

# **THE FREIGHT SHUTTLE:**

**The Crisis in Freight Transportation**

**And the Opportunity for a Green Alternative**



**A Concept for 21<sup>st</sup> Century Freight Movement**

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## **SUMMARY**

The convergence of several individual problems is creating the conditions for a transportation crisis of unprecedented scope and magnitude. It will result from sky-rocketing demand for transportation services and the capacity crisis on our highways, from complete dependence on oil for transportation, and from highway infrastructure deterioration. Of central concern – without innovative approaches, it may take shape in a funding atmosphere insufficient to avoid the consequences.

The crisis will result in unpredictable changes in the way we as a country do business. But it also creates an opportunity in freight transportation that is the subject of this paper. It describes an opportunity to move freight transportation systems into the 21<sup>st</sup> century by employing technological innovation to solve the pressing problems facing the public and private transportation sectors, shippers, consumers, and those government agencies charged with providing transportation services – and to do so in a way that is environmentally responsible.

## **1. INTRODUCTION**

The transportation of freight is the life-blood of the economy. Goods and material flow in vast quantities from manufacturers to customers in a highly complex system. Container ships, trucks, and double stack container movements by rail operate in concert to provide a seamless transportation network that can move cargo from overseas suppliers to distribution centers or retail outlets in sealed containers. This transportation system, which has developed over many decades, has achieved high levels of efficiency and responsiveness that in turn has fueled economic growth in both domestic and international markets.

However, for all of the accomplishments of the modern freight transportation industry, there are very real and significant problems emerging that threaten to constrain trade and limit future economic development. Among them are growing roadway congestion on a deteriorating highway infrastructure, escalating fuel costs and a completely oil-dependent transportation sector, air quality concerns, a capital and capacity-constrained railroad system, safety concerns resulting from mixing freight and passenger transportation on highways, port congestion, and sky-rocketing infrastructure maintenance costs. These problems provide an opportunity for the entry of an innovative transportation system that combines the best features of trucks and railroads with advanced command and control technology, robotics, and an environmentally sound propulsion system.

This paper introduces an approach to freight transportation that addresses the limitations and constraints of the existing systems and presents a new, hybrid system that draws attributes from both trucking and railroads and adds new technological elements that enable the system to achieve high performance and capacity levels along with lower costs and fewer adverse impacts. The concept, called the “*Freight Shuttle*,” offers a new method to transport containerized, intercity or port-to-



terminal freight. It consists of an automated vehicle, a specially designed guide-way, a linear induction propulsion system, and a control system that negates the need for an on-board driver. The propulsion system involves the vehicle and the guide-way working in concert as inherent components of the motor assembly. As a result it has virtually no moving parts to wear out or fail. The vehicle with its containerized cargo is designed to operate over a grade separated right-of-way, reducing the burden on highways in terms of safety, wear, and capacity while offering increased reliability and lower costs. These benefits are achieved by maintaining compatibility with existing intermodal systems.

## 2. THE NEED IN SOUTHERN CALIFORNIA

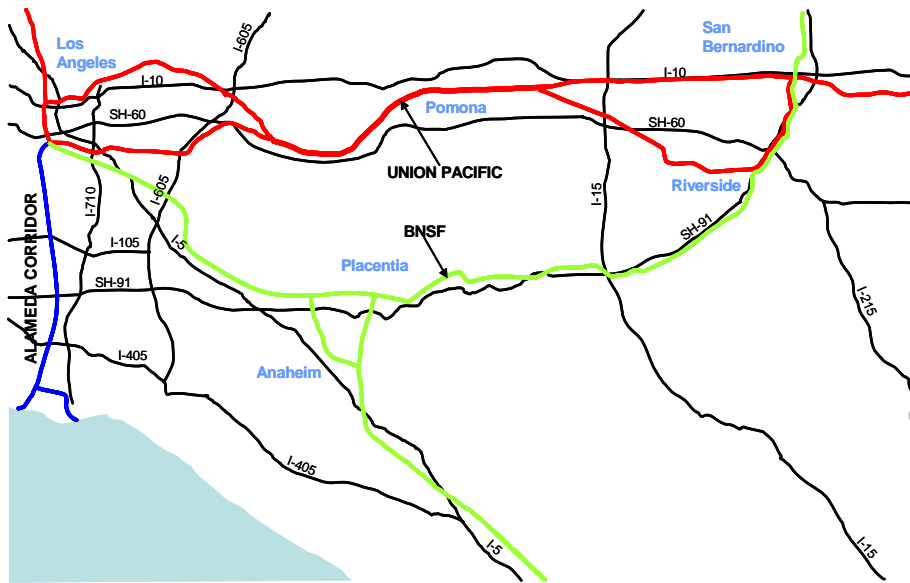
An opportunity to implement the Freight Shuttle may exist in Southern California. This coastal hub is a setting that is in dire need of a congestion mitigating transport system capable of high levels of sustained, cost-effective container throughput. The Ports of Los Angeles and Long Beach serve as the gateway for a dominate share of the nation’s container traffic – as much as 44 percent – 11.8 million TEUs in 2003. The local market of 17 million residents also attracts vast quantities of containerized imports. This population is projected to increase to over 23 million by 2025 (Los Angeles Economic Development Corporation, 2002). The potential growth in container trade is daunting

with projected movements tripling to over 30 million TEUs by 2025. This is an amount that cannot be moved over the current highway or rail system which now relies on trucks operating over capacity-constrained highways. Railroads play a key role in freight movement, focusing on long-haul movements of 500 miles or more. Current plans to attempt short-



haul rail service to the Inland Empire, a plan that may require substantial public subsidy, underscores the need for a better alternative.

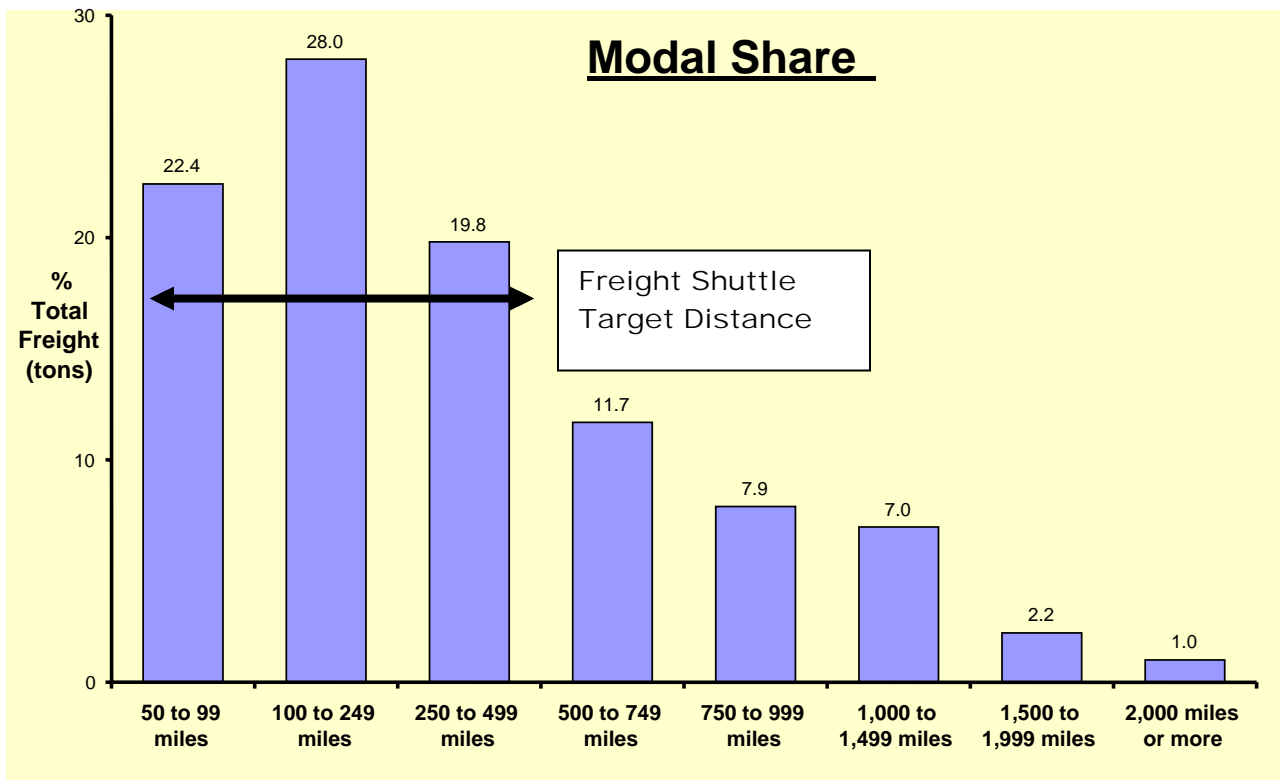
The adoption of the Freight Shuttle concept in Southern California could transport containers to truck transfer facilities 60-75 miles inland, avoiding capacity-constrained highways where congestion is exacerbated by heavy container traffic. The containers targeted for this transport are primarily those destined for local domestic consumption or for the warehouses and terminals located in the “Inland Empire” of San Bernardino and Riverside Counties, shown in Figure 1 below: This area is home to 360 million square feet of warehouse and distribution space that is expanding at a rate of 10 percent per year. The inland empire attracts approximately 20,000 truck trips per week, consuming highway capacity, degrading air quality, and jeopardizing safety throughout the area.



**Figure 1 – The Roadway and Railway Network in Southern California**

Most freight travels by trucks. The dominance of the trucking industry is due in large measure to the flexibility, speed and responsiveness of the mode. But as importantly, this

dominance is due to the benefit derived from the publicly subsidized infrastructure over which trucks operate. Railroads enjoy no such benefit, paying for the construction and maintenance of their facilities. These factors result in a clear dividing line between freight moved by truck and that moved by rail. Figure 2 displays the quantity of freight relative to the distance that freight is transported. As can be readily seen, the target distance for an alternative system need not be extensive in order to attract significant traffic levels and positively impact highway congestion, air quality, and urban quality of life.



**Figure 2 – Quantity of Goods and Material Moved By Distance**  
(Bureau of Transportation Statistics (USDOT) and U.S. Census Bureau, 2002)

## **The Greener Alternative**

The Freight Shuttle represents a more environmentally friendly alternative to the existing modes. It has three compelling attributes:

1. It is a more reliable and a higher-performance system – the grade separated, dedicated infrastructure, automated vehicles, and operations predicated on immediate dispatching means that the Freight Shuttle will provide a system that supports increasing transport capacity, essential to the economy of Southern California,
2. The system, given its flexible, electric energy source, will positively impact air quality in the region, reducing emissions and reducing reliance on oil.
3. The design of the system means that the adverse impacts of trucking on the transportation system – congestion, safety, and pavement damage – are directly avoided.

The use of linear induction motors results in a system that relies on remotely generated electrical power to operate the system. This power can be generated with a variety of fuels and with emissions controlled at the source – a clear air quality benefit for the communities suffering from increasing diesel emissions. Furthermore, the energy requirements stemming from the Freight Shuttle’s design are significantly lower than over-the-road transport. Projections for the energy requirements of the Freight Shuttle in this Southern California setting suggest that, at current PG&E electrical rates, a 60-mile

transit would cost roughly \$20 in power use – the only variable cost in the Freight Shuttle cost structure – far lower than the variable costs associated with trucking.

### **3. COMPETITIVE ANALYSIS**

The freight transportation industry is a highly competitive and cost-constrained industry. The Freight Shuttle system fits into this industry by fulfilling the growing need to move freight in a cost effective, efficient, and environmentally sound manner. The Freight Shuttle has several advantages and solves several major freight transportation problems. The system has been developed with the intention of providing a winning scenario for all major freight transportation stakeholder groups. Among these stakeholders are State Departments of Transportation, the existing freight transportation industry, the shipper community, and, perhaps most importantly, citizens that are both the ultimate customer of freight transport and that group who must also contend with the dis-benefits that freight movement systems inadvertently, but unavoidably, create.

#### **Improvements over Conventional Rail**

The Freight Shuttle’s design provides improvements over freight transport by rail in the following important categories:

- Intermediate (short haul) distances – the nature of freight rail, which involves complex sorting of cars in terminals as well as the strategic placement of locomotives and crews, is not competitive with trucking at distances under 500

miles. Rail has virtually no share of this “short haul” market. The Freight Shuttle will allow individual containers to be sent as they are received in a “just-in-time” shipping system and interact efficiently with existing modes.

- Technology – the railroads use technology that, while effective for their market, is difficult to change. Certain features of rail technology, such as steel wheel on steel rail, form the basis for the historical success of rail, other facets of the technology, namely rail serving as a guideway as well as a rolling surface, create problems (e.g. derailments). Further, railroads contend with complex and expensive locomotives, poor braking systems, wheel and bearing failure, etc. The Freight Shuttle has been designed to minimize or eliminate most of the technology issues railroads find themselves working to overcome. The linear induction propulsion system means there are virtually no moving parts related to motive power and propulsion.
- Crew – A major operational expense and logistical problem for railroads is found with the on-board crew. The Freight Shuttle will be automated and unmanned.
- Grade Separated Right-of-Way – Railroads operate over a system that has developed in concert with the highway system. As a result, the railroad network crosses thousands of streets and highways at grade level. While the railroads maintain the right of way at grade crossings, these intersections are a significant safety, operational, and financial issue for the railroads. The Freight Shuttle requires grade separation throughout any corridor over which service is

contemplated. This requirement enables many of the positive benefits identified for the system. In Texas, the Trans Texas Corridor offers the opportunity to develop a fully grade separated system free of the impediments posed by crossing other transportation infrastructure.

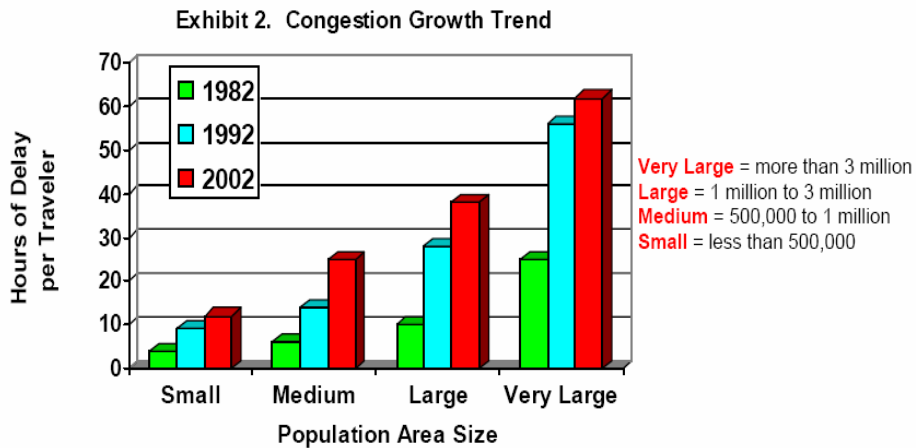
- Oil Dependency – The railroads are a major user of oil (diesel) and highly dependent on both the availability and price of this fuel. Fuel represents about one-half of the variable operating costs for railroads and virtually the entire domestic fleet of locomotives is diesel powered. Restricted availability, increased prices, or limitations on emissions may impact the railroad’s ability to serve key markets. The Freight Shuttle is designed to operate on electricity, a power source that provides the system considerable flexibility in terms of basic fuel (or system; solar, wind, etc.) used to generate the energy and is a step away from dependency on foreign oil.

### **Improvements over Intercity Trucking**

The Freight Shuttle’s design provides improvements over freight transport by trucks in the following important categories:

- Operational Cost – The cost of intra-city drayage by truck in Southern California has been estimated at more than \$4.00 per mile, depending on the location of the operation. This figure includes the cost of the driver, fuel, maintenance, and depreciation on equipment.

- Performance – The transit time for intercity trucking is on the increase. TTI’s annual congestion assessment shows increases in delay for motorists for every community size surveyed.



Average speeds, which are impacted by traffic densities, rest and fuel breaks, and roadway incidents, are falling in some corridors to pre-interstate highway levels. Recent history suggests that new highway capacity is as rapidly consumed as it is provided. In fact, some contend that additional highway infrastructure has the affect of encouraging more trucking operations.

- Hours of service – Trucking companies and independent truckers are restricted by hours of service laws that limit driving and mandate rest periods. The Freight Shuttle, operating on dedicated right-of-way, will be able to run on a 24 hour per day, 7-days a week basis and be largely immune from delays caused by inclement weather, traffic congestion, or disruptive roadway occurrences. This feature will provide improved service and high capacity levels.

- Driver training and retention – a significant and growing problem for trucking companies that, as noted above for railroads, is not an issue with the Freight Shuttle. The system will allow truckers to operate in settings that provide greater revenue-generating potential.
- Greener option – the Freight Shuttle system will be compatible with the introduction of “urban dray” vehicles that are designed with short-haul and medium-haul capabilities and air-quality-friendly propulsion systems using alternative fuels such as propane or natural gas, reducing the use of heavy diesel tractors in urban areas and positively impacting air quality beyond the direct effects of transport by the Freight Shuttle.

### **Public Benefits**

The Freight Shuttle provides large public benefits in terms of avoided social costs in areas such as safety, pavement damage, congestion, and air quality. The Federal Highway Administration (FHWA) suggests that trucking operations create discernable costs to the public sector in 5 major categories, as noted in Table 1, below (Federal Highway Administration, 2000).

**Table 1 – FHWA Unit Costs for Trucking on Rural and Urban Highways  
in Dollars per Truck Mile**

| <b>Cost Category</b> | <b>Rural</b>    | <b>Urban</b>    |
|----------------------|-----------------|-----------------|
| Collision Damage     | \$0.0088        | \$0.0115        |
| Pavement Damage      | \$0.1270        | \$0.4090        |
| Highway Congestion   | \$0.0223        | \$0.2006        |
| Air Pollution        | \$0.0385        | \$0.0449        |
| Noise Pollution      | \$0.0019        | \$0.0304        |
| <b>Total</b>         | <b>\$0.1985</b> | <b>\$0.6964</b> |

These figures are derived from work performed in the 1980s. The actual costs are highly dependent on the region being evaluated. In Southern California, for example, ACTA indicated that the values were often considered at twice this stated FHWA rate. Regardless of the exact value placed on these categories, the understanding that the public sector bears significant costs associated with the transportation alternatives available to them supports the movement toward lower-impact alternatives.

## **5. SUMMARY**

The positive indicators for the Freight Shuttle are numerous and compelling:

- The Ports of LA and Long Beach are currently the largest container ports in the US and serve as the gateway for the exploding trade with the pacific-rim countries and China. The ports must develop a viable land-side transportation strategy to maintain growth.
- The public sector will be unable to meet the mobility needs of the region through highway expansion, particularly if new capacity is consumed by trucks as soon as it becomes available. Proposals for new highway infrastructure in the region

exceed \$20 billion over the next two decades, \$4 billion of which would be to expand the I-710 freeway leading to the ports – for which there is strong public opposition (Alameda Corridor Transportation Authority, 2004).

- The environmental concerns associated with diesel emissions in California are shared by a growing number of supporters of the Ports. The desire to increase trade and simultaneously decrease emissions will require a radical change in the approach to container transport.
- Shippers will support the proposed approach due to the direct advantage offered by a system that can operate efficiently at or below today's costs. The energy efficiency of the Freight Shuttle, the automated vehicles, and the potential for 24-hour operations, will attract significant support from a private sector dedicated to maintaining the competitive advantage and economic growth of the region.
- The trucking industry and owner-operators will support the Freight Shuttle due to its ability to transport containers to a region that is less capacity constrained. Since trucking revenues are usually earned on a per-mile basis, it will offer drivers the ability to net a higher income, expend fuel more efficiently, and reduce wear on equipment. Driver recruitment and retention is a major ancillary problem indirectly addressed by the Freight Shuttle which will not eliminate the need for trucks, but rather will allow trucking operations to take place in more suitable locations.

The Freight Shuttle represents a rare opportunity to fill a rapidly expanding vacuum in freight transportation. The problems emerging in this transportation sector are immense

and the solutions that are offered seldom provide more than an incremental improvement in the manner in which freight is transported. The Freight Shuttle offers a radical departure from today's standard practice that combines 21<sup>st</sup> century technology with the design simplicity necessary to accommodate the low-cost, high-reliability demands of the freight transportation industry while still improving emissions.

Serious problems exist today in the transport of freight - problems ranging from the environmental impacts of trucks to the shipper's bottom line. Historically, the freight transportation industry sees a significant shift in technology or approach about once every 50 years; the replacement of wagons by rail in the mid-19<sup>th</sup> century, the introduction of trucks at the turn of the 20<sup>th</sup> century, and the dominance of trucks over rail in the mid-20<sup>th</sup> century are cases in point. The explosion of containerized freight and advancements in automation has provided the foundation for yet another shift in the way America moves its goods.

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