

Four successive aircraft and crew schedule problems

- 1 Schedule planning
- 2 Fleet assignment
- 3 Aircraft routing
- 4 Crew planning

Still to do: crew planning

- Pilot
 - Flies the plane
 - Different requirements for different aircraft and flights
- Cabin crew
 - Responsible for security (and comfort) of passengers
 - Different requirements for different aircraft and flights
- Maintenance crew
 - Performs maintenance work
- Ramp service
 - Luggage handling
 - Taxi assist
 - Pushback
- Cargo handling
- Refuelling
- Customer service
 - Ticket sale
 - Check-in
- Gate staff
 - Responsible that only authorised people can board
- Catering staff
 - Deliver food and drinks
- Cleaning staff
 - Cleans airplane
- Dispatcher

- Most employees have a quite normal work situation and working hours
- Planning for the flying staff is a complex problem
 - They aren't always home at the end of the day
 - You have to ensure that there is always staff at the right place and the right time to be able to fly
 - Regulations

Rules and Regulations

- Max 10 flight hours/day
- Min 16h of rest between the last flight of a day and the first flight of the next day
- Max 40 flight hours within an arbitrary 7days period
- Min 24h time off (uninterrupted) at home base within an arbitrary 7days period

Can be exceeded by max 2h

Holds only if night rest is extended by 2*extension. If rest period in night before was longer than 16h, up to 1h can assigned to the night rest, with:
 $\min\{\text{extra night rest night before}/3, 1\}$

Can be exceeded by max 10h

Holds only if...

Problem 1: Crew rest time

10 points

Pilot X works for airline FlyFast. Because of good contacts to the unions, FlyFast managed to negotiate few, simple rules for the rest periods of their pilots:

- Maximum 10 flight hours per day. Those 10 hours can be exceeded by maximum 2 hours. This holds only if the night rest is extended by $2\times$ extension. If the rest period in the night before was longer than 16 hours, up to 1 hour can be assigned to the night rest of the prior night with: $\min\{(\text{extra night rest night before})/3, 1\}$ hours.
- Minimum 16 hours rest between last flight of a day and the first flight of the next day.
- Maximum 40 hours flight within an arbitrary 7 day period.
- Minimum 24 hours time off (uninterrupted) at home base within an arbitrary 7 days period.

Pilot X had 9 flight hours on October 5, October 6-8 he had time off at his home base LHR, on October 9 he flew 5 flight hours, with the last flight ending at 14:00 UTC.

On October 10 he flew:

- LHR-MAD, 2h 30 min flight time, 07:00-09:30 UTC
- MAD-LHR, 2h 20 min flight time, 10:30-12:50 UTC
- LHR-FCO, 2h 30 min flight time, 13:30-16:00 UTC
- FCO-LHR, 2h 40 min flight time, 17:00-19:40 UTC

TODO now

Unfortunately, FlyFast's pilot Y is sick on October 10. Amongst others he was scheduled to fly flight FF234, LHR-CDG, 1h 20 min flight time, 20:30-21:50 UTC. The crew controller plans that pilot X takes over flight FF234.

- (a) According to the rules for rest periods: Is it possible that pilot X flies on flight FF234, is it a feasible pairing? If yes, what is the earliest time a flight he is scheduled for can depart on October 11?
- (b) If X is used on flight FF234, what other consequences result for crew planning?

- Find a crew for all flights during a season, such that all work regulations are satisfied
- Discuss goals and requirements for the crew schedule, plus how the problem can be decomposed and solved

- Goal: few overnight stays not at home base, few dead head flights, robustness
- Requirements: regulations, balance, aircraft type
- How?: Decompose the problem

Crew planning - problem decomposition

- Aircraft type
 - Crew members are certified only for limited number of aircraft types
 - Can result in a problem per aircraft type
 - Plan a month at once
- Crew category
 - Create general, non-individual, feasible schedules for example for pilots
 - Choose among those schedules, each that all flights for the period are covered
 - Assign the chosen schedules to individuals

Crew pairing

Crew assignment

Pairing and duty

- A pairing (or rotation) is a sequence of flights that starts and ends at the same home base
- Pairing consists of several working days, so called duties, with intermediate rest periods
- Each single duty and the complete pairing complies with all regulations
- Procedure
 - Create many “good” duties
 - Combine duties to many “good” pairings of adequate length

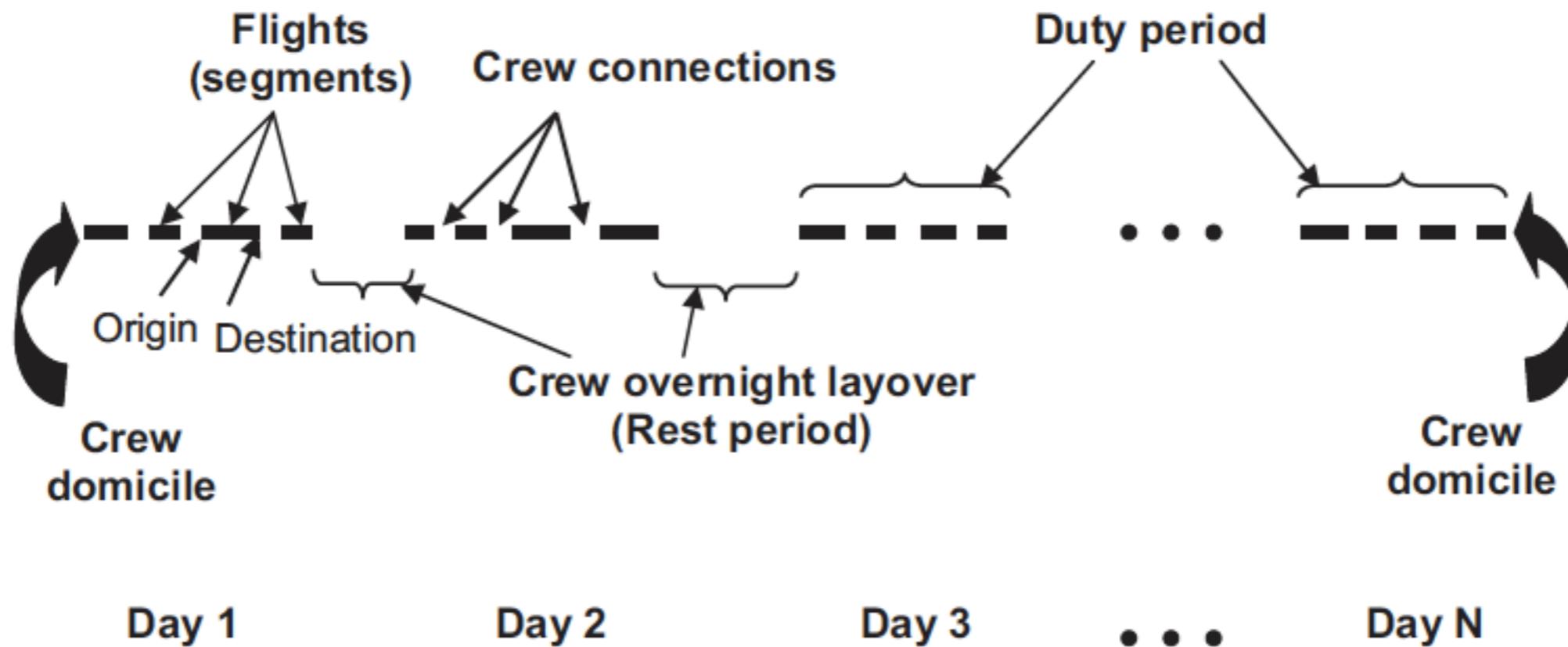
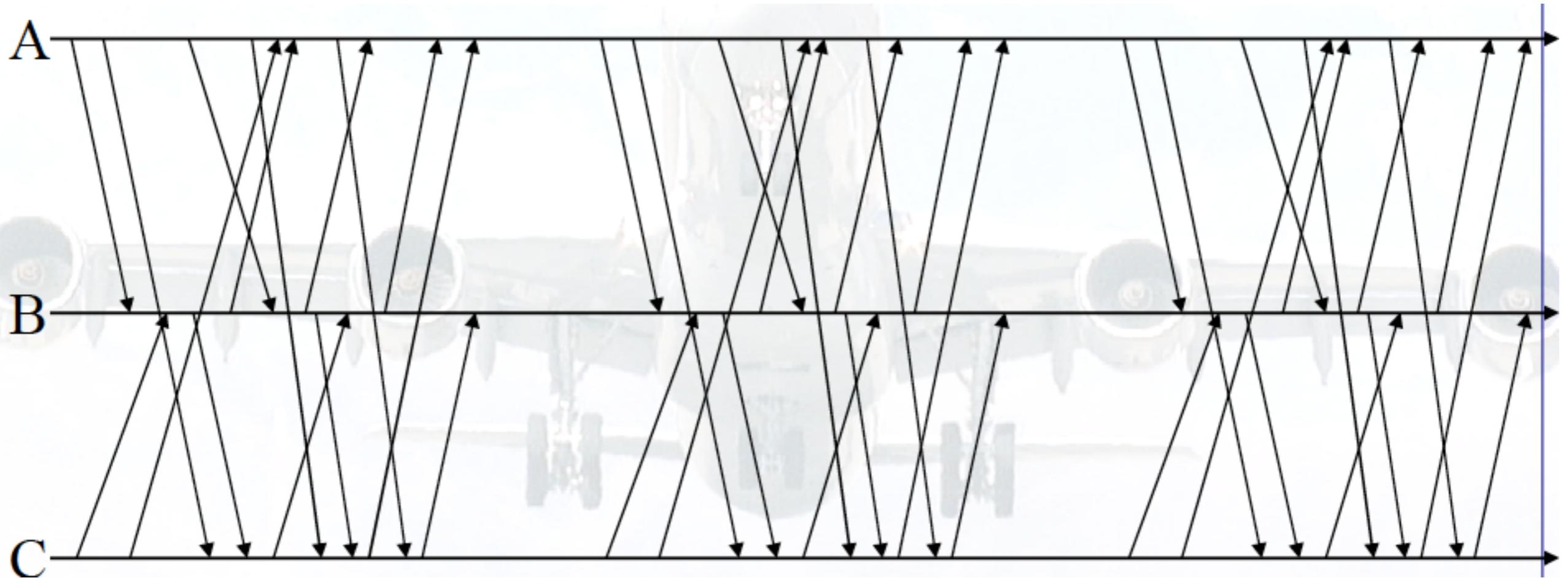
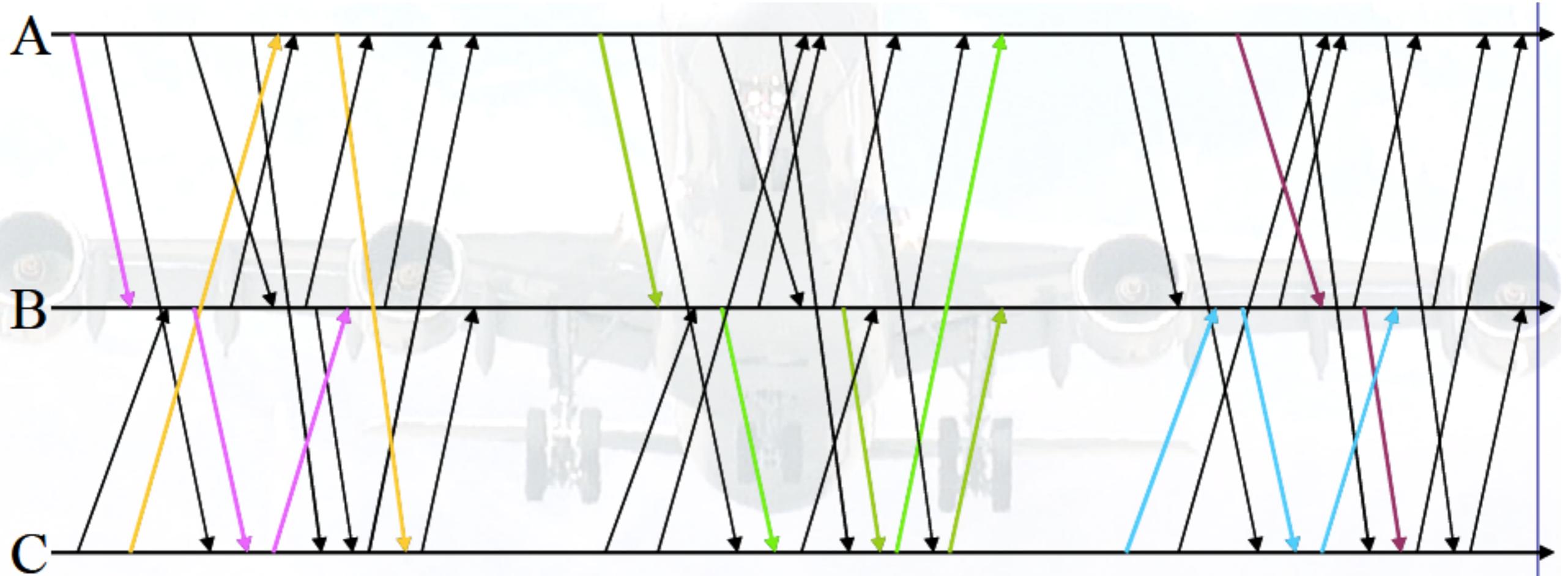
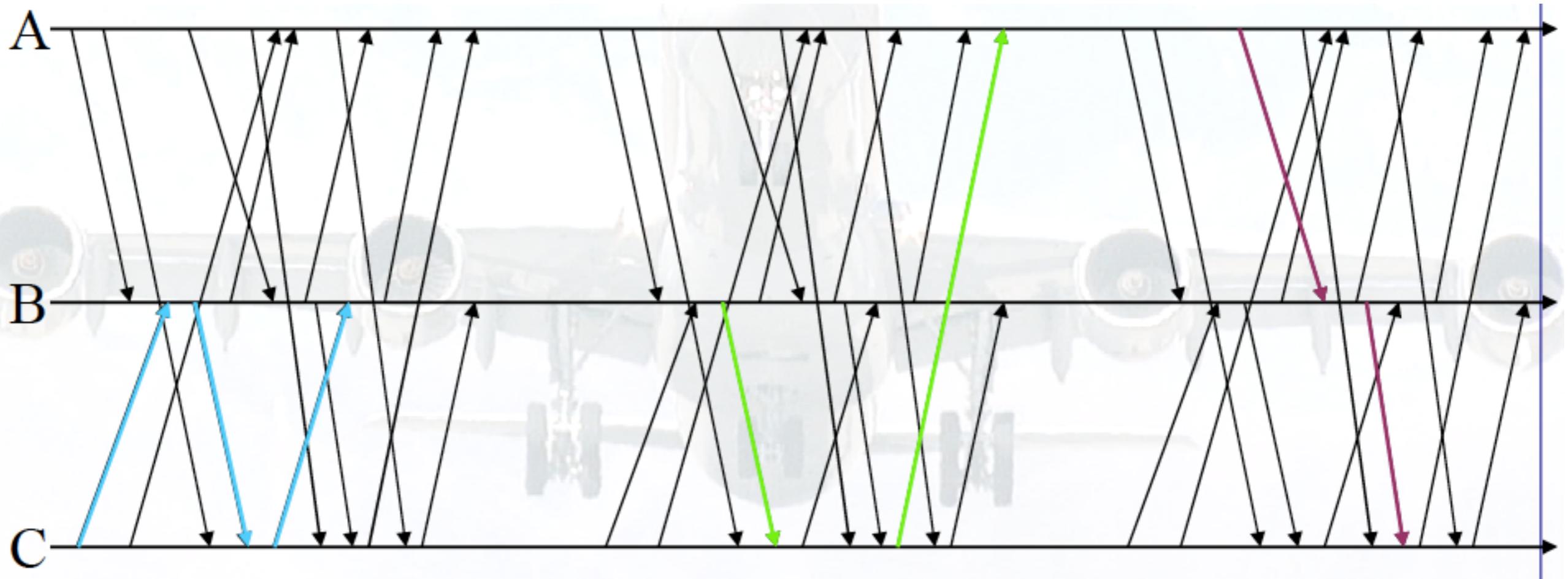


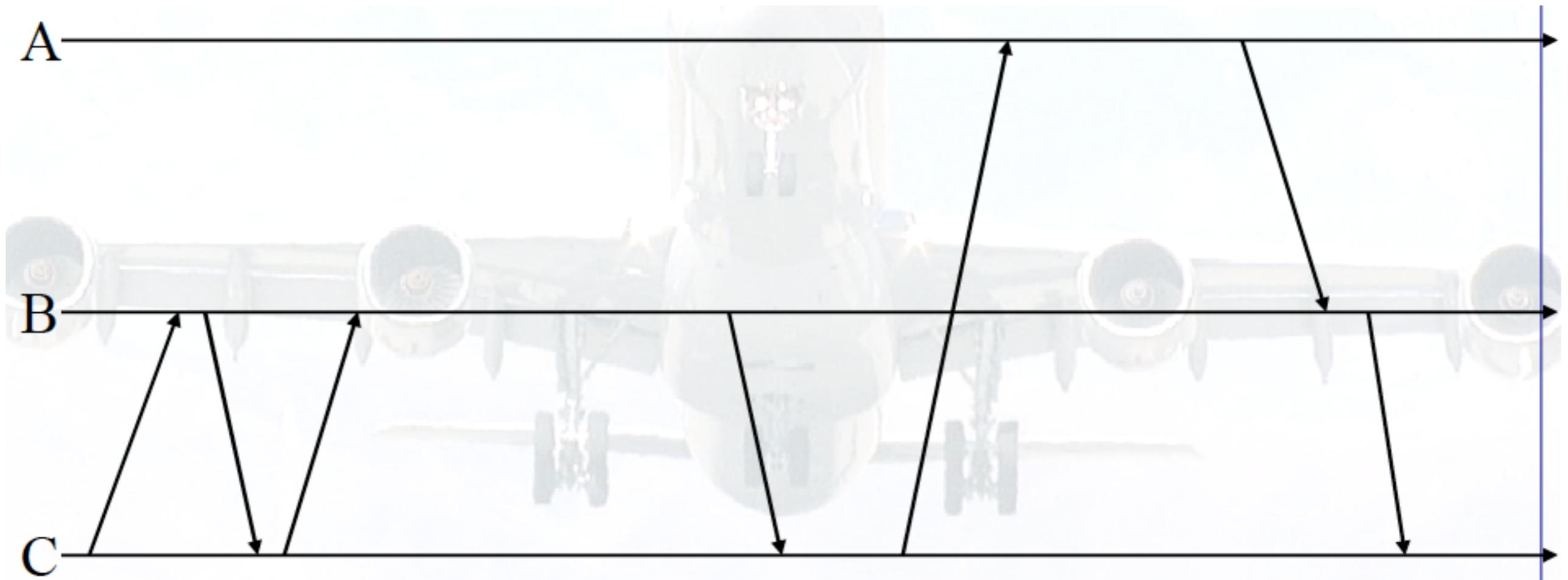
Figure 1.9 Example of a crew trippair

Abdelghany&Abdelghany, 2010









$$\min \quad c_1x_1 + c_2x_2 + c_3x_3 + c_4x_4 + c_5x_5 + c_6x_6 + c_7x_7 + \dots + c_nx_n$$

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$$x_i = 0 / 1 \quad \forall i = 1, \dots, n$$

Crew assignment

- The actual (monthly) work schedule is created by combining the chosen pairings and by assigning them to different crew members
- Different ways to do so:
 - *Bidline* (USA): first, anonymous rosters (or so-called “bidlines”) are created which are then assigned to individuals based on bids for these anonymous rosters
 - *Rostering* (Europe): individual rosters constructed directly for each crew member
 - *Preferential bidding* (SAS): personalized rostering with preferences, where crew “only” express preferences for certain attributes of their rosters without knowing exactly how the roster will look like

Bidline:

- Anonymous work schedules created, based on given pairings
- Crew members can then bid on these rosters
- Seniority takes precedence

Rostering:

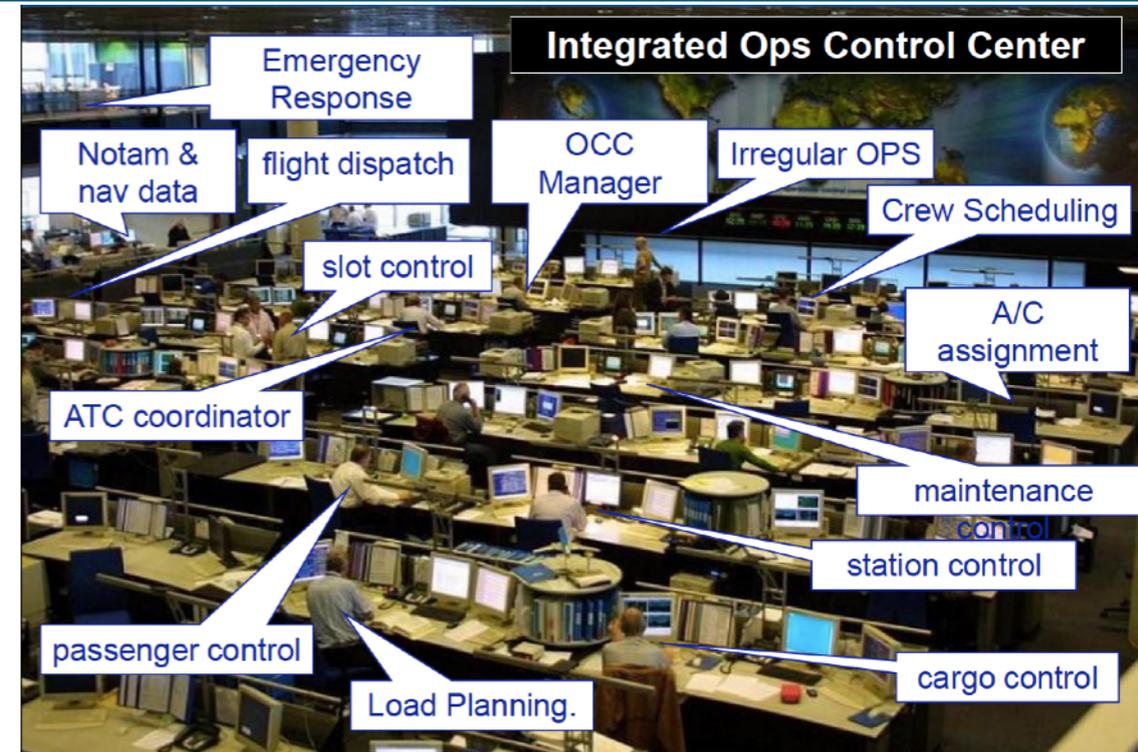
- Crew members can apply for holiday and other absence in advance
- Individual rosters created

Operations Phase

- Airline Operation Control Center
- Airline Operations Control (AOC), Operations Control (OCC), etc.
- Responsible that each flight can fly safe and effective
- Plans, controls and steers aircraft, flights and staff

AOCC structure

- Airline Operations Controller
 - Primarily responsible for schedule execution
- Aircraft controller
 - Steers aircraft and flights
- Crew controller
 - Takes care of daily crew schedule
- Maintenance controller
 - Controls how maintenance schedule is influenced
- Customer Service Representatives
 - Takes care of pax, connecting flights, etc.
- Flight Dispatchers
 - Responsible for individual flights, finds out about weather, creates flight plan. In the US: Shares responsibility for safety with pilot.



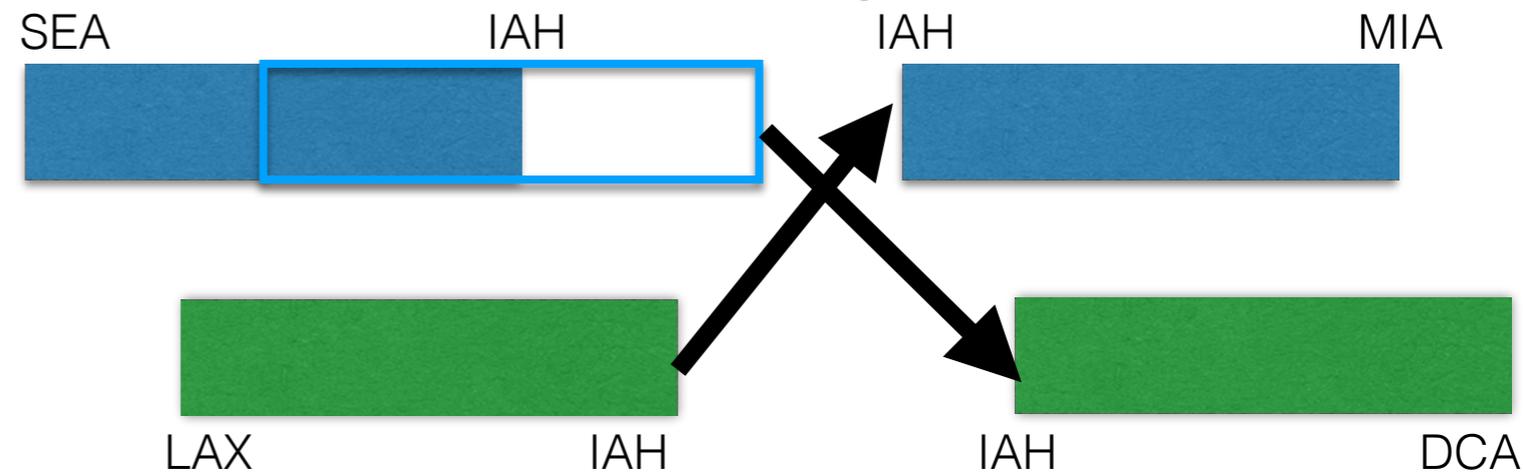
source: <http://www.iata.org/whatwedo/workgroups/Documents/ACC-2014-GVA/occ-3-occ.pdf>

Reasons for Disruptions

- Technical problems
- Crew related
- Central Flow Management Unit(CFMU)/Network Manager Operations Centre (NMOC) slots
- Weather
- Missing passengers
- etc.

Recover flight schedule

- Delay
 - Influences following flights
- Cancel
 - Balance
 - Alternative mode of transportation for passengers
- Swap
 - Balance
- Positioning (fly empty)
 - Balance



Delayed aircraft

Working process

