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Authors: J-P. Rodrigue, A. Ashar

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Transshipment Hubs in the New Panamax Era: The Role of the Caribbean

Jean-Paul Rodrigue, Dept. of Global Studies & Geography, Hofstra University, New York, USA
Asaf Ashar, National Ports and Waterways Initiative, University of New Orleans, USA

Abstract
Transshipment hubs are perhaps the most critical component in container shipping networks. Transshipment enables traffic consolidation and the related scale economies in ship size, rationalization of shipping routes and adjustment of ship capacity to traffic density, and expanding the number of ports covered by the shipping network. This paper provides an assessment of the current state of transshipment with a particular reference to the potential impacts of the expansion of the Panama Canal on this activity in the Caribbean basin. While US East Coast ports are expecting an increase in the size of ships deployed on the through-Panama services following the Canal expansion from the current Panamax to post-Panamax ships, it is argued that substituting direct calling by feederings and expanded transshipment activities in Caribbean hubs is more likely. This transformation in service pattern will be gradual, however. In the first period after the expansion the present direct calling is expected to continue, since post-Panamax ships initially deployed on through-Panama services will not differ much than those on through-Suez services already calling the US. The transformation will take place mainly in the second period, 5 to 10 years after the expansion, when larger ships, defined as New Panamax (NPX), which cannot be efficiently handled by US East Coast ports, will be deployed. Accordingly, a substantial growth in transshipment in the Caribbean Region will take place especially during the second period.

Keywords: Panama Canal Expansion, Transshipment hub, Caribbean, North American East Coast.

1. Introduction
Transshipment and its Incidence
The emergence of transshipment and transshipment hubs has been an integral part in the development of container shipping networks (Baird, 2006; Fleming, 2000). While cargo at ports always required some transshipment to smaller ships used as feeders to smaller ports, globalization and containerization triggered a geographical and functional specialization of transshipment. From a geographical perspective, it is impossible to directly connect all port pairs in trading regions, so transshipment is required to insure connectivity within the global trading system. From a functional perspective, with the growth of container volumes, many gateway ports have difficulties handling export, import and transshipment containers, which gave rise to the emergence of specialized transshipment hubs. These are dubbed as “pure transshipment ports” (PTP), since transshipment accounts for almost all of the traffic activity. The geographical and functional diffusion of transshipment went on par with the growing share of transshipments with regard to the totality of maritime containerized throughput.
Transshipment accounted for around 11% of the global port container throughput in 1980, 19% in 1990, 26% in 2000 and 29% in 2010 (Drewry, 2012); the level of transshipment activity has tripled since 1980.

Transshipment incidence refers to the share container transshipment traffic (ship-to-ship) in the total traffic handled by a port. Transshipment traffic is based on double counting of the same container, first when unloaded and second when loaded, which is why transshipment is considered more a traffic than a cargo activity. Since transshipment involves ship-to-ship transfer, PTPs, unlike gateway ports, do not require hinterland access, which gives terminal operators a wider range of port choices. Figure 1 provides a typology of transshipment incidences and the associated port functions. Transshipment incidence implies a very different function of the port within the container shipping networks and within their regional economies. The percentages of transshipment incidence used in this typology are indicative only. Gateways or feeder ports usually have a transshipment incidence of less than 10%, which implies that the majority of the port activities are related to hinterland-generated traffic. In the case of a gateway, we are dealing with a large port servicing an extensive hinterland and directly connected to a number of ports as part of their foreland. A feeder port is usually a small, port servicing its hinterland, with the bulk of its traffic channeled through a transshipment hub.

**Figure 1: Levels of Transshipment Incidence**

*Regional gateway ports* have a transshipment incidence around 25% and handle a substantial amount of hinterland traffic, but also act as low level transshipment hubs for a specific transshipment market that they are serving because of a technical (e.g. deeper draft) or geographical advantage. *Hub ports* have a transshipment incidence around 50%. While they function as transshipment hubs, they also service their hinterland, implying a complex and shifting balance between the gateway and transshipment functions. Such ports usually became hubs after shipping lines made the decision to use them as such. In many cases, the hinterland traffic acts as an anchor to transshipment traffic, thus calling the port enables
capturing additional traffic of other ports not directly called by these lines. **Pure transshipment ports** (PTP) have more than 75% of their traffic counting as transshipment, but many PTP have a transshipment incidence above 90%. They are labeled as a “pure” transshipment hub since transshipment is their exclusive function, handling little if any hinterland traffic.

Figure 2 classifies 92 worldwide ports using the above typology, depicting the amount of transshipped containers and the transshipment incidence. The Figure captures the bulk of the world’s transshipment activity. The data was collected from web sites of port authorities that are known to be involved in transshipment, but there are no consistent source for transshipment information. Because of the inconsistency in transshipment incidence and missing data we preferred presenting the average of the 2007 and 2012 periods. Some ports regularly publish transshipment figures while for others we had to derive the data from third parties such as news releases or government reports.

![Figure 2: Transshipment Volume and Incidence by Major Ports, 2007-12](image)

New York, Los Angeles and Felixstowe are examples of gateway ports having very little, if any, transshipment (they do not appear on the map). Antwerp, Rotterdam, Hamburg and Hong Kong are examples of regional gateway ports that are at the same time servicing extensive hinterlands and performing a regional transshipment function (Baltic and British Isles for Antwerp, Rotterdam and Hamburg and the Pearl River Delta for Hong Kong). Many smaller ports in the Baltic or the Caribbean are feeder ports that can access global shipping networks only through a regional transshipment hub. Further, regional transshipment hubs can also link long distance shipping services such as Antwerp handling transshipment between West Africa and North America. Such connectivity is however less common as long distance shipping services tend to be handled at pure transshipment hubs. Valencia, Barcelona and Cartagena are ports that are significant transshipment hubs (transshipment incidence
between 50 and 75%) as well as servicing their respective hinterlands. The higher the transshipment incidence, the more likely the transshipment hub will be involved in deep sea services. Ports such as Singapore, Tanjung Pelepas, Colombo and Balboa are among the world’s most prominent pure transshipment hubs (PTPs). Many were built specifically for this purpose taking advantage of their location on or very close to main maritime routes.

With the growth of long-distance containerized trade, major transshipments hubs grew in importance, facilitating connectivity between different systems of shipping services. About 50% of all the transshipment activity takes place within 200 nautical miles from the main circum-equatorial maritime route that goes through Panama, the Strait of Malacca, Suez and Gibraltar, linking the world’s major trading regions. From this main east / west route branch out north / south connectors. While most of the transshipment activity is concentrated in PTPs, there are many hub ports that handle both domestic and transshipment traffic. Ports with a transshipment incidence above 75% handled about 40% of all the world’s transshipments, while ports with a transshipment incidence between 50% and 75% handled another 20%.

There are seven major transshipment markets worldwide, accounting for the bulk of the transshipment activity (Figure 2). They are referred to as markets since transshipment traffic is not tied to a specific port, unlike gateway traffic which is linked with the ports serving a specific hinterland, at times difficult to contest. Still, transshipment hubs compete both for the transshipment and gateway traffic that can be substituted by transshipment. Geography plays an important role in the setting of a transshipment market, which is often at the crossroads of shipping routes and where the routes are funneled through a strait or a passage. The world’s most important transshipment market is Southeast Asia (Singapore as its main hub), which accounts for about 26% of the total transshipment. This market is characterized by mega PTPs with a high transshipment incidence. Southern China (The Pearl River Delta cluster) and the Strait of Taiwan are the second largest transshipment market with 16% of the activity. However the transshipment incidence of its ports is usually low since most of them serve as gateways for large hinterlands. The Mediterranean accounts for another 15% with most of the ports with a high transshipment incidence. This reflects the Sea’s dual role, serving the regional trade and as a conduit to the Asia-Europe global trade (Gourvenal, Debrie and Slack, 2005; Ridolfi, 1999).

The Factors Underlying Transshipment

The development of transshipment ports can be explained by three interrelated factors: shipping operations factors, terminal operations factors and cargo factors. Container shipping lines attempt to optimize the utilization of their assets and save operating costs. The common outcome of this attempt is the increase in ship size (economies of scale) and limits to the number of port calls over long haul services covering two or more maritime ranges (Notteboom, 2004). Smaller ships and feeder services are used for the ports that have been dropped from the long haul services (the "last ocean mile"). Also, ocean shipping has a low tolerance for deviations, particularly for transshipment, since it is an interchangeable activity. As shown on Figure 2, transshipment ports tend to be located in proximity to main route long haul shipping lanes.

Optimally, shippers prefer direct, point-to-point services, a preference that can only be met for major ports. Under such circumstances, transshipment is a balancing act between the operational constraints of shipping services and the requirements of shippers (importers and exporters) preferring an array of service options with timely and reliable services (Wiegmans, Van Der Hoest, and Notteboom, 2008).
Transshipment may add additional delays in supply chains, imposing mitigation strategies when the inventory is in transit (Wang and Meng, 2012). Further, the growth in the time-sensitive reefer trade is placing additional pressures on transshipment ports as refrigerated cargo is shifting from conventional reefer ships to container shipping services. Lastly, the hinterland usually has an anchoring effect on transshipment since hubs that are able to combine hinterland traffic with transshipment tend to be more stable than transshipment hubs with little hinterland traffic.

These three factors jointly interact to confer a level of suitability for each port to become a transshipment hub. The current transshipment system has emerged under specific conditions, mainly supporting the Asia-Europe trade and to a much lesser extent the transpacific trade (Notteboom and Rodrigue, 2010; Ng, 2006). Presently, transshipment accounts for around 40% of all the TEUs handled by hub ports involved in the Asia-Europe trade. The most active transshipment markets are in Southeast Asia, South Asia, the Middle East and the Mediterranean.

The Caribbean transshipment market, the subject of this paper, is much smaller than those serving to the Asia-Europe trade. Although there has been transshipment activity in the Caribbean for decades, its growth has been more modest.

Objectives
The expansion of the Panama Canal will enable a new class of containerships to transit between the Atlantic and the Pacific oceans, dubbed as “New Panamax” (NPX) or “Neo Panamax”. There has been a fair amount of speculations regarding the potential impact of the expansion on trade and shipping networks within the region (US DOT/MARAD, 2013). The common view is that the expansion will foster additional traffic for US East Coast ports1 as well as more direct all-water services using post-Panamax ships. This view needs to be nuanced with the prospects for transshipment in the post-expansion era, particularly within the Caribbean Region. Will the expansion consolidate the position of existing Caribbean hubs by boosting their traffic? Will it favor a new transshipment structure, or even the decline of transshipment to the benefit of more direct services? To gain insight into these questions, we first review the rationale and the general dynamics of transshipment in liner shipping services. We will proceed by assessing the specific dynamics of Caribbean services and the role that transshipment plays in the region. Finally, we will discuss the potential impacts of the Panama Canal’s expansion on Caribbean’s transshipment, focusing on scenarios depicting future configurations of shipping lines’ service networks in the Caribbean and the US East Coast.

2. Transshipment Patterns and Hubs
The Insertion of Transshipment Hubs
The geographic approach of network economics is a starting point for looking at transshipment since it is technically and economically impossible to establish direct shipping connections between every port of call (Fleming, 2000). There may not be enough traffic volume, or the ports may be far too distant from one another to justify direct services. Unlike bulk shipping, usually based on point-to-point services, liner (container) shipping networks are established as sequences of port calls along a route often structured to connect two main maritime trade regions (Fremont, 2007). Therefore, a set of direct or transshipment connections are required to link all country pairs by ocean shipping services. According to

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1 For reasons of simplicity the term East Coast also encompasses the Gulf Coast.
UNCTAD (2009), only 17% of all country pairs are directly connected, while 62% of all country pairs require at least one transshipment and 18.6% of all pairs require two transshipments. In addition to network economics, transshipment can be the result of ports that do not generate enough traffic or have insufficient draft and must thus be serviced by smaller ships. In this case, it is an imposed or “default” transshipment, since it stems from commercial or physical restrictions to the usage of a port by large mainline services. This accounts, perhaps, for a third of the global transshipment activity.

The emergence of a transshipment hub in an initial service rotation based on direct calls at a sequence of ports can be the result of five changes in the service pattern: by-passing, tail cutting, hubbing, relay and intersection (Ashar, 1995), as presented in Figure 3. With by-passing, a port call by a mainline may be dropped from a port in a sequence and replaced by a feeder service, mainly because of insufficient volume. It could also concern a port that is judged not productive enough for the original service sequence and be the cause of delays impacting the level of service, or a port lacking technical capabilities (e.g., depth). The throughput handled by the new hub port now includes twice the throughput handled by the by-passed port since each container imported or exported through the by-passed port must also be handled at the hub port. For instance, a service along the north-western European range calling Le Havre, Felixstowe, and Rotterdam could drop Felixstowe serving it instead, by a feeder service from Rotterdam. While container traffic at Felixstowe will remain unchanged, Rotterdam will gain twice of Felixstowe’s traffic on the feeder route. Another example involves a South American West Coast service by-passing the port of Guayaquil (Ecuador) and calling directly only at Peru’s (Callao). In this case Guayaquil can be serviced be feeder services from Panama or Peru.

*Figure 3: Transshipment Patterns*
Tail cutting involves a similar rationale to by-passing, except that in this case the furthest port(s) along a route sequence is dropped and replaced by a feeder service. The main rationale is an attempt to shorten the route and rotation time for the mainline service, which also could reduce the number of ships on the mainline service, while maintaining the same frequency of service. For instance, the same South American West Coast service which previously call at Chile’s southernmost port, St. Vicente, may omit this call and feeder St. Vicente through Chile’s main ports, Valparaiso and St. Antonio.2 By-passing and tail-cutting involve relatively small changes in service patterns and generate small volumes of transshipment traffic.

Hubbing concerns the most significant change in the service pattern as a new port, a PTP, can emerge as the only port call within a regional market. Ports are no longer directly serviced by the mainline; they are served by a new and shorter feeder services based at the PTP. For instance, several ports along the Mexican and US Gulf Coast could be serviced by a transshipment hub in the Caribbean (e.g. Kingston). Intersection transshipment involves connecting different mainline (mother) services that are reaching different regions. This often involves connecting east-west and north-south trade routes at a PTP. The Port of Salalah in Oman is an example of a relay PTP connecting east-west shipping routes between Asia and Europe and north-south routes linking the Middle East and East Africa. A similar function is performed by the Port of Algeciras, often used to connect Northern European, Mediterranean, West African and transatlantic routes (Figure 4). Relay takes place along mainline routes that are usually along a trade axis but which are servicing a different set of ports. For instance, Singapore could be used as a hub connecting Europe – Asia mainline services, one calling coastal China ports while the other calling South Korea or Japan (Figure 4).

In the cases of by-passing, tail cutting and intersection the port selected for transshipment is not necessarily a PTP, since it may still handle a substantial amount of gateway throughput. Usually, transshipment accounts in these ports for 30 to 40% of the total port throughput. However, in the case of a hub-and-spoke and intersection structures, a PTP emerges with a transshipment incidence that can reach 90% and beyond.

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2 Tail cutting is a common strategy in public transport systems. For example, Washington DC Metro (subway) turns back half of its suburb services midway during rush hour to increase frequency on the denser segments close to downtown, with passengers asked to move from the short to long-routed trains at transfer stations (“transshipment hubs”).
Figure 4: The Insertion of Transshipment Hubs

It is important to note that in the cases of by-passing, tail-cutting and hubbing, the transshipment (ship-to-ship transfer) is between mainline and feeder services while in the cases of intersection and relay it is between mainline services.

The Role of Intermediate Hubs
While there are network and geographical factors behind the selection of transshipment hubs, there are also port-specific criteria, namely greater depth to accommodate larger and deeper draft containerships and larger waterfront lands, granting them technical advantage over several older and smaller port sites, many of which becoming feeder ports. Transshipment ports also require large yard areas since only few
containers are leaving the terminal while most may be stored for several days waiting to be transshipped. They should include land for future expansion, a prerequisite for attracting additional, future traffic. Another important factor in transshipment remains terminal costs and productivity (e.g. high crane throughput), with ports located in developing countries usually having lower labor costs compensating for lower productivity.

Transshipment provides a fundamental cohesion between global trade flows and shipping service networks. The role of an intermediate hub within shipping networks is related with the rationale of its selection, which is to improve the overall efficiency and geographical coverage of the ocean shipping networks. Transshipment enables to link smaller ports to the global maritime shipping system in a more effective fashion.

In a hub-and-spoke configuration, the purpose of the intermediate hub is to provide an interface between short distance feeder lines (and ports) and long distance deep-sea mainlines, linking regional and global shipping networks. The hub acts as a point of consolidation of regional traffic, often taking place at a central location with convenient access to the whole region. Ship capacity of hub-and-spoke transshipment traffic differs significantly since feeder ships tend to be of smaller capacity than those on deep sea lines.

In an intersection role, the intermediate hub acts as a point of interchange (or point of continuation) between several long distance shipping routes. Ship capacity between hubs is relatively similar as long distances services try to optimize economies of scale. The privileged locations tend to be bottlenecks along strategic passages. In a relay role, the intermediate hub becomes an interface (or point of distribution) between several routes along the same maritime range, but servicing a different array of ports. While the hub-and-spoke intermediate function accounts for about 85% of all transshipment activities, relay and intersection account for about 15%.

3. Transshipment: The Caribbean Story
Triangles, Funnels, Corridors and Clusters
Although the Caribbean is the world’s smallest transshipment market with about 8% of all transshipment, it is the only significant one in the Americas. The Caribbean Basin is a region prone to transshipment activities, particularly because of the small economic size of most of its islands and countries (Frankel, 2002). Direct high volume deep-sea services provided by large ships cannot effectively call at Caribbean ports and transshipment hubs must be used to switch cargo to smaller short sea services. The intra-Caribbean transshipment market is however saturated, mostly because of the small economies involved with limited potential to generate additional cargo. Having small economies and poor hinterlands is not a climate prone into developing efficient port infrastructures; transshipment is often the only significant driver in port investments in the region (Wilmsmier and Hoffmann, 2010).

With the growth of containerized trade transiting through the Panama Canal and because of its proximity to shipping lanes, the amount of cargo being transshipped in the Caribbean has increased (McCalla, Slack and Comtois, 2005). This was particularly the case after 2000 with the growth of the transpacific trade, the diversification of routing alternatives to minimize the reliance on the North American rail landbridge (e.g. West Coast port strikes of 2002) and economic growth in Latin America generating additional foreign trade. As the amount of containerized cargo transiting through the region
increased, so did transshipment. Still, transshipment activities are highly concentrated with about 90% of the volume accounted by 5 ports (Table 1).

Table 1: Transshipment Activity at the Main Caribbean Hubs (TEU, 2012)

<table>
<thead>
<tr>
<th>Port</th>
<th>Total Traffic</th>
<th>Transshipment Traffic</th>
<th>Transshipment Incidence³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panama Gateway Cluster</td>
<td>8,975,759</td>
<td>7,580,219</td>
<td>84.5%</td>
</tr>
<tr>
<td>Cartagena (Colombia)</td>
<td>2,205,948</td>
<td>1,425,042</td>
<td>56.2%</td>
</tr>
<tr>
<td>Colon (Panama)</td>
<td>3,518,672</td>
<td>3,131,618</td>
<td>81.3%</td>
</tr>
<tr>
<td>Balboa (Panama)</td>
<td>3,251,139</td>
<td>3,023,559</td>
<td>94.0%</td>
</tr>
<tr>
<td>Windward Passage Cluster</td>
<td>3,009,212</td>
<td>2,285,240</td>
<td>75.9%</td>
</tr>
<tr>
<td>Kingston (Jamaica)</td>
<td>1,855,425</td>
<td>1,426,822</td>
<td>86.3%</td>
</tr>
<tr>
<td>Caucedo (Dominican Republic)</td>
<td>1,153,787</td>
<td>858,418</td>
<td>69.2%</td>
</tr>
<tr>
<td>Bahamas Cluster</td>
<td>1,202,000</td>
<td>1,189,980</td>
<td>99.0%</td>
</tr>
<tr>
<td>Freeport (Bahamas)</td>
<td>1,202,000</td>
<td>1,189,980</td>
<td>99.0%</td>
</tr>
<tr>
<td>Eastern Caribbean</td>
<td>1,393,112</td>
<td>629,722</td>
<td>45.2%</td>
</tr>
<tr>
<td>Point Lisas (Trinidad &amp; Tobago)</td>
<td>181,300</td>
<td>29,008</td>
<td>16.0%</td>
</tr>
<tr>
<td>Port of Spain (Trinidad &amp; Tobago)</td>
<td>365,895</td>
<td>262,347</td>
<td>53.3%</td>
</tr>
<tr>
<td>Puerto Cabello (Venezuela)</td>
<td>845,917</td>
<td>338,367</td>
<td>40.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14,580,083</strong></td>
<td><strong>11,685,161</strong></td>
<td><strong>80.1%</strong></td>
</tr>
</tbody>
</table>

Source: Web sites of port authorities and authors’ calculation.

Most of the transshipment activities take place within what is known as the "Caribbean transshipment triangle" (Pinnock and Ajagunna, 2012; West, 2010) that roughly encompasses Colon, Freeport and Port of Spain at each of its edges (Figure 5, upper left). The traditional determinants for locating transshipment hubs are proximity to trade route (minimizing deviation), local traffic volume and port productivity and cost. In the Caribbean, the Panama Canal essentially acts as a funnel for shipping lanes between the Atlantic and the Pacific Oceans (Figure 5, lower left). As seen in this figure, the southwestern section of the Caribbean accounts for 71.3% if all the regional transshipment activity. It is thus not surprising that ports on both sides of the canal (Balboa and Colon) have a dominant transshipment function as stopping to enter the Panama Canal offers the opportunity to drop or pick up cargo. Kingston, Jamaica has a central location, in proximity to the Gulf of Mexico, the US East and Gulf Coasts and transatlantic routes.

³ The transshipment incidence is the share of transshipment traffic over total traffic.
Transshipment in the Caribbean can also be considered according to the global trade served, with most of it currently geared towards Asia / US East Coast trade, the most important trans-Canal trade. Under such circumstances, 87.7% of the transshipment takes place along a corridor extending from Panama to Freeport and passing through the Windward Passage (Figure 5, upper right). This high share demonstrates the importance of the US East Coast for Panama Canal related trade flows. For instance the Asia / US East Coast route accounted for 39% of the traffic handled by the canal, followed by the West Coast South America / US East Coast route with 13%. For a transshipment corridor, each hub is interchangeable and its use is dependent on the strategies of the respective shipping lines, particularly its connectivity to its worldwide and regional service network.

Another perspective considers transshipment clusters where hubs in proximity are either competing or complementary when used by different shipping lines (Figure 5, lower right). This represents a functional division of the geography of transshipment based on the role of each cluster. Some clusters
have a greater share of relay activities while others are mostly focusing at feeder ing their local market. There are two major clusters. The "Panama Gateway" cluster (including Cartagena and possibly Moin) accounts for 52.5% of the transshipment activity and is characterized by a low deviation to trans-panama shipping routes. Transshipment in Panama is mostly intersection with long distance transatlantic and transpacific services interacting with Latin American services on both the South Atlantic and South Pacific. Still, the Panamanian hubs also handle regional feeder ing, mainly to Venezuela and Costa Rica.

The "Windward Passage" cluster (Kingston, Caucedo and eventually Mariel, Cuba) is benefiting from a small deviation from the mainline route to the US East Coast. Transshipment at these ports mostly concerns Caribbean Region since it is roughly the geographical center of the basin (McCalla, 2008). This cluster has a distinct hub-and-spoke function, transferring cargo between Caribbean and mainline services. The Eastern Caribbean cluster is of limited cohesion and is mostly composed of small ports servicing their national niches and with a transshipment structure supporting such activities. San Juan, a major port, is not considered as part of any cluster since it is a US port that can only be serviced by high-cost, US-flagged ships, the so-called Jones Act ships. Although there are transshipment activities in San Juan, they are limited in volume. Miami, being the first US port of call, would be a logical location for transshipment, but due to the need to use Jones Act ships the nearby Freeport (Bahamas) assumes that role. As such Freeport is not part of a cluster. Most of the Caribbean transshipment hubs are operated by global companies and already have (or will have in the near future) the technical capabilities of providing efficient transshipment services. Table 2 summarizes the main Caribbean transshipment paradigms that were discussed.

Table 2: Main Caribbean Transshipment Paradigms

<table>
<thead>
<tr>
<th>Perspective</th>
<th>Main Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transshipment triangle</td>
<td>A coincidental shape that has little meaning.</td>
</tr>
<tr>
<td>Transshipment funnel</td>
<td>Transshipment activities tend to converge towards the bottleneck (Panama). The closer to the bottleneck, the lower the deviation from main shipping lanes.</td>
</tr>
<tr>
<td>Transshipment corridor</td>
<td>A series of interchangeable hubs along a major shipping route. Mostly structured by the Asia /US East Coast trade route.</td>
</tr>
<tr>
<td>Transshipment cluster</td>
<td>Functional specialization of transshipment with focus on hub-and-spoke.</td>
</tr>
</tbody>
</table>

Potential Impacts of the Panama Canal Expansion on Transshipment

Following the completion of its expansion in early 2016, the Panama Canal will be able accommodate ships of 13,500 TEUs, defined as New Panamax (NPX), 3 times the size of the typical 4,500 TEU present Panamax. Accordingly, the deployment of NPX will force the consolidation of services resulting, at least in theory, in the elimination of two third of the present services. Still, it is unlikely that NPX will be deployed on Canal-crossing services immediately following the expansion in 2016. Also, the impact of the expansion on transshipment is contingent upon a number of factors involving the routing of shipping services determining how East Coast ports are going to be serviced. In addition to the capacity of US East Coast and Caribbean ports to accommodate the largercontainership drafts (50 feet / 15.2 meters), there must also be sufficient cargo volumes to justify direct port calls. Under such circumstances, several
East Coast ports may be facing a “tail cutting” or “by-passing” situation as direct services are eliminated and replaced by feeder services. There are four theoretical configurations to service East Coast ports through the expanded Panama Canal, alone or in conjunction with the others. (Figure 6; Ashar, 2002, 2012).

![Figure 6: Potential Shipping Configurations of All-Water Routes Servicing the East Coast, Post Panama Canal Expansion. Source: adapted from Ashar, 2012.](image)

The conventional service pattern involves a single rotation that covers the entire East Coast by directly calling at all main ports. The drawback of this pattern is the long route requiring more ships and
involving longer transit times; therefore, it has been gradually abandoned by shipping lines favoring shorter and more focused services. In the direct pattern, the East Coast is serviced by three (or more) different direct services, each focusing on a specific sub range such as the North Atlantic, Central Atlantic or South Atlantic / Gulf Coast. This regional service specialization is more time effective than the conventional service and also has the advantage of providing a wider coverage of ports. These services can also be differentiated by containership capacity, with 8,000-TEU ships calling at the deeper East Coast ports having the capacity to handle them (e.g. Halifax, New York, Baltimore, Hampton Roads) and 4,500 TEUs at the shallower Gulf Coast ports (e.g., Mobile, New Orleans, Houston). In both the conventional and direct patterns the Canal expansion results in no additional transshipment except perhaps in the Panama Gateway cluster where the transfer between services can take place (relay and intersection transshipment).

The transshipment alternative, which is emerging, is similar to the previous configuration, but with the introduction of a transshipment hub, most likely within the “Windward Passage” cluster, where deviation from major shipping lanes is relatively small. The US East Coast direct services are replaced by feeder loops based on smaller ships and higher frequencies. Since the early 2000s, this configuration has grown with the surge of all-water route services between Asia and the US East Coast. As clearly shown in Figure 6, the number of port calls by feeder services is much larger than previously called by direct, mainline services. Indeed, transshipment enables to increase the overall number of port of calls since the shorter distances enable adding ports to the rotation while maintaining the desired service frequency. Smaller ships in feeder services do not require deep channels and large terminals and therefore have a greater range of port of call options. Despite the obvious advantages of transshipment, the dominant configuration at present (2015) is still the conventional.

Last, the circum-equatorial alternative, also known as equatorial round-the-world or ERTW, involves introducing an additional hierarchy in the network structure. The upper echelon of the global shipping system will be based on circum-equatorial, "conveyor belt" services employing of high capacity containerships such as the 13,500 new-Panamax. Although round-the-world services have been proposed and at time implemented (AMAX service by Evergreen between 2005 and 2007), Panamax capacity issues have been a major hurdle in the competitiveness of these services. Likewise, previous services were based on traditional east/west services relayed together while the envisioned ERTW based on short rotation focusing on only calling major transshipment hubs. Another advantage of the circular routing of the RTW is the elimination of backhauls. The Canal expansion could indeed trigger this far-reaching global restructuring of shipping network, also defined as the “Fourth Revolution”, integrating Asian, European and South American services into a “global grid” (Ashar, 2002). This would dramatically increase the amount of transshipment in the Caribbean.

The last two scenarios (Transshipment and circum-equatorial) contradict the expectations of many US East Coast ports. Following the expansion of the Panama Canal, these ports expect more direct services by larger ship and higher traffic volumes, with the lower shipping costs is presumed to extend their market areas further into the North American hinterland. This contradiction is discussed in the next section.
4. More Direct Calls or More Transshipments?

The transshipment activity in the post expansion era depends on which of the configurations depicted in Figure 6 prevails and therefore is subject to wide uncertainty. Accordingly, the expansion could result in more transshipment -- or more direct services to the largest ports of the US East Coast. It is argued that both trends will play themselves out, but in two consecutive phases. The first phase of change follows immediately the expansion of the Panama Canal; within 5 years. In this short timeframe it is likely that post-Panamax ships of 8,000 TEU will replace most of the existing Panamax of 4,500 TEU on Cross-Canal shipping services. Although this will induce some growth of transshipment activities in the Caribbean, only limited changes in the service configuration are expected since these ships can directly call at most of the large North American East Coast ports. Under such circumstances, it can be expected that deepened East Coast ports (with most of the cost covered by US Federal Government) continue to attract direct services. Therefore, the direct configurations (Figure 6) is likely to remain dominant, with the direct services focusing on the larger East Coast gateways capable of handling ships of 8,000 TEUs.

The second phase relates to the changes expected to mostly take place within a decade after the Canal expansion (2025). At this stage new-Panamax ships of 13,500 TEU are likely to be deployed on Panama services with larger ships of 15,000 - 18,000 TEUs deployed on Suez services. The Asia/ Europe Suez route is already seeing 18,000 TEU ships that can only call a limited number of ports and therefore are fostering transshipment. With the exception of Norfolk, New York and Halifax, ships of 15,000 - 18,000 TEUs cannot be effectively accommodated by East Coast ports and with only one (or two) port calls in the North Atlantic, it would be difficult to justify their deployment on any US-bound route. Under such circumstances the circum-equatorial scenario becomes a likely outcome since it integrates transshipment and the setting of efficient round-the-world shipping services (see Figure 6). So far, the setting of these services have been constrained by due to the limitation of the existing Panama Canal. In the post-expansion era, these limitations are substantially mitigated, giving shipping companies more options about how to structure their service network to handle global trade. The second phase could thus see a leveling off of direct services to US East Coast ports and the growth of transshipment in the Caribbean. Accordingly, it could well be that at that time the Panama Canal could be further expanded to allow 18,000-TEU ships (JOC, 2014).

This expected growth will however not be uniform and the transshipment clusters that have been identified may face different dynamics. The Panama gateway cluster is likely to be negatively impacted by the expansion, particularly on the Pacific side. This is because the expansion will remove the ship size constraints that presently forces post-Panamax ships to stop at the Pacific side (port of Balboa), use rail (or road) to cross the isthmus and connect with feeder services on the Caribbean side. With this constraint less salient, several transshipment activities could move to a more central location involving shorter feeder distances. This location, the Windward Passage, could experience a re-emergence of its geographic advantage for hub-and-spoke networks. For the Eastern Caribbean, it is not expected that the Canal expansion will change much, mainly because there are limited sites available for the construction of large transshipment hubs. Freeport may also be negatively impacted as transshipment may relocate to the more centrally located ports around the Windward Passage. The issue of transshipment in Cuba is also a distinct possibility but subject to geopolitical considerations, particularly American trade restrictions, but developments that took place since 2015 (reestablishing diplomatic relations) are positive. If the situation was to normalize, the joint advantage of a growing Cuban market
and small deviation from main shipping routes could grant Cuba an important role as a transshipment hub in the Caribbean.

5. Conclusion
Transshipment hubs have become an important and perhaps even critical component of the global system of liner shipping. The setting of a network of mainline and feeder services and the use of transshipment hubs to link these services remains fundamentally a decision made by shipping lines. They try to optimize the usage of their assets and take advantage of ship’s scale economies while maintaining the port coverage required by cargo owners, a complex balancing act between shifting patterns of production and consumption and the shipping networks supporting them. It is worth noting that at some point, economies of scale are not necessarily to the advantage of cargo owners. They may gain lower transport costs, but must bear externalities. Larger ships usually involves less frequent services, which can be disruptive for supply chain managers, particularly importers that are more dependent on inventory management strategies. Since more cargo is handled during port calls made by larger ships, pickups, warehousing and deliveries need to be modified. There is also a cargo insurance risk since more cargo is being carried on less ships.

While most worldwide transshipment activity has taken part along the Asia / Europe route, the expansion of the Panama Canal is likely to also substantially expand this activity in the Caribbean basin. This paper argues that these developments will take place in two phases. The first phase, within 5 years of the expansion, would favor continuation of the existing configuration of direct services to the US East Coast, based on 8,000-TEU post-Panamax ships, the design ships of US harbors (Figure 6, upper-right panel). The second phase, about 10 years after the expansion, would bring in new-Panamax ships of 13,500 TEU that cannot be efficiently handled by most East Coast ports. This could foster substantial growth in transshipment activities in the Caribbean, particularly around the Windward Passage, its most central location, which also is near the US, the main future feedering range (Figure 6, bottom-right panel). This growth would be accelerated if new circum-equatorial round-the-world services are established (Figure 6, bottom-left panel).

Global terminal operators such as DPW (Puerto Caucedo), APM (Moin) and HPH (Freeport, Cristobal and Balboa) are well aware of the transshipment potential that the Panama Canal expansion is likely to generate. They are actively reviewing terminal developments sites, especially those with room for expansion and sufficient depth to accommodate the new generations of containerships. The decision to rely on transshipment is therefore a complex balancing act between carriers, terminal operators, and cargo owners. While the expansion of the Panama Canal will certainly be to the benefit of carriers with incentives at improving economies of scale, they will be facing constraints at meeting the requirements of cargo owners. Under such circumstances, factors such as frequency and reliability may play a greater role than economies of scale, underlining the potential of transshipment to accommodate and mitigate all these requirements.

References


