Intermodal’s big bottleneck: A possible solution

North America’s intermodal network is struggling to handle current volumes, let alone future growth. Here’s what the railroads could do to support continued expansion and prevent potential supply chain disruptions.

AFTER SEVERAL YEARS OF SIGNIFICANT GROWTH, the North American intermodal network once again finds itself approaching capacity. As the industry templates how it will handle current volume levels, users of intermodal services are on edge because there is a widespread fear that the railroads will not be able to handle any significant intermodal growth next year, and that they will attempt to manage supply and demand by raising rates.

The slightest hiccup in this network reverberates around the world and disrupts supply chains near and far—witness the impact of port congestion on the U.S. West Coast, and of two consecutive winters of abnormally cold and snowy weather that literally stopped trains in their tracks. This situation makes it imperative that the railroads find a solution that could accommodate both current and future intermodal volumes.

The traditional response has been to build more infrastructure—more trackage, more intermodal facilities, more container terminals with on-dock rail. But building more of what worked in the past will not solve problems that are rooted in quickly changing economic and trade patterns. Moreover, building additional infrastructure is incredibly expensive, and land for expansion is simply unavailable in the congested urban areas where most container terminals and rail yards are located. Furthermore, the completion date of any new infrastructure would likely come well past the point of gridlock.

Infrastructure isn’t the only thing holding back capacity expansion. As this article will explain, the main players in the intermodal system—the railroads, the ocean carriers, domestic shippers, the container terminals, and the drayage carriers—have conflicting economic and operational mandates. What benefits one works to the detriment of another, creating a disincentive for profit-making companies to implement significant change.

I believe that it is time to rethink North America’s international intermodal network from the water’s edge inland. If the North American intermodal system cannot accommodate more volume, it will have a negative impact not only on importers and exporters but also on economies throughout the Pacific Rim and beyond. But this is not solely an international issue. The container-based domestic intermodal system is subject to the same capacity concerns, and therefore the shared domestic and international network must also be considered.

This article will look at why the intermodal system may be incapable of handling current and future demand. It will also examine two major nodes, Southern California and Chicago, as well as two intermodal terminal alternatives that could help to provide the increased capacity that the industry desperately needs for both domestic and international container movements.

The impact of rail economics

Intermodal transportation is an asset-based, network operating business. In theory, it is an integrated system in which railroads, ocean carriers, container terminals, and drayage carriers cooperate to create a smoothly operating service with efficient handoffs, sufficient capacity and equipment available when and where needed, and clear communication. That is an ideal that is rarely achieved, and this shortcoming—much of it caused by the conflicting interests of the four main players—is a major reason for the challenge facing the intermodal system when it comes to handling future growth. To get a clearer picture of the contributing factors to the intermodal growth problem, consider the conditions and challenges confronting three of these entities: the railroads, the intermodal operators, and the drayage carriers.

Among the myriad problems facing intermodal...
operators, the ability to provide reliable, truck-compati-
bility transportation may be the most daunting.
Truly competitive intermodal transportation must provide
an all-in, door-to-door transportation service that is
consistent and reliable as the comparable truckload product. However, many factors are conspiring to make that difficult for inter-
modal operators to achieve. Among them:
- Growing network constraints are affecting service.
- While some performance is exemplary, frequently
the railroads’ choice is to deliver service that is both
poor and late, or to change the standard schedule
and deliver poor service that takes too long, is too
expensive, and consumes too many scarce assets—at
which point intermodal transformations from “like truck
or “truck plus one day” to “twice as long as truck.”
- Intermodal terminals’ problems quickly become every-
one’s problem. The intermodal terminals have their
own unique operating characteristics and capac-
ity challenges. Network arcs and nodes operate in
a delicate balance, where poor performance in one
terminal rapidly undermines the effectiveness of others.
- In fact, because railroad operations are so interdependent,
there is no such thing as an isolated, local problem; any difficulty that arises will inevitably affect
other parts of the system.
- The railroads are not always able to provide needed
equipment. Flatcars and, in some cases, intermodal
containers are supplied by railroads. Growth can generate imbalances that strain equipment
supplies, and service problems can consume
equipment capacity and overload logistics systems.
- Intermodal customers include liner shipping compa-
ies, logistics integrators, and some freight forwarders.
Each has different pricing and service requirements and desired windows of operation. In a capacity-constrained environment,
the choice to support one customer segment can
preclude accommodation or expansion of another
segment.
- Many terminals have nowhere to expand. To accom-
mmodate growth, on-dock rail facilities must consume
larger and larger tracts of terminal land—an exceed-
ingly scarce commodity in congested waterfront areas—but as container ships get bigger and carry
longer, this space increasingly is needed for vessel operations. Away from the docks, the problem is that most of the major terminals and
concentrated gateways such as Chicago. While “steel-wheel”
railroad connectivity is still possible, it has
the exception. Most inter-network connec-
tivity in recent years has been accomplished in the
railroad-to-railroad interchange (usually between eastern and western
railroads) with the introduction of established
railroad networks such as Chicago, while “steel-wheel”
interchange railroads operate a practice that exacerbates
congestion and delays.
- At the same time, inter-railroad connectivity has
become an especially acute problem. Rail-to-rail
interchange (usually between eastern and western
railroads) traditionally has involved highly desirable
long hauls and a high level of service. Each has different
and economies of scale. Railroads prefer to
run solid “unit” trains between two points, ideally
without intermediate stops, which consume network
capacity. This presents the lowest network operating
cost and the simplest and most reliable service, but
it requires significant and steady, balanced volume.
In an attempt to achieve that, railroads must often
hold outboard on-dock train segments in space-con-
strained rail yards adjacent to marine terminals until
they have sufficient volume to create a stable block
for a single destination, a practice that exacerbates
congestion and delays.
- Ocean carriers’ intermodal movements usually
involve at least one major port segment and may
preclude accommodation or expansion of another
segment.
- The impact of carrier alliances
Over the last 15 years, ocean carriers have
come together to focus on conveying
volumes while en route, with a different train picking
up and delivering the block of containers to the
destination. This was tolerable when
intermodal volumes were smaller. However, a single,
limited inbound connection could delay numerous
outbound departures.
- The varied equipment and service requirements of the
carrier alliances create additional complications. At the same time, inter-railroad connectivity has
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[FIGURE 1] INTERMODAL TRAIN PLANS
BEFORE AND AFTER OCEAN CARRIER
ALLIANCES

<table>
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<th>4,400-TEU Vessel</th>
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<tr>
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<td>Train #2</td>
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<td>Train #3 100 FEUs</td>
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<tr>
<td>Line #1 1,000 FEUs</td>
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<tr>
<td>Line #3 300 FEUs</td>
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<tr>
<td>Line #5 100 FEUs</td>
</tr>
<tr>
<td>TEU = 20 foot equivalent unit</td>
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<td>Container = 20 foot or 40 foot</td>
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(SOURCE: AUTHOR)

Ocean carriers want bigger ships so they can reduce their
unit cost, but today’s giant vessels are actu-
ally raising costs and creating bottlenecks on the
landside portion of a container’s journey. Back in the
case of Savannah, Georgia, that amount of working space is unavailable
at most U.S. marine terminals. When even
when land is available, it takes many years to get the necessary
permits to construct new terminals and associated
infrastructure. Upon completion, they may be opera-
tionally obsolete, unable to accommodate the require-
ments of the ever-larger ships introduced since design work
started. Meanwhile, demand continues to grow,
increasing the risk that a new container terminal could become
too small not long after it opens.
That has all changed. In the past few years, trans-Pacific shipping has been transformed by monolithic vessels and the deployment of mega-ships. The scope, scale, and complexity of these arrangements threatens to overwhelm the on-deck infrastructure that has been developed over the past 25 years and increasingly looks like the Maginot Line in 1939: impressive infrastructure that is unable to fight a modern war.

Nowhere are these problems more apparent than in Southern California. Transloaded imports are estimated to represent 70-90 percent of domestic rail movements from California—the "mother river" of North American intermodal traffic. Southern California, then, is unique in its influence on both the international maritime and domestic intermodal systems.

With the advent of increasingly larger container ships and the rise of vessel alliances (with as many as six distinct carriers sharing a single vessel), railroads and the intermodal system face a new set of challenges.

The impact of drayage issues

Intermodal drayage—the trucking services that move containers between the rail yards or container terminals and the shipper’s or consignee’s door—plays a crucial role in intermodal service. To compete with door-to-door truckload service, intermodal must replicate that service. To do that, intermodal providers market door-to-door service by bundling pickup and delivery, equipment, and rail movement, while providing a single invoice service similar to that of a truckload carrier.

The drayman provides pickup and delivery services between the customer locations and the line-haul terminal. (Drayage, by the way, is a tractor-only service. An equipment provider or the customer itself supplies the trailer or container.)

The drayage miles are a small percentage of the overall miles. (Where Ө is the threshold drayage mileage where the intermodal route is no longer competitive with truck.)

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Intermodal success also requires seamless transitions between service providers. While all members of a relay team are important, the first and last runners are critical. The first runner establishes position. The last runner, or anchor, is tasked with securing the win. Similarly, the drayman, who fills the first and last positions—pickup and delivery, the only two stages critical in the intermodal customer’s satisfaction.

One reason inland costs are so expensive is that railroad intermodal, which travels over a fixed network, faces a circuitry (ϕ) problem.

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The obvious solution to this challenge is to reduce the drayage distance and likelihood of ocean/land circuitry.
Drayage providers face another serious problem: a labor shortage. In the United States, over the past 10 years enhanced regulatory requirements, along with demographic changes, have reduced the pool of available truck drivers. For example, the development of the national commercial drivers license (CDL) eliminated the ability to maintain multiple state licenses. In the past, a driver who lost a license issued by one state could still drive using a license issued by another. Today, if a driver loses a license, he or she is out of work. Mandatory drug testing and a minimum age of 21 also eliminated many prospective drivers. Changes to hours-of-service (HOS) regulations reduced the amount of allowed driving hours, and enhanced medical oversight diminished the pool of acceptable drivers. The imposition of electronic driving logs and truck-speed governors will likely further shrink the pool of drivers because drivers will be restricted in the number of miles they drive.

These regulatory changes were imposed with the aim of improving safety, and the industry continues to debate their effectiveness and necessity. Regardless of one’s opinion on the matter, the fact is that since drivers are paid based on the amount of work they perform, any regulatory change that reduces the number of overall miles driven or the number of miles that the remaining drivers can cover, will increase scarcity. Scarcity will become a crisis if demand continues to grow.

At one time, experts believed that such requirements would benefit intermodal because they would disproportionately affect truckload carriers. However, the impact has been more widespread: drayage companies, and themselves competing with each other, have reduced their traditional motor carriers for drivers and often come up short.

Drayage offers drivers the possibility of regular hours, but it does come with other challenges. Intermodal, with its potential terminal congestion and train delays, can unpredictably impact task times, with the result that drivers often are forced to squeegee some of their on-duty time sitting still. Highway and contract logistics, by contrast, are door-to-door moves, with no intervening terminals. Some drayage carriers are reporting that owner-operators, looking to be classified as employees, are complicating the business. In September 2014, the Hub Group was forced to convert 350 owner-operators to company employees in California. A few years ago, Hub might have shut down its California operation and purchased drayage from third parties. Hub’s 2014 action may signal an acknowledgment that the company could not presume sufficient purchased capacity under any circumstance and should deal with company employees rather than take chances with outside providers.

Two possible solutions

Network design (and related infrastructure) historically has been more about engineering than economics. As a result, robust systems have become economically obsolete before the infrastructure itself physically deteriorates. This phenomenon is visible today in marine terminals designed for single lines and smaller vessels, warehouse clusters moored by the relocation of manufacturing and consolidation, car-load docks designed for 64-foot (not 72-foot) boxcars, and rail intermodal facilities that are no longer able to achieve critical mass.

There is no obvious systematic or uniform response to these networkwide challenges. Moreover, Southern California’s unique set of capabilities—terminal scale, rail scale and scope, warehouse and DC scale, and a large local population base—exist nowhere else in North America. A change in both the on-dock model as well as the supporting intermodal network model, therefore, is likely the best solution.

Two intermodal initiatives, representing two distinct work concepts, provide models for accommodating intermodal growth. BNSF Railway’s proposed Southern California Intermodal Gateway (SCIG) and CSX Transportation’s (CSXT) Northwest Port of Los Angeles (NWP) terminal serves the Port of Long Beach.

First, in 1980, when BNSF predecessor ATSF declined to participate in Southern California’s Intermodal Container Transfer Facility (ICTF), that railroad has sought to expand its capabilities in the San Pedro state dock, which includes the BNSF Intermodal Facility (also known as “Hobart,” located a few miles east of downtown Los Angeles) offers service to over 20, according to BNSF’s 2015 container service guide (see Figure 5). Although SCIG would offer the advantages of a near-dock facility, it is a product of a status quo men-
tality. It is a traditional engineering solution focused on the infrastructure’s expected physical life, rather than a solution that is based on economic analysis and is focused on expected useful life.

Over 2,000 miles east of Los Angeles lies CSXT’s Northwest Ohio terminal. CSXT officials describe NWO as the railroad’s third Chicago intermodal terminal, even though it is located 263 miles east of that city. NWO was designed as a network hub, rather than as a traditional origin/destination terminal; it feeds numerous terminals on (and off) its network. As shown in Figure 6, it currently offers direct connectivity to almost 30 intermodal terminals.

NWO offers a new way to accommodate scope and scale, all while providing additional Chicago capacity. The facility solves the scheduling critical mass problem by utilizing a classic “hub and spoke” system, which concentrates volume through NWO and then delivers them individually by highway to multiple destinations located in, or east of, Chicago.

NWO accommodates business between western railroad points and almost 20 eastern locations by allowing for a fourth option that frequently is better than the first three, traditional options listed below:

1. A western railroad could run a unit train from a western-railroad origin to its Chicago ramp, and then delivery would be made from Chicago. In that case, CSXT would not handle the load.
2. Solid cars could be loaded at a western-railroad origin to each of those locations for through movement to destination, via steel-wheel interchange in Chicago. Theoretically, this is ideal, but there is not enough volume to run all these point-to-point trains on a daily basis. In addition, the Chicago Region Environmental and Transportation Efficiency Program (CREATE), a partnership between numerous transportation stakeholders, has failed to achieve the groundbreaking network efficiencies first envisioned over 10 years ago.
3. Western-railroad origin terminals can co-load multiple destinations located in, or east of, Chicago on a mixed car to Chicago; unload them in Chicago; and then deliver them individually by highway to CSXT in Chicago for loading on a point-to-point train. However, CSXT terminal capacity in Chicago is scarce—as is the “cross-town” drayage necessary to accomplish the transfer.
4. Western-railroad origin terminals can co-load 18 destinations on a mixed car to the Northwest Ohio terminal, where they bypass Chicago handling and are reloaded on a point-to-point train. This NWO solution is by far the most efficient.

As an alternative to SCIG, if the western cargo origin is a San Pedro marine terminal, then the terminal could easily load a single train destined to NWO.

- Option #1 is currently possible from on-dock rail terminals.
- Option #2 is not uniformly possible.
- Although Option #3 solves the problem of handling disaggregated container volumes from their California origin, in reality, it is only transferring the disaggregation problem to Chicago. That is, the San Pedro off-dock drayage is eliminated, only to be replaced by a Chicago cross-town dray.
- Option #4 improves the network globally by eliminating truck moves in both San Pedro and Chicago.

Option #4 could have a significant operational impact on the national intermodal system. Moreover, CSXT believes that NWO makes immediate financial sense for two reasons. First, rather than increasing complexity—always anathema to customers—NWO simplifies intermodal container shipping by eliminating the need to use Chicago as a transfer point. And second, smaller-volume terminals can be supported by a single, daily train that concentrates all volume through a single, intermediate focal point.

This, in turn, supplies service to more terminals, thus allowing more proximate drayage service and making intermodal more competitive, without destroying any linerhaul economics. The hub-and-spoke network generates economies of both scope and scale. Just as NWO provided Chicago expansion outside Chicago, could an NWO-type facility outside Southern California offer an alternative to the proposed Southern California International Gateway? The current generation of marine terminals utilizes on-dock facilities that were designed as if they were near-track operations. An import container is discharged from the vessel, then transported to a “point of rest” (either on a chassis or in a stack) within the terminal and then loaded onto a point-to-point train, concentrating all traffic through a single, intermediate focal point. This, in turn, supplies service to more terminals, thus allowing more proximate drayage service and making intermodal more competitive, without destroying any linerhaul economics. The hub-and-spoke network generates economies of both scope and scale.
vessel crane would move a container directly to or from the rail car. This could eliminate the intermediate point of rest, thereby greatly accelerating terminal throughput and increasing terminal capacity without requiring additional infrastructure. The amount of space required for on-dock intermodal could be reduced by 60–90 percent, and space available in some terminals could increase by 140 percent. Not only would the resulting operation be vastly more flexible and fluid, but it also would generate some of the additional terminal capacity that is necessary—but not readily available—to handle larger ships.

This envisioned shuttle train would depart as a unit train in a faster, more efficient manner. Once inland, shuttle trains from the 13 San Pedro marine terminals could be reworked into unit trains destined throughout North America. Network hub locations as far as 1,000 miles away (such as BNSF at Clovis, New Mexico, or Union Pacific at Santa Teresa, New Mexico) could still generate the intended scope and scale economies.

The network hub could also be located in California’s Inland Empire region, which is home to numerous warehouse and distribution centers. The attraction here is one of opening the ultimate shorthaul intermodal market. From San Pedro (using the railhead in Wilmington, California) to Colton, California, an Inland Empire city served by both BNSF and Union Pacific, is a mere 70 miles, but this volume would increase train scale, eliminate truck congestion in the port, and allow draymen to work much more productively. Because network hubs are not intended to support a specific, adjacent hinterland, they offer the flexibility to accommodate unanticipated markets that may develop in the future. These may be single or multiple railroad routes.

New solutions for the future

In the North American intermodal system, conflicting economic and operational interests have created imperatives to expand both scale and scope, a situation that is creating diseconomies. As container ships get bigger and carry larger numbers of boxes, on-dock space increasingly is needed for vessel operation (diseconomy of scale). Moreover, on-dock rail yards originally were designed for loading multiple containers to single destination terminals, but meeting demand today requires loading to more, not fewer, intermodal terminals, in order to realize drayage savings (diseconomy of scale). In short, ocean and rail carriers are pushing for scale, which is a barrier to an effective drayage system, which demands scope. All of this is working against a meaningful intermodal product that benefits all of the providers as well as the exporters, importers, and domestic shippers that are the ultimate customers of the intermodal system.

This must change. The current intermodal system may become incapable of handling additional traffic because everyone is fighting the last war, not the war to come. There is no time to lose. What will happen if the Trans-Pacific Partnership (TPP) treaty is approved, and that causes a big leap in trade volumes? Consider also the effects of the recent West Coast port congestion and labor actions. When the freight transportation system is constrained, it has a measurable impact on the North American economy.

For these reasons and more, current capacity problems demand new solutions to ensure that the North American intermodal system continues to support domestic and international freight mobility in a reliable, economic, and environmentally benign manner. Introduction of network hubs promises to do just that. ♣

Notes:

1. This article will refer to “intermodal operators” to encompass both ocean carriers and domestic intermodal shippers.

2. The connectivity method is frequently the result of intense negotiations between the railroads. Critical mass is required for steel-wheel interchanges; however, other factors can obviate that solution. For example: terminal capacity at the first railroad’s origin or destination intermodal terminal, or at the second railroad’s origin intermodal terminal; train interchanges between the two railroads; interchange location; or the involvement of more than two railroads.

3. CREATE was intended to be a public-private partnership that would improve railroad-to-railroad connectivity and fluidity within Chicago. Other than a handful of projects, it has failed to deliver any significant improvements.

4. Since NWO is for containers only, trailers must still be interchanged through Chicago.

5. Increased volume could lead to multiple trains a day, which would improve the intermodal product by reducing train headway (the distance or time between vehicles in a transportation system).