PARTNERSHIP TO PROMOTE ENHANCED FREIGHT MOVEMENT AT PORTS AND INTERMODAL TERMINALS

A STRATEGIC PLAN

FEBRUARY 2000

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A STRATEGIC PLAN

NSTC Committee on Technology
Subcommittee on Transportation R&D

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EXECUTIVE SUMMARY

In November 1998, the Subcommittee on Transportation Research and Development (R&D) of the National Science and Technology Council (NSTC) released the first Federal *Transportation Technology Plan*. This plan presents initial implementation strategies for the private–public partnerships identified in the 1997 NSTC *Transportation Science and Technology Strategy*.[1] Among these partnerships, that on "Enhanced Goods and Freight Movement at Domestic and International Gateways" addresses the need for more flexible, efficient, and seamless freight transportation systems. The partnership has three key goals: (1) improve freight mobility at land borders and ports; (2) ensure the diffusion of freight information technologies and networks; and (3) expedite the global flow of goods.

The gateways partnership promotes an integrated freight R&D and investment policy and private–public collaboration on large-scale investment projects. This strategic plan outlines the partnership's outcome goals, investment strategies, and anticipated impacts for ports and intermodal terminals. Together with a companion document for border gateways, this plan provides a framework for a comprehensive R&D investment strategy for freight transportation.

OPPORTUNITIES AND CHALLENGES

The U.S. economy has benefited from the surge in global trade in three ways: (1) the growth in national income; (2) the emergence of new markets; and (3) the decline in the cost of goods. Furthermore, global outsourcing has intensified the economic gains from trade and fostered greater demand for innovative freight technologies.

Yet, this increase in trade also creates significant challenges. Threats to the transportation system's ability to meet the needs of trading partners warrant a strong Federal role in promoting a technology-intensive freight infrastructure. These threats include:

Port facilities' inability to meet the demands of containerships for better port access and on-dock container handling.

Capacity constraints that hamper railroads' and other intermodal carriers' abilities to meet the growing demand for container shipments while responding to intensified pressures to cut costs.

The spiraling costs of financing modern, large-scale, multi-jurisdictional freight facilities.

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[1] The NSTC released a *National Transportation Science and Technology Strategy* in April 1999.

The increasing complexity of emerging technologies, including the need to establish standards for interoperability.

OUTCOME GOALS

This partnership promotes national goals for economic growth and trade competitiveness by achieving four key outcome goals. These outcome goals, along with investment strategies, anticipated impacts, and critical elements, are as follows:

Outcome Goal 1: Ensure adequate throughput and intermodal capacity at the Nation's ports and other intermodal freight facilities.

Investment Strategy: Partner with State, local, and private agencies; port authorities; and intermodal service providers to improve network capacity by deploying advanced technologies that increase gate throughput, expedite cargo and container clearance time, and enhance navigation efficiency and information transparency at ports and intermodal facilities.

Impacts: Reduced operating costs, increased door-to-door cargo delivery speeds, and improved service.

Critical Elements: Automatic equipment identification, Global Positioning System location identification devices, and positive train control.

Outcome Goal 2: Promote advanced multi-modal terminals and consolidated cargo-handling hubs and feeder facilities.

Investment Strategy: Partner with State and local agencies and private carriers to leverage investment in multi-beneficiary intermodal terminals and freight corridors through mechanisms for cost-sharing and pooling resources.

Impacts: Reduced operating costs and congestion through economies of scale allowing the consolidation of large volumes of cargo in a single facility.

Critical Elements: Real-time supply-chain management systems and innovative financing mechanisms.

Outcome Goal 3: Support the development and diffusion of next-generation freight transportation technologies.

Investment Strategy: Accelerate the diffusion of existing marine, rail, and dual-use defense technologies through outreach and training efforts that make the technologies readily available to a larger group of users.

Impacts: Enhanced safety, efficiency, and capacity, with subsequent spillover benefits through growth in national income and productivity.

Critical Elements: Bi-modal rail equipment (such as the Iron Highway) and innovative container-handling devices.

Outcome Goal 4: Support interagency efforts to coordinate the development of standard technology protocols, shared information systems, and joint-use military facilities.

Investment Strategy: Provide Federal leadership to develop standard protocols for technology applications, remove institutional barriers to joint use of defense technologies, and formulate interagency strategies to arrive at a globally optimal freight network.

Impacts: More efficient resource use, cost-cutting opportunities for the freight industry, and economic growth through greater diffusion of dual-use technologies.

Critical Elements: Shared information and databases, including a one-stop shopping process for all Federal clearance permits required for international cargo.

IMPLEMENTATION

This partnership relies on a three-pronged strategy for implementation: (1) technology development; (2) technology deployment and diffusion; and (3) technology dissemination and outreach.

Technology development involves the identification of enabling technologies that enhance the management of existing resources and generate the greatest benefits for end-users, such as local freight investment planning agencies and small- and medium-sized carriers and shippers.

Technology deployment efforts promote technology applications at terminals and freight facilities through the identification of incentive grants and opportunities for strategic alliances.

Finally, *technology dissemination* involves the development of a clearinghouse for information on industry best practices and the identification of areas where Federal leadership is needed to overcome institutional barriers to innovation, for example, the establishment of standards or joint use of military facilities.

1. INTRODUCTION

In November 1998, the Subcommittee on Transportation Research and Development (R&D) of the National Science and Technology Council (NSTC) released the first Federal *Transportation Technology Plan*. This plan presents initial implementation strategies for the private–public partnerships identified in the 1997 NSTC *Transportation Science and Technology Strategy*.[1] Among these partnerships, that on "Enhanced Goods and Freight Movement at Domestic and International Gateways" addresses the need for more flexible, efficient, and seamless freight transportation systems. The partnership promotes an integrated freight R&D and investment policy and private–public collaboration on large-scale investment projects.

This strategic plan outlines the partnership's outcome goals, investment strategies, and impacts for freight gateways at the Nation's ports and intermodal terminals. Together with a companion document for border gateways, this plan provides a framework for a comprehensive R&D investment strategy for freight transportation.

VISION, GOALS, OUTCOMES, AND PARTNERS

A broad partnership among the Federal Government, State and local agencies, international societies, port and airport authorities, and industry, the gateways initiative will improve freight mobility through technology applications. As stated in the NSTC *Transportation Technology Plan*, the partnership's vision is "a more productive national economy afforded by a more flexible, efficient, and seamless freight transportation system." Its ultimate goals are to (1) improve freight mobility at the Nation's land borders and ports; (2) ensure diffusion of existing freight information technologies and networks; and (3) expedite the global flow of goods. Among the near-term outcomes of the partnership are the following from the Department of Transportation (DOT) *FY 2001 Performance Plan*:

> Reduce the percentage of ports reporting land-side impediments to the flow of commerce from 41 percent in 1998 to 37 percent in 2001.
>
> Reduce delay at National Highway System border crossings per 1000 vehicles processed in 2001.

The lead Federal agencies for the partnership are DOT's Office of Intermodalism and Intelligent Transportation System (ITS) Joint Program Office. Other Federal partners include, from DOT, the Federal Aviation Administration, Federal Highway Administration, Federal Railroad Administration, Maritime Administration, Research and Special Programs Administration, and United States Coast Guard; the Department of Commerce; the Department of Defense; the Department of Energy; the Department of

[1] The NSTC released a *National Transportation Science and Technology Strategy* in April 1999.

Justice's Immigration and Naturalization Service; the Environmental Protection Agency; the Department of State; the Treasury Department's U.S. Customs Service; and the Department of Agriculture.

Among the current and potential non-Federal partners are national governments and international societies, State and local agencies, port and airport authorities, air cargo companies, trucking companies, ship operators, railroads, parcel and freight companies, and equipment and vehicle manufacturers.

The gateways partnership is coordinated by the NSTC. Federal participants contribute resources and support as required, seeking ongoing guidance and involvement from State, local, and private partners. DOT's ITS Joint Program Office provides overall leadership and management of the partnership.

OUTCOME GOALS

This strategic plan covers the *port and intermodal terminal* elements of the gateways partnership. (A companion document addresses freight movement at *border gateways*.) These elements support national goals for economic growth and trade and the following core goal in DOT's *1997-2002 Strategic Plan*:

> *Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.*

This plan defines four key outcome goals for ports and intermodal terminals that support this broad national objective. For each outcome goal, the plan presents the following: (1) an investment strategy; (2) anticipated impacts; (3) critical technology (or other) elements; and (4) case studies. The four outcome goals are:

Outcome Goal 1: Ensure adequate throughput and intermodal capacity at the Nation's ports and other intermodal freight facilities.

Outcome Goal 2: Promote advanced multi-modal terminals and consolidated cargo-handling hubs and feeder facilities.

Outcome Goal 3: Support the development and diffusion of next-generation freight transportation technologies.

Outcome Goal 4: Support interagency efforts to coordinate the development of standard technology protocols, shared information systems, and joint-use military facilities.

SCOPE OF EFFORTS

Because it deals with investment in freight infrastructure—traditionally a private-sector function—and because of the nature of these investments—innovative, interagency, intermodal, and international—this partnership crosses the traditional boundaries of transportation investment decisions. Concepts such as "joint intermodal terminal," "consolidation hub," "intermodal condominium," or "integrated freight corridor" do not fit within the traditional frameworks guiding investments in transportation infrastructure. In this respect, this strategic plan is likely to present challenges to existing mode-based investment practices and the prevailing distinctions between the private and public realms. This partnership's scope is bounded by the extent to which it can enhance freight movement at ports and intermodal terminals through the following three-pronged strategy:

Technology development: These efforts will identify the enabling technologies that will enhance the management of existing resources and generate the greatest benefits for end-users, such as local freight investment planning agencies and small- and medium-sized carriers and shippers.

Technology deployment: Activities will promote technology applications at terminals and freight facilities that support the logistics objectives of global trading partners. The partners will accomplish this primarily through the identification of incentive grants and opportunities for strategic alliances.

Technology dissemination: Since technology transfer is this partnership's primary mission, the partners will assess the resources available to develop a clearinghouse for information on industry best practices and lessons learned. A related effort will identify areas where Federal leadership is needed to overcome institutional barriers to innovation, for example, the establishment of standards or joint use of military facilities.

The *geographic scope* of this partnership is ultimately international, as the ramifications of the flow of international cargo through the Nation's ports and freight terminals are far beyond the domestic sphere. The activities undertaken by or in support of the Organization for Economic Cooperation and Development, World Bank, North American Free Trade Agreement, and Asia Pacific Economic Cooperation will all impact the effectiveness of the strategies that this plan presents.

The partnership's *system boundaries* include, but are not limited to:

Domestic freight facilities: Marine ports (land-side and dock-side), rail terminals, barge terminals, airports, spaceports, and other intermodal facilities.

Domestic freight network: The physical and information infrastructure for marine, rail, and intermodal routes and networks.

Fleet and equipment: The next generation of marine vessels, rail, and trucking fleet; lift equipment and other specialized devices for container handling and loading.

Finally, the *technological scope* of the partnership encompasses state-of-the-art freight vehicle technologies, communications equipment (stand-alone or imbedded), sensing and control devices, and information systems.

THE FEDERAL ROLE

Market imperfections have historically warranted government intervention. The need to provide for the public good, correct for externalities, and redress the problems resulting from the building of freight facilities provide the impetus for a strong Federal role in freight transportation infrastructure:

Ports, waterways, and intermodal terminals are a public good: they provide a key link in the global supply chain. The private sector lacks the incentive to provide adequate investment to meet the demands of trading partners.

The physical and communications infrastructures of ports and freight facilities have many of the attributes of a public good, even though their use may not always be "non-rival" and "non-excludable." As gateways to international trade, access to these facilities generates external benefits to both payers and non-payers. Such attributes make conventional market pricing inapplicable. National security and the public infrastructure aspects of waterways require performance levels that private markets are not able to meet.

Economies of scale involved in the construction of intermodal terminals often preclude investment responsibility by a single private entity.

Funding large-scale freight projects, such as the Alameda Corridor, is beyond the scope of most private firms. Moreover, the private funding of such projects would create pricing problems that would lead to the exclusion of many potential facility users. Marginal cost pricing for such public projects would not be possible because of the high startup costs. Finally, the "lumpiness" of many such projects would preclude dividing them into smaller units to place them within the range of a private firm's budget and demand curve.

Multi-jurisdictional freight facilities involve significant externalities. Private or local-level decision-making processes are likely to arrive at locally optimal solutions that may undermine the Nation's global objectives. Federal leadership is needed to promote advanced freight technologies, set interoperability standards, and help arrive at a global optimum.

National security, transportation safety, environmental externalities, and the economic impacts of major transportation facilities are such that they cannot be left solely to private or local markets. While control of these facilities is likely to promote the short-term market objectives of some individual or local stakeholders, the long-term impacts at the regional or national levels are likely to be sub-optimal. Inter-port competition for attracting containerships and railroad decisions to discontinue service to some markets are examples of such negative externalities. Evidence suggests that the magnitude of the potential social gains from Federal R&D investments is sufficiently large to provide a comfortable margin of error for choosing among technologies to back.[2]

This plan outlines strategies that promote a research and technology approach to freight infrastructure investment and guide the following:

Investment in ports and intermodal freight infrastructure to correct the market failures resulting from disparities in multi-jurisdictional goals.

Cost-shared efforts to build rail and terminal facilities.

Collaborative technology application and investment efforts and incentive packages for building and deploying large-scale improvement programs that enhance the efficiency of the private sector and boost the Nation's trade competitiveness.

Efforts to establish uniform technology standards, remove institutional barriers to the joint use of military facilities, and maximize the benefits from the transfer of advanced technologies.

[2] For more detailed discussion of this issue see Lewis Branscomb and James H. Keller, *Investing in Innovation: Creating a Research and Innovation Policy That Works*, The MIT Press, Cambridge, MA, 1998; and Gene Grossman, "Promoting New Industrial Activities: A Survey of Recent Arguments and Evidence," *OECD Economic Studies*, No. 14 (Spring 1990), quoted in Michael Borrus and Jay Stowsky, "Technology Policy and Economic Growth," in Branscomb and Keller.

2. OPPORTUNITIES AND CHALLENGES

The opportunities afforded by the increase in international trade are significant. The U.S. economy has gained from the surge in trade in three ways: (1) the growth in national income; (2) the emergence of new markets; and (3) the decline in the cost of goods. Specifically:

Productivity gains from the high-technology segments of U.S. export industries have contributed to growth in the gross domestic product (GDP) and in incomes.

As firms have increased their output, labor productivity has grown, raising the real wages of workers in these sectors. In the past two decades, labor productivity in the U.S. has increased by 25 percent.[3]

Domestic producers have enjoyed the benefits of economies of scale as new markets have emerged.

Growth in exports has had a ripple effect, making new markets viable targets for U.S. industries. The development of new markets for the Nation's products has also generated significant economies of scale. With the growth in markets for final products, the markets for intermediate inputs have grown, and the linkages among the firms within the supply chain have allowed producers to expand production. The resulting critical mass and efficiency gains have further reduced production costs, as the growing backward and forward linkages in the manufacturing process have helped to generate network density.[4]

Average costs in many sectors have declined, as markets have become more competitive.

As trade has grown, production costs have declined through a combined process of removing monopolistic inefficiencies, applying technologies that improve productivity, re-engineering the firm-level production process, and streamlining the movement of goods within the supply-chain network. Downward declines in transportation and inventory carrying costs relative to GDP—from more than 16 percent of GDP a decade ago to about 10 percent today—illustrate the cost-reduction benefits of the growing efficiency of global outsourcing.

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[3] Paul Krugman and Anthony Venables, "Globalization and the Inequality of Nations," NBER Working Paper Series, Working Paper No. 5098, April 1995; Paul Krugman, *Pop Internationalism,* The MIT Press, 1996. Krugman points out that the growth of real incomes in the past two decades in the U.S. has been entirely due to domestic reasons, has had very little to do with trade, and has not been evenly distributed across all sectors. He emphasizes that the decline in demand for unskilled workers has nothing to do with globalization or what we produce, but is rather due to a change in production methods.

[4] Edgar M. Hoover, *An Introduction to Regional Economics,* Alfred Knopf, 1971; Alfred Weber, *Theory of the Location of Industries,* Russell & Russell, 1971; and Wilbur R Thompson, *A Preface to Urban Economics,* Johns Hopkins University Press, 1965.

Declining transportation costs, coupled with global wage differentials and the universal availability of information technologies, has stimulated global outsourcing among the goods-producing sectors of the economy.

It is now cheaper to assemble components produced and shipped from all over the globe than to try to minimize transportation costs and manufacture the goods in the proximity of the final consumption market. Integrated supply-chain management has allowed trading partners to trim costs by fully integrating transportation into the production and marketing process. Today, the logistics pipeline relies on transportation as its motive power, linking warehousing, distribution, inventory, marketing, sales, supply management, and manufacturing. Integrated supply-chain management has been created by connecting suppliers and customers at each end of the supply chain, with full transparency of the operations ensured through an efficient computerized interface system.

To reduce costs for each link within the supply chain, shippers have undertaken drastic process re-engineering.

Just-in-time production management techniques have cut costs by reducing inventories. Freight transportation costs at the aggregate level have been steadily declining (partly due to deregulation), to about 6 percent of GDP. Freight carriers are expected to continue to lower shippers' logistics costs by offering value-added services. Today, supply-chain management is increasingly driven from the demand side. "Mass customization" is in demand, as transportation carriers are asked to provide a higher level of operating flexibility for the customer (e.g., in routing and pricing), and to offer customized logistics service as opposed to the traditional point-to-point shipping service. Full integration of logistics and transportation is taking place through shippers' attempts to leverage their positions when negotiating customized service contracts with carriers.

Despite these benefits and opportunities, the *challenges* resulting from global trade are significant. Threats to the continued ability of the transportation system to meet the needs of trading partners warrant a strong Federal role in promoting a technology-intensive freight infrastructure.

The 1999 DOT report on the U.S. Marine Transportation System (MTS) identifies a number of trends affecting the Nation's ports and intermodal infrastructure and the competitiveness of the U.S. marine transportation system, including:[5]

> ***Competing water uses and the increasing size, speed, and mix of container vessels, passenger ferries, and recreational boats:*** The MTS report warns that "the increased use, coupled with vessel speed and size, will place additional demands on already congested waterways" (p. 34).

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[5] U.S. DOT, *An Assessment of the U.S. Marine Transportation System: A Report to Congress*, September 1999.

Growing dredging requirements: The report notes that some of this growth has been stimulated by the increased maintenance needed to meet the service demands of the maritime industry and that "the net effect could be a gradual upward trend in future annual dredging requirements" (p. 33).

Intermodal connections and land-side access to ports and terminals: As stated in the MTS report, "the intermodal connections between the transportation modes are often the weakest links in the Nation's transportation system." The report cites a 1997 Maritime Administration study of 58 ports, including 31 container ports, which identified a number of infrastructure impediments, such as traffic congestion on local truck routes, limited availability of truck turning lanes, and lack of near-dock rail terminals that would ease transfer of containers from rail to vessel (pp. 51-52).

This strategic plan focuses on a number of specific challenges confronting the U.S. freight transportation system:

Port facilities are increasingly unable to meet the demands of containerships for better port access and on-dock container handling.

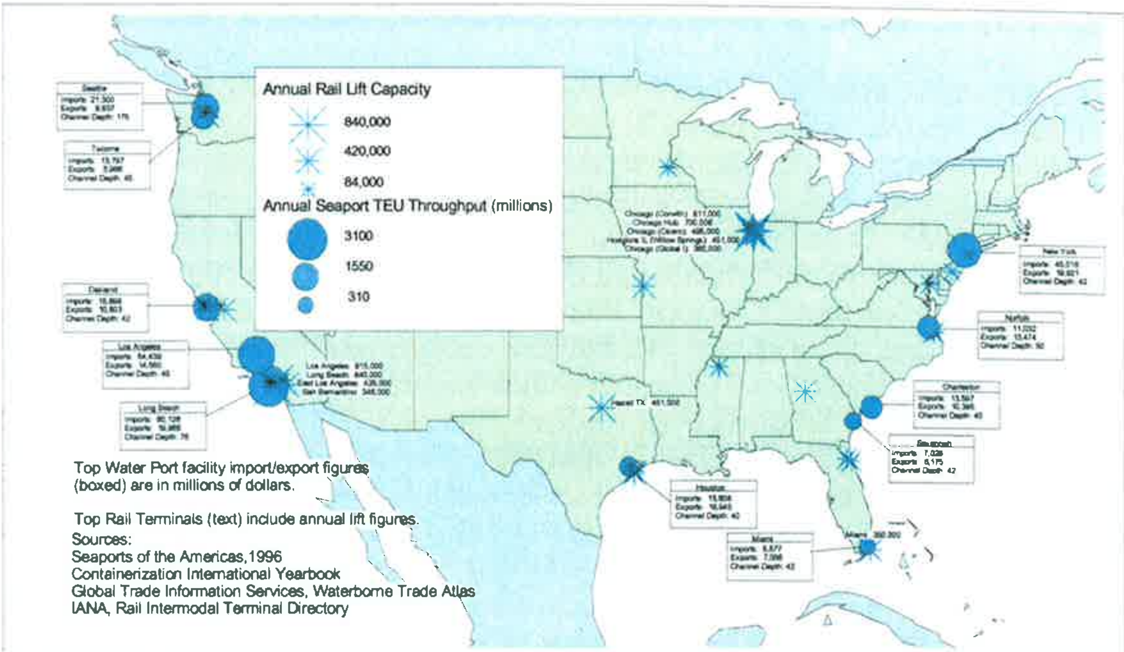
The expanding size of containerships has severely strained the resources of major load centers for facility modernization. Rapid rates of containerization, coupled with the imperative to reduce costs, have led to the emergence of large-capacity containerships.

In 1990, less than 6 percent of U.S. containerized cargo was moved on ships of 4,000 twenty-foot equivalent units (TEUs) or more. By 2010, ships in the 4,000 to 6,000 TEU class will handle 30 percent of the cargo.[6] With container vessels growing in size to 6,000 to 8,000 TEUs, ports face significant infrastructure modernization challenges. Shallow navigational channels and environmental regulations restricting the disposal of contaminated sediments have impeded the ability of ports to handle international cargo efficiently.

Demands for high-capacity terminal lift equipment have compounded the costs of dredging. Steamship carriers' specifications for a "super container hub" have sparked further competition among ports for expansion and capacity improvement. Recently, Maersk Lines and Sea-Land Service put out capacity requirements for such a hub that included up to 16 post-Panamax cranes; 6,000 contiguous feet of berth; on-dock or near-dock rail; and the ability to handle 550,000 lifts annually. Currently, not one of the East Coast ports can offer these ocean carriers what they need.[7]

[6] John Vickerman, "The Next Generation Container Vessels: Impacts on Transportation Infrastructure and Operations," *TR News*, May-June 1998.

[7] Michael Fabey, "Port Disneyland: Carriers Call for U.S. Ports to Meet Standards Set by Rotterdam and Kobe," *Traffic World*, May 18, 1998.



U.S. Ports and Intermodal Facilities

Land-side access bottlenecks and lack of adequate on-dock or near-dock rail pose other impediments. Only 40 percent of the container traffic on the West Coast and 24 percent on the East Coast moves by rail. The impediments faced by ports were addressed in a 1993 Transportation Research Board study.[8] This report cited a number of port constraints, including lack of bridge or tunnel clearance to accommodate double-stack trains for more than one-third of container ports; at-grade crossing on local streets, where trains tie up local traffic at half of all ports; inadequate access routes for trucks; local opposition to land-side improvements; and regulation of wetlands and dredged sediment disposal.

Finally, vessel logistics and cost-minimization objectives of steamship companies have reduced the number of ports of call. This has led to the funneling of container traffic through a handful of load centers on each coast, compounding other access problems and creating severe capacity constraints.[9]

Outcome goals 1 and 2 of this plan address the technology application strategies relevant to port throughput and intermodal terminal capacity.

[8] *Land-side Access to U.S. Ports*, Report #238.

[9] About 99.7 percent of the approximately 3,700 ocean and inland ports in the U.S. have excess capacity. Between 1993 and 1997, total capital expenditures by U.S. ports amounted to $5.5 billion, with 10 ports accounting for 74 percent of the total outlays (Long Beach, Los Angeles, Seattle, Oakland, New York/New Jersey, Miami, New Orleans, Houston, Georgia, and Tacoma).

Capacity constraints hamper railroads' and other intermodal carriers' abilities to meet the demand for container shipments while responding to pressures to cut costs.

As global container trade has grown, U.S. railroads and other intermodal carriers have become severely capacity-constrained; at the same time, the competitive post-deregulation environment has intensified pressures to reduce costs. In the aftermath of the 1980 Staggers Act, U.S. railroads face competitive pressures to cut costs. The move toward consolidation is partly in response to these pressures. The more competitive environment has reduced the Nation's total freight logistics costs from more than 16 percent of GDP to less than 11 percent. Though railroad profits have risen in some segments, intermodal operations have for the most part generated lower levels of profit. (These operations account for 18 percent of railroad revenues, but less than 10 percent of profits.) Recent rail service disruptions, capacity shortages, and "service meltdowns" at the Nation's ports and rail terminals have been due in part to merger-related adjustment difficulties and the "bunching" of container traffic that occurs during peak periods of vessel loading and unloading.[10]

Advanced technologies have allowed U.S. railroads to pursue aggressive modernization programs to deal with the pressures to cut costs. These technologies have allowed railroads to reduce track miles and locomotives in service while carrying more freight and having fewer accidents. In 1995, Class I railroads carried some 2 billion tons of cargo, a 16 percent increase from the 1.6 billion tons carried in 1980 (while the railroads lost market share to trucks in the same period). To compete with trucks, Class I railroads have had to keep costs down while maintaining a high level of capital investment. By investing in track infrastructure and new freight car technologies, the railroads have improved their capacity, and can now carry heavier loads and provide greater ton-miles of service on fewer miles of track.

New investments notwithstanding, track and yard congestion has posed a serious problem for rail carriers for the first time in U.S. history. Compounding track capacity shortages have been the higher maintenance costs due to the increasing average gross weight per train, higher locomotive speeds, more frequent train dispatching schedules, aging track infrastructure, and deteriorating rail bridges. Although rail operations are relatively safe and the number of rail accidents has been steadily declining, the publicity generated by recent incidents, coupled with downsizing practices that have reduced the number of maintenance workers, has given rise to popular concerns about the safety of rail freight transportation.[11]

Outcome goals 1, 2, and 3 address the strategies recommended for supporting next-generation rail and intermodal technologies and for funding advanced intermodal terminals.

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[10] See Ken Cottril, "Rail Snafus Fog Progress," *Traffic World*, January 12, 1998.

[11] The number of railroad maintenance workers is down from 29 employees per 100 miles of track in 1976 to 22 per 100 miles in 1995.

The costs of financing modern, large-scale, multi-jurisdictional freight facilities are spiraling.

The high costs of financing a modern terminal and the multi-jurisdictional nature of many advanced technology projects preclude effective single-source financing strategies for deployment of state-of-the-art freight technologies. For example, the Alameda Corridor project cost close to $2 billion and took more than a decade to plan, finance, and construct. Another project, the Freight Action Strategy (FAST) in Washington State, required legislative action and a public referendum for planning and financing.

Private stakeholders and local decision makers often lack the ability to formulate strategies that provide a globally optimal solution. The short planning horizon of the private sector, and the inability to capture non-local or non-commercial benefits from projects of national significance, preclude effective investment strategies at the local level. Often, the optimal approach to capacity shortages and congestion lies not at the local source of the problem, but at the regional or corridor levels—where infrastructure strategies such as feeder ports and revitalization of short-haul railroads provide the best solution.

Outcome goals 3 and 4 address the strategies related to promoting next-generation rail and marine technologies, joint use of underutilized military facilities, and shared information systems and technology standards.

Freight technologies are becoming increasingly complex.

The growing complexity and sophistication of freight technologies has created the need to set standards for interoperability and to facilitate data sharing.

Outcome goal 4 addresses efforts to coordinate the development of standard technology protocols and shared information systems.

3. INVESTMENT STRATEGIES

This plan for the "Enhanced Goods and Freight Movement at Domestic and International Gateways" partnership centers on four outcome goals that will advance the Nation's economic growth and the following core goal in DOT's *1997-2002 Strategic Plan*:

> *Advance America's economic growth and competitiveness domestically and internationally through efficient and flexible transportation.*

For each of these outcome goals, this section of the plan presents (1) an investment strategy; (2) anticipated impacts; (3) critical technology (or other) elements; and (4) case studies. The four outcome goals are:

Outcome Goal 1: Ensure adequate throughput and intermodal capacity at the Nation's ports and other intermodal freight facilities.

Outcome Goal 2: Promote advanced multi-modal terminals and consolidated cargo-handling hubs and feeder facilities.

Outcome Goal 3: Support the development and diffusion of next-generation freight transportation technologies.

Outcome Goal 4: Support interagency efforts to coordinate the development of standard technology protocols, shared information systems, and joint-use military facilities.

OUTCOME GOAL 1: THROUGHPUT AT PORTS AND OTHER FACILITIES

Investment Strategy: Partner with State, local, and private agencies; port authorities; and intermodal service providers to improve network capacity by deploying advanced technologies that increase gate throughput, expedite cargo and container clearance time, and enhance navigation efficiency and information transparency at ports and intermodal facilities.

This investment strategy involves cost-shared deployment of automated communications systems that help enhance capacity utilization and cargo-handling capability, provide real-time information on vehicle and cargo location, and improve overall transportation productivity. Application areas include computerized systems for load assignment and fleet management, expedited cargo dispatching to reduce cycle times, use of automated gate inspections to reduce gate delays and improve equipment utilization, and installation of automated warning systems at grade crossings.

Capacity and throughput improvements in general involve an array of infrastructure-based solutions that remove access bottlenecks, often involving regional corridor planning, and incorporate a mix of technological, infrastructure modernization, and institutional solutions. Given the diversity of the freight network, no single blueprint can be offered to suit all facilities. No cross-sectional or aggregate-level baseline measures are feasible for the complex network of ports in the country. Local facilities and private operators need to determine what the appropriate benchmarks are given their individual baseline performance.[12]

Impacts: Advanced freight technologies enable us to expand capacity for our severely constrained intermodal terminals and freight infrastructure, and to enhance rail, trucking, and navigational safety. The benefits from enhanced capacity and facility throughput include improved speed and lower costs. Terminal delays account for roughly one-fourth of the cost of delivering a container door-to-door. Applications of automated technologies improve facility productivity; they reduce transaction delays and clearance times by increasing lift productivity and reducing gate delays, terminal dwell times, and clearance times for inspections. Many software systems are designed to improve equipment utilization by reducing empty truck and train miles ("deadheading"), the perennial problem of the intermodal industry captured in the truism that "the commodity most frequently shipped is air." Real-time terminal management systems allow shippers and carriers to track cargo shipments, making deliveries more predictable. By creating an end-to-end visibility of the cargo movement process, these technologies improve fleet utilization, and reduce transit times and operating costs, by optimizing the number of loads per vehicle.

Critical Elements: The array of communication technologies available for this investment strategy includes radio frequency identification devices (RFID), automated equipment identification (AEI) tags, and bar codes and reader systems used for remote identification of equipment and control of container and chassis inventory. Systems for electronic data interchange (EDI), shipment data transmission and cargo monitoring,

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[12] Examples of highly aggregated baseline measures of port performance are listed below. Note that these measures are presented for purposes of illustration only.

Container clearance time at the gate: more than 30 minutes
Truck turns: 3 to 4 turns per day
Vessel offloading time: exceeds 8 hours
Container dwell times: 2-6 days
Container utilization: 10 to 12 loads per container per year
Lift productivity: 22-25 gross moves per hour (gmph)
Channel depth in most major ports: < 40 feet

Based on performance data from a number of international ports, a number of target performance benchmarks have been established:

Container clearance time at the gate: less than 10 minutes
Truck turns: more than 4
Vessel offloading time: fewer than 4 hours
Container dwell time: less than 1 day to 4 days
Lift productivity: more than 25-35 gmph
Container utilization: 15 or more turns per year
Channel depth: 45-50 feet for strategically selected ports

asset management and dispatching, and optimizing loads and managing container backhaul loads are also among those relying on computerized data communication. Overall, these technologies provide real-time information, in-transit visibility, vehicle and cargo identification and location, and shipment tracking.

For position information, the Global Positioning System (GPS) and differential GPS (DGPS) receivers are used to determine the location of vehicles, vessels, trains, and equipment. Location information from GPS devices is transmitted back to control centers over the intermodal carrier's communication networks. Intermodal facilities often employ mobile inventory vehicles (MIV), which deploy RFID devices in conjunction with GPS receivers for position identification, as part of a system for automated equipment inventory control; this creates an integrated equipment inventory and location identification system. At many marine ports, terminal operators also use vision enhancement technologies, including thermal imaging cameras mounted on board the vessel to enhance the ability to recognize objects during adverse weather conditions.

Advanced rail freight technologies for positive train separation (PTS) and intelligent transportation systems (ITS) are also used in a variety of real-time information management applications. Positive train control (PTC) technologies involve the application of digital data communications, automatic positioning systems, track-side interface units and detectors, on-board and control center computers, and other advanced display, sensor, and control technologies to manage and control rail operations. PTC will reduce the probability of collisions between trains, collisions between trains and maintenance-of-way crews, and over-speed accidents by more than 90 percent. PTC systems will also improve the efficiency of railroad operations by reducing train running time, increasing running-time reliability, increasing track capacity, and improving asset utilization. By maintaining accurate, timely information about train locations, PTC systems will result in improved railroad service reliability, with higher revenue potential, and cost reductions resulting from improved asset management.

Railroads have also been deploying a number of ITS-type systems complementary to PTC for yard and terminal management. Rail applications of ITS-type technologies include AEI, crew scheduling, wayside and in-vehicle defect detectors, remote control applications, and grade-crossing safety monitoring. Since 1995, all railroad cars and locomotives have been equipped with radio frequency (RF) AEI tags that transmit the vehicles' identifying initials and numbers to a wayside reader. This information is then brought together with information on car types, commodities, shippers, and consignees in the railroads' databases.

Marine applications of advanced technologies comprise an array of navigational systems for dockside and waterways management, including nautical charts and short-range navigational aids such as Electronic Chart Display and Information Systems (ECDIS). The U.S. Coast Guard maintains approximately 50,000 Federal aids to navigation and another 50,000 private aids to navigation. The Coast Guard also operates eight Vessel Traffic Service (VTS) systems, with two additional private VTS-like services.

VTS is an interactive, shore-based waterways management and communications system that typically consists of remote surveillance sensors, such as radar or closed-circuit television, and a central data-gathering location. VTS helps to determine the presence of vessels in and around ports and provides information to vessels on such matters as traffic, tides, weather, and port emergencies. After receiving information on marine conditions, VTS personnel assess the information and pass it on to mariners and vessels by radio.

Physical Oceanographic Real-Time Systems (PORTS) are Federal systems for real-time tide and current information. PORTS was initiated in 1994 by the National Oceanographic and Atmospheric Administration (NOAA) in an attempt to build on the capabilities of the modernized National Water Level Observation Network (NWLON) to access real-time navigational information. To date, the Ports of New York/New Jersey and San Francisco have implemented the PORTS system. (See Appendix A for more details on PORTS and VTS.)

Case Studies: A vast array of best practices can be cited for successful application of advanced information systems for freight handling and terminal management. A demonstration of PTC systems in Washington and Oregon on some 600 miles of railroads, for instance, successfully tested the application of GPS and RFID devices to enhance highway–rail grade crossing safety and track capacity by integrating PTC into the existing traffic control systems for traveler advisory. Another pioneering technology program is the Maritime Administration's Container Handling Cooperative Program (CHCP), which several years ago demonstrated an equipment location system (ELS) that integrated the use of an MIV featuring AEI tag readers, a DGPS receiver, an ultrasonic ranging device, a wireless local area network communications system, and an on-board computer in a container port environment. (See Appendix A for a description of the CHCP demonstration as well as other innovative systems, such as the shipyard planning system at the Port of Portland, the system for rail operations planning at the Port of Los Angeles, the drayage notification system used at the Norfolk International Terminal, and the real-time chassis management system used at the Maher Terminal.)

OUTCOME GOAL 2: ADVANCED MULTI-MODAL TERMINALS

Investment Strategy: Partner with State and local agencies and private carriers to leverage investment in multi-beneficiary intermodal terminals and freight corridors through mechanisms for cost-sharing and pooling resources. Increasingly, the private sector and local agencies are recognizing that meeting the funding needs of large-scale, highly complex automated freight facilities is feasible only through cost-sharing and public–private collaboration. Meeting these challenges is critical to the continued ability of the U.S. to compete in global trade.

Impacts: Investment in advanced freight terminals and multi-beneficiary facilities will generate *economies of scale* by allowing consolidation of large volumes of cargo in a single facility—reducing operating costs and benefiting users and the shipping public. By creating a more efficient freight transportation system, advanced freight terminals reduce shipping and inventory-holding costs and improve service quality and reliability.

Through integrated use of communication and positioning systems, advanced freight terminals have the potential to make an intermodal terminal an integral part of the global supply chain. In the next millennium, this supply chain is likely to enjoy "virtual integration" of all components. This means seamless interfaces among the links in the supply chain, real-time information exchange, and minimum transaction costs. An integrated and efficient intermodal terminal also offers opportunities for *economies of scope*. The deployment of advanced technologies generates these scope economies by allowing—in long-haul freight corridors—more efficient freight modes, such as rail or barge systems. This can further reduce operating costs and gain greater market share by lowering the break-even distance for competition in short-haul corridors.

Advanced intermodal terminals improve equipment and labor productivity, as well as terminal capacity, by reducing delays due to gate inspection and manual inventory. Minimizing the number of handoffs and equipment interchanges involved in a typical container move reduces overall operating costs. Better terminal management also improves equipment utilization and container turns by reducing lengthy railyard dwell times. Ultimately, these productivity gains lead to greater profitability for freight operators. The gains to the economy as a whole include further savings in total logistics costs, benefits due to the development of new product markets, and the sustained growth of international trade.

Critical Elements: Real-time supply-chain management systems involving the virtual integration of cargo movement, coupled with innovative financing mechanisms, are the cornerstones of this strategy. Advanced intermodal terminal technologies are a critical link between the global supply chain and the domestic transportation network. Increasingly, with globalization and the domination of the service industry in the economy, information constitutes a larger share of total freight operations, resulting in further substitution of information for physical movement. Advanced information systems have allowed the momentum that began several decades ago with just-in-time (JIT) inventory control, moving to the next level of efficiency. Whereas JIT inventory management substituted transportation for inventory stockpiles, real-time freight automation systems substitute information for much of the physical goods movement process. The integrated technology components of advanced intermodal terminals include real-time information processing, satellite-based location and positioning, and facility and fleet management systems similar to those described under output goal 1.

Case Studies: The Los Angeles Global Gateway South, a $700 million state-of-the-art terminal, illustrates the functional and design attributes of automated intermodal terminals. The Global Gateway was built on the concept of "transparent end-to-end intermodalism" and designed to integrate intermodal interface and cargo-handling operations. This means that the terminal offers "a rapid and seamless interchange of containers between land, sea, and rail," all the way from Los Angeles to South Kearny, New Jersey. Port operations—marine container lifts, yard and rail operations—are fully integrated: every piece of equipment and every software system in the terminal is a piece of a puzzle that fits together, with no stand-alone operations within the port.[13]

Successful public–private efforts to use innovative funding for multi-jurisdictional intermodal terminals include Washington's FAST Corridor, the Alameda Corridor, the Alliance Terminal, the North Carolina Global TransPark, and the Southeastern Michigan Intermodal Terminal (SMIT). (See Appendix A for a description of these cases.)

OUTCOME GOAL 3: NEXT-GENERATION FREIGHT TECHNOLOGIES

Investment Strategy: Accelerate the diffusion of marine, rail, and dual-use defense technologies through outreach and training that make the technologies readily available to a larger group of users; identify the economic impact of such technologies; develop a set of metrics to measure more accurately the costs and benefits of real-time freight transportation systems and integrated supply chains.

Impacts: Advanced freight technologies enhance freight transportation capacity and efficiency in a number of ways; they are enabling technologies that generate benefits far greater than the outlays needed for technology transfer. These technologies also tend to generate greater value-added and attract more R&D funding, thus better leveraging Federal resources. In the early 1990s, high-technology industries accounted for 20 percent of the Nation's manufacturing output, 24 percent of manufacturing value-added, and nearly 60 percent of its private R&D expenditures.[14] Such advanced industries are agents of productivity and net economic growth in three ways: (1) they provide a higher return to factors of production than could be earned elsewhere in the economy; (2) they provide external benefits in the form of spillover income gains in other segments of the economy; and (3) because of higher productivity, they generate higher wages and hence contribute to greater income growth. Other benefits include enhanced safety and national security as a result of more efficient safety and control systems.

Critical Elements: Examples of next-generation freight technologies and container-handling systems include the "agile port" concept, a next-generation terminal that utilizes real-time data to manage container operations and simultaneously discharge and load a vessel. One element of the agile port is an Efficient Marine Terminal (EMT), a system that moves the majority of cargo storage and sorting away from the waterfront, thus reducing the need for acreage. Another is the Intermodal Interface Center (IIC), a rail marshalling corridor specifically designed to receive trains for container transfer from ship to rail or to drayage truck. An agile port terminal, designed to increase terminal throughput by up to 300 percent, is under development by the Center for Commercial Deployment of Transportation Technologies (CCDOTT), a consortium of the Department of Defense's U.S. Transportation Command (USTRANSCOM), the Maritime

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[13] Robert Clark, "Terminal Operations—Port of Los Angeles, Marine Terminal and Inland Operations," paper presented at the Intermodal Freight Identification Technology Workshop: Current Applications and Future Needs, June 9-10, 1998.

[14] Lewis Branscomb and James Keller, *Investing in Innovation: Creating a Research and Innovation Policy that Works*, The MIT Press, Cambridge, MA, 1998.

Administration, and a number of private sector partners. High-speed ships are another example of next-generation technologies that promise to improve the efficiency of container freight movement. (See Appendix A for descriptions of the agile port and FastShip Atlantic.)

Case Studies: The prime example of a highly successful Federal R&D effort in support of technology dissemination is the Internet. Today's Internet is the result of research by the Defense Advanced Research Projects Agency (DARPA) on packet-switching technologies that would enable undisrupted communications even if major switching centers were incapacitated. In 1977, DARPA developed two packet-switching protocols (where the message is broken into chunks or "packets"), which differed significantly from the existing circuit-switched system (based on a direct circuit from the message's origin to its destination). Another key step in the evolution of the Internet was the establishment in 1986 of several supercomputer centers by the National Science Foundation (NSF), which funded a network to link the centers and allowed regional and university computer networks to link to this "backbone." In addition to using the network to remotely access the NSF supercomputers, the research community developed applications such as electronic mail, file-transfer protocols, and newsgroups to facilitate information sharing with colleagues.

Private sector examples of innovative intermodal freight technologies include bi-modal rail–truck container movement systems such as the Iron Highway, for which CSX Intermodal has already completed a commercial pilot test. The Iron Highway is a continuous platform for roll-on, roll-off loading and unloading of intermodal trailers—eliminating the need for lift equipment or mechanized terminals. (See Appendix A.) Another example of next-generation freight vehicles, still at the concept phase, is the Super Blimp, which could be explored for rapid transportation of high-value, high-urgency cargo and adapted for application during emergency response to remote or highly congested areas where freight-handling stations are not available.[15]

OUTCOME GOAL 4: STANDARDS, INFORMATION SHARING, AND JOINT-USE FACILITIES

Investment Strategy: Provide Federal leadership to develop standards for technology applications, remove institutional barriers to the joint use of defense technologies, and formulate interagency strategies to arrive at a globally optimal freight network. This strategy involves the removal of institutional barriers to the more efficient use of resources. One component is forging a stronger partnership to promote shared databases, particularly a "one-stop shopping" process to obtain clearance for vessels or international cargo.[16] Two other elements of this strategy are the development of standard protocols for technology applications and promotion of joint-use military facilities. The U.S. freight transportation network is replete with abundant excess capacity, while a small segment of

[15] Steve Nadis, "The Zeppelin Also Rises," *Technology Review,* October 1997.

[16] U.S. DOT, *An Assessment of the U.S. Marine Transportation System: A Report to Congress*, September 1999.

the system is severely capacity-constrained. Of the 3,700 ports in the U.S., more than 90 percent are under-utilized. A strategy based on greater coordination of Federal resources would improve the overall capacity and efficiency of the system.

Impacts: Given the technology-intensive nature of many military freight facilities, joint use offers cost-cutting opportunities as well as net benefits to the economy through greater diffusion of defense technologies. Regulatory oversight of the use of communications systems and standards for technology applications will promote greater market penetration of advanced technologies. Federal leadership and interagency collaboration are needed to ensure a stable, viable, and efficient freight transportation system.

Critical Elements: The most critical technologies are shared information systems, such as Commercial Vehicle Information Systems and Networks (CVISN); real-time navigational systems, such as PORTS; the Federal Railroad Administration/Coast Guard initiative to construct a nationwide DGPS to augment the existing marine navigation system; and the U.S. Customs Service's International Trade Data System (ITDS) and Automated Export System. (See Appendix A for descriptions of these systems.)

Case Studies: One example of the joint use of military facilities is the Port of Oakland's Joint Intermodal Terminal, which uses a Naval yard for civilian use while allowing for continued overseas military deployment. Other joint-use facilities include (1) the Pease International Tradeport, in Pease, New Hampshire, in which 1,700 acres of the Pease Air Force Base is used as a high-technology commercial park; and (2) the Rickenbacker Airport, a joint-use reliever airport in Columbus, Ohio, specializing in air cargo operations. (Appendix A describes these facilities in greater detail.)

4. IMPLEMENTATION

For implementation, this plan relies on the resources of a myriad of Federal, State, local, and private entities. Project planning, design, and funding remain the domain of the partner agencies and private stakeholders identified. Successful implementation of this plan requires coordination and collaboration among the following:

DOT agencies, including the Office of the Secretary, Maritime Administration, Federal Highway Administration and ITS Joint Program Office, U.S. Coast Guard, Federal Railroad Administration, and Federal Aviation Administration.

Defense agencies, including those involved in defense conversion in collaboration with the Department of Defense, DARPA, and USTRANSCOM.

The Immigration and Naturalization Service of the Department of Justice, the U.S. Customs Service of the Treasury Department, and the Department of Agriculture.

The Department of Commerce's Economic Development Administration, the Department of Energy's Sandia National Laboratory, and the Environmental Protection Agency.

State and local freight agencies, trade associations, and academic organizations, including the American Association of Port Authorities; private rail, water, and truck carriers (such as the American Trucking Association); intermodal trade associations (such as the Intermodal Association of North America); universities; and consortia created through collaborative efforts.

Partners in the gateways initiative will implement the strategies discussed in Section 3 through a three-pronged approach: (1) technology development; (2) technology deployment and diffusion; and (3) technology dissemination and outreach.

TECHNOLOGY DEVELOPMENT

These activities involve the identification of technologies that will enhance management of existing resources and generate the greatest benefits for end-users, such as local freight investment planning agencies, small- and medium-sized carriers, and shippers seeking to integrate their supply chains. Advanced container-handling systems, for example, will enable ports to reduce ship loading/unloading cycle times and achieve significant operating economies. Similarly, refinements of proprietary technologies, such as the Iron Highway, offer effective solutions for expanding intermodal rail service in short-haul corridors.

TECHNOLOGY DEPLOYMENT AND DIFFUSION

Deployment efforts promote technology applications at terminals and freight facilities through the identification of incentive grants and opportunities for strategic alliances. In particular, partners will promote technologies in application areas that achieve a close coupling of the deployment process with shippers' supply-chain integration objectives. Identifying technology applications further down the logistics pipeline, all the way to the consignee's dock, will allow carriers and terminal operators to adopt technologies that integrate container movements into customers' supply chains. Working closely with carriers, port authorities, and terminal operators, partners in this initiative will identify technology-adoption strategies that generate the greatest downstream efficiencies.

A key element of this activity is promoting greater interagency and international collaboration by championing efforts to coordinate training, research, and outreach. Partners are in a position to leverage R&D outcomes by supporting and promoting the existing networks of research, testing, and training institutions. Consortia, such as the CCDOTT in Southern California, and corridor-based coalitions such as the I-95 Corridor Coalition and the Southern California Commercial Vehicle International Border Operations System, offer further opportunities for generating synergies in technology deployment.

TECHNOLOGY DISSEMINATION

This involves the development of a clearinghouse for information on industry best practices and lessons learned, and the identification of areas where Federal leadership is needed to overcome institutional barriers to innovation, for example, the establishment of standards or joint use of military facilities.

The interagency clearinghouse will be a focal point of this partnership, as it will allow critical information on industry operations to be collected, analyzed, and disseminated. Information on advanced technologies, of great value for private sector investment planning and performance benchmarking, is often not readily available. This information scarcity is to some extent due to the "cult of secrecy" about the use of technology in new product development, and partly the result of the high degree of product differentiation that prevails in the high-technology environment. This partnership can provide a significant contribution by helping to correct this market failure.

Partners will also identify areas where Federal leadership is needed to establish technology standards and protocols. Providing regulatory oversight of the use of communications systems and establishing standards for technology applications will promote greater market penetration of advanced technologies. In the rail industry, for instance, a number of technology-related concerns dominate. Railroads are concerned that Federal policies regarding the auction of the 900-megaherz-spectrum band will have detrimental effects on train control operations, as this frequency is used for transmitting control messages. The rail industry is also worried about the migration from a signal-based rail system to a communication-based system. Yet another issue requiring interagency coordination is the nationwide implementation of DGPS for use in communication-based PTS systems. Some carriers have expressed concern about the industry's ability to obtain guarantees of full GPS accuracy to a minimum resolution of 50 feet.

In a related activity, gateways partners will collaborate with State, local, and private stakeholders to formulate institutional solutions to some of the more intractable freight capacity problems, such as open access, track sharing, and rail capacity enhancement. While efforts on the part of local ports and private carriers can lead to local solutions, they may not serve regional or national interests. A *global optimum* might require that individual stakeholders work together with the goal of maximizing the interests of a larger region. The recent decision by the Ports of Seattle and Tacoma to put aside competition and enter into a partnership encompassing the Puget Sound region illustrates the gains to both ports and the region as a whole. This regional alliance is based on the premise that "parts of independent strategic plans, already separately underway within the broader region, can be aligned and synchronized with each other. This is more of a bringing together than a subordination."[17]

The successful design of the cost-shared FAST Corridor is the culmination of these regional efforts. Because of its interagency nature, the gateways partnership is in a unique position to effectively spearhead a truly intermodal, interagency, collaborative effort to meet the challenges of funding, launching, and coordinating many large-scale projects. Such a collaborative effort would allow the formulation of solutions, such as the establishment of feeder ports or support for short-line railroads, which might not be the preferred solutions at the local level, but represent the global optimum.

Finally, partners in this initiative will facilitate the joint use of military facilities. This strategy offers the dual benefit of easing the difficult tradeoffs involved in defense downsizing, while meeting the needs of many capacity-constrained local freight facilities. The research consortia and regional technology-sharing alliances that are supported by the Defense Department present effective strategies for dealing with the planning, coordination, and R&D needs of defense conversion efforts. Gateways partners can play a pivotal role in facilitating the joint use of under-utilized defense facilities to augment national freight infrastructure capabilities.

[17] Peter Beaulieu, "Ports on the Edge: Sync-ing the Strategic Plans," Puget Sound Regional Council, paper presented at the Transportation Research Board's 23rd Annual Summer Conference on Ports, Waterways, and International Trade, Seattle, Washington, July 19-22, 1998.

APPENDIX A
CASE STUDIES

AGILE PORT DEMONSTRATION

This joint USTRANSCOM/MTMC initiative is funding a prototype high-speed sealift and cargo/personnel movement system that provides tracking and in-transit visibility. The CCDOTT in Southern California is a consortium of public, private, and academic organizations brought together to identify and deploy advanced transportation technologies, including next-generation lift platforms and container lift devices that optimize container throughput. Rapid Deployment Technologies is another CCDOTT program, which is studying the feasibility of leveraging advanced commercial marine–rail interfaces for use in inland ports. Efforts include development of Transportation Automated Measuring Systems (TRAMS) to incorporate advanced weigh-in-motion (WIM) technologies for use in military lift operations. MTMC has been involved in efforts to address the problems arising from the global flow of supplies, including the proliferation of megaships for transporting containerized cargo, and has also been active in projects involving the deployment of real-time data systems for in-transit visibility. Development of a Geographic Information System (GIS) linked to the National Bridge Inventory (NBI) will allow MTMC to identify security threats and risk levels. The GIS system will enable MTMC to coordinate port clearance of equipment and cargo and work closely with civil marine terminal officials to ensure that port capabilities will be available during national emergencies.

ALAMEDA CORRIDOR

The $1.9 billion price tag for the Alameda Corridor project is a prime example of the mechanism for funding a large-scale, multi-jurisdictional freight investment project. The Alameda Corridor will link the Ports of Los Angeles and Long Beach to downtown railyards and consolidate the operations of the three freight railroads that serve the harbor. The project is designed to mitigate the impact of the containerized international traffic transferring through the San Pedro Ports, reducing delays, emissions, and congestion. Upon completion of the project, Burlington Northern Santa Fe (BNSF) and Union Pacific/Southern Pacific, which currently utilize four separate routes consisting of 90 miles of track, will shift to a single 20-mile, high-capacity, below-grade train way. Ten miles of the corridor will be built below grade in an open trench along Alameda Street, eliminating over 200 at-grade rail crossings and widening the adjacent major highway. On-dock railyards will reduce the need for trucks to haul intermodal containers several miles between each port and the railyards. The Alameda Corridor project will be completed by 2001.

ALLIANCE TERMINAL

This 20,000-acre facility has been operational since 1989, when the Federal Aviation Administration asked for the donation of 418 acres to build an airport to complement Dallas–Fort Worth. Since beginning operation, the airport has attracted a variety of industrial sites. American Airlines has a maintenance facility that also serves as the new base for the Drug Enforcement Administration's fleet of 44 planes. BNSF built a railyard next to the airport for an intermodal rail–truck container interchange. The rail access enticed the Ford Motor and Food Lion Companies to construct major distribution centers there. Nestle also built a distribution facility, and Federal Express built an air freight center close to the airport. Zenith relocated from Chicago, and Nokia, the cellular phone manufacturer, has a workforce of 2,000 people on the site.

AUTOMATED EXPORTS SYSTEM (AES)

AES is a U.S. Customs Service test program that allows shippers to enter export declaration information electronically and submit it directly, expediting container inspections at ports. The Ports of Baltimore, Charleston, Hampton Roads, Houston, and Long Beach have implemented the test phase of AES. More conventional customs inspections procedures for marine cargo range from a cursory "tail gate" examination of the container to the full unloading of its contents.[1]

CONTAINER HANDLING COOPERATIVE PROGRAM (CHCP)

In 1992, the Maritime Administration conducted a demonstration program to test the application of an integrated container-handling system that uses MIVs to automate container inventory. The MIVs used RF readers to identify the contents of the containers-on-chassis equipped with RF transponders. The central terminal computer system stored information about each tagged chassis and its container. As the MIV driver navigated the rows of parked containers-on-chassis, the MIV reader interrogated the container tags, and an antenna mounted on the back of the vehicle emitted a signal that triggered a response from the tag, providing the chassis number to the driver via the radio wave. The CHCP demonstration also tested an ELS as an integrating mechanism, consisting of an MIV with AEI tag readers, a DGPS receiver, an ultrasonic ranging device, a wireless local area network communications system, and an onboard computer. This system integrated the operations of AEI systems used at the carrier's gate, on cranes, and in an MIV. It automatically identified tagged containers and chassis and related each to its slot location within the terminal.

FAST CORRIDOR AND OTHER PORT OF SEATTLE TERMINAL IMPROVEMENT PROJECTS

The FAST Corridor in Washington State is a $355 million freight improvement project in its final stages of approval. The initial phase of the corridor strategy will consist of 15

[1] Alan Abrams, "Customs Rethinks Inspection Procedures," *Journal of Commerce*, January 26, 1995.

ranked port access and rail grade separation projects, with a funding share of 25, 50, and 25 percent for the local/private, State, and Federal sources, respectively. One innovative funding component is a commitment by BNSF to fund 5 percent ($18 million) of the total corridor costs rather than pay a share of the costs of selected individual grade-crossing projects. The 25 percent Federal share is expected to come from the $700 million authorized in Sections 1118 and 1119 of the Transportation Equity Act for the 21st Century (TEA-21). The State, under the leadership of the Legislative Transportation Committee, is using the corridor framework to identify and rank projects. In July 1999, the Governor appointed a new Freight Mobility Strategic Investment Board to undertake the process of identifying and ranking candidate projects. Three other on-dock rail terminals and improvements involving roadway, railyard, and shoreline mitigation measures have been built at the Port of Seattle in the past few years, using both State and local funds.

FASTSHIP ATLANTIC

FastShip Atlantic, Inc., is designing a new generation of containerships. Currently in the design phase, the vessel will cut transit time for trans-Atlantic trips in half: Whereas conventional containerships take 7 to 8 days to cross the North Atlantic, the FastShip will make the same crossing in 3.5 days. Preliminary plans for operations between Philadelphia and Zeebrugge, Belgium, estimate that the vessel will be able to leave Philadelphia fully loaded, cross the ocean, deliver cargo and load new cargo, and return to Philadelphia in just 8 days. The vessel will have an average service speed of 37.6 to 42 knots, an overall length of 774 feet, and a draft of 34' 3". It will carry 1,400 TEUs and have an annual capacity of 100,000 TEUs per ship deployed. Specialized container-handling systems would allow accelerated container loading and unloading, reducing terminal dwell times. The new vessel technology would be attractive for transatlantic shipments of high value and time-sensitive cargo, which have traditionally used air as the preferred mode. Benefits other than speed include improved air quality, as the ship's gas turbines would produce less noxious fumes than diesel engines.

IRON HIGHWAY

An Iron Highway trainset consists of a 1,200-foot-long continuous platform with a split ramp in the center for "roll-on, roll-off" loading and unloading and a power unit on each end. Up to five Iron Highway trainsets can be used together in a multiple-unit configuration. The trainsets are capable of handling any combination of trailer length, moving as many as 40 trailers at a time. In 1994, CSX Intermodal bought out the interests of New York Air Brake Company, which had originally developed the concept. CSX has completed a commercial pilot test between Chicago and Detroit and leased four prototype trainsets to Canadian Pacific, which has them in service on the Montreal–Toronto corridor. The equipment is designed for short-haul markets—corridors between 250 and 700 miles—which cannot be served economically by double-stack trains because of their capital-intensive terminals. The Iron Highway uses standard truck trailers of any length and requires no lift equipment or mechanized terminals. It can serve the same portion of the market as the RoadRailer technology being used in Norfolk Southern's Triple Crown service and could also be used by Amtrak for carrying mail.

NORFOLK INTERNATIONAL TERMINAL DRAYAGE NOTIFICATION SYSTEM

The Norfolk terminal at Hampton Roads, Virginia, has increased terminal throughput by deploying communication systems between the terminal and drayage operators. The terminal has also cut yard dwell times by reducing the number of times a container is handled. Before a train arrives, the terminal promptly notifies the drayage company by fax. Instead of loading the container on the chassis and parking it, the system allows a driver to pick up the container immediately after it arrives, eliminating two additional lifts (for placing the container in a parking slot or on the chassis). The Virginia Port Authority maintains that the new system has expedited gate clearance times for truckers by 80 percent. The Norfolk terminal solution is analogous—in its more advanced applications—to systems for simultaneous loading and discharge, which offer an optimal solution to port bottlenecks. This mechanism has the potential for speeding ship loading and offloading, reducing land requirements, and making more efficient use of port equipment. Because the process involves the loading of import containers as soon as they come off the ship, it requires synchronized arrivals of the ship and train. If the rate of unloading the ship is matched by the rate at which the train is loaded and discharged, transferring ship inventory to the train could be accomplished with no buildup in the intermodal storage yard of containers from the ship.

NORTH CAROLINA GLOBAL TRANSPARK

This is a multi-modal industrial complex designed to link the Research Triangle with the available regional freight infrastructure. TransPark is a manufacturing and distribution facility as well as an integrated air, rail, road, and port terminal with a cargo airport, the Moorhead City Port, Norfolk Southern and CSX railroads, and Interstate Highway 70. The Global TransPark Authority is seeking $35 million from the Federal Aviation Administration to defray some of the $40.2 million needed for extending the existing airport runway to 10,500 feet. (The agency has already contributed the existing airport site at Kinston Regional Jetport and a grant for the initial Environmental Impact Study.) The cost–benefit analysis prepared in September 1997 identified significant savings in reduced freight rates and logistics costs to shippers. The Federal investment is leveraged by a commitment of $400 million from State, local, and private sources. The value of the on-site manufacturing operations has been estimated at $7.5 billion. The benefit–cost analysis of alternative airport sites concluded that making use of an under-utilized non-urban airport offered the most cost-effective solution for the project. The income that will be generated from the industrial park is estimated at $4.05 billion over the next 20 years.

PEASE INTERNATIONAL TRADEPORT

In 1992, the Department of Defense transferred more than 1,700 acres of the former Pease Air Force Base to the State of New Hampshire to be operated as a high-technology commercial park by the Pease Development Authority. The Department of State established national passport and visa centers at this site after a $5 million refurbishment. The New Hampshire Air National Guard's 157th Air Refueling Group, originally co-located with the Air Force, provides airfield services, including the Aircraft Rescue and Fire Fighting Unit. Emery Worldwide provides direct cargo service daily out of the airport; Seacoast Aviation offers services to private and corporate aircraft owners; and Phoenix Air Transport plans to begin cargo service to the Eastern Rim in the near future. Infrastructure improvements have been funded through the Department of Commerce's Economic Development Administration and the Federal Aviation Administration. Other private investments include a $30 million, 63,000-square-foot manufacturing park constructed by Celltech Biologicsa of the United Kingdom.

PHYSICAL OCEANOGRAPHIC REAL-TIME SYSTEMS (PORTS)

PORTS is a Federal–local partnership to provide safe and cost-effective navigation in major ports and harbors with real-time navigational data. PORTS was initiated in 1994 by NOAA in an attempt to build on the capabilities of the modernized NWLON.[2] The Ports of New York/New Jersey and San Francisco have implemented PORTS projects, but future efforts remain uncertain due to funding limitations. PORTS navigational data are currently transmitted by radio on an hourly basis. Development of an integrated VTS and PORTS system is under consideration.

PORT OF LOS ANGELES INTEGRATED PORT MANAGEMENT AND VESSEL PLANNING SYSTEMS

American President Line's new $700 million Global Gateway South terminal at the Port of Los Angeles deploys an integrated port management and vessel planning system for equipment identification and container tracking. The wide array of equipment and information systems that are installed at the terminal—from the rubber-tired gantry cranes and yard hustlers to the MIVs, AEI, RF chassis tags, GPS, and video camera technologies deployed for security—are all geared to provide data to feed into the three port management systems that control container movements. Additional systems for rail operations planning and yard/gate transactions provide the integrated end-to-end management of the intermodal container moves. With the operations planning system, terminal operators can view on the computer screen a schematic depiction of the different

[2] With NWLON, NOAA maintains a permanent database of tides and water levels. Stations are currently being upgraded from outdated electromechanical devices to state-of-the-art electrical data collection, processing, and dissemination systems. Upgraded NWLON can provide real-time water-level data for use by the maritime community to enhance safety and cost effectiveness and provide critical support for oil-spill response efforts. Currently, inadequate funding is preventing NOAA from completing the modernization of the NWLON and is limiting its use as a navigational aid.

ways a ship can be loaded. This is particularly helpful for packing heavy loads, hazardous materials, and perishable cargo.

PORT OF OAKLAND JOINT INTERMODAL TERMINAL

This new marine terminal will expand and improve the existing Port of Oakland intermodal operations of Southern Pacific/Union Pacific and BNSF by consolidating their activities in a single, jointly operated terminal. By converting the Naval yard to civilian use, the joint terminal will provide additional capacity for commercial operations while allowing for continued military overseas deployment efforts. The civilian use of the 526 acres of the closed military base at the Naval Fleet Industrial and Supply Center nearly doubles the port's original size, allowing it to construct two new berths and new marine terminals along the Inner Harbor. When completed, the joint terminal will serve as a public terminal that will provide both Southern Pacific/Union Pacific and BNSF near-dock access at the port. BNSF currently has no near-dock access to the port and must truck its containers 11 miles from Richmond. With near-dock access, BNSF will save on the expenses and delays of drayage operations on some of the most congested freeways in California. The joint terminal near-dock construction began in early 1999 and will provide adequate loading and parking capacity for expansion of both international and domestic container trade. The completed terminal will have a 1.6 million container capacity and will be able to accommodate 42 double-stack trains over 8 miles of loading tracks. The ship-to-rail facility will consist of a near-dock seaport intermodal terminal for transfer of containers between rail and ship. Competition between the two railroads will ensure efficient services for the domestic portion of the container moves. The terminal will incorporate state-of-the-art electronic and satellite technologies.

PORT OF PORTLAND'S ELECTRONIC SHIPYARD PLANNING SYSTEM

At the Port of Portland, Oregon, a computerized tracking system and electronic shipyard planning system have improved truck cycle times by 25 percent. The port has implemented a $3.8 million improvement project for a two-stage computerized gate system that speeds the processing of trucks through the gates. Previously, the trucks were weighed and the container numbers were recorded manually by the gate clerk, while the driver took a break. With the new system, the driver does not leave the cab. The clerk enters the data into the computer and the truck is waved into the yard. The shipyard planning system includes a phone network that relays cargo arrival and departure information—allowing trucking companies to dispatch their vehicles when the container is available for loading and cut down on the time trucks spend waiting in line. Truckers have been able to reduce their turnaround time, dropping off their load and picking up a new load in less than 30 minutes. At least two other ports, the Port of Los Angeles and the Georgia Port Authority, are equipped with a similar communications network.

POSITIVE TRAIN SEPARATION (PTS) AND HIGHWAY-RAIL INTERSECTION SAFETY

The application of ITS technology at highway–rail grade crossings offers the opportunity to reduce risks at what are currently the least safe locations on railroads—locations where over 400 people a year in the U.S. are killed. The ITS Joint Program Office addressed grade crossings in the overall ITS architecture program. Highway–railroad intersections were designated as User Service #30 in the ITS architecture, and the process was very successful in developing the architecture for "intelligent" grade crossings. At such crossings, motor vehicles will get advance warning of the approach of trains, and trains will get advance notice of whether or not the grade crossings are clear. While the annual number of highway–rail crossing casualties in the U.S. continues to decline, ITS technologies may dramatically reduce that number even further in the years to come.

RICKENBACKER AIRPORT

Rickenbacker is a joint-use reliever airport in Columbus, Ohio, specializing in air cargo operations. Currently, eight airlines conduct scheduled and chartered operations there. The airport provides a low-cost, efficient alternative to traditional North American gateway airports. The overall cost of moving air cargo through Rickenbacker is 50 percent less than New York's John F. Kennedy Airport, 45 percent less than Atlanta's Hartfield, and 35 percent less than Chicago's O'Hare. Part of the cost savings is due to the lower congestion at Rickenbacker. In addition, the airport's central Ohio location contributes to its high throughput. Central Ohio provides direct access to 50 percent of the U.S. and Canadian population and some 60 percent of consumer markets. The airport serves as the reliever airport with a 2,000-acre Foreign-Trade Zone, and is the pivotal point of the Greater Columbus Inland Port. The airport is dedicated to cargo and distribution operations and has two parallel 12,000-foot runways capable of landing any size aircraft 24 hours a day. Air National Guard and other military and general aviation facilities also are located at the airport. Since 1992, Rickenbacker has experienced rapid growth, with some 6.8 million square feet of new construction. The airport supports more than 38 companies, $330 million in private investments, and 5,600 permanent jobs. Air cargo activity grew by 18 percent in 1995 compared to the previous year, and quadrupled since 1991.

SOUTHEASTERN MICHIGAN INTERMODAL TERMINAL (SMIT)

This facility is a joint terminal in Southeastern Michigan, developed as an "intermodal condominium," with a "condo association" handling its operations. Project partners at the State and local levels view the SMIT as a world-class transportation hub that will benefit the State by reducing truck traffic and highway congestion and lowering maintenance costs. The terminal will benefit shippers by enhancing the long-term viability of the Big Three automakers in the State and improve their access to domestic and international markets. For railroads, the terminal will generate added intermodal traffic and capacity without a corresponding level of capital investment. Overall, the terminal is expected to benefit the shippers and the regional economy through greater logistics efficiency and lower costs. The terminal land will be publicly owned, providing equal access to all shippers and service providers. Common services will offer economies of scale, while allowing railroads to control all aspects of their respective operations. An enabling authority will be created to handle the financial and legal functions involved in land acquisition, terminal development, and rail access issues. Additionally, the 2,000-acre facility will accommodate load consolidation and warehousing facilities for trucking companies. In February 1998, the Michigan DOT funded Arbor Vista Transportation to advance the SMIT concept to the point where detailed engineering can begin.

UPS CHICAGO AREA CONSOLIDATION HUB (CACH) AND THE LOUISVILLE FREIGHT SORTING FACILITY

The $176 million CACH facility functions as a national consolidation point for handling UPS's domestic package volume. Ultimately, an adjacent BNSF facility will be used as the rail connection for the intermodal shipment of UPS trailers. UPS has initiated road and rail improvements at the Willow Springs BNSF railyard and is also building a number of other interchanges. The project is a model of how modern high-technology infrastructure improvements are made possible with joint investment and planning. The UPS freight sorting facility in Louisville, Kentucky, provides another example of the extent to which private investment decisions are intertwined with those of State and local governments. In March 1998, UPS announced plans to build Hub 2000, a new $860 million facility at Louisville's International Airport. The decision hinged on the State's obtaining a commitment from UPS to recruit, train, and house 6,000 new employees in addition to the 15,000 already employed at the current facility. UPS and the State will share the $4.6 million startup cost for programs at three local universities to recruit and train the workers. The new 2.7-million-square-foot facility will process 300,000 packages per hour, compared to the existing hub capacity of 165,000 packages per hour. Automated sorting using coded barcode labels will replace the present manual sorting.[3]

VESSEL TRAFFIC SERVICE (VTS)

The U.S. Coast Guard's VTS is the principal form of traffic control used in maritime commerce, providing information needed to improve navigational safety and efficiency. VTS is an interactive, shore-based waterways management and communications system that typically consists of remote surveillance sensors, such as radar or closed-circuit television, and a central data-gathering location. VTS helps determine the presence of vessels in and around ports and provides information to vessels on such matters as traffic, tides, weather, and port emergencies. After receiving information on marine conditions, VTS personnel assess the information and pass it on to mariners and vessels by radio. VTS also assists local port authorities with waterways management, search and rescue operations, and law enforcement. VTS is usually augmented with surveillance equipment (principally radar) for acquiring data on the position of vessels and traffic flow. The Coast Guard has installed and operated VTS in eight major ports (New York; San

[3] "UPS to Build Hub 2000," *Traffic World*, March 23, 1998.

Francisco; Houston–Galveston; Puget Sound; Valdez, Alaska; Morgan City, Louisiana; Louisville, Kentucky; and Sault Sainte Marie, Michigan). The Ports of Los Angeles/Long Beach and Delaware Bay operate VTS-like private systems. The Oil Pollution Act of 1990, passed in the aftermath of the 1989 Exxon Valdez oil spill, called for a needs assessment to establish the benefits of installing VTS at other ports. The Coast Guard proposal for expanding VTS to 17 new ports, called VTS-2000, is estimated to cost between $260 and $310 million, and would cost an additional $42 million in Federal funds each year to operate at the 17 sites. The estimated benefits of the new systems ranged from $254 million for a new VTS in New Orleans to $48 million for installing new systems in Port Arthur, Texas, and Mobile, Alabama. Negative net benefits were shown for expanding the existing private systems in Philadelphia and Baltimore (which have a radio-based, non-radar system) and for installing new systems in smaller ports such as Providence or Long Island Sound.

APPENDIX B
ACRONYMS

AEI	Automatic Equipment Identification
AES	Automated Exports System
BNSF	Burlington Northern Santa Fe
CACH	Chicago Area Consolidation Hub
CCDOTT	Center for Commercial Development of Transportation Technologies
CHCP	Container Handling Cooperative Program
CVISN	Commercial Vehicle Information Systems and Network
DARPA	Defense Advanced Research Projects Agency
DGPS	Differential GPS
DOT	U.S. Department of Transportation
ECDIS	Electronic Chart Display and Information System
EDI	Electronic Data Interchange
ELS	Equipment Location System
EMT	Efficient Marine Terminal
FAST	Freight Action Strategy
GDP	Gross Domestic Product
GIS	Geographic Information System
GMPH	Gross Moves per Hour
GPS	Global Positioning System
IIC	Intermodal Interface Center
ITDS	International Trade Data System
ITS	Intelligent Transportation Systems
JIT	Just-in-Time
MIV	Mobile Inventory Vehicle
MTMC	Military Traffic Management Command
MTS	Marine Transportation System
NBI	National Bridge Inventory
NOAA	National Oceanographic and Atmospheric Administration
NSF	National Science Foundation
NSTC	National Science and Technology Council
NWLON	National Water Level Observation Network
PORTS	Physical Oceanographic Real-Time Systems
PTC	Positive Train Control
PTS	Positive Train Separation
R&D	Research and Development
RF	Radio Frequency
RFID	Radio Frequency Identification
SMIT	Southeastern Michigan Intermodal Terminal
TEA-21	Transportation Equity Act for the 21st Century

TEU	Twenty-Foot Equivalent Units
TRAMS	Transportation Automated Measuring Systems
USTRANSCOM	United States Transportation Command
VTS	Vessel Traffic Service
WIM	Weigh-in-Motion