Commission Briefing Paper 4L-07

Implications of Investments Targeted at Reducing Rail, Rail/Highway, Rail/Port, Highway/Port, Rail/Barge, and Highway/Barge Freight Bottlenecks

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Date: March 13, 2007

Introduction

This paper is part of a series of briefing papers prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

Freight bottlenecks are widespread and in some instances quite noteworthy, impacting the performance of the national freight transportation system. Bottlenecks individually and in aggregate cause substantial impacts – harming individual firms, constraining regional growth, decreasing national productivity and competitiveness, and impacting quality of life. These often complex intermodal bottlenecks can be difficult to address due to layers of physical, operational, political, financial, and institutional barriers. This paper includes freight bottlenecks within the rail sector and intermodally between rail, highway, seaport, and/or barge facilities. Current and prospective mitigation and investment strategies to address freight choke points are presented.

Background

Freight bottlenecks are by definition a localized mismatch of transportation supply and demand. They may be identified on the physical side by capacity constraints due to land use, congestion, topography, and/or insufficient transportation infrastructure. They may also be identified from various operational and institutional problems. In many cases, bottlenecks represent a location where not just peak, but even ordinary demand levels are not adequately met. Bottlenecks include elements of the freight system dealing with bulk as well as high velocity cargos, although in recent years the latter has been more problematic.

There are numerous rail and intermodal freight bottlenecks causing transportation difficulties, with microeconomic effects on firms and economies – constraining economic growth or shifting it to other locations. However, there are also a number of large choke points of national significance, which impose both microeconomic and macroeconomic costs due to broad impacts on productivity and competitiveness. Travel time delays are a very significant consequence of bottlenecks, but capacity constraints and travel time reliability are perhaps even more important.

Bottlenecks can be difficult to relieve, as there are often multiple causes (physical capacity, operational practices, etc.), and no single public or private organization is in a position to address them. Recent activities addressing intermodal bottlenecks have been mainly comprised of infra-

structure and terminal capacity investments; they have helped significantly, but not solved the long-term problem. Network cascade effects (e.g., when removing one bottleneck results in another one appearing downstream) can be especially difficult if the corridor in question spans facilities of different operators, modes and/or jurisdictions. In some cases, readily apparent recurrent delays (e.g., a congestion delays requiring an expensive physical infrastructure investment) may overshadow an equally important, but less visible, operational delay (e.g., within the seaport gates to transfer a container to a drayage truck).

Multimodal investments, strategies, and coordination regarding bottlenecks are not very common; the typical presence of multiple public and private stakeholders is a major factor in this. Intermodal bottlenecks can be especially difficult to address because of operational differences between modes, the need for coordination among sometimes competing stakeholders, and the frequent lack of a single governmental or organizational focal point with "ownership" of the issue.

Key Findings

- Bottlenecks can be characterized by physical, operational, and institutional aspects that often are interrelated. And while there are many commonalities, each mode or intermodal combination also has distinct factors that can contribute to bottlenecks. Thus, one useful means to reliably identify them is based on cross-modal performance metrics. Time and reliability measures should be developed that span the multiple terminal and line-haul links. These could help identify bottleneck spillover impacts on cargo and equipment from one link or node to adjoining ones. Selection criteria for Projects of National and Regional Significance (PNRS), as recently published for comment by FHWA, provide a framework for such assessment.
- The impacts of bottlenecks can extend beyond the peak to normal demand levels and beyond local transportation and economics to the national level. Local problems and local congestion caused by local traffic can have regional or national impacts.
- Examination of critical national freight bottlenecks confirms that complex attributes require multi-pronged, multi-stakeholder approaches. For example, the Alameda corridor, CREATE program and Kansas City bottleneck investments, are much different than typical infrastructure investments, incorporating multimodal, operational, and institutional elements to address these complexities. The Federal role in funding bottleneck projects must be carefully defined and implemented, since these investment decisions may reward one facility or firm to the detriment of another.
- Physical infrastructure investments may include line-haul capacity, last-mile access, and terminal storage, distribution and handling capacity. Broader characterization of bottlenecks beyond the physical location of the choke point allows investments to better address cascade effects and the full extent of the bottleneck.
- Operational improvements can include coordinating joint use of access or terminal facilities, advanced terminal gates and information technology, or pricing-based peak spreading, such as PierPASS in southern California. This will result in much greater leveraging of physical investments.
- Institutional progress requires improvement to the freight planning capabilities of states and

MPOs, developing multistate coalitions to address freight corridors, and establishing innovative public/private stakeholder agreements such as the interagency agreement for CREATE. Removing constraints or creating incentives for carrier coordination may prove valuable in some cases. These strategies and investments may help resolve current bottlenecks, and also help avert future ones.

- Benefits of bottleneck removal programs are multifaceted, including improving travel time, reliability, throughput, productivity/competitiveness, reduced congestion, as well as environmental, energy, safety, and quality of life enhancements.

Characterization of Bottleneck Problems

Physical Infrastructure

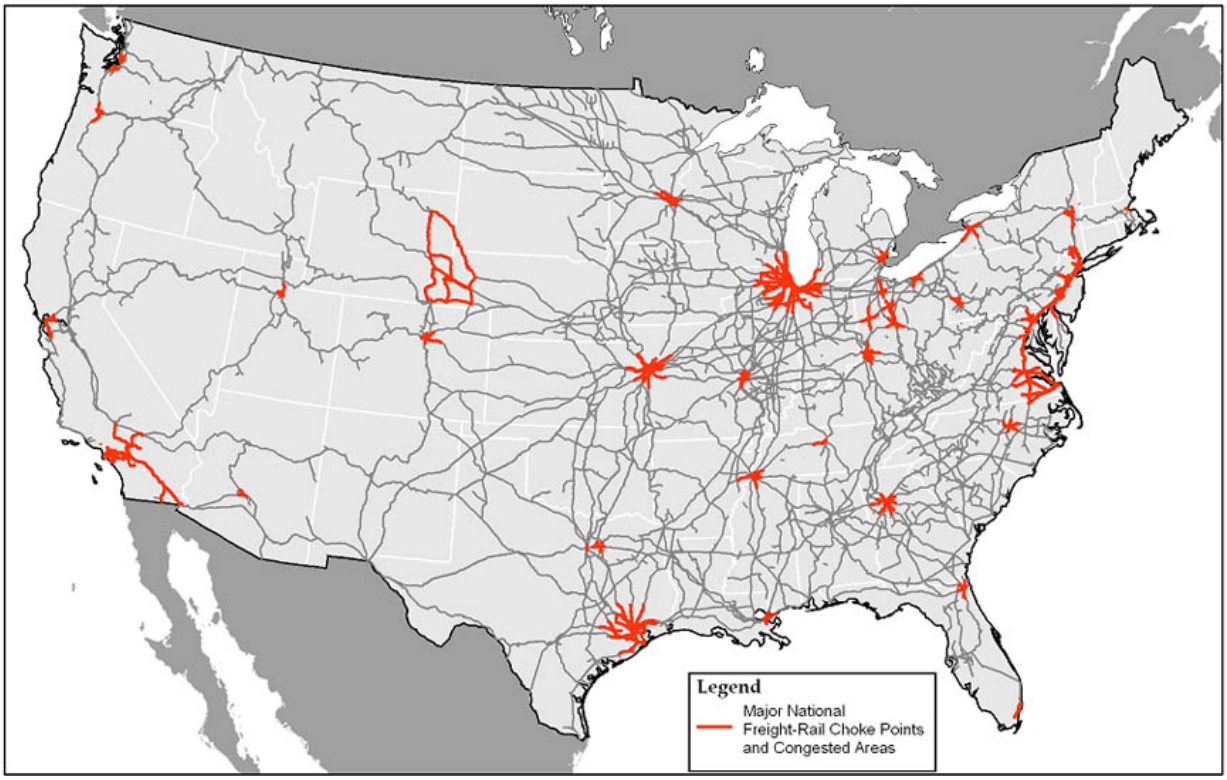
Almost all bottlenecks have a physical infrastructure element; the nature of these constraints varies widely depending on the mode and circumstances. The most readily apparent aspect of a bottleneck is often physical elements, certainly deserving attention, but perhaps receiving it disproportionately. They may be, or seem, the easiest problem to address, often because a single firm or agency is responsible for the facility. Infrastructure investments are often insufficient solutions alone, without operational or institutional changes. Further, cascade effects can make full identification of physical bottleneck solutions problematic due to the complex network effects that can result from changes to a single choke point.

Rail represents a large share of freight bottlenecks, both through intermodal connections and solely within the rail network. Line-haul capacity is an important constraint, as there are choke points both along individual lines (where one or more point constraints restrict flow along the entirety of a network segment) and on the national network (where a few links may impact a whole region).[1] Double-stack constraints are a notable example. The Heartland Corridor project illustrates how removal of several physical choke points (e.g., tunnel heights) can improve rail productivity for the entire Norfolk-Chicago corridor. Switch-yard storage and handling capacity and the quality of connections to multiple rail lines are also important. Regardless of line-haul capacity, terminal capacity will limit freight flows and yard access to other lines (e.g., cross-town rubber-tire rail interchanges). Other physical elements of the rail network that can create bottlenecks include the status of double/triple/quadruple-tracking and sidings.

Figure 1 contains a map of the nation's most severe railroad choke points and congested lines as assembled for the ongoing AASHTO Freight Bottom Line project. It includes congested corridors such as the Northeast Corridor and Southern California, major interchange locations such as Chicago, Kansas City, and Memphis, and congested hub facilities, including Atlanta, Houston, and Cincinnati. This map was constructed using the best professional judgment of experts as there is no systematic national inventory of rail capacity – a shortcoming that might help improve bottleneck relief.

[1] While the highway system shares some similar characteristics, its much more dense network mitigates these factors significantly unless within the proximity of an intermodal terminal or distribution point.

Figure 1. Major Freight-Rail Choke Points and Congested Areas



Source: Cambridge Systematics, Inc. prepared for the AASHTO Freight Transportation Bottom Line Reports, forthcoming, 2007.

The Class I railroads are responding to these choke points and congested corridors by selectively adding track and expanding facilities, when financially viable. The locations and pace of this expansion, though, are determined by private rate-of-return principles and not by overall transportation system efficiency, the public's desire for railroads to contribute to highway congestion mitigation, or other public benefits.

Rail/highway connections face similar bottlenecks. Capacity constraints from either mode into or out of intermodal facilities will limit throughput and/or cause delays. When the intermodal yard is in an urban area, congestion and at-grade crossings can impose severe constraints, especially at hours of peak passenger travel. Intermodal yard capacity itself has often been a problem. This has especially been the case with older, urban yards that face land constraints.

Most U.S. seaports' connections with rail lack on-dock or even near-dock rail connections, and thus must rely on marine terminal interchanges and especially drayage. This places stress on the system by requiring additional lifts, greater acreage within the gates, and more truck gate moves. Whether via on-dock rail or drayage, congestion and limited road and rail capacity near seaport terminals are also important elements of rail-port bottlenecks.

Highway-seaport connection bottlenecks also stem from the above elements. Terminal efficiency through technology can certainly improve the intermodal interchange. Still, the presence of "last mile" congestion or limited road capacity impose constraints on traffic flows.

Barge connections with both rail and highway also face physical limitations. In particular, cargo handling facilities often have little capacity for additional volumes or new cargo types.

Operational Issues

Local optimization by individual users, such as decisions on equipment purchases and operating hours, can harm system efficiency. Competing modes or firms sometimes must be pushed toward cooperation to improve system efficiencies. Self-interest can result in congestion effects and externalities unless institutional cooperation can be fostered or solutions introduced, such as congestion pricing and slot allocation, as with PierPASS in southern California ports.

Equipment interoperability is always evolving but can be a source of inefficiency. Yard equipment, chassis/railcar, trailer/container, and barge configurations can contribute to inefficiency and bottlenecks in the intermodal system.

Trackage right restrictions near yards and terminals can contribute to operational inefficiencies and community impacts. The Alameda Corridor project, for example, consolidated multiple lines running through many local communities into one higher speed consolidated trench corridor to serve the multiple railroads.

Institutional Issues

Institutional issues often involve multiple levels of governments and both public and private entities. Metropolitan freight planning still provides insufficient freight planning consideration and capabilities at the MPO level. State DOTs continue to organize to address freight transportation issues. Multi-state corridors are a fertile target for investment in multi-state planning. There is typically insufficient clarity of the Federal role and cross modal project eligibility; although SAFTEA-LU conceptually helped this, the complete earmarking of PNRS particularly hinders national approaches to bottleneck resolution.

Much of the nation's port system used for international trade is constrained by the lack of developable land. Transportation industry practices impose constraints by often limiting operating hours, thereby impacting multiple modes. Low wages and low productivity have also contributed to driver shortages. In addition, capital investment requirements and labor practices may inhibit a facility's ability to maximize production through extended operating hours or implementing state-of-the-art technology and operating procedures.

Cross-modal, cross-firm coordination can be an obstacle to overall system efficiency. When shippers design supply chains for their products, they try to use each mode to its greatest advantage. But while intermodal cooperation and alliances are increasing, competition and lack of cross modal communication can hinder supply chain and overall system efficiency. Preferential treatment for high-volume or high-rate shippers is a sound business practice, but may harm transportation system efficiency more than the logistics benefits accruing to individual firms. Environmental coordination and approval processes for complex public-private intermodal projects can be challenging and time consuming.

Illustrative Bottleneck Investment and Mitigation Tools

Illustrative Investment Tools

An exhaustive review of funding/financing tools is not possible in this brief paper however, Tables 1 and 2 briefly summarize Federal grant sources and financing tools, respectively, that can potentially respond to freight bottleneck improvement projects (although the listed discretionary grant programs that are currently funded were earmarked in SAFETEA-LU).

Table 1. Federal Grant Sources Summary

Program	Source	Funding Use	Funding Allocation
Highway Railroad Grade Crossing Program	FHWA Section 130	Improvement of highway-railroad crossings	Federal share is 90%
Congestion Mitigation and Air Quality Program (CMAQ)	TEA-21	Projects that improve/mitigate congestion and therefore reduce air pollution	Formula-based according to population and non-attainment areas
Capital Grant Program for Rail Line Relocation and Improvement Projects	SAFETEA-LU Section 9002	Rail line relocation and improvement projects that foster economic development	Federal share is 90 percent, not to exceed $20 million
National Corridor Infrastructure Program	SAFETEA-LU Section 1302	Primarily highway corridor projects, though sometimes for rail safety	The Federal share is generally 80 percent[a]
Coordinated Border Infrastructure Program	SAFETEA-LU Section 1119	Mexican or Canadian border safety projects	Formula-based
Projects of National and Regional Significance (PNRS) Program	SAFETEA-LU Section 1301	Projects of national significance (rail, highway, or any project eligible under 23 U.S.C.)	Federal share is 80 percent
Freight Intermodal Distribution Pilot Program	SAFETEA-LU Section 1306	Development of intermodal freight transportation	The Federal share is generally 80 percent[a]

Table 2. Federal Loan and Credit Enhancement Programs

Program	Source	Funding Use	Funding Allocation
Railroad Rehabilitation and Investment Financing (RRIF) Program	TEA-21 Section 7203	Acquisition, improvement, or rehabilitation of freight and passenger rail facilities, also refinance existing debt	Direct loans and loan guarantees to public and private entities
Transportation Infrastructure Finance and Innovation Act (TIFIA)	23 U.S.C. 181-189	Large surface transportation projects of national significance	Loans and guarantees, contingent Federal loans
State Infrastructure Banks (SIB)	NHS Act Section 350	Transportation projects	Subordinate loans, interest rate buy-downs on third-party loans, loan guarantees, and lines of credit
Private Activity Bonds	SAFETEA–LU Section 11143	Surface transportation projects	National capacity of liability is $15 billion

Available Mitigation Strategies

Physical capacity strategies include:

- Providing clearance for double-stacking, as currently underway in the Heartland Corridor;
- Intermodal rail and seaport terminal expansions, increased acreage, improved access to and between rail yards, and rail-to-rail and rail-to-highway separations (e.g., CREATE);
- Rail and highway access to seaports: rail on-dock access, intermodal connections between facilities and the NHS, and at-grade crossing reductions for rail and truck – such as the FAST Corridor in Seattle and the Alameda corridor in Southern California;
- Intermodal terminal/multimodal distribution center improvements: the Alliance Logistics Park in Dallas/Fort Worth and the CenterPoint Intermodal Center and ProLogis Park Joliet Arsenal in Illinois have addressed freight nodal interchange congestion by consolidating warehousing and distribution facilities with intermodal rail yard capabilities;
- Inland river/barge port investments, including terminal equipment for more cargo types and improved rail/truck access; and
- Short-sea shipping presents a relief valve for bottlenecks in other modes. Currently there are legislative impediments identified by industry (e.g., Jones Act and Harbor Maintenance Tax), but examples exist such as barge movements in the Gulf of Mexico. Ferry services also provide relief in some congested areas (e.g., New York harbor).

Operational improvements:

- Port productivity enhancements – Technology and other operating practices offer the potential for significant productivity and throughput improvement, but current industry practices and labor agreements impose constraints on the system by limiting the number of hours a facility may receive and process freight and limit deployment of new technology;
- Congestion pricing or other peak-spreading potential – e.g., PierPass; and
- Port information systems, including slot reservation systems offer greater potential.

Institutional responses:

- Freight planning – increase freight professional capacity and awareness at all levels of government. Create organizational structures to better address freight planning;
- Multi-stakeholder agreements – create public-private partnerships, multistate freight corridor coalitions, management/labor agreements;
- Inland river and barge ports – New inland waterway transportation initiatives such as the Port Authority of NY/NJ port inland distribution network (PIDN) have addressed potential freight transportation solutions through innovative freight modal interchange and systemic concepts that have largely failed due to lack of industry support; and
- Environmental facilitation – early consultation and streamlining of environmental processes can facilitate project development, and mitigation strategies such as green technologies can reduce the environmental impact of growing freight volumes.

Investment Needs and Implementation Strategies

Intermodal Investment Considerations

An important advantage that trucking, water, and air transport have over rail is that they essentially rent their pathways through fuel taxes, tolls, take-off and landing fees, and dock fees, thus turning these expenditures into variable costs related to usage. Railroads, conversely, must construct their own pathways, incurring fixed costs. The rail industry spends three to five times as much on infrastructure as other modes, much of this going to maintenance. As a consequence, both lenders and railroads tend to be very cautious about over-investing in infrastructure. Urban land constraints and a lack of eminent domain also hinder private rail investments. These factors can create a mismatch between rail demand and supply, increasing congestion and bottlenecks, and deteriorating service levels in many rail corridors and interchange locations.

One effort to join public and private visions is the Mid-Atlantic Rail Operations Study (MAROps). The I-95 Corridor Coalition, representing five states – Delaware, Maryland, New Jersey, Pennsylvania, and Virginia – and eight others in the Northeast Corridor, jointly with three railroads – Amtrak, CSX, and Norfolk Southern – are undertaking efforts to address regional transportation issues at the regional level. The 2002 study took an in-depth look at the possibilities of multi-state, public private partnerships to address rail system issues.

Investment Needs

In 2003, the AASHTO Freight-Rail Bottom Line Report estimated that at the level of investment the Class I railroads could afford, the rail system could handle only around half of its 'fair share' of the forecast growth in freight tonnage. The unmet half of new rail demand would likely shift to trucks and the highway system. To keep pace with economic growth and maintain its current share of freight tonnage, the rail system needs an investment of $175 to $195 billion over the next 20 years. The report anticipated that while the railroads would be able to provide the majority of the funding needs (up to $142 billion dollars), the remainder (up to $53 billion, or $2.65 billion annually) would have to come from other sources, perhaps including loans, tax credits, and other forms of public-sector participation.

Two regional programs have quantified their rail needs: 1) the MAROps study found that $6.2 billion of public-private improvements would be needed over 20 years just to ensure that the regional rail system could keep up with economic growth and not shed freight to an overburdened and congested highway system; and 2) the CREATE program in Chicago, a cooperative effort of six Class I railroads, the city, and the state; identified a $1.5 billion improvement program over 10 years including highway-rail and rail-to-rail grade separation, reduction of freight and passenger rail conflicts, and joint use corridor upgrades. Increased institutional cooperation has already resulted in short term operational improvements.

A qualitative analysis for the pending AASHTO Water Bottom Line Report suggests that today, each of the top ten container ports in the U.S. has some level of intermodal constraint. In some cases, these constraints can be considered severe – e.g., highway access in Los Angeles/Long Beach, rail access in New York/New Jersey. In most cases, discussions to address these constraints are underway, but the timeframe and funding available for implementation does not meet current and projected port operating needs. The California Marine and Intermodal Transportation System Advisory Council recently estimated $15 billion in high priority infra-

structure project needs at southern California ports alone. As with MAROps and CREATE, unquantified operational and institutional improvements are also needed.

Potential Benefits from Bottleneck Investment

- Strategic intermodal investments can remove deadweight loss from travel time delays and poor reliability; this will benefit both local economies and national competitiveness.
- National macroeconomic benefits from reduced total logistics costs, including direct cost savings and benefits from economic/industrial restructuring facilitated by improvements.
- Improved global competitiveness will occur through more efficient international gateway and corridors.
- Substantial co-benefits can be generated in terms of environmental, safety, economic, and congestion issues. MAROps, for example, identified nearly $19 billion in broad public benefits, ranging from reductions in highway delay, to reduced shipper logistics costs, to improved safety and air quality.

Potential Strategies

Suggested public and private policy and investment improvement strategies include:

- Refocus Federal programs to minimize nationally significant freight bottlenecks at gateways and international borders, and along major corridors and intermodal connectors.
- Support public-private partnerships for freight rail and intermodal investment. Partnerships can include railroads and state DOTs, but also involve shippers, motor carriers, steamship lines, and terminal operators. Partnerships can be limited to sharing of information and coordination of separate investments, or expanded to jointly leveraged pooling of funds for intermodal improvements.
- Support multistate institutions that help states build consensus and prioritize investments in projects of national and regional significance.
- Create regional, multistate investment banks and other mechanisms to finance improvements to regional and national freight corridors where costs accrue to a single state or locality, but benefits accrue to many states.
- Create regional operations entities (e.g., Alameda Corridor Joint Powers Authority) to coordinate, manage, and potentially even guarantee the travel time, reliability, and safety of economically important freight corridors.
- Increase grant and credit programs for public participation in public benefit projects, including dual-benefit freight- and passenger-rail improvements. In most urban areas, freight- and passenger rail services are tightly intertwined, sharing the same tracks and signal systems. Public sector investments in commuter rail improvements usually generate significant benefits for freight rail as well.
- Support tax credits and depreciation policies that encourage investment in private infrastructure and reward the sustained production of public benefits. Tax credits and depreciation policies can expand investment by shippers and terminal operators as well as accelerate

direct investment by the railroads. However, these public investments must be linked to national policy and to projects that will produce public as well as private benefits.

- Increase flexibility in the use of funds at all levels of government, support enhanced multimodal investment decision-making, and support broader shared community goals – economic, safety, social, and environmental.

- Develop a clear vision and rationale for new freight-oriented revenue mechanisms that can more equitably allocate the costs of improvements to those who will benefit. Examples include the imposition of container fees to fund part of the cost of the Alameda Corridor improvements.

Conclusions

Planning, funding, implementing, and operating agencies responsible for highway system improvements have developed detailed arrangements to guide decision-making on how resources are to be used and services/projects delivered. These complex intergovernmental arrangements are the product of long-standing Federal program structures where Federal highway funds are allocated to state DOTs in specific program categories, increasingly with flexibility to move funds among categories and to use highway funds for transit improvements. The same set of intergovernmental funding or institutional structures does not exist for freight improvements, particularly intermodally. Freight bottleneck projects face a set of unique funding and institutional challenges that result in *ad hoc* rather than systemic responses and improvement approaches. A set of potential strategies for all levels of governments and the private sector have been offered to help improve the decision-making and investment in the nation's critical intermodal freight bottlenecks.