermodal freight transportation in the United States. The Federal government can impact this vision by taking action in the following areas:

Provide Infrastructure Funding to Support Efficiency and Global Competitiveness. The private sector cannot provide seamless intermodal freight transportation services to support domestic and international trade without the underlying physical and information infrastructure provided by the Federal government. This is a crucial Federal role in transportation.

Action: Build on the programs begun under ISTEA by providing funding for the physical infrastructure essential to the intermodal transportation system, including terminal access roads and port navigation channels.

Action: Provide sufficient funding to support federal programs essential to the information infrastructure including weather information, the global positioning system, navigation information, and the full communication spectrum.

Support Regional and Corridor Efforts. Intermodal freight transportation is international in scope. Supporting the seamless flow of freight is in the national interest. Many issues transcend the local or state level. It is important to sustain corridor ("truck shed") activities such as those underway in the I-75 Advantage program, the I-95 Corridor and the HELP program and to fully involve the freight community, particularly ports and terminal operators in those efforts.

Action: Encourage, facilitate and participate in regional and corridor efforts. Establish regular funding mechanisms for these public-private alliances.

Understand the Freight Sector and Develop a Shared Vision of Technology Benefits. The complexity of the freight sector, the multitude of stakeholders involved, and their divergent priorities have created a conflicted vision of what the freight sector might gain from ITS technologies. The Federal government is positioned to provide leadership, to develop a shared vision of the capabilities of technology applied to global transportation and its benefit to the nation, to the private sector and to state and local governments, and to incorporate into this vision knowledge derived by Department of Defense as a major user of the system. To effectively meet the needs of the intermodal freight transportation sector it is necessary to understand freight transportation operations and priorities, including current awareness about the state of the art applications of information technologies.

Action: Participate actively in industry meetings, activities and working groups.

Action: Provide the Office of Intermodalism with the necessary authority and funding to serve as an effective advocate for intermodal freight issues, regardless of mode, and as a technical resource for the JPO in addressing private sector ITS issues.

Action: Work with representatives of the intermodal freight industry to create an Intermodal Freight Carrier Leadership Council to meet with the Secretary quarterly and provide input on the impact of the ITS program on the freight industry, as well as such other freight policy issues as may be of mutual interest.

Lead Transportation Technology Efforts of Federal Agencies. Federal government transportation technology initiatives are often not coordinated so that private transportation companies are required to integrate conflicting Federal initiatives. The current regulatory and reporting system for commercial transportation operators is complex and duplicative. ITS offers significant opportunities for single point electronic delivery of information to government agencies.

Action: Lead Federal transportation technology policy initiatives, particularly the work of the National Science and Technology Council's Transportation Committee.

Action: Coordinate transportation technology policy among Federal agencies, particularly border crossing initiatives.

Action: Coordinate DOT/DOD/industry efforts to adopt interoperable transportation technologies, particularly for tagging and tracking of cargo.

Action: Support CVO operational and corridor tests.

Action: Use technology to simplify the current regulatory and reporting system for commercial intermodal operators by providing single point electronic delivery of information to Federal and state agencies, as conceived in the CVISN program.

Maintain Commitment to Open ITS Architecture. Participants in intermodal transportation are reluctant to absorb the cost of implementing technology if there is a fear that the technology adopted will rapidly become obsolete or incompatible. This is of particular concern in the interface between private sector and government operated systems, e.g. toll facilities and border crossings.

Action: Facilitate private sector efforts to adopt industry-wide performance standards and data protocols.

Action: Address issues of data exchange and interoperability among commercial users and Federal agencies including the Departments of Transportation and Defense and the U.S. Customs Service.

Action: Involve port and intermodal freight terminal operators in ITS /CVISN deployment to identify opportunities and problems at the interface between ITS and the existing intermodal freight systems.

GLOSSARY OF INTERMODAL ACRONYMS

AAPA	Association of American Port Authorities
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACTS	Automated Train Control Systems
AEI	Automatic Equipment Identification
ANSI	American National Standards Institute
ATA	Air Transport Association of America
ATA	American Trucking Associations
ATCS	Automated Train Control Systems
ATS	Automatic Train Supervision
AVI	Automated Vehicle Identification
CAA	Clean Air Act
CLM	Car Location Message
COFC	Container on Flat Car
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operators
DSRC	Dedicated Short Range Communications
ECDIS	Electronic Chart Display and Information Systems
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transportation
EMP	Equipment Management Program
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Rail Administration
GPS	Global Positioning Satellites
IATA	International Air Transport Association
ICTF	Intermodal Container Transfer Facility
IFTA	International Fuel Tax Agreement
ILA	International Longshoremen's Association
ILWU	International Longshoremen's and Warehousemen's Union
IMC	Intermodal Marketing Company
IMO	International Maritime Organization
ISA	International Shipping Agreement
ISTEA	Intermodal Surface Transportation Efficiency Act
ITS	Intelligent Transportation Systems
ITV	Intransit Visibility
JIT	Just In Time (delivery)
LAN	Local Area Network
LCL	Less than Container Load
LEO	Low Earth Orbit
LTL	Less than Truckload
MACS	Mainline Automated Clearance System

MARAD	Maritime Administration
MPO	Metropolitan Planning Organization
NACS	North American Container System
NSTC	National Science and Technology Council
NVOCC	Non-Vessel Owning Common Carrier
TDCC	Transportation Data Coordinating Committee
TEU	Twenty Foot Equivalent Unit (a container size)
TOFC	Trailer on Flat Car
TOPAS	Terminal Operators and Port Authorities Subcommittee (of TDCC)
U. S. DOD	United States Department of Defense
U. S. DOT	United States Department of Transportation
VAN	Value Added Network
VTS	Vessel Traffic Systems

BIBLIOGRAPHY

AASHTO, *A Review of National Domestic Freight Policy*, Washington, DC, February 1993.

A&L Associates, *An Assessment of Technologies and Research Needs in Intermodal Transportation*, Cambridge, MA, June 1994 prepared for the National Commission on Intermodal Transportation.

American President Lines, "EDI and Tracing," APL sales brochure, 1995.

Amtech: Technology a generation ahead, February 1994, Marketing Brochure.

Aviation Week and Space Technology, (Bruce Nordwall/Washington) February 12, 1996

Aylward, Anne, "ITS and Intermodalism", presentation to the TRB Intermodal Task Force, Washington DC, April 1995.

Bonney, Joseph, "Plunging Deeper into EDI," American Shipper, March 1994

Borrone, Lillian, "Ports as Intermodal Platforms," *VIA Port of New York - New Jersey*, 1995

Bowman, Robert, "Long Distance Run," *World Trade*, May 1995

Brecher, Aviva, "Intermodal Freight Technologies: Overview and Issues," Cambridge, MA, October 1994.

Burke, Jack, "BN Inaugurates Network Operations Center," *Traffic World*, May 1995

Cambridge Systematics, *Intelligent Transportation Systems for Motor Carriers: Win, Place, and Show*, Cambridge, MA, prepared for ATA Foundation, March 1996.

Candler, Julie, "Smart Cars, Smart Roads," *Nation's Business*, February 1996

Crabtree, Joe, "Advantage I-75," *Public Roads*, Autumn 1995

Cassidy, William, "Software Update," *Transport Topics*, June 1996

Cassidy, William, "Computers: A Host of New Products and Services," *Transport Topics*, December 1995

Edgar, John T., "Cargo Handling Cooperative Program: Test Bed for New Technologies," speech presented to the American Defense Preparedness Association's Security Technology Division, June 21, 1995.

I-95 Corridor Coalition Commercial Vehicle Operations Program, "Carrier Operations Program," March 26, 1996.

I-95 Corridor Coalition, "I-95 CVO Program Operational Test Descriptions, " as presented to the I-95 Corridor Coalition Steering Committee, February 1, 1996.

ITS America Intermodal Task Force Research subcommittee, "Near-Term Research and Development Agenda," May 1996.

ITS America Intermodal Task Force Strategic Plan subcommittee, "Draft Strategic Plan," February 1996.

Johnson, Gregory, " New EDI standard sought to exchange truck rate data," JOC, April 1995

Johnson, Gregory, "Texas Company Assumes Control of Dutch Rails' Information Unit," JOC, June 20, 1995

Journal of Commerce Staff, "Xtra Systems Assist in Chassis Management," JOC, June 20, 1995

Journal of Commerce Staff, "American Airlines Joins Air Cargo EDI Group", JOC, October 3, 1995

Lamb, J.J., "Whiz-Bang!," World Trade, June 1995

Letteney, David, "Intermodalism: An Expensive Proposition," WWS/World Wide Shipping, April 1996

Mercer Management Consulting, *Intermodal Terminal Capacity and Outlook*, Washington, DC, January 1993, prepared for the Intermodal Policy Division, Association of American Railroads.

Mottl, Thomas and David Whitney, "Federal Policies at the Intersection of the Information Superhighway and Intelligent Transportation Systems," Stoneham MA 1995.

Muller, Gerhardt, *Intermodal Freight Transportation*, 3rd ed., Lansdowne, VA, Eno Transportation Foundation and the Intermodal Association of North America, 1995.

National Commission on Intermodal Transportation, *Toward A National Intermodal Transportation System*, Washington, DC, September 1994.

"Nippon Express Develops Global Cargo System," JOC, June 20, 1995

Norris, Bahar, *Intermodal Freight: An Industry Overview*, Cambridge, MA, U.S. DOT, Volpe National Transportation Systems Center, March 1994.

Norris, Bahar and Marsha Haines, *Implications of Intermodal Freight Movements for Infrastructure Access, Capacity, and Productivity*, Cambridge, MA, U. S. DOT, Volpe National Transportation System, March 1996.

Richardson, Helen, "Intermodal: Keeping Pace with Growth?" *Transportation and Distribution*, April 1995

Rosenfield, Ira, "Use It or Lose IT, JOC, May 10, 1995

Santos, Kim, "U.S. Customs EDI in the Intermodal Arena," Speech to the IANA Electronic Business Processes Committee, May 9, 1996, Chicago, Illinois.

Schulz, John D. "Truckers Embrace Line-haul Savings, Seek Greater Flexibility in Use of Intermodal," *Traffic World*, April 19, 1994, p. 40.

Sparkman, David, "Inch by Inch: Productivity Gains from Equipment Pools,": *Transport Topics*, May 1995

Sparkman, David, "Rail Intermodal: A Study in Dissonance" *Transport Topics*, May 29, 1995

Stone, Bryan, "Continental Divides," *Containerization International*, May 1995

Starkey, Larry, "efficiency Top Goals at Terminals: Computers Cut Paperwork," JOC June 20, 1995

Thurston, Charles, "Rail shippers savor tracking advances," JOC May 20, 1996

Thurston, Charles, "Electronic Charts Finding a Place in Canadian Waters," JOC, August 29, 1995

U.S. Department of Transportation, Federal Highway Administration, *Intermodal Freight Transportation: Volume I: Overview of Impediments*, Washington, DC prepared by Cambridge Systematics, December 1995.

U.S. DOT Federal Railroad Administration, "Differential GPS: An Aid to Positive Train Control," Report to the Committees on Appropriations, June 1995.

U.S. DOT Volpe National Transportation Systems Center, "Current and Future Federal Applications of Tagging and Tracking Technology," Cambridge, MA, June 1996.

U.S. General Accounting Office, *Information Superhighway: An Overview of Technology Challenges*, Washington, DC, January 1995.

U.S. DOT Federal Highway Administration "Implementation of the National Intelligent Transportation Systems Program: A Report to Congress," 1996.

Watson, Rip "BN Steps up Push to Open Fort Worth Transport Center", JOC, April 25, 1995

An Intermodal Tour Of DOD

*An Informal Overview
Of DOD Roles And Relationships
For Intermodal Issues And Containerization*

July 10, 1996
Version 2

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Intermodal and Logistics Systems Division
Volpe National Transportation Systems Center
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U.S. Department of Transportation

An Intermodal Tour of DOD¹

Version 2

Purpose of this material:

This paper describes organizational roles and identifies key players in intermodalism and containerization within DOD. It is an informal resource for people in DOT, particularly the ITS community. The paper was prepared at the request of Mike Onder in the ITS Joint Program Office, FHWA. The author is Mike Wolfe at the Volpe Center.² Comments, clarifications, and questions are welcome.

Office of the Secretary of Defense (OSD)

This is the home of transportation policy in DOD. They publish the DOD Instruction for Intermodal and Container Policy. The orientation in OSD is more towards business practices and interfaces with industry than to military operations -- but this is a matter of emphasis, not absolutes.

Asst. Deputy Undersecretary, Logistics (Transportation)

Mary Lou McHugh, a career SES, is the incumbent (703/697-6551). The container portfolio on her staff is generally with Army Colonel Bruce Dikeman, 697-7286). Mary Lou usually chairs the Defense Transportation Policy Council, a monthly information exchange meeting of senior players.

Joint Chiefs of Staff

Joint Staff, Director of Logistics, J4

The J4 is the focal point for logistics feasibility and supportability questions for deployed military forces. Intermodal issues, often referred to in DOD as containerization issues, are usually one of several responsibilities given to one action officer in the Strategic Mobility Division. The

¹ A note on phone numbers: DOD has its phone system, called Autovon or DSN. It has its own prefixes, although the last four digits usually are consistent with commercial numbers. All DOD phone numbers have commercial equivalents, which are listed here.

² 617/494-2007, fax -3013; wolfe@volpe1.dot.gov.

amount of emphasis on intermodal issues varies widely depending on the priorities of the senior officers. Over the past four or five years, JCS J4 has ceded most of the leadership on intermodal issues to TRANSCOM. Major Barber is the Joint Staff representative on the Joint Intermodal Container Working Group (703/697-6155).

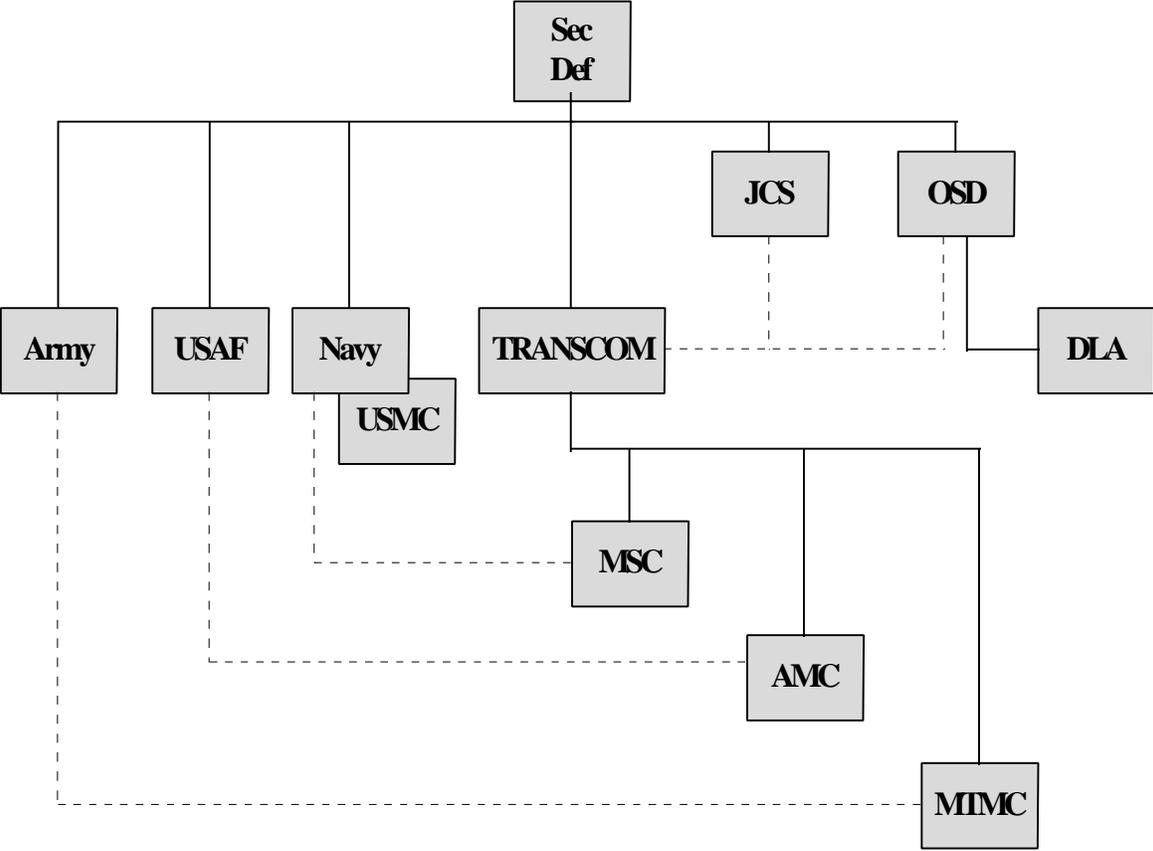
TRANSCOM Overview

The US Transportation Command was created in 1987 and re-chartered with greater scope and authority in 1992. Originally, it was responsible primarily for wartime readiness and emergency operations. After the Gulf war, it was given responsibility for managing the entire Defense Transportation System, or DTS, in peace and war. The Commander-in-Chief, or CINC, has always been an Air Force 4 star general. The Deputy or DCINC has been an Army 3 star or Navy 3 star (vice admiral).

TRANSCOM is a Unified Command under the orders of the President and the Secretary of Defense (the “National Command Authority” or NCA). In this regard it is similar to other unified “purple” commands, such as the European Command (EUCOM) or the Central Command (CENTCOM). The Chairman of the Joint Chiefs of Staff transmits the orders of the President or the Secretary to the CINCs.

On a more day-to-day basis, TRANSCOM’s headquarters staff elements take external guidance from the JCS Joint Staff, which is TRANSCOM’s principal point of entry into the Pentagon. The OSD staff also plays a role, setting policy for the DTS while TRANSCOM implements that policy.

DoD Transportation Relationships



TRANSCOM Headquarters

There are several groups involved in intermodal issues at TRANSCOM Hqs in the directorates of Logistics Operations (J3-J4) and in Plans (J5)

Gary Adams is the chief of the Joint Container and Plans Team, in J3/J4. Gary is the chair of the Joint Intermodal Container Working Group, and he is concerned with operational issues, such as tagging and tracking munitions in containers. (618/256-2848). Gary's people are the coordinators of the Joint Intermodal Container Master Action Plan (JICMAP 96). CDR Brian McKeever is Gary's key guy on the working group.

Another element of J3/J4 is relevant because of a significant role in Intransit Visibility (ITV). A major set of issues in ITV has to do with electronic tagging of containers. The key player is USAF Col. Vic Wald, chief of the Transportation Management Division, (618/256-3823).

The Plans shop, J5, is more concerned with long term business relationships, such as contractual arrangements between US flag carriers and DOD. The erstwhile Intermodal Team is now the Infrastructure Team, under Dave Dias (618/256-6529).

J5 is also the home of the VISA program, the Voluntary Intermodal Sealift Agreement. The key person is Frank Webber, the SES deputy J5 (256-3499).

The Transportation Component Commands (TCCs)

TRANSCOM has three principal subordinate commands, known as the TCCs. Each existed long before TRANSCOM, as they used to be known as the Transportation Operating Agencies, or TOAs, a term still used by some people.

There are several important fault lines to understand. The relationships among the TCCs and between two of the TCCs and TRANSCOM

carry a lot of baggage. For example, beginning in the '60s, MTMC and MSC had extraordinary cycles of conflict over container service management; MTMC and AMC fought long over the management of air movements; and MTMC and MSC struggled to maintain their independence within TRANSCOM.

The complexity continues today because each TCC is a major command in its parent service in addition to being a subordinate element of TRANSCOM. The Army, Navy, and Air Force have Title 10 U.S.C. responsibilities to raise, train, and equip the TCCs, and each service has control over their TCC's unique service responsibilities. The borders are sometimes blurred between unique Service responsibilities and TRANSCOM responsibilities.

Larry Korb, Assistant Secretary of Defense for Installations and Logistics in the Reagan years, put it well when he described the control of transportation resources and prerogatives as one of the most intensely emotional subjects in DOD.

Military Traffic Management Command (MTMC)

The Military Traffic Management Command, the Army TCC, is responsible for traffic management and terminal operations. MTMC is involved in domestic and export freight, personal property shipments, and some passenger group movements. MTMC has the largest operational role of any TCC in intermodal issues. MTMC also has the Transportation Engineering Agency (TEA) as a subordinate unit. MTMC is the organizer for the CORE (Contingency Response) Program, which includes industry and DOT elements.

MTMC is commanded by a two star general. The command has intermodal players in several parts of the organization. Joe Schuck (703/681-6042) is in the headquarters Plans shop and is the MTMC rep on the JICWG. Joe is most involved in military preparedness issues. There are many

intermodal players in the Operations Directorate; I would start with Len Priber, (681-6744), chief of the Delivery Systems Division, for a lead to the right people. There are also people in the MTMC Information Systems Directorate concerned with managing, tracking and tagging containers, and again I would recommend a gatekeeper: Ursula Loy, chief of the Integration Division (681-5702).

Transportation Engineering Agency (TEA)

TEA is in Newport News, and the Director is Tom Collinsworth, an SES (804)599-1100). TEA gets into modeling, hardware compatibility issues, and installation outloading capabilities. Pete Lennon 804/599-1635, has been the leader of their intermodal team.

Military Sealift Command (MSC)

The Military Sealift Command, commanded by a vice admiral, is the Navy component of TRANSCOM. MSC operates the “controlled fleet,” a mix of government-owned and chartered vessels, most operated by contract crews, some by civil service crews. The principal focus of the controlled fleet is on roll-on/roll-off and breakbulk ships.

MSC negotiates the Container Agreements with the US flag shipping operators. Doug Anderson is the key person on setting up container agreement contracts. A phone number to get his phone number is 202/685-5001.

The VISA program is managed at TRANSCOM headquarters, not MSC.

**Air Mobility Command
(AMC)**

The Air Mobility Command is the Air Force component of TRANSCOM. AMC operates the transport and air tanker fleet, manages the Civil Reserve Air fleet, and charters most group movement and special mission commercial airlift. AMC is commanded by CINC TRANS as a dual hat assignment. Day-to-day leadership is provided by an Air Force three star vice commander.

AMC is not a major player in ISO standard intermodal freight issues. It has a specialized interest in intermodalism, as it relates to air transportation. This includes modular cargo handling systems plus the issues raised by the occasional need to move ISO seavans by air..

Army

**Deputy Chief of Staff,
Logistics (Transportation,
Energy & Troop Support --
TRETS)**

The Army is very dependent on containerization, aware of it, and has many players active in different intermodal issues. Their participation list is much more complex than the other services.

The focal point for Army intermodal policy is in TRETS. The principal action officer is Norma Coffey (703/614-4059). She is their rep on the JICWG.

Army Materiel Command

**Industrial Operations
Command (IOC)**

IOC's major role is as the commodity (inventory) manager for munitions. They are involved in a proof of principal for tagging and tracking containerized munitions. Dan Stackwick is chief of the Transportation Division, 309/782-5579.

**Ammunition Logistics
Activity (AMMOLOG)**

AMMOLOG is the catalyst and facilitator for improving ammunition logistics. Doug Chesnulovitch is the key person on containerization. 201/724-4737. Jim Fedewitz is the key guy on tagging technologies (same number).

**Combined Arms Support
Command (CASCOM)**

CASCOM is the logistics doctrine developer for the Army. The Army Transportation School at Ft. Eustis, VA, is part of CASCOM. CASCOM is most interested in how systems work in the field (as in with deployed military units). Capt. Carey Gipson is their JICWG point of contact (804/734-0352).

Air Force

The focal point here is at Air Force Hqs -- the Air Staff. LtCol. Rich Modell is their main action officer. (703/697-3371)

Navy

The Navy seems to view itself as a self-contained transportation carrier/operator, and in my experience the Navy has been the least active military service in commercial intermodal container concerns. Their Hqs POC for the JICWG is Steve Donahue (703/614 7384).

Marines

Although the Marine Corps is an element of the Navy Department, the Marines are independent contributors to the intermodal dialogue. The Marines seem more sensitive to intermodal issues than the Navy since the Marines must be able to resupply deployed forces on the ground. The intermodal focal point at Marine Corps headquarters is Major Jim Scruggs (703/696-1090)

Defense Logistics Agency (DLA)

The DLA is probably the largest shipper of containerized goods in DOD. Shipments originate both at Defense Depots and directly from vendors of many different commodities. More than TRANSCOM or the military services, DLA's intermodal concerns are closer to those of a large commercial shipper. The DLA JICWG contact is Fred Crawmer, (703/767-3621).