Network Introduction

- This presentation is an introduction to and a comparison of the two of the most common networks in the airline industry
  - Direct Network (aka Point-to-Point Network) and
  - Hub & Spoke Network
- A network is required to manage all the routes that an airline has opened to service its customers
Direct Network

- A Direct Network is one where there is a direct service from one airport to another without a stop in a third airport

- It is optimally used under the following circumstances
  - Distance between two cities is small
  - Demand between two cities is high
  - Total number of cities served by the airline is small
Direct Network Advantages

- Schedule reliability (aka on time performance) is high
  - The direct flight does not have an interdependency on other flights
  - This minimizes the “domino effect” where one delay can multiply into other delays elsewhere in the network

- Aircraft utilization is high
  - Flights from one airport do not have to feed into downstream flights at the destination so schedule can be optimized for maximum aircraft utilization
Direct Network Disadvantages

- Schedule frequency (number of flights per day) is low
  - Due to the actual flight times, there are only so many flights you can have in a day when going from A to B
  - But when you schedule flights to stop at other cities before going to B from A, then you can have a lot more options

- Number of routes required to cover all cities as you introduce more cities in the network
Direct Network – Route Addition

- When you start off with Direct Network, it will grow as demonstrated below.
- If you fly only between 2 cities, you will need only 1 route.
Direct Network – Route Addition

- If you now fly between 3 cities, you will need 3 routes (1 existing route + 2 new routes)
Direct Network – Route Addition

- If you now fly between 4 cities, you will need 6 routes (3 existing routes + 3 new routes)
Direct Network – Route Addition

- If you now fly between 5 cities, you will need 10 routes (6 existing routes + 4 new routes)
Direct Network – Route Addition

- If you now fly between 6 cities, you will need 15 routes (10 existing routes + 5 new routes)
Direct Network Disadvantages

- As you can see, the number of routes needed to cover all the cities in Direct Network increases very quickly.
- In this network, if there are \( n \) cities, there will be \( \frac{n \times (n-1)}{2} \) routes.
- This will get very hard to manage very quickly.
- This will also be very expensive for the airline as it will need a lot of aircrafts and personnel to cover this.
Hub & Spoke Network

- A hub is an airport that an airline uses as a transfer point to get passengers to their intended destination.
- Spokes are airports that usually do not have major traffic for the airline.
- A hub & spoke network is one where traffic from spoke cities are routed to their intended destination via the hubs.
Hub & Spoke Network

- It is optimally used under the following circumstances
  - Distance between two cities is large
  - Demand between two cities is low
  - Total number of cities served by the airline is large
Hub & Spoke Network Advantages

- Schedule frequency (number of flights per day) is high
  - By creating routes through hubs, there can be more flights scheduled for a route giving more options to passengers

- Due to the nature of how hub & spoke networks work, addition of a new city does not need too many routes for complete coverage
Hub & Spoke Network – Route Addition

- When you start off with hub & spoke network, it will grow as demonstrated below.
- If you fly only between 2 cities, you will need only 1 route.
Hub & Spoke Network – Route Addition

- If you fly between 3 cities, you will need 2 routes (1 existing route + 1 new route)
Hub & Spoke Network – Route Addition

- If you fly between 4 cities, you will need 3 routes (2 existing routes + 1 new route)
Hub & Spoke Network – Route Addition

- If you fly between 5 cities, you will need 4 routes (3 existing routes + 1 new route)
Hub & Spoke Network – Route Addition

- If you fly between 6 cities, you will need 5 routes (4 existing routes + 1 new route)
Hub & Spoke Network Advantages

- As you can see, the number of routes required with hub & spoke network are greatly reduced.
- In this network, if there are n cities, there will be (n-1) routes.
- This reduces costs for the airline as the number of aircrafts and personnel required are reduced.
Hub & Spoke Network Disadvantages

- Schedule reliability (aka on time performance) is low
  - This type of a network suffers from interdependencies on other flights
  - This leads to the “domino effect” where one delay can multiply into other delays elsewhere in the network
Hub & Spoke Network Disadvantages

- Aircraft utilization is low
  - Flights from one airport usually have to feed into downstream flights so schedules have to match so there are no missed connections
  - This restriction leads to lower flight utilization
- Additional delays arise when the traffic at the hub city has exceeded its limits
Improving on Hub & Spoke Network

- One way to deal with increased traffic is to try to reduce traffic by increasing the fare.
- Another way is to start diagnosing the traffic patterns to see which spoke cities do the travelers go most to and from which spoke city.
- It may be wise to create a direct route between these cities to ease the traffic at the hub city.
Improving on Hub & Spoke Network

- Lets take the example of our 6 city network described earlier
Improving on Hub & Spoke Network

- As you can see, there is a significant amount of traffic going from E to B via A. In this case, it makes sense to create a separate route from E to B. This will ease the traffic on A.
- This does not mean that we close the existing routes of E to A and B to A. They are still required to go to A and other cities connected from A.
Improving on Hub & Spoke Network

- Here, a direct route has been added from E to B.
Improving on Hub & Spoke Network

- Another way of dealing with congestion in the hub may be to create another hub.
- This depends on a number of things:
  - Is the infrastructure at the potential new hub capable of handling the additional traffic?
  - Are there enough spoke cities whose traffic can be diverted to this new hub without rendering the existing hub unproductive?
  - How will the two hubs be connected?
## Summary - Network Comparison

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<tr>
<th>Points</th>
<th>Direct Network</th>
<th>Hub &amp; Spoke Network</th>
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<tbody>
<tr>
<td>Distance between two cities</td>
<td>Small</td>
<td>Large</td>
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<tr>
<td>Demand between two cities</td>
<td>High</td>
<td>Low</td>
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<tr>
<td>Number of cities served</td>
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<td>Large</td>
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<tr>
<td>Schedule frequency (number of flights per day)</td>
<td>Low</td>
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<tr>
<td>Schedule reliability (on time performance)</td>
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<td>Cost to airlines as routes grow</td>
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<td>Low</td>
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<tr>
<td>Aircraft Utilization</td>
<td>High</td>
<td>Low</td>
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References

- http://en.wikipedia.org/wiki/Point-to-point_transit
References