UNIT 23: STRATEGIC PLANNING FOR AIR TRANSPORT

TOPIC

Evaluate the techniques involved in airline planning to optimise fleet assignments and maximise capabilities

ESSENTIAL CONTENT

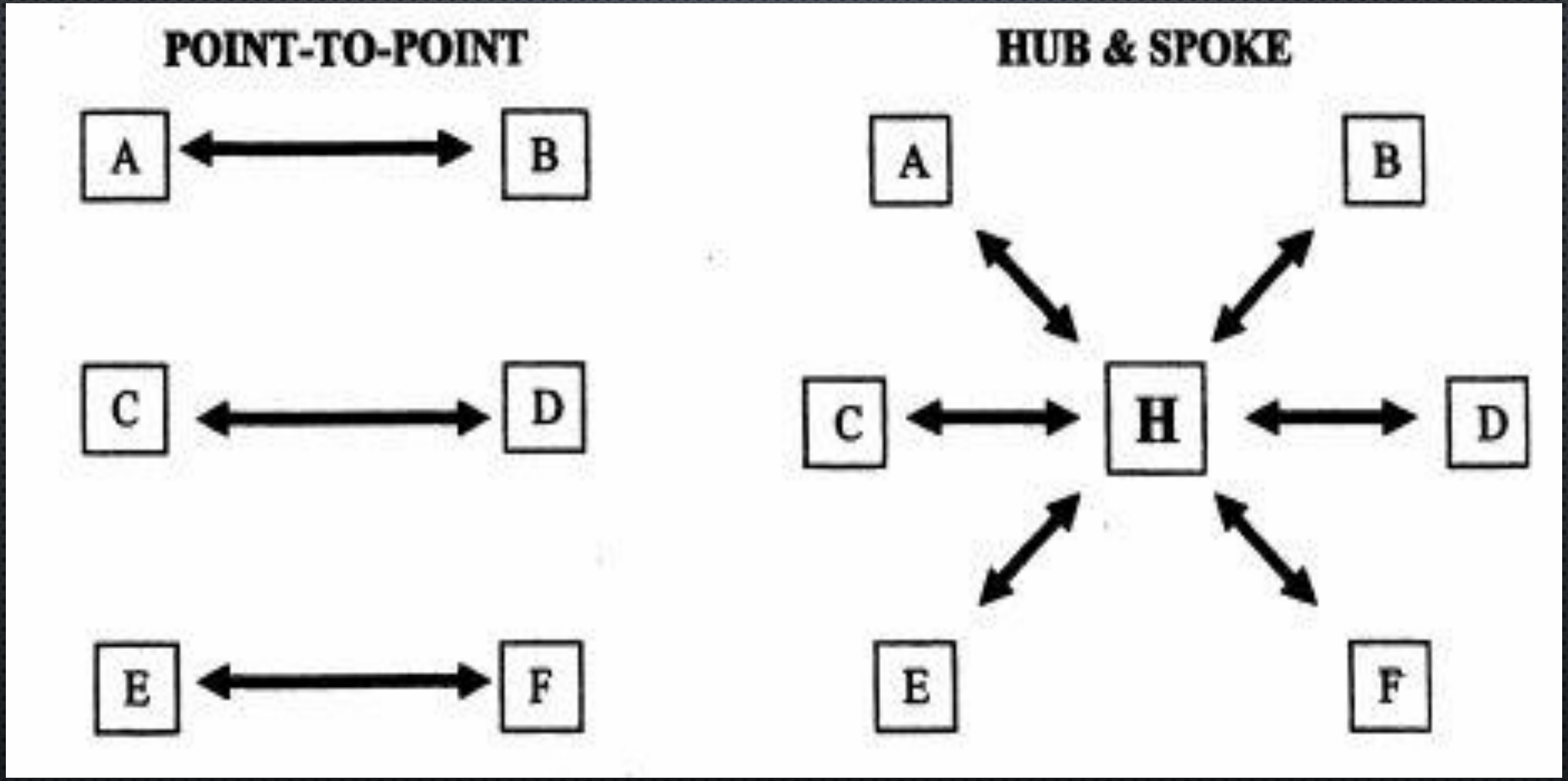
- Hub and Spoke System
- Airline Fleeting and Crew Pairing

HUB AND SPOKE SYSTEM

Route architecture choice is the foundation of an airline's product. Point-to-point and hub and spoke architectures lie at the poles of a continuum with most large airlines operating some combination of the two.

All passengers in a pure point-to-point system board at flight origin and deplane at the destination. In the hub and spoke system, by contrast, all passengers except those whose origin or destination is the bub, transfer at the hub for a second flight to their destination.

(Cook and Goodwin, 2008)


POINT-TO-POINT
A
B
C
D
E
F
HUB & SPOKE
A
B
C
H
D
E
F

HUB AND SPOKE SYSTEM

Point-to-point and hub-and-spoke networks are at the opposite ends of the connectivity spectrum. A point-to-point network connects directly a set of locations without any interruption of services even if the route itself may not be direct.

A hub-and-spoke network connects every location through a single intermediary location called a hub. Hub-and-spoke, as a network structure, allows for greater flexibility within the transport system through a concentration of flows.

(Avia Solutions, 2006)

Hub and Spoke System

The H&S route system became the post-deregulation standard for a variety of reasons. The system is optimized when providing air service to a wide geographic area and many destinations.

Passengers departing from any non-hub city bound to another spoke in the network are first flown to the hub where they connect to a second flight to the destination.

(Cook and Goodwin, 2008)

HUB AND SPOKE SYSTEM; ADVANTAGES

- A HUB-AND-SPOKE NETWORK PROVIDES HIGH-FREQUENCY SERVICE TO A LARGE NUMBER OF LOW-DENSITY CITY PAIRS.
- THE HIGH DEMAND FOR NONSTOP SERVICE ALLOWS A HUB-ANDSPOKE OPERATOR TO REALIZE HIGHER-THAN-AVERAGE FARES ON A NONSTOP ROUTE THAT IT MONOPOLIZES.
- THE LARGE NUMBER OF O-AND-D MARKETS SERVED ALLOWS A HUB-AND-SPOKE OPERATOR TO MINIMIZE ITS DEPENDENCE ON ANY PARTICULAR MARKET OR GROUP OF MARKETS AND TO REDUCE THE RISKS INVOLVED IN ADDING A NEW CITY TO ITS SYSTEM.

Hub and Spoke System; Advantages

- A carrier with a hub-and-spoke system can market a large number of possible itineraries and thereby increase the rate at which passengers are retained on-line.
- The large number of possible routings of aircraft and crew at hubs permits greater use of equipment and labor, as well as increased operational flexibility.

Hub and spoke system; disadvantages

- A huh-and-spoke network contributes to congestion and delay at major hub airports and in the traffic sectors that serve these airports.
- The consolidation of operations at hubs results in overuse of terminal staff, gates, and equipment at a carrier's hub stations
- Poor weather conditions at hub airports can result in increased costs because of reaccommodation of misconnected passengers, prevention of illegal crews, and other operational problems.

Hub and spoke system

The tactical planning process of an airline is typically decomposed into several stages among which fleeting, aircraft routing, and crew pairing form the core.

In such a decomposed and sequential approach the output of fleeting forms the input to aircraft routing and crew pairing. In turn, the output to aircraft routing is part of the input to crew pairing.

(Sandhu and Klabjan, 2007)

Airline fleeting and crew pairing

Airline business processes related to tactical planning consist of schedule planning, fleeting, aircraft routing, and crew pairing. In schedule planning, a set of flights with specific departure and arrival times is constructed.

Next is fleeting, which assigns an equipment type or fleet to each individual flight. The objective of the fleet assignment model (FAM) is to maximize profit subject to the number of available aircraft and other operational constraints.

(Sandhu and Klabjan, 2007)

AIRLINE FLEETING AND CREW PAIRING

The aircraft rotation problem or aircraft routing is to find a set of generic aircraft routes that satisfy maintenance requirements without exceeding the number of available aircraft.

In crew pairing a set of crew itineraries or pairings is constructed. The goal is to minimize the crew cost with each flight covered by exactly one pairing.

(Sandhu and Klabjan, 2007)

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Example

The fleeting solution decomposes the problems that follow by equipment type or crew-compatible fleets. The aircraft rotation and crew pairing problems are then solved over a subset of flights pertaining to a single equipment type, or, in the case of crew pairing, to crew-compatible equipment types.

The Fleet Assignment Model

Many airlines operate based on a hub-and-spoke flight network. Major airports where the activity is high are called hubs and the low activity airports, called spokes, are mostly served from hubs. Most flights either originate or terminate at hubs and there are only a few spoke to spoke flights.

An alternative flight network is the spoke-to-spoke network. In such a network the flights are equally distributed throughout the network without the notion of hubs.

(Sandhu and Klabjan, 2007)

The Fleet Assignment Model

The fleeting problem is to find an assignment of equipment types or fleets to flights in a given flight schedule while maximizing profit, subject to assignment constraints, flow balance, and plane-count constraints.

The input is the flight schedule, the different equipment types, and the available number of aircraft for each equipment type. The objective function in FAM has two components – revenue and operating cost.

(Sandhu and Klabjan, 2007)

AIRCRAFT ROUTING

An aircraft route is a sequence of flights flown by the same aircraft. A routing or rotation is a set of aircraft routes, which partition all the flights in the schedule, i.e. each flight is assigned to a unique route. Regulatory agencies impose several rules regarding aircraft maintenance.

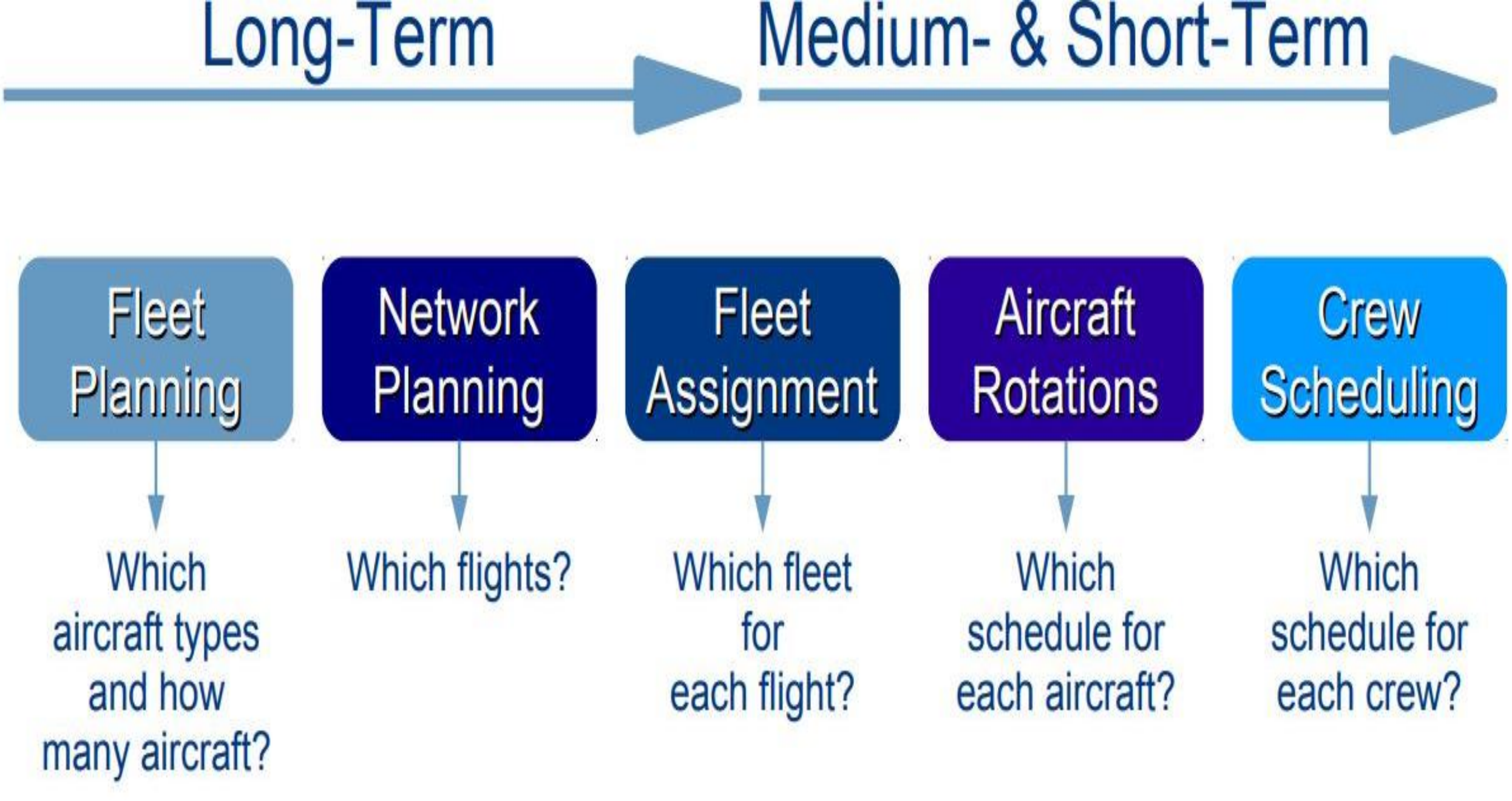
(Sandhu and Klabjan, 2007)

Crew Pairing

The crew pairing problem is to find a subset of pairings or crew itineraries that partition all the flights in the network while minimizing the crew cost. The input to this stage is the fleeting and the aircraft routes obtained in the previous stages. Similarly to the aircraft routing problem,

there is a separate crew pairing problem for each fleet family. A fleet family is a crew-compatible set of fleets all belong to the same fleet family. A pairing is a sequence of flights that satisfies several requirements.

(Sandhu and Klabjan, 2007)


Long-Term
Medium- & Short-Term
Fleet Planning
Network Planning
Fleet Assignment
Aircraft Rotations
Crew Scheduling
Which aircraft types and how many aircraft?
Which flights?
Which fleet for each flight?
Which schedule for each aircraft?
Which schedule for each crew?

REFERENCE

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